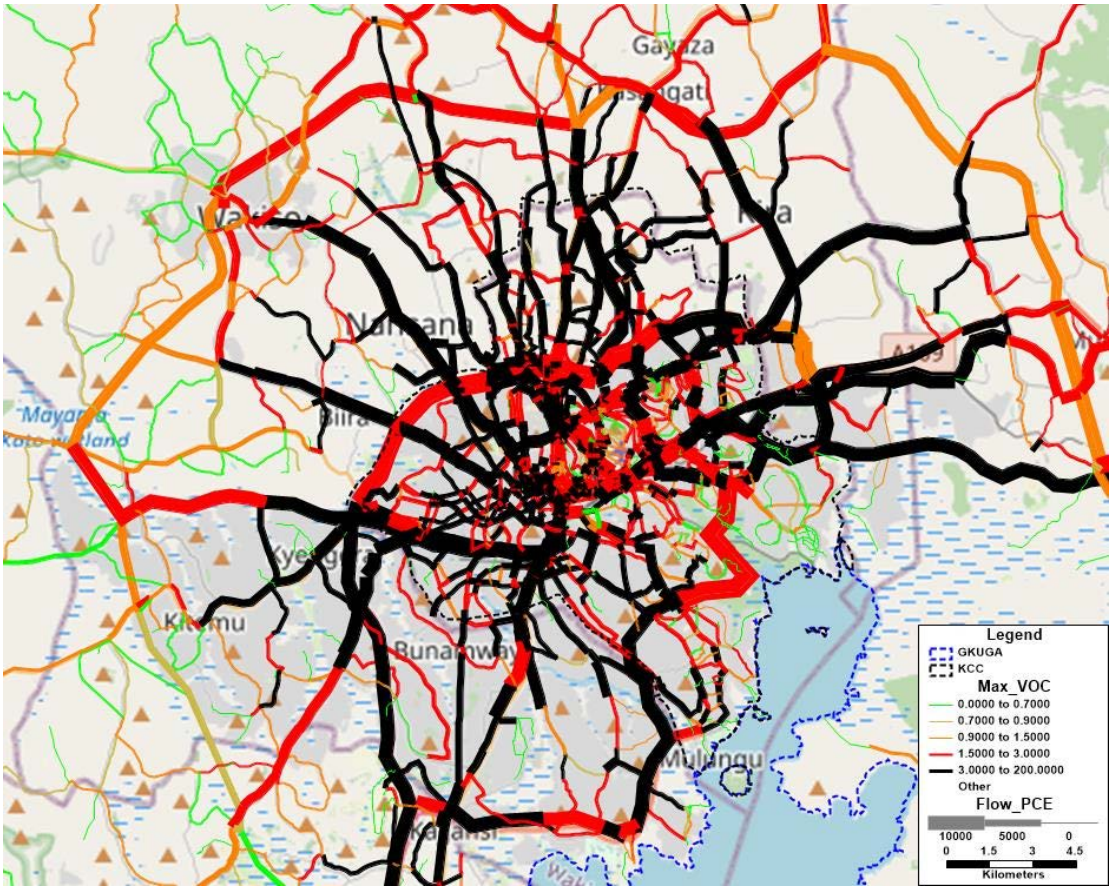
Chapter 14 Development Strategies of the Transport Sector in Greater Kampala Urban Growth Area (GKUGA) including Kampala Capital City (KCC)

14.1 Issues in the Transport Sector

(1) Surging Travel Demand

People in the GKUGA are experiencing serious traffic congestion every morning evening, and even during the daytime. It is expected that the situation will further aggravate in 2050 even if the planned expressways and BRT projects are implemented, due to population increase and economic growth (See Figure 14.1.1). Meanwhile, the progress of the projects proposed by MMUTMP is limited while MMUTMP proposed varieties of transit and travel demand management projects. Travel demand, which decreased due to the COVID-19 pandemic, has returned to the pre-pandemic level. Supply- and demand-side approaches are essential to catch up with the surging travel demand. The expected annual economic loss of traffic congestion is estimated at 448 million USD in 2021. The annual economic loss of traffic congestion will reach 6,799 million USD in 2050 in the case of the Do-Minimum Scenario, as shown in Section 14.5.



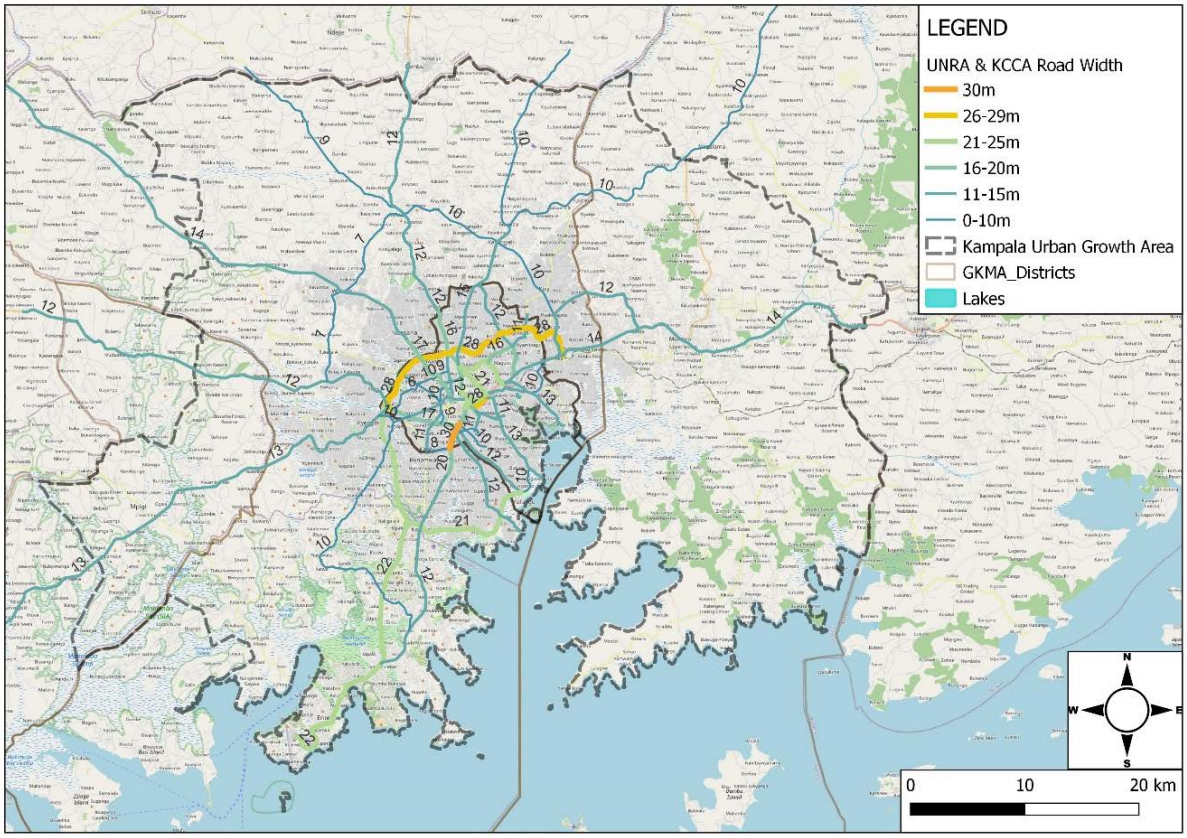
Source: JICA Expert Team (same as Figure 14.5.15. See Sections 14.4 and 14.5 for assumptions of travel demand forecast.)

Figure 14.1.1 Volume Capacity Ratio of Do-Minimum Scenario in 2050

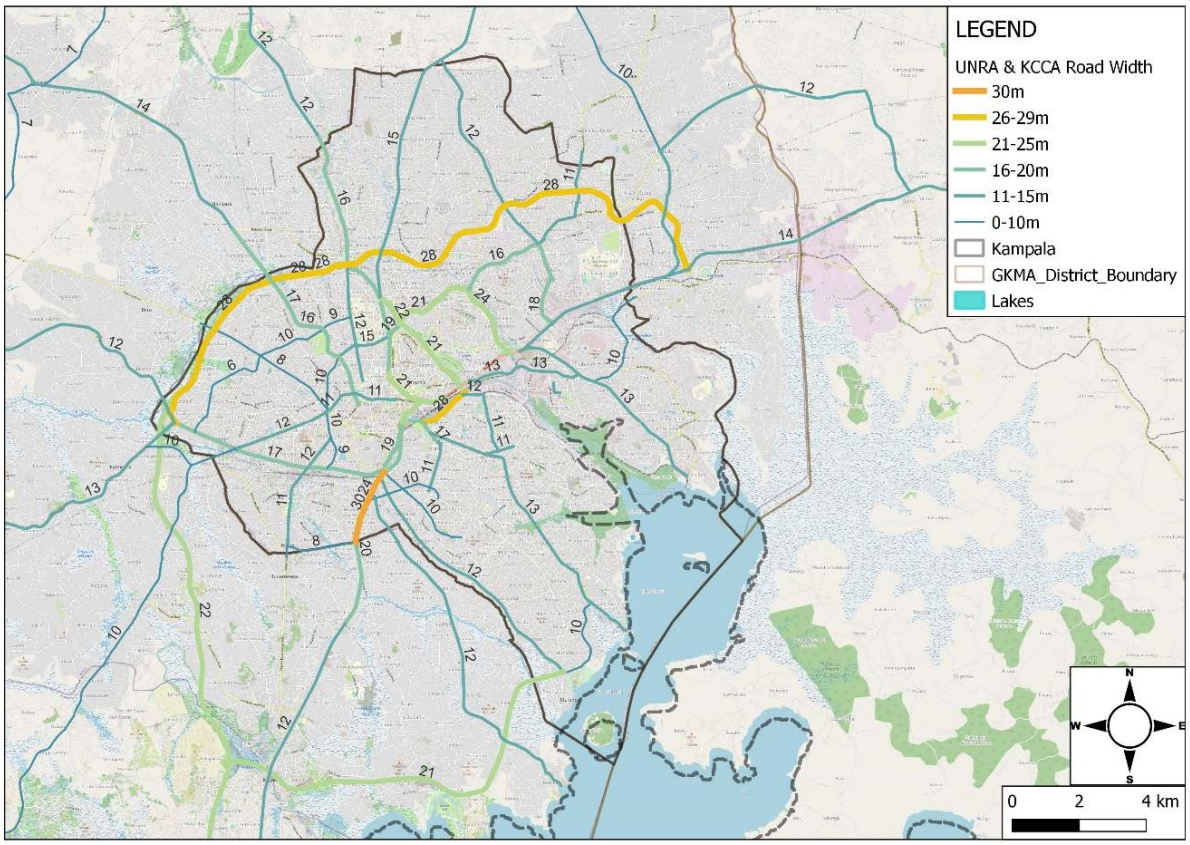
(2) Insufficient Road Network

Considering the population size of the GKUGA, especially the area of KCCA, the available space for road development is critically scarce as shown in Figure 14.1.2 and Figure 14.1.3. The width of most arterial roads in Kampala Capital City (KCC) is less than 20m, which means that it cannot accommodate four lanes of the carriageway (two lanes in one direction), median, shoulder and sidewalks. The exceptions are just a part of a few expressways, radial roads, and arterial roads in the CBD. This condition is one of the causes of traffic congestion mentioned above. It should be noted also that the shortage of road space means the shortage of space for public transport. Road space is essential in the case of at-grade and elevated structures with piers and girders to introduce all the transit modes including BRT with dedicated lanes, LRT, and MRT.

GKUGA



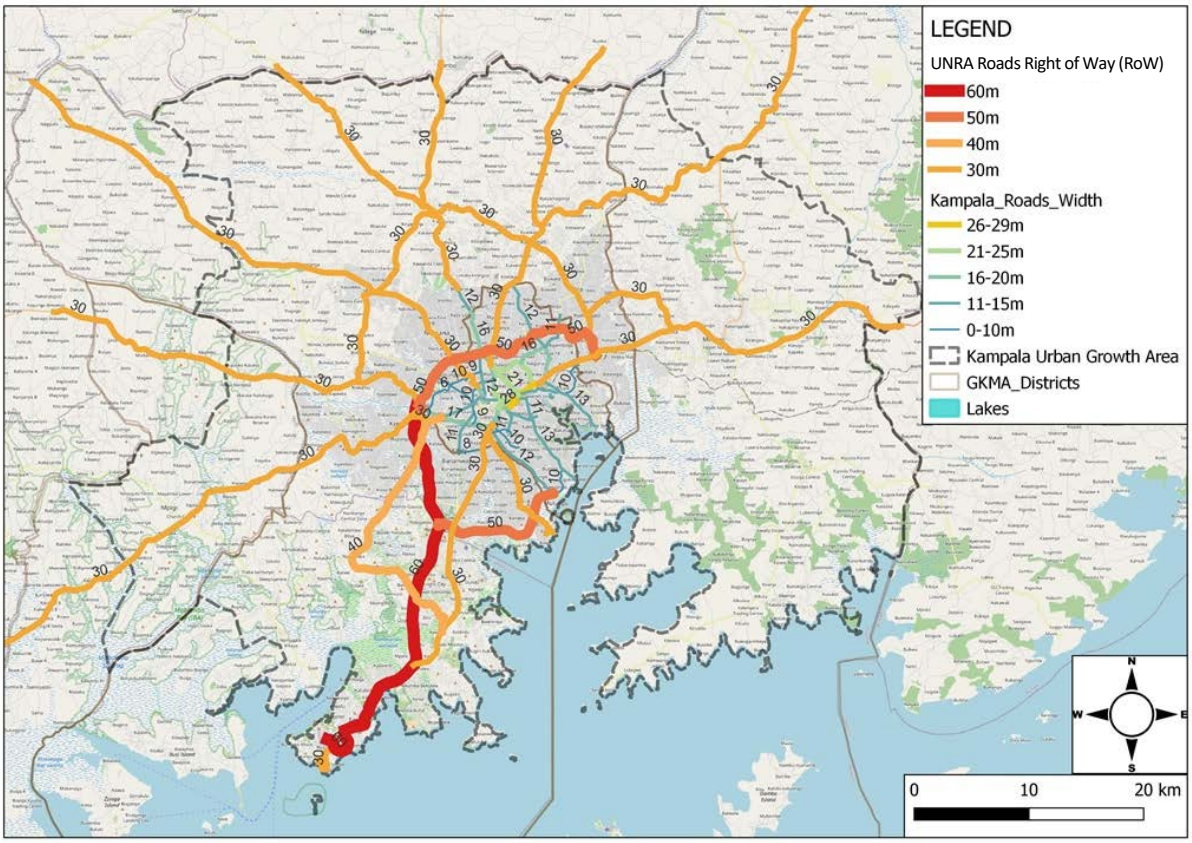
KCC and Surrounding Areas



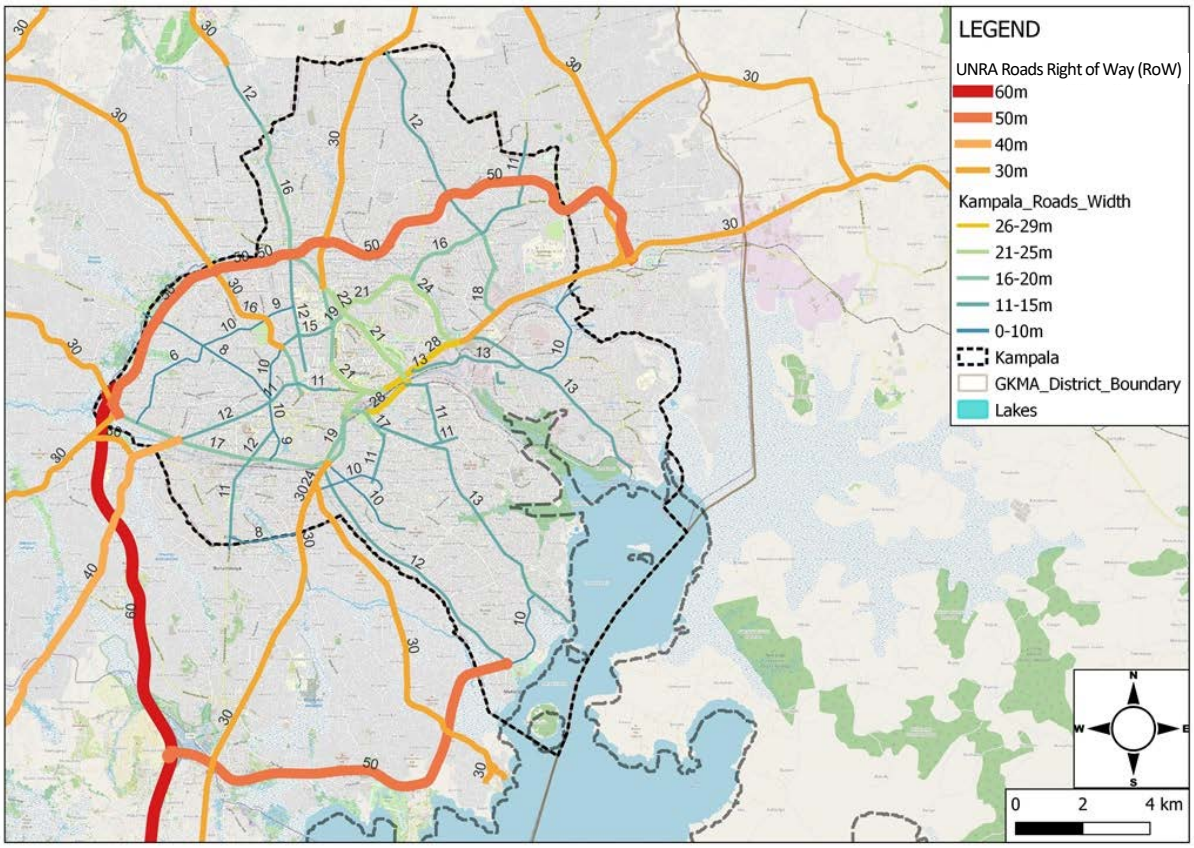
Source: JICA Expert Team Based on Satellite Images

Figure 14.1.2 Road Width of Arterial Roads in the GKUGA and KCC

GKUGA



KCC and Surrounding Areas



Source: JICA Expert Team Based on Interview with UNRA (for UNRA roads) and Satellite Images (Roads in KCC)

Figure 14.1.3 Right-of-Way of UNRA Roads and Road Width of Arterial Roads in GKUGA and KCC

With regard to radial roads which connect urban cores and suburban centres, some radial expressways are being developed such as the Kampala – Entebbe Expressway (completed) and Busega – Mpigi Expressway (under construction as of May 2024) while the progress of the other radial expressway plans is stagnant due to financial, land availability and other factors. Development of arterial roads, including road widening and construction of new roads after the formulation of KPDF/KPDP, is much limited compared with expressway development especially in the city centre due to land acquisition issues.

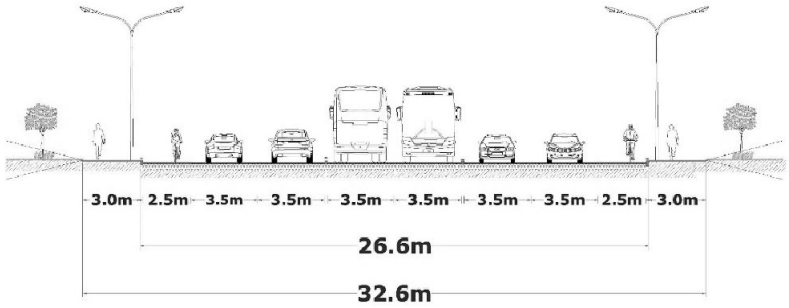
While the inner circular road system composed of the Northern Bypass and Southern Bypass is being developed, there is a missing link in the southeastern section. Although the feasibility study and design of the second circular road system, Kampala Outer Beltway (2nd Ring (Middle Ring)), have been completed, UNRA has sought funds for several years.

Pavement and its maintenance are issues to be taken into account. There are roads without any pavement, especially in suburban areas within GKUGA. Even on roads with pavement, there are issues concerning the budget for road maintenance. The long interval of road maintenance rather increases the lifetime cost of the infrastructure.

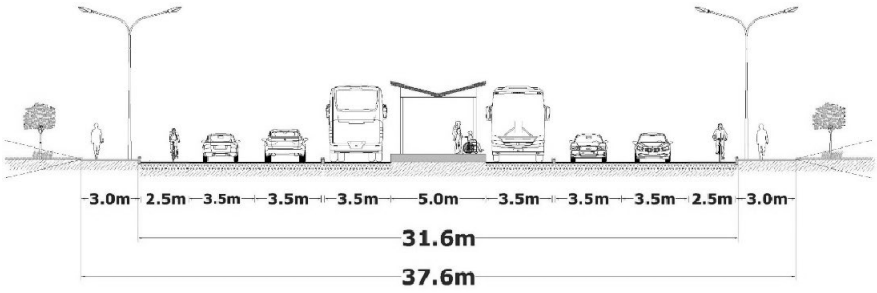
(3) Obstacles in Land Acquisition

The mechanism to reserve lands for road and public transport is essential. However, expanding road space is becoming more difficult for the government, especially in urban areas. Authorities, such as UNRA and KCCA, are facing the issue of land acquisition for implementing new road constructions and road widening. As land acquisition should be completed in a fair, equitable, and prompt manner according to the Ugandan constitution, the compensation for the land acquisition should be based on the market price and it should be made immediately after the acquisition. Because of the first condition (market price for land acquisition), the price of land surges once the road alignment is fixed. This causes delays and additional costs for the road project implementation. On the other hand, the second condition (prompt compensation for land acquisition) tends to weaken the power of officially approved physical development plans which designates the location of planned roads and other infrastructure.

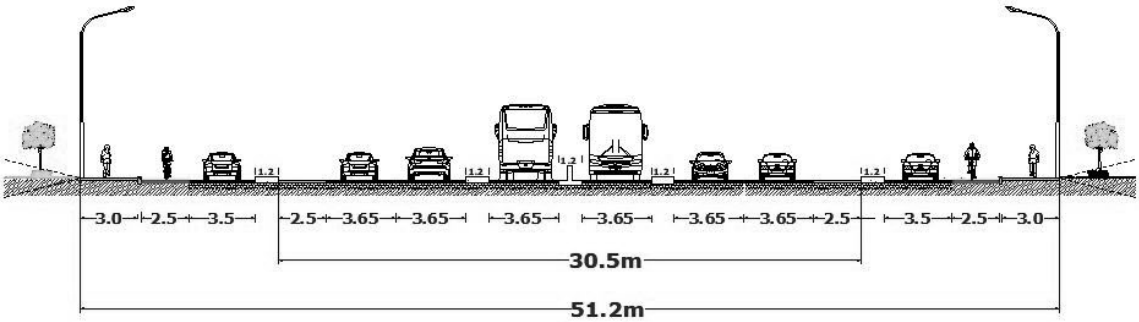
Roads accommodating BRT, sidewalks, and carriageways typically require a right-of-way of around 35 to 40m for urban roads considering Ugandan technical standards as shown in Figure 14.1.4. There are only a few road sections in GKUGA that meet this standard (see Figure 14.1.3).



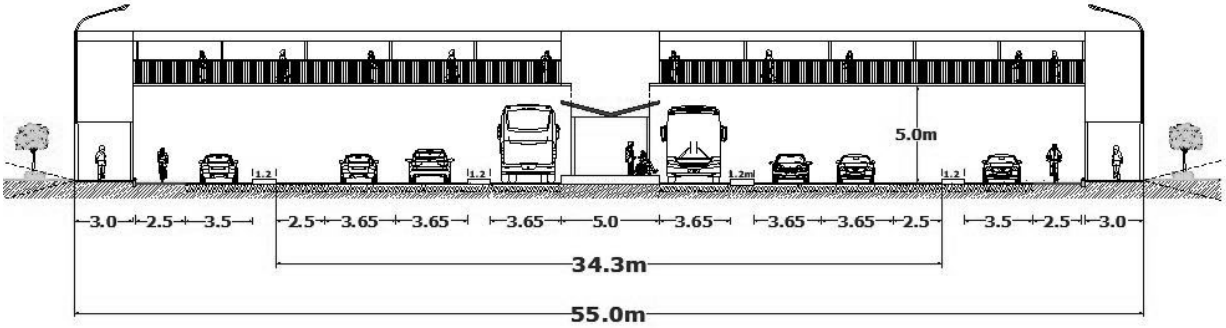
BRT on Urban Road



BRT on Urban Road (at Station)



BRT on Expressway



BRT on Expressway (at Station)

Source: JICA Expert Team Based on Ugandan Technical Standards

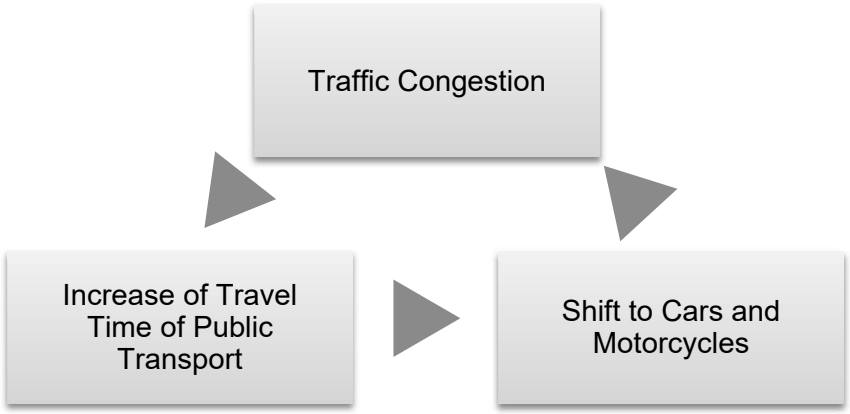
Figure 14.1.4 Conceptual Cross-Section of Road with BRT

(4) Vicious Circle of Road-Based Transport – Social Dilemma of Traffic Congestion of Roads

In many metropolitan areas in developing countries, road-based public transport (i.e., bus), which shares road space with other private modes, is losing patronage due to traffic congestion caused by motorisation. The mechanism is shown in Figure 14.1.5. In line with economic growth, the number of private motorised vehicles increases which causes traffic congestion. Due to road

traffic congestion, the travel time of road-based public transport decreases, and this leads to further motorisation. In addition, the features of "flexible" and "fast" motorcycles, such as driving over walkways, opposite lanes, and space in between other vehicles, further accelerate motorisation.

Even in cities with BRT, this social dilemma has a significant impact on travel behaviour. One of the reasons is that BRT is often affected by road traffic congestion, especially at the roundabout and the intersection without the public transport priority signalling. Therefore, it is critical to provide a public transport system which is not affected by traffic congestion on roads. The introduction of BRT with dedicated lanes can be a breakthrough in addressing this dilemma, in case delays at intersections are properly managed by public transport priority signalling.



Source: JICA Expert Team

Figure 14.1.5 Diagram of Vicious Circle of Motorisation

The passenger railway service can be a breakthrough in addressing this social dilemma as it is not affected by traffic congestion. However, in GKUGA, the existing railway service is operational only around 13 km between Kampala and Namanve, in which only two round trips are provided per day as of May 2024. This is far from being considered as an "urban railway service". Several railway tracks are not utilised for passenger service in GKMA such as Kampala to Port Bell, Namanve to Mukono and Kampala to Nalukolongo workshop. There is also an abandoned railway track from Nalukolongo workshop to Bujjuko via Kyengera. It should be noted that there is a huge potential for railway service expansion by utilising these sections.

(5) Weak Linkage between Physical Development Plan and Transport Infrastructure Development

Despite the proposal of formulating metropolitan zone centres, quartier centres and local centres by KPDF/KPDP almost a decade ago, urban sprawl has been prevalent in suburban areas of the city. While the MMUTMP adopted the urban structure of KPDF/KPDP, the roads for these centres are not clearly indicated in the MMUTMP. While the new expressways are being planned, studied, designed, and constructed, access roads to the proposed centres are merely considered.

The MMUTMP itself does not have any legally binding power to ensure its implementation. As the formulation of the MMUTMP is administrated by the KCCA, officers of surrounding districts and municipalities are not always aware of the detailed contents. Therefore, it is critical to formulate a metropolitan-level physical development plan, including a consistent transport infrastructure development plan, with a legally binding force to formulate a robust, compact, and transit-oriented urban structure which can accommodate the increasing population. Specifically, locations of metropolitan zone centres and their required transport infrastructure should be identified to ensure land for them.

In addition, it is critical to transform the urban structure to have urban centres and metropolitan zone centres with high density and mixed land use areas along the transit lines to achieve a metropolitan area with high transit modal share as mentioned in the previous section.

(6) Lack of Legal Framework for Public Transport

There are plans to create new modes of transport such as a formal bus service, a bus rapid transit (BRT) and modernised rail-based public transport modes such as LRT and MRT. However, the current legal and institutional framework is not designed for such new modes of transport. For instance, which organisation will plan, regulate, implement and operate these new modes of transport is not clearly defined as shown in Table 14.1.1.

With regard to the legal framework of water transport, there is currently no Merchant Shipping Act to organise the port and shipping activities. This means that the Ugandan government has no means to improve private water transport service level and safety at the international level. It should be also noted that annual shipping licence renewal requirements may prevent private ferry operators from investing as there is a risk of cancellation of operation licences.

Table 14.1.1 Urban Mobility Governance Matrix

		PUBLIC TRANSPORT					INDIVIDUAL/PRIVATE MODES	
		Planned Bus Rapid Transit	Planned City Bus Service	Planned Tondeka Metro Bus Service	Taxis and buses (post-reform)	Rail	Boda-bodas (post-reform)	Private vehicles and NMT
Strategic level What are the goals and the strategies/resources for their achievement?	Planning and Design	MoWT	KCCA	Uganda Development Corporation	KCCA (route allocation)	URC / MoWT	N/A	KCCA / Local governments
	Infrastructure Financing	MoWT + donor funding (World Bank, AFD)	KCCA + donor funding (AfDB)	Exim Bank of India	Local governments	URC / MoWT	N/A	Local government
	Infrastructure Development	MoWT or UNRA	KCCA	*MoWT*	Local governments	URC	N/A	KCCA / Local governments
	Procurement of rolling stock	???	???	Tondeka Metro/ Ashok Leyland	Private operators	URC	Private operators	N/A
Tactical level Which services need to be developed to reach the set objectives	Regulation and licencing	*MoWT (Licensing Council) + KCCA*	KCCA	???	MoWT (Licensing Council) + KCCA	N/A	MoWT (Licensing Council) + KCCA	MoWT (Licensing Council) / URA
	Contracting authority	???	KCCA	???	N/A	URC	N/A	N/A
	Enforcement	*Uganda Police Force Metropolitan Police Force*	*Metropolitan Police Force*	*Uganda Police Force Metropolitan Police Force*	Uganda Police Force	N/A	Uganda Police Force	Uganda Police Force
Operational level How to efficiently implement services?	Traffic management	*MoWT*	*KCCA*	???	??? (Uganda Police Force)	N/A	??? (Uganda Police Force)	??? (Uganda Police Force)
	Operations and maintenance	TBD	TBD	Tondeka Metro	Private operators	URC	Private operators	Users

Source: Urban Mobility Governance in GKMA, Paratransit and Street Usage Study, AFD, KCCA and MoWT (2020)

(7) Social Exclusion Due to Inaccessibility

Social exclusion can be defined as the "situation when people are being prevented from participation in the normal activities of the society in which they live or being incapable of functioning"[1]. Previous studies have identified groups of dwellers with relatively poor mobility: low-income households, households without access to private vehicles, women, elderly and youth, and people with disability[2].

In GKUGA, Traffic Analysis Zones (TAZs) with a high population density of very low and low-income groups are concentrated in an area roughly 2-10 km from the CBD. These areas are generally consistent with the location of slums. The width of roads in these areas is usually narrow

[1] Atkinson, A. B. (1998). Social exclusion, poverty and unemployment. In A. B. Atkinson and J. Hills (eds), Exclusion, Employment and Opportunity, CASE paper 4, London: CASE, London School of Economics.
[2] Stanley, J., Stanley, J. (2017). The importance of transport for social inclusion. Social Inclusion, 5(4), 108–115.

which allows only one car to pass, or sometimes a car cannot even pass through. These phenomena in conjunction with less regulated traffic flow aggravate the accessibility of people in the area.

Active travel modes and non-motorised transport (NMT)[3] are the main mode of transport in GKUGA, especially for people with poor mobility. However, the infrastructure for active travel in GKUGA is significantly limited except for a few roads in the NMT corridor renovated by KCCA. The majority of victims of traffic accidents are pedestrians. Walkways are often invaded by motorcyclists. Considering available road spaces, especially in the existing urbanised area, the allocation of space for pedestrians and motorised vehicles should be re-examined. The mechanism to form an NMT network for people with less accessibility and to improve access/egress to public transport is essential.

(8) Traffic Management and Road Safety Issues

There were only approximately 30 signalised junctions in GKUGA as of September 2021. Another 70 congested junctions and roundabouts in KCCA are controlled by traffic police officers. In line with motorisation, the number of congested intersections and roundabouts is expected to increase. Furthermore, there are problems in the geometry of intersections such as intersections without a right-turn lane/exclusive U-turn lane, too large turning area, intersections lacking or having faded markings, and potholes.

Ignorance of the Highway Code and aggressive driving behaviour tangle junctions and roundabouts without traffic control. The lack of proper enforcement also needs to be looked at. The boda-boda drivers do not usually follow any rules and disturb traffic by ignoring signals. Taxi drivers park their vehicles and wait for the passengers wherever they wish. These practices cause side friction to the general traffic flow and create traffic congestion.

(9) Lack of Coordination for Cross-boundary and Cross-sector Issues

Central government ministries, departments, and authorities implement several transport projects including expressways, medium-sized bus services, NMT projects, and so forth, while districts and municipalities have issues with project implementation in terms of budget and human resources. Each MDA (Ministries, Departments, and Agencies) is, in general, keen to implement projects within its mandate. However, a lot of transport projects often exceed the boundaries of districts and can cover issues of several sectors. A coordination mechanism for cross-boundary and cross-sector issues is expected to be formulated. Needless to say, the Ministry of Kampala Capital City and Metropolitan Affairs (MKCC&MA) should play a key role in addressing these issues, while its capabilities in terms of human resources and budget need to be enhanced.

(10) Financing Unprofitable Transport Infrastructures

The estimated cost to implement the MMUTMP reaches 18 billion USD including infrastructure development, procurement, operation, maintenance, and land acquisition. Public transport infrastructure development, especially rail-based transit infrastructure development, requires a significant amount of initial investment, and turning the urban railway business is very difficult. As infrastructure development benefits residents and triggers an increase in land value, it is expected to establish a mechanism to capture the increment of land values.

In addition, to find additional financial resources, it is also expected to reduce the investment cost by carefully examining the travel demand and timing of investment.

[3] The terms 'active travel' and 'walking and cycling' (…) encompass a range of methods of active mobility, including trips made by wheelchair, mobility scooters, adapted cycles and e-bikes (Department for Transport, UK, 2019). Non-motorized transport (NMT) is also the term utilised to describe it while e-assisted modes such as e-bike pedelec and e-assist handcycle are sometimes excluded from NMT.

14.2 Objectives of the Transport Sector

The objectives of the transport sector in GKUGA are as follows:

- To support economic development by providing smooth, reliable and affordable transport infrastructures and services
- To achieve social inclusion for all in GKMA by connecting people, goods and information
- To develop an environmentally sustainable transport system
- To improve the safety and security of transport
- To create an attractive walking environment

14.3 Strategies for the Transport Sector

To achieve the objectives mentioned above, the following strategies are proposed for the transport sector:

(1) Formulating the Backbone of Urban Transportation in Conjunction with Urban Spatial Structure, as well as with Urban Development

- To develop the backbone of urban transportation, which is composed of eight radial roads and ring roads, integrated with the urban spatial structure for GKUGA
- To upgrade primary, secondary, and service roads considering road hierarchy
- To promote joint development of urban centres and their infrastructure for consistent urban development and land value capture including "common ducts" along radial roads and ring roads to accommodate water, electricity, sewage and ICT and communication infrastructures
- To secure lands for transport corridor development by including them in physical development plans
- To accelerate the land acquisition process for transport infrastructure development, and ensure sufficiently wide road space for active travel modes (walking and cycling) and public transport including BRT and other modes

(2) Introducing Rapid Transit Services to Terminate Vicious Circle of Road Transport

- To introduce competitive rapid transit service (MRT, LRT, BRT and water transport) with dedicated track/lane toward modal shift to private modes
- To separate functions of trunk services (radial railways and BRT, and circular BRT lines) and feeder services (bus, taxi and boda-boda) for efficient operation of public transport
- To promote transit-oriented development around stations of rapid transit services
- To secure lands for rapid transit development by including it in physical development plans (roads, river, swamp)
- To prioritise cost-effective short- and medium-term projects, such as upgrading of existing railways and BRT, considering constraints in human resources and financing

(3) Managing Travel Demand with ICT

- To shift peak hour traffic by introducing parking control and dynamic toll pricing
- To increase road capacity and enhance modal shift through parking control and pricing
- To integrate all public transport services with the MaaS (mobility as a service) platform
- To support e-commuting to reduce commuting travel during peak hours
- To provide information on road traffic and transit

(4) Controlling road traffic and road-based public transport

- To signalise major junctions with advanced traffic control system and region-wide traffic control centre
- To regulate paratransit services (regulations on boda-boda and other public transport as feeder transport services)

- To optimise paratransit (taxi) operation with ICT

(5) Improving Walking Environment and Public Transport to Minimise Social Exclusion

- To formulate an Active Travel Master Plan for GKUGA to prioritise investment for active travel infrastructures
- To develop active travel corridors and to set active travel priority areas as the backbone and showcase of the active travel network
- Redesign of road space and redefinition of priority for active travel
- To secure dedicated space for active travel modes for new roads
- To develop sidewalks and to maintain existing roads
- To form strategic networks for bicycles by using space of water surface and railway track
- To obligate barrier-free facilities for all new mass transit modes

(6) Achieving Environmentally Sustainable Transport

- To promote low-emission vehicles such as electric vehicles through the provision of tax incentives and implementing regulations to promote them
- To enhance new environmental technologies with PoC (proof of concept) experiment

(7) Working Together with the Residents

- To promote mobility management (MM) to enhance modal shift to public transport and road safety education
- To accelerate pavement with labour-based technology (LBT) in slums and suburban areas
- To communicate closely with residents to understand their needs through public consultation, social media and other media platforms

(8) Ensuring Safety with 3E approach

The Urban Traffic Management Plan (UTMP), which was formulated in 2019 for the Kampala Traffic Management Capacity Building Project, proposed a management plan to achieve smooth flow, safety and shifting demand (3S) through the 3E method of Engineering, Enforcement and Education. The same approach can be applied in this plan.

- To ensure engineering measures include preparation of road/junction design standards, junction geometry improvement, signalisation, central traffic control and improvement of miscellaneous road infrastructure (i.e., signage, road marking)
- To ensure enforcement and legislation for safer and more effective traffic flow
- To ensure the provision of education to raise public awareness of safety

(9) Improving Competitiveness of GKMA by Unlocking Barriers of Logistics

- To develop Greater Kampala Metropolitan Freight Terminal to support logistics demand in GKMA and the Northern Corridor
- To promote a modal shift to rail and inland waterway transport by strengthening functions of intermodal facilities such as rail/road Inland Container Depots (ICDs) and ports
- To provide a bypass to urban centres by constructing three ring roads and the Kampala Rail Bypass (Freight Bypass)

(10) Formulating Institutional Framework and Raising Funds for Transport System Development

- Strategic implementation of Land Value Capture (LVC) to form the proposed urban structure and transport corridors (joint development of the urban centre and its infrastructures including roads and railways)
- Strengthening functions of MKCCMA for coordination among local governments of GKMA
- Vehicle and fuel taxation for infrastructure development
- Preparing legal framework for PPP

- Infrastructure maintenance with ICT technologies to minimise lifetime cost

14.4 Travel Demand Model Development

14.4.1 Changes in Socioeconomic Condition and Transport Infrastructure Development after the Formulation of MMUTMP

The government through UNRA, under the Ministry of Works and Transport, and the different municipalities and local governments had constructed, upgraded and refurbished a number of roads within the GKMA districts as shown by the number of upgraded expressways and arterial roads in Table 14.4.1. At present, it is not enough to alleviate current transport issues like traffic congestion in peak hours. Based on the latest information on the progress of transport infrastructure development, modifications are required in formulating the physical development plan.

It should be mentioned also that several inconsistencies are observed among the development plans of Expressway Development Masterplan (EDMP) and MMUTMP such as in the planning of second ring roads and some radial roads (R3, R6 and R8). The proposed urban centres by KPDF also should be re-examined considering the latest urban development trend. Based on the latest travel demand considering the urbanisation trend and directions of physical development, future road and public transport networks shall be proposed. The impact of COVID-19 also shall be taken into account for formulating the latest travel demand model.

Table 14.4.1 MMUTMP Investment Plan and Progress of the Projects

	Stations	Length (Km)	Cost (M USD)	PILOT (2018-2021)	SHORT (2022-2025)	MID (2026-2030)	LONG (31-35)	HORIZON (36-40)	STATUS (As of July 2022)
Suburban Passenger									
East		40	20	Design+Build	Operation	Operation	Operation	Operation	Design + Build has not yet started.
West		67	101	Design+Build	Operation	Operation	Operation	Operation	Design + Build has not yet started.
Metro Infrastructure									
Metro-Kololo CBD/Nansana	12	12.8	1,076	Design	Build	Operation	Operation	Operation	The design has not yet started.
Metro-Namanve/CBD	7	12.9	1,008		Design	Build	Operation	Operation	
Metro-CBD/Queensway	3	2.3	206			Design	Build	Operation	
Metro-Queensway/Kajjansi	7	9.5	770				Design	Build	
LRT Infrastructure									
LRT-Busega/Port Bell	36	17.94	395	Design	Build	Operation	Operation	Operation	The design has not yet started.
LRT-Kira/Gaba	47	23.5	517		Design	Build	Operation	Operation	
LRT-East Ring	40	19.6	432		Design	Build	Operation	Operation	
LRT-Completion of Ring	71	35.3	777				Design+Build	Operation	
LRT-Extension to a new neighbourhood	18	9	198				Design+Build	Operation	
BRT Infrastructure									
BRT-Pilot		22	330	Design+Build	Operation	Operation	Operation	Operation	The design has not yet started.
Dualization of BRT Corridor		22	330		Design+Build	Operation	Operation	Operation	
BRT-Entebbe Extension		31.6	474		Design+Build	Operation	Operation	Operation	
BRT-Masaka Extension		18.2	273		Design+Build	Operation	Operation	Operation	
BRT-Bombo Extension		5.6	84		Design+Build	Operation	Operation	Operation	
BRT-Gayaza Extension		5.2	78		Design+Build	Operation	Operation	Operation	
BRT-Jinja Extension		13.4	201			Design+Build	Operation	Operation	
Cable Car Infrastructure									
Cable Car-North		4.2	63	Design+Build	Operation	Operation	Operation	Operation	Design + Build has not yet started.
Cable Car-South		6.1	92		Design+Build	Operation	Operation	Operation	
Soft Measures									
Taxi & Bus Fleet Renewal			465	Design+Build	Operation	Operation	Operation	Operation	Design + Build has not yet started.
NMT		100	50	Design+Build	Operation	Operation	Operation	Operation	NMT Pilot Corridor 1.5km from Luwum Street to Bakuli (Namirembe Rd) is

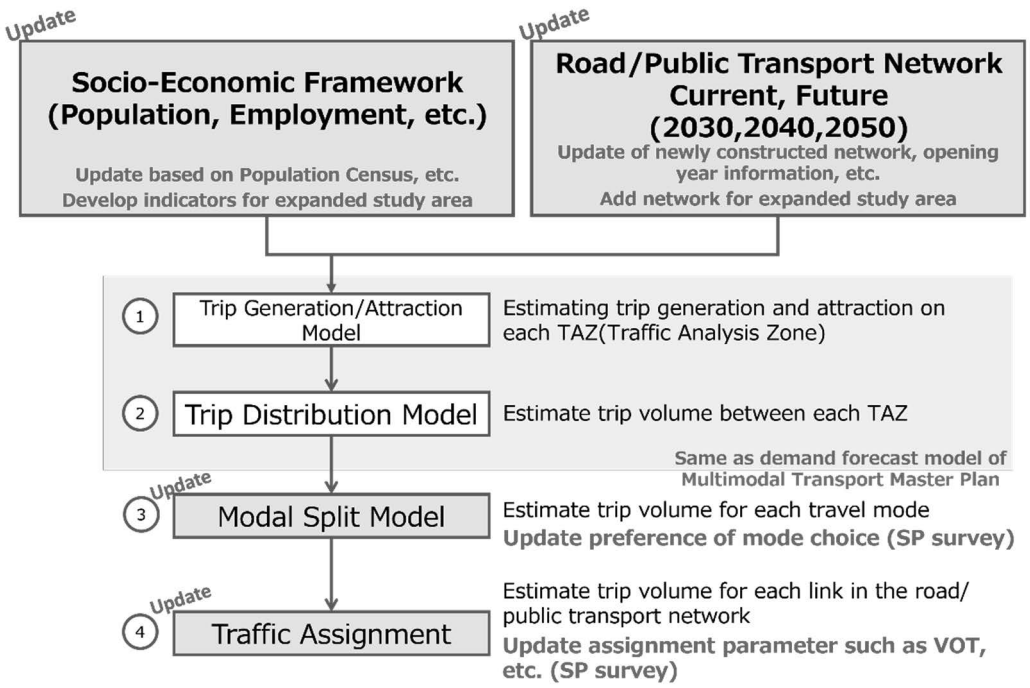
	Stations	Length (Km)	Cost (M USD)	PILOT (2018-2021)	SHORT (2022-2025)	MID (2026-2030)	LONG (31-35)	HORIZON (36-40)	STATUS (As of July 2022)
									completed and operational.
Traffic Management			15	Design+Build	Operation	Operation	Operation	Operation	Traffic signalisation in several junctions installed and operational.
Control Centre			10	Design+Build	Operation	Operation	Operation	Operation	Design completed and construction to start in 2022.
Parking			20	Design+Build	Operation	Operation	Operation	Operation	Old taxi park rehabilitated
Terminals			20	Design+Build	Operation	Operation	Operation	Operation	Design + Build has not yet started.
Waterways and Ports				Design+Build	Operation	Operation	Operation	Operation	The design + Build of the anticipated Bukasa Port has not yet started.
Roads									
Street Rehabilitation				Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	– Several street roads rehabilitated
Toll Roads				Build / Operation				Operation	– Kampala - Entebbe Expressway toll road completed and operational. – -Busega – Mpigi toll road under construction.
Roads Projects				Build / Operation				Operation	– Northern Bypass Phase 2 completed and operational. – Kampala-Entebbe Road completed and operational. – Busega – Mpigi Expressway under construction. – Kampala Flyover under construction. – Kampala – Busunju Expressway is under procurement for design services. – VVIP Expressway design is completed. – Kampala Jinja Expressway is under procurement. – Kampala Southern Bypass is under procurement. – Northern Bypass 1st Carriageway improvement maintenance ongoing

Source: KCCA, 2018, Final Report, Multi-Modal Urban Transport Master Plan, edited by JICA Expert Team

14.4.2 Travel Demand Forecast Model Development for GKMA – IUDMP

(1) Model Type

The travel demand forecast model developed in the GKMA-IUDMP study is a classic four-step model consisting of the trip generation/attraction model, trip distribution model, modal split model, and traffic assignment model. Its basic structure is based on the model developed in the MMUTMP study by TransCAD travel demand forecast software. Figure 14.4.1 illustrates the travel demand forecast model structure and updated section in this study.



Source: JICA Expert Team

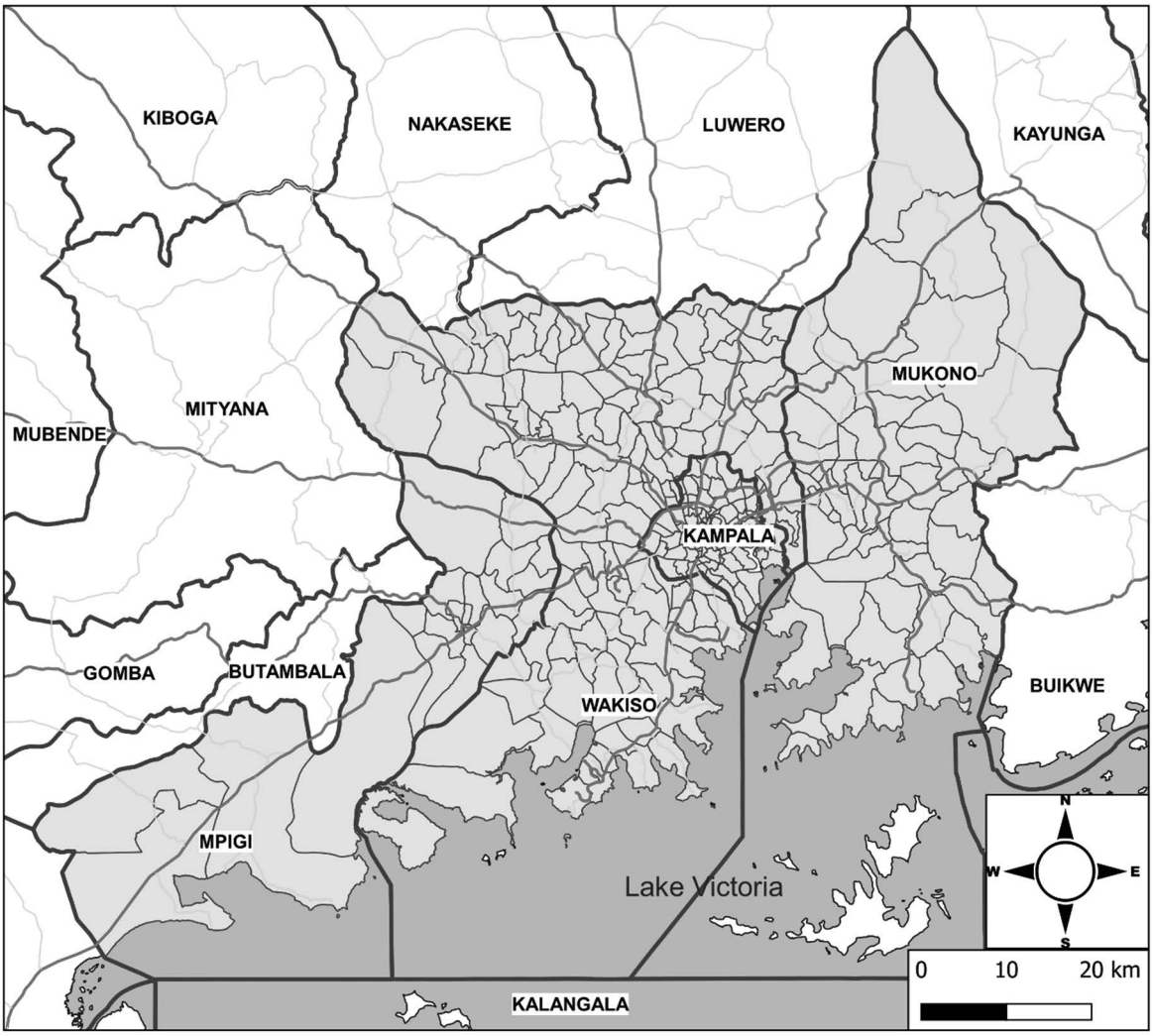
Figure 14.4.1 Travel Demand Forecast Model Structure

(2) Preconditions

1) Study Area and Model Zones

The travel demand forecast model is developed for the entire GKMA including KCC, Wakiso District, Mukono District and Mpigi District. As discussed in Chapter 2, the concept of three layers of PDP is considered.

The Traffic Analysis Zones (TAZs) were developed in GKMA-IUDMP as shown in Figure 14.4.2. Each TAZ represents the aggregate of the travel activities, socioeconomic and land-use demographics. A total of 331 TAZs were developed including 18 external zones. A TAZ was developed based on the administrative parish boundary, with a slight modification. The TAZs inside GKUGA and KCC are smaller than those in areas outside GKUGA as shown in Figure 14.4.2.



Source: JICA Expert Team

Figure 14.4.2 Traffic Analysis Zones of the Travel Demand Forecast Model

2) Socioeconomic Indicators

The following socioeconomic indicators for each Traffic Analysis Zone (TAZ) are included as input data for the travel demand forecast model for this study.

- Population, by income group (Very Low, Low, Medium, High)
- Employment (Workplace Population), by sector (Primary, Manufacture, Trade, Business, Education)
- Land Use Indicators (Urbanised Area, CBD Dummy, Commercial/Industrial/Government Area)
- Education Space (i.e., Number of Student Seats)
- Age Distribution by Age Group (0-4, 5-8, 9-12, 13-18, 19-30, 31-60, over 61)

The socioeconomic framework of the MMUTMP study was updated considering the time frame change from 2016 to 2021. Also, the socioeconomic framework in the expanded study area of the MMUTMP study was developed using the latest available statistics, such as the 2012 population census result of each parish[4], and Census of Business Establishments (COBE) 2019/2020, obtained from UBOS (Uganda Bureau of Statistics). However, the available statistics are insufficient to develop the necessary socioeconomic attributes for the travel demand forecast model. For example, there are no published data available for the population by income class of each TAZ (Traffic Analysis Zone). Thus, various methodologies for estimating the necessary

[4] The preliminary result of the Population and Housing Census 2024 is not reflected in the socioeconomic framework for the travel demand forecast.

socioeconomic attributes of each TAZ were examined to develop the socioeconomic framework for the entire GKMA area. The detailed methodology for estimating each socioeconomic attribute will be discussed and described in the technical working paper.

3) Time Period

The AM peak hour model that represents 40% of the trips generated within a 3-hour AM peak hour period (6:30-9:30) is developed.

4) Planning Horizon

Considering consistency with other plans and the planning horizon of the physical development plans, base year (2021), short-term (2030), mid-term (2040) and long-term (2050) models are being developed.

5) Vehicle Categories

The base year (2021) demand forecast model includes private cars, boda-boda, trucks, metre-gauge railway, buses, taxis, and NMT (non-motorised transport) as vehicle categories. Future year models include additional public transport modes, namely, MRT, BRT and ferry.

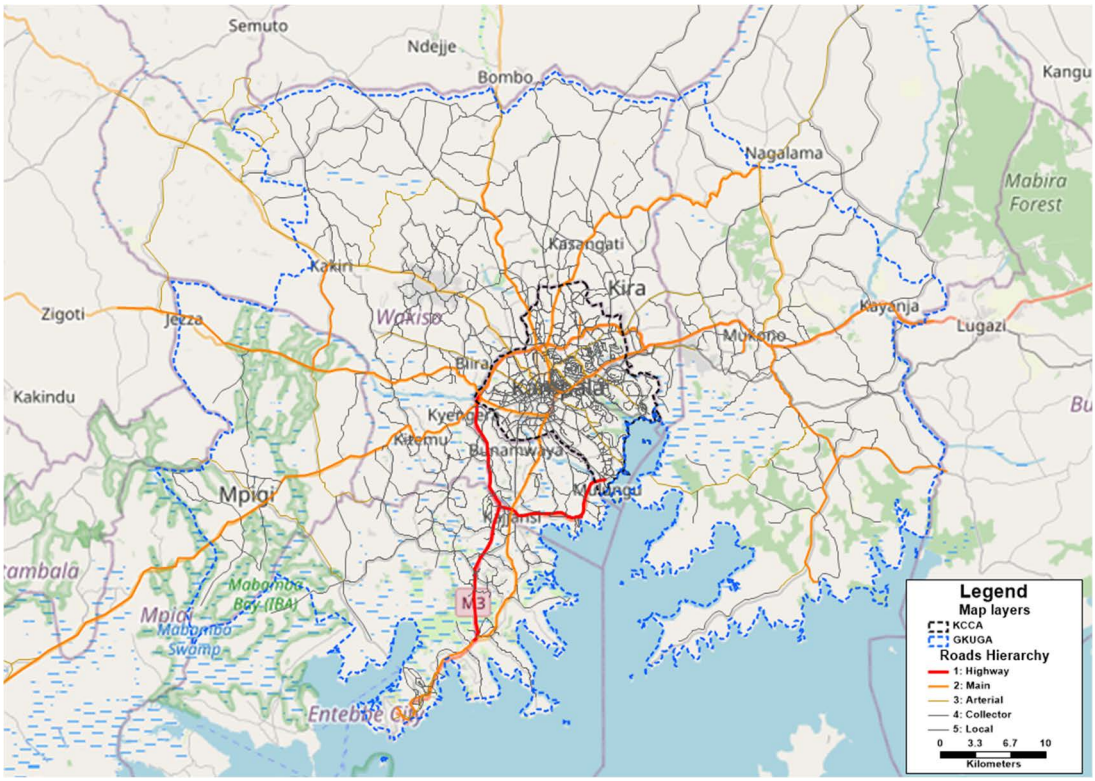
6) Trip Purpose Classification

Trip purposes are categorised by income level for home-based work and home-based educational trips. The detailed classification of trip purposes and income class is described below:

- HBW_L (Home-Based Work, Low income)
- HBW_M (Home-Based Work, Medium income)
- HBW_H (Home-Based Work, High income)
- HBE_L (Home-Based Education, Low income)
- HBE_M (Home-Based Education, Medium income)
- HBE_H (Home-Based Education, High income)
- HBO (Home-Based Other)
- NHB (Non-Home-Based)

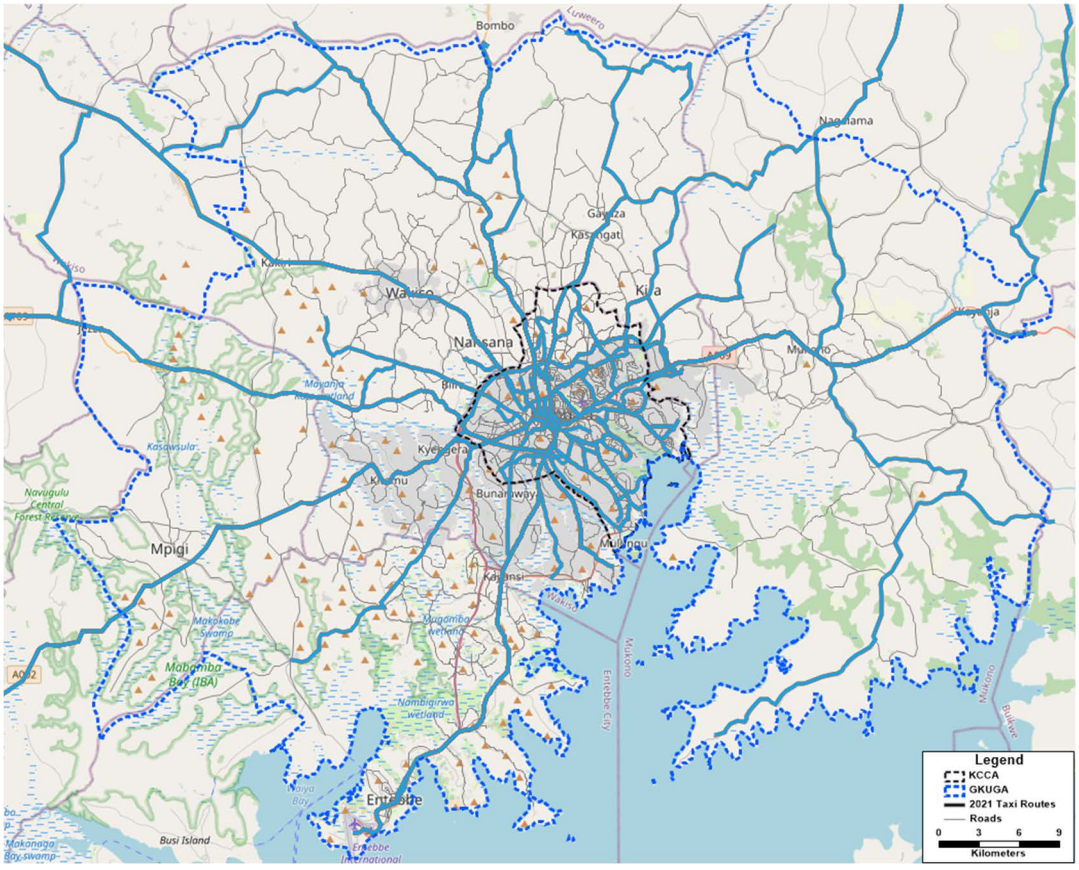
(3) Road and Public Transport Network

The road and public transport network for the base year 2021 is illustrated in Figure 14.4.3 and Figure 14.4.4.



