MINISTRY OF WATER AND IRRIGATION

National Water Quality Management Strategy (NWQMS) (2012 – 2016)

NATIONAL WATER QUALITY MANAGEMENT STRATEGY (NWQMS)

(2012 – 2016)

FOREWORD

The Department of Water Resources is in the process of developing an updated National Water Resources Management Strategy to provide a road map for sustainable management of our scarce water resources. Water quality management is a core component of water resources management. The National Water Quality Management Strategy (NWQMS) will be a critical input to the National Water Resources Management Strategy.

Admittedly, water quality has tended to take a back seat compared to water quantity in the provision of water in our country in an environment of limited potable water resources. But proper water quality management will obviate the need to spend huge resources to address waterborne diseases which contribute the largest percentage of bed occupancy in our hospitals. The NWQMS will be the bench mark not only for the protection of our water resources from pollution but also for ensuring the water provided to the consumer is safe – i.e. it is not injurious to health.

To develop the NWQMS, a comprehensive literature review was carried out. This was followed by a consultative process involving key stakeholders including: other departments in MWI, WRMA, WASREB, NEMA, KEBS, MoA, NCWSC and KIRDI, among others. The views and issues raised by the stakeholders have been taken into consideration in drafting the Strategy.

The NWQMS is meant to be a 'living' document which will continue to be reviewed to be in sync with expected reforms in the water sector to conform to the new constitution. It is my hope that this strategy will contribute positively to the wise management of our water resources in general and water quality in particular.

Finally, I wish to thank most sincerely all those who have put their time and energy to ensure the finalization of the NWQMS.

John Rao Nyaoro, HSC
DIRECTOR OF WATER RESOURCES

EXECUTIVE SUMMARY

The development of the National Water Quality Management Strategy (NWQMS) has been undertaken as a part of developing an updated National Water Resources Management Strategy. This is part of the reforms which the Ministry of Water and Irrigation (MWI), has been undertaking since 2003 following the enactment of the Water Act, 2002. The NWQMS comes at a time when most of the water resources in Kenya are threatened with serious water quality degradation. What is clearly evident is that water in most Kenyan rivers and lakes, is both brown and turbid due to contamination from silt and suspended sediment.

The NWQMS notes the bold steps taken by the Government in the areas of water and environmental protection, through the formulation of NEAP in 1994 and initiating the water sector reforms which created the new institutions Water Resources Management Authority (WRMA) and Water Services Regulatory Board (WASREB). The NWQMS underscores the fact that water quality issues are cross cutting and recommends that all stakeholders participate in its development and implementation.

In writing the NWQMS, a comprehensive literature review was carried out. This was complimented by interviews and consultations with key stakeholders, the MWI, WRMA, WASREB, NEMA, KEBS, MoA, NCWSC and KIRDI, among others. The views and issues raised by the stakeholders have been taken into consideration in the drafting the Strategy.

The NWQMS comprises of 4 Chapters as follows:

C**hapter 1:** Outlines the Introduction and Background to the Strategy. It looks at Water Sector Reforms, Challenges in the Sector, the need for the NWQMS, Vision, and Mission, Goals and Key principles and best practices to be adopted for effective water quality management.

Chapter 2: Forms the core of the NWQMS Report. It highlights the selected key strategic actions to be undertaken for the implementation of this Strategy. These are:

- Designing a National Water Quality Monitoring Program
- Support Drinking Water Quality Surveillance
- Development of a Sampling program
- Supporting Laboratories
- Procurement of Laboratory Equipment
- Drinking Water Quality Protection
- Control of Water Treatment Chemicals and Materials
- Development of Surface Water Protection programs
- Development of Ground Water Protection programs
- Protection of Coastal and Marine waters
- Protection of Urban and Rural water supplies
- Support Data Collection and information management
- Capacity building for Water Quality Management
- Institutional framework for Implementation of NWQMS

- Water Quality Implementation Plans
- Stakeholder and Community Participation
- Trans-boundary water quality management
- Biological Water Quality Monitoring
- Applied Water Research
- Prepare Guidelines for Water Quality Management
- Enhance Education and Awareness
- Enhance Enforcement and Compliance
- Review and Harmonization of Laws Policies and Strategies
- Monitoring Quality of all types of waters
- Establish a Centre for Water Quality Control and Pollution Control

Chapter 3: Sets strategic targets and budget estimates for the selected strategic actions, for 2015, with a budget of 1.2 billion Kenya Shillings, and for the year 2030, with a budget of 895 Million.

Chapter 4: Gives the Implementation Plan which is phase-wise; Short-term up to 2015; Medium-term 2016-2020 and Long-term 2021-2030. The possible sources of funding are also examined. The implementation of the proposed NWQMS by the year 2030 will total about 2 billion Kenya shillings.

The proposed implementation of the Strategy is at three levels; National, Regional/Catchment and Sub-Catchment or Sub-basin level. At the national level, after finalization of the NWQMS, there is need to develop a National Water Quality Management Policy. At the regional level, Catchment Water Quality Management Strategies will need to be elaborated, and shall contain sub-catchment water quality control implementation plans for each sub-basin. Water quality management at each sub-basin, will be coordinated at the regional level. The proposed 3-tier WQ management implementation structure, i.e., National, Regional/Catchment and Sub-catchment/sub-basin levels, is in line with the principle of subsidiarity and will ensure that action is taken at the sub-basin level by individuals and communities.

The MWI has the overall mandate to oversee the implementation of this strategy and coordinate the activities of the other water sector actors. The actual implementation of the NWQMS will be the primary responsibility of WRMA. However, WRMA shall consult and work closely with Water Quality and Pollution Control Division and WSBs in the execution of this mandate. The NWQMS shall be implemented alongside the already existing Water Services Strategy and the Water Resources Management Strategy; and shall be incorporated eventually into the later strategy during its revision.

WRMA will also take the lead in guiding the other water sector stakeholders in playing their respective roles with regard to the conservation and protection of the national water resources.

On the issue of Laboratories, a 3-tier arrangement is proposed as follows:

Central Water Testing Laboratory (CWTL):

To be based in Nairobi, and to oversee and monitor and give guidance and support to the regional/provincial and others labs at the district levels.

Regional Laboratories/County:

Based in the 6 regions or catchment areas, will implement the water quality management plans by carrying out water testing from samples drawn from the various sub-regions or sub-catchments or sub-basins. These will be under the management of WRMA.

District Laboratories/WSPs Labs

These Labs mainly at major water supplies and formerly being ran by the district water offices will mainly be used to monitor mainly the treated water before distribution to consumers.

The CWTL in Nairobi shall be elevated initially to a referral laboratory and later to semi-autonomous status but still operating under the Ministry, and assume the new name "Centre for Water Quality and Pollution Control". It will be an overseer of both WRMA and WSBs on water quality issues.

The Water Quality and Pollution Control Division currently within the Water Resource Department in the Ministry will remain, and its role will be mainly advisory on water quality and pollution control issues. With the support of the CWTL, it will also continue to oversee and evaluate the water quality monitoring and implementation by WRMA and WSBs.

WRMA will assume full control of the existing Provincial/ Regional laboratories, while the small laboratories in some Districts and at the Water Supplies will be managed through an arrangement to be worked out between WRMA and WSBs. Other private or institutional labs, such as University labs, within a region can also be used for analysis through an agreed arrangement between WRMA, WSBs and the institution. Such an arrangement will aim at optimizing the use of existing Lab facilities instead of every institution building its own Labs.

