



**Republic of Mauritius**

# **National Integrated Water Resources Management (IWRM) Plan**

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## Foreword

Water is essential for human health and wellbeing, the environment, as well as social and economic development. The availability of water in sufficient quantity and adequate quality is therefore central to achieving the country's economic, social and environmental objectives. Mauritius is faced with steadily growing demand for water, while at the same time the impact of climate change on water resources is beginning to be felt and expected to exacerbate in the future. Overall Climate change models predict an increase in heavy rainfall events in the wet season coupled with extended dry seasons with further reduced rainfall, compared to current levels. This highlights the need for innovative storage solutions combined with water conservation and efficient management of water resources.

In collaboration with UNOPS and UNEP, a regional Integrated Water Resources Management (IWRM) in Mauritius and five other islands since 2015. Under this project, we endeavour to promote the coordinated development and cross sectoral management of water, land and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

The project has been very beneficial to us in terms of assessing the quality of water in the northern aquifer, developing investigation methods and a GIS system to monitor the aquifer and creating awareness among water users, farmers, industrial operators, young people and the community on the need to protect the water resources.

In the context of the project, a IWRM Plan has been developed after consultations with relevant stakeholders, identifies a range of priority interventions that are required to implement IWRM and address identified challenges facing water management in the country. It will enable a holistic approach to water resources management and facilitate concerted actions among the key institutions and stakeholders.

In recognising the linkages between freshwater and the oceans and coastal zones, land, biodiversity and other resources, and integrating their management, the IWRM Plan contributes to achieving the social, economic and environmental development objectives of the country and contributes to meeting the country's water management challenges of the future.

*Hon Ivan Collendavelloo, GCSK, SC*  
Deputy Prime Minister, Minister of Energy and Public Utilities

## Acknowledgements

This National IWRM Plan was developed under the auspices of the Ministry of Energy and Public Utilities (MEPU) with numerous technical inputs and guidance from a wide range of stakeholders representing government, NGOs and CSOs, and the private sector. The process of stakeholder consultations and drafting of the document text was led by a team of consultants from the Stockholm International Water Institute (SIWI), led by Daniel Malzbender. Ms. N. Nababsing, Senior Chief Executive of MEPU was responsible for overall coordination and technical guidance.

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## Part 1: Background to the IWRM Plan

### 1. Water management in Mauritius - overview

#### 1.1 Water sources and climate projections

Mauritius has currently overall adequate rainfall but faces occasional seasonal water scarcity and water shortage. The availability of water resources in Mauritius, both surface water sources and groundwater, is governed by rainfall. The 2016 water balance of Mauritius has been calculated as follows (in Mm<sup>3</sup>/year)<sup>1</sup>.

	'Input'	'Output'		
	Rainfall	Surface runoff	Net recharge to groundwater	Evapo-transpiration
Island of Mauritius	3,536	2,122	353	1,061
Water balance	100%	60%	10%	30%

The average annual rainfall of Mauritius is about 2010 mm, with February being the wettest month and November being the driest. According to Mauritius Meteorological Services<sup>2</sup>, there has been an increase in average annual temperatures (1°C over the past 60 years), a decreasing trend in the rainfall over Mauritius over the past century, an increase in the number of consecutive dry days and a decrease in the number of rainy days. Future climate projections for the southern Indian Ocean region indicate further temperature increase; sea level rise; decreasing trend of annual rainfall; increase in heavy precipitation events and number of intense tropical cyclones; increase in the duration of dry spells; and increase in the events of tidal surges.

Mauritius hosts a dense network of river systems consisting of 25 major catchment areas and 21 minor river basins. These include 350 river-run off takes, three major river abstractions and six major impounding reservoirs. There are a number of dams and reservoirs on the river systems to provide supply when the shortage of water in the dry season is becoming worse.

There are also five main aquifers in Mauritius that are harnessed to cater for water demand through 520 boreholes. The potential for further groundwater exploitation is however becoming limited.

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<sup>1</sup> Energy and Water Statistics – 2016. Statistics Mauritius.

[http://statsmauritius.govmu.org/English/Publications/Documents/EI1317/Energy\\_Water\\_Stats\\_Yr2016.pdf](http://statsmauritius.govmu.org/English/Publications/Documents/EI1317/Energy_Water_Stats_Yr2016.pdf)

<sup>2</sup> <http://metservice.intnet.mu/climate-services/climate-change.php>

Some coastal hotels and tourist resorts use desalination facilities as per prevailing regulations, but for most users desalination is presently not a financially viable option.

Reuse of wastewater for irrigation has been recommended as part of a Master Plan for the development of water resources (2025-2050). In the hotel industry, the re-use of treated wastewater for garden irrigation is increasingly practiced since it commonly forms part of EIA recommendations. Otherwise, the re-use of treated wastewater is not yet widely practiced, mainly due to the high costs of treated wastewater and issues around the cultural acceptance of treated wastewater re-use in food crop irrigation.

## 1.2 Water uses

The agricultural sector is the dominant water user, but is currently facing increasing competition from domestic, tourism and industrial sectors where water demands have continuously increased over the past years. Historically, sugar cane cultivation has been the main agricultural activity in Mauritius, but efforts are being made to diversify the agricultural sector.

About 99.7% of the population has access to piped water supply and the annual volume of potable water treated is 230 million m<sup>3</sup>, of which surface water represents 44% and groundwater 56%.

Hydropower was the first type of electricity produced in Mauritius and still contributes about 4.0% of the total energy share. The hydropower potential in Mauritius has almost reached its limits and plans for future expansion concern primarily development of mini- and micro-hydro plants and enhancement of the existing dams' capacities. Presently, most of the electricity requirements are met from thermal power stations. The by-product from the sugar factories (bagasse), whose production is dependent upon irrigation water, is also used to supply electricity to the national grid during the sugar crop season.

## 1.3 Water management governance framework

Several pieces of legislation govern how the nation's water resources are protected, used, developed, managed and controlled:

- Central Water Authority Act (1971)
- Environment Protection Act (2002)
- Ground Water Act (1970)
- Irrigation Authority Act (1978)
- Planning and Development Act (2004)
- Public Health Act (1925)
- Rivers and Canals Act (1863)
- Waste Water Management Authority Act (2000)
- The Local Government Act (2011)
  
- Forest and Reserves Act (1983)
  
- Fisheries and Marine Resources Act (2007)

- National Disaster Risk Reduction and Management Act (2016)

As a result, the legal landscape governing water resources management in Mauritius is currently highly fragmented. A new comprehensive National Water Act consolidating legal rules governing water resources management is currently under development under the auspices of the Ministry of Energy and Public Utilities.

Mauritius has developed (2014) a National Water Policy consistent with IWRM principles, which needs to be supported by an appropriate legal framework. A Master Plan for Development of Water Resources in Mauritius was developed in parallel with the National Water Policy. It deals with four key thematic areas, i.e. analysis of water demand and water availability; water mobilization options and investment plan; legal analysis and water rights reform programme; and institutional set-up and capacity building.

Institutionally, the water sector is well served with modern agencies for sub-sectoral activities such as water supply, wastewater management and irrigation, as well as a dedicated Water Resources Unit.

