GROUNDWATER MANAGEMENT INSTITUTE

DETERMINING DEPENDENCY AND VULNERABILITY OF GROUNDWATER OF COASTAL CITIES (CAPE TOWN AND DAR ES SALAAM)

Conjunctive Management Strategic Action Plan: Dar es Salaam

February 2026

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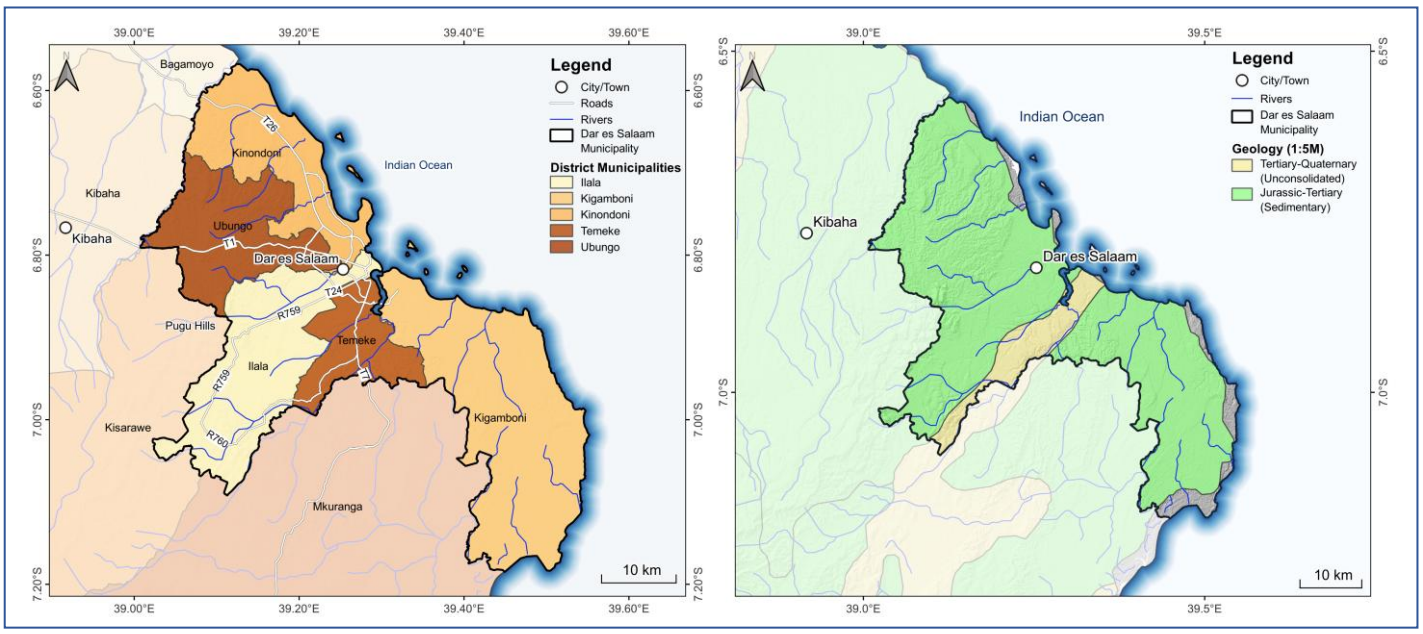
Conjunctive Management Strategic Action Plan: Dar es Salaam



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AUTHORS	:	**Sebastian Stenzl** **Errol Malijani** **Keanan Woolf** **Kornelius Riemann** **Aqeelah Benjamin** **Gemma Bluff** **Kate Snaddon** **Mark Bollaert** **Edward Hunja** **Leodgard Otmar Haule** **Charles Sokile**
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UMVOTO Africa (Pty) Ltd
Director
Kornelius Riemann

UMVOTO Africa (Pty) Ltd
Technical Reviewer
Keanan Woolf

SADC-GMI
Technical Advisor
Kevin Pietersen

Umvoto Africa (Pty) Ltd
Registration Number: 2001\013609\07

SABS ISO 9001

Directors: RI Kingwill, K Riemann
Non-executive Directors: MIH Hartnady, PRH Mathew, PX Hartnady

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

~	-	approximately
°	-	degrees
>	-	greater than
<	-	less than
%	-	percent
BMU	-	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BWB	-	Basin Water Board
CBD	-	Convention on Biological Diversity
CBWSO	-	Community Based Water Service Organisations
CBO	-	Community Based Organisations
DAWASA	-	Dar es Salaam Water Supply and Sanitation Authority
DAWASCO	-	Dar es Salam Water Supply Company
DarMAERT	-	Dar es Salaam Multi-Agency Emergency Response Team
DMD-PMO	-	Disaster management Department – Prime Minister's Office
DMDP	-	Dar es Salaam Metropolitan Development Project
DP	-	Development Partners
EIA	-	Environmental Impact Assessments
EMA	-	Environmental management Act
EWURA	-	Energy and Water Utilities Regulatory Authority
GDE	-	Groundwater Dependent Ecosystems
GPZ	-	Groundwater Protection Zone
INFORM	-	Index for Risk Assessment
IPCC	-	Intergovernmental Panel on Climate Change
IWRM	-	Integrated Water Resource Management
IWRMD	-	Integrated Water Resources Management and Development
km²	-	kilometre squared
LBSAP	-	Local Biodiversity Strategy and Action Plan
LGA	-	Local Government Authorities
LPF	-	Logical Planning Framework
Maji-IS	-	Maji Information System
Mamsl	-	metres above mean sea-level
MAR	-	Managed Aquifer Recharge
M&E	-	Monitoring and Evaluation
MHH	-	Menstrual Health and Hygiene
MoHSW	-	Ministry of Health and Social Welfare
MoW	-	Ministry of Water
MTEF	-	Medium-Term Expenditure Framework
NABSAP	-	National Biodiversity Strategy and Action Plan
NAPA	-	National Adaptation Plan of Action
NAWAPO	-	National Water Policy

NMSAP	-	National Biodiversity Strategy and Action Plan
NEMC	-	National Environment Management Council
NEP	-	National Environmental Policy
NWSDS	-	National Water Sector Development Strategy
NLP	-	National Land Policy
NWB	-	National Water Board
ODSS	-	Operational Decision Support System
PCA	-	Potentially Contaminating Activities
RAS	-	Regional Administrative Secretary
RDMC	-	Regional Disaster Management Committee
RUWASA	-	Rural Water Supply and Sanitation Authority
SADC	-	Southern African Development Community
SADC-GMI	-	Southern African Development Community Groundwater Management Institute
SDGs	-	Sustainable Development Goals
SEA	-	Strategic Environmental Assessment
SWAP	-	Sector Wide Approach to Planning
TanWIP	-	Tanzania Water Investment Programme
TBA	-	Transboundary Aquifer
TBS	-	Tanzania Bureau of Standards
TGS	-	Tanzania Geological Survey
URT	-	United Republic of Tanzania
WHO	-	World Health Organisation
WRBWB	-	Wami-Ruvi Basin Water Board
WRM	-	Water Resource Management
WRMA	-	Water Resources Management Act
WSDP	-	National Water Sector Development Programme
WSSA	-	Water Supply and Sanitation Act
WUA	-	Water User Association
WUG	-	Water User Groups
WUIMS	-	Water User Information Management System
WUP	-	Water Use Permit
WUPA	-	Water Use Permitting Analysis Tool

1. Introduction

1.1. Background

Southern Africa is home to approximately thirty (30) transboundary aquifers (TBAs) and numerous national strategic aquifers that support the primary water needs and livelihoods of a significant portion of the region's population. Due to climate change, the reliance on groundwater has increased. Although there is a fair understanding of the strategic aquifers, increased data collection will enhance the capacity of institutions to sustainably manage groundwater resources. Furthermore, developing groundwater-specific data-sharing protocols among riparian states contributes to the integrated management of shared aquifers. There is a unique opportunity to establish groundwater monitoring networks and strengthen institutional frameworks for shared water management. In addition to this, strengthening institutional capacity, legislation, compliance and enforcement, stakeholder engagement, and both demand and supply-side measures remain critical elements of achieving sustainable groundwater management.

The Southern African Development Community Groundwater Management Institute (SADC-GMI), a subsidiary of the SADC Secretariat, is established as a Section 21 Not-for-Profit Company under South African law. The vision of the SADC-GMI is to ensure the equitable and sustainable use and protection of groundwater and be a Centre of Excellence in groundwater management and management of groundwater-dependent ecosystems in the region. The role of the SADC-GMI is to:

- Promote sustainable groundwater management and provide solutions to groundwater challenges in the SADC region through building capacity, providing training, advancing research, supporting infrastructure development, and enabling dialogue and exchange of groundwater information.
- Conduct and support the SADC Member States in groundwater research, and serve as a focal interlocutor with national, regional, and international groundwater initiatives.
- Promote the sustainable conjunctive use of surface and groundwater.

As part of their programme to provide solutions to groundwater challenges, SADC-GMI embarked on a project to investigate and provide management strategies for **Groundwater Dependency and Vulnerability in the Coastal Cities of Dar es Salaam and Cape Town.**

Groundwater Dependency and Vulnerability in Coastal Cities

The dependency and vulnerability of coastal cities stem from multiple factors. Rapid urban expansion and population growth drive higher water demand, often met by groundwater due to insufficient surface water sources. Many urban authorities struggle to supply water through reticulated systems, leaving informal settlements reliant on shallow wells and boreholes.

Coastal cities are particularly susceptible to saltwater intrusion into aquifers, especially during dry seasons or due to excessive groundwater abstraction. Pollution from urban runoff, industrial activities, agricultural activities, and improper sanitation can degrade groundwater quality, making it unfit for consumption. Additionally, climate change has given rise to changing precipitation patterns, increasing temperatures and affecting groundwater recharge rates. These changes may increase water demand due to higher temperatures and evaporation, or reduced surface water availability, potentially leading to over-exploitation.

The urban sprawl in coastal cities, inadequate enforcement of regulations and improper management of groundwater resources can exacerbate these vulnerabilities. Given these challenges, this project aims to assess groundwater dependency and vulnerabilities of groundwater in the selected coastal cities of Cape Town and Dar es Salaam in the SADC region.

1.2. Project aims and objectives

The overall objective of this project is to determine the dependency and vulnerability of groundwater in coastal cities, using Cape Town and Dar es Salaam as case studies. This involves engaging with stakeholders, conducting high-level hydrogeological and environmental assessments, identifying gaps in the current monitoring networks, assessing vulnerability factors, evaluating the impacts of pollution and climate change, and incorporating socio-economic and gender dynamics with the ultimate goal of developing a conjunctive management strategic action plan for Dar es Salaam.

This report presents the conjunctive management strategic action plan for Dar es Salaam, designed to build the city's resilience to climate change and environmental pressures. The strategic action plans outlined in this report provide a framework to guide sustainable groundwater use, mitigating risks and enhancing resilience in Dar es Salaam and other coastal cities to climate change and environmental stresses.

1.3. Methodology

1.3.1. Definition of Terms

For the context of this project, the following terms are defined and described below:

Groundwater dependency refers to the reliance on groundwater for both human consumption and aquatic ecosystems (i.e., groundwater-dependent ecosystems, GDEs).

- In coastal cities like Cape Town and Dar es Salaam, increasing urbanisation and population growth increase water demand for human consumption, resulting in an increased reliance on groundwater due to inadequate surface water sources. This is termed “human dependency on groundwater” and is usually expressed as the percentage of groundwater in total water abstraction for all human water use. This can further be specified as human dependency on groundwater for domestic water use, agricultural water use, industrial water use, etc.
- Groundwater also plays a vital role in sustaining groundwater-dependent ecosystems, such as coastal wetlands and estuaries, which are crucial for maintaining biodiversity and ecological balance. Hence, groundwater-dependent ecosystems can be defined as “ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements to maintain their communities of plants and animals, ecological processes and ecosystem services”.

Groundwater vulnerability refers to how susceptible an aquifer is to the threats affecting the groundwater resource itself, the ecosystems it supports, and its availability and suitability for human use.

- Vulnerability to the aquifer specifically refers to the physical susceptibility of the aquifer to threats/hazards such as contamination, over-abstraction, sea-level rise, and reduced recharge. This is termed “aquifer vulnerability”.
- In the context of this study, the groundwater vulnerability also includes the vulnerability of the communities that depend on the groundwater resources. This is termed “human vulnerability” and depends on aquifer vulnerability and level of groundwater dependency. E.g.:
    - Is groundwater used? How much groundwater is used? What is it used for? (e.g. domestic supply, agriculture, garden watering, etc.). What are the health implications of contamination? If surface water/soil is in contact with a contaminated aquifer, are people in direct contact with contamination?
    - Do industries/agriculture use water? Do they have alternative sources if groundwater is polluted or reduced in yield?

- If municipal water supply is disrupted as a result of contamination or reduced water availability, what other sources exist?

Vulnerability of ecosystems can also usefully be split into three main components, sensitivity (i.e., the extent of **dependency** of an ecosystem or water users on water resources, whether ground- or surface water), adaptive capacity or **resilience** (i.e. capacity or ability to respond to shifts in drivers, such as climate or water quality, and their consequences), and exposure to stressors or **hazards** (i.e., the probability of being exposed to a certain impact) (Stuart-Hill et al., 2012; Esterhuyse et al., 2014).

Resilience or **Coping Capacity** refers to the capacity of the affected ecosystem or community to deal with an impact, to "bounce back" (i.e. persist and recover) to the status quo after a crisis or disaster, and potentially to "bounce forward" (i.e. adapt and transform) to something new that is better suited to emerging conditions.

- This includes institutional measures such as laws, regulations and by-laws, the effectiveness of their implementation, existing monitoring networks and regular data analysis, as well as the capacity of institutions, communities and individual users to cope with groundwater-related disasters. It also includes the resilience of ecosystems.

Hazards or **threats** are events or circumstances that potentially negatively impact on the groundwater resources. Key hazards include land use activities leading to water pollution, contamination, over-abstraction, climate change and seawater intrusion. The exposure to hazards is expressed in terms of probability.

The overall **Risk** of negative impact on groundwater users and the environment takes into account the likelihood of a **hazard** occurring (including severity of adverse effects on the groundwater resource, water users and receiving environment), the **vulnerability** of the receiving environment, and the **coping capacity** (or resilience).

- Key risks include contamination rendering the water quality unsuitable for the users, and reduction in water storage and discharge leading to less water available for users, seawater intrusion and degradation of groundwater-dependent ecosystems. These factors can compromise the availability and quality of groundwater for the people and ecosystems that depend on it.

Chronic stresses are underlying, ongoing pressures that weaken the functioning and resilience of a city on a day-to-day basis, such as high unemployment, inadequate infrastructure, violence, food insecurity and substance abuse.

Acute shocks are sudden, sharp events, such as droughts, floods, fires, disease outbreaks and infrastructure failures that threaten a city.

Green Infrastructure refers to nature-based elements designed to manage water, reduce pollution, enhance biodiversity and improve urban resilience. As a concept, green infrastructure advocates for the designed network of natural and semi-natural systems that integrate hydrological functions with ecological and social benefits. Examples of green infrastructure include constructed wetlands, rainwater harvesting, permeable surfaces that favour recharge, green roofs and rain gardens.

Water Sensitive Urban Design (WSUD) is an approach to city planning that integrates the entire urban water cycle (stormwater, wastewater, water supply) into urban design, mimicking natural processes to create sustainable, liveable cities that manage water better, reduce environmental harm, and improve community well-being by using green infrastructure like rain gardens and water harvesting. Examples of WSUD measures include rainwater harvesting, the construction of wetlands, retention and detention ponds that support flood control and infiltration and the protection and restoration of natural recharge areas, flood plains and wetlands.

1.3.2. Approach

This Conjunctive Management Strategic Action Plan is based on findings from the Groundwater Dependency and Vulnerability Assessments, which were the key technical assessments conducted for this project. The groundwater dependency assessment examined how municipalities, communities, industries, and groundwater-dependent ecosystems (such as wetlands, estuaries, and rivers) rely on groundwater in Dar es Salaam. Due to data limitations, this assessment was based on existing information.

The vulnerability assessment applied a qualitative risk-based approach to evaluate groundwater vulnerability in Dar es Salaam, focusing on the combined influence of hazards, aquifer vulnerability, and the socio-economic vulnerability and coping capacity of groundwater users and ecosystems. Given the limited availability of groundwater data for the region, the approach relied on the best available information in the form of published hydrogeological studies for specific threats to groundwater, including contamination from human activities, over-abstraction, reduced recharge due to climate change, and sea-level rise, expert judgement, and targeted analyses to identify key areas of concern and priority risk zones for management attention.

For Hazard mapping, a relative scoring system (1–5) was applied to indicate the probability and intensity of different groundwater threats. Where relevant, coping capacity was incorporated descriptively as part of the qualitative assessment. Instead of formally scoring coping capacity per area, the report reflects on broad socio-economic patterns, infrastructure differences, dynamic land use, and institutional capacity across the region. This approach acknowledges the wide variability in how different user groups, municipalities, and ecosystems are able to respond to groundwater risks, influenced by factors such as income levels, service provision, groundwater governance, and investment in water infrastructure.

This assessment, therefore, extends beyond hydrogeological analysis by incorporating the social, economic, and governance dimensions that shape groundwater risk exposure and vulnerability, and is aligned with international disaster risk assessment and reduction frameworks, such as INFORM (Marin-Ferrer et.al, 2017). The aim was to produce a practical decision-support tool that identifies where hazards, aquifer vulnerability, and user exposure overlap. The final risk insights are narrative and spatially descriptive, designed to highlight priority risk areas and user groups most in need of management attention.

The dependency and vulnerability assessments provided the basis for developing a Conjunctive Management Strategic Action Plan for Cape Town and Dar es Salaam by identifying high-risk and high-dependency zones where sustainable abstraction, pollution mitigation, and equitable water governance should be prioritised.

A top-down approach was used to develop the strategic action plan for conjunctive management in Dar es Salaam. The process began with a review of Dar es Salaam’s key policies and strategies to understand the region's vision. Thereafter, supporting plans and programmes were reviewed to determine how these strategies are being implemented in practice. This review highlighted several gaps, which informed the development of targeted action plans.

2. Dar es Salaam

2.1. Site Overview

2.1.1. Location

Dar es Salaam is the largest city in Tanzania, representing the country's industrial and commercial centre. It is located on the east African coast along the Indian Ocean (see **Figure 2-1**). The region is regarded as Tanzania's largest urban centre (1,393 km²) and one of the most rapidly growing cities in Sub-Saharan Africa. Dar es Salaam is located in the Wami-Ruvu Water Basin and is divided into five district municipalities (also often referred to as administrative districts). These districts, namely Kinondoni, Ubungo, Ilala, Temeke, and Kigamboni, each serve distinct roles in governance, commerce, and residential development (URT, 2022b; Lukenangula, 2023). Similar to Cape Town (SADC-GMI, 2025c), it comprises various land uses, including residential, commercial, industrial, and agricultural land uses, informal settlements, natural conservation areas, and a series of water bodies and wetlands.

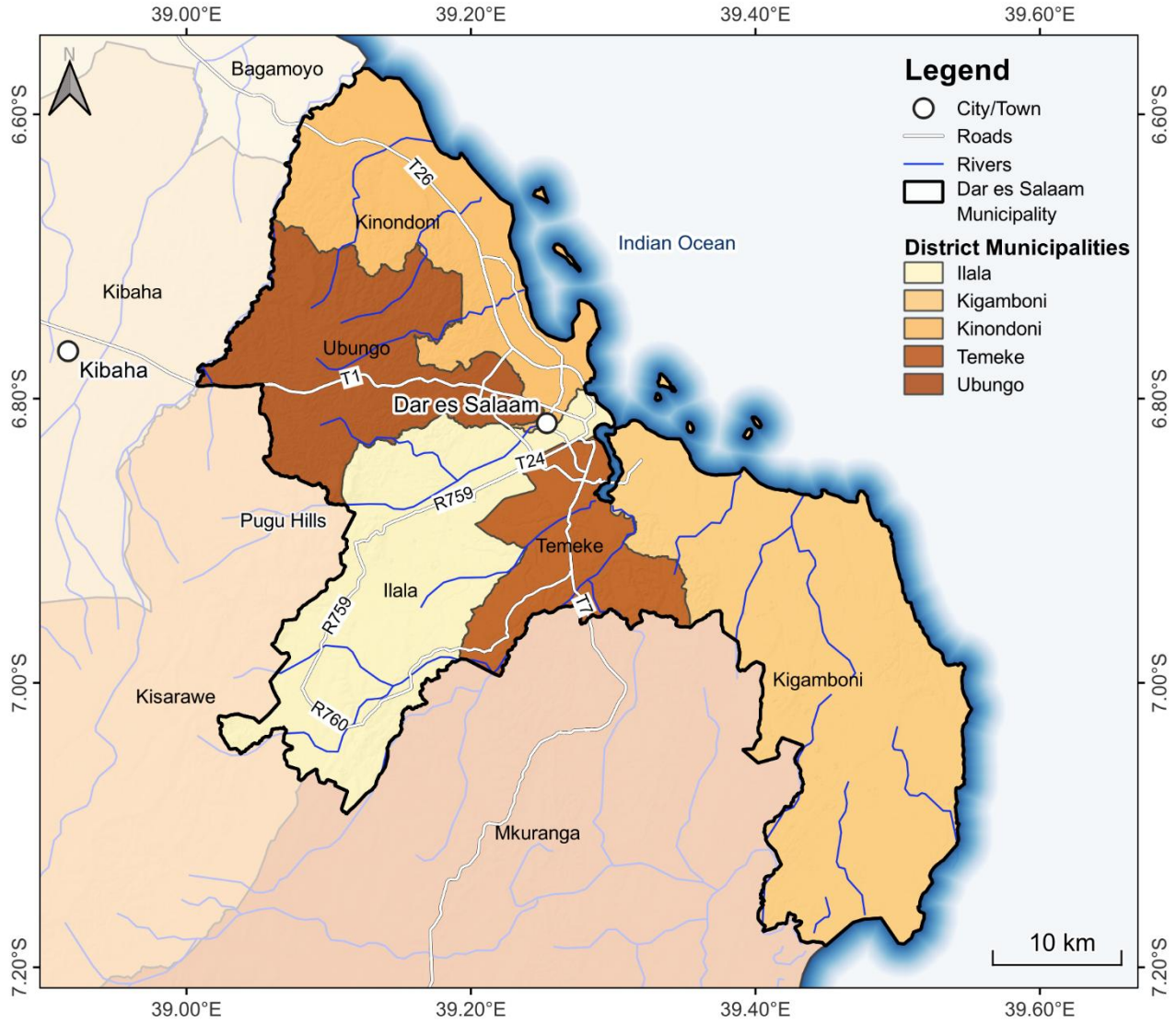

Figure 2-1 Locality map of the study area within the Dar es Salaam regional boundary.

2.1.2. Demography

The urban and peri-urban areas in Dar es Salaam have experienced rapid growth over the past five decades, mainly due to natural population growth and rural-urban migration (Van Camp et al., 2012). Between 2012 and 2022, the region's population increased by 23.4% (URT, 2024). As of 2022, the population was estimated at 5,383,728 inhabitants, with projections indicating an annual growth rate of approximately 4–5% (Msuya et al., 2021; URT, 2024).

More than 70% of the region's population resides in informal settlements (UN-Habitat, 2010, Dodman et al., 2011; Kombe and Muheirwe, 2024) where access to basic services, particularly water and sanitation, remains limited. Only 22% of the region's population is connected to the municipal water supply, while the majority, largely residents of unplanned settlements, rely on alternative water sources, such as boreholes, shallow wells and rainwater harvesting (Kyessa et al., 2019; The World Bank, 2025).

Rapid population growth and urbanisation, as well as inadequate infrastructure, have increased both pressure on natural resources and dependence on them for basic services. As a result, Dar es Salaam has experienced a marked increase in groundwater abstraction, particularly as upgrades to the water distribution infrastructure remain ongoing and municipal supply is insufficient to meet demand. These infrastructure constraints have sustained a high reliance on groundwater as an alternative water source (Van Camp et al., 2012; Smiley, 2013; Sappa and Luciani, 2014; World Bank, 2024). At the basin level, the Wami-Ruvu Basin Water Board, in particular, has recorded a significant rise in water use (groundwater and surface water) and drilling permits, reaching 124% of their planned water use target for 2026 in 2024, underscoring the growing dependency on groundwater in the Wami-Ruvu basin (URT, 2025b).

2.1.3. Climate

Dar es Salaam experiences a tropical climate, characterised by wet and dry seasons, where hot and humid conditions are prevalent throughout the year. According to the Köppen–Geiger climate classification system (Peel et al., 2007), Dar es Salaam's climate is classified as a tropical savanna (Aw). Monthly humidity ranges between 70-90%, with an annual mean of 80% (DAWASA, 2017).

During its warmest months (November to March), Dar es Salaam can experience average daily maximums between 31.2–32.8°C, and average daily minimums of 22.0–24.9°C. During the cooler months (April to October) average daily maximums reach 29.7–31.5°C, and average daily minimums between 19.1–23.2°C. The wet season occurs over two periods in Dar es Salaam, the first period, between March to May, is characterised by long and intense rainfall events, while the second period, between November to December, is characterised by less intense and shorter rainfall events. The dry season occurs from June – October, however, the region still experiences some rainfall during this period, albeit significantly lower than the wet season.

Precipitation during the long rainy season averages at 253 mm, with the second rainy season averaging at 117 mm (Mtoni et al., 2012). The mean total annual rainfall experienced by Dar es Salaam is 1149 mm, with monthly averages between 25 – 250 mm (Mjemah and Walraevans, 2015; DAWASA, 2017). The rainfall pattern in Dar es Salaam is largely influenced by monsoons, where winds blow south to southeast and north to northeast from April to October and November to March, respectively. During the dry season, potential evapotranspiration often exceeds precipitation, resulting in reduced rainfall to replenish and recharge essential surface water and groundwater resources (Mwakalila, 2007). Annually, the total average evapotranspiration is estimated at 1965 mm (Mjemah and Walraevans, 2015). Historically, rainfall has only exceeded evaporation and evapotranspiration from March to May. As a result, very little to no runoff and groundwater recharge occur during the rest of the year. Much of the scattered rainfall received during the course of the year is taken up by vegetation; however, as deforestation continues, less vegetation cover is available to prevent runoff.

2.1.4. Topography

Topographically, Dar es Salaam exhibits a relatively low-relief coastal plain, where its elevation ranges from sea-level at the coast, in the east and north-east, to approximately 200 metres above mean sea-level (mamsl), further inland in the west (**Figure 2-2**). The general topography is characterised by a gently undulating landscape interspersed with a series of low ridges and shallow valleys, shaped primarily by fluvial and marine processes during the Quaternary and Neogene periods (Msindai, 2002). The terrain becomes more elevated toward the west, reaching its highest points in the Pugu Hills and southern highlands, which form part of the Pugu Kaolinitic sandstones. These hills represent the highest natural elevations in the region and are geologically significant due to their kaolinitic sandstone beds (Msindai, 2002). These elevated areas are also important groundwater recharge zones and are thought to influence local drainage patterns.

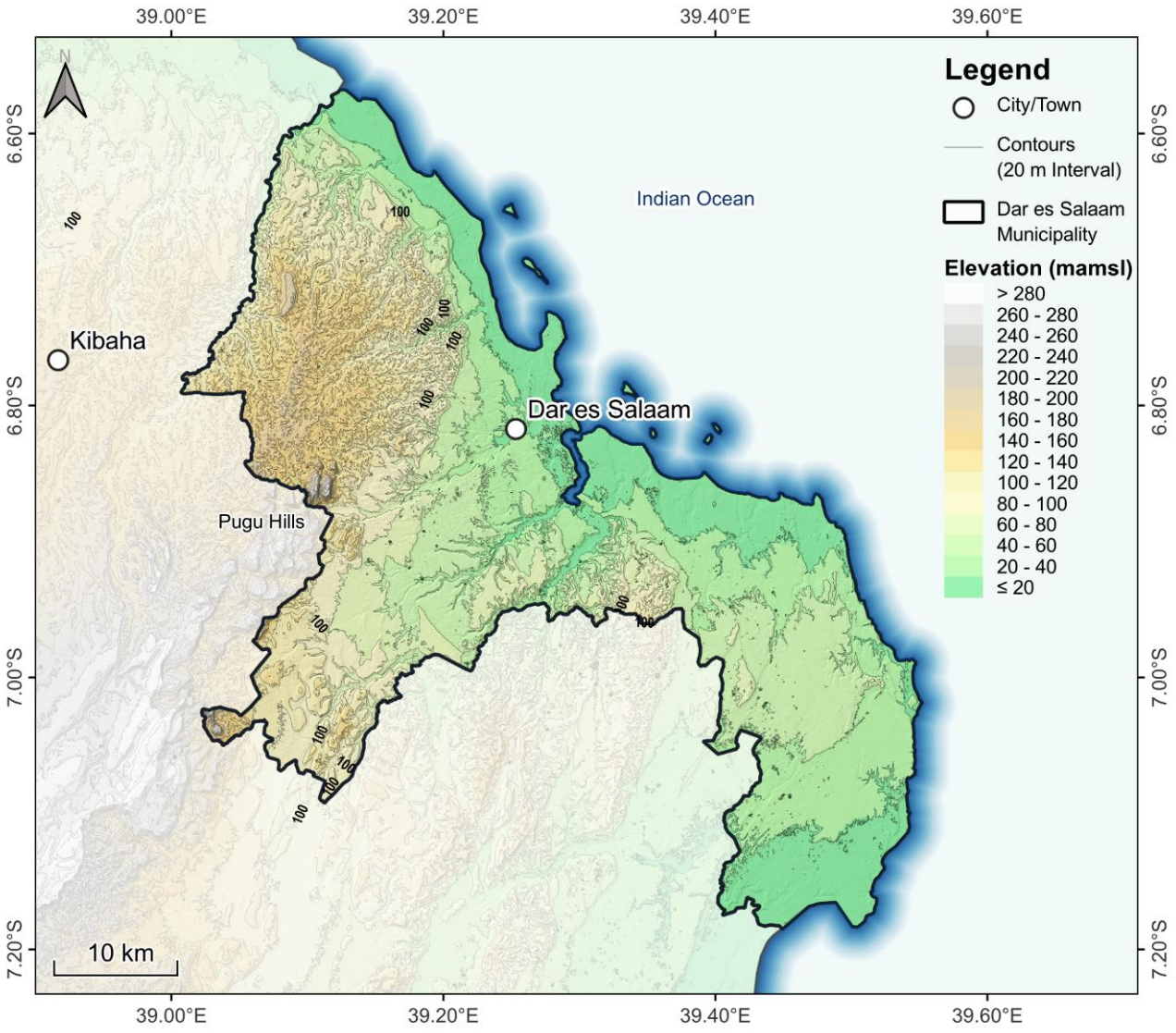

Figure 2-2 Topographical map of the Dar es Salaam region

2.1.5. Hydrology

Rivers, especially those with perennial flow, are likely to be reliant on groundwater discharge, especially during the dry season (June to October). Perennial rivers tend to support riparian areas that often support forest tree species. There are a number of rivers that flow through the City of Dar es Salaam (see **Figure 2-3**). The main rivers are the perennial Mzinga River, which is fed by springs in the Msongola Highlands to the west of the city (Mwakalobo et al. 2013), and Kizinga River, which flows through the city into the Mzinga Creek or estuary. The perennial Msimbazi River is located in the central Dar es Salaam District, flowing into the Harbour Area, and the Nguva/Ukooni Rivers to the south-east of the city centre. . North of the Msimbazi, the Mbezi originates from the west of the Ubongo distrct, flowing east into the Zanzibar channel. There is also a network of smaller, non-perennial rivers that flow out of the Pungu Hills to the west in the interior, and small rivers that flow over the coastal plains to the north and south-east of the city. The seasonal Mpiji River forms the northern boundary of the city. The larger rivers that flow through Dar es Salaam tend to be situated on alluvial sandy systems and flood plains that allow infiltration of water and recharge of groundwater (Tibesigwa et al. 2023). The alluvial nature of these terraces promote recharge across its extent and interactions with the rivers that have been formed through them. The bulk of municipal water is primarily supplied by the Ruvu and Kizinga Rivers

2.1.6. Environmental

Across the five district municipalities, there are a range of different wetlands and GDEs that can be found. Wetlands and estuaries: Wetlands, including mangrove and swamp forests, may be dependent on groundwater as either a direct or indirect source of water. Mangroves tend to occur at the mouths of rivers, which themselves may be groundwater-fed, at the interface between freshwater and marine ecosystems. Mangroves and estuaries provide important habitat and feeding grounds for a number of plant and animal groups. Very few wetlands are mapped in the Dar es Salaam District, but there are mangrove forests that have been mapped along the Kizinga and Mzinga Rivers, as they flow into the Mzinga Creek or estuary (see **Figure 2-3**). There are a few other mangrove forests mapped to the west and east of the city. These are not associated with large rivers, but rather are sandy coastal flats that support mangrove trees (see **Figure 2-3**).

The Dar es Salaam region hosts various freshwater wetlands, including riverine wetlands along floodplains and streams, seasonal lacustrine wetlands formed from high runoff into ponds, and marshes and swamps that occupy undrained topographic depressions. While these smaller wetlands remain poorly mapped at a regional scale, they hold significant socio-economic value for local communities, providing essential resources and services that improve their coping capacity.

Springs are also known to support wetlands and are essentially surface expressions of groundwater and are crucial for maintaining freshwater habitats, supporting wildlife, and providing water for human use. Springs are an important source of water for the rivers that flow through the city and streams that flow nearby communities, supplying water for their needs. Some terrestrial ecosystems, like particular kinds of forests, may also depend on groundwater, particularly during the dry season. The Pugu Hills Forest Reserve is located near Kisarawe, which is to the west of the city. The Kasarawe District Coastal Forest is one of a few Key Biodiversity Areas located in and around Dar es Salaam, pointing towards the high biodiversity value of these forests. The Vikindu Forest Reserve also lies just to the south of the city. The well-forested Pande Game Reserve is located in the northern part of the city.