Source: JICA Expert Team

Figure 14.4.3 Road Network for Base Year 2021



Source: JICA Expert Team

Figure 14.4.4 Public Transport Network for Base Year 2021

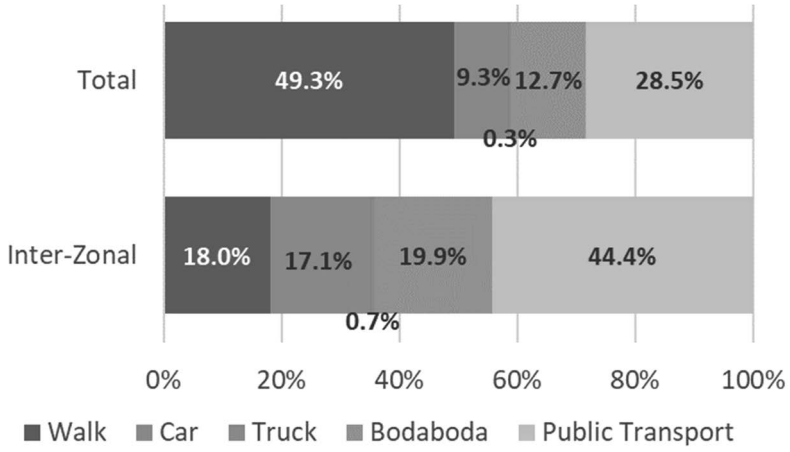
(4) The Model Structure

As described in 14.4.2 (1), the structure of the travel demand forecast model in the GKMA-IUDMP study is based on the model developed in the MMUTMP study. The details of the model structure can be found in "Multi-Modal Urban Transport Master Plan for Greater Kampala Metropolitan Area (GKMA) Final Report", and "Multi-Modal Urban Transport Master Plan for Greater Kampala Metropolitan Area (GKMA) Travel Demand Model Report".

As shown in Figure 14.4.1, the modal split model was updated based on the SP (Stated Preference) survey conducted in this study from October 2021 to May 2022, to reflect the citizens' latest preference on their transport mode choice in the travel demand forecast model, and to understand their preference on new transport modes such as BRT and LRT. Using the survey result, the modal choice model was redeveloped considering various explanatory variables, such as travel time and travel cost, for the utility function of the logit model.

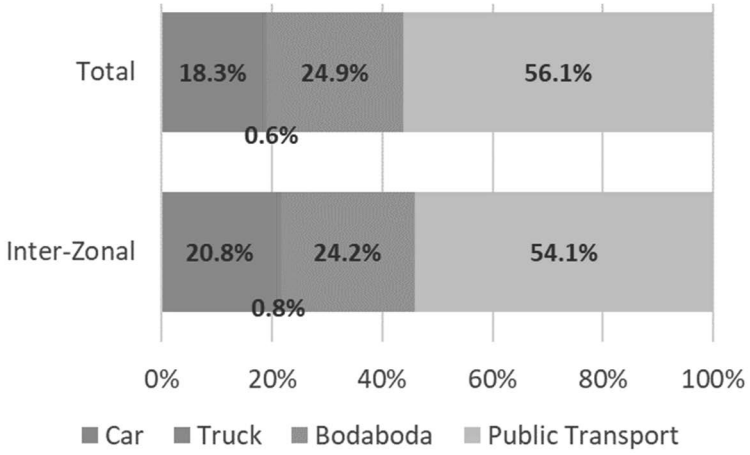
(5) Assignment Result for Base Year Scenario

Figure 14.4.5 illustrates the modal share of the 2021 base scenario including NMT (walking) trips, estimated from the travel demand forecast model. Although approximately 50% of total trips in GKMA were walking trips during the AM peak period, the composition of walking decreased to 18% in inter-zonal trips, implying that walking was not chosen for long-distance trips. Figure 14.4.6 shows the modal share of motorised transport. Based on the travel demand forecast model result, 21% of inter-zonal person trips during the AM peak period were completed by private car, 24% by boda-boda and 54% by public transportation such as taxis and buses.



Source: JICA Expert Team

Figure 14.4.5 AM Peak Modal Share, 2021 Base Scenario

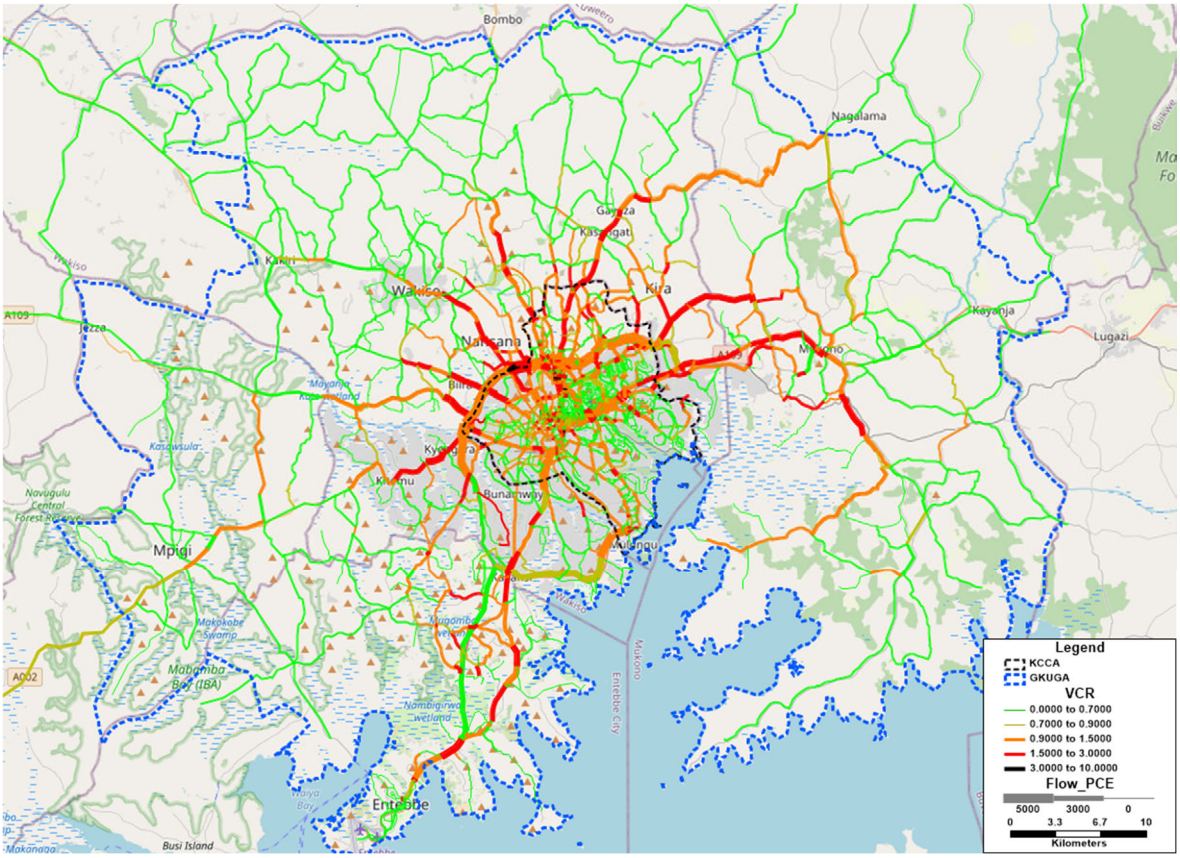


Source: JICA Expert Team

Figure 14.4.6 AM Peak Motorised Modal Share, 2021 Base Scenario

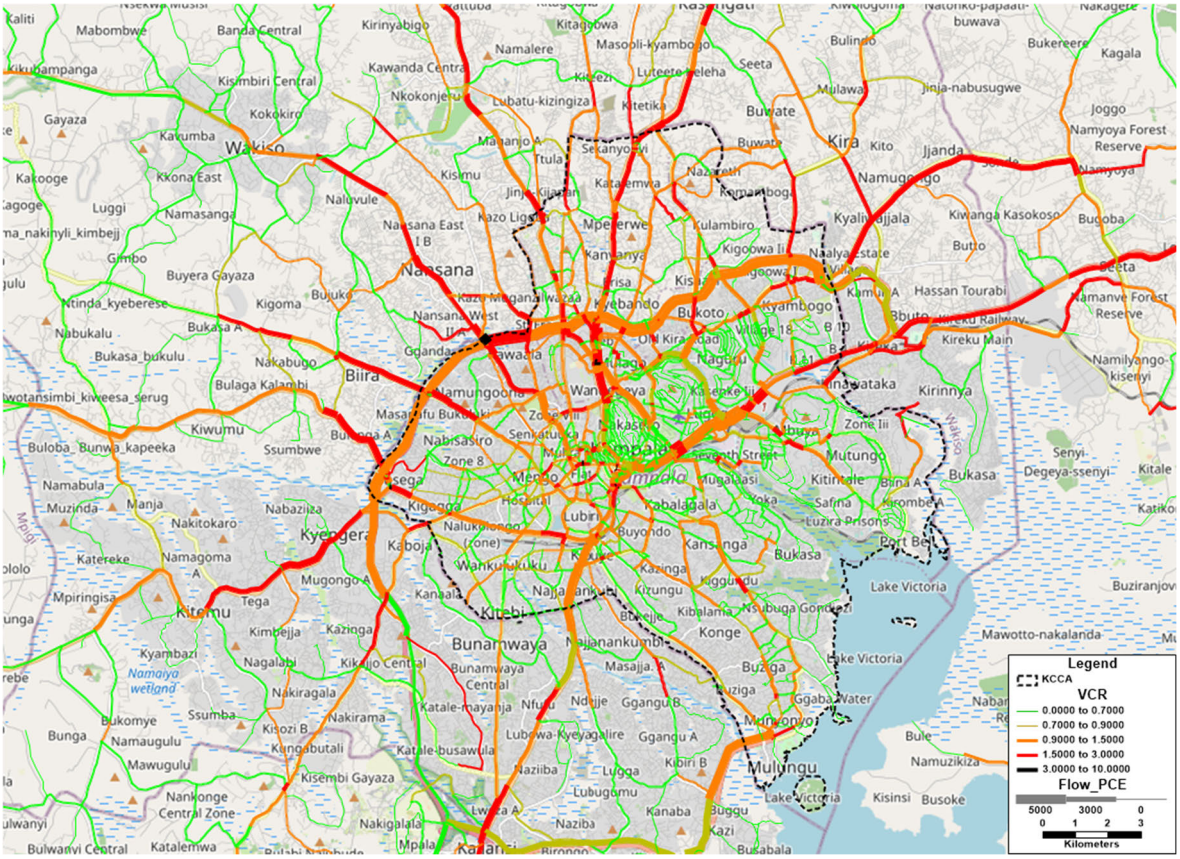
1) Volume to Capacity Ratio (VCR) and Traffic Flow

Figure 14.4.7 and Figure 14.4.8 illustrates volume to capacity ratio (VCR) and traffic flow of private vehicles in AM peak hour as an assignment result of the travel demand forecast model in the 2021 base scenario. Most of the major radial roads in the GKUGA area are currently congested, with a VCR over 1.5. A large volume of traffic flow was observed along the Northern Bypass and Jinja Road.



Source: JICA Expert Team

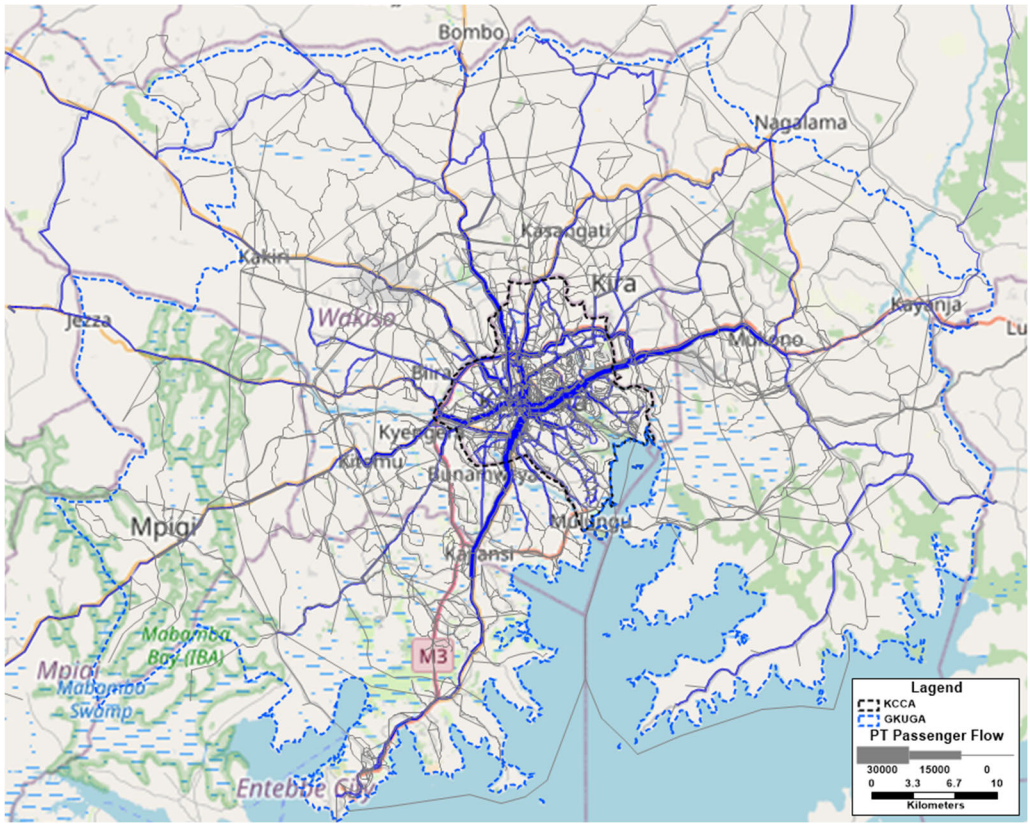
Figure 14.4.7 AM Peak Private Vehicle Volume to Capacity Ratio and Flow Volume in GKUGA, 2021 Base Scenario



Source: JICA Expert Team

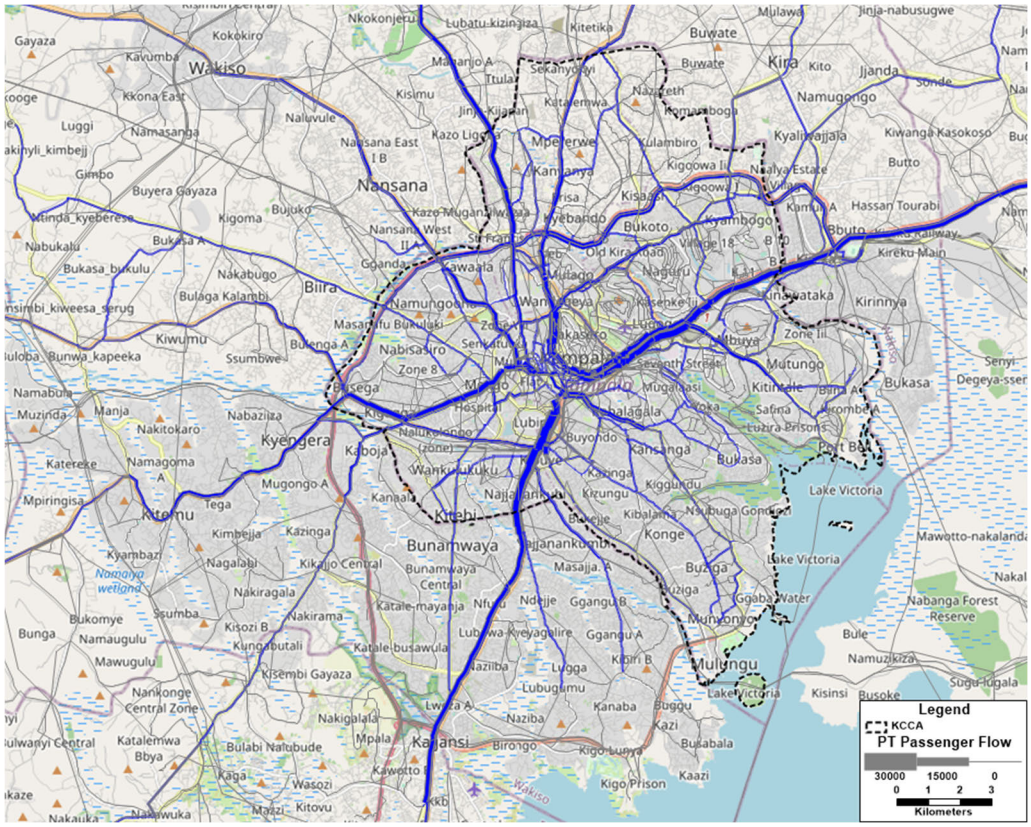
Figure 14.4.8 AM Peak Private Vehicle Volume to Capacity Ratio and Flow Volume in KCC, 2021 Base Scenario

Figure 14.4.9 and Figure 14.4.10 illustrate the demand for public transport during the AM peak period in the GKMA through the public transport passenger flow on the road network. As the current taxi service is a radial-based network, the majority of passenger flows can be seen along the main radial corridors, namely, Jinja Road and Entebbe Road, which connect to the centre of Kampala.



Source: JICA Expert Team

Figure 14.4.9 AM Peak Public Transport Passenger Flow in GKUGA, 2021 Base Scenario

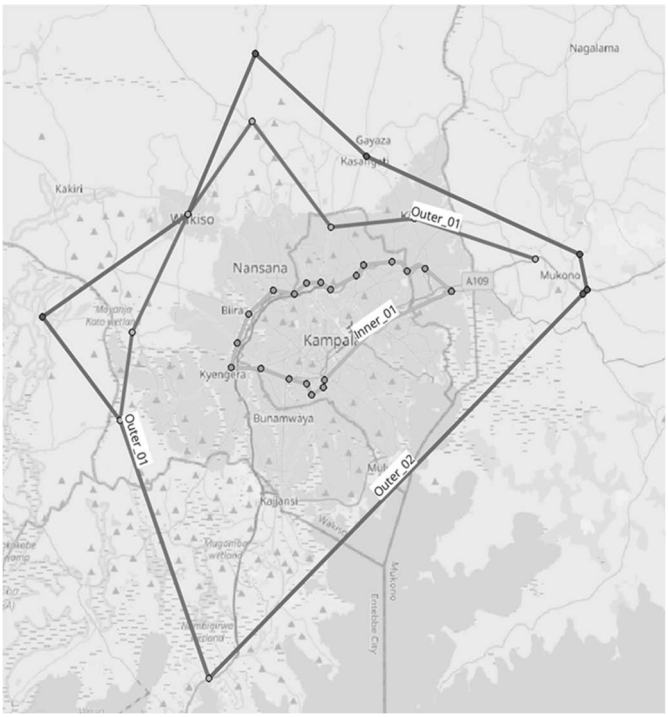


Source: JICA Expert Team

Figure 14.4.10 AM Peak Public Transport Passenger Flow in KCCA, 2021 Base Scenario

2) Model Validation

The validity of the travel demand forecast model was checked by comparing the model-estimated link volume with the link volume of traffic count survey data. Considering the availability of traffic count data, three screen lines (Inner-01, Outer-01 and Outer-02) showing the distance of Kampala's city centre were drawn for this comparison purpose, as illustrated in Figure 14.4.11.



Source: JICA Expert Team

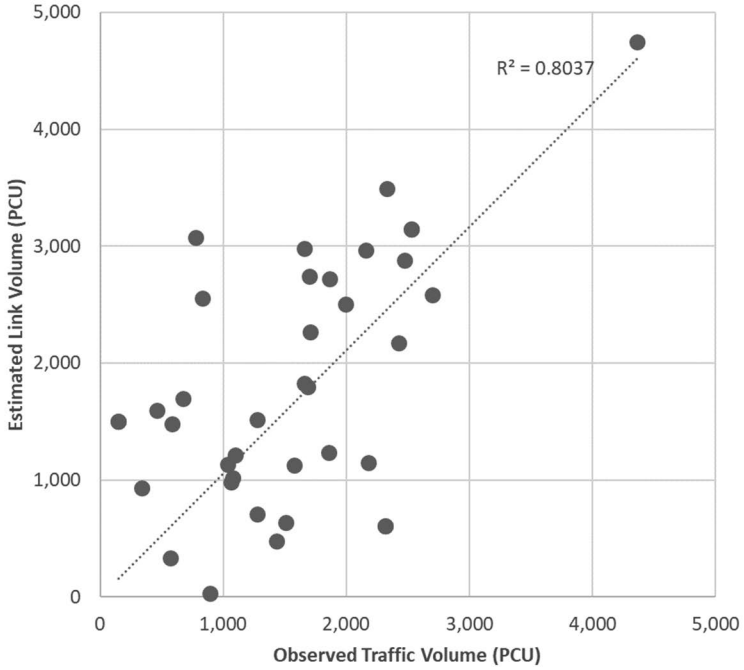
Figure 14.4.11 Location of Screen Lines

The traffic count data for volume comparison with the model-estimated volume were obtained from the Expressway Development Masterplan (EDMP) and National Integrated Transport Masterplan (NITMP), surveys which were conducted between July 2019 to January 2020 and August 2019, respectively. Table 14.4.2 illustrates the result of link volume comparison by screen line, and Figure 14.4.12 shows the scatterplot of observed traffic volume and model-estimated link volume. The ratio between model-estimated volume and traffic-count volume by screen line is in the range of 83% to 114%. The coefficient of determination (R^2) of the model-estimated volume and observed volume is 0.8037. Through this validation, it was confirmed that the developed travel demand forecast model replicates the current traffic condition in the study area.

Table 14.4.2 Comparison of Model-Estimated Link Flow and Traffic Count Link Flow by Screen Line

Screen Line	Model Estimated Link Flow (PCU)(A)	Traffic Count Link Flow (PCU)(B)	Match Rate (B)/(A)
Inner-01	42,355	35,182	83%
Outer-01	13,612	9,549	70%
Outer-02	7,786	8,872	114%

Source: JICA Expert Team



Source: JICA Expert Team

Figure 14.4.12 Scatterplot of Observed Traffic Volume and Estimated Link Volume

14.5 Transport Infrastructure Development Scenarios and Evaluations

To formulate road and public transport network plans, travel demand projection is one of the key references to be looked at. Since it is not practical to test hundreds of cases to evaluate network alternatives, three transport network scenarios have been selected to be tested with the travel demand projection model.

14.5.1 Transport Infrastructure Development Scenarios

Through discussions with MDAs and local governments, three alternatives for the transport network and urban development scenarios have been identified. The three scenarios with different transport project investment plans over the planning period are to be tested with the travel demand model as summarised in Table 14.5.1. Assumptions of each scenario are described in the following sections. The socioeconomic frameworks are also to be developed by the three scenarios.

Table 14.5.1 Summary of Assumed Projects in Each Traffic Demand Forecast Scenario

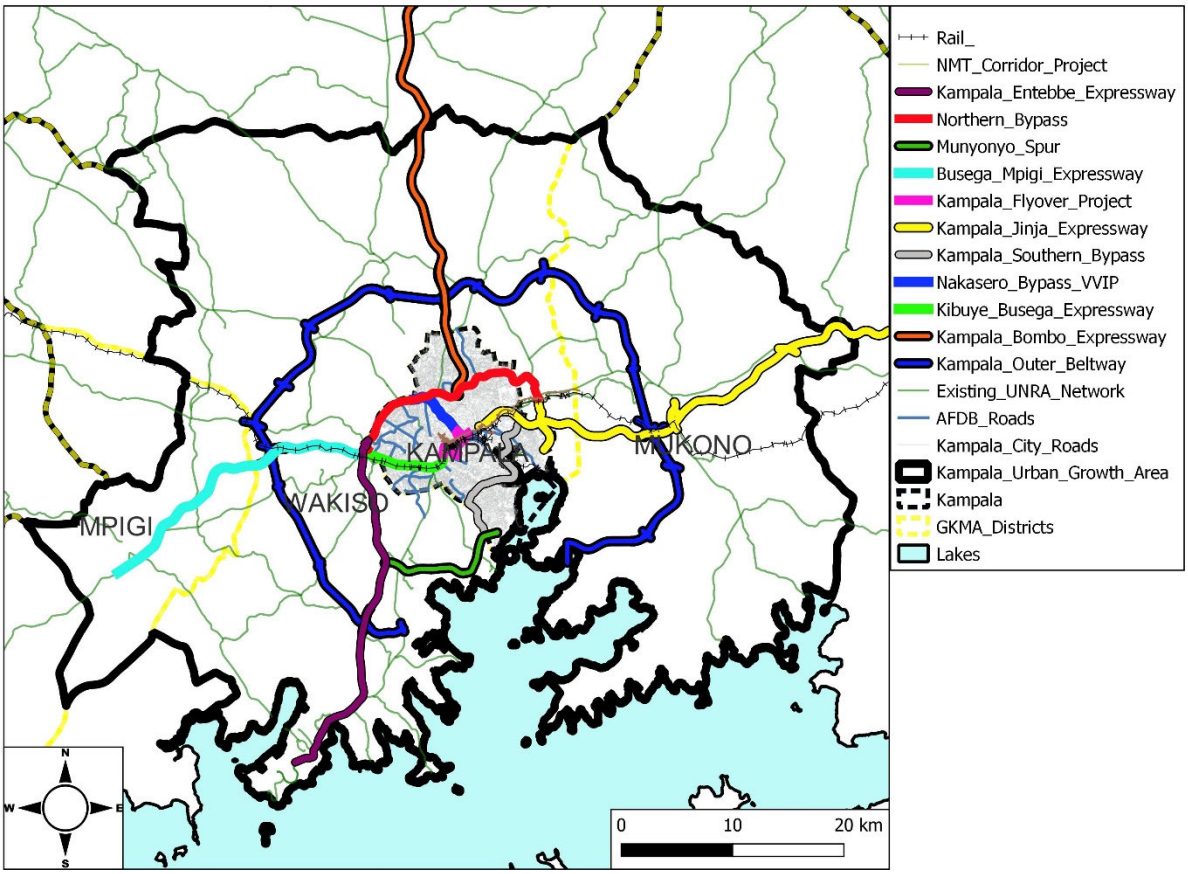
No.	Project Name	Do Minimum Scenario	MMUTMP Scenario (Intensive Transit Development)	Urban Centre TOD Scenario
	Road Infrastructure			
1	Ongoing and Committed Road Projects (See Figure 14.5.1 and Table 14.5.2 for details)	X	X	X
2	Expressway R4 (Nansana – Wakiso – Kakiri)			X
3	Expressway R6 (Kira – Kasaayi – Ngalama - Kigogola)			X
4	Urban Expressway (VVIP Southern Bypass)			X
5	Kampala - Mukonoe Expressway (bypass of Jinja Road and Kampala - Jinja Expressway)			X
6	Railway Station Access Roads Development			X
	Rail-Based Transport Infrastructure			
7	Upgrading of existing metre gauge railway service (See Section 0 for details)	X	X	X
8	Metre Gauge Railway along 2nd Ring (Middle Ring) (Kampala Outer Beltway)			X
9	MRT (Kololo-CBD-Nansana)		X	
10	MRT (Kyengera – Namungoona – Bujuko - Kakiri) along Expressway R4			X
11	MRT (Namanve-CBD)		X	
12	MRT (CBD-Queensway)		X	
13	MRT (Queensway – Kajjansi)		X	
14	LRT (Busega-CBD-Port Bell)		X	
15	LRT (Kira - CBD - Gaba)		X	
16	LRT East Ring (Kiwatule-Butabika-Portbell)		X	
17	LRT-Completion of Ring (Kiwatule-Busega-Kajjansi-Ggaba)		X	
18	LRT (CBD- Kajjansi - Entebbe Airport)			X
19	Water Transport (Port Bell - Ggaba - Kigungu (Entebbe), Katosi - Port Bell)			X
	Bus Rapid Transit (BRT)			
20	BRT Pilot Project (See Section 0 for details)	X	X	X
21	Dualisation of BRT Corridor		X	X
22	BRT Entebbe Road Extension (Zana-Entebbe)		X	X
23	BRT Kampala-Entebbe (along Expressway)			X
24	BRT-Masaka Extension (CBD-Mpigi)		X	X
25	BRT-Bombo Extension (CBD-Bombo)		X	
26	BRT-Gayaza Extension (CBD-Kalagi)		X	X
27	BRT-Jinja Extension (CBD-Mukono)		X	X
28	BRT Inner-Beltway - Ring Road (Along Northern Bypass - Kampala Entebbe Expressway - Southern Bypass)			X
29	BRT (CBD-Portbell)			X
30	BRT (Busega-Mpigi) along Busega-Mpigi Expressway			X
31	BRT (Nansana-Wakiso-Kakiri)			X
32	BRT (Namboole-Namugongo-Seeta)			X
33	BRT (Busega-Buloba) along Fort Portal Road			X
34	BRT (CBD-Bombo) along Bombo Expressway			X
35	BRT (Masooli-Kagoma-Matugga) along Bombo Road			X
36	BRT (Kampala- Kasanje) along Nakawuka Road			X
	Urban Development Policies			
37	Polycentric Urban Spatial Structure			X
38	Transit-Oriented Development		X	X
	Traffic Management Policies			
39	Boda-boda Restriction	X	X	X
40	Parking Restrictions and Tax in CBD		X	X

Source: JICA Expert Team based on interviews with the Ministry of Works and Transport, UNRA, URC and KCCA

(1) Do Minimum Scenario

Reference Scenario - An important first step in the scenario procedure is to ascertain the "Committed/Approved Projects," which are slated for implementation regardless of the findings or recommendations of the master plan as shown in Figure 14.5.1 and Table 14.5.2. These projects, collected from the project inventory list compiled in cooperation with all stakeholders, include infrastructure and operational upgrades as well as new infrastructure building projects. These projects, and their impacts, must be considered when evaluating the alternative-specific projects tested in the 2040 comprehensive transport scenarios.

The socioeconomic framework including population, working population and student population of this scenario is to be developed assuming that the current urbanisation trend continues.



Source: JICA Expert Team based on interviews with the Ministry of Works and Transport, UNRA and KCCA

Figure 14.5.1 Major Ongoing and Committed Road Projects in GKUGA

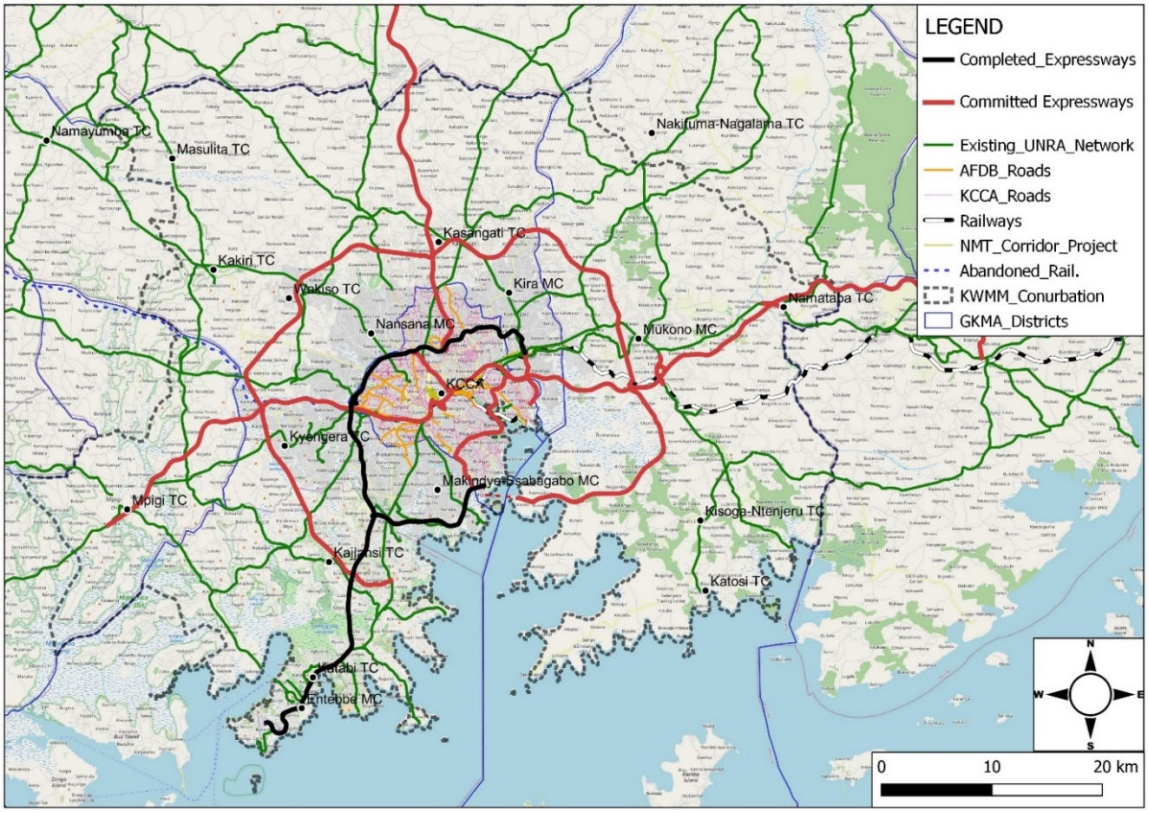
Table 14.5.2 Summary of Assumed Ongoing and Committed Projects in Each Traffic Demand Forecast Scenario

Project Name	Funding Agencies	Situation As of May 2024	Responsible Agency
Kampala Flyover	JICA	Lot 2 design completed Procurement to start end of 2024 Civil works to start 2025	UNRA
Central Traffic Control Centre (junction)	JICA	Construction ongoing Completion expected in 2024	KCCA
NMT Corridor Project	GoU	Design of 4km road in CBD and 16 km corridor along railway completed.	KCCA
Kampala City Road Rehabilitation Project (including drainage works, 2 big drainage works)	AfDB	Construction of roads ongoing	KCCA
GKMA-Urban Development Programme	World Bank	Procurement and design ongoing	MKCC & MA

Project Name	Funding Agencies	Situation As of May 2024	Responsible Agency
Upgrading of Northern Bypass	EU, GoU	Construction is ongoing, and capacity improvement completed Maintenance of 1st carriageway ongoing.	UNRA
Kampala Southern Bypass	AfDB, AFD and EU, GoU	Procurement is ongoing Construction to start in 2026	UNRA
Kibuye-Busega Expressway	China Exim Bank (UNRA Expectation)	The design update is ongoing and seeking funds. Construction expected to start in 2026	UNRA
Busega-Mpigi Expressway	AfDB	Construction ongoing (To be completed in 2026)	UNRA
Kampala-Jinja Expressway	AfDB, AFD and EU, GoU	Procurement ongoing. Construction to start in 2026	UNRA
Kampala-Bombo Expressway	Seeking funds	Finished F/S and design	UNRA
2nd Ring (Middle Ring (Kampala Outer Beltway)	Seeking funds	Finished F/S and design	UNRA
VVIP Expressway (Nakasero-Northern Bypass Expressway)	China Exim Bank (UNRA Expectation)	Finished F/S and design completed by 2019. Civil works expected to start in 2026	UNRA
Capacity improvement and signalisation of Kampala – Gayaza Road	GoU	Design is ongoing, expected completion by Dec 2024 Construction works to begin end of 2025	UNRA
Capacity improvement and signalisation of Kampala – Buloba Road	GoU	Detailed design to be carried out by Dec 2025	UNRA
Capacity improvement and signalisation of Namungona – Kakiri Road	AfDB	The design study will start once the contract is signed.	UNRA
Upgrading of Kyaliwajala – Kira – Matugga Road (including junctions along the roads)	GoU	Construction commenced, completion expected in 2026	UNRA
Upgrading of Najjanankumbi – Busabala (including junction signalisation)	GoU	Construction works ongoing, completion expected in 2026	UNRA
Upgrading of Matugga – Wakiso – Buloba	GoU	Detailed design ongoing, to be completed in Dec 2024, commencement of civil works in 2026 and completion in 2030	UNRA
Upgrading of Jokas – Namanve – Mukono	Seeking funds	Finished design. Procuring contractor for works.	UNRA
Upgrading of Natete – Nakawuka – Kisubi – Maya - Nakiwuogo	Contractor facilitated financing	Construction commenced in April 2024	UNRA
Uganda Railways Corporation Capacity Building Project	GoU and AfDB	Finished F/S in 2020 Construction is ongoing	URC
Bus Rapid Transit (BRT) for GKMA Phase 1: CBD to Kalerwe, Banda and Kibuye Phase 2: CBD to Mukono Phase 3: CBD to Kasangati Phase 4: CBD to Kajjansi	AFD and the World Bank	Finished F/S and design in 2012 A design review is being conducted.	MoWT

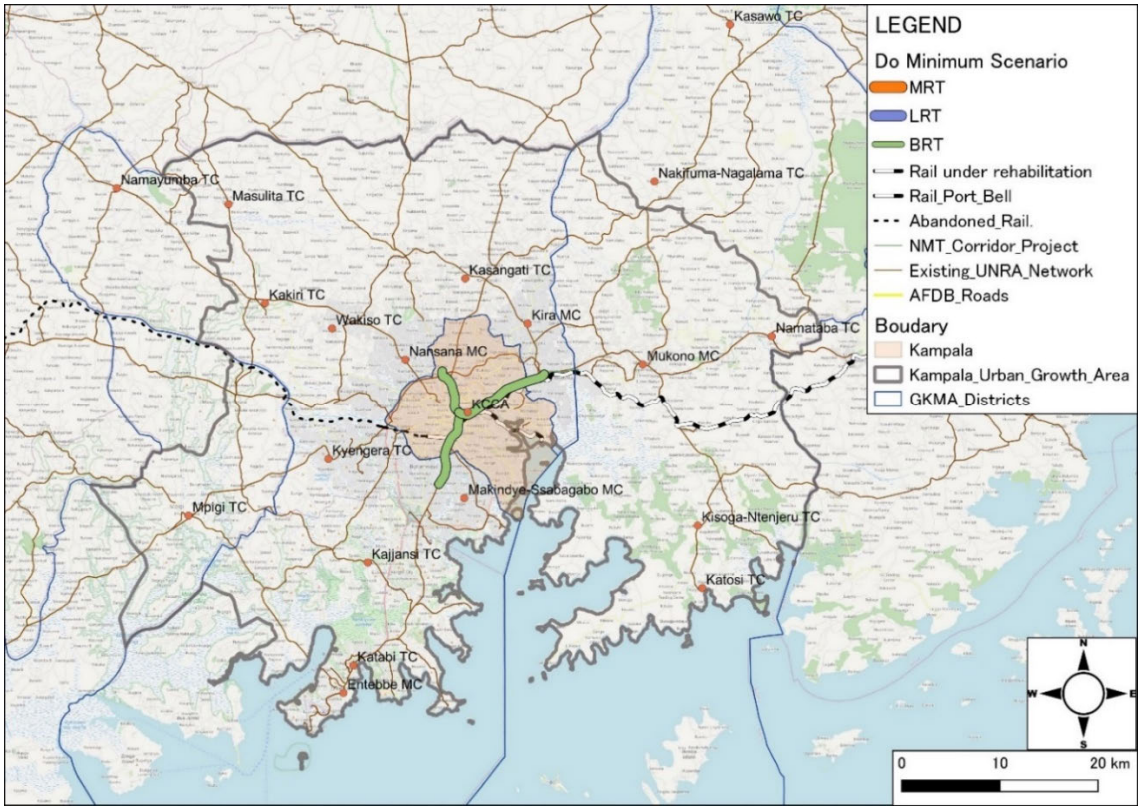
Source: JICA Expert Team based on interview with Ministry of Works and Transport, UNRA and KCCA in May 2024

The road network and public transport network of the Do Minimum scenario are shown in Figure 14.5.2 and Figure 14.5.3.



Source: JICA Expert Team

Figure 14.5.2 Road Network of Do Minimum Scenario



Source: JICA Expert Team

Figure 14.5.3 Public Transport Network of Do Minimum Scenario

(2) MMUTMP Scenario (Intensive Transit Development)

The MMUTMP scenario in this project is based on the Metro Plus Plus scenario of the MMUTMP TDM. The Metro Plus Plus scenario is the recommended scenario of the MMUTMP to achieve all objectives of the plan. This scenario provides significant improvements in parameters of accessibility and mobility due to infrastructural upgrades, while minor revisions are made considering the changes in travel behaviour and infrastructure development after the formulation of the MMUTMP. The socioeconomic framework of the MMUTMP project will be fully utilised for this scenario, while zonal indicators such as population, working population and student population for TAZs outside of KSPA are estimated based on the Do Minimum scenario. The MMUTMP scenario includes the following projects:

1) Mass Transit Improvements

With the increasing population within the GKUGA, investments for improved mass transit systems like MRT, LRT and BRT are to be implemented to achieve a sound and satisfactory transport system within the GKUGA. Therefore, an intensive rail-based transport network is proposed as shown in Figure 14.5.5. However, railway network development is mainly focused on KCC and adjacent areas.

2) Other Public Transport Improvements

There are two principal informal modes of public transport operating in the GKUGA, taxis and boda-boda. Both modes are part of the daily mobility paradigm of the GKUGA. Thus, those two modes are included in this scenario.

A water-based transport on Lake Victoria provides other options for commuters in the GKUGA. The Nakiwogo ferry demonstrates that there is, in fact, a demand for water-based transport when there is an availability of scheduled, operational and intermodal transportation.

3) Boda-boda Restriction

The registration of boda-boda units operating within Kampala was carried out in September 2022 by KCCA and the MKCC&MA. The registration was done to organise and regulate the boda-boda sector, with only the 35,000 registered boda-boda riders permitted to operate within KCC. The remaining unregistered boda-boda units are to operate outside KCC.

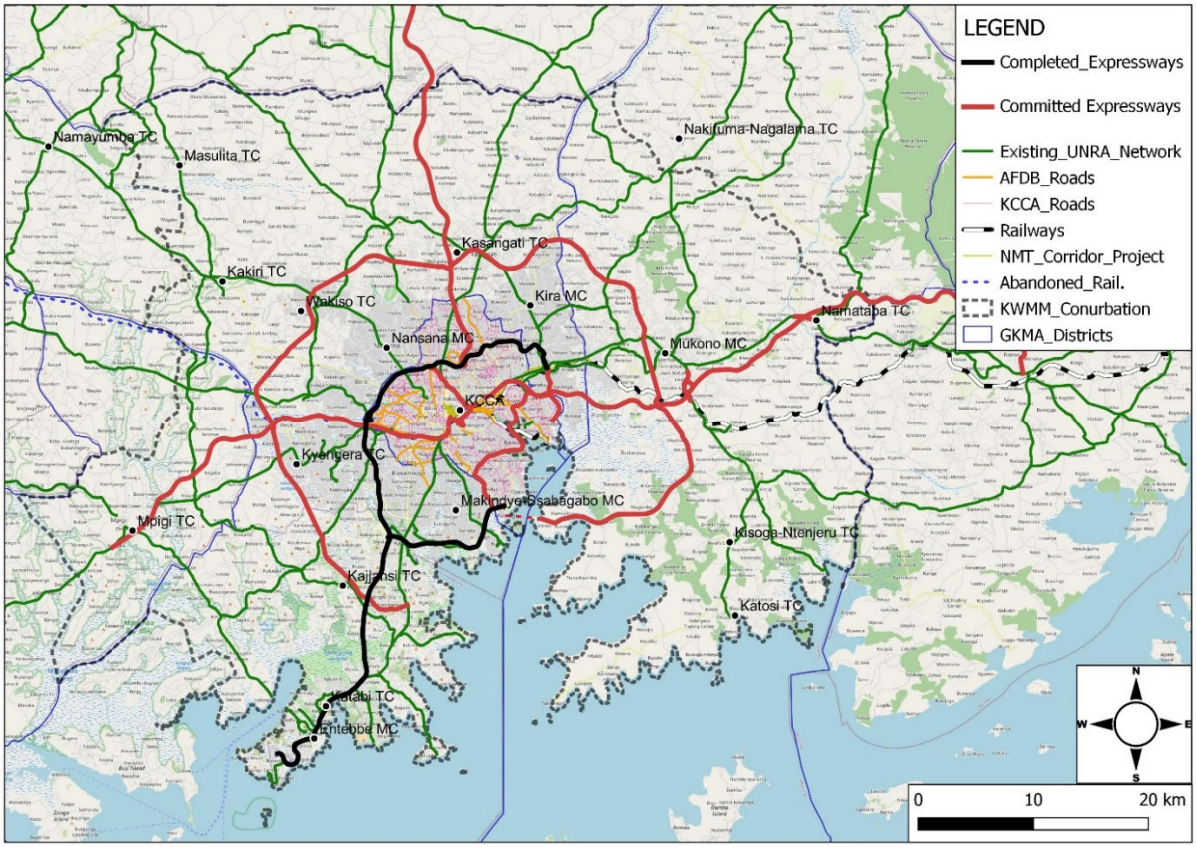
“Boda-boda free zones” that limit the movement of boda-boda within a given area may be implemented. Other restrictions to be considered are limiting boda-boda operations within a specified period during peak hours to encourage road users to adopt other public transport modes like taxis, buses like Pioneer and Tondeka and the existing train transport by URC from Namanve to Mukono.

4) Parking Restrictions in CBD

This can aid in reducing traffic within the CBD and can provide income for KCCA if charges are collected. In addition, parking management can be utilised to increase public transport ridership as well as road safety and decrease noise and air pollution. Similar to the boda-boda free zone policy, there is a need to implement parking restrictions within the CBD to reduce demand for daily private vehicle commuting and to simultaneously increase public transportation demand.

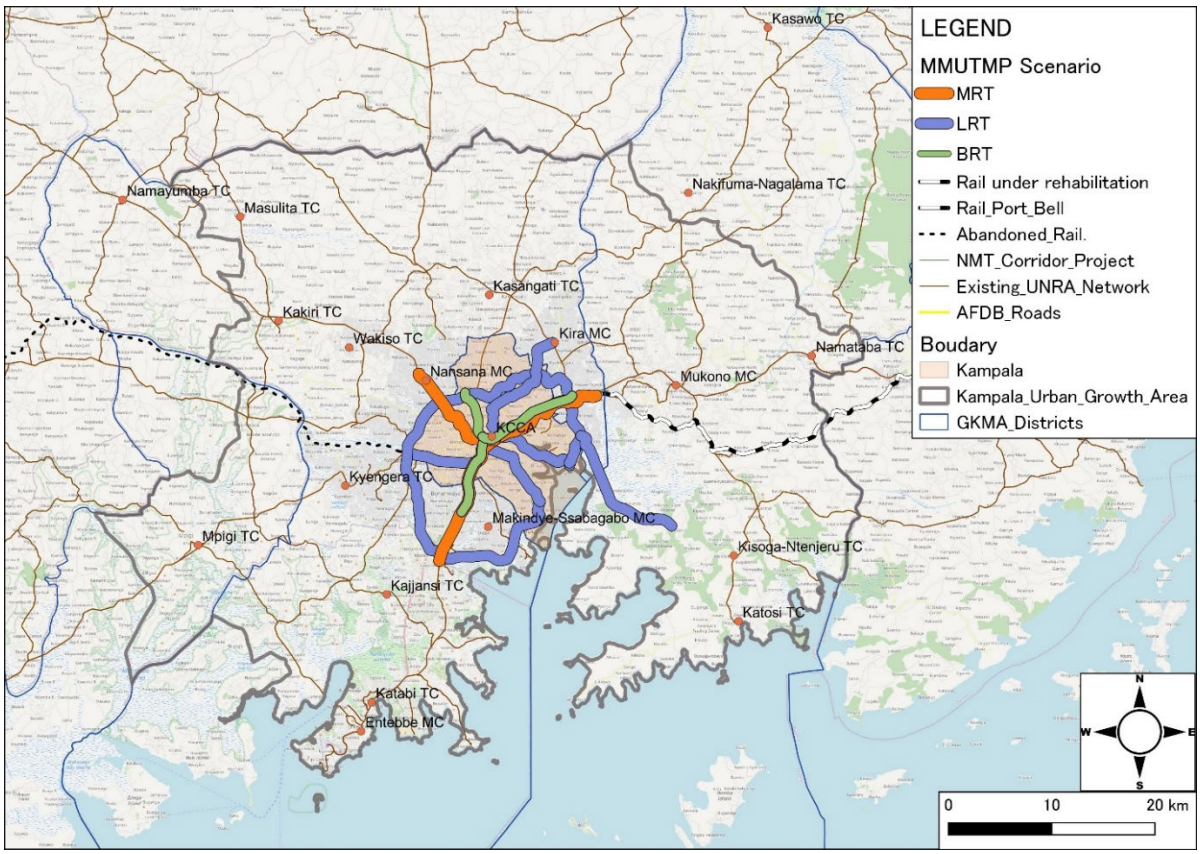
5) Transport-Oriented Development (TOD)

The application of TOD planning principles aims to provide sustainable transport to populations with varying socioeconomic levels in newly developed and developing urban spaces. This will minimise dependence on motor vehicles and the marginalisation of residents in lower socioeconomic levels.



Source: JICA Expert Team

Figure 14.5.4 Road Network of MMUTMP Scenario (Same as Do Minimum Scenario)

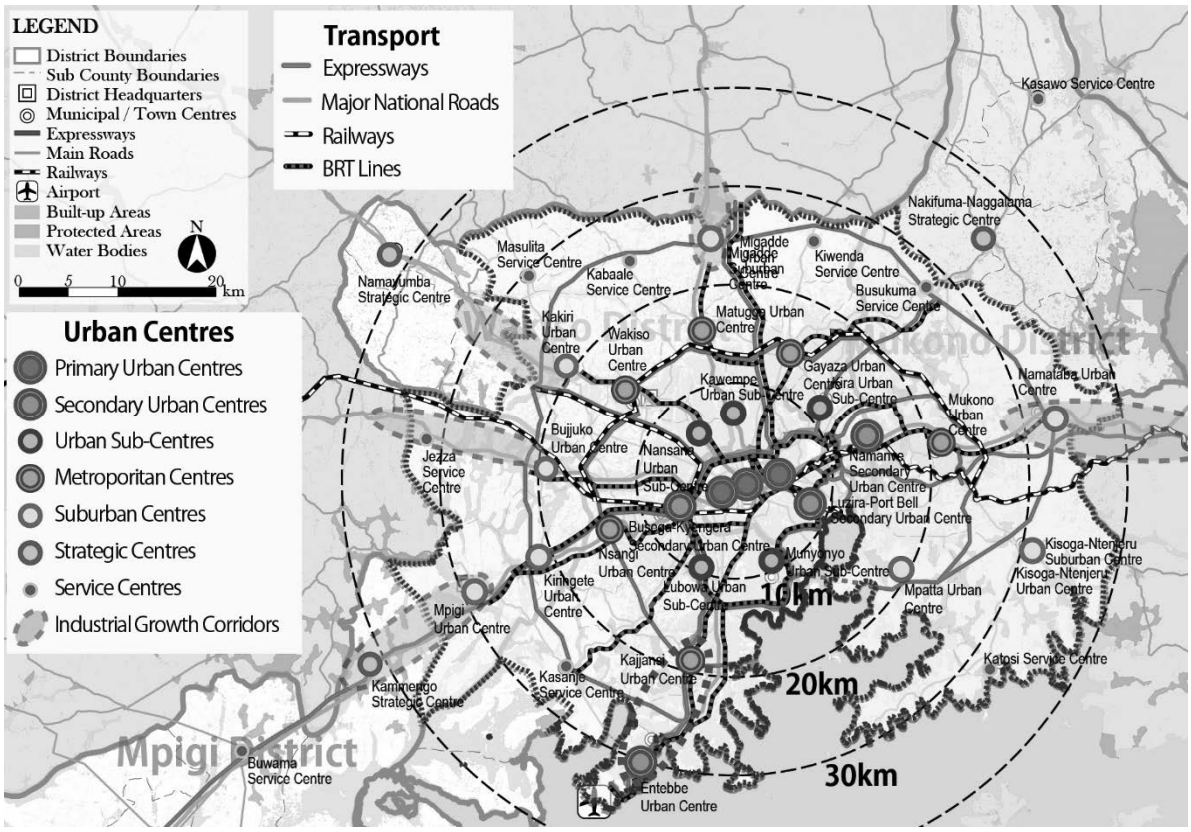


Source: JICA Expert Team

Figure 14.5.5 Public Transport Network of MMUTMP Scenario

(3) Urban Centre TOD Scenario (Moderate Transit Development and Joint Development of Urban Centres and Transport Infrastructures)

In this Project, development strategies, in which the urban centres to be developed outside KCC are integrated with the transport networks consisting of roads, BRT, LRT, MRT and TOD, will be considered and formulated for renewing the KPDF/KPDP. In this scenario, urban structures proposed in Chapter 10 are utilised as a basis for formulating a transport network. The conceptual urban structure and transport network are shown in Figure 14.5.6.



Source: JICA Expert Team

Figure 14.5.6 Conceptual Urban Structure and Urban Road Network Including Public Transport Network

TOD is a concept of urban development that introduces dense and mixed land use within walking distance of a transit station, along with improving the walking environment in the area. To prevent urban sprawl and formulate sustainable urban structure, TOD can be a key concept to break through the current urban issues in the GKUGA. As discussed in Chapter 10, several urban centres are proposed. To attract workers and residents in the proposed urban centres, it is critical to connect those urban centres. Thus, a significant number of new transit lines are proposed to connect those urban centres as shown in Figure 14.5.6.

Meanwhile, it is also critical to consider financial feasibility and sustainability in implementing transit projects as these kinds of projects, especially rail-based transit modes, require significant capital investments. Land availability is also a critical factor for project implementation. To overcome financial constraints and land availability problems, BRT can play a key role as it can be implemented with less capital investment. BRT is also a flexible mode of transport. It can utilise a dedicated lane for high-speed operation for a certain section while also utilising a mixed traffic lane in case the road width is not sufficient to accommodate a dedicated lane for BRT. It can also utilise expressways. During the time before the traffic volume of the expressway reaches a high congestion level, BRT can be operated on an expressway with or without a dedicated lane. Thus, the travel time of BRT can be significantly reduced. It is also assumed that BRT and expressways can be developed jointly to achieve transit-oriented development. The design of an expressway where the use of BRT is expected can accommodate space for bus stops.

1) Polycentric Urban Spatial Structure

Through intensive development of existing railways, the use of MRTs and BRTs in conjunction with urban centre development along the corridor aims to synchronise the timing of transport infrastructure development and green and brownfield urban developments along the transit corridor. Specifically, three corridors are focused on: Kampala-Kakiri (Nansana-Wakiso-Kakiri), Kampala-Mukono (Kireka-Bweyogerere-Mukono) and Kampala-Entebbe (Kajjansi-Katabi-Entebbe). The joint development of urban centres and transit lines enables development-based Land Value Capture (LVC).

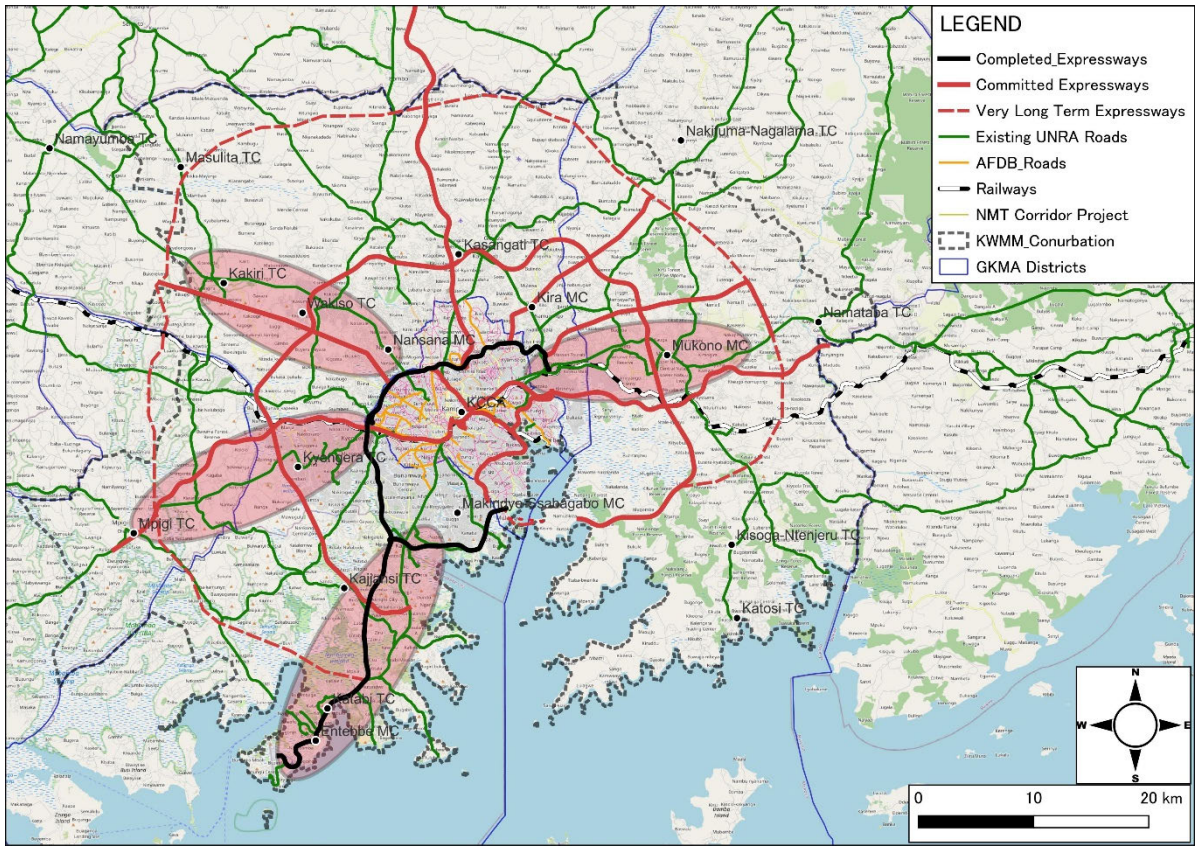
Aerial Photo of Construction Stage in 1985

Image of Current Railway Station and the Access-Controlled Roads

Image of Mixed-Use Urban Development Around Railway Station

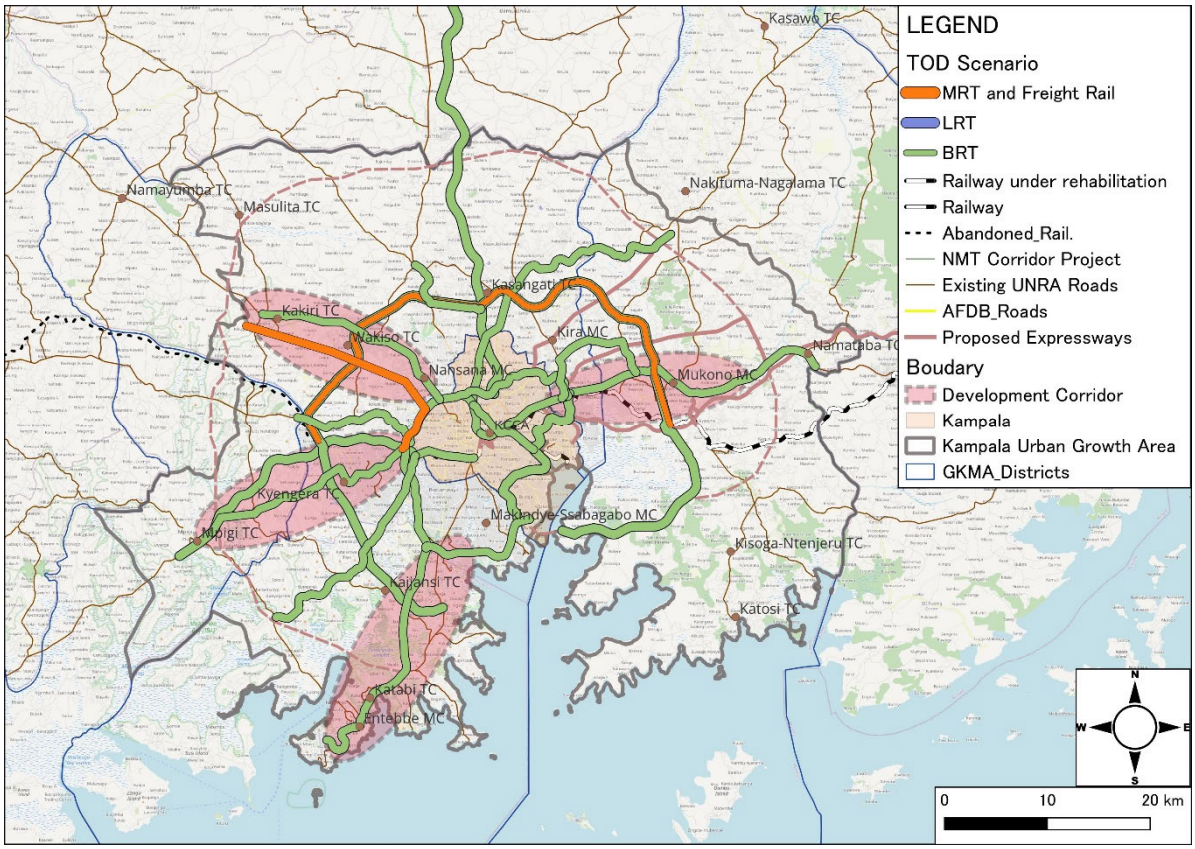
Source of top left image: KOBECCO https://kobecco.hpg.co.jp/14514/
Source of top right image: https://ameblo.jp/s-limited-express/entry-12669474259.html
Source of bottom image: Geospatial Information Authority of Japan
https://maps.gsi.go.jp/#16/34.681841/135.057456/&base=ort&ls=ort&disp=1&vs=c0g1j0h0k0l0u0t0z0r0s0m0f0

Figure 14.5.7 Example of Joint Development of a New Town and Transport Infrastructures in Kobe Gakuentoshi, Japan



Source: JICA Expert Team

Figure 14.5.8 Road Network of Urban Centre TOD Scenario



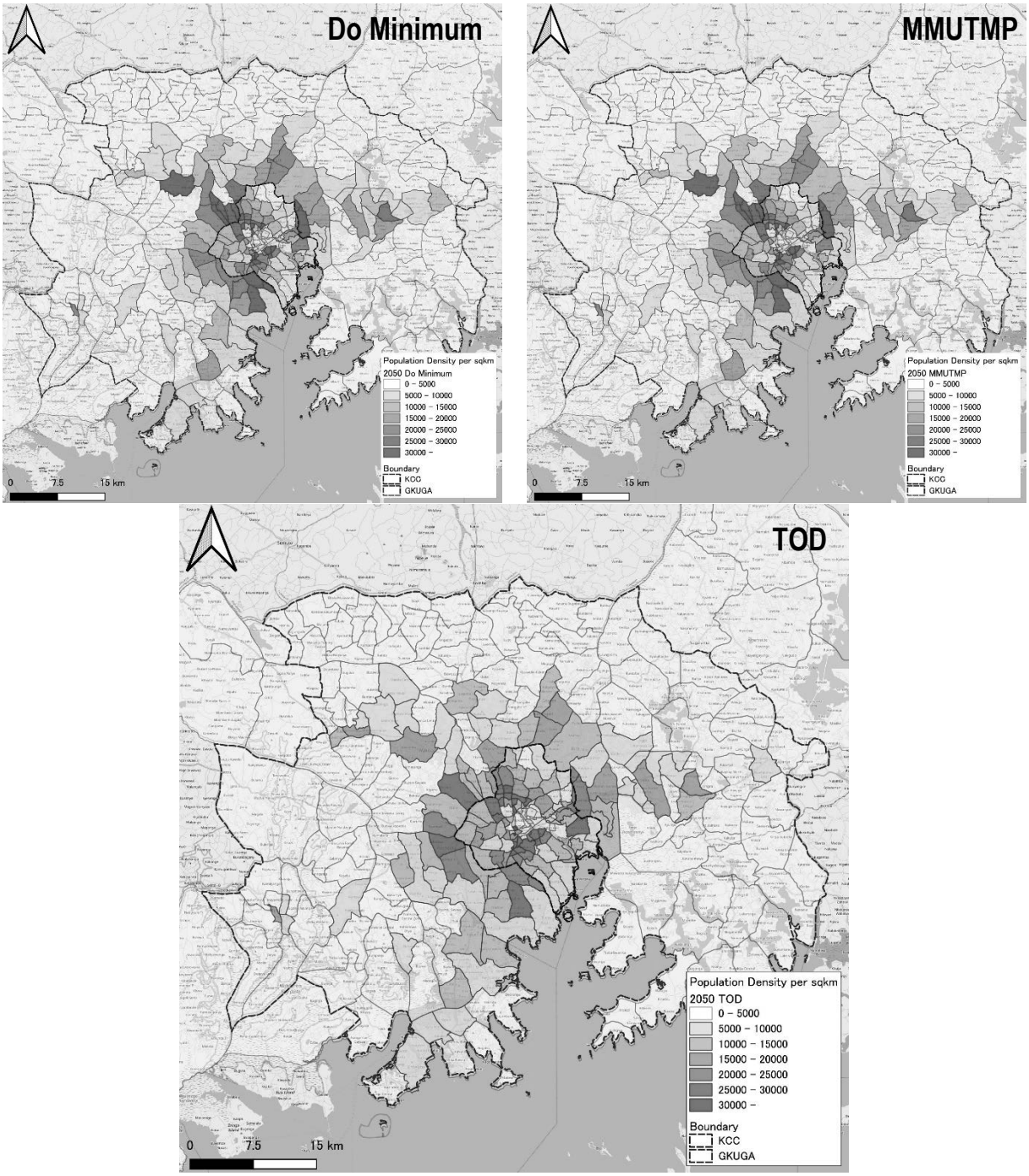
Source: JICA Expert Team

Figure 14.5.9 Public Transport Network of Urban Centre TOD Scenario

14.5.2 Comparison of Development Scenarios

(1) Population Distribution

Figure 14.5.10Figure 14.4.10 illustrates the population density of each traffic analysis zone in 2050 by development scenarios.