#### *Water resources management*

The Ministry of Energy and Public Utilities (MEPU) is the parent body for the management of water resources in Mauritius. The Water Resources Unit (WRU), as the executive agency, is responsible for the assessment, management, development and conservation of water resources. There are three subsidiary bodies (in the form of government owned parastatals) for managing the available water:

- Central Water Authority (CWA), responsible for potable water distribution, and to some degree the management of water supply infrastructure
- Irrigation Authority (IA), under Ministry of Agro-Industry and Food Security, is responsible for government supported irrigation schemes
- Wastewater Management Authority (WMA), responsible for managing wastewater in sewerred areas.

#### *Environmental protection and water quality monitoring*

The country has a comprehensive Environment Protection Act (EPA) that provides the legal framework for environmental protection throughout the country. The primary responsibility for environmental management in Mauritius rests with the Ministry of Social Security, National Solidarity, Environment and Sustainable Development (MoE). The Local Authorities act as Enforcing Agencies in their respective jurisdictions. MoE also hosts a division responsible for environmental safeguards during implementation of projects, a Pollution Prevention and Control Division and an Industrial Waste Audit Committee. The MoE also chairs an Environmental Impact Assessment (EIA) / Preliminary Environmental Report (PER) Monitoring committee which is responsible for overseeing proper implementation of projects licensed by the Ministry. The WRU is responsible for collecting data and ensuring appropriate measures are taken for the prevention of pollution of water resources, while CWA is responsible for the treatment of potable water for domestic, commercial and industrial usage.

As the scientific arm of the Ministry of Social Security, National Solidarity, Environment and Sustainable Development, the National Environmental Laboratory (NEL) monitors environmental quality to ensure compliance with prescribed environmental standards. The Ministry of Health and Quality of Life also undertakes independent spot-checks of drinking water quality, thereby fulfilling a watch-dog function.

### *Hydroelectricity*

Mauritius' nine hydroelectric plants are managed by the Central Electricity Board. They account for approximately 4 percent of the island's total effective capacity depending on the season.

### *Integrated Water Resources Management (IWRM)*

A Water Resources Monitoring Committee is in existence with members from relevant sectors and meets to discuss relevant strategies with regards to drought management, water conservation and other associated issues. This inter-agency mechanism is primarily concerned currently with sustainable resource allocation and meet on an ad hoc basis, primarily during the dry season.

In addition, a national IWRM Steering Committee has been set up as part of the oversight arrangements required to advise the UNDP/UNEP IWRM programme. It includes the following stakeholders:

- Ministry of Energy and Public Utilities.
- Wastewater Management Authority
- Central Water Authority
- Water Resources Unit
- Mauritius Meteorological Station
- Ministry of Social Security, National Solidarity, Environment and Sustainable Development.
- Ministry of Finance & and Economic Development

The Secretariat support to the IWRM Steering Committee was provided through the UNDP/UNEP programme funded staff but to ensure long-term sustainability and coordinated implementation of an IWRM plan, such support would probably need to be institutionalized, perhaps within the Water Resources Monitoring Committee.

## 2. Priority water management challenges in Mauritius

The management of water resources in Mauritius needs to be able to respond to developments in relation to the already occasional water shortages during dry season, the potential impacts of changes in rainfall patterns due to climate change, the need to reduce the reliance on imported fossil fuels and the increasing and competing demands for water due to increasing population and demands for economic growth through the promotion of

tourism, agriculture and expansion of the industrial sector. The following describes the key challenges for water management in the country.

### 2.1 Integrated catchment management

IWRM is rooted on the understanding that water is best managed using hydrologically defined catchments as the management unit. The thinking is that this allows best for the balancing of supply and demand (from within and outside the management unit) as well as the engagement with local stakeholders. Importantly, these IWRM zones also consider the land area of the catchment and the need for managing land and water resources in an integrated manner. In Mauritius, water is currently managed based on water supply zones. These differ from water management areas (also called IWRM zones) in the sense that they are not primarily hydrologically defined and only cover a small and public area of the island and are delinked from the actual geographical disposition of the water resources and the major uses. Given the relatively high number of hydrologically defined catchments, some the size of only a few square kilometers, not each catchment in Mauritius can be designated a stand-alone water management zone. However, the delineation and establishment of water management areas that cover the entire land area of catchments and allow for better integrated management of water and land should be considered.

Over half of Mauritius' potable water supply is from abstracted groundwater. The sustainable management and protection of groundwater aquifers is therefore important to ensuring safe and sustainable water supply for the country. While aquifers are actively managed by the WRU and CWA, there is a need to close some knowledge gaps. Moreover, currently aquifers are not managed based on tailored aquifer management plans and this is viewed as a gap in the management framework. The UNDP/ GEF Grand Baie aquifer management project has successfully contributed to closing knowledge gaps (i.e. through the setting of GIS systems, data collection, establishment of groundwater monitoring networks, yield assessment, pollution risk assessment etc.) and there is consensus that these or similar interventions need to be carried out for the other four main aquifers in the country.

### 2.2 Water resources management/ development, water use efficiency and water demand management

The demand for water is projected to continue to increase in Mauritius and climate projections indicate reduced rainfall. The Master Plan for Water Resources identified the need to ensure an additional 224 Mm<sup>3</sup> of water mobilization capacity by 2050 to be able to increase the present water use from 500 Mm<sup>3</sup>/year to 724 Mm<sup>3</sup>/year. To meet this objective, some challenges related to how water is currently managed need to be addressed, coupled with efforts to increase the amount of available water resources. The main challenges in this regard are of a regulatory and financial nature, with technical aspects playing a comparatively minor role.

At present, there is no comprehensive water use authorization (licensing) system for surface water in Mauritius. A groundwater licensing system does exist, but water management practitioners are of the view that it needs to be revised and updated. Likewise, there are no

water allocation guidelines (for in-stream needs, off-stream withdrawal, and groundwater abstraction), neither a raw water pricing framework that ensures water charges are levied in accordance with the economic value of water. Consequently, a clear picture of overall water use, and specifically of the type of economic activities it is used for, does not exist. Meanwhile, there is ongoing conversion of agricultural land to other commercial uses (housing developments, shopping malls etc.) and with it a shift in the use of water from the agricultural to other sectors. As a result, there is no allocation regime that allows for a strategic use of available water resources in a way that best fits the economic and social needs of the country and ensures the best economic and social returns for the country. Moreover, the absence of a raw water pricing system for surface water deprives water management authorities of an important source of revenue to finance necessary water management activities.

Water use efficiency in Mauritius leaves room for improvement, both in terms of household consumption and in commercial use. One contributing factor is the high amount of non-revenue water, which is largely caused by an aged and leaking pipe networks (see further detail on section 2.7). Moreover, the adoption of water saving technology (water saving equipment) in businesses and households is underdeveloped and needs to be promoted through awareness-raising, incentives and regulatory measures. Water use efficiency in the irrigation sector has improved in recent years, but inefficient irrigation technology is still in use, leaving room for efficiency improvement in that sector (which is the sector with the highest water consumption in the country). Further improvements in irrigation efficiency would require significant capital investments in irrigation equipment. Other segments of agricultural water management, such as the livestock and food processing industries, also leave room for water efficiency improvements.

