SITE, SETTLEMENT, WATERSHED:
Nairobi River Basin - Baseline Report

REV 00: June 29, 2012
01 executive summary

This document is designed as an introduction to the physical and political characteristics and challenges of the Nairobi River Basin. It is also a baseline document for Kounkuey Design Initiative’s exploration of the potential to improve watershed quality through interventions in informal settlements under their Kibera-based Site, Settlement, Watershed programme in 2012-2013. This document introduces some of the key literature on the environmental, political, and infrastructural aspects of the Nairobi River Basin and water and sanitation in Nairobi and informal settlements, in particular Kibera, as an invitation to further study and reading. It then establishes the key political and municipal entities involved in the management, remediation, and future protection of the Basin and related urban infrastructure systems. The document goes on to describe the physical characteristics of the Basin and summarizes key environmental pollution information (with particular reference to the impact of slums) from various sources, including the Nairobi River Basin Project’s pollution monitoring work. The report highlights the political and management structures for water, sewerage, drainage and solid waste in Nairobi and its informal settlements plus challenges faced in improving water and sanitation services and linkages back to watershed issues. Focusing in on Kibera the document includes plans of the topography, watercourses, sub-catchments, existing municipal and decentralized water and sewerage infrastructure using geo-referenced data from Nairobi Water Sewerage Company. The final section of the report introduces some reflections on the role of educational programs in engendering a broader understanding of watershed issues and to in turn encouraging environmental stewardship for residents of informal settlements. Overall it is hoped that information in this document will inform the approaches developed by KDI in 2012-2013 to reduce point pollution in Kibera through education, infrastructure provision and the promotion of behavior change at a local scale so that they can start to have a significant effect on water and environmental quality of the Ngong tributaries and hence the larger watershed.

NB: This report is a first version (Rev 00) and is intended to evolve and refine as feedback and input is received from a wide range of partners including KDI’s partners in Kibera, the Nairobi City Water and Sewerage Company and the Ministry of Environment and Mineral Resources.

02 introduction

The Nairobi River Basin is a complex ecological system that traverses political boundaries and diverse urban, peri-urban and rural geographies. The Basin has 80% of Kenya’s manufacturing and is the most polluted river basin in the country. It also serves much of the drinking water for Kenya’s capital and largest urban area, Nairobi. The sustainable management of the Basin is complicated by the challenging political and regulatory conditions that always accompany large-scale water resource management.

The rivers of the Nairobi River Basin are most severely polluted around industrial areas and the informal settlements of Nairobi where untreated organic effluents enter the watercourses. Informal settlements represent about 60% of Nairobi’s population, but take up just 5% of the city’s residential land area. Most informal settlements have limited water, sanitation and solid waste infrastructure.

Kibera is located on the Motoine-Ngong river - one of the three main river systems in the Basin. It is the largest informal settlement in Nairobi with a population of 700,000 over 250 hectares, and an average of 5 persons per household. Kibera’s high population density, insecure land tenure, insufficient infrastructure and poor housing creates numerous social economic and environmental problems.

Water and sanitation services in Kibera are limited. Water is expensive and often from illegal connections. Improved sanitation access is limited with the majority of Kibera’s residents relying on shared latrines with an average of 71 users per facility; the majority of untreated effluent makes its way into the ground and river systems. There is no formal solid waste collection and Kibera’s residents commonly dispose of their rubbish in the river systems. Hence, while Kibera makes up a small part of the watershed by area, it has a disproportionately high impact on water quality and environmental degradation in the Ngong River and downstream areas, and hence the watershed as a whole.

Tackling the lack of sanitation and waste disposal in Kibera is consistently identified by government and civil society as one of the most pressing concerns of remediation of Nairobi’s river systems. However there are few incentives for landlords or residents to invest in improving housing and infrastructure. At the same the efforts of NGOs, CBOs and vendors that provide water and sanitation services are often fragmented and of poor quality. Improvements have been underway to both the policy framework and physical development of city water and wastewater infrastructure but the municipality still struggles to bring forward lasting and fair results in communities such as Kibera. Larger infrastructural solutions remain
controversial and challenging due to cost and the necessity of re-housing affected residents. The Nairobi River Basin Programme (currently in its 4th iteration) represents the principal basin-wide approach to watershed management with current activities focused on remediation of pollution “hot-spots”.

The economic, social, political and ecological challenges of watershed remediation are complex, intertwined and in a critical state. The information within this document is intended to be a resource for organizations tackling one or more of the challenges described here to understand some of the interlinked issues, stakeholders involved and resources currently available. It is also a key resource for the Kounkuey Design Initiative in their exploration of the potential for supporting a healthier watershed by attempting to tackle many of these challenges together, albeit on a small scale. It is hoped that the approaches developed by KDI in 2012-2013 that will reduce point pollution through education, infrastructure provision and the promotion of behavior change at a local scale can start to have a significant effect on water and environmental quality of the Ngong tributaries and hence the larger watershed.

References

i University of Nairobi (year unknown) “Survey and Situation Analysis of the Biological Characteristics of the Main Tributaries of the Nairobi Rivers, Reservoirs and Wetlands”

ii The population of Kibera is debateable, with some sources saying there are over a million in Kibera, and other sources saying a few hundred thousand.


AWN - Africa Water Network
AWWSB - AH Water Services Board
BOD - Biological Oxygen Demand
CAAC - Catchment Area Advisory Committees
CBO - Community Based Organization
COD - Chemical Oxygen Demand
CLUES - Community-Led Urban Environmental Planning
CSO – Community Service Organisations
DO – Dissolved Oxygen
DoE - Department of Environment
EARO - East Africa Regional Office
EAWAG - Swiss Federal Institute of Aquatic Science and Technology
EMUP - Environmental Management and Urban Plan
F&AL – European Union Fisheries and Aquatic Life
GoK- Government of Kenya
IUCN - World Conservation Union
KARI - Kenya Agricultural Research Institute
KDI – Kounkuey Design Initiative
KNCP - Kenya National Cleaner Production Centre
KPSP – Kibera Public Space Project
KENSUP- The Government of Kenya’s Slum Upgrading Program
MDG- Millennium Development Goals
MWR - Ministry of Water and Irrigation
NCC- Nairobi City Council
NCWSC- Nairobi City Water and Sewerage Company
NETWAS - Network for Water and Sanitation International
NRB - Nairobi River Basin
NRBP- Nairobi River Basin Programme
NWSS- National Water Services Strategies
NGOs- Non-Governmental Organizations
PHAST - Participatory Hygiene and Sanitation Transformation
PMN - Pollution Monitoring Network
PPS - Productive Public Space
SHG – Self Help Group
SPA- Service Provision Agreement
TDS - Total Dissolved Solids
UoN - University of Nairobi
UNDP - United Nations Development Programme
UNEP - United Nations Environment Programme
WASREB - Water Services Regulatory Board
WRUA - Water Resource Users Associations
WSTF - Water Services Trust Fund
WAB - Water Appeal Board
WATSAN- Water and Sanitation Services
WHO – World Health Organisation
WSS- Water and Sanitation Services
WSSCC - Water Supply and Sanitation Collaboration Council
04 key references

This section introduces key reference documents for any exploration of water issues in the Nairobi area with specific attention to issues in informal settlements. Additional references are provided within each of the report sections.

