Commissioned by the Ministry of Health, Labour and Welfare

FY2022 Waterworks Project Planning Guidance Project
(Phase 2)

The Project for Improvement of Water Supply in Peri-Urban Area of Lusaka City, The Republic of Zambia

Final Report

March 2023

Japan Techno Co., Ltd.

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Summary

Summary

1. Background of the Project

The Republic of Zambia ("Zambia") has a very high youth age group, with a majority of the population under the age of 18 (53.4%). The estimated median age is 16.7 years (2015), which is among the lowest in the region and globally. Approximately 9,000 diarrhea-related deaths occur in the country each year, of which more than 75% are among children under 5 years of age. The financial cost of treating diarrheal infections has amounted to more than US$10 million, and most cases generally occur in the heavily populated Peri-urban settlement[1] of Lusaka.

The most recent Demographic and Health Survey (DHS 2018) indicates that 35% of children under 5 years of age are stunted (low height - low weight) and 4% are acutely malnourished or wasting (low weight - low height). Despite the prevalence of immunization and social awareness programs, the poor have an exceptionally high incidence of malnutrition exacerbating chronic infections, with the number of infections in Peri-urban settlements consistently double the number of infections in the urban centers.

In the Peri-urban settlements, which rely on unprotected shallow wells and improperly constructed boreholes for their existing water sources, floods caused by extreme increases in precipitation due to climate change have led to contamination of drinking water and living conditions, and direct health hazards such as cholera and diarrheal diseases, which is required to take urgent action.

The government of Zambia aims to become a middle-income country by 2030, and its long-term development policy, Vision 2030, states that "all people should have access to water supply and sanitation services by 2030 to improve their health and livelihoods. The Government of Zambia has prepared a National Development Plan as a medium-term plan to achieve this goal, and the Eighth National Development Plan (8NDP, 2022-2026), prepared in August 2022, identifies the development of water supply facilities, especially in areas with poor access to safe water, and the protection of groundwater sources as key issues in the water sector.

This project[2] will provide water supply facilities in the area identified by LCC and LWSC as the most problematic in terms of access to safe water and protection of groundwater sources in the Peri-urban settlement, which is identified in Vision 2030 as having poor and insufficient access to safe water, and will contribute to achieving the above goals and issues.

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1 Informal or formal settlements within the jurisdiction of a municipality: densely populated, low-cost housing, and areas with inadequate or missing basic services such as water, sewer, roads, storm drainage, and solid waste disposal.

2 Project: The Project based on the ODA Request Form to be prepared under this commissioned work.

2. Objective of the Commissioned Work

This commissioned work provides advice and guidance that contributes to the preparation of plans for solving problems from a professional and technical perspective, based on the problems (facility development, management and maintenance, human resource development, etc.) and potential needs faced by water utilities.

It also aims to improve the ability of the central and local governments of the countries concerned to create waterworks project plans, formulate waterworks policies, and operate waterworks businesses by examining specific measures to solve problems together with the administrative officials in charge of waterworks in the countries concerned and the staff of waterworks companies.

Specifically, among the Peri-urban areas (settlements located around urban centers) that the Zambian government is focusing on, the Garden Park area has the poorest water and sanitation services, including frequent cholera outbreaks, and is positioned by the LCC (Lusaka City Council) as the highest priority settlement for ensuring access to safe water.

In this commissioned work, the adequacy of the plan in terms of needs, consistency with higher-level plans, degree of urgency, and contents of facilities to be improved, etc., are assessed by organizing existing data and conducting field surveys, which followed by provision of specific support and guidance for the development of a more feasible plan, including the need for cooperation schemes and soft component support based on the scale of the project.

3. Problems and Challenges

(1) National Level

Mainly due to climate change, some areas of the country continue to experience raw water depletion, which has had a negative impact on water production. In addition, inadequate regulations on the use of groundwater resources have led to pollution of water sources and deterioration of water quality due to inadequate water treatment.

In terms of management and finances, the cost-effectiveness of water services is poor due to unstable macroeconomic factors such as exchange rates, inflation, and interest rates, as well as the fact that the water tariff remains unchanged despite increases in electricity and other fees, resulting in a higher rate of increase in costs than in revenues.

Major Problems and Issues in Water Services (National level)

Classification	Item
Business Plan	● Lack of coordination between urban planning and water supply and sanitation development planning
Management and Finance	● Securing construction improvement funds ● Increase in debt-to-water revenue ratio ● Collection of accounts receivable
Facility	-Water source. ● Insufficient water sources (drought and increased water demand due to climate change) -Facilities ● Insufficient capacity of facilities ● Increase in water leakage -Water supply. ● Normalization of planned water outages ● No water meter installed ● Ensure residual chlorine
Management	● Appropriate water pressure and water volume ● Implementation of asset management ● Improved management of business indicators
Personnel	● Improvement of technical skills of staff

(2) Project Target Area

In the jurisdiction of LWSC, which operates and maintains Lusaka's urban water supply facilities, the supply amount from water treatment plant facilities and groundwater in the city (2019) is less than 50% of the water demand (418,555 m^3/day), or approximately 200,000 m^3/day. Lusaka's population is expected to increase in the future, and the lack of water intake facilities and the inadequate water distribution network are the main reasons preventing the expansion of the water supply network.

In the target area (Garden Park), water service is not provided by LWSC and chronic water shortages continue due to inadequate water supply facilities. The target residents depend on unprotected shallow wells and other sources for drinking water, and the poor sanitary environment, which causes a large outbreak of cholera and other diseases during the rainy season, has spread and become a major social problem.

The target area is located in an aquifer with a high groundwater table and good permeability, and the absence of piped water supply facilities and reliance on unprotected shallow wells and improperly constructed boreholes for existing water sources creates a high potential for groundwater contamination to occur. There is an urgent need for safe groundwater development and water supply facilities to stop the use of unsanitary shallow wells, which can be a source of contamination.
Since unlined pit latrines etc. are also a source of contamination, the LWSC is introducing Septic tank.

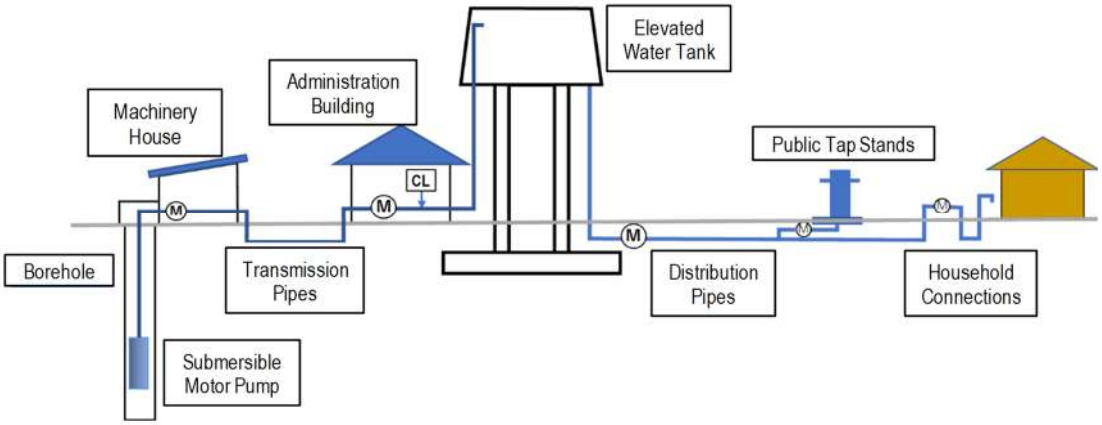
4. Project Outline

The initial request for the high-priority project is as follows.

Item	Target Area
Target area name and population	Garden Park Area、Population 87,000（Year 2022）
Target Year	2030
Target Population	125,000 (Year 2030)
Daily Water Demand	40 l/c/d
Planned pumping capacity	5,100 m^3/d

Classification		Facility	Specifications	Quantity
1. Facility construction	1-1	Borehole Drilling	Depth：100-150m Pumping rate：40-70 m^3/h	10
	1-2	Borehole Facilities (pump control room, guard house)	RC pillar and beam、borehole equipment	5 places
	1-3	Transmission Pipe	HDPE pipe DN75-160	1.3 km
	1-4	Administrative building	Office and warehouse	1 places
	1-5	Water distribution faciities (water distribution tank, chlorination room, flow meter room)	RC Elevated water tank V=300m^3、Chlorinator	5 places
	1-6	Distribution Pipe	HDPE pipe DN50-160	85 km
	1-7	Household connection kits (water supply pipe, water meter, faucet, etc.)	HDPE pipe DN20mm x 6m, water supply meter	1,800 units (10% of the planned number of households so that the service can be provided as soon as possible after construction is completed)
2. Design and construction supervision	2-1	Facility design, construction supervision, etc.	-	1 set

Since the target area is classified as an urban residential area distributed around the city of Lusaka, the basic plan is a stand-alone water supply system (satellite system) that is separated from the existing water supply network of LWSC. The water supply system consist of water source (borehole) and intake facilities (intake pumps), water transmission facilities (transmission pipes), water distribution facilities (distribution reservoirs and distribution pipes), water supply facilities (public tap stands and connections to individual houses), and auxiliary facilities (administration building, machine room, chlorine facilities)



System Outline Diagram

5. Conclusion

Although Lusaka City faces a variety of challenges, including urbanization, environmental pollution, and climate change, the need and urgency for water supply infrastructure development for the peri-urban areas are clear. Despite the high population growth rate and density in the peri-urban areas, water supply facilities are lagging behind, which is a major cause of deterioration in the living conditions. The service coverage rate of the LWSC is 0% in principle, and the residents are dependent on unprotected shallow wells.

In recent years, extreme increases in precipitation due to climate change have become more frequent, and flooding has caused contamination of water sources, resulting in direct health hazards such as cholera and diarrheal diseases. As a result, many aspects of the economy, from urban labor and education to trade, have been negatively affected, requiring urgent action by the Zambian government.

In addition, droughts have been endemic in Zambia, occurring in 1987/88, 1991/92, 1994/95, 1997/98, 2001/03, 2004/05, 2011/12, 2015/16, and 2018/2019, and their frequency is projected to increase in the future due to climate change. Decreased rainfall and warmer temperatures are projected in river basins, likely leading to increased evapotranspiration and decreased river runoff. In addition, it is predicted that higher temperatures will result in greater loss of water stored in reservoirs from increased evapotranspiration, which may further reduce the effectiveness of water storage.

Approximately 45% of the water used in Lusaka City is surface water from the Kafue River, but from the above, access to safe water is likely to be severely compromised during droughts. Therefore, as a response to drought, the project plans to provide a stable supply of safe drinking water by using groundwater from relatively deep aquifer, which are less affected by rainfall fluctuations.

Based on an understanding of the current situation and after examining plans to resolve the issues, we proposed grant aid projects having a high priority and impact that would contribute to enhancing Japan's presence.

【Basic Indicators】

Major Economic Indicators of the Republic of Zambia

Major Economic Indicators	2020	1990
Population	18.38 million	7.8 million
GNI per capita	USD 1,190	USD 450
Economic growth rate	-3.0%	-0.5%
External Debt Outstanding	USD 30.046 Billion	USD 6.916 Billion
DAC Classification	Least Developed	Least Developed
World Bank Classification	ii/Low- and middle-income countries	Low-income countries

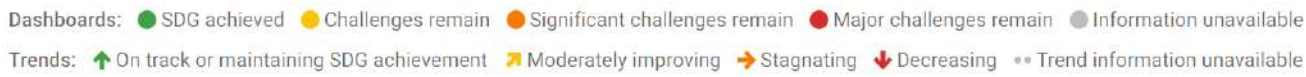
Source: Ministry of Foreign Affairs Country Data Book 2021, 2005

SDGs Main Indicators

SDGs Goals and Targets	Value	Year	Rating	Trend
SDG 1 ：No Poverty				
1.1_Poverty headcount ratio at $1.90/day (%)	58.9	2022	🔴	↓
1.2_Poverty headcount ratio at $3.20/day (%)	76.8	2022	🔴	↓
SDG2：Zero Hunger				
2.1_Prevalence of stunting in children under 5 years of age (%)	34.6	2018	🔴	→
2.2_Prevalence of wasting in children under 5 years of age (%)	4.2	2018	🟢	↑
SDG3：Good Health and Well-Being				
3.1_Maternal mortality rate (per 100,000 live births)	213	2017	🔴	↗
3.2_Neonatal mortality rate (per 1,000 live births)	24.0	2020	🔴	→
3.3_Mortality rate, under-5 (per 1,000 live births)	61.4	2020	🔴	→
3.4_ Incidence of tuberculosis (per 100,000 population)	319	2020	🔴	↗
3.5_New HIV infections (per 1,000 uninfected population)	3.6	2020	🔴	↗
3.6_Traffic deaths (per 100,000 population)	20.5	2019	🔴	→
SDG4:Quality Education				
4.1_Net primary enrollment rate (%)	85.1	2017	🟠	●
4.2_Lower secondary completion rate (%)	54.8	2013	🔴	●
4.3_Literacy rate (% of population aged 15 to 24)	92.1	2018	🟡	●
SDG5:Gender Equality				
5.1_Ratio of female-to-male mean years of education received (%)	76.8	2019	🟠	↓
5.2_Ratio of female-to-male labor force participation rate (%)	89.1	2020	🟢	↑
5.3_Seats held by women in national parliament (%)	16.8	2020	🔴	→
SDG6:Clean Water and Sanitation				
6.1_Population using at least basic drinking water services (%)	65.4	2020	🔴	→
6.2_ Population using at least basic sanitation services (%)	31.9	2020	🔴	→

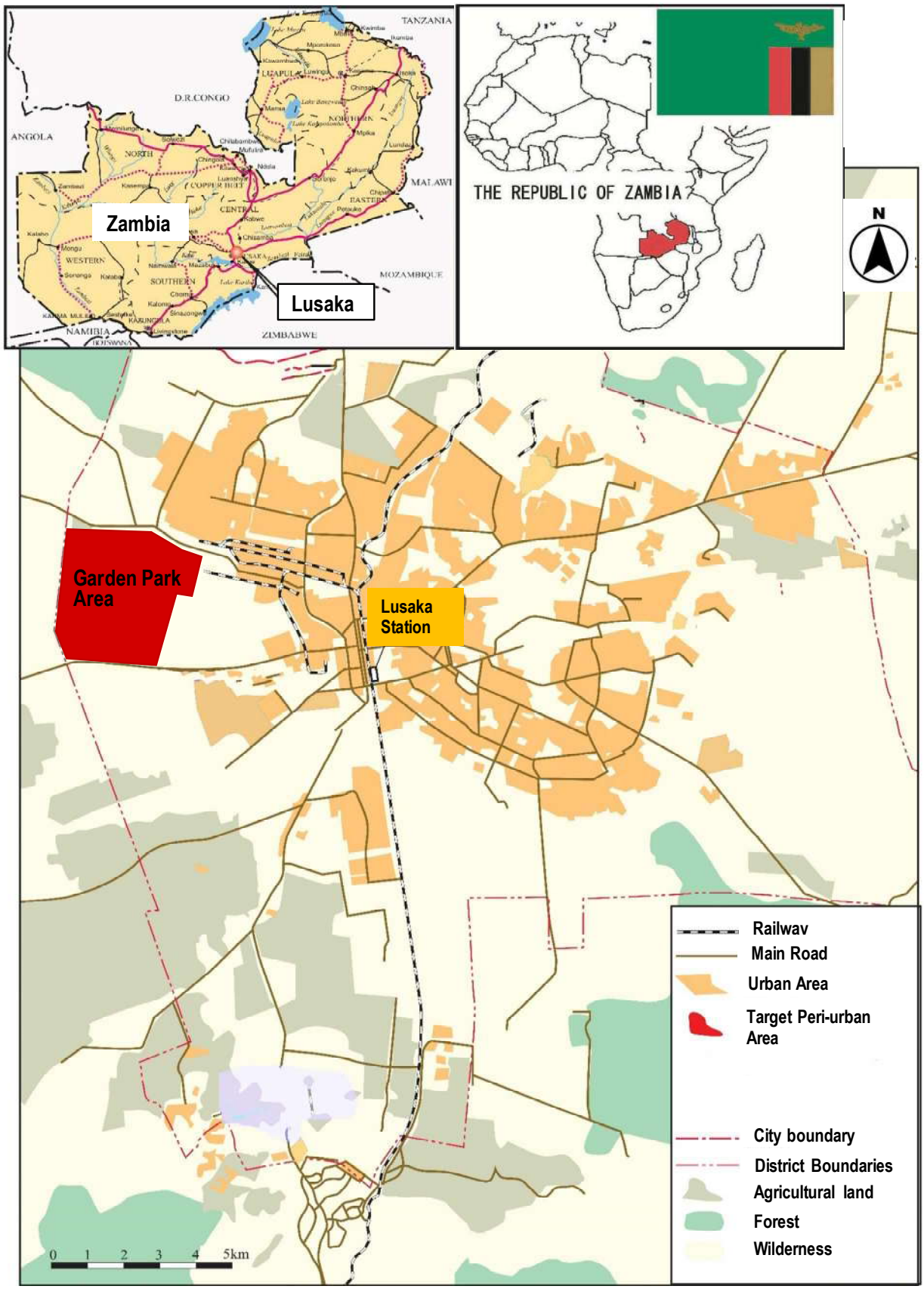
SDGs Goals and Targets	Value	Year	Rating	Trend
6.3_Freshwater withdrawal (% of available freshwater resources)	2.8	2018	●	●
SDG7:Affordable and Clean Energy				
7.1_Population with access to electricity (%)	43.0	2019	●	↗
7.2_Population with access to clean fuels and technology for cooking (%)	15.7	2019	●	→
7.3_ Share of renewable energy in total primary energy supply (%)	83.4	2019	●	↑
SDG8:Decent Work and Economic Growth				
8.1_Adjusted GDP growth (%)	-6.4	2020	●	●
8.2_Victims of modern slavery (per 1,000 population)	5.7	2018	●	●
8.3_Unemployment rate (% of total labor force)	13.0	2022	●	↓
SDG9: Industry, Innovation and Infrastructure				
9.1_Population using the internet (%)	19.8	2020	●	→
9.2_Mobile broadband subscriptions (per 100 population)	51.1	2019	●	↑
SDG10: Reduced Inequalities				
10.1_Gini coefficient	57.1	2015	●	●
10.2_Palma ratio	5.0	2018	●	●
SDG11:Sustainable Cities and Communities				
11.1_Proportion of urban population living in slums (%)	63.3	2018	●	↓
11.2_Annual mean concentration of particulate matter of less than 2.5 microns in diameter (PM2.5) (μg/m³)	26.3	2019	●	→
11.3_Satisfaction with public transport (%)	41.0	2020	●	→
SDG12:Responsible Consumption and Production				
12.1_Municipal solid waste (kg/capita/day)	0.5	2011	●	●
12.2_Production-based SO2 emissions (kg/capita)	5.3	2018	●	●
12.3_Production-based nitrogen emissions (kg/capita)	9.2	2015	●	●
SDG13:Climate Action				
13.1_CO_2 emissions from fossil fuel combustion and cement production (tCO_2/capita)	0.4	2020	●	↑
13.2_CO_2 emissions embodied in imports (tCO_2/capita)	0.2	2018	●	↑
13.3_CO_2 emissions embodied in fossil fuel exports (kg/capita)	1.5	2020	●	●
SDG14: Life Below Water				
14.1_Mean area that is protected in marine sites important to biodiversity (%)	N/A	N/A	●	●
14.2_Ocean Health Index: Clean Waters score (worst 0–100 best)	N/A	N/A	●	●
SDG15:Life on Land				
15.1_Mean area that is protected in terrestrial sites important to biodiversity (%)	46.1	2020	●	→
15.2_ Mean area that is protected in freshwater sites important to biodiversity (%)	56.8	2020	●	→
15.3_Permanent deforestation (% of forest area, 5-year average)	0.3	2020	●	↓

SDGs Goals and Targets	Value	Year	Rating	Trend
SDG16: Peace, Justice and Strong Institutions				
16.1_Homicides (per 100,000 population)	5.4	2015		
16.2_Unsentenced detainees (% of prison population)	28.0	2017		
16.3_Population who feel safe walking alone at night in the city or area where they live (%)	41	2021		
16.4_Children involved in child labor (% of population aged 5 to 14)	23	2019		
SDG17: Partnerships for the Goals				
17.1_ Government spending on health and education (% of GDP)	6.6	2019		
17.2_ Statistical Performance Index (worst 0–100 best)	59	2019		



Source: The Sustainable Development Report (https://dashboards.sdgindex.org/profiles/zambia)

Location Map



Photographs

Discussions with LWSC

Discussions with MWDS

Discussions with LCC

LWSC George office built with Japanese support

Tap Attendant in George Area

Concrete elevated water tank in George Area

Shallow well in Garden Park Area

On-site sanitation facilities in the Garden Park area

Photographs

Shallow well in Garden Park area

Borehole with hand pump in Garden Park area

Yard Tap in Kanyama Area

Steel elevated water tank in Kanyama area

PVC pipe laid in bedrock in SOS area

Water meter in the George area

Health Management Team, which oversees the Garden Park

Main arterial road to Garden Park

Abbreviations

AfDB	African Development Bank
CARE	CARE International
CBO	Community Based Organisation
CIA	Central Intelligence Agency
CU	Community Utility
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPPCA	Environmental Protection and Pollution Control Act
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
ITCZ	Intertropical Convergence Zone
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Program for Water Supply and Sanitation
KfW	Kreditanstalt für Wiederaufbau
LCC	Lusaka City Council
LWSC	Lusaka Water & Sewerage Company
MCC	Millennium Challenge Corporation
MDGs	Millennium Development Goals
MLGH	Ministry of Local Government and Housing
MoU	Memorandum of Understanding
MWDS	Ministry of Water Development and Sanitation
NCS	National Conservation Strategy
NEAP	National Environment Action Plan
NGO	Non-governmental Organisation
NUWSSP	Nationa Urban Water Supply and Sanitaiton Programme

NWASCO	National Water Supply and Sanitation Council
NWSSP	National Water Supply and Sanitation Programme
OD	Open defecation
O&M	Operation and Maintenance
pH	Potential of Hydrogen
PPP	Public-Private Partnership
PVC	Polyvinyl Chloride
RDC	Residents Development Committee
SCADA	Supervisory Control And Data Acquisition
SDGs	Sustainable Development Goals
SOMAP	Sustainable Operation and Maintenance Programme
UNICEF	United Nations Children's Fund
UPND	United Party for National Development
USAID	United States Agency for International Development
UWSSP	Urban Water Supply and Sanitation Programme
WARMA	Water Resources Management Authority
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WT	Water Trust
ZEMA	Zambia Environmental Management Agency
ZESCO	Zambia Electricity Supply Corporation

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Chapter 1: Introduction

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1.1 Background and Objectives

(1) Country Overview

The Republic of Zambia ("Zambia") is a landlocked country located in Southern Africa, surrounded by Angola, Congo, Tanzania, Malawi, Mozambique, Zimbabwe, Botswana, and Namibia. Its land area is almost twice that of Japan. Based on the latest data from the United Nations, the population of Zambia in July 2022 is estimated to be 19.32 million, with a population growth rate of 2.93%.