The Strategy recognizes that the water resources have to be managed as an environmental resource as it occurs in rivers, lakes and ground water, (a primary responsibility of WRMA) and also as a water supply after treatment and conveyance to consumers (a primary responsibility of WSBs). These two institutions will ensure that the resource is conserved and protected and that environmental and water quality standards and values are not compromised.

The overall success of implementation of the NWQMS lies in the recruitment of a strong team of water quality professionals, sourcing for funds for the execution of the proposed strategic actions such as designing and operationalizing the national water quality monitoring program, and supporting the existing laboratory facilities, that would then in turn generate data for planning and management purposes.

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ACRONYMS AND ABBREVIATIONS

AG	-	Attorney General
ASAL	-	Arid/Semi Arid Areas
AWSB	-	Athi Water Service Board
BOD	-	Biochemical Oxygen Demand
BWQM	-	Biological Water Quality Monitoring
Cap	-	Chapter
CB	-	Catchment Board
CBA	-	Coast Development Authority
CBOs	-	Community Based Organizations
CBS	-	Central Bureau of Statistics
COD	-	Chemical Oxygen Demand
CWTL	-	Central Water Testing Laboratory
DPs	-	Development Partners
DWQS	-	Drinking Water Quality Surveillance
EIA	-	Environment Impact Assessment
ERS-WEC	-	Economic recovery Strategy for Wealth and Employment Creation
GDP	-	Gross Domestic Product
GIS	-	Geographical Information System
GoK	-	Government of Kenya
IMSC	-	Inter Ministerial Committee
IMCE	-	Inter Ministerial Committee on Environment
IS	-	Information System
Lab	-	Laboratory
Labs	-	Laboratories
LVSWSB	-	Lake Victoria South Water Service Board
LVNWSB	-	Lake Victoria North Water Service Board
IWRM	-	Integrated Water Resources Management
KEWI	-	Kenya Water Institute
KFS	-	Kenya Forest Service
KENGEN	-	Kenya Electricity Generating Company
KIRDI	-	Kenya Industrial Development Research Institute
KMD	-	Kenya Meteorological Department
KPLC	-	Kenya Power Lighting Company
LVEMP	-	Lake Victoria Environmental Management Program
LVNCA	-	Lake Victoria North Catchment Area
KWS	-	Kenya Wildlife Service
KIHBS	-	Kenya Integrated Household Budget Survey
MCM	-	million cubic meters,
MDGs	-	Millennium Development Goals
MLG	-	Ministry of Local Government
MoA	-	Ministry of Agriculture
MoI	-	Ministry of Industry
MoL	-	Ministry of Lands
MoRD	-	Ministry of Regional Development

MoH	-	Ministry of Health
MoPND	-	Ministry of Planning and National Development
MWI	-	Ministry of Water and Irrigation
NGOs	-	Non Governmental Organizations
NBI	-	Nile Basin Initiative
NIB	-	National Irrigation Board
NTEAP	-	Nile Trans-boundary Environmental Action Project
NWCPC	-	National Water Conservation and Pipeline Corporation
NWQMS	-	National Water Quality Management Strategy
NWRMS	-	National Water Resources Management Strategy
NCWSC	-	Nairobi City Water and Sewerage Company
NWSS	-	National Water Services Strategy
O+M	-	Operation and Maintenance
PPP	-	Public Private Partnerships
PPCSC	-	Permanent Presidential Commission on Soil Conservation
PRSP	-	Poverty Reduction Strategy Paper
PSP	-	Private Sector Participation
RM	-	Regional Manager
RVWSB	-	Rift Valley Water Service Board
SIP	-	Sector Investment Plan
SPA	-	Service Provision Agreement
SWAP	-	Sector Wide Approach to Planning
TAWSB	-	Tana and Athi Water Service Board
TWSB	-	Tana Water Service Board
TSS	-	Total Suspended Solids
TCE	-	Tertiary Consulting Engineers Ltd
TDS	-	Total Dissolved Solids
UFW	-	Unaccounted for Water
UN	-	United Nations
UNDP	-	United Nations Development Programme
USD	-	United States Dollar
VIPs	-	Ventilation Improved Pits
WAB	-	Water Appeal Board
WASREB	-	Water Services Regulatory Board
WQM	-	Water Quality Monitoring
WQ	-	Water Quality
WRM	-	Water Resources Management
WRMA	-	Water Resources management Authority
WSBs	-	Water Services Boards
WSPs	-	Water Services Providers
WSs	-	Water Supplies
WSS	-	Water and Sewerage Services
WSTF	-	Water Services Trust Fund

CHAPTER 1 INTRODUCTION

1.1 Background

1.1.1 Global Context

Water is a finite and life sustaining resource and covers about 70 % of the physical environment, Fresh water resources are scarce and unevenly distributed. The amount of water available globally is about 1.4 billion cubic kilometers. Of this amount, 97 % is saline, and is in seas and oceans and is a habitat to diverse marine ecosystems. Of the 3 % fresh water, only less than 1 % is found in lakes and rivers, supporting all our developmental activities. About 2 % of the available fresh water resources is locked up in glacial ice at the poles. The fresh water in rivers and lakes thus needs to be managed well for our sustenance and that of future generations.
Globally fresh water is becoming an endangered resource. In the past, there was little or no water pollution and most of the rivers and lakes were in a pristine state. In modern times, water pollution is on the increase and quality deterioration is evident in many water bodies.
Adequate freshwater of good quality, is vital for the survival of all living organisms and the smooth functioning of ecosystems, communities, and economies. But the quality of the world's water is increasingly threatened as human populations grow, industrial and agricultural activities expand, and as climate change threatens to cause major alterations of the hydrologic cycle. Poor water quality threatens the health of people and ecosystems, reduces the availability of safe water for drinking and other uses, and limits economic productivity and development opportunities. Action must now be taken to conserve and protect our water resources by preventing water pollution, treating waters that are already contaminated, and restoring the quality and health of rivers, lakes, aquifers and wetlands. This will ensure that our waters meet the broadest possible range of human and ecosystem needs and uses.

1.1.2 Kenyan Context

Kenya has an area of 582,646 km^2 out of which 11,230 km^2 is covered by water and 571,416 km^2 by land. The mean annual rainfall is 621mm, ranging from 250 mm to 750 mm in ASAL areas to 1000 mm to 1690 mm in the coastal belt the central highlands and in the Lake Victoria Basin. The total annual volume of rainwater has been estimated at 360,000 million cubic meters (MCM), contributing to both surface water and groundwater (NWMP, 1992).

The spatial and temporal distribution of water is skewed, with ASAL areas receiving flash rains that end up as little conserved runoff. Population growth and proportionate demand for food in the higher potential areas has resulted in migration to lower potential and ecologically fragile areas and converting them to agricultural land.

Kenya's annual water availability has been estimated to be about 647 m^3 per capita of water (NWMP, 1992) and is expected to drop to about 250m^3 per capita in 2030 when population is expected grow to 64 million (NLCPD, 2010). Countries with less than 1,000m^3 per capita of water are regarded as water scarce. Kenya has a population of about 38 million (KNBS, 2009), and it faces enormous challenges in managing its limited water resources. Sustainable integrated water resources management is critical because poor water quality can aggravate water scarcity.