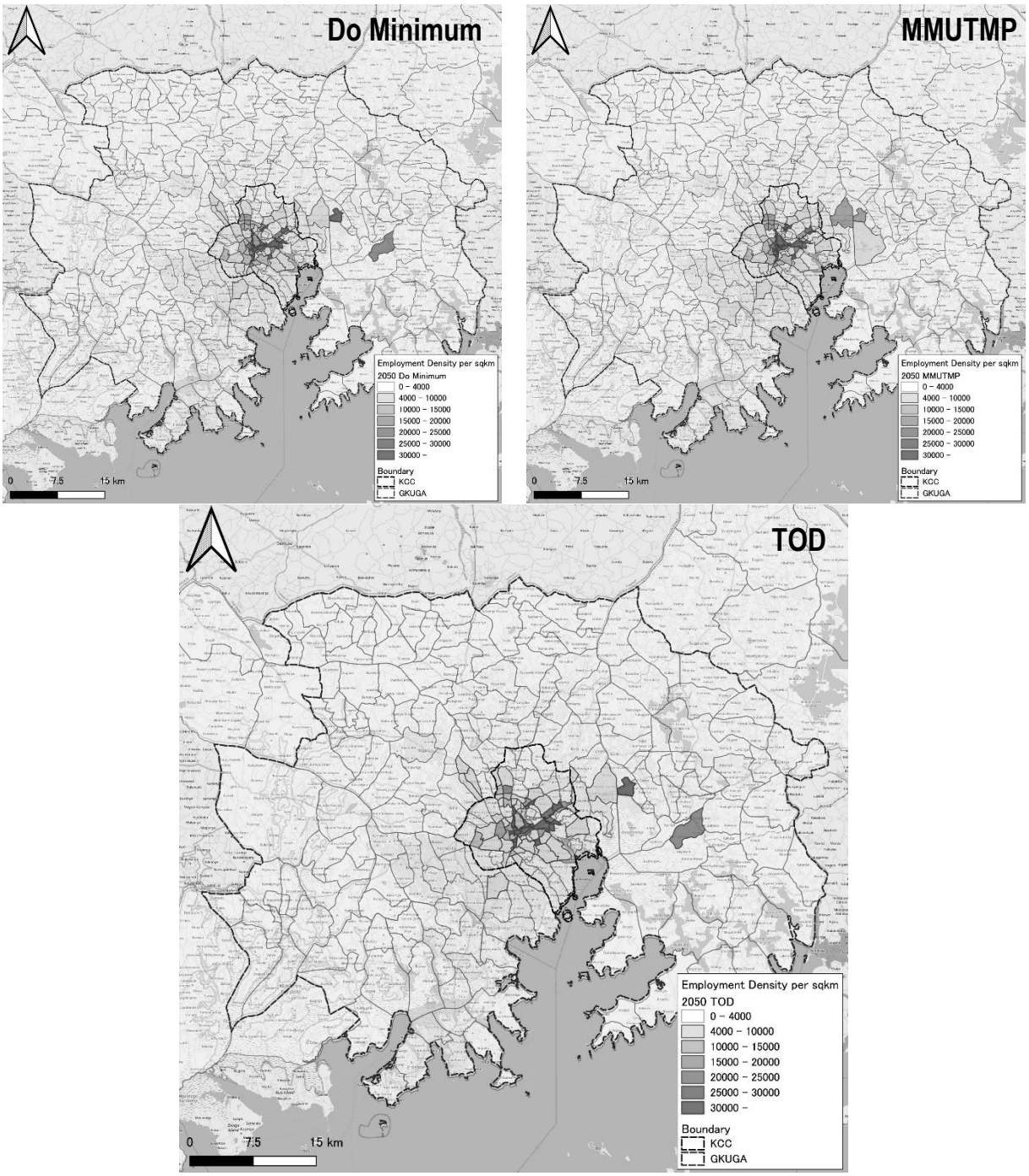


Source: JICA Expert Team

Figure 14.5.10 Population Density by 2050 Scenarios

(2) Employment Distribution

Figure 14.5.11 illustrates the employment density population of each traffic analysis zone in 2050 by development scenarios.



Source: JICA Expert Team

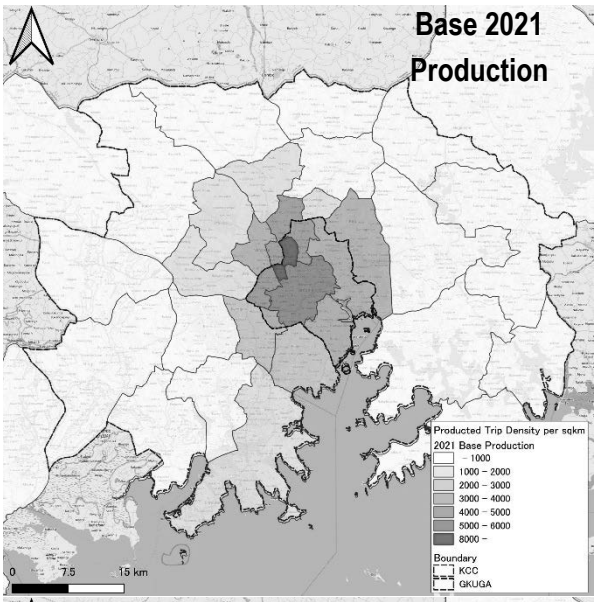
Figure 14.5.11 Employment Density by 2050 Scenarios

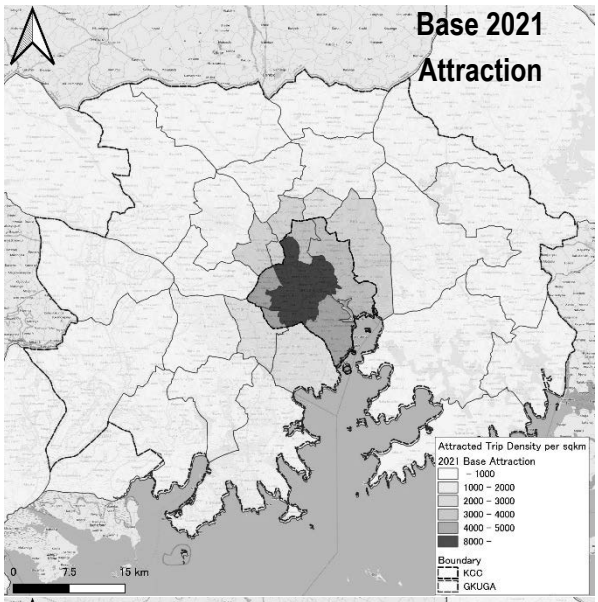
14.5.3 Travel Demand Forecast Result

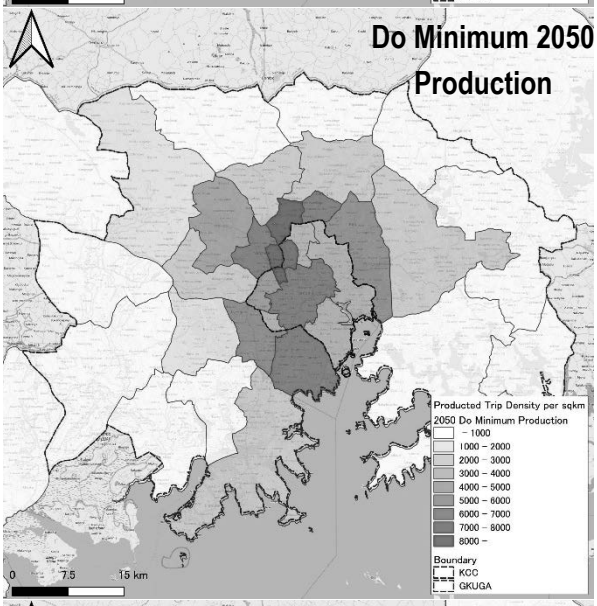
The travel demand forecast for future year three scenarios (Do Minimum, MMUTMP, and TOD) was examined by applying the transport network and socioeconomic framework of each one as described in Section 14.5.1.

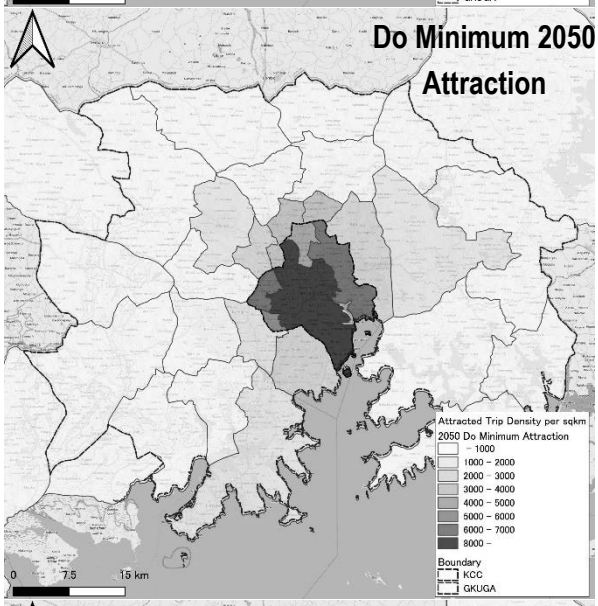
(1) Distribution of Generated and Attracted Trips

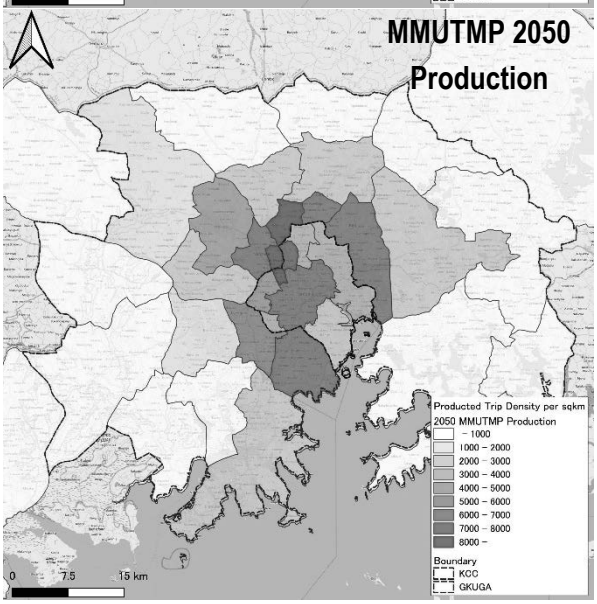
Figure 14.5.12 illustrates the spatial distribution of generated and attracted trip density in the base year and the estimated future distribution by development scenarios. The Do Minimum scenario has the most centralized attraction trip density in the CBD area compared to the other two scenarios, as employment is expected to continue growing only in the CBD area.

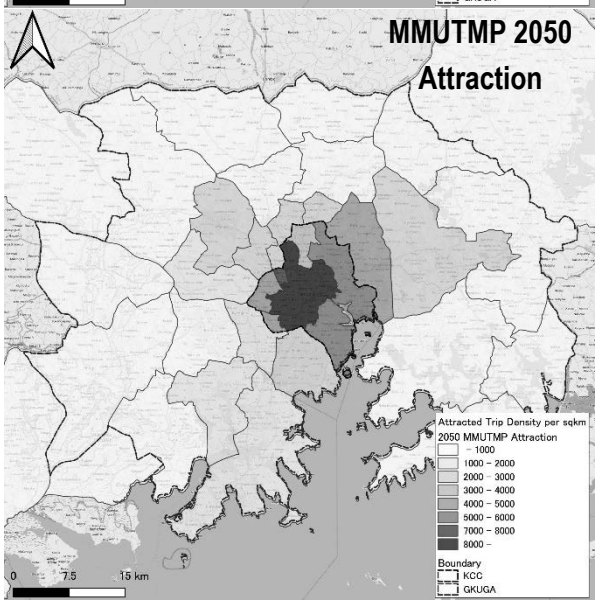

Base 2021
Production
Producted Trip Density per sqkm
2021 Base Production
- 1000
1000 - 2000
2000 - 3000
3000 - 4000
4000 - 5000
5000 - 6000
8000 -
Boundary
KCC
GKUGA
0 7.5 15 km

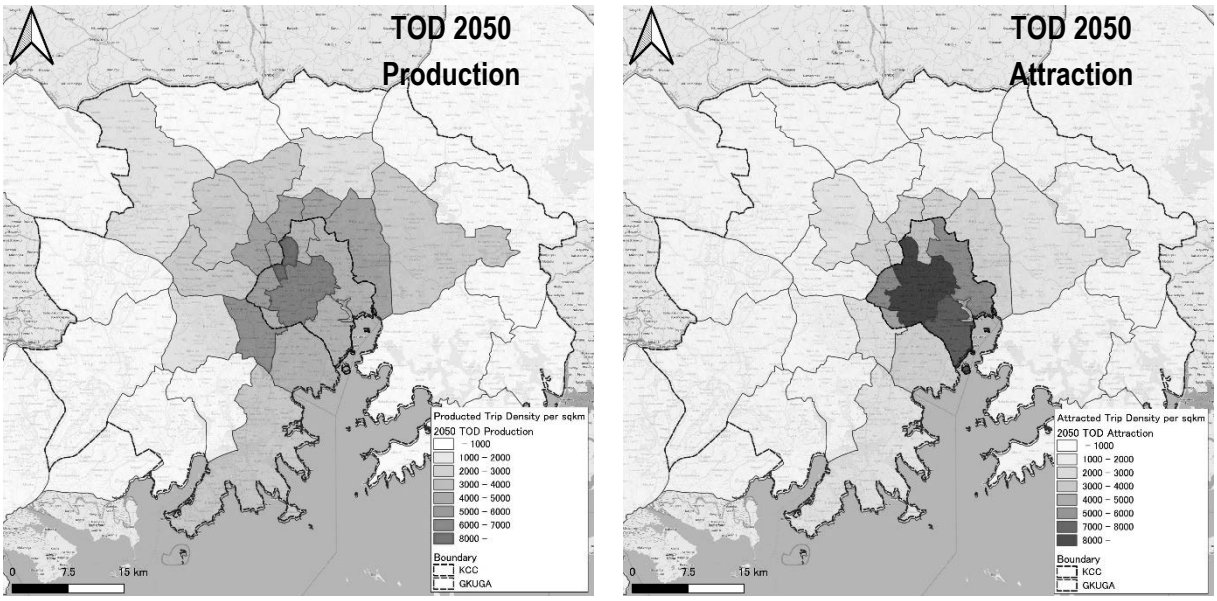

Base 2021
Attraction
Attracted Trip Density per sqkm
2021 Base Attraction
- 1000
1000 - 2000
2000 - 3000
3000 - 4000
4000 - 5000
8000 -
Boundary
KCC
GKUGA
0 7.5 15 km


Do Minimum 2050
Production
Producted Trip Density per sqkm
2050 Do Minimum Production
- 1000
1000 - 2000
2000 - 3000
3000 - 4000
4000 - 5000
5000 - 6000
6000 - 7000
7000 - 8000
8000 -
Boundary
KCC
GKUGA
0 7.5 15 km


Do Minimum 2050
Attraction
Attracted Trip Density per sqkm
2050 Do Minimum Attraction
- 1000
1000 - 2000
2000 - 3000
3000 - 4000
4000 - 5000
5000 - 6000
6000 - 7000
8000 -
Boundary
KCC
GKUGA
0 7.5 15 km


MMUTMP 2050
Production
Producted Trip Density per sqkm
2050 MMUTMP Production
- 1000
1000 - 2000
2000 - 3000
3000 - 4000
4000 - 5000
5000 - 6000
6000 - 7000
7000 - 8000
8000 -
Boundary
KCC
GKUGA
0 7.5 15 km


MMUTMP 2050
Attraction
Attracted Trip Density per sqkm
2050 MMUTMP Attraction
- 1000
1000 - 2000
2000 - 3000
3000 - 4000
4000 - 5000
5000 - 6000
7000 - 8000
8000 -
Boundary
KCC
GKUGA
0 7.5 15 km

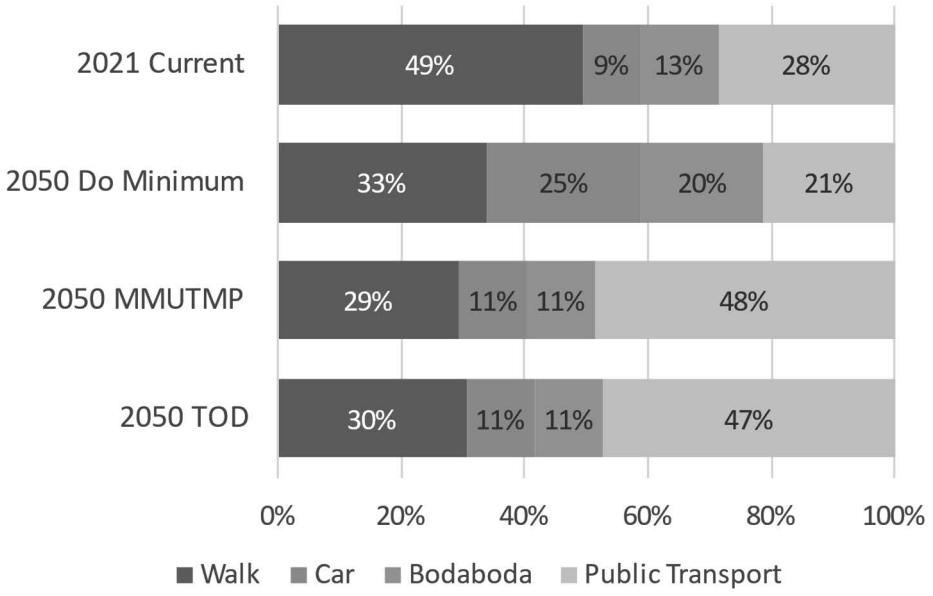


Source: JICA Expert Team

Figure 14.5.12 Density of Produced and Attracted Trips by Scenarios

(2) Modal Share

Figure 14.5.13 illustrates a comparison of modal share by scenario. Do Minimum scenario have the highest private cars and boda-boda modal share compared to the other two scenarios due to insufficient public transport network.



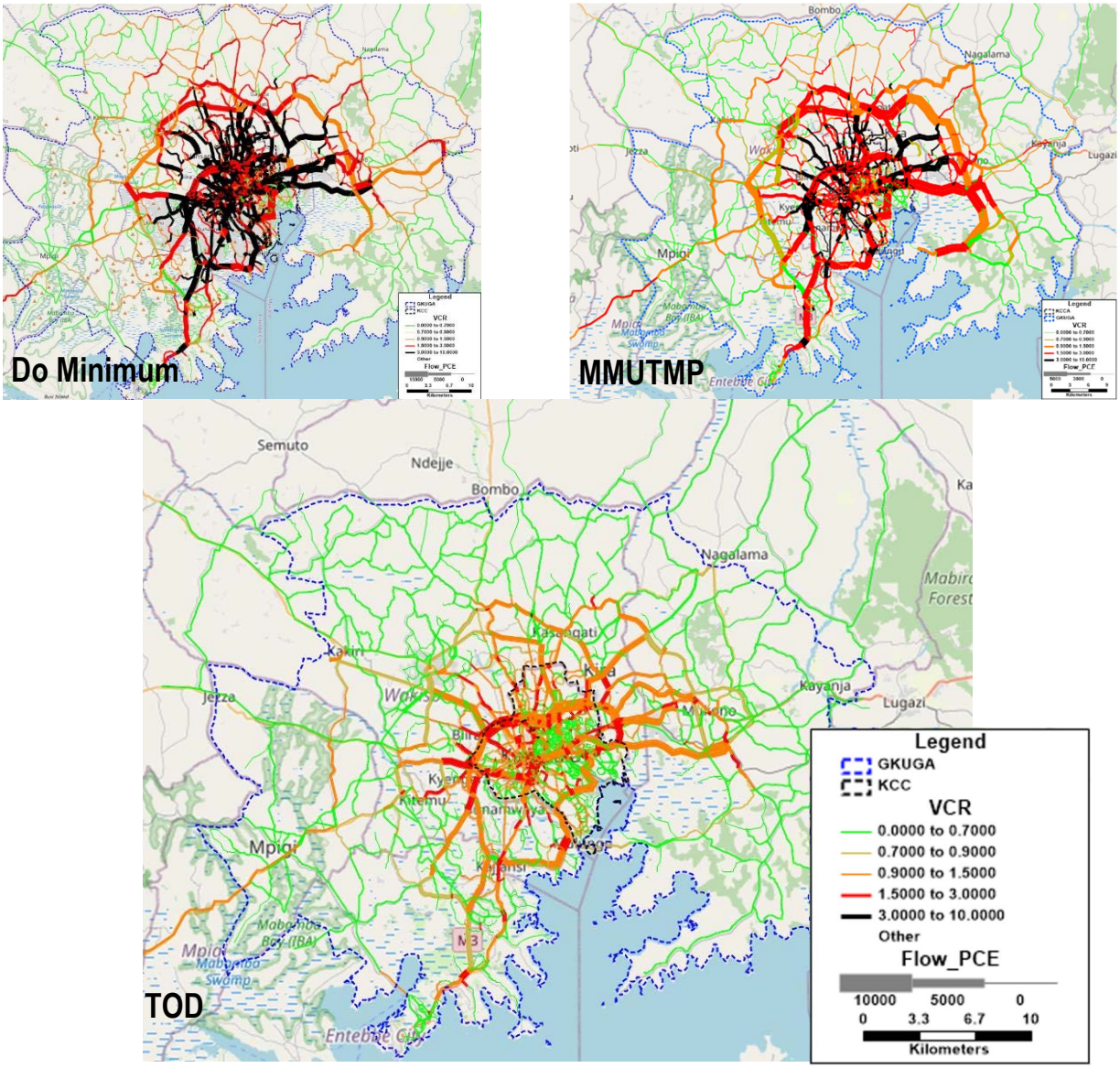
Source: JICA Expert Team

Figure 14.5.13 Comparison of Modal Share by 2050 AM Peak Scenarios

(3) Private Vehicle Volume to Capacity Ratio (VCR) and Traffic Volume Flow

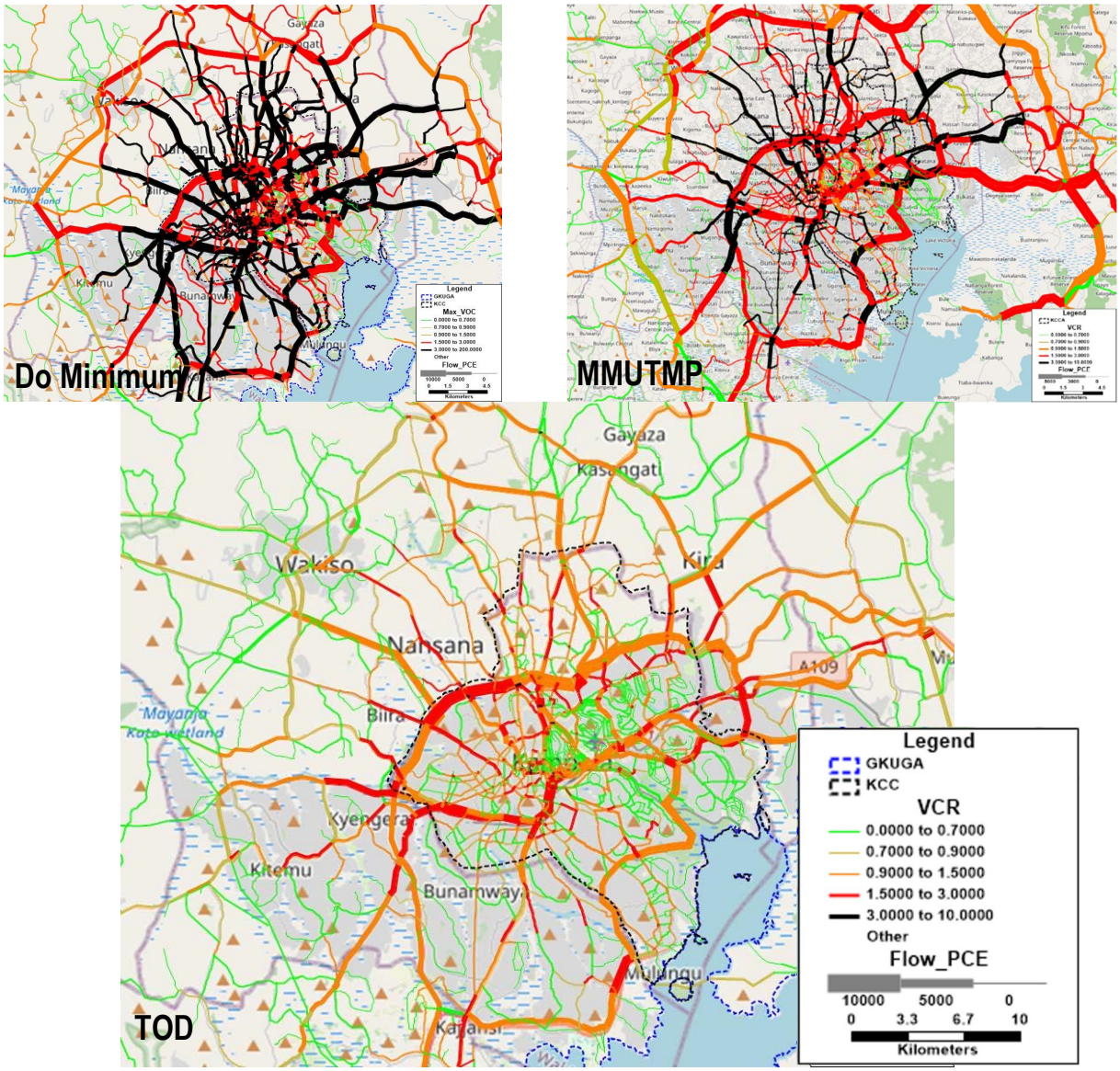
Figure 14.5.14 and Figure 14.5.15 show the volume to capacity ratio (VCR) in each scenario. The roads with VCR higher than 3 are observed in most of the major radial roads in Kampala, due to the centralisation of workplaces in Kampala city centre, and the sprawl of residential area in the sub-urban area.

TOD scenario has a lower VCR compared with the other two scenarios, having fewer roads that have a VCR higher than 3. The large traffic flow volume can be observed along the inner ring road (Northern Bypass – Kampala Entebbe Expressway – Southern Bypass). However, roads with VCR higher than 1.5 indicated in red colour are still existing in the main radial corridors connecting to Kampala's city centre area, namely, Entebbe Road, Jinja Road and Kibuye-Busega Expressways.



Source: JICA Expert Team

Figure 14.5.14 AM Peak Private Vehicle Volume to Capacity Ratio and Flow Volume in GKUGA, 2050

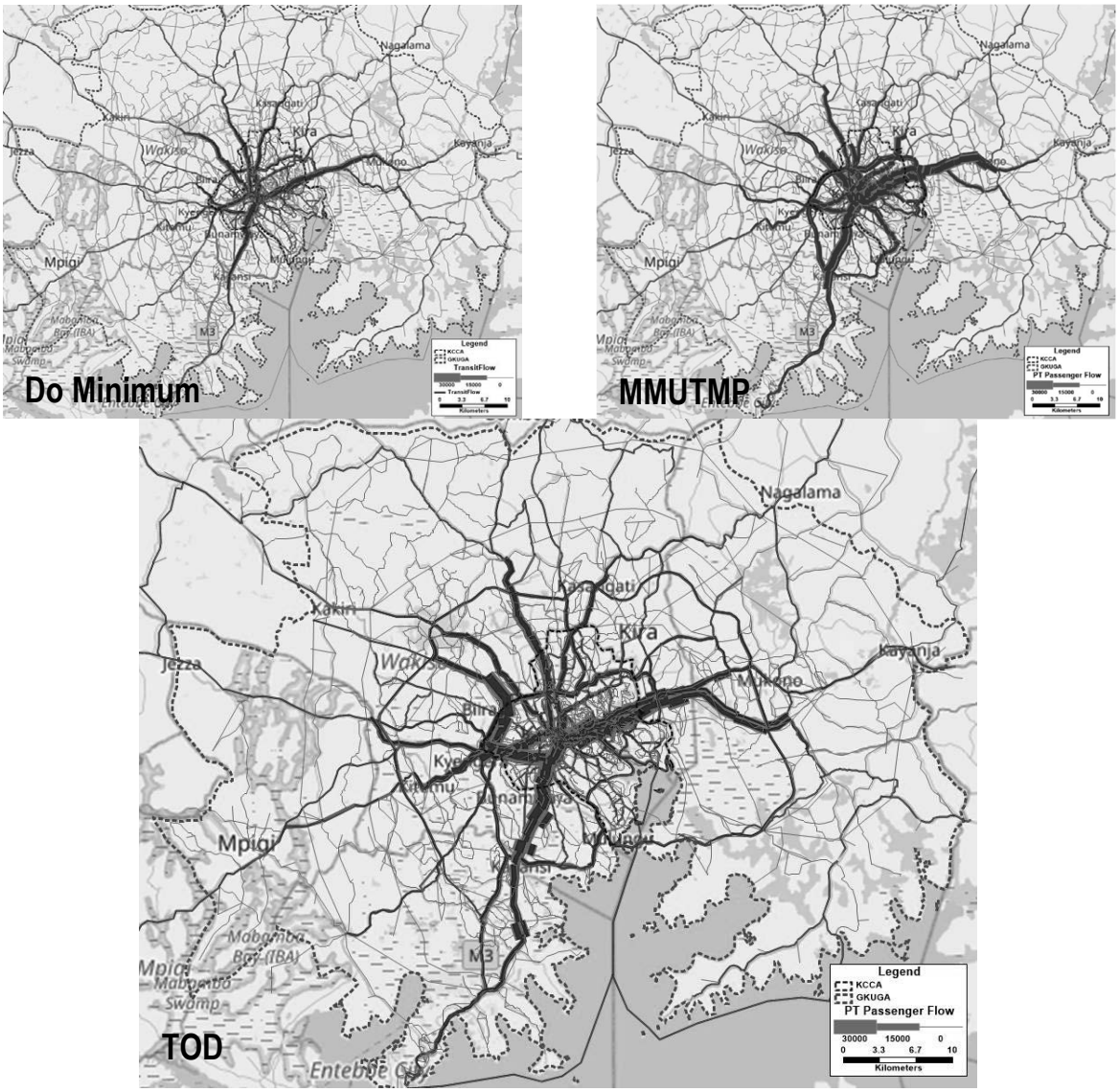


Source: JICA Expert Team

Figure 14.5.15 AM Peak Private Vehicle Volume to Capacity Ratio and Flow Volume in KCC, 2050

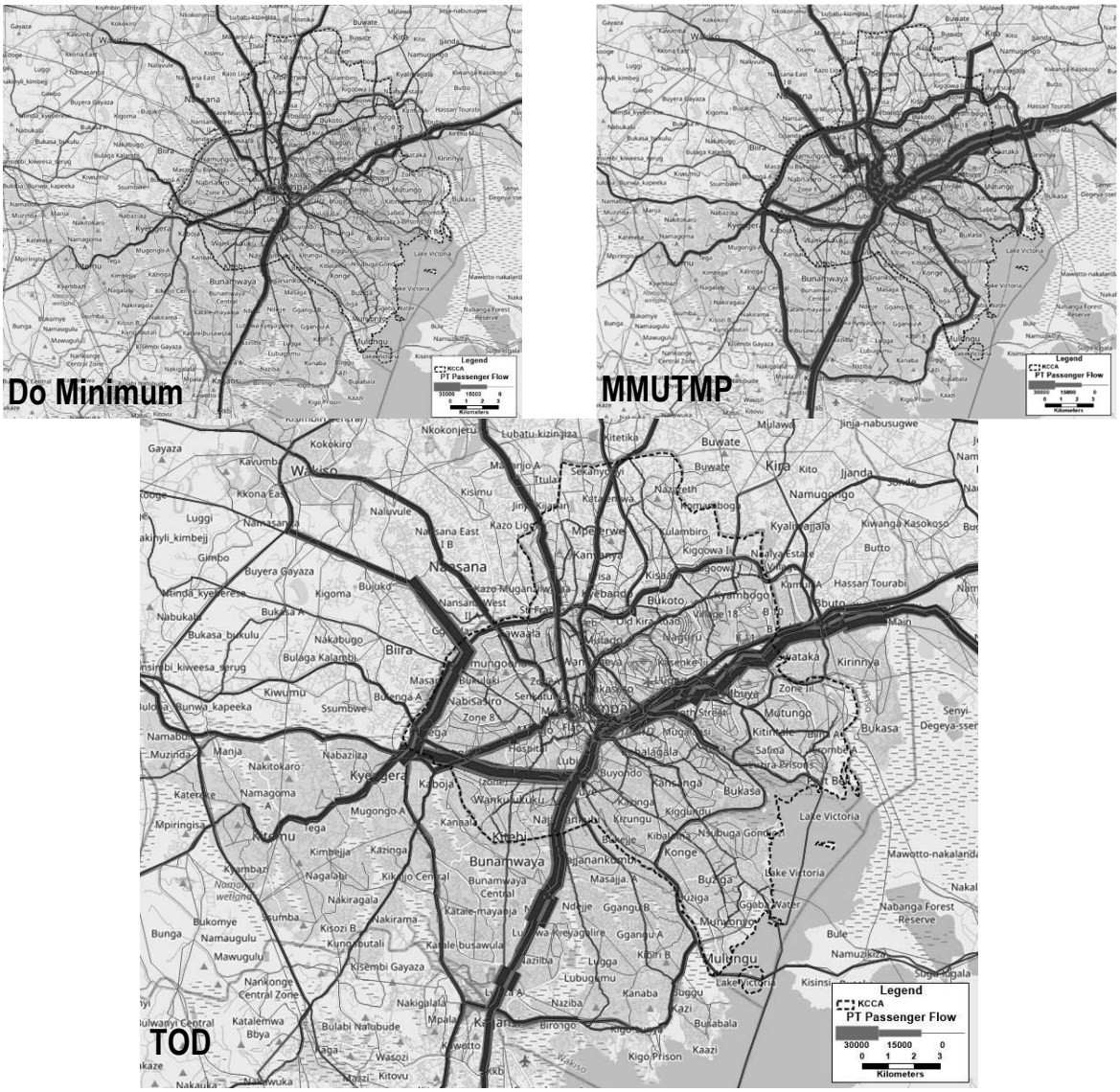
(4) Public Transport Passenger Flow

Figure 14.5.16 and Figure 14.5.17 illustrate the public transport passenger flow in each scenario. The Do Minimum scenario has the least passenger flow volume due to insufficient network compared with the other two scenarios. The large passenger flow volume can be expected for the metre gauge railway from Kampala to Mukono, and from Kampala to Kyengera.



Source: JICA Expert Team

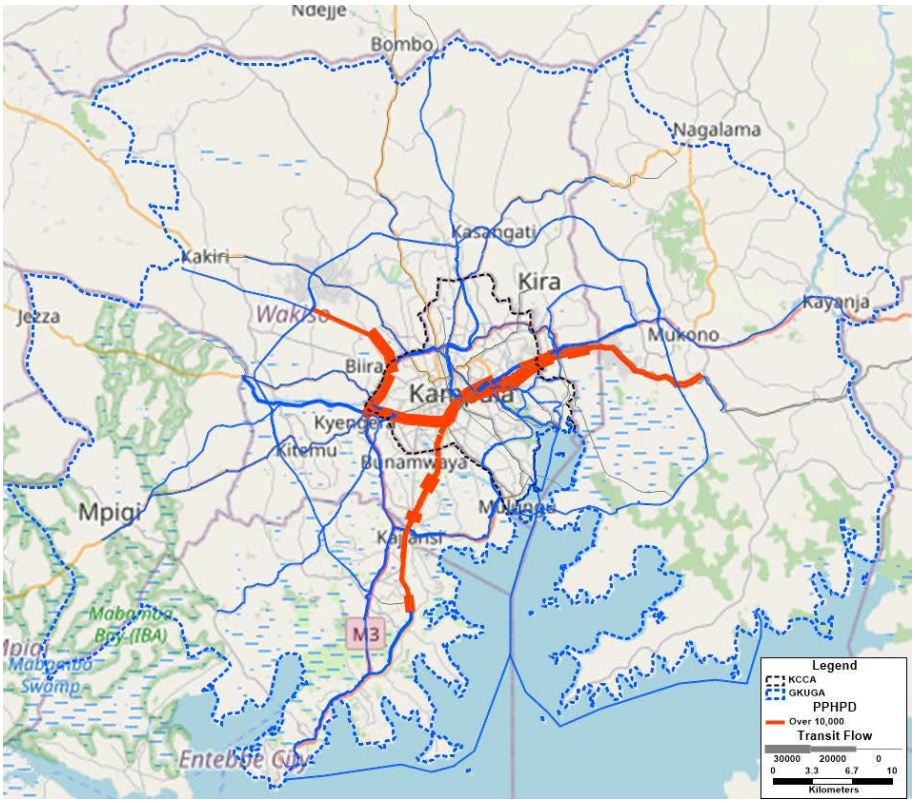
Figure 14.5.16 AM Peak Public Transport Passenger Flow in GKUGA, 2050 Future Scenarios



Source: JICA Expert Team

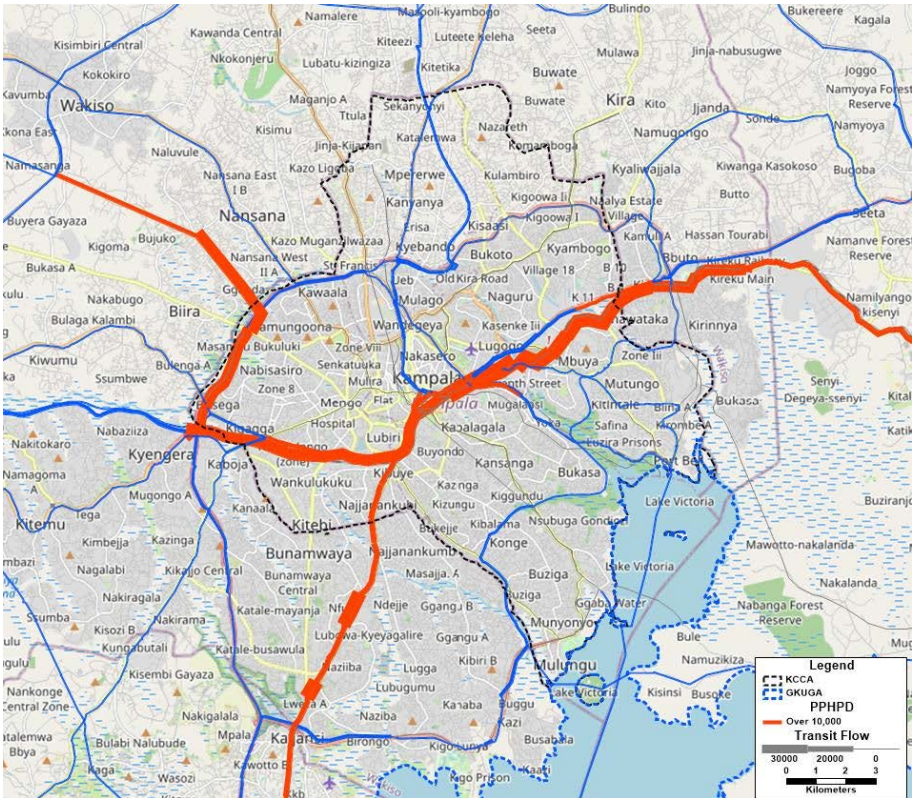
Figure 14.5.17 AM Peak Public Transport Passenger Flow in KCC, 2050 Future Scenarios

The PPHPD (passengers per hour per direction) was calculated to check whether the hourly capacity of each mode was not exceeding the passenger demand. Considering its capacity of one BRT vehicle and the frequency that can service within an hour, the hourly maximum capacity of the BRT was assumed as 10,000 passengers/hour/direction. As illustrated in Figure 14.5.18, and Figure 14.5.19 illustrates the public transport passenger flow of MRT, BRT and Rail, showing the section that exceeds 10,000 passengers/hour/direction in red colour. As illustrated in the figures, in the 2050 TOD scenario, most of the section that exceeds BRT capacity are those which can carry more passengers than BRT, such as the LRT line from Kampala to Entebbe, and improved railway lines from Mukono to Kyengera, and MRT line from Kyengera to Wakiso.



Source: JICA Expert Team

Figure 14.5.18 AM Peak Public Transport Flow (Excluding Taxis) in GKUGA, 2050 TOD Scenario



Source: JICA Expert Team

Figure 14.5.19 AM Peak Public Transport Flow (Excluding Taxis) in KCC, 2050 TOD Scenario

(5) Assignment Statistics

The assignment statistics by travel demand forecast scenario are described in Table 14.5.3.

Table 14.5.3 Assignment Statistics by Travel Demand Forecast Scenario

Indicator	Do Minimum 2050	MMUTMP 2050	TOD 2050
Vehicle Km Travelled	11,903,638	7,031,474	5,187,818
Passenger Hour Travelled	545,833,679	18,104,297	8,646,852
Vehicle Operation Cost (Mil. $/year)	5,136	2,876	1,984
Travel Cost (Mil. $/year)	669,935	22,003	6,150

Source: JICA Expert Team

14.5.4 Multicriteria Analysis (MCA)

(1) Criteria of MCA

Three alternative scenarios of transport network development were evaluated using multi-criteria analysis (MCA) considering various criteria shown in Table 14.5.4.

Table 14.5.4 Result of MCA

Criterion	Indicator	Unit	Base 2021	Do Minimum 2050		MMUTMP 2050		TOD 2050	
			Value	Value	Score	Value	Score	Value	Score
Economic Benefit	Travel Time	Passenger-billion hour/year (Passenger hour/person/year)	7.66 (1,324)	818.75 (48,993)	D	27.16 (1,625)	D	12.97 (926)	A
	Vehicle Operation Cost	Million $/year ($ /person/year)	1,386 (239.5)	5,136 (307.4)	C	2,876 (172.3)	B	1,984 (141.7)	A
Equity	Population coverage of high service level public transport*1 station within 1km	Percentage	0%*2	7.5%	B	22.3%	A	30.2%	A
Environmental Sustainability	CO_2 emissions from vehicles	Million ton/year (ton/person/year)	1,235 (213.5)	4,541 (271.7)	D	2,574 (154.0)	C	1,843 (131.7)	A
Safety and Security	Traffic accident risk	N/A	Baseline	Significant increase	D	Reduction of risk	B	Reduction of risk	B
Attractiveness	Walkability of NMT Infrastructures	N/A	Baseline	Same as the base year	C	Improved walkability	B	Improved walkability	B
Feasibility	Issues of land acquisition, technical issues and financial constraint	N/A	Baseline	Minimum land acquisition & investment	B	Highest initial cost and significant land acquisition	D	Moderate initial cost and significant land acquisition	C
Total					**C**		**B**		**A**

Note: Explanation of the Scores

A: The value of the indicator becomes a lot better than that of the base year.

B: The value of the indicator becomes a little better than that of the base year.

C: The value of the indicator will be the same as that of the base year.

D: The value of the indicator becomes worse than that of the base year.

*1: High-service level public transport is BRT, LRT, MRT and railway

*2: Although URC currently operates the metre-gauge railway service from Kampala to Namanve Industrial Park, the service level is not high considering its frequency and operation speed, as described in the present situation of the transport sector (Section 14.4). Thus, it was not counted as high-service level public transport.

Source: JICA Expert Team

(2) Method of Estimating Indicators

The following quantitative indicators were estimated using the following methodologies:

- Travel Time (passenger-billion hour /year): Calculated based on the travel time and the traffic flow volume in each link of road and public transport network, obtained from the result of the traffic assignment model in the travel demand forecast model.
- Population coverage that can access high-service level public transport (BRT, LRT, MRT and railway) station within 1km: Calculated based on spatial analysis using public transportation station buffer coverage and population by TAZ (Traffic Analysis Zone).
- CO_2 emission from vehicles (million tons/year): The unit CO_2 emission volume (grams/vehicle-km) by speed range by vehicle type was estimated based on the Highway Development and Management Model Four (HDM-4) developed by the World Bank. The total CO_2 emission was calculated by multiplying the unit CO_2 emission volume with the vehicle flow volume and travel distance.

(3) Results of Multicriteria Analysis

As a result of MCA, it was found that the TOD scenario is the best among the three scenarios evaluating various criteria and indicators. However, the traffic congestion inside the GKMA area continues and grows compared with the current traffic condition. The result of the travel demand forecast shows the capacity of public transport exceeds its capacity in the critical sections. Considering the above result, the study team is now examining the revision of the TOD scenario by applying various transport-related countermeasures such as the application of road-pricing in the CBD area, utilisation of inland waterway network, road-widening of major radial roads, to alleviate the traffic congestion in the TOD scenario.

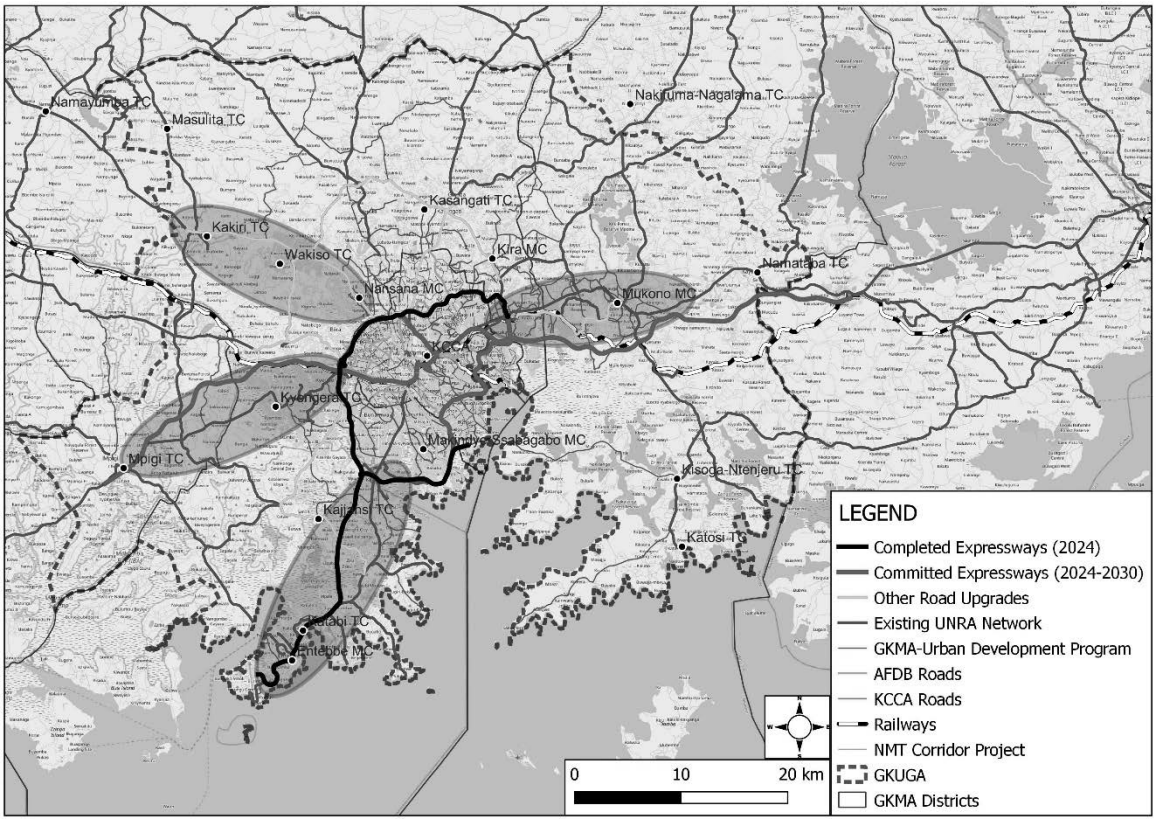
14.5.5 Travel Demand Forecast Result of Mid-Term Years

The travel demand forecast for the mid-term years of 2030 and 2040 was conducted, to check whether the assumed transport infrastructure development in the TOD scenario contributes to alleviating traffic congestion in the mid-term years of 2030 and 2040.

(1) Development of Socio-Economic Framework and Transport Network

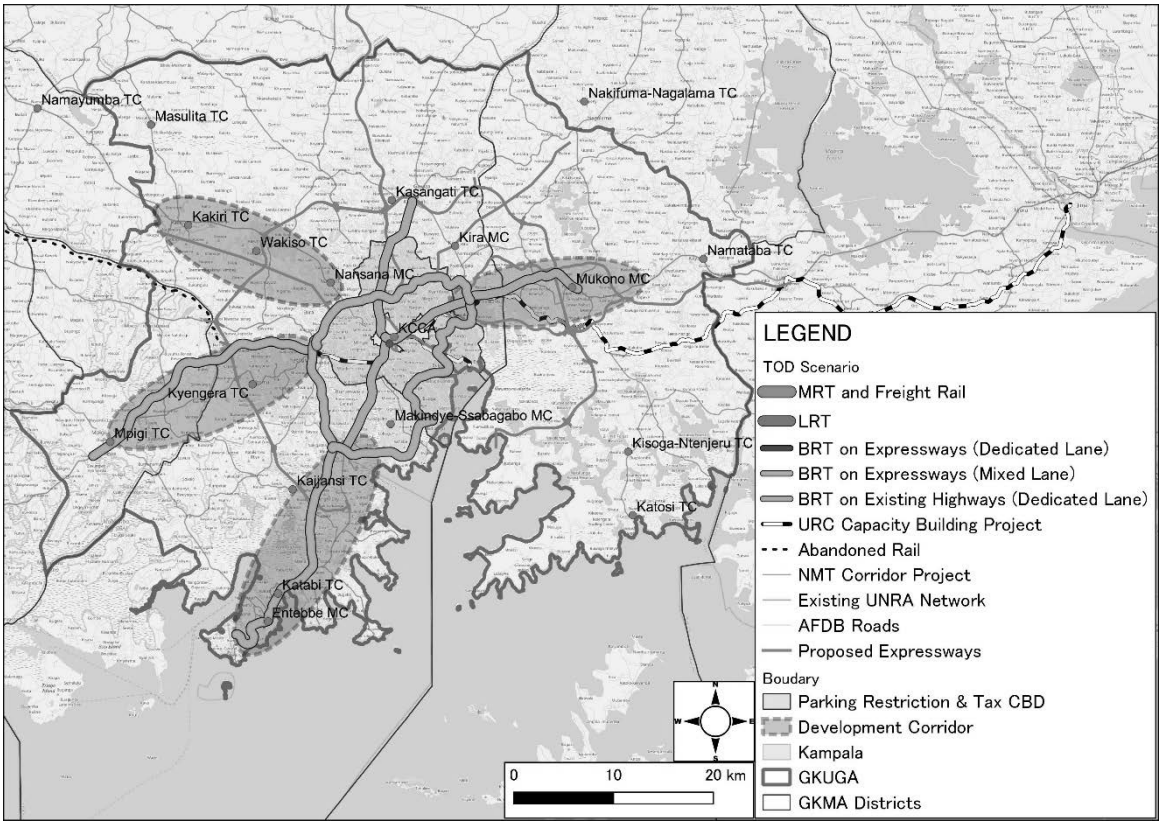
The socio-economic framework for mid-term years was developed considering urban structure in the mid-term years.

The transport network for mid-term years was also developed considering transport projects that will be committed during each phase of short (2024-2030), middle (2031-2040) and long (2041-2050). Figure 14.5.20, and Figure 14.5.21 illustrate the road and public transport network in 2030. Figure 14.5.22, and Figure 14.5.23 illustrate the road and public transport network in 2040. Figure 14.5.24, and Figure 14.5.25 illustrate the road and public transport network in 2050.