Water demand management and the development of alternative sources of water supply is limited. A clear policy on the promotion of alternative water sources (rainwater harvesting, wastewater re-use, desalination, managed aquifer recharge) is yet to emerge and thus the potential of these alternative resources remains largely untapped.

Ensuring financial sustainability for water resources management and development remains an overarching challenge. The financial sustainability of the utilities (CWA, WMA) through tariff revenue is discussed under section 2.7. Water management operations of the WRU and MEPU are financed by tax revenue from the government budget. The same applies to major infrastructure developments. There is a need to broaden the financial sources for financing water management in the country and the introduction of a raw water pricing system proposed above would be an important contributor to that.

### 2.3 Water quality and environmental sustainability

Water quality concerns include contamination of ground- and surface waters, localized eutrophication and damage to corals. As an example, submarine groundwater discharge has been reported to be a source of nitrate in coastal lagoons. Furthermore, coastal aquifers are subject to increasing risks of seawater intrusion due to a combination of increased groundwater abstraction and climate-induced sea-level rise.

The main sources of water pollution are untreated or poorly treated industrial waste disposed into streams and rivers, intensifying use of fertilizers and pesticides, and contamination of water resources by domestic sewage. Only about 26% of the population (in the urban areas) is connected to the four main sewer networks (Port Louis, Grand Baie, Baie Du Tombeau and Upper & Lower Plaine Willems). Although the remaining 74% of the population are currently not connected to the public sewer, their on-site disposal system is governed by the Planning Policy Guidance 2004. About 6 Mm<sup>3</sup> of industrial wastewater is produced annually from sugar production, textile, breweries, food processing, leather tanning and galvanizing, only part of which being directed to sewerage treatment plants. Desalination is sometimes used by coastal hotels and tourist resorts and the brine is often injected into existing boreholes, which may affect the aquifer in question.

Apart from addressing the limited connection to sewerage, key issues that needs consideration to strengthen the capacity for water quality management in Mauritius include the limited enforcement capacity in local authorities and the lack of access by all responsible authorities to water quality data since there is no adequate central water quality database. The water quality enforcement institutional framework requires streamlining. Presently, CWA has the primary responsibility for drinking water quality monitoring. In addition, the Ministry of Health functions as an independent watchdog and takes their own samples. The MEPU is responsible for enforcing inland water quality (groundwater and surface water) and counter pollution, but has at present no enforcement unit to do it. There is some duplication of monitoring activities between the CWA and Ministry of Environment for raw water and effluent discharge. The applicable standards for surface water and effluent quality require update and strengthening. There is also a need to establish guidelines for groundwater quality.

There are increasing incidents of freshwater/ coastal zone/ marine interaction with detrimental environmental effects (sediment discharge on corals; saltwater intrusion into groundwater). These interactions need to be better understood, high risk areas identified and appropriate responses developed and implemented.

#### 2.4 Security from water related disasters

Climate projections indicate increasing risks for water-related disasters in coming decades both in terms of flooding and extended dry periods (increasing high precipitation events, increasing events of tidal surges, increasing number of intense tropical cyclones and increasing duration of dry spells). It is therefore important that Mauritius has sufficient disaster prevention and mitigation capacity to deal with these challenges. To some degree, the needed interventions highlighted in Section 2.2 above (water demand management, alternative water sources, improved management) are already a response to challenges related to extended dry periods. More specific responses need to be developed for actual disaster events. Overall, the capacity for disaster prediction, early warning and disaster response needs to be strengthened, especially with respect to outreach to community level.

In this regard, some institutional streamlining, capacity strengthening and awareness raising is required.

### 2.5 Water resources information management

Fundamental to water management is the need for a reliable, accurate and accessible base of information. Mauritius generates a fair amount of relevant data, but lacks a cohesive central water sector database in which the data is stored and accessible to all relevant authorities. This for example leads to the avoidable duplication of some water quality monitoring activities carried out by several entities (see section 2.3).

There are some gaps in the data generated, for example there is a limited level of knowledge of the surface water resources and their current use, largely due to the absence of an abstraction registration and water use allocation system. Moreover, some sectoral data and information is missing to allow a proper water demand management.

The Water Resources Unit (WRU), which is the agency responsible for water resources monitoring, has the basic skills and equipment but there is a need to upgrade and modernize the infrastructure and equipment and the capacity of the staff to keep pace with new development in the water sector. Likewise, modern computer-based tools are urgently required, together with the training in their use. Significant improvements in water information management are needed, in terms of technical infrastructure for data management, data management procedures, and human resources capacity in data management and application for decision-making. Overall, a general increase in the number of staff is desirable.

### 2.6 Stakeholder participation, capacity building and water education

The involvement of stakeholders in water management is a central pillar of IWRM. In Mauritius stakeholder participation takes place largely in the form of inter-sectoral coordination between different government entities, albeit on an ad hoc basis (e.g. the Water Resources Monitoring Committee). The engagement with non-government stakeholders is not sufficiently legislated and stakeholder consultation and decision-making structures are limited as far as non-government stakeholders are concerned. With water being managed on a CWA supply zone basis and not based on hydrologically defined Water Management Areas, there are no operational management-area based local stakeholder structures.

Mauritius has generally good human capacity for water management, but gaps exist with respect to human resources capacity, both in certain skills areas and in personnel numbers. These are exacerbated by systemic shortcomings, such as the absence of a central water resources information system (see Section 2.5) and inadequate enforcement capacity in several areas. It is therefore critical that key capacity gaps are identified in a systematic manner and addressed through a coherent and well-coordinated capacity building plan. Part of this needs to be a staff retention strategy to counter the loss of skilled personnel after they have received training.

## 2.7 Water and sanitation services provision

Access to piped potable water supply is nearly 100% in Mauritius. Challenges in this area concern primarily the needs for network refurbishment and maintenance to reduce the currently very high rate of leakage.

The sewage network is far less developed with only 26% of the population connected. The sewage Master Plan provides a clear framework for network expansion. This is being implemented under the auspices of the WMA, but financial constraints for the large-scale capital investments required for network expansion make it doubtful that the Master Plan targets can be achieved in time.

At present the operating expenses of the CWA and WMA are financed through consumer tariffs, with the bulk of revenue generated from industrial clients (despite these only consuming a relatively small amount of the total distributed) due to the higher industrial tariffs. The current tariffs do not cover capital expenditure for the network repair (water supply) and expansion (wastewater). At present capital projects are funded by government through grants, or more recently, loans from the Public-Sector Investment Programme. However, servicing the loans poses a significant challenge for the parastatal companies given the currently relatively low tariffs. Therefore, from 2018 onwards the parastatals will no longer be required to take out loans and instead Government will provide equity participation. Water tariffs in Mauritius are low in international comparison, and a review and potential upward adjustment of tariffs (while considering social concerns) would have the dual effect of improving the CWA's and WMA's revenue stream (thus allowing further investments in infrastructure) and a potential of providing an incentive to curbing the high per capita household demand in the country.