Therefore, water quality management issues will be of paramount importance as the country grapples to meet water demands for the different sectors including the needs for the environment. Furthermore, water resources are constantly under threat from pollution by domestic, municipal, industrial and agro-based activities, hence underpinning the need for effective water quality management.

1.1.3 Previous National Initiatives

The development of a National Water Quality Management Strategy (NWQMS) is important and is long overdue. Since the Earth Summit in Rio de Janeiro in 1992, Kenya has made tremendous progress towards water and environmental management. The NEAP Report (Kenya's Agenda 21), was concluded in 1994. The EMCA and Environment and Development Policy were finalized in 1999. The National Water Policy on Water Resources Management and Development was passed in1999, while the Water Act 2002, came into force in 2003. The Act separated the two roles of policy making and policy implementation and was the basis of the Water Sector reforms which created WRMA and WASREB among other institutions. The objective of the creation of the two institutions was the separation of role of management of the Water Resources from that of Water Services delivery with a view to improve efficiency. Water quality management issues have prominently featured in phase I and II of LVEMP since 1997. Kenya is also a participant in the NBI, which under the NTEAP has a water quality component.

1.2 Vision

"To be a regional and global leader in water quality management".

1.3 Mission

"To facilitate sustainable and integrated water quality management for human health, environmental health and national development".

1.4 Goals

The following are the goals of the NWQMS:

i. Improved water quality by reducing pollution from point and non-point sources,
ii. Enhanced water quality monitoring programmes, water quality data management, information management and sharing,
iii. Harmonized water quality management guidelines recognizing differences in institutional, social and natural conditions,
iv. Equipped laboratories at three levels with professional staff for improved water quality analysis
v. Enhanced trans-boundary water quality management by enacting Trans-boundary policies and protocols,
vi. Improved enforcement and compliance to water quality standards and guidelines,
vii. Establishment of applied water quality research programs for sustainable water quality management, and
viii. Introduction of biological water quality monitoring techniques.

1.5 Challenges facing WQM in Kenya

Human activities such as agriculture, industry, mining, disposal of human waste, population growth and urbanization impact negatively on water quality. Some of the major challenges affecting water quality in Kenya are:

i. Inadequate measures to control pollution from point and non-point sources.
ii. Inadequate enforcement capacity by institutions mandated to control pollution and enforce water quality standards.
iii. Lack of incentives to polluters and low compliance.
iv. Inadequate water quality data for planning and decision making.
v. Inadequate allocation of financial resources.
vi. Inadequate human resource capacity.
vii. Research gaps in water quality.
viii. Scarcity of potable water.
ix. Dilapidated potable water distribution network.
x. Dilapidated/inadequate sewerage system.
xi. Poor land use practices including unplanned urbanization.
xii. Conflicting laws and policies.
xiii. Inadequate documentation and dissemination of available information.

1.6 Justification for NWQMS

The National Water Quality Management Strategy is in response to the need to streamline, and harmonize water quality management. A management framework, which sets out the roles of the various stakeholders, needs to be established. Better coordination of activities would reduce duplication and streamline overlaps for effective resource use and eventual positive impact. Effective Water quality management will also add to the attainment of the MDGs and Vision 2030, and is thus of national importance.

1.7 Structure of the NWQMS Report

The NWQMS comprises of 4 Chapters as follows:

C**hapter 1:** Outlines the Introduction and Background to the Strategy.
Chapter 2: Highlights the selected key strategic actions that must be undertaken for the implementation of this Strategy.
Chapter 3: Sets Strategic targets and Budget estimates for the selected strategic actions,
Chapter 4: Outlines the Implementation Plan of the Strategy at three levels; National, Regional/Catchment and Sub-Catchment or Sub-basin level.

1.8 Implementation of the NWQM Strategy

1.8.1 Institutional Roles

The MWI has the overall mandate to oversee the implementation of this strategy and coordinate the activities of the other water sector actors. The actual implementation of the NWQMS will be the primary responsibility of WRMA and WASREB. These institutions shall consult and work closely with MWI in the execution of their mandates. The NWQMS is to be implemented alongside the already existing Water Services Strategy and the Water Resources Management Strategy; and shall be incorporated eventually into the two strategies during their revision. WRMA will take the lead in guiding the other water sector stakeholders in playing their respective roles with regard to the conservation and protection of the national water resources, while WASREB will take the lead in ensuring safe drinking water provision. It is proposed that a 3-tier WQ management implementation structure be adopted, i.e., National, Regional/Catchment and Local/Sub-catchment/sub-basin levels. This is in line with the principle of subsidiarity and will ensure that action is taken at the sub-basin level by individuals and communities.
A 3-tier arrangement for laboratories is proposed as follows:

(i) Central Water Testing Laboratory

The CWTL to be a referral laboratory on water quality and pollution control within the Ministry Headquarters and will oversee, monitor, guide and support the laboratories under both WRMA and WASREB/WSBs. It will also be a useful tool for the ministry in carrying out its role of evaluating and monitoring the water quality activities of the two institutions.

(ii) Regional/Catchment Laboratories

These will be based in the 6 regions or catchment areas and will assist in the implementation of the water quality management plans by carrying out water testing within the catchment. It is proposed that WRMA and WASREB/WSBs take over the existing Regional laboratories, depending on the major activity, i.e. whether potable or raw water testing, of a given laboratory.

(iii) Subcatchment and other Laboratories

These laboratories will be based at the subcatchments level. They will be used mainly for routine environmental water quality monitoring and for drinking water quality surveillance. The laboratories whose main activity will be environmental water quality testing will be under WRMA while those mainly undertaking drinking water quality surveillance will be under WSBs or WSPs.

The Strategy recognizes that water resources have to be managed as an environmental resource (a primary responsibility of WRMA) and exploited sustainably (a primary responsibility of WASREB and WSBs)

1.9 Key Principles

(a) Policy Directions

Sessional Paper Number 1 of 1999 on National Water Policy on Water Resources Management and Development provides the policy direction to address the above mentioned challenges. The policy directions include the following:

- Treat water as a social and economic good.
- Preservation, conservation and protection of available water resources.
- Sustainable, rational and economical allocation of water resources.
- Supplying adequate amounts of water meeting acceptable standards for the various needs.
- Ensuring safe wastewater disposal for environmental protection.
- Developing a sound and sustainable financial system, for effective and efficient water resources management, water supply and water borne sewage collection, treatment and disposal

(b) Environmental Principles

The following are some of the common environmental principles to be adopted in the implementation of the national water quality management strategy:

1. Water quality management to be carried out in an integrated and holistic manner, acknowledging that all elements of the environment are interrelated;
2. Adoption of integrated planning as water issues are cross-cutting;
3. The precautionary principle to water quality management applies, in which active measures are taken to avert or minimize potential risk of undesirable impacts on the environment and necessary measures are taken to prevent environmental degradation from threats of serious or irreversible harm to environmental health;
4. The principle of pollution prevention at source and control at the lowest appropriate level;
5. The principle of environmental impact assessment of planned activity;
6. The principle of environmental audits of existing projects and economic activities in a given Catchment area;
7. The "polluter pays" principle, which says the cost of remedying pollution, degradation of resource quality and consequent adverse health effects, and of preventing, minimizing or controlling pollution, is the responsibility of the polluter;
8. The principle of sustainable development that takes into account the needs of the present generation without compromising the needs of future generations to use the same resources;
9. Equity in resource allocation; that requires the need to ensure that gender and other concerns are mainstreamed throughout the water quality management cycle – at all levels;
10. Cross-sectoral integration, which seeks to enlist all water-related sectors and ensure that they are coordinated to achieve Integrated Water Resources Management (IWRM);
11. Principle of application of realistic standards and regulations so that the standards must be realistic, achievable and regulations enforceable.
12. Principle of Data and Information sharing for effective decision making and planning.

