



Promoting Green Urban Development in African Cities

KAMPALA, UGANDA

Urban Environmental Profile



Promoting Green Urban Development in African Cities

KAMPALA, UGANDA

Urban Environmental Profile

COPYRIGHT

© 2015 International Bank for Reconstruction and Development / The World Bank

1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

September 2015

RIGHTS AND PERMISSIONS

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to the Publishing and Knowledge Division, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.

ACKNOWLEDGEMENTS

The Promoting *Green Urban Development in African Cities*, Urban Environmental Profile for Kampala, Uganda was prepared by a core study team led by Roland White (Global Lead: City Management, Governance and Financing - Task Team Leader) and included Chyi-Yun Huang (Urban Specialist), Herbert Oule (Environmental Specialist), Martin Onyach-Olaa (Senior Urban Specialist) and a consultant team from AECOM including John Bachmann, Diane Dale, Brian Goldberg, Maritza Pechin, and Dr. Jane Turpie (Anchor Environmental). Dr. Jeffrey Wielgus Yanovich (Consultant/Environmental and Natural Resource Economist), Dr. Timm Kroeger (Senior Environmental Economist, The Nature Conservancy), Babirye Kagga (AECOM) and Dr. Charles Koojo Amooti (Urban Research and Training Consultancy) contributed invaluable technical insights, critical review and guidance. Sonia Wheeler and Annette Nabisere Byansansa offered organizational and administrative support.

The document was prepared under the overall guidance of Francisco Ferreira (Chief Economist), Sameh Wahba (Practice Manager), Mukami Kariuki (Practice Manager), Philippe Dongier (Country Director) and Ahmadou Moustapha Ndiaye (Country Manager).

This Urban Environmental Profile benefited immensely from close collaboration with representatives from the Government of Uganda, including the Kampala Capital City Authority (KCCA), Ministry of Lands, Housing & Urban Development, Ministry of Water & Environment, National Environmental Management Authority and National Water & Sewerage Corporation. The team would like to express its gratitude especially to Ms. Jennifer Semakula Musisi and Ms. Judith Tukahirwa Tumusiime of KCCA, for their close involvement and guidance, and to their team represented by Dr. Najib Lukooya Bateganya and Mary Karooma for their support and important contributions made.

The study would not have been possible without the generous financial contribution of Korean Green Growth Partnership.

CONTENTS

I.	INTRODUCTION	5
A.	Methodology	5
B.	Summary of Report	6
II.	BACKGROUND AND CONTEXT	7
III.	QUALITY OF THE ENVIRONMENTAL ASSETS	13
A.	Aquatic Ecosystems	13
B.	Terrestrial Ecosystems	22
C.	Air Quality	25
IV.	DIRECT DRIVERS AND CAUSES OF ENVIRONMENTAL VULNERABILITY AND DEGRADATION	27
A.	Informal Settlements	27
B.	Effluents	28
C.	Stormwater Runoff	32
D.	Solid Waste	34
E.	Air Emissions	36
V.	INSTITUTIONAL CHALLENGES	39
A.	Overview	39
B.	Prevailing Institutional Landscape	40
VII.	KEY FINDINGS	49
VIII.	BIBLIOGRAPHY	51
IX.	APPENDIX	57

FIGURES

Figure 1	Political Boundaries of the KCCA (area within red outline and the GKMA (entire area of light gray, including KCCA)	7
Figure 2	Topography and Slope Analysis of GKMA	7
Figure 3	GKMA Settlement Pattern	8
Figure 4	Rate of Population Growth in Kampala and GKMA	8
Figure 5	Kampala Population and Project Growth	8
Figure 6	Spatial development from 1989 to 2010 in GKMA and KCCA	9
Figure 7	KCCA Undeveloped and Developed Land, 1985-2010	9
Figure 8	Projected Scale of Footprint (Hectares) for Informal Areas Under Future Growth Scenarios for GKMA	9
Figure 9	Monthly Rainfall Recorded at Makerere University May 2012-April 2013.	10
Figure 10	Observed and Future Rainfall in Kampala	10
Figure 11	Observed and Future Projections of Temperature in Kampala	10
Figure 12	Major Drainage and Wetland Systems of Kampala	16
Figure 13	Aerial View of Mayanja Wetland	17
Figure 14	Aerial View of Agricultural Activity within Mayanja Wetland	17
Figure 15	Aerial View of Encroached Kinawataka Wetland	18
Figure 16	Aerial View of Nolubaga Wetland	18
Figure 17	Increased Costs of Water Treatment Chemicals in Gaba Water Treatment	20
Figure 18	Location of Lutembe Bay, Kampala	21
Figure 19	Bird Counts in Lutembe Bay, 1994-2003	21
Figure 20	Natural Resources and Open Spaces in Kampala	24
Figure 21	Distribution of Sample Industries in Kampala, 2012	31
Figure 22	Increase in Roof Area per Catchment, 2004-2010.	32
Figure 23	Waste Received at Kampala's Only Landfill	34
Figure 24	Composition of Solid Waste Collected	35
Figure 25	Kampala Modal Split in 2011	38
Figure 26	Key Actors Involved.	40
Figure 27	KCCA Management Structure	42

TABLES

Table 1	Wetland Conversion Over Time	14
Table 2	Kampala's Drainage and Wetland Systems	15
Table 3	Forecast of Faecal Sludge (FS) Collection	29
Table 4	Change in Impervious Coverage via Building Indicators at Catchment Level, 2004-2010	32
Table 5	Waste Generation Tables for Kampala FY 2012-2103	34
Table 6	Measurement of Leachate at Mpererwe Landfill.	35
Table 7	Baseline Inventory of Emissions in Kampala (2009)	36
Table 8	Distribution of Households by Cooking Fuel (%)	37
Table 9	Increase in Vehicle Use 2002-2012	37
Table 10	Newly Imported Vehicles in Uganda, 2009-2013	38

EXECUTIVE SUMMARY

The City of Kampala is uniquely situated on a number of low rolling hills linked by wide valleys of wetlands that have defined the character and functions of the city throughout its history. In past decades the city has undergone a period of rapid urbanization that has significantly altered the scale and character of urban development as well as degraded the quality of the wetlands and other key environment assets of the city. With an annual population growth rate above or near 4% for 30 years and a large number of new migrants arriving year after year, the city's capacity to provide adequate housing and public services for these new residents and to absorb them within the formal economy has been severely challenged.

At the same time, climate change is further straining the city's ability to address urban environmental problems. Projected changes include an increase in temperature, a decrease in overall annual rainfall, and an increase in rainfall intensity. The increased intensity will contribute to storm runoff levels that exceed the capacity of the city's limited infrastructure, exacerbating already chronic flooding and the spread of pollution. Such conditions have already degraded the quality of the city's environmental assets and the vital ecosystem services that they provide.

An overall objective of this undertaking is to link the study of urban environmental issues with the promotion of more sustainable urban development. The Urban Environmental Profile for Kampala has been prepared as the first component of the assignment "Promoting Green Urban Development in Africa: Enhancing the Relationship Between Urbanization, Environmental Assets and Ecosystem Services," a project being conducted under the leadership of the World Bank. The Profile summarizes the existing quality of the wetlands and other aquatic and terrestrial environmental assets, identifies the key drivers of their environmental vulnerability, and the key institutional challenges and constraining factors that limit the city's ability to address environmental management challenges.

The relatively new government in the City of Kampala has begun to address some of the urban environmental challenges. This document is intended to be a resource for municipal officials and stakeholders engaged in environmental resource management. Their informed decision-making can lead to better safeguards of the environmental assets as the City of Kampala continues to develop as an important urban center of political, social, and economic activity.

Impact of Urbanization on Environmental Assets

40% of the population lives in unplanned, densely populated informal settlements that lack basic provision of water, storm drainage, sewage treatment, and solid waste collection. While an array of political, social, and economic factors have driven the informality of development, the high demand for affordable and accessible land for housing has been a primary cause. The scale of the environmental management problems, due to the vast area of informality, is clearly unprecedented and has led to the severe degradation of the city's environmental assets, particularly the quality and function of the city's aquatic ecosystems.

From 1989 to 2010, corresponding with explosive population growth, the area of developed land within the city increased from 27% to 78%. Land conversion for dense housing areas has proliferated in the marginal land, predominantly along the wetlands. The loss of soil and vegetation coverage due to the conversion of land has led to severe erosion and sedimentation, which has clogged urban drainage channels and degraded the natural drainage systems.

While still a city of trees and gardens, Kampala has lost much of its urban vegetation cover to development. Kampala has not implemented structured open space or urban forestry plans. Due to development, the lowland forests in KCCA were almost eliminated between 1983 and 2004. Former public open space within the city, such as Kololo Children's Park, Wandegaya Children's Park and Children's Park at Jinja Road, have also been converted to urban uses.

Kampala's wetlands have been severely reduced in size and function due to encroachment and pollution. Nakivubo Wetland, the most dominant in the urban area, has been significantly degraded. More than 50% of the wetland has been modified by channelization in the central city and by encroachment of residential and industrial development as the wetland flows toward Murchison Bay. The wetland has been used for tertiary treatment of municipal waste water and has received untreated effluent and storm runoff from the industrial and residential areas.

Large-scale infrastructure projects have had significant negative impacts on wetland quality and function. The Nakivubo Channel project, funded by the World Bank to improve storm water drainage and flood management through channelization, has increased the rate of water flow and disruption of the hydrological function of the wetland. The Lubigi Channel drainage project, constructed to reduce impacts of extreme floods, has altered vegetation, soil and hydrological functions of a section of the wetland system. The Northern Bypass, built to ease traffic congestion, has encroached on the wetlands, altered hydrological function and threatened the loss of biodiversity of plant species due to the impact of limestone on water chemistry. The proposed Southern Expressway, to be built through the Nakivubo wetland, could cause further degradation, loss of habitat and overall wetland function.

The lack of a comprehensive piped sewerage network, adequate wastewater treatment, and the subsequent discharge into the wetlands and Murchison Bay are key drivers of degradation and loss of ecosystem services. Only 10% of the population, primarily in the Central Business District (CBD) and affluent areas, is served by the sewer system. Twenty percent use septic tanks and the remaining 70% rely on on-site sanitation, which is discharged untreated into the natural environment. As a result, Murchison Bay, the primary source for potable water for the city of Kampala, is the recipient of surface runoff, sewage effluent, industrial wastewater. However, new wastewater treatment facilities are being planned to address the service deficit. Bugolobi Sewage Treatment Plant Expansion and new facilities at Lubigi and Kinawataka have been proposed.

The city's storm water drainage system has not kept up with the rapid urban growth and the development of informal settlements. The increase in impervious surface area from dense, compacted land uses, rooftops and roads has resulted in an increased volume and coefficient of storm runoff, which carries sediment and pollutants to the wetlands and rivers. A large increase in the number of buildings within the 10 year flood line has further reduced the ability to manage storm water. Higher rates of precipitation and increasing storm events due to climate change will exacerbate conditions.

Approximately 35% of the total solid waste generated within the city is not properly removed. A great deal of solid waste is thrown or carried by runoff into drainage channels and wetlands, causing blockage and backups of drainages as well as water quality degradation. However, waste collection rates have increased from 54% to 65% over the past two years and KCCA and NEMA are implementing commercial ratepayer collection services.

The ambient air quality has deteriorated significantly in the past two decades due primarily to the heavy reliance on wood and charcoal for cooking and the increase in the number of motor vehicles. Wood fuel is used by 78% of households. The increase in number of motor vehicles and the structural shift in the composition of vehicle stock, from auto to higher emission emitting motor cycles (boda-boda), are having a significant impact on air quality.

A Greenhouse Gas (GHG) Inventory was prepared in 2012. Employing international protocols to analyze emissions by sub-sector, the inventory found that solid waste disposal (34%) and waste water treatment (18%) were the greatest sources of emissions due to the release of methane gas at the landfill and plant. Given the increase in the use of motor vehicles, the inventory is being revisited to address on-road transport emissions, which were found to be less than 1% of emissions.

Key Findings

Inadequate and ineffective planning has been a key obstacle to providing the management required to protect the city's environmental assets. For decades, the city has lacked an effective physical development plan to guide growth and development. Historically, there has been sectoral planning in silos, each with separate goals, targets and planning horizons. New procedures are underway to establish a more integrated urban planning approach. This will be essential to implementing more sustainable solutions. The stakeholder engagement process can be developed to bring a broad array of considerations into the planning process.

Little protection for the city's environmental assets has been afforded under the current regulatory regime. Environmental regulations have created the enabling framework for protecting the wetlands, but essential actions such as survey and delineation of wetland areas have not been implemented due to political, social and economic implications of restricting land use. Regulations for discharge of effluent, particularly to control industrial discharge, have not been widely enforced, and the enforcement capacity of institutions charged with environmental management is generally limited.

The land management system requires significant financial outlays for public acquisition of land for infrastructure and service facilities, which constrains delivery of sanitation, solid waste and drainage services. The current system limits the supply of developable land, driving informal development to marginal areas and to environmentally sensitive areas. It distorts the spatial structure of the city and complicates and delays urban planning and development.

Foremost, Kampala is a rapidly growing city: the built environment will continue to expand and there will inevitably be some amount of natural resource and ecosystem loss. Kampala has arguably pursued a “build everywhere” approach. Development has proceeded with little awareness or sensitivity of the overall impacts on ecosystems. There has not been a serious attempt to integrate protection or enhancement of critical natural asset systems within physical development.

Development has not been guided by a strategic concept or framework for what might be called the “grand bargain”—a planning mechanism that identifies the critical natural assets and prioritizes them—so that there is a structure to balance development and mitigate the loss of assets, or to preserve or even enhance them. A strategic concept would provide the platform for the city to use innovative tools; such as development offsets, now being considered. Wetland degradation is the primary example. Historically, the Kampala region has been uniquely bestowed with an abundance of this highly valuable natural resource. Within KCCA, this resource is now largely gone—resulting in what could be described as the very the opposite of “Green Urban Development.”

Development in Kampala and its environmental impacts needs to be considered at the metropolitan scale. The broader metropolitan region still has critical natural assets, such as the large area of wetlands east of Murchison Bay, which should be protected and conserved as urbanization expands. Proper consideration of proposals for development in the context of the remaining assets can allow the city to avoid the mistakes of the past.

Valuable ecosystems are under acute pressure, and action will need to be taken soon if their continued deterioration is to be arrested. From a fiscal perspective, Kampala will have limited resources to invest in gray infrastructure that is required to offset the degradation of the green asset base. Given these constraints, leadership and institutional actions—feasible and capable of addressing key problems—are particularly important.

Key steps for the future include:

- Development of a profile of natural assets at the metropolitan scale and a broad strategy to address pressures on these assets;
- Identification of specific opportunities for Green Urban Development interventions supported by thorough action planning to these opportunities forwards;
- Institutional actions move to regulate, enforce and protect assets in line with what is already in current policy and law and the development of more sophisticated measures to address ecosystem loss.

I. INTRODUCTION

The city of Kampala has undergone a period of rapid urbanization that has contributed to the degradation of the city's natural environment. The arrival of thousands of in-migrants year after year has overwhelmed the city's ability to deliver adequate public services, housing, and jobs. Unplanned, densely populated informal settlements that lack basic water, sewer, and waste services now cover much of the city's land area.

Climate change is placing further strains on the city's ability to manage the urban environment. Increasing levels of rainfall from climate change contribute to storm runoff levels that exceed the capacity of the city's infrastructure, causing flooding and the spread of pollution. Such conditions have degraded the quality of the city's natural environment and the vital ecosystem services that it provides.

The Urban Environmental Profile for Kampala has been prepared as the first component of the assignment "Promoting Green Urban Development in Africa: Enhancing the Relationship Between Urbanization, Environmental Assets and Ecosystem Services," a project being conducted under the leadership of the World Bank. An overall objective of this project is to link the study of urban environmental issues with the advancement of more sustainable urban growth. The Profile summarizes the existing quality of the wetlands and other aquatic and terrestrial environmental assets, identifies the key drivers that are the cause of their vulnerability, and describes the key institutional challenges and constraining factors that limit the city's ability to address environmental management challenges.

A. Methodology

The Urban Environmental Profile was developed based on the collection of data using the Rapid Urban Environmental Assessment (RUEA) tool developed jointly by the United Nations Development Programme, United Nations Centre for Human Settlements (UNCHS – Habitat), and the World Bank (Leitmann, 1994). The purpose of the RUEA is to document available data and identify gaps in knowledge. A questionnaire was developed to guide the collection of data and to generate a baseline of environmental information.

The RUEA questionnaire includes numerous charts to be populated with specific data on sanitation, solid waste, energy, and other urban systems and services. While the questionnaire was used as a starting point for data collection, the team found that for the most part the information was not available in this format and that the focus of the questionnaire was more narrow than that of the study. However, while the questionnaire often could not be answered directly within the format or specific units requested, it did guide the team towards the intended data, provided that the team considered the purpose or intention of each question.

Identification of the key environmental assets and key drivers of environmental degradation within the city required a more comprehensive review of reports on urban planning and infrastructure services. The required information was too complex to fit into the RUEA questionnaire format. Therefore, the process evolved to the definition and annotation of an outline for the profile that was then developed into this document.

There is limited environmental data available on Kampala. For instance, the city of Kampala does not have data on the status of urban vegetation, wildlife, land, soil, or air quality. There is considerable information available on Kampala's wetlands as they have been the subject of academic research. But the available information typically addressed individual wetlands, while the specific focus of the research topic rather a comprehensive review of the wetland system. For example, a table developed for the Profile provides a summary of the condition of the eight major wetlands systems by referencing nine sources. The most current and comprehensive inventory of the wetland system was last completed in 1999.

The city has recently made progress in the development of key infrastructure systems such as solid waste management and sanitation. The available information has frequently been generated for an environmental impact statement for specific projects and is therefore limited in geographic scope. There also has been little development of baseline inventory or analytics of the city's environmental assets.

Consultation with key stakeholders informed the drafting of the profile. A kick-off workshop held in Kampala in September 2014 introduced relevant municipal officials and stakeholders to the objectives and intentions of the study. Participants provided overall direction on relevant secondary sources of environmental data, such as municipal development plans and strategic planning documents and reports prepared by national-level ministries, the World Bank, and United Nations (UN). Information was also gathered from interviews with municipal officials.

A PowerPoint presentation summarizing the intermediate findings was presented during a second workshop in December 2014. During the event, key stakeholders provided preliminary comments and feedback that guided the refinement of the Profile.

B. Summary of Report

The Urban Environmental Profile is organized as follows:

Section II: Background and Context sets the background and context for Kampala, providing an overview of the impacts of rapid urbanization and climate change, drawing linkages to urban environmental assets.

Section III: Quality of the Environmental Assets of Kampala describes the state of the key environmental assets, including the terrestrial assets, aquatic assets, and air quality, and attempts to infer the associated historic and current trends.

Section IV: Drivers of Environmental Vulnerability and Degradation describes the key issues that are driving degradation and the impacts caused. Drivers include informal settlements, effluent, stormwater runoff, solid waste, and emissions.

Section V: Institutional Issues and Challenges describes the key factors that constrain Kampala's ability to effectively address environmental management challenges.

Section VI: Summary provides a synthesis of key findings.

II. BACKGROUND AND CONTEXT

Kampala has experienced decades of significant urban growth and is currently the second-fastest-growing city in Eastern Africa. As Uganda's capital city, Kampala is the industrial, commercial, and education center and vital to the country's economic growth. As shown in Figure 1, the city (referred to as the Kampala City Center Area or KCCA), is within the Greater Kampala Metropolitan Area (GKMA), which also includes the inner suburbs, the outer dormitory towns and suburbs, peripheral towns, and peri-urban extension to the south-west towards the Entebbe community (referred to as the KMTC) (KCCA, 2012). KCCA consists of five urban divisions, including: Central, Kawempe, Makindye, Lubaga and Nakawa. Collectively, these divisions cover a total of 189 square km, with 169 square km of land and approximately 20 square km of water. The GKMA is a 970 km² area roughly defined by a 20km radius from Kampala City Centre that includes 171 parishes, of which 99 are in Kampala District, nine in Mukono District and 63 in Wakiso District (Uganda Ministry of Works and Transport, 2008).

The city of Kampala developed on hills linked by wide valleys of wetlands and river channels that flow into the Murchison Bay on Lake Victoria.

Kampala has grown outward from the urban center along upland corridors, with development spreading down the slopes of the city's 24 hills into the low-lying wetland areas (Figure 2, N.B. darker colors indicate areas of steep topography). This growth has led to an increasingly inefficient pattern of development that encroaches into wetland areas. This pattern has furthermore presented difficulties for provision of adequate sanitation, drainage, flood control and environmental asset protection in addition to proving costly for the government to service (KCCA, 2013; Fichtner, 2014).

About 23% of the GKMA is fully urbanized, a significant portion (60%) is semi-urbanized, and the remainder consists of rural settlements. These rural areas are those generally not represented by color overlays (Figure 3) (KCCA, 2014b). By contrast, the KCCA is almost entirely developed, with less than 10% of the land mass vacant. Approximately 7% of the GKMA area is wetlands (KCCA, 2012).

A consequence of rapid urbanization has been the overall decline in the quality of the urban natural environment. The impacts of climate change have exacerbated the rate and extent of environmental degradation and have made the city's efforts toward environmental management all the more challenging.