Zambia's economy is projected to have a GNI per capita of US$1,190 in FY2020, an economic growth rate of -3.0% (World Bank, 2020), a price inflation rate of 21.6% (World Bank, 2020), and an unemployment rate of about 12%. The country's economy has been a monoculture economy dependent on copper production since colonial times (copper accounts for about 70% of exports), and fluctuations in copper production and international prices have had a significant impact on Zambia's economy. Economic reforms and job creation which focused on agriculture, mining, tourism, and manufacturing have been identified as key strategic development areas and they were promoted by strategic interventions in the energy, transport, and water resources development sectors.

Zambia's high level of accumulated public debt led to Africa's first default under the new coronavirus epidemic in November 2020, and continued support from the international community will be essential in the future as the country moves forward with poverty reduction, one of its greatest challenges.

(2) Background of the Project[1]

Zambia has a very high youth age group, with a majority of the population under the age of 18 (53.4%). The estimated median age is 16.7 years (2015), which is among the lowest in the region and globally. Approximately 9,000 diarrhea-related deaths occur in the country each year, of which more than 75% are among children under 5 years of age. The financial cost of treating diarrheal infections has amounted to more than US$10 million, and most cases generally occur in the heavily populated Peri-urban settlement[2] of Lusaka City, the capital city of Zambia.

The most recent Demographic and Health Survey (DHS 2018) indicates that 35% of children under 5

[1] Project: The Project based on the ODA Request Form to be prepared under this commissioned work.

[2] Informal or formal settlements within the jurisdiction of a municipality: densely populated, low-cost housing, and areas with inadequate or missing basic services such as water, sewer, roads, storm drainage, and solid waste disposal.

years of age are stunted (low height・low weight) and 4% are acutely malnourished or wasting (low weight・low height). Despite the prevalence of immunization and social awareness programs, the poor have an exceptionally high incidence of malnutrition exacerbating chronic infections, with the number of infections in Peri-urban settlements consistently double the number of infections in the urban centers.

In the Peri-urban settlements, which rely on unprotected shallow wells and improperly constructed boreholes for their existing water sources, floods caused by extreme increases in precipitation due to climate change have led to contamination of drinking water and living conditions, and direct health hazards occurred by spread of infection like cholera and diarrheal diseases, which is required to take urgent action.

The government of Zambia aims to be a middle-income country by 2030, and the long-term development policy vision 2030 aims that "Everyone can be able to access to water and sanitation services by 2030 to improve health and life". To achieve this, the government of Zambia has promoted a national development plan as a medium term plan. The Eighth National Development Plan (8NDP: Eighth National Development Plan, 2022-2026) was created in August 2022, which revealed the main problem in water sector as especially the maintenance of the water supply facilities and the protection of the groundwater resources for the area with bad access situation for safe water.

This project[3] focus on the Peri-urban settlements, where was criticized by vision 2030 as the poor and insufficient areas to access to safe water. This project will provide water supply facilities in an area that Lusaka City Council: (LCC) and Lusaka Water Supply & Sanitation Company (LWSC) has identified as the most troublesome areas for safe access to water and protection of groundwater resources. Therefore, this project will contribute to achieving the above goals and resolution of the issues.

(3) Purpose of the Commissioned Work

This commissioned work provides advice and guidance that contributes to the preparation of plans for solving problems from a professional and technical perspective, based on the problems (facility development, management and maintenance, human resource development, etc.) and potential needs faced by water utilities.

It also aims to improve the ability of the central and local governments of the countries concerned to

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create waterworks project plans, formulate waterworks policies, and operate waterworks businesses by examining specific measures to solve problems together with the administrative officials in charge of waterworks in the countries concerned and the staff of waterworks companies.

Specifically, among the Peri-urban areas (settlements located around urban centers) that the Zambian government is focusing on, the Garden Park area has the poorest water and sanitation services, including frequent cholera outbreaks, and is positioned by the LCC as the highest priority settlement for ensuring access to safe water.

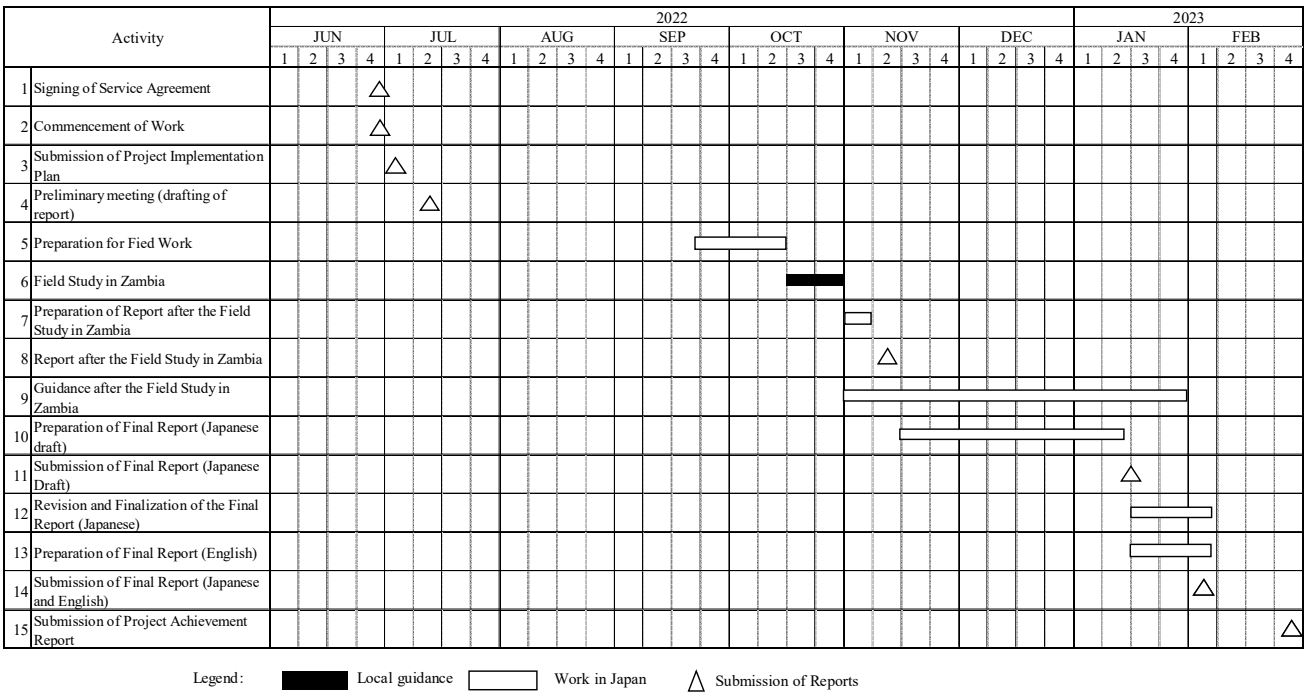
In this commissioned work, the adequacy of the plan in terms of needs, consistency with higher-level plans, degree of urgency, and contents of facilities to be improved, etc., are assessed by organizing existing data and conducting field surveys, which followed by provision of specific support and guidance for the development of a more feasible plan, including the need for cooperation schemes and soft component support based on the scale of the project.

1.2 Schedule and Survey Method

(1) Schedule

The overall schedule of this commissioned work is shown in Table-1. In addition, because of the infection situation of Covid-19 and the border measures of Japan, the Field Study has been carried out in October.

Table-1: Implementation Schedule



(2) Survey Method

Existing information and data were collected from the project responsible authority, the supervising agency “Ministry of Water Development and Sanitation” (hereinafter referred to as "MWDS"), and the implementing agency “Lusaka Water Supply & Sanitation Company” (hereinafter referred to as "LWSC"). In addition, a field survey was conducted on the current status and operation of existing water supply facilities in peri-urban areas in Lusaka City.

1.3 Composition of Survey Team

The members of the survey team engaged in this commissioned work are listed in the Table-2.

Table-2: Composition of Survey Team

Name	Affiliation	Assignment
Moeko Yoshitomi	Ministry of Health, Labour and Welfare Government of Japan, Office of Global Health Cooperation, International Affairs Division, Minister’s Secretariat &Water Supply Division, Pharmaceutical Safety and Environmental Health Bureau	Project Supervisor
Kazuhiro Arita	Japan Techno Co.,Ltd.	Project Team Leader/Supply Planning/Facility Planning and Design
Shoichi Yokoki	Japan Techno Co.,Ltd.	Water Source Development
Noki Mori	Japan Techno Co.,Ltd.	Operation and Maintenance
Takeo Yamaguchi	The International Welfare Service Corporation	Specialist Advisor

Chapter 2: Present Status of Project

Chapter 2: Present Status of Project

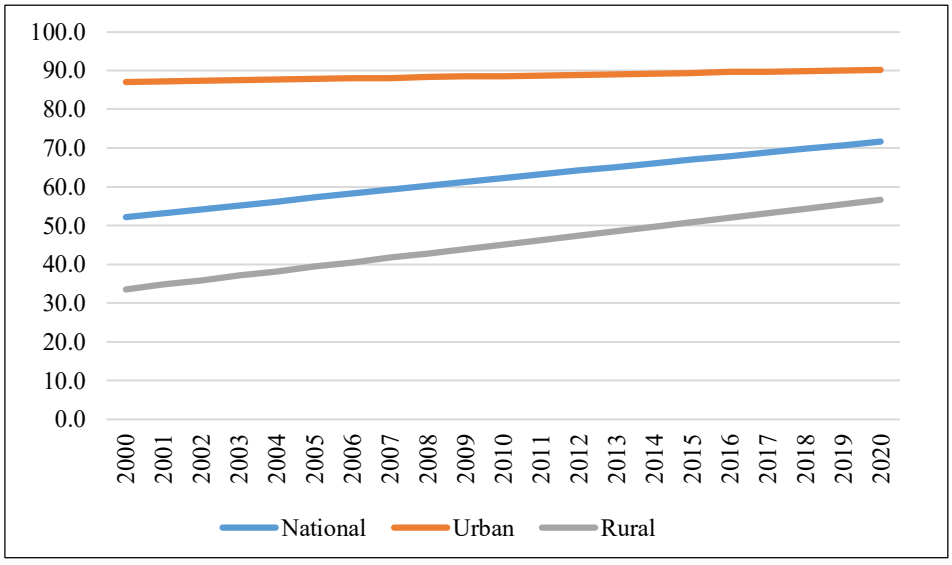
2.1 Water Supply Projects of Zambia and Their Problems

2.1.1 Present Status of Water Supply Sector (National Level)

(1) Water Supply Facilities Coverage Rate

The Zambian government's Vision 2030, its long-term development policy for the period up to 2030, states that "80% of the population will have access to safe water by 2015 and 100% by 2030 to improve health and livelihoods". The Eighth National Development Plan (2022-2026), prepared in August 2022, calls for an increase in access to safe water in rural areas from 58% in 2018 to 67% by 2026. In urban areas, the goal is to increase access to safe water from 91.8% in 2018 to 98% by 2026.

However, as shown in Figure-1, data from the Joint Monitoring Program on Water and Sanitation (JMP) indicates that the water supply rate in urban areas is as high as 90.2% in 2020, while the rate in rural areas remains low at 56.6%. It is noted that the situation is rather deteriorating around the capital city of Lusaka. One of the reason is explained as the expansion of peri-urban areas with progress of urbanization.



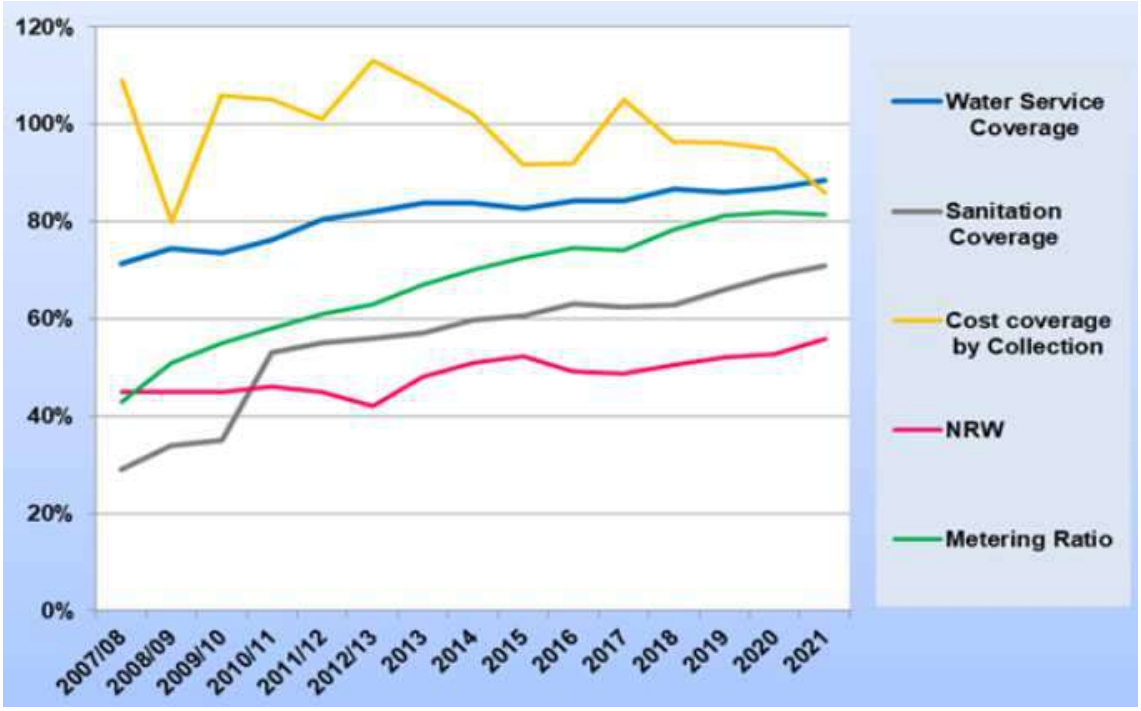
Source：WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation

Figure-1: Percentage of Population with Access to Safe Water in Zambia (%)

Figure-2 shows the performance of key indicators in urban and peri-urban areas in Zambia over a 15-year period. It can be seen that there has been a steady annual increase in water and sewage coverage. On the other hand, cost coverage through water bill collection has shown a declining trend due to the

rising prices of electricity and raw materials used for water treatment.

The water meter installation rate has remained flat in recent years, partly due to an increase in the number of failed meters being replaced. The non-revenue water rate increase to 56% by 2021 and continues to worsen. The high non-revenue water is thought to be due in part to aging water supply facilities and inadequate estimates of water production and consumption in cases where meters are not installed.



Source：NWASCO : Urban and Peri-urban Water Supply and Sanitation Sector Report 2021

Figure-2: Trends in key indicators over the past 15 years

(2) Legislation

1) Water Supply Law

In Zambia, many of the entities that provide water and wastewater services in urban areas have been commercial utilities (CUs) since 2000, and the National Water Supply and Sanitation Council (NWASCO), the central regulatory and supervisory body, has issued licenses to the CUs and provides guidelines that specify the minimum services to be achieved by each water and wastewater utility. The basic requirements for water and wastewater facilities are set forth in the Zambia Bureau of Standards. In addition, the ISO standards are to be adopted for the standards that are not specified in this standard.

2) Water Quality Standards

Water quality standards are set forth in Zambia Bureau of Standards (ZS 190: 2010 DRINKING

WATER QUALITY –Specification). The Table-3 shows a comparison with Japanese standard.

Table-3: Water Quality Standards

Item	Japanese standard value (R2.4.1)	Zambia Standard
General bacteria	The number of settlements formed in 1 ml of test water is less than 100.	20 or less（discontinuous）
Escherichia coli (E. coli)	Undetectable.	Undetectable.
Cadmium and its compounds	Less than or equal to 0.003 mg/L of cadmium.	0.003mg/L or less
Mercury and its compounds	0.0005mg/L or less in terms of mercury content	0.001 mg/L or less
Selenium and its compounds	Less than or equal to 0.01 mg/L of selenium	0.01 mg/L or less
Lead and its compounds	0.01 mg/L or less in terms of lead content	0.01 mg/L or less
Arsenic and its compounds	0.01 mg/L or less in terms of the amount of arsenic	0.01 mg/L or less
Hexavalent chromium compounds	0.02 mg/L or less of hexavalent chromium	−
nitrite nitrogen	0.04mg/L or less	−
Cyanide ion and cyanide chloride	Less than or equal to 0.01 mg/L of cyanide	0.01 mg/L or less
Nitrate-nitrogen and nitrite-nitrogen	10mg/L or less	10 mg/L
Fluorine and its compounds	0.8mg/L or less in terms of fluorine content	1.5 mg/L or less
Boron and its compounds	1.0 mg/L or less in terms of boron content	−
Carbon tetrachloride (CCl4)	0.002mg/L or less	−
1,4-Dioxane	0.05mg/L or less	−
Cis-1,2-dichloroethylene and trans-1,2-dichloroethylene	0.04mg/L or less	−
Dichloromethane	0.02mg/L or less	−
Tetrachloroethylene	0.01mg/L or less	−
Trichloroethylene	0.01mg/L or less	−
Benzene	0.01mg/L or less	0.01mg/L or less
Chloric acid	0.6mg/L or less	−
Chloroacetic acid	0.02mg/L or less	−
Chloroform	0.06mg/L or less	−
Dichloroacetic acid	0.03mg/L or less	−
Dibromochloromethane	0.1mg/L or less	−
Bromic acid	0.01mg/L or less	−
Total trihalomethane	0.1mg/L or less	−
Trichloroacetic acid	0.03mg/L or less	−
Bromodichloromethane	0.03mg/L or less	−
Bromoform	0.09mg/L or less	−
Formaldehyde	0.08mg/L or less	−
Zinc and its compounds	Less than or equal to 1.0 mg/L of zinc	3.0 mg/L
Aluminum and its compounds	0.2mg/L or less in terms of aluminum content	0.2 mg/L
Iron and its compounds	Less than or equal to 0.3 mg/L of iron	0.3 mg/L
Copper and its compounds	Less than or equal to 1.0 mg/L of copper	1.0 mg/L
Sodium and its compounds	Less than 200 mg/L of sodium	200 mg/L
Manganese and its compounds	Less than or equal to 0.05mg/L for the amount of manganese	0.1 mg/L
Chloride ion	200mg/L or less	250 mg/L
Calcium, magnesium, etc. (hardness)	300 mg/L or less	200 mg/L
Evaporation residue	500mg/L or less	1000 mg/L

Item	Japanese standard value (R2.4.1)	Zambia Standard
Anionic surfactant	0.2mg/L or less	−
Deosmin	0.00001mg/L or less	−
2-methylisoborneol	0.00001mg/L or less	−
Non-ionic surfactant	0.02mg/L or less	−
Phenols	0.005 mg/L or less in terms of the amount of phenol	0.002 mg/L
Organic matter (total organic carbon (TOC))	3mg/L or less	−
pH value	5.8 to 8.6	6.5 – 8.0
Taste	No abnormalities.	No abnormalities.
Bad smell	No abnormalities.	No abnormalities.
Chromaticity	Less than 5 degrees	15TCU
Turbidity	Less than 2 degrees	5NTU

(3) Environmental Impact Assessment

1) Related Organizations

The National Conservation Strategy (NCS) was formulated in 1985, identified key environmental issues and made recommendations for policies, programmes and actions to address these issues. The NCS stated the need to manage natural resources and the environment in the context of a centrally planned and controlled economy. In response to the recommendations of NCS, the Environmental Protection and Pollution Control Act (EPPCA) was enacted in 1990, which was amended in 1999, to become the supreme environmental law in Zambia.

Under the EPPCA, the Environmental Council of Zambia (ECZ) was established to ensure the sustainable management of natural resources and protection of the environment as well as prevention and control of pollution. In addition, as the purpose of renewal of the NCS, National Environment Action Plan ("NEAP") was established in 1994 and the basic idea was decided as following:(1) the right to the clean and healthy environment of the residents;(2) local and private sector participation in natural resource management (3) duty of environmental impact assessment of major development projects in all fields.

Then, in 2007, the government adopted the National Policy on Environment with the main purpose to create an umbrella policy for the welfare of the nation's environment so that socio-economic development will be achieved effectively without damaging the integrity of the environment or its resources.

Moreover, through the Environmental Management Act of 2011, while continuing its original roles and responsibilities, the ECZ was renamed the Zambia Environment Management Agency (ZEMA). Presently, ZEMA is the agency in charge of environmental impact assessment.

2）Legal System

As a consequence of the environment disruption by rapid growth in population and industrialization, especially the large scale mining development and industrial development, the National Conservation Strategy (NCS) was formulated in 1985 and the Environmental Protection and Pollution Control Act (EPPCA) was enacted in 1990.

The strategy was incorporated into the National Environmental Action Plan (NEAP), and in 1997, the Environmental Impact Assessment (EIA) Regulations (Statutory Instrument SI No. 28, 1997) were enacted. Since EIAs are now mandatory under this decree, it is hoped that a balance will be achieved between development and environmental protection in the country of Zambia. The major environmental laws and regulations are listed in Table-4.