(c) Shared Trans-boundary Water Resources Principles

The following general principles dealing with trans-boundary water resources have also been adopted for the implementation of the National Water Quality Management Strategy:

1. The principle of international cooperation and the principle of prior notification and information sharing where the potentially affected state has a right to demand notification in order to safeguard its interests;
2. The principle of the prevention, minimization and control of pollution of watercourses which is meant to minimize adverse effects on freshwater resources and their ecosystems, including fish and other aquatic species and on human health;
3. The inter-generational principle which states that future generation should not be deprived from access to an adequate resource base;
4. Trans-boundary responsibility where the government's responsibility does not end at the frontier; that in a country's own interest, it is important to have agreements on the equitable sharing of resources;
5. The trans-boundary principle where upstream water users have a responsibility towards downstream water users and vice-versa; this principle is in a sense the extension of the equity and precautionary principles across national borders.

1.10 Monitoring and Evaluation of the NWQMS

The MWI will have the overall mandate of monitoring and evaluating the implementation of the NWQMS. WRMA and WASREB will however be expected to develop indicators to monitor and evaluate their own pace of implementation of the NWQMS against the proposed strategic targets.

CHAPTER 2 NATIONAL WATER QUALITY MANAGEMENT STRATEGY

2.1 Key Strategic Actions

To ensure effective National Water Quality Management some key strategic actions should be taken.

2.2 Designing a National Water Quality Monitoring Program

Water Quality Management Cycle (Fig. 2.1 below) depicts the important components necessary for effective water quality management. All the components are essential and are inter-related. However the design and implementation of a national water quality monitoring program, is a very important component of the cycle. Regular national water quality monitoring, is the backbone of water quality management. The products of a national water quality monitoring program are water quality assessment reports. Based on these reports, further management decisions can be made, pollution control measures taken, and rules and regulations governing water use and protecting water sources developed.

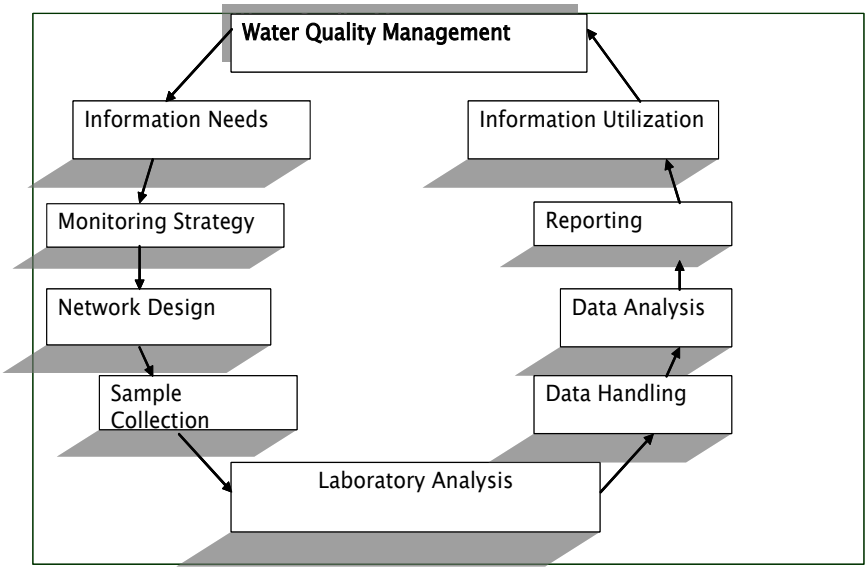

Fig 2.1: The Water Quality Management Cycle

However, a water quality monitoring program must be based on clear objectives and the criteria for selecting sampling stations agreed on.

2.2.1 Status and Challenges

The two main environmental water quality management tools currently operational under the MWI are:

- National Water Quality Monitoring Program
- The Laboratory Analytical Services

National Water Quality Monitoring Program is supported by six (6) Regional Water Testing Laboratories based at Kisumu, Nakuru, Nyeri, Embu, Mombasa and Kakamega. The Central Water Testing Laboratory (CWTL) is based in Nairobi and is operated by the MWI and WRMA while the six Regional Laboratories are shared between WRMA and the WSBs.

The Monitoring program currently being operated by WRMA faces the following challenges:

i. Inadequate human resources capacity
ii. Inadequate equipment
iii. Inadequate allocation of funds
iv. Lack of clear management and ownership structure for the water laboratories.

2.2.2 Strategic Responses

i. Revitalize the National Water Quality Monitoring Program to be operated by WRMA, in consultation with the MWI, WASREB, and other stakeholders.
ii. Ensure the selected monitoring stations in the catchment areas are stationed close to the RGS, to enable calculation of mass loadings of pollutants.
iii. Make an interactive map of the selected monitoring stations
iv. Establish a Water Quality data base managed by WRMA.
v. Produce regular water quality reports depicting the water quality status of the water resources in each catchment, and disseminate this information.

2.3 Enhancing Drinking Water Quality Surveillance Program

2.3.1 Status and Challenges

The DWQS Program was started in 1990. The objective was to monitor all drinking water sources for compliance against local and international drinking water quality standards. This involves sampling and testing of urban, rural, and community water supplies. For the program to run effectively it requires adequate finances. Both laboratory and field equipment are necessary to make this program a success. Currently WRMA is undertaking most of the activities of the programme while MWI, WASREB and the WSBs also play some role. The program appears to have stalled due to underfunding and there is therefore need to revive it. It should be noted that this activity is the responsibility of WASREB and WSBs working in conjunction with the WSPs who are under their supervision.

2.3.2 Strategic Responses

i. Revitalize the DWQS program under WASREB and WSBs.
ii. Make an inventory of all WSPs, including water tankers and vendors, and monitor the quality of their water regularly.
iii. Make an interactive map of all the selected monitoring points.
iv. Ensure that private water sources that also serve the public are also regularly monitored.

2.4 Rehabilitating Laboratories

2.4.1 Status and Challenges

Laboratories are critical tools in water quality management. There are six regional laboratories based at Kisumu, Nakuru, Nyeri, Embu, Mombasa and Kakamega and the Central Water Testing Laboratory based in Nairobi. The laboratories are not operating optimally due to inadequate allocation of funds and inadequate equipment and human resources capacity.

Currently the CWTL and the regional laboratories carry out only basic physico-chemical and microbiological analysis on raw, potable, and waste water. The current scope of analysis does not cover the full range of parameters, for example not all the pollutants being discharged into our water resources are analyzed for.

2.4.2 Strategic Responses

The laboratories must be selected or set up to meet the objectives of a monitoring program and attention paid to the choices of analytical methods. The range of concentrations measured by the chosen analytical methods must correspond to the concentrations set by the national water quality standards or any applicable guidelines or standards. In the very initial stages of development of a monitoring system, basic variables of water quality which do not require expensive, sophisticated equipment should be focused on.