## 2.8 National water resources governance

The 2012 Water Master Plan identifies reforms to the legal and institutional architecture as critical for improved, IWRM based, water management in the country. This notion is then carried forward in the National Water Policy which calls for a reform of the legal and institutional frameworks for water management.

Some of the key challenges concern the fragmented and partially outdated legal/regulatory framework, which is from the pre-IWRM era and thus not well suited to IWRM. The development of a new National Water Act is ongoing, providing the legal framework for water management going forward.

Another challenge is the limited inter-sectoral coordination at the national level, which has resulted in negative impacts on water resources development in the past. There is currently no formal fully multi-sectoral Apex body for IWRM. The existing Water Resources Monitoring Committee has a limited scope and meets only on an ad hoc basis. The establishment of a national, inter-sectoral IWRM coordination mechanisms with a broader mandate of overseeing IWRM implementation and which meets and assesses progress regularly is needed. Such mechanism needs to be aligned with the needed stakeholder engagement structures discussed in section 2.6.

### 3. Purpose and Objectives of the IWRM Plan

The overall purpose of the IWRM Plan is to mainstream IWRM principles into water resources management in Mauritius. Guided by the National Water Policy, the IWRM Plan provides an implementation framework for priority interventions required to address current challenges facing the Mauritius water sector.

Specifically, the objectives of the IWRM Plan are:

1. To develop, protect and manage the country's water resources for the economic and social benefits of all on an equitable and sustainable basis;
2. To ensure the availability of water to all sectors of the economy;
3. To promote water efficiency at all levels;
4. To maintain high levels of financial and technical performance of water supply services by applying modern management practices;
5. To develop an appropriate legal, regulatory and institutional framework for the optimal integrated management of the country's water resources;
6. To heighten awareness and understanding of the value and benefits of integrated water resources management; and
7. To provide a training/ skills development programme in IWRM to technical staff
8. To mobilize resources and partners, including the private sector, for implementation of specific projects to address the identified water management challenges.

### 4. IWRM Plan development process

This IWRM Plan was developed under the auspices of the MEPU and guided by the principles and policies of the National Water Policy. The drafting of the plan was carried out collaboratively by a team of international consultants and MEPU, with numerous contributions and inputs from a broad range of stakeholders obtained through a consultative process involving individual and small-group interviews/ consultations with many sector role-players, as well a broad-based national consultation workshop.

### 5. IWRM Plan implementation, coordination and monitoring

The lead agency for the implementation of this IWRM Plan is MEPU, who oversee overall coordination, implementation of the identified priority interventions as well as of monitoring plan implementation. At the same time, it is recognized that the successful implementation of the Plan requires a consolidated and well-coordinated effort from a wide range of role-players both within and outside government. To this end the Plan itself proposes (in priority area 8 on water resources governance) some interventions for the establishment of appropriate coordination and implementation mechanisms.

The interventions proposed in this Plan are for a 5-year time frame, i.e. they should be started latest within 5 years from adoption of the plan, not necessarily all completed as some interventions take a long-term outlook. It is proposed that when the plan enters its 5<sup>th</sup> year following initial adoption, a review of the plan is carried out through a consultative process, through which the priority interventions for the next 5-year cycle are determined.

Of the targets described in the priority areas in Part II of this Plan, seven have been identified as the most urgent high priority targets (i.e. targets 2.4, 3.1, 3.4, 6.1, 6.2, 7.4, 8.1).

## Part 2: Priority areas of action

This part of the IWRM Plan provides an overview of priority areas of action that have been identified for Mauritius with respect to water management. The priority areas of action are grouped into the eight thematic themes in which the key water management challenges are described in Part 1, Section 2. The interventions presented in this part are in direct response to the key challenges identified through the stakeholder consultations and which are described in Part 1, Section 2. Targets have been agreed for each thematic priority area and a set of interventions required to achieve the targets has been identified. The agreed targets and required interventions are subsequently summarized in the action programme in Part 3, where further detail on proposed lead agencies, complementing ongoing initiatives as well as monitoring indicators are presented.

### 1. Integrated catchment management

#### *Target 1.1: Feasibility of establishment of Water Management Areas based on hydrological zones determined*

To respond to the increasing water demands from different sectors, adjoining pressures on water quality and projected decreased annual rainfall there is a need to strengthen the capacity for integrated catchment management and inter-sectoral coordination. There is a need to assess whether this is most effectively done in the Mauritius context within the current water supply zones, or if the establishment of new Water Management Areas based on hydrologic zones would bring additional benefits.

The following interventions are logical next steps if the study would conclude that new Water Management Areas should be established and would only apply in that instance.

Following the recommendation of the study to establish Water Management Areas, these areas would be geographically determined and established by law (or regulation). Thereafter integrated catchment management plans with the participation of all key sectors and stakeholders will be developed for each Water Management Area. Such plans will be based upon an analysis of development priorities, available water resources, environmental state and vulnerabilities of land, water, delta, coastal and marine resources, potential impacts of planned activities and agreed management response within the designated Water Management Area.

#### *Target 1.2: Groundwater effectively protected and sustainably utilized in all aquifers*

The UNDP/ GEF Grand Baie aquifer management demonstration project is widely considered within government as a successful and useful project and there is a keen interest to roll out similar interventions for the other four main aquifers in the country to increase the knowledge of the aquifers and improve their management. This includes a detailed assessment of the aquifers (i.e. setting of GIS systems, data collection, establishment of groundwater monitoring networks, yield assessment, pollution risk assessment etc.). Studies

need to be carried out to explore the technical feasibility of aquifer recharge (with rainwater and treated wastewater) and the social acceptance of recharge with treated wastewater. Comprehensively aquifer management plans need to be developed for each aquifer in accordance with determined safe-yield levels. Strengthened groundwater protection legislation/ regulations needs to be adopted and adequate enforcement capacity for groundwater protection established and maintained.

## 2. Water resources management/ development, water use efficiency and water demand management

### *Target 2.1: Water use authorization system and water allocation guidelines developed and implemented*

It is important that the water resources management authorities have a clear picture of the level of abstractions taking place, and that all abstractions happen within a framework of an abstraction authorization system. While such a system is fairly well developed for groundwater in Mauritius, little exists in terms of surface water abstraction. There is a need to carry out an audit of current water uses/ abstractions and to log these in a central water abstraction register for the authorities to have a clear picture of ongoing abstractions. The abstraction register needs to be combined with a water license database, in which abstraction licenses are registered. Such licenses can take various forms, from licenses for specific users to more general authorizations for types of uses in designated catchments. A full licensing system needs to be progressively developed, in combination with water allocation guidelines that define the framework for the license/ authorization system.

The proposed abstraction register/ license database forms a key component of the national water resources database that is proposed to be established (target 5.1). The registration and licensing of abstraction is also closely linked with the development of a new raw water pricing framework set out in target 2.2 below.

