



THE GOVERNMENT OF KENYA

MINISTRY OF WATER AND IRRIGATION

**WATER & SANITATION SERVICE IMPROVEMENT PROJECT
ADDITIONAL FINANCING (WaSSIP AF).**

SECOND DRAFT

**ENVIRONMENTAL AND SOCIAL MANAGEMENT
FRAMEWORK (ESMF)**

November, 2011



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GLOSSARY OF TERMS

Cumulative impacts/effects: The total effects on the same aspect of the environment resulting from a number of activities or projects.

Developer/Proponent/Sponsor: the entity – person/ company/agency – proposing to develop/implement/install a new project/sub- project or expand an existing project under the WaSSIP Additional Financing.

Direct impacts: An effect on the environment brought about directly by the WaSSIP Additional Financing projects.

Disclosure: Information availability to all stakeholders at all stages of the development of projects.

Environment: physical, biological and social components and processes that define our surroundings.

Environmental Impact Assessment (EIA): A comprehensive analysis of the project and its effects (positive and negative) on the environment and a description of the mitigative actions that will be carried out in order to avoid or minimize these effects.

Environmental Monitoring: The process of examining a project on a regular basis to ensure that it is in compliance with an Environmental Management Plan (EMP), or the Government of Kenya (GoK) Environmental Impact Assessment (EIA) certification of approval conditions and / or environmental prescriptions.

Impact: A positive or negative effect that a project has on an aspect of the environment.

Indirect impact: A positive or negative effect that a project indirectly has on an aspect of the environment.

Involuntary resettlement: The forceful loss of land resources that requires individuals, families and / or groups to move and resettle elsewhere.

Lead Agency: The agency with primary responsibility for the protection of the environment. For instance, the lead agency for environment matters in Kenya is the National Environment Management Authority (NEMA).

Mitigation measures: The actions identified in an EIA to negate or minimize the negative environmental impact that a project may have on the environment.

Project and sub-project: a set of planned activities designed to achieve specific objectives within a given area and time frame.

Project Brief: The initial submitted document to NEMA to initiate the process that will lead to the issuance of the EIA certificate of approval.

Scoping: The initial stage in an environmental assessment that determines the likely major environmental parameters that will be affected and the aspects of the project that will bring upon these effects.

Screening: An initial step when a project is being considered for environmental assessment. The screening is the determination of the level of assessment that will be conducted. In the case of GoK, screening will place project into one of three environmental categories (I, II or III).

Significance: Importance.

Significant effect: An important impact on an aspect of the environment.

Stakeholder: Any person or group that has an interest in the project, and the environmental effects that the project may bring about.

ACRONYMS & ABBREVIATIONS

AFD	French Development Agency
AF	Additional Financing
AfDB	African Development Bank
AWSB	Athi Water Services Board
CAS	Country Assistance Strategy
CBO	Community Based Organisation
CWSB	Coast Water Services Board
DDO	District Development Office
DEO	District Environment Officer
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMCA	Environmental Management Co-ordination Act
EMP	Environmental Management Plan
ERSWEC	Economic Recovery Strategy for Wealth and Employment Creation
ESMF	Environmental and Social Management Framework
GDP	Growth Domestic Product
GoK	Government of Kenya
HIV/AIDS	Human Immuno-Deficiency Virus
IBA	Important Bird Area
IDA	International Development Association
ITCZ	Inter Tropical Convergence Zone
IUCN	World Conservation Union
KFS	Kenya Forest Service
LVNWSB	Lake Victoria North Water Services Board
M&E	Monitoring & Evaluation
MDG	Millennium Development Goals
MoWI	Ministry of Water and Irrigation
MTR	Medium Term Review
MWI	Ministry of Water and Irrigation
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organization
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SEA	Strategic Environmental Assessment
USD	United States Dollars
WAB	Water Appeals Board
WaSSIP	Water and Sanitation Service Improvement Project
WB	World Bank
WRMA	Water Resources Management Authority
WSBs	Water Services Board
WSPs	Water Services Provider
WSTF	Water Services Trust Fund
WUA	Water Users Association

EXECUTIVE SUMMARY

This Environment and Social Management Framework (ESMF) relates to the Water and Sanitation Service Improvement Project (WaSSIP) Additional Financing (AF) which is being financed by the World Bank. The Ministry of Water and Irrigation (MoWI) through the Water Services Board Coastal Water Services Board (CWSB) Athi Water Services Board (AWSB) and Lake Victoria North Water Services Board (LVNWSB) remain responsible for implementing the WaSSIP (AF) including the provisions of this ESMF.