Kenya Vision 2030: The popular version

(2007)

Based on three pillars – economic, social, and political initiatives – the Kenya Vision 2030 is the country’s major long-range planning tool. Major goals include maintaining a 10% economic growth, have a just and cohesive society in a clean and secure environment; and an issue-based, people-centered, result-oriented and accountable political system. Another goal is to have met Kenya’s MDG 2014 deadline. The document is a summary of the foundations of the Vision, related to strengthening institutional and governance reforms, opportunities for the poor, economic stability, land reform, and the provision and expansion of physical infrastructure.

National Land Reclamation Policy

The Permanent Secretary Ministry of Water and Irrigation Nairobi (2011)

This policy points to the reclamation, sustainment, and productive use of degraded and fragile lands as a means to achieve national development goals. Guidelines include how to create sustainable, productive lands, restore degraded lands, rehabilitate salt affected soils, remove and prevent pollution, and conserve a balanced ecosystem. The policy also outlines the challenges from uncoordinated policy, legal and regulatory framework, low investment, limited research, climate change and unsustainable exploitation of natural resources that are faced.

Act No. 8 of 2002 Water Act

By Governmnet of Kenya (2002)

The National Water Services Strategy shall detail existing water services; the number and location of persons not provided with basic water supply and sewerage; plans for extension of water services; time frame for the plan; and an investment program. It shall also provide national monitoring and information on water systems and services.

Lessons from a Multi-Country Review of EcoSan Experience in East and Southern Africa

By Barry Jackson, Andreas Knappe

This study looks at environmental sanitation (EcoSan) projects in Southern and Eastern Africa. The authors attempted to identify as many successful EcoSan projects as possible and to learn from their experiences. They used these lessons to understand why take-up of EcoSan has been limited in this region.

Towards a National Policy on Wastewater Reuse in Kenya

By J.W. Kaluli, C. Githuku, P. Home and B.M. Mwangi (2011)

This paper looks at public toilets in three informal settlements in Nairobi, Kenya. The authors reviewed data on potable and wastewater reuse in Nairobi. This data analyzed chemicals in Nairobi wastewater in comparison to NEEMA standards. Taking this data this report suggests ways in which Kenya can create a national wastewater reuse policy (it is currently illegal) and the necessary provisions for water quality monitoring.

Community-Led Urban Environmental Sanitation Planning: CLUES

By Christoph Lüthi, Antoine Morel, Elisabeth Tilley, and Lukas Ulrich (2011)

CLUES is a comprehensive guideline for planning and implementation of environmental sanitation infrastructure and services in urban and peri-urban communities. CLUES approach is multi-sector and multi-actor, which includes 7 planning steps, 3 cross-cutting tasks, and the enabling environment.

Summary Description of Water Sector Institutions in Nairobi, Kenya and their Roles

By Hakimji Trust and COHRE

Created to provide community based water and sanitation groups and the general public with information on the formal government water sector institutions and services provided in Nairobi, Kenya. The booklet provides information on municipal and national government agencies whose services affect water and sanitation infrastructure and services.

Tenancy and Sanitation Provision in Informal Settlements in Nairobi: Revisiting the Public Latrine Option

By Madeleen Wegelin-Schuringa and Teresia Kido (1997)

This paper looks at public toilets in three informal settlements in Nairobi. It describes the experiences of construction or improvement of each latrine, the organization developed for maintenance and the cost of recovery. The authors argue that public latrines are the only possible sanitation solution in these types of settlements.

Strategic Guidelines for Improving Water and Sanitation Services in Nairobi’s informal Settlements

By Nairobi City Water and Sewerage Company and AHW Water Services Board (2009)

NCWSC and AWSS have developed a framework that provides NCWSC with tools to improve water and sanitation services (WSS) in Nairobi’s informal settlements and allow NCWSC and AWSS to scale up their efforts. AWSS has received $8 million from 2009-2014 from the EU World Bank to improve and extend services in Nairobi’s informal settlements. The guidelines will help drive these infrastructure decisions and help to increase access, affordability, and sustainability of safe water services and basic sanitation facilities. The guidelines provide the context of sanitation and water in the national context and challenges of working in Nairobi’s informal settlements, and provide a guide in how to implement and steer interventions in these areas.

By Nairobi City Water and Sewerage Company and AHW Water Services Board (2009)

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Best Practices for Environmental Conservation for the Nairobi River Basin Programme
By David Kuria
This study describes case studies on the Nairobi River Basin Project’s best practices in environmental conservation.

Survey and Situation Analysis of the Biological Characteristics of the Main Tributaries of the Nairobi Rivers, Reservoirs and Wetlands
University of Nairobi
This document discusses the native flora and fauna within the Nairobi River Basin and specific to each river within the basin. It discusses which species are under threat from urban expansion, and deliberates why certain species of flora and fauna are present while others may not be. It also goes into great detail on the ecology of each riverine system within the watershed, stating the original ecological conditions and how they have changed after human interference.

Nairobi River Basin Programme Phase III: Resource Booklet on Pollution Monitoring Activities
NETWAS (2003)
This Booklet provides information on the monitoring and assessment activities carried out as part of the Nairobi River Basin Project. The Booklet compiles studies related to Phase II of the Nairobi River Basin Project with a main focus on the Mobire/Ngong River.

Biocentre user survey conducted in Gatwekera Village, Kibera
By Priscilla Kagune
A two-storey bio-center with ground floor sanitation block that converts human waste into bio-gas and fertilizer was built and designed to serve up to 500 people by Umande Trust and Ecosan. This report shows the results of a survey conducted to assess the impact of the biocenter in terms of provision of water and sanitation services.

The Right to Water and Sanitation in Kibera, Nairobi, Kenya: Summary Version
By Umande Trust, COHRE, Hakijamii (2007)
The Kibera report provides a summary on key themes and data that can be used to assess government implementation of water and sanitation in Kibera as part of their duties under human rights law. The report provides an analysis of the legal basis for right to water and sanitation. Other important data analysis include an overview of current water and sanitation services, institutional responsibilities, technical options for water and sanitation extension, and community recommendations for ensuring access.

Inside Informality: Poverty, Jobs, Housing and Services in Nairobi’s Slums
By World Bank (2006)
This document used household surveys from 1755 households in Nairobi to fill in demographic, economic and infrastructure gaps on informal settlements within Nairobi. The paper discusses demographics and statistics that typify informal settlements. It also looks at infrastructure services within Nairobi’s slums, including water supply, energy, sanitation, drainage, and transportation. Within these are use, cost, and access. The study suggests that the government should prioritize actions that improve infrastructure access, help increase education levels, facilitate further development of household enterprises, reduce unemployment, and reduce the gender handicap borne by women. Slum dwellers themselves identify their top four development priorities as toilets, water, health, and electricity.
Institutional Framework for Water and Sanitation Services

The Government of Kenya and various institutions and policies guide development of water and sanitation services in Nairobi. The same Government institutions are responsible for water and sanitation services in Nairobi’s formal and informal settlements. In informal settlements, however, water and sanitation infrastructure development is set apart from formal settlements by lack of Government presence and involvement of international organizations, non-governmental organizations, community-based organizations, and self-help groups.