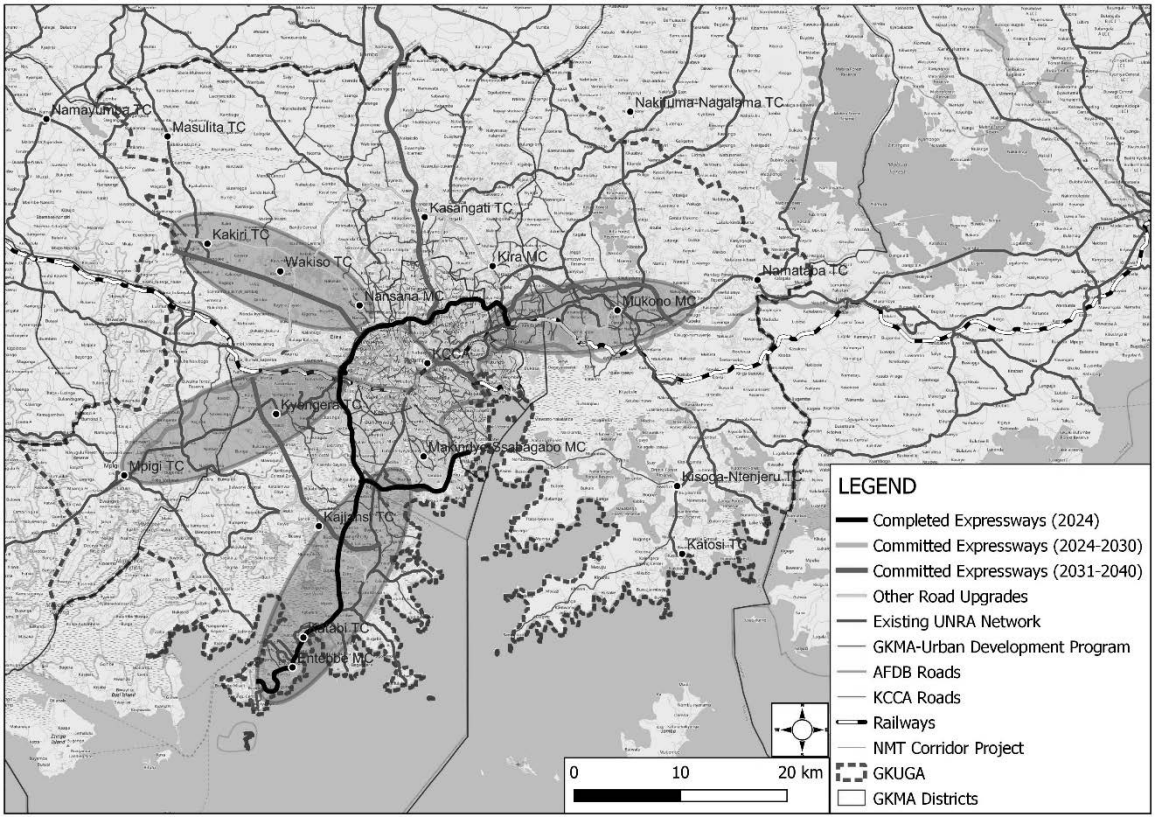
Source: JICA Expert Team

Figure 14.5.20 Road Projects Committed during 2024-2030 (Short Term)



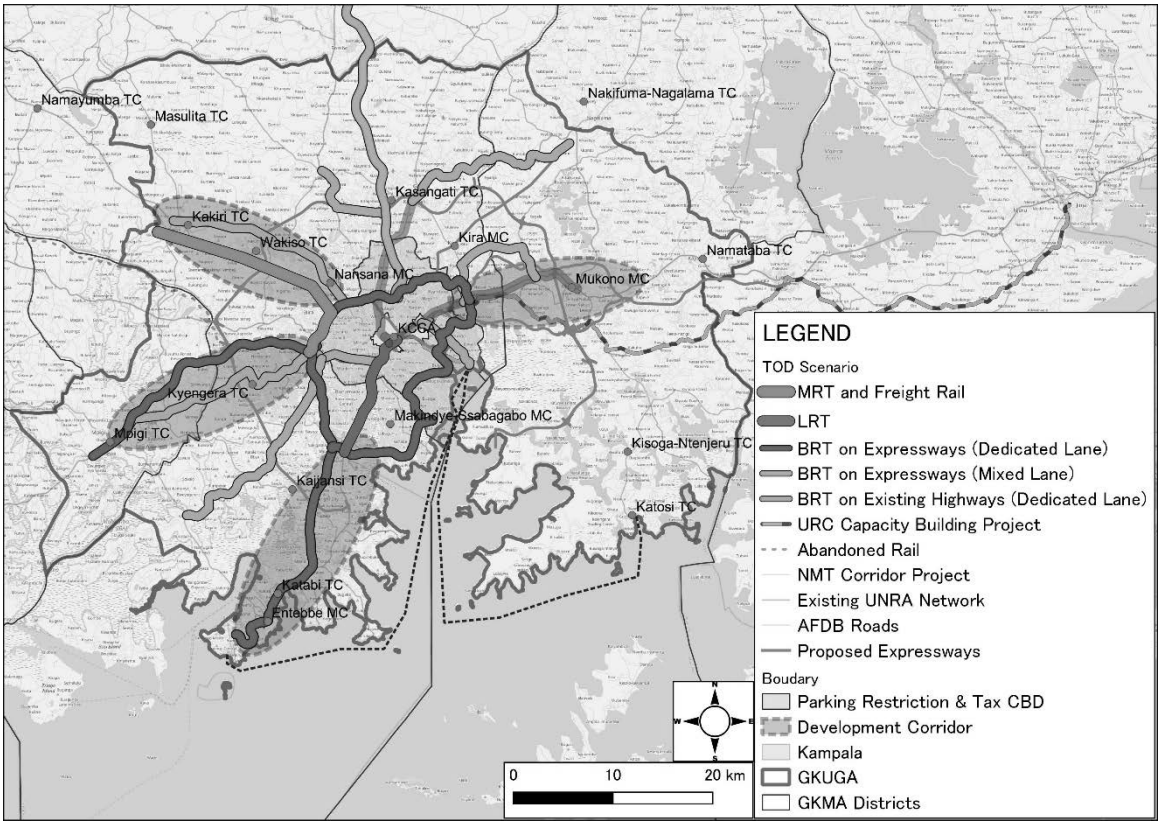
Source: JICA Expert Team

Figure 14.5.21 Public Transport Projects committed during 2024-2030 (Short Term)



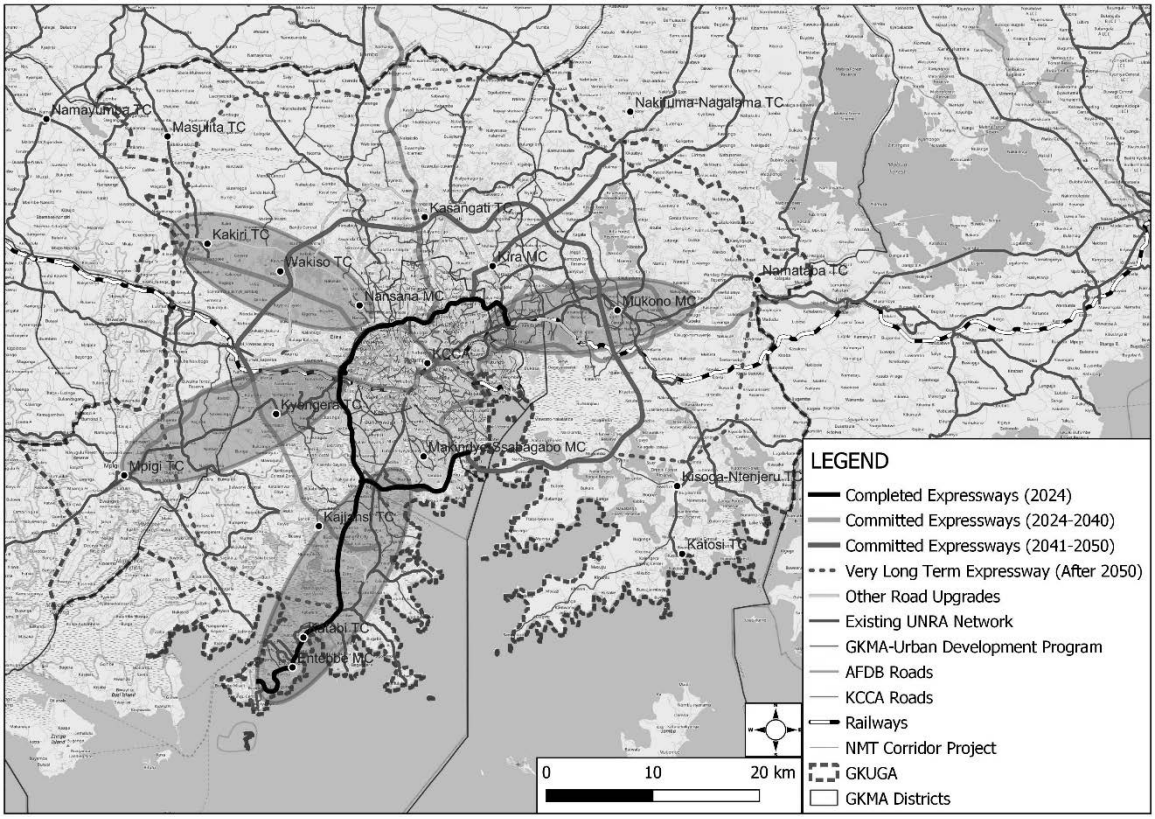
Source: JICA Expert Team

Figure 14.5.22 Road Projects committed during 2031-2040 (Middle Term)



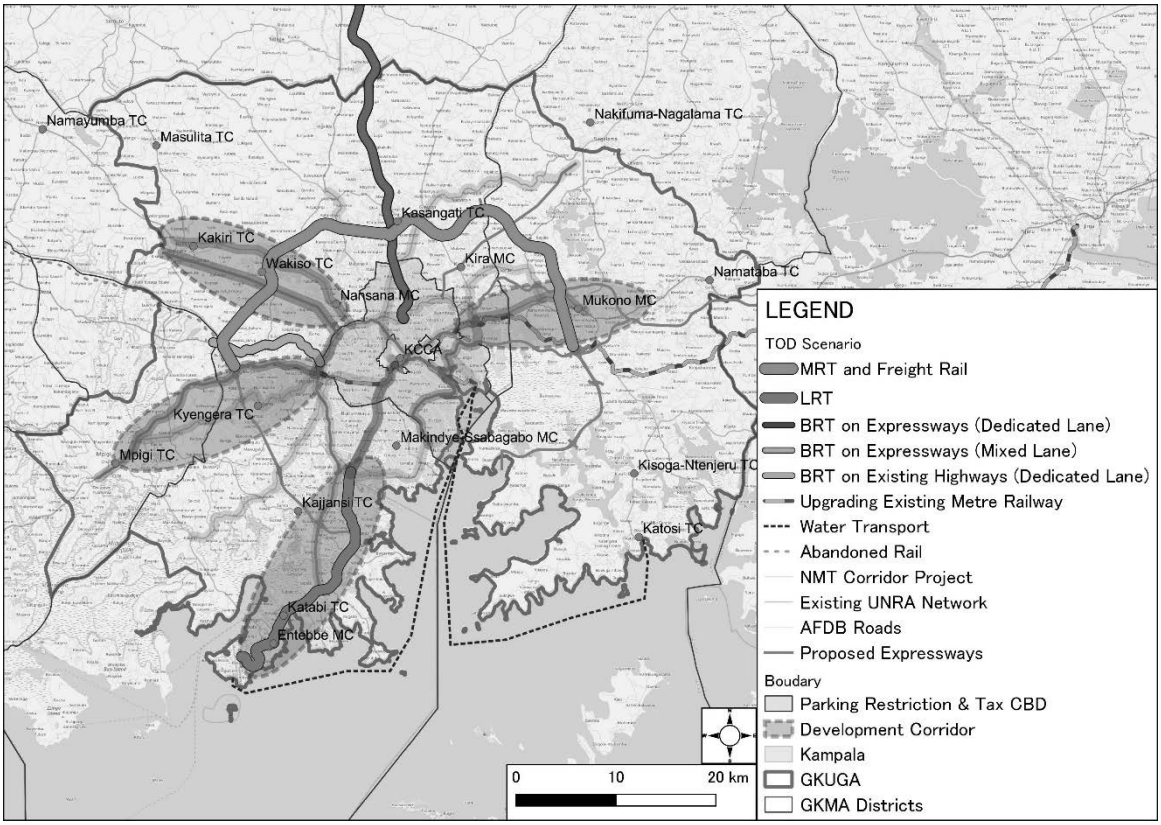
Source: JICA Expert Team

Figure 14.5.23 Public Transport Projects committed during 2031-2040 (Middle Term)



Source: JICA Expert Team

Figure 14.5.24 Road Projects committed during 2041-2050 (Long Term)

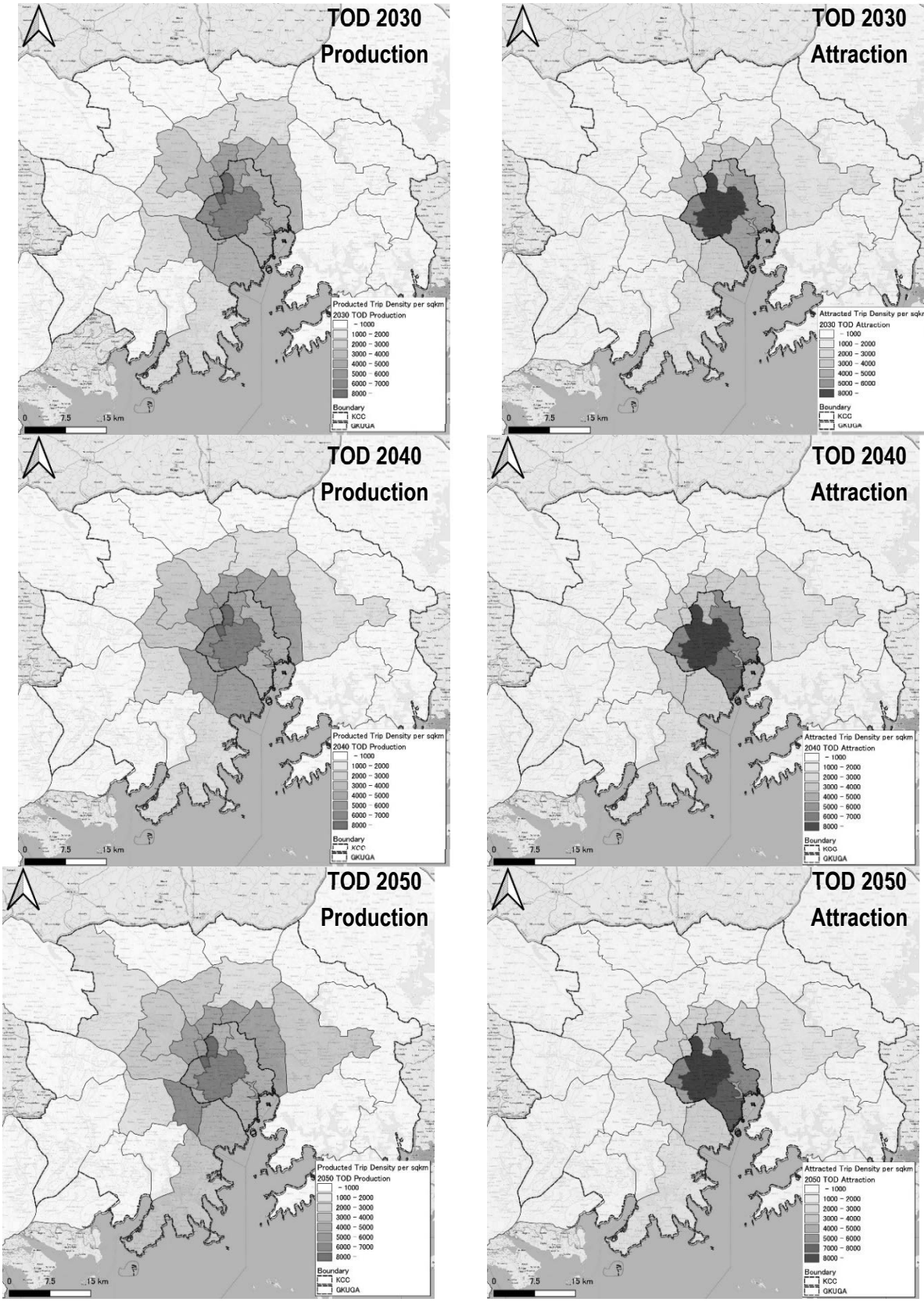


Source: JICA Expert Team

Figure 14.5.25 Public Transport Projects Committed during 2041-2050

(2) Distribution of Generated and Attracted Trips

Figure 14.5.26 illustrates the distribution of generated and attracted trip density in 2030, 2040 and 2050.

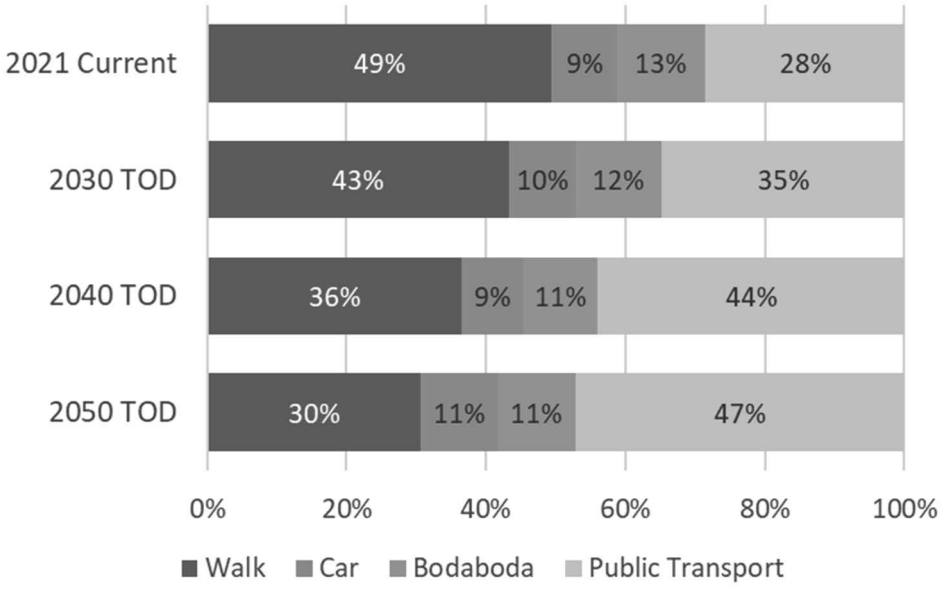


Source: JICA Expert Team

Figure 14.5.26 Density of Produced and Attracted Trips in 2030, 2040 and 2050

(3) Modal Share

Figure 14.5.27 illustrates a comparison of modal share for years 2030, 2040 and 2050 in the TOD scenario estimated by the travel demand forecast model. Year 2030 will have the lowest share of public transport with 35%, due to insufficient levels of public transport network development, such as BRT and MRT. As indicated in Section 14.6.5, those BRT and MRT are expected to be open by 2040. Therefore, the modal share of public transport is expected to increase rapidly between the years 2030 and 2040, from 35% to 44%.

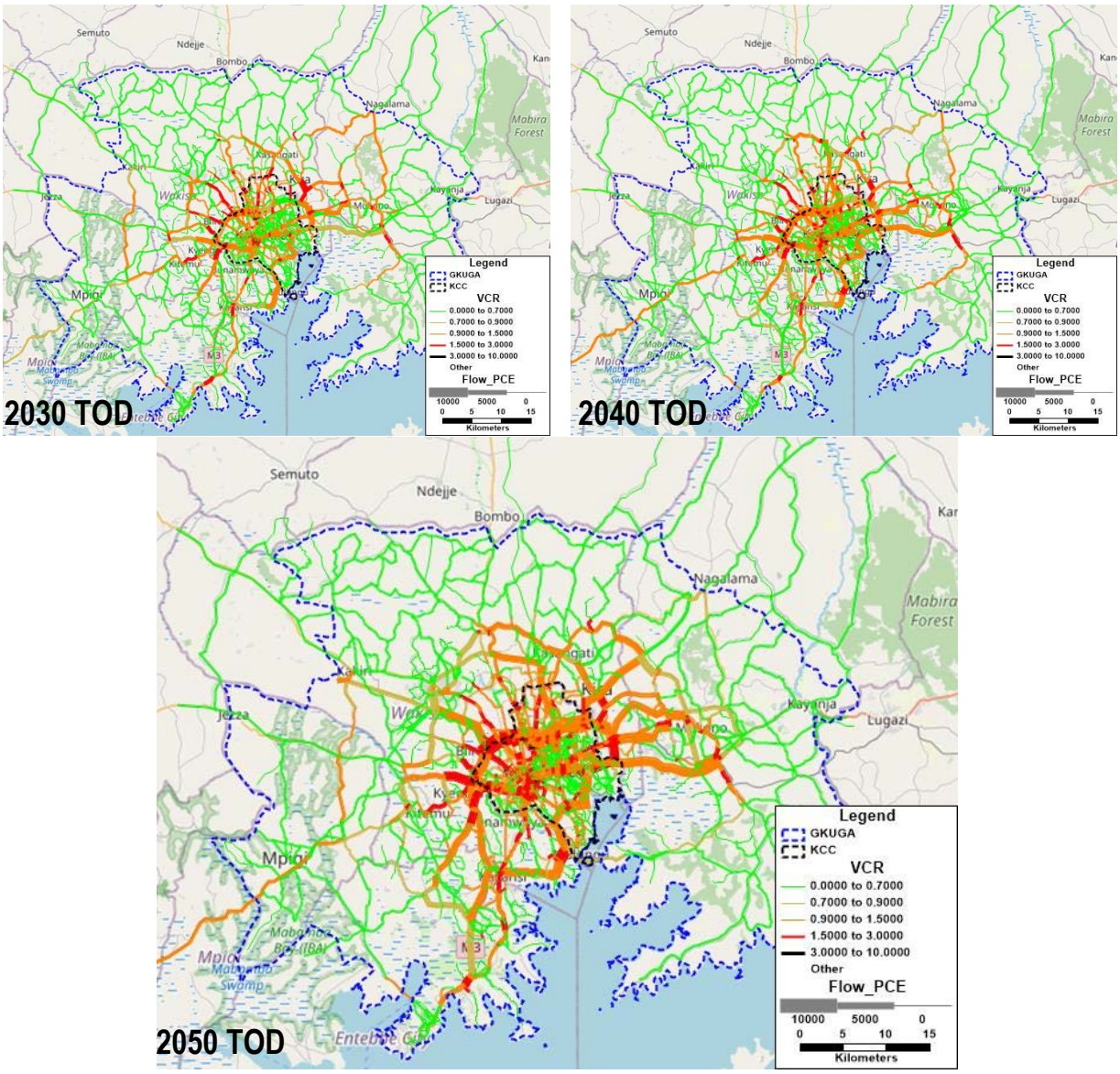


Source: JICA Expert Team

Figure 14.5.27 Comparison of Modal Share by Years of 2030, 2040 and 2050 in TOD Scenario

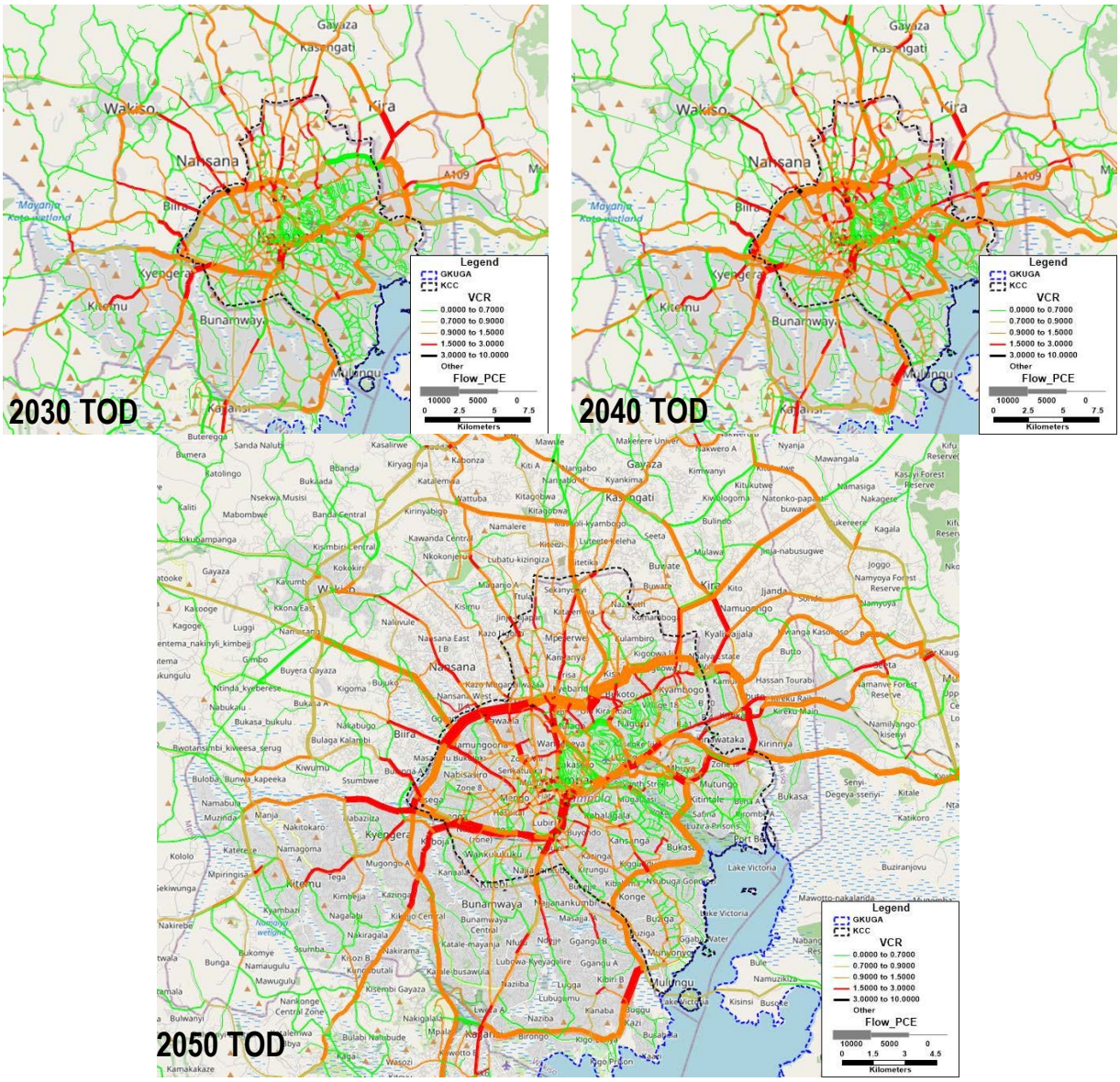
(4) Private Vehicle Volume to Capacity Ratio (VCR) and Traffic Volume Flow

Figure 14.5.28 and Figure 14.5.29 show the volume to capacity ratio (VCR) of the TOD scenario in the years 2030, 2040 and 2050. In 2040, the traffic congestion will be the worst in three years, having the most sections that have high VCR.



Source: JICA Expert Team

Figure 14.5.28 Peak Private Vehicle Volume to Capacity Ratio and Flow Volume in GKUGA, 2030, 2040, and 2050

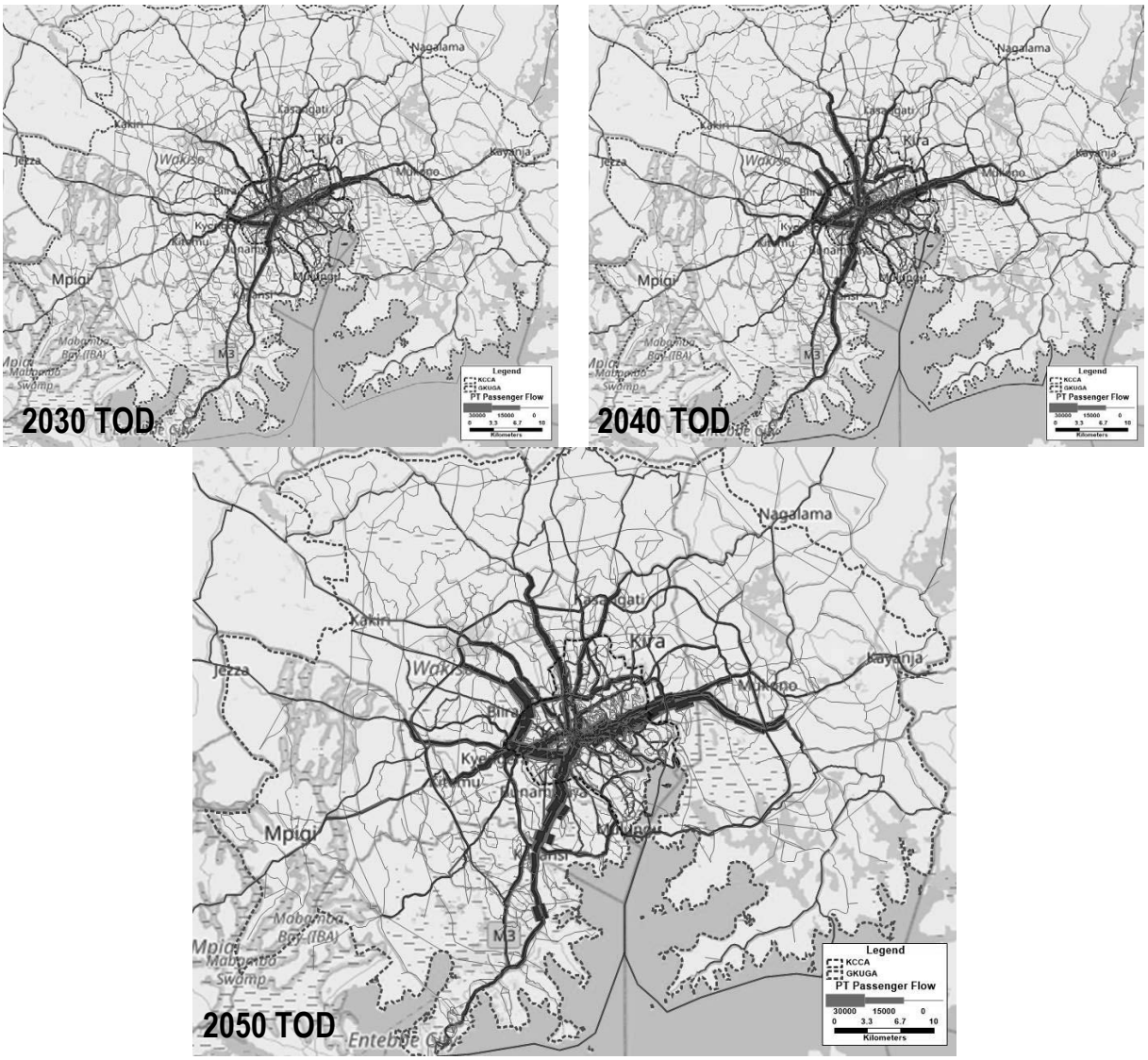


Source: JICA Expert Team

Figure 14.5.29 Peak Private Vehicle Volume to Capacity Ratio and Flow Volume in KCC, 2030, 2040, and 2050

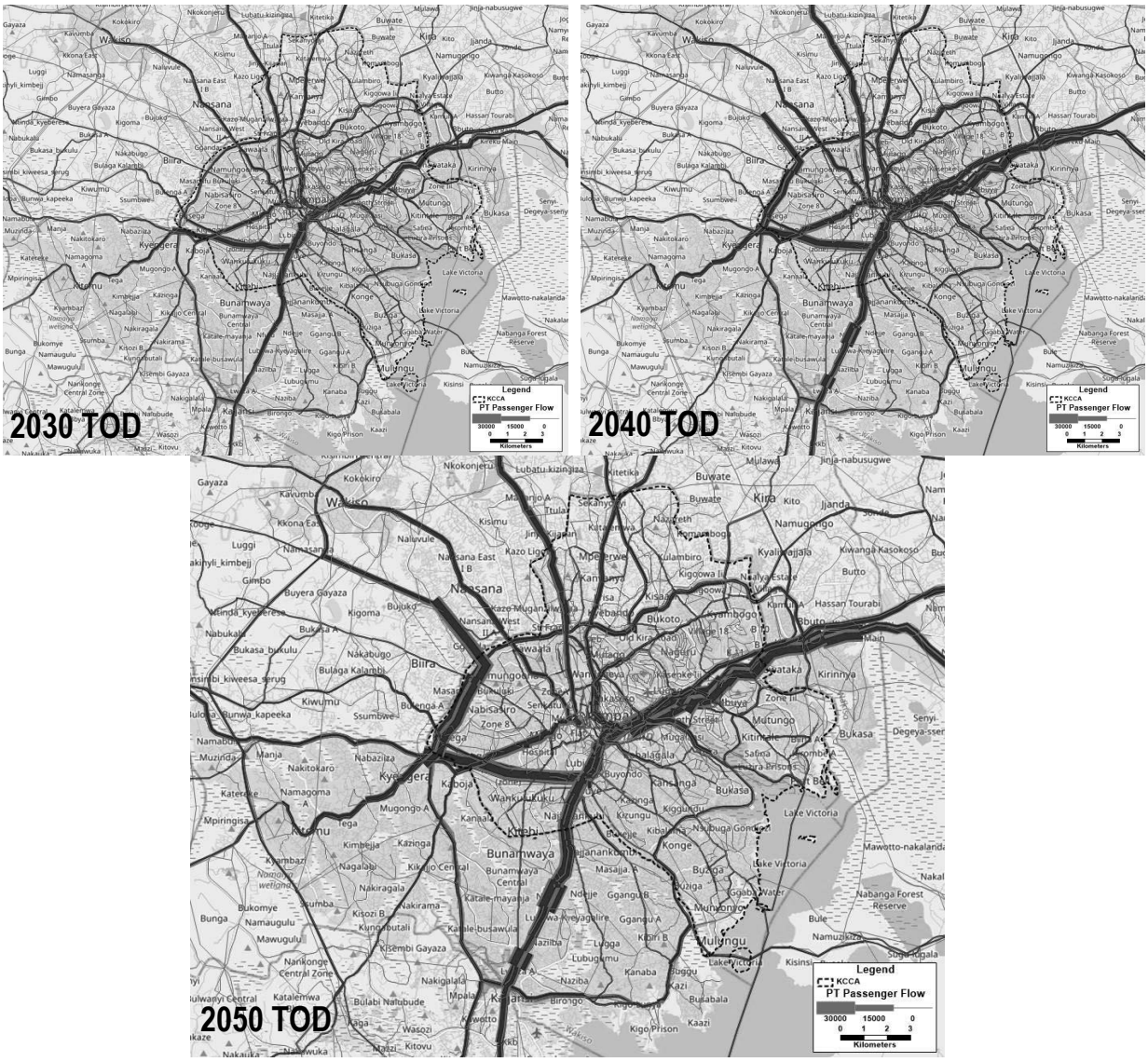
(5) Public Transport Passenger Flow

Figure 14.5.30 and Figure 14.5.31 illustrate the public transport passenger flow for the TOD scenario in the years 2030, 2040, and 2050. In 2030, the major flow of public transport passengers is Kampala-Mukono, Kampala-Kyengera, and Kampala-Kajansi, which demand is carried by the construction of BRT pilot projects and improvement of existing metre gauge railway projects. In 2040 and 2050, the flow of public transport will increase in other corridors as the BRT network develops in other corridors.



Source: JICA Expert Team

Figure 14.5.30 AM Peak Public Transport Passenger Flow in GKUGA, 2030, 2040, and 2050 TOD Scenario



Source: JICA Expert Team

Figure 14.5.31 AM Peak Public Transport Passenger Flow in KCC, 2030, 2040, and 2050 TOD Scenario

(6) Assignment Statistics

The assignment statistics by assignment years in the TOD scenario are described in Table 14.5.5.

Table 14.5.5 Assignment Statistics by Estimation Years

Indicator	TOD 2030	TOD 2040	TOD 2050
Vehicle Km Travelled	3,669,287	4,192,010	5,187,818
Passenger Hour Travelled	8,313,309	8,393,478	8,694,722
Vehicle Operation Cost (Mil. $/year)	1,329	1,539	1,984
Travel Cost (Mil. $/year)	5,479	5,644	6,150

Source: JICA Expert Team

14.6 Projects for the Transport Sector

14.6.1 Tactics of Staged Network Development

(1) Land Acquisition and Development Control at an Earlier Timing

Transport network infrastructure development such as roads and railways requires huge costs and time. Limited lands in urbanised areas lead to expensive elevated and underground structures and land acquisition.

Financial capacity is limited for the government sector in the short term. On the other hand, land price increases due to price escalation, and transport infrastructure development induce land price increases in the long-term. Land price is a significant financial burden in the long term.

In suburban areas, infrastructure development should be included in a new town development project as its future residents will utilise infrastructures.

By utilising a limited budget for land acquisition in the short term, it can avoid huge land acquisition costs in the long term. Meanwhile, minimum transport infrastructure such as pavement and bus rapid transit can be enough for short-term travel demand. This approach can avoid future "gridlock" of increased travel demand and increased land prices. Land acquisition at an earlier stage of network infrastructure development can also enhance investment from the private sector as it is one of the key risk factors for investment.

(2) Joint Development of Road and Public Transport Network Infrastructures

New transport network infrastructure development is implemented independently by each organisation such as the MoWT, UNRA and URC. This means that land acquisition has to be done by each organisation. For instance, the 2nd Ring (Middle Ring), or Kampala Outer Beltway, is to be implemented by UNRA while the National Integrated Transport Master Plan proposed that the Kampala Rail Bypass shall be developed by URC.

By joint development of both road and public transport infrastructure adjacently in a single right-of-way, reduces the number of land parcels. It also should be noted that the MDAs with vast experiences in land acquisition such as UNRA can transfer their knowledge of land acquisition to other MDAs and LGs.

(3) Step-by-Step Upgrading of Infrastructures

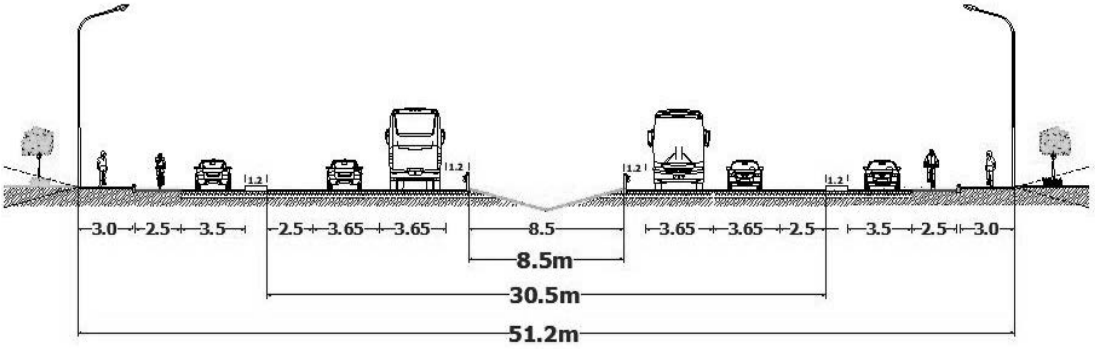
Even before the formulation of a detailed physical development plan, land acquisition for the entire stretch of the planned corridor of a road and public transport shall commence. Lands are recommended to be purchased as early as possible considering future land price increases due to the expected infrastructure development.

After the land acquisition, the minimum infrastructures for the short-term shall be developed such as the 4 lanes of an expressway. An express bus can share lanes with other traffic. It should be noted that lands for a bus stop and its approach should be kept. Vacant land can be left in the middle of the carriageway for future infrastructure development and to avoid illegal settlement (upper image of Figure 14.6.1). The express bus service can share the lane with other traffic. An example of a bus stop for expressway bus service in Japan is shown in Figure 14.6.2.

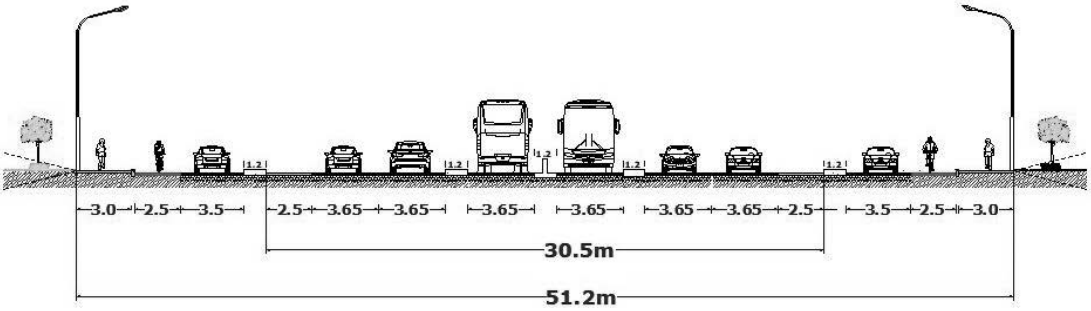
For the medium term, the Bus Rapid Transit (BRT) system can be developed in the middle of the section to provide rapid public transport services (middle image of Figure 14.6.1).

Finally, the elevated public transport system such as mass rapid transit or light rail transit in the median and additional lanes can be developed in case travel demand cannot be handled by the BRT (bottom image of Figure 14.6.1).

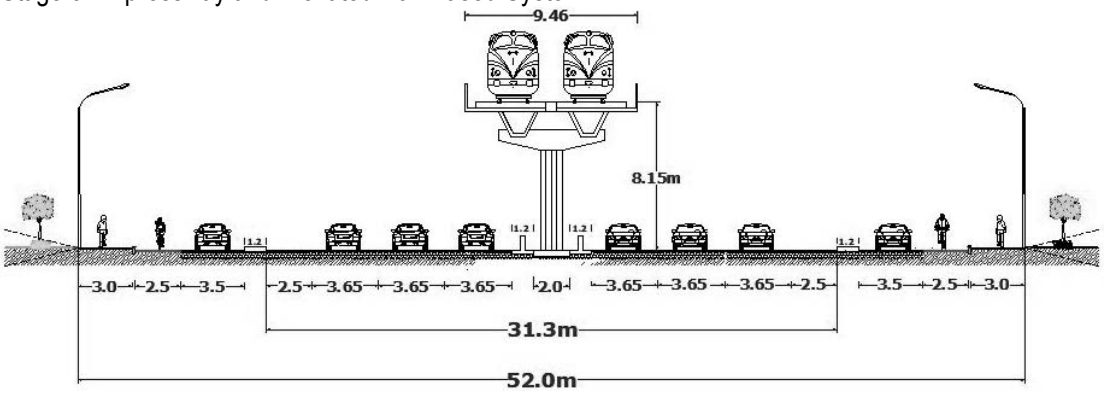
Stage 1: Expressway Bus (no dedicated lane for buses)



Stage 2: Expressway and BRT with dedicated lane

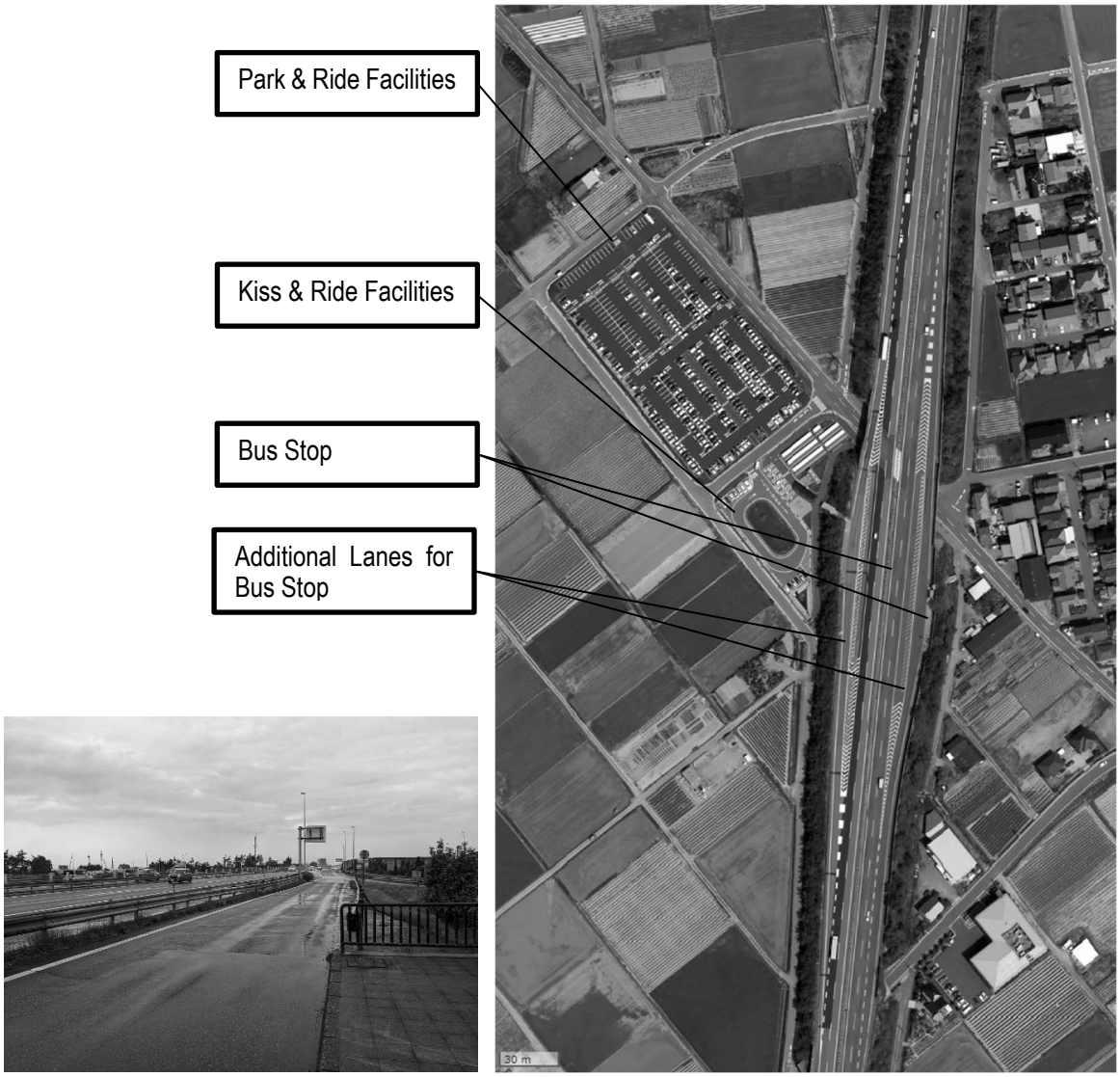


Stage 3: Expressway and Elevated Rail-Based System



Source: JICA Expert Team

Figure 14.6.1 Example of Staged Development of Expressway and BRT Corridor



Maki Katahigashi Bus Stop

Torihara Bus Stop

Nagaokakyo Bus Stop

Hino Bus Stop

Source of top left image (Maki Katahigashi Bus Stop): JICA Expert Team
Source of top right image (Torihara Bus Stop): Geospatial Information Authority of Japan
https://maps.gsi.go.jp/#17/37.850300/139.003687/&base=ort&ls=ort&disp=1&vs=c1g1j0h0k0l0u0t0z0r0s0m0f1&d=m
Source of bottom right image (Hino Bus Stop):
https://contents.trafficnews.jp/image/000/061/711/large_220916_bs_01.jpg
Source of bottom left image (Nagaokakyo Bus Stop): https://smatra.jp/blog/wp-content/uploads/2016/02/kousokunagaokakyo.jpg

Figure 14.6.2 Examples of Bus Stop on Expressway in Japan

14.6.2 Development Policies by Sub-Sector of Transport

This section describes the development policy for each transport mode by the strategy presented in section 14.3 and with reference to the selected network development scenarios in section 14.5.

(1) Rail-based Transit Modes

This section describes the policy for the improvement of existing railways, MRT, LRT and other mass transit systems in the GKUGA.

The railway is a public transport mode with the highest capacity among all land-based public transport. On the other hand, it is the most expensive public transport and, once introduced, it is extremely difficult to change the alignment. Therefore, a feasibility study (F/S) needs to be carried out to examine various aspects such as technical aspects, social environment (including involuntary resettlement), natural environment, economic efficiency, accessibility, maintenance effectiveness and connectivity to the surrounding network, in addition to the traffic demands described in sections 14.4 and 14.5. In this section, the policy for rail-based transit modes is formulated mainly from the perspective of travel demand and the physical space for installation.

1) Upgrading of Exiting and Abandoned Railways

The upgrading of existing railways can significantly increase transport capacity with limited investment, as land is available and there is existing infrastructure for some sections. For this reason, the upgrading of the Kampala - Namanve - Mukono, Kampala - Port Bell and Kampala - Kyengera - Bujjuko is of critical importance in the Plan. In the short term, the project is based on single-track, non-electrified development, but the frequency of operations can be significantly increased by installing additional tracks at stations, improving signalling and adding additional rolling stock. As these will utilise existing infrastructure, it is envisaged that the trains will operate in narrow gauge. In addition, the structure is assumed to be at grade and level crossing. It should be noted that the higher frequency of operations will have a greater impact on the intersecting roads and may cause more severe congestion. In the medium term, these sections will be double-tracked, electrified and elevated to significantly increase transport capacity and shorten journey times as an urban railway service, while minimising the impact on roads.

For the sections where the Standard Gauge Railway is expected to be introduced, the technical standards of the Standard Gauge Railway will be adopted in terms of construction gauge, but for the time being the railway will be constructed in narrow gauge to minimise additional investment in the short term.

2) MRT and LRT

As indicated in 14.5.3(4), the results of future traffic travel forecasts indicate that the capacity of BRT will be exceeded in some sections. Therefore, it is necessary to introduce public transport with higher transport capacity, such as MRT and LRT, etc. In the direction of Wakiso, a new R4 expressway is planned, and it is proposed that urban railways should also be introduced in the Kyengera-Namungoona-Bujuko-Kakiri section, in conjunction with the expressway development. The section close to the city centre, such as KCC, is assumed to be elevated, while the section to be integrated with the R4 expressway is assumed to be at grade if the space for introduction can be secured and there are no problems with the alignment. Based on the results of the travel demand forecasts, the proposal in this plan proposes the introduction of MRT by 2040, but the selection of the transport system, detailed alignment and structural form will need to be reconsidered during the F/S.

For the Kampala - Kajjansi Metropolitan Centre section, it is similarly proposed to introduce medium-volume public transport (e.g. LRT) by 2040 based on the results of travel demand forecasts. For this line, an elevated structure is envisaged as it passes through an existing urban area. Similarly, the selection of the transport system, detailed alignment and structural form will need to be reconsidered during F/S.

3) Heavy Rail – Along Kampala Outer Beltway (2nd Ring (Middle Ring))

Kampala is a major city on the Northern Corridor, part of the corridor linking the port of Mombasa with western Uganda, as well as Rwanda and eastern DRC, where much inter-city and international cargo is expected to pass through Kampala. In the future, these regions will be linked by rail. It is envisaged that these cargoes will be disrupted if existing railways are upgraded and passenger rail services operate at high frequencies between Mukono - Kampala and Kyengera. Therefore, the construction of a railway along the 2nd Ring (Middle Ring) will mitigate the impact on regional and international freight; the railway along the 2nd Ring (Middle Ring) will also provide passenger services, thus ensuring access to the radial railway lines. Depending on traffic demand, it is envisaged that the railway will be constructed as a single track, non-electrified and at grade, but double track and electrification may also be envisaged depending on demand.

As the introduction of the Standard Gauge Railway is envisaged, it is necessary to determine whether the network will be built in standard gauge or narrow gauge, while adopting the technical standards of the Standard Gauge Railway with regard to building limits and linear standards, depending on the network conditions at the time of construction.

(2) BRT and Bus on Expressway

BRT is inexpensive to build and more cost-effective than railways. As they utilise bus vehicles, they also offer a high degree of flexibility, e.g. some sections can be run as buses. On the other hand, it has limited transport capacity. In some cases, service levels are similar to those of buses, as they are affected by traffic congestion when they do not have dedicated lanes or when priority is not granted at intersections. Therefore, it is important to know how to ensure high speeds when introducing BRTs. As detailed designs were carried out in 2014 but have yet to be realised, it is important to strengthen not only the technical aspects but also the organisational aspects and coordinate with existing public transport services such as Taxi when introducing BRTs.

1) BRT on Arterial Roads

For BRT, a study including a detailed design was carried out in 2014; as of July 2024, a BRT design review is being prepared for implementation with support from the African Development Bank and the World Bank. For the short term, it is envisaged that the results of the design review will be used to introduce the system on existing roads. In existing urban areas, the width is limited and some sections will likely have to make use of mixed traffic. It is desirable to secure dedicated lanes as far as possible by utilising one-way traffic. In the medium term, BRT should be introduced along major radial roads. Where road widths are inadequate, it is envisaged that roads may be widened in the medium to long term.

2) Bus on Expressway without Dedicated Lane

As mentioned in 14.6.1 Staged Network Development, it is proposed to introduce buses without dedicated lanes on the expressway in the short to medium term. In cases where congestion on the expressway is not significant or where it is difficult to provide a dedicated BRT lane on the expressway, the operation of intra-urban express buses (Bus on Expressway) can significantly increase the speed at which buses can travel. In addition, the provision of bus stops with additional lanes on the expressway can ensure access for users. In principle, the design and construction of new expressways should be premised on the installation of these facilities.

3) BRT on Expressway with Dedicated Lane

As mentioned in 14.6.1 Phased Development Plan (Stage 2), if congestion on the expressway becomes significant and the number of intra-city buses (Bus on Expressway) is also expected to increase, the introduction of BRT on Expressway (BRT on Expressway) with dedicated lanes should be considered. Dedicated lanes will further increase speed, maintain punctuality and increase transport capacity by operating large vehicles and articulated buses at a higher frequency.

If traffic demand is expected to increase further, the introduction of MRTs or LRTs may be considered.

(3) Buses and Shared Taxies

1) Development of Trunk and Feeder Network System

Currently, shared-ride minibus services, known as "Taxi", operate on both trunk and non-trunk routes, and even routes with large traffic demand are served by a large number of Taxi vehicles. In the short term, the introduction of medium- and large-sized bus vehicles, BRTs and improvements to existing railways are planned, and over the medium term, a number of trunk public transport routes, including MRTs and LRTs, are proposed. It is inefficient to leave public transport with small transport capacity, such as Taxi, in parallel with these mass transit systems. In conjunction with the introduction of new trunk line public transport routes, the division of roles between trunk line, semi-trunk line and feeder routes should be clarified. Duplication should be allocated, and appropriate transport services should be selected by the function of the routes. As these studies go beyond the specifications of this plan, it is recommended that a public transport network planning study be carried out in the future.

2) Bus and Taxi Service Improvement (Introduction of New Large or Middle size buses)

Operating trunk bus routes with smaller vehicles is inefficient due to the increased number of vehicles. For this reason, it is essential to increase the size of vehicles for trunk bus routes. Large and medium-sized bus vehicles will be introduced and gradually the operation will be shifted from individual to company organisation. In doing so, care should be taken to ensure that existing public transport vehicle owners, drivers and conductors continue to be employed. The aim is to establish rapid and efficient public transport services by utilising private funding and private ideas, taking into account social impacts such as driver unemployment. On the other hand, existing public transport vehicles such as Taxi will also be used for feeder routes where demand is relatively small. Furthermore, Boda-boda is envisaged to operate on feeder routes where demand is small.

3) Development of Multi-modal Transport Hubs

Taxi parks and taxi stages located in the CBD and urban centres are used for taxi transfers and as waiting areas for taxi vehicles. For small transfer points, waiting taxi vehicles is not a major problem. In case the number of transfer passengers is large, it is necessary to set up a large area of taxi waiting areas in the city centre, which is not efficient.

With the planned upgrading of railways and the development of mass transit systems such as MRT, LRT, BRT and large and medium-sized buses, it is essential to ensure smooth transfers between existing public transport systems such as Taxi and Boda-boda in addition to these new transport systems. The multi-modal hub for CBD KCC is discussed in detail in the next section.

4) Development of a Platform for Mobility-as-a-Service (MaaS)

In addition to improvements in physical services, all public transport services are expected to be integrated as MaaS service in terms of payment and fee structures. A MaaS platform will be developed under the leadership of the government, with the participation of all public transport operators and a mechanism for sharing information on operations and fare payments in a common format. In addition, the government will mediate the exchange between transport operators regarding payment system and fee structures and encourage the smooth integration of fare systems and payment integration.

(4) Inland Water Transport

1) Port Bell Port, Bukasa Port and Other Port Facilities

As noted in Chapter 7, Port Bell is one of the main ports in the Northern Corridor and is the contact point for the GKMA and GKUGA. It is essential to develop the port to accommodate the expected increase in cargo volumes in line with economic growth. In particular, the expansion of the existing Port Bell port is essential from an environmental point of view, as waterborne traffic emits less greenhouse gases. The development of Bukasa Port is also planned to complement Port Bell port.

In addition to cargo, the Port of Port Bell is an important hub for passenger services as it is connected to the railway. The existing facilities at the ports providing ferry services are ageing and need to be upgraded.

2) Passenger Inland Waterway Services

Travel demand for inland waterway service was examined (see sections 14.4 and 14.5). As a result, the following two passenger routes are proposed to be introduced in the medium term as a certain level of travel demand is expected.

- Port Bell - Ggaba - Kigungu (Entebbe)
- Katosi - Port Bell

Trips are expected to be used for trips to/from the above port areas; for Katosi - Port Bell, time savings can be expected for some OD pairs. However, for the Port Bell - Ggaba - Kigungu (Entebbe) route, traffic volumes are limited compared to land-based traffic. This is due to the fact that the ports of Port Bell and Entebbe are far from the CBD and major destinations, requiring transfers on both the access and egress sides. Also on land, future transport improvements such as Buses on Expressway, BRT and rail are envisaged and are less competitive than these services.

3) Upgrade of Ferry Services

As mentioned in section 7.2.3, ferry services are provided by UNRA on Nakiwogo (Entebbe, Wakiso) - Kyanvubu (Buwaya, Wakiso). As it is an important route linking Entebbe, Mpigi and Kasanje, services in this section will continue with service improvements. In the course of this project, the construction of a bridge was also proposed for this section. The 3rd Ring (Outer Ring) could replace the functions of this section if the 3rd Ring (Outer Ring) is constructed nearby. The construction of the bridge is a long-term issue and will be considered when considering the construction of the 3rd Ring (Outer Ring).

(5) Road Network and Road Traffic

1) Expressway Network Development

The road network is the backbone of the urban structure, of which expressways play the most important role in connecting CBDs and Metropolitan Centres, as well as connecting them to the outside GKMA. The concept of forming an expressway network is described in Chapter 7, and is proposed in existing plans and studies in the GKUGA, and conceptualised in the Expressway Development Master Plan (2021), as indicated in Section 7.2.2. In addition, as indicated in section 14.5.1 (1), some expressways have already been built (Kampala - Entebbe Expressway) and are under construction (Busega - Mpigi Expressway), and the number of expressways is under study and seeking funds. The expressways under construction and investigation form a major radial and ring road network. Eight radial roads and two ring road networks (1st Ring (Inner Ring: Northern Bypass + Southern Bypass), and 2nd Ring (Middle Ring: Kampala Outer Beltway)) will be formed. The phased development will be developed in conjunction with the Metropolitan Centre development.

The two new proposed projects are the following two expressways:

- Kampala - Mukono Expressway (Bypass of Jinja Road and Kampala - Jinja Expressway): the Kampala - Mukono is the main radial corridor within the GKUGA and is also a section through which international freight, including the Northern Corridor, passes. For this reason, traffic demand forecasts were carried out, which resulted in the assumption of significant traffic congestion. Based on this, the construction of another east-west expressway is proposed.
- Urban Expressway (VVIP-Southern Bypass): although the Kampala Flyover project is underway in the CBD, there is a limited network of arterial roads traversing the CBD. The Nakasero - Northern Bypass Expressway (VVIP Expressway) is planned to be constructed. However, it will connect to the Kamapala Flyover in the CBD and is not a continuous expressway network. Therefore, the VVIP Expressway will be extended to the south and connected to the Southern Bypass, making it a north-south expressway through the CBD.

Travel demand forecasts for the 3rd Ring (Outer Ring), assuming long-term implementation, showed that the traffic demand for the 3rd Ring (Outer Ring), could be handled with only one lane in each direction. On the other hand, the long length of the Expressway means that the cost of maintenance is high, and it is not expected that sufficient benefits will be achieved in the long term. The 3rd Ring (Outer Ring) is therefore positioned as a very long-term project.

2) Arterial Road Network Development

A number of trunk road improvement projects are being planned, designed and constructed, mainly outside the KCC. Projects include the paving and widening of primary and secondary roads with support from the World Bank and the African Development Bank. These roads form part of the ring road outside the KCC, radial roads. It is also proposed to provide access roads to stations where future rail improvements are envisaged. See the project list from Section 14.6.4 onwards for more details.

On the other hand, projects within the CBD are limited, such as the Kampala Flyover. Given the size of the city, it is desirable to build a more extensive road network, however, it is not easy to secure land in built-up areas, especially in the CBD. In addition, the hilly geography of the city limits the amount of space available for a new road introduction.

3) Traffic Management

Bottlenecks in traffic flow are at intersections. This is because capacity is reduced at intersections. For this reason, it is extremely important to improve intersections as well as roads (single carriageway sections), and in GKUGA, intersection improvements, installation of traffic signals and construction of a traffic control centre are already underway with the support of JICA, the African Development Bank and the World Bank. These projects will be continued, and comprehensive improvement projects should be carried out at intersections that cause traffic congestion.

(6) Active Travel Modes: Walking, Wheeling and Cycling (Non-motorized Transport)

Until recently, walking and cycling have been described as non-motorised transport (NMT) and have generally been treated as a means of access to public transport, especially in the context of developing countries. In recent years, they have been defined as 'active travel' modes and an increasing number of countries are actively promoting them from the perspective of promoting equity, reducing greenhouse gas emissions and improving public health. Definitions and designations vary from country to country, for example, UK's Department for Transport defines that the terms 'active travel' and 'walking and cycling' (…) encompass a range of methods of active mobility, including trips made by wheelchair, mobility scooters, adapted cycles and e-bikes (Department for Transport, UK, 2019).

1) Formulation of Master Plan for Active Travel

In GKUGAs, active travel should be actively promoted to ensure fair mobility for all, promote the use of public transport to ease traffic congestion, improve public health and enhance the attractiveness of the city. Since active travel is used on all roads, except expressways and other roads that are exclusively for cars, it is desirable to ensure dedicated space for active travel on all roads, such as pedestrian walkways and bicycle paths of sufficient width. However, financial and human resources make it difficult to make all improvements at once, and improvements need to be made by prioritising and changing the allocation of space to and from motor vehicles.

Specifically, the functions of each street should be defined from the road's link function (function of traffic) and place function (function of retention), the functions of each street should be clarified and a policy for the development of facilities should be established; as it is not easy to widen roads, especially in CBDs in GKUGA, the functions may be shared among several roads. In addition, road cross-section should be reconfigured on roads where emphasis should be placed on the place function, to provide more space for active travel modes and to improve safety and comfort for active travel by setting speed limits.

The network perspective is also considered so that a network of active travel can be built, and the construction of active travel corridors is proposed where there are more active travel users.

2) Development of Active Travel Corridor and Active Travel Priority Area

In the GKUGA, active travel corridor development is proposed along existing railways. The development of a continuous active travel corridor will be a showcase for active travel promotion. In the CBD, efforts have already started to improve road space to increase place functions and improve circulation. Walking environment of some areas of the CBD such as Luwum Street have been improved.