The project development objectives are to (a) increase access to reliable, affordable and sustainable water supply and sanitation services; and (b) improve water and wastewater services in the areas served by Athi Water Services Board (AWSB), Coast Water Services Board (CWSB) and Lake Victoria North Water Services Board (LVNWSB).

This ESMF is to be used by the MoWI in order to ensure that the World Bank environmental safeguard policies, with emphasis on Operational Policy OP 4.01 (Environmental Assessment) are adequately addressed. MoWI should in addition ensure that the relevant capacity and training needs are established in order for the recommended measures to be implemented effectively.

The purpose of this ESMF is to ensure that environmental and social management is integrated into the development and operation of projects to be financed under the WaSSIP AF to ensure effective mitigation of potentially adverse impacts while enhancing accruing benefits.

This ESMF has been prepared in compliance with the World Bank's Safeguard Policies and Kenya's Environmental Management and Coordination Act (EMCA) of 1999, both of which require environmental and social assessment prior to any investment. The ESMF recognises all World Bank (WB) safeguard policies relevant to social and environmental management and has also factored and duly recognised all Kenyan sectoral laws with bearing to environmental and social management within WaSSIP AF.

Preparation of the ESMF employed both desktop and field research methods, whereby project planning documents were reviewed to provide an insight into the scope, design and motivation of the project and later complemented by on-the ground observations and consultations with municipalities and the public within target municipalities. The core outcome of the ESMF process is an Environmental Management Plan (EMP) through which municipal and community action in environmental and social mitigation within WaSSIP AF will be collated.

Project Background

The Water and Sanitation Service Improvement Project (WaSSIP) will increase access to reliable, affordable and sustainable water supply and sanitation services; and improve the water and wastewater services in the areas served by the three Water Services Boards. At present, about 60 percent of Kenyans have access to safe drinking water while access to basic sanitation is at 80 percent. The project is expected to benefit about 9.3 million Kenyans in 27 districts with improved water and sanitation services, including residents of some of Kenya's largest urban informal settlements.

Water sector reforms since 2002 have included (i) the clarification of roles and accountabilities of sector institutions; (ii) the inclusion of multiple stakeholders in decision making processes of service delivery institutions; (iii) the financial ring-fencing of the operations of service delivery

institutions; (iv) financial and technical audits of sector institutions' operations and performances; and (v) strengthened financial management and procurement capacity. The Bank supported these actions through the \$15 million Nairobi Water and Sewerage Institutional Restructuring Project which was completed in December 31, 2007.

The WaSSIP represents the second phase of the World Bank's support to the Government of Kenya's water sector reform. The project will consolidate, enhance and scale up these measures, improve the dissemination of information as well as strengthen the risk management and internal controls of water services institutions.

Project Description

The project comprises three components. These are:

Activities envisaged under the WaSSIP AF include:

Component 1: Support to the Athi Water Services Board. This component will support the rehabilitation and extension of water supply systems, including the development of additional water sources for Nairobi and other drought mitigation measures, and improvements in wastewater collection and treatment facilities in the jurisdiction of the Athi Water Services Board (AWSB). Technical assistance will also be provided to the AWSB and its water services providers, the Water Services Regulatory Board, and the Water Appeal Board.

Component 2: Support to the Coast Water Services Board. This component will support the rehabilitation and extension of water supply schemes, including drought mitigation measures and institutional strengthening of the Coast Water Services Board and its various water service providers.