**Water Framework**

The government of Kenya is made up of 21 ministries. Water and sewerage provision is the responsibility of the ministry of water and irrigation (see figure 1). Historically, water and sewerage services were provided by the Water and Sewerage Department of the Nairobi City Council. However, in 2002 the Ministry of Water and Irrigation (MWI) created the Water Act. The Water Act, 2002 provides for the formulation of a national water services strategy to design a program to ensure the progressive extension of water and sanitation services to everyone in Kenya and ensure that all areas in the country are adequately serviced. The Act provides that the strategy must detail the existing water services in the country, the number and location of persons who are currently underserved or not served at all, and the plans to extend water services to these underserved areas. The Act further provides that the national water services strategy must indicate details of the timeframe for expansion and extension of services and the investment programme.

In 2007, the Government published its first national water services strategy. The overall goal of the National Water Services Strategy (NWSS) is to ensure sustainable access to safe water and basic sanitation to all Kenyans. The NWSS recognizes that sustainable access to safe water and basic sanitation is a human right. Under the NWSS water and sanitation are recognized as both a social and economic good. The Strategy provides that water and sanitation service provision for the poor should be enabled by social tariffs that provide for a minimum of 20 litres of water per person per day. It also provides that users of water and sanitation must pay according to their consumption. The NWSS is guided by specific principles that apply to water supply and sanitation in the urban and rural setting.

The National Water Services Strategy, formed the Water Services Regulatory Board (WASREB), the regulating authority for water and sanitation services in Kenya. WASREB licenses regional Water Service Boards (WSBs), delegates work to Water Service Providers,
The Water Act of 2002, established 8 water service boards to manage water resources in the country (See Figure 1). Under the act, water service providers are licensed by water service boards to retail water in their jurisdictions. Nairobi, including Kibera, falls under the jurisdiction of the Athi Water Services Board (AWSB). In 2004 AWSB, the asset management company, contracted Nairobi City Water and Sewerage Company (NCWSC) to be Nairobi’s main water and sewerage service provider. NCWSC is a subisidiary of the Nairobi City Council. The company however has operational autonomy to enable it to run without interference. NCWSC has an independent Board of 12 Directors drawn from the private sector, NGO sector and the City Council. AWSB and NCWSC contribute to wet infrastructure development by monitoring and reporting on water service coverage, standards, and water quality in Nairobi. AWSB is responsible for creating, extending, and fixing water services, though they may delegate responsibilities to NCWSC. The AWSB and NCWSC prefer public ownership of wet infrastructure, but are willing to consider individual or community ownership models. The Water Act of 2002 has not yet generated desired water supply improvements. Water supplied to informal settlements remains insufficient and irregular.

Two additional acts have had significant influence on delivery of water services to the poor and underserved:

- The Pro-Poor Implementation Plan for Water Supply and Sanitation (PPIP - WSS) 2007

Several other organizations play a role in water services include the Water Appeal Board (WAB) to hear appeals, the Water Services Trust Fund (WSTF) to finance pro-poor investments, and the Water Resources Management Authority (WRMA) to manage and protect Kenya’s resources. The Catchment Area Advisory Committees (CAAC) support the WRMA regionally and the Water Resource Users Associations (WRUA) support the WRMA at the sub-catchment level.

The above institutional framework applies to Nairobi at large. There are also programs for water service delivery specifically in informal settlements. In order to support community water development efforts with NGOs, CEO’s The Nairobi City Water and Sewerage Company launched the Informal Settlements Department. Through this department, the NCWSC targets specific informal settlements to extend water and sanitation services through construction water kiosks and public toilet blocks.

In addition, the Government of Kenya and UN-HABITAT have been partnering to address inadequate housing and living conditions in Kenya’s settlements and slums through the Kenya Slum Upgrading Programme (KENSUP) since 2000.
The Kenya Slum Upgrading Programme (KENSUP) is a key core poverty Programme aimed at addressing the challenge of housing problems affecting the majority of the urban population who live in slums and informal settlements. The Government and the UN-HABITAT entered into a Memorandum of Understanding (MOU) on 15th February 2003 to upgrade slums and informal settlements in Kenya starting with selected slums within the administrative boundaries of the Nairobi, Mavoko, Mombasa and Kisumu. The Programme aims at improving the lives of people living and working in the slums and informal settlements in all urban areas of Kenya and to contribute to poverty reduction and fulfillment of the Millennium Development Goals, specifically Goal No 7 target 11- of improving the lives of 100 million slum dwellers by the year 2020.

Institutional Structures

The implementation of the KENSUP broadly falls under three key institutions namely; the Government, Local Authorities; and United Nations Human Settlement Programme-UN-HABITAT. The Programme is coordinated through the following institutions: Inter-Agency Steering Committee (IASC): IASC is the supreme Programme organ composed mainly of Accounting Officers of Key relevant Ministries, Local authorities, UN-HABITAT and Development Partners. The IASC set for approval of policy decisions, giving agency policy, making and provides opportunity for fundraising.

Sanitation Framework

Sanitation is the responsibility of Kenya’s Ministry of Public Health and Sanitation, created in 2008. The Ministry is mandated to provide hygiene education and basic sanitation where sewerage systems are unavailable, as in Kibera. Through the Public Health Act and the Local Government Act, the Ministry has made the Nairobi City Council responsible for safely disposing of human waste. The NCC, however, operates an unreliable latrine emptying service. Community members, local organizations, or private companies manually empty pit latrines into NCC sewers and drainage channels. In addition, the Public Health Act established Nairobi’s housing and sanitation standards, which seek to require landlords to install sanitation and waste removal services for their tenants. Local authorities are supposed to enforce the Public Health Act standards. According to the Nairobi City Council, local authorities have not enforced the Act in informal settlements and landlords have yet to comply with the standards.

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Drainage, Waste Water, and Solid Waste Framework

The Ministry of Water and Irrigation put the Nairobi City Council in charge of providing environmental services including drainage channels, human waste water, and solid waste management. The NCC’s responsibilities for drainage, waste water, and waste management are outlined in the Solid Waste Management and Wastewater Conservancy By-laws of 2007. Despite outlay of responsibility, the NCC does not have capacity to construct or maintain drainage channels or to collect human and solid waste in Nairobi’s informal settlements. Because the NCC has limited capacity to reach informal settlements, the responsibility for drainage channel construction and upkeep and for solid waste collection falls on consumers, CBOs, NGOs, SHOs and other local organizations. Note that AWSB and NCWSC are only responsible for managing water and water-borne sewerage, not open drainage, human waste water or solid waste.

References


Best Practices 43.


The Nairobi River Basin consists of three major rivers, the Nairobi, Motoine-Ngong and Mathare, whose catchments are found within the Kikuyu and Limuru hills. Key tributaries consist of the Gitathuru, Ruuruaka, Mbagathi, Kamiti, Kiserian, Mutuari and Riara river systems. The hydrological boundary of the basin encompasses an area of 1,078 km² and includes grassland and forest ecosystems as well as a number of urban areas, the greatest being Nairobi. The Nairobi River and its tributaries flow west to east through Nairobi Province, into the Athi River and eventually into the Indian ocean.

According to the Kenya National Cleaner Production Centre (KNCPC), the Nairobi River Basin is the most polluted river basin in the country. Raw sewage from informal settlements and discharges from industries (80% of Kenya’s manufacturing is within the Basin) are identified as the main polluters of the Nairobi River. Other key sources of pollution have been identified as incidences of burst/blocked sewers, direct release of industrial effluent and solid waste discarded into the river.