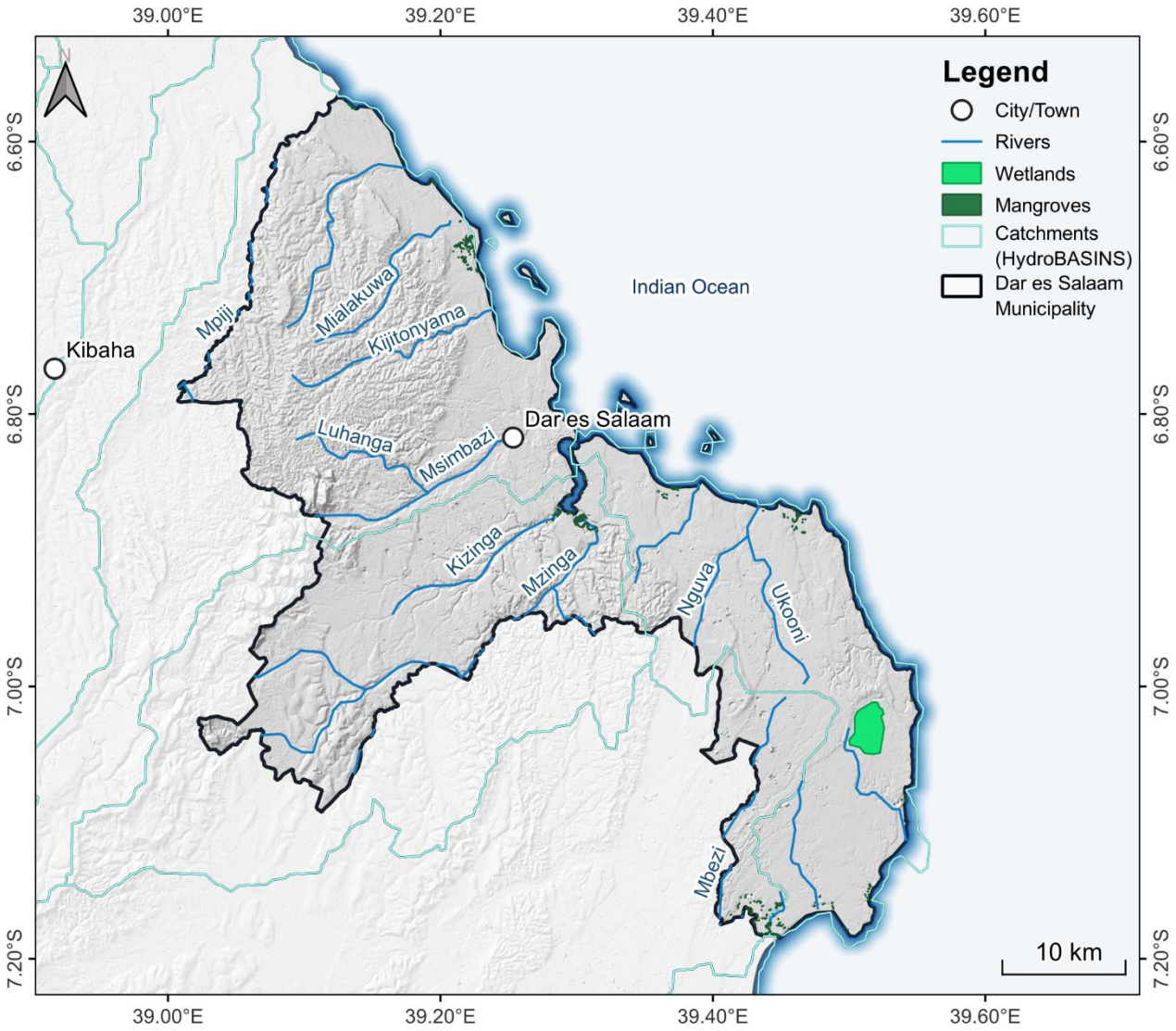

Figure 2-3 Hydrological map of the Dar es Salaam region.

2.1.7. Geology

The region of Dar es Salaam comprises a Precambrian crystalline basement overlain by a succession of sedimentary formations ranging from the Karoo Supergroup to recent Quaternary deposits. Inland areas are dominated by weathered basement and Neogene sandstone units, such as the Pugu Hills sandstone, while the coastal strip features younger marine and alluvial sediments (see **Figure 2-4** and **Figure 2-5**). This layered stratigraphy reflects both tectonic evolution and marine influences, and it plays a significant role in shaping the region's groundwater systems.

The basement rocks consist of Precambrian Mozambique belt metamorphic rock, composed mainly of meta-sedimentary rocks, which occur mostly in the Uluguru Mountains and the Ngerengere sub-basin located further inland (IUCN, 2010). These meta-sedimentary basement rocks can be divided into three main lithological groups, acid gneisses, granulites and crystalline limestone (IUCN, 2010). The basement rocks have undergone thrusting and uplift, resulting in distinct fault zones in the rocks (JICA, 1994). The overburden above the basement consists of unconsolidated sediments with interspersed and relatively thin layers of Jurassic to Cretaceous sandstones, clays and Pliocene-Pleistocene coral limestones (Msindai, 2002).

The continental Karoo sequence represents the oldest part of the sedimentary layers in Tanzania's coastal basin. Throughout the Jurassic, Cretaceous, and Tertiary periods, the region experienced alternating phases of marine regression and transgression. During regressions, deposition was dominated by clays, silts, and silty limestones, whereas transgressions led to the accumulation of calcareous, sandy, and shelly limestones (Van Camp et al., 2014). The Karoo deposits unconformably overlay the Precambrian basement complexes. The tectonic structure accommodating these Karoo deposits was a result of occasional subsidence followed by the down-faulted low relief depressions, which were filled with clastic sediment (JICA, 2005).

The Neogene period (Miocene and Pliocene) was marked by significant tectonic activity, which played a key role in shaping the current landscape. In the highland areas located to the south and west of the city centre, Neogene sandstone formations that are interbedded with siltstones and mudstones are predominant. These formations exhibit a variety of sandstone types, covering more than three-quarters of the region. One of the most prominent Miocene exposures is the kaolinitic sandstone of the Pugu Hills (DAWASA, 2017), characterised by thick, kaolinitic, and cross-bedded layers, with calcareous sandstones present in back reef upland zones. Terrace development in the area is controlled by the underlying massive terrace sandstone. Overlying these Pugu Hill sandstones are Neogene (Miocene and Pliocene) deltaic deposits, referred to as "clay-bound sands", outcropping north and south of the city centre (see **Figure 2-4**). These Neogene deposits can reach a thickness of > 750 m (Van Camp et al., 2014).

During the Quaternary period, sedimentation and erosion were influenced by tectonic shifts, sea-level changes, and climatic variations. In the coastal region near Dar es Salaam, Quaternary deposits (up to 150 m thick) can be categorised into three main geological units: alluvial, coastal plain, and coral reef limestone layers (Van Camp et al., 2014). Alluvial sediments, comprising a mix of fine to coarse-grained sands, clays, and occasionally gravel and pebbles that fill the river valleys of the Mzinga, Kizinga, and Msimbazi rivers (see **Figure 2-4**). The coastal plain consists of unconsolidated sediments, predominantly sand, with evidence of multiple marine incursions. Coral reef limestone deposits are located along the coastline, consisting of coralline limestones where carbonate rocks occur in the form of fringing reefs and elevated reef structures, with fringing reefs being sparse in the northern area and raised reefs dominating the western upland margins (see **Figure 2-4**) (Msindai, 2002). Overall, the geological composition of the area includes unconsolidated sediments from the Neogene and Quaternary periods. The alluvial and coastal plain deposits, dating from the Pleistocene to the present, are mostly found along river valleys extending inland from the coast (Sappa and Luciani, 2016).

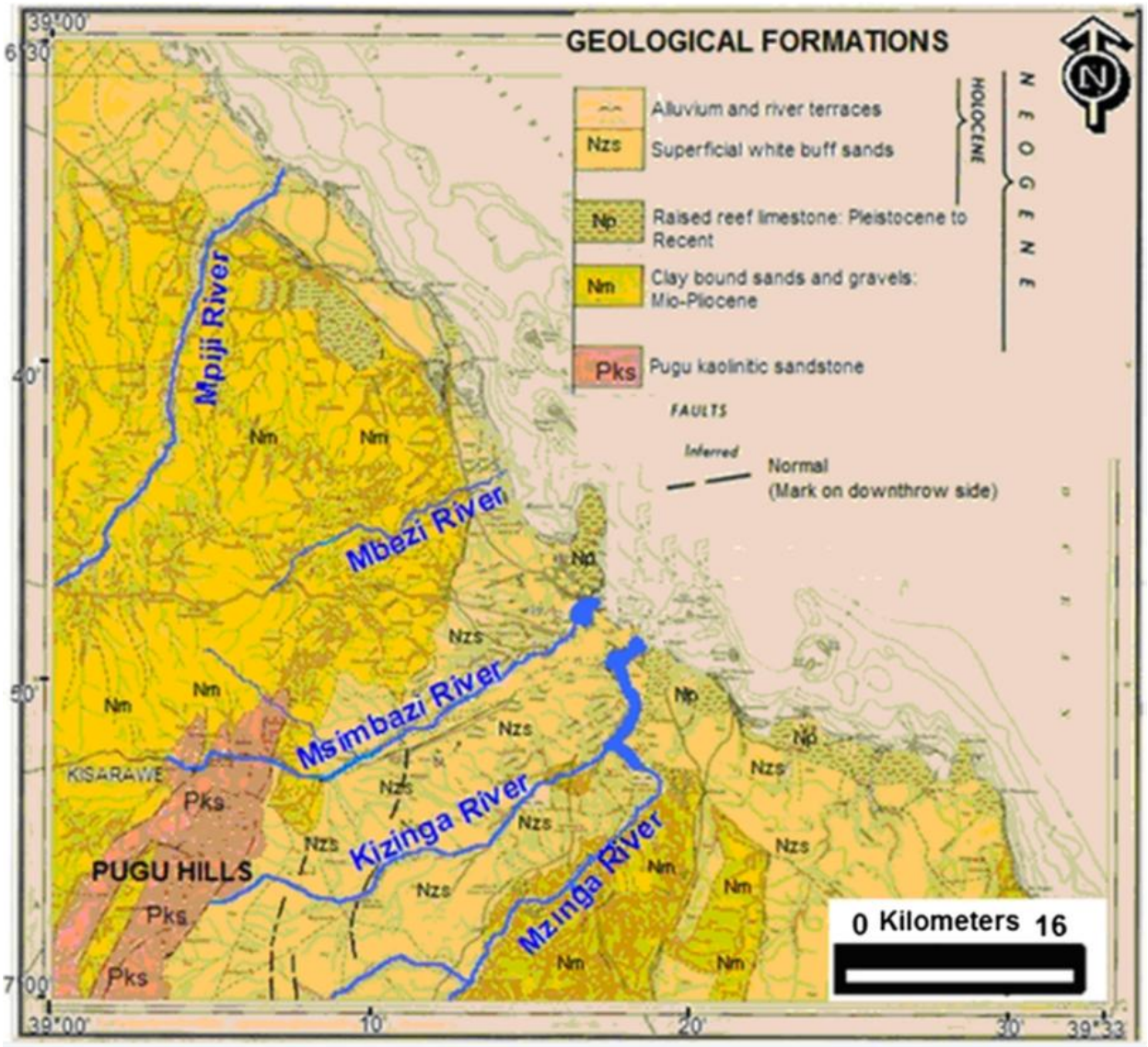

Figure 2-4 Geological map of the Dar es Salaam region (Van Camp et al., 2014).

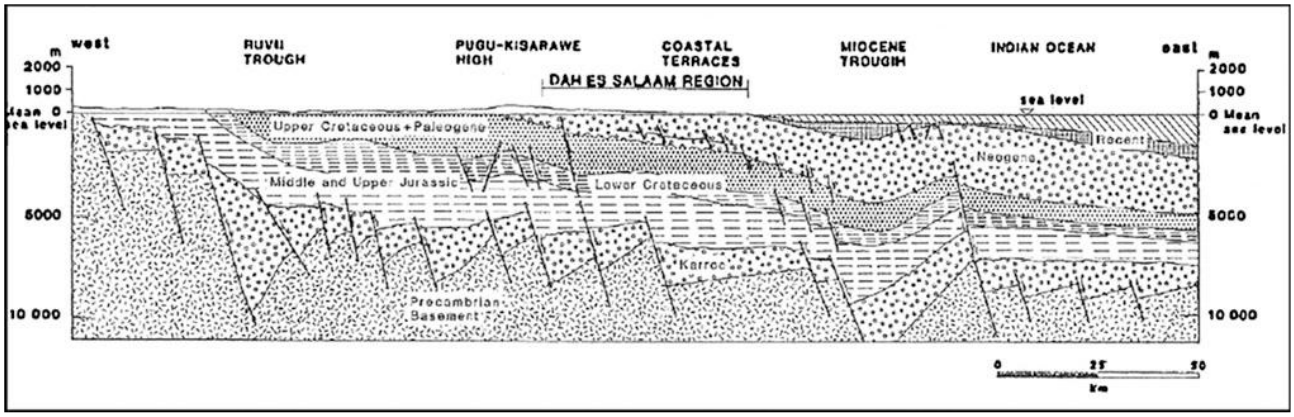

Figure 2-5 Cross-section across the central Dar es Salaam region showing coastal terraces in Dar es Salaam (Sappa et al., 2014 after Msindai, 1988).

2.1.8. Hydrogeology

Dar es Salaam contains three main aquifer types, including the primary unconfined and semi-confined Quaternary Aquifer, the confined and semi-consolidated Neogene Aquifer, and the fractured and weathered groundwater systems of the Precambrian Basement Aquifer (**Figure 2-6**).

Dar es Salaam's Quaternary Aquifer varies in yield, but due to its hydraulic properties is typically regarded as a moderate to very high-yielding aquifer. This is why many groundwater users target this aquifer for private, communal and agricultural supply. While many users rely on water from this aquifer, its favourable hydraulic characteristics also facilitate its susceptibility to contamination from anthropogenic sources. As a primary sandy system, it is characterised by unconfined and semi-confined conditions. Known as the Quaternary Groundwater Reservoir, this formation consists of fluviatile and deltaic sediments from the Pleistocene.

The city's Quaternary Aquifer consists of two aquifer systems (see **Figure 2-7**); a lower semi-confined aquifer of medium to coarse sands, with gravels and clay; and an upper unconfined aquifer made of fine to medium sands with silt and clay, with coral reef limestone deposits present along the coastline. These two aquifer systems are separated by a clay aquitard, which becomes fragmented near the coast (Van Camp et al., 2012). Water from the upper unconfined aquifer is mainly accessed by shallow hand-dug wells, wellpoints, and small-diameter boreholes, serving households and small industries. In contrast, the deeper lower aquifer supplies water to agricultural and industrial users, and select municipal sources (Ngasala et al., 2019). In peri-urban and coastal areas like Kigamboni, where piped infrastructure is absent, this aquifer system often acts as the sole water source (Van Camp et al., 2014).

The Neogene Aquifer is considered a high-yielding aquifer and, for that reason, has been investigated and targeted by Dar es Salaam Water and Sewerage Authority (DAWASA) to supplement the municipal supply. The Neogene Aquifer System consists of semi-consolidated fine to coarse-grained sandstones, interbedded with clays and siltstones and extends across southern and inland parts of Dar es Salaam (see **Figure 2-6**). These units, which include the Pugu deposits and other Miocene-age sediments, lie beneath the Quaternary deposits and typically form confined aquifers. The aquifer can reach depths of over 200 m, thickening toward the coast. These aquifer layers are separated from shallower Quaternary Aquifers by continuous aquitards, which reduce vertical exchange and enhance the aquifer's protection from surface contaminants.

One of the most significant groundwater systems within this formation is the Kimbiji Aquifer, situated in the southern and eastern portion of Dar es Salaam and extending into the Mkuranga District. Areas in the south of the city, where infrastructure is unable to transport treated surface water from the Ruvu River, have opted to develop this aquifer as the main source of water supply to various groundwater users. The depth and confining nature of the aquifer appear to protect it from contamination that may enter the Quaternary Aquifer above. However, areas where these Neogene deposits outcrop are susceptible to contamination. They also form important groundwater recharge zones.

The Kimbiji Aquifer is being developed to improve municipal water supply in southern Dar es Salaam, where the existing piped infrastructure from surface water sources is unable to supply the southern districts. Wellfields are being developed at Kimbiji and Mpera, and are identified as critical to long-term water security in the region. The aquifer is viewed as a key strategic source for bulk supply expansion, due to its relatively large storage, good yield, and water. Additional to municipal boreholes, private boreholes have also been drilled in these areas for water supply (DAWASA, 2017).

The weathered and fractured Precambrian Basement aquifers are typically very low to low-yielding (Mjemah et al., 2011) and are primarily utilised in rural settings where access to piped infrastructure and high-yielding aquifers are absent. The Precambrian basement complex beneath the sedimentary cover hosts localised fractured and weathered aquifers. These occur in areas with thin sedimentary cover or where basement rocks are exposed, particularly to the far southwest of the main Dar es Salaam city. Due to their fractured and weathered nature, these systems often exhibit

low storage capacity and transmissivity, making them vulnerable to over-abstraction and contamination, particularly in areas where the aquifer is closer to the surface. These aquifers are used primarily in inland and peri-urban areas lacking access to more productive systems.

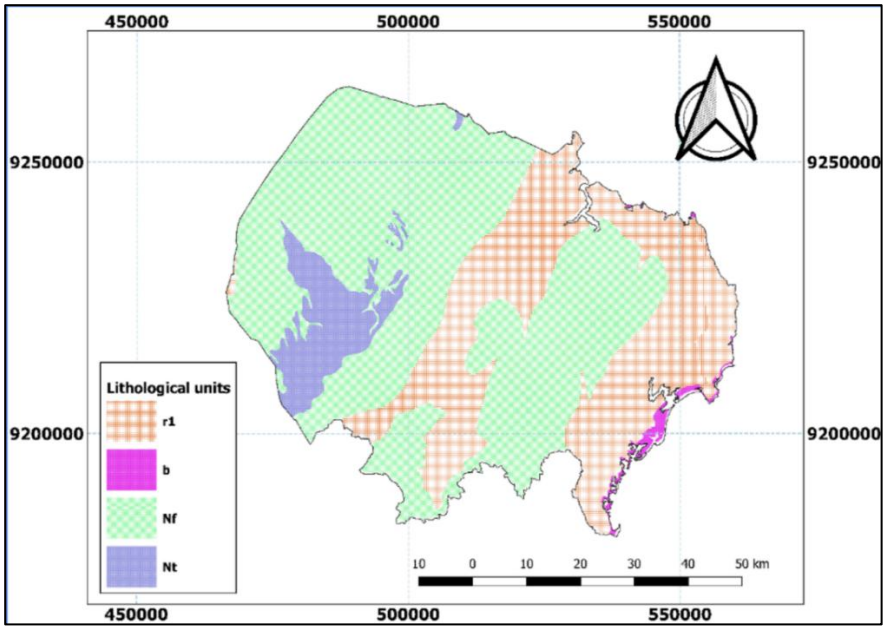

Figure 2-6 **Regional geological map of Dar es Salaam showing the distribution of Quaternary and Neogene deposits which form the major aquifer units of the region. r1 – Quaternary fluvial deposits; b – Quaternary beach sand dune deposits; Nf – Neogene fluvial marine sand; Nt – Neogene terrace deposits (Mussa et al., 2021).**

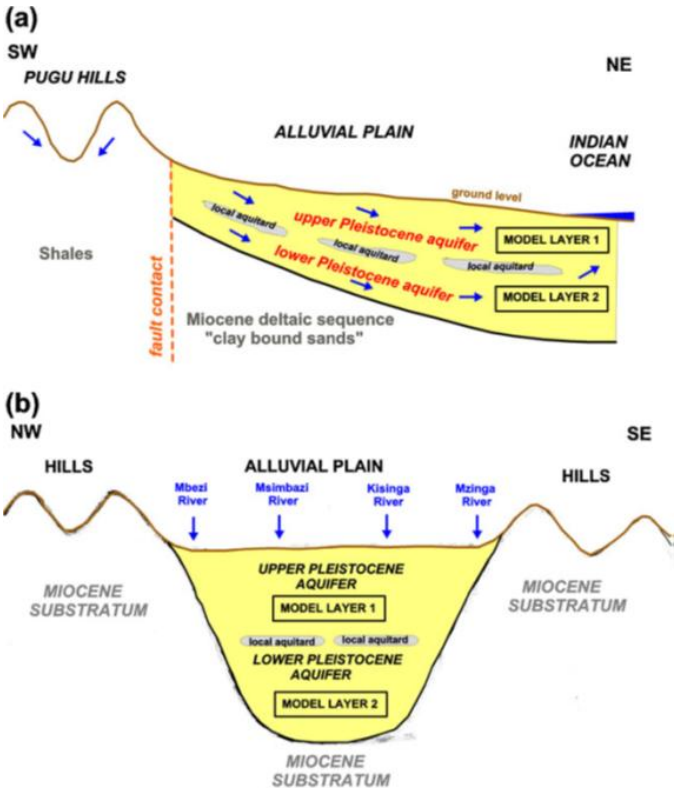

Figure 2-7 **Schematic cross-sections across the central Dar es Salaam region, showing the distribution of the lower and upper Quaternary Aquifers (Van Camp et al., 2012).**

2.2. Overview of Vulnerability and Dependency Assessments

A detailed assessment of groundwater dependency (SADC-GMI, 2025a) and vulnerability (SADC-GMI, 2025b) was undertaken during this study. The groundwater-related risks in Dar es Salaam, summarised below, are based on integrating the identified hazards, aquifer vulnerability, and the vulnerability and coping capacity of groundwater users and ecosystems. Risk is not determined by hazard alone but by the interaction between the likelihood of the hazard occurring, the exposure and sensitivity of aquifers, users, and ecosystems, and their ability to cope or adapt. The risk assessment identifies areas where management interventions are most needed to protect groundwater resources and the services they provide.

Groundwater plays a critical role in meeting the water needs of Dar es Salaam's rapidly growing population, particularly in areas where surface water infrastructure is limited or unable to meet demand (SADC-GMI, 2019). Dar es Salaam has the largest water supply deficit in Tanzania, driven by rapid urbanisation and population growth, which have significantly increased the city's water demand that surface water resources cannot supply. While the Upper and Lower Ruvu and Mtoni Rivers supply over 90% of the water distributed through the municipal network (DAWASA, 2019; Andersson, 2019), the baseflow of the Ruvu River, Dar es Salaam's primary surface water source, has been declining due to climate variability, increased upstream abstractions, and catchment deforestation (Andersson, 2019). To substitute the surface water supply, DAWASA extracts water from the shallow coastal aquifer, however, this aquifer is sensitive to climate change and is prone to seawater intrusion as a result. Furthermore, deeper boreholes, up to 600 m in the Kimbiji aquifer, were also drilled by Dar es Salaam Water Supply Company (DAWASCO) (before the merger with DAWASA) for portable water supply for the city (DAWASA, 2008; SADC-GMI, 2019). To bridge the surface water supply gap, many communities, particularly in the south of Dar es Salaam and in unplanned informal settlements, also privately supplement surface water supply with groundwater and water from private vendors. Due to the large deficit of water supply in Dar es Salaam, groundwater dependency is likely to increase in the city to meet the increasing water demands.

The industrial and agricultural sectors further contribute to the city's groundwater use. Urban farming often relies on shallow wells and other informal sources, while peri-urban and rural farming shifts toward groundwater use during dry periods (Wessels et al., 2024; SADC-GMI, 2019). Industries, facing similar limitations in municipal supply, increasingly depend on privately drilled boreholes to maintain operations (GLOWS-FIU, 2014; SADC-GMI, 2019).

Across Dar es Salaam's administrative districts, it is evident that the major use of groundwater varies. In the north, groundwater in Kinondoni is predominantly for supply to its communities, this is where the majority of higher-income households are found. Ubungo possesses a strong industrial and commercial presence, which makes use of groundwater for its operations, with industrial groundwater users in Ilala also possessing a high dependency on groundwater. In Temeke, groundwater is mostly used by low-income communities and those who reside in unplanned areas. The regional south in Kigamboni is highly dependent on groundwater, since municipal supply from the Ruvu River does not reach this far south of Dar es Salaam. Within this district, groundwater is mostly used for the irrigation of peri-urban agriculture. Hence, the biggest users per district are (see **Figure 2-8**):

- Kinondoni ~ Communities
- Ubungo ~ Commerce and Industrial
- Ilala ~ Industrial
- Temeke ~ Community
- Kigamboni ~ Irrigation

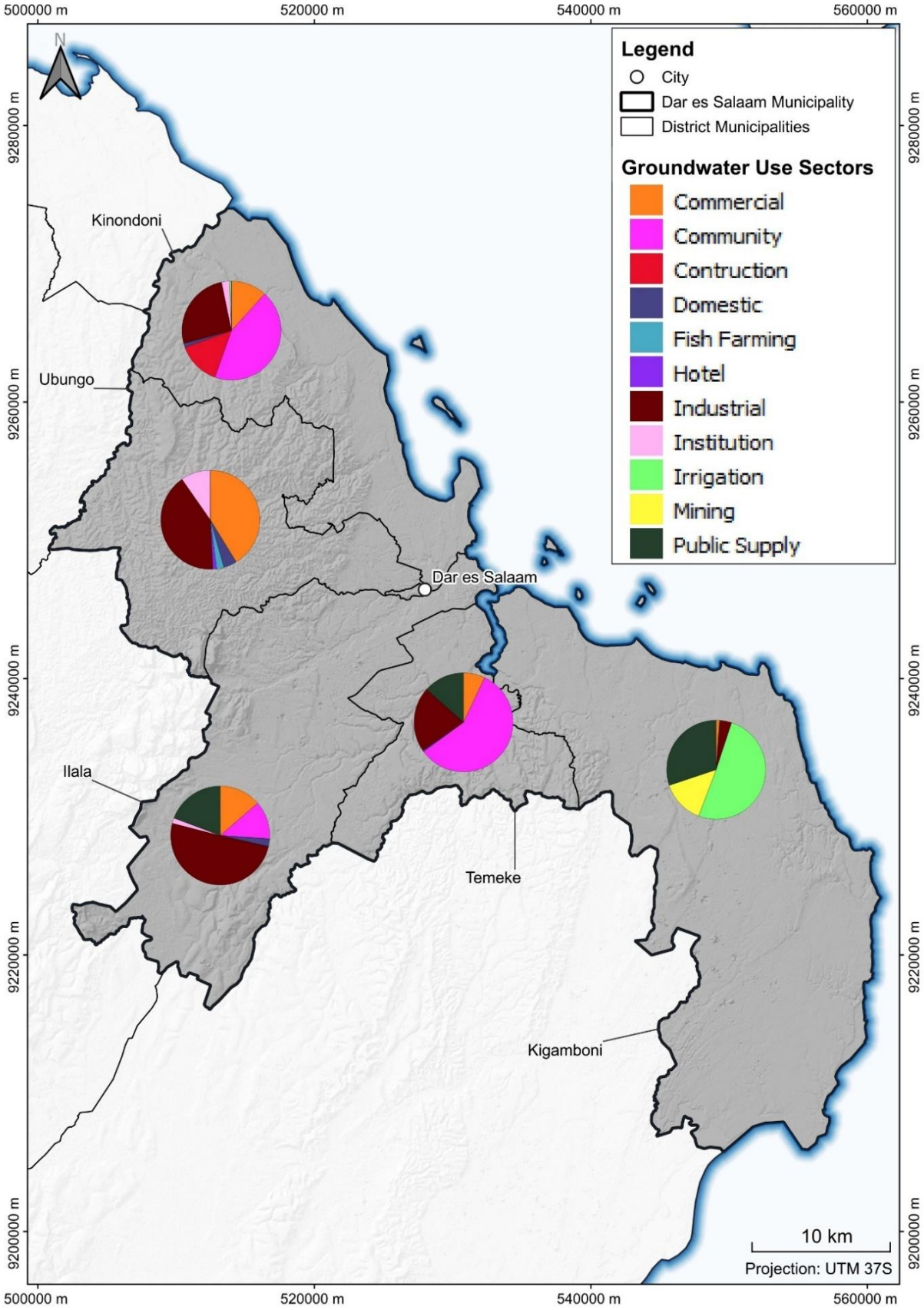

Figure 2-8 **Dar es Salaam's groundwater use per sector per administrative district (data obtained from the Wami-Ruvu Basin Water Board (WRBWB).**

Aquifer contamination in Dar es Salaam was assessed by producing a contamination hazard map, considering the physical characteristics of the aquifer (e.g. whether the aquifer is confined/unconfined) and coping capacity. To produce the contamination hazard map (**Figure 2-9**), a land cover map was generated using supervised classification in Google Earth Engine, with training data using current satellite imagery and guided by previous land cover maps. A hazard scoring system (1 representing very low and 5 representing very high) was then applied to each land use category based on its potential to cause groundwater contamination (see SADC-GMI, 2025b).

According to this assessment, aquifer contamination risk in Dar es Salaam is highest in the Quaternary Aquifer system, particularly the upper portion, due to its shallow unconfined nature that results in high infiltration rates and a limited natural protection. Areas underlain by this system (e.g. Temeke and Ilala) are also the most urbanised parts of the region, where most industries, informal settlements and other Potentially Contaminating Activities (PCAs) are located (**Figure 2-9**). In contrast, the deeper, confined Kimbiji Aquifer in the south generally display lower contamination risks due to its greater depth and natural confinement, except in areas where it outcrops in the west.

To produce the **over-abstraction** hazard map (**Figure 2-10**), which highlights areas in Dar es Salaam that are likely to be threatened by over-abstraction, each district was assigned a hazard score based on groundwater use volumes obtained from the Wami-Ruvu Basin Water Board (WRBWB) of Tanzania (normalised to the area of each district) and the extent of the impervious surface area. In the absence of recharge data for the region, impervious surface coverage was used as a proxy to deduce areas of limited direct recharge in the Dar es Salaam region. Furthermore, the physical characteristics of the aquifer (e.g. whether the aquifer is confined/unconfined) were also considered (see SADC-GMI, 2025b).

The risk of over-abstraction is highest in shallow, unconfined aquifers, in areas with high concentrations of groundwater users, where aquifers are stressed, and where recharge is low or restricted due to urban development. In Dar es Salaam, the Quaternary Aquifer faces the highest risk of over-abstraction due to its shallow nature, easy access and heavy utilisation, particularly in the central parts of the region, which forms the city's economic hub. Districts such as Temeke and Ilala (**Figure 2-10**) are especially vulnerable because they have the highest registered groundwater use and extensive impervious surfaces that reduce natural recharge. Many low-income and unplanned informal settlements, which heavily rely on groundwater, are also concentrated in these districts and contribute significantly to over-abstraction, since many of these communities have no water supply and resort to groundwater for household use. Additionally, abstraction from a groundwater scheme that targets the Quaternary Aquifer through a series of shallow boreholes also adds to abstraction volumes. These risks are exacerbated during drought periods when groundwater pumping increases to compensate for declining surface water availability across the region. Coastal areas face an additional challenge, as over-abstraction increases the risk of saline intrusion into freshwater aquifers (Mjemah, 2007; Mtoni et al., 2011; Mtoni et al., 2013).

Due to the absence of local CMIP **sea-level rise** projections for Dar es Salaam, a conservative sea-level rise of 0.34 m for the 2041–2060 period was adopted based on regional Intergovernmental Panel on Climate Change (IPCC) projections and nearby NASA reference points, and applied uniformly to a Copernicus 30 m digital surface model to illustrate potential coastal inundation relative to mean sea level (see SADC-GMI, 2025b, for a more detailed explanation). **Figure 2-11** illustrates that the IPCC SSP5-8.5 projection will result in some coastal inundation of Dar es Salaam and offshore islands. The port of Dar es Salaam, situated in the Kurasini Creek, a small coastal inlet, is projected to experience flooding, with greater inundation occurring in the lower reaches of the Msimbazi River.

The Quaternary Aquifer is the most vulnerable to climate change-induced **sea-level rise** because of its shallow, unconfined nature, proximity to the coast, and elevation relative to sea-level. The low-lying coastal plains and areas such as those found in Kigamboni and the Msimbazi Basin are the most susceptible to groundwater inundation, while saline intrusion in coastal boreholes has been observed in several locations along Dar es Salaam's coast. Rising sea-levels threaten to deteriorate groundwater resources, impacting communities and industries dependent on coastal groundwater.

The Kimbiji Aquifer, with its deeper, confined nature, is thought to be less susceptible; however, it requires monitoring to ensure long-term resilience.

In the absence of recharge projections for Dar es Salaam, projected changes in precipitation from IPCC and Copernicus Climate data were used as a proxy to assess aquifer vulnerability to **reduced recharge**. The climate dataset indicates a high confidence in an increase in total precipitation of 2.34% and 3.21% (SSP5-8.5 relative to 1961-1990 and 1981-2010, respectively) for the medium-term period (2041-2060). An increase in the mean soil shallow moisture content of 1.39% and a mean daily accumulated runoff increase of 23.77%, respectively, were also indicated, although confidence is very low and low (SSP5-8.5 relative to the historical period 1981-2010 for the medium-term 2041-2060 projection).

By considering the aforementioned variables as a proxy for recharge, it appears that recharge has the potential to increase due to climate change, as predicted by the CMIP6 medium-term projections. This would imply a low vulnerability of the aquifer to reduced recharge. These projections, however, are based on cumulative annual values and do not provide insight into seasonal variation. In addition, climate change-induced fluctuations in rainfall could result in extended dry periods and erratic rainfall, which may reduce effective recharge and increase aquifer vulnerability. A degree of uncertainty remains regarding projected precipitation patterns. While climate models such as CMIP6 SSP5-8.5 suggest an increase in total precipitation, which could lead to higher recharge and runoff that will likely increase flooding, other predictions also point to prolonged drought periods that imply a possible decline in precipitation (see SADC-GMI, 2025b, for a more detailed explanation).

Climate change-induced reductions in recharge, should they occur, will disproportionately affect the Quaternary Aquifer, especially in urbanised areas with limited infiltration. Prolonged dry seasons and erratic rainfall patterns will exacerbate water scarcity, straining the groundwater resource. The Kimbiji Aquifer, in contrast, is at less risk of reduced recharge as its main recharge zones are thought to be in the hinterlands of the region, where higher rainfall occurs, and the area of impermeable surfaces is minimised.