Component 3: Support to the Lake Victoria North Water Services Board. This component will support the rehabilitation and extension of water supply schemes, including drought mitigation measures and institutional strengthening of the Lake Victoria North Water Services Board and its various water service providers.

The Additional Financing will support all three project components (one for each WSB) and be used to expand the types of activities supported by the current project, specifically investment in water and sanitation infrastructure and support for strengthening of the water sector entities. Specifically, the water services boards have indicated that they need technical assistance to establish and operate a computerized complaints system, undertake energy audits, assess unaccounted for water, improve billing and collection, reform human resources management, map and model networks, improve communication and outreach, and align of sewerage master plans with urban and metro development plans.

Therefore, in compliance with the requirements outlined in the Environmental Management and Coordination Act (1999) and enforced by the National Environment Management Authority (NEMA) and the World Bank's Safeguards Policies, the government of Kenya represented by the **Ministry of Water and Irrigation (MoWI)**, has prepared this Environmental and Social Management Framework (ESMF). The ESMF is an instrument, through which the sub-project's environmental and social impacts are identified, assessed, evaluated and have appropriate mitigation, management and monitoring measures, designed and incorporated within the sub-project itself.

This ESMF is prepared for the WaSSIP Additional Financing and will be complemented by two other safeguards instruments: Environmental Assessments (EAs) accompanied by Environmental Management Plans (EMPs) for each subproject identified under WaSSIP AF. A Resettlement Policy Framework (RPF) has also been prepared that provides standards and procedures for compensation for any land acquisition, assets, or restriction of access to resources that WaSSIP AF investment may require, in accordance with World Bank OP 4.12 – Involuntary Resettlement. An Indigenous People Policy Framework (IPPF) has also been prepared in regard to the potential impacts the WaSSIP AF may have on the Sengwer community (LVNWSB area) who are categorised as indigenous.

Rationale for Additional Financing, rather than alternatives

The proposed Additional Financing would finance additional investments to improve access to water and sanitation services, and the drought response measures will make these services more reliable. These investments would permit the scale-up of the project's impact and development effectiveness. The Recipient is fully committed to scaling up the project activities, and processing an additional credit would bring procedural and other cost-effectiveness gains for the Recipient, as compared to preparing a new project. Moreover, the scale-up of activities can be easily accommodated in the context of the ongoing project, as implementation will rely on the Recipient's existing capacity and existing project arrangements. Activities would be completed within three years of the original project closing date of December 31, 2012. Thus, the Additional Financing will require an extension of the current project closing date. The economic justifications of the additional activities remain the same as in the original project. The additional activities will not raise the environmental category of the original project (category B) or trigger any new safeguard policies. Several changes to the project's key performance indicators are proposed for the original project to reflect the Bank's core indicators. These will be also used to monitor the outcomes of the proposed Additional Financing including the outcomes of the drought response measures. Targets will be adjusted to reflect the impact of the Additional Financing.

Environmental and Social Requirements

The Government of Kenya (GoK) by its national laws and the World Bank's Operational and Procedural Policies, specifically OP 4.01 (Environmental Assessment) requires the government to prepare an Environment and Social Management Framework (ESMF), which establishes a mechanism to determine and assess future potential environmental and social impacts of the MoWI planned investments/activities under the proposed WaSSIP AF.

An ESMF is prepared during project preparation as per OP 4.01 when the nature of the proposed investments is well understood, but details (either locations, designs, or both) of the specific investments in the project are not yet known, and therefore a detailed ESIA cannot be prepared. The purpose of the ESMF is:

- (i) to provide as much information as possible about environmental and social impacts (including possible land acquisition and resettlement) at the project's current state of preparation;
- (ii) to inform project planning and design process by comparing potential impacts of alternative locations, configurations, and construction techniques that are under consideration; and
- (iii) to describe procedures for subsequent assessment of impacts and development of appropriate impact management instruments when the details of the project become available.