3) Redesign of Road Space and Redefinition of Priority

As it is difficult to secure new space for active travel in existing urban areas, the width for road carriageways should be reduced and the width of walkways and bike lanes should be increased in roads where the place function is more prioritized than the link function.

On the other hand, certain roads in CBD require the link function in addition to the place function. On such roads, vehicle speed limits will be imposed and facilities for slowing down (humps, bollards, cranks, etc.) will be introduced to ensure the safety of active travel and increase its relative attractiveness.

4) Addition of Dedicated Space for Active Travel Modes for New Road Projects

Widening existing roads is challenging, however, space for active travel modes can be secured in the planning stage if new roads are to be built.

14.6.3 Policies for Transport in CBD

In the central business district (CBD) defined in Chapter 10, transport problems are evident due to the concentration of people and goods. Special tactics are, therefore, required to alleviate them. Comprehensive approaches including push and pull policies are essential to solve the tangled transport problems in the CBD. The overall policy of urban transport in the CBD is as below.

(1) Accessible CBD with Transit and Active Travel Modes

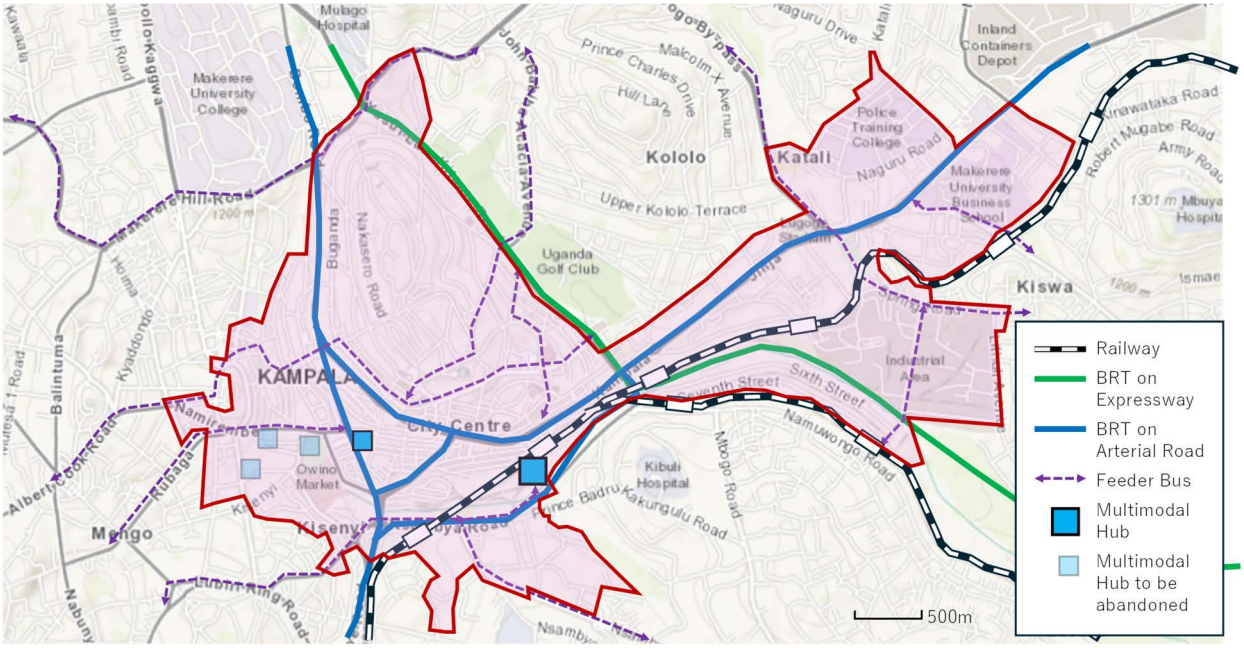
As a centre of GKUGA, GKMA, Uganda and East Africa, the CBD should be accessible to all the people and shall attract people regardless of attributes such as gender, disabilities and vehicle ownership. Thus, all the CBD areas should be accessible by either public transport or active travel modes such as bicycles and walking. By strategically locating railway stations, BRT stations and feeder bus/taxi stops, all the CBD areas can be covered by a 1 km buffer from the stations and

stops which means around 15 minutes walking distance. Improvement of the walking environment is also essential to achieve an accessible, safe, attractive and efficient urban centre.

In terms of the capacity of transport modes, transit with active travel modes has the highest capacity. Considering the land availability in the CBD area, transit and active travel modes are the only feasible options.

The challenge of GKUGA is hilly geography. Slopes are obstacles for pedestrians, bicycle riders and wheelchair users. Electric Vehicles (EVs) including electric bicycles and battery-assisted bicycles together with infrastructures such as charging stations and bike lanes will be a solution.

Figure 14.6.3 shows the conceptual public transport network in the CBD. By providing feeder services, new railway stations and BRT stops, all the CBD areas can be accessible with a 1 km walk.



Source: JICA Expert Team

Figure 14.6.3 Concept of Public Transport Routes in CBD

(2) Trunk and Feeder Services

Taking efficiency and capacity into consideration, functions of high-capacity modes such as rail-based transit and BRT and medium-capacity modes such as buses and shared taxis should be clarified. The trunk routes should be serviced by high-capacity modes while the feeder service can be covered by the medium-capacity modes as shown in Figure 14.6.3. In addition to the conventional "taxi", medium-sized buses can be served for the relatively high-demand feeder routes while the modernized on-demand taxi service and ride-hailing service also can play a role of feeder services for the area. It is expected that the current taxi service serving the expected feeder routes can be converted to medium-sized buses while the remaining taxi service is expected to be modernized by strictly applying the service standard.

(3) Maximum Utilization of Road Space with Intelligent Traffic Management

As discussed in Section 14.1, land acquisition is expensive and time-consuming due to the constitution and legal framework of land ownership in Uganda. The feasibility of road widening and construction of new roads in the CBD is limited in GKUGA. It is, therefore, important to increase the capacities of existing road spaces with intelligent traffic management such as intelligent traffic signalling. Management of on-street parking also can prevent the reduction of road capacities.

(4) Improvement Connectivity and Efficient Public Transport Operation with the Multimodal hubs

The existing "Taxi Parks" are utilized not only for boarding and alighting of passengers but also for a depot of taxi vehicles and a rest area for taxi drivers. Large-scale taxi parks such as Old Taxi Park, New Taxi Park, Kisenyi Taxi Park and Namirembe Taxi Park are located in the centre of the CBD. Besides, long-distance bus parks are located in the CBD. This is aggravating the traffic congestion in the CBD. The location of the depot and rest area can be shifted to the suburbs to avoid the concentration of vehicles in the CBD. Some taxi parks can be shifted to the planned Multimodal Hub at the central railway station of Kampala. The multimodal hub will play a key role in connecting serval transport modes and in providing efficient fleet operation of taxis and buses.

(5) Travel Demand Management to Enhance Modal Shift

The application of parking tax together with strict enforcement of codes on parking will enhance the modal shift to public transport. Minimizing illegal on-street parking also contributes to increasing road capacities. It should be mentioned that the revenue from the parking tax can be a source of infrastructure development.

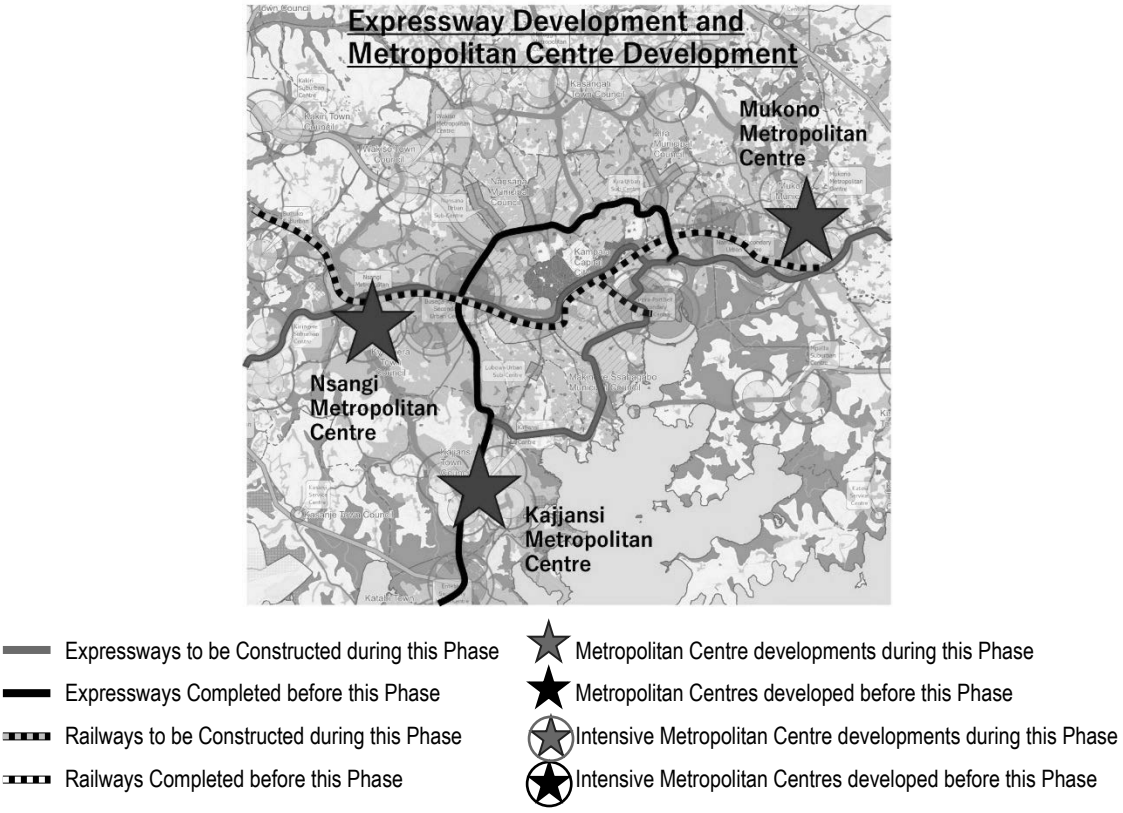
Mobility Management is a communication-oriented measure to encourage more smart and appropriate ways of using travel modes for solving travel issues such as traffic congestion. In contrast to conventional transport policies, such as building transport infrastructure or improving transport services, Mobility Management aims at helping targeted individuals think about their communities and change travel behaviour by themselves, leading to more sustainable transport systems for society.

14.6.4 Short-Term Projects (2025/26– 2029/30)

This section describes the list of projects to be implemented in the short term. Needless to say, ongoing projects should be included in the list. In addition, feasibility in terms of finance and land availability is one of the key points to be taken into account for the selection of projects for short-term implementation. Considering the available funding and cost-effectiveness, some key network infrastructure projects connecting the CBD and the proposed urban centres are included as shown in Figure 14.6.4.

Parking restrictions in CBD to collect parking tax revenue are critical, not only to regulate traffic but also to generate revenues for the implementation of other projects.

The list of projects for short-term implementation is shown in Table 14.6.1. The total estimated cost of these projects under the transport sector is estimated at 4,072 million USD.



Source: JICA Expert Team

Figure 14.6.4 Concept of Transport Network in 2029/30

Table 14.6.1 List of Short-Term Projects of the Transport Sector

ID	Sector	Status	Project Name	Funding Agencies	Respons-ible Agency	Lanes	Dist. (km)	Cost (million. USD)	Est. No. of Affected Buildings	Est. Affected Building Area(ha)
RD-S1	Road	On-going	Capacity Improvement and Signalisation of Kampala – Gayaza Road	Seeking funds	UNRA	4	15	18.0	-	-
RD-S2	Road	On-going	Capacity Improvement and Signalisation of Kampala – Buloba Road	Seeking funds	UNRA	4	12	15.0	-	-
RD-S3	Road	On-going	Capacity Improvement and Signalisation of Namungona – Kakiri Road	AfDB	UNRA	4	30	25.0	-	-
RD-S4	Road	On-going	Kampala Flyover	JICA	UNRA	4	7	153.7	40	0.7
RD-S5	Road	On-going	Kampala City Road Rehabilitation Project (including drainage works, 2 big drainage works)	AfDB	KCCA	4 & 2	76	246.0	-	-
RD-S6	Road	On-going	GKMA-Urban Development Programme	World Bank	MKCC&MA	2	610	514.4	-	-
RD-S7	Road	On-going	Upgrading of Northern Bypass	EU, GoU	UNRA	2	21	141.1	-	-
RD-S8	Road	On-going	Kampala Southern Bypass	AfDB, AFD & EU, GoU	UNRA	4	18	200.0	1,837	9.9

ID	Sector	Status	Project Name	Funding Agencies	Respons-ible Agency	Lanes	Dist. (km)	Cost (million. USD)	Est. No. of Affected Buildings	Est. Affected Building Area(ha)
RD-S9	Road	On-going	Kibuye-Busega Expressway	China Exim Bank (Expected)	UNRA	4	10	229.0	1,132	7.1
RD-S10	Road	On-going	Busega-Mpigi Expressway	AfDB	UNRA	4	27	196.8	-	-
RD-S11	Road	On-going	Kampala-Jinja Expressway	AfDB, AFD & EU, GoU	UNRA	8, 6 & 4	77	800.0	57	0.3
RD-S12	Road	On-going	VVIP Expressway (Nakasero-Northern Bypass Expressway)	China Exim Bank (Expected)	UNRA	4	5	200.0	465	2.7
RD-S13	Road	On-going	Upgrading of Kyaliwajala – Kira – Matugga Road (including junctions along the road)	GoU	UNRA	2	21	54.3	-	-
RD-S14	Road	On-going	Upgrading of Najjanankumbi – Busabala (including junction signalisation)	GoU	UNRA	2	11	70.1	-	-
RD-S15	Road	On-going	Upgrading of Matugga – Wakiso – Buloba	GoU	UNRA	2	19	30.4	-	-
RD-S16	Road	On-going	Upgrading of Jokas – Namanve – Mukono	Seeking Funds	UNRA	2	14	13.0	-	-
RD-S17	Road	On-going	Upgrading of Natete – Nakawuka – Kisubi – Maya - Nakiwuogo	Seeking Funds	UNRA	2	71	91.9	-	-
RD-S18	Road	Proposed	Railway Station Access Roads Development	Seeking Funds	Local Gov.	2	30	111.0	-	-
TM-S1	Traffic Mng	On-going	Central Traffic Control Centre (junction)	JICA	KCCA	-	-	18.8	-	-
TM-S2	Traffic Mng	On-going	Parking Restrictions and Tax in CBD	Private Fund	KCCA	-	-	0.5	-	-
PT-S1	Public Transport	On-going	Uganda Railways Corporation Capacity Building Project	GoU and AfDB	URC	-	92	366.3	-	-
PT-S2	Public Transport	On-going	BRT-Pilot1 (CBD-Kajjansi)	AFD and the World Bank	MoWT	-	14	172.4	231	1.7
PT-S3	Public Transport	On-going	BRT-Pilot2 (CBD-Mukono)	AFD and the World Bank	MoWT	-	22	270.9	104	1.0
PT-S4	Public Transport	On-going	BRT-Pilot3 (CBD-Kasangati)	AFD and the World Bank	MoWT	-	15	184.7	357	2.2
PT-S5	Public Transport	Proposed	BRT Kampala-Entebbe (along Expressway) Mixed Lane	Donor & Private Fund	MoWT	-	33	7.0	-	-
PT-S6	Public Transport	Proposed	BRT Busega-Mpigi (along Busega-Mpigi Expressway) Mixed Lane	Donor & Private Fund	MoWT	-	27	6.2	-	-
PT-S7	Public Transport	Proposed	BRT Inner-Beltway - Ring Road (Along Northern BP - Kampala Entebbe Expressway - Southern BP) Mixed Lane	Donor & Private Fund	MoWT	-	45	9.6	-	-
PT-S8	Public Transport	Proposed	Bus and Taxi Service Improvement (Introduction of New Large or Middle size buses)	Donor & Private Fund	KCCA	-	-	20.0	-	-

ID	Sector	Status	Project Name	Funding Agencies	Respons-ible Agency	Lanes	Dist. (km)	Cost (million. USD)	Est. No. of Affected Buildings	Est. Affected Building Area(ha)
PT-S9	Public Transport	Proposed	Development of Multi-modal Transport Hubs	Donor & Private Fund	URC/KCCA	-	-	400.0	-	-
PT-S10	Public Transport	Proposed	Development of Platform for Mobility-as-a-Service (MaaS)	Donor & Private Fund	MKCC&MA	-	-	20.0	-	-
NM-S1	NMT	On-going	NMT Corridor Project	GoU	KCCA	-	16	-	-	-

Source: JICA Expert Team

Major short-term projects in the list are summarised below.

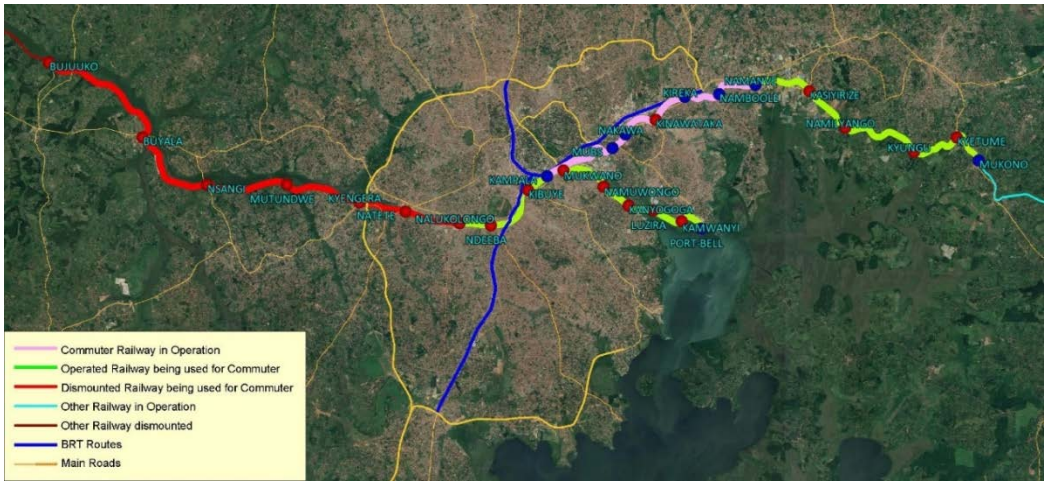
(1) Ongoing and Committed Road Projects

As shown in Table 14.5.2 and Figure 14.5.1, radial and circular expressways are being designed and constructed. The projects under construction are assumed to be completed in the short term. It is also assumed that these projects' completed design and started procurement will be completed in the short term. However, for expressway projects seeking funds that require huge capital investment such as the Kampala – Bombo Expressway and Kampala Outer Beltway (2nd Ring (Middle Ring)), only a part of the works is expected to be completed in the short term.

(2) Uganda Railways Corporation Capacity Building Project (Improvement of Existing Railways and Rehabilitation of Abandoned Railways)

With a fund from the EU, the feasibility study on the improvement of passenger service in GKMA was conducted in 2020. It is proposed to improve the existing railway lines of Kampala – Namanve and Kampala – Port Bell and to rehabilitate the abandoned railway track of Kampala – Kyengera – Bujjuko. The following four types of trains are planned to be operated twice during peak hours for a scenario tested in the feasibility study. The African Development Bank (AfDB) showed interest in this project.

- Bujjuko – Kampala – Port Bell
- Kyengera – Kampala
- Kampala – Namanve
- Kampala – Mukono



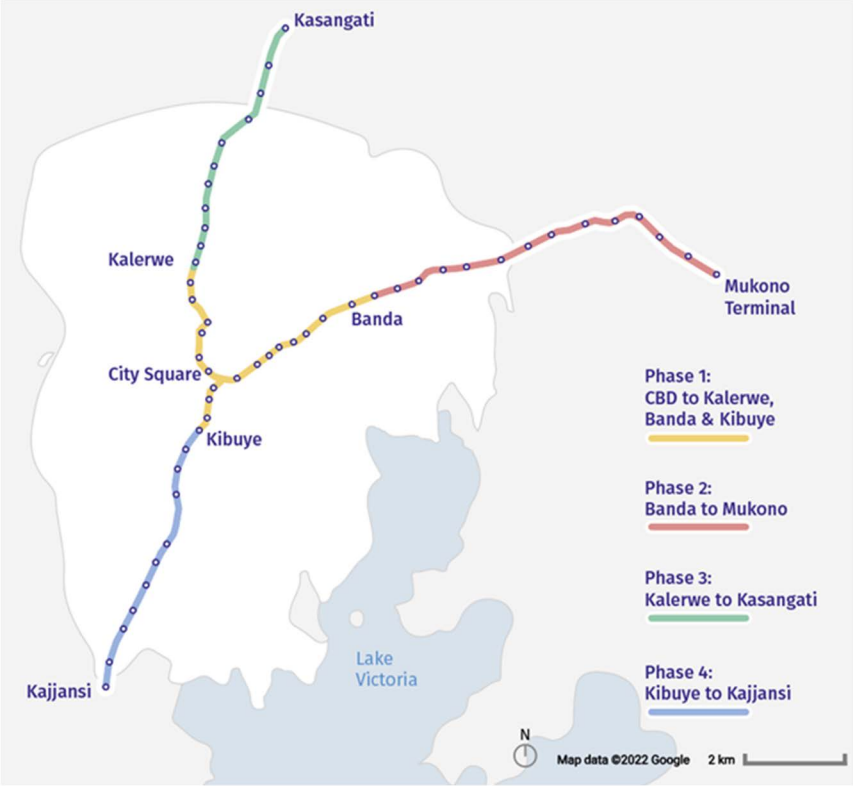
Source: Feasibility Study of Expansion of Uganda Railways Passenger Services in Greater Kampala Metropolitan Area (2020)

Figure 14.6.5 Target Railway Sections for Improvement

To further improve railway transport with a more stable track, increased train operating speeds, passenger comfort and efficient freight and passenger transport services, as of April 2023 Uganda Railways Corporation under the Capacity Building Program commenced with replacing the old steel sleeper line with concrete sleepers from Kampala to Namanve. The same development will during the second phase be implemented on Namanve to Tororo, Kampala to Port Bell and Kampala to Kyengera railway lines.

(3) Kampala BRT (Kampala to Mukono, Kampala to Kasangati, Kampala to Kajjansi)

A feasibility study and design of Bus Rapid Transit (BRT) for GKMA was conducted in 2012. Nine corridors of the BRT full network with 88 km in length were proposed. Among the nine corridors, three corridors with 25 km length have been selected for a Pilot BRT. The Pilot BRT routes include Kampala to Kireka, Kampala to Kalerwe and Kampala to Zana. The estimated cost for the Pilot BRT is 490 million USD. Three corridors are designed to connect feeder services. To evaluate whether the existing design is still adequate and up to date as well as to ensure participation and ownership of all key stakeholders, a strategic review was conducted and the ToR for the detailed design review and preparation of the required contract bidding documents were drafted. The detailed design review/update is to be undertaken using funding from the African Development Bank (AfDB) as of July 2024. The BRT infrastructure is to be financed by the Government of Uganda through consolidated funds and development partner concessional loans and grants such as the World Bank. The phased approach will be applied as shown in Figure 14.6.6. The first phase will be the Y-shaped corridor that comprises the Kalerwe (Bwaise) to Kibuye with a link to Banda along Jinja Road, all within the KCCA area of jurisdiction. The total length of the four phases will be around 42km.



Source: KCCA (2023)

Figure 14.6.6 Phasing Plan of Kampala Bus Rapid Transit

(4) BRT on Expressway along Inner Beltway, Kampala – Entebbe Expressway and Busega – Mpigi Expressway

In addition to the Pilot BRT, the formation of a circular BRT line is expected to utilise existing and committed expressways of Kampala Northern Bypass, part of the Entebbe Expressway via

the Munyonyo spur through the planned Southern Bypass. As this BRT utilises sharing lanes with other traffic, it does not require additional land acquisition except for the bus stops. By slightly modifying the design of the expressway, the bus stops can be incorporated for passenger boarding and alighting.

(5) Development of Multi-modal Transport Hubs

Public transport is not a door-to-door service. To provide a seamless public transport service, improvement of connectivity at railway and major BRT stations and bus/taxi terminals is essential. A station square including bus and taxi stops should be provided at all passenger railway stations. The multi-modal transport hub (MmTH) where a number of passengers depart and arrive has a high potential for urban development. The MmTH can be developed with the public-private partnership (PPP) scheme which reduces funding from the public sector. The MmTH development is planned at Kampala Railway Station. Besides, it is recommended to develop station plazas with bus and taxi stops at all passenger railway stations to improve connectivity.

(6) Parking Restrictions and Imposition of Tax in CBD

Parking restrictions in CBD in conjunction with the collection of parking tax from on-street and off-street parking in CBD can contribute to reducing inflow traffic during peak hours and maximise the capacity of roads. Revenue from parking tax can be utilised for other infrastructure projects. However, it should be noted that parking restrictions should be implemented along with public transport improvement as visitors will have no alternative modes to choose from.

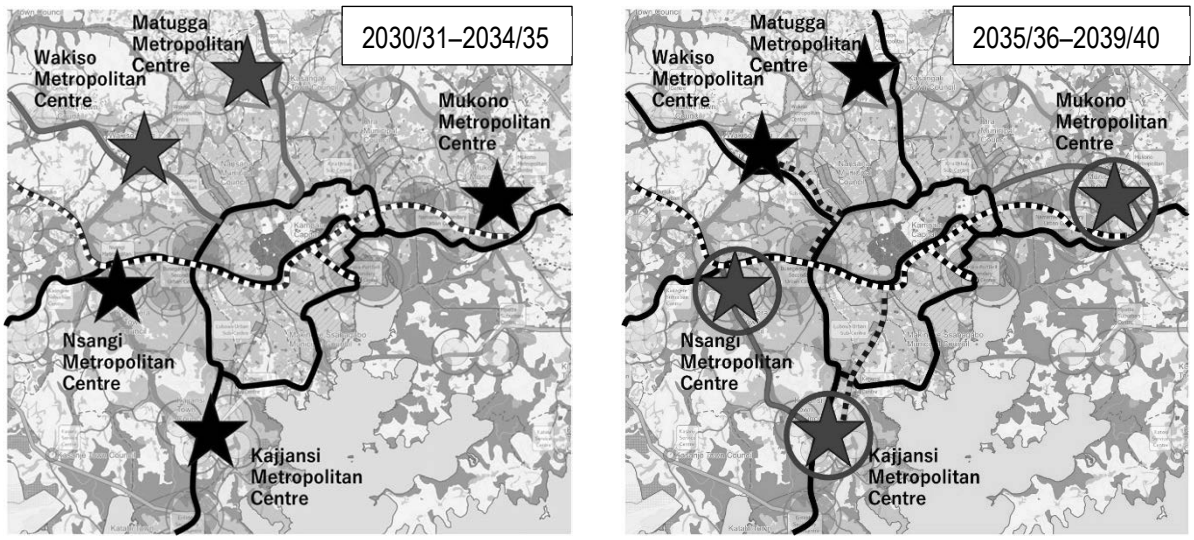
(7) Improvement of Walking Environment around Transit Stations and NMT Corridor Development

Non motorised transport (NMT) is one of the main modes of transport in the GKUGA. As NMT is an emission-free, congestion-free healthy mode of transport, a lot of metropolitan areas in both developed and developing countries implemented policies to enhance the use of NMT.

NMT is also a critical factor in promoting TOD to solve the first-mile last-mile problem of public transport. In line with railway and BRT improvement, NMT infrastructures are essential, including the installation and improvement of walkways, pedestrian crossings and lighting. It is also important to form a network of bicycle roads/lanes to serve the medium-distance trips.

14.6.5 Mid-Term Projects (2030/31 – 2039/40)

In the medium-term 2031 – 2040, urban centre development in conjunction with transport network development is expected to serve the increasing population and alleviate urban problems such as congestion. During the period 2031 and 2035, new radial corridors of Kampala – Nansana – Wakiso – Kakiri and Kampala – Matugga – Bombo, and a part of the circular corridor of the 2nd Ring (Middle Ring) (Kampala Outer Beltway), are proposed to be developed. Both expressways and BRTs should be developed jointly as discussed in Section 14.6.1. The concept of phased corridor development is shown in Figure 14.6.7, and the list of midterm projects is shown in Table 14.6.2. Considering Kajjansi Metropolitan Centre development and Bwebaja government campus development, the LRT line that connects Kampala-Kajjansi should be developed to support the increasing demand in the section.



Note: See Figure 14.6.4 for the legend. Source: JICA Expert Team

Figure 14.6.7 Concept of Transport Network to be Developed in 2030/31 – 2034/35 and 2035/36 – 2039/40

Table 14.6.2 List of Mid-Term Projects of the Transport Sector

ID	Sector	Status	Project Name	Funding Agencies	Responsible Agency	Lanes	Dist. (km)	Cost (million. USD)	Est. No. of Affected Buildings	Est. Affected Building Area (ha)
RD-M1	Road	On-going	Kampala-Bombo Expressway	Seeking Funds	UNRA	4	50	559.9	949	6.3
RD-M2	Road	On-going	Kampala Outer Beltway Phase 1 (Kajjansi-Nsangi) (2nd Ring (Middle Ring))	Seeking Funds	UNRA	4	22	246.4	35	0.4
RD-M3	Road	Proposed	Expressway R4 (Kampala – Wakiso – Kakiri)	Donor & Private Fund	UNRA	4	20	256.9	330	2.3
RD-M4	Road	Proposed	Kampala - Mukono Expressway (Bypass of Jinja Road and Kampala - Jinja Expressway)	Donor & Private Fund	UNRA	4	14	191.2	564	6.0
RD-M5	Road	Proposed	Urban Expressway (VVIP-Southern Bypass)	Donor & Private	UNRA	4	6	110.9	582	5.0
TM-M1	Traffic Mng	On-going	Boda-boda Restriction	GoU	KCCA	-	-	2.0	-	-
PT-M1	Public Transport	Proposed	Upgrading of Existing Metre Gauge Railway Service	GoU & AfDB	URC	-	92	1908.0	-	-
PT-M2	Public Transport	Proposed	Dualisation of BRT Corridor	Donor & Private Fund	MoWT	-	51	40.0	-	-
PT-M3	Public Transport	Proposed	BRT Kampala-Entebbe (along Expressway) Dedicated Lane	Donor & Private	MoWT	-	26	317.6	-	-
PT-M4	Public Transport	Proposed	BRT-Masaka Extension (CBD-Mpigi) Dedicated Lane	Donor & Private Fund	MoWT	-	30	374.3	425	1.6
PT-M5	Public Transport	Proposed	BRT -CBD-Portbell	Donor & Private Fund	MoWT	-	12	149.0	-	-
PT-M6	Public Transport	Proposed	BRT-Gayaza Extension (CBD-Kalagi)	Donor & Private Fund	MoWT	-	32	395.2	483	1.2
PT-M7	Public Transport	Proposed	BRT-Jinja Extension (CBD-Mukono)	Donor & Private Fund	MoWT	-	13	161.3	324	1.7

ID	Sector	Status	Project Name	Funding Agencies	Responsible Agency	Lanes	Dist. (km)	Cost (million. USD)	Est. No. of Affected Buildings	Est. Affected Building Area (ha)
PT-M8	Public Transport	Proposed	BRT -Nansana-Wakiso-Kakiri	Donor & Private Fund	MoWT	-	20	249.9	-	-
PT-M9	Public Transport	Proposed	BRT Busega-Mpigi (along Busega-Mpigi Expressway) Dedicated Lane	Donor & Private Fund	MoWT	-	27	330.0	-	-
PT-M10	Public Transport	Proposed	BRT -Nansana-Wakiso-Kakiri (along Expressway R4, Namungoona-Bujuko-Kakiri)	Donor & Private Fund	MoWT	-	20	246.2	-	-
PT-M11	Public Transport	Proposed	BRT CBD-Bombo (Along Bombo Expressway) Mixed Lane	Donor & Private	MoWT	-	-	10.8	-	-
PT-M12	Public Transport	Proposed	BRT Inner-Beltway - Ring Road (Along Northern BP - Kampala Entebbe Expressway - Southern BP) Dedicated Lane	Donor & Private Fund	MoWT	-	63	776.9	-	-
PT-M13	Public Transport	Proposed	BRT Kampala- Kasanje (along Nakawuka Road)	Donor & Private Fund	MoWT	-	25	307.8	567	3.0
PT-M14	Public Transport	Proposed	BRT Masooli-Kagoma-Matugga (along Bombo Road)	Donor & Private Fund	MoWT	-	20	251.2	488	2.4
PT-M15	Public Transport	Proposed	BRT Namboole-Namugongo-Seeta	Donor & Private Fund	MoWT	-	14	176.1	332	1.0
PT-M16	Public Transport	Proposed	Water Transport, Port Bell - Ggaba - Kigungu (Entebbe), Katosi - Port Bell	Donor & Private Fund	MoWT	-	-	270.0	-	-
PT-M17	Public Transport	Proposed	MRT (Kyengera-Namungoona-Bujuko-Kakiri) (along Expressway R4)	Donor & Private Fund	MoWT		24	1,861.9	750	4.7
PT-M18	Public Transport	Proposed	LRT (Kampala-Kajjansi Metropolitan Centre)	Donor & Private Fund	MoWT		18	552.0	253	1.1

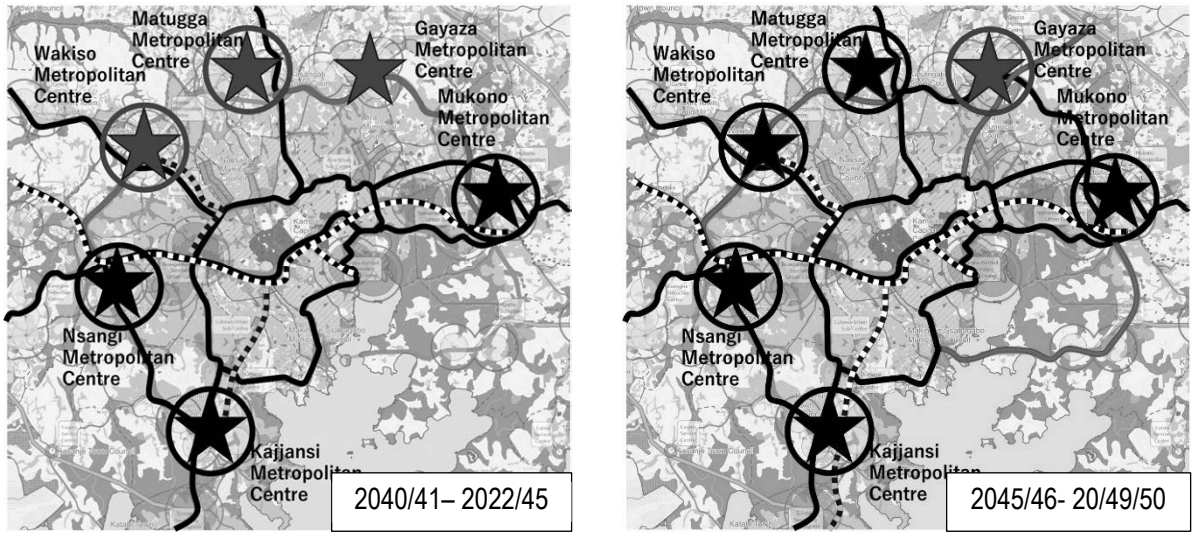
Source: JICA Expert Team

14.6.6 Long-Term Projects (2040/41-2049/50)

Population growth brings traffic congestion in the long term. A modal shift to public transport and transit-oriented urban development is critical to achieving sustainability in urban areas. Hence, a dense radial and ring transport network shall be formulated. Urban centres are located at the junctions of these corridors. It should also be noted that the Government of Uganda can finance large infrastructure projects in the long-term due to economic development.

In terms of freight transport, traffic in the Northern Corridor can be affected by congestion in the CBD. It is critical to separate through traffic and intracity traffic with the Kampala Freight Rail Bypass project which utilises the right-of-way of the 2nd Ring (Middle Ring) (Kampala Outer Beltway).

The provisional list of long-term projects is shown in Table 14.6.3.



Note: See Figure 14.6.4 for the legend. Source: JICA Expert Team

Figure 14.6.8 Concept of Transport Network to be Developed in 2040/41 – 2044/45 and 2045/46 – 2049/50

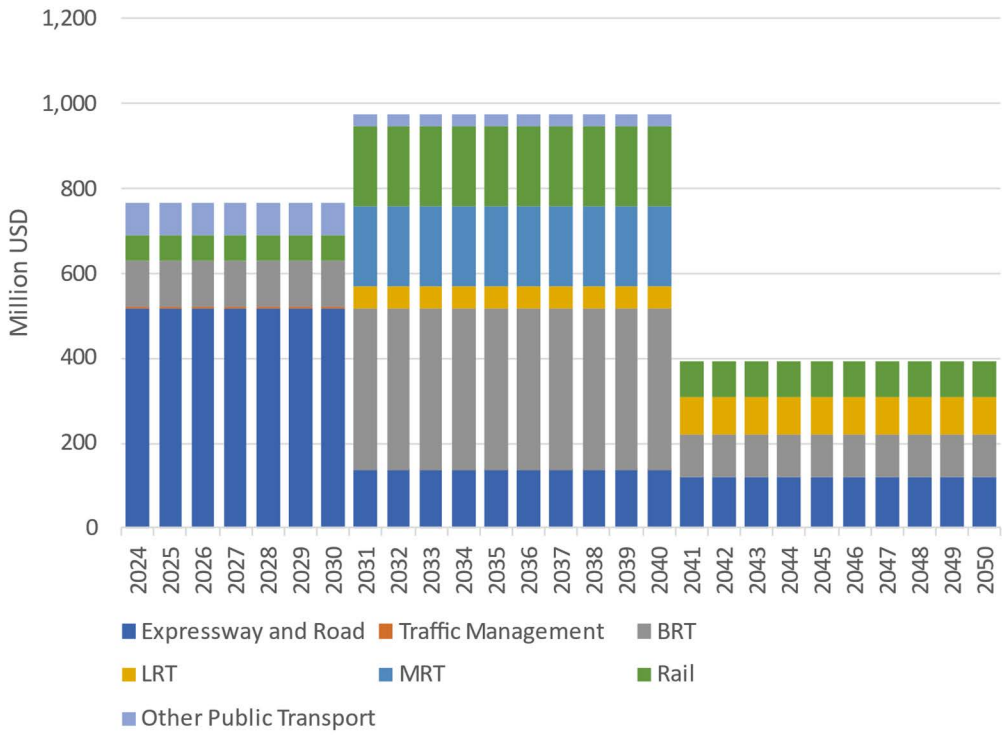
Table 14.6.3 Provisional List of Long-Term Projects of the Transport Sector

ID	Sector	Status	Project Name	Funding Agencies	Responsible Agency	Lanes	Dist. (km)	Cost (million. USD)	Est. No. of Affected Buildings	Est. Affected Building Area (ha)
RD-L1	Road	On-going	Kampala Outer Beltway Phase 2 (Nsangi-Wakiso-Gayaza-Mukono-Muknyonyo) (2nd Ring(Middle Ring))	Seeking Funds	UNRA	4	85	951.9	345	2.8
RD-L2	Road	Proposed	Expressway R6 (Kira – Kasaayi – Ngalama - Kigogola)	Donor & Private Fund	UNRA	4	20	260.0	337	2.7
PT-L1	Public Transport	Proposed	LRT (Kajjansi Metropolitan Centre – Entebbe Airport)	Donor & Private Fund	MoWT		30	900.0	93	0.2
PT-L2	Public Transport	Proposed	Heavy Rail, Along 2nd Ring(Middle Ring) - Kampala Freight Rail Bypass	Donor & Private Fund	MoWT		56	841.5	-	-
PT-L3	Public Transport	Proposed	BRT Busega-Buloba (along Fort Portal Road)	Donor & Private Fund	MoWT		32	395.2	140	0.4
PT-L4	Public Transport	Proposed	BRT CBD-Bombo (Along Bombo Expressway) Dedicated Lane	Donor & Private Fund	MoWT		47	582.3	488	2.4

Source: JICA Expert Team

14.6.7 Summary of Project Cost for the Transport Sector

Figure 14.6.9 illustrates the yearly project investment cost for the transport sector. The investment cost for the transport sector is the largest in the year between 2031 and 2040, due to large numbers of project implementation for BRT, and MRT during this period.



Source: JICA Expert Team
Note: Annual average investment cost was calculated for the short-term project (2024-2030), middle-term project (2031-2040), and long-term project (2041-2050).

Figure 14.6.9 Yearly Project Investment Cost for the Transport Sector

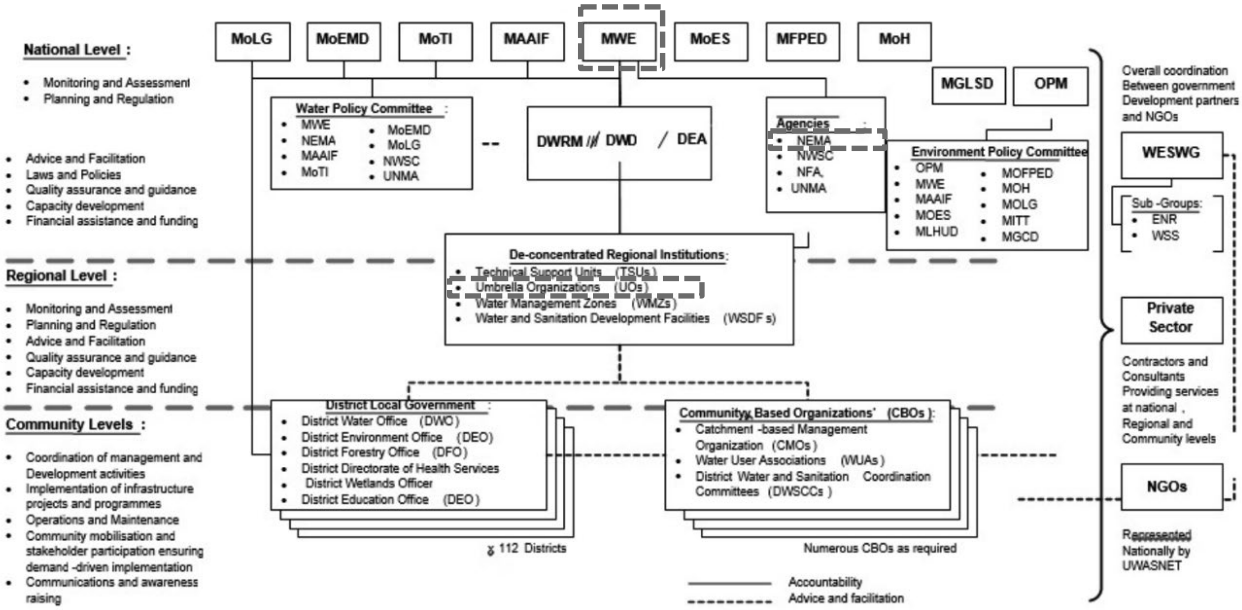
Chapter 15 Development Strategies for Infrastructure Sectors in Greater Kampala Urban Growth Area (GKUGA) including Kampala Capital City (KCC)

15.1 Water Supply

15.1.1 Background of Water Supply Sector (Summary of Present Situation)

(1) Organisations and Jurisdiction Areas

Water supply services in Uganda are mainly administrated by the National Water and Sewerage Corporation (NWSC) and Umbrella Organisations (UOs) under the Ministry of Water and Environment (MWE) and are partially organised by local governments under the Ministry of Local Governments.



Source： NWSC Corporate Plan 2021-2024

Figure 15.1.1 Organisational Chart of the Ministry of Water and Environment

The NWSC was established in 1972 as a public corporation owned by the Government of Uganda to provide water and sewerage services in urban areas.

The NWSC served in Uganda more than 887,000 water subscribers at the end of 2022, of which 28,000 connections were pro-poor Public Stand Posts (PSPs) for low-income households, whose tariff is subsidised. NWSC is endowed with 4,467 skilled, experienced, and motivated staff. Its core business is the provision of water and sewerage services in urban centres in Uganda.

The UOs, established in August 2017, comprised of association of Water Supply and Sewerage Boards in a particular region installed voluntarily basis, to pool resources and ideas for achieving sustainable water and sanitation services. UOs cover places that are out of NWSC's service areas. The typical activities of UOs offered to their members are training, advice, support and services. The six Ugandan UOs (North, East, Central, South-west, Mid-west, and Kramoja) are supported by the MWE.

In GKUGA, NWSC and UOs are divided by region such as urban areas and suburban areas. In urban areas, NWSC are primarily responsible for piped water supply from water treatment plants

(WTPs) and deep groundwater supply. In suburban areas, the Central Umbrella Organisation (CUO) of UOs manages deep groundwater supply. The CUO controls eight water supply schemes in GKUGA as of 2020.

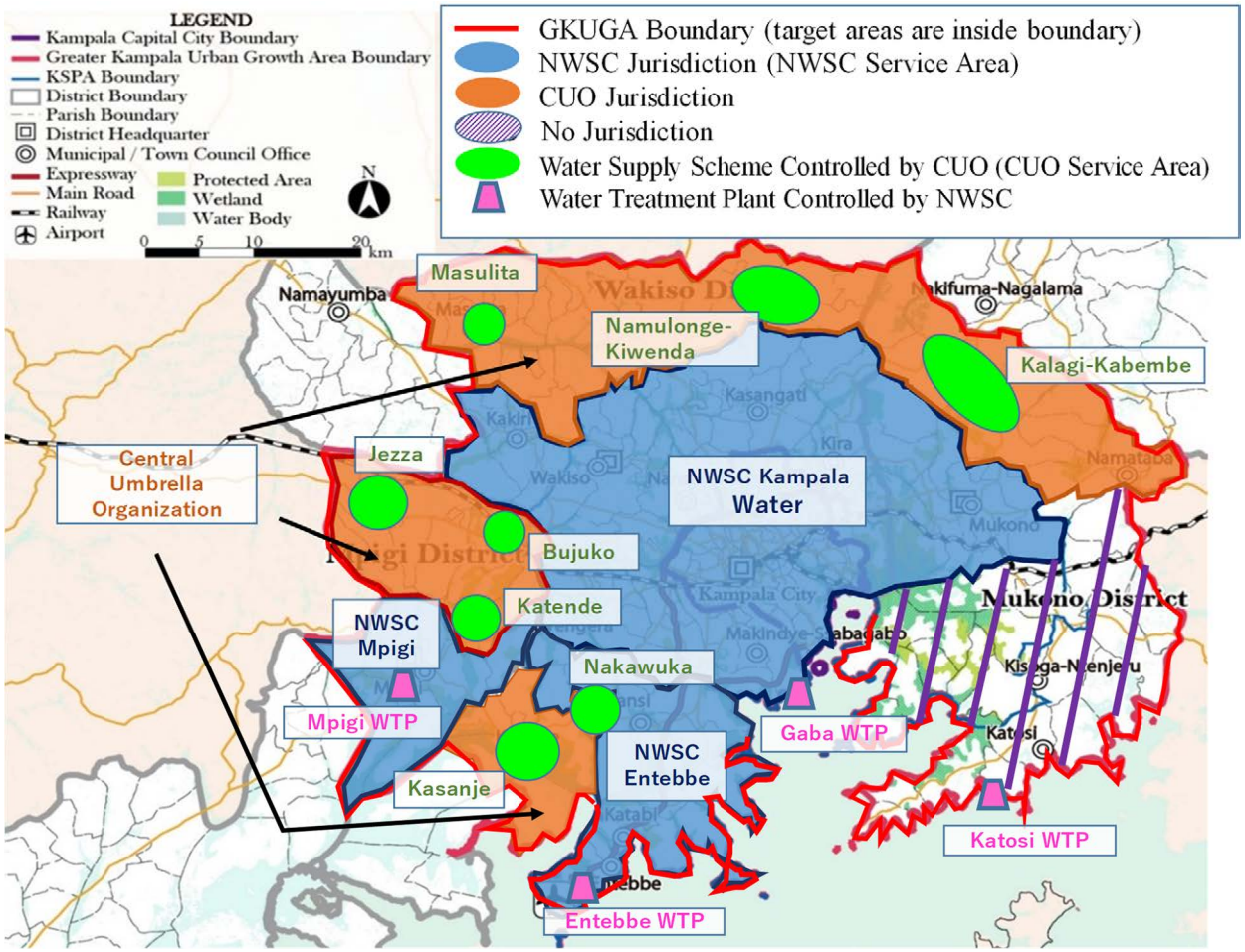
The jurisdiction of water supply facilities in each subcounty is shown in Table 15.1.1 and Figure 15.1.2. As shown in Figure 15.1.2 NWSC provides services to Kampala Capital City (KCC), the central-east GKUGA in Mukono District, and the south-west GKUGA in Mpigi District. Additionally, NWSC provides services in the south Wakiso District, where the international airport is located, specifically in Entebbe City. On the other hand, the areas controlled by CUO is in the suburban, and the operated water supply facilities are limited.

Furthermore, the south-east GKUGA in Mukono District, where forested areas are extensive and the population is sparse, is currently not part of the jurisdiction of NWSC and CUO. As a result, water supply primarily relies on facilities established and maintained by local government, NGOs, and individual households. Such water supply facilities exist throughout GKUGA beyond the service areas of NWSC and CUO.

Table 15.1.1 Jurisdiction of Service Areas in GKUGA

Jurisdiction Organisation	District	Subcounty (Service Areas)
NWSC Kampala Water	Kampala Capital City (KCC)	Central Division, Kawempe Division, Rubaga Division, Makindye Division, Nakawa Division
	Mukono District	Nakisunga (Kyetume, Namuyenje), Nama (Namubiru), Mukono Central Division, Mukono Goma Division
	Wakiso District	Kakiri (Luwunga, Buwanuka), Kakiri Town (Busujja, Kakiri, Kikubampanga, Nakyelongoosa), Kyengera Town, Wakiso, Wakiso Town, Mende (Banda, Namusera, Mende, Kaliiti)、Kira Municipality (Bweyogerere Division, Kira Division, Namugongo Division), Kasangati Town, Makindye-Ssabagabo Municipality (Bunamwaya Division, Masajja Division, Ndejje Division), Nansana Municipality (Busukuma Division (Magigye), Gombe Division (Matugga), Nabweru Division, Nansana Division)
NWSC Entebbe	Wakiso District	Kajjansi Town (except for Nakawuka), Katabi Town, Entebbe Division A, Entebbe Division B
NWSC Mpigi	Mpigi District	Kiringente, Mpigi Town
Central Umbrella Organisation	Mukono District	Kyampisi, Nama (except for Namubiru)
	Wakiso District	Kakiri (except for Luwunga and Buwanuka), Kakiri Town (except for Busujja, Kakiri, Kikubampanga, and Nakyelongoosa), Kasanje、Kajjansi Town (Nakawuka) , Masuliita、Masulita Town, Nansana Busukuma Division (except for Magigye), Nansana Municipality Gombe Division (except for Matugga)
	Mpigi District	Muduuma
No Jurisdiction Note)	Mukono District	Nakisunga (except for Kyetume, Namuyenje), Ntenjeru, Mpatta, Mpunge

Note) There are water supply facilities being operated by local governments, NGOs, and individual households in areas where NWSC and CUO have no juridication.
Source: JICA Expert Team



Source: JICA Expert Team

Figure 15.1.2 Current NWSC and CUO's Jurisdiction Areas in GKUGA

The NWSC's branch offices by NWSC's jurisdiction areas are as shown in Table 15.1.2.

Table 15.1.2 HQ and Branch Offices of NWSC in GKUGA

NWSC Administrative Region	NWSC HQ	NWSC Branch
Kampala Metropolitan	NWSC Kampala Water	Kampala City Centre, Nakawa, Nkulabye, Kasanga, Ntinda, Bwaise, Msanafu, Nateete, Salaama, Bulenga, Luzira, Kireka, Najjanankumbi, Udejje, Wakiso, Matugga, Nasana, Kasangati, Kyaliwajjala, Bulenga, Kyengera, Mukono, Seeta
Central Region	NWSC Entebbe	Entebbe, Kajjansi
	NWSC Mpigi	Mpigi

Source: JICA Expert Team

Urbanisation is progressing in the peripheral area outside KCC. According to the 2014 population census, KCC had a population of approximately 1.5 million, the while population of whole GKUGA was 3.9 million. The projected population for 2050 is around 2.2 million in KCC and approximately 13 million in whole GKUGA. The Kampala Water Lake Victoria Water and Sanitation Project (KW LV WatSan Project) was planned in 2015 focusing on service area of NWSC Kampala Water Head Quarter, aiming for a target year of 2040. The future demand used in this project was based on population forecasts from the 2002 census and underestimated the population growth rate in the peripheral areas of KCC. Therefore, it targeted approximately 7.5 million people as a service population by 2040.

Subsequently, the master plan was revised before the start of Detailed Design (DD) of part of KW LV WatSan Project in 2021, considering the population growth rate from the 2014 population census. The revised plan targets around 8.3 million people by 2040 after taking account of financial situation. However, even including the CUO's water supply schemes, around 13 million people (projected population in 2050) comprising whole GKUGA would not be covered by the master plan.

(2) Planned and Ongoing Project

1) Kampala Water Lake Victoria Water and Sanitation Project

Kampala Water Lake Victoria Water and Sanitation Project (KW LV WatSan Project) targets service areas which are controlled by NWSC Kampala Water HQ in GKUGA. KW LV WatSan Project consists of the following six packages:

- Package 1: Upgrading and rehabilitation of the Gaba WTP
- Package 2: Transmission, primary distribution system, and water network modeling and master planning, rezoning and extension
- Package 3: Refurbishment and optimisation of Gaba WTP
- Package 4: Construction of Katosi WTP and water quality measurement
- Package 5: Improvement of water supply and sanitation services in informal settlements
- Package 6: Accompanying measures including asset management and capacity building

The budget for this project is approximately 212 million euros, funded jointly by the Government of Uganda, Kreditanstalt für Wiederaufbau (KfW), Agence Française de Développement (AFD), European Investment Bank (EIB), and the European Union Infrastructure Trust Fund (EU-ITF). The project aims to expand sustainable water supply and sanitation services around KCC and provide stable water supply services by 2040.

A master plan for Kampala Water Lake Victoria Water and Sanitation Project, mentioned in Package 2, was initially planned in 2003 (updated in 2010) based on a long-term water supply expansion strategy for the peri-urban areas around KCC. It was officially issued as the master plan in 2015. This project is closely linked to the ongoing and future implementation of the Kampala Sanitation Master Plan (2004).

The master plan covers the period from the intermediate year 2025 to the final year 2040. The target areas include parts of Wakiso District and Mukono District, and KCC covering approximately 1,300 km². Population projections were based on the 2002 population census by the Uganda Bureau of Statistics, estimating around 4.6 million people by 2025 and reaching 7.5 million by 2040. These projections closely aligned with the population estimates from the Kampala Physical Development Plan (KPDF) 2012. Additionally, water demand was estimated to increase from 210,000 m³/day in 2010 to 325,000 m³/day by 2025 and 525,000 m³/day by 2040. However, these figures were based on the 2002 population census, and an Optioneering Report reflecting the 2014 population census was issued in November 2021 during the DD stage. Subsequently, DD was completed, and the Detailed Design Report for Component-1 (GKMA) was issued in June 2023. The updated projected water demand was estimated to 345,863 m³/day by 2025 and 577,269 m³/day by 2040 in Optioneering Report is shown in Table 15.1.3.

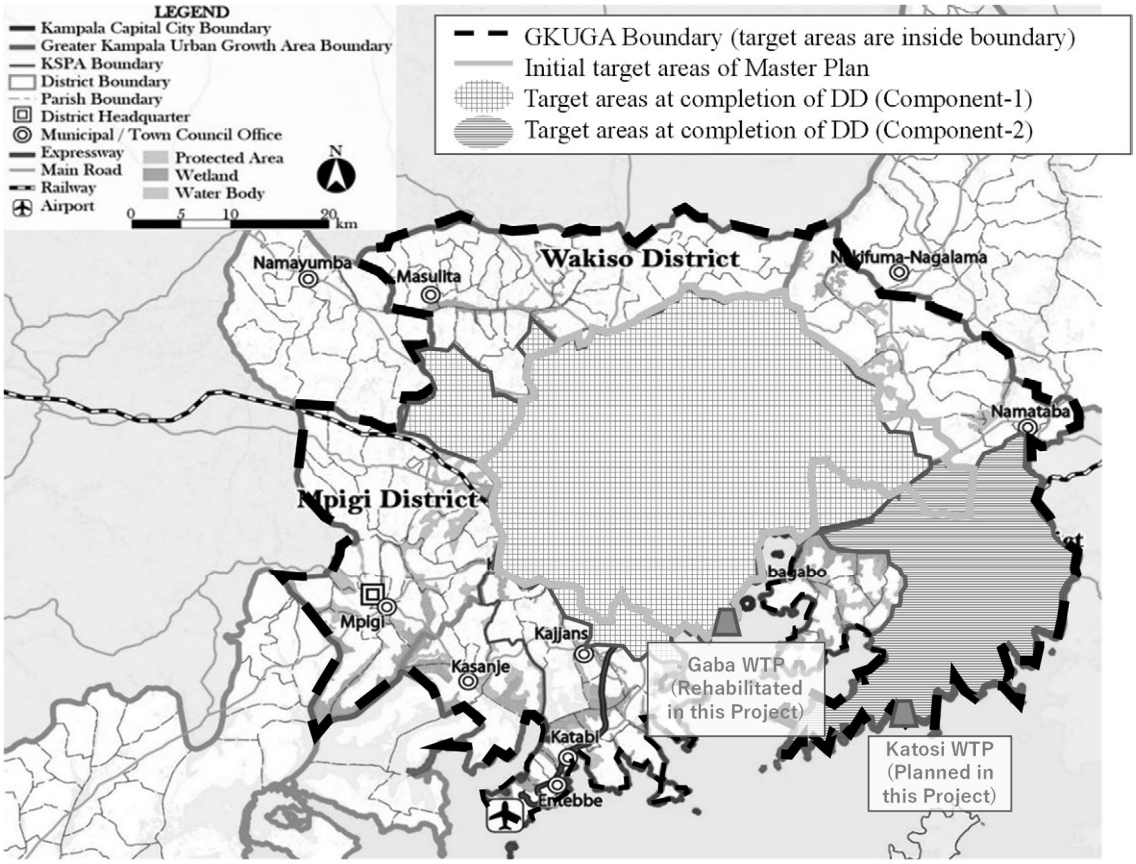
Table 15.1.3 Updated Projected Water Demand in KW LV WatSan Project

District	Sub-County	Projected Population		Projected Domestic Consumption (m^3/day)		Projected Non-Domestic Consumption (m^3/day)		Projected Total Water Demand (m^3/day)		Non-Revenue Water (%)	Total Water Demand/Supplied to Network (m^3/day)	
		2025	2040	2025	2040	2025	2040	2025	2040		2025	2040
Kampala Capital City	Central Division	90,707	104,428	3,990	4,593	2,016	2,322	6,006	6,915	25%	8,008	9,219
	Kawempe Division	408,668	470,489	17,108	19,696	8,131	9,361	25,239	29,057	25%	33,652	38,742
	Rubaga Division	462,430	532,384	25,686	29,571	1,423	1,639	27,109	31,210	25%	36,145	41,613
	Makindye Division	474,245	545,988	22,401	25,790	6,617	7,618	29,018	33,408	25%	38,691	44,544
	Nakawa Division	382,552	440,423	24,611	28,335	7,005	8,064	31,616	36,399	25%	42,155	48,532
Mukono	Mukono Central Division	92,421	122,054	4,043	5,340	1,820	2,403	5,863	7,743	25%	7,817	10,324
	Mukono Goma Division	123,421	162,994	5,534	7,308	2,706	3,573	8,239	10,881	25%	10,986	14,508
Wakiso	Kakiri (Luwunga, Buwanuka)	21,328	46,832	1,090	2,393	22	48	1,112	2,441	25%	1,482	3,254
	Kakiri Town Council (Busujja, Kakiri, Kikubampanga, Nakyelongoosa)	30,445	66,848	1,556	3,415	31	69	1,587	3,484	25%	2,116	4,645
	Kajjansi Town Council (Bweya, Kitende,Nsaggu)	23,956	52,602	984	2,160	37	81	1,021	2,241	25%	1,361	2,988
	Kyengera Town Council (except for Kyengera) Nsangi	289,602	635,894	10,447	22,938	272	599	10,719	23,537	25%	14,292	31,382
	Wakiso	249,670	548,215	9,875	21,684	82	180	9,958	21,864	25%	13,277	29,152
	Wakiso Town Council	110,268	242,123	4,162	9,138	83	182	4,245	9,320	25%	5,659	12,427
	Mende (Banda, Namusera Ward, Kaliiti, Mende)	24,792	54,437	938	2,060	27	60	966	2,120	25%	1,287	2,827
	Kira Division	611,413	1,342,515	29,415	64,589	8,420	18,488	37,835	83,077	25%	50,447	110,769
	Kasangati Town Council	260,720	572,479	10,188	22,371	285	625	10,473	22,996	25%	13,964	30,661
	Makindye-Ssabagabo Division	546,091	1,199,084	25,532	56,063	815	1,790	26,348	57,853	25%	35,130	77,137
	Nansana Busukuma Division (Magigye)	12,668	27,816	475	1,043	10	21	485	1,064	25%	646	1,419
	Nansana Gombe Division (Matugga)	60,924	133,774	2,665	5,853	133	292	2,799	6,145	25%	3,732	8,194
	Nansana Nabweru Division	194,615	427,329	6,082	13,354	1,783	3,914	7,864	17,268	25%	10,486	23,025
	Nansana Nansana Division	278,548	611,624	8,705	19,113	2,194	4,817	10,898	23,930	25%	14,531	31,906
Total		**4,749,484**	**8,340,332**	**215,487**	**366,807**	**43,910**	**66,146**	**259,398**	**432,953**		**345,863**	**577,269**

Source: Optioneering Report- Component 1 (Greater Kampala Metropolitan Area)

In the Detailed Design Report for Component-1, due to increasing water demand in the suburb, the target area was divided into Component-1 (GKMA) and Component-2 (Mukono and Buikwe Districts), covering a total of 2,356 km² (as shown in Figure 15.1.3).The outline of Component-1 and 2 are as follows:

- Component-1: Greater Kampala Metropolitan Area (GKMA)
  - Installation of main water supply pipelines in GKMA [total length: 313 km, including 259 km of new pipelines, 29 km of replacements, and 25 km of pipeline of District Metering Areas (DMA)] and installation of booster pumping stations.
  - The detailed design (DD) was completed in June 2023, and construction contracts are planned to be signed in April 2024.
- Component-2: Mukono and Buikwe Counties
  - Construction of a new 60 km main water supply pipeline from Nsumba Reservoir to Lugazi in order to provide water supply to Lugazi town with the aim of providing future water supply provision to several parishes located within Mukono and Buikwe Districts (including Lugazi Municipality). Development of reservoirs and booster pumping stations is also planned. As of 2024, DD is ongoing, and the donor has not been determined.