It is proposed that the management of the laboratories be re-organized as follows:

i. The CWTL will be upgraded to be the premier reference water quality laboratory for the whole water sector. It will be run directly by the MWI where it will be a useful tool for the ministry's oversight role in the water sector.

ii. It is proposed that the six regional laboratories be managed by WRMA. They will assist in the implementation of the water quality management plans by carrying out water testing within the catchment.
iii. The laboratories at the subcatchments level will be used mainly for routine environmental water quality monitoring and for drinking water quality surveillance and will be managed by either WRMA or WSBs depending on whether the main activity is environmental water quality testing or drinking water quality surveillance.

iv. The equipment in all the laboratories will need to be modernized and a program of continuous improvement be put in place.
v. To ensure that the CWTL and the regional laboratories meet regional and international standards of good practice, they will need to be accredited.

2.5 Water Treatment Chemicals and Materials

2.5.1 Status and Challenges

The WSPs, which operate under the WSBs , mostly continue to use the traditional water treatment chemicals i.e. Alum, Soda ash and Calcium Hypochlorite. These chemicals have been in use in many countries for many years. They are easy to assay, are readily available and have few known side effects on human health. However, a number of new chemicals are now being introduced for water treatment. Their chemistry, side effects and efficacy may not be well understood, and some are not easy to test for their purity. In addition, many new water treatment filtration equipment, and disinfectants are now in the market for sale. The quality of some of the products cannot be ascertained; neither can they be easily replaced and serviced.

2.5.2 Strategic Responses

Before new water treatment chemicals or equipment are adopted for regular use, a vetting process needs to be put in place in order to safeguard water quality and the health of consumers. This will involve the Ministry and all the relevant stakeholders.

2.6 Surface Water Protection

2.6.1 Rivers

2.6.1.1 Status and Challenges

Most Kenyan rivers are adversely affected by human activities. Rivers react differently depending on the level and type of pollutant load discharged into it. Although rivers have some capacity to self-purify and cleanse themselves by diluting many of the pollutants, if the loads are too high, like in the case of upper Athi, the rivers lose this capacity and become ‘dead’ rivers. The main pollutants affecting Kenyan rivers iclude:

- All types of sediments
- Untreated municipal wastes
- Feacal matter from pit latrines
- Untreated industrial effluent
- Untreated storm water
- Leachates from solid waste dumps
- Agrochemical and pesticide residues
- Nutrients, such as nitrogen and phosphorus
- Mining wastes

2.6.1.2 Strategic Responses:

To address the above challenges, enforcement of environmental guidelines and rules and regulations for the protection of rivers and lakes needs to be enhanced.

2.6.2 Lakes

2.6.2.1 Status and Challenges

Unlike rivers, lakes have a long water residence time. This contributes to their complex dynamics including their ability to remediate pollutants. Lakes provide many valuable ecosystem services, support biodiversity, buffer flood flows and provide food and water. Lakes also support transportation, recreation, and other cultural amenities. Like rivers many Kenyan lakes are polluted.

The potential water quality threats to Kenyan lakes include:

- Increased salinity, changes in surface temperature, and contamination by municipal, industrial and agricultural chemicals.
- Excessive nutrients that lead to eutrophication
- Invasive weeds such water hyacinth.
- The over-productivity of organisms in water, leading to the creation of algal blooms and the depletion of oxygen concentrations, which threatens many animal and plant species.
- Cyano-bacterial blooms which pose human health threats, as the cyano-bacteria often release toxins, many of which are very toxic.

2.6.2.2 Strategic Responses

- Intensify regular water quality monitoring.
- Intensify surveillance on activities in the catchment.
- Sensitize farmers on proper use of agro-chemicals.
- Educate farmers on good farm husbandry.
- Plan all activities in the basin and within the vicinity of the lake.
- Treat all liquid wastes entering the lake, and avoid dumping solid wastes into lakes.
- Enhance enforcement of environmental guidelines and rules and regulations for the protection of rivers and lakes.
- Observe the lake reserve and avoid encroaching on it.

2.6.3 Wetlands

2.6.3.1 Status and Challenges

Wetlands are productive ecosystems providing many important benefits sometimes described as goods and services, including water storage, flood control, water filtration, recharge and discharge of water systems, important wildlife habitats, nutrients cycling/storage and related pollution control, landscape and amenity services, recreational services, agricultural production,

shoreline protection and storm buffer zones, food web functions and climate mitigation. Wetlands are key resources for sustainable development especially poverty alleviation and improvement of the livelihood of communities and require to be well managed.

Wetlands in Kenya occupy about 3% to 4% of the land surface and up to 6% during the rainy season. However, many of the Kenyan wetlands have been drained and used for agriculture and other developmental activities, leading to a loss in their full benefits.

2.6.3.2 Strategic Responses

The required strategic responses include:

- Adopting the wise use principle as stipulated in the Ramsar Convention in the management and use of wetland resources.
- Stopping destruction of wetlands as they act as pollutant filters.
- Carrying out EIAs before any alteration is carried out on wetlands.

2.6.4 Rainwater

2.6.4.1 Status and Challenges

Rainfall in Kenya is unevenly distributed in time and space. However, even in low rainfall areas, it can be harvested directly on roofs, ground surfaces or any other appropriate surfaces. Rainwater can used for various purposes including domestic, livestock/wildlife watering, recreational, and farming. It is often underutilized but if well exploited it can significantly reduce the water demand gaps in the different uses.

2.6.4.2 Strategic Responses to Ensure Rainwater Quality

2.6.4.3 The strategic responses include

- Conservation of runoff water, from the selected catchment in well maintained storage facilities.
- Allowing the first rains that clean the roof catchment to run off, before harvesting the clean rainwater,
- Disinfecting or boiling the rainwater before drinking where the quality is in doubt.
- Use of alum for sedimentation for turbid rainwater followed by filtration and disinfection before use.
- Selection of appropriate non-toxic roofing materials, storage tanks and facilities that do not contaminate the water.
- Covering storage tanks to keep out birds, frogs, lizards and dirt.
- Collaboration with the Kenya Rainwater Association, and other related NGOs in awareness creation, training, policy enhancement and advocacy, networking and information exchange, research and development in rainwater usage.

2.6.5 Ponds and Pans

2.6.5.1 Status and Challenges

Many Kenyans in the ASAL areas rely mainly on water that has been trapped in pans and ponds. These sources do not provide good quality water for drinking and therefore pose a health risk to consumers.

2.6.5.2 Strategic Responses

The water quality challenge for the pans and ponds can be addressed by:

- Sanitary protection of the pans and ponds.
- Avoiding use of harmful chemicals in the immediate catchment of the pan.
- Protecting the pan or pond with vegetative cover all round to trap sediment.
- Have a cut off trench to keep out contaminated storm water from entering the pan.
- Isolate livestock watering points from points where water is abstracted for domestic use.
- Boil or disinfect water from these sources before drinking.

2.6.6 Floods and Droughts

2.6.6.1 Status and Challenges

Water quality in Kenyan rivers and lakes is a close function of climate variability. Floods while having a dilution effect on rivers and lakes leading to lower levels of salts, contribute to the high color and turbidity of the waters. On the other hand, droughts lead to high concentrations of salts in the rivers and lakes and also greatly reduce the waste absorptive capacities of many rivers and lakes. In Kenya, due to poor emergency preparedness, floods are also often associated with deaths and displacement of families when they occur. They also disrupt many sewers and storm water drains, giving rise to discharge of raw effluent into water bodies.