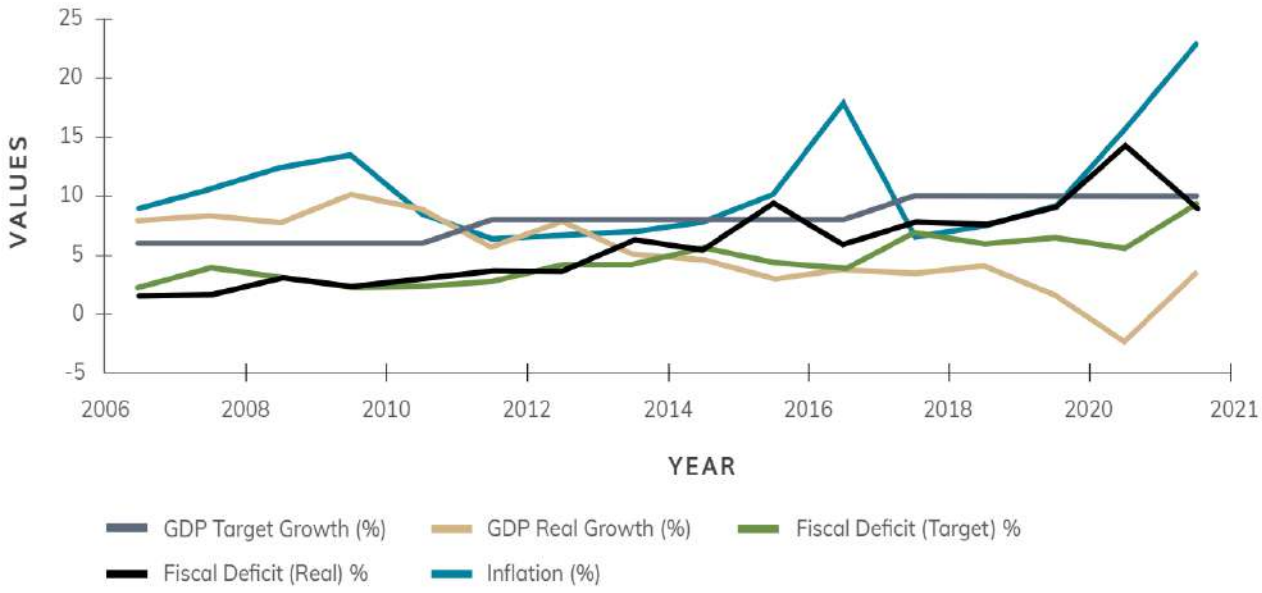
Table-4: Environmental and Social Consideration Laws and Regulations of Zambia

Type	Name of Legislation
Higher plan	The Constitution of the Republic of Zambia, 1973, Amended 1991, 1996, 2009, 2016 年
	The National Long Term Vision 2030, 2006
	Eighth National Development Plan 2022-2026, 2022
	The National Policy on Environment, 2009
Environment	The National Conservation Strategy of Zambia, 1985
	The Environmental Protection and Pollution Control Act, 1990
	The National Environmental Action Plan, 1994
	The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997
	The Environmental Protection and Pollution Control (Amendment) Act, 1999
	The National Policy on Environment, 2007
	The Environmental Management Act, 2011
Water Resources, Supply and Sanitation	The Water Act, 1949
	The Water Pollution Control (Effluent and Waste Water) Regulations, 1993
	National Water Policy, 1994
	Water Supply and Sanitation Act, 1997
	The Water Resources Management Act, 2011
Air	The Air Pollution Control (Licensing and Emissions Standards) Regulations, 1996
Waste	The Waste Management (Transporters of Waste/ Operation of Waste Disposal Sites) Regulations, 1993
	The Hazardous Waste Management Regulations, 2001
Toxic Substances	The Pesticides and Toxic Substances Regulations, 1994
	Ozone Depleting Substances Regulations, 2000
Forests	The Forests Act, 1773
	The Local Forests (Control and Management) Regulations, 2006
Lands	The Lands Act, 1995
	The Lands (Amendment) Act, 1996
	The Lands Acquisition Act, 1992
National Heritage	The National Heritage Conservation Commission Act, 1989
	National Parks and Wildlife Act, 1998

(4) Financial Condition

Zambia's main industries are agriculture (corn, tobacco, etc.), mining (copper, cobalt, etc.), and nature park tourism. With a GNI per capita of US$1,190 in 2020, the country is one of the least developed countries.

Real gross domestic product (GDP) growth over the period 2006 to 2021 averaged 5.2 %. During the period from 2017 to 2021 this declined to an average of 1.4 %, with a recession of 2.8 % recorded in 2020. The national debt stand at 119 % of GDP as at 2021, public expenditure for development investments will be severely constrained. Inflation remained in double digits throughout 2020, averaging 15.7 %, and reached a high of 22.2 % in February 20213, due to a prolonged fallout from COVID-19, increased fiscal and domestic liquidity challenges and the length of time for Zambia to embark on key macroeconomic and structural reforms.



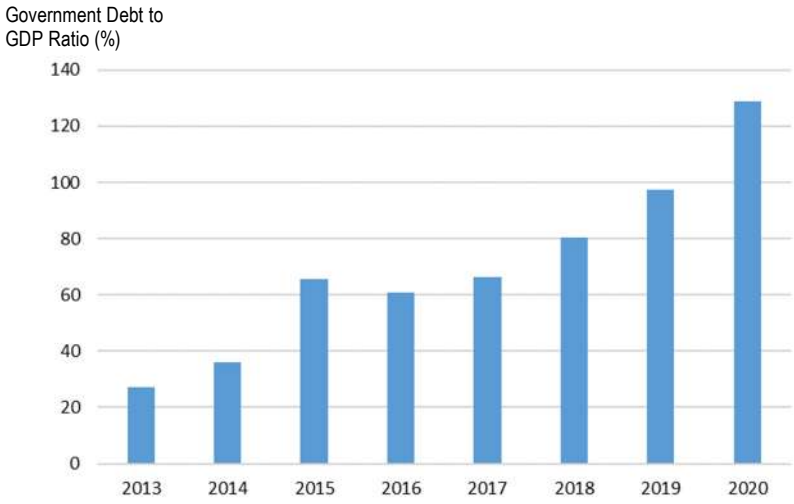
Source：MWDS Zambia Water Investment Programme 2022-2030

Figure-3:Performance of Zambian Economy（2006～2021）

The new coronavirus epidemic has put a significant number of Zambians in a precarious situation, and food insecurity is on the rise. The Zambian nation ranks 143rd out of 189 countries on the 2019 Human Development Index, with 48% of the population unable to meet minimum calorie requirements and more than one-third of children under five stunted.

Zambia has borrowed heavily from international markets for infrastructure development since 2011, and the high level of public debt accumulation has led to Africa's first default under the new

coronavirus epidemic in November 2020. According to statistics released by the Zambian Ministry of Finance, the country's government and state-owned enterprises' debt to Chinese creditors exceeded $6 billion as of June 2021, accounting for more than 40% of Zambia's $14.67 billion external debt.



Source： IMF

Figure-4: Zambia's External Debt

2.1.2 Problems of Water Supply Services (National Level)

Although Zambia is rich in ground water nationwide, mainly due to climate change, some areas of the country continue to experience raw water depletion, which has had a negative impact on water production. In addition, inadequate regulations on the use of groundwater resources have led to pollution of water sources and deterioration of water quality due to inadequate water treatment. In terms of management and finances, the cost-effectiveness of water services is poor due to unstable macroeconomic factors such as exchange rates, inflation, and interest rates, as well as the fact that the water tariff remains unchanged despite increases in electricity and other fees, resulting in a higher rate of increase in costs than in revenues. Table-5 shows the main problems and issues in the water supply service.

Table-5: Major Problems and Issues in Water Services (National level)

Classification	Item
Business Plan	● Lack of coordination between urban planning and water supply and sanitation development planning
Management and Finance	● Securing construction improvement funds ● Increase in debt-to-water revenue ratio ● Collection of accounts receivable
Facility	-Water source. ● Insufficient water sources (drought and increased water demand due to climate change) -Facilities ● Insufficient capacity of facilities

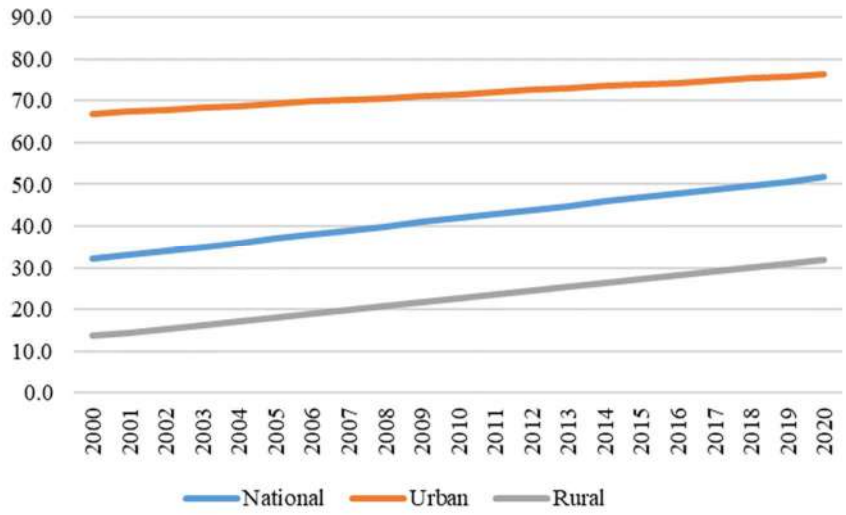
Classification	Item
	● Increase in water leakage -Water supply. ● Normalization of planned water outages ● No water meter installed ● Ensure residual chlorine
Management	● Appropriate water pressure and water volume ● Implementation of asset management ● Improved management of business indicators
Personnel	● Improvement of technical skills of staff

2.1.3 Issues related to Sanitation and Waterborne Diseases (National level)

(1) Sanitation Facilities (toilets)

The Zambian government's Vision 2030, its long-term development policy for the period up to 2030, calls for "68% of the population to have access to sanitation services by 2015 and 90% by 2030 in order to improve health and livelihoods". The Eighth National Development Plan (2022-2026), prepared in August 2022, calls for the increase of access to safe sanitation from 37.2% in 2018 to 55% in 2026 in rural areas and from 77.7% in 2018 to 90% in 2026 in urban areas.

However, as shown in Figure-5, data from the Joint Monitoring Program on Water and Sanitation (JMP) indicate that the access rate to safe sanitation facilities in urban areas in 2020 is 76.3%, while the rate in rural areas remains low at 31.9%.



Source：WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation

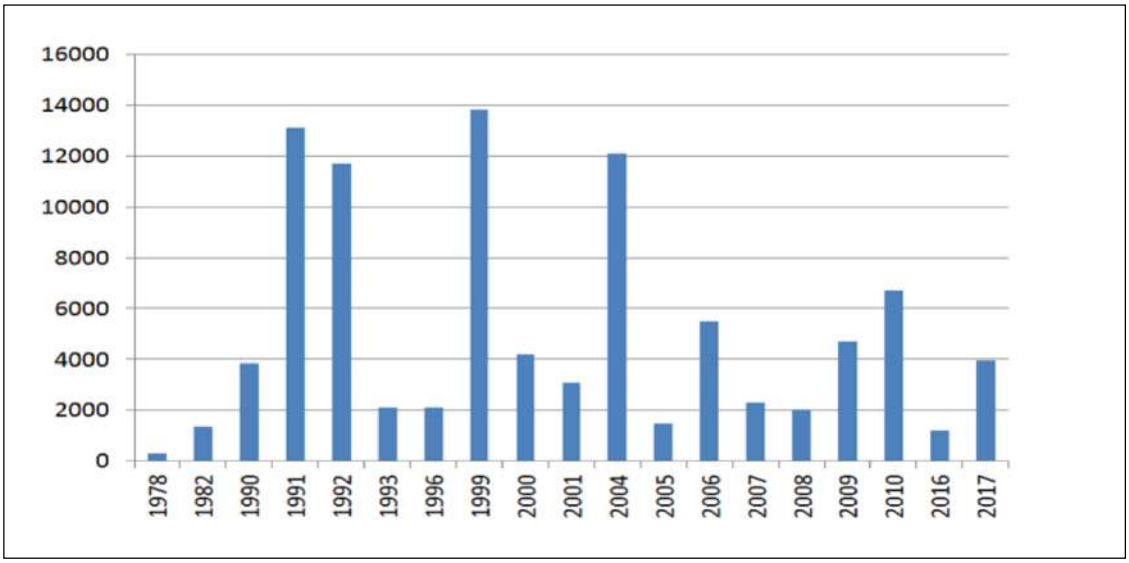
Figure - 5: Percentage of Population with Access to Safe Sanitation Facilities in Zambia (%)

(2) Waterborne Diseases

The reality of the environment in unplanned settlements is that housing is built in an unregulated manner without basic facilities, and basic living conditions are not met, resulting in unsanitary

conditions and inadequate access to necessary social services.

In Zambia, cholera has spread since 1990, with major epidemics in 1991, 1992, 1999, and 2004, sometimes exceeding 10,000 cases (Figure-6).



Source：Cholera Country Profile: Zambia. World Health Organization (WHO).

Figure-6：Major Outbreaks of Cholera in Zambia

The cholera outbreak in Lusaka City from October 2017 to May 2018 recorded 5,414 infections and 98 deaths. Contaminated water from shallow wells was the main cause of the outbreak, which had a major economic and social impact, including the closure of universities and other educational institutions, the suspension of economic activities on streets and markets in certain areas, and the imposition of curfews in many unplanned residential areas.

	
Shallow well（Garden Park）	Pit Latrine (Garden Park)

2.1.4 Current Status of Water Supply (Project Area)

(1) Overview

LWSC is the oldest and largest water and wastewater utility in Zambia, having been established in 1989. The Corporation owns and operates water and wastewater assets inherited from Lusaka City, provides water and wastewater services to the city, and is expected to operate on a commercially sustainable basis.

Table-6 shows LWSC's performance in key indicators. It can be seen that the non-revenue water ratio has remained at a high level, ranging from 42% to 47%, and that the water supply rate and staff efficiency are improving. The cost recovery rate has been above 100% for the past five years, which is sufficient to cover O&M expenses and confirms that LWSC is at a financially sustainable stage.

Table - 6: LWSC's Performance in Key Indicators

Year	No. of Connections	No. of Staff	NRW (%)	Water Quality compliance (%)	Metering Ratio (%)	Water Service Coverage (%)	Hours of Supply (hr/d)	Staff Efficiency	Collection Efficiency (%)	O+M Cost Coverage by Collection (%)	Ranking
2021	130,150	756	47	80<95	71.7	93.7	16	0.37	100.0	103	3
2020	121,570	772	44	80<95	70.0	90.0	16	0.44	100.0	108	6
2019	115,871	888	47	>95	70.0	87.5	16	0.56	81.6	102	3
2018	109,454	905	45	80<95	66.0	86.7	17	0.53	80.3	111	5
2017	102,320	923	46	80<95	64.0	85.4	18	0.51	91.0	122	4
2016	97,008	899	46	80<95	67.0	82.9	17	0.67	77.0	89	5
2015	94,184	889	47	80<95	72.0	82.9	17	0.63	96.0	88	4
2014	92,440	758	42	98	72.0	86.0	18	0.56	100.0	100	1
2013	85,832	838	42	95	70.0	87.0	20	0.48	98.0	123	2

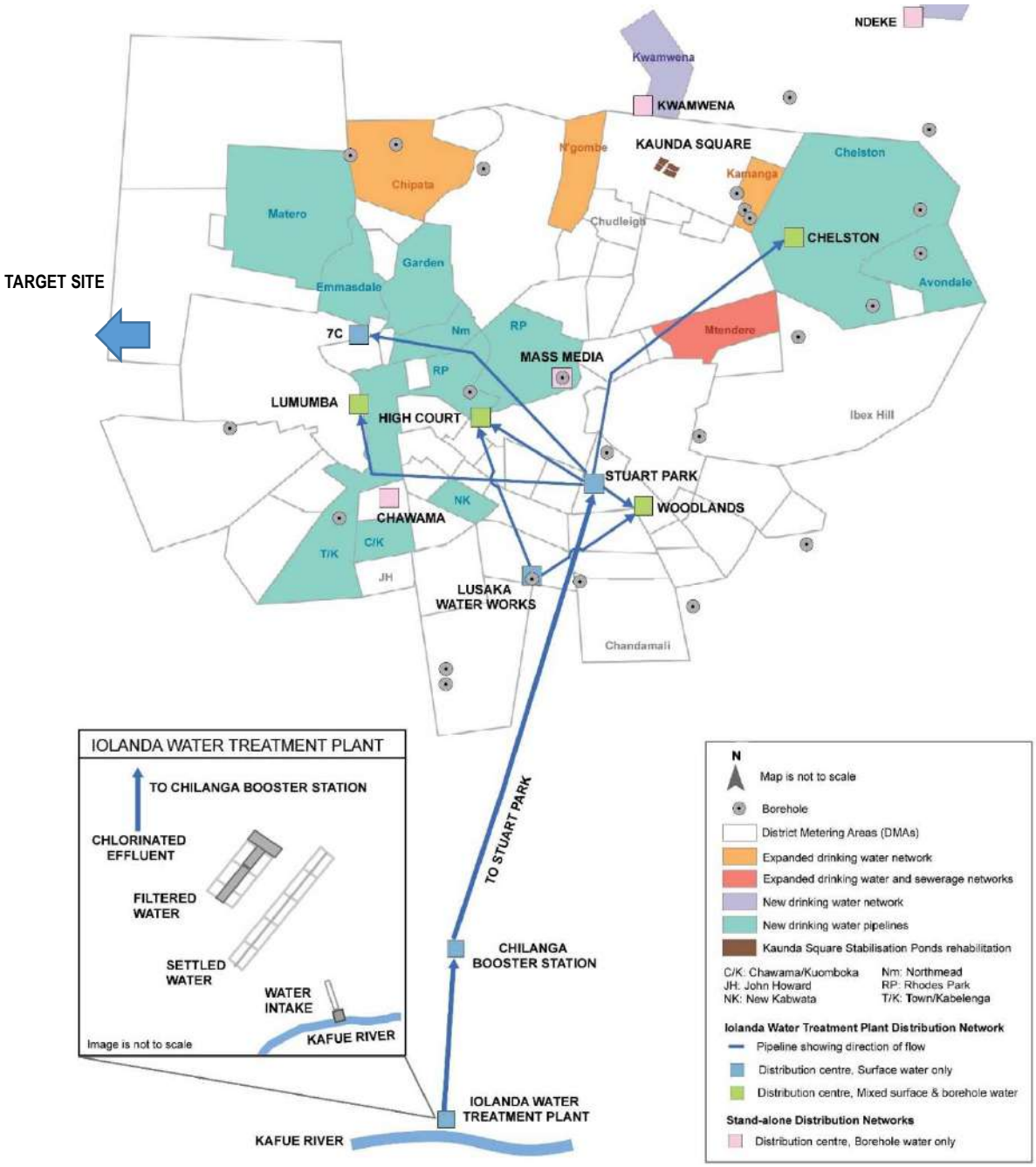
Source：NWASCO : Urban and Peri-urban Water Supply and Sanitation Sector Report 2013-2021

LWSC supplies approximately 200,000 m^3/day of water to the City of Lusaka, according to its 2019 annual report. Lusaka's water is supplied from both ground and surface water sources. More than 116 boreholes within and around the city provide 55% （110,000m^3/day）of the total supply. The remaining 45% （90,000m^3/day）is surface water abstracted from the Kafue River and treated at Iolanda water treatment plant(WTP), about 50 km from the city. Then the water is delivered to Stuart Park (approx. V=90,000 m^3), the largest water distribution reservoir in the city of Lusaka.

The Stuart Park water distribution plant is 325 m higher in elevation than the Iolanda water treatment plant, and the Chilanga booster pump station pumps water to the Lusaka Water Works reservoir (approximately 5,420 m^3) and the Lumumba reservoir (approximately 9,090 m^3). The Lusaka Water

Works reservoir pumps water to distribution reservoirs in the Woodlands and High Court areas.

The management of the network and water distribution is done through five zones or branches –Central, Chelstone, Kabulonga, Kabwata, and Lumumba including Matero



Source：STAR REPORT ZAMBIA, The Millennium Challenge Corporation's (MCC)

Figure-7: Schematic of the Lusaka Water Distribution Network

Most of the water distribution system was constructed in the 1960s and 1970s, and in 2013, approximately 21% of the distribution and transmission pipes were of unknown remaining service life. The total length of the water transmission and distribution network is 1,308 km, consisting of 109 km

of water transmission mains and 1,199 km of distribution mains. Most of the pipes are more than 40 years old and consist of older pipes made of AC, GI, and CI prior to the 1990s and recently laid PVC pipes. On the other hand, in the peri-urban areas, water supply systems are inadequate. Most of them use hand-dug shallow wells as their water source, and untreated water is supplied.

	
Iolanda Water Treatment Plant	Kwamwena Reservior

(2) Water Tariff (Charges)

Water tariff in Zambia are set by NWASCO. The current tariff system is shown in Table-7 below. An increasing block tariff has been introduced for water supply to households, commercial entities, institutional entities and a separate tariff system has been established for water supply for kiosks and public taps public taps. It should be noted that the tariff collection rate by LWSC is reported as 100% in NWASCO sector report, but this may not be an accurate figure due to the low installation rate of water meters (71%).

Table-7: Current and Approved Tariffs for 2022 – 2024 (ZMW)

Type	Block	Usage (m^3/month)	Current	Approved			% change		
			2021	2022	2023	2024	2022	2023	2024
Households	1st Block	0 – 6 m^3/m	5.93	7.04	8.28	9.60	19%	18%	16%
	2nd Block	6 – 30 m^3/m	7.12	9.89	11.63	13.75	39%	18%	18%
	3rd Block	30-100 m^3/m	8.08	10.55	13.00	15.65	31%	23%	20%
	4th Block	100-170 m^3/m	9.49	12.62	14.85	17.88	33%	18%	20%
	5th Block	Above 170 m^3/m	11.64	14.03	16.50	19.87	21%	18%	20%
Commercial	1st Block	0 – 30 m^3/m	5.93	7.04	8.28	9.60	19%	18%	16%
	2nd Block	30 – 170 m^3/m	7.12	9.89	11.63	13.75	39%	18%	18%
	3rd Block	Above 170 m^3/m	8.08	10.55	13.00	15.65	31%	23%	20%
Institutional	1st Block	0 – 30 m^3/m	5.93	7.04	8.28	9.60	19%	18%	16%
	2nd Block	30 – 170 m^3/m	7.12	9.89	11.63	13.75	39%	18%	18%
	3rd Block	Above 170 m^3/m	8.08	10.55	13.00	15.65	31%	23%	20%
Kiosks and Public taps			5.00	5.00	5.00	5.00	0	0	0

Source：LWSC : Tariff 2022-2024 Approval Letter from NWASCO 25.Feb.2022

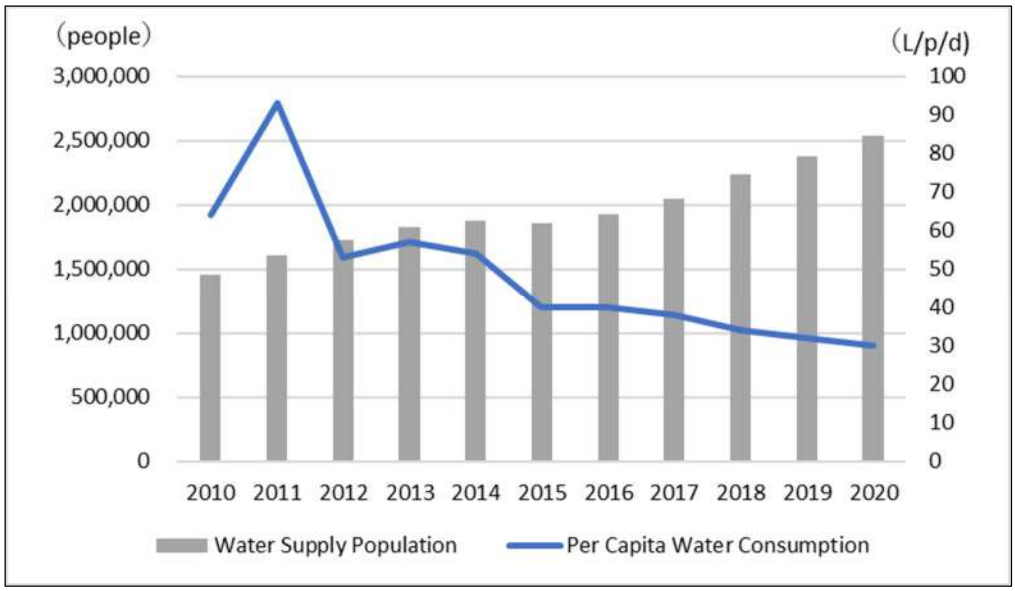
2.1.5 Problems of Drinking Water Supply (Project Area)

(1) Insufficient Capacity of Facilities

In the jurisdiction of LWSC, which operates and maintains Lusaka's urban water supply facilities, the supply amount from water treatment plant facilities and groundwater in the city (2019) is less than 50% of the water demand (418,555 m^3/day), or approximately 200,000 m^3/day. Lusaka's population is expected to increase in the future, and the lack of water intake facilities and the inadequate water distribution network are the main reasons preventing the expansion of the water supply network.