Ecology of the Nairobi River Basin

The Nairobi River Basin occupies a unique position between the savannah grasslands of southern Kenya and the forested slopes of the Aberdare range. The Basin has an abundance of grassland and forest communities of plants and animals and supports transient migratory communities, associated with transitional habitats, such as seasonal wetlands. Among the transitional habitats are riverine reservoirs and seasonal rock pools and marshes in Embakasi, Kayole west plains and Dandora. These wetlands support substantial numbers of resident and migratory birds.

Faunal communities within the river systems include fish such as Tilapia, Catfish, Barbus and Mudfish. Birds like Sacred ibis, Cattle egrets, pied kingfisher and African fish eagle are common in the Kangemi/Kabebe dams. Five taxonomic groups of macroinvertebrates have been identified and described in detail along the Nairobi river tributaries: Caenis (Mayflies), Simulium (Blackflies), Chironomidae (Midge flies), Cheumatopsyche (caddisflies) and Baetidae (Mayflies). Some of the plant life generally found in the valley bottom wetlands are Typha and Cyperus sp, with Napier grass in the surrounding areas, which is used as fodder for animals. The native Sesbanias viz. S. sesban var. nubica and S. keniensis trees are endangered from urban expansion in the Nairobi city area.
water sources for nairobi city area; source: NCWSC

Ecosystem Level Changes

Among the major impacts at an ecosystem level has been the reduction in natural habitats, especially forests, rank grasslands, and wetlands. Water has also been transferred from Thika river basins to facilitate human settlements. The Nairobi city area has lost most of its wetlands to human development. Similarly, wetlands along the upper parts of the Motoine River and lower parts of the Motoine-Ngong River have been heavily polluted, rendering these rivers unfit not only for domestic, agricultural and industrial use but also unable to support diverse aquatic life. The rivers currently exhibit limited biological diversity and mainly serve as open sewers to carry away waste from human settlements. While the natural vegetation in the basin has been greatly modified small and progressively shrinking pockets of indigenous vegetation still remain undisturbed in the Ngong Forests (the headwaters of the Ngong River). In general the profile of pollution in the river systems reflects the anthropogenic activities that lie along the rivers.

A more detailed description of species found within the NRB area and the ecological impacts of human development are given within the University of Nairobi report entitled “Survey and Situation Analysis of the Biological Characteristics of the Main Tributaries of the Nairobi Rivers, Reservoirs and Wetlands”.

Water Quality in the Nairobi River Basin

Many of the rivers of the Nairobi River Basin are used as conveyance for uncollected solid waste, human waste from informal settlements (such as Kibera), industrial waste in the form of gaseous emissions, liquid effluents and solid wastes; agro-chemicals, and other wastes especially petro-chemicals and metals from micro-enterprises – the “Jua-Kali” (informal manufacturing sector); and over-flowing sewers. These practices can be linked to the spread of water-borne diseases, loss of riverine livelihoods, loss of biodiversity, reduced availability of and access to safe potable water, and the exposure to toxic substances and heavy metal poisoning. A brief summary of some of the key pollutants, sources and impacts is given below.

Organic and Nutrient loading

Organic pollutants in the Nairobi River Basin originate from human and industrial waste resulting in increased Biological Oxygen Demand (BOD), leading to the death of aquatic organisms and choking the river system. BOD levels recorded around Nairobi City are extremely high peaking at 4.400 mg/l at the Donholm sampling point on the Ngong River and at 2.250 mg/l on the Nairobi River (after being through the central business district of the city) with similarly high values reported on the Mathare River.

Nutrient loading in the Nairobi river system occurs via natural as well as anthropogenic activities. Natural sources include animal and human waste while anthropogenic sources include surface run off containing fertilizers from agricultural land and effluent from factories. Both sources provide nutrients for plant growth in the riparian zone and algae growth along the river and substrate. Many of the rivers in the Basin are characterized by heavy plant growth as a result of increased nutrient input leading to eutrophication of the rivers and their reservoirs. As a classic example the Nairobi dam is entirely covered by water hyacinth. This all-consuming plant growth slows the flow of water, prevents light penetration and therefore primary productivity, and causes increased BOD, severely affecting the biological diversity of the river systems. Water hyacinth has also contributed significantly to the collapse of fishery and recreational facilities around Nairobi and in the Nairobi Dam in particular.

Heavy metals

Heavy metals such as cobalt, cadmium, chromium, iron and copper have been identified within the Basin in food crops such as kales and amaranths which can subsequently transferred to human beings. Cadmium (Cd) concentration ranges from a minimum of 0.004 mg/l at the Dagoretti sampling point to a maximum of 0.15 mg/l at Chromo sampling point, in excess of the EU Fisheries and Aquatic Life (F&AL) allowable levels of 0.005-0.112 mg/l. Excessive levels of heavy metals affect the physiological processes of organisms and can cause death. They are also a threat to humans utilising water from the rivers for domestic as well as agricultural purposes. Excessive metal pollutants also lead to increased Chemical Oxygen Demand (COD) leading to anoxic conditions in the water and sediments.

Erosion

Soil erosion from human development, farming, and unstable river banks has led to increased turbidity in the river system that affects
organisms’ biological processes. The destruction of the Ngong and Dagoretti Forests and Ondiri/Kikuyu wetlands, which are the major water sources of the Nairobi River, have also led to increased sediment loads.

Pollution Monitoring and Remediation Activities

A number of pollution monitoring activities have taken place in the Nairobi River Basin over the last thirty-five years. The Motomi-Ngong River has been studied most frequently while the Nairobi River has the highest number of sampling points as well as parameters reported over the years. Some of the key studies are as follows:

• Effect of Industrial discharges on quality of Ngong river waters in Kenya” by Prof. S. O. Wanjala (1996)
• “The Nairobi Master Plan Project” (1996)
• “Concentrations of Heavy Metals, Organochlorine pesticides, Organic and Micrological Pollution in the Nairobi River and its tributaries” by Grace Oyo-Mboko
• “Effects of Land Use Changes on the Hydrology and Water Quality of Upper-Adhi River Basin, Kenya” by Shadrack Muel Kithia (University of Nairobi) (2001)
• “Industrial Effluents” by NCIC and University of Nairobi (2002)
• “Managing Water for African Cities” by NCC/UNUCS (2002)

The Nairobi River Basin Programme Phase III Pollution Monitoring Report Desk Study and Annexe produced by the Department of Chemistry at the University of Nairobi (2005) aims to summarize thirty-five years of pollution assessment data from 1969 – 2004. The Nairobi River Basin Programme is one of the key projects that aims to tie together pollution monitoring and integrated remediation strategies at a number of scales and is described further in this section.

Nairobi River Basin Programme (NRBP)

The Nairobi River Basin Project (and later Programme, hereafter referred to as NRBP) is a multi-stakeholder, multi-phase initiative created in 1999 bringing together the Government of Kenya, UNEP, UN-Habitat, UNDP, the Nairobi City Council (NCC), the private sector and civil society. The vision of NRBP is “a restored riverine eco-system with clean water for the capital city and a healthier environment for the people of Nairobi” vi, v. The objective of the NRBP is to “provide improved livelihoods (especially for the poor), increased biodiversity, and a sustainable supply of water for water quantity and quality measuring protocols developed and tested, and 3. Service delivery, environmental conservation and sustainable utilisation of resources enhanced, and 5. Public awareness and participation in environmental issues affecting the Nairobi River Basin enhanced.