### *Target 2.2: Raw water pricing framework adopted*

At present, licensed water abstractions are charged with a mere nominal fee that does not reflect the value of that water to the economy. In accordance with the IWRM principles of treating water as an economic good, it is important that Mauritius progressively move to a system where the value of water is reflected in the charge levied for the use of it. In this context, it is important to have a good understanding where water is used in the economy, and what the economic returns are. A water use audit needs to be carried out to determine historic and current water use by sector as well as long-term sector demand predictions.

Using that sector specific water use information, different raw water pricing options need to be developed using economic modelling tools. These options need to be interrogated in a national stakeholder consultation effort to gauge the view of the various sectors. Following the consultations, a new raw water pricing framework needs to be adopted and progressively implemented.

### *Target 2.3: Businesses and households are water efficient*

Interventions to improve water efficiency in businesses and household are needed. The use of water saving devices and water storage facilities for businesses needs to be regulated. This should include regulations on criteria for water self-sufficiency for large businesses, especially in the tourism industry. Likewise, the progressive adoption of water saving devices in households needs to be ensured through a mix of regulatory and price measures as well as incentives. Regulatory measures in this regard could be import restrictions or high import duties on high water use devices, while water saving devices are waived from import duty or receive tax benefits. An effective measure for curbing high water use in the domestic sector is an increase in water tariffs, a measure which is proposed under target 7.3 and discussed in that section below.

### *Target 2.4: Water use efficiency in irrigated agriculture improved*

Agricultural irrigation remains the highest water user in the country, mainly for large-scale sugar cane farming. At the same time, there is demand for further irrigation expansion into currently rainfed areas by small-scale farmers planning to diversify from sugar to other crops. While considerable efforts have been made in recent years to improve water efficiency in irrigated agriculture, there is a need to further improve water use efficiency in the sector. Measures include the refurbishment of existing pipe systems, introduction of new water meters, as well as the adoption of new, more water efficient technologies. Since irrigation in Mauritius is predominantly private sector driven and will require private sector investments, moving towards increase water efficiency in the agriculture sector will require close cooperation between government and the private sector. The stakeholder engagement mechanism proposed to be established (target 6.1) will provide a useful platform for that engagement.

This target was identified as being of high priority
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### *Target 2.5: Water demand management strategy implemented*

There is a need for new sources of water supply to meet the projected ‘water supply gap’ of Mauritius. Such investments will be undertaken in parallel with the implementation of a targeted programme aimed at introducing a range of water conservation and demand management measures.

The water sector investment plan will have to be regularly updated to identify priority investments and financing options. It will be complemented by a water pricing framework based upon raw water pricing options developed using economic modeling tools.

Meanwhile, a water demand management strategy will be developed identifying and prioritizing measures for water conservation and demand management in terms of technical options e.g. water efficient technology, water-wise gardening and landscaping, re-use of grey water, waste recycling; awareness raising and behavioral change options e.g. the use of participatory approaches, educational/promotional activities, customer advice services; and efficiency and productivity improvements, e.g. measures to reduce non-revenue water.

*Target 2.6: Water sector investment plan adopted*

Financial needs for water infrastructure and management are high and the development of new water resources requires significant amounts of capital investments. It is therefore critical that the short-, mid- and long-term investment priorities are clearly identified and financial needs determined. Based on that assessment, a resource mobilization strategy needs to be developed, targeting both the national budget, as well as other sources of funding such as external grants or loans and, where possible, private sector investment. Options for public-private partnerships should be part of the resource mobilization strategy where feasible. In terms of funds raised locally, an appropriate pricing framework for raw water and treated water (tariffs) needs to be part of the financing plan.

### 3. Water quality and environmental sustainability

*Target 3.1: Catchments effectively protected*

Protecting the integrity of water catchments is crucial for ensuring, among other things, natural water retention capacity and good water quality. At present the Forestry Service has control of catchment protection in State Forests only, but the relevant Act is currently undergoing amendment to permit access to private land by the Forestry Service. With activities detrimental to catchment integrity on the increase, it is important that efforts are made to enforce current protection legislation and, where necessary, adopt and enforce new measures. In this context, comprehensive catchment protection legislation/ regulations need to be adopted and enforced (for example on protected reserves, buffer zones; activity controls etc.), especially for particularly important and vulnerable parts of catchments. To ensure compliance with these rules, in addition to enforcement measures, it is crucial that awareness raising activities are carried out to sensitize local stakeholders about the need for these measures. Moreover, the capacity of local authorities to enforce environmental legislation requires strengthening.

In addition to the regulatory, institutional and awareness raising measures physical catchment restoration and maintenance interventions need to be undertaken. This includes the restoration of important wetlands to increase the natural water storage and retention capacity, the continuation and upscaling of erosion prevention measures and the control of alien invasive species. An important element of maintaining the health of catchment ecosystem is the implementation of in-stream flow requirements. While this is called for in the National Water Policy, in-stream flow requirements have as yet not been determined in the country and undertaking this is a priority.

This target was identified as being of high priority
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*Target 3.2: Effective water quality monitoring system operational*

While water quality monitoring takes place regularly for potable water in accordance with the drinking water standards of Mauritius of 1996, some improvement in the monitoring of

water resources is needed. Comprehensive quality guidelines for surface water, groundwater, and wastewater/effluents need to be adopted, which are feasible to be monitored and implemented in the Mauritius context. Water quality laboratories need strengthening in terms of equipment and human resources capacity and should be accredited for relevant parameters. The results need to be integrated into the water quality component of the national water database/ water information system (see target 5.1).

*Target 3.3: Effective environmental enforcement mechanisms in place*

Like the need for the strengthening of water quality monitoring capacity, the establishment and strengthening of environmental enforcement mechanisms and capacity is needed. This requires as streamlining and clear delineation of responsibilities for environmental enforcement, especially with regards to water quality and effluent discharge. The necessary enforcement units need to be in place and adequately capacitated in terms of human resources and necessary equipment.

*Target 3.4: Pollution prevention and reduction measures implemented*

On the ground pollution prevention and reduction measures need to be undertaken. As a first step, a clear understanding of the scale and location of water pollution is required. This will be gained through a mapping of point and non-point sources of pollution and the identification of pollution hot-spots. A pollution management strategy needs to be adopted and implemented. A key component of this strategy has to be raising awareness and sensitizing communities on pollution issues, accompanied by strong pollution prevention and reduction regulations and the enforcement thereof.

This target was identified as being of high priority
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*Target 3.5: Freshwater/ ocean interactions understood and protection measures implemented*

As an island nation that is economically heavily dependent on tourism, the integrity of coastal and marine ecosystems is of vital importance for Mauritius. There are natural interactions between freshwater and the coastal and marine environment and negative environmental impacts can therefore affect the health of each of these integrated ecosystems. There is a need to conduct research to better understand the exact nature of the freshwater/ coastal/ marine interactions (e.g. impact of catchment erosion and sediment loads on corals, saltwater intrusion into groundwater etc.) and to identify areas at high risk of environmental degradation. Based on an improved understanding, appropriate protection measures need to be defined and implemented, such as sustainable extraction rates for groundwater to reduce risks for saltwater intrusion in coastal aquifers, measures to reduce polluted groundwater or river discharge into coastal waters and to prevent coastal erosion as a result of upstream water extraction and/or sediment trapping. Management and enforcement mechanisms and cooperative mechanism between key stakeholders responsible for freshwater management and coastal zone/ marine management established.