The groundwater risks outlined above have serious implications for both people and the environment, particularly for **GDEs or sensitive ecosystems**. Over-abstraction and reduced recharge can significantly diminish the groundwater needed to sustain GDEs, leading to shrinking or the complete drying out of these systems, and as such, the loss of critical biodiversity. Additionally, GDEs may be sensitive to groundwater contamination, which can result from human activities and saline intrusion due to sea-level rise. In the short term, GDEs within the Quaternary Aquifer are most at risk due to exposure to multiple groundwater hazards. Over the longer term, abstraction from the Kimbiji Aquifer may also affect GDEs where abstraction from deeper portions may influence groundwater levels in shallower section where hydraulically connected, with potential impacts on wetlands and sensitive ecosystems (DAWASA, 2017).

Dar es Salaam's **socio-economic** vulnerability to Groundwater-related risks is dependent on water supply accessibility and financial capacity. Low-income communities, particularly in unplanned areas, face the highest risks due to reliance on often contaminated and over-exploited groundwater, limited access to alternative water sources, and both inadequate water supply and sewerage infrastructure. High-income areas with better access to treated municipal water and financial resources exhibit a lower vulnerability. Despite a better adaptive capacity, these areas are still at risk given frequent service disruptions. Industries and agriculture, while contributing to contamination and over-abstraction, vary in their ability to adapt based on financial capacity.

Overall, this highlights the need for targeted interventions to improve equitable groundwater resilience. Priorities include protecting aquifers through improved sanitation and waste management, regulating registered and unregistered boreholes to prevent unsustainable abstraction, implementing flood mitigation for vulnerable coastal communities, and supporting climate adaptation for marginalised populations with limited alternatives. Additional measures include improving water efficiency, maintaining infrastructure to reduce losses, promoting water conservation, and exploring water reuse in the industrial sector. Addressing these challenges will reduce risk, strengthen community resilience, and support sustainable groundwater management in Dar es Salaam.

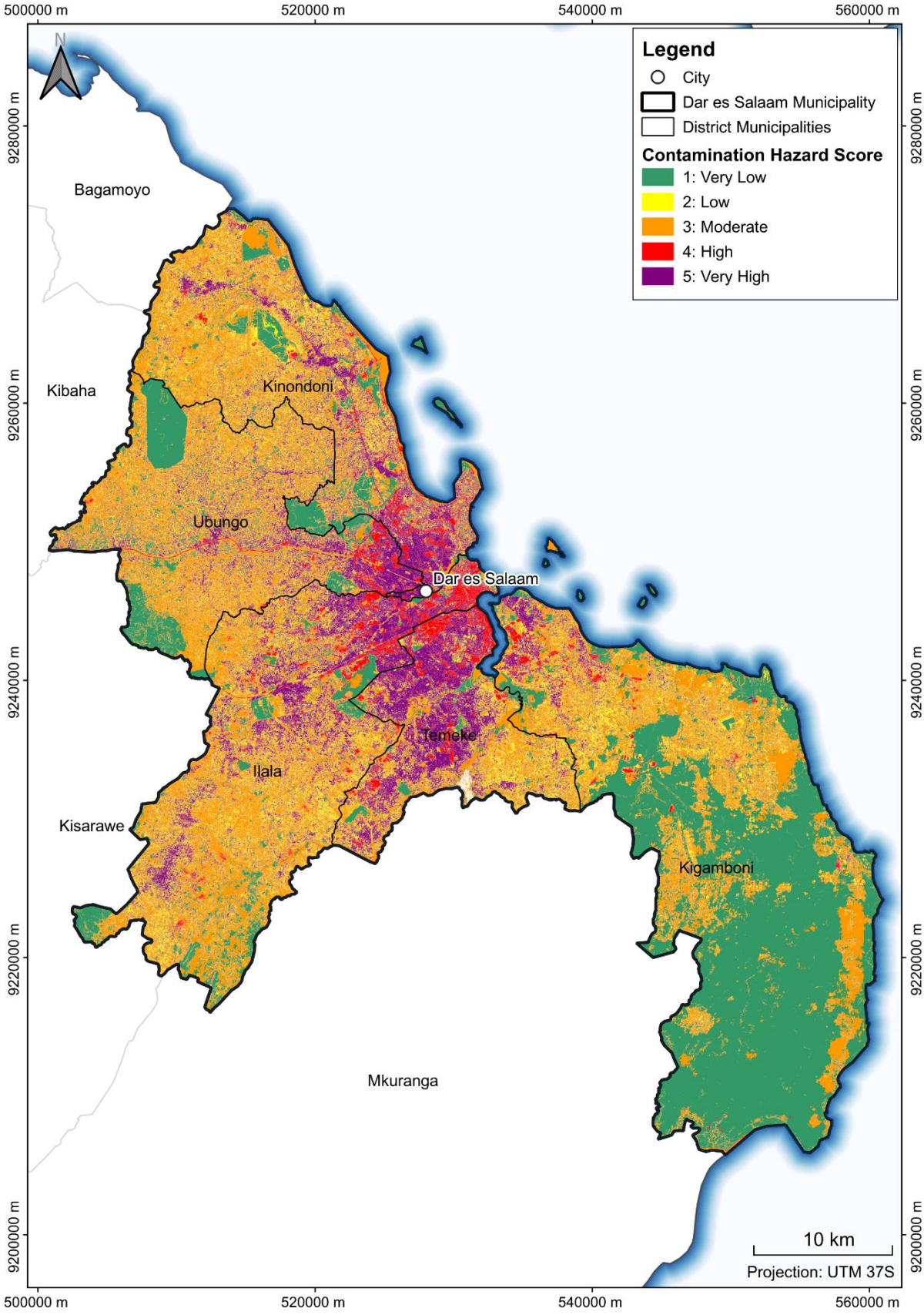

Figure 2-9 Groundwater Contamination Hazard Map of Dar es Salaam.

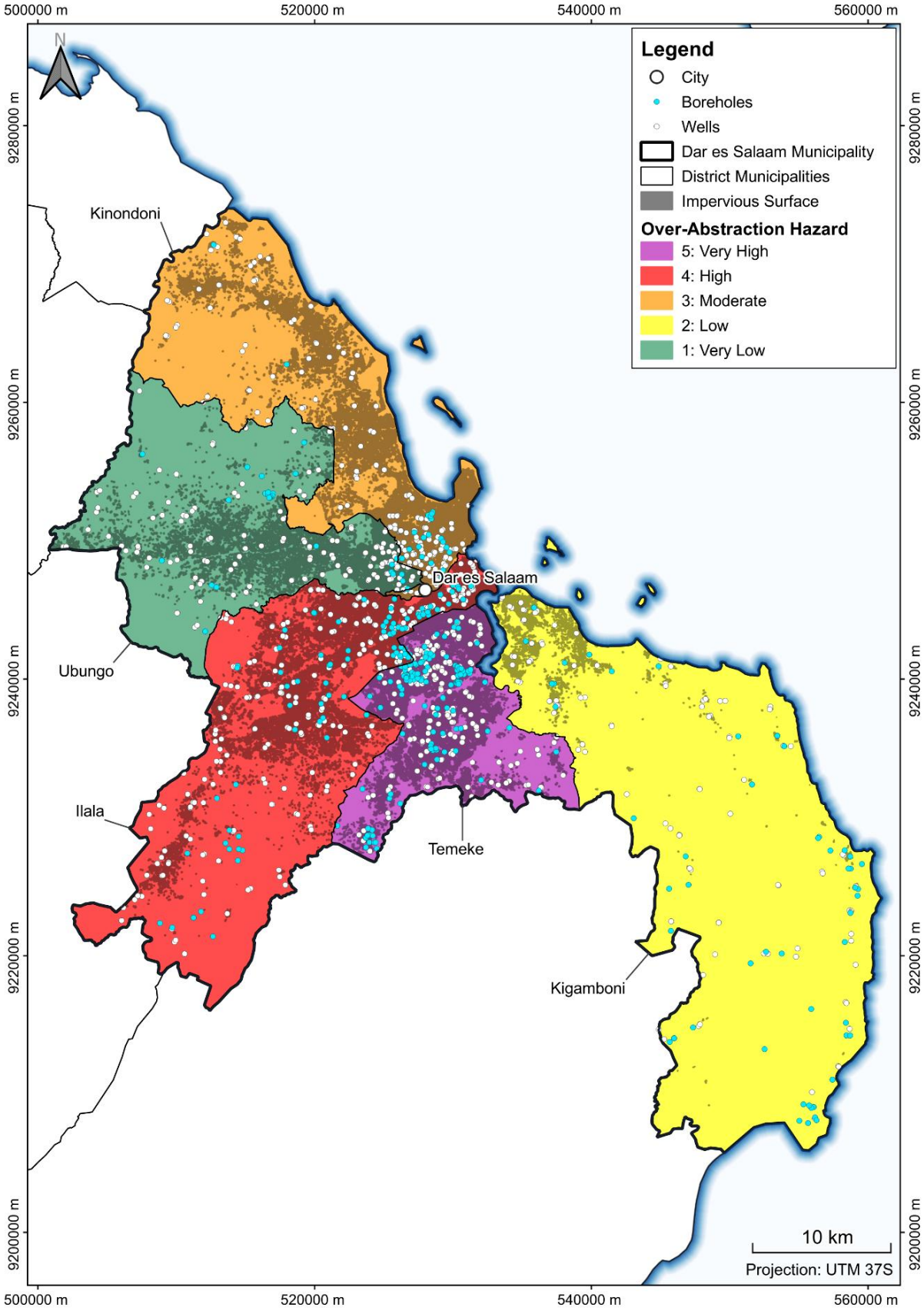

Figure 2-10 Over-abstraction hazard map of Dar es Salaam.

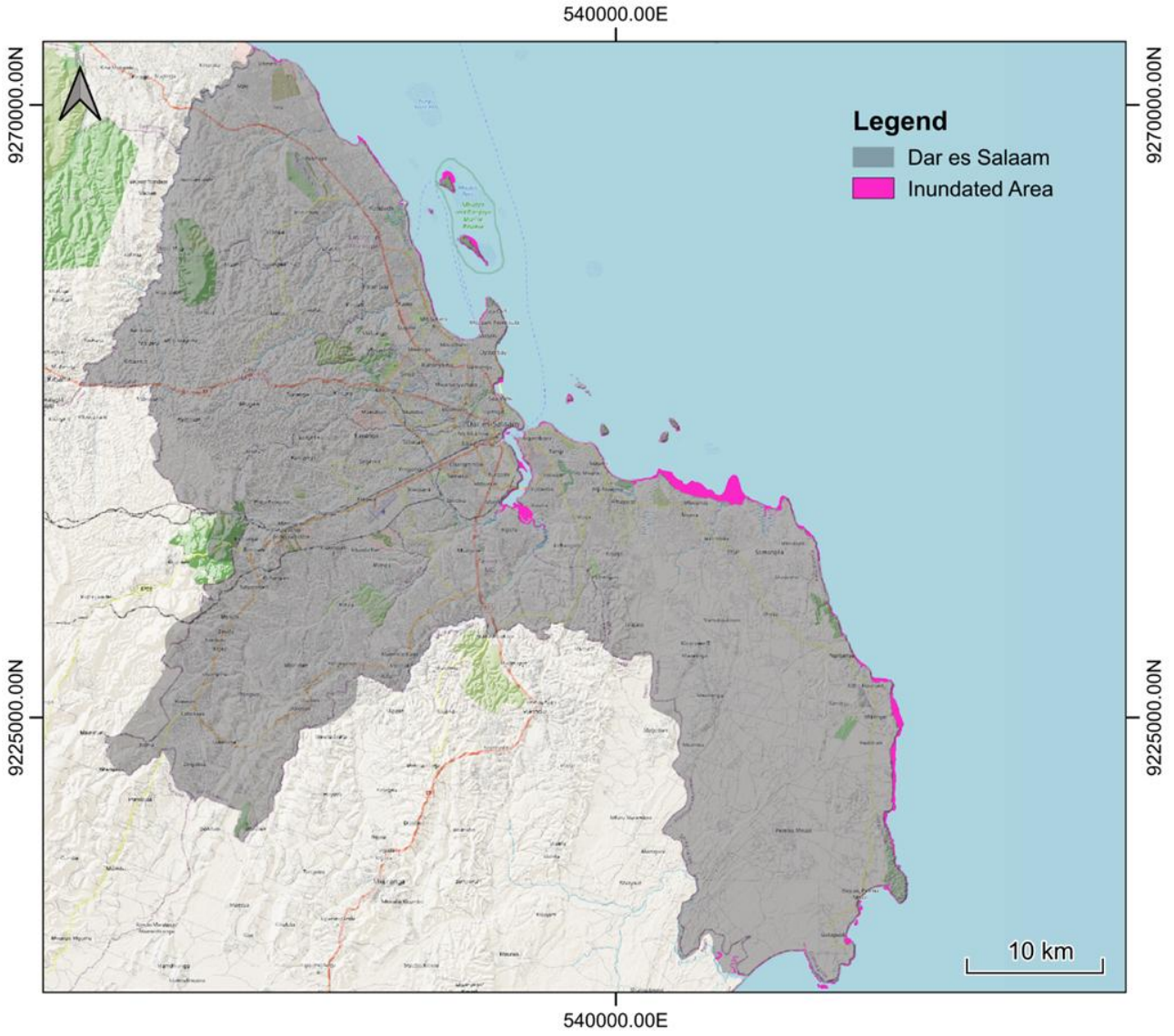

Figure 2-11 **Influence of sea-level rise on the Dar es Salaam Metropolitan Area for the medium-term (2041 – 2060) according to NASA (n.d).**

2.3. Tanzania's Development Vision 2050

Tanzania's Development Vision 2050, launched in July 2025, is the country's long-term national development blueprint and succeeds Development Vision 2025, which was launched in 2000. Vision 2025 sought to attain middle-income country status by 2025, with a focus on agricultural modernisation, industrialisation, infrastructure development, and technological advancement, among other priorities.

From the achievements of Vision 2025, Tanzania attained a lower-middle-income status in 2020. According to URT (2025a), notable progress was achieved in the water and infrastructure sectors, particularly in access to clean and safe water, which expanded significantly in both rural and urban areas from 32% and 55% in 2000 to 79.9% and 94%, respectively, by 2024. However, despite these achievements, several targets of Vision 2025, which concludes its implementation in June 2026, fell short of expectations and are therefore to be succeeded by Vision 2050.

Vision 2050 is rooted in Tanzania's history and the achievements under Vision 2025. It promotes resilience and adaptability as essential attributes for navigating a dynamic world, promoting sustainable development and protecting the environment. A key target of Vision 2050 is to achieve universal access to safe and clean water and sanitation, which currently remains a big challenge in the country and in Dar es Salaam in particular (URT, 2025a). Approximately 70% of the region's population resides in informal settlements that are not connected to the municipal water supply network and therefore rely on alternative water sources, including shallow and often contaminated groundwater (Dakyaga et al., 2018; Andersson, 2019). For a more detailed description of Dar es Salaam's water supply challenges and groundwater dependency, see SADC-GMI (2025a).

Vision 2050 recognises growing water stress, climate variability, rapid population growth, and urbanisation as key risks to national development, all of which increase reliance on groundwater. Groundwater underpins both rural water supply and a significant share of urban and peri-urban systems, making its sustainable management essential for achieving the Vision's goals of universal access to safe water, public health improvement, and economic transformation. The Vision's emphasis on environmental integrity, climate change resilience, and pollution control directly aligns with the need to protect aquifers from over-abstraction and contamination, particularly from inadequate sanitation and land-use pressures. Furthermore, its call for stronger data-driven planning, digital monitoring, and integrated water resources management creates a clear mandate for improved groundwater assessment, monitoring, and governance, ensuring that groundwater continues to function as a reliable buffer against droughts and climate shocks while supporting long-term socio-economic development.

3. Legislation and Regulations

This chapter outlines Tanzania's governance, legal, and policy framework for water resource management, with a focus on groundwater relevance in Dar es Salaam. It details the multi-level institutional structure of governance, and it explains their distinct but interconnected roles in regulation, planning, service delivery, and community engagement. The chapter then examines the legal and regulatory landscape, focusing on cornerstone water-related acts. It reviews key subsidiary regulations governing groundwater exploration, water quality monitoring, stormwater management, and financing. Furthermore, it situates water governance within the broader context of environmental and climate change legislation, highlighting how environmental and climate change frameworks integrate water resource sustainability and resilience.

The overall goal of this chapter is to provide a clear understanding of how various institutions, laws, and policies that authorise, guide and constrain water management actions in Tanzania operate. Its scope explores how national mandates are operationalised in Dar es Salaam, identifying the relevant implementing agencies, statutory controls for groundwater use, and the strategic policy direction aimed at ensuring sustainable and climate-resilient water resource governance for the city.

3.1. Governance Structure

3.1.1. National Water Resource Management

Tanzania established a comprehensive institutional framework under the Water Resources Management Act No. 11 of 2009 and the National Water Policy of 2002 to ensure the sustainable management and protection of its water resources (see **Figure 3-1**). The primary water governance structures that operate at various levels to govern water resources in Tanzania, and their responsibilities include:

- **The Ministry of Water (MoW)** is responsible for developing national strategies and policies for water resources management, like the mandate for integrated water resource management (IWRM) across the different water boards. The ministry provides policy formulation, strategic oversight, and sector coordination. The Water Resources Division is responsible for managing both surface and groundwater.
- **The National Water Board (NWB)** advises the Ministry of Water on policy and legislative matters concerning water resources related to IWRM, ensuring that national strategies align with sustainable development goals. NWB is also involved in the coordination of Basin Water Boards (BWB).
- **Basin Water Boards (BWB)** are decentralised authorities established under the Water Resources Management Act No. 11 of 2009 to manage and protect water resources, including groundwater, within the country's nine hydrological basins. Each Basin Water Board operates within a specific basin and is responsible for water resources management, including planning, water resource monitoring, water allocation, permitting, stakeholder coordination, and conservation. For groundwater resources, the responsibility includes issuing water use and drilling permits and monitoring groundwater use and quality at the local level. Dar es Salaam falls within the Wami-Ruvu Basin.
- **Catchment/Sub-catchment Management Committees** operate under the Basin Water Boards, coordinating the conservation and protection of water sources, facilitating community participation, and implementing water management plans at the catchment level. The establishment of sub-catchment committees within the Wami-Ruvu Basin and Dar es Salaam are an ongoing process that has been prioritised by the WRBWB.

- **Water User Associations (WUA)** are community-based organisations that work closely with the BWBs to support conservation efforts, monitor permit compliance, support the collection of water permit fees, and regulate conflict between water users. The scope of WUAs in the Wami-Ruvu Basin is focused on surface water and makes no inclusion for groundwater resources. In its current state, WUAs do not have the capacity to assist with groundwater management.

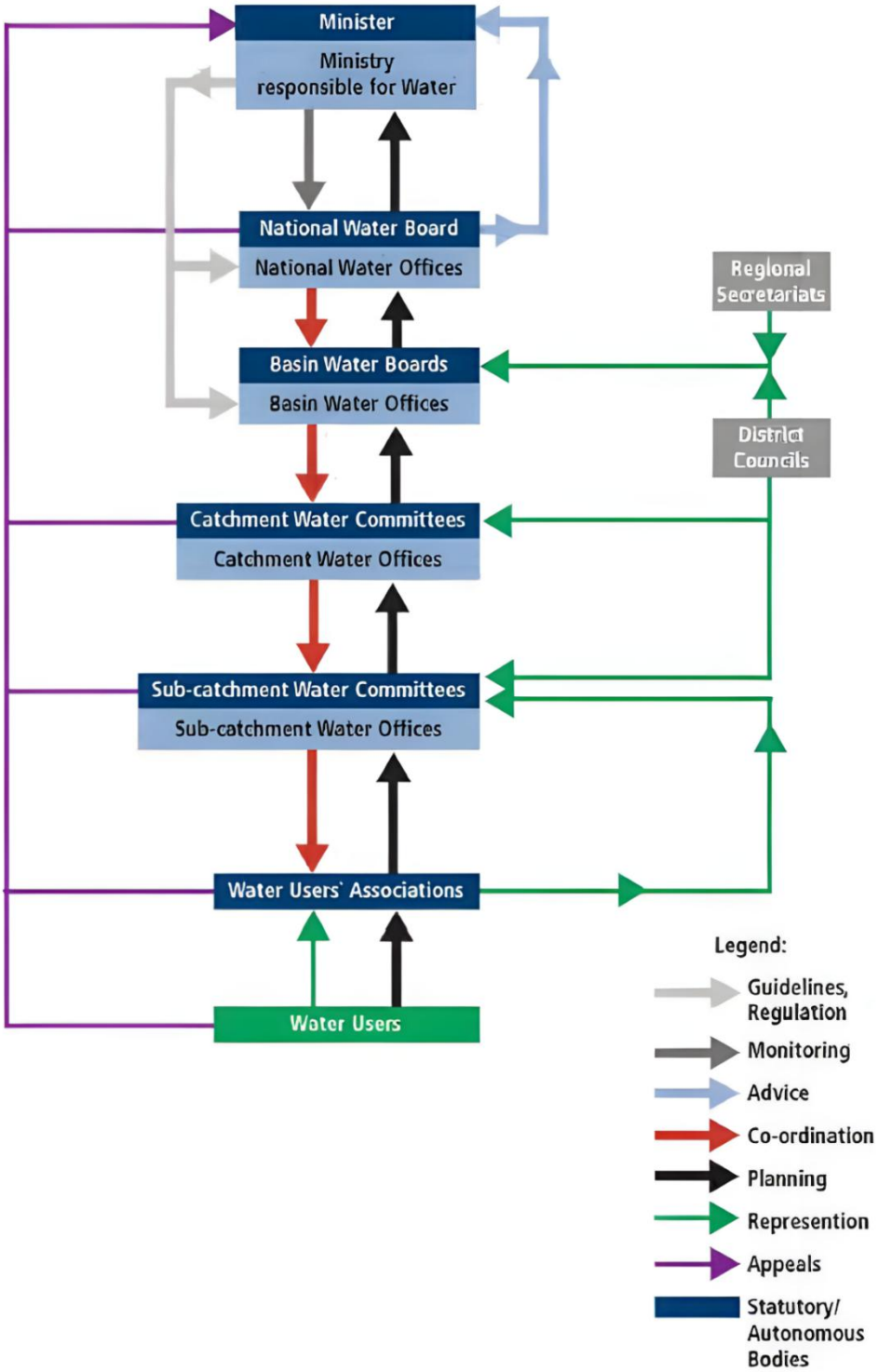

Figure 3-1: Governance Structure for Water Resource Management in Tanzania (The World Bank, 2016).

- **Municipalities** collaborate with relevant water supply authorities to treat and distribute water to residents and other water users where infrastructure is available and operational. Dar es Salaam comprises five (5) district municipalities/councils (i.e. Kinondoni, Ilala, Temeke, Ubungo and Kigamboni).
- The **Rural Water Supply and Sanitation Agency (RUWASA)** is created under the Water Supply and Sanitation Act No. 5 of 2019, and is mandated to ensure rural communities in Tanzania mainland have access to clean and safe water supply services. RUWASA is also to provide water services to specific urban areas. RUWASA supervises the Community-Based Water Service Organisations (CBWSOs) at the district level. CBWSOs collect water charges from communities and are responsible for maintenance, while RUWASA constructs, supervises and regulates water supply services in the rural areas.
- For Dar es Salaam City, the **Dar es Salaam Water and Sewerage Authority (DAWASA)** is the institution responsible for the development and management of water supply and sanitation assets, including the water generation and the supply network (see **Figure 3-2**). Following some recent reforms, DAWASA has assumed roles that were under the now-defunct DAWASCO, including the provision of water and sanitation services to consumers and the collection of revenue.
- Other institutions of interest include
    - The **NEMC** implements the Environmental Management Act (above) and ensures that groundwater development projects comply with environmental safeguards.
    - The **Tanzania Geological Survey (TGS)** conducts geological and hydrogeological surveys and provides scientific data on groundwater aquifers and their potential.
    - The **EWURA** regulates water utilities, including pricing and service standards, where groundwater is a key source. Groundwater tariffs, for example, cannot change without approval from EWURA.

3.1.2. Role of Local Government in Groundwater Management

The role of local government in water resource and groundwater management is primarily as an implementing agent, where local government acts according to development plans and sector laws primarily in rural and peri-urban settings but also in urban settings such as in Dar es Salaam. The regulation of groundwater management is the responsibility of Basin Water Boards as per the WRMA (2022), hence, local government authorities (LGAs), district, municipal, and city councils and committees are not the primary regulators of groundwater. Instead, LGAs play a complementary role, serving as a link between local communities, service delivery agencies (RUWASA/WSSAs), and the Basin Water Boards. The National Water Policy 2002 (2025 version) prescribes that district representatives from district councils and local government authorities sit on these basin boards and catchment committees. They provide support in planning, implementation, monitoring, and protection of groundwater resources at the local level (see **Figure 3-2**). WUAs or Water User Groups (WUGs) are the lowest level of management within the Tanzanian water management structure. WUAs aim to assist the Basin Water Office in managing water sources in the basin (IUCN, 2010).

Within **Planning and Coordination**, LGAs are responsible for integrating water supply initiatives into their district development plans and budgets. They coordinate with RUWASA for rural supply, and WSSAs for urban supply to ensure boreholes, wells, and groundwater schemes are strategically aligned with local needs and priorities. Furthermore, LGAs support the preparation and implementation of broader IWRM plans at the catchment and basin level by effectively linking community priorities with the work of the basin water boards.

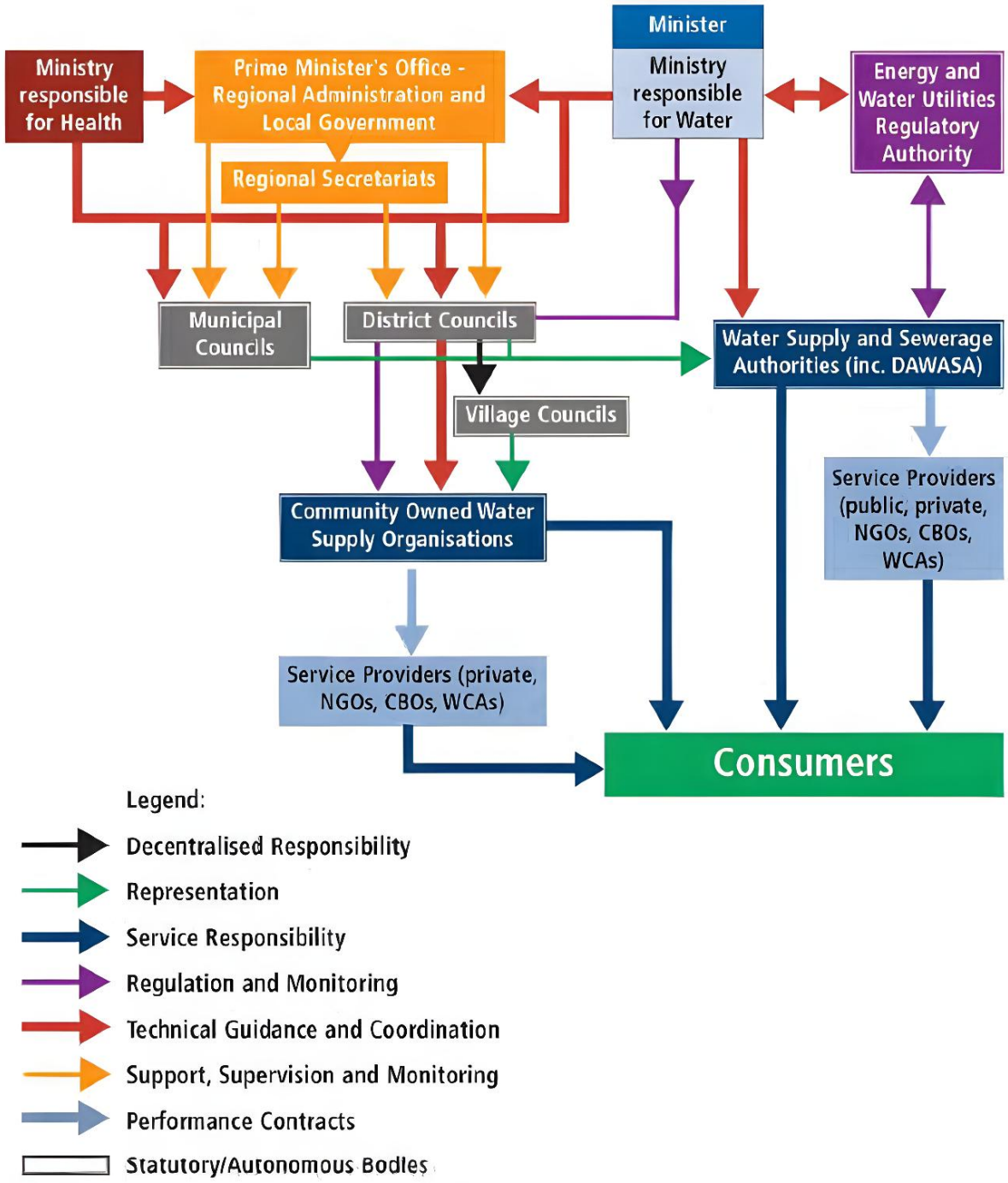

Figure 3-2 Governance Structure for Planning and Implementation of Water and Sanitation Services (The World Bank, 2016).

From an **Implementation and Service Delivery** perspective, LGAs are key facilitators that work through RUWASA and community-based organisations (CBOs) involved in water supply, to implement groundwater-based supply projects, mostly in rural and peri-urban communities. Their support is typically in the form of the siting and development of wells and boreholes, including the facilitation of construction and oversight of small-scale community boreholes that provide access to water for villages, schools, and other public institutions. In urban areas, the work is usually carried out by DAWASA or similar urban Water Supply and Sanitation Authorities, while the LGAs support the WSSAs where required.

A large part of how LGAs contribute to the management of groundwater is through **Monitoring and Compliance Support**. LGAs act as an "on the ground" presence for basin waterboards through monitoring of illegal abstraction, assessing pollution risks, and identifying unlicensed drilling within their jurisdictions. LGAs also play an important data collection role, as they gather and share local information on borehole performance, well status, and groundwater quality with their relevant basin water boards.

Through **Community Engagement and Awareness**, LGAs mobilise communities to adopt practices that safeguard groundwater resources. This involves raising awareness on the importance of establishing groundwater protection zones, ensuring sanitary siting of wells, and preventing pollution. They also promote the enforcement of local bylaws designed to protect water sources from contamination. This is primarily observed through the regulations that restrict the construction of pit latrines too close to wells.

While basin water boards retain authority, LGAs provide a necessary layer of local oversight through **Enforcement Support**. They enforce local by-laws pertaining to land-use, waste disposal, and environmental sanitation, all of which directly impact groundwater quality. Environmental health officers are employed to identify and mitigate contamination risks originating from solid waste, pit latrines, and agricultural chemicals in the bid to protect water resources at their point of use.

3.1.3. Groundwater Use Authorisation and Registration

Tanzania's groundwater management framework combines statutory controls under the WRMA 2009 (as amended 2022) including regulations on licensing, monitoring, and safe/sustainable abstraction. By requiring permits for use, licensing drillers, enforcing water quality standards, and designating protection zones, the system aims to ensure groundwater is developed responsibly, safeguarded against pollution, and sustainably managed through Basin Water Boards as frontline institutions. This integrated approach can position groundwater as a secure and reliable resource for current and future generations, if implemented and enforced effectively.

The introduction of water rights and permits, as part of the WRMA, was introduced to regulate water use, ensuring the allocation of water to users is fairly distributed, and provides a means of preventing over-exploitation. Through water allocation and prioritisation, water use is prioritised first for domestic use and basic human needs, then water supply for livestock, environmental conservation, irrigation, and industry. Under the act, water is considered public property, requiring legal authorisation for its access. Authorisation for large scale use is granted through water use permits (WUP), while small scale domestic use for households and livestock do not require a permit. Permits pertaining to the establishment of infrastructure for water abstraction and discharge are also covered under the act. The drilling of boreholes requires a drilling permit, while discharging permits are required for the releasing of agricultural, industrial and sewage runoff into water bodies.

To strengthen the implementation and enforcement of the Water Resources Management Act No. 11 of 2009, the Ministry of Water has developed several digital platforms aimed at improving the management of water use and permits in Tanzania. To date, several systems have either been developed or are in the final stages of development. These include the Water User Information Management System (WUIMS), the Maji Information System (Maji-IS), and the Operational Decision Support System (ODSS) – Water Use Permitting Analysis Tool (WUPA). The WUMIS is a web-based platform designed to manage water use, discharge, and drilling permit applications. This system was initially developed for the Wami-Ruvu Basin Water Board (WRBWB). It is the only system currently accessible to the general public and can be accessed through https://wumis.maji.go.tz. Maji-IS is a sector-wide information management system that, among other functions, holds records of all existing water uses and users, supports water permit applications, assesses customer water usage during different periods, and ensures that customers receive accurate water invoices based on their consumption. ODSS-WUPA, which is currently in the development stage, will interface with both Maji-IS and WUMIS to analyse the effects of potential new water abstractions on the system's overall water balance and, in particular, on existing water uses

3.2. Overview of Water-Related Legislation and Regulations

Tanzania's water sector is governed by two principal Acts, complemented by updated policies and regulations:

i. **Water Resources Management Act (WRMA), 2009 (Act No. 11 of 2009), as amended by the Water Resources Management (Amendment) Act, 2022 (Act No. 8 of 2022)** – the current law governing surface and groundwater resources. The 2022 amendment modernised institutional arrangements and procedural provisions, including reforms in water use permitting.

ii. **Water Supply and Sanitation Act (WSSA), 2019 (Act No. 5 of 2019)** – the latest service-delivery law. It repealed the Water Supply and Sanitation Act, 2009 and the DAWASA Act, creating the current institutional and regulatory framework for water supply and sanitation.

In addition, the Government recently issued the **National Water Policy 2002 (Version 2025)** to align sector policy with the Sustainable Development Goals (SDGs) and Tanzania's evolving water and sanitation architecture. While highly influential, it remains a policy document rather than legislation.

Overarching Objectives

- **WRMA 2009 (as amended 2022):** Promote sustainable development, allocation, and protection of water resources; prevent and control pollution; strengthen integrated water resources management (IWRM) planning; enhance stakeholder participation; and modernise outdated water utilisation laws that facilitate adaptive management, prioritise climate resilience.
- **WSSA 2019:** Ensure sustainable, efficient, and transparently regulated water supply and sanitation services; establish and empower responsible authorities and financing mechanisms; and safeguard consumer rights.