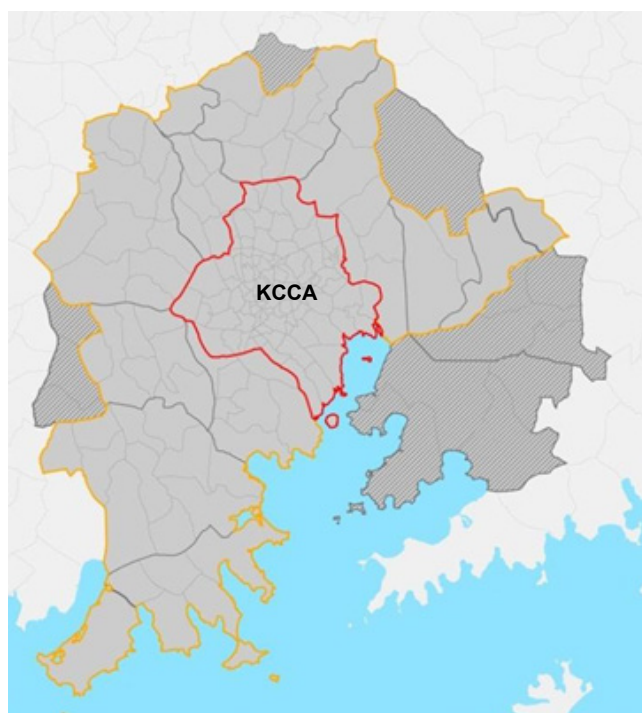


Figure 1 Political Boundaries of the KCCA (area within red outline and the GKMA (entire area of light gray, including KCCA)
Source: KCCA, 2012

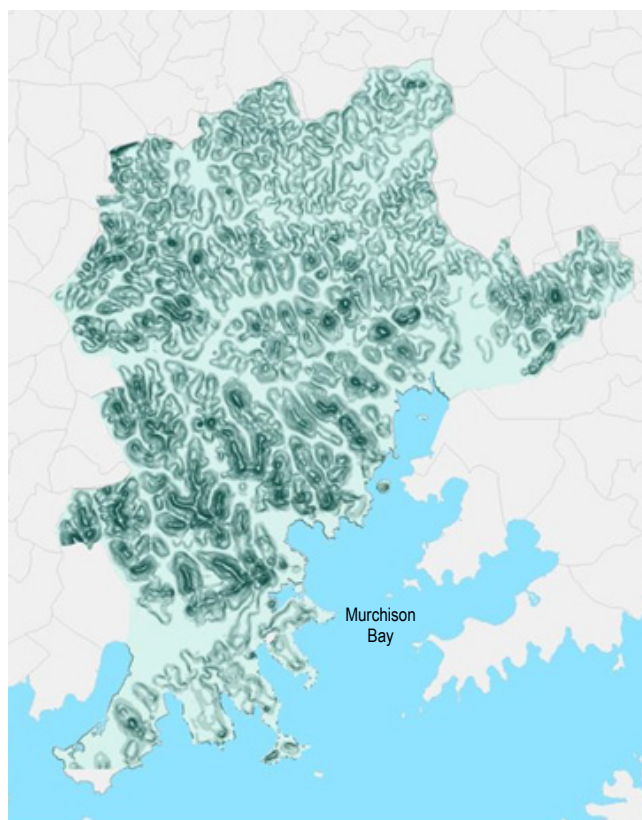


Figure 2 Topography and Slope Analysis of GKMA
Source: KCCA, 2012

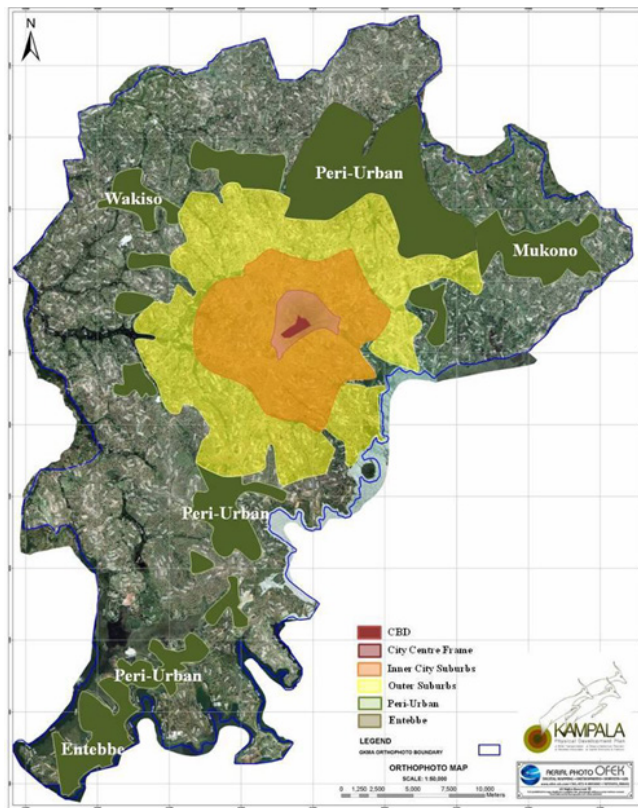


Figure 3 GKMA Settlement Pattern
Source: KCCA, 2012

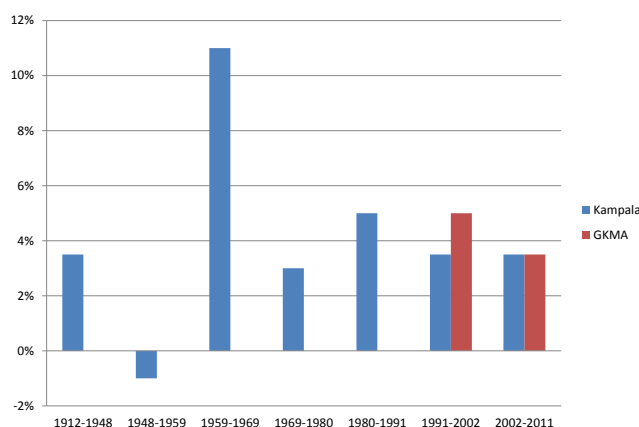


Figure 4 Rate of Population Growth in Kampala and GKMA
Source: KCCA, 2012

Urbanization

Kampala has experienced rapid population growth for decades. The current annual population growth rate of the urban area of Kampala is 3.9% (above the national rate of 3.3%) (KCCA, 2012). The rate of growth in the urban center has been above or near 4% for 30 years (see Figure 4). As illustrated, the overall rate of growth in Kampala, reflecting KCCA, has slowed since 1980-1991.

The absolute number of urban residents will continue to increase at high levels. In 1970, Kampala had a population of 330,700. Nearly 20 years later, in 1991, the population had more than doubled, to 774,241 (UBOS, 1991). In 2002, the population of the city was 1,189,142 (UBOS, 2002). In 2014, Kampala's population was approximately 1,516,210 (UBOS, 2014). The GKMA region's population was a little over 3 million in 2012 and is projected to reach approximately 5 million by 2020 and 13 million by 2040 (see Figure 5) (KCCA, 2012).

Kampala's rate of growth reflects both push and pull factors. The country's political instability in the 1970s and 1980s led to the deterioration of public services that was experienced more pronouncedly in the rural areas, pushing people away from the countryside. Rural populations were also pulled to Kampala as Uganda's capital city and commercial and economic hub. Kampala is a key driver with respect to growth in the Great Lakes Region, contributing approximately 60% of Uganda's GDP, and accounting for 80% of the country's industrial sector (KCCA, 2012).

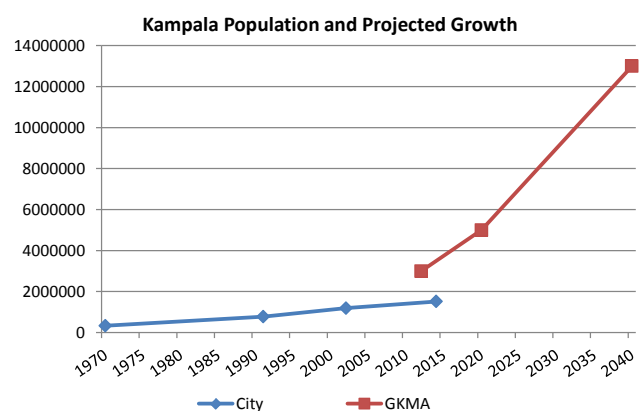


Figure 5 Kampala Population and Project Growth
Source: KCCA, 2012

As Kampala's population has increased, open space and undeveloped land in the city center has been replaced with development that has often occurred in environmentally vulnerable areas. Figure 6 illustrates Kampala spatial development from 1989 to 2010. Prior to 1989, most development occurred within upland areas of the urban core and along major transportation corridors, which represented 27% of KCCA's total land area (Abebe, 2013). With the increase in population, particularly the in-migration of the rural poor, development spread to unplanned areas on the lower slopes and low-lying drainage corridors and marginal areas: areas are often prone to flooding and are environmentally vulnerable.

From 1989 to 2010, the area of developed land increased from 27% to 78% (Abebe, 2013). Figure 7 illustrates the trend in the conversion of land from undeveloped to developed within the past 25 years. The majority of Kampala's urban development has been residential, which covers approximately 23% of the GKMA landmass (over 60% of the total developed areas in the GKMA) and approximately 64% of the KCCA land area. Employment-associated land uses account for 3% of the GKMA land area and 10% of the KCCA. Public services and facilities land uses are 2% of the GKMA and 6% of the KCCA (KCCA, 2012).

A recent survey estimated that 40% of the city population, and much of the recent migration, live in informal settlements and/or slums that lack basic infrastructure services for the provision of water, storm drainage, sewage treatment, and solid waste collection (KCCA, 2012). While an array of practical and social factors have driven informality, the demand for affordable and accessible housing has been key. Planning scenario projections indicate that the demand for land could vary between 200,000 ha in the worst case scenario to around 100,000 ha in the best case scenario by 2040 (Figure 8). The dense informal settlements predominate at the edges of the wetland corridors throughout the city and, as later sections of this document will discuss, have become one of the key drivers of environmental degradation of the water quality in wetlands and drainage courses.

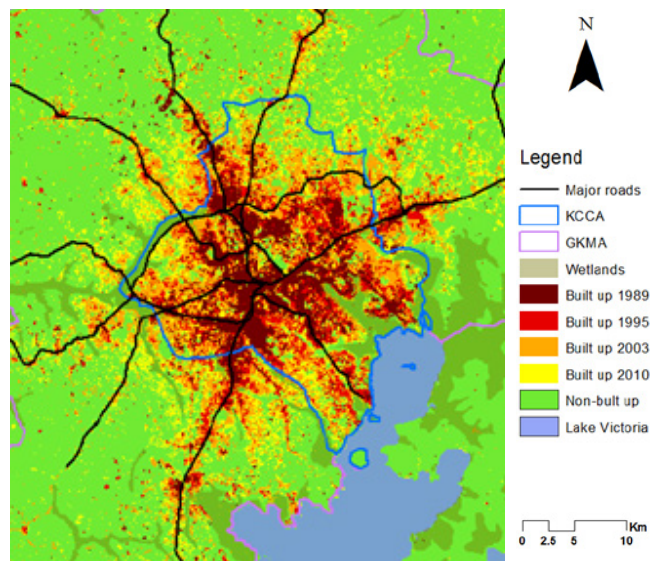


Figure 6 Spatial development from 1989 to 2010 in GKMA and KCCA
Source: Abebe, 2013

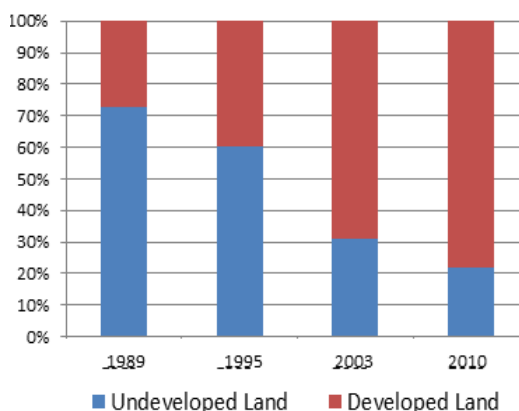


Figure 7 KCCA Undeveloped and Developed Land, 1985-2010
Source: AECOM created chart with data from Abebe, 2013

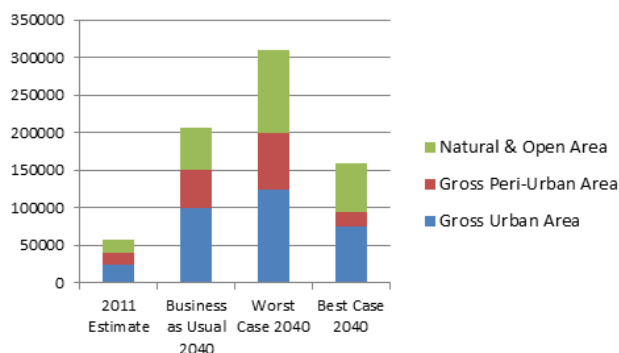


Figure 8 Projected Scale of Footprint (Hectares) for Informal Areas Under Future Growth Scenarios for GKMA
Source: KCCA, 2012

Climate Change

As Kampala is located near the equator, there is little fluctuation in the average temperature throughout the year. Temperatures range from average lows in the mid-60s F to average highs in the low 80s F. However, the tropical rainforest climate provides variation, with two annual wet seasons. There is a long rainy season from August to December and a short rainy season from February to June that has substantially heavier rainfall per month. The average annual rainfall is between 1,750 and 2,000 mm, with monthly rainfall ranging from approximately 50mm to 260mm (World Meteorological Organization, 2013 in UN Habitat 2013) (Figure 9). Recent climate projections for Uganda conclude that while overall rainfall totals for the country may remain similar to the present, and Kampala's total rainfall may decrease (Figure 10), the seasonality of rainfall may see a longer wet season that extends from September through to the start of the February rainy season (Baastel, 2014, Baastel, 2014b).

Projected climate change impacts for Kampala anticipate an increase in temperature and decrease in overall precipitation, threatening water supplies (Baastel, 2014). Recent analysis focused on Kampala suggests a temperature increase of 1.5°C to 3.0°C by 2095 (Figure 11) and a 20 mm decrease in precipitation by 2095 (Figure 10) under a moderate greenhouse gas emissions projection. (Baastel, 2014). Furthermore, a rise in mean annual temperatures could intensify an urban heat island effect that where built-up areas absorb and generate more heat than nearby rural areas. This combination of higher temperatures could strain water resources by reducing flows and degrading quality.

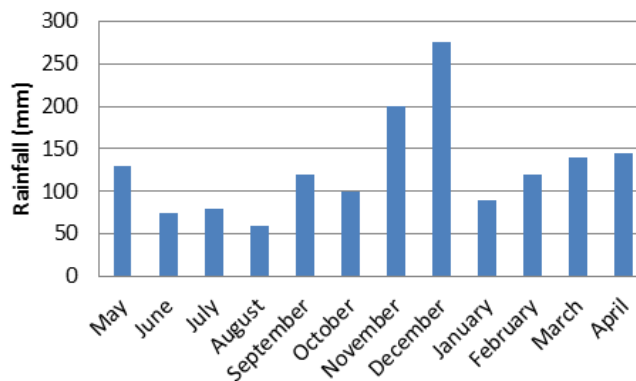


Figure 9 Monthly Rainfall Recorded at Makerere University
May 2012-April 2013

Source: UN Habitat, 2013

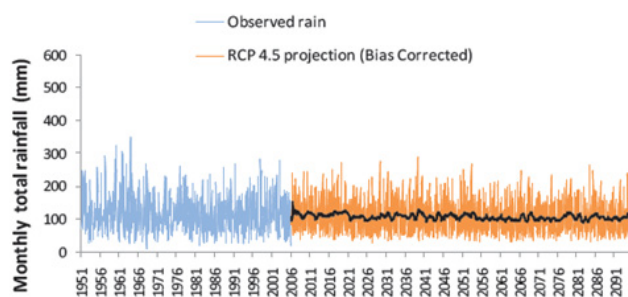


Figure 10 Observed and Future Rainfall in Kampala

Source: Baastel, 2014

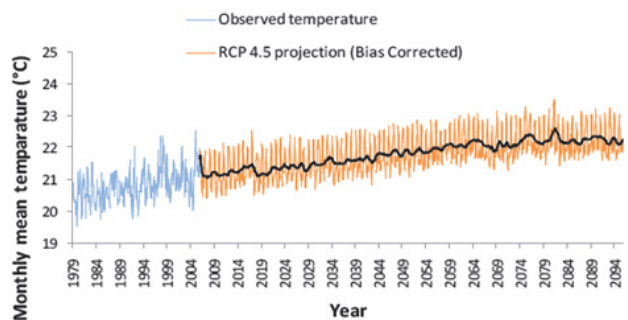


Figure 11 Observed and Future Projections of Temperature in Kampala

Source: Baastel, 2014

The city has already experienced an increase in rainfall during extreme climate events. Rainfall data is being developed at a weather station installed at Kampala's Makerere University as part of a flood modeling program. While there is limited modeling and few weather stations, the analysis indicates an increase in intensity of rainfall and greater likelihood of extreme weather effects that can cause harm to human and natural systems (UN-Habitat, 2013).

The increase in rainfall has already exacerbated existing chronic urban environmental management conditions due to rapid urbanization without corresponding development of urban services. The City of Kampala's Carbon Disclosure Report (CDP) 2013 Report notes that changes in the seasonality of rainfall are already a serious risk, affecting the predictability of planting and harvesting and increasing already-chronic flooding (CDP, 2013). Low-lying areas of informal settlements will continue to be the most vulnerable as they are already located in hazard prone areas and are subject to flooding and or high storm runoff from the adjacent hills (UN-Habitat, 2012). During heavy rains in June and November, 2014, there were news reports of trees uprooted and latrine slabs lifted and carried by floodwaters, polluting waters with human waste (Daily Monitor, June 10, 2014; UGO News, 2014). Public health challenges from increased flooding include the rise of cholera outbreaks during the rainy season (Lwasa, 2010).

Although new information about climate change specific to Kampala is underdevelopment (Baastel, 2014), the city's efforts to address climate change mitigation and adaptation actions have been limited. There is a Climate Change unit within the Ministry of Water and Environment, but a national policy on climate change has yet to be produced. However, there is no local adaptation policy to comprehensively address climate change issues in an integrated and strategic manner. There is an inherently low capacity to adapt to climate change given the large population of urban poor, the un-serviced informal settlements, and inadequate urban services in general (Lwasa, 2010).



Photo: Floods from heavy rains exacerbate degradation of environmental assets through water pollution.

Source: Daily Monitor November, 29 2014

III. QUALITY OF THE ENVIRONMENTAL ASSETS

Kampala's key environmental assets are predominantly the network of wetland waterways that course throughout the city, delivering a suite of ecological services, including flood attenuation, water purification, and wastewater treatment. The quality and function of the city's aquatic system has been significantly degraded. The city's terrestrial assets are composed of hills, open spaces, and trees. These areas are being rapidly developed and lack formal protection and environmental management. While there is limited data available about the city's air quality, existing findings show increased degradation due to the rise in vehicle emissions. Furthermore, the lack of national air quality standards will continue to delay establishment of baseline monitoring.

A. Aquatic Ecosystems

The City of Kampala and the GKMA are rich with aquatic environmental assets. The urban fabric has been shaped by the wetlands and the waters that flow into Murchison Bay on Lake Victoria (Figure 2). These aquatic ecosystems provide floodwater attenuation, sewage treatment, water purification, food, and building materials, while areas such as Lutembe Bay, designated an Important Bird Area by BirdLife International, provide critical habitat for the city's biodiversity.

Wetlands

The City has relied on Kampala's wetlands throughout the settlement's history to provide numerous ecological services that support the City:

- Wetlands have served as the city's primary infrastructure for physically and biologically cleansing water, filtering out sediments and nutrients that enable the raw drinking water to be cost-effectively treated for human consumption.
- The wetland system has also served as the city's primary sponge for absorbing stormwaters, slowly releasing and cleansing waters by discharging into Lake Victoria or recharging groundwater flows.
- Wetlands have provided the city's predominant human waste processing function by receiving raw sewage and mechanically treated waste water, processing nutrient loads, and releasing waste water downstream with a higher degree of treatment.
- Wetlands have provided food, fuel, and building materials. Additionally, the wetlands help support the fisheries that provide livelihoods for approximately 1,200 people at Portbell, Ggaba and Munyonyo (KCCA, 2014).



Photo: Housing Encroaching Upon Wetlands.
Source: AECOM



Photo: Farming in Wetlands.
Source: AECOM

However, the steady decrease in wetland area is driving overall wetland system decline. Once a large and vital ecosystem, the remaining area of wetlands constitutes approximately 9% of the total Kampala City surface area, according to recent spatial analysis based on satellite imagery (KCCA, 2012).

Unfortunately, the city's wetland resources are now mostly characterized by their state of degradation.

Urbanization; encroachment; indiscriminate disposal of wastewater from the settlements, industries, and commercial establishments; and the illegal dumping of solid waste have led to degradation of almost all of Kampala's wetlands to some extent in past decades and disrupted the ecological functions the city has relied on throughout its history.

Wetland conversion to developed land has progressed quickly over the past few decades. Wetlands within the GKMA have been consistently encroached upon by development, causing a steady decrease in wetland area, a direct indicator of overall wetland system decline.

Table 1 notes the amount of wetland area that has been converted to development between 1989 and 2010, indicating a significant growth in area of wetland encroachment. While the change in percentage of wetland encroached during each time period has decreased from 2003 to 2010, it is important to note that as the area of wetlands that are available to be encroached decreases, the percent of change in encroached area will also decrease. The extent of encroachment in the past decade also indicates limited enforcement and monitoring activities in the wetlands despite the development of environmental regulations protecting wetlands from encroachment (see section IV).

Analysis of wetland encroachment (Table 1 and Table 2) reveals that most of the encroachment is occurring within the KCCA. Known encroachment of permanent and seasonal wetlands is illustrated in the purple and blue areas, while the built-up areas at the edges of wetlands are shown in red. Most of the major permanent wetlands have settlement that is approaching the wetland edges. While wetland areas outside the KCCA have received less encroachment, these areas are under future threat due to increasing population settlement anticipated in GKMA areas (see "II. Background and Context, Urbanization").

Compared to the wetland area of early Kampala settlement, the degradation of wetlands is significant. By 1993, 8 km² or 25% of the original wetland area was converted for development, and by 1999, 46 % of the original wetland areas of Kampala had been converted for urban development. Of the remaining wetland area, only about 8% remains highly functioning (KCCA, 2014b). Due to the expanse of urbanization and increased runoff, there has been increasing pressure to develop in low-lying flood prone areas (i.e. within the 1 in 10 year flood line) with substantial amounts of construction occurring inside this flood line between 2004 and 2010 (UN-Habitat, 2013).

The wetlands are used by the residents of informal settlements and slums for domestic and small-scale income-generation uses. Yam, sugarcane, cassava, sweet potatoes, mixed vegetables and matoke are grown; papyrus is harvested, and brick-making and fish farming also occur (Emerton, 1998). While this local use of wetland goods and services is an important source of livelihoods for the residents, these activities also directly contribute to degradation of the wetland and its functions.

Kampala's wetlands have been further modified and compromised by drainage enhancements, cultivation, and extraction of natural resources. The city has numerous wetlands that serve as tributaries within broader wetland systems. The Table 2 shows a general status of the city's major drainages and associated wetlands.

Table 1 Wetland Loss Over Time

Study Period	Permanent Wetlands			Seasonal Wetlands		
	Area (ha)	Change (ha)	Change (%)	Area (ha)	Change (ha)	Change (%)
1989	45	-	-	79	-	-
1995	118	73	162	183	104	132
2003	375	257	218	878	695	380
2010	658	283	75	1639	761	87

Source: Abebe, 2013

Table 2 Kampala's Drainage and Wetland Systems

Number Corresponds to Drainage Area Map	Name of Major Wetland and Drainage System ¹	Wetlands within the Drainage System	General Condition
1	Nakivubo	Nakivubo	50% modified; ² Significant loss of surface area due to encroachment in upper sections by industry and housing; downstream areas retain functionality; heavy effluent loading; water purification uses ^{3,4}
2	Lubigi	Lubigi; Jugula; Nabisasiro; Nsooba; Bulyera; Kyabatola	Heavily degraded and modified along eastern sections by settlement and drainage works; good condition along western-most sections; ⁵ Nabisasiro is considered 100% modified ⁶
3	Nalukolongo	Nalukolongo; Mayanja;	Heavily encroached by industry and settlement along upper reaches; most vegetation has been modified through agriculture and settlement, threats from drainage; ⁷ lower reaches in good condition; ⁸
4	Kansanga	Kansanga	60% modified from road construction, settlement, nursery production; ⁹ water purification uses
4a	Gaba	Kansanga	60% modified from road construction, settlement, nursery production; ¹⁰ water purification uses
5	Mayanja/ Kaliddubi	Mayangi; Kaladdubi; Kawaga;	At least 50% modified with significant loss of surface area for drainage and subsistence agriculture; conversion to settlement; ^{11,12} Mayanja shows considerable encroachment from agriculture ¹³
6	Kinawataka	Kinawataka; Bukasa	Significant loss of surface area in upper section due to industrial and housing encroachment; heavy effluent loads also present and contributing to invasive species growth; water purification dependence; ¹⁴ significant effluent loading and degradation from upstream industry ¹⁵
7	Nolubaga	Nalubaga; Nyanjarede	Good condition with limited modification; subsistence agriculture along edges; ^{16,17}
7a	Nokelere/ Nolubaga		Good condition with limited modification; subsistence agriculture along edges; ^{18,19}
8	Walufumbe	Walufumbe	20% modified; ²⁰ some subsistence cultivation; impacts from upstream agriculture; ²¹ threatened by development and cultivation
8a	Mayanja North	Mayanja North	100% modified; ²²

Source: AECOM, 2014; 1 Kampala Sanitation Program ESIA, 2009; 2 MWE, 2014; 3 Kansiime, 2007; 4 MWE, 2014; 5 UNRA, 2011; 6 Namakambo, 1999; 7 Kampala Sanitation Programme ESIA, 2008; 8 MWE, 2014; 9 KCCA, 2012; 10 KCCA, 2012; 11 Namakambo, 1999; 12 Google Earth, 2014; 13 Google Earth, 2014; 14 MWE, 2014; 15 Walakira, 2011; 16 Namakambo, 1999; 17 Google Earth, 2014; 18 Namakambo, 1999; 19 Google Earth, 2014; 20 KCCA, 2012; 21 Namakambo, 1999 22 Namakambo, 1999

The Kampala Drainage Master Plan (Figure 12) designates 8 major wetland systems. The steady decrease in wetland area is driving overall system decline. Between 2002 and 2010, the area of wetlands declined from 18% to 9% of city surface area. Only one (Nolubaga and Nokelere/Nolubaga drainage) of the city's eight major wetland systems is generally observed to be in good condition (see Table 2) (KCCA, 2014b).