## 4. Security from water related disasters

### *Target 4.1: Climate change adaptation strategy for the water sector adopted and implemented*

Climate change is likely to impact on water resources management in Mauritius in the future. Albeit, the exact nature, scale and timing of climate change impacts is difficult to predict. Targeted research to get a better understanding of likely climate-change induced changes is therefore needed. This will provide solid scientific and technical inputs and guidance for the development of a targeted climate change adaptation strategy for water resources management. A climate change adaptation strategy for the water sector will be developed, adopted and implemented, identifying priorities in relation to the climate resilience of water infrastructure, measures needed to ensure water safety during flooding events and potential needs for water use re-allocation during dry spells. In this context, it noteworthy that many of the interventions identified in this IWRM Plan (e.g. development of storage options and alternative water sources; water efficiency measures etc.) are effectively already responses to changing climatic conditions, even though there are additional drivers (economic growth, population growth) that make these interventions necessary.

### *Target 4.2: Effective disaster mitigation systems established and disaster mitigation capacity enhanced*

Adequate disaster prevention and mitigation mechanisms and capacity is critical in dealing with water-related disasters, especially in view of the predicted increase in extreme events, i.e. extended droughts and increase in rainfall intensity. The disaster prevention and mitigation systems related to water management in Mauritius need strengthening. There is a need to develop water allocation guidelines for drought scenarios, allowing for long-term planning as well as emergency measures such as reduction of abstractions, prioritization of uses during extended dry periods and the like. Likewise, guidelines for flood and drought mitigation measures other than those related to water allocation, such as provision and continuation of services during and after emergencies, plans for rehabilitation and repair of water systems etc. also need to be developed. The disaster prediction and warning systems require strengthening and effective institutional coordination and response mechanism need to be established. This needs to be accompanied by targeted capacity building in disaster prediction, risk management and disaster mitigation.

## 5. Water resources information management

### *Target 5.1: Central national water resources database and Decision Support System established*

Mauritius needs a comprehensive central national water resources database, also called water information system (WIS). This system would include the integration of the existing hydrometric data information system into the database. Importantly, this needs to be complemented by a water abstraction and water licenses registry. The need for the establishment of a comprehensive water licensing and abstraction monitoring system is

identified as a priority and included in this plan under target 2.1. This registry needs to be an integral part of the WIS. Likewise, water quality monitoring data also needs to be integrated into the database. Further, a list of water professionals including their respective area expertise should be included in the database to support the development of a targeted capacity building programme.

Following the initial stage of establishing the WIS and populating it with basic information, the WIS needs to be continually upgraded and maintained. Next steps could also be the development of a Decision Support System (DSS) that informs decision making on water allocation in accordance with the agreed water allocation guidelines. Once the basic IT infrastructure is established and the database populated, the technical access for all relevant role-players needs to be ensured and access rules agreed and implemented. Capacity building in the use and maintenance of the database and DSS needs to complement the establishment of the system.

*Target 5.2: Information sharing platform operational*

The WIS will be complemented by a water observatory, a platform for public information sharing and dissemination. The water observatory could technically be the public component of the WIS, but would provide access to only those parts of information that are cleared for public dissemination.

## 6. Stakeholder participation, capacity building and water education

*Target 6.1: Stakeholder involvement mechanisms designed and implementation initiated*

The National Water Policy, in line with IWRM principles, identifies stakeholder involvement as an important element of integrated water resources management. In this context, a more detailed mapping of stakeholders, including water users in the private sector and civil society needs to be undertaken. Based on this mapping, a stakeholder involvement strategy needs to be developed and appropriate mechanisms and platforms for engagement established. In this context, the creation of a dialogue platform for pertinent water management issues between government and non-government stakeholders is considered a high priority. The stakeholder engagement mechanism eventually should become an integral part of the water management institutional framework.

The detailed role, mode of engagement and institutional set-up of stakeholder engagement is likely to be progressively developed and implemented, starting with more limited direct involvement in management, but possible moving to stronger stakeholder/ community roles on some water management aspects such as local catchment monitoring and conservation. As such the development of appropriate stakeholder engagement platforms needs to be closely aligned with the review and possible reform of the institutional architecture for water management that is proposed in target 8.2 of this IWRM Plan.

This target was identified as being of high priority
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*Target 6.2: Human resources development plan implemented*

Mauritius has generally solid capacity levels in most water management areas, but it is known that some capacity building and training needs exists, both in terms of certain skills areas as well as in the number of trained personnel. This plan therefore highlights the need to carry out a detailed capacity needs assessment, based on which targeted capacity building interventions will be identified and implemented.

The second element of this priority area is capacity building. Mauritius has generally solid capacity levels in most areas, but it is known that some capacity building and training needs exists. This plan therefore highlights the need to carry out a detailed capacity needs assessment, including both qualitative and quantitative aspects, based on which targeted capacity building interventions will be identified and implemented.

This target was identified as being of high priority
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## 7. Water and sanitation services provision

### *Target 7.1: Sewerage network expanded (in accordance with Sewerage Master Plan)*

The low coverage level of the sewerage network has detrimental effects on water quality (and indirectly potentially on human health). This is recognized by the government and the Sewerage Master Plan sets ambitious targets for the expansion of the network. The biggest hurdle for achieving the objectives of Sewerage Master Plan are raising the significant amounts of capital required for the network expansion (and subsequent maintenance). It is important that a realistic funding strategy for capital investments is developed, based on which capital is raised and the progressive construction of the expanded network takes place. Realistically, a critical component of such funding strategy would include raising the income (of the WMA) from wastewater tariffs. A tariff review is proposed and described in target 7.3

### *Target 7.2: Amount of non-revenue water reduced*

Significant amounts of CWA treated water are lost, so-called non-revenue water, with negative effects on the water resources balance as well as on the CWA balance sheet. The bulk of that loss is due to pipe leakage, with the remainder due to faulty meters and illegal connections. Addressing this issue is an ongoing priority of the CWA who have carrying our network repair programmes to bring down the amount of non-revenue water. The replacement of faulty or outdated meters and the curbing of illegal connections and meter tempering also forms part of this strategy and needs to be continued, ideally expanded if financial means allow.

### *Target 7.3: Water and sanitation tariff structure revised in accordance with principles of cost recovery and social equity*

Water and sanitation tariffs in Mauritius are low by international standards. This affects the revenue stream of CWA and WMA, barely allowing it to cover operational costs, but prohibiting capital investments in the maintenance of infrastructure of the development of

new one from its own revenue base. Moreover, the low tariffs encourage wastage and contribute to the high level of per capita consumption in the country. For both reasons, and in accordance with the principle of treating water as an economic good, a revision of the current tariff structure is needed. A tariff review needs to be carried out that provides the basis for the development of different potential tariff models in consideration of economic, financial as well as social aspects. Following stakeholder engagement on the different tariff options, a revised tariff regime needs to be adopted and implemented.