Key Provisions

i. Water Resources Management

- **Basin approach & institutions:** Establishes Basin Water Boards and Catchment/Sub-catchment Committees for resource allocation, protection, and planning. The 2022 amendment replaced "permits" with "titles", devolved issuance powers (e.g., Basin Water Officer → Basin Water Director), and updated related procedures. The implementation of titles was introduced as a measure to register a borehole and mandate payment for water usage annually. Permits are now only required for the drilling of boreholes, and not for the usage of groundwater.
- **IWRM planning:** Mandates both national and basin-level IWRM Plans to guide sustainable management.
- **Water use & discharge titles:** Requires mandatory titles for abstraction and wastewater discharge, with fees and conditions set by regulation.
- **Water quality & classification:** Provides for national water classification and effluent quality standards under WRM regulations.
- **Stormwater & transfers:** The 2018 regulations govern stormwater control and procedures for transferring water use, discharge, and groundwater titles.

ii. Water Supply, Service Delivery & Quality

- **Institutional framework:** Recognises Urban Water Supply and Sanitation Authorities (WSSAs), the Rural Water Supply and Sanitation Agency (RUWASA), and the National Water Fund, each with defined roles in service provision and financing.
- **Regulation & tariffs:** Assigns Energy and Water Utilities Regulatory Authority (EWURA) to regulate service quality, standards, and tariff setting.

- **Consumer protection:** Requires utilities to publish customer service charters, establish complaint-handling mechanisms, and adhere to minimum service standards.
- **Water quality:** Utilities are obligated to meet national drinking water quality standards set by Tanzania Bureau of Standards (TBS) and monitored under EWURA's regulatory framework.

iii. Groundwater Management

- **Groundwater titles:** All siting and abstraction require formal titles, with minimum distance requirements and aquifer protection provisions under the WRMA.
- **Licensing of drillers/explorers:** The *Groundwater (Exploration and Drilling) Licensing Regulations, 2013* (GN 219) require firms and drillers to be licensed, with prescribed procedures for applications, conditions, and appeals.
- **Well quality monitoring:** The *WRM (Water Well Quality Monitoring) Regulations, 2018* (GN 155) oblige well owners to test water against TBS standards and report results for compliance monitoring.
- **Permit transfers:** The *Water Use, Discharge and Groundwater Permit Transfer Regulations, 2018* (GN 157) govern transfer processes.
- **Dam safety & aquifer protection:** The *WRM (Dam Safety) Regulations, 2013* and WRMA provisions safeguard aquifers, protect groundwater from waste, and establish protection zones.
- **Technical guidance:** The Ministry of Water has issued detailed guidelines for groundwater exploration and well drilling to standardise practice and improve sustainability.

3.2.1. Water Resources Management Act, no 11 of 2009

Water resource management in Tanzania is governed by the WRMA No. 11 of 2009 and its 2022 amendment. The Act regulates the management, utilisation, and protection of all water resources, including groundwater, and recognises water as a public resource that must be allocated equitably, protected from degradation, and managed sustainably. The Act replaced the Water Utilisation Act of 1974 and introduced several key reforms, such as the integration of IWRM and basin-based governance, with management organised through Basin Water Boards, mandatory water-use permitting and licensing for the abstraction of both surface water and groundwater, including conditions on volumes, and monitoring, the regulation of groundwater exploration and drilling and the prioritisation of water allocations.

The Act provides the institutional and legal framework for the sustainable management and development of water resources and sets out core principles for water resource management and the prevention and control of water pollution. A key principle of the Act is IWRM, which emphasises managing water resources at the river basin level. To date, seven of Tanzania's nine river basins have successfully developed basin IWRM and development plans, while the remaining two (including the Wami-Ruvu Basin) are in the process of finalising their plans.

The Act requires any person intending to construct a deep well or borehole in a groundwater-controlled area, or elsewhere as specified, to obtain a groundwater permit. It further states that using water in excess of the volume authorised in a water-use permit, or for purposes other than those approved, constitutes an offence. In addition, the Act prohibits the discharge of waste into any water body, including groundwater, without written authorisation. Beyond permitting and compliance, the WRMA sets guidelines and standards for the construction and maintenance of water-resource structures, the issuing and operation of water permits, and the registration of boreholes. Institutionally, it mandates the Ministry of Water to oversee national policy, establishes the National Water Board to advise the government on water policy and regulation, and creates Basin Water Boards to manage resources at the basin level, supported by Water User Associations to strengthen

community participation in local management. Together, these provisions reflect the Act's emphasis on decentralised, basin-based water governance in Tanzania.

3.2.2. Water Supply and Sanitation Act No.5 of 2019 (Amendment of Act No.12, 2009)

The Water Supply and Sanitation Act of 2019 provides a foundation for managing, delivering, and regulating water supply and sanitation services across Tanzania. The Act replaces outdated regulations such as the Water Supply and Sanitation Act of 2009 and the Dar es Salaam Water and Sewerage Authority Act of 2001 to better respond to current challenges and provide updated governance structures, improve service delivery models, and promote accountability.

The Act promotes important principles such as decentralising service delivery to the lowest appropriate level, empowering communities to manage their own water schemes, encouraging partnerships with the private sector, protecting public health and water sources, and ensuring affordability for low-income households. At the national level, the Minister responsible for water is tasked with setting national policy and overseeing implementation. Regional secretariats and local government authorities also have defined responsibilities, especially in supporting local service delivery and community engagement.

The Act supports and establishes several key institutions to support its objectives. These include Dar es Salaam's Water Sewerage Authority (DAWASA), the Rural Water Supply and Sanitation Agency (RUWASA), the National Water Fund, and Community-Based Water Supply Organisations. Each plays a distinct role in ensuring that safe, reliable, and affordable water supply and sanitation services are delivered to all communities, especially in underserved rural and peri-urban areas.

In particular, RUWASA, established under the Act, is the primary national institution responsible for constructing, supervising, and regulating water-supply services in rural areas. It delivers this mandate through rural water projects, many of which depend on groundwater exploration and borehole development. DAWASA, also governed by the Act, serves as the urban water supply and sanitation authority for the Dar es Salaam region. The city's supply remains largely dependent on surface water from the Ruvu and Mtoni Rivers, which increases vulnerability during drought periods. To strengthen supply resilience, DAWASA supplements surface-water sources with groundwater from the Quaternary shallow coastal aquifer and is developing the deeper Kimbiji Aquifer as an additional potable-water source (SADC-GMI, 2019).

In rural areas, the Act empowers communities through the formation of Community-Based Water Supply Organisations. These organisations, governed by elected committees, are responsible for managing local water sources and systems. RUWASA plays a key role in supporting these community efforts, including helping to cluster smaller schemes to improve efficiency and access to funding. Additionally, to support infrastructure development and catchment protection, the Act established the National Water Fund. This fund mobilises financial resources and provides grants and loans for water projects throughout the country.

The above mentioned water authorities are responsible for managing services within defined geographical areas, operating efficiently and economically. They are regulated by the Energy and Water Utilities Regulatory Authority (EWURA), which ensures compliance with national standards and protects consumer interests, including in the setting of fair tariffs.

The legislation also addresses the quality of workmanship, introduces penalties for offences related to water and sanitation misuse, and includes transitional provisions to support a smooth shift from the previous legal frameworks.

3.2.3. Regulations

Tanzania has specific regulations governing water resources to ensure environmental protection and sustainable groundwater use. The key regulations are discussed below.

3.2.3.1. Ground Water (Exploration and Drilling) Licensing Regulations, 2013

The Ground Water (Exploration and Drilling) Licensing Regulations, 2013, enacted under the WRMA of 2019, provide for the requirements and procedures for the application and issuance of a groundwater exploration licence. Regulation 4 (1) requires any person or entity who wishes to undertake groundwater exploration activities to apply for a licence.

The primary objective of this regulation is to establish a mandatory licensing system for all individuals and companies involved in groundwater drilling, thereby ensuring that groundwater development is conducted by qualified professionals. Through this, it:

- standardises the industry,
- ensures technical competence,
- creates a database,
- improves accountability,
- protects water infrastructure.

By requiring proper borehole siting, design, construction and documentation, the Regulation reduces the risk of borehole failure and minimises groundwater contamination.

3.2.3.2. Water Resources Management (Water Well Quality Monitoring) Regulations, 2018

The Water Resources Management (Water Well Quality Monitoring) Regulations, 2018, outline the legal framework for the mandatory monitoring of groundwater quality from all types of wells/ boreholes in Tanzania. This regulation makes reference to the responsibilities of well owners and operators, requiring them to conduct regular sampling and physical, chemical and biological analysis according to parameters set out by the Tanzania Bureau of Standards (TBS) and World Health Organisation (WHO). It mandates the reporting of this sampling data to the relevant Basin Water Boards, contributing to a developing national database on groundwater quality.

The purpose of this regulation is to achieve a shift from unregulated groundwater use to a managed and monitored system that is assessed on health, potential contamination hotspots and pollution trends. Through the enforcement of these regulations, public health is prioritised through the identification of unsafe water sources. This regulation forms part of the **WRMA** and complements the **Environmental Management Act** by providing the data needed to assess environmental impacts and compliance with effluent standards.

3.2.3.3. Environmental Management (Water Quality Standards) Regulations, 2007

The **Environmental Management (Water Quality Standards) Regulations, 2007,** are a comprehensive piece of subsidiary legislation enacted under the Environmental Management Act (EMA). They focus on providing a framework for the management and protection of water resources throughout Tanzania by establishing limits for a wide range of physical, chemical and radiological parameters that define acceptable water quality. These standards are categorised according to specific water uses and include standards for drinking water, environmental ecosystems and recreational activities. Within the environmental ecosystems category, the regulations explicitly cover rivers, lakes, marine areas and groundwater.

In addition, the regulations also address the quality of industrial effluent discharged from industrial facilities into the environment (rivers, lakes, sewers and land), which ultimately has the potential to contaminate groundwater. This regulation aims to operationalise the government's mandate for environmental protection by setting clear, measurable benchmarks for pollution control and water resource management. It empowers regulators such as the NEMC to:

- Monitoring compliance
- Issue wastewater discharge permits
- Penalise polluters

Through defining the required water quality for different water uses, it also aims to safeguard public health from waterborne diseases, protect aquatic ecosystems and aquifers from degradation and ensure the availability of clean water for economic activities in a manner that is sustainable. This regulation provides the legal backbone for preventing water pollution, ensuring Tanzania's water resources are protected and managed sustainably, **working in complimentary with the WRMA**.

3.2.3.4. Water Resources Management (Control and Management of Storm Water) Regulations, 2018

The Water Resources Management (Control and Management of Storm Water) Regulations, 2018, were established to address the growing challenges of urban flooding, pollution from runoff, and the sustainable management of stormwater. While the **Environmental Management Regulations** focus on quality, these regulations focus on the quantity, flow, and management of stormwater as a water resource, instead of integrating it into the national water governance structure overseen by the MoW and Basin Water Boards. Through this regulation, clear ownership and responsibility are established, sustainable drainage systems are promoted, and a clear planning and permitting framework is presented. Among other things, they set out the responsibilities for flood control and mitigation for Basin Water Boards, Water Authorities, and Local Government Authorities (LGAs). The **Water Resources Management (Control and Management of Storm Water) Regulations** aim to:

- mitigate flood risk,
- regulate activities in flood-prone areas and stormwater areas,
- promote the construction of stormwater and flood control structures in municipal areas,
- Identify, map, and protect flood-prone and stormwater regulatory areas,
- provide legal means to demolish unauthorised structures that increase flood risk and contribute to pollution,
- prevent water pollution,
- promote water conservation and reuse,
- protect water resources.

This regulation fills a critical gap in Tanzania's water resource management framework by addressing stormwater not just as a waste product, but as a valuable resource that must be managed integrally. To achieve this, it integrates the urban water cycle, empowers Basin Water Boards, builds climate resilience and complements existing laws.

Even though these regulations target urban flooding and runoff management, they are highly relevant to groundwater because stormwater is both a primary recharge source and a major contamination pathway for shallow aquifers. By promoting infiltration-based drainage, controlling land use in stormwater zones, and reducing polluted runoff, the Regulations protect groundwater quantity and quality and help reduce future abstraction pressure.

3.2.3.5. National Water Fund Regulations, 2019

The National Water Fund Regulations, 2019, aim to create a sustainable financial system that enables Tanzania to effectively protect, manage and develop its water resources (including groundwater). The Fund's purpose is to execute water supply and sanitation projects in Mainland Tanzania, particularly in areas with the lowest coverage, as well as to manage catchment areas and develop water sources. The water projects shall include

- protection and conservation of water catchment areas;
- development of water storage, safety, and security facilities;
- construction, rehabilitation, and expansion of water supply and sanitation infrastructure.

The National Water Fund Regulations help address the financing gap in Tanzania's water sector by establishing a more reliable mechanism to fund water-resources management activities that have historically been under-resourced. By providing stable financial support for Basin Water Boards and other implementing agencies, the regulations strengthen the institutional capacity required to implement Integrated Water Resources Management (IWRM) and improve basin-level governance.

3.2.4. Tanzanian Water Quality Guidelines

The National Guidelines on Drinking Water Quality Monitoring and Reporting (2018) and the Water and Wastewater Quality Monitoring Guidelines (2020) are the primary tools for water quality monitoring for water utilities in the country. The ultimate goal of the National Guidelines on Drinking Water Quality Monitoring and Reporting, 2018, is to ensure that drinking water supplied at various levels meets the acceptable national water quality standards. These guidelines guide water supply entities on the monitoring of the quality of drinking water in both rural and urban areas, including private water suppliers, vendors, and groundwater extracted for bulk water supply by DAWASA.

The Water and Wastewater Quality Monitoring Guidelines, 2020, cover all the key aspects of water quality monitoring for water supply and sanitation authorities. These include: the setting up of water quality parameters; number of samples and frequency of sampling; monitoring aspects, compliance and operation, interpretations and reporting. The guidelines also highlight the procedures and methods to be adopted in undertaking the key elements of water quality monitoring by Water Supply and Sanitation Authorities. Since Dar es Salaam's Water Supply and Sanitation Authorities (DAWASA) also supplements surface water supply with groundwater, the above guidelines also apply to groundwater quality monitoring within DAWASA's wellfields.

3.3. Overview of Environmental-Related Legislation

The **Environmental Management Act, 2004 (EMA, Cap. 191),** forms the foundation of Tanzania's environmental management framework and serves as the principal law governing environmental protection, the sustainable use of natural resources (including groundwater), and the enforcement of environmental rights and duties. The Act establishes the National Environment Management Council (NEMC) as the regulatory authority responsible for overseeing activities that may affect groundwater quality and aquifer integrity. It mandates key environmental management instruments, including Environmental Impact Assessments (EIAs), Strategic Environmental Assessments (SEAs), Environmental Audits, and Pollution Control measures, which collectively aim to prevent groundwater contamination from development activities. Complementing this are sector-specific laws (described in sections above), including:

- The **Water Resources Management Act of 2009 (as amended in 2022)**, which integrates environmental safeguards in water allocation, pollution control, and groundwater protection;
- The **Water Supply and Sanitation Act of 2019**, which enforces quality standards for drinking water;

Together, these laws integrate groundwater into environmental governance, ensuring that groundwater resources are protected, sustainably used, and monitored within national development and service delivery processes.

3.4. Overview of Climate Change-Related Legislation

Climate change is addressed through a mix of legislation, national policies, and international commitments that together form the country's climate governance framework. These instruments collectively provide Tanzania with a multi-layered climate governance framework, linking domestic laws and strategies with global commitments. Climate change legislation aims provide a form of mitigation and adaption to address climate change.

National Legislation (with climate relevance) include:

- **Environmental Management Act, 2004 (Cap. 191):** The principal law on environment and climate; mandates government coordination of climate change actions, requiring EIAs/SEAs, and provides tools for pollution control and adaptation measures. These mandates often protect groundwater resources from overutilisation and contamination. To read more on the EMA, refer to **Section 3.3**. The link between groundwater management and climate change is specifically related to preventing the deterioration of resources and the natural processes that maintain them. As the impacts of climate change grow in magnitude, it is crucial water resources are at their most resilient to manage through these periods.
- **Water Resources Management Act, 2009 (amended 2022):** as noted earlier, it supports climate resilience by regulating sustainable water allocation, groundwater protection, and pollution control. To read more on the WRMA, refer to **Section 3.2.1**. Through effective regulation of sustainable water use and ensuring the quality and quantity of groundwater are protected, users and the environment, which are dependent on groundwater, can be more resilient against the impacts of climate change.
- **Water Supply and Sanitation Act, 2019:** Ensures climate-resilient water service delivery and safeguards drinking water quality. To read more on the Water Supply and Sanitation Act refer to **Section 3.2.2**. By minimising water losses and ensuring sufficient water supply and quality, the vulnerability of groundwater systems and their users can be reduced. Similarly, if sufficient sanitation services are provided and infrastructure is maintained, the quality of groundwater can be protected, and any unnecessary strain due to aquifer contamination can be avoided. This is especially relevant when climate change occurs and water availability is limited.

Relevant National Policies & Strategies include:

- **National Climate Change Strategy, 2012 (under review):** Framework for adaptation and mitigation across sectors such as agriculture, water, energy, health, and forestry.
- **National Environmental Policy, 2021:** Mainstreams climate change into development planning and sector policies. Through development planning, city planners can be cognizant of impacts on groundwater recharge and quality (see **Section 4.1.2**).
- **Disaster Management Policy (2004)** ensures a safe livelihood with minimal disaster interruptions to social and economic development programmes. This could describe the intent to address issues related to over-abstraction as a result of drought or severe contamination of aquifers (see **Section 4.1.3**).
- **National Adaptation Plan (NAP, in development):** Long-term framework for coordinated adaptation across priority sectors. This includes adaption to various climate change scenarios, including alterations to the availability of water resources.

4. Relevant Policies and Strategies of Tanzania

The policies and strategies that guide the management and governance of water resources in Dar es Salaam were conceptualised and mandated on a national level, creating a top-down governance structure. These national instruments establish the principles for integrated water resource management, allocate water rights, and set climate adaptation priorities. Through these overarching policies and strategies, Tanzania has aimed to build resilience against climate change and improve the governance of national assets. At the local level, institutions such as DAWASA, WRBRB and municipal authorities function primarily as implementing agencies. Their role is to interpret and operationalise these national directives into local planning, infrastructure development and day-to-day water resource management practices.

Groundwater in Tanzania is not governed by a standalone national groundwater policy, but is instead embedded in broader water and environmental policies. The most relevant of the polices are the National Water Policy (NAWAPO) of 2002, which has been updated into the National Water Policy of 2025, and the National Environmental Policy of 2021. These frameworks, together with the Water Resources Management Act, 2009 (amended in 2022), set out the principles and rules for sustainable groundwater management across the country, including Dar es Salaam.

Sustainable groundwater management, as governed by the above-mentioned regulatory instruments, is critically important in Dar es Salaam due to the city's growing dependence on groundwater. This dependency is driven by rising water demand, limited and variable surface water availability, and increasing climate-related pressures. DAWASA, working in coordination with the Wami-Ruvu Basin Water Board, oversees the urban water supply system, including the abstraction and management of groundwater resources. Groundwater plays a vital role in supplementing surface water from the Ruvu and Kzinga Rivers, particularly in peri-urban and underserved areas where reticulated supply is limited. However, rapid urbanisation, the proliferation of unregulated private boreholes, coastal saltwater intrusion, and pollution from onsite sanitation systems pose significant risks to the sustainability and quality of the city's groundwater resources.

The approach to address these challenges is threefold and based on three complementary pillars:

1. **Strengthened Regulation & Monitoring:** through the stricter enforcement of permits, metering, and systematic data collection by Basin Water Boards
2. **Expansion of Aquifer Protection & Pollution Control Measures:** which will involve the delineation of wellfield protection zones, regulation of borehole siting, and pollution mitigation measures.
3. **Integration of groundwater into Urban Water Security Planning:** involving investing in recharge initiatives, alternative water sources, and improved sanitation infrastructure.

The Ministry of Water, through the new NAWAPO 2025 and the national Water Sector Development Programme (WSDP, Phase III), is steering these efforts, while in Dar es Salaam, DAWASA and the Wami-Ruvu Basin Board are expected to implement groundwater management as part of the city's long-term water supply master plan.

Through the recently amended NAWAPO 2025, the WSDP Phase III, and collaboration with local authorities, this strategy aims to position groundwater as a resilient, safe, and sustainable resource for present and future water supply. The relationship between NAWAPO 2025 and other policies, strategies, programmes and plans is illustrated in **Figure 4-1**.

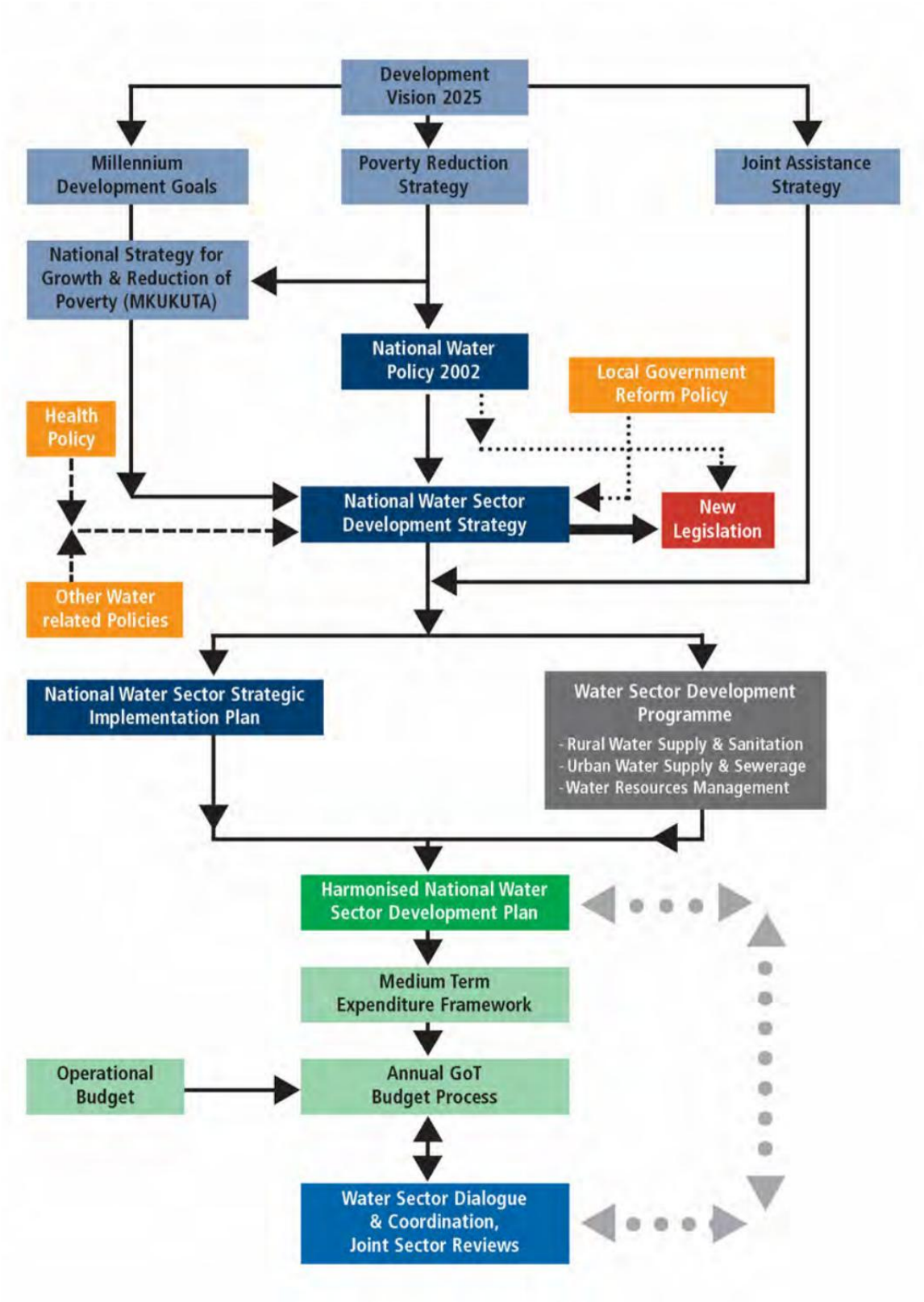

Figure 4-1 **The relationship between the National Water Policy and water sector strategies, programmes and plans (URT, 2008).**

4.1. Policies

4.1.1. National Water Policy (NAWAPO)

The National Water Policy (NAWAPO) of 2025 is an update of the original 2002 Water Policy, developed in response to emerging challenges and national development priorities. Extensive stakeholder consultations, technical assessments, and alignment with global water governance standards guided the revision process. Key drivers for the policy update included:

- Population growth and urbanisation, placing pressure on existing water infrastructure.
- Climate change and variability, increasing the frequency and severity of water scarcity and flooding.
- Food and energy security demands, requiring integrated water planning.
- Technological advancement and the need to adopt smart and sustainable water solutions.
- Financing gaps in the water sector and a push for diversified investment models.

Under NAWAPO 2002, groundwater is recognised as a strategic water resource for both rural and urban water supply. The policy requires that groundwater abstraction be subject to permits, monitoring, and pollution safeguards, and that aquifers be protected from over-exploitation and contamination. It also promotes IWRM at the basin level, where groundwater is managed together with surface water. The recently amended NAWAPO 2025 strengthens this by emphasising climate resilience, expanding groundwater monitoring networks, promoting groundwater recharge and protection zones, and integrating groundwater into long-term water security planning.

NAWAPO's 2025 vision is to achieve a water-secure country with equitable, sustainable, accessible, affordable and reliable water and sanitation services for socio-economic development. The specific objectives of the policy are:

- To enhance sustainable management of water resources;
- To improve water resources development;
- To improve water and wastewater quality management;
- To enhance sustainable water supply services and water management systems;
- To enhance reliable and sustainable sanitation services;
- To strengthen private sector participation in the water sector;
- To enhance research and technology development in the water sector; and
- To promote cross-cutting issues, which include environmental and climate change resilience, gender and good governance.

Key Components of NAWAPO include:

- **The Establishment of a National Water Grid:** The policy promotes the establishment of a transformative national water grid, which is an interconnected system to transfer water from surplus regions to deficit regions. This aims to address regional disparities and climate-induced water stress.
- **Private Sector Participation and Green Financing**: The policy encourages investment from non-state actors in water supply, irrigation, and conservation initiatives and promotes innovative financing models, such as green bonds and blended financing.
- **Climate-Resilient Water Infrastructure:** The policy supports the development of dams, boreholes, and rainwater harvesting infrastructure that can withstand extreme weather events. Also emphasised is compliance with environmental and social safeguard frameworks

during the planning and implementation of large-scale water projects to ensure sustainability and minimise negative impacts.

- **Strengthening Water Governance:** Clarifying roles of institutions at national, basin, and local levels. Enhancing the capacity and autonomy of Basin Water Boards and Catchment Committees and promoting transparency, digital water data systems, and stakeholder participation.
- **Focus on WASH (Water, Sanitation, and Hygiene):** Reinforcing access to safe and affordable drinking water and sanitation, particularly in underserved areas. This also involves promoting community hygiene practices and education.
- **Water Conservation and Resource Protection:** The policy aims to strengthen catchment protection, recharge zones conservation, wetland management and pollution control through permits, licensing, and the enforcement of regulations.
- **Promotion of Innovation and Youth Engagement:** Encouraging the use of digital tools and mobile technology for water monitoring and service delivery. Targeting the youth and technical graduates for water entrepreneurship and vocational training.
- **Gender and Social Inclusion:** Mainstreaming gender equity and social inclusion across all water sector activities. Ensuring the participation of women, the youth and vulnerable groups in decision-making. This aspect also includes prioritising service provision to vulnerable groups and underserved communities.

NAWAPO is operationalised by the National Water Sector Development Strategy (**Section 4.2.1**), the Water Sector Strategic Implementation Plan, and the Water Sector Development Programmes (**Section 5.1**)**,** which are described in the sections that follow.

4.1.2. National Environmental Policy (NEP) 2021

The National Environmental Policy (NEP) of 2021 sets a comprehensive and updated framework for sustainable environmental management. It replaces the 1997 policy to address new and emerging challenges, including climate change, waste management (including e-waste and oil pollution), invasive species, chemical management, and the safe use of biotechnology.

The 2021 amended policy envisions a sustainable, safe, clean, and healthy environment for Tanzania. To achieve this, the policy sets out specific objectives which:

- Strengthen coordination of environmental management across all sectors and governance levels.
- Enhance environmentally sound management of land resources to support socio-economic development.
- Promote effective environmental management and protection of water sources.
- Strengthens the conservation of wildlife habitats, biodiversity, and forest ecosystems.
- Manage and reduce pollution for a safe and healthy environment.
- Strengthen the national capacity to address climate change impacts through adaptation and mitigation.
- Enhance the conservation of aquatic ecosystems for sustained ecological services and socio-economic wellbeing.
- Ensure the safe use and regulation of modern biotechnology.
- Promote gender integration in environmental management.
- Promote good governance in environmental management at all levels.
- Ensure predictable, accessible, adequate and sustainable financial resources for environmental management.

Although NEP is broad in scope, it has several provisions outlined above that directly support groundwater protection, sustainable use and risk reduction. The policy directly supports sustainable groundwater management by emphasising the protection of water sources, strengthened pollution control, improved land-use planning, and climate-change adaptation. Its directive to safeguard water source, which includes aquifers, springs, wellfields, and recharge zones, creates a national mandate for reducing contamination risk. The NEP also promotes ecosystem conservation and stronger institutional coordination, reinforcing the roles of Basin Water Boards, NEMC, and local authorities in managing groundwater impacts. Together, these provisions enhance sustainable groundwater development and protection in Dar es Salaam.

4.1.3. National Disaster Management Policy, 2004 (Revised in 2025)

The National Disaster Management Policy of 2004 provides the overall policy framework for disaster risk management in Tanzania. Its primary aim is to reduce the vulnerability of people, property and the environment to disasters and integrate disaster management into national development planning. The policy was developed in response to shortcomings in disaster mitigation, prevention, preparedness, response, recovery and rehabilitation. These gaps largely stem from weak institutional arrangements, legal frameworks and technical capabilities. To address this, the policy seeks to strengthen institutional capacity, coordination, and cooperation, promoting a comprehensive and integrated approach to disaster management across all stakeholders and levels of government.

Key policy objectives include:

- Strengthening preparedness, response, and mitigation capacity for all types of disasters.
- Promoting public knowledge and awareness of disasters and enhancing community participation in disaster management.
- Establishing and maintaining effective institutional arrangements for coordination and collaboration.
- Promoting research and information sharing on disasters.
- Mainstreaming disaster management into development plans, sectoral policies and programmes at all levels.

The policy covers three main areas:

1. **Risk Reduction**: Sustaining measures that reduce or eliminate long-term risks to people and property from hazards and their effects.
2. **Capacity Building**: Strengthening emergency management capacity to effectively prepare for, mitigate, respond to, and recover from any hazard through planning, training, research, rehearsals, and investigations.
3. **Emergency Operations**: Implementing coordinated actions to save lives, protect livelihoods and property by pre-positioning emergency equipment and supplies, evacuating potential victims, providing food, water, medical care and restoring critical public services in the event of a disaster.

Although the National Disaster Management Policy focuses broadly on disaster risk reduction, it has several important implications for groundwater management. Many of Tanzania's key hazards, such as drought, floods, contamination events, saltwater intrusion, and infrastructure failure, directly affect groundwater availability and quality. By strengthening preparedness, risk reduction, and institutional coordination, the policy provides an enabling framework for managing groundwater-related risks as part of national disaster resilience.

The National Disaster Management Policy has been revised in 2025 to accommodate changes in legislation, however, remains broadly the same. It is operationalised by the National Disaster Management Strategy (2022 – 2027), described in **Section 4.2.3**.

4.1.4. National Land Policy (NLP), 1995 (Revised in 2023)

The National Land Policy of 1997 considers land tenure, management, and administration. Its main objectives include promoting and securing a reliable land tenure system in Tanzania and encouraging the sustainable and optimal use of land. The policy stresses integrated planning and improved management of urban centres and land use designations, taking environmental impact into account. It acknowledges the importance of social services such as water supply, road networks, waste management, and energy development on land for human benefits, emphasising the need to manage these in ways that protect land for other uses and prevent land degradation.

The policy also highlights the need for mechanisms for protecting sensitive areas such as water catchment areas, rivers, national parks, and areas of biodiversity to be developed. This includes prohibiting private allocation of sensitive areas and ensuring they remain under public use, conservation and careful regulation. The protection of hazard lands, such as river valleys, areas of steep slopes, and mangroves, against settlement or inappropriate development is also highlighted to reduce land degradation, pollution and other forms of environmental destruction. It is also recommended that recharge zones be considered for protection and integrated into land planning.

The policy has strong implications for groundwater management because land-use management directly influences groundwater recharge and vulnerability to contamination. By promoting integrated land-use planning and protecting sensitive areas such as water catchments, wetlands, and hazard lands, the policy helps prevent pollution and land degradation that threaten aquifers. It also recommends that groundwater recharge zones be identified and incorporated into planning processes, providing a clear basis for safeguarding groundwater resources in rapidly growing cities like Dar es Salaam. The NLP was revised in 2023, with key changes focussing on fees and the length of time land can be occupied. The update to this policy includes the introduction of the commissioner of land as part of a change in organisational structure. However, the key objectives of the policy remain the same.

4.2. Strategies

Strategies play a crucial role in the conjunctive management of water resources, especially those that ensure the sustainable and integrated use of surface and groundwater. Effective strategies help balance supply and demand, mitigate risks such as over-abstraction, aquifer contamination and reductions in recharge, and enhance resilience against climate variability. By combining regulatory measures, technological innovations, and community engagement, conjunctive management optimises resource allocation, protects ecosystems and secures long-term water availability. Groundwater, as a vital resource, is often utilised to mitigate against drought, which requires strategic planning to maintain its reliability and sustainable use. Therefore, in order to reduce the potential impacts on groundwater resources, well-designed and integrated policies are essential for holistic water security.