An Environmental Management and Urban Plan (EMUP) system for the Nairobi River system was developed under the World Conservation Union (IUCN) East Africa Regional Office (EARO) in collaboration with UNEP.vi. An audit of existing institutional capacities (human resources and facilities) for the implementation of the EMUP was developed by ICN, UNEP and ESF in 2009vii.

A number of projects associated with the NRBP have been developed and identified as “best practice” for environmental conservationviii. Some of the key activities are as follows: a bio-lamine and reforestation programmes in Mw Njira Humana Village; mushroom farming and recycled waste products in Nairobi River Catchment, Jaa Kail enterprises pilot project between Genome Cinema and Pana Cceuse roundabout; Bee keeping and environmental remediation of Kanu Forest and the community cooker in Kiberaiv.

Challenges to implementation of NRBP in Informal Settlements

The objectives of Phase II were to pilot improvement of health and well-being of the residents of the Nairobi River Basin, and in particular the Motomi-Ngong river stretch. The Nairobi Water and Sanitation Pilot Project in Kisauni Village aimed to restore the basic infrastructure of the “village” through community participation, including, community cleanups of roads and access pathways and construction of primary drainage. While mobilisation, sensitisation, clean-up and construction of some sanitation facilities was successful the overall impact was limited due to delayed MoUs and funding making co-ordination of implementing partners on the ground difficultvii. Demonstration projects aimed at showing the potential of artificially constructed wetlands for re-use water and improving the quality of polluted water systems in Nairobi Dam and the Kenya Wildlife Service Headquarters did not succeed due to lack of land to construct the demonstration projectsviii.

Initial activities of Phase II have been successful in developing an Environmental Management and Urban Plan (EMUP) though it is not clear how many of the additional “result areas” have been impacted. In 2009 Amnesty International published a report on slum residents in Nairobi that raised concerns about the implications of the NRBP programme for slum residents and challenged UNEP and Government of Kenya to implement proper consultation with affected communities with regards to NRBP activities, particularly where relocation of (or eviction) was a possibilityix.

NRBP Next Steps

The NRBP strives to continue in the present day under the Government of Kenya and various Ministries including Water and Irrigation, Lands and Housing, Local Government, Environment and Natural Resources, Roads and Public Works. The Ministry of Environment and Mineral Resources is leading many of the NRBP activities, including in Kibera. The majority of recent activities have focused on tree-planting and clean-up/remediation of particularly polluted and degraded areas. Recent clean-up activities include Donholm and Maker Hospital Bridge on the Ngong River and Gikomba on the Nairobi River.

Motomi-Ngong River System, Kibera and the Nairobi Dam

Motomi-Ngong River System is of particular interest in the work of ICID and partners as it includes the Kibera settlement, one of the most polluted stretches of any of the Basin’s rivers it represents some of the greatest challenges to remediation of the Basin. The Motomi River joins the Ngong tributary at Kibera, and flows adjacent to Kibera on the southern side of the settlement and then into the Nairobi Dam. From the dam it passes the industrial area at Donholm before joining the Nairobi River. The overall system drops about 520 metres for a horizontal distance of about 42.3 kilometres. Motomi-Ngong River has the highest number of sampling points and pollution in various locations through the river systems due to the heavy pollution at the Kibera settlement, and to Donholm and Mater Hospital Bridge on the Ngong River and Gikomba on the Nairobi River.

The major pollutant of the Motomi-Ngong River is organic pollution, from human and solid waste discharged in the Kibera slum and other informal settlements located along the riparian waterway as well as industrial waste discharges from the slums and industrial areasx. The estimated solid waste production of Kibera, the majority of which is disposed of in the tributaries of the Ngong river, is 280 tonnes per dayv. The BOD of the river has been reported at a maximum of 4.401 mg/l at the Donholm sampling point with a low of 58 mg/l due to the self-cleansing effect of the Nairobi Dam. A maximum COD of 759 mg/l was reported at the industrial area with COD patterns following closely those of BOD. Faecal colloids have shown a peak of 50 million counts/100ml at Enterprise Rd and total colloids were found to be at a high of 170 million counts/100ml at the Outer ring sampling point, both downstream of the industrial areaxix.

The Ngong River reports the highest pollutant concentration level of heavy metals all of the NRBP rivers at the industrial area sampling points. The heavy metals of concern in the river waters were cadmium, chromium, zinc and copper. Chromium was particularly high with a peak of 0.2 mg/l during the Canadian F&AL levels are 0.002-0.02 mg/l making the river unfit for aquatic life.xii.

The Ngong river has a reported average flow rate of 0.7 m3/s along the profile with a low of 0.2 m3/s and a high of 1.0 m3/s. Field observations taken after the heavy flooding of April 2012 showed velocities in the order of 2 m/s where the Canadian F&AL levels are 0.002-0.02 mg/l making the river unfit for aquatic life.

The organic pollution at Kibera and the industrial pollution in Donholm represent the key effluent inputs on the river as demonstrated in the following...
The urbanization of the Nairobi area has led to increased runoff into the river systems and into the Motoine-Ngong. According to K rhoda (2002), storm water runoff from paved surfaces contributes significantly to the waters of the Nairobi Dam. Kibera contributes a large proportion due to the high coverage of iron roofs and packed earth paths making the settlement highly impermeable. The sub-catchments in and around Kibera are described in more detail in this report.

Nairobi Dam is of particular interest being immediately downstream of Kibera and KDI’s KPSP 01 project. The Nairobi Dam receives most of the human waste from the Kibera slum. The dam presently acts as an informal wastewater treatment area, albeit with poor efficiency due to oxygen depletion and sunlight reduction due to presence of heavy plant growth. Within the Nairobi dam, pollutants and turbidity decrease due to the retention of water and its slow movement, and a great deal of sedimentation taking place within the dam - its retention capacity can hence be seen to be rapidly decreasing. Aerial photographs suggest that the river short circuits through the dam and thus there is no mixing taking place between the centre and sides of the dam. Downstream of the Nairobi dam, turbidity and heavy metals concentration increase rapidly. During the heavy rains of April 2012 the Nairobi Dam was opened to allow flood waters to pass through the dam - from field observations it is likely that this has resulted in significant volumes of sediments being washed downstream and potentially an increase in the retention capacity of the dam.

Key Observations

Overall there are disparities within data on water quality as methods of pollution analysis are variable between different studies. However general trends can be established as relevant to the consideration of the pollution from Kibera and the potential impacts of water, sanitation and solid waste management within public space projects in the settlement. Some of the key considerations are as follows:

- Kibera remains the key contributor of organic pollution to the Ngong River and one of the main causes of pollution in the overall watershed;
- Tackling the lack of sanitation and waste disposal in Kibera is consistently identified as one of the most pressing concerns of watershed remediation;
- Establishing the exact impact of water and sanitation interventions in Kibera is challenging due to the variety of reported pollution monitoring and inconsistencies in sampling approaches and procedures - that said successful interventions would be able to demonstrate a discernible change;
- The industrial area on the Ngong river shows the highest indicators of pollution in many areas including chemical and heavy metal concentrations – any efforts to remediate the river systems must tackle the discharge of industrial effluents;
- There is no clear coordinating authority for watershed remediation activities and mainstream government support remains limited.