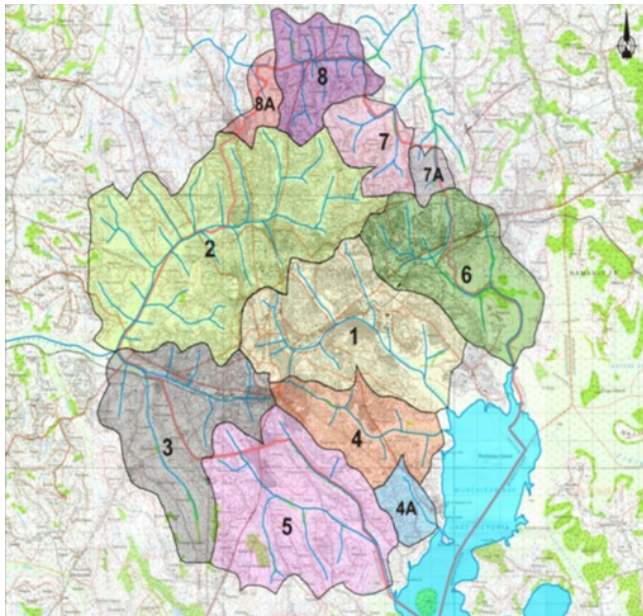


Figure 12 Major Drainage and Wetland Systems of Kampala
Note: Map numbers of each drainage system correspond to Table 2.
Source: Kampala Drainage Master Plan, 2003

The character and conditions of these wetland systems are summarized in Figure 2 and as follows:

- **System 1, the Nakivubo wetland**, is the most dominant wetland of the urban area and one of the major wetlands on the north-western shores of Lake Victoria. The Nakivubo forms the boundary between Nakawa and Makindye Divisions in the valley between Bugolobi, Mpanga, and Muyenga hills. The Nakivubo has permanent water and is fed by the Nakivubo channel. With an original surface area of 5.29 km² and a total catchment extending over 40 km², the area of wetland has since been reduced to 2.8 km² by 1991 and 0.69 km² in 2007 (Kansiime et al., 2007).
- Papyrus and *Mischanthus* sp. dominate the plant community at Nakivubo, although the less wet areas have been modified by the cultivation of yams and sugar cane, especially around Namuwongo and Bugolobi. The slum close to Namuwongo is expanding into the wetland, and the wetland is used for tertiary treatment of effluent from the National Water and Sewerage Corporation, by farmers cultivating crops and harvesting papyrus, and by brick-making operations. A portion of the Nakivubo wetland in

the central city has been channelized for drainage and flood control that has resulted in an increased rate of runoff and limitation on pollutant purification functions. Although more than 50% of the wetland has been modified, the lower part of this wetland is in a relatively better condition than the upstream sections. This wetland is earmarked for protection through the National Wetlands Programme (MWE, 2014). Rehabilitation and enhancement of the Bugolobi Sewage Treatment Works, anticipated to start in 2014, could improve nutrient management in the lower Nakivubo (NWSC, 2013).

- **System #2, the Lubigi wetland**, is located along the existing Northern Bypass road and reflects a mixture of conditions common within each of Kampala's wetlands. The portion of the wetland along the westernmost section of the bypass has a high level of species richness and overall function, while areas of the wetland toward the northeast sections of the bypass are increasingly degraded (UNRA, 2011). The westernmost sections have been modified significantly for a flood control project that has been constructed within the wetland, altering vegetation, soil quality, and hydrological function (UNRA, 2011).

A sewage and fecal sludge treatment plant (SFSTP) is under construction in the Lubigi wetlands alongside the Northern Bypass in one of the sections that is already degraded (NWSC, 2014; NWSC, 2013). This facility is anticipated to collect and remove nutrients from on-site sanitation systems located throughout the catchment that would otherwise be loading into the Lubigi. However, the construction of the facility within the wetland has resulted in the loss of wetlands area.

- **System #3, the Nalukolongo wetland**, which is connected to the Lubigi Wetland system, is located in Lubaga and generally runs alongside and south of Masaka Road. Unlike the Nakivubo and the Kinawataka, which flow into Lake Victoria, the Nalukolongo wetland feeds Lake Kigoya to the north of Kampala. It comprises both permanent and seasonal wetland stretching along the Nalukolongo and Mayanja rivers. Most of the original vegetation has been modified through agricultural activity and settlements, but there is still some papyrus and sedge habitat. The area floods excessively during peak rains, affecting many homes and industries. The wetland is gazetted as an industrial area by the Kampala City Council in its Urban Planning Structure Plan. A large part (the Mayanja to the south) of this wetland falls outside the Kampala District. Although approximately 50% modified, the lower part is in relatively good condition (MWE, 2014).



Figure 13 Aerial View of Mayanja Wetland

(Left) An aerial image of the mouth of Mayanja wetland, outlined in red, at the outlet to Inner Murchison Bay reveals extensive disturbance within the center of this wetland. See Figure 14 inset image.

Source: Google Earth, downloaded December 2, 2014. Image dated July 5, 2014



Figure 14 Aerial View of Agricultural Activity within Mayanja Wetland

(Right) Aerial image of Mayanja wetland reveals extensive agricultural cultivation in center of the wetland near the outlet to Inner Murchison Bay (see Figure 13 for location context of this image).

Source: Google Earth, downloaded December 2, 2014. Image dated July 5, 2014

- System #4/4a, the Kansanga/Gaba wetlands**, feed Murchison Bay and the Lake Victoria watershed catchment. This wetland system also directly influences Murchison Bay's Gaba Water Treatment intake plant near Gaba beach, close to the outlet of this wetland system. The wetland is considered mostly degraded, approximately 60% modified by settlement, agricultural cultivation, and construction of drainage channels that have collectively altered the system's hydrology and function (KCCA, 2012; Daily Monitor, 2012). The wetland has been partially converted to other uses upstream and has observed populations of monitor lizards and the swamp-dwelling antelope called a sitatunga. Papyrus, Miscanthus sp., Typha sp. and Phragmites sp. were also observed as dominant vegetation downstream, while relics of swamp forest dominated by Phoenix sp. and sedges were common upstream (Nanakambo, 1999).
- System #5, Mayanja/Kaliddubi wetlands** are located just south of the Kansanga/Gaba system. This system feeds into Murchison Bay and the Lake Victoria catchment. There is little information available on this wetland system. However, an analysis of aerial imagery of the wetlands' largest section, the area closest to the Bay, reveals degradation (see Figure 13 and Figure 14) that covers most of the widest and most extensive area of this wetland. Closer analysis reveals considerable filling of land for agriculture.
- System #6, the Kinawataka - Bukasa wetland** is the second major wetland after Nakivubo wetland, with dense vegetation thickets and riverine trees. The wetlands are dominated by papyrus downstream, with patches of Phragmites sp, Typha sp, Echinochloa sp and Afromomum sp (MWE, 2014). The wetland serves to protect the Inner Murchison Bay from the catchments of Mutungo, Mbuya, Nakawa, Ntinda, Kyambogo, Banda, Kireka, Bweyogerere, Namboole, Kirinya, and Butabika. Similar to conditions at Nakivubo, these catchments are heavily industrialized and densely populated, leading to release of nutrient-rich effluents, which are potential pollutants to Lake Victoria.

The Kinawataka wetland has been found to serve as an effective sponge for retaining nitrates, phosphates, and other nutrients that enter the wetland from upstream industry and sewage effluent (Busulwa, 2002). However, water testing has concluded that water pollution levels are too high for human consumption and for irrigation of vegetable production (Walakira, 2011). Upstream factories that are contributing untreated effluents into the Kinawataka include fish filleting, foods, beverages, plastics, chemicals, pharmaceuticals, iron, and steel factories (Walakira, 2011).



Figure 15 Aerial View of Encroached Kinawataka Wetland
Source: Google Earth, 2014

In addition to the industrial effluents, the streams of Kinawataka, Mayindo, Kasokoso, and Namboole are major carriers of raw sewerage effluents draining from the catchment. However, development of a new waterborne sewerage treatment system is planned for a location within/adjacent to the Kinawataka that will serve the eastern part of KCCA (NWSC, 2013).

The Kinawataka-Bukasa wetland also faces encroachment from housing and petty trading, such as illegal car washing and settlement activity (Speech by National Environment Management Authority (NEMA) Exec Director, 2011). Figure 15 shows how the green strip of the Kinawataka wetland's western section (the left side of the image) contains industrial development lining the wetland with the Kinawataka slums encroaching the wetland along the eastern side of the image. The wetland's flow to the southeast is significantly compromised by filled land and a roadbed.

- **System #7/7a, the Nolubaga/Nokelere Nalubaga wetlands** are a small system located in the northeast section of Kampala that measures approximately .74km² (surveyed by Nakambo, 1999). This system feeds the Victoria Nile catchment. While considered in good condition when surveyed in 1999, this area of GKMA has experienced significant development in recent years (Flood Risk Management, 2013). Aerial imagery analyses from Google Earth 2014 reveals considerable levels of agriculture and settlement encroachment as shown in Figure 16 (Nakambo, 1999; Google Earth, 2014).

- **System #8/8a, Walufumbe and Mayanja North wetlands** are located about 10km north and north east of the city center. These wetlands drain into the Victoria Nile catchment and were considered to be in good condition when surveyed by Nakambo in 1999. As this system is located in one of GKMA's fastest growing areas, it is likely to experience a fair threat of encroachment and decline (UN Habitat, 2013).

Large-scaled infrastructure projects that involve filling in wetlands, the clearance of wetland vegetation, and channelization and/or redirection of the flow of water and drainage have impacted wetland flood absorption and decreased wetland health. Wetland encroachment for roadway and other infrastructure construction, particularly along the Northern Bypass, has also reduced the capacity of the wetland areas to capture, store, and dissipate storm water (UNRA, 2011).

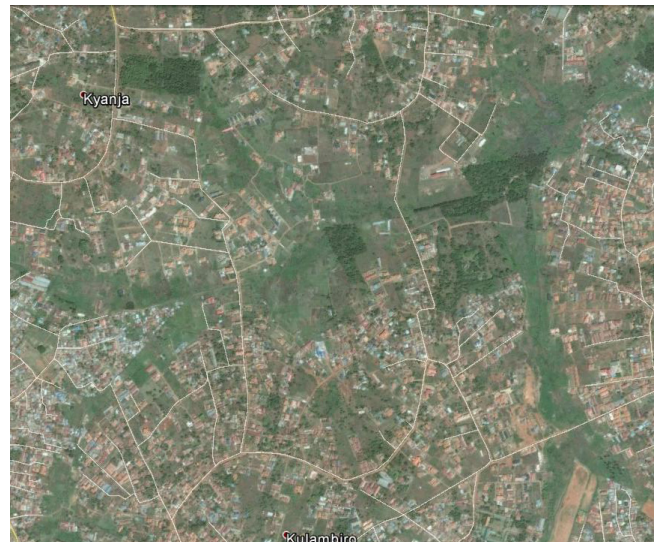


Figure 16 Aerial View of Nolubaga Wetland
Aerial image of a portion of Nolubaga wetland system in Northeast Kampala, which shows settlement and agricultural encroachment
Source: Google Earth, 2014

The 2001 Lubigi Channel Drainage Improvements, implemented by the World Bank's Institutional and Infrastructure Development Program, has reduced impacts of extreme floods however, the intervention has inhibited future wetland restoration potential by significantly altering the vegetation, soil, and hydrological functions of this section of the wetland system (LVP, 2001; KCCA, 2012). The Nakivubo Channel project, also funded by the World Bank to improve stormwater drainage and flood management through channelization, has altered the rate of water flow and has degraded the function of the wetland.

The Southern Expressway, proposed to be built through the Nakivubo wetland, is anticipated to cause further disturbance to the wetland's function and hasten its decline, while expansion of the Northern Bypass road is expected to further contribute to loss of habitat and loss of overall wetland function. In particular, road construction at Lubigi is anticipated to reduce the diversity of plant species due to construction materials such as limestone which alters wetland water chemistry. The reduced wetland size will reduce the wetland's overall capacity to store and slowly release storm water and filter sediment and pollutants from inflowing water. Also, increased use of the road will result in higher traffic noise levels, affecting nesting/reproductive success for birds in which mates depend on sound for pairing and bonding (UNRA, 2011).

Small-scale agriculture is also a threat to the wetland system's overall health and function and is observed as a threat in most of Kampala's wetlands. Uprooting wetland vegetation and converting the land to agriculture can compromise a wetland's nutrient cycling functions by reducing its ability to treat wastewater. While the cocoyam is commonly cultivated in Kampala's wetlands by removing native-grown papyrus, the papyrus has a higher wastewater treatment potential, removing 95% of nutrients from wastewater compared with the cocoyam's 65% rate of nutrient removal (Kansiime et al., 2007).

Murchison Bay and Water Supply

The City of Kampala sits on the shores of Murchison Bay, a shallow embayment in the north-western part of Lake Victoria. Murchison Bay covers a total area of about 62 km. The bay is described as the Inner Bay and the Outer Bay. Inner Murchison Bay (IMB), which is most directly impacted by Kampala City, has an area of about 18.4 km and an average depth of 3.2 m. Its catchment area is composed of both wetlands and urban areas of the city, with the Nakivubo channel and wetland serving as the largest drainage outlet into the IMB, carrying water and wastes from the City (Akurut, 2014).



Photo: Murchison Bay.
Source: AECOM

The Inner Murchison Bay is the primary drinking water supply source for Kampala City and Mukono and Wakiso districts. Across Kampala, the daily production levels for the National Water and Sewerage Corporation (NWSC), the main utility for urban centers in Uganda, average 98,700 m³/day with approximately 1,881,000 persons connected (Fichtner, 2014). NWSC operates three treatment plants (Gaba I, Gaba II and Gaba III) within IMB which pipe water to secondary, hillside reservoirs that have a capacity of approximately 65,220 m³ or 35.6% of current treatment capacity (Fichtner, 2014; MWE-DWD 2010, 2012). This water supply serves approximately 70% of the city population with drinking water (NWSC, 2010).

The distribution network throughout Kampala consists of 1,350km of pipes with an average age of 40 years (Fichtner, 2014). The KPDP Household Survey and other surveys of informal settlements and slums indicate that there is an increasingly high rate of access to piped water (>90 %). In 2002, there were 44,000 connections, and in 2009, there were 133,000 connections (LVP, 2009). However, the quality of the piped water is a continuous problem, and it is estimated that only 17% have access to reliably safe water (UBOS, 2002).

Degradation of the Nakivubo and its deteriorating water quality has caused the National Water and Sewerage Corporation (NWSC) to relocate their raw water intake and treatment facility as a result of increased treatment costs (see Figure 17). The major challenge facing drinking water treatment in Kampala is pollution of the water source at Gaba, which is heavily saturated with effluent discharges from Nakivubo Channel (MOE Dir of Water, 2010). The treatment costs at the Gaba Water Works facility near the outlet of the Nakivubo increased fourfold over the last 10 years as a result of the encroachment of Nakivubo and degrading water quality (Kansiime et al., 2007; NEMA Exec Dir speech, 2011). The potential of the Nakivubo wetland to provide some natural pre-filtering has been almost entirely lost (African Development Fund, 2008).

The NWSC has upgraded the water intake facilities at Gaba to more effectively treat contaminated water. As an additional measure to reduce water treatment costs, the NWSC has plans to install an offshore pipeline at a distance of 1.5km into Lake Victoria at a depth of 11m, to enable the treatment plants to draw a better-quality raw water (Water Technology, download 2014). The Corporation has also commenced the implementation of the Kampala Lake Victoria Watsan Project, which will entail the refurbishment of the Gaba II Water Treatment Plant. (NWSC, July 2014)

Approximately 20% of Kampala's population uses groundwater, springs, wells and other unimproved water sources, where piped water is not available (Fichtner, 2014).

Due to inadequate provision of waste water and sewage treatment services, Murchison Bay is the defacto recipient for surface runoff, sewage effluent, and industrial and municipal wastes, which have steadily increased with the rapid population growth of the city. The majority of these wastes are transported through the Nakivubo Channel, the largest drainage outlet of the Bay. The surface waters of the Nakivubo Channel have high levels of pollution attributed to the discharge of untreated and partially treated wastewater and solid waste, including more than 85% of the nitrogen loads coming from wetlands feeding the Bay (MWE, 2014), (Ramsar, 2005). 33% (2,700 m³/d) of industrial discharge flowing into the Bay comes from Nakivubo Channel while Luzira/Port Bell, mostly un-sewered with major industries (Uganda Breweries and Ngege Fish), contributes about 40% of the Bay's partially treated discharge (Akurut, 2014). Another significant source of partially treated effluent comes from the Bugolobi Sewerage Treatment Works (BSTW), which discharges wastewater into the Nakivubo Channel (NWSC, 2004).

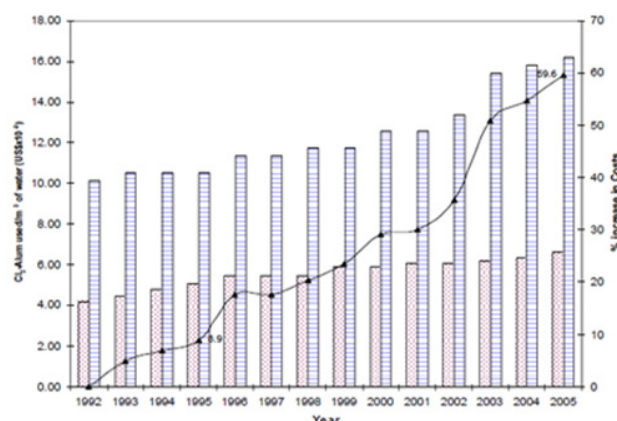


Figure 17 Increased Costs of Water Treatment Chemicals in Gaba Water Treatment

Source: Mwanuzi et al., 2005

In the mid-1950s, Lake Victoria had approximately 350 species, of Haplochromine cichlids (Witte et al. 2000). As part of an initiative to improve declining fish stocks of (*O. esculentus* and *O. variabilis*), non-indigenous species of Nile perch (*Lates niloticus*) and tilapiines (Nile tilapia *Oreochromis niloticus*, *O. leucostictus*, *Tilapia zilli* and *T. rendalli*) were introduced. While native species were already in decline, this species introduction program contributed to further decline of native stocks as more than 200 species have disappeared from the lake since the 1960s. Nile perch catches in the late 1990s and early 2000s have stagnated at around 90,000 tons annually (MWE, 2014).

Kampala has approximately 33 kilometers of shoreline along Lake Victoria. While the land condition can be classified into a variety of levels of degradation, numerous plans are being developed for converting the lakefront area into leisure and recreational resorts. While the recently opened Speake Hotel and Conference Center is an example of lakefront economic development, the development of the hotel appears to have required extensive filling of wetlands. This trend of lakefront development could threaten wetland and lake health if similar-scale development proceeds along the lakefront (MWE, 2014).

Bird Hotspot

Pockets of biodiverse habitat exist and are protected within the greater Kampala area, such as Lutembe Bay. However, threats from development and natural resource extraction are pressuring this sensitive environmental asset. Lutembe Bay, a 8 km² site between Kampala and Entebbe alongside Murchison Bay (see Figure 18), is an internationally recognized Birdlife International Important Bird Area and Ramsar Convention wetland. The site supports 20,000 – 50,000 roosting waterbirds as well as events of more than 1,000,000 White winged black tern (*Chlidonias leucopterus*) on muddy islets between October and February when the water level is low (Birdlife International data, download Nov 24, 2014). The highest count was 2,639,567 birds in December 1999, with counts exceeding 1 million birds on five other occasions (March and August 2000, April and October 2002, and March 2003) (Byaruhanga and Nahlanga, 2006). Figure 19 illustrates a ten-year period of Lutembe Bay accommodating thousands of birds each month.

Because of its richness in biodiversity, the site was identified by the Ramsar Convention as one of the minimum critical sites that have to be protected if Uganda is to conserve its wetland biodiversity. The Bay has among the region's highest count of wetland-dependent plants and supports most of the region's wetland macrophytic plant species, with 18 genera and 19 species (Ramsar, 2005). It is one of the most important migration stop-over sites in the Lake Victoria basin, with other notable species including Caspian Tern, Hottentot Teal, Temminck's Stint, and the recently recorded Great Knot and Broad-billed Sandpiper (Birdlife International, 2014).

Regular waterfowl counts coordinated by NatureUganda and Wetland Inspection Division show a total of 108 water bird species supported by the system, of which 26 species are Palaearctic migrants and 15 species are Afro-tropical migrants and other resident species. More than 100 species of butterflies have been recorded in the wetland system, including three rare species (*Acraea pharsalus*, *Belenois solilucis*, and *Cacyreus virilis*), which have not been recorded in any other of the 30 Important Bird Areas for Uganda (Ramsar, 2005).



Figure 18 Location of Lutembe Bay, Kampala

Source: Google Earth, 2014

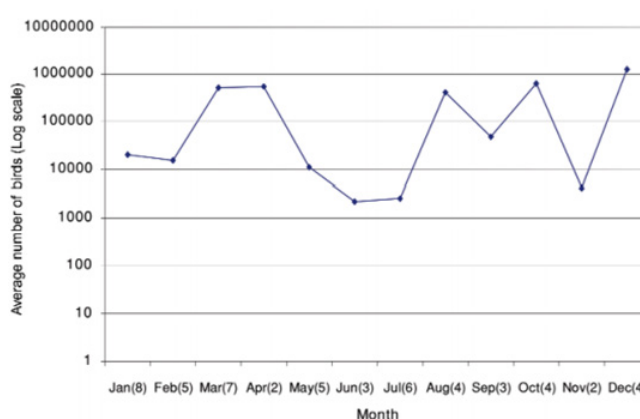


Figure 19 Bird Counts in Lutembe Bay, 1994-2003

Note: Numbers in parentheses are the number of counts that took place in each month.

Source: Byaruhanga and Nahlanga, 2006

While a 2012 assessment determined that more than 90% of the site's remaining habitat is in good condition, Lutembe Bay faces degradation of its ecological character: agro-chemicals used by five flower farms close to the Bay have been detected in its waters (Byaruhanga and Nahlanga, 2006). The development of large-scale, industrial greenhouse flower farming along the wetland's Western edge has impacted Lutembe's water quality due to the farms' development of the wetland buffer, extraction of water for irrigation and discharge of effluents (See Figure 18) (New Vision, 2013a). Although the flower farm has a wastewater treatment facility, media reports suggest pollution has still been observed (New Vision, 2013a).

The 2012 assessment by Birdlife International also noted that quarrying, mining, water extraction, pollution, housing, and commercial development are occurring at low levels and represent growing pressures on this sensitive asset (BirdLife International, download Nov. 24, 2014).



Photo: Massing of waterbirds at Lutembe Bay.
Source: Nature Uganda, download from website 2014

Alien invasive species threaten Lutembe Bay's ecological health as well as other wetlands in Kampala. Alien species are invading wetlands in Kampala including the Lutembe wetland (UNRA, 2011). Three invasive species of plant were recorded in Lubigi wetland and threaten its long-term health, as disturbance of the wetland can further exacerbate invasive species growth:

- *Mimosa pigra*
- *Xanthium strumarium*;
- *Lantana camara*

Mimosa pigra and *Lantana camara* have a large potential to expand their coverage throughout city wetlands, once disturbances are chronic (Cronk & Fuller 1995, Kalema & Bukenya-Ziraba 2005).