4.2.1. National Water Sector Development Strategy (2006-2015)

4.2.1.1. Background and Vision

The vision of the National Water Sector Development Strategy (NWSDS) is to achieve the sustainable development and management of all water resources (including groundwater) for economic benefits and improved access to water supply and sanitation. Its main objective is to provide a coherent, holistic, and integrated strategy that outlines how the Ministry responsible for Water will implement the National Water Policy of 2002. This, in turn, guides the formulation of the National Water Sector Development Plan and the Water Sector Development Programme.

Other specific objectives of the strategy include:

- Providing an overall strategic and planning framework into which ongoing sub-sectoral initiatives and projects (e.g., rural water, urban water, sewerage, water resources management) can be aligned, and supported through a Sector Wide Approach to Planning (SWAP);
- Supporting harmonisation and realignment between the National Water Policy, the consequent water sector legislation, and the policies and legislative provisions of other key water-related sectors, such as agriculture, energy, and industry; and
- Highlighting and strengthening inter-sectoral linkages of water resources management, especially through public education and awareness programmes, as well as encouraging the Inclusion of water-related issues in school curricula.

4.2.1.2. Motivation

The development of the National Water Sector Development Strategy was prompted by several factors. These include:

- The recognition of water as central to the social and economic development of Tanzania.
- The need to protect ecosystems and adapt to climate variability (e.g. droughts and floods)
- The need to address inequitable service provision and a lack of sustainable financing
- The need to align the water sector with broader national and regional reforms.

4.2.1.3. Implementation

The National Water Sector Development Strategy (NWSDS), which is the main mechanism for operationalising NAWAPO, is implemented through the National Water Sector Strategic Implementation Plan (NWSSIP) and sub-sectoral investment programmes under the WSDP, both of which are inputs of the National Water Sector Development Plan.

The NWSSIP is a short- to medium-term operational plan that introduces a Logical Planning Framework (LPF) with defined goals, indicators, activities, responsibilities, and timelines to achieve the strategy's main objectives. The first steps towards implementation involve harmonising water sector legislation with other sectoral laws and policies to create coherence across government reforms.

Implementation is carried out through subsector priorities:

- Strengthening Basin Water Boards and Catchment Committees for sustainable water resources management, which directly enhances groundwater regulation, permitting and monitoring;
- Expanding rural water and sanitation services through community ownership, local government engagement, and hygiene education;
- Improving urban water supply (which is heavily reliant on groundwater development in Dar es Salaam) and sewerage management by empowering autonomous Water Supply and Sewerage Authorities (WSSAs), rehabilitating and expanding networks, and fostering private sector participation.

Cross-cutting measures include institutional reform, capacity building, and sustainable financing through government budgets, donor support, and cost recovery, all integrated with the Medium-Term Expenditure Framework (MTEF).

4.2.2. The National Climate Change Response Strategy (2021-2026)

4.2.2.1. Background and Vision

The vision behind Tanzania's National Climate Change Response Strategy is to enhance the country's national resilience to the impacts of climate change and enable the country to pursue low-emission development pathways to achieve sustainable development. It aims to integrate climate change considerations into all levels of planning and decision-making, ensuring that Tanzania can achieve its development goals outlined in Vision 2024 and the Five-Year Development Plans, ultimately achieving this while maintaining its commitment to building a climate-resilient and green economy.

4.2.2.2. Motivation

The National Climate Change Response Strategy provides the overarching framework that guides government actions to manage and mitigate the impacts of climate change. The strategy is particularly relevant to groundwater management, as it supports planning and response measures for periods of reduced recharge and increased abstractions during droughts, when municipal surface water supplies are most constrained. By strengthening preparedness and adaptive capacity, the strategy helps reduce the risks associated with climate-induced water scarcity and enhances the resilience of groundwater users, who increasingly rely on aquifers as a buffer against climate variability.

This strategy is a revised version of Tanzania's first climate strategy (2012 – 2018), developed in response to growing concerns over the impacts of climate change on the country's social, economic, and environmental systems. Tanzania's economy is largely dependent on climate-sensitive sectors such as agriculture, livestock, fisheries and tourism. These sectors are increasingly vulnerable to extreme weather events like droughts, floods and rising temperatures. The revision of the original strategy included an audit of the achievements and gaps of its predecessor, as well as considering emerging global and national developments. The adoption of the Paris Agreement and SDGs is among the few it included; it also incorporated inputs from a wide range of stakeholders through a participatory multi-sectoral approach to provide an informed strategy that considers current issues and those predicted in the future. It ultimately provides the basis for identifying short, medium, and long-term adaptation activities designed to address existing and emerging threats of climate change. In relation to water resources, it provides adaptation interventions for freshwater resources, to ensure their sustainable management and resilience, as well as building adaptive capacity for the coastal and marine environment.

The strategy outlines several specific objectives to:

- Enhance mainstreaming climate change issues into national sector and local government development plans and budgets,
- Facilitate implementation and monitoring of Tanzania's Nationally Determined Contribution,
- Align climate change interventions with the national development agenda of an industrialised economy,
- Devise and implement strategic adaptation and mitigation measures in line with the national circumstances, requirements of climate change-related multilateral environmental agreements, SDGs, Sendai Framework for Disaster Risk Reduction and related bilateral and regional agreements,
- Enhance research, public awareness, education and capacity building on climate change issues,
- Promote the production and integration of traditional weather and climate services for improved warning systems and reducing climatic disaster risks,

- Enhance coordination and institutional capacity, including the provision of climate services and the implementation of the national framework for climate services,
- Facilitate mobilisation of sustainable and adequate finance and technologies to support climate change adaptation and mitigation interventions,
- Promote and facilitate transfer of climate-smart technologies to support climate change adaptation and mitigation,
- Promote gender-responsive climate change adaptation and mitigation interventions, and
- Promote inclusive engagement of stakeholders, including community, media, civil society organisations and the private sector, in designing, implementing and monitoring sustainable climate change adaptation and mitigation interventions.

4.2.2.3. Implementation

To achieve its objectives and aims, Tanzania's government has looked to improve on 5 key areas as part of its implementation arrangements, these include:

- **Institutional arrangements,** which refer to the implementation of institutional-level capacity building. Through the National Environmental Policy (1997), EMA (2004) and related sector policies and legislation, various institutions across governance and the public sector have been incorporated to, and or empowered to combat environmental and climate-related issues.
- **Coordination of this strategy** will be required for the effective governance and implementation between the various institutions.
- **Information and communication arrangements** require commitment and involvement of different organisations and individuals at all levels. Those who are involved will develop and communicate sector-specific information that can be used in addressing the challenges of climate change.
- **Reporting arrangements** would require various levels of government to provide regular reports that capture information on the implementation of the strategy.
- **Resource mobilisation** is a major component of the Climate Change Response Strategy. Addressing climate change in Tanzania will largely depend on the availability and accessibility of sustainable climate financing from both domestic and international sources. The strategy proposes the establishment and operation of the Climate Change Budget Cord or objectives and the National Climate Change Financing Mechanism to prioritise resource allocation.
- **Monitoring and evaluation arrangements** have been made through the establishment of a Monitoring and Evaluation Framework for climate change adaptation in Tanzania. Additionally, the Vice President's Office has established Monitoring and Evaluation Guidelines to follow standard government protocols. M&E is proposed to occur at all levels, taking into account different approaches and outlining milestones and key performance indicators for each objective and strategic intervention.

4.2.3. National Disaster Management Strategy (2022 – 2027)

4.2.3.1. Background and Vision

The vision behind the National Disaster Management Strategy is to achieve an effective and efficient disaster risk-sensitive and responsive society for sustainable development. This strategy envisions a Tanzania where all levels of society are aware of disaster risks, proactively take measures to reduce them, and are capable of responding effectively when a disaster occurs.

Due to its geographical location, Tanzania is highly susceptible to a wide range of disasters. Floods, droughts, fires and earthquakes are all examples of relatively frequently occurring hazards experienced in the country. These are exacerbated by climate change, environmental degradation, unplanned urbanisation, and high population growth. The occurrence of these disasters often affects the progress of socio-economic development. Despite policy and a legal framework for disaster management, the country has experienced an increase in the frequency and magnitude of disaster events. Existing challenges, such as inadequate integration of disaster risk into development planning, a lack of a comprehensive multi-hazard early warning system, and a reactive approach to disaster risk management, create gaps in effective disaster risk management. This strategy was developed to address these gaps and provide a comprehensive, integrated framework for holistically managing disaster risk. Several pieces of legislation have been incorporated in the development of this strategy, notably some of the major pieces include the EMA, National Disaster Management Policy 2004 and Disaster Management Act No. 6 of 2022.

4.2.3.2. Motivation

The purpose and motivation behind this strategy is to provide guiding actions on disaster risk management intervention in Tanzania, to strengthen socio-economic resilience and humanitarian services. The increased occurrence of natural disasters and inefficiency in recovering after these events has highlighted the need for an improvement in disaster risk management. The primary motivation for the development of this strategy was to shift the disaster response model from reactive to a proactive disaster risk reduction approach. The strategy was also motivated by the need to align national efforts with its commitment to regional and international frameworks such as the Sendai Framework for Disaster Risk Reduction (2015 – 2030), SDGs, the Paris Agreement on Climate Change, and Africa's Agenda 2063. Through these efforts and the aim of consolidating and coordinating with a wide range of stakeholders, the strategy aims to present a cohesive and integrated national action plan.

The strategy outlines several specific objectives to strengthen national disaster resilience through inclusive, comprehensive, and integrated disaster risk management measures. These include:

- Increasing understanding of disaster risks at all levels.
- Enhancing disaster prevention, mitigation and preparedness capacity at all levels for community resilience.
- Improving multi-hazard, end-to-end and people-centred early warning systems.
- Strengthening disaster response capacity and relief services at all levels.
- Building back better in recovery, rehabilitation and reconstruction for community resilience.
- Increasing public and private financing and investments in disaster risk management.
- Improving governance on disaster risk management at all levels.
- Strengthening the integration of gender, youth and persons with disabilities and other vulnerable groups' needs and cultural diversity in disaster risk management.
- Strengthening the implementation of recognised regional and international disaster risk management practices.

- Increasing multi-sectoral approaches in managing environmental degradation and climate change for disaster resilience.

The National Disaster Management Strategy is directly relevant to groundwater management because it outlines interventions for preventing, preparing for, and responding to disasters that can affect groundwater quantity and quality. The strategy becomes particularly important when aquifers are stressed by climate-related hazards such as droughts, floods, or saltwater intrusion, or when contamination arises from anthropogenic activities. By strengthening institutional preparedness and community resilience, the strategy enhances the coping capacity of groundwater-dependent users and supports the protection of groundwater as a critical resource during emergencies.

4.2.3.3. Implementation

The **Strategy Implementation Matrix** of the National Disaster Management Strategy has been included to outline a comprehensive and multi-faceted approach to achieving its ten strategic objectives. The matrix details specific strategies and targets for each of these strategies across all of its objectives, and is supported by budget allocations, timelines, and responsible institutions. Key actions include:

- Conducting comprehensive disaster risk assessments and integrating risk information into sectoral planning.
- Developing and mainstreaming DRM guidelines and educational content.
- Enhancing early warning systems through technology and local knowledge.
- Building rapid response teams and contingency plans.
- Promoting “build back better” principles in recovery.
- Increasing financing through risk transfer mechanisms and investments.
- Strengthening government structures and legal frameworks.
- Ensuring inclusivity of vulnerable groups.
- Fostering regional and international cooperation.
- Integrating environmental and climate change considerations into disaster resilience efforts.

Each objective is broken down into actionable strategies with measurable targets. Examples such as establishing evacuation centres, developing standard operating procedures, creating platforms for information sharing, and conducting training and drills have been put forward as actions. The matrix also emphasises a multi-stakeholder approach, where it involves the likes of various government ministries, LGAs, development partners, academic institutions and non-state actors. The use of technology, research, and community engagement to build a resilient nation, capable of anticipating, mitigating and responding to disasters effectively, is also encouraged. Overall, these actions are aimed at protecting communities’ lives and property from the impact of disasters and to create an effective and efficient disaster risk-sensitive and responsive society for sustainable development. By developing this Strategy, the Government reaffirms its commitment to considering a holistic approach towards disaster risk management and humanitarian services, emphasising working together with all stakeholders to develop and implement strategic, scientific, and innovative partnerships for community resilience.

4.2.4. National Biodiversity Strategy and Action Plan

4.2.4.1. Background and Vision

Tanzania is a signatory to the Convention on Biological Diversity (CBD) and has developed a National Biodiversity Strategy and Action Plan (NBSAP) for the period 2015 - 2020 (NBSAP, 2015). The NBSAP was updated in late 2024 to incorporate the Kunming-Montreal Global Biodiversity Framework global goals and lessons learnt to date for its 2025 – 2030 version. National governments are encouraged to develop NBSAPs to meet their commitment to the CBD and to work towards the following three goals:

- Conservation of biological diversity;
- Sustainable use of the components of biological diversity, and
- Fair and equitable sharing of the benefits arising from the utilisation of genetic resources.

The vision of this strategy is closely aligned with Tanzania's Development Vision 2050 and the Global Biodiversity Framework, with the overarching aim of reversing biodiversity loss and ensuring that biodiversity is conserved, restored, and used sustainably to support socio-economic development by 2030. This vision is linked to groundwater, as biodiversity conservation and groundwater systems are closely interconnected, particularly through GDEs, the provision of ecosystem services, and the sustainable management of natural resources.

4.2.4.2. Motivation

Tanzania's National Biodiversity Strategy and Action Plan is driven by the necessity to meet the country's international commitments, while simultaneously addressing national, environmental and socio-economic challenges. As a signatory of the Convention on Biological Diversity since 1996, Tanzania is required to create and implement national conservation strategies, a commitment which was further emphasised after committing to the 2011 – 2020 global Aichi Biodiversity Targets. Domestically, the strategy guides the actions required to address biodiversity decline in an environmentally and ecologically diverse landscape. Especially where natural ecosystems underpin economic stability, agricultural productivity, tourism, and, in many cases, the daily sustenance of communities. The revision from the 2001 National Biodiversity Strategy and Action Plan was necessitated due to the impacts and escalating threats from climate change, the spread of invasive species, Habitat loss, Degradation and Fragmentation, pollution, overexploitation of plants and animal species, genetic erosion, and the environmental footprint of rapidly growing oil, gas, mining, and large-scale biofuel production.

4.2.4.3. Implementation

The NBSAP 2015 - 2020 adopted the Aichi Biodiversity Targets, which are grouped under the following five strategic goals:

- Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
- Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use;
- Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity;
- Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services, and
- Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building.

Each goal has a number of targets, which are cross-walked to the Aichi Biodiversity Targets. The NBSAP action plan is a roadmap to achieving the Aichi Targets, with guides to prioritising actions. The action plan includes milestones, timelines and responsibilities for implementation. There are also performance indicators for monitoring and evaluation.

The 2025 – 2030 NBSAP further builds on and consolidates achievements in the implementation of the NBSAP 2015- 2020 by building on the four post 2020 GBF targets that align with the Kunming-Montreal Global Biodiversity Frameworks. These four strategic goals include:

- Strategic Goal A: Protect and Restore
- Strategic Goal B: Prosper With Nature
- Strategic Goal C: Share Benefits Fairly
- Strategic Goal D: Invest and Collaborate

Under these four strategic goals, the framework groups and describes 125 actions of the 23 prioritised targets. Similarly, the up-to-date version of the action plan includes milestones, timelines and responsibilities for implementation, as well as performance indicators for monitoring and evaluation.

4.2.5. Dar Es Salaam Local Biodiversity Strategy and Action Plan

4.2.5.1. Background and vision

The Ilala Municipal Council prepared Tanzania's first Local Biodiversity Strategy and Action Plan (LBSAP) in February 2022, updated in 2024 under the Interact-Bio Project, funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) (Dar es Salaam City Council, 2022). The LBSAP recognises that local biodiversity must be protected, restored, and enhanced to support human wellbeing. It serves as a guiding framework that identifies key focus areas and sets out specific goals and actions to ensure the effective protection, sustainable use, and sound management of biodiversity within the municipality.

The vision of the LBSAP is to ensure that Dar es Salaam maintains and expands its open spaces and gardens, while protecting and restoring the municipality's green and blue infrastructure, including forests, wetlands, rivers, mangroves, and ponds. The strategy also emphasises raising public awareness of the value of nature and supporting improved livelihoods through green infrastructure initiatives.

4.2.5.2. Motivation

The strategy is a response to:

1. The need to develop actions relating to local biodiversity at the level of local government, and
2. The need to support Tanzania's national and global biodiversity commitments as embodied in the NBSAP of 2015 (see **Section 4.3.4** above).

Dar es Salaam is located in a globally important biodiversity hotspot called the East African coastal forest. Once covering about 30,000 km², this unique and threatened centre of endemism, which is home to numerous plants, mammals, birds, reptiles, frogs, butterflies, snails and millipedes (Burgess et al., 2017), has now been reduced to only 2,000 km² (LBSAP, 2024), warranting the need for such a strategy and action plan.

Although the LBSAP focuses on biodiversity and green–blue infrastructure, many of its objectives directly support sustainable groundwater management in Dar es Salaam. By supporting the maintenance and expansion of open spaces and gardens in Dar es Salaam, the LBSAP promotes groundwater recharge. The ecosystems the LBSAP protects also act as natural filters that trap sediments and pollutants before they reach the underlying aquifer, protecting groundwater from

contamination. Additionally, by positioning green and blue infrastructure as priority assets in municipal planning, the LBSAP creates an opportunity to align biodiversity conservation areas with groundwater protection zones and recharge areas, reinforcing spatial controls on harmful land use around wellfields and vulnerable aquifers. The LBSAP's emphasis on raising public awareness of the value of nature can be used to promote community awareness of the role of green infrastructure in protecting groundwater.

4.2.5.3. Implementation of the LBSAP

The Ilala LBSAP is to be implemented based on the following six key focus areas:

1. Awareness raising and capacity building
2. Maintain, expand and restore green and blue infrastructure;
3. Improve livelihoods through green infrastructure initiatives;
4. Utilise local and novel solutions for waste management;
5. Integration with land use management and other urban frameworks, and
6. Mobilise financial resources.

The LBSAP sets out 13 goals aligned with its focus areas and provides guidance on how these goals should be pursued. For each goal, the strategy includes a high-level action plan outlining the key actions, responsible institutions, and timeframes. The LBSAP also highlights its alignment with, and contribution to, the National Biodiversity Strategy and Action Plan (NBSAP), emphasising the synergies between local and national biodiversity priorities.

5. Status of Relevant Programmes and Plans

5.1. Water Development Programmes

Over the years, Tanzania has introduced several programmes aimed at strengthening the water sector and supporting sustainable development, most of which focus on water supply and sanitation infrastructure. The key programmes include;

5.1.1. Water Sector Development Programme (2006 – 2025)

The WSDP is Tanzania's sector-wide programme for strengthening water resources management and expanding access to water supply and sanitation services. The programme is guided by the National Water Sector Development Strategy (NWSDS) (described in **Section 4.2.1**), which operationalises the National Water Policy (NAWAPO) (described in **Section 4.1.1**).

In Dar es Salaam, WSDP interventions have focused on strengthening water supply, protecting groundwater resources, and improving institutional capacity. Key measures include the rehabilitation and expansion of water supply infrastructure to improve service coverage; the expansion and upgrading of the Lower and Upper Ruvu water treatment plants to increase DAWASA's surface water production capacity and reduce reliance on groundwater; and the construction and rehabilitation of sewerage networks and wastewater treatment facilities to limit groundwater pollution. These infrastructure investments have been complemented by institutional strengthening initiatives aimed at improving customer service, billing systems, and overall operational efficiency.

Implementation of the WSDP is structured into three phases:
WSDP Phase I (2006-2016) laid the foundation for institutional reforms, the establishment of basin water boards responsible for the regulation, permitting, and monitoring of water resources, including groundwater, and improvements in rural and urban water supply infrastructure.

WSDP Phase II (2016-2022) accelerated these efforts through substantial investments in water resource management, including the construction of multipurpose dams, the issuance of water use permits, the enhancement of basin-level management plans, and the promotion of climate resilience in the water sector. The phase also sought to increase water supply coverage and access to sanitation facilities, achieving notable progress at the national level. Overall, WSDP II laid a critical foundation for expanding water access, improving urban and rural water supply and sanitation services, largely dependent on groundwater, institutionalising integrated water management, and aligning the sector with Tanzania's National Development Vision 2025 objectives for universal coverage and sustainable water resource use.

WSDP Phase III (2022-2026), which is expected to conclude in June 2026, builds on the achievements of earlier phases described above and focuses on strengthening water quality management, sanitation, and hygiene, and water resources development. The phase is designed to contribute to Tanzania's broader development objectives, including the Tanzania Development Vision 2025, the Sustainable Development Goals (SDGs) 2030, and Africa's Agenda 2063. Phase III is structured around five components, as summarised in **Table 5-1**.

Table 5-1 Core components of the WSDP phase III, their primary objectives and their subcomponents.

Key Component	Primary Objective	Subcomponents
Water Resources Management (WRM) and Development	To ensure sustainable, equitable, and efficient management of Tanzania's water resources.	• Catchment and Basin Planning: Implementation of Integrated Water Resources Management and Development (IWRMD) plans across all nine river basins, including the Wami-Ruvu basin that supplies Dar es Salaam. • Hydrological Monitoring: Installation and upgrading of monitoring infrastructure (e.g., gauging stations, groundwater monitoring) to enhance water quantity and quality data. • Water Use Regulation: Strengthening the permit system for abstraction and discharge to reduce illegal use and overexploitation. • Climate Resilience and Environmental Protection: Integrating environmental flow requirements and adaptation strategies into basin-level planning, particularly relevant due to Dar es Salaam's vulnerability to climate variability.
Water Quality Management	Safeguard the quality of water resources used for public supply, protecting human health and ecosystems.	• Water Quality Monitoring and Surveillance: Implement routine testing of both raw and treated water, especially targeting key source points such as the Ruvu River that supplies Dar es Salaam. • Standards Compliance: Define and uphold standards for potable water quality, aligning with national guidelines and regulatory oversight by EWURA. • Pollution Control: Enforce regulatory measures to minimise contamination from industrial, agricultural, and municipal sources, with collaboration from institutions like the Ministry of Health and Social Welfare (MoHSW). • Response Planning: Establish rapid response mechanisms for contamination events, ensuring safe alternatives are available and public health is protected.
Water Supply	To expand access to safe water and improved sanitation services in both rural and urban areas.	• Service Coverage Expansion: Rehabilitation and expansion of water supply infrastructure in urban centres, with priority on high-growth cities such as Dar es Salaam. • Non-Revenue Water (NRW) Reduction: Targeted interventions to reduce water losses through leak detection, meter calibration, and network management. • Water Source Diversification: Feasibility studies and implementation plans for new water sources, including desalination, rainwater harvesting, and managed aquifer recharge (MAR). • Wastewater Management: Development of sewerage networks and wastewater treatment systems to address pollution of surface water sources like the Ruvu River and local aquifers.

Key Component	Primary Objective	Subcomponents
Sanitation and Hygiene	Enhance public health and dignity through improved sanitation facilities, hygiene practices, and behaviour-change communication.	• National Sanitation Campaign: Building on Phase II's BCC slogan, Phase III has integrated these efforts into the "Mtu ni Afya Campaign," set to launch in 2024. • House-to-House Monitoring: LGAs conduct quarterly inspections to track household sanitation improvements; as of December 2023, sanitation coverage rose from 73.2% to 77.5%, while hand-washing facilities improved from 42% to 45%. • Menstrual Health and Hygiene (MHH): Focused on dignity and wellness for women and girls—by the end of 2023, 2,847 schools received MHH facilities, and 6,583 matrons/MHH counsellors were trained. Procurement of sanitary pads costs approximately TZS 2.44 billion, partially funded through the Schools Capitation Grant. • Institutional and Educational Reach: Expanded access to improved sanitation and hand-washing has reached 1,095 schools and 1,904 healthcare facilities, supporting inclusive access and hygiene standards.
Programme Coordination and Delivery Support	Strengthen planning, management, accountability, and institutional capacity to ensure efficient and effective implementation of WSDP Phase III.	• Policy, Planning & Fiduciary Management: Review and dissemination of water policies, strategies and sector legislation. Improved sector capacity in budgeting and planning. Preparation of annual sector plans and budgets Ambition for all implementing agencies to achieve unqualified audit opinions, including one technical and four financial audits, by June 2026. • Coordination, Monitoring & Evaluation: Implementation of robust sector M&E systems. Enhanced coordination across national ministries, sector agencies, LGAs, and development partners. • Institutional Strengthening & Capacity Building: Tailored training and capacity development for agencies involved in water, sanitation, and quality management. Supporting institutional environments that facilitate effective delivery and collaboration. • Cross-cutting Issues: Addressing fundamental themes like gender equity, climate resilience, environmental sustainability, and inclusive service delivery.

5.1.2. Tanzania Water Investment Programme (2024 – 2030)

The Tanzania Water Investment Programme (TanWIP) was developed to promote targeted water investments for sustainable social and economic development with a foresight vision of contributing to the attainment of SDGs and the African Union's Agenda 2063. The programme also aligns with the country's Vision 2050, which emphasises sustainable water resource management to ensure the country remains free from water stress while also providing social needs, ecological balance and long-term water security.

The programme underscores key priority areas, including the construction of a national water grid,

development of groundwater resources, the enhancement of sanitation services and construction of multipurpose water security dams. Dar es Salaam, as the socio-economic hub of the country, is expected to benefit significantly from these investments, improving both water supply and sanitation infrastructure while supporting sustainable urban growth.

While the WSDP laid the foundation for sector-wide reforms in Tanzania's water sector, focusing on expanding water supply and sanitation coverage, strengthening institutions such as Basin Water Boards, DAWASA, and urban water authorities, and mobilising resources for infrastructure rehabilitation and development, the TanWIP represents a forward-looking investment framework designed to scale up financing and address emerging challenges in the country's water sector and other related sectors.

TanWIP prioritises groundwater development as a key national investment area, strengthening Basin Water Boards responsible for groundwater governance, and promoting improved sanitation infrastructure to protect aquifers from contamination. The programme positions groundwater as a strategic resource for long-term water security, complementing surface water systems and supporting climate resilience, especially in rapidly growing urban areas such as Dar es Salaam.

5.1.3. Dar es Salaam Metropolitan Development Project (DMDP)

The Dar es Salaam Metropolitan Development Project (DMDP), supported by the World Bank, is a flagship initiative addressing the critical infrastructure and urban management challenges of Dar es Salaam, Tanzania's largest and most rapidly growing city. The project focuses on upgrading key urban services, including stormwater drainage, flood control, road networks, solid waste management, and institutional capacity. It targets major river basins, such as the Sinza, Msimbazi, and Gerezani, where interventions with the potential to positively impact groundwater include the construction of detention ponds for floodwater storage, particularly where these are designed to promote infiltration, and the clearing of clogged waterways to reduce flood risks and restore natural flow pathways.

Beyond drainage, the project enhances basic urban services in low-income communities by improving roads, drainage, lighting, markets, and parks through participatory community approaches. Institutional strengthening is integral to the project, aiming to improve metropolitan governance, urban data analytics, and operations and maintenance with the support of GIS tools. Climate resilience is prioritised through infrastructure upgrades and nature-based solutions, while emergency preparedness and environmental and social safeguards ensure sustainable, inclusive outcomes. The project also supports expanding urban mobility through road network upgrades and public transit improvements, including Bus Rapid Transit systems. Over 4 million residents have benefited from completed works so far, reflecting significant progress in flood risk mitigation, pollution control, and urban infrastructure modernisation.

The ongoing and planned Phase Two investment, financed by a nearly one billion USD loan, includes upgrading 250 kilometres of roads to asphalt standards, building new waste disposal facilities, upgrading marketplaces and bus terminals, and installing climate-smart drainage systems. Community awareness, technical assessments, and hydrological modelling studies in flood-prone catchments like the Msimbazi River complement the physical infrastructure improvements and capacity-building initiatives aimed at changing behaviours and increasing institutional readiness to manage stormwater.

This approach positions the DMDP as a cornerstone for transforming Dar es Salaam into a climate-adaptive, sustainable metropolitan area with improved infrastructure, governance, and service delivery, addressing both the pressures of rapid urbanisation and legacy drainage challenges. It directly aims to address sustainable use of groundwater, promote sufficient drainage and recharge, protect it from contamination, and ensure there is sufficient supply to meet the demands of the city's residents.

Although the DMDP is primarily focused on urban infrastructure and management challenges, it has several initiatives that support groundwater sustainability in Dar es Salaam. Its focus on the construction of detention ponds for floodwater storage and the improved management of catchments favours groundwater recharge, while restoration efforts in river systems improve groundwater to surface water interactions. Improved solid waste management and flood management minimise the risk of aquifer contamination by reducing the spread of contaminants that can infiltrate into the ground. Additionally, through improved institutional capacity and urban planning, the DMDP contributes to the sustainable use and protection of groundwater in Dar es Salaam.

5.2. Management Plans

The country has developed a number of strategic and sectoral plans to guide sustainable water resources management, environmental protection, and climate change adaptation, which are also applicable to the Dar es Salaam regional context. Compared to programmes which focus primarily on infrastructure, these plans focus on institutional development. Key among these is:

Ministry of Water Five-Year Medium-Term Strategic Plan 2019/20-2023/24. This is a nationwide sectoral document aiming at ensuring sustainable water resources management and development for universal access to water and sanitation services, as well as for economic development, to achieve the national Vision of having a secure water country, where people have sustainable access to sufficient quantity and quality of water to meet human, environmental and economic needs. To protect the environment in relation to the water resources, the plan aims to (i) create awareness on management and conservation of water sources and groundwater recharge areas at all levels; (ii) establish a water resources database, models and maps; (iii) facilitate accreditation of water laboratories. As for Governance, the document promotes the strengthening of institutional capacity to deliver quality services and improving the human resources, working environment and social welfare amongst MoW staff.

National Environmental Master Plan for Strategic Interventions (2022 – 2032) is a nationwide sectoral document aiming at guiding coordinated environmental interventions at all levels, based on the spatial variation of environmental challenges and intervention options. It will guide the implementation of environmental interventions to tackle the 12 crucial environmental challenges, namely (1) land degradation; (2) deterioration of water sources; (3) impacts of climate change; (4) environmental pollution; (5) deforestation and forest degradation; (6) loss of wildlife habitat and biodiversity; (7) deterioration of coastal and marine ecosystem; (8) wetland deterioration; (9) inadequate waste management; (10) urban environmental challenges; (11) proliferation of invasive species; and (12) inadequate environmental governance.

Tanzania National Adaptation Plan of Action (2007), The National Adaptation Plan of Action (NAPA) overall vision is to identify immediate and urgent Climate Change Adaptation Actions that are robust enough to lead to long-term sustainable development in a changing climate. It also identifies climate change adaptation activities that most effectively reduce the risks that a changing climate poses to sustainable development. With the financial support of the United Kingdom and the World Bank, the Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT), the first initiative of its kind in Tanzania, was developed to bring together emergency response stakeholders to serve as the tactical branch of a Regional Disaster Management Committee. The DarMAERT provide frontline disaster management services in the region, supported by the city's five municipal disaster management committees. It reports to the Disaster Management Department - Prime Minister's Office (DMD-PMO) through the Regional Disaster Management Committee (RDMC) under the Regional Administrative Secretary (RAS). This plan has the potential to include measures for groundwater development and address disasters such as drought, aquifer salinization and aquifer contamination.

6. Proposed Conjunctive Management Strategic Action Plans

Based on the groundwater dependency and vulnerability assessment and review of legal instruments and implementation programmes, a Conjunctive Management Strategy for Dar es Salaam is proposed to strengthen the city's groundwater and surface water management, and its resilience to climate change and growing environmental pressures from population growth and increased water demand. This strategy outlines broad recommendations towards groundwater management, sustainable groundwater development and climate-responsive management (**Section 6.1**), followed by an overview of the methodology used to develop the action plans (**Section 6.2**), and the detailed set of proposed action plans (**Section 6.3**).

6.1. Recommendations for a Conjunctive Management Strategy

6.1.1. Groundwater Management

The WRBWB has taken significant steps towards strengthening groundwater management and demonstrating a commitment to sustainable resource governance in Dar es Salaam. However, while progress has been made in monitoring, stakeholder engagement and policy implementation, many opportunities to enhance strategies for long-term water security remain. It is recommended that the following areas be included in a publicly available strategic action plan:

- **Managing Landuse Contamination**: The urban context presents a multitude of potential contaminant sources which pose a risk to groundwater quality. Spatial and land use planning can assist in limiting the potential for future contamination in areas of strategic groundwater importance, and as such, solutions are proposed to this end. The prevalence of groundwater use across Dar es Salaam's urban centre, as well as the presence of existing high-risk land use practices, including a high prevalence of potentially contaminating activities (PCAs) such as industries, fuel stations, and pit latrines associated with unplanned and informal settlements, means that future land use planning initiatives alone will not fully address the risks of groundwater contamination. As such, additional mitigation measures are proposed to manage the prevalent high-risk PCAs mentioned above and improve stormwater management in areas of strategic groundwater importance.
- **Groundwater Protection Zones (GPZ)**: The delineation and implementation of GPZs to protect DAWASA's groundwater schemes is recommended. These zones are typically set as a means of reducing the risk of contamination. They are delineated according to contaminant travel time and proximity to boreholes. The implementation of Stage 1 GPZs to protect and fence off the immediate vicinity of the production boreholes is recommended. Furthermore, it is recommended that further stages taking into account two, five and ten-year travel times be included as a precautionary measure to safeguard the water supply. These GPZs aim to prevent future pollution by restricting high-risk land uses and guiding land-use planning processes. Included with these GPZs is a recommendation that detailed vulnerability mapping and PCA mapping be conducted as part of managing land-use contamination to identify areas of high vulnerability and to prevent PCAs from occurring near production boreholes.
- **Pollution Incident Response Plan**: DAWASA and the WRBWB should develop a conjunctive groundwater pollution incident response management plan to provide step-by-step guidance on how to respond to contamination events that would otherwise affect groundwater abstraction schemes. These would be especially relevant to the Quaternary Aquifer, which is currently the most susceptible to contamination of the targeted groundwater systems in Dar es Salaam. In the event that contaminants pass through to a water treatment works, an incident management protocol would therefore be in place to guide operational decisions, ensuring the protection of water quality before it enters the municipal distribution system.