2.6.6.2 Strategic Responses

To address the above challenges with respect to water quality, the sampling program should include dry and wet seasons to capture the water quality during these periods.

2.7 Ground Water Protection

2.7.1 Status and Challenges

Groundwater forms 619 million cubic meters of the available 14 % of national water resources. 31% of this is located in deep aquifers while the remaining 69% is in shallow ones. Generally groundwater water is less polluted than surface water. It varies both in quantity and quality and is unevenly distributed. In most of the high rainfall areas, there are many aquifers with high yields and fresh while in the drier areas, they are low yielding and tend to be saline. Over 18,000 boreholes have been drilled in Kenya as per the MWI borehole records. The average abstraction

yield is estimated at 7m^3/hr with about half of the boreholes drilled, yielding less than 4.8m^3/hr. (NWMP, 1992).

Along the coastal belt, salinization has become a big threat to groundwater, due to seawater intrusion. Higher than recommended fluoride levels are also encountered in some areas

2.7.2 Strategic Responses

- Extraction of groundwater at sustainable rates to avoid seawater intrusion.
- Intensifying groundwater quality monitoring by sinking observation boreholes.
- Establishing a monitoring program for selected production wells to capture any changing trends
- Requiring all borehole owners to have their water tested periodically as part of the water quality monitoring programme.
- Maintain updated database of borehole data

2.8 Protection of Coastal and Marine Waters

2.8.1 Status and Challenges

Marine and coastal resources are of direct human interest, because of their inherent ecological values. The Kenyan coast is ranked among the most productive and natural marine ecosystems. The rich biological diversity reflects the valued habitats which starting from the oceanic side include deep waters, comparatively close inshore, coral reefs, marine protected areas (MPAs), sea-grass meadows, sandy beaches, rocky shores, mangroves swamps, estuarine mudflats, lowland coastal forests and coastal hill forests which eventually give way to the savannah plains inland.

The marine and coastal areas are threatened by wastewater discharge and solid waste disposal. Another problem is the accidental oil spills from ships or unauthorized disposal of hazardous chemicals by ships. Other threats include mining wastes e.g. titanium and salt mines. The extent of damage to the marine life, including fisheries and the mangroves and coral reef, has not been fully quantified as no systematic monitoring is carried out.

2.8.2 Strategic Responses

To protect marine and coastal ecosystems the following is required:

- Intensification of water quality monitoring to determine composition of effluent discharges and the sediment loading.
- Enforcement of the pollution control regulations in respect to marine and coastal ecosystems
- Monitoring pollution from ships.

2.9 Sewage Treatment and Sewerage Management

2.9.1 Current Status and Challenges

It's the responsibility of the WSPs to collect, convey, treat and dispose of domestic wastewater, a task previously handled by Local Authorities. However, the current status is far from perfect and most of the WSPs are now being blamed for polluting many receiving water bodies. The challenges include:

- The sewerage systems in most of our urban towns are mixed sewer systems i.e. receive both domestic and industrial effluent.
- The areas covered and the populations served by the sewerage facilities are far below the areas covered and the populations served by the respective water supplies.
- The current treatment methods for sewage /domestic wastewater in the country are: oxidation ditches, aerated lagoons, trickling filters, stabilization ponds, wetlands and, trickling filters combined with stabilization ponds.
- The final effluent from sewage treatment plants is discharged into the aquatic environment while sludge is dumped in open fields with some being used as manure in agriculture.
- Predominantly the stabilization pond system is the mode of sewage treatment in most of our urban towns.
- Sewage treatment plants are either under loaded, overloaded and/ or are poorly maintained.
- Most of the sewage treatment works in the country do not have metering devices for both the inflow and outflow.
- The effluent from most of the sewage treatment plants does not meet the effluent discharge standards.
- The national costing policy for industrial effluent discharged into the public sewers is only based on volume and not quality.
- Only a few municipal councils in the country have sewerage and sewage treatment plants that are functional.
- There is inadequate pollution control enforcement capacity.

2.9.2 Strategic Responses

In this regard:

- There is urgent need for sewerage systems and sewage treatment plants to be rehabilitated/ expanded in the country in order to protect water resources.
- Adequate funds should be allocated for urban wastewater management.
- Enforcement capacity should be strengthened

2.10 Industrial Waste Water Management

2.10.1 Status and Challenges

Industries are often located in the urban centres. However, many of these industries do not treat or pre-treat their waste water before connecting to the sewers. This interferes with the treatment

of municipal domestic waste water resulting in poor quality final effluent. Some of the worst polluters therefore are industries and by extension municipalities.

2.10.2 Strategic Responses

- License all point sources of pollution such as effluent discharge points from factories.
- Incorporate effluent discharge licensing into issuance of water abstraction permits or connections to public water utilities.
- License storm water drains as point discharge points.
- Treat all storm water before discharge.
- Apply polluter pays principle.
- Intensify data collection and management from all polluters.
- Promote information dissemination and awareness creation on the effects caused by discharging untreated wastes, in order to change attitudes.
- Give tax incentives for waste water treatment equipment.

2.11 Onsite Sanitation and Pollution from Slums

2.11.1 Status and Challenges

Low-income households account for 30-70% of the urban population, depending on the city or town, and comprise the fastest growing segment of the urban population. These people live in informal settlements where water and sanitation utilities are not provided. Onsite sanitation and pollution from slums pose serious challenges to water quality. These include:

- Current levels of access to improved sanitation are 45% in rural areas and 55% in urban areas (NWSS, 2007)
- Most slum dwellers pay to use the communal toilets while some use the 'flying toilet'- where faeces is wrapped into a polythene paper and flung into the river or in the open.
- There is inadequate capacity to enforce municipal bylaws with regards to hygiene and sanitation in slum areas.

2.11.2 Strategic Responses:

- Sensitize and educate communities on the policies, regulations and laws that concern public health, ensuring that gender and cultural concerns and practices are addressed.
- Develop a sustainable national programmes on water and sanitation, suitable for rural, urban, peri-urban and slum communities.
- Enforce hygienic disposal of human waste.
- Discourage practices like defecating in the bush, in fields or in open pits and give proper sanitation high priority.

2.12 Pollution from Agrochemicals

2.12.1 Status and Challenges

The Kenyan economy is mainly agro-based. Pollutants from agricultural activities include fertilizers and pesticides. Due to poor usage and management of the agrochemicals as well as inadequate soil conservation measures, the residues get into water bodies.

2.12.2 Strategic Response

- Educate farmers and pastoralist on best usage and management of agrochemicals.
- Hazardous agrochemicals should be disposed off in environmentally acceptable manner.
- All stakeholders should work together to ensure best practices.

2.13 Special wastes

These include hospital, laboratory and radioactive wastes.

2.13.1 Status and Challenges

Many health facilities in the country handle various materials and tools, which may be harmful if not safely disposed of. Some of the wastes may be infectious, radioactive or carcinogenic. If such wastes are not carefully handled and disposed of, they pose a great danger of contaminating water sources.

Wastes from many public, commercial, and private laboratories may contain toxic and harmful substances, depending on the nature and type of laboratory. The wastes may also be highly acidic or alkaline and are thus corrosive to plumbing works. Often laboratory wastes are washed down the sink and into the sewer, without any treatment, thereby posing a real danger to the sewage works, and eventually the receiving water bodies.

2.13.2 Strategic Responses

- Special wastes should be sorted out by type and nature, and disposed of appropriately, including incineration where necessary.