Overview of Aquatic Asset Trends

The quality of Kampala's aquatic assets has declined considerably in recent decades with significant loss of wetland area and associated wetland vegetation and ecosystem services. With all but a few of the city's wetlands in a relatively unmodified state (e.g. Nalubaga, Nyanjarede, Walufumbe and Nokelere) and Inner Murchison Bay experiencing considerable nutrient loads that are deteriorating water quality, Kampala's overall aquatic assets have become heavily degraded.

Kampala's aquatic assets, notably the Nakivubo and Lubigi wetland systems, have received considerable analysis from environmental, planning and economic perspectives associated with infrastructure development projects. It is clear that these systems have experienced decline in the past decade and face considerable threats that will limit the ability of these wetland systems to slow degradation and reverse trends towards improved ecological health. Although sites rich in biodiversity, such as Lutembe Bay, are still in good ecological health, threats from greenhouse flower farming suggest that future environmental quality will continue to deteriorate.

Based on the overall assessment of the city's wetland assets (see Table 2) which cites 9 different sources, there has been no comprehensive inventory of the city's aquatic systems within the 15 years. The mosaic of independent data points shows that most of the city's wetlands are facing considerable encroachment threats. More alarming though, as observed from aerial imagery analysis are 2014 images showing more extensive encroachment than has been documented in academic, National Ministry and city documents (e.g. Manyaza wetland discussion above) (Google Earth, 2014). Aerial imagery analysis of other wetland systems shows that the amount of visible wetland modification from encroachment is higher than currently documented in published reports, suggesting urgent action needed to prevent further wetland deterioration (Google Earth, 2014).

The lack of a comprehensive baseline inventory of wetland health with periodic updates prevents a timely understanding of aquatic asset health that can empower decision-makers to avert further losses of ecosystem services.

B. Terrestrial Ecosystems

Kampala's terrestrial ecosystems include hills and a patchwork of forests, urban tree canopy, and lowland forests/floodplain forests alongside wetlands that collectively provide habitat for a considerable diversity of birdlife. Available information is limited about the state of the city's terrestrial environmental assets; however, spatial analysis shows that the amount of undeveloped land in Kampala decreased more than 50% between 1989 and 2010, indicating a significant overall degradation of the city's terrestrial assets. Combined with the conversion of protected open spaces and gardens into development, this loss of soil, vegetation, habitat, and biodiversity constitutes a significant threat to the city's overall ecological health.

Land & Soil

While the topography of Kampala provides a distinct urban character and identity for the city, it has presented a difficult physical setting for the expansion of the city that has been costly and challenging to manage and has contributed to the degradation of the city's ecosystems.

The city is characterized by a varied topography of low hills that are separated by wide shallow valleys with papyrus swamp wetlands and drainage courses. Historically, the important institutional purposes, such as the government, churches, universities, were located on the hill tops in the central city, while the slopes were developed with commercial and residential uses.

The regulatory context for the development of the land during the colonial period established conditions that led to further environmental degradation beyond the challenges of working with the physiography. Urban development of the land under the control of the British Crown was subject to formal planning, while the area occupied by the local African population evolved organically without formal physical planning (Koojo, 2005). Decades of expanding urban development has led to the clearance of much of the natural vegetation on the hill tops and slopes. This has destabilized the soil and caused increased runoff, erosion, siltation, and flooding in the low lying areas between.

The topography has also made it very challenging to develop a well-organized road and/or public transport system. For ease of construction and to reduce costs, the transport infrastructure is located in low-lying areas. The impacts of road construction, the disturbance of land on either side of the road, increased runoff, the parcelization of wetland sections, and the disruption of hydrology functions have also contributed to the degradation of wetlands. At the same time, low-lying roads also facilitate the informal settlement of wetland edges alongside new roads (i.e. Northern Bypass).

Vegetation

Kampala does not have a structured, contiguous, maintained, and protected open space system or an urban forestry program to protect and monitor resources.

Residential and industrial development has reduced the land area of low land forests in the KCCA from 7.6% in 1983 to 0.4% in 2004 (Nyakaana, et al. 2004). Forest lands have been virtually eradicated from the KCCA with only 58 ha remaining (KCCA, 2012). Forest lands cover only 3% of the GKMA landmass (KCCA, 2012). There is little city-specific information available. The National Forestry agency addresses forestry at the country-scale. Notable in Figure 20 is the limited area of the GKMA that has been identified as natural resource and open space area for a metropolitan area of this size and population.

A significant number of trees within Kampala are located on private lands and alongside roads. Primarily shade and ornamental plantings, commonly planted trees include *Cassia agnes*, *Markhania platycalys*, *Cassia gradus* and *Jacaranda mimosifolia*. Other plant species include *Bougainvillea spp*, *Acalypha spp* and grasses such as *Brachiaria spp*, and *Hyparrhenia spp* (UNRA, 2011).



Photo: Hillside Development in Kampala.
Source: AECOM



Photo: Industrial rail line running through Nakivubo Wetland.
Source: AECOM

Kampala was once known as “the garden city of Africa.” While much vegetation has been lost to development, it remains a city of trees and gardens (KCCA, 2012). The few developed and maintained gardens in the city are concentrated in the City Centre and generally closed off from the public (KCCA, 2014b). Kampala Golf Course is too far from the center to satisfy the needs of the growing city. Other former public park spaces have been converted to urban development; Kololo Park is now a shopping plaza, and Shoprite Game is now a shopping plaza and convention center. While the wetland areas are used for recreation, such use leads to infilling, i.e., for playing fields, that contributes to their further degradation. Most residential neighborhoods lack public open space, gardens, parks, and playgrounds that allow city residents to escape from the congestion and density of urban life.

The Namanve Forest Reserve is a formally gazetted area of forest located in Kira district, approximately 15km east of Kampala's city center. While approximately 1,000 ha were de-gazetted in 1997 and allocated to the Uganda Investment Authority for development, approximately 1,200 ha remained as gazetted. While there are numerous reports in local media concerning development activities occurring within the forest reserve, such as tree plantations and housing settlements, the state of this environmental asset is not widely documented (New Vision, 2013c; Daily Monitor, 2013; Observer, 2013).

Kampala's seasonal rains (August to December and February to June), which generate pollutant-laden stormwater runoff that spreads across the land, also influence the diversity of vegetation growth by season. For example, vegetation studies of the city's Mapererwe Landfill area at Kiteezi reveal that while there are 108 plant species observed growing in the area during the dry season, an additional 37 plant species were recorded growing during the wet season (AWE, 2013). Additionally, eight of the dry season species are specially adapted to growing only in dry conditions and are not present during wet season conditions (AWE, 2013). This increase in species composition during wet seasons is partially attributed to higher level pollutant loads that accumulate on slopes following stormwater runoff events (AWE, 2013). Plants such as *Cynodon dactylon*, *Pennisetum purpureum*, *Leucaena leucocephala*, *Vernonia amygdalina* and *Solanum mauritianum* are tolerant of high pollution levels and high levels of salt, which can be deposited by stormwater runoff (AWE, 2013).

Wildlife

Given its relatively small geographic size, Uganda is considered to have a fairly high number of bird species (Pomeroy, 1993) with more than 1,040 bird species currently recorded (Carswell et al, 2005, R Skeen, pers comm), making it one of the most species-rich areas in Africa (UNRA, 2011). The seminal publication of Bird Life in Kampala Area in 1986 remains the most comprehensive accounting of birds for the city, with 577 bird species listed. While at least 11 species listed in the 1986 book have not been seen in decades and have limited likelihood of being seen again, at least 19 newly observed species have been added to the list. These additions might be due to either an increase in the number of people observing birds and/or population expansion of these species.

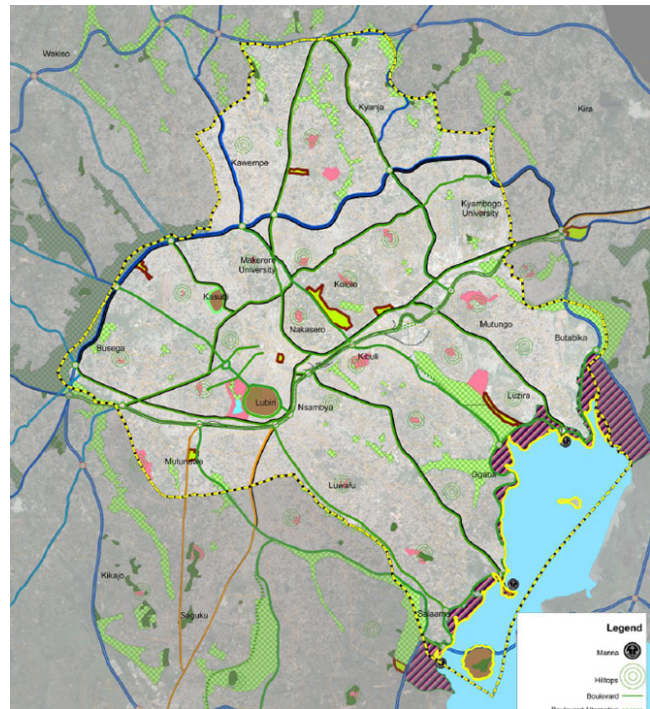


Figure 20 Natural Resources and Open Spaces in Kampala
Source: KCCA, 2012

In addition to extensive birdlife located in Kampala's natural areas (see Aquatic Assets), a considerable variety of wildlife has also been observed at an area of significant human disturbance, the Mpererwe Landfill in Kiteezi Parish. The 35 acre site containing mainly open trash mounds also contains some wetland and is home to an observed 52 bird species with the most abundant species noted as those commonly seen throughout Kampala: marabou storks, cattle egrets and speckled pigeons (AWE, 2013). Also observed at the Landfill were two globally threatened bird species, the Grey Crowned Crane and Hooded Vulture; 18 species of butterfly; and mammals including vervet monkeys and striped-ground squirrel (AWE, 2013).

Agriculture is a threat to terrestrial environmental assets, as it is readily observed within and along the edges of the city's wetland areas in proximity to informal settlements, and frequently contributes to degradation within wetlands (see Aquatic Assets section). Agriculture has decreased from 62% of total land area in 1993 to approximately 40% of the remaining undeveloped land in the City (Nyakaana, et al. 2004; KCCA, 2014b).

Overview of Terrestrial Asset Trends

Within recent decades, Kampala's forested hillsides, large tracts of undeveloped land, and lower slopes alongside wetlands have since become considerably fragmented, deforested and settled. This significant decline in overall forest coverage and associated topsoil erosion has left Kampala with only a few areas of extensive, contiguous forest habitats and upstream catchments (see Namanve Forest Reserve and outer GKMA district areas far from major roadways). While there is limited data regarding wildlife counts, it is likely that the loss of forest habitats has also contributed to a decrease in overall diversity of wildlife living in Kampala.

Despite the limited availability of forest coverage data, analysis of aerial imagery reveals that while there are extensive swaths of deforested lands, the landscape still retains patches of tree canopy coverage, particularly ornamental trees within private yards, which provide an array of ecosystem services (Google Earth, 2014). Furthermore, the diversity and resilience of plant species within the region demonstrates that there are numerous tree species adapted to the higher temperatures, vehicle impacts and varying water regimes of urban growing conditions. The city's ability to sustain existing tree canopy and increase the overall tree canopy coverage in urbanized areas can likely improve the overall quality of Kampala's terrestrial assets and lead to improvements of Kampala's aquatic assets and air quality.

Furthermore, the lack of comprehensive, baseline data documenting an inventory of terrestrial assets in Kampala makes it challenging to understand the current state of terrestrial assets and to identify areas of significant change. While there is limited data on vegetation and wildlife, it appears to be generated for discrete projects, largely through environmental impact assessments covering specific areas. This segmented pattern of available data inhibits a broader, more comprehensive view of overall urban environmental health.

C. Air Quality

There is limited information about local air quality conditions and risks for Kampala. There is limited data, sample collection and public information available on type and concentrations of particulate matter (PM) in Kampala's air, and studies of the associated human health impacts are extremely limited (Schwander et al. 2014; World Bank Sub-Saharan Study, 2009). The lack of finalized air pollution standards by NEMA also contributes to a limit of available data required to be monitored and regularly collected.

The results of a 2014 pilot study are indicative of unhealthy air and suggest that exposure to ambient air in Kampala may increase the burden of environmentally induced cardiovascular, metabolic, and respiratory diseases, including infections. The observed PM_{2.5} mass concentrations in Kampala are three and four times higher than the US 24-hr PM_{2.5} National Ambient Air Quality Standards (NAAQS; 35 µg/m³) and the WHO air quality guidelines (25 µg/m³), respectively (Source: Schwander et al., 2014).

Various anthropogenic sources appear to contribute to the elevated coarse particle and PM_{2.5} levels in Kampala, such as soil dust disturbed by vehicles on unpaved roads, vehicle emissions particles, and burning of biomass (Schwander et al., 2014). One World Bank study noted that the approximately 274 kg firewood burned per Kampala resident per year is a key contributor to the high level of PM emissions (ICF, 2009).

Deteriorating air quality also has implications for public health through outdoor air pollution, particularly automobile exhaust, particulate matter from burning, road dust, and factory emissions (US EPA, 2014). This trend is indicated by Mulago Hospital admitting approximately 2,500 people with asthma in 2009/2010, up from 1,899 the previous two years (Daily Monitor, 2011).

Air quality measurements at the Mpererwe Landfill conducted in 2013, the city's only formal landfill for receiving waste collected from throughout Kampala and a neighboring community, found that the air quality conformed to the draft national limits (AWE, 2013). While Uganda does not have any national standards for nuisance odor levels, measurements at the landfill recorded high levels of nuisance odor at 7 OU. According to a survey of regulatory agencies worldwide, an acceptable odor range is considered to be 2 OU to 7 OU (AWE, 2013).

Kampala prepared a greenhouse gas (GHG) inventory in 2012, using 2012 as the inventory base year. Solid waste and wastewater discharge sectors contributed the greatest amount of GHG emissions, 42% and 23% respectively. These numbers reflect the lack of mechanisms for capturing methane, a high-intensity greenhouse gas, at the city's Mpererwe Landfill. Furthermore, the significant amount of emissions from sanitation reflects the use of pit latrines, septic systems, and other non-central sewage collection systems that release methane without any capture by treatment facilities (Lwasa, 2013). Transportation-related emissions are likely to increase with improvement in roads as well as the rise in private modes of transport within the city-region (Lwase, 2013) (See discussion of Emissions as a driver of air quality degradation).

Overview of Air Quality Trends

Based on the limited data available from a pilot study and media reports, Kampala's local air quality appears to show signs of poor quality with regard to particulate matter from vehicles, road dust and biomass burning. While data from air quality measurements at the city landfills in the outer-lying area of the city conforms to the draft national standards, it is likely that additional air quality monitoring of Kampala's urbanized areas, similar to the 2014 Schwander et al. study, will continue to show a correlation of poor air quality where there is significant vehicle and road presence. The absence of adopted, national air quality standards will likely delay any significant efforts to generate comprehensive baseline data with periodic monitoring of the city's air quality.

From a greenhouse gas (GHG) perspective, Kampala's establishment of a 2012 GHG baseline is a strong start for assessing future GHG emissions trends and evaluating impacts from GHG mitigation activities, such as the proposed landfill gas capture infrastructure for Mpererwe Landfill. Given the growth of vehicles in Kampala (see Drivers section on Air Emissions), it is anticipated that GHG emissions from vehicles will grow. Future GHG inventories will be needed to evaluate whether improved solid waste management and construction of new wastewater treatment facilities with higher levels of overall sewerage treatment will be effective in capturing GHG emissions and preventing their release into the atmosphere.



*Photo: Kampala on a clear day.
Source: Schwander et al, 2014*



*Photo: Kampala on a day with extensive air pollution.
Source: Schwander et al, 2014*

IV. DIRECT DRIVERS AND CAUSES OF ENVIRONMENTAL VULNERABILITY AND DEGRADATION



*Photo: Informal settlement along drainage corridor at Northern Bypass.
Source: AECOM*

As described in Section II, Kampala's environmental assets have been significantly degraded by anthropogenic actions. While ancillary drivers certainly exist, this section of the Urban Environmental Profile documents the direct drivers of environmental vulnerability and degradation.

A. Informal Settlements

A significant consequence of the decades of rapid urbanization is manifest in the vast area of informal settlements that have proliferated in Kampala and have increasingly encroached into the wetlands and drainage corridors. The scale and density of informal settlements are unprecedented and have overwhelmed the capacities of the city's urban and environmental management systems. The physical and human impacts of this type of development are one of the most significant drivers of vulnerability for Kampala's environment and ecosystems.

By their very nature, these settlements have developed without any formal urban planning or organization – although they are structured and organized by informal social and economic systems. The dense and un-serviced informal settlements are lacking basic public infrastructure such as water, sewage, solid waste collection, and transit services. Limited services available have tended to be provided adhoc and do not comply with urban and environmental standards. The KCCA documented 31 slums in 2011 (KCCA, 2012). The majority of the informal settlements are populated by the urban poor and have evolved primarily as areas of extremely dense slums in these marginal and low-cost areas of the city.

The density and location of the informally settled slum areas are driven by the lack of an adequate supply of accessible and affordable land for residential, industrial, infrastructure, utility, and service facility development.

Land area exists on a scale to meet current housing needs, but it is unavailable for development due to the land tenure system, the inefficiencies of the real estate and property market, gross income inequality, and the effective absence of a residential construction industry, as well as the absence of adequate long-term planning and implementation. Kampala has a gross density of approximately 89 persons per km² and is projected to reach a gross density of some 100-plus persons per km² as the population increases to 2 to 2.25 million (KCCA, 2012).

Given the constant demand for cheap inner-city housing, its limited supply, and the decreasing supply of available land, settlements are constructed as tenements (Muzigo) in increasingly high densities. They lack public or private open space, with only narrow paths or lanes providing pedestrian access while doubling as outdoor “kitchens,” “shop fronts,” or play areas for children (KCCA, 2012). Rental costs in these areas can be an expensive option. For example, the rental cost per square meter in an inner city Muzigo was found to be one of the most expensive of housing options in Kampala (KCCA, 2012).

The density of settlement and the lack of public infrastructure present significant public health issues that primarily affect the poor, particularly during periods of flooding. Spring and surface water supply is easily contaminated by sanitary conditions and flooding. Floods cause frequent outbreaks of water-borne diseases, such as cholera, which had outbreaks recorded in 1997, 1999, 2004, 2006, and 2008 due to the increased floods in the city. Heavy rains can be followed by an upsurge of malaria, while flooding is followed by diarrheal diseases. During drought, the population is predisposed to meningitis epidemics and other diseases caused by lack of water for adequate sanitation, such as eye and skin infections.

The floods contribute to crop failure, food insecurity, and even malnutrition. The frequency of public health challenges is expected to increase in rainfall and flooding due to climate change. An estimated 45% of the health units of Kampala are located in flood-prone areas, furthering the implication of flooding on public health. Despite the risks of living within the floodplain, the marginal land within the city is occupied by settlements to provide better proximity to employment opportunities in or around the city centre.

There is no national or local government mechanism currently in place to address the challenges of the informal settlements, either to prevent the development of new slums or to find solutions to existing ones (KCCA, 2012).

B. Effluents

The lack of a comprehensive effluent management system, including adequate waste water treatment facilities, point source pollution controls, and controls on non-point effluent discharge, degrades the city’s wetland system and contributes to a loss of its ecosystem services. Effluents from both formally planned and informally settled residential areas and commercial and industrial discharges are the primary source of pollution and degradation of the city’s water resources and of the Murchison Bay.

Waste Water Treatment

Approximately, 10% of the population of Kampala is served by the sewer system (figures vary), which covers the Central Business District and the affluent areas, while 90 % of the population, mainly the urban poor, relies on various forms of on-site sanitation (figures vary): pit latrines (55-65%), improved (VIP) pit latrines (27.5%), septic tanks (20%), public toilets (1%), and open defecation (African Development Fund, 2008; KCCA, 2012; (KCCA, 2014a). These untreated effluents are discharged into the environment, flow through the Nakivubo channel and, ultimately, into the Inner Murchison Bay of Lake Victoria. While wetlands can retain nutrients from wastewater and cleanse wastewater of nutrient loads, the degradation of wetland vegetation and encroachment of wetlands by development reduces this nutrient cycling capacity (Kansiime et al, 2007).

The city’s main treatment plant, Bugolobi Sewage Treatment Plant (BSTP), with a capacity of 200 m³/day, is highly inefficient and ineffective due to its location, requiring siphons and pumping stations for moving more than 55% of the sewage sent to Bugolobi. In other instances, operational problems, such as the frequent blockages of the siphons and low performance of the pumping stations, result in sewage discharged untreated into the environment. The facility does not comply with nutrient and coliform removal standards (African Development Fund, 2008). After passing through BSTP, partially treated sewage is mixed with the untreated effluents already in the drainage channels before entering the wetlands. The Nakivubo Channel, which passes through informal settlements, slums and commercial areas, contributes a significant pollution load into Inner Murchison Bay. The Nakivubo Channel is also among the largest recipient of organic matter discharged from un-

sewered areas, in the form of solid waste and wastewater (Kizito, 1986)(MWE, 2014). The Nakivubo Channel has been found to transport domestic wastes equal to the raw sewage from an estimated 100,000 households and is the source of approximately 75% of the nutrients entering the wetland. (COWI/VKI 1998) (IUCN, 2003).

Just under a tenth of households (John van Nostrand Associates, 1994) and approximately two thirds of medium and large industrial facilities in Kampala (COWI/VKI 1998) are connected to the BSTP (Emerton, 1998). Thus, up to 8,000 households discharge domestic wastes into the wetland as runoff into the surface waters that enter it or through groundwater inflows from the infiltration of rainfall on hills beside the swamp, from pit latrines, septic tanks, soak pits, and leaking waste pipes. At least three other point sources of wastes enter southern parts of the wetland directly, including effluents from Uganda Breweries and two sewage outflows from Luzira Prison (Emerton, 1998).

It is estimated that 99% of the domestic resident population and 85% of the institutional, commercial and industrial sector are using onsite sanitation treatment (Fichtner, July 2014). On-site sanitation generates fecal sludge which, depending on the technology, may need to be removed from the site and treated elsewhere once the pit is full. While on-site sanitation can be a cost effective solution to sewage management, inadequate pit design and lack of collection can cause pits to collapse or overflow or lead to disposal outside of designated collection facilities, contaminating environmental assets such as groundwater, soil and downstream surface water. A lack of sludge collection from pits requiring sludge removal can also cause pits to become abandoned, consuming valuable space below ground that becomes more congested for installing future pit latrines. The most common form of on-site sanitation in Kampala is the simple pit latrine which is difficult to empty (representing 64% of households in a 2014 survey) (KCCA, 2014a). The inability to empty a simple pit latrine enables fecal sludge to remain available in the environment for potential contamination of ground and surface waters (KCCA, 2014a).

The inadequate collection and disposal of fecal sludge is an environmental issue due to spills and incomplete treatment and disposal of sludge that lead to a high pollution load into Kampala's wetlands and Inner Murchison Bay (Fichtner, 2014). Only 43% (390 m³/day) of fecal sludge generated in the city is collected (KCCA, 2014a). While 99% of the fecal sludge collected comes from lined facilities, 74.5% of the fecal sludge generated from these lined facilities is collected. (KCCA, 2014a).

There are currently numerous challenges to increasing the rate of fecal sludge collection, such as high transport

costs which can disincentivize collection, use of unlined pits which do not allow mechanical emptying and limited capacity for fecal sludge disposal (Fichtner, 2014). Table 3 shows that the rate of daily faecal sludge collected will more than double by 2040.