- **Improved Data and Monitoring**: Regular groundwater monitoring over a sufficient extent to understand changes in quality and quantity is recommended. This includes establishing an appropriate and efficient data-capturing and storage system. It should also include drilling and well permits. Data should be readily available for the WRBWB to provide insight into changing dynamics and environmental systems. To date, an online system is under development, and once completed, it is expected to be released for public access.
- **Hydrogeological Assessment**: Current availability of hydrogeological data is severely lacking, and data that is available is often incomplete or at coarse resolutions, preventing detailed and localised analysis. The geology of the Dar es Salaam region should be surveyed at least on a 500 to 250 km scale. Aquifer extent and type should also be better defined at a finer resolution than what is currently available, and data should include aquifer yields. Currently, there are no formalised maps of recharge and GDEs for the Dar es Salaam region. Groundwater recharge is another dataset which needs to be further defined and improved. Effective management of groundwater resources requires a sufficient understanding of hydrogeological properties and conditions.

6.1.2. Sustainable Groundwater Development

Dar es Salaam is currently developing the coastal quaternary aquifer and Kimbiji Aquifer for groundwater use to augment DAWASA's water supply. It is recommended that the development of these groundwater schemes continue, with particular emphasis on:

- Piloting and assessing the feasibility of managed aquifer recharge schemes in the Quaternary Aquifer.
- Upgrading and optimising the current Quaternary Aquifer Management Scheme.
- Enhancing groundwater monitoring, modelling and management across both schemes.
- Including climate-based scenarios in modelling for both the Quaternary and Kimbiji aquifers.
- Improving enforcement of regulations by conducting regular audits to track usage and sustainability. This is especially applicable to the already over-exploited Quaternary Aquifer.
- Implementing zoning policies (e.g., critical, semi-critical, safe zones) with tailored restrictions. This includes recharge zones.

6.1.3. Climate-Responsive Management

The National Climate Change Response Strategy 2021 – 2026 was created to improve Tanzania's climate resilience while pursuing sustainable development. The WSDP – phase III (2023 – 2023), implements climate-resilient water infrastructure to develop climate resilience in the water sector. Challenges in implementation, however, are often associated with Institutional coordination gaps between **DAWASA, WRBWB,** and **local municipalities,** hindering unified action. Despite this, grassroots initiatives, such as **community-based groundwater monitoring** through WUAs, demonstrate localised adaptive capacity. To strengthen governance, Dar es Salaam must prioritise:

1. **A groundwater-specific crisis plan** with triggers for water rationing and alternative supply activation. It should be integrated into broader adaptive strategies.
2. **Incorporation of climate change projections** into groundwater planning and management strategies (especially seawater intrusion and reduced recharge).
3. **Vulnerability mapping** to target protection measures in at-risk neighbourhoods (e.g., informal areas that are not connected to the municipal water supply network and lack proper sanitation services or areas located near other PCAs) and critical infrastructure (e.g., hospitals).

4. **Legally enforced recharge zone protections**, especially in the **Msimbazi Basin** and coastal aquifers, including regional recharge zones located west, in the hinterlands of the region.
5. **Diversification of water supply**, including currently planned surface water schemes, water reuse and desalination.
6. **Strengthening of drought preparedness and response**, especially through augmentation and diversification of resources.

Proactive measures such as these have the potential to shift responses from reactive coping to long-term resilience. However, achieving this requires strong political commitment and investment.

6.2. Conjunctive Management Strategy Methodology

The dependency and vulnerability assessments described in **Section 2.2** provided the basis for developing a Conjunctive Management Strategic Action Plan for Cape Town by identifying high-risk and high-dependency zones where sustainable abstraction, pollution mitigation, and equitable water governance should be prioritised. The approach used during these assessments is described in detail in **Section 1.3**.

A top-down approach was used to develop the strategic action plan for conjunctive management in Dar es Salaam. The process began with a review of Dar es Salaam's key policies and strategies to understand the region's vision. Thereafter, supporting plans and programmes were reviewed to determine how these strategies are being implemented in practice. This review highlighted several gaps, which informed the development of targeted action plans.

6.3. Action Plans

The proposed action plans outlined below are organised into five main categories: improved governance, improved data acquisition and monitoring, aquifer protection and pollution control, water security planning and outreach and education.

The rationale, key objectives, priority areas, implementing organisations, timelines, priority level, and budget class are outlined for each action plan under all categories. The budget class for each action plan was determined according to the anticipated level of investment required for implementation. Actions involving infrastructure development or physical construction, typically the most high-cost activities, were classified as high-budget. Actions that do not involve infrastructure but still require additional resources beyond existing resources, such as staff training or the development of new operational processes, were assigned a medium budget. Actions that can be implemented largely through existing avenues and staff capacity, supported by minimal materials or routine outreach resources, were classified as low budget.

The priority level of each action plan was determined by assessing whether it directly addresses groundwater-related hazards or strengthens the region's coping capacity. Priority setting also considered the logical phasing of actions and the dependencies between them, recognising that certain actions must be implemented before others can proceed. Meanwhile, the activities and timelines stipulated for each action plan are based on the expert knowledge of the project team.

6.3.1. Improved Governance

Good groundwater governance is a prerequisite for effective groundwater management, which, in turn, can enhance aquifer protection from over-abstraction and pollution, and ensure the equitable and sustainable use of groundwater resources.

Strengthening the involvement of local government in Dar es Salaam will require the Wami-Ruvu Basin Water Board to develop targeted programmes, which will involve the local government at the municipal, street (mtaa) or village level and will require support from local communities.

6.3.1.1. Improved groundwater use enforcement

The enforcement of groundwater use permits and abstraction limits is a critical issue undermining groundwater management in much of Tanzania, especially in Dar es Salaam. The lack of enforcement has allowed groundwater self-supply, driven primarily by limited municipal water availability, to remain largely unregulated, contributing to over-abstraction in some areas.

The Wami-Ruvu Basin Water Board, which is responsible for regulation in Dar es Salaam, are severely understaffed and lacks the local presence needed to monitor and enforce compliance effectively across the basin. To address this, a decentralised, multi-stakeholder action plan is proposed, which involves formally integrating Street (Mtaa) and Village Executive Officers into the enforcement chain to act as local monitors. These officers are local government administrators operating at the lowest administrative level in urban and rural areas, respectively, and serve as the primary link between communities and higher levels of government. Their continuous presence at the community level positions them well to observe, report, and support enforcement related to unregulated groundwater abstraction and other potentially contaminating activities, thereby strengthening local compliance and supporting the WRBWB.

Through targeted community outreach (see **Section 6.3.5**), the general public can be educated on relevant regulations and empowered to report illegal activities. By incorporating local government structures as described above and community vigilance into monitoring efforts, the WRBWB can establish a scalable, decentralised monitoring network, allowing it to focus its limited resources on investigating reported cases and enforcing compliance. These measures, when combined with broader initiatives to improve water supply in the region, such as the diversification of water resources (described in **Section6.3.4.2**), can help control over-abstraction and support the long-term sustainability of groundwater aquifers.

This action plan directly addresses the risk of over-abstraction by strengthening groundwater governance, curbing the spread of unregulated self-supply, and preventing long-term declines in groundwater levels. Its success depends on clear mandates and strong, well-coordinated collaboration between the WRBWB, local government, Village and Mtaa officers, and the communities they serve. Equally crucial is sustained community trust and buy-in, which supports people's willingness to report illegal abstraction and assist with local monitoring, ensuring the decentralised enforcement network functions effectively.

Table 6-1 Implementation details for improved groundwater use enforcement.

Category	Description
Implementing Organisations	WRBWB, Local Government, Street Officers (Mtaa), Village Executive Officers
Budget Class	Medium
Activities and Timelines	1) Hydrocensus to identify where groundwater users are (**0-12 months**); 2) Amendment or creation of by-laws with the development of guidelines (**6-12 months**); 3) Enforcement and rollout of by-laws (**3 - 5 years**).
Priority	High
Alignment	NAWAPO

6.3.1.2. Capacity Building

One of the key challenges associated with groundwater management in Dar es Salaam is the lack of institutional capacity. While Basin Water Boards are the primary institutions responsible for groundwater management, the lack of trained personnel across their jurisdiction reduces the effectiveness and efficiency of their management. Capacity should therefore be developed across all relevant stakeholders, by training officials within the municipalities, local institutions (LGAs), the Basin Water Board and the National Environmental Management Council (NEMC) on groundwater management and WSUD. This training would include a modular course that covers classroom and field sessions, covering topics such as aquifer systems (hydrogeology), geographical Information systems, protection zones, monitoring methods, spill response, WSUD, operations, maintenance, and risk communication. Through this capacity building, institutions can be empowered with the knowledge necessary to undertake sustainable water management. In the long term, this would also create local expertise capable of performing regular wellfield and water-sensitive urban design asset maintenance, while generating both local employment opportunities and ensuring the longevity of these assets.

This action plan directly addresses the region's lack of institutional capacity, which currently undermines effective groundwater governance. By training officials and developing local WSUD and groundwater management expertise, Dar es Salaam can, over time, reduce reliance on external specialists for routine monitoring, maintenance, and operational tasks. Its success depends on a credible, locally relevant training programme delivered by qualified facilitators, a clear agreement on roles and participation across all relevant institutions, and, critically, embedding the training into institutional procedures so that new skills translate into everyday decision-making and practice.

This action directly addresses the lack of institutional capacity, which results in poor groundwater governance across the region. By developing local experts on WSUD through training, the region, over the long term, can reduce its reliance on outside groundwater experts for routine groundwater/ WSUD tasks. The success of this action plan depends on a credible, locally relevant training programme delivered by qualified facilitators, a clear agreement on roles and participation across all relevant institutions, and, critically, embedding the training into institutional procedures so that new skills translate into everyday decision-making and practice.

While this action plan is designed specifically to build institutional capacity for groundwater management, its impacts extend far beyond this single action plan. The foundational skills developed, particularly in aspects such as hydrogeology, Geographical Information Systems, data management protocols, and water resource monitoring, support and contribute to the success of several other action plans recommended in this conjunctive management strategy. While not directly linked to groundwater, strengthening capacity in these adjacent areas would improve the success of multiple action plans.

Table 6-2 Implementation details on capacity building

Category	Description
Implementing Organisations	MoW, WRBWB
Budget Class	Low
Activities and Timelines	1) Initial training of different stakeholders (**3 - 6 months**); 2) Refresher/ ongoing training over the long term (**5 years**).
Priority	High
Alignment	WSDP III, NAWAPO, and NWSDS

6.3.1.3. Improved Institutional Coordination

Given that the management of water catchments is primarily driven by Basin Water Boards, the governance of groundwater resources is centralised. While there is input from stakeholders at all levels, institutional coordination is often limited and or does not occur. Consequently, this can result in inefficient and ineffective water resource management. It is therefore recommended that the lack of integrated management and institutional coordination between DAWASA, WRBWB and LGAs be addressed.

Through the implementation of joint planning processes, alignment can be achieved across different spheres of government. The management structure should include national and city-level governing entities, civil society, and the private sector to help disperse information about climate risks and promote effective environmental management of the land and seascape critical to building resilience, rather than obstructing development (Stuart et al., 2021). Furthermore, to address the delays in policy and strategy implementation, programs should be formulated by the Basin Water Boards to involve LGAs and support communities to increase capacity. Through these changes, coordination becomes more robust by improving its efficiency and its capacity to achieve its targets. The success of this action is dependent on strong institutional buy-in, a clear framework for coordination, a joint planning process that is practical and effective, and multi-stakeholder engagement.

Table 6-3 Implementing details for improved institutional coordination.

Category	Description
Implementing Organisations	MoW, WRBWB, DAWASA and LGAs
Budget Class	Low
Activities and Timelines	1) Interdepartmental management team (**6 months**); 2) Operationalisation of management team (**1-2 years**).
Priority	High
Alignment	WSDP III, NAWAPO, NWSDS

6.3.1.4. SDG-6 Integrated Water Resources Management

SDG 6 is part of the 2030 Agenda for Sustainable Development, a set of priorities and goals Tanzania has committed to reaching by 2030. SDG 6 aims to ensure availability and sustainable management of water and sanitation for all, essentially a commitment to clean water, sufficient toilets and good hygiene a reality for all by 2030, while also protecting and restoring water-related ecosystems. Part of improving governance would therefore be to incorporate SDG 6 as part of integrated water resources management. During self-assessments in 2017 and 2020, challenges were identified that highlighted inadequate financing and institutional capacity as major challenges hindering effective IWRM implementation. Key issues included delays in approving management plans, limited government capacity, stakeholder engagement, and budget gaps for pollution control and disaster risk programs. To address these challenges, the Wami-Ruvu Basin's action plan (GWP, 2022) has outlined four work packages: resource mobilisation, capacity building, knowledge management and monitoring and evaluation.

Each of these packages has goals to contribute to and enhance financial, institutional and technical aspects of water management. The action plan aims to strengthen the financial environment by reforming legal frameworks to attract private investment, increasing revenue through revised water tariffs, and securing more public and international funding. It also emphasises demonstrating the economic value of water resources to justify higher budget allocations. Part of its approach is building capacity and managing knowledge by improving personal skills and institutional capabilities through the enhancement of data management, raising stakeholder awareness, and promoting a culture of knowledge sharing through training, peer-learning and better communication between stakeholders

and amongst those involved in the governance of water resources. Part of holding this process accountable and ensuring its longevity and effectiveness, the plan proposes the development of an M&E framework to track IWRM implementation, including the creation of standardised training materials and enhancing staff capacity within basin institutions for accountability and effective program delivery.

Given that the Wami-Ruvu Basin Action Plan Report was published in 2022, and that implementation efforts are already underway, this action plan recommends strengthening and prioritising the continued implementation of the four strategic work packages included in the Action Plan Report. Utilising an already developed framework is more efficient and provides the opportunity to also simultaneously improve groundwater governance. Moreover, it also addresses the risk of over-abstraction and improves the coping capacity of groundwater users within Dar es Salaam. To avoid delays in completion, this plan requires the securing of financing and fostering active cooperation and coordination among all involved parties.

Table 6-4 Implementation details for achieving Integrated Water Resource Management as part of SDG-6.

Category	Description
Implementing Organisations	MoW, WRBWB, DAWASA
Budget Class	High
Activities and Timelines	1) Resource mobilisation (see **Appendix A.1**), (**2 years**); 2) Capacity building (see **Appendix A.2**), (**5 Years**); 3) Development of knowledge management (see **Appendix A.3**), (**7 years**); 4) Development and ongoing Implementation of a Monitoring and Evaluation Strategy (see **Appendix A.4**), (**1 year development**).
Priority	High
Alignment	NAWAPO, WSDP III, TanWIP

6.3.1.5. Disaster Preparedness

Currently, Dar es Salaam faces a significant gap in disaster preparedness for climate-induced groundwater threats, specifically reduced recharge and salinisation. The city's high dependency on groundwater makes the absence of specific plans to mitigate these hazards a vulnerability. To address this, action is required to develop a proactive strategy instead of maintaining a reactive approach. The government has attempted to shift away from a reactive kind of approach in recent revisions of policies and developed strategies.

The proactive plan should look at initiatives that could aid in mitigating the occurrence and impacts of reduced recharge and salinisation to improve the region's coping capacity. For example, conducting detailed feasibility studies for MAR and establishing formal drought allocation rules could be beneficial and build on what is currently in place. Allocation rules, in particular, would be essential for managing water equity during dry periods (Dar es Salaam's August to November), when the river flows in the Ruvu and Kzinga Rivers are minimal. Theoretically, water for MAR could be collected from major watercourses during the rainy season and pumped into the over-exploited Quaternary Aquifer to improve recharge and storage in preparation for the subsequent dry season. Another alternative is treated wastewater, however, none of the current wastewater treatment plants are equipped for water reuse. For this to be viable, water reuse would need to be considered as part of improved sanitation services and infrastructure (see**Section 6.3.4.5**).

The success of this action plan depends on the availability of reliable datasets and the ability to

secure funding for feasibility studies that assess the viability of MAR, identify suitable recharge methods and potential sources of infiltration water, and to ultimately determine optimal locations for its possible implementation within the city. If MAR is found to be viable, informed decisions can be made on investing in infrastructure that could prevent salinisation and seawater intrusion, while also ensuring groundwater availability.

To further improve disaster preparedness in the region, the developed drought allocation rules should be integrated into urban planning and drought response plans to maximise their effectiveness. Together, these measures will strengthen Dar es Salaam's resilience to climate variability and growing demand, while securing water resources for its population.

Table 6-5 Implementation details for disaster preparedness

Category	Description
Implementing Organisations	WRBWB, Municipal Councils, Disaster Management Department (DMD) of the Prime Minister's Office.
Budget Class	Medium
Activities and Timelines	1) Development of drought allocation rules (**1 year** *after sufficient data is acquired); 2) MAR feasibility study (**2 years**); 3) The implementation of drought allocation rules (**1 year** *after concluding the development of drought allocation rules).
Priority	Medium
Alignment	National Disaster Management Policy and Strategy, National Climate Change Response Strategy, NAWAPO, NWSDS

6.3.1.6. The Expansion of WUA Purview

The current purview of WUAs in Dar es Salaam is limited to surface water features. To improve the management of groundwater in the region, it is recommended that the mandate of WUAs be expanded to include groundwater systems. WUAs if implemented correctly, bridge the gap between government authorities and local water users (agricultural, industrial, and domestic), and ultimately facilitates the sustainable governance of water resources in a conjunctive manner. The benefits of updating the current WUA purview may include improved data collection and enhanced monitoring, aligned efforts to protect aquifers, build capacity and local expertise, address water equity and water conflicts, and promote collaborative decision-making that leads to more informed sustainable management decisions.

The action plan, if implemented and incorporated correctly, directly improves groundwater management and addresses the risk of over-abstraction and aquifer contamination. By working together with the WRBWB, users can agree on actions and measures to prevent over-abstraction and aquifer contamination. By holding each other accountable, the enforcement and regulation of use and discharge can be more effectively managed to minimise the risk of these hazards. As a result of these efforts, the coping capacity of both the resource and its users improve significantly. Buy-in from users also improve as they become more aware of the threats to the water resources they depend on, and how their actions can potentially impact groundwater and surface water. The success of this action plan is dependent on enforcing participation, ensuring stakeholder engagement remains a core aspect of its implementation, and that there is a responsible institution to drive the action plan and ensure changes are made.

Table 6-6: Implementing details for the expansion of WUA purview.

Category	Description

Implementing Organisations	WRBWB, NEMC
Budget Class	Low
Activities and Timelines	1) Alter definition of WUAs to include groundwater (**3 months**); 2) Identify stakeholders (**3 months**); 2) Hold Intersectoral meetings and engagements (**6 months**)
Priority	High
Alignment	NAWAPO and WSDP III

6.3.2. Improved Data Acquisition and Data Management

6.3.2.1. Improved baseline hydrogeological and environmental data

Baseline hydrogeological and environmental data are essential for guiding effective and sustainable groundwater management. Establishing accurate information on aquifer extent, thickness, and hydraulic properties (hydraulic conductivity, transmissivity, etc.) provides the basis for estimating groundwater storage, available yields, and flow directions. Long-term monitoring of groundwater levels and abstraction rates to establish relationships between groundwater head decline and groundwater abstractions is fundamental for quantifying sustainable groundwater use.

Critical data gaps in Dar es Salaam include the delineation of aquifer extent and geology, recharge areas, the quantification of recharge rates, the determination of sustainable yields for major aquifers, and the continuous monitoring of groundwater levels and abstraction rates. Addressing these gaps will improve understanding of aquifer replenishment and support the setting of evidence-based abstraction limits. Improved aquifer characterisation will also strengthen the management of abstraction schemes and domestic groundwater use, particularly as numerical models are updated to account for climate-change impacts. In addition, the delineation and assessment of groundwater-dependent ecosystems (GDEs) will enhance resource protection, given their ecological importance and their role in supporting surrounding communities.

Establishing baseline water quality and implementing routine monitoring of environmental factors such as sea-level rise and land-use change are also key action areas. These datasets enable the identification of contamination sources, the modelling of risks such as seawater intrusion, and the development of targeted protection strategies for vulnerable areas. Without this information, management decisions rely on assumptions rather than evidence, increasing the likelihood of over-abstraction, contamination, and ineffective mitigation measures.

This action plan addresses the risk of over-abstraction, seawater intrusion and groundwater contamination in Dar es Salaam. Its success depends on the availability of and sharing of reliable hydrogeological, drilling and environmental data from relevant institutions, a sufficient budget to support monitoring efforts, coordination between the water board, municipalities, research institutions and drilling companies, strong technical capacity for data collection, analysis and aquifer modelling, and a centralised data management system.

Table 6-7 Implementing details for improved baseline hydrogeological and environmental data.

Category	Description
Implementing Organisations	MoW, NEMC, WRBWB, DAWASA, University Institutions, and Private Sector.

Budget Class	Medium
Activities and Timelines	1) Field campaign to collect baseline data (**1 - 2 hydrological years**); 2) Assessment of baseline data (**1 year** * after baseline data has been collected).
Priority	High
Alignment	NWSDS, WSDP III and NAWAPO.

6.3.2.2. Establishment of Monitoring Networks for Groundwater and Surface Water

The establishment of sufficient monitoring networks for surface and groundwater is an important step towards achieving effective groundwater management. The lack of a sufficient monitoring network in Dar es Salaam makes it impossible to collect meaningful data, which limits the early detection of contamination, accurate assessment of water-quality trends, robust groundwater modelling, verification of remediation efforts, and the ability to track climate-change impacts. These gaps undermine sustainable resource management and the protection of human health and ecosystems.

It is therefore recommended that monitoring networks be expanded in spatial extent to cover groundwater, surface water, effluent, runoff and stormwater. For groundwater specifically, the routine monitoring of water levels and water quality in Dar es Salaam is critical, as this enables the detection of groundwater contamination and unregulated groundwater use, which are widespread in the region. Furthermore, such monitoring would support the detection of climate-related risk to groundwater, such as declining recharge or seawater intrusion. Data generated through these networks will provide the government with the evidence needed to support informed, timely, and effective groundwater-management decisions. The establishment of monitoring networks should include these priorities for consideration, as well as several implementation aspects. Planning should take into account existing networks, priority areas such as recharge zones and existing municipal wellfields, known PCAs, and GDEs.

The success of this action plan is largely dependent on adequate funding for the installation of loggers, sampling equipment and laboratory analysis, strong technical capacity (**Section 6.3.1.2**), good coordination between relevant institutions (**Section 6.3.1.3**), clear institutional roles and mandates, accessibility to baseline data and a centralised data management system to consistently store, standardise and analyse monitoring data (**Section 6.3.2.5**).

Table 6-8 Implementing details for the establishment of monitoring networks for groundwater and surface water.

Category	Description
Implementing Organisations	MoW, WRBWB, DAWASA, University Institutions, Private Sector and Community Based Organisations (CBOs)
Budget Class	Medium
Activities and Timelines	1) Review existing monitoring networks (**6 months**); 2) Design of an integrated monitoring network (groundwater + surface water, institutional cooperation) (**1 year**); 3) Establish additional monitoring sites (**1-3 years**); 4) Ongoing monitoring (**ongoing**).
Priority	High
Alignment	NWSDS, WSDP III and NAWAPO

6.3.2.3. Improved hydrological, hydrogeological and ecological monitoring

While the establishment of new and improved monitoring networks that cover a variety of water resources is an important measure to improve groundwater management, the improvement of

current hydrological and hydrogeological assets is as important, as they are the only infrastructure available to acquire the necessary information to inform the effective management of the city's water resources.

It is therefore recommended that Dar es Salaam's groundwater monitoring programmes be expanded and standardised to ensure routine, long-term data collection across a sufficient spatial extent. At present, groundwater quality and level monitoring are limited and inconsistent. Extending monitoring, particularly along the coastline, high-risk areas, and where groundwater abstraction occurs, would support the early detection of seawater intrusion, over-abstraction and groundwater contamination. The most cost-efficient method for seawater intrusion monitoring would be to produce electrical conductivity profiles using an electrical conductivity probe at predetermined depths. The use of a dip meter or water level loggers can be used to monitor any changes in groundwater availability.

Enhanced monitoring of rainfall and river flows would further serve as an early warning system for potential flooding or drought conditions. Surface water bodies, especially rivers and wetlands, should be regularly monitored for both quality and quantity, given their direct links to ecosystem functioning and their interactions with underlying aquifers. The effective monitoring of these systems improves conjunctive management as it informs the government on how it should shift its reliance between surface water and groundwater before a disaster occurs. Priority should be given to sites or areas with high groundwater use, where understanding surface water–groundwater interactions is particularly important. As mapping of wetlands, rivers and mangroves is completed, these ecosystems should be incorporated into routine water quality monitoring.

This action plan is closely aligned with the broader objective of establishing adequate monitoring networks. Infrastructure alone cannot improve groundwater governance; it must be supported by consistent, reliable, and long-term monitoring that enables the City to assess resource conditions, detect emerging risks, and make informed decisions about sustainable water resource management.

The successful implementation of this action is dependent on the availability of functional and sufficient monitoring infrastructure, which may require the installation of additional monitoring points (**Section 6.3.2.2**), especially in priority areas (e.g. coastal zones, high-risk abstraction and contamination zones). Also important for success is the development of standardised and consistent monitoring protocols, foundational mapping of GDEs, abstraction zones and high-risk coastal zones, adequate technical capacity, strong institutional coordination (**Section 6.3.1.3**), a centralised data management system (**Section 6.3.2.5**), adequate funding, and the integration of such efforts into early warning systems.

Table 6-9 Implementing details for the improvement of hydrological, hydrogeological and ecological monitoring.

Category	Description
Implementing Organisations	WRBWB, City Council, Municipal Councils, University Institutions, and CBOs
Budget Class	Medium
Activities and Timelines	1) Establishment of a sufficient monitoring network (**1-3 years**); 2) Continuous monitoring after a sufficient monitoring network has been achieved (**Ongoing**).
Priority	High
Alignment	NWSDS, WSDP III and NAWAPO

6.3.2.4. Development and Implementation of Citizen Science

The lack of groundwater monitoring in Dar es Salaam has been highlighted as a major concern in the current and previous project reports (SADC-GMI, 2025a; 2025b). This gap has resulted in limited hydrogeological data and, consequently, poor groundwater management, including widespread contamination and over-abstraction. This general lack of groundwater monitoring is driven by a limited monitoring capacity, as both the Basin Water Board and local municipalities remain under-resourced and understaffed.

To address this gap, local communities can play an active role in strengthening groundwater monitoring. By training community members to collect and record groundwater data, the overall monitoring network can be expanded and made more sustainable. For example, a Hydrocensus can be undertaken to identify suitable monitoring boreholes and communities could regularly measure and log groundwater levels within their neighbourhoods. If implemented across many communities, this approach would significantly enhance the spatial and temporal coverage of groundwater data. Data could be uploaded via an app to a collective or nationally managed database for visualisation and storage.

Beyond quantitative data collection, community members can be equipped and trained to use basic, low-cost instruments, such as electrical conductivity (EC) and pH meters, as well as simple test kits, together with mobile applications (some of which are freely available) to monitor and record groundwater quality data. Routine measurement of these basic parameters, combined with physical observations such as changes in taste, colour, and odour, can provide early indications of salinity, sulphur, or other contamination issues. When integrated with formal scientific monitoring programmes, such community-based monitoring efforts can provide a cost-effective means of expanding monitoring coverage.

The proposed action plan to implement citizen science in Dar es Salaam addresses challenges faced in the region regarding an insufficient monitoring coverage caused by limited institutional capacity. The regular monitoring of water levels and observations on water quality indicators by citizens, as described above, directly addresses the risk of over-abstraction and groundwater contamination, allowing for the early detection of risks to groundwater caused by declining water levels, seawater intrusion and contamination.

The success of this plan is dependent on effective community buy-in and mobilisation, adequate training programmes and simple data collection protocols, the provision of basic monitoring equipment, a centralised data management system, quality assurance and verification mechanisms, and continuous institutional support and coordination. Most importantly, the success of this plan is dependent adequate planning and management of equipment and finances.

Table 6-10 Implementing details for the development and implementation of citizen science.

Category	Description
Implementing Organisations	WRBWB, City Council, Municipal Councils, University Institutions, and CBOs.
Budget Class	Medium
Activities and Timelines	1) Awareness campaign on groundwater and groundwater monitoring requirements (**6 months**); 2) Development and implementation of a training programme (**1-2 years**); 3) Development of a tool for data capturing and visualisation (**1-2 years**); 4) Supply of monitoring kits (**6 months**); 5) Roll out of programme (**1-2 years**).
Priority	Medium
Alignment	NWSDS, WSDP III and NAWAPO

6.3.2.5. Mandating the Submission of Data by Drilling Companies

Drilling companies capture and compile important hydrogeological data at the time of borehole drilling/installation and development. This information typically includes borehole coordinates, total depths, lithological logs, casing and screening specifications, static water levels and, where available, pump test results. Mandating the timely submission of such data to the WRBWB would reduce reliance on voluntary borehole registration, limiting the need for enforcement mechanisms, which would be particularly useful in Dar es Salaam, where the capacity for such enforcement is limited. The WRBWB could formalise the submission of borehole drilling data as a condition linked to drilling permits or authorisations, abstraction permits or water use licence renewals.

The systematic submission and centralised storage of this information would drastically strengthen groundwater data acquisition going forward in Dar es Salaam. Improved data availability would help address existing knowledge gaps related to aquifer extents, refinement of hydrogeological conceptual models, delineation of groundwater protection zones, identification of recharge areas, and vulnerability mapping for the identification of over-abstraction hotspots. It would also enhance the ability to track groundwater abstraction trends across the district and support evidence-based groundwater management.

For this action plan to be effective, several conditions are required. A standardised reporting template must be developed, alongside a digital submission portal to streamline data capture. Submission requirements should be formally linked to permitting or licensing processes to ensure compliance. In addition, adequate institutional capacity must be established to manage, quality-control, and maintain the database to ensure that the data collected is reliable and actively utilised in planning and regulatory decision-making.

Table 6-11 Implementing details for mandating the submission of data by drilling companies.

Category	Description
Implementing Organisations	WRBWB
Budget Class	Low
Activities and Timelines	1) Development of a standard format (**3 months**); 2) Development of an online submission system (**6 months**); 3) Gazetting the requirements for drillers (**6 months**); 4) Engagement with drillers to specify gazetted requirements (**6 months**).
Priority	High
Alignment	NWSDS, WSDP III and NAWAPO

6.3.2.6. Data Storage

To strengthen the governance and long-term sustainability of Tanzania's groundwater resources, particularly in a rapidly growing city like Dar es Salaam, it is essential to establish a centralised, national integrated groundwater database. While a national database for borehole drilling and groundwater quality is currently under development, it should be expanded to include systematic groundwater level data as well as detailed borehole construction information to clearly identify the aquifers being monitored and their lithologies. In addition, the database should be routinely updated and maintained to ensure its continued relevance and effectiveness for groundwater management and decision-making.

Effective groundwater management relies on long-term, reliable datasets that capture water quality, groundwater levels, abstraction rates, and recharge areas. At present, information is fragmented across government departments, Basin Water Boards, research institutions, and private entities and stored in incompatible formats that limit standardised analysis. Metadata such as borehole construction information is also often missing. This lack of integration constrains decision-making and contributes to unsustainable abstraction, inadequate protection of recharge zones, and weak preparedness for drought and contamination events.

The development of this database and or its timely release is urgent in Tanzania, where rapid urbanisation, industrial expansion, and agricultural intensification are placing increasing pressure on major aquifers. A centralised system would enable regulators to track trends, enforce abstraction and drilling permits, support climate-change modelling, and design targeted interventions for risks such as seawater intrusion. Investment in this data infrastructure will help Tanzania shift from reactive responses to proactive groundwater management, strengthen evidence-based governance, and promote more equitable and sustainable water use across all sectors.

The success of this action plan is dependent on strong institutional cooperation (**Section 6.3.1.3**), standardisation of data, continuous data collection (**Section 6.3.2.3**) and regular updates to the system, adequate technical capacity, long-term funding, strong regulatory frameworks that mandate data submission, the integration of data into existing water-resource regulations, open data accessibility, and the adoption of the system by decision-makers to guide allocations and permits.

Table 6-12 Implementation details for improved data storage.

Category	Description
Implementing Organisations	WRBWB, University institutions, Private Sector, and CBOs
Budget Class	Low
Activities and Timelines	1) Development of a centralised system (**currently ongoing**); 2) Development of a standard format (**3 months**); 3) Integration of various existing institutional databases (**6 months**); 4) Ensuring accessibility through a database dashboard (**1 year**).
Priority	High
Alignment	NWSDS, WSDP III and NAWAPO

6.3.3. Aquifer protection and pollution control

6.3.3.1. Mapping of Potentially Contaminating Activities (PCAs)

The mapping of PCAs should be undertaken, as it is essential to identify and manage contamination risks to aquifers, rivers, wetlands, and other water resources in Dar es Salaam. This mapping exercise should involve the use of GIS and remote sensing data, with ground-truthing for accurate mapping. PCAs should be classified according to their potential contamination risk to groundwater and surface water, with priority given to areas surrounding municipal abstraction boreholes, zones with high self-supply boreholes and hand-dug wells, and key groundwater recharge areas. Particular attention should also be paid to urban and peri-urban areas, where agricultural activities, informal settlements, and industrial or manufacturing land uses are most concentrated and pose elevated contamination risks.

PCA mapping should be integrated into urban planning processes, EIAs, and GPZ planning to ensure proactive risk management. In identified high-risk areas, targeted interventions such as infrastructure upgrades, wastewater treatment improvements, and WSUD retrofits should be implemented to mitigate contamination threats and safeguard critical water resources. Without ground-truthing, the accuracy of a PCA decreases; it is therefore important that sufficient ground-truthing occurs and mapping protocols are followed to ensure efficiency and reduce running costs. The mapping of PCAs ultimately aids in managing the risk of aquifer contamination.

Table 6-13 Implementation details of mapping potentially contaminating activities (PCAs).

Category	Description
Implementing Organisation/s	WRBWB, NEMC, City Councils, and Municipal Councils
Budget Class	Medium
Activities and Timelines	1) Identify areas of high risk (aquifer vulnerability ~ **12 – 18 months**); 2.1) List of potentially contaminating activities (**1 – 2 years)**: 2.2) Mapping of PCAs (desktop ~ **1 – 2 years**); 2.3) Field verification of PCAs (**1 – 2 years)**: 3) Implementation of PCAs in GPZ to identify high risk areas (**e.g. urban planning, monitoring, response plan ~ 1 - 5 years* linked to GPZs and should run parallel**).
Priority	High
Alignment	WSDP III, TanWIP, DMDP, and NWSDS.