*Target 7.4: Public awareness on cost of potable water production, importance of water saving and impact of pollution on water resources raised*

Targets 7.2. and 7.3 above both aim at increasing water efficiency, combining technical and regulatory/ financial approaches. It is important that these measures are complemented by an awareness raising drive. Especially domestic users are frequently not aware of the costs associated with water treatment and reticulation and of the impact of water wastage or pollution on the overall water balance and thus economy of the country. Targeted awareness-raising activities in this area need to be carried out.

This target was identified as being of high priority
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## 8. National water resources governance

*Target 8.1: Comprehensive National Water Act enacted*

With current Mauritius water legislation being fragmented and outdated, a new National Water Act that consolidates all key water management aspects in one comprehensive Act, is urgently needed. This is currently on its way and listed in this plan for completeness. A detailed review of existing legislation is being undertaken, identifying gaps or shortcomings with respect to IWRM implementation. Based on this review, a new draft Water Act is being prepared. Once a final draft of the Act has been agreed, parliamentary approval processes and enactment are the final steps.

This target was identified as being of high priority
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*Target 8.2: Institutional framework for water management streamlined in accordance with IWRM principles*

The Water Master Plan makes specific recommendation for the reform of the institutional framework. While these provide valuable starting points for debate, a more comprehensive analysis of the strengths and weaknesses of the current institutional framework is required. This plan therefore highlights the need for a comprehensive institutional assessment of all relevant water sector institutions and the development of options for a re-alignment of functions and possible restructuring of institutional responsibilities in accordance with IWRM principles. Such study would include a consideration of the separation of regulatory and water resources management functions (currently partly combined within CWA), with regulatory functions being carried out independently. Further, the role and composition of an

intersectoral committee for IWRM implementation and the role of institutionalized stakeholder involvement in water management form part of this intervention. Following the development of options for a re-aligned institutional framework and the selection of a priority options following stakeholder debate, the agreed institutional changes need to be progressively implemented.

*Target 8.3: National IWRM coordination mechanism established*

An important element of a re-aligned institutional framework for water management in Mauritius is the establishment of an appropriate inter-sectoral coordination mechanism for the implementation of the IWRM Plan. To this end, options for such mechanism need to be developed and discussed among key stakeholders, and following a decision on an appropriate mechanism it needs to be created. It should be noted that a coordination mechanism does not necessarily (or perhaps should not) mean the creation of a new, possibly expensive organization. The emphasis is on coordination mechanism, rather than body. Focal points of all relevant water management bodies need to be appointed to this mechanism to ensure true inter-sectoral discussion, coordination and decision-making. Coordination channels between this national coordination mechanism and local stakeholder platforms need to be defined and maintained.

## Part 3: The Action Programme

Priority Area 1: Integrated catchment management				
Targets	Activities/ Interventions	Corresponding Water Policy Statement	Responsible lead agency	Other relevant agencies/ stakeholders
	0-5 years			
<b>Target 1.1:</b> Feasibility of establishment of Water Management Areas based on hydrologic zones determined	Study carried out determining pros- and cons of changing from current supply zone management to hydrological zone based management	3.3.1 3.3.2	MEPU	WRU
	(Only if study is in favour of change) Delineation and legal establishment of Water Management Areas			
	(Only if study is in favour of change) Development of integrated catchment management plans for each Water Management Area			
<b>Target 1.2:</b> Groundwater effectively protected and sustainably utilised in all aquifers	Water resource assessment of aquifers carried out (setting of GIS systems; data collection; establishment of groundwater monitoring networks; yield assessment, pollution risk assessment)	3.3.1 3.3.2 3.3.3 3.3.4	MEPU	WRU CWA Forestry Service MoE

	Artificial groundwater recharge option explored and implemented where feasible, including study on social acceptance of recharge with treated wastewater			MoA
	Aquifer management plans developed in accordance with determined safe-yield levels			
	Groundwater protections legislation/ regulations adopted			
	Adequate enforcement capacity for groundwater protection established and maintained			
<b>Priority Area 2: Water resources management/ development, water use efficiency and water demand management</b>				
Targets	Activities/ Interventions	Corresponding Water Policy Statement	Responsible lead agency	Other relevant agencies/ stakeholders
	0-5 years			
<b>Target 2.1:</b> Water use authorization system and water allocation guidelines implemented	Water allocation guidelines developed (incl. for in-stream needs; off-stream withdrawal; and groundwater abstraction)	3.8.2 3.3.6	MEPU	WRU CWA MoE MoA
	Water use authorization (licensing) system for surface water established and groundwater licensing system revised and updated			
<b>Target 2.2:</b> Raw water pricing framework adopted and implemented	Water (use) audit carried out country-wide	3.7.4	MEPU	WRU CWA
	Raw water pricing options developed using economic modeling tools			

	Raw water pricing framework developed			
<b>Target 2.3:</b> Businesses and households are water efficient	Use of water saving devices and water storage facilities in all business regulated	3.3.5	MEPU	WRU CWA MoE MoA NGOs
	Green labeling system to encourage use of water saving devices developed			
	Regulations for water self-sufficiency for large businesses developed and implemented			
	Regulatory measures facilitating water demand management and reduced water consumption adopted and incentive schemes for adoption of water saving devices in households in place			
<b>Target 2.4:</b> Water use efficiency in irrigated agriculture improved	Existing pipe systems refurbished and new water meters introduced	3.1.3	MEPU	WRU CWA IA FAREI
	Rainwater harvesting on farms promoted			
	Awareness of farming community on water efficiency raised			
<b>Target 2.5:</b> Water demand management strategy implemented	Illegal surface water abstraction curbed through appropriate strategies/ mechanisms	3.2.2 3.3.5	MEPU	WRU CWA MoA
	Suitable options of water demand management and alternative sources of water supply identified (Rainwater harvesting; water efficient equipment; pricing mechanisms)			
	Water demand management strategy implementation accompanied by awareness raising campaign (incl. on wastewater-reuse and wastewater standards)			

	Regulatory measures facilitating water demand management and reduced water consumption adopted			
<b>Target 2.6:</b> Water sector investment plan adopted	Sector needs determined and investment priorities identified	3.7.1	MEPU	CWA WRU MoF
	Resource mobilization strategy developed	3.7.2		
	Options for PPPs identified and conceptualised	3.7.3		
<b>Priority Area 3: Surface -, Ground- and Wastewater quality and environmental sustainability</b>				
Targets	Activities/ Interventions	Corresponding Water Policy Statement	Responsible lead agency	Other relevant agencies/ stakeholders
	0-5 years			
<b>Target 3.1:</b> Catchments effectively protected	Consolidated catchment protection legislation/ regulations (incl. reserve and buffer zone establishment; activity controls etc.) adopted and implemented	3.3.1	MEPU	WRU NPCS Forestry Service
	Local landowners and users sensitized and awareness raised	3.3.2		
	Enforcement capacity of local authorities strengthened	3.3.3		
	Degraded ecosystems restored (e.g. erosion reversal/ prevention; re-grassing; re-forestation; wetland restoration)	3.3.4		
	Ecosystem needs and in-stream water requirements determined and implemented			
<b>Target 3.2:</b> Effective water quality monitoring system	Surface-, ground-, and wastewater quality standards adopted	3.3.3 3.3.4	MEPU	WRU MoH