Source: JICA Expert Team based on Optioneering Report, Detailed Design Report for Component-1 (GKMA)

Figure 15.1.3 Target Areas of KW LV WatSan Project

2) Wakiso West Water and Sanitation Project

Wakiso West Water and Sanitation Project (Wakiso West WatSan Project) targets service areas in South Wakiso District, West Wakiso District, and Central Mpigi District in GKUGA.

Wakiso West WatSan Project consists of three components:

- Component-1 of the project will expand the access to drinking water for the population in

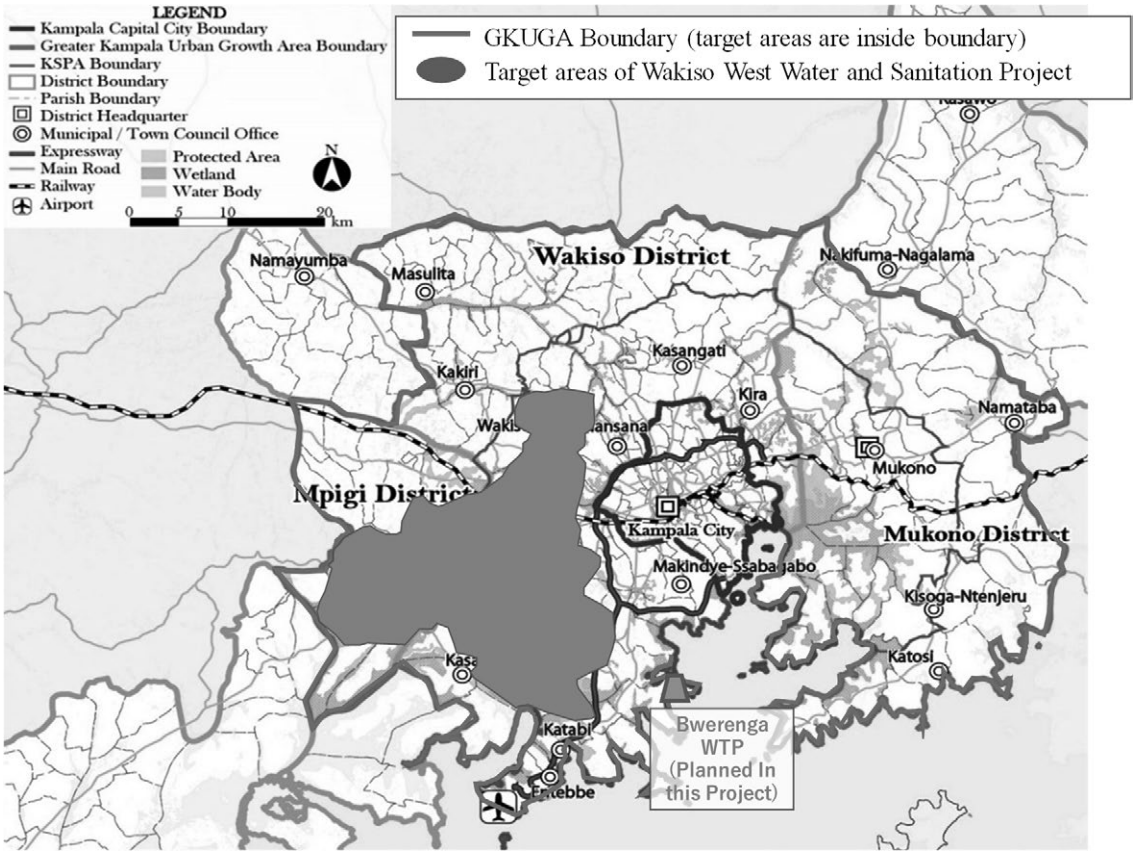
West Wakiso and North Mpigi districts as well as to provide bulk water transfers especially to the existing networks of the Entebbe-Kajjansi-Kampala arterial which experience shortfalls of supply.

- Component-2 of the project aims at improving the faecal sludge treatment and disposal in the project area by the construction of a decentralised faecal sludge treatment plant (FSTP) with a capacity of 400 m^3/day.
- Component-3 will be centred on network expansion for the establishment of community water dispensers (CWDs) and yard taps with electronic pre-paid meters to improve access to water in informal settlements at an affordable cost.

The project design horizon is 2040. However, constructing the required infrastructure to meet 2040 demands exceeds the currently available budget.

As for water supply facilities, the new WTP is planned at Bwerega in this project and its capacity is planned to be 62,500m^3/day for Phase I, and another 62,500m^3/day for Phase II. Therefore, the new WTP has planned water production capacity of 125,000m^3/day in total by 2040. The target service areas are as shown in Figure 15.1.4. As current progress in 2024, the feasibility study of Phase I has been completed and NWSC is undergoing procurement of consultancy for DD.

As for overall budget, the total project cost is 182.4 million euros, of which Danida Business Finance may provide 129.8 million euros as a subsidised loan. The feasibility study assumed the project tertiary networks for Phase I cover a large area but within the capacity of NWSC to rapidly connect these networks to consumers. This will result in an early high uptake of water.



Source：JICA Expert Team based on Wakiso West WatSan Project

Figure 15.1.4 Target Areas of Wakiso West WatSan Project

(3) Tariff System

In GKUGA, different tariff systems are available, as shown in Table 15.1.4.

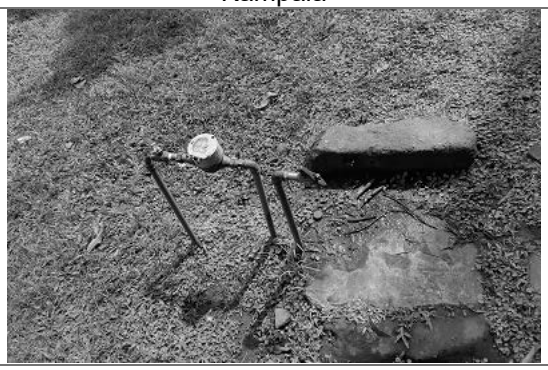
The NWSC implements a uniform tariff with a cross subsidy in all towns and consumer categories. Since there were insignificant changes on the indexation parameters, the tariff structure has been maintained. Item No.1 in Table 15.1.4 shows the NWSC tariff implemented for the various consumer categories during the Financial Year 2021/22.

Water supply facilities outside of NWSC's controlled areas are established by CUO. The pro-poor public stand posts (PSPs), installed by NWSC's urban pro-poor branch, aim to provide facilities with affordable tariffs to low-income households. These are pre-paid systems using electronic billing generated by token, and the water tariff is UGX 25 for a jerrycan (20-litre poly tank). However, tokens are often out of stock, and private vendors who have tokens resell water to poor people at UGX 100 per jerrycan. Therefore, some poor people have no option but to purchase water at a high cost. Due to this circumstance, the resell tariff was corrected from UGX 100 to UGX 50 per jerrycan by NWSC in January 2021. Additionally, it is not easy to maintain PSPs and most of them are out of order; therefore, the government has begun rehabilitating them since 2022.

Table 15.1.4 Water Supply Tariff Systems in GKUGA

No.	Facility Type	Organisation	Water Tariff
1	Piped water through NWSC water supply system from Gaba WTP, Katosi WTP, deep ground water, and surface water with treatment 1) Pro-poor Public Stand Posts (PSPs) 2) House connection supply/yard tap 3) Institution/ Government 4) Commercial 5) Industrial	・ NWSC ・ MWE	1) Pro-poor Public Stand Posts: UGX 25 for a jerrycan (20 litres) or UGX1,060 / m^3 2) House connection supply (domestic customers): UGX 83 for a jerrycan (20 litres) or UGX3,516 / m^3 3) Institution/Government: UGX 84 for a jerrycan (20 litres) or UGX3,558 / m^3 4-1) Commercial (500m3/month): UGX 99 for a jerrycan (20 litres) or UGX4,220 / m^3 4-2) Commercial (500-1,500 m^3/month): UGX 79 for a jerrycan (20 litres) or UGX3,373 / m^3 5-1) Industrial (1,000 m^3/month or less): UGX 99 for a jerrycan (20 litres) or UGX4,220 / m^3 5-2) Industrial (more than 1,000 m^3/month): UGX 59 for a jerrycan (20 litres) or UGX2,500 / m^3
2	Public stand post and house connection supply using deep groundwater, shallow well and protected spring	・ CUO ・ MWE ・ District local government	Public stand post: UGX 100 for a jerrycan (20 litres) <Tariff depends on the county> House connection supply: UGX 3,400/m^3 <Tariff depends on the county> Commercial supply: UGX2,120/m^3 <Tariff depends on the county>
3	Purchasing water from vender such as domestic user described in No.1	Private	UGX100 for a jerrycan (20 litres)
4	1) Shallow well and borehole without any treatment 2) Protected / unprotected spring 3) Water from rainwater harvest tank	Private	Free of charge

Source: Compiled by JICA Expert Team based on NWSC Integrated Annual Report 2021-2022

	
Pro-poor public stand posts (PSPs) at Kyamga in Kampala	Token for PSPs
	
House connection supply/yard tap at Kyamga in Kampala Capital City	Public stand post organised by District Local Government in Wakiso subcounty, Wakiso District (Lukwanga Solar Powered Piped Water Supply System)

Source: JICA Expert Team

Figure 15.1.5 Facility by Tariff Systems in GKUGA

As for house connection supply by NWSC, the following connection costs were covered by the government until September 2020; however, these costs had been borne by residents from October 2020 due to financial difficulties of the government. Accordingly, most house connections are installed in medium-income and high-income households.

- Cost of pipe materials between distribution pipe and house connection points
- Installation cost of connection pipe depends on diameter of intermediary distribution pipes
- Cost of water meter

(4) Water Supply Facilities

As major water supply facilities in GKUGA, there are WTPs and deep groundwater facilities which are controlled by NWSC, and deep groundwater facilities controlled by CUO. However, deep groundwater facilities controlled by NWSC are limited.

In GKUGA, Katosi WTP and Gaba WTP are main WTPs that supply water to KCC, as well as in the central-east Mukono and from central-west to central-east Wakiso district. Additionally, there are two more water treatment plants: Entebbe WTP in the south Wakiso district and Mpigi WTP in Mpigi district. There are four WTPs in total to provide water supply in GKUGA.

Table 15.1.5, Table 15.1.6 and Figure 15.1.6 shows some details of each facility. The Katosi WTP, shown in Table 15.1.5, was constructed as the master plan known as the KW LV WatSan Project. The master plan includes expansion works to achieve a production capacity of 240,000 m^3/day by 2040. Currently, the four WTPs in GKUGA have an estimated surplus water production capacity of around 90,000 m^3/day. Regarding Katosi WTP's surplus portion of 70,000 m^3/day out

of 90,000 m^3/day, is planned to be provided to the major water supply facilities under construction starting in 2024 as component-1 of KW LV WatSan Project.

CUO's water supply facilities operate exclusively using deep groundwater sources. However, there is a possibility that the CUO's facilities have no potential of surplus water production capacity due to decrease in pumped water volume since the construction of water supply facility in Jezza as basis. The details of water supply facilities of CUO in GKUGA are shown in Table 15.1.6.

Table 15.1.5 Water Supply Facilities of NWSC in GKUGA (as of 2021)

NWSC HQ	NWSC Kampala		NWSC Entebbe	NWSC Mpigi
WTP	Gaba I, II, III WTP	Katosi Ia, Ib WTP	Entebbe WTP	Mpigi WTP
Construction Year	Gaba I：1929 （rehabilitated in 2017） Gaba II： 1993 Gaba III：2007	Katosi Ia：2021 Katosi Ib：2021	2007	2007
Intake Facility and Raw Water Transmission Pipe	Water source: Lake Victoria Intake pump: 4,000 m^3/hr x 4 units （standby: 1 unit） Raw water transmission pipe: Approx. 220 m (intake point is 220 m offshore from the lake shore)	Water source: Lake Victoria Intake pump: 1,950 m^3/hr x6 units (standby: 2 units) Raw water transmission pipe: Approx. 530 m (intake point is 530 m offshore from the lake shore)	Water source: Lake Victoria Intake pump: 700 m^3/hr x 1 unit, 400 m^3/hr x 1 unit Raw water transmission pipe: Approx. 330 m (intake point is 330 m offshore from the lake shore)	Water source：Makokobe Wetland Intake pump:50 m^3/hr x 2 units Raw water transmission pipe: PN150, Approx. 500 m
Design Capacity	Gaba I：72,000 m^3/day Gaba II：80,000 m^3/day Gaba III：80,000 m^3/day	Katosi Ia：80,000 m^3/day Katosi Ib：80,000 m^3/day Total 160,000 m^3/day	26,000 m^3/day (1,000 m^3/day is used inside WTP for operation) 2)	1,200 m^3/day
Total	419,200 m^3/day			
Average Water Production	Total: 232,000 m^3/day	Total:70,000 m^3/day 1)	26,000 m^3/day	1,200 m^3/day
Total	329,200 m^3/day			
Surplus Water Production Capacity	Total: 0 m^3/day	Total: 90,000 m^3/day	0 m^3/day	0 m^3/day
Total	90,000 m^3/day			
Water Treatment Process	Receiving well→Flocculation basin→Sedimentation →Rapid sand filter→Clear water reservoir→Transmission main	Receiving well→Flocculation basin→Sedimentation→Dissolved-air flotation→Rapid sand filter→Clear water reservoir→Transmission main	Receiving well→Flocculation basin→Sedimentation →Rapid sand filter→Clear water reservoir→Transmission main	Receiving well→Aeration→Flocculation basin→Sedimentation →Rapid sand filter→Clear water reservoir→Transmission main

Note1) Average water production in Katosi WTP in February 2024 was 85,000 m^3/day.
Note2) 1,000 m^3/day as WTP internal use was included in average water production in Entebbe WTP
Source: JICA Expert Team based on interview survey

Table 15.1.6 Water Supply Facilities of CUO in GKUGA (as of 2020)

Scheme	Kalagi-Kabembe	Masulita	Namulonge-Kiwenda	Nakawuka	Kasanje	Jezza	Bujuko	Katende
District	Mukono	Wakiso	Wakiso	Wakiso	Wakiso	Mpigi	Mpigi	Mpigi
Division/Town/ Subcounty	Kyampisi and Nama	Masulita & Masulita TC	Busukuma	Kajjansi	Kasanje	Mudduma	Mudduma	Kiringente
Construction Year	2018	-	2018	2004	2013	2014	2009	2016
Power [1)]	Commercial power supply/ diesel	Commercial power supply	Commercial power supply/ diesel	Commercial power supply	Commercial power supply/diesel	Commercial power supply	Commercial power supply	Commercial power supply
Design Capacity	768 m^3/day	44 m^3/day	460 m^3/day	106 m^3/day	175 m^3/day	150 m^3/day	45 m^3/day	112 m^3/day
Total	1,860 m^3/day							
Average Water Production	379 m^3/day	44 m^3/day	348 m^3/day	106 m^3/day	177 m^3/day	110 m^3/day	21 m^3/day	112 m^3/day
Total	1,297 m^3/day							
Surplus Water Product ion Capacity	379 m^3/day	0 m^3/day	112 m^3/day	0 m^3/day	0 m^3/day	0 m^3/day [2)]	24 m^3/day	0 m^3/day
Total	515 m^3/day							
Water Treatment System	Pump up from deep groundwater → Collection tank → Elevated tank → Distribution to each household and PSPs (without chlorine injection)							

Note1) Diesel power generation was introduced for emergency
Note2) At the time of site survey in 2024, actual water production capacity in Jezza was decreased, and there was no surplus production capacity
Source: Umbrella Authorities 2020

SCADA system in Katosi WTP (centralised management system)

Rapid sand filter in Entebbe WTP

Aeration facility in Mpigi WTP

Transmission pump in Gaba WTP

Water collection tank at Namulonge-Kiwenda scheme

Elevated tank at Kalagi-Kabembe scheme

Source: JICA Expert Team

Figure 15.1.6 Water Supply Facilities in GKUGA

(5) Water Demand

Table 15.1.7 indicates the estimated per capita water supply and population served in NWSC's service areas in accordance with actual water supply.

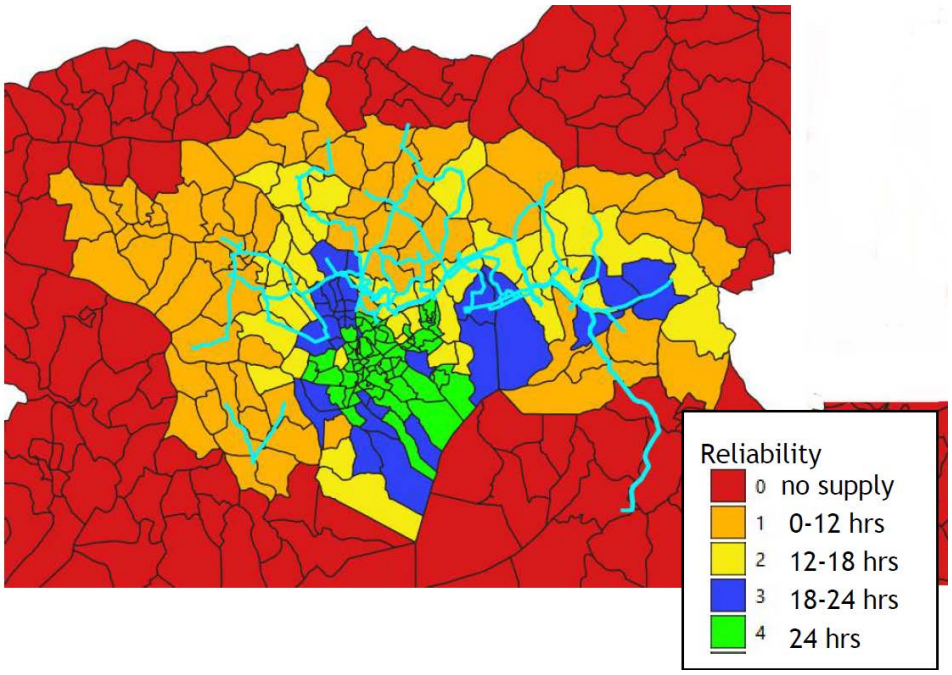
The estimated service population in the whole NWSC's service areas in GKUGA is approximately 4,712 thousand people, with an actual per capita water supply of approximately 37.5 litres per capita per day. The lower water supply volume in NWSC Mpigi is attributed to the fact that Mpigi's water treatment plant follows a conventional system designed for small urban areas, relying primarily on PSPs for water distribution.

Table 15.1.7 Actual per Capita Water Supply of NWSC Service Areas in GKUGA (2021-2022)

NWSC HQ	A. Water consumption (m^3/day)	B. Estimated population in 2021	Actual per capita water supply (L/capita/day) < A / B >
NWSC Kampala Water	159,267	4,232,000	37.6
NWSC Entebbe	16,383	393,000	41.7
NWSC Mpigi	1,020	87,000	11.7
Total	**176,670**	**4,712,000**	**37.5**

Note) Estimated population is calculated by JICA Expert Teqam based on the National Population and Housing Census 2014 and population growth rate.
Source: NWSC Integrated Annual Report 2021-2022

Furthermore, variations in water supply volume occur across different service areas, with NWSC Kampala Water's service areas showing significant disparities. In the central part of KCC, there is 24-hour water supply; while in the peripheral, water supply ranges from 0 to 12 hours per day as shown in Figure 15.1.7. Therefore, it is estimated that actual per capita water supply is less than 50% of target per capita water supply in peripheral of KCC.



Source: Optioneering Report- Component-1 (Greater Kampala Metropolitan Area) prepared by NWSC

Figure 15.1.7 Reliability of NWSC's Kampala Water in Its Service Areas （as of December 2020）

The population in CUO's service areas in GKUGA was 107,300 in 2020 as shown in Table 15.1.8. The actual per capita water supply was 7.4 litres per capita per day calculation with billed water amount.

Table 15.1.8 Actual per Capita Water Supply in CUO's Service Area in GKUGA (as of 2020)

Scheme	District / Sub County	Population in 2020	Service population	C. Billed water amount (m³/day)	Actual per capita water supply (L/capita/day) < C / B >
Kalagi-Kabembe	Mukono District/ Kyampisi Sub County	62,000	25,075	244	9.7
	Mukono District/ Nama Sub County	56,000			
Masulita	Wakiso District/ Musulita Sub County	12,000	10,560	39	3.7
	Wakiso District/ Musulita Town	20,000			
Namulonge-Kiwenda	Wakiso District/ Nansana Busukuma Division	40,000	16,367	209	12.8
Nakawuka	Wakiso District/ Kajjansi Town	12,000	15,987	53	3.3
Kasanje	Wakiso District/ Kasanje Sub County	35,000	13,452	91	6.8
Jezza	Mpigi District/ Muduuma Sub County	37,000	9,900	71	7.2
Bujuko			10,000	16	1.6
Katende	Mpigi District/ Kiringente Sub County	22,000	5,689	68	12.0
Inside Scheme Sub-Total		296,000	107,030	791	7.4
Outside Scheme Note)		104,000	-	-	-
Total		**400,000**	-	-	-

Note) Sub counties of the outside scheme are Kakiri (except for Luwunga, Buwanuka), Kakiri Town (except for Busujja, Kakiri, Kikubampanga, and Nakyelongoosa), Nansana Gombe Division (except for Matugga)
Population of Nakawuka in 2020 is reference value.
Source: Compiled by JICA Expert Team based on Umbrella Authority 2020 and National Population and Housing Census 2014

According to the 2nd edition of *Uganda Water Supply Design Manual* issued in 2013 by MWE, the per capita minimum design water supply in CUO's controlled areas in GKUGA is 20 litres per capita per day (average value is 37 litres per person per day). Consequently, the actual per capita water supply in CUO's service areas is approximately 30% of the per capita minimum design water supply. It shows shortage of water supply significantly.

The total population in CUO's service areas in GKUGA was estimated to be 400 thousand as of 2020, based on the 2014 population census and population growth rate as shown in Table 15.1.8. Therefore, approximately 293 thousand people in the whole CUO's controlled areas in GKUGA were not receiving water supply from CUO's water supply facilities. Therefore, service coverage rate was approximately 27% in 2020.

The primary water supply facilities in uncontrolled areas of NWSC and CUO are operated by local government, NGOs, and individual households through independently developed water supply facilities.

(6) Water Quality

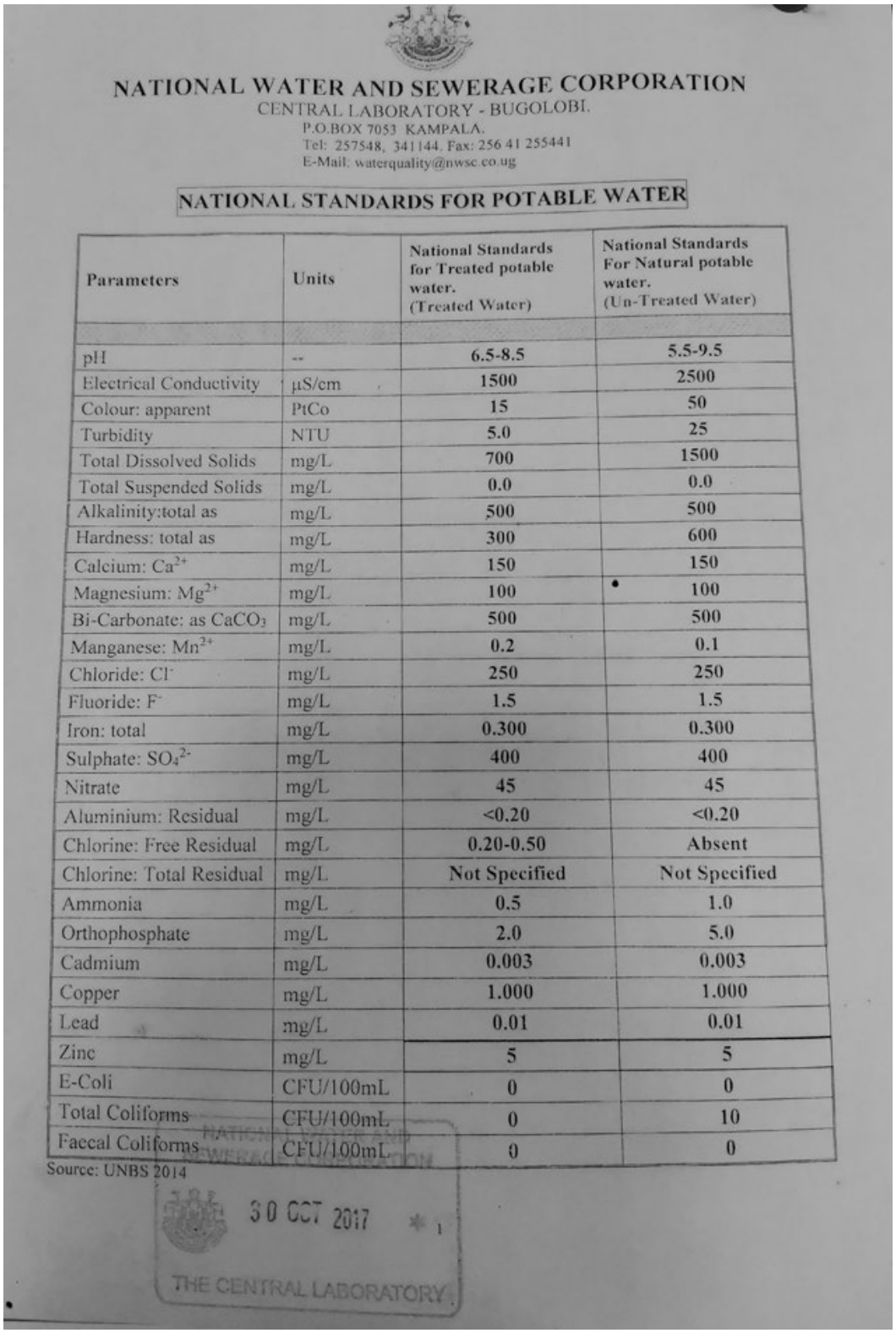
NWSC has established laboratories for water quality tests which adhere to international standards. These are the Central Laboratory, Regional Laboratory, and Area Laboratory, where water quality tests are conducted. Additionally, collaborative water quality monitoring is conducted involving information sharing with the Kampala Capital City Authority (KCCA), the Uganda National Bureau of Standards (UNBS), and MWE. Furthermore, the Central Laboratory provides water quality testing services to external clients.

Regarding drinking water quality standards, NWSC's Central Laboratory has developed standards based on World Health Organization (WHO) guidelines. These standards have been operationalised as the National Standard for Potable Water since 2017 as shown in Figure 15.1.8

Regarding NWSC's service areas, a water quality test is conducted regularly (once a week to once a month) by NWSC, with varying testing frequencies depending on the sampling locations. These sampling points include reservoirs, booster pumps, hospitals, markets, public taps, private taps, and deep groundwater wells. According to the NWSC Integrated Annual Report 2020-2021, 98% of water samples nationwide met the national standards for potable water, achieving the target set for the 2020 fiscal year mentioned in the NWSC Corporate Plan 2021-2024. Therefore, an achievement rate on water quality was 100%. It can be assumed that achievement rate on water quality was similar in GKUGA.

Additionally, each water treatment plant conducts water quality tests on both raw water and treated water. The test items and testing frequency at WTPs are shown in Figure 15.1.9.

For instance, examining the test results from the Katosi WTP for the period July to September 2021, out of a total of 952 samples, only two samples exceeded the standard for colour, while 950 samples remained within the standard (99.8% compliance).



NATIONAL WATER AND SEWERAGE CORPORATION
CENTRAL LABORATORY - BUGOLOBI.
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NATIONAL STANDARDS FOR POTABLE WATER

Parameters	Units	National Standards for Treated potable water. (Treated Water)	National Standards For Natural potable water. (Un-Treated Water)
pH	--	6.5-8.5	5.5-9.5
Electrical Conductivity	µS/cm	1500	2500
Colour: apparent	PtCo	15	50
Turbidity	NTU	5.0	25
Total Dissolved Solids	mg/L	700	1500
Total Suspended Solids	mg/L	0.0	0.0
Alkalinity:total as	mg/L	500	500
Hardness: total as	mg/L	300	600
Calcium: Ca^{2+}	mg/L	150	150
Magnesium: Mg^{2+}	mg/L	100	100
Bi-Carbonate: as $CaCO_3$	mg/L	500	500
Manganese: Mn^{2+}	mg/L	0.2	0.1
Chloride: Cl^-	mg/L	250	250
Fluoride: F^-	mg/L	1.5	1.5
Iron: total	mg/L	0.300	0.300
Sulphate: SO_4^{2-}	mg/L	400	400
Nitrate	mg/L	45	45
Aluminium: Residual	mg/L	<0.20	<0.20
Chlorine: Free Residual	mg/L	0.20-0.50	Absent
Chlorine: Total Residual	mg/L	Not Specified	Not Specified
Ammonia	mg/L	0.5	1.0
Orthophosphate	mg/L	2.0	5.0
Cadmium	mg/L	0.003	0.003
Copper	mg/L	1.000	1.000
Lead	mg/L	0.01	0.01
Zinc	mg/L	5	5
E-Coli	CFU/100mL	0	0
Total Coliforms	CFU/100mL	0	10
Faecal Coliforms	CFU/100mL	0	0

Source: UNBS 2014

30 OCT 2017
THE CENTRAL LABORATORY

Source: NWSC

Figure 15.1.8 National Standards for Potable Water

Parameter	Raw water	Clarified water	Filtered water	Final water
pH	Daily	Daily	Daily	Daily
Electrical Conductivity	Daily	NR	NR	Daily
Turbidity	Daily	Daily	Daily	Daily
Colour	Daily	Daily	Daily	Daily
Total suspended solids	Daily	NR	NR	Daily
Hardness	Twice a week	NR	NR	Twice a week
Total alkalinity	Twice a week	NR	NR	Twice a week
Total Iron	Twice a week	NR	NR	Twice a week
Aluminium Residual	NR	NR	NR	Twice a week
Free chlorine	NR	NR	NR	Daily
Total chlorine	NR	NR	NR	Daily
Bicarbonate as $CaCO_3$	Quarterly	NR	NR	Quarterly
Total Dissolved Solid	Quarterly	NR	NR	Quarterly
Silica	Quarterly	NR	NR	Quarterly
Sulphate	Quarterly	NR	NR	Quarterly
Nitrate	Quarterly	NR	NR	Quarterly
Chloride	Quarterly	NR	NR	Quarterly
Magnesium	Quarterly	NR	NR	Quarterly
Fluoride	Quarterly	NR	NR	Quarterly
Manganese	Quarterly	NR	NR	Quarterly
Arsenic	Quarterly	NR	NR	Quarterly
Tri-halo methane (THM)	Quarterly	NR	NR	Quarterly
Total Organic Carbon (TOC)	Quarterly	NR	NR	Quarterly
Na, K, Ca, Ba, Li	Quarterly	NR	NR	Quarterly
Heavy metals	Quarterly	NR	NR	Quarterly

Note) NR is "not applicable"
Source: NWSC

Figure 15.1.9 Test Items at WTPs Controlled by NWSC

In the CUO, water quality test is conducted every three months using mobile laboratories and water quality testing facilities owned by the MWE. The sampling points include public taps, private taps, elevated tanks, and office buildings. Additionally, water quality standards applied are consistent with those used by NWSC, following the National Standards for Potable Water.

Based on the water quality test results conducted by CUO in 2020 (specifically focusing on microbiological tests), approximately half of the water supply facilities in GKUGA showed the detection of microorganisms such as *E. coli*, Total Coliforms, and Faecal Coliforms as shown in Table 15.1.9.

Table 15.1.9 Results of Water Quality Test for CUO's Water Supply Facilities in GKUGA (2020)

Scheme	% of Microbiology Tests complying with criteria	National Standards Criteria (CFU/100 ml) Note)
Kalagi-Kabembe	80	0
Masulita	100	0
Namulonge-Kiwenda	No data	0
Nakawuka	No data	0
Kasanje	100	0
Jezza	67	0
Bujuko	50	0
Katende	No data	0

Note) CFU/100 ml（Colony Forming Unit/100 ml）is number of bacteria per 100 ml
Source: Umbrella Authorities 2020

(7) Non-Revenue Water

The non-revenue water (NRW) rates of each NWSC's service area in GKUGA from fiscal years 2018 to 2021 are shown in Table 15.1.10. Over the past four years, there had been a trend of increasing NRW rates, with approximately 40% for the whole NWSC's controlled areas in GKUGA.

Notably, NWSC Kampala Water, which controls the central part of GKUGA, had a high NRW rate of 41%, while NWSC Mpigi's NRW rate was approximately 18%.

There are many ageing pipelines, and high internal pressure inside the pipes leads to water leakage in the central part of GKUGA. On the other hand, for NWSC Mpigi's service areas, leakage is relatively found easier due to the smaller population served and shorter total pipeline length. Therefore, it is assumed that NWSC Mpigi's service areas have a lower non-revenue water rate.

The main reasons for NRW are the following:

- Damages to the pipe network arising from road works
- Aged pipe network which is prone to leaks and bursts and requires replacement
- Under registering of some meters mainly due to old age
- Water theft through illegal connections and meter bypasses

Table 15.1.10 NRW Rates in NWSC's Service Areas in GKUGA (2018-2022)

NWSC HQ	FY2018-2019	FY 2019-2020	FY 2020-2021	FY 2021-2022
NWSC Kampala Water	35%	40%	41%	41%
NWSC Entebbe	26%	36%	38%	30%
NWSC Mpigi	21%	17%	19%	18%
Total	**34%**	**39%**	**40%**	**40%**

Note) Total value was calculated based on average water production and billed water amount
Source: NWSC Integrated Annual Report 2018-2019, 2019-2020, 2020-2021, and 2021-2022

NRW rate in CUO's service areas in GKUGA is shown in Table 15.1.11. In 2020, the NRW rate of the whole CUO's service areas was approximately 39%. However, during the site survey in 2024, NRW rate had increased significantly, except for some areas, resulting in a high rate of 49% for the whole CUO's service areas in GKUGA.

Table 15.1.11 NRW Rate in NWSC's Service Areas in GKUGA (2018-2022)

Scheme	District/ Subcounty	Year 2020			Year 2024
		Average water production (m^3/day)	Billed water volume (m^3/day)	NRW rate <(A - B) /A>	NRW rate
Kalagi-Kabembe	Mujkono District/ Kyampisi and Nama subcounty	379	244	36%	41%
Masulita	Wakiso District/ Musulita Subcounty and Musulita Town	44	39	10%	No data
Namulonge-Kiwenda	Wakiso District/ Nansana Municipality Busukuma Division	348	209	40%	49%
Nakawuka	Wakiso District/ Kajjansi Town	106	53	50%	53%
Kasanje	Wakiso District/ Kasanje Subcounty	177	91	49%	62%
Jezza	Mpigi District/ Muduuma Subcounty	110	71	36%	No data
Bujuko		21	16	23%	No data
Katende	Mpigi District/ Kiringente Subcounty	112	68	39%	53%
Total		**1,297**	**791**	**39%**	**49%**

Source: Umbrella Authorities 2020 and Central Umbrella Organisation

15.1.2 Issues on Water Supply Sector

(1) Balance of Future Water Demand with Water Supply

NWSC has planned water production volume for the water treatment plants, including those newly established under the Master Plan (KW LV WatSan Project) and the Wakiso West WatSan Project, up to year 2040 as shown in Table 15.1.12. As of 2021, the average water production was 329,200 m³/day, while the planned design capacity for 2040 was 624,200 m³/day. Therefore, the surplus water production capacity by 2040 will be 295,000 m³/day.

Table 15.1.12 Planned Design Capacity of WTP in GKUGA (2040)

WTP	A. Planned design capacity in 2040 (m³/day)	B. Average water production in 2021 (m³/day)	C. Surplus water production capacity in 2040 (m³/day) <A – B>	Implementation of the future project 1)	NWSC HQ to be controlled
Gaba I	232,000	232,000	0	-	NWSC Kampala Water
Gaba II					
Gaba III					
Katosi IA Katosi IB	160,000	70,000 2)	90,000	KW LV WatSan Project (component-1)	NWSC Kampala Water
Entebbe	26,000	26,000	0	-	NWSC Entebbe
Mpigi	1,200	1,200	0	-	NWSC Mpigi
Katosi II	80,000	0	80,000	KW LV WatSan Project (component-2)	No Jurisdiction 3)
Bwerenga	125,000	0	125,000	Wakiso West Watsan Project	NWSC Kampala Water, NWSC Entebbe and NWSC Mpigi
Total	624,200	329,200	295,000	-	-

Note 1) Gaba WTP, Entebbe WTP, and Mpigi WTP are existing WTPs in 2024.
Note 2) Operation water production is 85,000m³/day in 2024.
Note 3) None of controlled HQ for service areas of Katoshi II WTP in 2024; therefore, NWSC Kampala Water is planned to take control in the future.
Source: Compiled by JICA Expert Team based on Optioneering Report, DD Report – Component-1 (GKMA) and Wakiso West Water and Sanitation Project Feasibility Study Report

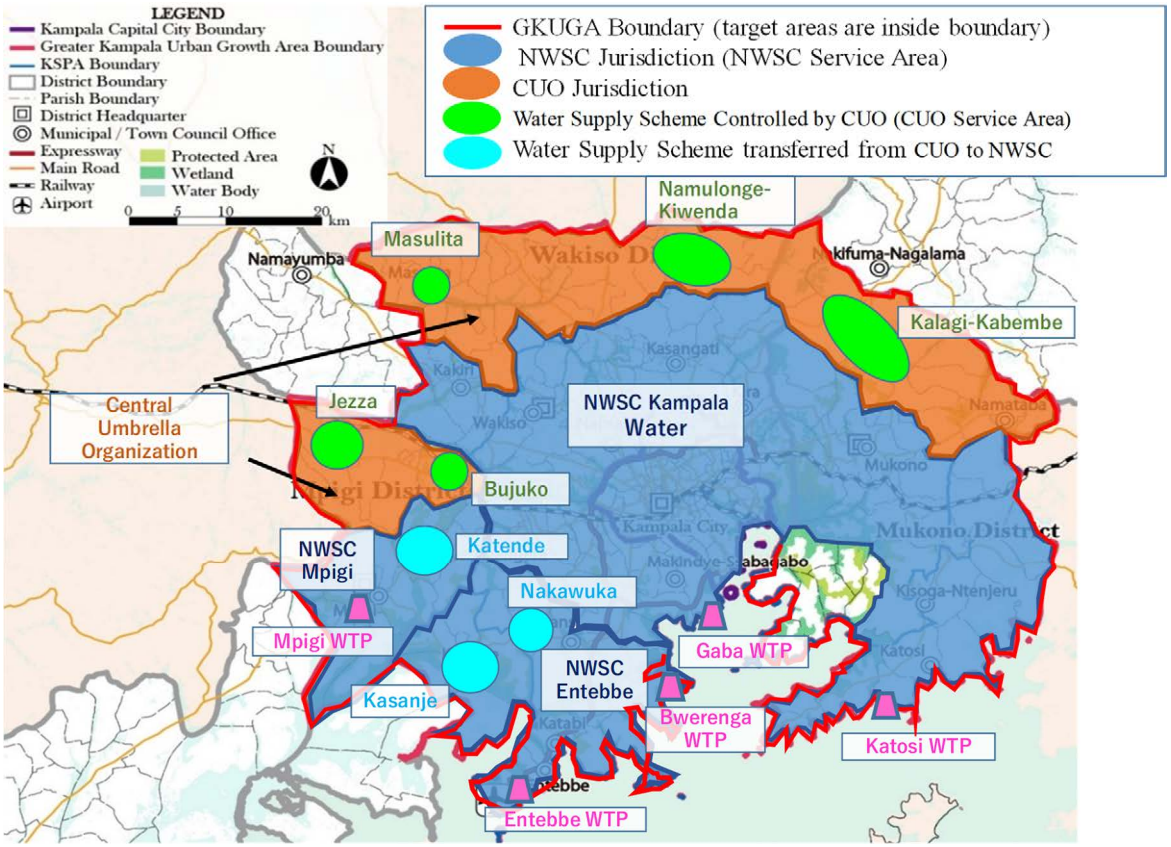
According to the Master Plan, it is estimated the per capita design water supply is increased by 1 % annually. Based on the per capita design water supply in 2040 for KW LV WatSan Project and Wakiso West WatSan Project, the projected water demand for 2050, which is the target year of the Project, is 707,060 m³/day in whole GKUGA as shown in Table 15.1.13. On the other hand, since the planned design capacity of WTPs controlled by NWSC by 2040 is 624,200 m³/day (Table 15.1.12), the water supply volume from WTPs will be 468,150 m³/day with consideration of 25% of non-revenue water rate. In addition, since the design capacity of CUO's scheme is 1,860 m³/day in total (Table 15.1.6), the water supply volume from CUO's scheme will be 1,395 m³/day with consideration of 25% of non-revenue water rate as well. The total planned water supply volume is 469,545 m³/day, which only meets the water demand in some sub counties (Kasangati Town, Nabweru Division in Nansana Municipality, Nansana Division in Nansana Municipality), however, not in most sub-counties.

As shown in Table 15.1.13, 214,181 m³/day is shortage for projected water demand in whole GKUGA in 2050 and the average service coverage is 67% in whole GKUGA in 2050. In addition, in order to meet the water demand of 2145,181 m³/day, a water supply facility with a design capacity of 385,575 m³/day is required.

Especially in the sub counties (Muduuma, Kyampisi, Nama, Kakiri, Kakiri Town, Masuliita, Masulita Town, Busukuma Division in Nansana Municipality, Gombe Division in Nansana

Municipality) that include the areas controlled by CUO, the service coverage is low (20% of average service coverage), it is necessary to improve the water supply at an early stage.

In addition, the water supply jurisdiction areas in 2040 are shown in Figure 15.1.10. As the CUO schemes of Kasanje, Nakawuka and Katende are included in the water supply area of the Wakiso West Watsan Project, jurisdiction will be transferred from the CUO to the NWSC.



Source: JICA Expert Team

Figure 15.1.10 Water Supply Jurisdiction Areas in GKUGA (until 2040)

Table 15.1.13 Projected Balance of Water Demand with Water Supply each Sub-County in GKUGA (2050)

District	Sub County	A. Planned water supply volume by NWSC (m^3)	B. Planned water supply volume by CUO (m^3)	C. Projected population in 2050	D. Projected per capita design water supply in 2050 (L/capita/day)	E. Projected water demand in 2050 <Domestic> (m^3/day) E=C x D /1000	F. Projected water demand in 2050 <Non-Domestic> (m^3/day)	G. Total projected water demand in 2050 (m^3/day) G=E+F	H. Planned non-revenue water rate I=G-(A+B)	I. Required water supply volume (m^3/day) I=(G-(A+B))/(1-H)	J. Service coverage J=(A+B)/G*100
Kampala Capital City	Central Division	6,554		130,000	48.6	6,316	2,800	9,116	25%	3,416	72%
	Kawempe Division	28,686		520,000	46.2	24,046	10,967	35,013	25%	8,436	82%
	Rubaga Division	32,711		595,000	61.4	36,507	1,935	38,442	25%	7,641	85%
	Makindye Division	35,355		655,000	52.2	34,176	9,479	43,655	25%	11,066	81%
	Nakawa Division	30,698		576,000	71.1	40,934	10,800	51,735	25%	28,048	59%
Mpigi	Kiringente	3,208	84	129,000	52.5	6,769	202	6,971	25%	4,904	47%
	Mpigi Town Council	4,250		149,000	52.5	7,818	268	8,086	25%	5,114	53%
	Muduuma		146	180,000	52.5	9,445	257	9,702	25%	12,740	1.5%
Mukono	Kyampisi		285	208,000	48.6	10,110	1,306	11,415	25%	14,840	2.5%
	Nakisunga	7,014		153,000	48.6	7,436	1,069	8,506	25%	1,989	82%
	Nama	2,073	291	267,000	48.6	12,977	1,648	14,625	25%	16,348	16%
	Ntenjeru	7,071		176,000	48.6	8,554	1,078	9,632	25%	3,415	73%
	Mpunge	1,897		43,000	48.6	2,090	289	2,379	25%	643	80%
	Mukono Central Division	12,532		298,000	48.3	14,402	4,741	19,143	25%	8,814	65%
	Mukono Goma Division	21,960		556,000	49.5	27,537	9,250	36,787	25%	19,769	60%
Wakiso	Kakiri	1,798		128,000	56.4	7,225	766	7,991	25%	8,257	22%
	Kakiri Town Council	3,305		86,000	56.4	4,853	152	5,005	25%	2,268	66%
	Kasanje	1,883	131	57,000	52.5	2,991	131	3,122	25%	1,477	65%
	Kajjansi Town Council	34,719	79.5	960,000	52.0	49,889	1,462	51,351	25%	22,070	68%
	Katabi Town Council	5,643		263,000	52.5	13,799	622	14,421	25%	11,705	39%
	Masuliita		12	14,000	48.6	680	123	803	25%	1,054	1.6%
	Masulita Town Council		21	23,000	48.6	1,118	202	1,319	25%	1,732	1.6%
	Kyengera Town Council	25,726		831,000	47.4	39,370	1,010	40,381	25%	19,540	64%
	Wakiso	35,820		1,248,000	48.1	60,005	380	60,384	25%	32,752	59%
	Wakiso Town Council	12,204		395,000	47.1	18,596	304	18,900	25%	8,929	65%
	Mende	8,345		386,000	43.4	16,765	1,230	17,996	25%	12,868	46%
	Entebbe Division A	1,119		48,000	52.5	2,519	123	2,642	25%	2,030	42%
	Entebbe Division B	952		41,000	52.5	2,151	105	2,256	25%	1,738	42%
	Kira Bweyogerere Division	17,189		300,000	53.1	15,943	4,548	20,492	25%	4,404	84%
	Kira Kira Division	15,982		408,000	53.1	21,683	2,664	24,347	25%	11,154	66%
	Kira Namugongo Division	13,625		238,000	53.1	12,648	2,271	14,920	25%	1,727	91%
	Kasangati Town Council	34,838		860,000	43.2	37,123	731	37,853	25%	4,021	100%
	Makindye-Ssabagabo Bunamwaya Division	7,186		126,000	51.6	6,507	206	6,714	25%	0	100%
	Makindye-Ssabagabo Masajja Division	13,740		240,000	51.6	12,395	2,226	14,621	25%	1,175	94%
	Makindye-Ssabagabo Ndejje Division	15,809		338,000	51.6	17,456	2,561	20,018	25%	5,611	79%
	Nansana Busukuma Division	659	345	65,000	41.4	2,692	409	3,102	25%	2,796	32%
	Nansana Gombe Division	4,486		220,000	48.3	10,633	1,164	11,797	25%	9,747	38%
	Nansana Nabweru Division	17,649		321,000	34.5	11,081	3,106	14,187	25%	0	100%
	Nansana Nansana Division	9,485		168,000	34.5	5,799	1,435	7,235	25%	0	100%
Total		**476,169**	**1,395**	**12,399,000**	**50.2**	**623,039**	**84,021**	**707,060**	**25%**	**314,242**	**67%**

Note) Planned water supply volume is divided proportionally according to population rate
Planned non-revenue water rate is according to KW LV WatSan Project

Source: Compiled by JICA Expert Team on Optioneering Report, Detailed Design Report – Component1 (GKMA) and Wakiso West Water and Sanitation Project Feasibility Study Report

(2) Decreased Water Supply Volume Due to High NRW Rate

Non-Revenue Water (NRW) refers to the water lost in the water distribution system that cannot be billed to customers, making it a significant challenge for water utility companies. In the areas controlled by NWSC and CUO in GKUGA, the NRW rate generally exceeds 40%, indicating a

very high level of water loss. NWSC has NRW-related departments and leak detection equipment, but their effectiveness appears to be insufficient.

Additionally, the water production capacity of Katosi WTP designed by Component-1 of the KW LV WatSan Project was completed in 2021. However, construction of new major water distribution pipelines is scheduled to begin after 2024. Katosi WTP has been gradually operated since 2021, and existing pipeline connections have led to increased internal pressure. There are concerns that this will contribute to further water leakage in the future.

While there are currently no specific projects focused on NRW reduction, in the master plan as for reduction of NRW, installation of District Metered Areas (DMAs), implementation of SCADA systems at WTP, upgrade of pipeline, and the establishment of an NRW Management Department are described.

The projected NRW rates of 33% by 2025 and 27% by 2040 are given in the master plan. During the review of the master plan in 2021, a projected water supply volume was calculated with a target NRW rate of 25% for 2040. NWSC's Annual Report 2021-2024 sets a long-term goal of achieving a 15% NRW rate. Challenges will arise if the NRW rate cannot be reduced as planned, such that it will not be able to satisfy the water demand planned at DD.

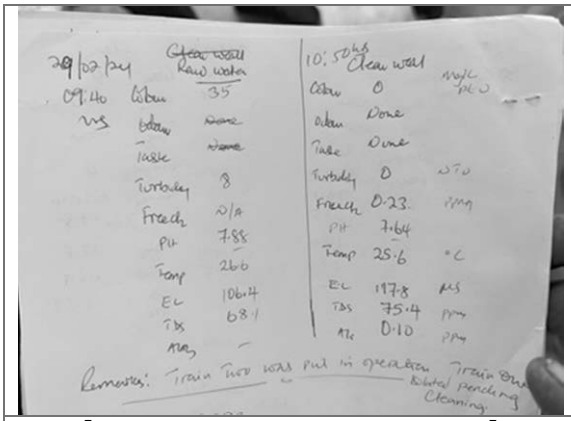
Regarding NRW reduction of water supply schemes managed by CUO, the plumber just conduct patrol for ground surface leakage periodically.

To significantly reduce NRW, proactive measures are necessary, including organised underground leak management.

(3) Water Quality Management by CUO

As mentioned in Section 15.1.1 (5), approximately half of the water schemes managed by CUO in GKUGA do not meet water quality standards. Additionally, outside of GKUGA, there is one scheme, Katunga-Busaana Water Supply and Sanitation System established in 2021, which has WTP managed by CUO. An evaluation of water quality management revealed the following inadequacies at the WTP:

- No water quality management forms are available.
- Only minimal testing is conducted using simple water quality test kits.
- Lack of proper equipment for water quality management.
- Jar tests are performed only twice a year.

	
【Water quality management sheet】 Form of water quality management sheet is not prepared.	【Water quality test kits】 Only simplified measurement is conducted by test kits. This kit is used for mobile laboratory as well.

	
【Sampling bottles】 Pet bottles are used instead of sampling bottles.	【Jar tester】 Jar tester is used only twice a year. When season changes, jar test is conducted.

Source: JICA Expert Team

Figure 15.1.11 Current Situation of Water Quality Management in WTP Being Managed by CUO

Currently, there is no WTP managed by CUO in GKUGA. However, if the water quality of the new scheme in GKUGA is planned to be managed by CUO in the future, it will be necessary to strengthen its management system.

(4) Role of NWSC in the Development of Water Supply Facilities

As the current project only deals with the primary distribution network (also called transmission network in the master plan), it is assumed that NWSC will carry out the necessary works on the secondary and tertiary networks so that water supply reach to people.

It is important to highlight that the current project focuses on primary distribution formulated by NWSC HQ. But of course, additional works are needed to make sure the secondary and tertiary networks will be able to supply water to the customers in an appropriate way (in particular, regarding the creation of proper District Metered Areas) and will be conducted by NWSC Branch.

In NWSC Mukono Branch, the primary distribution was installed from Katosi WTP, and the water supply volume has a sufficient capacity to supply water to all design service areas. However, the budget in NWSC Mukono Branch is inadequate and 15% of design service areas still have not been covered.

Therefore, in case NWSC Branch is not able to secure budget to install secondary and tertiary networks including house connections, it will be difficult to achieve the design criteria in 2040.

15.1.3 Objectives for the Water Supply Sector

(1) To Secure Adequate Water Supply in the GKUGA

GKUGA is surrounded by the urban growth boundaries and an integrated urban development master plan will be formulated. The area functions to promote urbanisation with integration with Kampala City in the Greater Kampala Metropolitan Area: Kampala Capital City, Wakiso District, Mukono District, and Mpigi District. Adequate water supply has to be secured for residents in GKUGA based on the projected water demand escalation. Otherwise, it will hinder the integrated urban development and suburbanisation of the area due to inadequate water supply inside urban growth boundaries.

In GKUGA, some areas needing water supply are not covered by existing projects as shown in Figure 15.1.12. Most of the service areas are inside the KSPA boundary. The north-west to north-east of Wakiso District, the north of Mukono District, and the north of Mpigi District in GKUGA are not part of existing projects (LV WatSan Project and Wakiso West WatSan Project). Consequently, in these areas, it will not be possible to ensure sufficient water supply by the

planned annual target of 2040 due to lack of existing projects. Particularly beyond 2040, there are no projects currently planned, so it is assumed that there will be a shortage of water supply volume of 195,799 m³/day by the target year 2050 in the Project (Table 15.1.14).

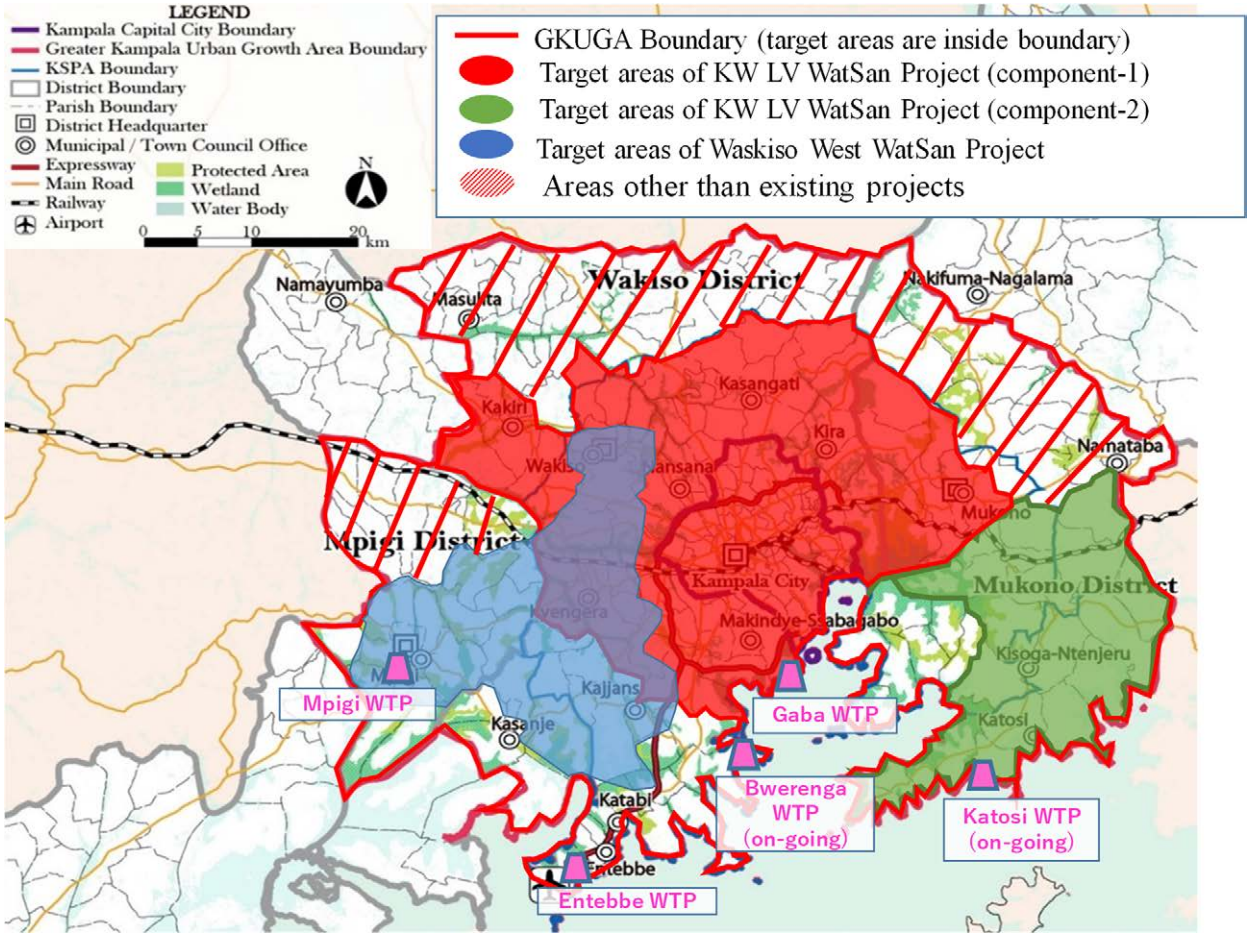
In addition, for areas other than those of existing projects, if the per capita minimum design for rural water supply is assumed to be 20 litres per capita per day, it is predicted that there will be a shortage of 19,685 m³/day of water supply volume by 2050 as shown in Table 15.1.15. If the 50 litres per capita per day as projected per capita design water supply in 2050 (Table 15.1.13) is considered, the shortage volume will be 51,286 m³/day. Considering the future urbanisation of the suburb in GKUGA, it is necessary to gradually secure the water supply volume of 51,286 m³/day. Particularly urgent is the need to achieve the per capita minimum design water supply of 20 litres per capita per day for rural water supply, so early construction of water supply facilities to meet this requirement should be considered.

GKUGA has three existing WTPs managed by NWSC, and there is a total of five WTPs planned to be operated by 2050, including one under construction (Katosi WTP) and one planned (Bwerenga WTP). Katosi WTP is located in the south Mukono District, where there are no residential areas around the WTP, making land acquisition relatively easy for its expansion. However, for Bwerenga WTP, the surrounding area is a recreational area with residential zones, which will have challenges for expanding the plant (Figure 15.1.13). Additionally, recent water quality pollution in Murchison Bay due to algae has raised concerns about the raw water quality near Bwerenga WTP in the future.

In case of water transmission from Katosi WTP to west Wakiso District and Mpigi District, the length of water distribution pipeline is longer, and quantities of booster pump and reservoirs are increased since Katosi WTP is located in south Mukono District. As a result, water supply systems will be inefficient.