The scope and coverage of an ESMF generally includes the following key tasks:

- Task 1: Screening and Scoping of Issues
- Task 2: Environmental Policy and Regulatory Framework
- Task 3: Identification of Key Environmental and Social Issues
- Task 4: Description of Typical Mitigation Measures to Avoid or Minimize Impacts
- Task 5: Outlines of Environmental and Social Management Plans
- Task 6: Public Consultation and Disclosure Process

An ESMF is required for this project because the precise details of the majority of investments are yet to be defined in terms of their exact location etc. Therefore it is not possible to ascertain the precise location and nature of impacts at this stage.

The draft ESMF report will firstly be made publicly available to project-affected groups and local NGOs in Kenya by placing a public notice in a national newspaper and making the report available at the offices of relevant government ministries and NEMA. This measure will also satisfy the Environmental Management and Coordination Act (EMCA).

OP 4.01 further requires that the ESMF report must be disclosed as a separate and stand alone by the Government of Kenya and the World Bank as a condition for Bank Appraisal of the WaSSIP AF. The disclosure of these documents should be both in locations where it can be accessed by the general public and local communities using the media, and at the InfoShop of the World Bank. The date for disclosure must precede the date for appraisal of the project. Following revisions, the ESMF will be officially submitted to the World Bank, and the final version will be disclosed prior to the Project being sent for approval to the Executive Directors of the World Bank.

Safeguard Screening Procedures

The proposed project has been rated Category A under the World Bank Operational Policy on Environmental Assessment (OP4.01), requiring a full Environmental Assessment (EA). The ESMF provides a baseline environmental assessment, assesses positive and negative environmental and social impacts of the project through screening tools, and recommends mitigation measures to limit negative impacts. The screening and review process will determine whether a particular subproject will trigger a safeguard policy, and what mitigation measures will need to be put in place. The screening and review process will also ensure that subprojects that may have potentially significant impacts will require more detailed study and the need for subproject specific EA and/or EMP. Environmental Management Plans have been prepared for subprojects under the original project; an Environmental Assessment has been prepared for the Northern Collector Tunnel subproject that is being financed from the Additional Financing.

Procedure for screening and development of EMPs

The ESMF serves as a guide to the preparation of subsequent site-specific Safeguards documents such as an Environmental and Social Impact Assessment, Environmental Management Plan, Emergency Response Plan, or similar documents that are appropriate to the nature of the project, once specific sites and project designs are selected and can be subject to detailed impact assessment. This ESMF requires that all the large subprojects in WaSSIP AF be subjected to the development of an EA and EMP and each of the smaller investment proposed for funding under the WaSSIP AF be screened for social and environmental impacts using the Screening Checklist provided in section 6.4.1. The screening will take place at the feasibility stage and will determine

compliance with both Government of Kenya (GoK) and World Bank Safeguard Policies and statutes, following which TORs for follow-up environmental impact assessment (EIA) and resettlement action plan (RAP) studies will be developed.

Follow-up EIA studies will be guided by LN 101 of EMCA 1999, and World Bank OP 4.01 while the scale of RAP studies will depend on whether screening has allocated an S1, S2 or S3 category to the sub-project in line with the RPF. Screening and follow-up EIA study will yield an Environmental Management Plan (EMP)—a generic version of which is outlined below—which will be reviewed and approved by WaSSIP Additional Financing and the World Bank for submission to NEMA. Upon approval by NEMA, the EMP will guide resolution of all potential environmental and social impacts likely to be identified for each investment. A RAP will be developed to deal with any resettlement or compensation that is needed as a result of project activities.