The LWSC's water supply population and per capita water consumption for the past 10 years are shown in Figure-8. According to NWASCO's sector report, the LWSC's water supply population has been increasing every year, from 1.46 million in 2010 to 2.53 million in 2020, an increase of about 75%.

On the other hand, the per capita water consumption is 30 l/c/d in 2020 compared to 93 l/c/d in 2011, a decrease of 68%.



Source：NWASCO : Urban and Peri-urban Water Supply and Sanitation Sector Report

Figure-8: LWSC's Served Population and per capita Water Consumption over the past 10 years

Population growth and urbanization in the city of Lusaka have created a number of problems in the provision of water services. These are amplified by a poor governance for land allocation that encourages rapid growth in peri-urban areas. More than 60% of Lusaka's population lives in unplanned settlements, which were developed on plots illegally acquired by residents due to the lack of legitimate land allocation. Currently, unplanned settlements are declared Improvement Areas, and there has been a major policy shift from demolition to regularization and servicing, with residency rights secured

through the issuance of Occupancy Licenses.

Expansion of water distribution networks is important in developing countries because some areas do not have access to safe drinking water. However, in Lusaka, the expansion of the water distribution system is often done on an ad hoc basis, as water companies supply water after settlements have been developed. This problem stems from inadequate urban planning. Due to a lack of infrastructure investment, the development of new water sources is limited, but many new water distribution pipe network expansions are undertaken.

This will result in a decrease in water supply hours and water volumes in the originally served areas. New water sources have been supplemented mainly by boreholes, but this has been slow progress because of the heavy dependence on donor support.

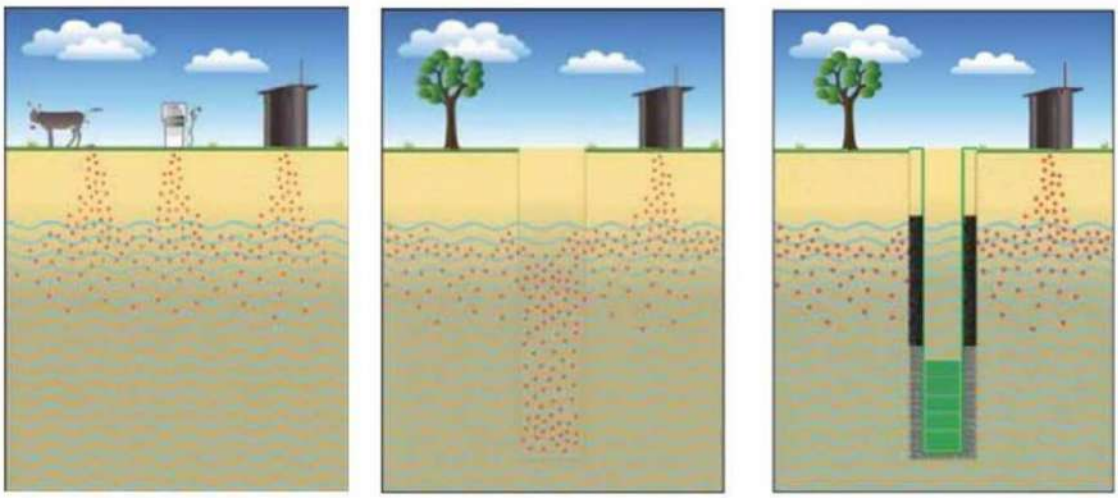
In the target area (Garden Park), water service is not provided by LWSC and chronic water shortages continue due to inadequate water supply facilities. The target residents depend on unprotected shallow wells and other sources for drinking water, and the poor sanitary environment, which causes a large outbreak of cholera and other diseases during the rainy season, has spread and become a major social problem.

(2) Groundwater Source Pollution

In Zambia regulation defining basic standards of borehole construction has now been introduced by WARMA (Water Resources Management Authority). This was to a great extent due to the poor quality of many boreholes drilled and constructed. In Lusaka the cost of drilling a borehole had reduced to less than US$ 1,000 due to competition between drilling companies. The low prices led to cost savings which manifested as low quality borehole drilling, mostly in terms of depth and diameter and poor quality construction.

A main risk factor is the lack of proper grouting of a borehole where shallow groundwater or flood water can flow into the borehole via the annulus between the casing and the borehole, thus allowing water to bypass the weathered zone and flow directly down to the aquifer.

The illustrations below (Figure-9) show how bacterial and other contaminants like fuel can migrate down to the aquifer. When a borehole is drilled this creates a pathway for harmful contaminants to migrate down to the deeper aquifer. This can be prevented by installing solid screen to block the shallow water, but this must also be sealed using a sanitary seal which is made from cement and also ideally bentonite.



Source：Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)

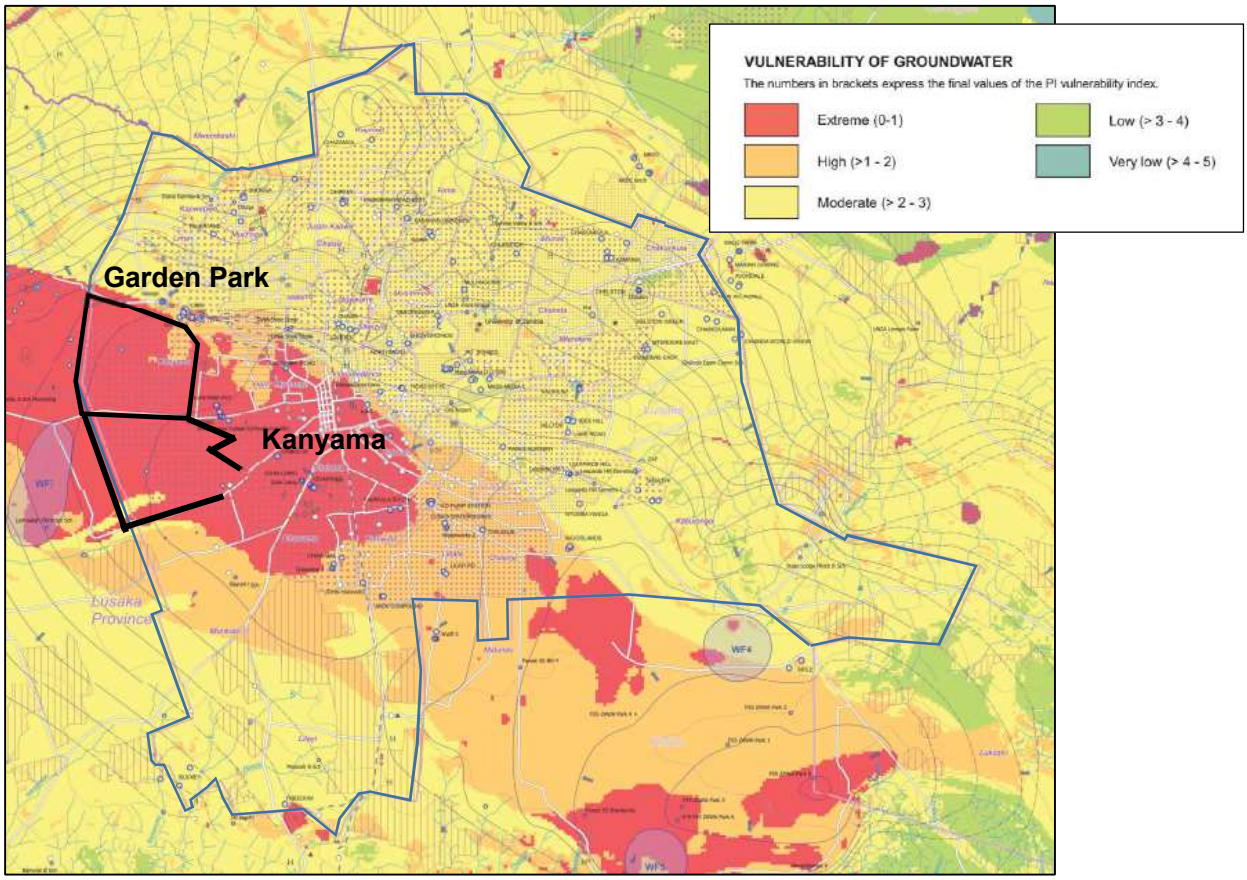
Figure-9: Groundwater Contamination Process

Groundwater contamination is likely to contaminate agricultural foods in urban and peri-urban areas that depend on groundwater for irrigation. Accumulation of heavy metals, which tend to be highly toxic, in the food chain can have long-term detrimental effects, especially on the health of fetuses and children.

In addition, they can have negative health, social, and economic effects, such as increased reliance on food from distant sources and higher food prices for urban residents. Groundwater contamination may also reduce the attractiveness of cities for commercial investment, tourism, and other sectors.

The areas in Lusaka City with a high risk of groundwater contamination are shown in Figure-10. Garden Park and Kanyama in the mid-western part of Lusaka City are located in an aquifer with a high groundwater table and good permeability, indicating a very high risk of groundwater contamination.

In particular, Garden Park, which has no piped water supply systems and relies on unprotected shallow wells and improperly constructed boreholes for existing water sources, is considered to have a very high potential for groundwater contamination.



Source：Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)

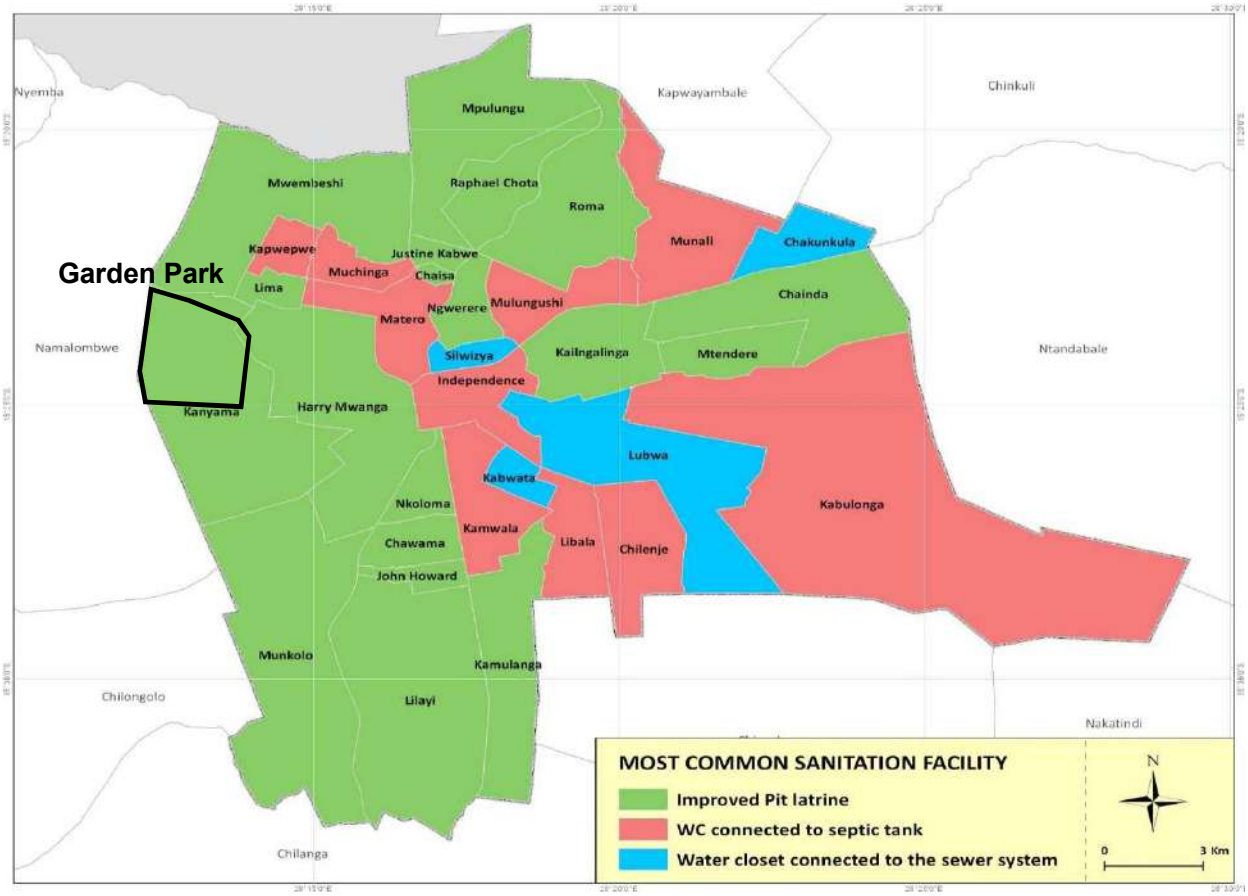
Figure-10: Groundwater Contamination Hazard Map of Lusaka City

2.1.6 Issues related to Sanitation and Waterborne Diseases

Most of Lusaka's sewer network was constructed over 40 years ago, has received little maintenance, and has not been expanded to serve the current population. As shown in Figure-11, access to the sewer network is limited, and a survey conducted by the LWSC revealed that 90% of Lusaka residents use on-site sanitation facilities (22% septic tanks, 10% flush toilets, 50% improved pit toilets, and 8% traditional toilets) was found to be the most common type of sanitation. Only 9% of households are connected to the sewage system, while the remaining 1% use open defecation (OD). Most of these sanitation facilities are constructed and maintained by individual landowners and residents without public assistance.

In peri-urban areas, land is limited, lot sizes are relatively small, and there tends to be no space for new pit latrines due to the presence of old pits that have already been abandoned. Many of the working class in Lusaka rent homes in the peri-urban areas, which are relatively less expensive than the urban areas. Many landlords have begun to build multiple houses on a single plot in order to earn more income. As a result, there is no space to build septic tanks or toilets on the property. In addition, in

areas where the groundwater table is high, sludge leaches from poorly constructed pits and overflows during the rainy season, affecting water sources such as shallow wells, resulting in frequent outbreaks of cholera and other diseases.



Source：LWSC　Low Income Sanitation Provision Lusaka Experience 27.Jan.2022

Figure-11: Major Sanitation Facilities in Lusaka

There has been no health and sanitation education in the target area, and the improvement of the hygienic environment is a challenge due to the high incidence of waterborne diseases such as malaria, diarrhea, and schistosomiasis, as well as respiratory infections, parasites, and other diseases. Currently, LWSC is considering a plan to construct water supply system in the target area, but the system is small with a single borehole, covering only 15% of the residents in the target area.

2.2 Related National Plans

2.2.1 Outline of Development Plan

The Government of Zambia aims to become a middle-income country by 2030, and has formulated the Eighth National Development Plan (2022-2026) in August 2022 as a medium-term plan to realize

its long-term development policy, Vision 2030. In the water sector of this plan, improvement of water supply and sanitation is listed as one of the basic services for achieving economic growth and poverty reduction.

It also states that "all people should have access to water supply and sanitation services by 2030 to improve health and livelihoods. The policy on water supply and sanitation lists "the development and sustainable supply of safe water for urban and peri-urban areas" as one of its seven main strategies.

2.2.2 High Level and Related Plans of Project Area

In Zambia, the National Water Policy was revised in February 2010, and the Water Resources Management Act was enacted in 2011. With regard to urban water supply and sanitation, the National Urban Water Supply and Sanitation Program (NUWSSP: 2009-2030) was officially promulgated in October 2011, which "expands the scope of water supply so that all peri-urban areas are equipped with at least one public water tap." is highlighted as an issue to be addressed between 2009 and 2015.

In this context, the strategic plan (2018-2022) developed by the LWSC aims to increase the water supply rate to 90% and the sanitation coverage rate to 80% by 2022.

2.2.3 Project Urgency and Priority of Zambian Side

In its voluntary report on the SDGs, the Zambian government has indicated that water supply and sanitation services in peri-urban areas are in the worst condition, and since the area is also prone to frequent cholera outbreaks, the expectations of the implementing agency for this project are very high. The contents of the project outline are also shared with the Ministry of Water Development and Sanitation (MWDS), the supervising agency, as well as with the implementing agency, to ensure the significance of the project.

2.2.4 Mutual Comparison with Other Candidate Projects

There are no other candidate projects.

2.2.5 Other Relevant Sector Information

The population of rural areas is about 58% of the national population, yet according to the Joint Monitoring Program for Water and Sanitation (JMP), the urban water supply rate in 2020 is high at 90.2%, while the rural water supply rate remains low at 56.6%. It is necessary to accelerate the provision of access to safe and affordable drinking water to rural areas.

Currently, Zambia is focusing on water supply through piped water supply rather than point source such as borehole with hand pumps in rural growth centers, and is in the process of developing National Guidelines for Operation and Maintenance (O&M) of Small Piped Water Schemes. In 2018, NWASCO revised its framework for water and sewerage service provision and regulation in rural

areas to include the provision of services to rural areas in the operating licenses of commercial utilities. In this field survey, MWDS has expressed a sincere request for the development of piped water supply facilities and the establishment of maintenance and management systems in rural growth centers.

MWDS has a desire to develop small-scale piped water supply facilities similar to the "Groundwater Development in Luapula Province Phase 3" implemented with Japan's assistance to other regional centers, and MWDS, GIZ, and a major German consultant have conducted an inspection of small-scale piped water supply facilities in Luapula Province in August 2022 to gather information.
There are also many villages in rural areas where service level of borehole with hand pumps is sufficient. In order to realize the SDGs' goal of "leaving no one behind," there is a great need for groundwater development projects in rural areas, where Japan has a proven track record.

2.3 Responsible Authorities and Implementing Agencies

2.3.1 Related Government Agencies

The Ministry of Water Development and Sanitation (MWDS) is the central authority responsible for the entire water supply and sanitation sector: The National Water and Sanitation Council (NWASCO), an independent regulatory agency, supervises the 11 commercial utilities based on the policies set by the MWDS. Its duties include issuing licenses, determining and regulating water tariff, monitoring service level, and strengthening the service capacity of the commercial utilities through the preparation of guidelines and other measures.

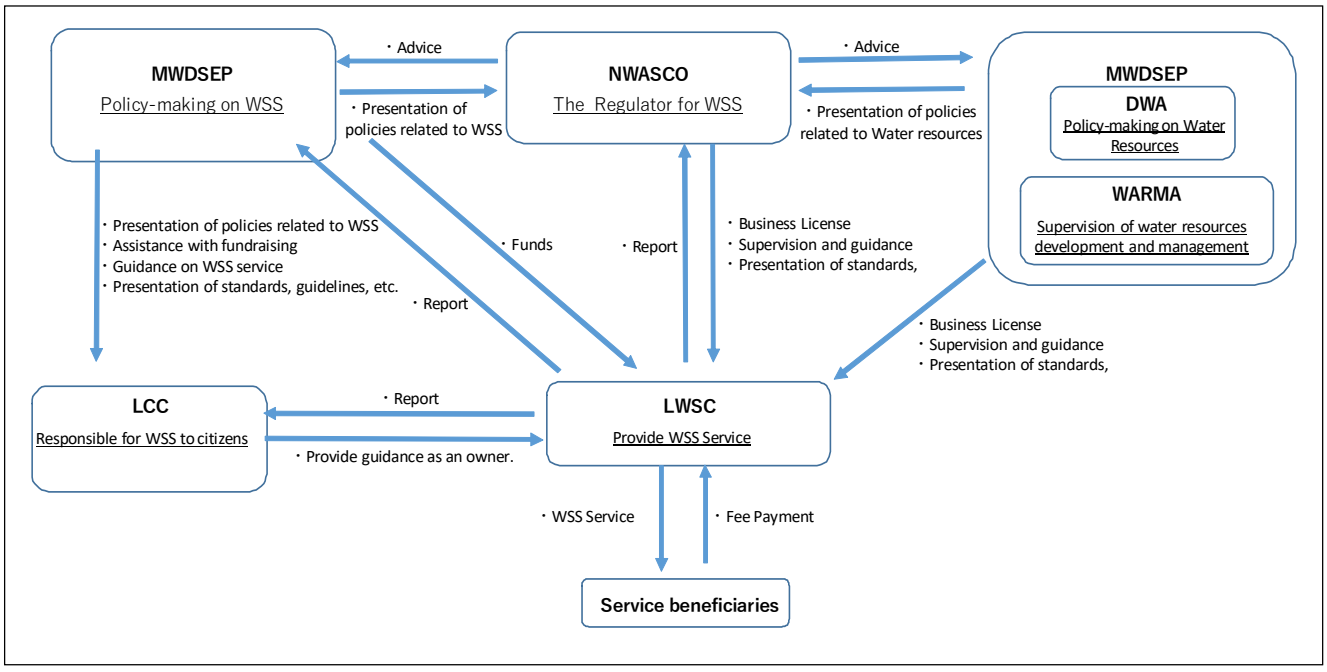
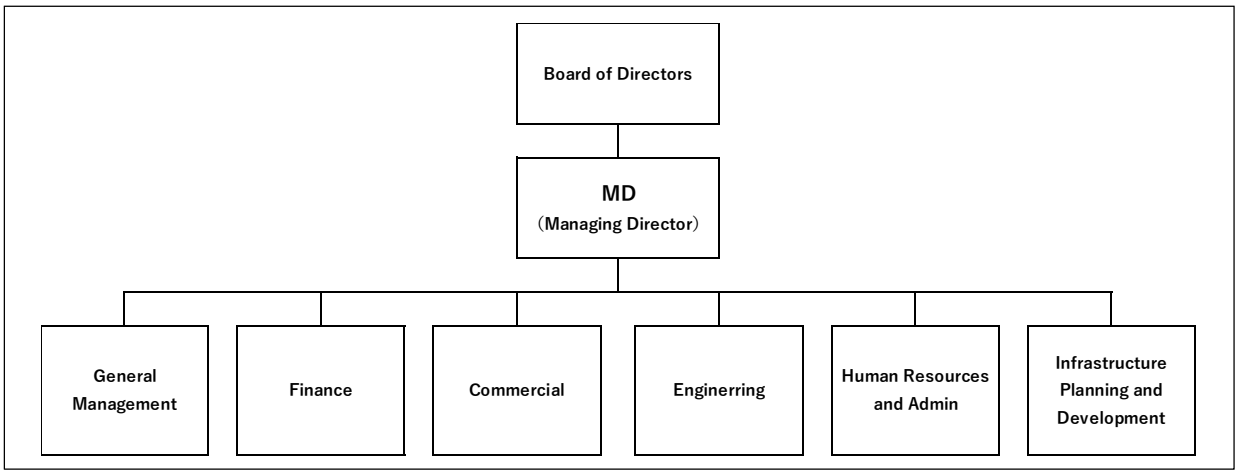


Figure-12: Lusaka City: Water Supply and Sanitation Sector Structure

Lusaka's urban water supply services are provided by the Lusaka Water and Sewerage Company Limited (LWSC), whose shareholding structure is 43% owned by Lusaka City Council, 17% by Kafue City Council, and 10% each by Chongwe City Council, Luangwa Town Council, Chilanga Town Council, and Lufungsa Town Council. LWSC was first profitable in 2009 with the support of the World Bank's Water Sector Performance Improvement Project.