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<tr>
<td>Biological Oxygen Demand – BOD5 (mg/l)</td>
<td>20 mg/l industrial discharges</td>
<td>4-wet, 10 mg/l, -dry, 50 mg/l</td>
<td>6-wet, 30 mg/l, -dry, 50 mg/l</td>
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<tr>
<td>Chemical Oxygen Demand – COD5 (mg/l)</td>
<td>50 mg/l</td>
<td>4-wet, 10 mg/l, -dry, 50 mg/l</td>
<td>5-wet, 40 mg/l, -dry, 150 mg/l</td>
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<tr>
<td>Total Coliforms</td>
<td>1,000 mg/l (WHO drinking water)</td>
<td>Never exceed minimum</td>
<td>67- 18,000,000 counts/100 ml</td>
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<tr>
<td>TDS</td>
<td>15 mg/l</td>
<td>4-wet, 7.9, -dry, 7.5</td>
<td>5-wet, 8, -dry, 7.5</td>
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<tr>
<td>Permanganate Value (PV)</td>
<td>15 mg/l</td>
<td>4-wet, 7.9, -dry, 7.5</td>
<td>5-wet, 8, -dry, 7.5</td>
</tr>
<tr>
<td>pH</td>
<td>5 mg/l</td>
<td>4- dry, &lt;2 mg/l</td>
<td>5- dry, 35 mg/l</td>
</tr>
<tr>
<td>Ammonia</td>
<td>5 mg/l</td>
<td>4- dry, &lt;2 mg/l</td>
<td>5- dry, 35 mg/l</td>
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<tr>
<td>Nitrate</td>
<td>6-2.5 mg/l</td>
<td>4- dry, 1242 mg/l</td>
<td>69- 835 μS/cm</td>
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<tr>
<td>Phosphate</td>
<td>10-20 mg/l</td>
<td>6- dry, 1242 mg/l</td>
<td>67-0.5 mg/l</td>
</tr>
<tr>
<td>Chloride</td>
<td>67- 0 mg/l</td>
<td>68-10 mg/l</td>
<td>69- 8 mg/l</td>
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<tr>
<td>Conductivity</td>
<td>seriously polluted waters have levels of 1000 μS/cm</td>
<td>67-0.5 mg/l</td>
<td>68-25 mg/l</td>
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<tr>
<td>Dissolved Oxygen (DO)</td>
<td>69- 835 μS/cm</td>
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*Pollution monitoring points from the NETWAS study are as follows: 4 - Nyong River (upstream of Kibera), 5 - Kibera Bridge, 6 - Nairobi Dam Inlet
**Pollution monitoring points from the University of Nairobi study are as follows: 67 - Showground Academy, 68 – Kibera Bridge, 69 – Inlet Nairobi Dam
***EU for Fisheries and Aquatic Life
References:
i Wandiga et al (2005) “NRBP – Phase III - Desk study of existing water quality assessments of Nairobi rivers”. University of Nairobi


iii University of Nairobi (year unknown) “Survey and Situation Analysis of the Biological Characteristics of the Main Tributaries of the Nairobi Rivers, Reservoirs and Wetlands”

iv Kahara (2002), NRBP II Pollution Monitoring Report, Collated Data and Baseline Samplings of March 2002

v NETWAS (2003), Nairobi River Basin Programme Phase III, “Resource Booklet On Pollution Monitoring Activities”, IUCN and UNEP


Access to adequate water and sanitation services is critical for health and livelihood. Even so, infrastructure in Nairobi’s informal settlements remains insufficient and unreliable, preventing quality of life improvement for Nairobi’s residents in areas such as Kibera. Nairobi’s water supply, household sanitation, sewerage, drainage, waste water, and solid waste management systems remain especially problematic. To develop Nairobi’s water and sanitation infrastructure the Government of Kenya has delegated responsibilities to a network of institutions through core policies. While the sector’s development is underway, various challenges continue hampering access to infrastructure services in Nairobi. This chapter reviews water and sanitation services, institutions, and challenges in Nairobi’s informal settlements with focus on Kibera in order to build understanding that will foster infrastructure development.

Water and Sanitation Services in Nairobi and Kibera

Nairobi’s water and sanitation services include water supply, sanitation, sewerage, drainage, waste water, and solid waste management, which are described in this section.

Water Supply

Nairobi

The majority of residents in Nairobi’s informal settlements have yet to access sufficient water supply. In Nairobi, 22% of residents in informal settlements have household water taps, while 75% of residents buy water from water kiosk resellers with private connections. According to the Government of Kenya, “vendors sell water of uncontrolled quality to consumers who have to spend hours to fetch it at prices that are often between 5 and 20 times the tariff applied to consumers with a metered connection.” The official Nairobi City Water and Sewerage Company (NCWSC) water rate in informal settlements is Ksh 10 per m3. Residents of informal settlements pay much higher water rates per cubic meter at private vendor kiosks than their non-poor counterparts who own private taps. Kiosk water in Nairobi’s informal settlements normally sells at Ksh 2-5 Rs per 20 L container or Ksh 100-250 per m3.

Kibera

In Kibera, water outlets are 4% in-home taps, 15% yard taps, and 68% kiosks. An average Kibera resident uses 16-20 L of water per day. Kibera receives a daily water supply of 20,000 m3, which arrives through a haphazard spaghetti network of small gauge plastic pipes; 40% of Kibera’s supply is lost to leakage. Even when water is running in the city, most of Kibera’s water network receives little or no flow due to limited municipal pump capacity or to the utility diverting supply to other neighborhoods. Limited supply leads Kibera’s water kiosk operators
to set high rates. If residents cannot afford inflated kiosk rates, they must take time to seek water in neighboring areas. Residents commonly pay 2-3 Ksh per 2L container (500-1,000 Ksh/m3) at kiosk and cart vendors in Kibera. During water shortages prices increase to 10-20 Ksh per container (500-1,000 Ksh/m3). Water availability varies in Kibera’s villages. While Kandia, Gakibere, and Makina have regular water supply with normal wait times of 10-30 minutes, Musaumbi, Klauna Nito, and Kamiti Muru have hundreds of households relying on each tap and long waits.

Sanitation

Nairobi

Nairobi’s sanitation situation in informal settlements is more severe and complex than the city’s water supply. Approximately 24% of residents have access to a private toilet, while 68% of households rely on pay-per-use shared facilities, and 6% have no toilet access. Of those with toilet access, 64% use a pit latrine and 29% use a toilet connected to a stand-alone pit without sewerage connections in Kibera. Pit latrines are present, human waste and waste water are commonly conveyed to or manually placed in hand-built open channels that are unavailable due to limited space and the inability to empty full pit latrines manually. 68% of Nairobi’s residents rely on shared latrines with an average of 7 users per facility, often implemented by NGOs and managed by CBOs. Residents pay 100 Ksh per month to use shared latrines. In Makina and Kambi Muru, residents contribute 50 Ksh per month for using a shared latrine. Some toilet facilities in Kibera cost 3 Ksh per use. Both private and shared latrine substructures are commonly shallow and poorly constructed stand-alone pits without sewerage connections in Kibera. Pit latrines offer minimal privacy and are often used as bathing rooms. Kibera households without latrine access use alternative sanitation methods such as open defecation or flying toilets.