Environmental and Social Impacts

The following adverse impacts have been identified as likely to arise from the implementation of the WaSSIP Additional Financing and which this ESMF report seeks to address:

Environmental Impacts

- *Water quality and quantity degradation (both surface & ground water)*
- *Soil erosion and quality deterioration*
- *Loss of biodiversity*
- *Ecological imbalances due to construction of intake and abstraction of water from the rivers*
- *Surface water sedimentation*
- *Damage to aquatic habitats*
- *Soil salinity*
- *Sanitation and waste management problems*
- *Pathogen breeding ground*
- *Introduction of invasive flora species*
- *Loss of high value trees especially those with medicinal value*
- *Borrow pit impacts*
- *Downstream flooding or water reduction*

Socio-cultural and Economic Impacts;

- *Displacement of local inhabitants*
- *Damage to property e.g. crops, structures, houses*
- *Water use conflicts*
- *Land use change*
- *Loss of crops*
- *Damage of aesthetics of the area/land*
- *Dam safety related impacts*
- *Traffic congestion*
- *Camp construction impacts*

Health Impacts

- *Spread of water borne diseases*
- *Spread of HIV/AIDS*
- *Dust impacts*
- *Noise impacts*

- *Construction Camps related impacts*

The impacts are considered to be localised to the specific project areas, limited in scale and in terms of magnitude and should be easily mitigated through the preparation of adequate EMPs and RAPs whenever required.

Positive Impacts

- *Catchment Rehabilitation and Management*
- *Soil Conservation*
- *Water Resources Conservation*
- *Birdlife Habitat*
- *Improved soil conservation*
- *Environmental Protection*
- *Food Security*
- *Poverty Alleviation*
- *Raise Rural Income*
- *Improved access to water for domestic purposes*
- *Water for domestic use-washing clothes, bathing, watering of livestock*
- *Employment creation for community members*

Reporting and Performance Review Requirements

Quarterly environmental and social progress reports will be prepared by the AWSB, CWSB, LVNWSB Technical Assistance Consulting Team comprised of Social and Environmental specialists. These reports will be submitted to WaSSIP AF before the Bank's supervision mission arrives. The quarterly reports will be shared with AWSB's Project Coordinating Team (PCT), MoWI, NEMA, World Bank and other relevant government agencies.

Capacity Building and Training

Effective implementation of the Environmental and Social Management Framework will require that adequate capacity enhancement within institutions and other stakeholders are undertaken. There will be training for the entire WaSSIP AF Project implementing bodies (WSBs). The training will cover implementation of the ESMF including project screening, impact identification and analysis, Environmental Assessment procedures and requirements (EA and EIA), Design and implementation of mitigation measures at sub project level, monitoring and review of environmental performance and reporting.

Cost implication of this ESMF

The financial implication for implementing the ESMF is USD 7 million to cater for RAP implementation and monitoring studies, monitoring, and capacity building. However, as at the time of finalizing this ESMF, potential projects are still undergoing identification and their environmental and social impacts largely remain unknown.

Report Structure

The key highlights in this ESMF report are presented as follows:

- **Introduction** about the objectives of the ESMF including description about the WaSSIP AF. The description of the project is found in **chapter 1** and further details the WaSSIP AF project components and anticipated sub project activities within the components.

- **Chapter 2** of the ESMF outlines the methodology that was used in undertaking and developing this framework.
- Detailed and comprehensive environmental and social baseline data which provide the environmental and social management process with key baseline information when identifying adverse impacts is found in **chapter 3**. The information contains data on Kenya's bio-physical environmental features such as its, climate, hydrology in terms of ground and surface water resources, major and sensitive wetlands, flora and fauna. On social baselines the report discusses the main features of Kenya in terms of demographics, public health features, education, water and sanitation and poverty.
- **Chapter 4** presents a description of the administrative, policy and regulatory framework related to environmental concerns in Kenya.

A review of the World Banks Safeguards Policies is made in chapter 5. The triggered policies are:

- Environmental Assessment (OP4.01, BP 4.01, GP 4.01)
- Involuntary Resettlement (OP/BP 4.12)
- Natural Habitats (OP 4.04, BP 4.04, GP 4.04)
- Forestry (OP 4.36, GP 4.36) may apply
- Projects Implemented on International Waterways (OP/BP 7.50)
- Dam Safety OP/4.73
- Indigenous People OP/BP 4.0

Potential adverse environmental and social concerns and impacts from anticipated project activities have been identified and presented in detail in **chapter 6** in a generic format. A monitoring plan for the mitigation measure is in the same chapter. **Chapters 7 and 8** highlight the project coordination and implementation agreements, approvals and reporting.