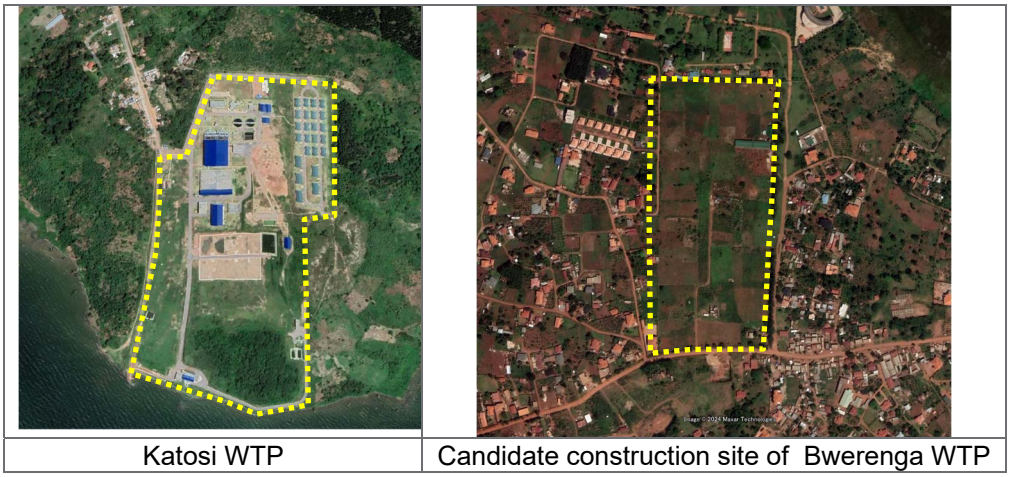
Furthermore, expanding the WTP and connecting it to existing water supply pipelines can lead to changes in water head pressure from the original design, potentially affecting water delivery to the endpoints.

Therefore, it is considered that WTP is expanded and newly constructed, and the water transmission pipe is newly installed in order to achieve 50 litres per capita per day (the per capita design water supply) finally, with division into water distribution areas such as west Wakiso District and Mpigi District, as well as east Wakiso District and north Mukono District.



Source: JICA Expert Team

Figure 15.1.12 Target Areas of Water Supply in Existing Projects



Katosi WTP	Candidate construction site of Bwerenga WTP

Note: Location and candidate construction site of WTP inside dotted line
Source: JICA Expert Team

Figure 15.1.13 Photos of Surroundings of WTPs of Existing Project

Table 15.1.14 Balance of Water Demand with Water Supply in GKUGA in 2050 (Existing Project Areas)

Target areas in GKUGA	A. Projected population Note1)	B. The per capita design water supply (L/capita/day)	C. Projected water demand (m3/day)		D. Total projected water demand (m^3/day)	E. Planned design capacity (m^3/day) Note 2)	F. NRW rate Note4)	G. Water supply volume (m^3/day) < E x （100%-F） >	H. Required water supply volume (m^3/day) < D – G >
			Domestic < A x B>	Non-Domestic Note 3)					
Areas other than those covered by existing project (areas controlled by NWSC)	11,193,000	50	559,650	79,649	639,299	663,949	25%	468,150	171,149

Note 1) Calculated by JICA Expert Team based on National Population and Housing Census 2014
Note 2) Refer to Table 15.1.12
Note 3) Estimated based on projected water demand in 2040 in mater plan
Note 4) NRW rate at DD in master plan

Source: JICA Expert Team

Table 15.1.15 Balance of Water Demand with Water Supply in GKUGA in 2050 (Areas Other than Those Covered by Existing Project)

Target areas in GKUGA	A. Projected population Note1)	B. The per capita design water supply (L/capita/day)	C. Projected water demand (m^3/day)	D. Planned design capacity (m^3/day) Note 2)	E. NRW rate Note3)	F. Water supply volume (m^3/day) < D x （100%-F） >	G. Required water supply volume (m^3/day) < C – F >
			Domestic < A x B>				
Areas other than those covered by existing project (areas controlled by CUO)	1,054,000	20	21,080	1,860	25%	1,395	19,685
		50	52,700				51,305

Note 1) Calculated by JICA Expert Team based on National Population and Housing Census 2014
Note 2) Refer to Table 15.1.6.
Note 3) NRW rate at DD in master plan

Source: JICA Expert Team

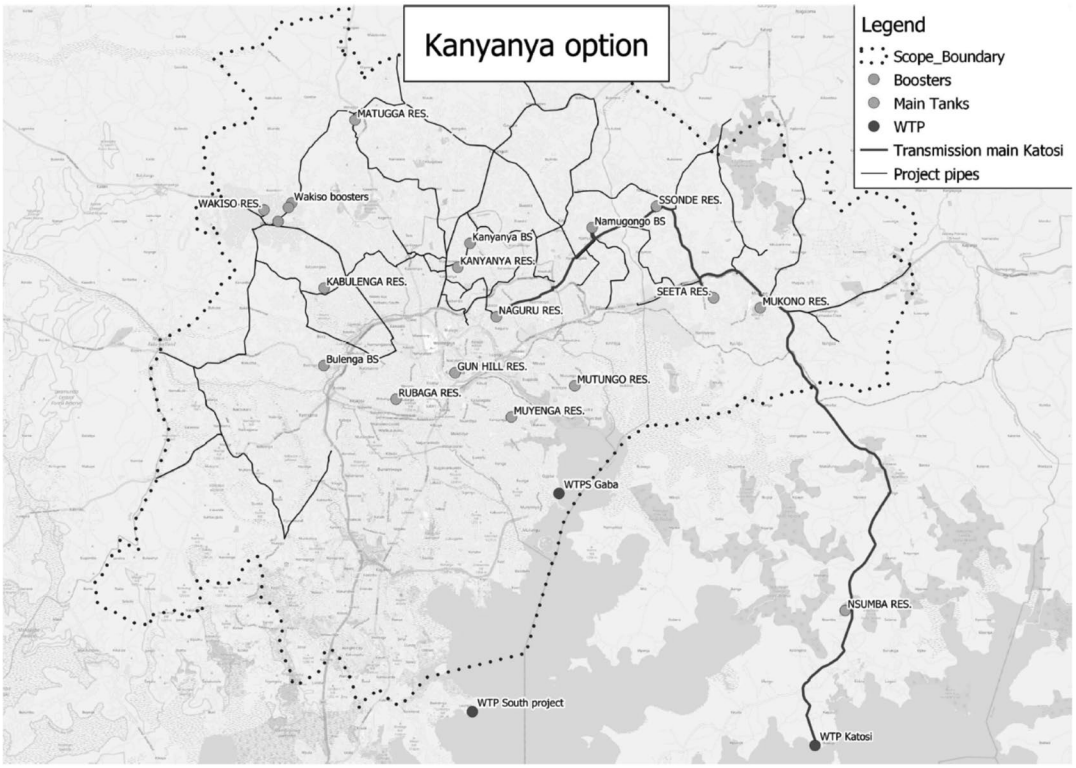
(2) To Ensure Distribution of Water Supply to Customers in a Sustainable and Continuous Manner in NWSC Branch Level

Planned water distribution pipe in each component by 2040 according to DD Component-1 Report (GKMA) is shown in Figure 15.1.14.

- Component-1 – Parishes within the Greater Kampala Metropolitan Area- GKMA which include consideration of approximately 313 km pipeline provision comprising of new pipelines (259km), rehabilitation/ replacement pipelines (29km) and DMA pipelines (25 km).
- Component-2 – Parishes within the Districts of Mukono and Buikwe which include consideration of approximately 60 km pipeline provision for new primary distribution from Nsumba Reservoir to supply Lugazi town and other parishes within the project area.

These planned pipelines are a primary distribution network; therefore, in order to secure water supply to residents, NWSC has to carry out the necessary works on the secondary and tertiary networks by each NWSC Branch. Otherwise, water will not be supplied to end users and reliability of the water supply will not improve. Therefore, it is necessary that NWSC Branch formulates the secondary and tertiary network installation plan to be carried out in GKUGA.

The budget allocation for installation had been confirmed to be planned to secure budget from MWE during the site survey in 2024.



Source: JICA Expert Team

Figure 15.1.14 Layout of Primary Distribution Networks at DD in the Master Plan (Component-1)

15.1.4 Strategies for the Water Supply Sector

The strategies to achieve the objectives are below.

(1) Development of Deep Groundwater Supply System in Short and Medium Term (Northeast and Northwest of GKUGA)

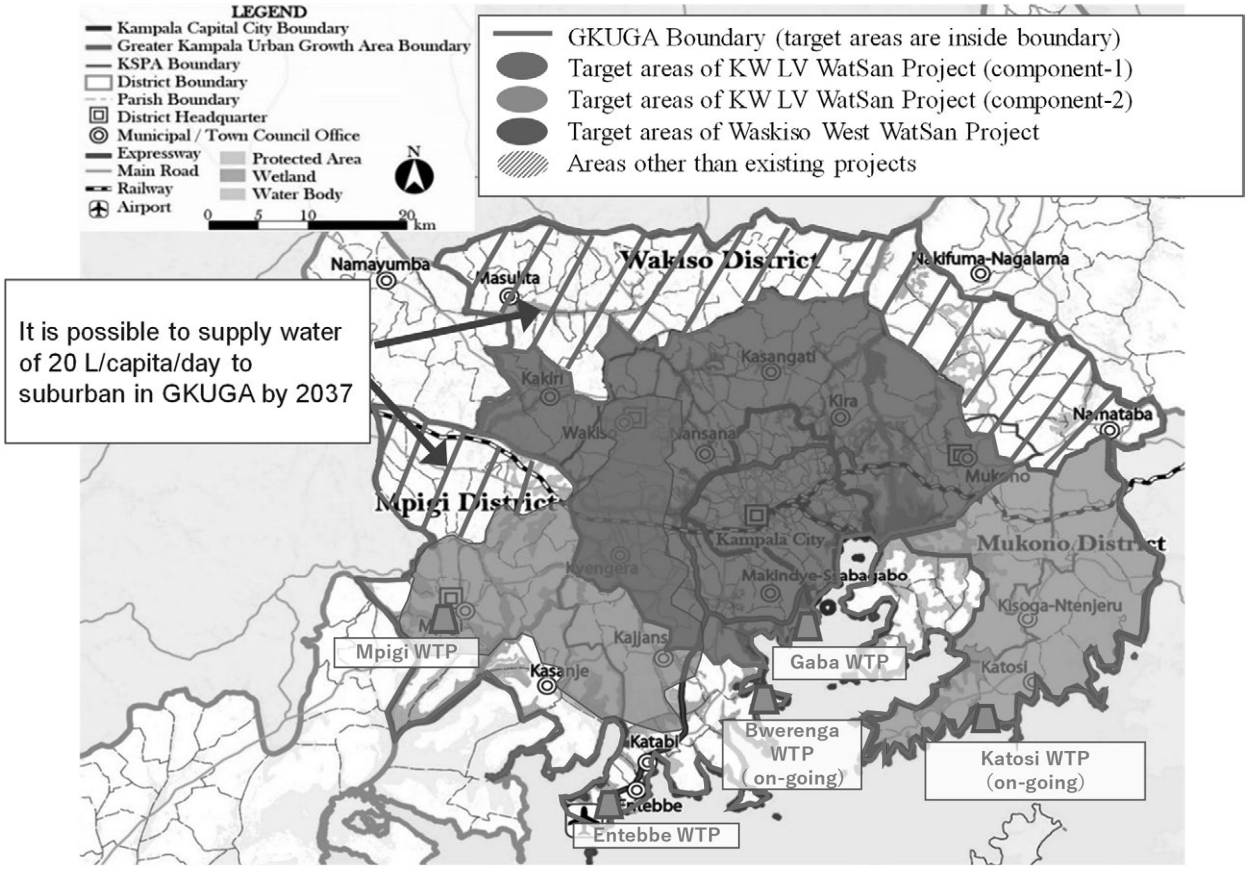
As shown in Figure 15.1.12, water supply volume will be increased in GKUGA except for parts of GKUGA due to by 2040 implementation of existing projects.

However, for areas not covered by existing projects, meeting the per capita per minimum design water supply of 20 litres per capita per day by 2050 will require a water supply of 19,685 m³/day, as shown in Table 15.1.15. Considering a planned NRW rate of 25%, a water supply facility with a capacity of 26,247 m³/day will be necessary.

The areas other than those covered by existing projects are controlled by CUO, and currently deep groundwater supply facilities are operated.

As for consideration of costs, the cost of deep groundwater supply facilities is estimated at approximately USD 85 million, while cost of WTP supply facilities is estimated at USD 172 million. Therefore, prioritising cost effectiveness, the deep groundwater facilities similar to existing facilities are planned as proposed project until 2037. The deep groundwater supply facilities, they can be commissioned gradually after completion of construction, allowing prioritised areas to receive water supply.

Launching this proposed project will enable early provision of the per capita per minimum design water supply of 20 litres per capita per day to the suburban areas in GKUGA, serving the projected population of 1,054 thousand by 2050.



Source: JICA Expert Team

Figure 15.1.15 Strategy for Water Supply in Suburban Areas of GKUGA (Short and Medium-Term)

(2) Development and Expansion of Water Supply System Supplied by WTPs in Medium and Long Term (Whole GKUGA)

According to the projected water demand in whole GKUGA in 2050 (Table 15.1.13), in order to meet the projected per capita design water supply of 50 L/capita/ day covering only existing projects until 2040, a water supply volume of 314,242 m^3/day is required.

Considering the water production capacity of deep groundwater supply facility, which is established in short and medium term, a water supply volume of 217,197 m^3/day is required, as

shown in Table 15.1.16. In addition, considering a planned NRW rate of 25% of the required water supply volume, a water supply facility with a capacity of 289,596 m^3/day will be necessary.

Regarding the priority of target areas for water supply, as shown in Table 15.1.16, the average service coverage in 2050 is projected to be 70%, therefore, sub county with a service coverage of less than 70% will be prioritized as target areas for water supply.

In 2024, during the site survey, NWSC was considering plans to develop reliable water supply facilities in the future. Therefore, water supply facilities utilizing Lake Victoria as the water source.

As for strategy of water supply facilities in the Project, the planed WTPs are as follows.

- Expanding Katosi WTP
- Establishing a new WTP (tentatively named Kasanje WTP) along the Lake Victoria coast in Kasanje

Since the Katosi WTP is located on the coast of Lake Victoria in the southern part of Mukono District, water supply from Mukono District to KCC and eastern Wakiso District will be considered as target areas.

In addition, regarding water supply to west Wakiso District and Mpigi District, new WTP is considered to establish in Kasanje outside Murchison Bay and supply water.

The priority target areas for water supply are as shown in Figure 15.1.16, and the planned design capacity of each WTP is shown in Table 15.1.17. In the medium term, 95,332 m^3/day is expanded to Katosi WTP, and 138,747 m^3/day is expanded to Kasanje WTP as design capacity, in order to achieve service coverage of 100% in high priority areas. In the long term, 142,090 m^3/day is expanded to Katosi WTP, and 1547,506 m^3/day is expanded to Kasanje WTP as design capacity in total, in order to achieve service coverage of 100% in whole GKUGA.

It is able to supply the designed per capita water of 50 L/capita/day to whole GKUGA, serving the projected population of 12,399 thousand by 2050.

Table 15.1.16 Required Water Supply Volume in Medium and Long Term in whole GKUGA (2050)

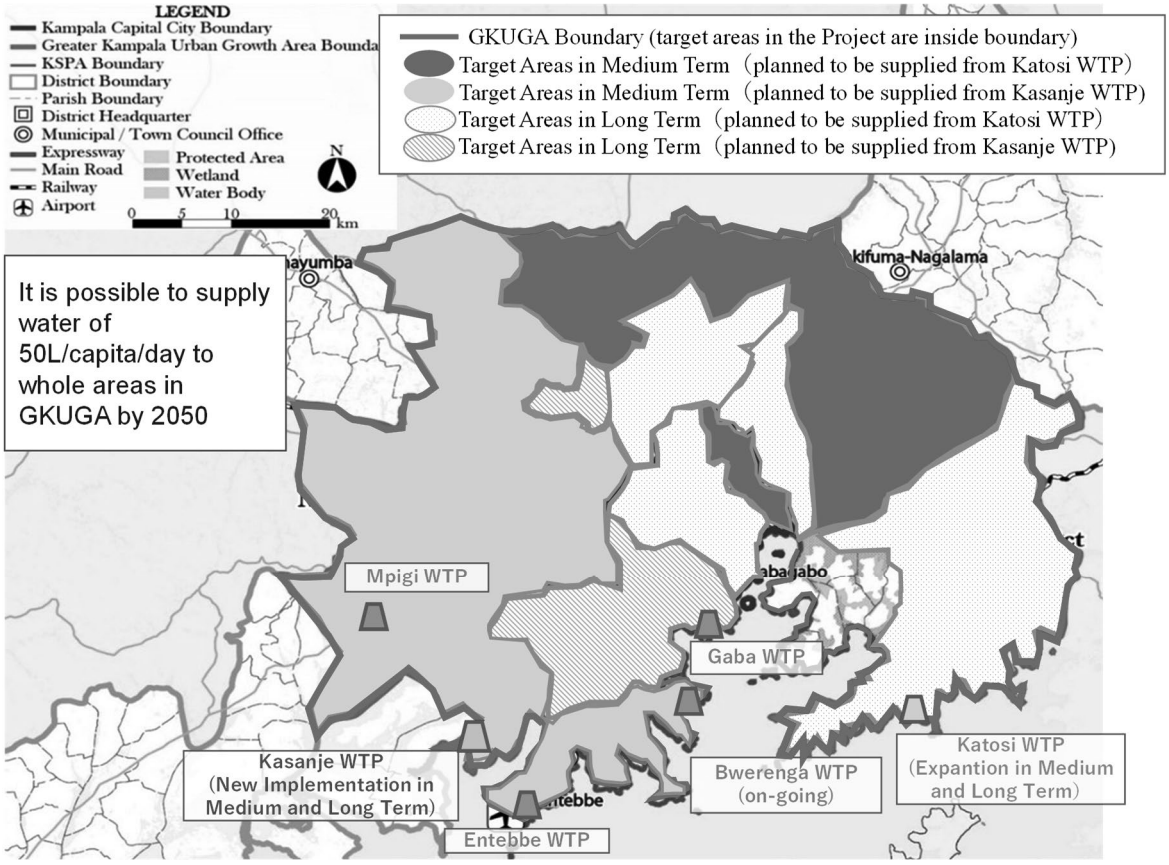
District	Sub County	A. Planned water supply voume by NWSC (m^3)	B. Planned water supply volume by CUO (m^3)	C. Planned Water Supply Volume in Short and Medium Term	D. Projected population in 2050	E. Projected per capita design water supply in 2050 (L/capita/ day)	F. Projected water demand in 2050 <Domestic> (m^3/day) F=D x E /1000	G. Projected water demand in 2050 <Non-Domestic> (m^3/day)	H. Total projected water demand in 2050 (m^3/day) H=F+G	I. Planned non-revenue water rate	J. Required water supply volume (m^3/day) J=(H-(A+B+C))/(1-I)	K. Service coverage K=(A+B+C)/G*100	Planned WTP
Kampala Capital City	Central Division	6,554			130,000	48.6	6,316	2,800	9,116	25%	3,416	72%	Katosi
	Kawempe Division	28,686			520,000	46.2	24,046	10,967	35,013	25%	8,436	82%	Katosi
	Rubaga Division	32,711			595,000	61.4	36,507	1,935	38,442	25%	7,641	85%	Katosi
	Makindye Division	35,355			655,000	52.2	34,176	9,479	43,655	25%	11,066	81%	Katosi
	Nakawa Division	30,698			576,000	71.1	40,934	10,800	51,735	25%	28,048	59%	Katosi
Mpigi	Kiringente	3,208	84		129,000	52.5	6,769	202	6,971	25%	4,904	47%	Kasanje
	Mpigi Town Council	4,250			149,000	52.5	7,818	268	8,086	25%	5,114	53%	Kasanje
	Muduuma		146	3,600	180,000	52.5	9,445	257	9,702	25%	7,940	39%	Kasanje
Mukono	Kyampisi		285	4,160	208,000	48.6	10,110	1,306	11,415	25%	9,294	39%	Katosi
	Nakisunga	7,014			153,000	48.6	7,436	1,069	8,506	25%	1,989	82%	Katosi
	Nama	2,073	291	4,316	267,000	48.6	12,977	1,648	14,625	25%	10,594	46%	Katosi
	Ntenjeru	7,071			176,000	48.6	8,554	1,078	9,632	25%	3,415	73%	Katosi
	Mpunge	1,897			43,000	48.6	2,090	289	2,379	25%	643	80%	Katosi
	Mukono Central Division	12,532			298,000	48.3	14,402	4,741	19,143	25%	8,814	65%	Katosi
	Mukono Goma Division	21,960			556,000	49.5	27,537	9,250	36,787	25%	19,769	60%	Katosi
Wakiso	Kakiri	1,798		1,783	128,000	56.4	7,225	766	7,991	25%	5,880	45%	Kasanje
	Kakiri Town Council	3,305		222	86,000	56.4	4,853	152	5,005	25%	1,972	70%	Kasanje
	Kasanje	1,883	131		57,000	52.5	2,991	131	3,122	25%	1,477	65%	Kasanje
	Kajjansi Town Council	34,719	80		960,000	52.0	49,889	1,462	51,351	25%	22,070	68%	Kasanje
	Katabi Town Council	5,643			263,000	52.5	13,799	622	14,421	25%	11,705	39%	Kasanje
	Masuliita		12	280	14,000	48.6	680	123	803	25%	681	36%	Kasanje
	Masulita Town Council		21	460	23,000	48.6	1,118	202	1,319	25%	1,119	36%	Kasanje
	Kyengera Town Council	25,726			831,000	47.4	39,370	1,010	40,381	25%	19,540	64%	Kasanje
	Wakiso	35,820			1,248,000	48.1	60,005	380	60,384	25%	32,752	59%	Kasanje
	Wakiso Town Council	12,204			395,000	47.1	18,596	304	18,900	25%	8,929	65%	Kasanje
	Mende	8,345			386,000	43.4	16,765	1,230	17,996	25%	12,868	46%	Kasanje
	Entebbe Division A	1,119			48,000	52.5	2,519	123	2,642	25%	2,030	42%	Kasanje
	Entebbe Division B	952			41,000	52.5	2,151	105	2,256	25%	1,738	42%	Kasanje
	Kira Bweyogerere Division	17,189			300,000	53.1	15,943	4,548	20,492	25%	4,404	84%	Katosi
	Kira Kira Division	15,982			408,000	53.1	21,683	2,664	24,347	25%	11,154	66%	Katosi
	Kira Namugongo Division	13,625			238,000	53.1	12,648	2,271	14,920	25%	1,727	91%	Katosi
	Kasangati Town Council	34,838			860,000	43.2	37,123	731	37,853	25%	4,021	92%	-
	Makindye-Ssabagabo Bunamwaya Division	7,186			126,000	51.6	6,507	206	6,714	25%	0	100%	Kasanje
	Makindye-Ssabagabo Masajja Division	13,740			240,000	51.6	12,395	2,226	14,621	25%	1,175	94%	Kasanje
	Makindye-Ssabagabo Ndejje Division	15,809			338,000	51.6	17,456	2,561	20,018	25%	5,611	79%	Kasanje
	Nansana Busukuma Division	659	345	1,071	65,000	41.4	2,692	409	3,102	25%	1,369	67%	Katosi
	Nansana Gombe Division	4,486		2,593	220,000	48.3	10,633	1,164	11,797	25%	6,290	60%	Katosi
	Nansana Nabweru Division	17,649			321,000	34.5	11,081	3,106	14,187	25%	0	100%	-
	Nansana Nansana Division	9,485			168,000	34.5	5,799	1,435	7,235	25%	0	100%	-
Total		**476,169**	**1,395**	**18,484**	**12,399,000**	**50.2**	**623,039**	**84,021**	**707,060**	**25%**	**289,596**	**70%**	

Note) Highlited service coverage is less than 70 %
Source: JICA Expert Team

Table 15.1.17 Planned Design Capacity of WTP in Medium and Long Term in GKUGA (2050)

Term	Planned WTP	Target areas (sub counties)	Planned service population	Planned design capacity (m^3/day) (Expansion /Newly established)
Medium Term	Katosi WTP	KCC Nakawa Division, Kyampisi, Nama, Mukono Municipality Central Division, Mukono Municipality Goma Division, Kira Municipality Kira Division, Nansana Municipality Busukuma Division, Nansana Municipaity Gombe Division	2,598,000	95,332
	Kasanje WTP	Kiringente, Mpigi Town Council, Muduuma, Kakiri, Kasanje, Kajjansi Town, Katabi Town Council, Masuliita, Masulita Town, Kyengera Town, Wakiso, Mende, Entebbe Municipality Division A, Entebbe Municipality Division B	4,724,000	138,747
		Sub-total	7,450,000	234,079
Long Term	Katosi WTP	KCC Central Division, KCC Kawempe Division, KCC Rubaga Division, KCC Makindye Division, Nakisunga, Ntenjeru, Mpunge, Kira Municipality Bweyogerere Division, Kira Municipality Namugongo Division, Kasangati Town	3,670,000	46,759
	Kasanje WTP	Kakiri Town, Kajjansi Town, Wakiso Town, Makindye-Ssabagabo Municipality Bunamwaya Division, Makindye-Ssabagabo Municipaity Masajja Division, Makindye-Ssabagabo Municipality Ndejje Division	941,000	8,759
		Sub-total	4,949,000	55,517
		Total	11,4933,000	289,596

Source: JICA Expert Team



Source: JICA Expert Team

Figure 15.1.16 Plan of Water Supply in Medium and Long Term in Whole GKUGA

15.1.5 Projects for the Water Supply Sector

To realise the strategies for the water supply sector, the priority projects below are proposed. The actual implementation agencies and costs are written in the list of priority projects in Chapter 16.

- WS-01: Kampala Water Lake Victoria Water and Sanitation Project
- WS-02: Wakiso West Water and Sanitation Project
- WS-03: Development of Water Supply System Piped from Deep Groundwater Water in Short and Medium-Term
- WS-04: Establishment of Water Supply System Piped from WTP in Mukono, North-East Wakiso and North KCC
- WS-05: Establishment of Water Supply System Piped from WTP in West Wakiso and Mpigi
- WS-06: Establishment of Water Supply System Piped from WTP in Areas Not Targeted by WS-04 and WS-05
- WS-07: Connecting Primary Pipelines with Secondary and Tertiary Pipelines by NWSC Branch

15.2 Sewerage

15.2.1 Background of Sewerage

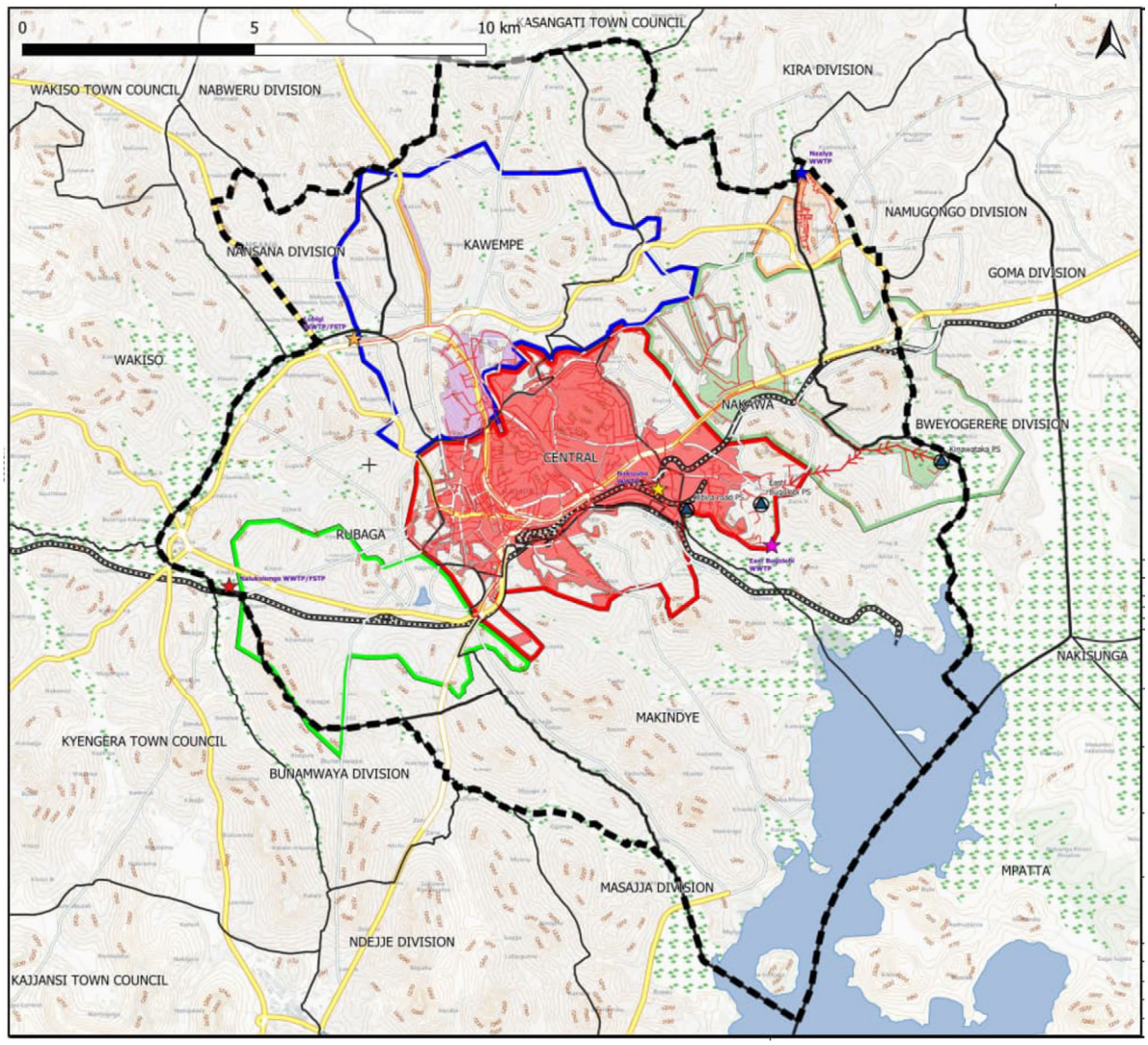
(1) Existing Sewerage Infrastructure in GKUGA

1) Sewerage Network

Sewerage system in Uganda exists in limited areas in 18 cities, municipalities and towns, including Kampala and Entebbe, and the service is provided by the National Water and Sewerage Corporation (NWSC).

The jurisdiction of NWSC in charge of Kampala Metropolitan Area covers mainly KCC, Mukono Municipality, Kira Municipality, Makindye-Ssabagabo Municipality, Nansana Municipality, Wakiso Town, Kakiri Town and the surrounding sub counties.

It is estimated that within the jurisdiction area of Kampala Metropolitan of NWSC, the sanitary sewerage system serves 4% of the estimated total population. The current sewerage network in Kampala Metropolitan Area is shown in Figure 15.2.1. The sewerage connection is concentrated in KCC, and in 2022/23 the number of connections was 12,782 with a total of 252 km of sewer network.



Source: Fichtner Water & Transportation Engineering + Consulting, 2022, Review of the Kampala Sanitation Master Plan and the Preparation of Climate Related Investments and Improvements Work Package A Report Volume 1: Report Update of Master Plan and Indentification of Investment Clusters

Figure 15.2.1 Existing Sewerage Network in Kampala Capital City as of 2022

Other areas outside KCC in the jurisdiction area of NWSC's Kampala Metropolitan Area are not connected with the sewer network operated by NWSC yet, but some sites such as Naalya Housing Estate and Nambole National Stadium in Kira Municipality are connected to waste stabilisation ponds.

The southern part of Wakiso District, including Entebbe Municipality and Kajjansi Town, are under the jurisdiction of the office in charge of Entebbe. In Entebbe Municipality, there is a sewer system covering part of the city centre, which is connected to the waste stabilisation ponds at Kitooro. In addition, NWSC serves the Fire Quarters, Survey Quarters, Windsor Lake Victoria Hotel and State House by the sewer services. In 2022/23 the number of connections was 465.

Mpigi Town and Kirringete Sub County in Mpigi District, which is in the service area of NWSC Mpigi, does not have any sewerage infrastructure.

2) Sewerage Treatment Facilities

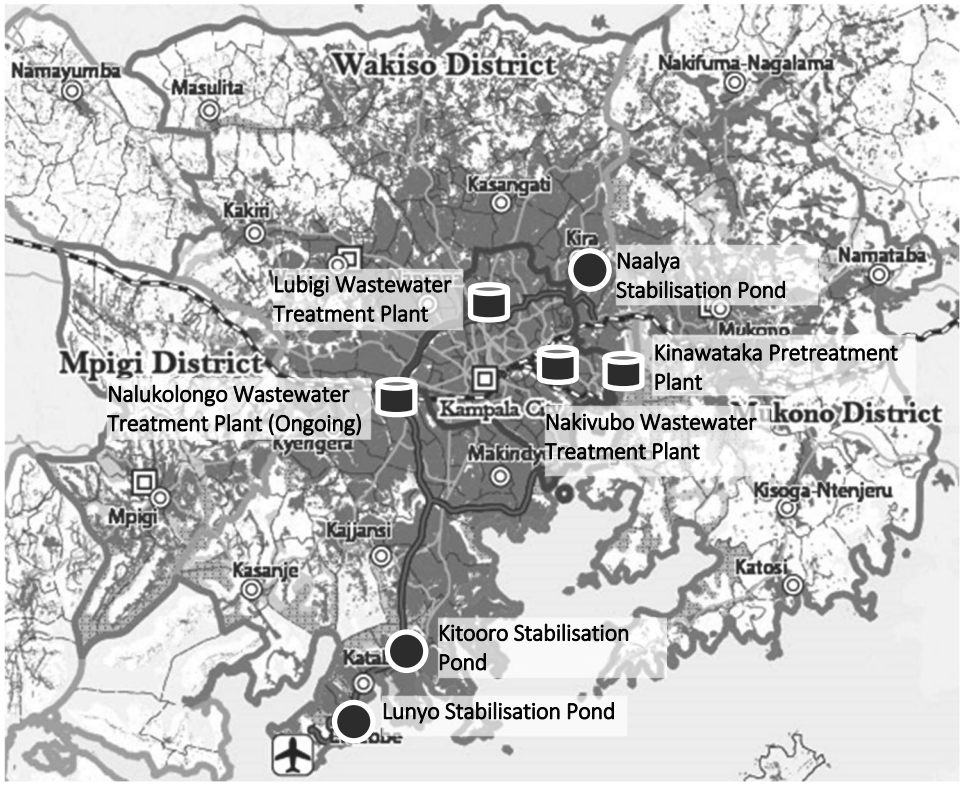
There are three operational wastewater treatment plants in GKUGA as shown in Figure 15.2.2.

Nakivubo Wastewater Treatment Plant is the largest wastewater treatment plant in East Africa, which completed its construction in 2021. It has the capacity of processing 45,000 m^3 of wastewater per day. Approximately wastewater generated by the population of 380,000 can be treated in this plant.

Lubigi Wastewater Treatment Plant was constructed under the Lake Victoria Project Phase I and was commissioned in May 2014. It has the capacity to treat 5,000 m^3 of wastewater per day. The wastewater generated by a population of approximately 50,000 goes to this plant.

Kinawataka Pretreatment Plant has the capacity to treat 45,000 m^3 of wastewater per day. It was constructed in 2020 and is now in operation.

In addition to the above three sewerage treatment plants, Nalukolongo Wastewater Treatment Plant is under implementation.



Source: JICA Expert Team based on information from NWSC

Figure 15.2.2 Locations of Wastewater Treatment Facilities in GKUGA

NWSC also operates stabilisation ponds at Naalya and East Bugolobi within Kampala Metropolitan jurisdiction area, and within Entebbe jurisdiction area there are stabilisation ponds at Kitooro and Lunyo.

3) Faecal Sludge Treatment Facilities

There are two faecal sludge treatment facilities serving NWSC's Greater Kampala jurisdiction area. Lubigi Faecal Sludge Treatment Plant with the capacity of 400m^3/day is functioning since 2014. However, the actual average amount of faecal sludge collected as of 2022 is 515m^3/day and exceed the design capacity of Lubigi Faecal Sludge Treatment Plant. Therefore, Bugolobi Sewerage Treatment Plant is now used for the treatment of faecal sludge to cope with the lack of faecal sludge treatment capacity since the role of sewerage treatment plant was taken over by Nakivubo Wastewater Treatment Plant.

Furthermore, Nalukolongo Faecal Sludge Treatment Plant with a capacity of 400m^3/day is being implemented under Package 5B: Improvement of Water Supply and Sanitation Services in Informal Settlements in Kampala Water Lake Victoria WatSan Project. In addition, another faecal sludge treatment plant with the capacity of 400m^3/day is planned to be implemented in Kajjansi under Wakiso West WatSan Project.

In Mpigi District, the existing faecal sludge treatment facility is at Kayabwe in Buwama Subcounty, approximately 35km west of Mpigi Town. Although this faecal sludge treatment facility has the capacity of 1,000 m^3/day, due to the distance, most faecal sludge from Mpigi Town and the surrounding areas are taken to Lubigi Faecal Sludge Treatment Plant, and the plant at Buwama receives approximately 20m^3 of faecal sludge per day.

Other ongoing faecal sludge treatment projects in GKUGA are listed in Table 15.2.1.

Table 15.2.1 Ongoing Faecal Sludge Treatment Projects in GKUGA

Projects	Organisation in Charge	Funding	Contents	Implementation Schedule
Kira Faecal Sludge Management and Treatment Project	MWE	AfDB	Proposes as part of 5 town clusters in central and southwestern Uganda, the construction of a FSTP with a capacity of 172 m^3/d in Kira.	Feasibility study completed in September 2020. Detailed Design completed in March 2021.
Kikoko Faecal Sludge Treatment Facility	MWE	KEITI	Construction of a FSTP with a capacity of 60 m^3/d to serve 200,000 people by 2040 in Nansana Municipality, Wakiso District.	Project implementation scheduled in the period 2022 - 2025.
Faecal Sludge Treatment Plant for the Greater Kampala Metropolitan Area (GKMA)	MWE	GGGI	Development of a faecal sludge management system in GKMA including the identification of a site for a new FSTP and design and construction of the FSTP including development of business and O&M models.	Consulting services tendered in 2022.
Mukono Faecal Sludge Treatment Plant	MWE	UNICEF Finland	Implementation of a FSTP with a capacity of 15 m^3/d in Mukono District for the production of briquettes to be used as fuel. The FSTP was established in Mukono District at the site of the municipal organic waste management plant.	Under Implementation

Source: Fichtner Water & Transportation, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, August 2022, NWSC-KfW

4) Onsite Sanitation

Onsite sanitation is implemented in buildings that are not connected to the sewerage network. Most households in GKUGA use pit latrines. It is said that most of these pit latrines do not meet adequate standards, and almost 45% of them are abandoned just after five years once they are full or broken.

Furthermore, in KCC, approximately 1.8% of households do not have access to toilet facilities at all.

A citywide sanitation survey in KCC was carried out in 2017 in Kampala Faecal Sludge Management Programme supported by KCCA with the support of UK's Department for International Development (DFID). The result showed that although 99% of the population in KCC have access to sanitation, only 20% of the population have access to improved sanitation[1].

Also, there is a survey result that shows 30% of the latrines in the informal settlements are emptied by discharging the waste to the environment.

In Mpigi District, it is estimated that approximately 65% of the onsite sanitation is pit latrines, and NWSC is encouraging the use of biodigesters since it is not necessary to empty.

There are 189 cesspool emptier trucks servicing KCC. These trucks are registered at NEMA and KCCA.

5) Industrial Area

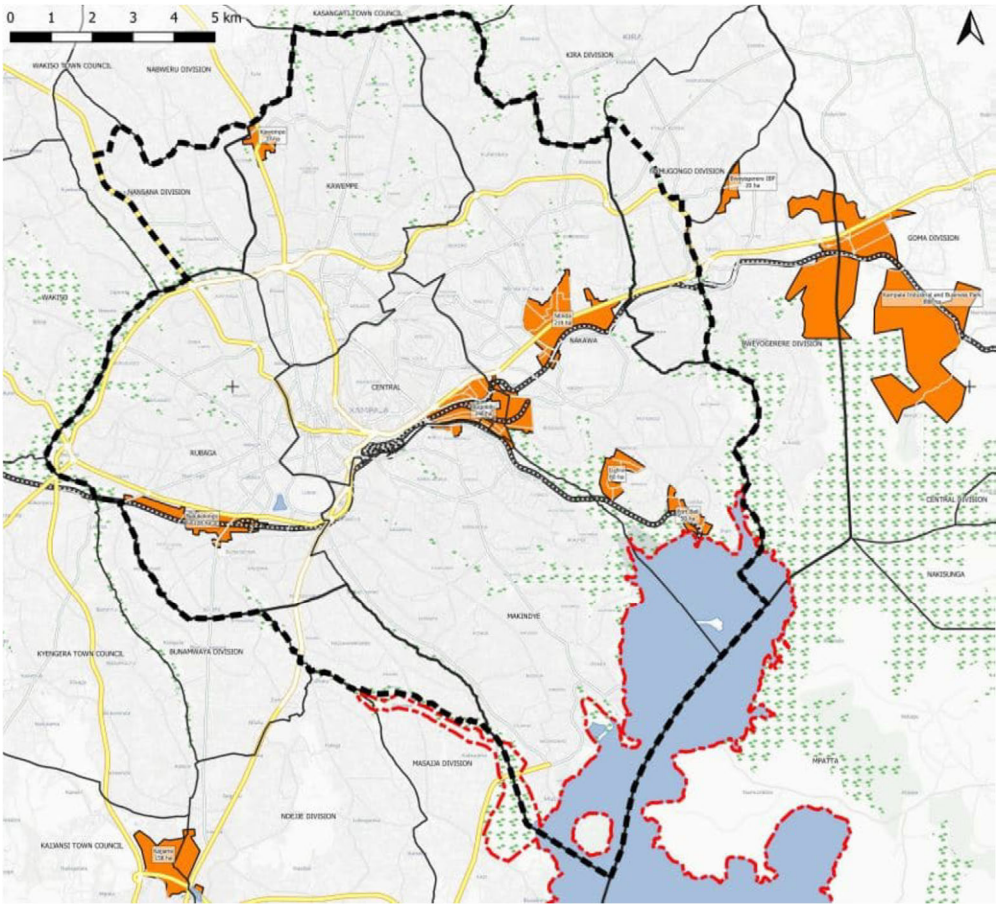
The industries connected to NWSC's sewer system in GKUGA are limited to four industries as of February 2022.

To improve this situation, NWSC has been working closely with the Uganda Investment Authority (UIA) which operates the industrial parks including Kampala Industrial and Business Park in Namanve and Luzira Industrial and Business Park. Based on the discussion, Kampala Industrial and Business Park, Bweyogerere Industrial Business Park and Luzira Industrial and Business Park are to be served by wastewater treatment plant to be constructed by UIA.

The Sewerage Service Department (SSD) of NWSC oversees industrial pollution control and monitoring. The monitoring activities are to be implemented through activity plans of Pollution Task Force that was established by KCCA in 2020. However, due to COVID-19 pandemic, the task force activities could not be conducted, and by March 2022, the task force had exit of active members.

The nine industrial areas acknowledged by NWSC's Kampala Sanitation Masterplan are shown in Figure 15.2.3.

[1] Improved sanitation facility includes flush/pour flush to piped sewer, septic tank or pit lined latrine or lined/ composting toilet.



Source: Fichtner Water & Transportation GmbH, 2022, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, NWSC-KfW

Figure 15.2.3 Industrial Areas Acknowledged in Kampala Sanitation Master Plan to Provide Sewerage Service

(2) Organisation

The Ministry of Water and Environment (MWE) is the overall responsible body for sewerage services and appoints NWSC and Umbrella Organisations for Water and Sanitation (UOs) as the orgainsations in charge of sewerage.

The jurisdiction area of sewerage service in GKUGA is as shown in Table 15.1.1.

NWSC is the sewerage authority which has the mandate to collect, transport and treat the sewage. The services provided in GKUGA by NWSC are covered by three separate zones, namely: Kampala Metropolitan, Entebbe and Mpigi. However, as written previously, NWSC Mpigi does not provide sewerage service in their jurisdiction area as of now.

Central Umbrella Organisation in charge of water supply and sewerage in part of Wakiso, Mukono and Mpigi Districts as in Table 15.1.1. However, CUO does not manage a pipped sewerage network. Where there are faecal sludge treatment plants, the CUO is responsible for the management of the plant.

On the other hand, there is no clear organization fully taking charge of onsite sanitation. The responsibilities for onsite sanitation are shared among the following ministries:

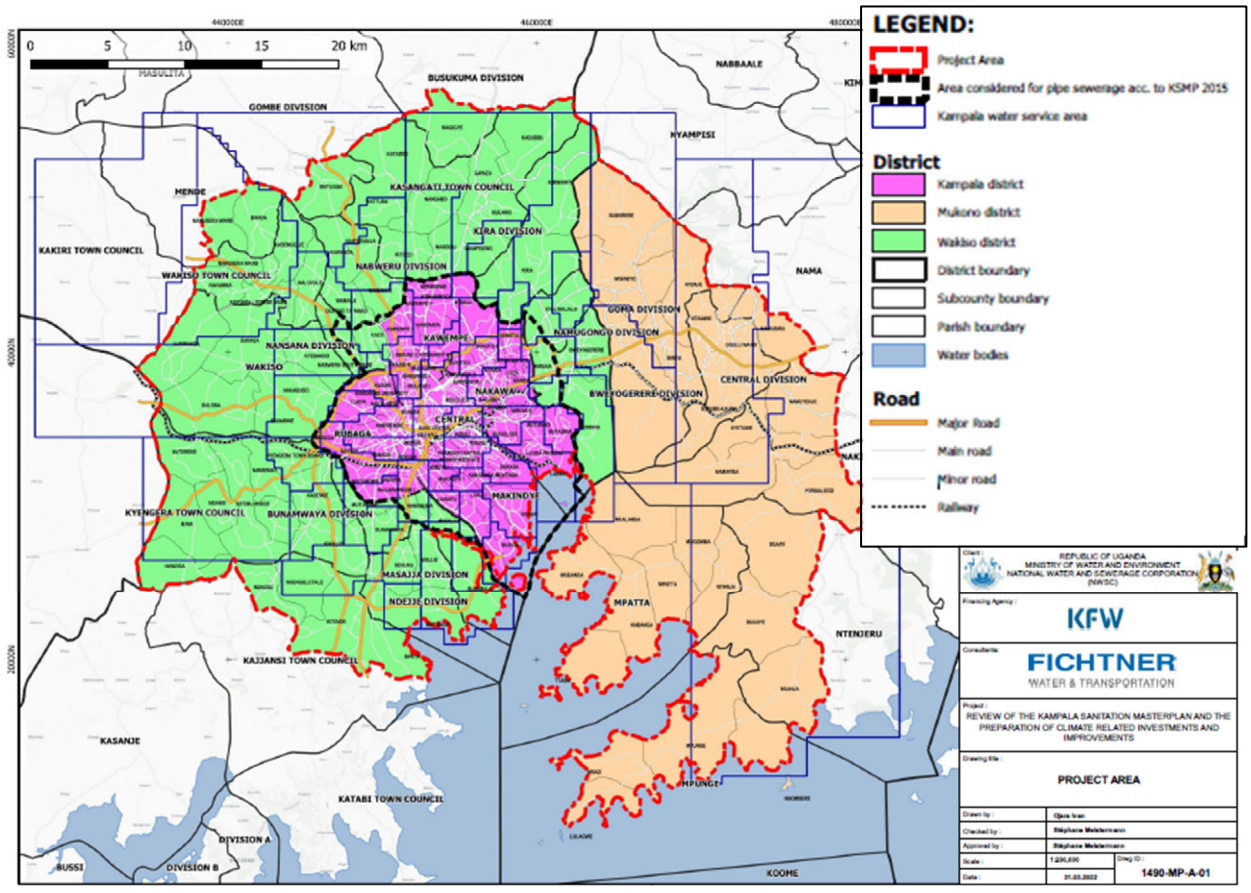
- Ministry of Water and Environment for public sanitation and promotion of good practices of hygiene and sanitation
- Ministry of Health for promotion of household hygiene and sanitation
- Ministry of Education and Sports for school sanitation and hygiene education
- Ministry of Kampala and Ministry of Local Government for sanitation in public facilities, for policy, regulation and enforcement

(3) Kampala Sanitation Master Plan and Updated Kampala Sanitation Master Plan

Kampala Sanitation Master Plan was prepared in 2003 as a 30-year plan to improve the sanitation in KCC with the support of KfW Development Bank. The plan was revised in 2015 and was updated again in 2022.

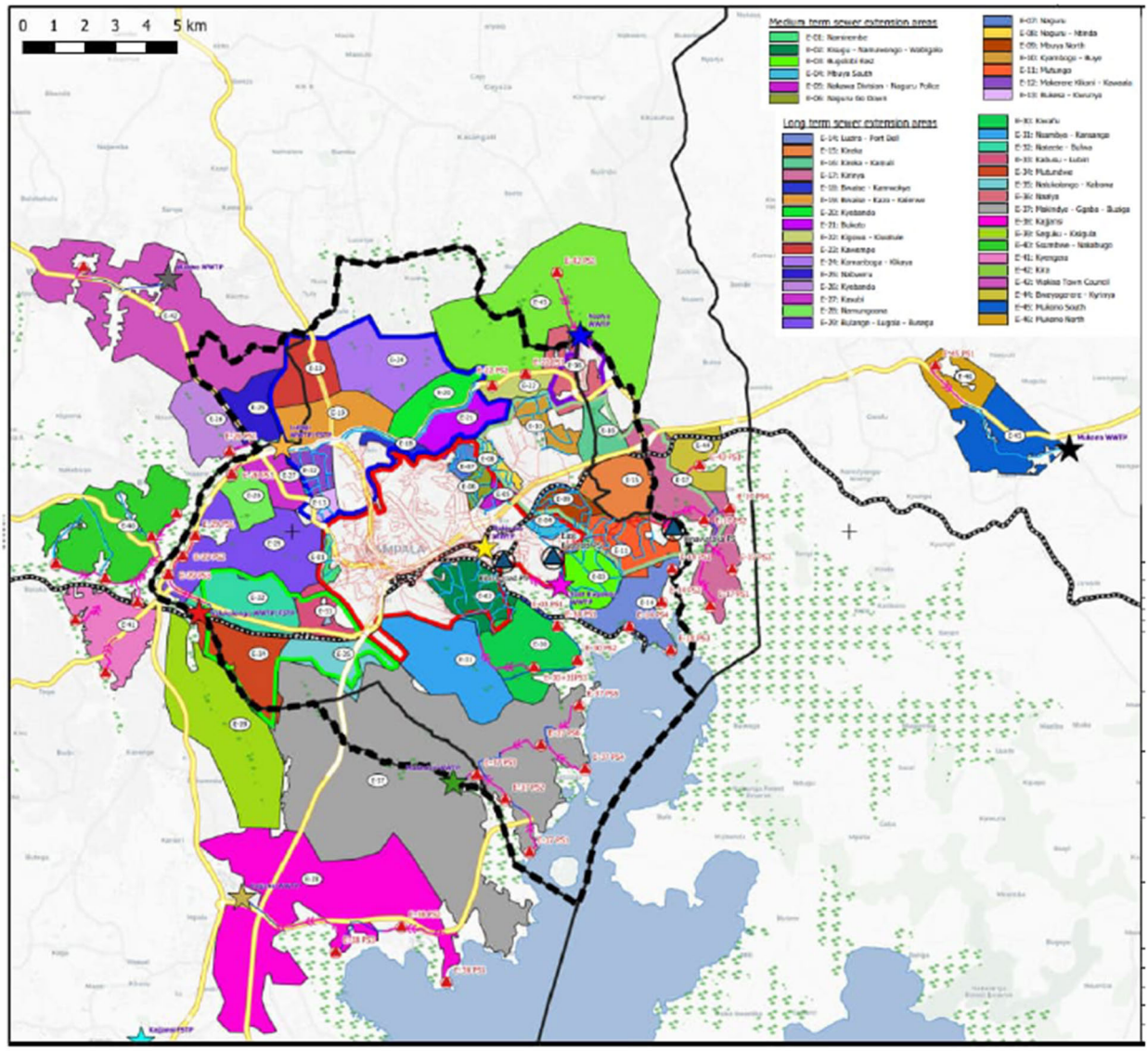
The main objective of the recent plan updating is to consider the recent developments in the sanitation situation in Kampala and identify priorities to be reviewed. It focuses mainly on the development of a sustainable piped sewerage system to be operated and maintained by NWSC.

The original planning area covered in this master plan in 2015 includes the area currently covered with sewer services as well as, KCC and very small areas in Nansana Municipality, Kira Municipality and Makindye-Ssabagabo Municipality as shown in Figure 15.2.4. In the revision of the master plan conducted in 2022, the sewerage service area has been reconsidered based on future urban structure of GKUGA and population distribution. The service area has been expanded to part of Mukono Municipality, part of Wakiso Town, part of Kyengera Town and part of Kajjansi Town as shown in Figure 15.2.5.



Source: Fichtner Water & Transportation GmbH, 2022, Review of the Kampala Sanitation Masterplan and the Preparation of Climate Related Investments and Improvements Volume 2: Drawings Update of Master Plan and Identification of Investment Clusters, NWSC

Figure 15.2.4 Planning Area of Kampala Sanitation Master Plan and Present Sewerage Service Area



Source: Fichtner Water & Transportation GmbH, 2022, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, NWSC-KfW

Figure 15.2.5 Sewerage Service Area by NWSC Kampala Metropolitan in 2050

The forecasted volumes of wastewater to be generated in the four catchment areas in KCC to be treated by wastewater treatment plans was estimated as 102,300 m^3/day for a population of approximately 900,000 by 2040 in the update of the Kampala Sanitation Masterplan in 2015.

This future forecast has been revised in the revision of the master plan in 2022 and the number of treatment plant to serve the NWSC's Kampala Metropolitan jurisdiction area has increased to 10 from four, and the forecasted volumes of wastewater to be treated by wastewater treatment plants is projected to be 288,294 m^3/day in 2040 and 396,988 m^3/day in 2050. The projected volumes of wastewater to be treated by wastewater treatment plant is summarised in Table 15.2.2. This forecast is estimated to serve the population of approximately 4.2 million and all industrial area by 2050.

This forecast is based on the assumption that 90% of the inhabitants and 90% of the industries are connected to sewer networks by 2030.

Table 15.2.2 Forecast of Wastewater Generation by Catchment Area in the Kampala Sanitation Master Plan Updated in 2022 (2030, 2040, 2050)

Wastewater Treatment Plant	2022	2030	2040	2050
Nakivubo	14,987 m³/day	43,242 m³/day	53,017 m³/day	61,810 m³/day
Kinawataka	1,332 m³/day	22,095 m³/day	28,988 m³/day	37,215 m³/day
Lubigi	1,298 m³/day	40,027 m³/day	55,888 m³/day	70,062 m³/day
Nalukolongo	6 m³/day	23,483 m³/day	36,048 m³/day	51,656 m³/day
Naalya	654 m³/day	11,467 m³/day	19,974 m³/day	32,585 m³/day
Makindye	0 m³/day	28,635 m³/day	45,454 m³/day	68,181 m³/day
Kajjansi	0 m³/day	6,221 m³/day	12,273 m³/day	21,826 m³/day
Ssumbwe	0 m³/day	7,779 m³/day	13,413 m³/day	21,160 m³/day
Wakiso	0 m³/day	12,637 m³/day	21,557 m³/day	30,359 m³/day
Mukono	0 m³/day	1,288 m³/day	1,682 m³/day	2,135 m³/day
Total	18,277 m³/day	196,874 m³/day	288,294 m³/day	396,988 m³/day

Source: Fichtner Water & Transportation GmbH, 2022, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, NWSC-KfW

The following measures are proposed in the 2022 Kampala Sanitation Master Plan Update:

- Rehabilitation of the existing sewer network
- Densification of the sewer network
- Extension of the sewer network beyond KCC
- Implementation of simplified sewerage for densely populated areas located near to existing sewer connecting to the sewer by gravity
- Extension of sewerage treatment capacities of the existing wastewater treatment plant
- Connection of sewer system to the industries in the industrial areas

The direction for the implementation of wastewater treatment plant to satisfy the future forecasted wastewater generated by approximately 4.2 million inhabitants are proposed as in Table 15.2.3.

Table 15.2.3 Proposed Direction for Implementation of New Wastewater Treatment Plants by Kampala Sanitation Masterplan

New Wastewater Treatment Plants	Proposed Direction for Implementation
Makindye Wastewater Treatment Plant	Very large area including the southern part of the Makindye and Rubaga Divisions of Kampala Capital City as well as a relevant part of Wakiso District. The major part of this extension area drains by gravity to a central WWTP which is located in Gangu. Only the eastern part of this extension area including Ggaba, Buziga, Mawanga and Munyonyo will require several pumping stations for the transfer of the wastewater to the central WWTP. Treated effluents will be discharged into Lake Victoria via the existing swamp
Kajjansi Wastewater Treatment Plant	Extension area located east of the Kampala-Entebbe Expressway. This extension area shall be connected to a separate WWTP located close to the Kajjansi expressway toll station. The major part of the area can be drained by gravity to the proposed WWTP. Pumping stations would be required to connect the areas in the east of the extension area and the lows lying areas close to Victoria Lake. The location of the planned Kajjansi FSTP is not considered suitable as it is too from the extension area and would require pumping of the totality of the wastewater. Construction of a WWTP at the site of the Kajjansi FSTP could however be considered in case this WWTP would serve a bigger area, notably the Akright city and other important urban development area which are outside of the project area of the present Kampala Sanitation Master Plan.
Ssumbwe Wastewater Treatment Plant	The proposed concept is in line with Wakiso Water Supply and Sanitation Master Plan which foresees to build a centralised sewerage system in the densely currently or in future densely urbanised areas of Wakiso Sub County and Kyengera Town in Wakiso District. The two extension areas E-40 Ssumbwe-Nakabugo and E-41 Kyengera delineate the densely urbanised areas of the above indicated zones. The future centralised sewerage system of these two extension areas shall be connected to a central WWTP in Ssumbwe. The location of the WTTP is as proposed in the Wakiso Master Plan.

New Wastewater Treatment Plants	Proposed Direction for Implementation
Wakiso Wastewater Treatment Plant	Wakiso Town and densely urbanised areas around Wakiso Town shall be served in future by a centralized sewerage system connected to a central WWTP located close to the Kampala - Hoima Road. A pumping station will be required for the transfer of the effluents from the north-western part of the extension area to the Wakiso WWTP.
Mukono Wastewater Treatment Plant	The proposed concept is in line with the design developed for Mukono Town in 2002. The two extension areas E-45 Mukono South and E-46 Mukono North are larger than the areas proposed for piped sewerage in the above design. Instead of two WWTPs with one for each sewer extension area, it is proposed to transfer the effluents from the smaller area (E-46) by pumping to one single central WWTP located downstream of Mukono.