Kibera

In Kibera, 50-90% of residents do not own a private latrine. Latrines are unavailable due to limited space and the inability to empty full pit latrines manually. 68% of Kibera’s residents rely on shared latrines with an average of 7 users per facility, often implemented by NGOs and managed by CBOs. Residents pay 100 Ksh per month to use shared latrines. In Makina and Kambi Muru, residents contribute 50 Ksh per month for using a shared latrine. Some toilet facilities in Kibera cost 3 Ksh per use. Both private and shared latrine substructures are commonly shallow and poorly constructed stand-alone pits without sewerage connections in Kibera. Pit latrines offer minimal privacy and are often used as bathing rooms. Kibera households without latrine access use alternative sanitation methods such as open defecation or flying toilets.

Solid Waste Management

Nairobi

An estimated 4-20 tons of waste is generated in Nairobi daily. Since Nairobi’s settlements lack formal solid waste management, the NCC is only able to collect 10% of the city’s total solid waste. In fact, only 0.9% of households are served by the public waste collection system. The vast majority of households turn to alternative disposal methods. 78% of households dump waste in their neighborhood, 10% of households burn orbury their waste at home, and 10% of households use a private collection system, which costs Ksh 10 per collection or Ksh 100 per month with biweekly collection.

Although problematic, Nairobi’s solid waste management situation has led to livelihoods opportunities via an informal scavenging system. Residents collect recyclables from waste sites which include industrial recyclers purchase and process. A number of NGOs and CBOs are involved in composting food wastes, which are sold to generate income. Other groups are involved in composting food wastes, which are sold to farmers or landscapers.

Kibera

Kibera’s informal waste collection system does not exist in Kibera. Kibera’s residents commonly solid waste as open channels in or the river for disposal. Limited information is available on Kibera’s informal solid waste management and disposal system. The paragraphs above on solid waste in Nairobi’s informal settlements should represent the situation of Kibera to a large extent as well. Water and Sanitation Challenges

Institutions, policies, and programs are now in place to improve Nairobi’s water and sanitation infrastructure. There is reason to believe access to water and sanitation will continue improving over the coming years. In continuing to enhance access to infrastructure, institutions and users will need to navigate numerous barriers, some of which are discussed in this section and summarized the SWOT diagram.

• Institutional barriers: Lack of coordination and presence of conflicting objectives can lead to inefficiencies in operations among the agencies and organizations in the infrastructure system. Despite a full lot of ministries, development agencies, local organizations, and boards engaging in water and sanitation infrastructure improvement in Nairobi, sewer pipes in older settlements frequently burst or overflow. 71% of households pour grey water down a nearby drain, 19% dump it onto the road or pavement, and 10% use other means. 71% of Kibera has drainage channels, but only 58% report drainouts outside their homes, and only 25% report the drain works. Drains are used as dumping points for liquid waste, solid waste, and for sewerage. Footpaths often become temporary drainage channels, carrying human waste to rivers.

• Weaknesses: Poor communication between institutions. There are bare-minimum investments. Public action is insufficient. Lack of enforcement to ensure landlords provide infrastructure. Low water pressure/access in slums. Limited institutional capacity in Government.

Opportunity

Enhancing municipal and public action. Building more ribatia infrastructure. Building new enterprises to provide services unfilled by Government. Building new laws, organizations, relationships. Exploring applicability for micro-credit or micro-infrastructure payments in kibra.

Threat


Conclusion

Residents of Nairobi’s informal settlements continue to struggle to achieve access to adequate water and sanitation services. The Government of Kenya is working to achieve improved services and infrastructure through numerous institutions. Improvements are happening to Nairobi’s wet infrastructure but the municipal projects still struggle to bring forward lasting and fair results in communities such as Kibera.
References

Best Practices 43.


Subcatchments and Watercourses in Kibera

The topography in Kibera ranges from a high point of 1770 m above sea level in the northwestern-most corner of Kibera, and slopes down to 1685 m above sea level at the edge of the Nairobi Dam on the southwestern corner of Kibera. This creates a total elevation change of 85 meters over a distance of about 3.25 km, or an average slope of 3%. The steepest slopes within Kibera are along the banks of the Ngong River, with an average slope of 10%.

There are five subcatchments within Kibera, each feeding into a water course. The southernmost subcatchment has a majority of the catchment to the south of Kibera and feeds directly into the Ngong River. Viewing the subcatchment plan included here and going clockwise from the Ngong River subcatchment, the next subcatchment to the northeast runs through Kibera and feeds into a tributary of the Ngong River. The following three subcatchments run through Kibera and feed into tributaries that discharge directly into the Nairobi Dam.

The Ngong River defines the southern border of Kibera, while the other main watercourses through Kibera that drain into the Ngong are directly abutted by housing. Drainage within Kibera is in the form of ditches within paths that often flood during the rainy season. The spine road under construction in the east of Kibera has concrete drainage channels and lead offs at each boundary.
Subcatchment 1 (SC) has an area of 645 hectares, SC 2 has an area of 135 hectares, SC 3 has an area of 145 hectares, SC 4 has an area of 121 hectares, and SC 5 has an area of 144 hectares.
Please note that these perspective images of the topography of Kibera have exaggerated topography by a factor of 3, allowing the viewer to understand the slopes, but is not a realistic view.
kibera: topography

- topography
- rivers

kibera: roads + rail

- topography
- rail
- rivers
- roads
This "Water Network" map portrays the piped water network throughout Kibera. Each pipe has information within the GIS data on its material, diameter and length of pipe. As can be seen from the image, there are many areas of Kibera without direct access to formalised piped water supply. The map portrays Geographic Information System (GIS) overlaid in Google Earth. The GIS data of water, sewerage, and topography are courtesy of the NCWSC.
This "Sewerage Network" map portrays the gravity-fed piped sewerage network throughout Kibera. Each pipe has information within the GIS data on its material, diameter and length of pipe.

As can be seen from the image, there is one main sewerage pipe that runs from the northern edge of Kibera along the eastern streams within Kibera and down to the southeastern border near to the Nairobi Dam. This main sewerage line has a diameter of 450mm. All of the sewerage pipes within Kibera are fed down to the lowest elevation on site, which is at the outlet of the Nairobi Dam. It is understood that this line runs to the south of Kibera and discharges to farmland as reported by Kaluli et al, 2007. This will be verified with NCWSC. The map portrays Geographic Information System (GIS) overlaid in Google Earth. The GIS data of water, sewerage, and topography are courtesy of the NCWSC.
This “Water and Sewerage Network” map portrays the water and sewerage networks throughout Kibera, as well as locations of the 4 KDI PPS sites. Site 1 is located near the Nairobi Dam, and is 130m away from a municipal potable water connection and 140m away from the sewerage network. Site 2 is located along an eastern stream, and is 45m away from a municipal potable water connection and 40m away from the sewerage network. Site 3 is located along the Ngong River, and is 220m away from a potable water connection. Site 4 is 315m upstream of Site 2, and is directly adjacent to municipal sewerage and water connections. Proximity to networks does not necessarily denote ability to connect especially for sewerage due to elevational requirements for drainage.
This "Municipal and Decentralized Water and Sewerage Network" map portrays both the municipal water and sewerage pipes, as well as decentralized public access to water, public toilets, bio-centres, dumping sites, recycling points, and urban agriculture. For each point, there is an ID, a responsible operator, the status of the operation (operational, bad), and a description. There are a total of 582 operation points within the database. The decentralized water and sanitation GIS information is courtesy of MapKibera.
In 2012-2013 KDI will implement a watershed education and outreach program as part of the ongoing Kibera Public Space Project. Previous projects in the community have allowed KDI to develop relationships with key individuals and organizations that will play important roles in this program. KDI has also formed formal partnerships with NCWSC and the Ministry of Environment’s Nairobi River Basin Programme, both of whom will be engaged in the education and outreach work. The education component will serve to engage residents in an interactive way that will shed light on their role within the watershed and their responsibilities as watershed stewards. The program also aims to give governing officials further experience regarding Kibera residents’ needs as watershed users in order to create a partnership of environmental stewards in Kibera and the Nairobi River Basin.