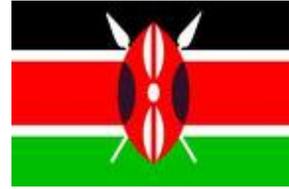
The ESMF report is organized as follows:

- Acronyms and abbreviations
- Executive summary
- Chapter 1-Introduction Chapter and description of the proposed project
- Chapter 2-Study Methodology and consultation
- Chapter 3-Baseline information
- Chapter 4-Description of National and International Regulatory Framework
- Chapter 5-World Bank Environmental and Social Safeguards Policies
- Chapter 6- Determination of Potential Environmental Impacts
- Chapter 7- Project Coordination and Implementation Arrangements
- Chapter 8 - Capacity building and training requirements
- Chapter 9- References
- Technical annexes
 - *Annex A Stakeholders Consulted*
 - *Annex B- Suggested format for EA studies.*
 - *Annex B– Suggested format for a simple EMP.*



REPUBLIC OF KENYA

MINISTRY OF WATER AND IRRIGATION



ATHI WATER SERVICES BOARD (AWSB)

FEASIBILITY STUDY AND MASTER PLAN FOR DEVELOPING NEW WATER SOURCES FOR NAIROBI AND SATELLITE TOWNS

Preliminary EIA for the Selected Scenario:
Nairobi Water Sources, Phases 1 & 2

Version 03



December 2011

in association with :

 **egis** bceom
International

MBP
+ PARTNERS
CONSULTING ENGINEERS

MANGAT, I.B. PATEL
& PARTNERS

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Executive Summary

The Government of Kenya has received a credit from International Development Association (IDA) and the Agence Française de Développement (AFD), and intends to apply part of the proceeds for Consulting Services for Improving Water Security: Feasibility Study and Master Plan for Nairobi and Satellite Towns. The Water Sources Options Review, August 2011, compared six potential development scenarios on the basis of a range of technical and natural resources, economic, environmental, and social criteria. The development of bulk water sources to supply Nairobi and 13 satellite towns will impact on the general water resources balance in the region as a whole. The chosen development scenario, considered as the priority strategy to meet the 2017 water demand for Nairobi, includes two initial phases for which potential environmental impacts are assessed. These are:

- Phase 1: Groundwater development in Kiunyu area (2014) then in Ruiru area (2015);
- Phase 2: Northern Collector Tunnel Phase I from Maragua, Gikigie and Irati Rivers to Thika reservoir (2016)

This report focuses on the potential impacts relating to Phase 1 and Phase 2. Initial investment options for Phases 1 and 2 involve the development of two well fields at Kiunyu and Ruiru to supply groundwater (with an estimated total yield of 64,800 m³/d) and development of the Northern Collector Phase 1 (with an estimated yield of 138,240 m³/d). These developments are expected to increase Nairobi water supply by 50% over current supply levels by 2017.

The availability of potential groundwater resources was presented in the Review of Groundwater Resources, June 2011. A program of exploratory drilling is required in order to locate suitable high yielding formations and to give precise estimation of the well-fields' potential and to confirm the availability and suitability of this resource, significant use of this groundwater resource as part of the Nairobi water supply is expected. In the absence of more detailed plans, a full environmental assessment is not currently feasible. However, a scoping of potential impacts from the potential development of these well fields and associated distribution pipelines is presented. Potential impacts include:

1. Changes in groundwater contribution to base flows in rivers, and reduction in local water supplies available from springs and dug wells.
2. Degradation of aquifers.
3. Clearance of vegetation as a result of site establishment and associated impacts on agricultural land.
4. Impacts from drilling activities themselves, including noise, and accidental spillage.