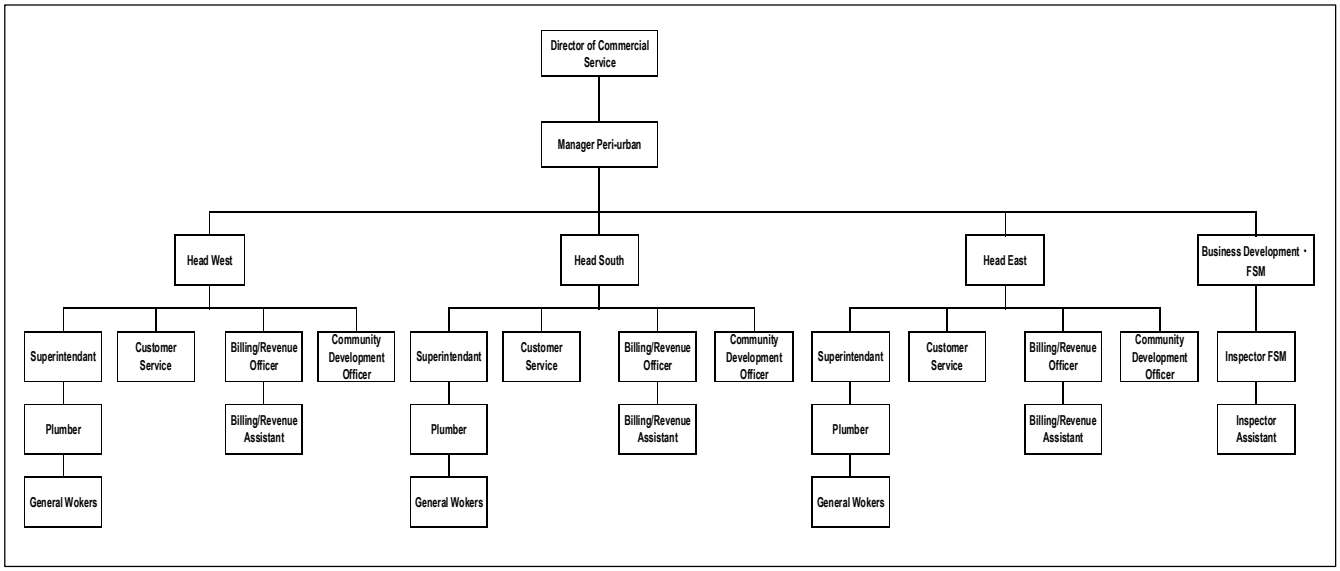
2.3.2 Organization of the Implementing Agency

The organization of the LWSC consists of an MD (Managing Director) under the Board of Directors (Board of Directors) and the following six divisions. Eleven non–executive Board of Directors provide oversight and policy guidance to the Company.



Source：LWSC Strategic Plan 2018-2022

Figure-13: LWSC Organization



Source：LWSC Peri-urban Department 2022

Figure-14: LWSC Organization of Peri-urban Department

The Managing Director (MD) is responsible for the day-to-day operations of the company and is accountable to the Board of Directors. The Managing Director is assisted by six divisions namely; General Management, Finance, Commercial, Engineering, Human Resources and Administration and infrastructure Planning and Development. Figure-13 shows the overall organization chart of LWSC and Figure-14 shows the organization chart of the Peri-urban Department, which is in charge of the peri-urban area.

2.3.3 Operations of Implementing Agency

LWSC is a commercial utility providing water and sanitation services in Lusaka Province; it was established under the Companies Act 1988 and commenced operations in 1990. It is a private limited liability company established under Chapter 388 of the Laws of Zambia (now the Companies Act No. 10 of 2017) and is in the business of providing water supply and sanitation services in urban, peri-urban and rural areas of Lusaka Province. Figure-15 shows the area and population under the jurisdiction of LWSC. LWSC also has 10 water trusts operating in the Lusaka peri-urban area under licenses issued by LWSC.

DISTRICT	POPULATION (2010)	PERCENTAGE (%)
CHILANGA	107,051	5
CHIRUNDU	14,864	1
CHONGWE	141,301	6
KAFUE	120,415	5
LUANGWA	24,304	1
LUSAKA	1,747,152	79
RUFUNSA	51,002	2
SHIBUYUNJI	16,723	1
TOTAL	2,222,812	100

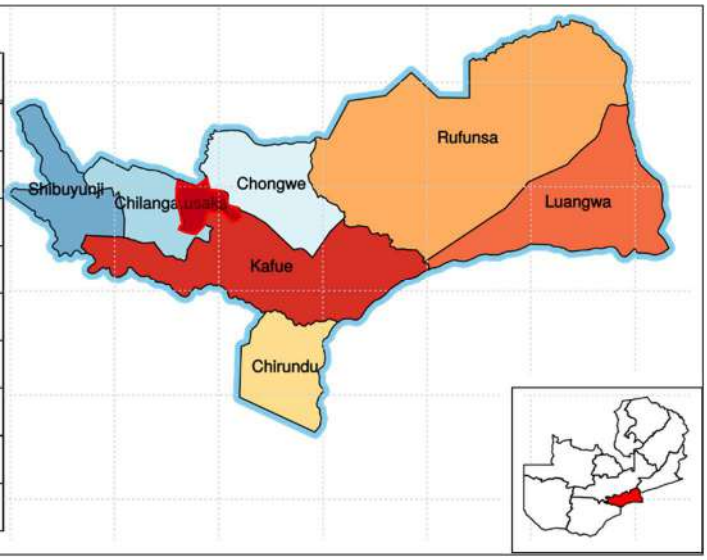


Figure-15: LWSC Jurisdictional Districts and Population

Peri-urban areas are lagging behind in water supply development despite their high population growth rate and density. The delay is a major cause of low living standards of the residents. LWSC aims to "achieve a level of service appropriate for urban water services" in terms of both quality and quantity in peri-urban areas. The LWSC has formulated a development plan for the development of water supply services in the areas, taking into consideration the location of the water supply area, the availability of water sources, the possibility of using existing pipe networks, and the social

environment, etc. As a result, the policy is to construct a "satellite system" as a stand-alone water supply system rather than simply extend the existing system.

2.4 Progress of Cooperation by Japan

2.4.1 Progress of Grant Aid Project

In the urban water supply sector, development studies and grant assistance have been conducted intermittently since the late 1980s to improve water supply in Lusaka.

In addition to the construction of borehole with hand pumps, Japan has been working to strengthen the capacity of the local government and communities so that they can maintain and upgrade existing borehole with hand pumps.

2.4.2 Progress of Technical Cooperation Project

As for technical cooperation projects, support was provided to strengthen the capacity building of the Lusaka, Luapula, Western, and Kahubu commercial utilities. Nationwide dissemination and capacity building support for the operation and maintenance management system model for borehole with hand pumps (SOMAP O&M model) was also being implemented.

2.4.3 Comments on the above Cooperation by the Counter Country or Organization

In Lusaka City, the constructed boreholes, elevated water tanks, and public tap stands in the George unplanned settlement are still in operation 25 years after the "Water Supply Project in Satellite Area of Lusaka " implemented from 1993 to 1999, making it one of the successful examples of a water supply project in peri-urban area. Therefore, the expectations for Japan's support remain high.

2.5 Progress of Cooperation by Third Countries and International Organizations

In 2012 through support from the Millennium Challenge Corporation, master plans for water supply and sanitation were developed. LWSC has implemented infrastructure development projects as outlined in the master plans as follows.

(1)Lusaka Water Supply, Sanitation and Drainage Project (LWSSDP)

This is a 354 million USD project funded by the United States of America through the Millennium Challenge Corporation (MCC) compact.

- Construction of the main drainage system in Lusaka
- Development of groundwater sources and domestic water supply in peri-urban areas such as Mutendere, Malapodi, Garden, Chawama, Cuomboca, Camanga, and Chipata.

・Installation of water and sewerage in Mtendere and house connection.

(2) Kafue Bulk Water Project

This Chinese capital project aims to increase surface water supply to the city of Lusaka and alleviate water demand shortages by constructing a 50,000 m^3 per day water treatment plant at the Iolanda Water Treatment Plant and a water transmission pipe from Kafue to Lusaka. The project has already been completed and the facility has been operational since December 2021.

(3) Chongwe Water Supply Project

The project was funded by the Government of Zambia to support groundwater development in the southern part of Chongwe Township as an alternative source of water to supplement surface water from the Chongwe River.

(4) Emergency Works in Peri Urban Areas of Lusaka Province

The project aims to provide water supply services to 95,000 residents in the Kanyama, Bauleni, Gardern House, Chawama, Chunga, and Chipata areas in Lusaka City, and to contribute to improving sanitation and hygiene conditions in the surrounding urban areas. The contractor started construction in April 2018, but the project was halted on August 30, 2019 due to non-issuance of interim payment certificates.

2.5.1 Cooperation Results and Forms related to the Subject Project

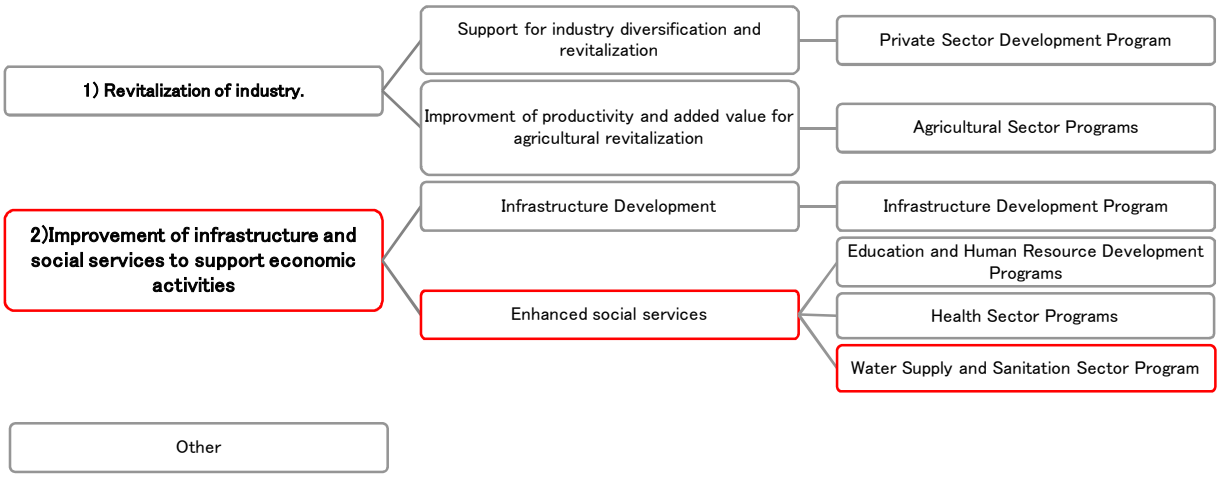
There is currently no assistance from third countries/international organizations to peri-urban area in Lusaka City related to this project.

2.5.2 Availability and Results of Requests related to the Subject Case

LWSC will prepare a request for cooperation for the water supply in peri-urban area and submit it to the Embassy of Japan in Zambia and the JICA Zambia office by March 2023, in order to approach them for implementation of the grant aid.

2.5.3 Consistency of the Target Project with Japan's Aid Policy

The country-specific development cooperation policy for 2018 states that in order for Zambia to promote diversified and robust economic growth that breaks away from excessive dependence on mining, the government will focus its support on (1) revitalizing industries and (2) improving infrastructure and social services that support economic activities (Figure-16).



Source：Ministry of Foreign Affairs of Japan, Country Development Cooperation Policy (June, 2008)

Figure-16: Country-wise Development Assistance Policy

The assistance policy for water supply is shown in "2) Improvement of Infrastructure and Social Services to Support Economic Activities," which states, "Given the continued high prevalence of waterborne diseases, assistance will be provided to improve access to safe water, especially in urban areas". Based on the policy, programs are being implemented to support the strengthening of urban water supply infrastructure and the improvement of the operational capacity of water utilities. According to the Ministry of Foreign Affairs' Business Development Plan, subject-specific training in the areas of water supply and sanitation is also being implemented.

2.5.4 Necessity of Project Linkage with Cooperation by Third Countries/International Organizations

According to the LWSC, there is currently no direct assistance from other donors for access to safe water in peri-urban areas. However, there is a need for close linkage with "The Integrated Development Plan for the Greater City of Lusaka," which the Zambian government plans to prepare with Japanese assistance.

2.5.5 Reasons for not having the Subject Project Implemented by a Third Country/International Organization

In Zambia, the World Bank, African Development Bank, USAID, KfW, UNICEF, Chinese government and other aid organizations such as CARE International are engaged in a wide range of activities.

Although NGOs are engaged in water supply projects, capacity building, etc in Zambia, most of the projects in peri-urban area are dedicated to activities in the sanitation (e.g., sanitation facility construction) sector.

In addition, CARE International, which provided support for water supply in the peri-urban areas in Lusaka in the past, is focusing on water supply project in rural areas, partly due to the poor progress in access to safe water in rural areas, as described above in "2.1.1 Current Status of the Water Supply Sector (National Level)".

Chapter 3: Project Related Information

Chapter 3: Project Related Information

3.1 Improvement of Problems

3.1.1 Problems in Water Supply Services (National Level) and Relation to the Project

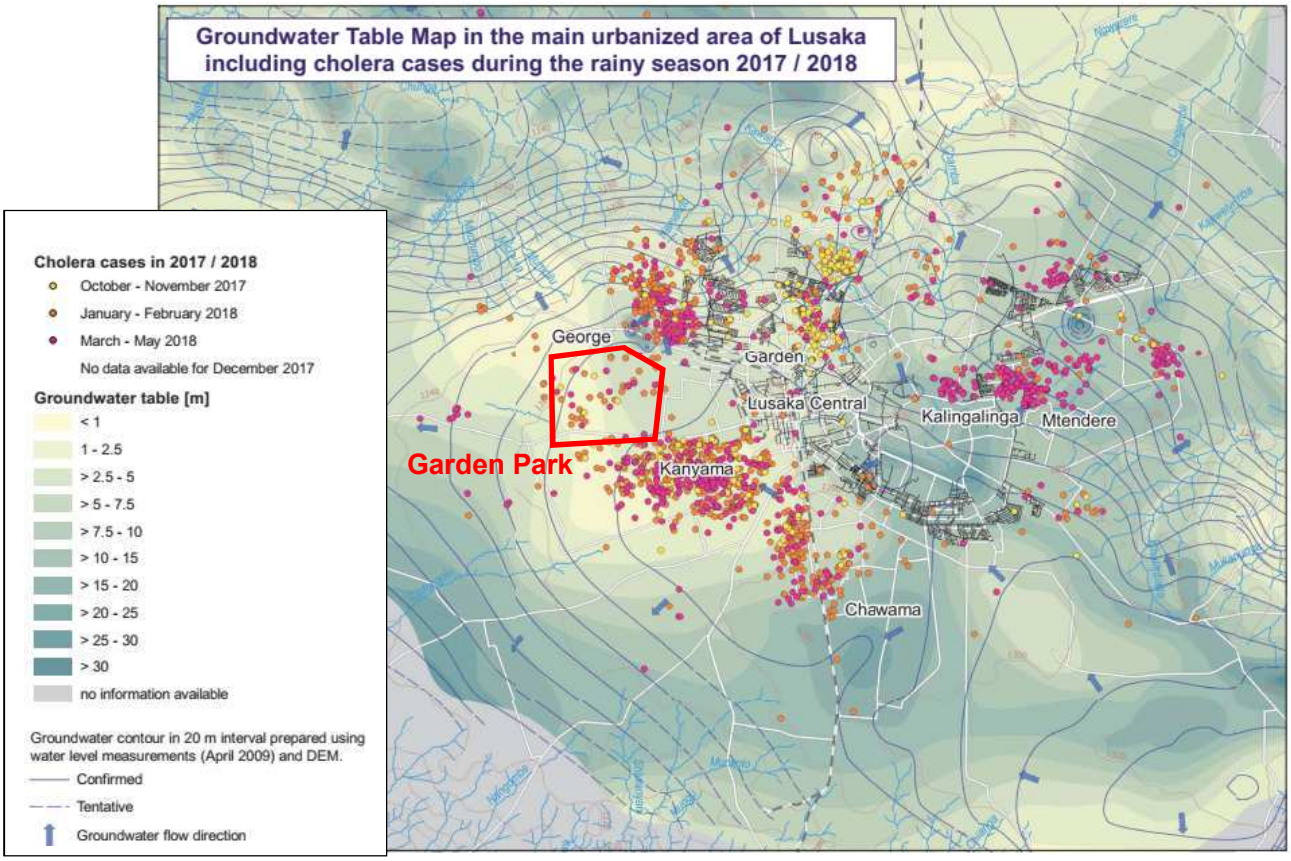
Among the problems (at the national level), the proposed project is expected to improve the shortage of water sources, water pollution, insufficient capacity of facilities, water leakages and routine execution of water outages.

Table-8: Relationship between Problems in Water Supply Services (National Level) and the Project

Classification	Problems
Business Plan	● Lack of coordination between urban planning and water supply and sanitation development planning
Management and Finance	● Securing funds for construction of facilities ● Low net profit margin ● Recovery of non-collected fees
Facility	Water source. ● Insufficient water sources (drought and increased water demand due to climate change) ● Water pollution (environmental pollution, frequent flooding due to climate change) -Facilities ● Insufficient capacity of facilities ● Increase in water leakage Water supply. ● Frequent planned water outages ● Insufficient installed water meter ● No assurance of residual chloride
Management	● Insufficient water pressure and water volume ● Non-implementation of asset management ● Poor management indicators
Personnel	● Low capacity of technical skills of staff

3.1.2 Current Status of Water Services and Problems in Drinking Water Supply (Target Areas) and their relation to the Project

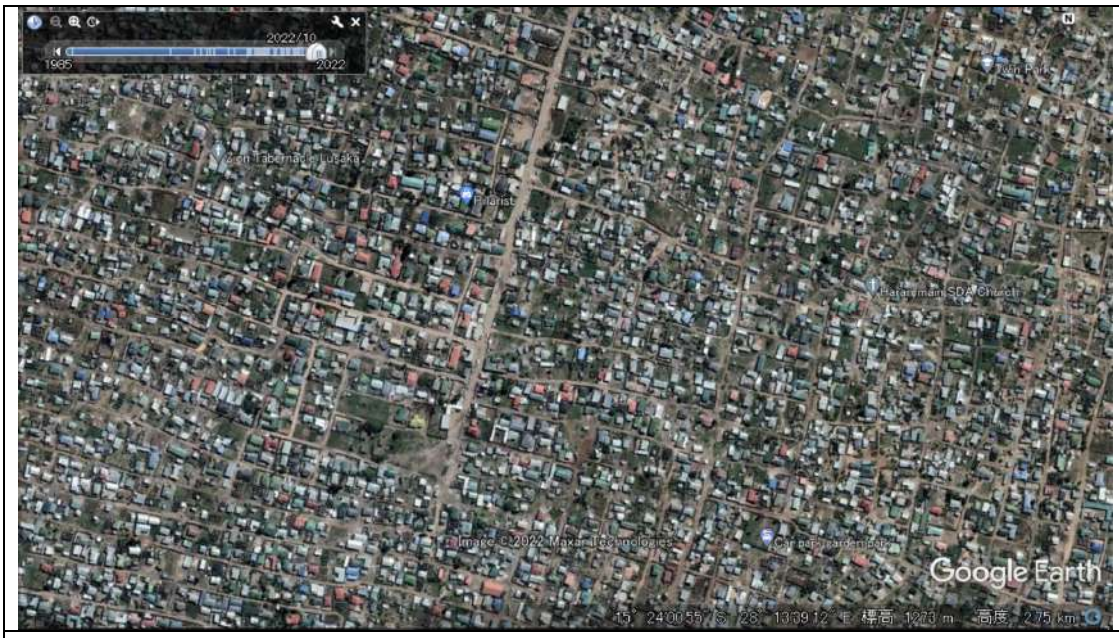
As shown in Figure-17, the cholera outbreak in the 2017-2018 has been observed in areas located to the west of Lusaka City, the Kanyama area (Kanyama), located south of the Garden Park area (Garden Park) with a high groundwater table, and the George Area (Geroge), located north of Garden Park. In Garden Park, a relatively new unplanned residential area, the number of cholera outbreaks was low because the population influx had not yet progressed, as shown in Figure-18.



Source： Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)

Figure-17：Lusaka City: Cholera Cases (2017/2018) and Groundwater Table Map

Satellite image of some residential areas within Garden Park (September 2016)



Satellite image of some settlements in Garden Park (October 2022).

Source：Google Earth

Figure-18: Satellite Image, Residential Area in Garden Park (2016, 2022)

From the perspective of improving resilience and helping the most vulnerable communities to cope with climate risks from global warming, the social impact of this project is expected to be very high, as the project will pump up safe groundwater after forming an appropriate impervious layer in the boreholes, and supply safely managed drinking water through underground distribution pipes after chlorine disinfection.

3.1.3 Scope of Cooperation

The scope of cooperation for this project, if adopted as a grant aid project, will be a series of packages, starting with a preparatory study for cooperation to improve access to safe water in unplanned settlements in Lusaka, followed by construction of the facilities, construction supervision, and soft components.

3.1.4 Type of Cooperation

LWSC expects the construction of the facility to be funded by a general grant from the Japanese government.

3.1.5 Period of Implementation

The project is expected to take about six years from the request to the completion of construction.

Table-9: Tentative Overall Construction Period

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Acceptance of Request						
Preparatory Survey						
Cabinet Decision						
Detailed Design						
Construction Tendering						
Construction Work						

3.2 Purpose of the Project

3.2.1 Short-Term Objective

In the short term, the construction of water supply facilities using groundwater as the water source will contribute to the reduction of waterborne diseases and improvement of water access condition, with the aim of eliminating areas without water service.

3.2.2 Medium- and Long-term Objectives

In the medium and long term, the project aims to contribute to the improvement of the health of the residents, the orderly growth of the city, and economic development by implementing hygiene awareness activities in conjunction with the construction of the facility. The following are the medium- and long-term objectives of the project.