Table 3 Forecast of Faecal Sludge (FS) Collection

Collected FS by Population Type (kg TS/d)	2014	2020	2025	2040
Inner Ring Population	7,100	8,800	12,300	21,800
Transient Population	4,400	4,300	4,300	3,100
Outer Ring Population	2,700	3,500	5,300	11,100
Total Population (rounded)	14,000	17,000	22,000	36,000

Source: Fichtner, 2014

KCCA provides each division with a vacuum tanker as part of the Kampala Urban Sanitation Project for emptying service to households. In addition, the collection service is provided with 32 trucks that belong to private cesspool emptiers, with a total capacity of 120 m³. According to Kampala Sanitation Program, the average collection volume of fecal sludge per truck is 4.6m³. While the collected sludge will be discharged at the newly Renovated Lubigi plant in 2014, the Lubigi plant has already experienced overloading with the mean daily sludge volume reaching 600 m³/day while the plant's capacity is 400 m³/day (Fichtner, 2014). Clogging of the sedimentation tanks' pumping station and clogging of drying beds have contributed to the overloading (Fichtner, 2014). Once treated, the final sludge disposal is provided to farmers as an agricultural soil amendment (Fichtner, 2014).

Future Sewage Treatment Facilities

Kampala currently has a sewer network of 143 km with 135km in the Nakivubo/Bugolobi catchment and 8km in the Lubigi catchment (Fichtner, 2014). High investment and maintenance costs and the low prioritization of sanitation services within the city have led to deferred investment in sanitation and compounded the sanitation challenges Kampala faces (KCCA, 2014b).

There are several measures planned or underway in the KCCA, and while these measures would provide very significant improvements to the sanitation systems, the development of the systems has been plagued with financing problems driven by both inability and unwillingness of the population to pay for appropriate facilities (KCCA, 2012).



Photo: Emptying fecal sludge at Bugolobi WWTTP.
Source: PEAU, Feb 2014

Measures planned or underway in the KCCA include the following:

- Completion of the Sewage and Fecal Sludge Treatment Plant (SFSTP) in the Lubigi wetlands alongside the Northern Bypass in 2014 provides 400 m³ per day capacity for faecal sludge treatment (Fichtner, 2014). The Lubigi facility also includes a sewage treatment plant for the Lubigi catchment with a capacity for 5,000 m³/day and can be extended to a 12,500 m³/day.
- Rehabilitation and expansion of the city's waterborne sewerage system by rehabilitating the existing sewage treatment works (STW) at Bugolobi and abandoning the proposed STW in the Nakivubo wetland due to incompatible soil conditions (NWSC, 2013).
- Development of a new waterborne sewerage system at Kinawataka to serve the eastern part of KCCA. This Kinawataka system will connect to the rehabilitated Bugolobi STW and include a pumping station (Fichtner, 2014).
- Additionally, the KPDP recommends a piped sewer network for the Lubigi catchment, in addition to those of Kinawataka and Nakivubo, and to undertake planning for additional sections of the Nakivubo system.

While construction of new and enhanced sewage treatment has been proposed at multiple locations, including Nakivubo and Kinawataka wetlands (African Development Fund, 2008), the NWSC is proceeding with rehabilitation of the sewage treatment facility at Bugolobi (NWSC, May 2014).

Point-Source Pollution

“Wet” industries are those that discharge wastewater into sewers or storm water drainage channels that eventually enter surface water (Matagi, 2002). Most of these industries have obsolete technologies, which in most cases are environmentally polluting. None have pre-treatment facilities for their wastewater before it is discharged into either the environment or public sewer. As noted previously, Nakivubo Channel has the highest concentration of “wet” industries.

Since many industries (Figure 21) do not treat the effluents generated before discharge, the direct release into wetlands is resulting in severe accumulation of contaminants. The Nakawa-Ntinda Industrial area is within the Kinawataka wetland's watershed and broader inner Murchison bay catchment. This industrial area's discharges from food industries, heavy metals, and pharmaceutical industries are degrading water quality with high Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), color, pH, TN and turbidity (Walakira and Okot-Okumu, 2011).

Many industries were set up without implementing an Environmental Impact Assessment (EIA) or completing mandatory periodical Environmental Audits (EA). Therefore, most industries do not have an environmental management policy and environmental management plan for managing the wastewater generated (Walakira and Okot-Okumu, 2011). Uganda has established a National Cleaner Production Centre in partnership with UNIDO-UNEP for reducing pollution intensity of industrial output while promoting economic competitiveness (UNEP, 2009; UNEP-UNIDO, 2010). A 2011 study, however, was unable to identify any industries in one of Kampala's major industrial areas, Ntinda-Nakawa, that were operating within Cleaner Production standards (Walakira and Okot-Okumu, 2011).



Photo: Point source pollution from informal settlements.
Source: AECOM

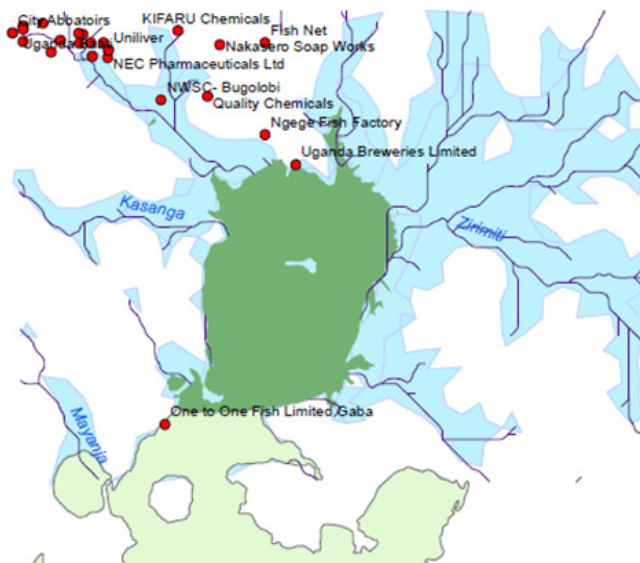


Figure 21 Distribution of Sample Industries in Kampala, 2012
Source: Walakira et al, 2011

The most heavily polluted areas are adjacent to the industrial slum areas of Kisenyi and Katwe, home to most of the city's car repair garages. Chemical wastes from the car repairs are dumped directly into streams. Other point sources of wastewater within the IMB catchment enter from the Luzira Prison. These are numerous small, medium, and larger- scaled industries that discharge high organic, nutrient-rich effluent laden with other metal pollutants into the surface water.

Non-Point Source Pollution

Non-point source pollutants flowing into the city's aquatic resources largely consists of storm runoff during the wet season, which increases the concentrations of all nutrients, in turn affecting water quality (Banadda 2011). Runoff during the wet season increases the concentrations of ammonia, phosphorus, nitrites, and nitrates. (Ammonia varied from 0.1 to 0.19 mg/L, phosphorus from 0.01 to 0.18 mg/L, nitrites from 0.01 to 0.05 mg/L and nitrates 0.02 to 0.36 mg/L.) Field measurements confirmed that nutrient concentrations decrease as one moves deeper from the shores into the lake due to dilution. High BOD levels within the city's wetland channels can also degrade aquatic assets, as observed pollution has reached levels sufficient for producing ammonia and hydrogen sulphide that can kill fish (Oyoo, 2008).

Collectively, it is estimated that pollution sources around Kampala City amount to high levels causing water quality impairment, including 6.34 tons of BOD, 1.5 tonnes of nitrogen, and 1 tonne of phosphorus, that discharge daily into Murchison Bay and Lake Victoria (Okwerede et al. 2005). A consequence to the wetland system and its services of untreated and unmanaged discharge from multiple sources is represented in the escalating cost of treating raw water drawn from the Nakivubo drainage at the Gaba drinking water treatment facility (See Figure 17) (Mwanuzi et al., 2005). As noted previously, these escalating costs have caused the National Water and Sewerage Corporation to invest in a new drinking water production facility located farther from the Nakivubo drainage outlet at Katosi (NWSC, 2013). Oyoo (2009) confirms findings that to reduce the water treatment cost at Gaba, there is a need to reallocate the raw water abstraction point to the outer bay. It has also been found that high organic nutrient concentrations in the Nakivubo channel have impaired the self-purification capacity of the Nakivubo (Oyoo, 2008). The KPDP also endorses this concept by recommending the commissioning of new water treatment plants (KCCA, 2012).

Non-point source pollution from auto shop areas is a driver of water quality degradation in the Kinawataka wetland system. Downstream lead concentration can be attributed to the high concentration of vehicles in this zone due to the numerous car sale depots and vehicle parking lots that discharge (leak) fuel and contaminated engine oil into the environment (Walakira and Okut, 2011).

Along Kinawataka stream, samples with high lead values from the Kampala Pharmaceutical Industry site are 14 times the NEMA-acceptable value for effluent. While these readings could be due to point-source pollution by pharmaceutical facilities, the study finds that these high lead levels could also be originating from non-point sources such as the leaded fuel in the industries and the chemicals as well as disposal sites for old batteries left at petrol stations (Muwanga and Barafijo, 2006).

C. Stormwater Runoff

Expansion of the city's drainage system has not kept up with the rapid urban growth and development of informal settlements. As previously stated, Kampala has seen a 197% increase in the number of buildings constructed in the city from 2004-2010. The extent of impervious surfaces and compacted land area, the higher rates of precipitation and increasing storm events, and poor maintenance of the existing drainage system collectively have caused an increase in the volume and coefficient of runoff. This lack of an adequate drainage system required to manage storm water runoff and flooding is a key driver of Kampala's environmental asset degradation. A reduction in pervious land creates greater storm water runoff volumes, leading to increased flooding and increased pollution of waterways as storm water collects solid and liquid waste from settlement areas and roads, transporting pollutants into the city's wetlands.

Between 2004 and 2010, Kampala's amount of impervious roof area has grown 262% across the city with substantial increases in each drainage area (Figure 22) (Table 4). Also, the buildings have generally increased in size, leading to an even higher rate of increase in roof area. These conditions have increased the frequency and severity of flooding problems throughout the city. A detailed case study analysis as part of the Kampala Flood Risk Management Report 2013 shows that the amount of impervious surfaces in a catchment is a major determinant of the volume and speed of surface water runoff and therefore flooding (UN-Habitat, 2013).

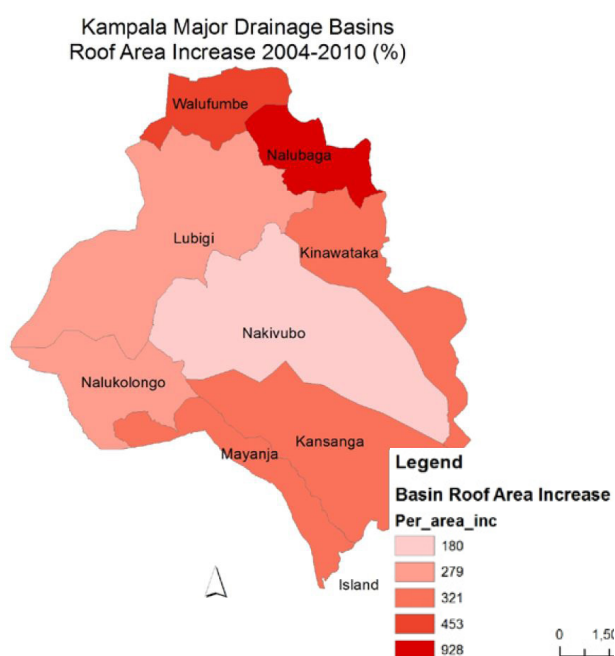


Figure 22 Increase in Roof Area per Catchment, 2004-2010
Source: UN, 2013

Table 4 Change in Impervious Coverage via Building Indicators at Catchment Level, 2004-2010

Catchment	No. Buildings 2004	No. Buildings 2010	% Change Buildings 2004-2010	Roof area 2004 (sq.m)	Roof area 2010 (sq.m)	% Change Roof Area 2004-2010
Kansanga	15,522	35,253	227	1,313,902	3,887,729	296
Kinawataka	9,854	27,413	278	983,637	3,147,210	320
Lubigi	51,870	85,728	165	3,291,477	9,170,916	279
Mayanja	8,545	20,803	243	629,495	2,020,945	321
Nakivubo	31,714	50,252	158	4,155,398	7,556,993	182
Nalubaga	3,086	12,808	415	152,044	1,411,113	928
Nalukolongo	13,861	28,557	206	1,212,545	3,083,009	254
Walufube	4,358	12,171	279	251,366	1,138,757	453
Total	138,810	272,985	197	11,989,864	31,416,671	262

Source: UN, 2013

Inadequate stormwater management facilities threaten to degrade the quality of Kampala's remaining high-quality wetlands. Drainages such as the Kinawataka, Walufumbe, Nalubaga and Mayanja that have received the largest growth in impervious coverage between 2004 and 2010, also contain the city's least degraded wetlands (see Aquatic Assets). However, this staggering growth in impervious surface coverage suggests that these peri-urban wetland assets could be considered highly threatened due to increasing runoff velocities and volumes, erosion and sedimentation, nutrient enrichment, and pollutant-heavy non-point source runoff.

Flooding

Poor quality and maintenance of the existing drainage system contributes to flooding. Storm water runoff from upland and overland flow discharges into drainage channels and then flows to the wetlands where, under environmentally healthy conditions, runoff would be stored and flood peaks would be attenuated. Drainage systems and wetlands are frequently overtopped, however, and flooded when they are impeded by solid waste, filled by sediment/siltation, and overwhelmed by the volume of flow. Channelization of some of Kampala's wetlands has occurred in an effort to reduce the negative effects of flooding (UN-Habitat, 2013).

Most drainage systems in the built areas of the city flow in open culverts along the roadside. The open culverts are frequently used as dumping grounds for waste disposal, which clogs the systems and causes flooding and health risks (KCCA, 2012). Low-lying settlement areas, such as Bwaise, Kinawataka, Natete, Ndeeba, and Katwe, are increasingly prone to levels of flooding that destroy houses, roads, and culverts as well as contaminating the water supply (Lwasa, 2010). There were five observed flood events in 1993, which increased to nine in 1997. There were eight flood events in 2007 (Lwasa, 2010).

Review and update of the 2002 Kampala Drainage Master Plan is anticipated to improve response to environmental management challenges associated with storm water runoff. The 2002 plan has been ineffective because the analysis has not been based on detailed rainfall intensity data. It also became outdated due to the change in the drainage pattern and increase of built up areas in the upland and lowland areas of the city (KCCA, 2014b). The World Bank has provided funding under the Kampala Institutional and Infrastructure Development Project Phase (KIIDP2) program for review and update of the Drainage Master Plan and to guide investment (World Bank, 2014). UN-Habitat has also conducted a Flood Risk Assessment to demonstrate how flood risk can be addressed by the city in an integrated and comprehensive manner and with stakeholder participation (UN-Habitat, 2013).

KCCA plans to address sustainable urban drainage through enhancement of primary channels and secondary drainages, including:

- The redevelopment of The Nakivubo Channel, implementing sustainable drainage management plans for the precincts, construction of the secondary and tertiary channels, and creation of public parks and an animal sanctuary to boost eco-tourism.
- Complete construction of the Lubigi drainage channel, including secondary and tertiary drainage channels and an extension to the River Mayanja on Mityana Road.
- Other drainage system enhancements for the Nalukolongo, Kinawataka, and Kansanga wetlands (KCCA, 2012).

D. Solid Waste

Approximately 34.8% of the total waste generated is not properly removed by the city. The amount of solid waste generated overwhelms the capacity of the city to collect and dispose of it and, as a result, a great deal of the solid waste is thrown or carried by runoff into the drainage channels and wetlands. Because of the limited funds that have been allocated to solid waste management in Kampala, only the central business district and affluent neighborhoods in the city receive adequate solid waste collection (AWE, 2013).

A large percentage of solid waste that is generated is not properly collected or disposed. In 2009, 40% of the 1,200–1,500 tons of garbage generated daily was collected. The collection rate increased to 54 percent by 2010, and by 2013 solid waste collection had increased to 65% (WaterAid Uganda, 2011; Madinah et al., 2014). This means, however, that in 2013, 35 percent of garbage still was not properly collected and disposed.

The KCCA has worked with NEMA to implement a program in which commercial businesses pay for solid waste collection services while KCCA offers free solid waste collection to slum locations, including Kawempe, Kampala central, Lubaga, Makindye, and Nakawa divisions (Madinah et al., 2014). Early analysis shows that solid waste management efficiency of collection has improved by approximately 10% in the last 2 years (Madinah et al., 2014).

The lack of solid waste collection across most of the urban area contributes to the degradation of the city's land, wetlands, and air. Solid waste not properly disposed of causes blockage and backup of the limited drainage system and natural drainage corridors, thereby contributing to the flooding problem. Rotting and/or burned waste cause odors and air pollution. These consequences contribute to poor health and the spread of disease (KCCA, 2012).

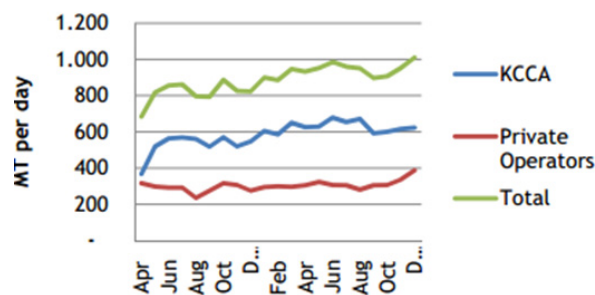


Figure 23 Waste Received at Kampala's Only Landfill
Source: IFC, 2013

The city's only formal landfill at Mpererwe (Kiteezi Parish), is anticipated to reach capacity within a few years, requiring expansion or construction at another site.

Waste loads to Kampala's only landfill, the 35 acre site a Mpererwe (also referred to as Kiteezi), steadily increased from April 2011 through December 2012, whereas increased collection efficiency within 2013 is expected to have increased the average daily load approximately 30% more (totaling 1,400-1,500 metric tons per day of waste) compared to the December 2012 load of 950 metric tons per day (Figure 23) (N.B. 2013 figures not yet available) (IFC, 2013). Opened in 1996, the 35 acre landfill contains 29 acres under current landfill activities with an extension of 6 acres that are being developed for landfilling (AWE, 2013). Extensions to the Kiteezi Landfill, anticipated to be constructed through 2015, will increase the Landfill's total capacity by 620,000 m³, however, this is only expected to provide two additional years of capacity for the landfill (IFC, 2013).

While there are no recycling or composting facilities in the KCCA, the nearby municipality of Mukono has an effective waste composting facility, and Entebbe has plans to develop a facility. In addition to households dumping waste into stormwater channels, sewers, or public areas, there is illegal dumping and burning by refuse collectors or building contractors. There is very little organized waste collection and disposal in KMTC. Medical and other toxic waste is untreated and is generally discarded with other solid waste (KCCA, 2012). Evidence also shows that toxic smoke from the burning of solid waste might be a contributor to air quality degradation in Kampala (Schwander et al., 2014).

While there is limited consistency of available data regarding solid waste generation trends for Kampala, data available for FY 2012-2013 provides a baseline for future measurement of waste generation trends (Table 5).

Table 5 Waste Generation Tables for Kampala FY 2012-2103

Quarters	KCCA	Private	Total
Quarter 1	58,816 (68.30%)	27,304 (31.70%)	86,119.8
Quarter 2	56,414 (64.09%)	31,615 (35.91%)	88,029.1
Quarter 3	56,414 (64.09%)	33,627 (38.41%)	87,556.18
Quarter 4	56,668 (63.48%)	32,603 (36.52%)	89,270.3

Source: Madinah et al., 2014

The waste that is collected, transported and disposed at the city's only landfill at Mpererwe contributes to degradation of water and air resources. Inefficient leachate treatment at the landfill results in effluent that does not comply with national standards while the lack of landfill gas collection results in release of methane, a high-intensity greenhouse gas emission (IFC, 2013). Table 6 shows the general lack of environmental compliance of leachate treatment effluent, which degrades environmental assets and adjacent community resources when the leachate is carried away from the landfill via groundwater, stormwater and soil erosion. During heavy rains, the lack of a stormwater management system contributes to flooding of the leachate treatment system which enables untreated leachate to mix with stormwater and move off site (AWE, 2013). The landfill's leachate discharged into groundwater, without full treatment by reed beds, has posed a significant health risk to the adjacent community. Specifically, water analysis from three nearby community boreholes that access an aquifer adjacent to the landfill showed that the levels of lead were 20, 80 and 90 times, respectively, higher than the national standard for potable water (AWE, 2013). Lead exposure, particularly for children, can cause numerous health effects and have a harmful impact on children's learning and behavior (WHO, 2014). The high levels of lead at the landfill are attributed to alloys, paints and batteries (AWE, 2013). The landfill also emits methane from the decomposition of wastes. While a system was designed to capture the landfill's methane and convert the gas into an energy source, the system has not yet been installed, enabling this high-intensity GHG to contribute to global climate change (AWE, 2013).

The high organic composition of Kampala's solid waste is a driver of water quality degradation. According to Madinah et al, 2014, almost 74 percent of the garbage generated in the city is organic, while the rest is inorganic, comprising glass, plastic, paper, metals, and construction and demolition waste (Figure 24). The high composition of organic solid waste can cause considerable nutrient loading of drainage channels and wetlands, once the waste is transported into Kampala's water bodies. The resultant nutrient concentrations contribute to algae growth and other indicators of high nutrient levels observed in the waters near Gaba treatment works and other wetlands throughout the city (Ooyo, 2009).

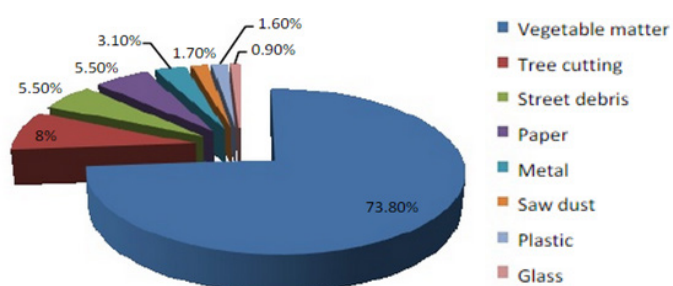


Figure 24 Composition of Solid Waste Collected
Source: Madinah et al, 2014

Table 6 Measurement of Leachate at Mpererwe Landfill

Chemical	Dry Season		Wet Season	
	Measurement	National Standard	Measurement	National Standard
pH	8.37	6.5- 8.5	8.53	6.5 -8.5
Chemical oxygen demand (COD)	1587 mg/l	100 mg/l	165 mg/l	100 mg/l
5-day Biochemical oxygen demand (BOD ₅)	280 mg/l	50 mg/l	-	-
Faecal coliform bacteria	-	5000 CFU/100ml	213150 CFU/100ml	5000 CFU/100ml
Ammonia-nitrogen	33 mg/l	10 mg/l	24 mg/l	10 mg/l
Total phosphorus	13 mg/l	10 mg/l	26 mg/l	10 mg/l
Lead	0.6 mg/l	0.1 mg/l	-	-
Alkalinity	2773 mg as CaCO ₃ /l	800 mg as CaCO ₃ /l	4771 mg as CaCO ₃ /l	800 mg as CaCO ₃ /l

Source: AWE, 2013

Solid waste is also a driver of drinking water quality degradation for Kampala's water intake system at Gaba.

Solid waste flushed into drains contributes to water quality degradation in wetlands such as the Nakivubo Channel, Murchison Bay, and the inlets near Kampala's water intake plants at Gaba (Ooyo, 2009). An NWSC representative notes that most solid waste near Gaba Beach ends up in a drainage channel, which then pollutes the lake water that is drawn into the treatment facilities Gaba II and Gaba III (DW.DE, 2012).

E. Air Emissions

In regards to GHG mitigation activities, the Ministry of Water and Environment's Climate Change Department is the designated national authority that approves projects on the basis of reduction of greenhouse gas (GHG) emissions (CDP Cities, 2013) while a 2012 GHG Inventory established.

The majority of Kampala's emissions of PM_{10} , $PM_{2.5}$, SO_x , NO_x and Benzene are generated from domestic sources and transportation activities, per Table 7 (ICF, 2009). Domestic source emissions specifically include open-air burning of household wastes, wood, and charcoal. Transportation activities are also driving the majority of the city's local emissions from passenger cars, trucks, and motorcycles. Re-circulation of roadway dust by passing vehicles is also a primary driver of PM_{10} and $PM_{2.5}$ emissions (ICF, 2009).