Important mitigation measures include the installation of an increased network of river gauges and recording stations in order to fully cover the potentially impacted areas. Regular, daily monitoring and reporting of these river gauges will be necessary. At times when reduced base flows are considered to have occurred, or are likely, and where these fall below accepted Reserve Flow limits, it will be necessary to supply an increased flow from upstream resources in order to compensate for the reduced flow and to ensure adequate downstream flows (environmental flows and compensation flows). Springs and wells in the areas within the geological strata affected by the proposed groundwater well fields also need to be identified and the yields monitored. Alternative, piped water supplies may need to be provided in cases where these water sources are impacted by reduced groundwater levels resulting from abstraction.

Longer term impacts will subsequently result from the operation of each of the well sites together with associated transmission and distribution pipelines. This will include:

- Compensation for loss of land.
- Compensation for loss of agricultural production and livelihoods.
- Operation of the pipeline wayleave in private land.
- Impacts resulting from potential pipeline leakage.

Phase 2 of the selected scenario for development of water sources for Nairobi includes the development of the Northern Collector Tunnel Phase I. This will enable the abstraction and diversion of water from Maragua, Gikigie and Irati Rivers to Thika reservoir. Implementation is planned by 2016.

The main environmental and socioeconomic impacts resulting from the Northern Collector Tunnel Phase 1 will be related to the diversion of water, and the resulting reduction in downstream flows in these rivers. This requires the assessment of the required downstream Reserve Flows, including both environmental flows and compensation flows. Such impacts are expected to be long-term. Additional impacts are related to the construction of the facilities themselves. However, these are expected to be local-level and relatively short-term impacts.

Downstream Reserve Flows are described, including compensation flows and the characteristics of environmental flows. Options for environmental flow release are outlined, including (i) the release of 2xQ95 Reserve Flows and (ii) the adoption of an alternative strategy that depends on the volume of incoming flow, with greater proportions being abstracted from higher flows together with the specification of a "hands off" flow below which no abstraction is allowed. The details of variable abstraction rates can be adapted at individual intake sites to cater for the needs of all users. Results of flow modelling show that abstractions will reduce the frequency of middle-level and high-level flows and increase the frequency of low-level flows. The general absence of high flow pulses, small floods and large floods, associated with release of 2xQ95 Reserve Flows will result in inevitable long-term changes to downstream riverine and riparian environments.

Operational procedures will need to be established so that, under periods with naturally low flows (e.g. extreme low flows), sufficient flows are allocated to:

- a) Cater for downstream demands from communities, households, agriculture (crops and livestock), and commercial or industrial requirements,
- b) Provide environmental flows of sufficient quantity to prevent critical decline of downstream aquatic environments,
- c) Ensure the maintenance of water quality (including the requirements related to sewage treatment and disposal), and
- d) Provide some flow for Nairobi water supplies whilst taking account of available storage in reservoirs. Rationing of water to all consumers may need to be considered under such circumstances.

An important recommendation is that all river flows must be monitored and reported on a regular daily basis both above and below each of the weirs and intake structures, as well as at sites downstream. Information on flows will then be available to form the basis for day-to-day operational management decisions.

Regular monitoring and updating of downstream water abstraction and use will need to be carried out. This includes, for example, the use of water by households and communities, or for use as irrigation supplies and commercial/industrial use. This should include both currently licensed and unlicensed

abstractions. This information will need to be fed into regular operating procedures in order to optimise the use of available water resources and continue to provide environmental flows capable of maintaining downstream environments and critical environmental services.

Cumulative impacts are considered, and are expected to include the following primary considerations:

- Reduced flows as a result of diversion of a majority of the flows originating from the Aberdares at Irati, Gikigie and Maragua intakes to the Northern Collector, resulting in:
- Reduction in the flow reaching Masinga Reservoir of 3.17% on an annual basis, and therefore a reduced flow available for hydroelectric power generation.
- Some short periods or single days with potentially zero flow (0.33% of daily flows). These periods can be mitigated by the release of higher flows from the Northern Collector intake sites over selected periods in order to prevent unacceptable low flows downstream.
- Less flow available for use by future agricultural activities in selected downstream areas (irrigation) that can be expected to be in demand in order to provide some of the additional food required by the increasing population of Nairobi.