- In addition to supplying safe water to slums and other inappropriate living environments, the project will promote the improvement of the health of the beneficiaries and the stable growth of the city by implementing hygiene awareness activities such as measures against infectious diseases.

- To contribute to economic development by reducing negative influence to human health and the living environment through the prevention of groundwater pollution.

- To encourage consideration of resilient and sustainable water supply facilities in the face of climate change, which is expected to have increasingly severe impacts in the future.

3.3 Contents of the Project

3.3.1 Outline of the Project

The initial requests for high-priority project is shown in Table-10.

Table-10: Project Outline (Initial Request)

Item	Target Area
Target area name and population	Garden Park Area、Population 87,000（Year 2022）
Target Year	2030
Target Population	125,000 (Year 2030)
Daily Water Demand	40 l/c/d
Planned pumping capacity	5,100 m^3/d

Classification		Facility	Specifications	Quantity
1. Facility construction	1-1	Borehole Drilling	Depth：100-150m Pumping rate：40-70 m^3/h	10
	1-2	Borehole Facilities (pump control room, guard house)	RC pillar and beam、borehole equipment	5 places
	1-3	Transmission Pipe	HDPE pipe DN75-160	1.3 km
	1-4	Administrative building	Office and warehouse	1 places
	1-5	Water distribution faciities (water distribution tank, chlorination room, flow meter room)	RC Elevated water tank V=300m^3、Chlorinator	5 places
	1-6	Distribution Pipe	HDPE pipe DN50-160	85 km
	1-7	Household connection kits (water supply pipe, water meter, faucet, etc.)	HDPE pipe DN20mm x 6m, water supply meter	1,800 units (10% of the planned number of households so that the service can be provided as soon as possible after construction is completed)
2. Design and construction supervision	2-1	Facility design, construction supervision, etc.	-	1 set

3.3.2 Description, Scale, and Quantity of the Project

The overall system and each facility of the project are described below.

（1）Outline of Overall System (Facilities Construction)

1) Facility Overview

Since the target area is classified as an urban residential area distributed around the city of Lusaka, the

basic plan is a stand-alone water supply system (satellite system) that is separated from the existing water supply network of LWSC. The water supply system consist of water source (borehole) and intake facilities (intake pumps), water transmission facilities (transmission pipes), water distribution facilities (distribution reservoirs and distribution pipes), water supply facilities (public tap stands and connections to individual houses), and auxiliary facilities (administration building, machine room, chlorine facilities) (Figure-19).

The water supply system to be constructed in this project will be designed in consideration of the current operation and maintenance system, such as installing one water distribution facility for one or two borehole, mainly to simplify operation and maintenance. Therefore, this plan assumes five water supply systems from the above-mentioned water source to the water distribution facilities.

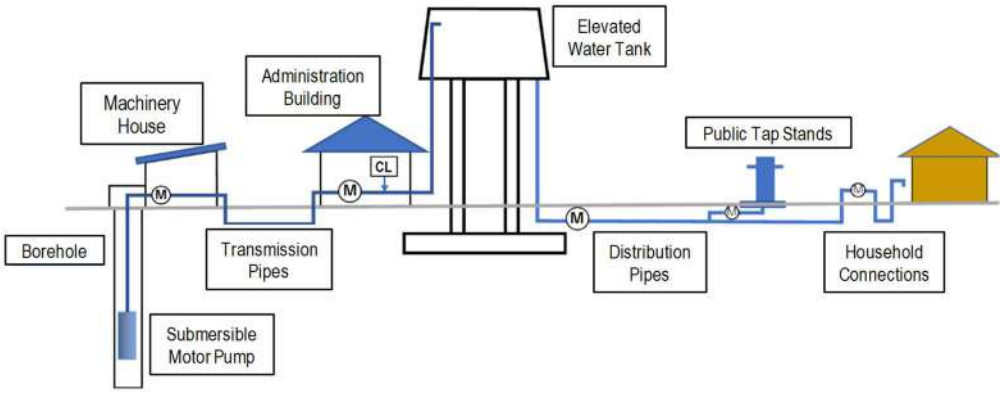
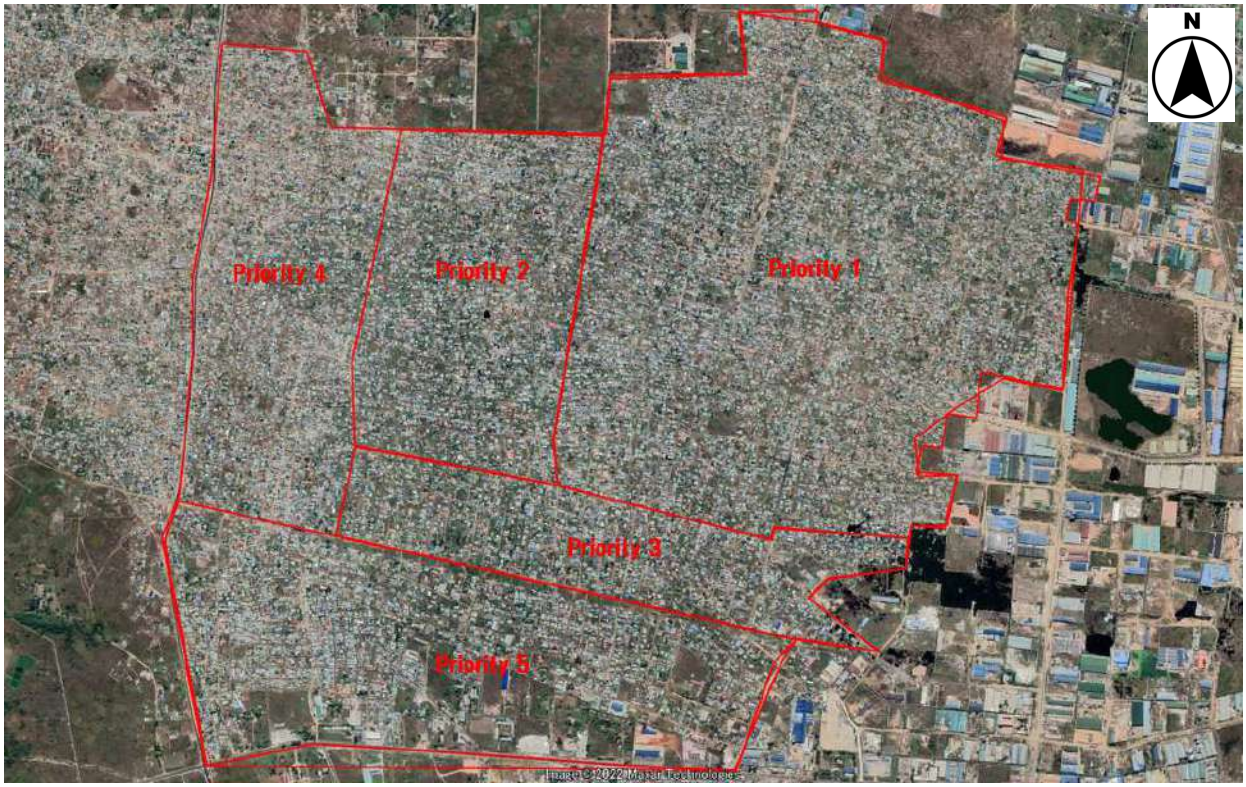


Figure-19: System Outline Diagram

2) Outline of the Target Area

Based on the field survey and discussions with LWSC, it was decided to target 125,000 people in the entire target area as shown in Figure-20. Since there is no LWSC water supply service in the entire target area and there is no difference in access to safe water within the area, the priority 1 (high) to 5 (low) was decided in consideration of

a) The target area spread from the northeast part
b) Location of public facilities such as schools
c) The boundaries (along the main roads)
d) LWSC George office, which will be responsible for operation and maintenance, located in the northeast of the target area.



Source：Compiled by the Survey Team based on Google Earth

Figure-20: Priorities in the Subject Area

(2) Outline of Each Facility (Proposed Construction Site, Scale, Capacity and Quantity)

1) Water Source

Since there is no surface water available for use as a water source in the vicinity of the Garden Park area and there is contamination of shallow groundwater, the target water source for this project will be a deep borehole to obtain safe and stable groundwater. Based on drilling data around the target area, borehole depth of 105.8 m and a pumping rate of 70-80 m^3/h per borehole are expected.

2) Water Intake Facilities

A submersible motor pump will be used to transport groundwater from borehole to the distribution facilities. Pump operation hour is planned to be 16 hours, which is the current water supply hour of the LWSC. The pumps will be operated automatically, with an interlock to prevent dry operation and a control circuit to stop the pump when the distribution reservoir is full.

3) Water Distribution Reservoir

With regard to the water distribution reservoirs applied in this project, elevated water tank is considered in consideration of the topography, elevation, and location of the water supply facilities. While concrete elevated water tanks were used in the previous Japanese supported water supply

project in George area, steel elevated water tanks were used for most of the piped water supply project in Zambia. Since this project will utilize groundwater, which tends to be acidic (low pH) and highly corrosive, there are concerns regarding the use of steel distribution tanks in terms of durability. Therefore, concrete elevated water tanks with a long service life will be planned.
In principle, water distribution pipes should be installed along roads (public land) as much as possible. The covering depth shall be in accordance with local standards, and it shall be 600 mm.

4) Transmission and Distribution Pipe

The transmission and distribution system in this project does not directly supply water from the borehole to the distribution facilities, but supply water from the elevated water tank through the distribution pipes by gravity flow. In addition, water supply systems divided into water supply zones are used, and water meters will be installed in the distribution branch pipes to monitor the volume of water in each supply zone, making it easier to prevent water leakage and non-revenue water.

5) Water Supply Facilities

It was confirmed in discussions with LWSC that the basic policy is to minimize the use of public tap stands and use house connection (yard tap) for water supply. The house connection shall be of the structure that is standardly adopted by the implementing agencies. Specifically, a water supply pipe (20 mm diameter) will be branched at the saddle from the distribution pipe network, and a valve, water meter, and tap will be installed.
Due to construction schedule constraints, not all households will be connected in this project. The policy for this project is to procure connection kits, which will then be installed by LWSC.

6) Chlorine Injection Facilities

Chlorine injection facility will be installed because a free residual chlorine level of at least 0.2 (mg/L) at the water tap regardless of the water source is mandatory for piped water supply in Zambia. LWSC is using calcium hypochlorite for chlorination. It is easier to procure and store than sodium hypochlorite. Therefore, calcium hypochlorite shall be used for the Project. The chlorine injection facility is planned to be installed in a machinery house attached to the administration building.

7) Individual House Connection Facilities

LWSC basically aims to connect all water supplies to each household. In this project, the plan is to connect each household to approximately 10% of the total number of households in order to be able to start water distribution as soon as possible after construction is completed and to recover the minimum operation cost.

3.3.3 Contents, Scale and Quantity of Dispatch of Experts and Equipment Procurement

The establishment of an administrative office or business office for collecting fees and O&M is not considered necessary since Peri-urban West, a branch office of LWSC that is in charge of water and sanitation services for peri-urban area, is located near the Garden Park area, using a building constructed by JICA's George Compound Project. Since no new technology will be introduced to LWSC, it is possible for staff from existing LWSC offices to provide guidance to new staffs, except for initial operational guidance.

LWSC's policy regarding water supply is basically to provide water to individual house (either by yard tap or indoors). Therefore, the policy is to procure connection kits to the extent that they can be installed during the construction period of the project and operated promptly after the facility begins operation.

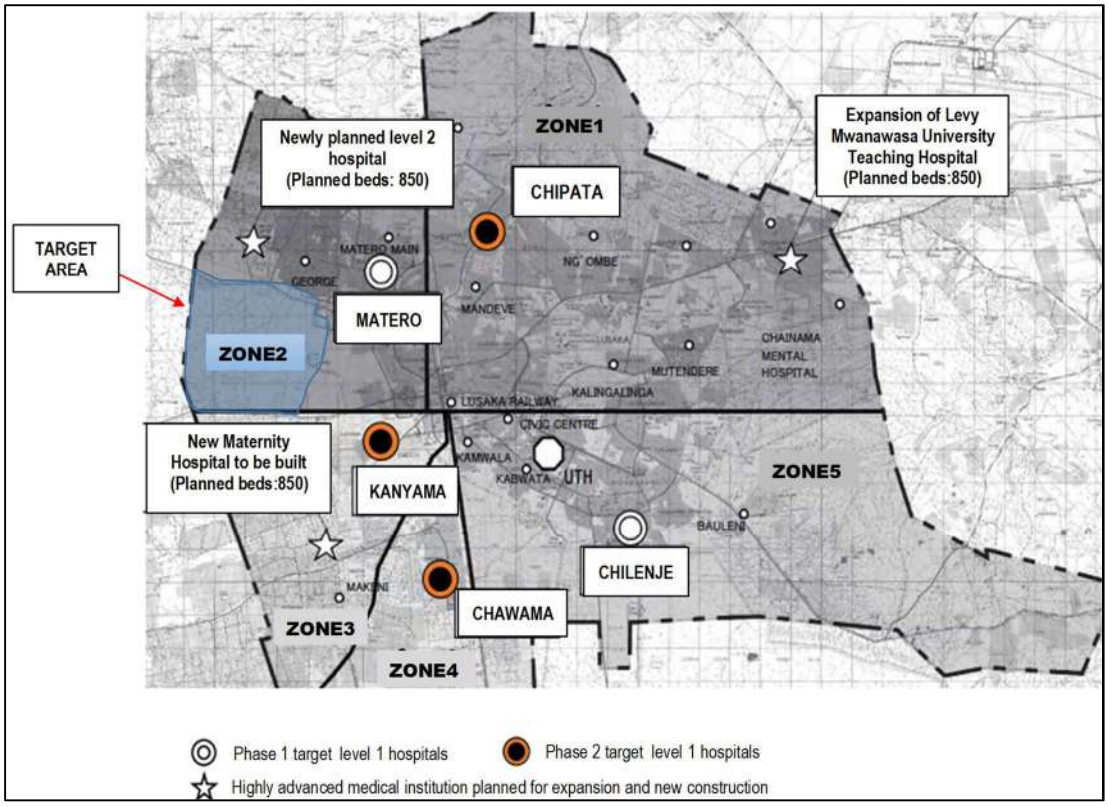
3.3.4 Possibility of a Multi-sectoral Approach

Improved nutrition requires multiple factors such as food security, access to health care, child care practices, and access to safe water and sanitation facilities be adequately addressed for children. Therefore, multi-sectoral approach will also be considered in order to effectively manifest the results expected by the Project. Specifically, with regard to the reduction of waterborne diseases such as cholera, the project will not limit its approach to the water sector, but will also incorporate the perspective of the health sector in hygiene education with the cooperation of neighboring hospitals/health centers that have jurisdiction over the target areas, or health extension workers who are active in these areas.

LWSC's 2018-2022 Strategic Plan calls for the construction of 12,000 household latrines over a five-year period. The project area is extensively covered with limestone and other materials, and the structures must be raised from the ground surface. Therefore, if this project is implemented, it is desirable to include educational activities related to the improvement of sanitation.

3.3.5 Synergistic Effect with other Projects carried out by Japan's Support

In the area adjacent to the target area (Kanyama, Chawama, Matero), there are three hospitals in which construction and equipment were carried out by the support of Japan (Figure-21), and " Project for strengthening Management Capacity of the First Level Hospitals in Lusaka District " for strengthening the hospital ability is carried out from 2021. Although the main activities of the project are to strengthen the hospital infection countermeasures, it is considered possible to conduct hygiene awareness and other activities in cooperation with the hospital that has jurisdiction over the target area.



Source：Lusaka District Primary Health Care Project（Phase 2）,JICA,2017

Figure-21　Location map of the five hospitals covered in Lusaka District Primary Health Care Project （Phase 1, Phase 2）

3.3.6 Utilization of Information and Communication Technology (ICT)

LWSC is promoting the use of electronic payments as much as possible as part of its digital transformation to improve customer service and to protect customers and employees from COVID-19 infection. A mobile application that can be downloaded from the Google Play Store and the Apple App Store is also introduced (Figure-22), which provide following service:

1. Online payment of water bills
2. Finding for the nearest LWSC office / pay point
3. Meter-reading
4. Confirmation of water consumption
5. Confirmation of the statement, report of the trouble and complaints

Until now, the use of ICT has been limited in the Peri-Urban area, but this project aims to use ICT to transform services provided to customers, such as online procedures and payments, to increase satisfaction and improve operational efficiency.

Source：LWSC

Figure-22: Mobile payment ads introduced by LWSC

3.3.7 Project Cost Estimation

The estimated project cost is shown in Table-11.

Table-11: Project Cost Estimation

	Facilities to be Constructed and Other Items	Quantity	Construction Cost (million yen)
I	Construction cost		
1	Borehole drilling	10 boreholes	111
2	Water source facilities construction (machinery house, pump equipment, pump pit, etc.)	5 locations	28
3	Transmission main and transmission pipeline laying (HDPE pipe DN75-160)	1.3km	50
4	Administrative building (Office and warehouse)	1 location	11
5	Water distribution center construction (elevated water tank V=300m^3, disinfection room, flow meter room)	5 locations	219
6	Distribution pipe laying（HDPE pipe DN50-160）	85km	819
7	Household connection kits (water supply pipe, water meter, faucet, etc.)	1,800 units	36
8	Transportation cost		15
9	Total direct construction cost		1,290
10	Indirect cost		516

	Facilities to be Constructed and Other Items	Quantity	Construction Cost (million yen)
	Subtotal		1,806
Ⅱ	Design and construction supervision cost		
1	Design and construction supervision cost		181
2	Soft component cost		20
	Subtotal		201
Ⅲ	Contingencies		
1	Contingencies such as price escalation, etc.		100
	Subtotal		100
	Total		2,107

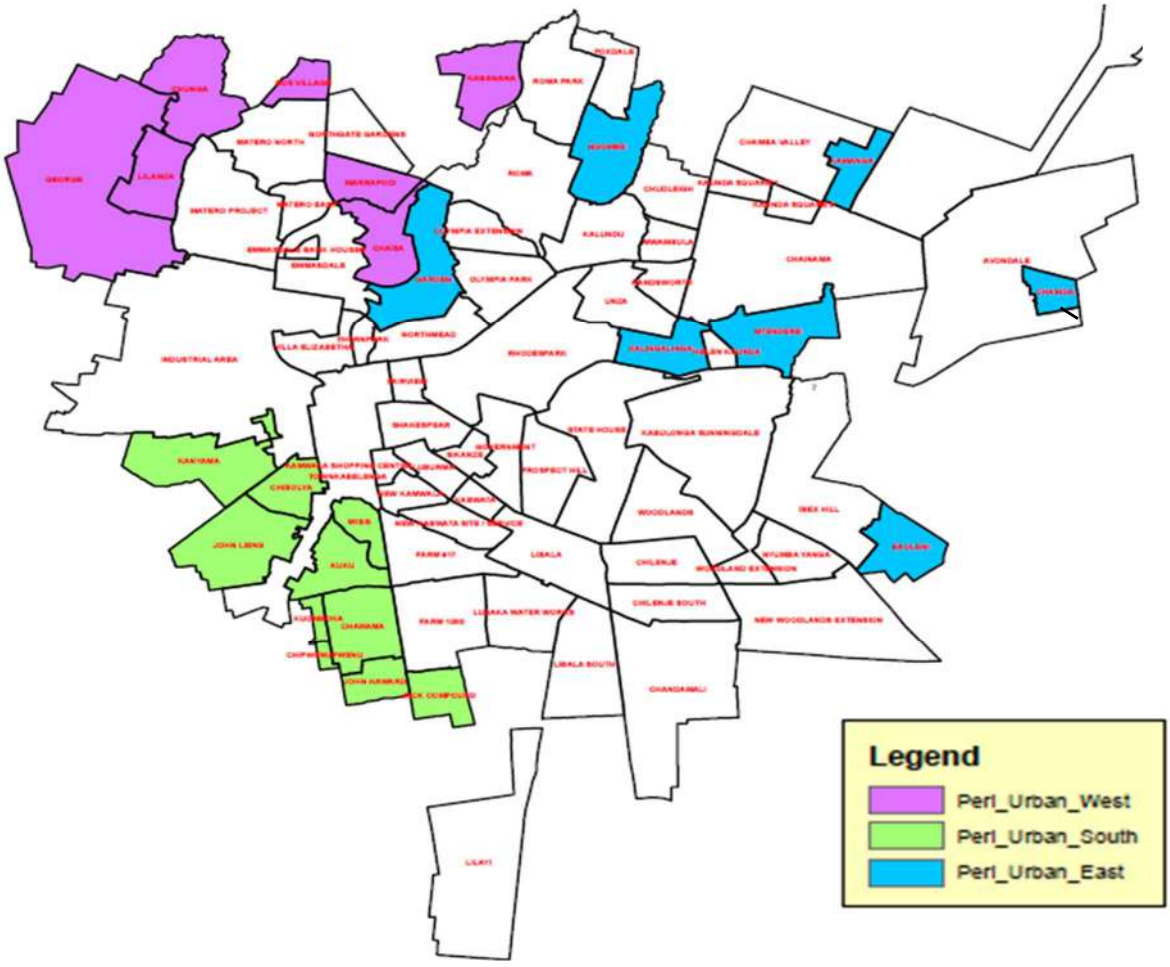
3.3.8 Operation and Maintenance

Water and sanitation services in unplanned settlements are provided in two systems: operation and maintenance by LWSC and operation and maintenance by Water Trust (WT), as described below. By law, water and sanitation supply infrastructure is owned by LWSC even if not funded by LWSC. Even facilities funded by donors and handed over to the WT representing the community and is responsible for all operations and maintenance, the LWSC owns the assets.

LWSC's water tariff collection policy is to install 100% post paid meters by the end of the next fiscal year for efficient collection. The payment of water tariff by cell phone has been increasing. The operation and maintenance of the project is assumed to be by LWSC's Peri-urban West as described below.

(1) Operation and maintenance by LWSC

LWSC directly manage the water supply system with RDC (Resident Development Committee), which was introduced at JICA's George Compound. The RDC collects water tariff and the management of the collected water tariff and the technical aspects of the facility will be handled by staff dispatched by LWSC. Currently, three branch offices (Peri-urban West, Peri-urban East, and Peri-urban South) have been established for operation and maintenance for peri-urban area, and the Peri-urban West office is housed in a building constructed for JICA's George Compound project. The areas under the jurisdiction of each branch are shown in Figure-23.



Source：Proposed Water Supply Interventions in Selected Peri-urban Areas and other areas of Lusaka (LWSC), 2020

Figure-23: Jurisdiction of LWSC Peri-urban Branch Office

(2) Operation and maintenance by Water Trust (WT)

Care International established Water Trusts (WTs) to provide community-owned and managed water and sanitation services in peri-urban settlements in Lusaka from 2001 to 2005. The WT was established in the unplanned settlements of Kanyama、Chaisa、Chibolya、Chazanga、Chipata、Garden, while the other five unplanned settlements (Mtendere, Kabanana, Mandevu / Marapodi, Jack, and Chunga) were handed over to LWSC after construction of water facilities.