There has been a steady increase in use of wood fuel in Kampala's informal settlement areas, due to the lack of feasible alternative energy services, see Table 8. Wood fuel is used by approximately 75% of households, 10% of commercial establishments, and 5% of industry. Overall, charcoal production meets approximately 10% of energy needs in the city (KCCA, 2012). The high dependency on wood fuel and charcoal has implications on the increased release of carbon through deforestation as well as the carbon dioxide emission through combustion (KCCA, 2012).

An increasing number of vehicles in Kampala degrade the environment through greenhouse gas emissions and related mobile source pollution. In 2012, Kampala had an estimated 465,000 motor vehicles in use. In the last ten years, vehicle use has increased as follows: light transport 5.7%, automobiles 7.4%, mini buses 12.6%, buses 5.4%, trucks 9.2%, and motorcycles 15.8% as shown in Table 9 (UBOS, 2012). The increase in the number of motor vehicles has increased consumption of petroleum products. There is not an efficient public bus system to mitigate the city's congestion or to reduce the number of automobiles or small vans used for informal transit. GHG emissions from transportation are relatively high and likely to increase with improvement in roads as well as from the rise in private modes of transport within the city-region. Mode, vehicle-kilometers traveled, energy use, and number of trips per day per person are all factors driving GHG emissions from motor vehicles (Lwasa, 2013).

Table 7 Baseline Inventory of Emissions in Kampala (2009)

Source Type	Emissions (% of Total Pollutants)				
	PM_{10} (t/y)	$PM_{2.5}$ (t/y)	NO_x (t/y)	SO_x (t/y)	Benzene (t/y)
Roadway Dust	14,686 (47.5%)	1,627 (10.0%)	-	-	-
Domestic Sources	15,587 (50.4%)	14,028 (86.5%)	2,676 (39.9%)	-	273 (30.9%)
Vehicle Sources	618 (2.0%)	556 (3.4%)	3,984 (59.3%)	1,747 (68.8%)	610 (69.1%)
Industrial Sources	10 (0.0%)	9 (0.1%)	55 (0.8%)	793 (31.2%)	-
Total (tpy)	30,901 (100.0%)	16,220 (100.0%)	6,715 (100.0%)	2,540 (100.0%)	883 (100.0%)

Source: ICF, 2009

Table 8 Distribution of Households by Cooking Fuel (%)

Fuel Type	2005/2006	2009/2010
Charcoal	77.7%	74.5%
Firewood	5.8%	2.4%
Kerosene	5.2%	7.8%
Electricity	1.4%	3.4%
Other	9.9%	11.9%

Source: UBOS, Community Survey, 2005/6, 2009/10

Table 9 Increase in Vehicle Use 2002-2012

Mode Share	2002 - 2012
Light Transit	5.7%
Mini Buses	12.6%
Buses	5.4%
Trucks	9.2%
Motorcycles	15.7%

Source: UBOS, 2012



Photo: Road Congestion in Kampala.

Source: KCCA, date unknown

As vehicle ownership increases, greenhouse gas emissions and other forms of mobile source pollution from transportation will also increase. In 2011, there were 635,656 registered vehicles in Uganda, approximately 50% of which are located in Kampala (Schwander et al, 2014). Newly registered vehicles in Uganda increased by 18.5% from 2010 to 2011 (UBOS, 2012 as cited in Watundu, 2013). While no data is available to identify the proportion of this increase that is specific to Kampala, the previous citation from 2011 of 50 percent of Uganda's registered vehicles being located in Kampala gives an idea of the potential increase in the study area. Most of the newly registered vehicles are second-hand vehicles purchased from Japan. To date, there are no age restrictions or emissions requirements for vehicles in Uganda (Schwander et al, 2014).

The degradation in air quality from mobile-source pollution, oxides of nitrogen, and volatile organic compounds promotes formation of ground-level ozone that can be harmful to people, animals, crops, and other materials by inhibiting respiratory systems and altering cellular formation (US EPA ground level, 2014). Ground level ozone can also interfere with the ability of sensitive plants to produce and store food; visibly damage the leaves of trees and other plants; lead to increased susceptibility of sensitive plant species to disease, damage from insects, pollutants, competition, and harm from severe weather; and have adverse impacts on ecosystems, including loss of species diversity and changes to habitat quality and water and nutrient cycles (EPA Ozone, 2014).

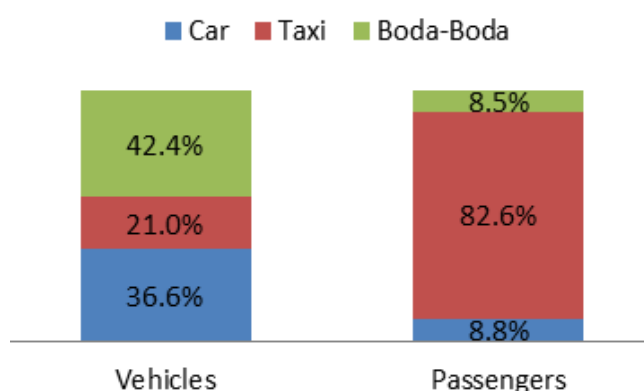
Table 10 Newly Imported Vehicles in Uganda, 2009-2013

Vehicle Type	2009	2010	2011	2012	2013	Total
Tractor head/trailer	607	627	827	1,268	1,157	4,486
Mini bus	2,950	3,260	2,164	2,033	3,533	13,940
Saloon (sedan)	22,133	31,879	24,897	28,179	29,397	136,485
Lorries	8,293	9,453	7,536	7,751	8,254	41,287
Total vehicles	33,983	45,219	35,424	39,231	42,341	196,198
Motorcycles	63,734	69,717	101,736	69,368	85,183	389,738
Total	131,700	160,155	172,584	147,830	169,865	782,134

Source: Ministry of Works and Transport, 2014

Another factor in air quality in Kampala is the large number of motorbikes (or “boda-bodas”) driven in the city. Motorcycles have a significant impact on air quality as they generate more pollution per Km than other vehicles. Boda-boda usage data is variable. In Uganda, since 2009, approximately twice as many boda-bodas have been imported compared to all other vehicles combined (Table 10). KCCA Strategic Plan recently noted that a free registration exercise recorded 55,000 motorcycles (KCCA, 2014b). In 2011, boda-bodas accounted for 42% of vehicles on Kampala’s roads but only carried 8.5% of the passengers (Figure 24) (KCCA, n.d.a).

The inability to build road infrastructure that keeps pace with the expanding number of vehicles in the city has led to traffic congestion. Vehicles idling in traffic contribute to greenhouse gas emissions in addition to GHGs released when moving to the destination point. In 2011, a baseline of automobile traffic flow on Kampala roads was recorded at 181,216 vehicles per day (KCCA, 2011 as cited in Watundu, 2013). Limited availability of data inhibits a comparison of average traffic counts in Kampala from additional years.

**Figure 25** Kampala Modal Split in 2011

Source: KCCA, date unknown

V. INSTITUTIONAL CHALLENGES

A. Overview

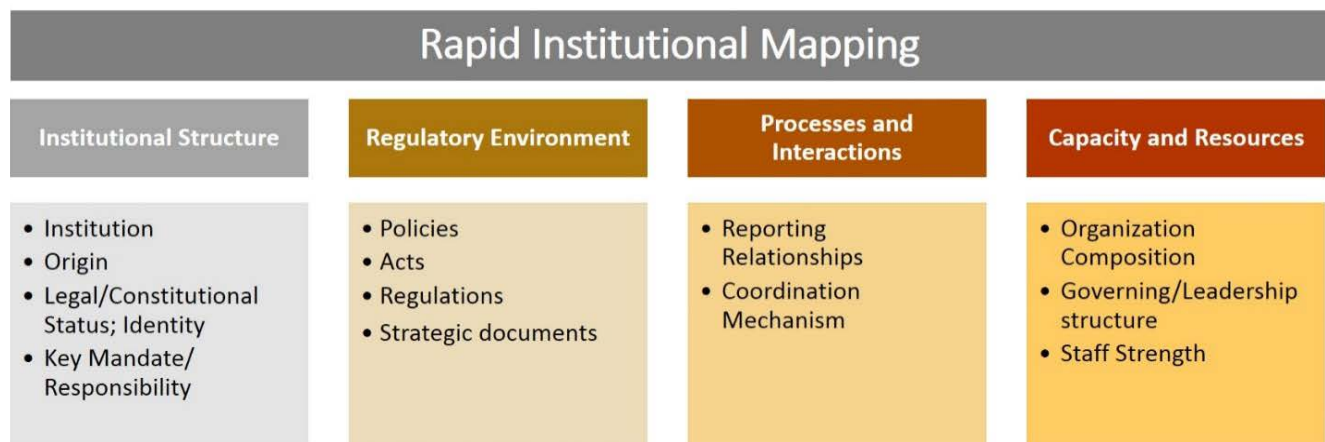
In discussing the key drivers and causes of environmental vulnerability and the promotion, or lack thereof, of green urban development, the threads converge onto governance and institutional issues. This section, therefore, seeks to first characterize the prevailing institutional landscape around promoting green urban development in Kampala, thereby highlighting key institutional factors or challenges that may foster or hinder green urban development, and finally offer some possible suggestions for improvements. To provide more tangible examples, for Kampala, we focused on the environmental assets of land and water and on the issue of protection, use and restoration of wetlands. These are discussed within a broader context of urban planning and development.

The first half of the section will present an overview of the prevailing institutional landscape through a rapid institutional mapping organized around four main areas: (i) institutional structure, (ii) relevant regulatory environment, (iii) typical processes and interactions and (iv) capacity and resources (as below). The selected key agencies or institutions involved in the planning, execution and management related to the environmental assets of land and water are introduced.

With the overall understanding established in the first part, the second half of the section explores the key institutional challenges and issues related to these four areas. Finally, the section concludes by offering some suggestions and recommendations for improvements to decision makers and practitioners.

The methodology undertaken comprised mainly: (i) data collection through desk-research on the background of the selected agencies/institutions for the institutional mapping and conducting face-to-face interviews with senior technical staff in some of the agencies/institutions; and (ii) institutional context analysis using information mainly drawn from the interviews and any supplementary documents or data collected.

The discussion here does not seek to be comprehensive and does not cover all relevant stakeholders, given significant data and time constraints. Instead, through the qualitative and anecdotal evidence provided by focused discussions, it serves to highlight and reveal some of the main institutional obstacles, to candidly surface issues being faced and reflect honest opinions, in the hopes of feeding into larger ongoing debates, assisting with tackling the challenges of green urban development and identify areas for deeper analysis.



B. Prevailing Institutional Landscape

Institutional Structure, Capacity and Resources

For Kampala, the key institutional actors include both the national and city level agencies and can be broadly considered under three areas: (i) urban planning and development, (ii) service provision (especially water and sewerage) and (iii) environmental management.

National Level

Two main ministries (Ministry of Lands, Housing & Urban Development and Ministry of Water & Environment) and their agencies/departments play a critical role in the preservation and development of urban environment of Kampala. Their institutional structure, relevant mandates and capacity are briefly described here.

- a. *Ministry of Lands, Housing & Urban Development (MoLHUD)*: responsible for providing policy direction, national standards and coordination of all matters concerning lands, housing and urban development for the country. It guides and directs policy, legal aspects and sets the regulatory agenda on land, housing and urban development to ensure sustainable land management promote sustainable housing for all and foster orderly urban development in the country. Politically, the ministry structure has one Minister who gives the overall political guidance and direction with support of three Ministers of State for Lands, Housing and Urban Development respectively. Within the ministry, there are three directorates and multiple departments as shown in the organogram below. Departments that are particularly relevant and

related to the environmental issues of Kampala are described below:

- i. *Department of Land Registration*: responsible for issuance of certificates of titles, general conveyance, keeping custody of the national land register, coordination, inspection, monitoring and back-up technical support relating to land registration and acquisition processes to local governments.
 - ii. *Department of Land Administration*: responsible for supervision of land administration institutions and valuation of land and other properties.
 - iii. *Department of Land use regulation and compliance*: responsible for formulation of land use related policies, plans and regulations. It also provides technical support and guidance to Local Governments in the field of land use regulation, monitoring and evaluation, and systematization of the land use compliance monitoring function and practice. This department has approximately 20 staff including 5 support staff. (Reference organogram of Ministry of Lands, Housing and Urban Development).
- b. *Ministry of Water & Environment (MWE)*: responsible for setting national policies and standards, managing and regulating water resources and determining priorities for water development and management. It also monitors and evaluates sector development programs to keep track of their performance, efficiency and effectiveness in service delivery.

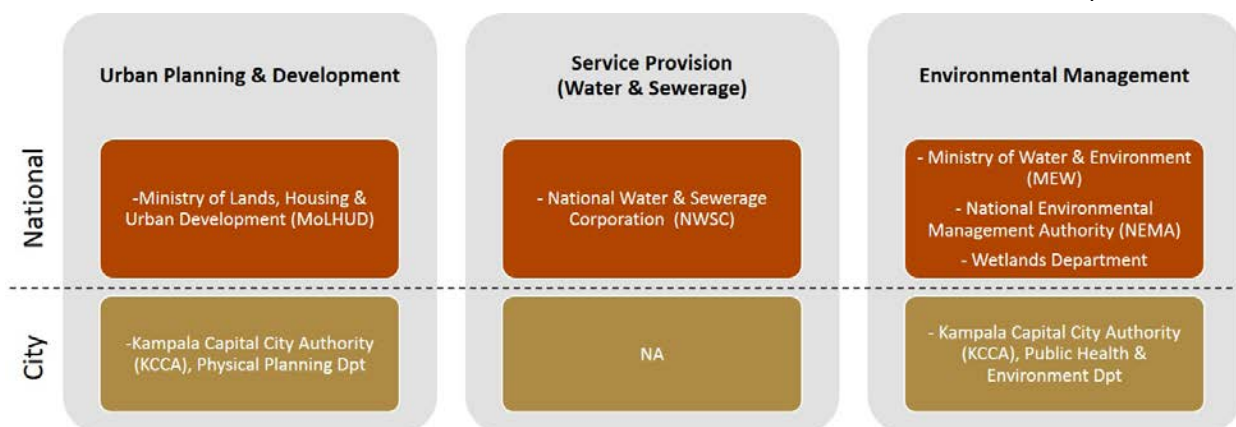


Figure 26 Key Actors Involved

Source: World Bank Staff

- i. *National Environmental Management Authority (NEMA)*: A semi-autonomous parastatal agency (officially under the Ministry of Water and Environment) established in 1995 under the National Environment Act. It is responsible for coordinating, monitoring, regulating and supervising environmental management in the country. Its regulatory functions and activities focus on compliance and enforcement of the existing legal and institutional frameworks, covering both green and brown issues of environmental management. It oversees the implementation of all environment conservation programs and activities of the relevant agencies both at the national and local Government level. (Reference Appendix B organogram of Ministry of Water and Environment).

One key regulatory function of NEMA is the review and approval of Environmental Impact Assessments and Environmental Impact Statements as well as Environmental Audits. Further on the management of wetlands, NEMA is empowered as the authority, in consultation with the lead agencies, District Environment Committees and local environment committees, to establish guidelines for the sustainable management of wetlands, to identify wetlands of local, national, and international importance and to declare wetlands to be protected wetlands. There are around 65 NEMA staff (of which around 35 are technical staff and the rest non-technical staff) to cover its entire portfolio.

- ii. *Department of Wetlands Management*: Directly in charge of monitoring, supervision, enforcement and compliance of wetlands and ensures the conservation of wetland resources for sustained utilization. Within the department, there are two divisions: (i) Policy, planning and enforcement – for M&E (eg encroachment), EIAs report review, auditing and standards; and (ii) awareness-raising, information and management – for R&D, assessment and inventory (coverage and info), district supervision (training and technical support). Currently the department has only 20 technical staff covering the entire country, with 1 staff in each district.
- iii. *National Water & Sewerage Corporation (NWSC)*: is a public utility company (100% state-owned), under the Ministry of Water and Environment, that is responsible for providing efficient and cost effective water supply and sewerage services and for the maintenance

of the sewerage and water supply network, targeting coverage for all urban centers in Uganda. Currently, it operates and provides water and sewerage services for 23 large urban centers across the country including Kampala. Its current staff strength is around 2500 people country-wide, with 1600 staff focusing on Kampala (mainly on water supply).

City Level - Kampala Capital City Authority (KCCA)

The Kampala Capital City Authority (KCCA) is mandated with the delivery of public services for Kampala that enable residents and businesses to function in a conducive environment that supports development. Specifically, the authority is obliged to plan, implement, and monitor the delivery of public services, and guide city development. The Authority is charged with a duty of initiating and formulating relevant policies, setting service delivery standards, determining taxation levels, monitoring general administration and provision of services in the divisions, enacting legislation, and promoting economic development. It is further responsible for constructing and maintaining main roads and major drainages, installing and maintaining street lights, organizing and managing traffic, physical planning and development control, and monitoring of the delivery of service within the area of jurisdiction. The Authority is also charged with maintenance of law, order and security, mobilization of residents for community development and local taxation purposes, and registration of residents' births and deaths (KCC Act 2010).

KCCA was formed in 2010 to replace the Kampala City Council (KCC) and had a status equivalent to a national government agency. There are two wings within KCCA - a political wing headed by the Lord Mayor and an administrative wing headed by the Executive Director (ED) at the rank of a Permanent Secretary. Overall, a Minister is responsible for the Capital City and he is the authority to whom the executive director and the Lord Mayor report.

Under the Lord Mayor, there are five divisional Mayors (Makindye, Nakawa, Rubaga, Kawempe and Central Division) who are elected by their electoral constituencies; and around 240 councilors representing different localities at different councils in the city. On the other hand, the administrative wing is headed by the ED and consists of ten Directorates. Each of the directorates report to a standing committee of KCCA. In turn, the chairman of the standing committee presents the quarterly directorate performance with guidance from the director to the KCCA during quarterly performance review meetings.

The ten Directorates are: Administration and Human Resources Management; Treasury Services; Engineering and Technical Services; Public Health and Environment; Education and Social Services; Legal Affairs; Revenue Collection; Gender, Community Services and Production; Internal Audit and Physical Planning. These are responsible for city planning, management and day-to-day operations and policy implementation. The two Directorates most relevant to this discussion are the Public Health and Environment Directorate and the Directorate of Physical Planning.

As the KCCA is a relatively young organization, its staff strength has not reached full capacity – currently at around 70% of the approved establishment (including both permanent (around 400) and temporary (around 500) staff). The staffing level also varies in the different directorates. For example, for Physical Planning Directorate, it is currently only at 40% staffing level and thus poses significant capacity constraints. In terms of resources, it is highly dependent on National Government funding, although it is making significant improvements in the own source revenue collections (an average annual growth rate of around 12% since FY06).

Regulatory Environment

Overall

Generally, there is a basic array of legal tools such as policies and regulations to guide urban development and the protection of urban environment at both the national and local level. Major changes in environmental policy and the water sector took place around the 90s with the adoption of a National Environment Management Policy and the National Environment Statute in 1994 and 1995 respectively, and the adoption of the Water Action Plan (WAP), a water policy and two new laws: the Water Statute 1995 and the National Water and Sewerage Corporation Statute 1996. However, the national level guidance on urban development and land management evolved only in recent years (eg. the National Land Policy was approved in 2013). Interviewees have also highlighted several areas which are desired but still being developed (for example, the National Urban Policy and Act are still under draft, and a Wetlands Act is desirable).

KAMPALA

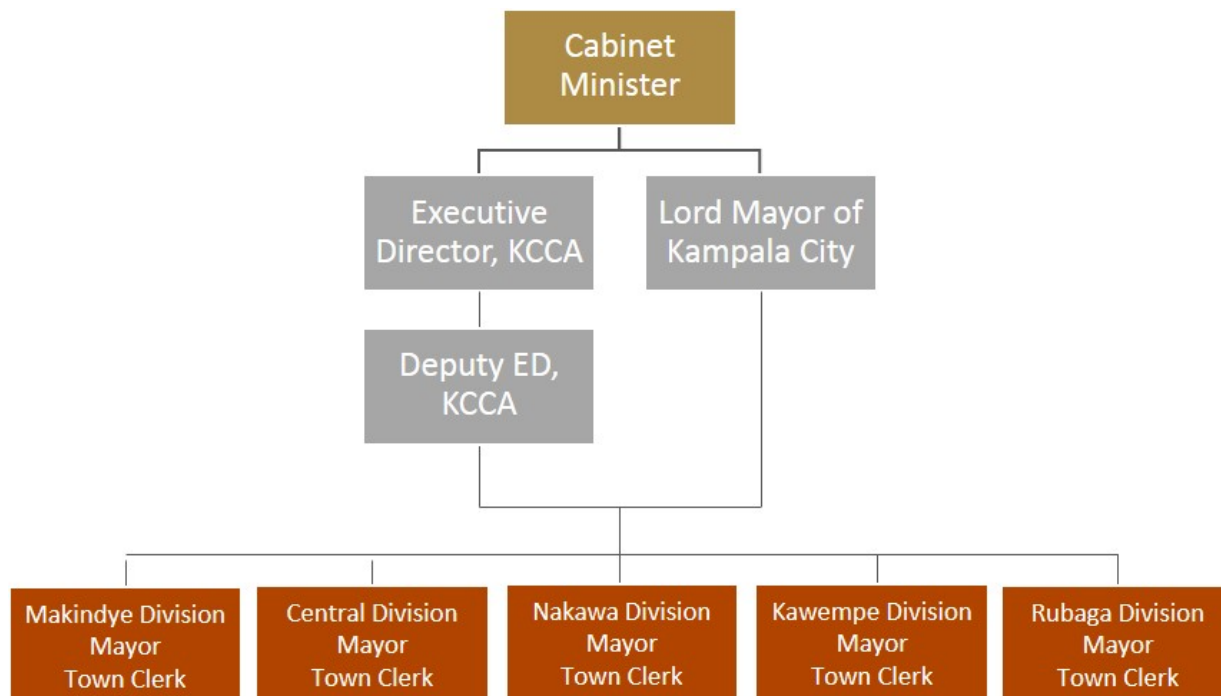


Figure 27 Figure: KCCA Management Structure
Source: Adapted from KCCA Website

The key national level documents currently in place include: National Development Plan, National Environment Act (established NEMA), National Environment Regulations (covering various areas including wetland and lakeshore management, minimum discharge standards for effluents etc.), National Environment Water Act and Water Statute, National Policy for the Conservation and Management of Wetland Resources 1995 (National Wetlands Policy), National Environment Waste Management Regulation, Public Health Act, National Land Policy (2013) and Land Acts, Physical Planning Act 2010, National Physical Planning Standards and Guidelines, Local Government Act etc.

At the local Kampala level, there are various local government ordinances and regulations which supplement the national level ones, such as Building Regulations, Urban Agriculture Ordinance, Solid Waste Ordinance etc. After KCCA was formed in 2010, a new wave of strategies and policies have been put in place to guide the development of Kampala and improve service delivery and governance in various areas. These include the Kampala Capital Cities Act 2010, the KCCA Strategic Plan (updated yearly, and each valid for a 5-year period; spells out clearly the development objectives, performance standards, strategic projects and budgets etc.), and the introduction of results-driven working culture in KCCA (eg. performance based compensation system) by the new leadership team that included a dynamic and aggressive approach to addressing governance and anti-corruption issues. Substantial improvements in governance and citizen's satisfaction with service delivery and the urban environment have been observed since the change to KCCA.