Catchment protection is an important component of the overall management of water resources. Impacts related to catchment protection in the Irati, Gikigie and Maragua catchments are considered to be manageable issues with no negative impacts. Major parts of the catchments of the proposed Northern Collector abstraction sites are included within the protected areas of the Aberdares, including the Aberdare National Park and neighbouring Aberdare Forest Reserve. Significant parts of the catchments are therefore considered to be under a "high protection" status. Outside of the protected areas, land cover of managed land is predominantly tea plantation. The deep roots and ground cover provided by tea results in relatively good soil and water conservation. Downstream of the intake weirs it is also recommended that regular land management and control measures will be required for catchment protection, in particular in order to reduce the risks of soil erosion. Where possible this should be combined with local on-farm water harvesting measures and agricultural practices such as Conservation Tillage.

The Maragua, Gikigie and Irati Rivers each provide riparian vegetation along their length. Over this stretch of river no specific important ecosystems are identified with the exception of this riparian vegetation that provides an important natural corridor. Reduced flows will have an overall negative impact on the riparian vegetation cover, with expected long-term effects including reduced habitats, degraded stream bank stability, and potential changes in the depth of the water table. Combined with expected increase in clearance for agricultural activities, the long-term changes to riparian vegetation are expected to have a negative impact on the species diversity and populations of many bird, small mammal and other wildlife species using these resources. As a result, population numbers of some bird species are expected to decline downstream of the intake structures. Impacts are expected to reduce in intensity further downstream as other tributaries merge with the main rivers and the effective catchment area increases, providing some seasonal hydrological changes, including small floods and large floods.

Potential negative impacts that can be expected from construction of the proposed intakes at Irati, Gikigie and Maragua, together with the construction of the Northern Collector Tunnel include:

- a) Land acquisition and loss of cultivated areas, especially smallholder tea, in areas adjacent to the Intake Sites.
- b) Soil erosion resulting from site preparation and construction activities, including the construction of weirs, tunnels and pipelines.

- c) Change in local topography during site preparation/grading.
- d) Pollution from machinery and construction activities.
- e) Construction of access roads, temporary settlement and workmen's camps, and permanent offices and settlement required to maintain and run each of the weirs.
- f) Disposal of rock and other material excavated from the Northern Collector Tunnel and access shafts.
- g) Pollution from machinery and construction activities, including accidental spillage.
- h) Possible impacts on hydrogeology as a result of tunnelling.

Construction activities will result in significant volumes of excavated material derived from the rock excavated from the tunnels. No areas for "spoil" dumps have been clearly identified. Disposal of the material from the tunnel in dumps will have inevitable negative impacts. It is strongly suggested that instead of considering the excavated material as spoil, requiring disposal, it should be used as raw material for a range of activities such as road repair and construction, and for use as building material, including for example the making of blocks/bricks for buildings. Long-term storage of excavated material that is not used for other purposes should be included in the management or rehabilitation of unused or abandoned quarry sites.

The installation of the necessary transmission and distribution pipelines will result in potential disturbance to natural habitats, to agricultural land and to communities along the pipeline routes. Habitat restoration and maintenance will be required after pipeline construction is completed. Impacts on local flora and fauna will be long-term if habitat restoration is not carried out. Most of the pipelines will be in settled areas that are already environmentally altered and land will need to be acquired. Positive impacts from pipeline construction include the creation of job opportunities, as well as the potential for improved habitats for local wildlife species along the wayleave if this strip of land is managed appropriately. Compensatory plantation of trees and other vegetation should be carried out at the rate of a minimum of five trees planted for every tree cut. Compensation of affected land and property assets lost should be provided. There may also be a requirement for provision of new or modified infrastructure to compensate for loss or impacts to existing facilities (including roads, schools, health facilities, market areas etc.). Consideration should also be given to ensure that communities traversed by the pipelines are fully provided with piped water supplies.