WT has a five-year service management contract with LWSC to provide water supply services; WT consists of a Board of Directors, headed by a Board of Trustees, and a supporting management team. The main role of the board is to supervise and guide the management team, which is required to manage the water supply system on a daily basis and report regularly to the board.

Water tariff collected are deposited in two separate bank account for the improvement/expansion of

the system and for the maintenance of operations. LWSC's policy is to continue to support the current activities of WT, but in the long term, LWSC will be directly responsible for providing water and sanitation services in WT's service area, and WT will only be responsible for meter reading and water tariff collection on behalf of LWSC.

3.4 Selection Process for Target Sites

The background of the selection of the Garden Park as the target area is described below.

3.4.1 Target Areas Requested by Lusaka Water Supply and Sanitation Company (LWSC)

LWSC requested five unplanned settlements for the study, which are (1) Garden Park (House), (2) Kanyama, (3) Bauleni, (4) Kabanana, and (5) SOS, as highly deprived settlements without access to safe water (Figure-24: Location of requested unplanned settlements).

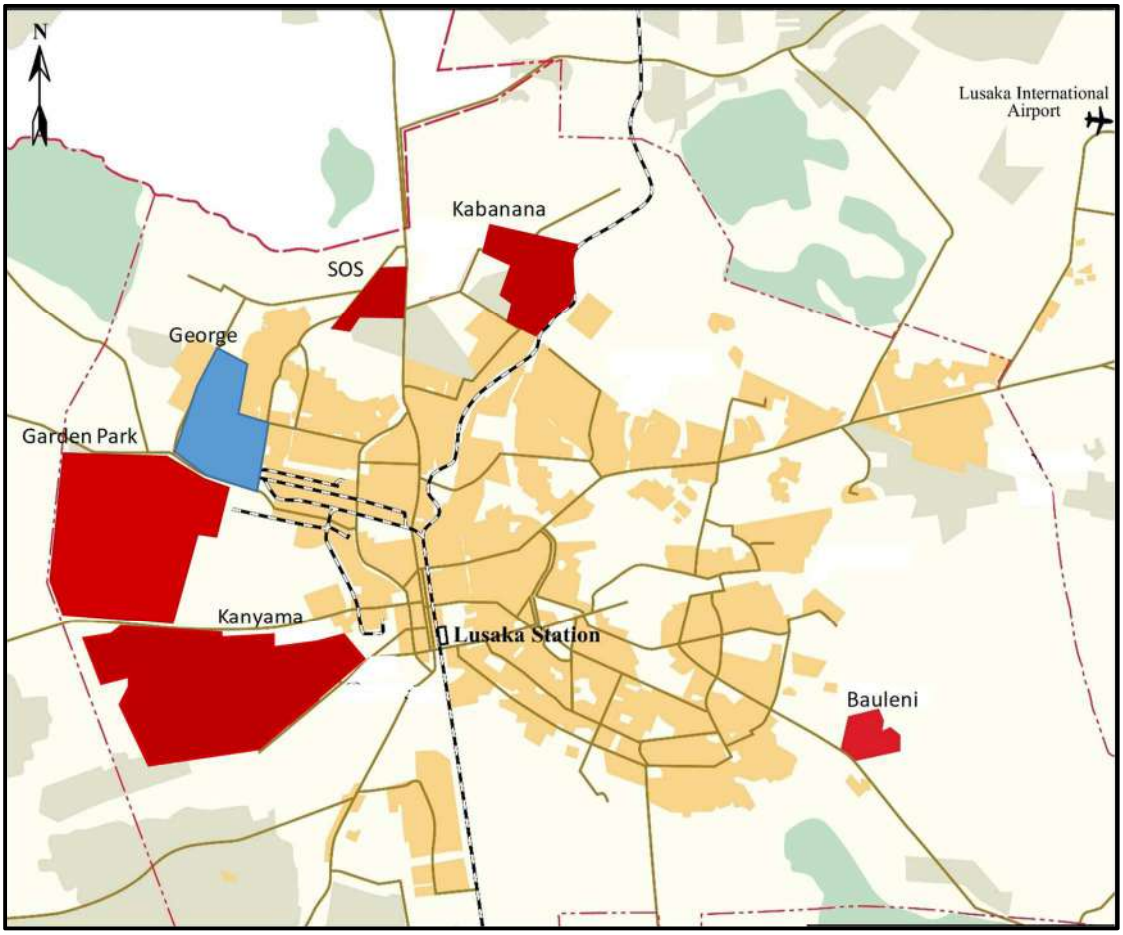


Figure-24: Location Map of Requested Unplanned Settlements

3.4.2 Current Status of the Target Unplanned Settlements

The following is the current status of access to safe water obtained from the field study.

(1) Garden Park

There are no piped water supply system, and unprotected shallow wells and boreholes with hand pumps are the main water sources.

	
Shallow Well	Borehole with handpump

(2) Kanyama

In the Kanyama unplanned settlement, there are piped water supply system operated by the Water Trust (WT) and piped water supply system operated by the LWSC (Annex 4-2).

1) Piped water supply system operated by Kanyama WT

The water supply system with four boreholes and five elevated water tanks, constructed with support from Care International, serves approximately 60,000 households. In the past, the operation was not viable due to low water tariff collection rate of about 10% and unclear management of funds, but LWSC dispatched a manager to supervise the system, and now the water tariff collection rate is improved to about 80-85%. The WT is able to cover the costs required to maintain the existing system, but has not been able to recover the funds needed to expand the water supply system.

	
Elevated Water Tank	Borehole as water source

2) Piped water supply system operated by LWSC (Peri-urban South)

The water source is two boreholes with a pumping rate of approximately 140 m^3/hour in total. The water is distributed by direct pumping as there is no water distribution reservoir.

	
Borehole as water source	Borehole as water source

(3) Bauleni

There is a piped water supply system operated by LWSC (Peri-urban South); seven boreholes were constructed but only three boreholes are in service; one of the three boreholes can only operate for six hours per day due to low yields. The water distribution network covers the entire area, but due to the limited capacity of the boreholes, the water supply area is divided into two sections and water is supplied every other day. In addition, there are some areas water is supplied on a weekly basis.

	
Water Source: Borehole	Unused Elevated Water Tank and Kiosk

(4) Kabanana

There is a piped water supply system managed and operated by LWSC (Peri-urban West: George). 2 boreholes are used as the water source, but the yields of the boreholes is low and water is only supplied for 2 hours a day, from 6 to 7 am and from 4 to 5 pm. On the other hand, the water distribution network covers almost the entire area. There is only one public tap stand, almost all of the users are serviced

by a yard tap (connected to each house).

	
Elevated Water Tank (300m^3)	Unused Public Tap Stand

(5) SOS

There is a piped water supply system with one borehole (Annex 4-5) operated by LWSC (Peri-urban West: George). But the borehole is currently not supplying water due to low yield of the borehole. Sewer network have been installed in the target area with the support of China, but they are not being utilized due to lack of water flow.

	
Borehole and Machinery House	Elevated Water Tank (10m^3)

3.4.3 Selection of the Target Area

The final target sites were selected through the following process (Figure-25), based on field surveys and discussions with LWSC. As a result, the Garden Park area (currently not served by LWSC) was selected.

(1) Selection Flow of Target Areas

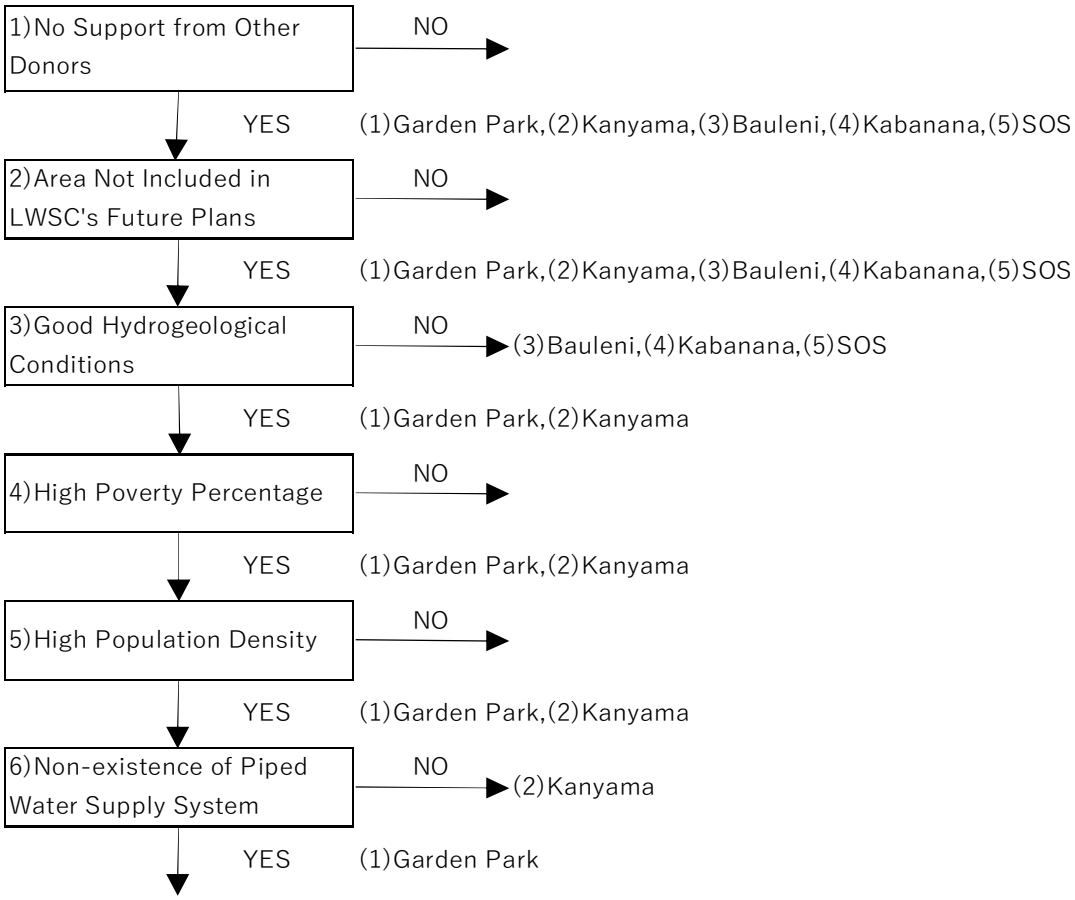


Figure-25：Selection Flow of Target Areas

(2) Selection of Target Area

1) No Support from Other Donors

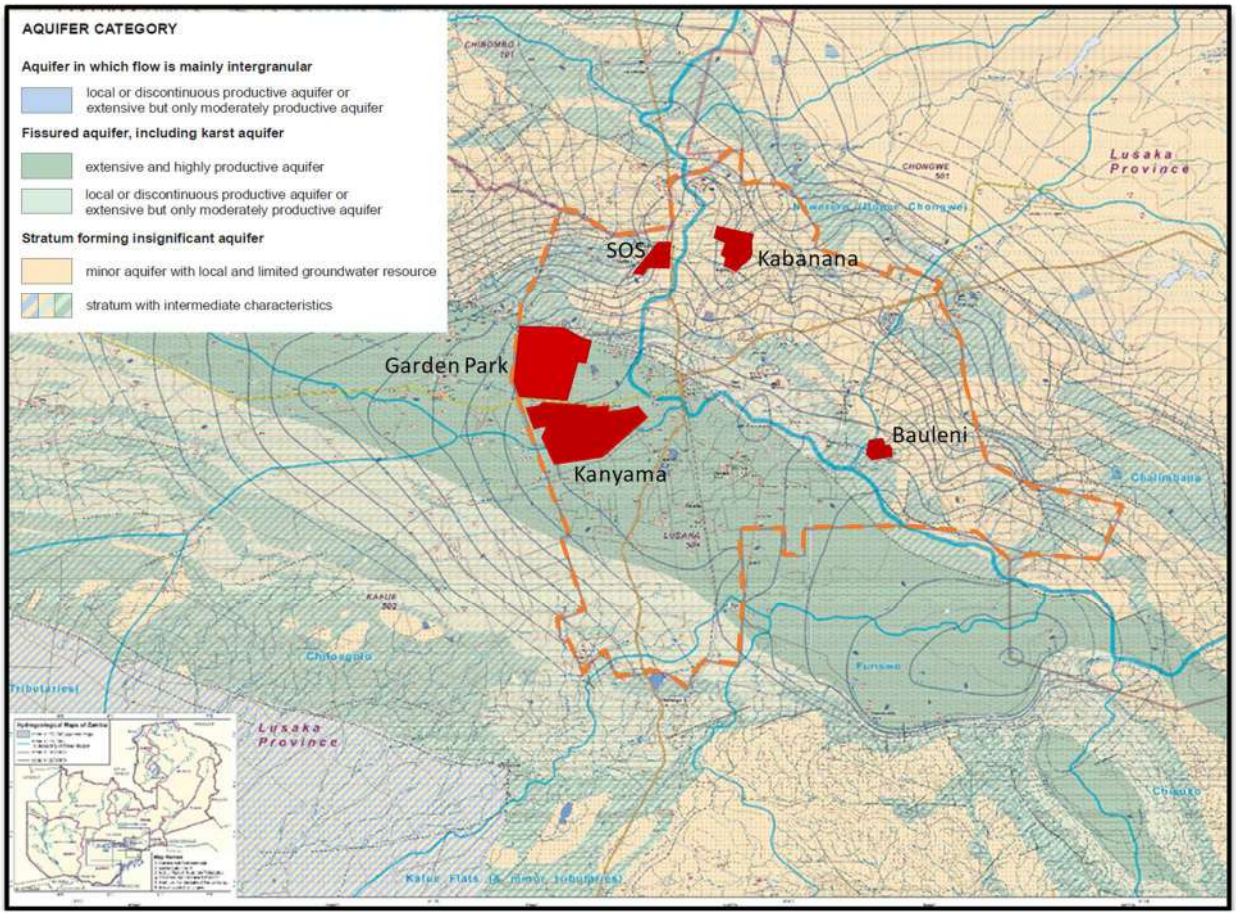
No other donors or other support is confirmed in all target areas.

2) Area Not Included in LWSC's Future Plans

All target areas have been included in LWSC's future plan through 2025 but have not been implemented due to budget shortfalls.

3) Good Hydrogeological Conditions

As shown in Figure - 26, only Garden Park and Kanyama are considered suitable for use of groundwater as water sources.



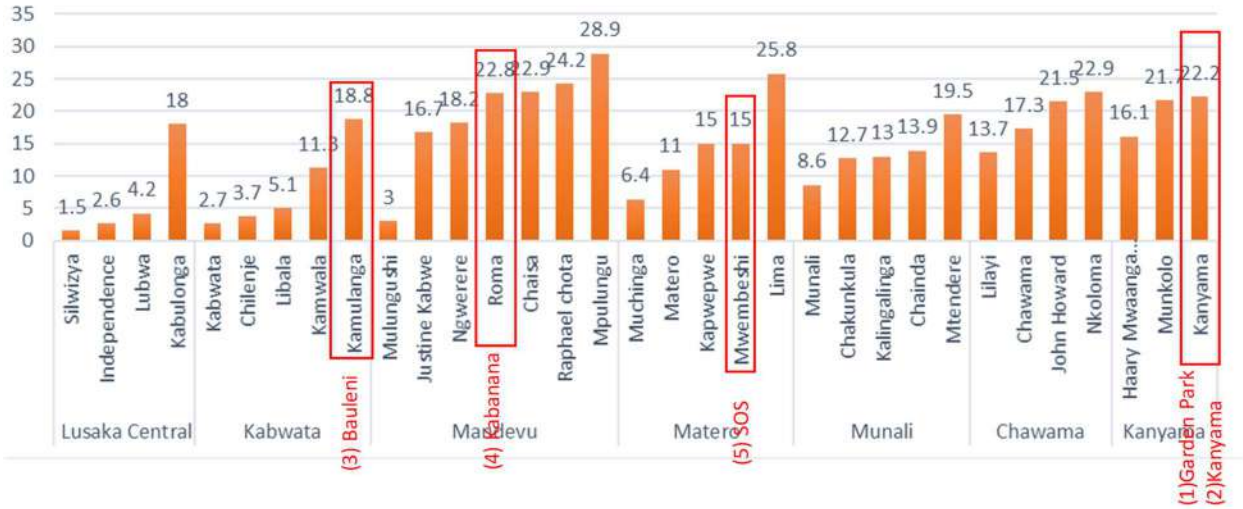
Source：Compiled by the Survey Team based on Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)

Figure-26: Groundwater Potential Map of Lusaka

4) High Poverty Percentage (in terms of access to health, education, water and sanitation)

Figure-27 shows the poverty levels based on access to health, education, safe water and sanitation for each Ward in the latest census (2010).

Among the wards surveyed, the Mwembeshi ward, to which Kabanana belongs, and the Kanyama ward, to which Garden Park and Kanyama belong, have a high percentage 22.8% for Mwembeshi ward and 22.2% for Kanyama ward.

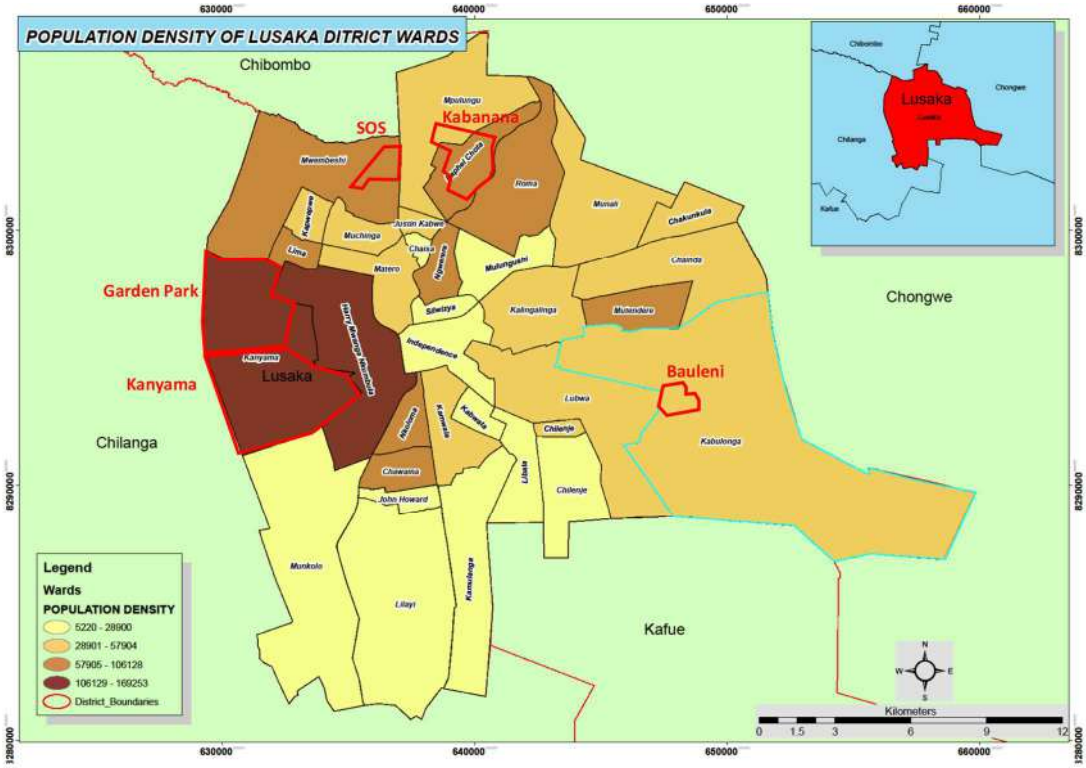


Source：LCC 2022

Figure-27：Poverty Level (in terms of access to health, education, water and sanitation)

5) High Population Density

High population density is considered important factor for the efficient provision of water services. The latest information obtained from Lusaka City Council indicates that Garden Park and Kanyama have a higher population density than other unplanned settlements, as shown in Figure - 28.



Source：Compiled by the Survey Team based on The Central Statistical Office of Zambia (CSO), 2021

Figure-28：Population Density of Lusaka City

5) Non-existence of Piped Water Supply System

As shown in Annexes-4, piped water supply facilities already exist in all unplanned settlements except Garden Park.

3.5 Site Condition

3.5.1 Location (Land Acquisition, Land Use, Pollution causing Facilities, etc.)

(1) Location of the Target Area

Lusaka is rapidly expanding because of the spontaneous expansion of unplanned residential areas in and around the city center, which were not recognized in the original city plan. These are called "compounds," and with the exception of a few areas, they have expanded spontaneously and rapidly without urban planning, and are not zoned. With the exception of the city center, the roads inside the residential areas are unpaved, and the infrastructure for daily life is inadequate.