Source: Fichtner Water & Transportation GmbH, 2022, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, NWSC-KfW

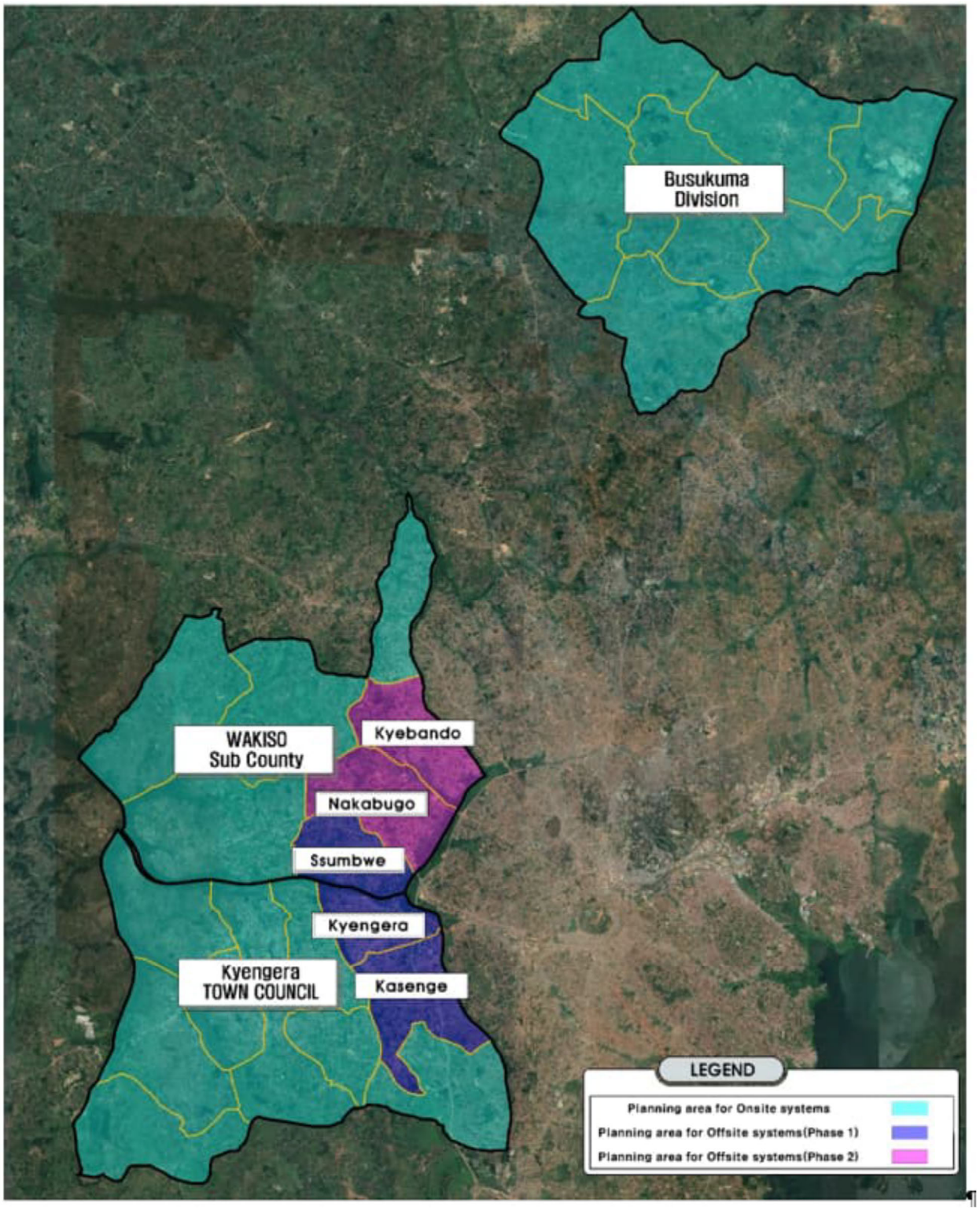
(4) Water Supply and Sanitation Master Plan for Wakiso Town

Water Supply and Sanitation Master Plan for Wakiso Town in implemented by MWE with the support of Korea Environmental Industry & Technology Institute (KEITI). The actual planning area of this master plan is Kyengera Town, Wakiso Sub County and Busukuma Division in Wakiso District as shown in Figure 15.2.6.

The formulation of the master plan was launched in May 2019 and is now completed. Within the planning area, the master plan proposes a centralised sewerage system for three densely populated wards and parishes, namely Ssumbwe, Nakabugo and Kyebando Parishes in Wakiso Sub County and Kasenge and Kyengera Wards in Kyengera Town. To treat the wastewater, Ssumbwe Wastewater Treatment Plant is proposed in Ssumbwe Parish. The implementation is to be done in two phases and the capacity of the treatment plant for the target year 2040 (Phase 1) is 14,000 m^3/day. The initial implementation is to be completed by 2030 with the capacity of 6,500 m^3/day.

The target year of Phase 2 is 2050 and an additional treatment capacity of 56,000 m3/day shall be provided.

The treatment plant plans to have a combined treatment of sewage and faecal sludge with a capacity of 482 m^3/d in Phase 1 and an additional capacity of 814 m^3/d in Phase 2.



Source: Sungil Entech, 2020, Water Supply and Wastewater Management Master Plan for Wakiso District, Uganda. Final Report. Saman - K Water

Figure 15.2.6 Planning Areas for Water Supply and Sewer Service in Water Supply and Sanitation Master Plan for Wakiso Town

(5) Feasibility Study and Design a Faecal Sludge Treatment Plant for the Greater Kampala Metropolitan Area (GKMA).

The MWE has conducted a feasibility study for the implementation of faecal sludge treatment plant for GKMA with the support of Global Green Growth Institute (GGGI) in 2022.

The study includes the following activities:

- Conducting a feasibility study to identify suitable sites and preparation of site-specific engineering designs for one Faecal Sludge Treatment Plant (FSTP) in the GKMA
- Development of financially viable Business and Operations & Maintenance (O&M) model for the FSTP
- Identification and study of potential sludge valorisation options
- Identification of sustainable governance structure and supporting the selection process of public or private operator for the FSTP

GGGI has selected Mukoo Faecal Sludge Treatment Plant to conduct the feasibility study.

(6) Kampala Physical Development Plan (KPDP)

The goal of the sewerage sector for KCC in 2022 as stated in the KPDP is as follows:

"All residential areas should have either piped sewers with treatment plants of sufficient capacity or, as a temporary solution only, regular collection of faecal sludge from latrines and other facilities; with the sludge being treated in a scientific manner which prevents pollution of ecological systems, and allows for recycling of the end product. In addition, all industrial areas should be connected to proper sewerage systems, with pretreatment as appropriate, and, if necessary, specialised treatment facilities."

In the KPDP, the following strategies are recommended:

- Future planning for the sewerage sector is to be based on the long-term capacity projections of the KPDP.
- Set and work towards the following goals:
  - 2002 Target: 100% coverage of primary employment centres, 80% coverage of Inner City Zone, and 50% coverage of adjoining towns and sub counties of KCC
  - Long Target: 100% coverage of primary employment centres, Inner City Zone, adjoining towns and sub counties of KCC, and 80% coverage of planned urbanised areas
- Commence the planning of a piped sewer network for the Lubigi catchment and for other catchments in addition to those of Kinawatka and Nakivubo, and undertake planning for additional sections of the Nakivubo system
- Accelerate the upgrading, rehabilitation or augmentation of the existing network and treatment plants and the commissioning of new water treatment plants
- Require all industries and formal commercial establishments and institutions to have appropriate connections or pretreatment facilities as a condition for building plan approval, and make authorisation of occupancy and implementation of water supply as condition to the implementation of those connections / facilities, while also strengthening enforcement capabilities
- Adopt and implement appropriate progressive fee structure to ensure development and proper maintenance of the sewage network on an economic basis
- Adequate interim financing for capital investment

(7) Wakiso District Physical Development Plan

The following action plans are considered in Wakiso District PDP as the guiding principles for the future sanitation system:

- Priority to gravity sewers by following the natural topography to avoid pumping stations
- Priority to major polluters such as densely populated areas, industrial areas, commercial and institutional facilities
- Priority to increase sewer connections in already sewered areas compared to major extension of sewer network
- New Nalukolongo Sewerage System to be operated and maintained by NWSC by 2040
- New Kajjansi Sewerage System to be operated and maintained by NWSC by 2040

15.2.2 Issues on the Sewerage Sector

(1) Low Coverage Rate of the Sewerage Network System and Insufficient Pipes in the Existing Network

The coverage rate of the sewerage system in the already urbanised area in KCC, especially in the commercial are still low despite the existence of sewer network. One of the reasons is due to the low performance in the installation of new sewer connections because the water customers are reluctant to connect to the sewerage system due to the cost. Most water customers have already invested in their onsite sanitation facilities and it is also cheaper to continue to use the onsite sanitation than connect to the NWSC sewer network. For example, residential house with a waterborne toilet which uses septic tank needs to empty every two to five years and will cost around 300,000 UGX per emptying. On the other hand, the cost of sewerage is estimated to cost around 385,000 UGX per year. It is also said that most customers are favouring a connection to the sewer, in comparison to on-site sanitation options if the financial aspect is not considered.

For NWSC to sustainably provide the sewerage services, it is necessary to increase the number of sewerage connection especially in the existing service coverage area.

In addition to the low coverage rate of the sewerage network system, approximately 43.4% of the existing sewer network in Kampala was installed over 50 years ago, and 36.6% of the pipe are not sure of the installed year as shown in Table 15.2.4.

Table 15.2.4 Age of Sewer Pipes Installed in Kampala Capital City

No	Pipe Installation Year	Pipe Length [m]	Age [years]	Percent
1	Unknown	92,501	Unknown	36.6%
2	2020	1,550	2	0.6%
3	2019	436	3	0.2%
4	2018	19,400	4	7.7%
5	2014	14,452	8	5.7%
6	2007	221	15	0.1%
7	1998	14,486	24	5.7%
8	1967	449	55	0.2%
9	1958	20,842	64	8.2%
10	1940	88,437	82	35.0%
Total		**252,774**		**100%**

Source: Fichtner Water & Transportation GmbH, 2022, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, NWSC-KfW

Assuming that the lifetime of the sewer pipes are 50 years, at least 43 % of the existing sewer with a total length of approximately 110 km need to be replaced.

Furthermore, approximately 40% of the sewer pipelines installed currently have less than 200 mm diameters. A size of 200mm is considered as minimum diameter for a state-of-the-art communal sewer. The distribution of the sewer length by diameters of installed pipes is shown in Table 15.2.5.

Table 15.2.5 Diameters of Sewer Pipes Installed in Kampala Capital City

No	Pipe Size	Pipe Length [m]	Percent
1	DN 1500	1,566	0.6%
2	DN 1200	1,116	0.4%
3	DN 900	1,647	0.7%
4	DN 800	3,289	1.3%
5	DN 675	313	0.1%
6	DN 600	6,024	2.4%
7	DN 525	249	0.1%
8	DN 500	4,900	1.9%
9	DN 450	5,530	2.2%
10	DN 400	3,462	1.4%
11	DN 375	3,081	1.2%
12	DN 300	11,413	4.5%
13	DN 250	7,592	3.0%
14	DN 225	6,624	2.6%
15	DN 200	6,598	2.6%
16	DN 175	100,618	39.8%

Souce: Fichtner Water & Transportation GmbH, 2022, Review of the Kampal Sanitation Masterplan and Preparation of Sanitation Investments and Improvements Work Package A Report Volume 1: Report, NWSC-KfW

(2) Lack of Sewerage and Sanitation Infrastructure in GKUGA Outside KCC

The urban population in GKUGA living outside KCC is larger than the population in KCC, and commercial activities and industrial development in the area outside KCC is emerging rapidly. However, the only area outside KCC that has sewerage infrastructure in GKUGA is Entebbe.

In the revision of the Kampala Sanitation Master Plan conducted in 2022, sewerage infrastructure for areas outside KCC were considered, which includes some of the urban centres in the GKUGA's future urban structure, namely Busega-Kyengera Secondary Urban Centre, Namanve Secondary Urban Centre, Wakiso Metropolitan Centre, Mukono Metropolitan Centre and part of Kajjansi Metropolitan Centre. (The remaining part of Kajjansi Metropolitan Centre is within the NWSC's jurisdiction area of Entebbe.) On the other hand, Nsangi Metropolitan Centre, Gayaza Metropolitan Centre and Matugga Metropolitan Centre were not included as part of the sewerage network to be implemented by 2050.

The existing capacity of faecal sludge treatment plant considering the ongoing projects is also not sufficient for the future urban population in GKUGA.

(3) Wastewater from Industrial Areas

Most of the industrial facilities in GKUGA are not connected to sewerage system. This is due to the lack of willingness to connect to the sewer network.

In addition, pollution control and monitoring system of the industrial pollution is not functioning.

(4) Degraded Wetland due to Improper Onsite Sanitation Situation

Besides KCCA, the responsibility for on-site sanitation is unclear in GKUGA. Therefore, due to improper onsite sanitation situation, wetlands have been degraded.

15.2.3 Objectives for the Sewerage Sector

The objectives of sewerage sector development are as follows:

- To increase the capacity of sewerage treatment and faecal sludge treatment facilities
- To increase the number of sewer connection by prioritising the sewer network service area to KCC, Secondary Urban Centres and six Metropolitan Centres by 2050
- To improve the onsite satiation situation
- To legalise industrial facilities in GKUGA to connect to sewer network or have adequate onsite sanitation facilities

15.2.4 Strategies for the Sewerage Sector

(1) Strategies for Increasing the Capacity of Sewerage Treatment and Increase the Coverage Rate of Sewerage System in Kampala Capital City

For improving the situation of sewerage and sanitation in KCC the following set of strategies are necessary:

- To promote business, commercial, manufacturing and public facilities in KCC to connect to sewer network (Short Term)
- To implement Nalukolongo Wastewater Treatment Plant and Faecal Sludge Treatment Plant (Short Term)
- To densify the sewer network for the areas with existing sewer network following the implementation plan of Updated Kampala Sanitation Master Plan 2022 (Short – Medium Term)
- To replace the old sewer pipes (over 50 years old) and pipes that have less than 200 mm diameter (Short - Medium Term)
- To extend the sewer network to cover the whole of KCC following the implementation plan of Updated Kampala Sanitation Master Plan 2022 (Medium – Long Term)
- To upgrade the capacity of Nakivubo Wastewater Treatment Plant and Lubigi Wastewater Treatment Plant to prepare for the future wastewater to be generated (Medium – Long Term)

(2) Strategies for Expanding the Sewerage System to Secondary Urban Centres

For improving the situation of sewerage and sanitation in the secondary urban centres the following set of strategies are necessary:

- To implement Namanve Wastewater Treatment Plant planned by UIA for Namanve Secondary Urban Cetnre (Short Term)
- To expand the sewerage system to cover the four secondary urban centres following the implementation plan of Updated Kampala Sanitation Master Plan 2022 (Short Term)
- To implement Ssumbwe Wastewater Treatment Plant and Ssumbwe Faecal Sludge Treatment Plant under Water and Sanitation Master Plan for Wakiso Town for Busega-Kyengera Secondary Urban Centre (Short - Long Term)
- To implement Entebbe Wastewater Treatment Plant (New Proposal) for Entebbe-Katabi Secondary Urban Centre (Medium – Long Term)

(3) Strategies Preparing Sewerage System for Metropolitan Centres

In the short to medium term, the metropolitan centres are expected to use faecal sludge treatment. The sewer services in the metropolitan centres should be implemented in accordance with the phase development of the metropolitan centres. Mukono, Kjjansi and Nsangi are the first metropolitan centres expected to develop followed by Wakiso, Mattuga and Gayaza.

For improving the situation of sewerage and sanitation in the six metropolitan centres the following set of strategies are necessary:

- To implement Mukono Faecal Sludge Treatment Plant and Kajjansi Faecal Sludge Treatment

Plant (Short Term)
- To review and update the sanitation plan prepared by Support to Rural Towns Water and Sanitation Project for Mukono Town and Seeta Urban Centre in 2002 (Short Term)
- To prepare sanitation plan for providing sewerage system in Wakiso, Kajjansi, Nsangi, Matugga and Gayaza Metropolitan Centres (Short Term)
- To expand sewerage network to Mukono, Kajjansi, Nsangi and Wakiso Metropolitan Centres (Medium Term)
- To implement Mukono Wastewater Treatment Plant proposed in Updated Kampala Sanitation Master Plan 2022 for Mukono Metropolitan Centre (Medium Term)
- To implement Kajjansi Wastewater Treatment Plant proposed in Updated Kampala Sanitation Master Plan 2022 for Kajjansi Metropolitan Centre (Medium Term)
- To implement Nsangi Wastewater Treatment Plant (New Proposal) for Nsangi Metropolitan Centre (Medium Term)
- To implement Wakiso Wastewater Treatment Plant proposed in Updated Kampala Sanitation Master Plan 2022 for Wakiso Metropolitan Centre (Medium Term)
- To expand sewerage network to Matugga and Gayaza Metropolitan Centres (New Proposal) (Long Term)
- To implement Matugga Wastewater Treatment Plant or Waste Stabilisation Pond (New Proposal) for Matugga Metropolitan Centre (Long Term)
- To implement Gayaza Wastewater Treatment Plant or Waste Stabilisation Pond (New Proposal) for Gayaza Metropolitan Centre (Long Term)

(4) Strategies for Developing Faecal Sludge Treatment Plants in GKUGA and Sewerage Infrastructure for Urban Sub-Centres and Suburban Centres

While the sewer network is expected to expand to 20km radius from Kampala city centre by 2050, it is assumed that the area outside the 20km radius will not have limited sewer network in 2050. Furthermore, it is assumed that not all household within the area of 20km radius from Kampala city centre will be connected to sewer network by 2050.

For some suburban centres such as Mpigi and Kakiri, sewer system utilising waste stabilisation ponds could be considered to be implemented in the long term.

The following strategies are considered for improving the situation of sanitation in the other areas in GKUGA:

- To implement faecal sludge Treatment Plants for Nansana and Kira Urban Sub-Centres (Short Term)
- To conduct a study on waste stabilisation pond and faecal sludge treatment plants in GKUGA for providing sanitation infrastructure especially for the suburban centres designated in GKUGA future spatial structure (Short Term)
- To implement Makindye Wastewater Treatment Plant (Medium Term)
- To implement necessary faecal sludge treatment plant based on the study conducted for GKUGA (Medium – Long Term)
- To implement waste stabilisation ponds and sewer network to serve suburban centres if necessary (Long Term)

(5) Strategies for Improving Onsite Sanitation in GKUGA

For improving onsite sanitation in GKUGA, the following strategies are considered:

- To strengthen the monitoring system of onsite sanitation and determine the role of responsibilities for onsite sanitation in GKUGA among the stakeholders
- To upgrading unlined pit latrines to lined toilets to ensure minimum standards for onsite sanitation technologies
- To increase the capacity of faecal sludge collection

(6) Strategies for Industrial Areas

The following strategies should be implemented for the industrial areas based on Updated Kampala Sanitation Master Plan 2022:

- To legalise industrial facilities in GKUGA to connect to sewer network or have adequate onsite sanitation facilities
- To setup of an efficient industrial pollution control structure and policy within NWSC aiming at connecting the highest possible number of industries to the sewerage system, however in a controlled manner with the issuance of discharge permits and establishment of efficient monitoring and control procedures
- To coordinate with UIA for the wastewater treatment plants to be implemented for Kampala Industrial and Business Park, Bweyogerere Industrial and Business Park and Luzira Industrial and Business Park

15.2.5 Projects for the Sewerage Sector

(1) Short-Term Projects

The following are the project for sewerage sector in short term (2024-2030):

- [WW-01] Project for Rehabilitation of Existing Sewer Network in Kampala Capital City
- [WW-02] Project for Implementation of Nalukolongo Wastewater Treatment Plant and Faecal Sludge Treatment Plan
- [WW-03] Project for Sewer Network Densification in Kampala Capital City
- [WW-04] Project for Implementation of Ssumbwe Wastewater Treatment Plant and Ssumbwe Faecal Sludge Treatment Plant (Phase 1)
- [WW-05] Project for Implementation of Namanve Wastewater Treatment Plant
- [WW-06] Project for Expansion of Sewerage System (Phase 1)
- [WW-07] Project for Implementation of Mukono Faecal Sludge Treatment Plant
- [WW-08] Project for Implementation of Kajjansi Faecal Sludge Treatment Plant
- [WW-09] Project for Implementation of Nansana Faecal Sludge Treatment Plant
- [WW-10] Project for Implementation of Kira Faecal Sludge Treatment Plant
- [WW-11] Project for Formulation of Sanitation Implementation Plans for Metropolitan Centres in GKUGA (Including review and Update of sanitation plan prepared by Support to Rural Towns Water and Sanitation Project for Mukono Town and Seeta Urban Centre)
- [WW-12] Project for Study on Road Map for Sanitation Improvement in GKUGA for Suburban Centres
- [WW-13] Project for Strengthening the Capacity of NWSC to Promote Connecting to Sewer Network

(2) Medium-Term Projects

The following are the project for sewerage sector in medium term (2031-2040):

- [WW-01] Project for Rehabilitation of Existing Sewer Network in Kampala Capital City
- [WW-03] Project for Sewer Network Densification in Kampala Capital City
- [WW-04] Project for Implementation of Ssumbwe Wastewater Treatment Plant and Ssumbwe Faecal Sludge Treatment Plant (Phase 1)
- [WW-06] Project for Expansion of Sewerage System (Phase 2)
- [WW-14] Project for Upgrading Lubigi Wastewater Treatment Plant
- [WW-15] Project for Implementation of Entebbe Wastewater Treatment Plant (Phase 1)
- [WW-16] Project for Implementation of Mukono Wastewater Treatment Plant
- [WW-17] Project for Implementation of Kajjansi Wastewater Treatment Plant
- [WW-18] Project for Implementation of Nsangi Wastewater Treatment Plant
- [WW-19] Project for Implementation of Wakiso Wastewater Treatment Plant
- [WW-20] Project for Implementation of Makindye Wastewater Treatment Plant

- [WW-21] Project for Implementation of Faecal Sludge Treatment Plants for Suburban Centres in GKUGA (Phase 1)
- [WW-22] Project for Strengthening the Capacity of CUO for O&M of Faecal Sludge Treatment Plants

(3) Long-Term Projects

The following are the project for sewerage sector in medium term (2041-2050):

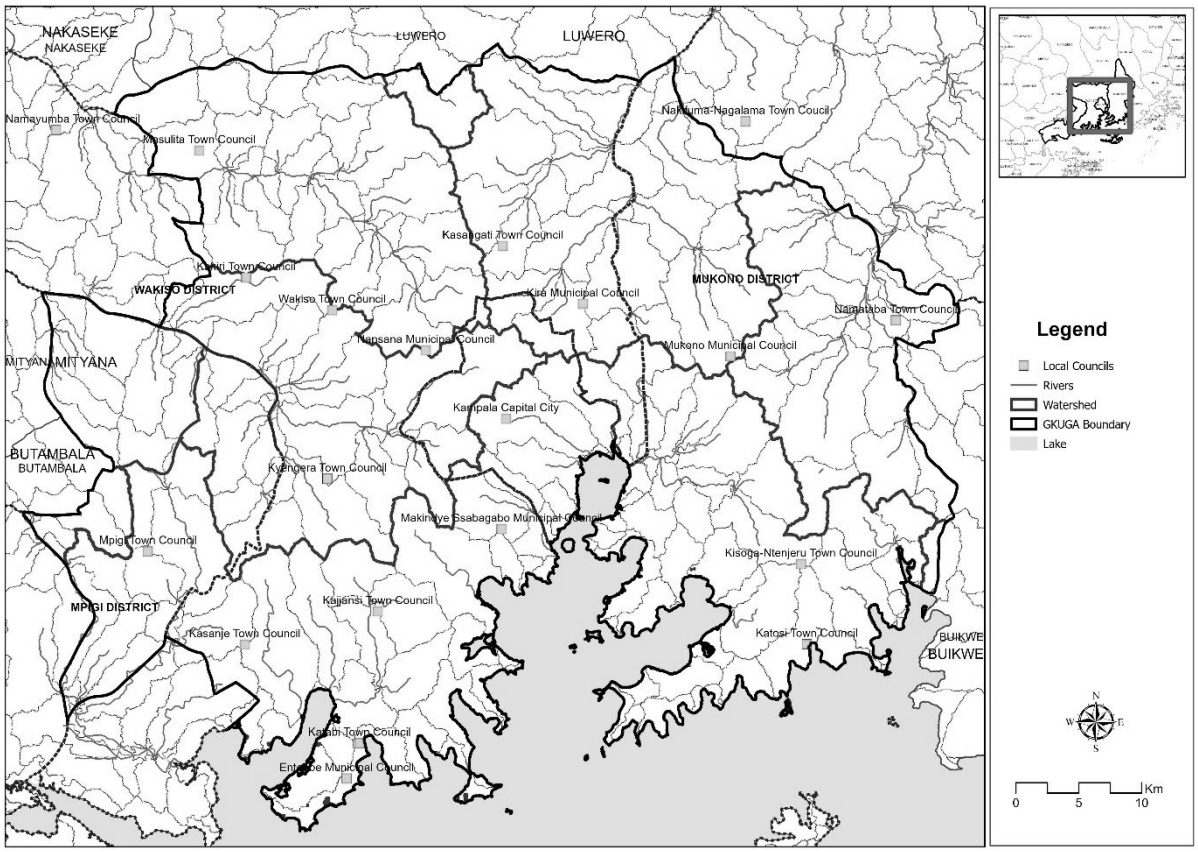
- [WW-04] Project for Implementation of Ssumbwe Wastewater Treatment Plant and Ssumbwe Faecal Sludge Treatment Plant (Phase 2)
- [WW-06] Project for Expansion of Sewerage System (Phase 3)
- [WW-15] Project for Implementation of Entebbe Wastewater Treatment Plant (Phase 2)
- [WW-21] Project for Implementation of Faecal Sludge Treatment Plants for Suburban Centres in GKUGA (Phase 2)
- [WW-23] Project for Upgrade of Nakivubo Wastewater Treatment Plant
- [WW-24] Project for Implementation of Sewerage Treatment Facility for Matugga
- [WW-25] Project for Implementation of Sewerage Treatment Facility for Gayaza
- [WW-26] Project for Implementation of Sewer Infrastructure for Suburban Centres in GKUGA
- [WW-27] Project for Implementation of Kalukolongo Wastewater Treatment Plant

15.3 Drainage

15.3.1 Background of Drainage Sector

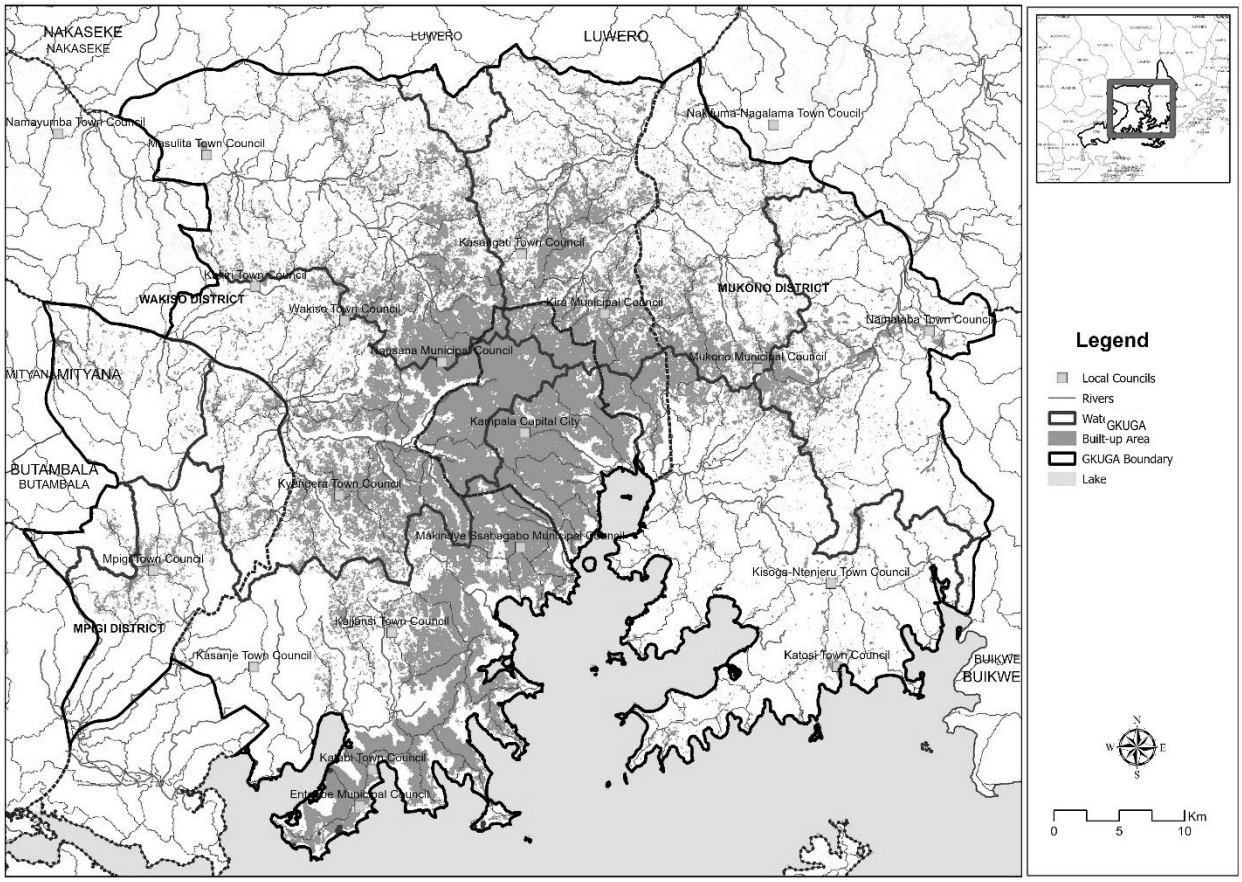
The background summary of the problems in Greater Kampala Metropolitan Area (GKMA), such as flooding and its causes, are shown below.

- In KCC and its neighbouring districts (Wakiso, Mukono and Mpigi Districts), flooding (inundation and overflow of river water) is a frequent occurrence.
- The northeastern and northern part of Kampala Capital City is upstream of Wakiso District, as shown in Figure 15.3.1. The central, eastern and southern part of KCC is the watershed of the Lake Victoria, as shown in Figure 15.3.1.
- For KCC, the Kampala Drainage Master Plan 2016 shows flood control policy and measures. On the other hand, in GKMA outside of KCC (Wakiso, Mukono, Mpigi Districts), neither the flooding situation nor flood control measures have been studied. There is also no documentation on the present situation of drainage channels nor records of flooding disasters in these three districts.
- KCC and its neighbouring districts have undergone land use changes (increased impervious area, reduced storage effects) due to rapid population growth and urbanisation with economic development. See Figure 15.3.2.



Source: JICA Expert Team

Figure 15.3.1 Watershed Areas in the GKUGA



Source: JICA Expert Team

Figure 15.3.2 Urbanisation Areas and Watershed Areas in the GKUGA

(1) Kampala Capital City

The reduction of surface infiltration capacity due to rapid urbanisation and reduction of wetlands as floodplains have led to the reduction of the rainwater retention and retention functions of the watershed. In addition to the problem of inadequate flow capacity (bottlenecks) at road intersections, sediment accumulation and blockage due to the collapse of drainage channel slopes and the reduction of flow capacity due to solid wastes have resulted in frequent flooding. In Kampala City, flooding is inundation, with a scale of about 30 cm in depth, and it lasts for 1 to 3 hours in the case of short-period heavy rainfall.

Source: KDMP 2016 LR (Photo by Daily Monitor)

Source: KDMP 2016 LR (Photo by Daily Monitor)

Source: JICA Expert Team（23rd Oct. 2021）

Source: JICA Expert Team（23rd Oct.2021）

Figure 15.3.3 Past Flood Damage in Kampala Capital City

Source: KDMP 2016 LR

Source: KDMP 2016 LR

Figure 15.3.4 Poor Drainage Conditions due to Insufficient Flow Capacity of Drainage Infrastructure in Kampala Capital City

Source: KDMP 2016 LR

Source: KDMP 2016 LR

Figure 15.3.5 Collapse of Drainage Channel Slopes in Kampala Capital City

Source: KDMP 2016 LR

Source: JICA Expert Team

Figure 15.3.6 Dumping of Solid Wastes in Drainage Channels

Source KDMP 2016 LR

Figure 15.3.7 Deposit of Sediment in Drainage Channel

KCCA has been constructing new and improved drainage channels with KCCA funds based on the Drainage Master Plan, mainly in the secondary channels, although the planned WB-funded improvement works in the primary channels (Kansanga, Gaba and Kinawataka channel) have been cancelled. For example, about 4,000 m of drainage channels have been improved since 2018. In addition, the design of the primary channel in Kansanga, Gaba and Kinawataka and the secondary channel in Lubigi, Kansanga, Gaba and Kinawataka have already been carried out in 2016.

Table 15.3.1 Record of Drainage Channel Improvement Works in Kampala Capital City

Division name	Length of Construction Work for Drainage Channel (m)	Location
Makindye	1,128	St. Denis, Kabaluka and Nakinyuguzi
Lubaga	981	St. Nabunya, Kimera, Kabaawo and Sebanja
Central	1,951	Kitamanyangamba and Nabulagala

Source: KCCA Management Executive Committee Report, on the 25th March, 2022

(2) Wakiso District

The summary of the results of the interviews in Wakiso District is shown below.

- In Wakiso District, flooding occurs after heavy rains and during the rainy season. In Wakiso, there is a tendency for flooding to occur mainly around roads constructed in low-lying areas and wetlands. In some cases, flooding occurs due to lack of capacity of roadside drainage channels.
- Figure 15.3.8 shows the photos of flooding conditions and Figure 15.3.9 shows a location map of flooding hotspots.
- Flood depths are generally 50 cm. The duration of flooding is about 24 hours.
- Damage caused by flooding mainly consists of inundation of buildings, damage to agricultural fields, and traffic jams on roads. There were no reports of injuries or loss of life.
- The cause of the flooding was the lack of capacity of the drainage channels (box culverts and concrete pipes) installed under the road that crosses the wetland. Another problem is the installation of infrastructure facilities and housing on low land, such as wetlands where rainwater easily collects.
- In Wakiso, the area of wetlands has decreased from 11% to 9% in recent years; however, it is important to conserve wetlands.
- Smaller scale works, such as improvement of drainage channels in wetlands, can be carried out with Wakiso funds. In the event of a serious disaster, the Ministry of Works and Transport will provide support for large-scale construction work.

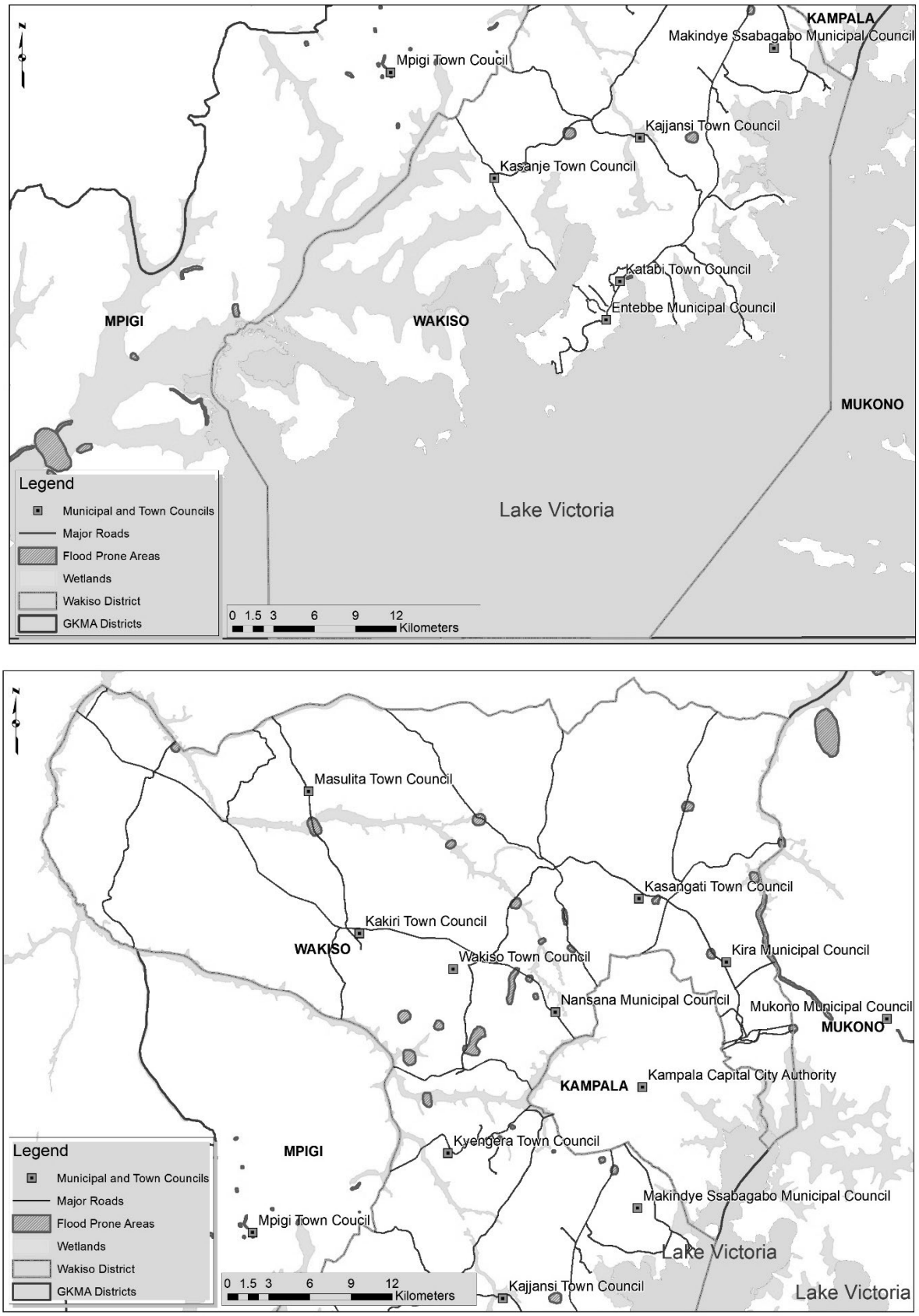
Flooding Situation at Mende_Sanga_Wetland

Bulenga_Lubanyi_Road_Flooding

Flooding in Nakiduduma Swamp

Source: JICA Expert Team

Figure 15.3.8 Past Flood Damage in Wakiso District



Source: JICA Expert Team based on the hearing from Wakiso District Local Government

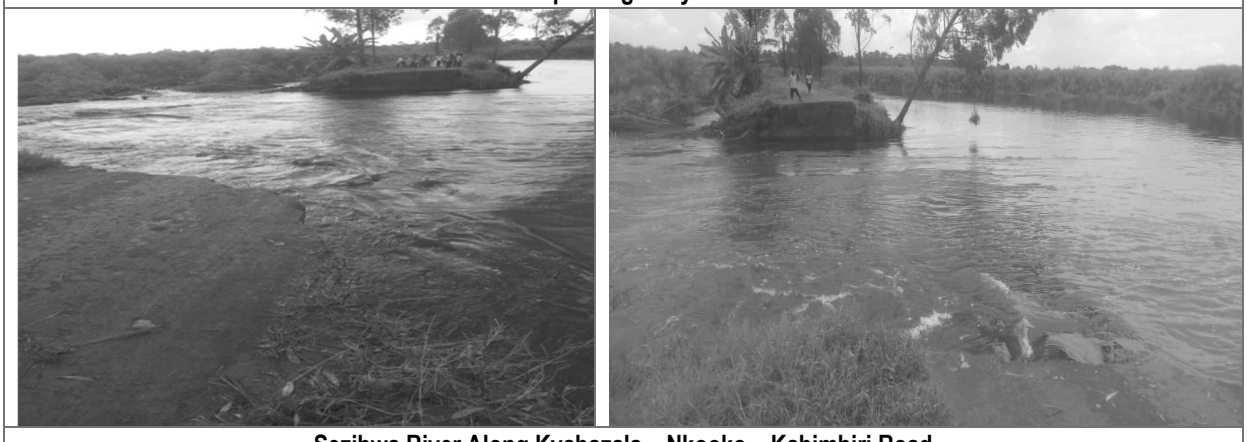
Figure 15.3.9 Location Map of Flooding Hotspots in Wakiso District

(3) Mukono District

The summary of the results of the interviews in Mukono District is shown below.

- In Mukono district, flooding occurs during the very rainy season. In Mukono, there is a tendency for flooding to occur mainly at low-lying areas within wetlands. In some cases, flooding occurs due to lack of capacity of roadside drainage channels.
- Figure 15.3.10 shows the photos of flooding conditions and Figure 15.3.11 shows a location map of flooding hotspots.
- Flood depths are generally 50 cm.
- Flooding may continue upstream of the inundated area for 1-2 days but may continue for 1-2 weeks in the downstream areas.
- Flooding is caused by lack of drainage channel capacity and backwater from narrowed areas in the lower reaches of wetlands.
- Floods cause damage to buildings, agricultural land, and traffic congestion.
- In one case, two people died when their motorcycles were crossing a road through a wetland during flooding. They drove the bike incorrectly and fell into the wetland, where they were swept away and killed. This is not a case where flooding was the direct cause.
- To improve the drainage channel, three box culverts were installed in the wetland in Mukono District. The work was funded under the budget of Mukono District and planned and designed by an engineer of Mukono District.

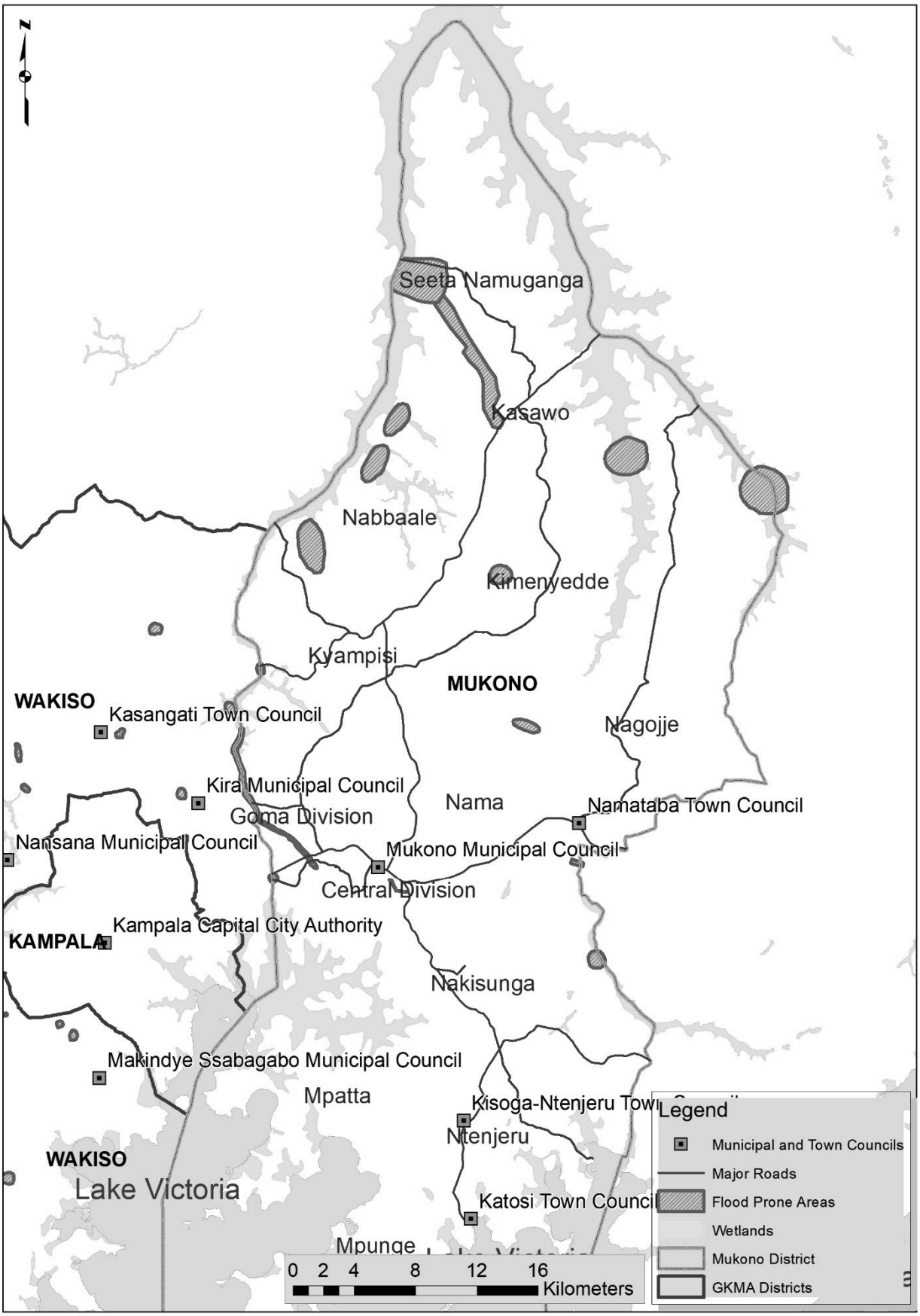
Matumbwe Swamp Along Nacyeke – Gimbi Road



Sezibwa River Along Kyabazala – Nkooko – Kabimbiri Road

Source: JICA Expert Team

Figure 15.3.10 Past Flood Damage in Mukono District



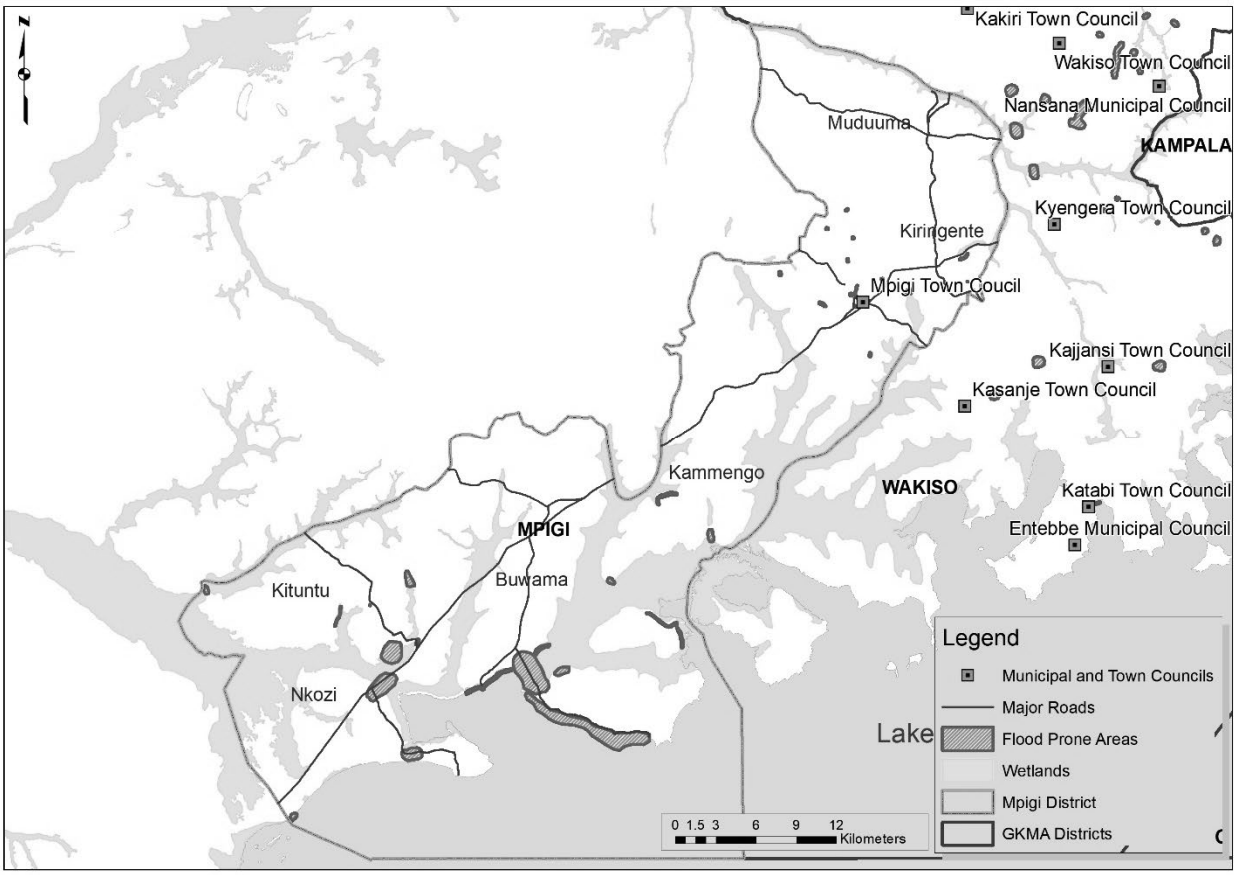
Source: JICA Expert Team based on the hearing from Mukono District Local Government

Figure 15.3.11 Location Map of Flooding Hotspots in Mukono District

(4) Mpigi District

The summary of the results of the interviews in Mpigi District is shown below.

- Flooding occurs with every heavy rainfall event. Figure 15.3.11 shows a location map of flooding hotspots. Flooding is more likely to occur along roads or around Lake Victoria and wetlands.
- The inundation area ranges from the road periphery to 10 km^2 and varies.
- The flood depth is usually around 20 cm - 1 m.
- The duration of the flooding varied greatly from place to place, ranging from a few hours to a week or two, with flooding lasting up to a month around Lake Victoria.
- Flooding has mainly affected crops, livestock, fisheries and movement of people and goods. In some cases, the only road connecting the outlying islands in Lake Victoria was inaccessible for several days due to flooding, and although there were no direct human casualties, there is concern about secondary damage. Five people died during the 2020 floods while passing on the roads in the flooded Luloio wetland.
- One of the causes of flooding is the lack of drainage channel capacity and the tendency for more silt to run off into the drainage channels due to land erosion caused by rainfall. This reduces the capacity of drainage channels.



Source: JICA Expert Team

Figure 15.3.12 Location Map of Flooding Hotspots in Mpigi District

15.3.2 Issues on Drainage Sector

From the background described above and considering future urban development, the issues related to drainage are identified as follows:

(1) Increasing Flooding and Inundation due to Expanding Urbanised Areas in GKUGA

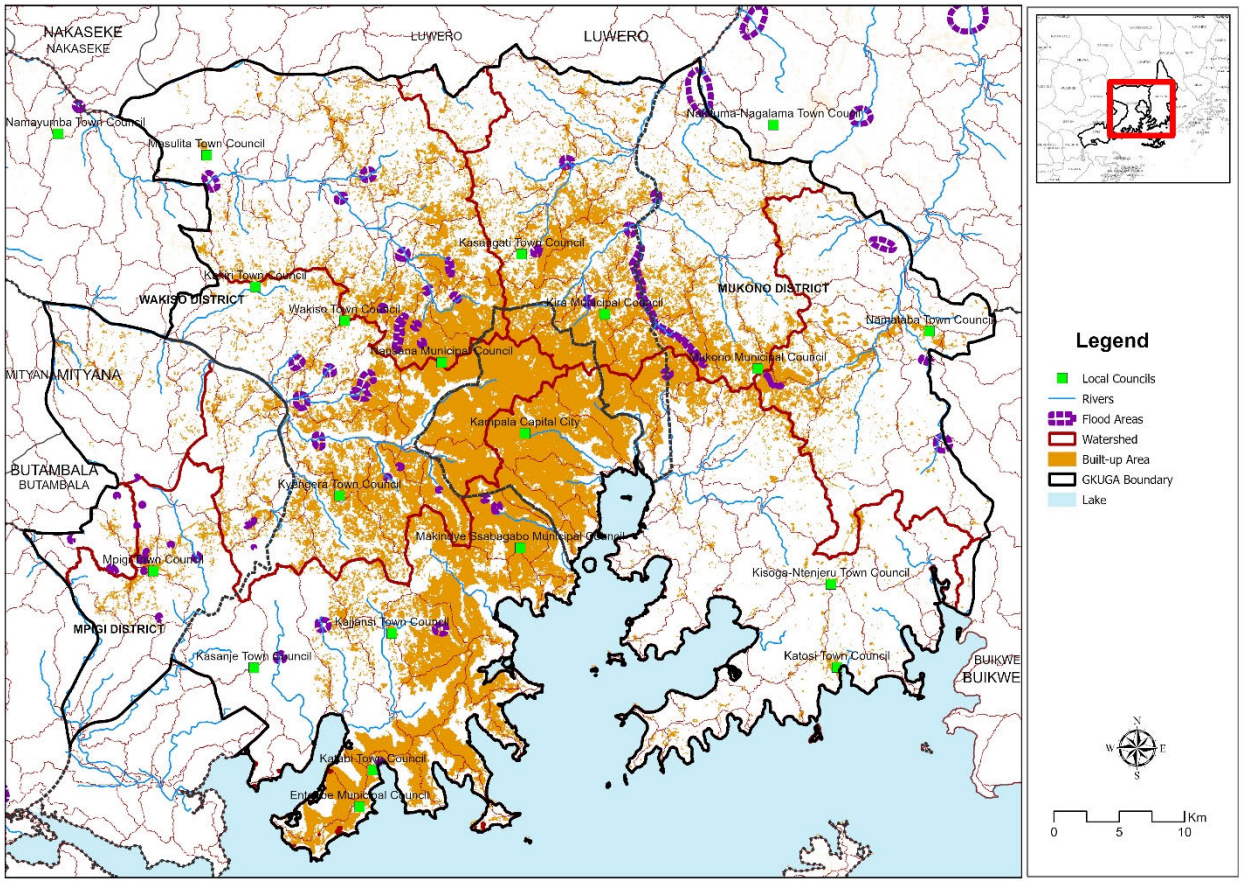
The decreased size of floodplain areas including wetlands and the reduced infiltration capacities of the ground in expanding urbanised areas have caused flooding and inundation in wider areas, damaging the following:

- People's residential buildings, commercial and industrial properties
- Road pavements
- Drainage facilities
- Economic activities
- Road traffic conditions

(2) Increasing Risk of Flooding in GKUGA outside of Kampala Capital City

Urbanisation is taking place in GKUGA outside KCC, and flood hot spots are found near wetlands and low lying areas, as shown in Figure 15.3.13.

Intensive urbanisation within KCC would increase the rate of rainfall runoff due to land use change (increased impervious areas, reduced effect of storage due to reduced wetlands, etc.). The implementation of drainage infrastructure within KCC, which would increase the flood risk in GKUGA outside KCC, which are downstream to KCC.



Source: JICA Expert Team

Figure 15.3.13 Interview at Mpigi District Local Government

(3) Drainage Systems

The capacities of drainage systems have been reduced due to sediment accumulation, dumping of solid waste, and crossing of water pipes as follows:

- Sedimentation: Sediments generated by excavation earth works for infrastructure enter open drains, resulting in reduced capacities of drainage.

- Dumping of solid waste: Densely populated areas generally have poor solid waste management services; therefore, people tend to dispose of domestic solid waste directly into drainage channels and roadside drains, resulting in reduced capacities of drainage channels.

(4) Drainage Master Plans for GKUGA outside Kampala Capital City

The surrounding districts (Wakiso, Mukono and Mpigi) of KCC are located downstream of KCC. More urbanisation and expanding concrete pavement of roads and building lots would generate quick and massive run-off towards downstream areas in GKUGA.

However, GKUGA does not have any master plans for drainage systems. As a result, their plans for drainage improvement, maintenance plans for drainage channels, and flood control policies are unclear.

(5) Organisations

While KCCA has established a manager position and a supervisor position in charge of drainage under the Deputy Director of Directorate of Engineering and Technical Services, the neighbouring district local governments do not have any special positions or staff in charge of drainage.

There is insufficient information sharing and collaboration between KCCA and the surrounding district local governments and municipalities with respect to drainage issues.

(6) Documentation of Drainage Systems and Record Taking of Flooding Occurrence

The three district local governments do not have any documents of flooding records within the district area, nor documents or maps of drainage facilities. It is fundamental for governments to have basic records of drainage facilities and flooding occurrence to conduct flood risk analysis, as well as rainfall data and river flow data.

(7) Construction Implementation

In KCC, the implementation of construction works in accordance with KDMP 2016 has been postponed or cancelled due to problems related to the Resettlement Action Plan (RAP), which provides for the resettlement of people who will be physically displaced due to the construction of drainage systems. In particular, the high cost of resettlement compensation and the difficulties in negotiations have caused delays and cancellations of project implementation.

15.3.3 Objectives for Drainage Sector

The objectives for the drainage sector in GKUGA are set as follows:

- To reduce risks of flooding (inundation and overflow of river water) in the rapid urban development in GKUGA
- To strengthen the institutional framework for enhancing the resilience against flooding both in KCC and in GKUGA outside KCC.

15.3.4 Strategies for Drainage Sector

In GKUGA where urban development is being promoted in tandem with KCC, it is essential to implement structural measures for drainage necessary to reduce damage risk from flooding, which may hinder urban development and economic sector development.

The strategies to achieve the objectives are as follows:

- The Kampala Drainage Master Plan 2016 guides the design and construction of several drainage and flood management systems in the city. The master plan recommends structural measures (such as construction of new drains and crossings) and non-structural measures (such as improving solid waste management and promoting use green/ pervious compounds for new developments), etc. KCC will promote measures to solve drainage challenges based on this master plan. In addition, in “Final Detailed Design Report/ Lubigi, Kansanga/Gaba

& Kinawtaka Drainage Systems report 2016" there is a design for the improvement of the drainage channels in the Lubigi, Kansanga, Gaba and Kinawtaka watersheds. So, based on the results of these studies, it is appropriate to proceed with the improvement work.

- Currently, the drainage master plan only covers the KCC's surface area and associated catchments, but a drainage master plan for catchments covering the entire GKUGA needs to be developed.
- In GKUGA, it is necessary to prepare basic data on drainage problems, including the mapping of flood risk areas, in order to understand the current state of risk. Then, drainage-related data should be collected and analysed.
- At the same time, it is necessary to add personnel in charge of drainage within each district local government, as well as each municipal council.
- In GKUGA, priority is given to flood control studies such as planning and design in the Nalukolongo and Kinawataka watersheds. See Figure 15.3.14.
- At the same time, drainage-related strategies include the need to promote waste management and wetland protection to keep drainage facilities functioning.

15.3.5 Projects for Drainage Sector

(1) [DR-01] Capacity Development for Collecting and Measuring Drainage-Related Data and Formulation of Drainage Master Plan for GKUGA

Since urbanisation and population increase have occurred not only in KCC (KCC) but also outside the KCC, and the KCC occupies the upstream areas of the GKUGA, it is necessary to formulate strategies and measures for preventing flooding and inundation in all over the GKUGA. However, the existing Drainage Master Plan prepared for the KCC and surrounding watershed areas in 2016 does not cover the wide areas of GKUGA.

As more urbanisation proceeds in the upstream KCC and concrete covered areas increase, higher runoff coefficients in the KCC increase the risk of flooding to downstream areas. Furthermore, as drainage facilities are developed in the KCC, faster rainfall will flow into the GKUGA outside the KCC.

To prepare a drainage master plan for the whole area of the GKUGA, first, it is important to collect and measure basic data, such as rainfall, river levels and flooding conditions (flood area, flood frequency, flood depth, etc.). Prior to the formulation of a drainage master plan for a metropolitan area, it is necessary to conduct a project component to design and instal basic data collection facilities and equipment.

In addition to the basic drainage-related data collection and measurement, it is essential to analyse detailed topography including low-laying lands, wetlands, other water body and agricultural lands for assessing the necessary volume of water necessary to retain in the GKMA in case of certain probability of rainfall amount and existing and planned instalment of drainage capacity. The Kampala Drainage Master Plan's Flooding Situation and Hotspot Analysis Report are useful as references for hydrologic analysis methods.

(2) [DR-02] Short-Term Improvement of Basic Drainage Facilities in GKUGA outside KCC

Until the data collection facilities and equipment are ready, it is necessary to start with the short-term implementation of basic measures to improve drainage channels in areas that are becoming more suburbanised and in areas that are developing suburban urban centres.

(3) [DR-03] Strengthening of Institutional Capacity for Drainage Sector for GKUGA outside KCC

Currently there are no government officers in charge of drainage in District Local Governments, Municipality and Town Council Administrations outside KCC within GKMA. Therefore, there are no official records of flooding and inundation. There are no local government budgets for drainage problems. To address these issues, it is necessary for the central government to take

action for introducing a new mandate and personnel, as well as budgets, for drainage issues firstly in district local governments

(4) [DR-04] Continued Implementation of Projects Identified by Kampala Drainage Master Plan for Kampala Capital City

In KCC, drainage channel improvement works in Lubigi, Kansanga, Gaba, and Kinawataka areas, which have already been identified by the Kampala Drainage Master Plan 2016. The identified and designed works have been done in accordance with the Kampala Drainage Master Plan 2016 with the support of the World Bank. It is necessary to continue implementing remaining works.

Additionally, the Greater Kampala Integrated Flood Resilience Partnership (GKIFRP) started support in identification of flood hotspots and the designing and implementation of drainage channel improvement works. This kind of works should be continued.

Source: Flooding Situation and Hotspot Analysis Report 2021

Figure 15.3.14 Drainage Network and Sub Catchments covered by the Greater Kampala Integrated Flood Resilience Partnership (GKIFRP)