2.14 Urban Solid Wastes

2.14.1 Status and Challenges

Current approaches to solid waste management are neither effective nor sustainable. Most local authorities give priority to waste water treatment giving little attention to solid waste. The authorities have been unable to cope with collection, treatment and disposal of solid wastes due to inadequate capacity and financial constraints.
Some of the challenges include:

- Solid waste in most urban areas is disposed of in open dumps or sanitary landfills, burned or composted.
- There are no properly designated dumping sites.
- Incineration is expensive and not affordable by many municipalities.

2.14.2 Strategic Actions

Adopt effective and sustainable solid waste management practices including:
- Minimizing the production of waste at source.
- Developing programmes that will stimulate waste recycling and reuse.
- Adopting appropriate technologies and increasing service coverage.
- Strengthening enforcement and compliance with various legal environmental provisions.
- Designating appropriate solid waste dump sites in all urban centres.
- Sorting out solid wastes at source by type, and disposing them separately.

2.15 Strengthening Data Collection and Information Management

2.15.1 Status and Challenges

The pillar for effective water quality management is data collection, data evaluation and analysis, and the resultant water quality status information which is then used for further decision making and forward planning. Currently data management as a whole appears to be a weak area and a lot needs to be done in data generation, storage and handling. There is also the issue of data integrity, which is linked to laboratory accreditation.

2.15.2 Strategic Responses:

- All the stakeholders should collect and maintain the water quality data and information pertaining to their mandates in an appropriate manner.
- WRMA will maintain a comprehensive and up to-date, sector-wide water quality data base.
- Data and information dissemination modalities will be established.

2.16 Capacity Building for Water Quality Management

2.16.1 Status and Challenges

Many local institutions offer some form of training in water and sanitation. Most public universities also offer undergraduate, Masters and PhD courses related to water science and public health, while Certificate and Diploma courses are offered by some universities and national polytechnics.

Some of the training institutions have the capacity to carry out water quality analysis and they also have modern technologies and computer facilities to carry out data analysis and interpretation. Despite the availability of many training facilities for WQM personnel, the sector is still understaffed with water professionals. This may be due to the lack of harmonization of the schemes of service for chemists, analysts and ecologists. Currently the personnel strength of the

WQ&PC officers in MWI and its institutions is less than 40, compared to a minimum requirement of up to 100 technical officers to be able to carry out meaningful national water quality management.

2.16.2 Strategic Responses

- Tertiary institutions should be encouraged to develop courses relevant to water quality management.
- Kenya Water Institute needs to be given additional support to improve training for water quality personnel.
- Establish collaboration with the private sector e.g. for attachment of trainees.
- Carry out overall training needs assessment required for the implementation of the NWQMS.
- Community training and awareness on water quality issues to be initiated.
- Improve terms and conditions for WQM pesonnel

2.17 Institutional Framework for Implementation of NWQMS

2.17.1 Status and Challenges

The MWI undertook Water Sector Reforms (2002-2005) to create new institutions: These new institutions are: Water Resource Management Authority (WRMA) whose role is to effectively manage use of water resources; Water Services Regulatory Board (WASREB) with responsibility for regulating and monitoring Water Services Boards (WSBs). WSBs which develop water services infrastructure and license Water Service Providers (WSPs); Water Service Providers (WSPs) who provide water and sanitation services; Catchment Area Advisory Committees (CAAC) which facilitate community involvement in the conservation of catchments areas; and Water Users Associations (WRUAs) which represent the interests of consumers in the water sector.

However, despite the reforms, water quality management was not given due emphasis in the mandates and roles of these institutions. Currently co-ordination between the multi sectoral institutions is weak. The Ministry of Environment has developed a policy on water catchment areas and protection of resources such as the water towers, but under MWI similar catchment management issues are also addressed through the CAACs, WRUA's, and other relevant institutions. NEMA has also developed its own rules on wastewater management which are in conflict with WRMA's rules.

2.17.2 Strategic Responses

- Incorporate NWQMS in the strategies of the water sector institutions.
- Establish a coordination mechanism for implementation of NWQMS for all relevant stakeholders. Enhance the capacity of CAAC's and WRUA's to be effective players in the implementation of the NWQMS.
- Facilitate KEWI to spearhead research and appropriate technology adoption in water quality management.
- Establish a Research Fund to ensure sustainability of water research, including water quality.

- Regularly review water quality standards to ensure relevance to evolving national and d international requirements.
- Ensure adequate human resource capacity and financial support.

Table 2.1 shows the Institutional Structures proposed to implement the NWQMS.

Table 2.1: *Institutional Structures for Implementing NWQM strategy*

Institution	**Function and Responsibilities**
Ministry of Water and Irrigation (MWI)	Policy management on, development and review of and overseeing implementation of, the National water Quality management Strategy
Water Resource Management Authority (WRMA)	Designing and implementation of National (Environmental) Water Quality Monitoring Programme.
Catchment Areas Advisory Committees (CAAC)	To advise on water quality issues at catchment level
Water Resource Users Association (WRUA)	Assist in water monitoring and information gathering.
Other Stakeholders	Provide complementary roles in some aspects of water quality monitoring; including resource mobilization and awareness creation.
Water Services Regulatory Board (WASREB)	Overseeing the WSBs in implementation of National Drinking Water Quality Surveillance
Water Services Boards (WSBs)	Implementation of National Drinking Water Quality Surveillance
Kenya Water Institute	To facilitate research in collaboration with local and international institutions for technology transfer and capacity building

2.18 Water Quality Implementation Plan

2.18.1 Status and Challenges

Currently the various roles of water quality management shared among WRMA, WASREB and their respective institutions are not clearly specified. As a result of this scenario, some aspects of water quality are not properly tackled. Also, enforcement for compliance is weak. The situation is compounded by inadequate human resources capacity with respect to water quality management.

2.18.2 Strategic Response

- MWI to oversee the overall implementation of the NWQMS.
- WRMA to implement the National (Environmental) Water Quality Monitoring Programme.

- WASREB to oversee the implementation of National Drinking Water Quality Surveillance by WSBs.

2.19 Stakeholder and Community Participation

2.19.1 Status and Challenges

IWRM recognizes the importance of community participation and the involvement of all stakeholders for sustainability. It also recognizes the special role played by women and children as critical water managers/players. The success in the implementation of the NWQMS pre-supposes effective stakeholder and community participation at the sub-catchment and catchment levels.

2.19.2 Strategic Response

- WRMA to bring together the water sector stakeholders and communities to address water quality and pollution control problems.
- WSPs to create public awareness on drinking water quality within their respective areas.

2.20 Trans-boundary water quality management

2.20.1 Status and Challenges

About 50% of Kenyan waters are trans-boundary in nature. TB waters should be well managed, harnessed and utilized for the social and economic benefit of all Kenyans. In this regard Kenya, is formulating a policy on the management of TB waters, based on the internationally recognized principles accepted for the sustainable management and equitable utilization of trans-boundary waters. Before formulation of the policy on the management of trans-boundary water resources, the country's approach in the management of its trans-boundary waters was reactive and, on the whole, lacking a clear vision. This undermined the ability to harness and protect trans-boundary waters effectively for socio-economic development.

Already, the MWI has established the Trans-boundary Waters Division as the focal point for issues dealing with trans-boundary waters.