Physical Planning and Development

The Kampala Physical Development Plan was finalized and approved in 2013 which provides the basic framework and structure to guide the development of the city. However, further translation of the structure plan into detailed physical development plans are still underway. (The latest KCCA Strategic Plan 2014/2015-2018/2019 outlined the first key strategy and project for the coming 5 years as the development and implementation of detailed neighborhood precincts and embark on the "Detailed City Physical Development Plan Project".) The detailed plans would be essential to operationalize the overall structure plan, coordinate development of infrastructure and public amenities and direct socio-economic investments. The detailed plans would be a key regulatory tool to provide the legal basis for clear, objective, transparent, plot-by-plot guidance to developments.

Wetlands Management

Wetlands have traditionally been marginalized as "wasteland" or "no-man's land", open to exploitation. Up until 1988 when Uganda acceded to the Ramsar Convention, the legal regime over wetlands have been unclear. With the establishment of the National Wetlands Conservation and Management Programme in 1989, the process of policy and legislative review began. However, adoption of the National Wetlands Policy only took place in 1995 after rounds of revisions.

The National Wetlands Policy has clearly laid down the guiding principles and strategies which supports the conservation and sustainable management of wetlands. Those of particular importance include:

- **Government is not supposed to lease land or give land tenure in wetlands.** "All wetlands are a public resource to be controlled by the Government on behalf of the public. There shall be no leasing of any wetland to any person or organisation in Uganda at any given moment and for whatever reason." "All future land tenure documents including maps and layouts will indicate whether the area contains a wetland and will accordingly exclude these wetlands from tenure."
- **Any development in the wetland is subjected to EIAs and the continuous monitoring of their impacts.** "... all proposed modifications and restorations on wetlands be subject to an EIA, the result of which will determine whether such restoration or modification should proceed and if so to what extent." "All planned new wetland developments will be subjected to an EIA process to determine the required environmental controls." "Those, which have been subjected to EIAs, will continuously be monitored to assess their impact on the environment and where the impact is detrimental, Government will require that such a development be halted."
- **There are varying categories of wetlands, including fully protected wetland areas and those for partial use.** "Government will establish fully "Protected Wetlands Areas" of important biological diversity." "Any wetland serving as a source of water supply or receiving effluent, as part of a designated service to any human settlement shall be declared a fully protected wetland from any encroachment, drainage or modification." "Government may also establish certain wetlands, which will be used for partial exploitation such as research."
- **Government may permit the use of wetlands only for certain non-destructive functions and in a sustainable manner.** "Wetlands may be utilised in

such a way that they do not lose traditional benefits presently obtained from them.” “Any decision to use wetlands must consider the requirements of all other users in the community.” “Only those uses that have been proved to be non-destructive to wetlands and their surroundings will be allowed and/or encouraged. These include water supply, fisheries, wetland edge gardens and grazing.”

In addition, the management of wetlands has been regarded as an integral part of environmental management. The National Environment Statute of 1995 included specific provisions on wetlands, in addition to pollution, environmental restoration orders, environmental easements, public awareness and enforcement of the law. The statute thus set in place a framework but the various provisions would need to be further developed in regulations to be applicable as law on the ground.

Process & Interaction

Land Management and Physical Planning

Land management (such as the issuing of land titles) is largely centralized and is the function of MoLHUD. However, MoLHUD has established zonal offices and at various places, co-locates its officers with local government for the processing of land titles and the Land Information System. For example, there is one MoLHUD officer residing with KCCA to oversee such matters and issue relevant land titles for Kampala. Typically, private developers or the local government submit the requests to MoLHUD for issuance of land titles. Having the close physical proximity of MoLHUD officer in KCCA enhances the coordination and interaction during this process.

Physical planning, on the other hand, is largely decentralized. Physical Planning Committees are established at the district, urban and local levels and charged with the development of their respective local physical development plans, approval of development applications and other related development control functions (in this case under the charge of the KCCA Physical Planning Directorate). A pre-requisite to submitting a planning application is the proof of land title.

Thus far, data and information on land and physical planning are not consolidated in one database, although there are moves towards using the GIS platform to allow this. The interactions between the MoLHUD and local governments are largely based on individual issues or projects – for example during application processes, or the local government may submit minutes of relevant meetings to the Ministry or the Ministry may conduct supervision trips to investigate certain issues.

Wetlands Conservation and Management

As described earlier, multiple agencies are involved in the conservation and management of wetlands, including the local government, NEMA and the wetlands department under MWE. The regulatory framework provided guidance on the roles and responsibilities for the respective entities, the core of which are: local government for day-to-day development control, approval of planning application and enforcement; NEMA for review and approval of EIAs; wetlands department to be consulted whenever a development application/EIA involves wetlands. The interactions amongst these agencies is mainly through the issuance process of planning permits and EIAs where inter-agency consultations have to be done. Joint inspections have also been conducted when there are applications related to wetlands and these have been found to be effective, enhancing coordination and reducing frictions between issuance of various permits. However, interviewees reflected that such processes may not always be conducted in the proper sequential order or completely following the due process in reality.

C. Institutional Key Findings

Institutional Challenges

1. ***Institutional fragmentation – overlapping mandates, weak integration and coordination.*** As described earlier, both national-level (MoLHUD, MWE, NEMA, Wetlands Department) and city-level agencies (KCCA) are directly involved in different aspects of land and urban environment management and their regulatory scope and responsibilities overlap.

As Kampala has a unique physical characteristic of numerous low rolling hills linked by wide valleys of wetlands, the balance between developing on the hills and protecting the integrity and functions of the wetlands are especially important for the sustainable development of the city. However, there are multiple institutional fragmentation with regards to the management of wetlands – at both the national level and also vertically with the local level.

At the national level within MWE, functions of NEMA and the Wetlands Department with regards to the management of wetlands are overlapping and the division of work unclear. While NEMA is clearly the key agency presiding over the EIA process, it is also specifically empowered to manage wetlands as established under the National Environment Statute. At the same time, the Wetlands Department is the primary department overseeing wetland matters. The horizontal integration or alignment between

the two is sorely lacking, leading to much conflict and less than optimal resource use.

In terms of service delivery and the management of urban environment especially wetlands, the regulatory scope and responsibilities of national level agencies also overlap with that of the city-level agency – KCCA. For example:

- The NWSC is the agency directly charged with providing and maintaining the water supply and sewerage services and network for Kampala (backed by the National Water and Sewerage Corporation Act) while KCCA also has the mandate to deliver such services for its Kampala residents (backed by the Kampala Capital City Act 2010) - including the planning, implementation, monitoring of such services, as well as setting relevant policies such as service delivery standards, determining taxation levels and so on.
- KCCA also has the function to “enact legislation for the proper management of the Capital City” and its Metropolitan Physical Planning Authority has the responsibility and power to “veto physical plans or activities inconsistent with the Metropolitan Authority Development Plan or land use policy”, and “ensure that the land use in the City and the metropolitan area follow designated plans, irrespective of the tenure of land”. With respect to wetlands within Kampala, KCCA thus has the authority to monitor and enforce that such land are used in accordance with the designated land use zone (“Natural Wetland Reserve”). This is in addition to the similar mandate given to both Wetlands Department and NEMA - to monitor, supervise and enforce wetlands.

As it stands, these overlapping mandates, unclear lines of reporting create ambiguity in terms of accountability and complicate the processes for planning, implementation, monitoring and enforcement of the urban environment. While it may not be necessary to eliminate overlapping functions, there needs to be clear understanding of the roles and responsibilities of each, whether there is or needs to have a reporting structure or relationship between agencies/departments. In addition, better coordination and streamlining of the processes and reinforcing the complementarity of roles would lead to better ultimate results.

2. ***Weak development guidance at city level and overall weak regulatory environment around wetlands conservation and management.*** While the basic array of legal tools is available at both the national and local level, two key weaknesses are:

- a. *The lack of detailed physical development plan for Kampala.* Currently, around forty percent of

the population lives in unplanned and densely populated informal settlements which lack basic service provision. The high level of informality contributes to severe degradation of environmental assets. While an array of political, social and environmental factors are behind the informality, the lack of proper physical planning and effective development management process is a key driver. Further, rapid and uncontrolled urban growth also leads to environmental degradation (eg. exacerbating the loss of soil and vegetation coverage due to conversion of land). Currently, Kampala lacks detailed physical development plans and development is only guided by general and broad planning standards and guidelines (often at the national level) and issued on an ad-hoc basis, mainly through the process of development planning applications. It is thus, difficult to coordinate and implement infrastructure and public amenities and other economic-socio investments. Further, environmentally sensitive areas are not adequately demarcated, identified and further protected through the associated regulatory planning tools such as structured open space plan (often part of detailed physical plan) or zoning. The absence of detailed plans also means that development decisions are largely subjected to the discretion of individual planners and are thus contentious and could be easily challenged. Enforcement proves even more difficult without the clear legal backing of detailed plans.

- b. *Weak regulatory environment around wetlands conservation and management.* While the key strategies and objectives have been laid out in the National Environment Statute and Wetlands Policy, the reality currently is that different government agencies may act contrary to such guidelines and principles. For example, on occasions, the Land Commission has leased wetlands or MoLHUD has given land titles on wetlands. These may in part, be due to the absence of clear demarcation of wetland boundaries (not all wetland areas are surveyed/accurately mapped) and/or a comprehensive wetlands inventory, as well as insufficient integration with development related plans and database (eg. landuse plans and land titling database). In addition, while there are sectoral laws that refer to some aspects of wetlands such as water, or land or prevention of pollution, there is an absence of a comprehensive law or act for the effective management of wetlands in correspondence with the Wetlands Policy. The various provisions under the Environment Statute would merit further translation into enforceable regulations.

3. ***Loose adherence to development approval process.***

Current coordination and integration vertically between the national and city-level agencies are weak especially with regards to the issuance and enforcement of related permits and approvals for development (EIA certification, land title, user permit, planning permit); this is exemplified by developments in wetland areas. The instituted due processes may not always be conducted in the proper chronological order or followed in reality. For example, inter-governmental consultation does not work effectively: whenever a development application or EIA permit application involves wetland, the Wetlands Department should be consulted, but in practice, it does not always happen. Or, agencies do not reinforce each other's mandate throughout the development process. Rather, the current observation is that once a potential development obtained one of the government issued title/permit/document (be it land title, or EIA or planning permit), this is cause for demanding all the other related government licenses, even those undue.

4. ***Constraints in current capacity and resources; and competing priorities for resource allocation.*** The lack in both financial and staff capacity and resources is a common challenge highlighted by all institutions. The current situation is critical on several fronts. In terms of staffing, both the overall staffing level (for example: KCCA – only around 30% permanently staffed, and 40% in physical planning department; Wetlands Department only has 20 technical staff, or 1 staff per district; NEMA only has around 35 technical staff) and recruiting staff timely and with necessary skills are a challenge. The difficulty in staff recruitment could partially be attributed to the institutional process; for example, ministry level staff had to be recruited centrally through the Ministry of Public Services.

Obviously, the lack in staff capacity poses serious constraint on effective management and especially in enforcement. Even with all necessary structure and regulations in place, enforcement is often the greatest challenge. For wetlands, the policing and enforcement has been especially weak. At the permit stage, even when conditional approvals were given, there may not be cross checks between departments for consistency, or to ensure that conditions of conditional permits were met eventually. At times, even when physical markers for wetlands are put up, the next round of inspection to ensure the integrity of the boundary may only occur after a year or more. Often, encroachment or development with irreversible impacts would have occurred. KCCA has the primary responsibility for enforcement (it conducts its own inspections) and is structured to have enforcement officers at the ward/parish level. However, it is often not able to carry this out.

On the other hand, the Wetlands Department has neither a dedicated enforcement department nor enforcement officers. While joint inspections (conducted by the related departments) have been found to be effective, it is done on a selective basis largely due to capacity constraints.

As compared to economic and social development causes, environmental issues tend to be given a relatively lower priority or even perceived as a “burden” when it comes to resource allocation and political backing. As such, the resultant general lack in financial resources for environmental causes is another major challenge. For example, the Wetlands Department could not execute the ongoing program to properly survey, map and delineate wetlands, an expensive endeavor, due to lack in financial resources. Or where NEMA is trying to catch up and correct the pre-1995, pre-NEMA era issues to cancel land titles issued in wetland areas; there are insufficient funds for compensation.

Suggestions and Recommendations

1. ***Consolidate and reinforce institutional structure and mandates.*** At the national level within MWE, there is a need to clarify and consolidate the functions and responsibilities between NEMA and Wetlands Department over the management of wetlands. Vertically between the national and city-level agencies, clearer delineation in terms of the roles and functions and in correspondence to the development chain of activities would be beneficial. For example, one model is to have the local authority, KCCA, carry out the day-to-day functions and be the first line of initiation and response; while national-level agencies should serve the overall policy and regulation setting role, provide backstopping support and reinforcement when called upon, as well as coordinate functions to ensure alignment between agencies/sectors and compatibility to national level goals. This division of work could apply to the entire chain of activities from planning to management and enforcement. It is imperative to clarify institutional roles, functions and mandates to empower the various agencies with the necessary authority and power to plan, implement and enforce their regulatory functions. Enabling this may require amendment of existing laws or a commitment to enforce them and establishing new ones.
2. ***Complete the system, regulations and tools surrounding detailed physical development plans for Kampala and on wetlands.*** As mentioned previously, KCCA is on the right track to develop the detailed physical development plans for Kampala, and starting with priority areas (which could include environmentally very sensitive areas). This should

be encouraged and momentum kept up. In terms of wetlands, while there are various ideas and initiatives around more effective management of wetlands, most of these have been underway or ongoing for many years. To tackle this issue, there is a need to advance and complete these initiatives especially: (i) a set of legal regulations specifically around wetlands management, (ii) complete the survey, mapping and demarcation of wetland boundaries, and integrating with other information systems for development (eg. land info database), (iii) where necessary, establish district/local level by-laws for the proper management of wetlands.

3. ***Improve inter-agency integration and coordination across the full chain of development processes.***

Related to the sorting out of the institutional structure and mandates, the processes around development control and permitted use on wetlands should be improved. This starts with integrated planning (develop city-wide detailed plan and planning guidelines), sharing of information and aligning database compatibility and information coherence amongst agencies, to realizing mandatory consultations, aligning procedures and requirements for the issuance of relevant permits and licenses and closing the loop on conditional ones, and finally to effective enforcement (conducting joint inspections where necessary and build in joint reporting at the right forums). In addition, coordination between all relevant agencies at various steps of the process should be strengthened, potentially through reinforcing standard operating procedures, or setting up of regular forums or specific task forces. (One possibility is to revive an earlier initiative – the “Pollution Control Task Force” and improve upon it.)

4. ***Institute accountability and track performance.***

Within each agency, it would be useful to devise monitoring and evaluation indicators and system to track development cases, permits/licenses issued and conditions attached to them, in addition to an associated follow-up plan. This would allow better monitoring and enforcement of the necessary requirements and procedures. Audit mechanisms could also be considered to assess the performance of both national level and local governments on aspects such as environmental regulation enforcement, together with built-in incentives or disincentives related to performance as determined by the audits.

5. ***Conduct public education and communication initiatives.***

Creating public awareness and even enabling community/self-policing would be another good way to strengthen the enforcement of relevant environmental regulations. The objectives of conducting public education and communication initiatives could be multi-fold. The first objective is to demonstrate and publicize the benefits of green urban environment and the direct positive impacts to communities (eg. improvements to public health, increase in property values etc.). Secondly, responsibilities of various government agencies should be clarified to create transparency and build trust with the public. The public should be able to direct queries and report any misconduct to the relevant authority and hold it accountable, and see that appropriate actions are taken. Conversely, the relevant authority would have the power to enforce its mandate without unnecessary interference. Therefore, each agency could embark on a communication campaign to outline its mandate, responsibilities, assessment methods (eg. for licensing or permits) and publish public guideline documents through means (illustrations, pamphlets, websites etc.) easily accessible and understandable (in plain language free of jargons) by the general public. In addition to the public at large, the management team in each agency and the local leaders should be the first target group to obtain the alignment in thinking. Once these leaders are on board, it would be easier to rely on them to disseminate the correct messages and communicate directly with their own reports/constituents to strengthen the cause.

6. ***Strengthen capacity and boost resources.*** In addition to macro level improvements such as increasing Kampala’s own source revenue or improving education and skills training, other steps could be taken to strengthen capacity and boost resources. While capacity and resources are always scarce, the economic case of environmental resources and initiatives could be better justified such as through commissioning relevant analytical work (eg. the Ministry of Finance had once requested the Wetlands Department to present the economic value of wetlands to justify government allocation of resources and funding). In addition, consolidating institutional functions and structure, better planning to align staff numbers and skills with development priorities, or smart use of technology could help to increase efficiency for carrying out the necessary tasks. Each agency, especially the local governments, should also have control over its own budget and staffing plan and decisions, in line with their functions and obligations.

VII. KEY FINDINGS

Foremost, Kampala is a rapidly growing city: the built environment will continue to expand and there will inevitably be natural resource and ecosystem loss. As the capital of Uganda, Kampala is an important political, cultural, and economic center. It will continue to draw new residents and new activity that will fuel the city's continued growth as an important economic engine. Thus, it is not the urbanization and growth of Kampala that is at issue; it is the nature of the urban development that is revealed in this study of the city's environmental assets that is of concern.

The approach to development in the past decades can be characterized as a "build everywhere" approach. It has spread down the city's hills to the lowlands and has encroached well into the city's most important environmental assets, its wetlands. Development has proceeded with little awareness or sensitivity of the overall impacts on ecosystems. Along the way, it has reduced the urban forest and open landscape space, degraded the land and soil, and failed to provide essential infrastructure services that are essential to managing the impacts of urban development. The city has not made a serious attempt to integrate the protection or enhancement of critical natural asset systems within physical development.

Development has not been guided by a strategic planning framework such as a "grand bargain" – a planning mechanism that identifies the critical natural assets and prioritizes them - so that a structure could balance development and mitigate the loss of assets, or to preserve or even enhance them. Inadequate and ineffective planning has been a key obstacle to providing the management required to protect the city's environmental assets. For decades, the city has lacked an effective physical development plan to guide growth and development. As a result, the city lacks detailed urban planning and urban design concepts to guide development. There is little guidance or tools available to offer specific direction to the city agencies as they consider the city, holistically, as districts, or on a project by project basis.

A first generation of strategic level planning documents has been generated in the past several years, but they remain high-level and lack both baseline data and analytics. There is much more comprehensive spatial planning required that employs a process to effectively integrate transportation and infrastructure planning with land use planning.

A strategic planning framework would provide spatial definition to both the development and conservation priorities of the city. With a comprehensive and city-wide strategic framework in place, the city would have the platform to more successfully evaluate individual proposals

for development and establish a balance in the tradeoffs as they consider the interests of development and the impacts on the natural environment. This approach is also essential if the city pursues innovative planning tools such as offsets.

The degradation of the city's wetlands provides a primary example: historically, the Kampala region has been uniquely bestowed with an abundance of this highly valuable natural resource. Within KCCA, this resource is now largely gone as the impacts of development were allowed to directly and indirectly exploit the natural resources without recognition of the full value of the natural assets.

The city lacks the tools to evaluate the tradeoffs of large-scaled infrastructure projects, which are conceived to solve drainage and flooding but have resulted in significant negative impacts on the overall quality of the city's wetland system. A strategic planning framework, with clear development and conservation goals and priorities, would provide context for a fuller assessment of the environmental impacts of large-scaled infrastructure projects, such as those described in the Profile, that are intended to improve public services and support economic development.

The continued development of informal settlements within the Kampala and the Greater Kampala Metropolitan Area is inevitable. Urban spatial planning will need to address where informal settlements will be located and how they will be provided basic services. Without intentional urban planning interventions, the informal settlements will continue to be a primary source of environmental degradation. Kampala will continue to attract residents that cannot afford housing and are without the means to participate in the formal economy. The impacts of informal settlement on the environmental assets that have been described in the Profile will only expand if the city does not take an active role in the designation and servicing of areas for informal settlements. Since urbanization and population growth has spread to the larger metropolitan area, there is the opportunity to think beyond jurisdictional lines and collaborate on the development of policies for informal development that will benefit the region.

Data to inform environmental planning and management is limited within the city. Development of baseline environmental data would be an important tool to support the strategic planning approaches being advocated in these findings. Availability of environmental data that is specific to the city is limited. The city does not have programs or information addressing urban vegetation, open space and landscape, land soil, wildlife, or air quality – although there are some national level

sources of information. There is considerable information available on Kampala's wetland as they have been the focus of considerable academic study. However, the studies have typically addressed individual wetlands and there has not been a comprehensive inventory since 1999. The Wetland Atlas that is under development will be an important step in establishing a framework for protection and conservation.

The planning and technical information that is available is often developed for a specific project or environmental impact assessment, resulting in a patchwork of information rather than a comprehensive assessment of the city and its systems as a whole.

The relationship of the Nakivubo wetland, historically a unique and important green infrastructure spine of the city, to the form and pattern of the urban development is close to being lost. Restoration of Nakivubo as a vital green landscape element of the city will require a comprehensive study of the wetland as a complete ecosystem. The Nakivubo, the primary wetland that flows through the urban center, has been severely degraded by impacts of urbanization. In the center of the city, the wetlands' natural flow and drainage course has been altered and channeled within hard edges. The remainder of the wetland has been heavily encroached upon by informal settlements and industries. The cumulative effects of urbanization, along with the outputs of storm water runoff, discharge of effluents, and the disposal of solid waste, has been grave.

Preliminary urban concepts call for the reconnection of the Nakivubo as an important landscape element within the city. Restoration of the wetland will require a large-scale planning initiative that includes a full analysis of the different sources of pollution and the steps – or tradeoffs – that will need to be taken to return the wetland to a healthy state.

Development in Kampala and its environmental impacts needs to be considered at metropolitan scale. As the city develops a strategic planning framework, it should look beyond its boundaries to the broader metropolitan region and evaluate the impacts of urban development of the regional environmental assets. The metropolitan regional still has critical natural assets, such as the large area of wetlands east of Murchison Bay, that should be protected and conserved as the city continues to expand. The strategic framework will assist the city in giving proper consideration of proposals for development in the context of the remaining assets. A broader view of environmental assets can allow the city to avoid making the same types of mistakes that have been made in the past.

Valuable ecosystems within the city of Kampala are under acute pressure; action will need to be taken soon if their continued deterioration is to be arrested. The Profile has highlighted the key drivers of environmental degradation within the city. Much of the degradation of the environmental asset base is coming from the lack of adequate sanitation and drainage infrastructure. However, from a fiscal perspective, Kampala will have limited resources to invest in the grey infrastructure that is required to offset the degradation of the environmental asset base. There is opportunity to integrate green infrastructure within the city to mitigate some of the impacts, particularly within the urban landscape to capture and attenuate storm water runoff. However, even green infrastructure approaches will require a balance of grey infrastructure to address the magnitude of the drainage issues in Kampala.

Given these constraints, leadership and institutional actions - feasibility and capacity for addressing key problems - are particularly important.

Little protection for the city's environmental assets has been realized under the current regulatory regime. An essential first step in environmental protection is the enforcement of existing environmental regulations. Environmental regulations have created the enabling framework for protecting the wetlands but essential actions, such as survey and delineation of wetland areas, have been delayed due to political, social, and economic implications of restricting land use. Regulations for discharge of effluent, particularly to control industrial discharge, have not been widely enforced and in general, the enforcement capacity of institutions charged with environmental management is limited. A recent action by the agency charged with protection of the wetlands has highlighted the issue of capacity to balance the interests of economic development and environmental protection.

Key steps for the future include:

- The development of a profile of natural assets at the metropolitan scale and a broad strategy to address pressures on these assets.
- The identification of specific opportunities for Green Urban Development interventions supported by well-analyzed actions to progress these opportunities.
- Institutional actions taken to regulate, enforce and protect consistent with what is already in current policy and law; and the development of more sophisticated measures to address ecosystem loss.