6.3.3.2. Groundwater Protection Zones

Establishing clearly defined groundwater protection zones around critical water infrastructure would significantly improve groundwater management. These zones would delineate specific areas for protection, help identify activities that require additional protection measures (e.g., impermeable surfaces and spill prevention measures for petrol stations), permits, monitoring, or prohibition, and provide a legal basis for enforcement. Through improved governance and integration into urban spatial planning, these areas can be protected from various levels of high-risk land uses that threaten the quality of groundwater.

This plan includes upgrading infrastructure to reduce the risk of contamination, prioritising precincts with solutions and retrofits that incorporate WSUD, and strengthening spatial planning to avoid high-risk industrial activities or the expansion of unplanned informal settlements near groundwater abstraction schemes. Together, these measures will enhance the long-term protection and sustainability of Dar es Salaam's aquifers. Through the implementation of GPZs, the risk of aquifer contamination can be minimised and consequently, the coping capacity of groundwater users in Dar es Salaam improved. The successful establishment of GPZs in Dar es Salaam is largely dependent on effectively mapping potentially contaminating activities, public awareness and education, and the enforcement of regulations to ensure compliance and buy-in from those who partake in land-use activities that can impact the quality of groundwater.

Table 6-14 Implementation details for the establishment of groundwater protection zones.

Category	Description
Implementing Organisation/s	MoW, NEMC, WRBWB, DAWASA, City Council, and Municipal Councils
Budget Class	Medium
Activities and Timelines	1a) Map out groundwater users and identify all public utilities (**12 – 18 months**); 1b) Assess the status and effectiveness of current protection/regulation (**12 – 18 months**); 2) Modelling around municipal well fields (only for critical wellfields) (**12 – 18 months**); 3a) Defining groundwater protection zones (GPZ), with establishing limitations of landuse (**6 months**); 3b) gazetted by Ministry / Parliament (**6 months**); 4) Implementation of GPZ around DAWASA wellfields (**1 – 5 years after defining point 3**); 5) Integration of GPZ into urban and spatial planning (**2 – 5 years**).
Priority	High
Alignment	TanWIP, NWSDS, NAWAPO, WSDP III

6.3.3.3. Groundwater Recharge Zone Protection

Groundwater Recharge Zones are often designated to safeguard areas where significant replenishment of aquifers occurs through the infiltration of precipitation. When these areas are impacted by over-abstraction and aquifer contamination, the aquifer's ability to recover may be compromised, posing risks to long-term water security and public health. The long-term sustainability of groundwater resources requires these areas to be managed and protected against high-risk land-use activities that could impact the quality and quantity of groundwater that is effectively abstracted downgradient. In Dar es Salaam, where impermeable surfaces cover a large extent of the city centre, preserving recharge areas is crucial for extending the long-term function of the region's already stressed aquifers.

This action plan addresses the risk of over-abstraction, aquifer contamination and improves the coping capacity of groundwater users. By ensuring the annual replenishment of Dar es Salaam's aquifers, over-abstraction can be mitigated, and the coping capacity of both the resource and its users strengthened. Similarly, by preventing aquifer contamination at the source, more users are protected from relying on polluted groundwater. The success of its implementation is dependent on GIS capacity and ensuring recharge zones are accurately mapped across Dar es Salaam. Without sufficient experience in analysing and delineating recharge zones, the wrong areas could be identified for protection. Moreover, once these zones are recognised and protected, if their protection is not monitored and penalties enforced, offenders will continue to disrupt and degrade the region's groundwater systems.

Table 6-15: Implementation details for the protection of groundwater recharge zones.

Category	Description
Implementing Organisation/s	MoW, WRBWB, and NEMC
Budget Class	Medium
Activities and Timelines	1) Build GIS capacity (**1 year**); 2) Map and delineate areas of high recharge (**2 years**); 3) Gazette protection measures as part of national or local law (**1 year**).
Priority	High
Alignment	NWSDS, NAWAPO, WSDP lll, and DMDP

6.3.3.4. Creation of Pollution Incident Response Plans

The development of a Pollution Incident Response Plan integrated with established GPZ would significantly enhance Dar es Salaam's preparedness for pollution events and strengthen groundwater protection measures. This minimises the magnitude of potential aquifer contamination and improves the coping capacity of nearby groundwater users. Such a plan shifts groundwater management from being purely reactive to proactive by ensuring rapid and coordinated responses to incidents such as chemical spills, leaking underground storage tanks, and sewage overflows, which can spread quickly and are difficult to remediate once contaminants reach the aquifer. By outlining clear procedures, responsibilities, and emergency measures, particularly around abstraction schemes, the response plan could minimise the severity and spatial extent of contamination, thereby safeguarding water quality and ensuring the resilience of the city's groundwater supply. To ensure appropriate responses are undertaken, it is important that the scope of land-use activities is fully understood and accounted for. Additionally, it is essential that those involved with managing and partaking in incident response are sufficiently trained to do so, with yearly checks to ensure compliance.

Table 6-16 Implementation details for the creation of pollution incident response plans.

Category	Description
Implementing Organisation/s	WRBWB, NEMC, DAWASA, City Council, and Municipal Councils
Budget Class	Low
Activities and Timelines	1) Creation of incident response plan (**6 months**); 2) Update incident response plan with groundwater protection zones in place (**2 - 3 years**); 3) Implementation of the incident response plan (**1 - 5 years**).
Priority	High
Alignment	WSDP III, TanWIP, NAWAPO and NWSDS

6.3.3.5. MAR and Hydraulic Barriers

DAWASA, the institution responsible for water supply services in the region, faces several challenges and limitations that have significant implications for water access. Despite increased efforts to address water supply needs, coverage remains limited, with piped water primarily serving formal residential areas. Consequently, less than 40% of the city's population has access to reliable municipal supply, leaving the majority without access to these services. To supplement surface water supply, DAWASA abstracts groundwater from the region's shallow coastal aquifer and deep Kimbiji Aquifer.

The shallow coastal aquifer, in particular, is susceptible to seawater intrusion, where several boreholes along the coast have observed salinisation. To bridge the supply gap, many communities, particularly in informal settlements and in southern Dar es Salaam, privately supplement their water needs with groundwater and purchases from private vendors. Due to the city's large water deficit, dependency on groundwater is already high and is projected to increase, leading to an over-reliance on this resource to meet growing demand. MAR can directly mitigate the impacts of over-abstraction and prevent groundwater user coping capacity from deteriorating.

The over-abstraction of coastal aquifers in particular can cause groundwater levels to drop below sea-level. This disrupts the natural pressure gradient that normally causes freshwater to migrate towards the sea, leading to a reversal of flow direction within the aquifer, causing seawater to migrate into the freshwater zone of the aquifer and leading to salinisation of groundwater. To mitigate this, MAR can be implemented to stabilise groundwater levels, limiting seawater intrusion, improving groundwater quality and also improving the reliability of DAWASA's groundwater schemes, making abstractions more sustainable and ensuring the long-term supply of water for users who have become increasingly dependent on groundwater.

Either active or passive MAR can be implemented and the reliance on either would be dependent on the availability of water at a suitable quantity and quality. Passive MAR can be practised through Green Infrastructure and integration of recharge-enhancing mechanisms (see **Section 6.3.4.1**), where runoff during the wet season can potentially be directed and left to naturally infiltrate into the subsurface. Active MAR could also use runoff water during times of abundance; however could also make use of treated effluent to be directly injected through wellfields into the underlying Quaternary Aquifer. This would require sufficient development of sanitation infrastructure (see **Section 6.1.1 & 6.3.4.6**) to become viable as the current sanitation infrastructure are not equipped for re-use. Alternatively, desalination could be explored as a source of freshwater, however, given the development and operational costs, this may not be the most viable option.

The success of this action plan relies on several factors, including consistent monitoring to inform decision making, sufficient feasibility studies and the finances to fund the development of MAR infrastructure. Once implemented, MAR and hydraulic barriers would address the risk of reduced recharge, over-abstraction, aquifer contamination, seawater intrusion and consequently improve the coping capacity of users who would be affected by these hazards.

Table 6-17 Implementation details for managed aquifer recharge and hydraulic barriers.

Category	Description
Implementing Organisation/s	MoW, NEMC, WRBWB, DAWASA, University Institutions, and Private Sector
Budget Class	High
Activities and Timelines	1) Design of managed aquifer recharge scheme (**2 - 5 years**); 2) Construction of managed aquifer recharge scheme (**5 - 10 years**); 3) Operation of managed aquifer recharge scheme (**10 > years**).
Priority	Medium
Alignment	NWSDS, NAWAPO, WSDP III, TanWIP and DMDP

6.3.3.6. Addressing Inadequate Sanitation

Poor sanitation services present one of the most significant sources of groundwater contamination in Dar es Salaam, largely due to the widespread reliance on pit latrines, which are still used by approximately 76% of households. These risks are most acute in unplanned informal settlements, which are extensive in and around the city's urban core, particularly within the districts of Temeke, Ilala, Ubungo, and Kinondoni. In these areas, the high density of pit latrines, combined with poorly

designed or malfunctioning septic tanks, poses a direct threat to groundwater quality. Addressing this requires the expansion and upgrading of sanitation services and the improvement of septic tank design and management in the informal settlements of Dar es Salaam. High-risk settlements such as Manzese, Tandale, and Vingunguti should be prioritised for such interventions. By improving sanitation infrastructure, the city can reduce groundwater contamination risks and protect the users and the region's aquifers that are vital for water supply. The Success of addressing inadequate sanitation is largely dependent on the availability of finances to fund development and the efficiency to complete developments on time. Moreover, it would require additional technical and institutional capacity to adhere to regular monitoring campaigns, ensure compliance and provide regular maintenance to infrastructure.

Table 6-18 Implementation details for addressing inadequate sanitation.

Category	Description
Implementing Organisation/s	MoW, NEMC, DAWASA, City Council, Municipal Councils, and Private Sector
Budget Class	Very High
Activities and Timelines	1) Study of methods to improve current conditions (**3 - 6 months**); 2) Implementation of initiatives to improve existing on-site infrastructure (**5 years**); 3) Monitoring and ensuring compliance with new sanitation requirements (**5 > years *currently ongoing**); 4) Improving transportation and treatment infrastructure (**3 - 5 years* currently ongoing**); 5) Formalisation of sewage infrastructure across the city (**10 > years* currently ongoing**).
Priority	High
Alignment	NWSDS, NAWAPO, WSDP III, TanWIP, and DMDP

6.3.4. Water Security Planning

6.3.4.1. Integration of Recharge-Enhancing Initiatives

Integrating recharge-enhancing initiatives into urban planning is increasingly important for sustaining groundwater resources in rapidly urbanising cities such as Dar es Salaam. Growing water demand, climate variability, and expanding impervious surfaces are placing increasing pressure on the city's underlying aquifers, which play a critical role in both formal and informal water supply. Given this context, it is recommended that three priority recharge-enhancing initiatives be integrated into Dar es Salaam's spatial planning framework: MAR, WSUD, and urban green infrastructure. An initial feasibility assessment would be required to evaluate the technical, institutional, and environmental viability of specific interventions, including artificial wetlands, infiltration ponds, and injection wells.

Through the implementation of MAR, the WRBWB could increase groundwater storage and improve water security and the region's resilience to drought. Furthermore, given Dar es Salaam's well-documented exposure to frequent flooding during the wet season, passive recharge and filtration measures, such as artificial wetlands and infiltration ponds, would provide multiple benefits. These interventions can function as multifunctional green infrastructure, enhancing flood and stormwater management, improving water quality through natural filtration, and increasing groundwater recharge. When strategically integrated into urban planning, such measures can strengthen the resilience of DAWASA's groundwater supply systems and enhance the sustainable capacity of groundwater abstraction for water users across the city.

The incorporation of WSUD and Green Infrastructure principles into spatial planning would be highly beneficial for Dar es Salaam, particularly given the continued prioritisation of new urban developments. WSUD seeks to integrate the urban water cycle into urban planning and design in a holistic manner, while Green Infrastructure looks to use natural and semi-natural infrastructure to improve environmental and ecological function. Ongoing and planned interventions within the Msimbazi Basin provide practical examples of WSUD in action, including the application of MAR and Green Infrastructure approaches to promote recharge and reduce flooding. When implemented alongside a comprehensive stormwater management action plan, these measures would support the effective adoption of WSUD principles and contribute to the protection of groundwater system health. Collectively, the integrated implementation of these actions would enhance Dar es Salaam's resilience to water scarcity and the impacts of climate change.

The implementation of this action plan requires careful phasing, as each step requires detailed planning and completion before the subsequent step is implemented. Without sufficient feasibility studies and regular groundwater monitoring, the government cannot make informed decisions on these proposed mechanisms. Furthermore, guidance should come from a variety of stakeholders with relevant experience in the field of hydrogeology, sustainable urban design and environmental engineering. Without adequate data and experience, ill-informed decisions on these recharge-enhancing mechanisms would likely be made. Once implemented, groundwater users would benefit from additional water availability in the aquifers they depend on, especially as, through these mechanisms, the risk of over-abstraction, reduced recharge, and aquifer contamination is reduced.

Table 6-19 Implementation details for the integration of recharge-enhancing initiatives.

Category	Description
Implementing Organisations	WRBWB, NEMC, DAWASA, Educational Institutions, and Private Sector
Budget Class	High
Activities and Timelines	1) Feasibility study (**1 - 2 years**); 2) Identify pilot areas and test suitable methods (**2 -5 years**); 3) Development of guidelines and by-laws (**1 year* after point 2**); 4) Development of an implementation programme (**1 year**); 5) Roll out of initiatives (**5 - 10 years**).
Priority	Medium
Alignment	WSDP III, TanWIP, DMDP, NWSDS and NAWAPO

6.3.4.2. Diversification of Water Resources

Dar es Salaam's municipal water supply is heavily dependent on surface water, with over 90% of its water supply sourced from the Upper Ruvu, Lower Ruvu, and Mtoni rivers. Due to the impacts of climate change and increasing upstream abstractions, baseflow to the city's primary water source (the Ruvu River) has been reduced (which has implications for MAR, as surplus water could be limited). These impacts have created a need for diversification of the bulk water supply. To supplement the surface water, DAWASA has developed its groundwater abstraction schemes that target the shallow coastal aquifer and the deep Kimbiji Aquifer to provide potable water. Given the potential of the Kimbiji Aquifer, it is recommended that the advancement of the Kimbiji/Mpera wellfields should remain a strategic priority to improve long-term water supply security. Additionally, the commissioning of dams and reservoirs (where feasible) would significantly increase the city's holding capacity of its surface water resources.

Diversification of water resources across surface water, groundwater, and large-scale infrastructure would greatly improve the aquifer's ability to withstand over-abstraction, reduced recharge, and salinisation. This diversification requires the conjunctive management of surface water and groundwater to create a sustainable water supply. The coping capacity of users who rely on these resources would be significantly improved. The successful diversification of water resources is dependent on ensuring the technical capacity of the government is adequate and that, financially, there are funds to first determine the viability of using different sources, and also to develop the necessary infrastructure for their utilisation. Similar to the implementation of MAR and hydraulic barriers, it is crucial that relevant stakeholders from the water sector are included in the planning and steering of diversification and development. Its implementation is a step towards reducing reliance on a single source of water and building resilience to climate variability and growing demand.

Table 6-20 Implementation details for the diversification of water resources.

Category	Description
Implementing Organisations	MoW, Ministry of Finance and Planning (MOF), Water Resources Integration Development Initiative (WARIDI), NEMC, DAWASA, WRBWB, City Council, University institutions and Private sector
Budget Class	High
Activities and Timelines	1) Advancing the Kimbiji/Mpera wellfields (**2 - 5 years**); 2) Feasibility and potential development of a managed aquifer recharge scheme (**7 - 10 years**); 3) Commissioning of the Kidunda Dam (**Currently ongoing* hydropower plant may be operational already**)
Priority	High
Alignment	WSDP, TanWIP, NWSDS and NAWAPO

6.3.4.3. Incorporation of Urban Groundwater Modelling

The incorporation of urban groundwater modelling into city and land-use planning is critical to support sustainable water management in Dar es Salaam. Groundwater models should be developed and regularly updated to inform the delineation of GPZs, identify opportunities for MAR, and design intrusion barriers to prevent seawater intrusion in coastal aquifers. These models should also integrate climate change scenarios, such as reduced recharge and shifting rainfall patterns, to ensure that future groundwater schemes remain robust under changing conditions. Embedding groundwater modelling into urban planning processes will provide a scientific basis for decision-making, strengthen the protection of vital aquifers, and enhance the city's capacity to balance development needs with long-term water security.

The inclusion of groundwater modelling in decision making directly improves groundwater management, and indirectly reduces the risk of reduced recharge, over-abstraction, seawater intrusion and aquifer contamination. Together, these improvements and reductions benefit users by either improving their coping capacities or ensuring they are not diminished. While groundwater modelling is a powerful tool that can greatly inform the government on how to manage groundwater and protect it from various hazards, without sufficient and reliable data to develop and run these models, the information it derives can negatively impact the management of groundwater. Therefore, it is crucial that sufficient monitoring programmes are established and operated to ensure the consistent input of reliable data. Another crucial aspect to consider is ensuring the hydrogeological conditions of Dar es Salaam's aquifers and the impacts of contamination, climate variability and over-abstraction are adequately studied and understood. Without this information, the development of a groundwater model will be limited in its accuracy.

Table 6-21 Implementing details for the incorporation of urban groundwater modelling.

Category	Description
Implementing Organisations	MoW, WRBWB, DAWASA, University institutions, and Private sector.
Budget Class	Low
Activities and Timelines	1) Improving data collection and spatial coverage (**1 - 3 years * once a sufficient monitoring network has been established**) 2) Review and assemble existing data (**6 months**); 3) Develop an urban groundwater modelling framework (**6 - 12 months**); 4) Incorporate into disaster preparedness and groundwater management (**1 year**).
Priority	High
Alignment	WSDP III and TanWIP

6.3.4.4. Improving City Planning

Improving urban planning in Dar es Salaam is essential to safeguard groundwater resources and other key strategic water source areas, to build resilience to climate and urbanisation pressures. The protection of recharge zones should be formally integrated into city planning processes to guide both existing and future developments in areas of high recharge potential. This will help preserve natural permeability and limit land use changes that do not favour recharge. In addition, recharge area protection, flood control, and stormwater management measures should be incorporated into the city's master plans as proactive interventions. Embedding these considerations within spatial planning frameworks will reduce contamination risks, enhance infiltration, and improve the overall sustainability of Dar es Salaam's water resources.

Effective urban planning in Dar es Salaam requires sustained inter-departmental coordination to integrate key principles into urban frameworks and also to ensure continuity after implementation, as without collaboration, action plans face delays and can become ineffective. Planning should be adaptive, regularly updated, and properly enforced to remain relevant to current requirements and future conditions.

Table 6-22 Implementation details for improved city planning.

Category	Description
Implementing Organisations	City Council, Municipal Councils, NEMC, DAWASA, and Private Sector
Budget Class	Medium
Activities and Timelines	1) Update and enforce planning regulations (**1 - 2 years**); 2) Integrate Water Sensitive Urban Design into urban designs (**1 - 2 years**); 3) Prioritise institutional cooperation and conjunctive management (**1 year**).
Priority	Medium
Alignment	WSDP III, TanWIP, and DMDP

6.3.4.5. Improved Sanitation Services and Infrastructure

Improving water security in Dar es Salaam requires strengthening sanitation services and infrastructure to reduce groundwater contamination risks and protect the potable supply. Sewer and faecal sludge management (FSM) systems should be expanded beyond the city's core wards through increased treatment capacity, the establishment of designated sludge disposal sites, and the formalisation of private desludging operators. While FSM pilots and desludging regulations have been initiated, their implementation status remains unclear and requires urgent attention. A gradual shift away from widespread pit latrine use towards a sewered sanitation system will be essential. This shift should also be supported through integration with spatial planning to ensure coverage across both formal and informal settlements. Improved wastewater management infrastructure is also needed in industrial zones such as Vingunguti, Mikocheni, and Ubungo, where inadequate disposal of effluent and stormwater continues to threaten groundwater quality. By embedding sanitation infrastructure improvements within water security planning, Dar es Salaam can reduce pollution risks, safeguard aquifers, and ensure a more resilient water supply for its growing population.

The improvement of sanitation services and associated infrastructure in Dar es Salaam will likely take place over several years and may be extended should sufficient planning and implementation measures be ineffective and or delayed. Without securing adequate financing over this time period, delays in development and upgrades could be further exacerbated. While this action plan focuses solely on sanitation services, it is highly recommended that access to improved water supply and associated infrastructure be developed concurrently to reduce complications that may arise in the future. Due to the objectives of this action plan, there may be financial backing through TanWIP. The upgrades to infrastructure and sanitation services directly align with these programmes, and within the metropolitan area, there is also the potential for funding through the DMDP.

Table 6-23 Implementation details for the improvement of sanitation services and infrastructure.

Category	Description
Implementing Organisations	MoW, MoF, NEMC, DAWASA, City Council, and Municipal Councils
Budget Class	Very High
Activities and Timelines	1) Upgrade and maintain existing sewage distribution and wastewater/water treatment infrastructure (**1 - 15 years**); 2) Expansion of sewage infrastructure to reach the entire city (**10 > years* currently ongoing, however, should run concurrently with improved water supply access and infrastructure action plan**).
Priority	High
Alignment	TanWIP, DMDP

6.3.4.6. Improved Water Supply Access and Infrastructure

The extension of DAWASA's water supply coverage should be prioritised to improve water access in Dar es Salaam. At present, many residents lack a reliable piped supply, as municipal services are concentrated in formal areas and benefit less than 40% of the population. The majority of residents (over 70% of the city's population) live in informal settlements, where connections to the municipal network are limited or absent, leaving households reliant on private vendors, shallow wells, or other unsafe water sources. Expanding equitable access to safe piped water would reduce dependence on contaminated groundwater and mitigate the risks posed by inadequate sanitation systems, such as pit latrines and poorly designed septic tanks, which threaten aquifer quality.

Additionally, most of the city's water supply infrastructure is old and inefficient, with non-revenue

water (NRW) losses estimated at 46.7% in 2017 by the Energy and Water Utilities Regulatory Authority (EWURA). While NRW reduction programmes are already underway, continued prioritisation of infrastructure upgrades, leak detection, and system maintenance is essential. Strengthening the supply network will not only improve efficiency and reliability but also contribute to groundwater protection and public health by reducing the demand for unsafe alternative water sources. Improved access to sufficient water supplies also reduces the risk of over-abstraction and seawater intrusion as users are less likely to rely on groundwater for supply, thereby significantly improving the coping capacity of Dar es Salaam's groundwater-dependent communities.

Similar to improving sanitation services and supply infrastructure, this action plan would take place over several years and would require meticulous planning and financial backing to ensure there are no delays during upgrades and development. Moreover, by running concurrently, the implementation of these two action plans would be the most efficient and cost-saving, as singular implementation over their own time scales could extend programme run times by several years and or decades. These upgrades and developments should be prioritised in areas where infrastructure is yet to be developed (Kigamboni and Temeke), as well as in areas where users are the most susceptible to complications of using unsuitable groundwater.

Table 6-24 Implementation details for the improvement of water supply access and water supply infrastructure.

Category	Description
Implementing Organisations	MoW, MoF, NEMC, WRBWB, DAWASA, City Council, and Municipal Councils
Budget Class	Very High
Activities and Timelines	1) Upgrade and maintain existing reticulation and water treatment infrastructure (**1 - 15 years**); 2) Expansion of water supply infrastructure to reach the entire city (**10 > years* currently ongoing, however, should run concurrently with improved sanitation services and infrastructure**).
Priority	High
Alignment	WSDP III, TanWIP, DMDP, and NWSDS

6.3.5. Outreach & Education

6.3.5.1. Groundwater Training and Education - Bilingual Public Campaigns

The development and implementation of bilingual groundwater training and education public campaigns delivered in both English and Swahili are recommended to strengthen awareness and stewardship of groundwater resources in Dar es Salaam. Priority areas should include low-income informal areas that are predominantly reliant on groundwater, areas with contaminating activities, municipal wellfields, coastal zones where over-abstraction occurs and recharge zones. Campaigns should focus on:

- **Promoting good groundwater practices:** Raise awareness on behaviour changes that promote good groundwater practices, which promote aquifer protection from contamination and over-abstraction (to avoid saline intrusion due to over-pumping). Such campaigns can focus on communities, municipal and basin officers and technical teams.
- **Encouraging borehole registration and metering:** Raise community awareness on the importance of the registration and the metering of private boreholes through public campaigns. This will empower community members to report illegal drilling or groundwater use to the street/mtaa/ village/ward officer, who will inform the Basin Office, allowing them to take action and enforce groundwater use. Focus areas can include peri-urban wards

(Kinondoni, Temeke, Ilala outskirts) where thousands of poorly regulated wells exist.

- **Support wellfield protection through community involvement:** Community involvement in wellfield protection. Public awareness and participation are crucial for sustainable groundwater management. Engaging communities in decision-making processes, promoting conservation practices and fostering a sense of ownership contribute to long-term protection and equitable use of groundwater resources.

The development and implementation of such a public campaign addresses key risks to groundwater sustainability in Dar es Salaam. It helps mitigate groundwater quantity risks by raising awareness of the consequences of poor borehole registration, unregulated abstraction, and excessive pumping, which can lead to declining water levels and increase the likelihood of saline intrusion in coastal aquifers. The campaign also addresses groundwater quality risks by promoting behaviour changes that reduce contamination pathways, encouraging safer borehole construction and operation practices, and strengthening community understanding of how everyday activities can impact aquifer health.

The success of this campaign is dependent on clear, effective communication, strong public participation and engagement, adequate resources and capacity, strong institutional involvement for clear messaging and clear pathways for the reporting of illegal abstractions or drilling and alignment with broader groundwater governance efforts.

Table 6-25 Implementation details for a public groundwater training and education campaigns.

Category	Description
Implementing Organisations	WRBWB, Municipal Councils
Budget Class	Medium
Activities and Timelines	1) Identification of groups to be targeted for training, including users in informal settlements and relevant municipal staff (**1 year**); 2) Development of modules/packages for groundwater training relevant for targeted groups (**2 years**); 3) Launching and rollout of the campaign (**3-5 years**).
Priority	High
Alignment	NAWAPO, NWSDS and NWDP

6.3.5.2. School Water Clubs & Youth Ambassadors

This action plan recommends the rollout of an interactive education and stewardship programme for schools with activities designed to build awareness on groundwater protection and practical conservation behaviours. This initiative could be a critical entry point for shaping long-term behaviour changes in communities and households. It promotes the culture of water conservation and protection from an early age. Core components can include:

- A starter kit with educational materials and simple groundwater experiments (e.g., infiltration tests, water quality demonstrations).
- Leak-hunt campaigns on school grounds to identify and fix water wastage.
- Tree planting and aftercare to demonstrate links between vegetation, infiltration, and aquifer recharge.
- An annual citywide challenge to showcase school initiatives, encourage peer learning, and recognise best practices.

This initiative can be targeted at learners of all ages, with tailored activities for different grades, and at government bodies and facility managers responsible for day-to-day water and infrastructure maintenance at schools. Target areas can include schools within the key aquifer areas and those within informal settlements where awareness and stewardship can benefit the community.

The success of this plan depends on securing adequate resources for programme delivery, strong collaboration with schools and education authorities, and sustained participation from learners, teachers and facility managers to ensure that stewardship activities are implemented and maintained over time.

Table 6-26 Implementation details for school water clubs & youth ambassador programmes.

Category	Description
Implementing Organisations	WRBWB, Municipal Councils
Budget Class	Medium
Activities and Timelines	1) Development of criteria and nomination of schools to formulate clubs aimed to elevate public perception, knowledge and education on groundwater management (**6 months**); 2) Preparation of relevant education and promotional content to engage clubs (**1 year**); 3) Development of website and communication through social media, factsheets and newsletters (**1-2 years**); 4) Preparation of the annual awards program and certification (**6 months**).
Priority	Medium
Alignment	NAWAPO, NWSDS and NWDP

6.3.5.3. Community progress reports

Strengthening outreach and education through regular community progress reports will build public awareness and support for sustainable water management in Dar es Salaam. These reports should provide accessible insight into the state of water resources, infrastructure, and ongoing projects, while clearly explaining their importance to community well-being and long-term water security. Transparent communication of progress and challenges will help keep communities informed, foster trust in institutions, and encourage public participation in protecting water resources. Information can be shared through a range of channels, such as pamphlets, newspapers, community meetings, and national or community radio, to ensure a broad reach across different social groups and equal access to information. By embedding community progress reporting into water governance, the city can strengthen accountability, increase public engagement, and promote shared responsibility for groundwater protection and water security.

The successful implementation of regular community progress reports depends on reliable and up-to-date groundwater and water supply data, along with strong institutional coordination and a commitment to transparent communication. It requires the capacity to translate technical information into clear, accessible messages and the development of inclusive educational materials tailored to different literacy levels. Effective dissemination through multiple communication channels, supported by adequate resources and mechanisms for community feedback, is also essential to ensure broad reach and sustained public engagement.

Table 6-27 Implementation details for community progress reports.

Category	Description
Implementing Organisations	WRBWB and DAWASA
Budget Class	Low
Activities and Timelines	1) Development of report formatting and what should be regularly communicated to the public (**1 - 2 years**); 2) Implementation of regular reporting (**1 year**).
Priority	Medium
Alignment	NAWAPO, NWSDS and NWDP

6.3.5.4. Household-level sanitation and well safety education

Education on household-level sanitation and well safety is a key component of outreach and awareness programmes. In high-density informal and unplanned settlements such as Manzese, Tandale, and Vingunguti, targeted education on PCAs and their impact on groundwater is essential because communities in these areas rely heavily on shallow wells and boreholes. Educational content should focus on how poor household sanitation practices, particularly the design, location, and maintenance of pit latrines and septic tanks, can negatively impact the underlying aquifers. This includes raising awareness of how the proximity of hand-dug wells and drilled boreholes to sanitation facilities and PCAs can directly contribute to groundwater contamination. By strengthening understanding among users who are both highly dependent on and influential in the condition of local groundwater resources, behaviour change can be encouraged to improve the protection, utilisation, and management of groundwater.

The successful implementation of this action plan depends on sufficient capacity to train facilitators and outreach teams, as well as strong institutional coordination between the Basin Office, DAWASA, and the Municipal Council to ensure consistent messaging. It also requires the development of culturally appropriate educational materials, with simple, accessible content tailored to different literacy levels and delivered in Swahili. Effective implementation further relies on the willingness of communities to participate and the inclusion of trusted community leaders who can support mobilisation, reinforce key messages, and facilitate sustained behaviour change.

Table 6-28 Implementation details for household-level sanitation and well safety education.

Category	Description
Implementing Organisations	WRBWB, Municipal councils, and NGOs
Budget Class	High
Activities and Timelines	1) Development of sanitation and well safety education materials (**1-2 years**); 2) Implementation in high-density informal settlements, e.g. Manzese, Tandale, Vingunguti (**3 - 5 years**).
Priority	High
Alignment	NAWAPO, NWSDS and NWDP

6.3.5.5. Promoting citizen science

Promoting citizen science initiatives can strengthen groundwater governance in Dar es Salaam by engaging communities directly in monitoring and protecting water resources. Local community members can be trained and equipped to collect and record simple groundwater data (e.g. water levels and physical properties), providing information that complements formal monitoring networks. Involving communities in data collection would not only significantly enhance the spatial and temporal coverage of groundwater data, but it would also empower citizens to become active participants in groundwater stewardship, allowing them to be more conscious of groundwater-related challenges and building awareness of the importance of good groundwater practices, which promote aquifer protection from contamination and over-abstraction. Furthermore, the promotion of citizen science also fosters engagement between citizens and local government, institutions such as DAWASA and Basin Water Boards.

Promoting citizen science addresses the challenge of insufficient spatial and temporal groundwater monitoring, which often limits effective planning and decision-making. By actively involving communities in data collection, it transforms citizens from passive groundwater users into informed stewards who help protect aquifers, monitor local conditions, and report illegal drilling, over-abstraction, or pollution risks. Increased community participation not only supports behaviour changes that improve aquifer protection but also enhances the early detection of groundwater hazards.

The success of this action plan is largely dependent on the willingness of communities to participate, practical training and capacity building, clear protocols and simple data-collection methods, the provision of equipment, strong institutional coordination, and effective data management systems for the uploading, storing and visualisation of citizen-collected data.

Table 6-29 Implementation details for promoting citizen science.

Category	Description
Implementing Organisations	WRBWB, Municipal Councils, and NGOs
Budget Class	Medium
Activities and Timelines	1) Development and implementation of actions to engage communities in groundwater management interventions (**1 - 3 years**).
Priority	Medium
Alignment	NAWAPO, NWSDS and NWDP

6.3.5.6. Seasonal Risk Alerts (Floods, Droughts, Heatwaves)

Climate-related risks such as flooding, drought, contamination and heatwaves pose growing threats to Dar es Salaam's communities, infrastructure and water security. Vulnerable communities are often most affected, yet the least informed. The development and implementation of a citywide early warning and seasonal risk alert system using pre-templated alerts delivered in English and Swahili is recommended for timely communication on:

- Flood risks and safety measures.
- Water contamination alerts.
- Drought stages and water-use restrictions.
- Heat-health warnings and protective actions.

The system should be developed in close coordination with the Disaster Management Department (DMD) of the Prime Minister's Office, which is mandated by the Disaster Management Act to establish early warning systems across sectors, collect and disseminate information, and issue directives during disaster situations. The Basin Water Board has already developed a flood forecasting and early warning system, which provides a good foundation. However, this system should be expanded to include heatwaves, water quality risks, and other climate change-induced hazards to strengthen citywide preparedness and resilience.

Alerts targeted at all the residents in the region, with special focus on vulnerable areas such as informal settlements with limited coping capacity, can be disseminated through multiple accessible channels, including community radio, WhatsApp groups, ward councillor channels, and loud-hailing in high-risk areas. This would support faster, more coordinated communication about seasonal risks, thereby improving residents' coping capacity across the region.