operational	Water quality monitoring laboratories strengthened			MoE CWA
	Centralised water quality database established and information access protocols developed and implemented			
<b>Target 3.3:</b> Effective environmental enforcement mechanisms in place	Institutional responsibilities for environmental enforcement, especially with regard to water quality/ effluent discharge clearly defined and assigned	3.3.3 3.3.4	MEPU	WRU MoH MoE CWA
	Enforcement units in place within responsible authorities			
	Capacity of enforcement unit personnel strengthened			
<b>Target 3.4:</b> Pollution prevention and reduction measures implemented	Point source and non-point source pollution hot-spots mapped	3.1.8 3.3.3 3.3.4	MEPU	WRU CWA MoE FAREI
	Awareness raised and users sensitized on sustainable use of pesticides and fertilisers			
	Regulatory measures to reduce pesticide and fertiliser use adopted and implemented			
<b>Target 3.5:</b> Freshwater/ ocean interactions understood and protection measures implemented	Impacts of groundwater interaction with ocean/reefs researched (saltwater intrusion in groundwater; polluted groundwater discharge on reef ecology) and understood	3.1.8 3.3.3 3.3.4	MEPU	WRU MoE Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping
	Impacts of surface water interaction with ocean/reefs researched (catchment erosion; effluent discharge) and understood			
	High risk areas identified and appropriate protection measures implemented			

	Regular engagement mechanism between freshwater and marine management bodies/ stakeholders established and operational			
<b>Priority Area 4: Security from water related disasters</b>				
Targets	Activities/ Interventions	Corresponding Water Policy Statement	Responsible lead agency	Other relevant agencies/ stakeholders
	0-5 years			
<b>Target 4.1:</b> Climate change adaptation strategy for the water sector adopted and implemented	Research to assess future impacts of climate change on water resources carried out	3.4.1	MEPU	WRU Met Services
	Climate change adaption strategy for water resources management developed			
<b>Target 4.2:</b> Effective disaster mitigation systems established and disaster mitigation capacity enhanced	Development of water allocation guidelines (for drought scenarios)	3.4.2 3.4.3	MEPU	WRU Met Services NDDRRMC Land Drainage Authority
	Development of guidelines for flood and drought mitigation developed			
	Disaster risk prediction and warning systems developed, and effective institutional response mechanisms established, including stakeholder engagement mechanism			
	Capacity building in disaster preparedness, risk management and mitigation carried out			

Priority Area 5: Water resources information management				
Targets	Activities/ Interventions	Corresponding Water Policy Statement	Responsible lead agency	Other relevant agencies/ stakeholders
	0-5 years			
<b>Target 5.1:</b> Central national water resources database and Decision Support System (DSS) established	National water abstraction/ license register integrated with central database	3.5.1 3.5.2	MEPU	CWA WRU MoE MoH
	Water quality monitoring systems (surface water, groundwater and wastewater) integrated into national database			
	Access protocols and database update mechanisms implemented, including defined access rights for the public			
	IT infrastructure in relevant bodies in place to access and manage database			
	Capacity for managing and updating database and applying DSS strengthened			
<b>Target 5.2:</b> Information sharing platform operational	Water observatory for information dissemination set up	3.5.2	MEPU	CWA WRU
	Rules for data/ information sharing among stakeholders (especially government bodies) adopted and key stakeholders for information sharing identified			

<b>Priority Area 6: Stakeholder participation and capacity building</b>				
<b>Targets</b>	<b>Activities/ Interventions</b>	<b>Corresponding Water Policy Statement</b>	<b>Responsible lead agency</b>	<b>Other relevant agencies/ stakeholders</b>
	<b>0-5 years</b>			
<b>Target 6.1:</b> Stakeholder involvement mechanisms designed and implementation initiated	Relevant stakeholders identified through stakeholder mapping	3.6.2	MEPU	WRU MoE MoA NGOs Private sector
	Appropriate mechanism and platforms for regular stakeholder engagement developed and established			
	Platforms established for private sector to share their available information (with government and non-government stakeholders)			
<b>Target 6.2:</b> Human resources development plan implemented	Capacity needs assessment carried out	3.6.1 3.6.3	MEPU	WRU CWA WMA
	Capacity building plan developed			
	Capacity building measures in priority needs areas carried out			
<b>Priority Area 7: Water and sanitation services provision</b>				
<b>Targets</b>	<b>Activities/ Interventions</b>	<b>Corresponding Water Policy Statement</b>	<b>Responsible lead agency</b>	<b>Other relevant agencies/ stakeholders</b>
	<b>0-5 years</b>			
<b>Target 7.1:</b> Sewerage network expanded (in accordance with Sewerage Master Plan)	Funding strategy for capital investments developed and implemented	3.1.2	WMA	MEPU
	Capital funds mobilised			

	Network construction ongoing			
<b>Target 7.2:</b> Amount of non-revenue water reduced	Replacement of old, leaking pipes ongoing	3.3.5	CWA	MEPU
	Replacement of faulty meters ongoing			
	Programmes to curb illegal connection and unbilled consumption ongoing			
<b>Target 7.3:</b> Water and sanitation tariff structure revised in accordance with principles of cost recovery and social equity	Detailed tariff review carried out and recommendations for tariff reform made	3.7.1	MEPU	CWA WMA
	Revised tariff regime developed, agreed and implemented	3.7.4		
<b>Target 7.4:</b> Public awareness on cost of potable water production, importance of water saving and impact of pollution on water resources raised	Awareness raising campaign conceptualised and prepared	3.5.2	MEPU	CWA WMA MoE NGOs
	Awareness raising activities carried out			
	Campaign impact monitored			
<b>Priority Area 8: National water resources governance</b>				
Targets	Activities/ Interventions	Corresponding Water Policy Statement	Responsible lead agency	Other relevant agencies/ stakeholders
	0-5 years			
<b>Target 8.1:</b> Comprehensive National Water Act enacted	Detailed review and gap analysis of existing legislation relevant for water management with detailed recommendations for National Water Bill	3.8.1	MEPU	n/a

	Drafting of National Water Bill through consultative process			
	Repealing of existing Acts (or parts thereof) and Enactment of National Water Act			
<b>Target 8.2:</b> Institutional framework for water management streamlined in accordance with IWRM principles	Detailed review study of powers and function within current institutional set-up and development of detailed recommendations for reformed allocation of powers and functions in accordance with IWRM principles	3.9.2	MEPU	n/a
	Based on study recommendations, development of options for overall institutional architecture for the water sector (e.g. new independent regulator? Strengthening of inter-sectoral committee?)			
	Selection of priority option and implementation			
	Effective permanent stakeholder engagement platform established as integral part of water management architecture			
<b>Target 8.3:</b> National IWRM coordination mechanism established	Appropriate inter-sectoral coordination mechanisms for IWRM Plan implementation identified and established	3.9.2	MEPU	n/a
	IWRM focal points in relevant agencies designated			
	Coordination and reporting mechanisms with local catchment/ watershed committees determined and established			