VIII. BIBLIOGRAPHY

- Abebe, Aweke Gezahegn, 2013. *Quantifying Urban Growth Pattern in Developing Countries Using Remote Sensing and Spatial Metrics: A Case Study in Kampala, Uganda*. Feb. 2013.
- African Development Fund. 2008. *Uganda: Kampala Sanitation Programme Environmental and Social Impact Assessment Summary (ESIA)*. Prepared by Fichtner, July 2008.
- Akurut M., Willems, P., and Niwagaba. 2014. *Assessing the influence of Lake Victoria flux on the Inner Murchison Bay water quality*, WIT Transactions on Ecology and The Environment, Vol 182.
- Amayo, J. 2012 Presentation of MRI Pilot Project - Kampala Water Lake Victoria Water and Sanitation Project – (KW-LVWATSAN Project), Water Supply & Sewerage Services within Kampala, National Water and Sewerage Corporation, Kampala
- Angelsen, A. and S. Wunder, 2003. *Exploring the Forest—Poverty Link* CIFOR occasional paper 40: 1-20.
- AWE, 2013. *Environmental Audit of Kampala Capital City Authority (KCCA) Landfill at Mpererwe*. Prepared for KCCA. December 2013.
- Baastel, 2014. *Economic Assessment of the Impacts of Climate Change in Uganda. Dynamical and statistical downscaling of climate change projects for Kampala, Uganda*. Prepared for Climate Change Unity, Ministry of Water and Environment. Prepared by Baastel Consortium. October 15, 2014.
- Baastel, 2014b. *Economic Assessment of the Impacts of Climate Change in Uganda. Regional-scale Climate Change Projections of Annual, Seasonal and Monthly Near-Surface Temperatures and Rainfall in Uganda*. Prepared for Climate Change Unity, Ministry of Water and Environment. Prepared by Baastel Consortium. May 31, 2014.
- Banadda, N. 2011 Characterization of non point source pollutants and their dispersion in Lake Victoria: A case study of Gaba landing site in Uganda, *African Journal of Environmental Science and Technology* 5(2): 73-79
- Birdlife International. 2014. *Important Bird and Biodiversity Area. UG018 Lutembe Bay*. 2014. Downloaded November 11, 2014.
- Busulwa, H et. Al. 2002. *Buffering capacity studies in a rural and an urban wetland in Lake Victoria catchment, Uganda*. 2002.
- Byaruhanga, A. & Nalwanga, D. 2006. *Ten years of continuous waterbird monitoring at Lutembe Bay, Lake Victoria, Uganda*. *Waterbirds around the world* (Eds. G.C. Boere, C.A. Galbraith & D.A. Stroud). The Stationery Office, UK. pp. 457-458.
- Byaruhanga, A. & Leonard Ssozi. 2012 *The Impact of population growth on the Ecosystems and Biodiversity of Kampala: Lessons for Sustainable Urban Development*. *Sustainable Futures: Architecture and Urbanism in the Global South Kampala, Uganda*, 27 – 30 June 2012
- CCCI, 2009. United Nations Human Settlements Programme *Un-Habitat Sud-Net Cities In Climate Change Initiative*.
- CDP Cities, 2013. *Information Request: Kampala City*
- COWI/VKI, 1998. *Kampala Water Quality Monitoring Programme: Murchison Bay Water Quality Project, Report* prepared for Ministry of Natural Resources National Water and Sewerage Corporation by COWI in association with VKI, Kampala.

Daily Monitor. 2012. *Government silence on the Namanve degazettment saga deafening*. March 3, 2012.

Division Solid Waste Generation and Composition in Kampala Capital City Authority, 2013. *Uganda: Trends and Management*, IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 10 Ver. III (Oct. 2014), PP 57-62 2013

Daily Monitor. 2014. *Floods Bring Kampala to Standstill*. June 10, 2014.

Daily Monitor, 2012. *Encroaches Evicted from Ggaba Wetland*. December 31, 2012.

Directorate of Water Development, Ministry of Water & Environment, 2010, *2012 Kampala District Information* www.mwe.go.ug

Daily Monitor, 2011. *Kampala Chokes on Pollution*. June 7, 2011. DW.DE.2012. *Cleaning Up Kampala's Water Sources*. December 2012. Downloaded from <http://dw.de/p/1462C>

Fichtner, 2014. *Lake Victoria WATSAN Project. Package 5A: Development of an Appropriate Sanitation Concept, Review of Water Supply Aspects in Informal Settlements and Feasibility Study. Draft Feasibility Study Report. Volume 1: Report*. Prepared for NWSC. July 2014.

Gumm, Emily, 2011. *"The Use and Misuse of Wetlands in Kampala" (2011). Independent Study Project (ISP) Collection*. Paper 1022. http://digitalcollections.sit.edu/isp_collection/1022

ICF, 2009. *Sub-Saharan Refinery Project Health Study* Prepared for World Bank, September, 2009.

IFC 2013, *Kampala Solid Waste Management PPP Project*. KCCA. *Pre-Bid Investors Conference*. May 2, 2013.

IUCN, 2003. *Integrating Economic Values Into River Basin Management: Nakivubo Swamp, Uganda: Managing Natural Wetlands for their Ecosystem Services Case Studies in Wetland Valuation #7: May 2003*

Kabisch Nadja, 2014. *Ecosystem service implementation and governance challenges in urban green space planning—The case of Berlin, Germany*. 2014.

Kampala Capital City Authority, 2014. *Strategic Plan 2014/15-2018/19 – Laying the Foundation For Kampala City Transformation*. 2014.

Kansiime, F., Kateyo, E., Oryem-Origa, H. Mucunquzi, P., 2007. *Nutrient status and retentions in pristine and disturbed wetlands in Uganda: Management Implications*, Wetlands Ecology and Management.

KCCA, n.d.a, Kitaka, Andrew M, Director Engineering & Technical Services, *Promoting Non-Motorised Transport*.

KCCA, 2012. *Kampala Physical Development Plan: Updating Kampala Structure Plan and Upgrading the Kampala GIS Unit*, Draft Final Report.

KCCA, 2014a. *City Partnerships for Urban Sanitation Service Delivery in Africa and South Asia. Analytical Report Improving Faecal Sludge Management (FSM) for OnSite Sanitation in Kampala City, Uganda*. Supported by Bill and Melinda Gates Foundation and DFID. August 15, 2014.

KCCA, 2014b. *KCCA Strategic Plan 2014/15-2018-2019. Laying the Foundation for Kampala City Transportation*. KCCA.

Kizito, Y. S. (1986). *The evaluation of pollution levels in Nakivubo Channel, Kampala Uganda* (Doctoral dissertation, MSc thesis, Makerere University, Makerere).

- Koojo, Charles Amooti, 2005. *Implementation of Physical Plans with Reference to Wetland Land Use in Kampala City, Uganda*. Makerere University.
- Lake Victoria environmental management programme (LVEMP), 2001. *Cost benefit analysis of wetlands Resources Uganda. Part III: Wetland characteristics and development scenarios Report*.
- Leitmann, Josef. 1994.. Rapid Urban Environmental Assessment. Lessons from Cities in the Developing World Volume 1. Methodology and Preliminary Findings. World Bank, Washington, DC.
- Lwasa, S. 2010 Adapting urban areas in Africa to climate change :the case of Kampala, *Current Opinion in Environmental Sustainability*, 2(2010):166–171.
- Lwasa, S., 2012 or 2013? Strategies for mitigation of emissions by low emitting cities. Department of Geography, Geo-informatics and Climatic Sciences, Makerere University.
- Lwasa, S. 2013. Greenhouse Gas Emissions Inventory for Kampala City and Metropolitan Region. Mackererie University. 2013.
- Mackererie University, 2012. *Strategies for Mitigation of Emissions and GHG Inventory Review*. 2012.
- Mackererie University, n.d.a. *Habitat Partner University Initiative Climate Change Hub*. Date unknown.
- Mackererie University, n.d.a. *Policy considerations for Urban and peri-urban agricultures in adaptation and mitigation of climate change in African cities*. Date unknown.
- Madinah et al., Division Solid Waste Generation and Composition in Kampala Capital City Authority, 2014. *Uganda: Trends and Management, 2013*. IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 10 Ver. III (Oct. 2014), PP 57-62
- Ministry of Water and Environment (MWE), 2014. *Development of a Pollution Management Strategy to Improve Long Term Water Quality Status in the Inner Murchison Bay, Lake Victoria and Initiate Implementation of its Initiatives: Inception Report*. Kampala, Uganda.
- Murithi Njiru, Lewis sitoki, Chrisphine Nyamweya, Tsuma Jembe, Christopher Aura, Edna Waithaka, and Frank Masese, 2012.*Habitat degradation and changes in Lake Victoria fisheries*, NOVA Science Publishers
- Muwanga, A. and Barifaijo, E. 2006. African Journal of Science and Technology (AJST) Science and Engineering Series Vol. 7, No. 1, pp. 51 – 63, 2006.
- MWE. 2010. *Kampala: Overview of Water and Sewerage Operations*. Directorate of Water Development, Ministry of Water & Environment. 2010.
- Namakambo, Norah. 2000. *Kampala Wetlands*. Produced 2000.
- National Environment Management Authority (NEMA), 2010. *State of Environment Report*.
- National Environment Management Authority (NEMA), Feb 2011. *World Wetlands Day. 2nd February 2011 Theme: Wetlands for Forests*. Feb 2011.
- National Water and Sewerage Corporation, 2010. *Update of the 2003 Feasibility Study for Kampala Water Supply*, July 2010.

National Water and Sewerage Corporation, 2013. *NWSC Annual Activity Report for FY2012/2013*. NWSC, 2013.

NWSC, 2014a. *Construction works of the Bugolobi/Nakivubo sewerage treatment plant begins*. May 2, 2014. NWSC.co.ug.

National Water and Sewerage Corporation, 2014b. *Lake Victoria WATSAN project package 5a: concept development and feasibility study for the improvement of the water supply and sanitation situation in informal settlements in Kampala, feasibility study report*. September 2014.

National Water and Sewerage Corporation, 2014c. *Providing Efficient and Cost Effective Water and Sewerage Services*. June 2014.

Nature Uganda. 2006. *Birds of Kampala, 25 year Update*. 2006.

New Vision, 2013a. *Flower Farms Drive Fish Away from Lutembe*. April 23, 2013.

New Vision, 2013b. *Namanve encroachers targeting compensation*. Mar 17, 2013

New Vision, 2013c. *Namanve Forest in Deep Trouble*. March 7, 2013.

New Vision, 2014. *Dry Zones in Greater Kampala to Get Water Soon*. September 5, 2014.

Ntambirweki, John, 1998. *The Evolution of Policy and Legislation on Wetlands in Uganda*. July 1998.

Nyakaana, J. B., H. Sengendo, et al. 2004. *Urban Development, Population and the Environment in Uganda: The Case of Kampala City and its Environs*.

Odull, Michael and Achilles Byaruhanga, 2011. *Important Bird Areas in Uganda; Status and Trends*. 2010. Published 2011.

Okwerede, L., Kanyesigye, C., Kansiime, F., Byamukama, D., Oyoo, R., Kinobe, J. & Kalibbala, H. (2005). *Industrial and Municipal effluents management. Technical report*. National water and sewerage Corporation, Lake Victoria Management Project, Kampala, Uganda.

Ooyu, Joseph 2013, *PASCAL International Exchanges (PIE)*, Kampala City Stimulus Paper

Ramsar, 2005, *Lutembe Bay Wetland System Ramsar Information Sheet*. Prepared by Byaruhanga, Achilles and Stephen Kigoolo. Nature Uganda, 2005.

Schwander et al., 2014. *Ambient Particulate Matter Air Pollution in Mpererwe District, Kampala, Uganda: A Pilot Study*. Journal of Environmental Public Health. Feb 17, 2014.

The National Environment (Wetlands, River Banks and Lake Shores Management) regulations, No. 3 of 2000

The Observer. 2013. *Namanve destruction Illustrates Ugandans' In difference*. March 21, 2013.

The Republic of Uganda, 1995. *Uganda National Wetlands Policy 1995*, 1995.

The Republic of Uganda, 2010. *The Physical Planning Act 2010*, 28th May 2010.

The Republic of Uganda Ministry of Lands, Housing and Urban Development, 2013. *The Uganda National Land Policy*, February 2013.

Uganda PSD/MSEPU (1999), Urban Formal Sector In Uganda.

- Uganda Bureau of Statistics (UBOS), 2012. 2012 Statistical Abstract. June 2012.
- Uganda Bureau of Statistics (UBOS), 2013. Statistical Abstract. August 2013.
- Uganda Demographic and Health Survey UDHS, 2013.
- Uganda Ministry of Works and Transport, 2008. Annual Transport Master Plan. Transport Master Plan for Greater Kampala Metropolitan Area.
- Uganda National Population and Housing Census, Uganda Bureau of Statistics, 2002
- Uganda National Roads Authority (UNRA). *Environmental & Social Impact Assessment for Widening of Northern Bypass, Uganda*. UNRA. November 2011.
- UGO News. 2014. *Motorcyclists Struggle through Kampala's Flooded Roads*. Posted November 29, 2014. Downloaded December 2, 2014. <http://news.ugo.co.ug/photos-motorists-cyclists-struggle-kampala-flooded-roads/>
- UNDP, 2014. *Uganda Starts Process to Build the National Greenhouse Gas (GHG) Inventory System*. August 20, 2014. Downloaded from <http://www.undp.org/content/brussels/en/home/presscenter/articles/2014/08/20/uganda-starts-process-to-build-the-national-green-house-gas-ghg-inventory-system/>.
- UNEP, 2009. *Resource Efficient and Cleaner Production in Developing Countries*. Downloaded December 3, 2014 from http://www.unep.fr/scp/cp/network/pdf/List_of_Regional_NCPC.pdf
- UNEP, 2002. *UNEP EIA Training Resources Manual: Wetland conservation: institutional constraints and community awareness*. 2002.
- UNEP-UNIDO, 2010. *Joint UNIDO-UNEP Programme on Resource Efficient and Cleaner Production in Developing and Transition Countries*. April 2010.
- UN-Habitat, 2007. Kampala Slums Situational Analysis.
- UN-Habitat, 2009. Climate Change Assessment for Kampala, Uganda: A Summary Cities in Climate Change Initiative (CCC1), Nairobi, Kenya
- UN-Habitat, 2013. *Flood Risk Assessment, Strategies and Actions for Improving Flood Risk Management in Kampala, Final Report of Integrated Flood Management Project Kampala*. 2013.
- U.S. EPA, n.d.a., *Asthma Triggers*. Downloaded December 4, 2014. <http://www.epa.gov/asthma/outdoorair.html>
- U.S. EPA. Ground Level Ozone Ecosystem Effects. Downloaded December 3, 2014. <http://www.epa.gov/groundlevelozone/ecosystem.html>
- U.S. EPA, 2014. *The Ozone Problem*. Downloaded December 3, 2014. http://www.epa.gov/region1/airquality/oz_prob.html
- Van Stigt, R., Driessen, P.P.J., Spit, T.J.M., 2014. *A user perspective on the gap between science and decision-making. Local administrators' views on expert knowledge in urban planning*. 2014.
- Vermeiren, K., et al., 2012. *Urban growth of Kampala, Uganda: Pattern analysis and scenario development. Landscape Urban Plan*. (2012), doi:10.1016/j.landurbplan.2012.03.006

Walakira, Paul and James Okot-Okumu, 2011. *Impact of Industrial Effluents on Water Quality of Streams in Nakawa-Ntinda, Uganda*. Journal of Applied Science and Environmental Management. June, 2011Vol. 15 (2) 289 – 296 2011..

World Bank, 2009. *Lake Victoria Environmental Management Project Phase II*, 2009.

World Bank, 2013. *Kampala Institutional and Infrastructure Development Project Phase 2 2013*, KCCA, Government of Uganda, World Bank

World Bank, 2014. *Second Kampala Institutional and Infrastructure Development Project*. Report No. 84224-UG. February 25, 2014.

World Health Organization (WHO), 2014. *Water-Related Diseases: Lead Poisoning*. Downloaded from http://www.who.int/water_sanitation_health/diseases/lead/en/#.

IX. APPENDIX

Appendix A: Summary of Institutional Analysis

	Prevailing Institutional Landscape	Institutional Challenges	Suggestions and Recommendations
Institutional Structure	<ul style="list-style-type: none"> Both National-level (MoLHUD, MWE, NEMA) and City-Level agencies (KCCA) are directly involved in aspects of urban/land and urban environment management 	<ul style="list-style-type: none"> Institutional fragmentation – overlapping mandates, weak integration and coordination. 	<ul style="list-style-type: none"> Consolidate and reinforce institutional structure and mandates
Regulatory Environment	<ul style="list-style-type: none"> Basic array of legal tools available at both national and local level On urban development, lacks: National Urban Policy and Act;; Detailed physical development plan for Kampala Need to strengthen wetlands management through enacting a Wetlands Act (to complement National Wetlands Policy), clear demarcation of wetland boundaries and/or a comprehensive wetlands inventory. 	<ul style="list-style-type: none"> Weak development guidance at city level and overall weak regulatory environment around wetlands conservation and management. 	<ul style="list-style-type: none"> Complete the system, regulations and tools surrounding detailed physical development plans for Kampala and on wetlands
Processes and Interactions	<ul style="list-style-type: none"> <i>Land Management and Physical Planning</i> – Issuance of land titles largely centralized and a function of MoLHUD. Physical planning largely decentralized and under purview of local government. Data and information on land and physical planning are not consolidated in one database. Interactions between the MoLHUD and local governments are largely based on individual issues or projects. <i>Wetlands Conservation and Management</i> - local government for day-to-day development control, approval of planning application and 	<ul style="list-style-type: none"> Loose adherence to development approval process. 	<ul style="list-style-type: none"> Improve inter-agency integration and coordination across the full chain of development processes Institute accountability and track performance

	<p>enforcement; NEMA for review and approval of EIAs; wetlands department to be consulted whenever a development application/EIA involves wetlands.</p> <ul style="list-style-type: none"> Interactions mainly through issuance process of planning permits and EIAs where inter-agency consultations have to be done. Joint inspections have also been conducted. Such processes may not always be conducted in the proper chronological order or followed in reality. 		
Capacity and Resources	<ul style="list-style-type: none"> General lack in capacity and resources especially staff and financially. eg: <ul style="list-style-type: none"> NEMA: 35 technical staff for entire country Wetlands Department: 25 technical staff (1 in each district only); wetland demarcation and inventory is an expensive exercise; KCCA only 70% staffed (for permanent staff, only 30%); Physical Planning Directorate only 40% staffed 	<ul style="list-style-type: none"> Constraints in current capacity and resources; and competing priorities for resource allocation 	<ul style="list-style-type: none"> Conduct public education and communication initiatives Strengthen capacity and boost resources

Appendix B: Institutional Figures

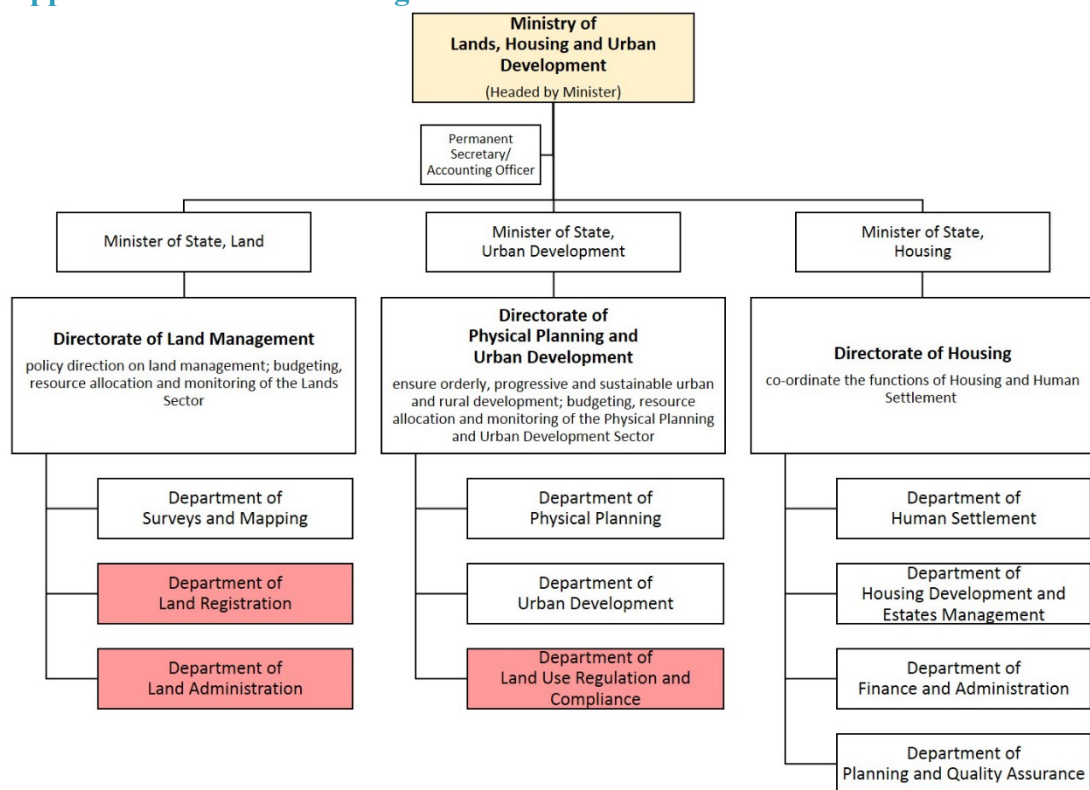


Figure: Organogram of Ministry of Lands, Housing and Urban Development
(with most relevant departments highlighted)

Source: Staff interpretation adapted from MoLHUD website

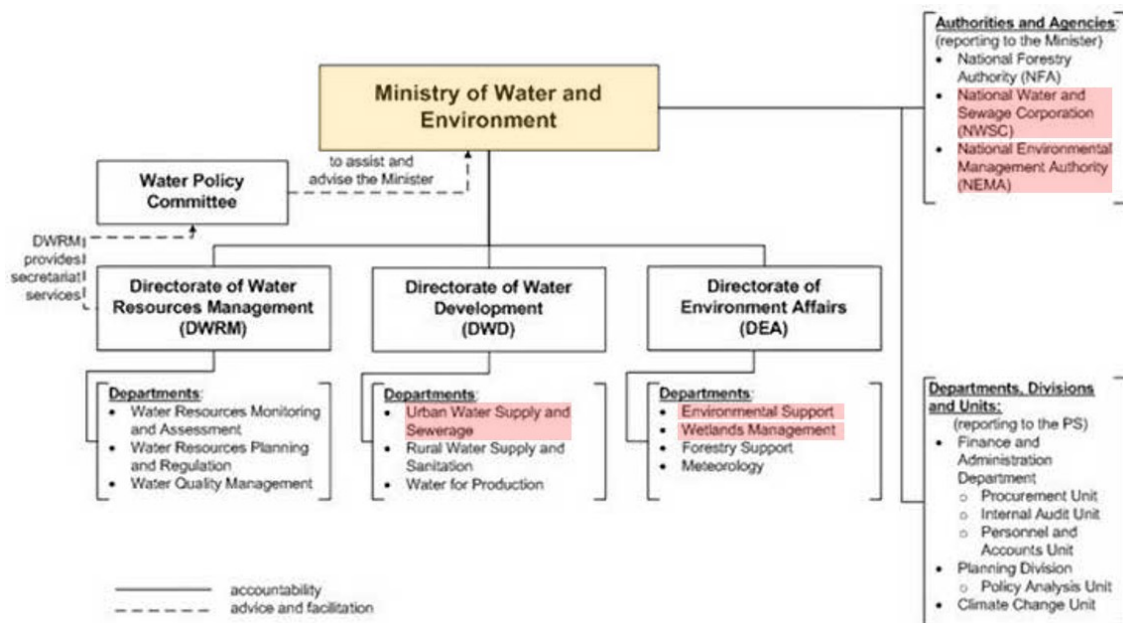


Figure: Organogram of Ministry of Water & Environment
(with most relevant departments and agencies highlighted)

Source: MWE website