The success of this plan depends on good coordination across different levels of government, reliable communication channels, and effective outreach so that alerts are delivered and understood by all residents, especially in vulnerable communities and in both languages. This action plan is directly aligned with the National Disaster Management Policy and the National Disaster Management Strategy, which emphasise the need for information sharing on disasters.

Table 6-30 Implementation details for a seasonal risk alert system.

Category	Description
Implementing Organisations	WRBWB, Municipal Councils, Disaster Management Department (DMD) of the Prime Minister's Office.
Budget Class	Medium
Activities and Timelines	1) Dissemination to key actors/ the public of a citywide early warning and seasonal risk alert system and preparedness (**1 year**); 2) Prepare drought allocation rules for rivers like Ruvu in dry periods (**1- 2 years**).
Priority	High
Alignment	National Disaster Management Policy and National Disaster Management Strategy.

6.3.5.7. Educational Workshops in Protection Zones

Industrial, commercial and residential activities in protection zones pose significant risks to groundwater quality if not managed properly. To address this, targeted workshops should be organised for both communities and businesses operating in sensitive areas, with the aim of building awareness and capacity to prevent contamination. These workshops should include all relevant groups, recognising that pollution sources are diverse and require collective responsibility to manage effectively. Training sessions should provide practical guidance on best practices for waste management, land use, and groundwater protection, while also empowering participants with knowledge of their rights and responsibilities in maintaining and conserving water resources and the surrounding environment. Complementary campaigns should be undertaken to disseminate this information widely to both public and private organisations, ensuring consistent messaging and stronger compliance across all sectors.

While all user groups should be engaged, industry-focused workshops remain essential in areas where high-risk activities are concentrated to limit groundwater contamination. These sessions can offer tailored training for managers, technicians and operators at industrial and commercial premises, supported by compliance checklists, visual guidance materials and on-site signage to reinforce correct practices. Priority areas may include Dar es Salaam's urban core, where industrial activities and informal settlements are prominent.

The success of this plan depends on strong participation from businesses and residents in protection zones, effective delivery of training and awareness materials, and ongoing follow-up by the WRBWB to reinforce good practices and ensure that high-risk activities adopt the required safeguards.

Table 6-31 Implementation details for educational workshops in protection zones.

Category	Description
Implementing Organisations	WRBWB, Municipal Councils, NGOs, and NEMC
Budget Class	Medium
Activities and Timelines	1) Identification of priority groundwater protection zones (**1 year**); 2) Implement workshops on contamination risks to all groups (**3 - 5 years**); 3) Disseminate information to the public on maintaining and conserving water resources and the environment (**1 - 2 years**).
Priority	Medium
Alignment	WSDP III, TanWIP, and DMDP

6.3.5.8. Gender and Social Inclusion

The inclusion of women and marginalised social groups in groundwater management is essential to ensure equitable and effective water governance in Dar es Salaam. This action plan, therefore, recommends actively involving these groups in aquifer protection, groundwater monitoring, planning, and decision-making processes. Such engagement not only strengthens representation but also enhances the sustainability of groundwater management efforts.

Such involvement can be achieved through efforts towards increasing the representation of women and marginalised groups in governance processes, strengthening collaboration between communities and the Basin office in groundwater monitoring and enforcement and addressing social and cultural barriers that limit the participation of women and marginalised groups in groundwater management. Empowerment can be further enhanced through targeted awareness-raising and capacity-building programmes focused on groundwater regulations and compliance requirements, enabling community members to better understand their roles and responsibilities in groundwater protection, regulation, and enforcement.

With adequate knowledge, women and marginalised groups can support the Basin Office by reporting illegal drilling or groundwater use to the street/mtaa or village/ward officer, who in turn can escalate cases to the relevant authorities. By fostering this participation, groundwater governance becomes more inclusive, accountable, and responsive to the needs of all community members.

The success of this action plan largely depends on inclusive community engagement structures, targeted awareness and capacity building programmes and the ability to address social and cultural barriers that hinder women and marginalised groups from participating in water-related issues.

Table 6-32 Implementation details for gender and social inclusion.

Category	Description
Implementing Organisations	WRBWB, Municipal Councils, and NGOs
Budget Class	Medium
Activities and Timelines	1) Conduct a holistic gender and social inclusion analysis to facilitate the representation and participation of different groups in conjunctive water management (**1 - 5 years**).
Priority	Medium
Alignment	NAWAPO and NWSDS

7. Conclusion

To achieve the objectives of this strategic action plan for conjunctive management in the Dar es Salaam region, a top-down approach was adopted, comprising:

- A critical review of Tanzania's overarching legislation and policies, including the National Water Policy 2025, National Environmental Policy 2021, National Disaster Management Policy 2004, and National Land Policy 1995. These policies were largely formulated to address deficiencies in the management of Tanzania's resources and reflect the nation's commitment to multilateral environmental agreements.
- A review of relevant strategies, programmes, and plans to frame the approach to water resource and environmental management in Tanzania.
- Based on the gaps identified during the above review and the groundwater dependency and vulnerability assessments, action plans were formulated to support the management of groundwater resources in Dar es Salaam.

These action plans are structured under five main categories

- improved governance,
- improved data acquisition and data management,
- aquifer protection and pollution control,
- water security planning, and
- outreach and education.

Within each category, action plan recommendations were made, noting where initiatives have already been undertaken or are planned to be implemented. For each action plan, detailed implementation requirements were specified, including the rationale, objectives, strategic alignment, dependencies, priority areas, implementing organisations, budget class, timelines and priority level, to support the effective and coordinated execution of the proposed action plans.

Dar es Salaam and Cape Town, the two cities selected as case studies for this project, differ significantly in terms of groundwater dependency, vulnerability, and governance. Accordingly, this strategic plan was tailored specifically to address the challenges and opportunities faced by the relevant institutions in Dar es Salaam, and targeted action plans have been recommended to respond to these challenges unique to the region. For example, a dedicated focus on aquifer protection and pollution control was included for Dar es Salaam because, unlike Cape Town, where most residential areas are connected to the municipal water supply and have proper sanitation infrastructure, large parts of Dar es Salaam lack adequate sanitation infrastructure. As a result, greater emphasis on groundwater protection measures is required in Dar es Salaam.

Furthermore, Tanzanian's highly centralised water resource governance system and the severe resource constraints of its WRBWB weaken the regulatory management of groundwater use, protection, and monitoring, especially when compared to Cape Town. As a result of these differences, multi-stakeholder actions that formally integrate local government and community members into groundwater governance, management and monitoring efforts have been recommended for Dar es Salaam.

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Appendix A – Joint Action Plans for Wami-Ruvu Basin

Summary of proposed strategies and actions from:

Groundwater Partnership Tanzania (GWP). (2022). Sustainable Development Goals (SDG) IWRM Support Programme (SDG-SP): Joint action plans informing Wami-Ruvu basin in formulating appropriate responses to water resources management challenges Stage 2. Groundwater Partnership Tanzania, Dar es Salaam.

Appendix A.1 – Resource Mobilisation Strategy

Table 8-1 Resource Mobilisation Strategy objectives and associated actions (taken from GWP, 2022).

Strategic Objective	Actions
Reformation of basin water investment legal framework (laws, policies and regulations) & governance structures to be more supportive of private sectors involvement.	• Review how the existing Legal Framework affects Private Sector Involvement in financing. • Initiate open dialogue between the public and private sectors in basin on shortcomings of the existing legal and regulatory framework. • Design new water investment Legal Framework that considers observations from the review and stakeholders' engagement. • Improve basin office financial governance by making them creditworthy or increase their creditworthiness and efficiency in capital planning/ reducing unit costs. • Develop capacities for financial planning, financial management, financial control, and evaluation of non-conventional technical projects.
Integrate water financing considerations across all water related sectors	• Identify different sectors that benefit from or affect the sustainability management of the water resources in the basin. • Review existing strategies, policies and plans of the identified sectors on their flexibility and limitations for cross-sector coordination & planning with the Ministry of Water and Wami-Ruvu Basin Office. • Identify appropriate instruments for mobilizing financial resources from the identified sectors so as to finance expenditures for sustainable water management in the Wami-Ruvu basin. • Conduct a collaborative assessment of multi-purpose infrastructure costs, risks and returns/benefits to different sectors which will form the basis for allocation of the same. • Develop capacities for planning across the sectors relating to the basin water resource.
Increase revenues internally generated in the basin	• Introduce cost recovery targets across other sectors. • Review water tariff structures to reflect realistic economic value of water. • Introduce/Strengthen economic policy instruments for water management (such as water abstraction or water pollution charges).

Strategic Objective	Actions
Increase allocations of public budgetary resources to Wami-Ruvu Basin IWRM activities.	• Assess the economic value of Wami-Ruvu waters contribution to GDP, and use it as a basis for requesting for higher public funding allocation. • Device means of incorporating public expenditures managed in water-related sectors (e.g., energy, agriculture, environment, urban development) into the basin water resources management activities. • Carry out governance and policy reforms to facilitate evidence-based allocation of financial resources for supporting Water Governance activities. • Develop basin capacities for execution and management of allocated financial resources.
Mobilize additional resources from domestic private actors	• Identify potential basin private sector actors/ investors. • Initiate open dialogue between the private and public sector actors in the basin to explore potential partnerships or financial relationships and transactions. • Open dialogues with potential private investors in the water sector to identify the main barriers that prevent their involvement in basin investment initiatives (either by issuing loans, buying bonds, taking equity investments, or other mechanisms). • Raise awareness among potential investors about the opportunities and responsibilities to invest in basin water governance. • Develop capacities for showcasing investment opportunities and for entering into a dialogue with potential investors.
Increase the amount of financial resources mobilized from international partners.	• Identify new potential financial partners from the global water financing portfolio that are likely to align with the interest of the basin. • Initiate a forum for promoting dialogue between the basin management and existing and new international financial partners to improve alignment of their support with basin objectives. • Develop good quality proposals for water-related projects to mobilize climate financing. • Use government and donor funds better to catalyse commercial finance via blending (i.e., blending of Government finance or Donor Concessional finance with domestic commercial finance). • Develop capacities for project preparation and for accessing blending finance which adequately allocate risks and returns across financiers, building on good international practices.

Appendix A.2 - Capacity Building Strategy

Table 8-2 Capacity Building Strategy objectives and associated actions (taken from GWP, 2022).

Strategic Objectives	Actions
Strengthen the capacity to collect, store, process, and disseminate hydrometeorological data (quantity and qua	• Develop Standard, Specification, and Guidelines for acquiring and installation of monitoring system • Enhance water resources assessment capabilities and measurement networks; • Strengthen the water resources assessment and monitoring system, including establishing the baseline situation; • Establish water resources databases and develop mechanisms for acquiring water use and water demand information from water users; • Device an efficient system for information storing, processing, management and sharing; • Train Technicians to operate, organize and maintain the system appropriately; • Promote the use of data for water resource management decision-making; and • Define broad goals and long, medium and short-term objectives for the basin.
Increase stakeholder awareness of their participatory roles and responsibilities	• Prepare and operationalize proper guidelines on the engagement of stakeholders • Increase number of stakeholders meeting/seminar • Establishment of more WUAs and catchment/sub-catchment committees • MoU between Wami-Ruvu basin and key stakeholders to ensure sustainable implementation of agreed plans • Public awareness on the importance of water resources management • Strengthen coordination among government agencies and other stakeholders involved in management of water resources
Skills development and career advancement (capacity enhancement)	• Undertake needs capacity enhancement. • Training senior experts on new technologies and skills for governing water resources.
Staff exchange and mentoring for capacity enhancement	• Establish appropriate mechanisms for staff exchange program and equipment between basin water boards. • Create favourable working environment to attract skilled staff from other organizations. • Promote mentorship for junior staff.

Appendix A.3 - Knowledge Management Strategy

Table 8-3 Knowledge Management Strategy objectives and associated actions (taken from GWP, 2022).

Strategic Objective	Actions
Enhancing technical capacity for knowledge management	• Develop Action Plan on KM at each level and capture innovation and learning as it happens in the field by project activities. • Harvest stories for dissemination by translating raw data into meaningful Knowledge products • Share relevant information and knowledge on lessons, results and impact. • Assist the respective river basin or IWRM institution on media related issues such as media engagement of journalists etc. • Collecting relevant data that is useful for the team as knowledge • Developing an overall framework that guides knowledge management. • Actively promoting the knowledge agenda within and beyond the team • Overseeing the development of the knowledge infrastructure • Facilitating connections, coordination and communications
Enhancing financial capacity for knowledge management	• Setting up a budget for knowledge management at the start of each financial year • Mapping of potential stakeholders for resources mobilization • Building institutional and human capacity to mobilize financial mobilization
Strategies to enhance stakeholders' engagement	• Development of communication strategy focusing on outreach and development of strategic massages
Enhancing knowledge sharing culture	• Organizing knowledge exchange interventions such as Knowledge sharing events and exchange tours. • Basin Multi Stakeholder Forums could plan for exchange tours to enable basin to-basin or peer-to-peer learning. • Setting out a clear approach to monitoring, evaluation, learning and reporting of implemented knowledge management initiatives.

Appendix A.4 - Monitoring and Evaluation Strategy

Table 8-4 Monitoring and Evaluation actions (taken from GWP, 2022).

Proposed actions	• Development of standardized M&E training materials • Development of skilled M&E trainers through a train-the-trainer (tot) program • Development of a multi-year training plan to facilitate structured and sequenced M&E training • Implement training using the capacity-building modalities

Appendix B – Action Plans

Table 8-5 Combined action plan summary.

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
Improved Governance	Improved groundwater use enforcement	Provides the government with a better indication of GW use and ensures compliance	Addresses the risk of over-abstraction, improves GW management, and improves user and municipal coping capacity • **GW management**; • **Over-abstraction**; • **Coping capacity**.	High	Medium	1) Hydrocensus to identify where Groundwater users are 2) Amendment or creation of by-laws with the development of guidelines 3) Enforcement and rollout of by-laws	1) 0-12 months 2) 6-12 months 3) 3 - 5 years	NAWAPO	WRBWB, Local Government, Street Officers (Mtaa), and Village Executive Officers
	Capacity building	Ensures that officials across all relevant institutions (municipalities, water board, LGAs, NEMC) are trained about groundwater management.	Strengthens GW management and improves coping capacity. • **GW management**; • **Coping capacity**.	High	Low	1)Initial training of different stakeholders 2) Refresher/ ongoing training over the long term	1) 3 - 6 months 2) 5 years	WSDP III, NAWAPO, and NWSDS	MoW and WRBWB
	Improved institutional coordination	Ensures coordination across different tiers of government and user groups.	Strengthens GW management and improves coping capacity. • **GW management**; • **Coping capacity**.	High	Low	1) Interdepartmental management team 2) Operationalisation of management team	1) 6 months 2) 1 - 2 years	WSDP III, NAWAPO, and NWSDS	MoW, WRBWB, DAWASA, and Local Government Authorities (LGA)

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
	SDG-6 Integrated water resource management	Ensures the sustainable management of water and sanitation, providing clean water and sufficient toilets.	Strengthens GW management and addresses the risk of over-abstraction and improves user coping capacity. • **GW management**; • **Over abstraction**; • **Coping capacity**.	High	High	1) Resource mobilisation, 2) Capacity building, 3) Development of knowledge management, 4) Development and ongoing Implementation of a Monitoring and Evaluation Strategy *Refer to Joint Action Plans for Wami-Ruvu Basin Report	1) 2 years 2) 5 years 3) 7 years 4) 1 year	NAWAPO, WSDP III, and TanWIP	MoW, WRBWB, and DAWASA,
	Disaster Preparedness	Important for mitigating the impacts of hazards before they occur.	Improves the coping capacity of users against hazards. • **Coping capacity**	Medium	Medium	1) Development of drought allocation rules 2) MAR feasibility study 3) The implementation of drought allocation rules	1) 1 year* after sufficient data is acquired 2) 2 years 3) 1 year* after concluding development of drought allocation rules	NDMP, NDMS, NCRS, NAWAPO, and NWSDS	WRBWB, Municipal Councils, and Disaster Management Department (DMD) of the Prime Minister's Office.
	Expansion of WUA's Purview	Currently WUAs are only involved in managing surface water, including both promotes stakeholder engagement and groundwater in management discussions	Strengthens GW management and addresses the risk of over-abstraction, aquifer contamination and user/resource coping capacity **•GW management** **•Over-abstraction** **•Aquifer contamination** **•Coping capacity.**	High	Low	1) Alter definition of WUAs to include groundwater 2) Identify stakeholders 2) Hold Intersectoral meetings and engagements	1) 3 months 2) 3 months 3) 6 months	NAWAPO and WSDP III	WRBWB and NEMC

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
Aquifer Protection and Pollution Control	Groundwater Protection Zones	Protects groundwater from contamination by regulating high-risk activities. They provide a spatial reference for where intense monitoring should occur.	Addresses the risk of aquifer contamination and improves user coping capacity. • **Aquifer contamination**; • **Coping capacity.**	High	Medium	1a) Map out groundwater users (identifying all public utilities) 1b) Assess status and effectiveness of current protection / regulation 2) Modelling around municipal well fields (only for critical wellfields) 3a) Defining groundwater protection zones (GPZ), with establishing limitations of landuse 3b) gazetted by Ministry / Parliament 4) Implementation of GPZ (DAWASA: for wellfields) 5) Integration of GPZ into urban and spatial planning	1) 12 - 18 months 2) 12 - 18 months 3) 6 months 4) 1 - 5 years* after defining point 3 5) 2 - 5 years	TanWIP, NWSDS, NAWAPO, and WSDP III	MoW, NEMC, WRBWB, DAWASA, City Council, and Municipal Councils
	Mapping of Potentially Contaminating Activities (PCAs)	Protects groundwater by identifying and managing high-risk activities and informs protection zone delineation.	Addresses the risk of aquifer contamination. • **Aquifer contamination**	High	Medium	1) Identify areas of high risk (aquifer vulnerability, desktop) 2.1) List of potentially contaminating activities 2.2) Mapping of PCAs (desktop) 2.3) Field verification of PCAs 3) Implementation of PCAs in GPZ to identify high risk areas (e.g. urban planning, monitoring, response plan)	1) 6 months 2) 1 - 2 years 3) 1 - 5 years *linked to GPZs and should run parallel	WSDO III, TanWIP, DMDP, and NWSDS	WRBWB, NEMC, City Councils, and Municipal Councils
	Creation of pollution incident response plans	Ensure a rapid, coordinated and effective response to pollution incidents.	Addresses the risk of aquifer contamination and improves user and municipal coping capacity. • **Aquifer contamination**; • **Coping capacity.**	High	Low	1) Creation of incident response plan 2) Update incident response plan with GPZ in place 3) Implementation of the incident response plan	1) 6 months 2) 2 - 3 years 3) 1 - 5 years	WSDP III, TanWIP, NAWAPO, and NWSDS	WRBWB, NEMC, DAWASA, City Council, and Municipal Councils

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
	MAR and hydraulic barriers	Important for improving groundwater storage and supporting drought resilience.	Addresses risk of reduced recharge to aquifers, aquifer contamination, seawater intrusion and improves user and municipal coping capacity. • **Reduced recharge;** • **Over-abstraction;** • **Aquifer contamination;** • **Seawater intrusion;** • **Coping capacity.**	Medium	High	1) Design of managed aquifer recharge (MAR) scheme 2) Construction of MAR scheme 3) Operation of MAR scheme	1) 2 - 5 years 2) 5 - 10 years 3) 10 > years	NWSDS, NAWAPO, WSDP III, TanWIP and DMDP	MoW, NEMC, WRBWB, DAWASA, University Institutions, and Private Sector
	Addressing inadequate sanitation	Protects groundwater resources from contamination from leaking pit latrines and septic tanks.	Addresses the risk of aquifer pollution and improves coping capacity. • **Aquifer contamination**; • **Coping capacity**.	High	Very High	1) Study of methods to improve current conditions 2) Implementation of initiatives to improve existing on-site infrastructure 3) Monitoring and ensuring compliance with new sanitation requirements 4) Improving transportation and treatment infrastructure 5) Formalisation of sewage infrastructure across the city	1) 3 - 6 months 2) 5 years 3) 5 > years* currently ongoing 4) 3 - 5 years* currently ongoing 5) 10 > years* currently ongoing	NWSDS, NAWAPO, WSDP III, TanWIP, and DMDP	MoW, NEMC, DAWASA, City Council, Municipal Councils, and Private Sector
	Groundwater Recharge Zones	Similarly to Groundwater Protection Zones, recharge zones are areas of high importance. They are a major source of water to aquifers and if there are activities that alter recharge or quality of groundwater in these source areas, recipients downstream are affected. The delineation and protection of these zones are crucial	Addresses the risk of aquifer contamination, over-abstraction and improves the coping capacity of users and the resource. •**Over-abstraction** •**Aquifer contamination** •**Coping capacity.**	High	Medium	1) Build GIS capacity 2) Map and delineate areas of high recharge 3) Gazette protection measures as part of national or local law	1) 1 year 2) 2 years 3) 1 years	NWSDS, NAWAPO, WSDP III, , and DMDP	MoW, WRBWB, NEMC

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
Improved Data Acquisition and Monitoring	Establishment of Monitoring Networks for Groundwater and Surface Water	Effective management and governance requires data, without sufficient data, decisions can be based on unrepresentative conditions. This can often be counterproductive and lead to unintended impacts.	Strengthens GW management through improved data coverage and helps manage against the risk of over-abstraction and aquifer contamination. • **GW management;** • **Over-abstraction;** • **Aquifer contamination.**	High	Medium	1) Review existing monitoring networks 2) Design of an integrated monitoring network (Groundwater + Surface water, institutional cooperation) 3) Establish additional monitoring sites 4) Ongoing monitoring	1) 6 months 2) 1 year 3) 1 - 3 years 4) ongoing	NWSDS, WSDP III and NAWAPO	MoW, WRBWB, DAWASA, University Institutions, Private Sector and Community-Based Organisations (CBOs)
	Development and Implementation of the Citizen Science Water Programme	Citizen Science improves monitoring capacity, spatial distribution and awareness around GW. Given that institutional capacity is stretched thin, this initiative could address multiple action plans.	Strengthens GW management through improved data coverage and helps manage against the risk of over-abstraction and aquifer contamination. It improves user and municipal coping capacity. • **GW management;** • **Over-abstraction;** • **Aquifer contamination.** • **Coping capacity**	Medium	Medium	1) Awareness campaign on groundwater and groundwater monitoring requirements 2) Development and implementation of a training programme 3) Development of a tool for data capturing and visualisation 4) Supply of monitoring kits 5) Roll out of programme	1) 6 months 2) 1 - 2 years 3) 1 - 2 years 4) 6 months 5) 1 - 2 years	NWSDS, WSDP III and NAWAPO	WRBWB, City Council, Municipal Councils, University Institutions, and CBOs.
	Improved Baseline Hydrogeological and Environmental Data	Baseline hydrogeological and environmental data form the foundation for effective and sustainable groundwater management.	Strengthens GW management and addresses risk to reduced recharge, over-abstraction, aquifer contamination, salinisation and improves user and municipal coping capacity. • **GW management;** • **Reduced Recharge;** • **Over-abstraction;** • **Aquifer contamination;** • **Seawater intrusion;** • **Coping capacity.**	High	medium	1) Field campaign to collect baseline data 2) Assessment of baseline data	1) 1 - 2 hydrological years 2) 1 year *after baseline data has been collected	NWSDS, WSDP III and NAWAPO	MoW, NEMC, WRBWB, DAWASA, University Institutions, and Private Sector

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
	Improved Hydrological, Hydrogeological and Ecological Monitoring	Limited hydrological and hydrogeological monitoring hinders effective management of these resources.	Strengthens GW management and addresses risk to reduced recharge, over-abstraction, aquifer contamination, salinisation and improves user and municipal coping capacity. • **GW management;** • **Reduced Recharge;** • **Over-abstraction;** • **Aquifer contamination;** • **Seawater intrusion;** • **Coping capacity.**	High	medium	1) Establishment of a sufficient monitoring network 2) Ongoing monitoring after a sufficient monitoring network has been achieved.	1) 1 - 3 years 2) Ongoing	NWSDS, WSDP III and NAWAPO	WRBWB, City Council, Municipal Councils, University Institutions, and CBOs
	Data Storage	Currently, data is often fragmented across different institutions and is often in incompatible formats.	Strengthens GW management and improves user and municipal coping capacity. • **GW management;** • **Coping capacity.**	High	Low	1) Development of a centralised system 2) Development of a standard format 3) Integration of various existing institutional databases 4) Ensuring accessibility through a database dashboard	1) Currently ongoing 2) 3 months 3) 6 months 4) 1 year	NWSDS, WSDP III and NAWAPO	WRBWB, University institutions, Private Sector, and CBOs
	Mandating Drilling Companies to submit data	Educates groundwater users, raises awareness and supports compliance by requiring submissions of basic well information and groundwater	Strengthens GW management and improves both user and resource coping capacity. It also addresses over-abstraction and aquifer contamination • **GW management;** • **Coping capacity,** • **Over-abstraction,** • **Aquifer contamination.**	High	Low	1) Development of a standard format 2) Development of an online submission system 3) Gazetting the requirements for drillers 4) Engagement with drillers to specify gazetted requirements	1) 3 months 2) 1 year 3) 6 months 4) 3 months	NWSDS, WSDP III,, and NAWAPO	WRBWB

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
Education and Outreach	Public Groundwater Training and Education Campaigns	Equips GW users with the awareness needed to facilitate the effective protection and management of GW.	Addresses risk of over-abstraction and aquifer contamination, and improves coping capacity. • **Over-abstraction**; • **Aquifer contamination**; • **Coping capacity.**	High	Medium	1) Identification of groups to be targeted for training including users in informal settlements and relevant municipal staff 2) Development of modules/packages for groundwater training relevant for targeted groups 3) Launching and rollout of the campaign	1) 1 year 2) 2 years 3) 3 - 5 years	NAWAPO, NWSDS and NWDP	WRBWB and Municipal councils
	The Rollout of School Water Clubs and Youth Ambassador Programmes	Educating the youth and promoting awareness on GW instils responsibility and promotes sustainable use.	Addresses risk of over-abstraction and aquifer contamination, and improves coping capacity. • **Over-abstraction**; • **Aquifer contamination**; • **Coping capacity.**	Medium	Medium	1) Development of criteria and nomination of schools to formulate clubs aimed to elevate public perception, knowledge and education on groundwater management 2) Preparation of relevant education and promotional content to engage clubs 3) Development of website and communication through social media, factsheets and newsletters 4) Preparation of annual awards program and certification	1) 6 months 2) 1 year 3) 1 - 2 years 4) 6 months	NAWAPO, NWSDS and NWDP	WRBWB and Municipal councils
	Seasonal Risk Alerts (Floods, Droughts, Heatwaves)	Early warning communications on floods, heatwaves and storms are already established, however can be expanded upon. This is focused on awareness to potential hazards.	Improves the coping capacity of users and communities. • **Coping capacity**.	High	Medium	1) Dissemination to key actors/ the public of a citywide early warning and seasonal risk alert system and preparedness 2) Prepare drought allocation rules for rivers like Ruvu in dry periods	1) 1 year 2) 1 - 2 years	NDMP and NDMS	WRBWB, Municipal councils, Disaster Management Department (DMD) of the PMOs
	Household-level sanitation and well safety education	Reduces groundwater contamination and improves knowledge needed to safely manage sanitation and domestic wells.	Addresses the risk of aquifer contamination. • **Aquifer contamination**.	High	High	1) Development of sanitation and well safety education materials 2) Implementation in high-density informal settlements (e.g Manzese, Tandale, Vinguguti).	1) 1 - 2 years 2) 3 - 5 years	NAWAPO, NWSDS and NWDP	WRBWB, Municipal councils, and Relevant NGOS

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
	Community progress reports	Important for providing regular information to local communities about the state of water resources and infrastructure progress and ongoing projects.	Improves coping capacity. • **Coping capacity**.	Medium	Low	1) Development of report formatting and what should be regularly communicated to the public. 2) Implementation of regular reporting	1) 1 - 2 years 2) 1 year	NAWAPO, NWSDS and NWDP	WRBWB and DAWASA
	Promoting citizen science	Strengthens groundwater governance by engaging communities in monitoring and protecting water resources and empowering them to become groundwater ambassadors.	Addresses the risk of aquifer contamination and over-abstraction • **Over-abstraction**; • **Aquifer contamination.**	Medium	Medium	1) Development and implementation of actions to engage communities in ground water management interventions	1) 1 - 3 years	NAWAPO, NWSDS and NWDP	WRBWB, MUNICIPAL Councils, and NGO
	Educational workshops in protection zones	Improves awareness and capacity to prevent contamination in sensitive areas.	Improves coping capacity. • **Coping capacity**.	Medium	Medium	1) Identification of priority GPZ 2) Implement workshops on contamination risks to all groups 3) Disseminate information to the public on maintaining and conserving water resources and the environment	1) 1 year 2) 3 - 5 years 3) 1 - 2 years	WSDP III, TanWIP, and DMDP	WRBWB, MUNICIPAL Councils, NGOs, and NEMC
	Gender and social inclusion	Ensures that different groups of people (women and marginalised social groups) are included in groundwater management.	Strengthens GW management and improves user coping capacity. • **GW management**; • **Coping capacity**.	Medium	Medium	1) Conduct a holistic gender and social inclusion analysis to facilitate representation and participation of different groups in conjunctive water management	1) 1 - 5 years	NAWAPO and NWSDS	WRBWB, MUNICIPAL Councils, and NGOs

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
Water Security Planning	Integration of Recharge-Enhancing Initiatives	Sustain groundwater levels, improve the urban water balance and build resilience to climate change.	Strengthens GW management and addresses risk to reduced recharge and over-abstraction. It also improves user and municipal coping capacity. • **GW management**; • **Reduced recharge**; • **Over-abstraction**; • **Coping capacity**.	Medium	High	1) feasibility study 2) Identify pilot areas and test suitable methods 3) Development of guidelines and by-laws 4) Development of an implementation programme 5) Roll out of initiatives	1) 1 - 2 years 2) 2 - 5 years 3) 1 year* after point 2 4) 1 year 5) 5 - 10 years	WSDP III, TanWIP, DMDP, NWSDS and NAWAPO	WRBWB, NEMC, DAWASA, Educational Institutions, and Private Sector
	Diversification of Water Resources	Impacts of climate change and over-exploitation on aquifer and rivers create a need for diversification.	Strengthens GW management and addresses risk to reduced recharge, over-abstraction and salinisation. It also improves user and municipal coping capacity. • **GW management**; • **Reduced recharge**; • **Over-abstraction**; • **Salinisation**; • **Coping capacity**.	High	High	1) Advancing the Kimbiji/Mpera wellfields 2) Feasibility and potential development of a MAR scheme 3) Commissioning of the Kidunda Dam.	1) 2 - 5 years 2) 7 - 10 years 3) Currently ongoing*	WSDP, TanWIP, NWSDS and NAWAPO	MoW, Ministry of Finance and Planning (MOF), Water Resources Integration Development Initiative (WARIDI), NEMC, DAWASA, WRBWB, City Council, University institutions and Private sector
	Incorporation of Urban Groundwater Modelling	Supports sustainable GW management and provides opportunities to manage against impacts of climate change.	Strengthens GW management and addresses the risk of reduced recharge, over-abstraction, aquifer contamination and seawater intrusion. It also improves municipal and user coping capacity. • **GW management**; • **Reduced recharge**; • **Over-abstraction**; • **Aquifer contamination**; • **Seawater intrusion**; • **Coping capacity**.	High	Low	1) Improving data collection and spatial coverage 2) Review and assemble existing data 3) Develop a urban groundwater modelling framework 4) Incorporate into disaster preparedness and groundwater management	1) 1 - 3 years * once a sufficient monitoring network has been established 2) 6 months 3) 6 - 12 months 4) 1 year	WSDP III and TanWIP	MoW, WRBWB, DAWASA, University institutions, and Private sector.

Category	Action Plan	Rational	Addresses	Priority	Budget	Task List	Timeline	Alignment	Implementing organisations
	Improved City Planning	Safeguards groundwater resources and builds resilience to climate and urbanisation pressures	Strengthens GW management and addresses risk to aquifer contamination. It also improves municipal and user coping capacity. • **GW management**; • **Aquifer contamination**; • **Coping capacity**.	Medium	Medium	1) Update and enforce planning regulations 2) Integrate Water Sensitive Urban Design into urban plans 3) Prioritise institutional cooperation and conjunctive management	1) 1 - 2 years 2) 1 - 2 years 3) 1 year	WSDP III, TanWIP, and DMDP	City Council, Municipal Councils, NEMC, DAWASA, and Private Sector
	Improved Sanitation Services and Infrastructure	Improving water security in Dar es Salaam requires strengthening sanitation services and infrastructure to reduce groundwater contamination risks and protect potable supply.	Addresses risk of aquifer contamination and improves user coping capacity. • **Aquifer contamination**; • **Coping capacity**.	High	Very High	1) Upgrade and maintain existing sewage distribution and wastewater/water treatment infrastructure. 2) Expansion of sewage infrastructure to reach the entire city.	1) 1 -15 years 2) 10 > years* currently ongoing, however this should run concurrently with the Improved Water Supply Access and Infrastructure action plan	TanWIP and DMDP	MoW, MoF, NEMC, DAWASA, City Council, and Municipal Councils
	Improved Water Supply Access and Infrastructure	It is estimated 70% of Dar es Salaams population live in informal settlements, where connections to the municipal network are limited or absent.	Addresses the risk of over-abstraction, seawater intrusion and improves user and municipal coping capacity. • **Over-abstraction**; • **Seawater intrusion**; • **Coping capacity**.	High	Very High	1) Upgrade and maintain existing reticulation and water treatment infrastructure. 2) Expansion of water supply infrastructure to reach the entire city.	1) 1 - 15 years 2) 10 > years* currently ongoing, however, this should run concurrently with the Improved Sanitation Services and Infrastructure action plan	WSDP III, TanWIP, DMDP, and NWSDS	MoW, MoF, NEMC, WRBWB, DAWASA, City Council, and Municipal Councils

Address: 24 Meiring Naude Road,
Brummeria, Pretoria, 0184,
Pretoria, South Africa

Phone: +27 - 051 0419
Email: info@sadc-gmi.org
Website: www.sadc-gmi.org