The program will take advantage of existing networks in Kibera and the leaders and innovators that connect these networks to each other. It will require tapping into the knowledge and creativity of local Kibera residents, utilizing a local foundation to reach the community. KDI will act as a facilitator in this endeavor, building upon best practices developed by the World Health Organization and UN Habitat for public participation and education.

Previous Educational Work in Kibera

All of KDI’s projects have had educational components. Design and community development professionals from Kenya, the US and other countries have brought the best of their experience to projects while community members, residents and volunteers have brought their knowledge and skills. The main forum for exchange and learning on both directions has been the participatory design process, which allows for a free and close exchange of ideas and learning. KDI has also conducted a number of educational and outreach programmes about critical issues in Kibera.

In 2012 in conjunction with Kibera Public Space Project 03, KDI employed the work of Helen Lessick, a Los Angeles-based artist who helped to develop an innovative public art project in Kibera that combined elements of public education and design. Helen designed a series of sketches that identified the relationships between people and soil. Local sign makers were then employed to interpret her sketches and create paintings that would be hung at kiosks in Kibera. While the signs themselves serve to help the community understand the linkages between healthy soil and healthy communities, the process in creating the signs also proved to be a useful exercise in public outreach. In addition to local sign makers, farmers and business owners were invited to participate in the process. Other neighbors were
PHAST also creates linkages between quality of life and the environment. Clean water and sanitation practices can improve both of these things. It is through this linkage that we envision reaching people by creating an engrained sense of responsibility for the environment as it relates to peoples' lives. This linkage will be explored throughout the workshops.

UN Habitat, in conjunction with the Swiss Federal Institute of Aquatic Science and Technology (Eawag) and the Water Supply and Sanitation Collaboration Council, also developed a guide for public participation. The document, titled Community-Led Urban Environmental Sanitation Planning, CLUES, details methods of participatory planning in the realm of sanitation and water infrastructure. They promote a seven-step process that gradually builds on public interests in the project and relies on local ideas and desires for development.

They also identify three key principles that are essential for participatory planning: 1) raise awareness, 2) develop capacity, and 3) monitor and evaluate the process. Additionally, creating an “enabling environment” is crucial to a successful program. To do this, CLUES identified six elements that contribute to an environment that fosters participation and sets the stage for successful projects. These six elements are shown in the picture below. We will focus on these six elements when implementing the watershed education and outreach program in Kibera, and when designing the water and sanitation infrastructure for the three upcoming sites.

The World Health Organization developed a step-by-step guide to public participation for sanitation programs. The guide, entitled Participatory Hygiene and Sanitation Transformation (PHAST), provides guidance for developing interactive community participation workshops that aim to educate the public and influence behaviors as they relate to sanitation and hygiene. While the program is aimed specifically at diarrhoeal disease prevention, several principles can be applied to the watershed education program planned for Kibera.

PHAST stresses that group selection is an important process that should not be overlooked. Leaders – whether formal or informal – in the community can provide insight into the community and can serve as vector for information transmission. In Kibera, and within the smaller communities that will be involved with KSPS 4, 5, and 6, community leaders (i.e. from our partner CBOs, the surrounding residents groups and from traditional leadership structures) will form the core of our working group. We will ask these leaders also involved, providing input on everything from wording to color schemes. This process of local involvement proved to be a powerful tool to create local interest and teach local leaders about soil health in the process.

Public Participation Best Practices

A number of useful tools exist in the public realm to support effective community outreach, education and participation with regard to safe water and sanitation practices. KDI has developed a successful approach to participation in Kibera for site design, implementation of physical water and sanitation infrastructure (and the social and business components of their successful adoption and use) and a number outreach programmes with regard to water. This approach will be further developed in 2012-2013, when projects will have a particular focus on water, sanitation and watershed management and draw further on some of the established practices. Some of the key approaches are summarised here.
Public Outreach Program

The program specifics will be further developed and implemented over the summer of 2012. A general, adaptable approach is given here to help guide the program development.

Building a Foundation using Workshops

We intend to hold a series of workshops that engage stakeholders and local governing bodies around the ideas of environmental stewardship and watershed awareness. In these workshops, KDI personnel will act mostly as facilitators, not as teachers. The first few workshops will engage residents only. We will ask questions and guide participation to help people reach their own conclusions rather than explicitly telling them what we believe. We will ask broad questions in the beginning, such as the following:

- How will the community benefit from a cleaner environment?
- How could you personally benefit from a cleaner environment?
- How do you currently use the local environment and the larger watershed in your daily life?
- How do you think you can change your environment?

Based on the answers to these questions, we will move on to more specific subjects. We want to make realizations about a few key concepts, also, such as connectedness, upstream/downstream phenomena, linkages among health, food, water, and environment, and behavior. Most importantly, we want community members to walk away from these workshops feeling empowered – empowered to work within their community, to interact with governing bodies, and to ultimately change their environment.

With this empowerment and confidence, we then will bring residents and government officials to the same table. The residents will be able to communicate their needs and wants, and officials will begin to understand the environmental issues from a personal perspective. It is within this environment of mutual respect that we hope to make strides in how each side understands each other, fostering the basis for cooperative future work.

Spreading the Message

By bringing the appropriate people to workshops and involving interested parties in the process, the messages of environmental stewardship and behavioral change will begin to spread naturally. Word-of-mouth campaigns can be very powerful, particularly when influential people are the mouthpiece. We can assist in this effort, though, by providing the right environment for message transmission and reinforcing the ideas. This is where campaigns such as the public art project mentioned above become so important.

People will hear certain ideas through friends or relatives, and these ideas will be reinforced throughout the community – constant reminders that these ideas are not throw-aways. Public art, flyers, promotional materials, and even music or dance can serve as reinforcement. The key to understanding exactly how to reinforce the message is understanding how the local community works. For this, we will need to rely upon community leaders as well as community “insiders” – people who may not hold positions of power but who understand local inclinations – to give us insight on this aspect of the program.

Partnerships

As mentioned above, KDI has formed partnerships with several local groups that could be involved in the education program in Kibera. We will also continue to explore potential partners throughout the summer as the program is developed. A list of organizations we have already identified as potential partners is as follows:

- Umande Trust
- Haki Water
- Maji Na Ufanisi (MnU) (Water and Development)
- Network for Water and Sanitation International (NETWAS)
- Ushirika Wata Usafi Laini Saba (UMMK)