2.20.2 Strategic Responses

- Incorporate NWQMS in the implementation of the National Trans-boundary Waters Policy.
- Prepare protocols on the transboundary water quality management

2.21 Biological Water Quality Monitoring

2.21.1 Status and Challenges

Biological monitoring is an important aspect of water quality management. It can supplement the current physico-chemical water quality monitoring as it is easy and versatile and can be easily adopted. Pilot Biological Water Quality Monitoring (BWQM) trials have already been carried out successfully on streams within the Lake Victoria basin.

2.21.2 Strategic Responses

- Extend the biological water quality monitoring (BWQM) that has already been successfully piloted in the Lake Victoria Basin to be a core component of the National (Environmental) Water Quality Monitoring Programme.
- Build capacity for BWQM.
- Involve schools and communities in BWQM.

2.22 Applied Water Research

2.22.1 Status and Challenges

Research in water has stalled since about 1993 in MWI. Research and development is critical to water quality management. It therefore needs to be addressed.

There are many areas, in which research can be carried out, such as in, best treatment technologies, innovative water treatment options for rural communities and effective waste water treatment methods. Many institutions of higher learning carry out research on water, but there is no coordination.

2.22.2 Strategic Responses

- Empower KEWI to take the lead role in water research including water quality.
- Establish a coordinating mechanism for research on water among the various players.

2.23 Water Quality Standards

2.23.1 Status and Challenges

Kenya now has its own water quality standards, custody of Kenya Bureau of Standards, with respect to drinking water (including bottled water) and waste water. However water quality standards for various other uses still need to be developed.

2.23.2 Strategic Response

The WQ standards that should be developed include for:

- Environmental water quality
- Irrigation Waters
- Food processing industries
- Livestock Watering
- Wildlife Watering
- Recreational waters
- Fisheries
- industries
- Water re-use

2.24 Information, Education and Communication

2.24.1 Status and Challenges:

One of the major challenges in water quality management is lack of adequate and reliable information. Water quality issues are often not well or easily understood, and are only appreciated when there is a water quality crisis. The collection, handling, processing, storage and dissemination of data and information have hitherto not been carried out efficiently and effectively. Coordination, networking and sharing of data/information among all relevant stakeholders to enhance integrated planning and informed decision making has been lacking.

2.24.2 Strategic Response

- Enhance data and information collection.
- Improve on data analysis/processing.
- Establish a coordination and networking mechanism among the stakeholders
- Establish a Water Quality Data Base for the whole water sector.
- Regularly update and share water quality data and information as necessary.
- Establish mechanisms for water quality data and information dissemination.
- Utilize the existing organs and forums to educate consumers on the importance of water quality issues, e.g. through workshops, seminars, school programs and media campaigns.
- MWI and WRMA to arrange for annual events / open day, e.g. during World Water Day, for other stakeholders and consumers to acquaint themselves with water quality issues and their expected roles.
- Incorporate water quality information into school curriculum to inculcate early an understanding of water quality issues and the roles and responsibilities of consumers.

2.25 Enforcement and Compliance to Environmental Guidelines

2.25.1 Status and Challenges:

Clear, comprehensive and enforceable standards are a critical key in addressing persistent water quality pollution challenges. This should be accompanied by adequate levels of voluntary compliance among the polluters. Unfortunately we have very low levels of voluntary compliance

in Kenya. This is compounded by generally weak enforcement capacities in the responsible institutions.

2.25.2 Strategic Responses

- Enhance enforcement capacities in the responsible institutions.
- Provide incentives for voluntary compliance.

2.26 Review and Harmonization of Laws Policies and Strategies

2.26.1 Status and Challenges

Kenya has good water and environmental protection laws and regulations. However, the mandates for their implementation and enforcement are spread among various institutions, thereby creating overlaps and coordination difficulties.

2.26.2 Strategic Response

A periodic review of the laws and regulations to conform to changing trends and needs is required.

2.27 Establishment of National Water Quality Laboratories

2.27.1 Status and Challenges

The Central Water Testing Laboratory (CWTL) is based in Nairobi and is the MWI's main tool in monitoring and evaluating the implementation of water quality and pollution control activities by WRMA, WASREB and WSBs. It also supplements the activities of WRMA, WASREB and WSBs by sending intervention teams of technical personnel to assist in cases of emergencies such as water-borne disease outbreaks. The laboratory also offers water quality analytical services to other institutions and the public. The CWTL is however underfunded, poorly equipped and under-staffed.

2.27.2 Strategic Response

The CWTL in Nairobi should be elevated initially to a referral laboratory and later to a semi-autonomous status under the MWI. Once it assumes semi autonomous status, it can be renamed the "National Water Quality Laboratories". It will be the premier reference water quality laboratory - a centre of excellence for water quality analysis - for the whole water sector.

CHAPTER 3 PROPOSED TARGETS

3.1 List of Selected Key Strategic Actions

The following is a list of the Key selected Strategic Actions of the NWQMS that should be implemented to safeguard the quality of the national waters and hence human and environmental health:

1. Development of a National Water Quality Management Policy
2. Preparation of Regional WQ Management Strategies and Sub-Catchment WQ Management Action Plans
3. Revitalization of the National Water Quality Monitoring Programme
4. Revitalization of Drinking Water Quality Surveillance
5. Upgrading of CWTL and the lower level laboratories
6. Strengthening human resources capacity for water quality management
7. Preparation of NWQMS Implementation Plans,
8. Involvement of Stakeholders and Community Participation
9. Improving trans-boundary water quality management
10. Incorporation of Biological Water Quality Monitoring
11. Strengthen Applied Water research
12. Strengthening guidelines for implementation of both National Environmental Water Quality Monitoring and Drinking Water Quality Surveillance programmes
13. Supporting data collection and information management and establishing an up to date water quality database
14. Adopting modern technologies in all aspects of water quality management
15. Enhancing education and awareness
16. Enhancing enforcement and compliance
17. Improving management of water pollution episodes/disasters
18. Regular Review and Harmonization of Policies, Laws and Strategies
19. Establishment of the National Water Quality Laboratories to be the centre of excellence in water quality analysis

CHAPTER 4 IMPLEMENTATION PLAN

Table 4.1: *Overall Time Schedule, 2012-2016*

S/No	Planned Strategic Action	2012	2013	2014	2015	2016
1	Preparation of Regional WQ Management Strategies and Sub-Catchment WQ Management Action Plans					
2	Revitalization of the National Water Quality Monitoring Programme					
3	Revitalization of Drinking Water Quality Surveillance					
4	Upgrading of CWTL and the lower level laboratories					
5	Strengthening human resources capacity for water quality management					
6	Preparation of NWQMS Implementation Plans					
7	Involvement of Stakeholders and Community Participation					
8	Improving trans-boundary water quality management					
9	Incorporation of Biological Water Quality Monitoring					
10	Strengthening applied water research					
11	Strengthening guidelines for implementation of both National (Environmental) Water Quality Monitoring and Drinking Water Quality Surveillance programmes					
12	Supporting data collection and information management and establishing an up to date water quality database					
13	Adopting modern technologies in all aspects of water quality management					
14	Enhancing education and awareness					
15	Enhancing enforcement and compliance					
16	Improving management of water pollution episodes/disasters					
17	Regular Review and Harmonization of Policies, Laws and Strategies					
18	Establishment of National Water Quality Laboratories					
19	Development of a National Water Quality Management Policy					

References

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