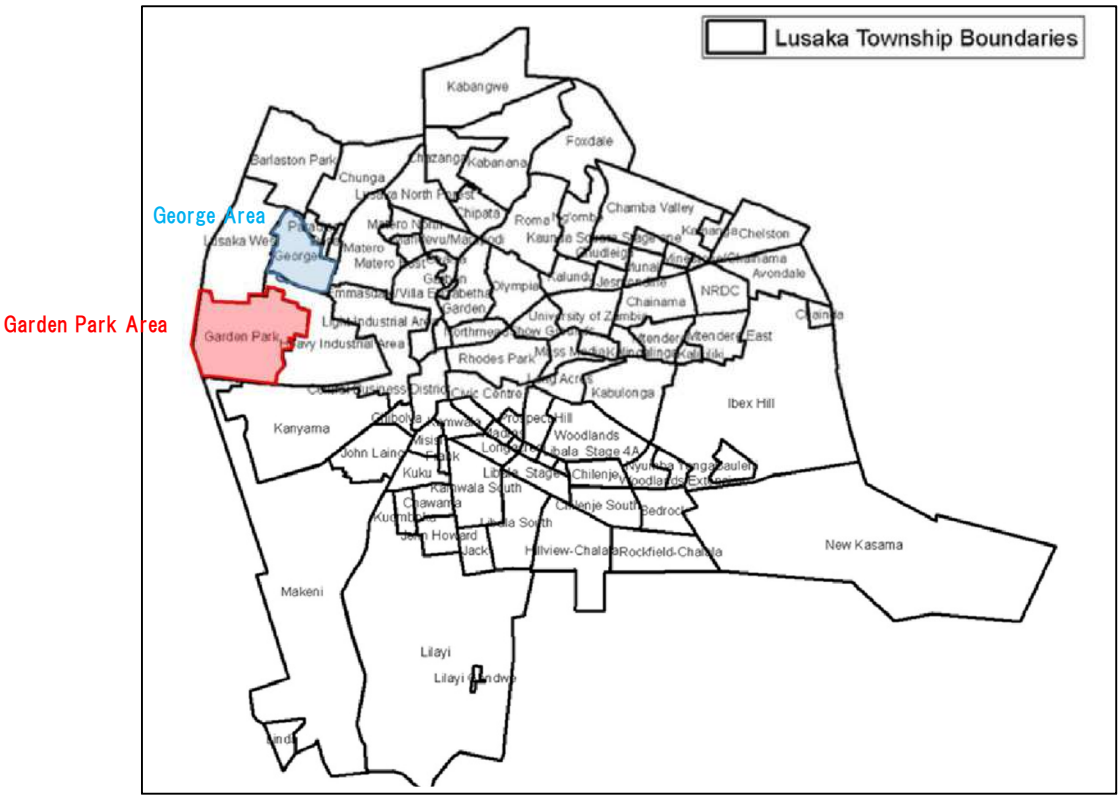


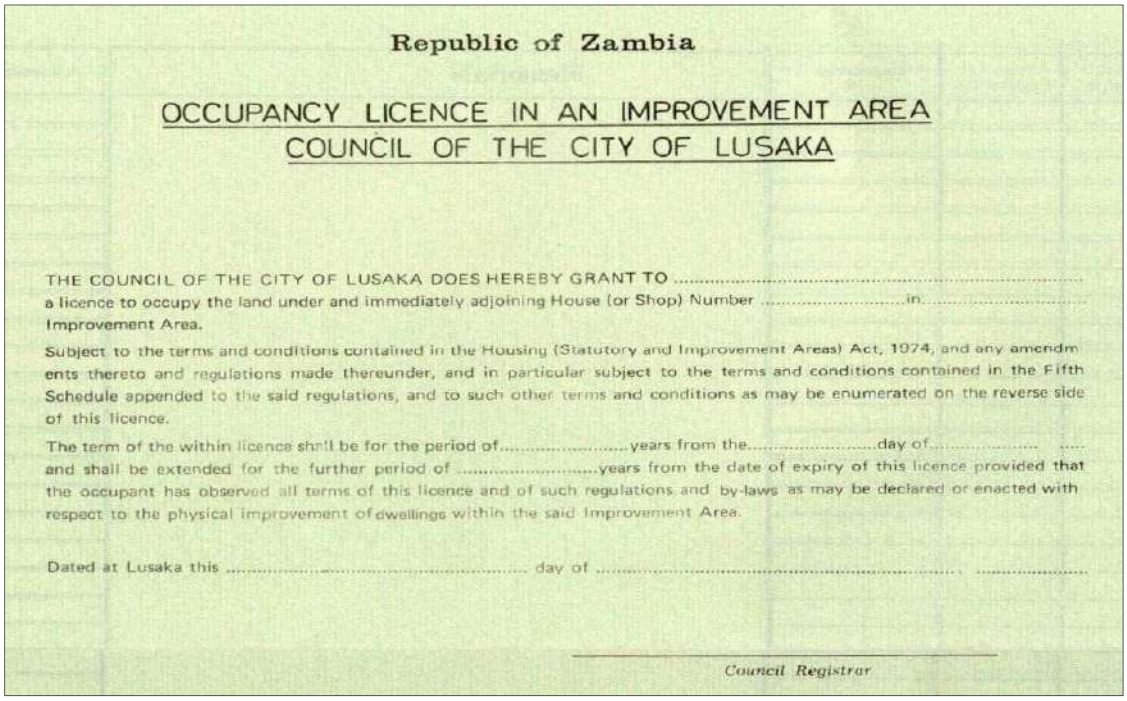
Figure-29: Boundaries within Lusaka City

The Garden Park is a large residential area located west of the city of Lusaka. It is one of the largest (with a population of approximately 100,000) and most densely populated unplanned residential areas in the city. It is home to many low-income and poor people who live without adequate services from the municipality. The majority of them do not have access to safe water and frequently suffer from

cholera epidemics. Many of them use shallow wells as their water source, and due to the effects of climate change, including severe droughts, many of them do not have year-round water supplies. The George District, where water supply facilities were constructed through grant assistance in 1993-1996, is located to the north of the proposed area (blue line).

(2) Land Ownership

Zambia is one of the countries that officially provides some degree of tenure security to informal settlers. In 1974, infrastructure development in some informal communities was undertaken under the Lusaka Squatter Upgrading Project (LSUP), a development program supported by the World Bank. In line with the World Bank's policy of financing urban development in developing countries, the program provides basic housing infrastructure, community services, loans for building materials, and tenure security by facilitating land regularization and titling. In response, the Government of Zambia enacted the Housing (Statutory and Improvement Areas) (HSIA) Act of 1974, which mandates the provision of security of tenure and basic social facilities to informal settlements. It also declared informal settlements as Improvement Areas, a major policy shift from demolition to regularization and servicing. The right for tenure in unplanned settlements in Lusaka is secured through the issuance of Occupancy Licenses (Figure-30). The Occupancy License grants the holder the right to occupy the property for a period not exceeding 30 years, and can be extended or renewed.



Republic of Zambia

OCCUPANCY LICENCE IN AN IMPROVEMENT AREA
COUNCIL OF THE CITY OF LUSAKA

THE COUNCIL OF THE CITY OF LUSAKA DOES HEREBY GRANT TO .....
a licence to occupy the land under and immediately adjoining House (or Shop) Number .....in.....
Improvement Area.

Subject to the terms and conditions contained in the Housing (Statutory and Improvement Areas) Act, 1974, and any amendments thereto and regulations made thereunder, and in particular subject to the terms and conditions contained in the Fifth Schedule appended to the said regulations, and to such other terms and conditions as may be enumerated on the reverse side of this licence.

The term of the within licence shall be for the period of.....years from the.....day of..... and shall be extended for the further period of .....years from the date of expiry of this licence provided that the occupant has observed all terms of this licence and of such regulations and by-laws as may be declared or enacted with respect to the physical improvement of dwellings within the said Improvement Area.

Dated at Lusaka this ..... day of .....

Council Registrar

Source：Lusaka City Council 2022

Figure-30: Occupancy License

3.5.2 Natural Conditions

(In Particular, Descriptions of Water Sources such as Precipitation, River and Groundwater)

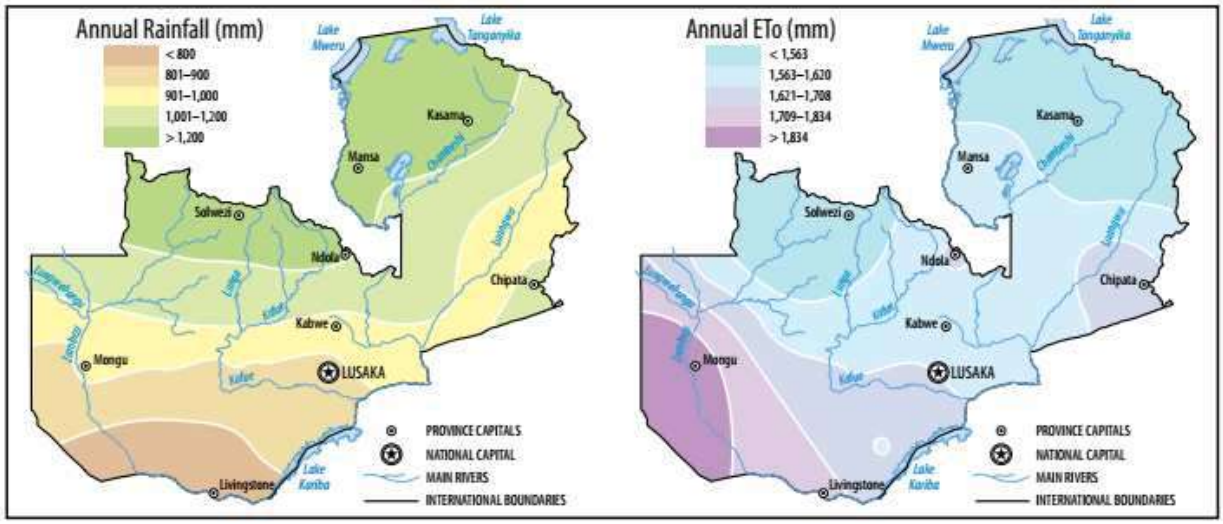
(1) Precipitation

Although Zambia is located in the tropics in terms of latitude, it is situated on a plateau between 900 m and 1,500 m above sea level, and thus has a relatively mild subtropical or tropical savanna climate. The seasons can be broadly classified into three categories as follows.

Hot dry season : August to October, temperatures 26-38°C
Warm rainy season : November-April, temperatures 27-34°C
Cool dry season : April-August, temperatures 13-26°C

The rainy and dry seasons are distinctly different, with no rainfall at all during the dry season from June to August. The rains are brought by the ITCZ and sometimes become storms and hail with thunderstorms. This region is particularly affected by the ITCZ. El Niño/Southern Oscillation (ENSO) also has a strong influence in some years and tends to bring more precipitation and flooding in the north during this period. On the other hand, La Niña years show the opposite trend.

Regionally, as shown in Figure-31, there is less (less than 800 mm) and more evapotranspiration (more than 1,800 mm) in the south. On the other hand, the central and northern regions have more (more than 1,200 mm) and less annual evapotranspiration.



Source：World Bank, Zambia Managing Water for Sustainable Growth and Poverty Reduction, 2009

Figure-31: Distribution of Rainfall and Evapotranspiration

(2) Topography

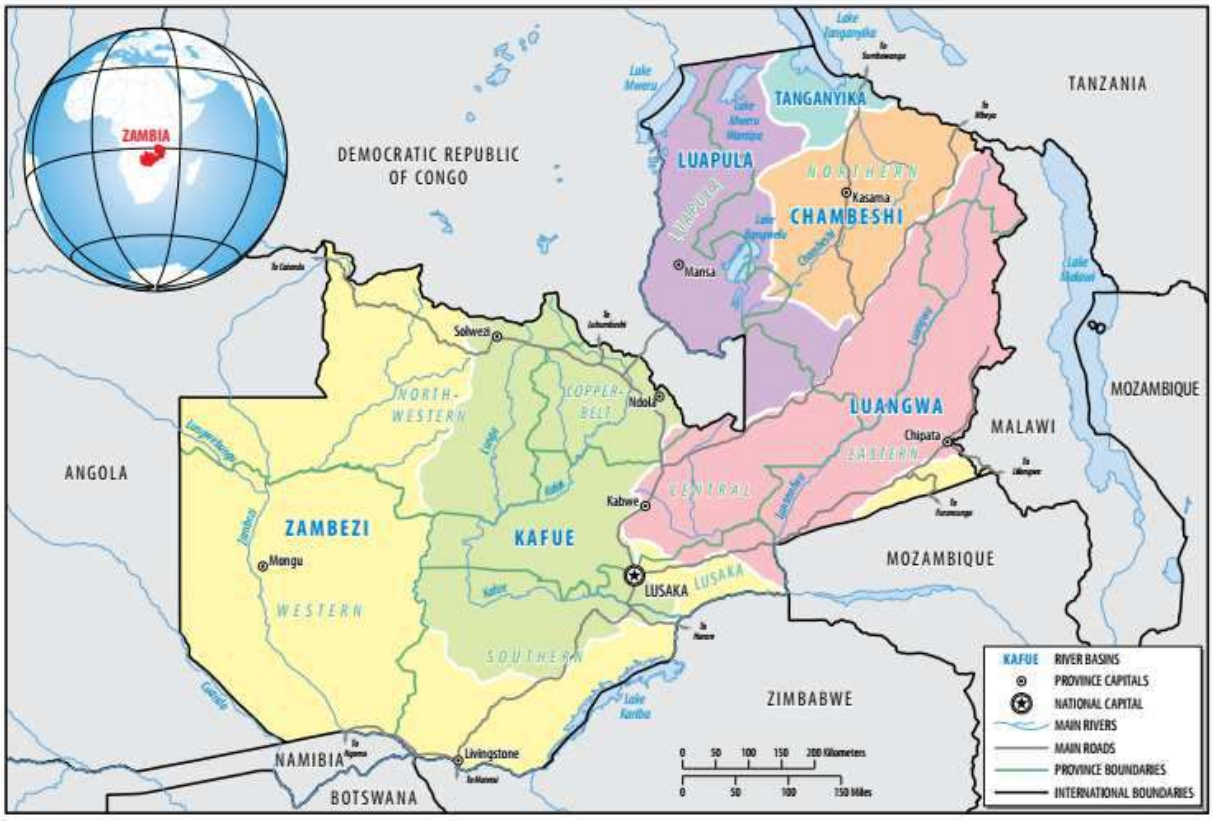
Lusaka is located on a plateau at an elevation of 1,200 to 1,300 meters above sea level. The topography depends on geological conditions, with dolomite and limestone areas being flat with a Kallenfeld

topography, while schist and quartzite areas have a hilly topography. The urban area of Lusaka is formed on the schist hills and is slightly higher than the surrounding area, making it the center of the watershed. Therefore, there are no major rivers flowing through the city of Lusaka, as rivers are centered here and develop in all directions. The ground surface is covered with sandy laterite layers. In general, the laterite layers are thicker on the hillsides, which are mainly schist, and thinner in the dolomite and limestone areas.

(3) Surface water potential

Zambia's renewable water resources are about 105 km^3 per year, of which about 80 km^3 is recycled domestically. Per capita renewable water resources are estimated at about 8,700m^3 per year, well above the Sub-African average (7,000m^3 per capita per year) and the world average (8,210m^3 per capita per year).

The country of Zambia has 72% of its land area within the Zambezi basin, which includes the upper reaches of the main Zambezi River and the entire Kafue and Luangwa River basins (Figure-32). The remaining 28% belongs to the Upper Congo River Basin, which includes the catchments of the Luapula, Chambesi, and Tanganyika rivers.



Source : World Bank, Zambia Managing Water for Sustainable Growth and Poverty Reduction, 2009

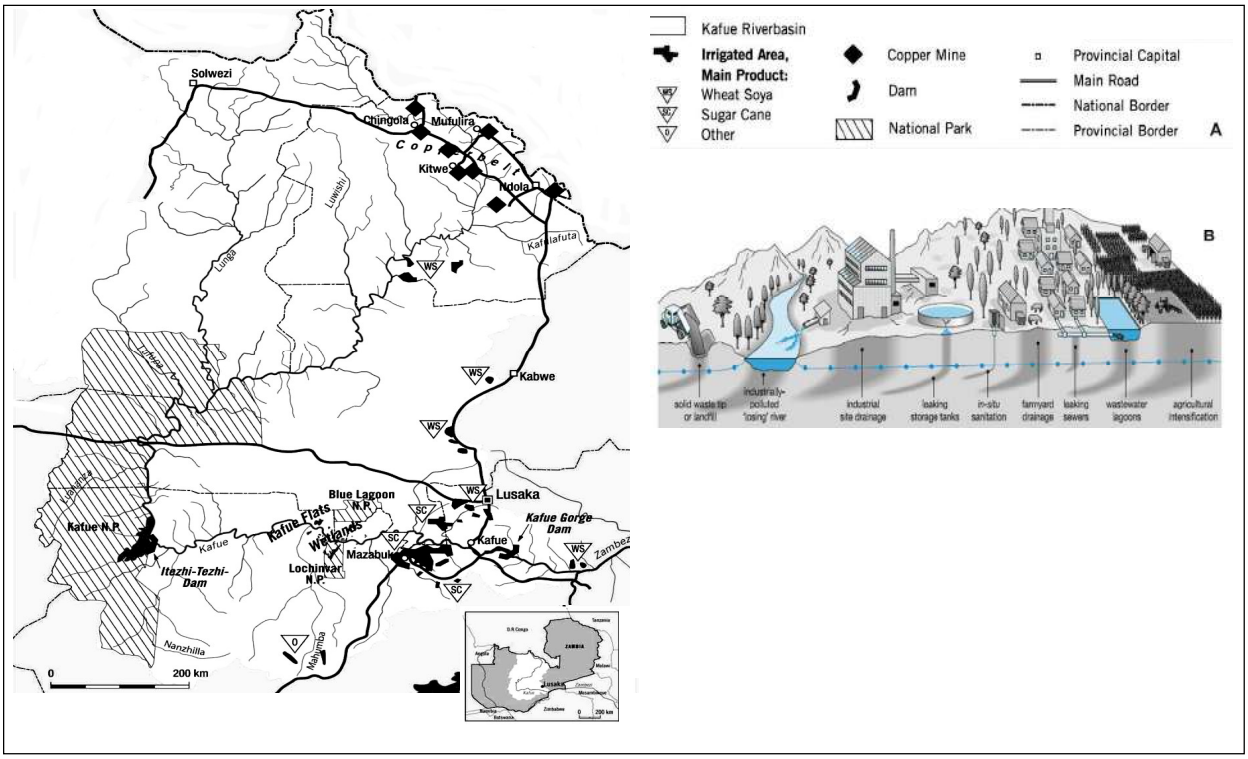
Figure-32: Surface Water Basin Map

Table-12 shows the length in Zambia, total area (within and outside Zambia), their respective contributions to surface water flow, and annual runoff. In years of high precipitation, the annual runoff can be as high as 130 km^3, but in years of severe drought, it drops to nearly half, 68 km^3.

Table-12: Basin Area and Annual Runoff

Sub-Basin	Length in Zambia (km)	Basin area (km^2)			% contribution to surface water potential	Annual Run-off (km^3)
		Total	In Zambia	Outside Zambia		
Zambezi	1,700	687,049	268,235	418,814	36.36	41.75
Kafue	1,300	156,995	156,995	-	8.40	9.88
Luangwa	850	147,622	144,358	3,264	19.44	22.32
Chambeshi	560	44,427	44,427	-	7.62	8.75
Luapula	615	173,396	113,323	60,073	26.25	30.14
Lake Tanganyika	250	249,000	15,856	233,144	1.73	1.99
Total	**5,272**	**1,458,489**	**743,194**	**715,295**	**99.8**	**114.83**

Source：National Water Resources Master Plan for Zambia, JICA-MEWD, 1995



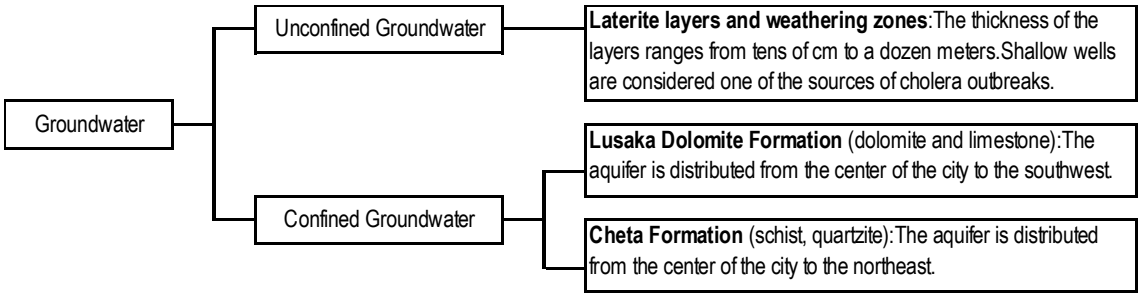
Source：Uhlendahl, et al., 2011、GWMatePublications.

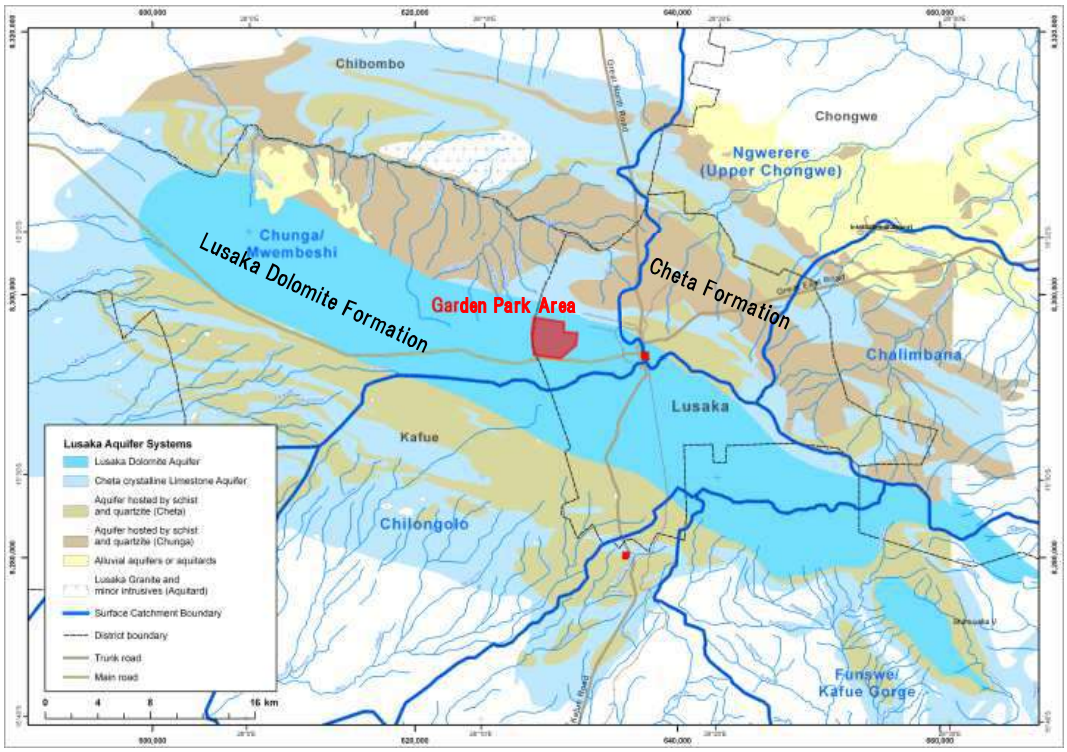
Figure-33: Map of Kafue River Basin

The Kafue River Basin supports approximately 45% of the country's population and a wide variety of activities that utilize its water. Continued economic growth and a steady increase in population have increased the risk of polluting water resources, especially in the Kafue watershed, including mining, commercial agriculture, hydropower, industrial reservoirs, on-site sanitation, farm drainage, wastewater lagoons, and leaking sewage.

(4) Groundwater Potential

The city of Lusaka and its surrounding area have abundant groundwater, but the amount of groundwater varies considerably depending on the geological conditions. As shown in Figure-34, groundwater is classified into two types: unconfined groundwater in lateritic and weathered zones at the surface and confined groundwater flowing through hard rock fractures and fault zones at depth. The Garden Park area is located in the Lusaka Dolomite Formation.





Source： Federal Institute for Geosciences and Natural Resources , Hannover, Germany.

Figure-34: Groundwater Potential Map around Lusaka

In the target area of this project, the construction of piped water supply system using boreholes as the source was carried out in the previous grant aid project (in George area), and as mentioned above, the geology is also the same dolomite and limestone. As shown in Table-13, the average depth of boreholes constructed through the grant aid project was 105.8 m and the average pumping rate was 79.1 m^3/h, which is relatively high, and the same amount of water can be expected in the project area because of the same geological conditions.

Table-13: Drilling Results in George Area

BH Number	Borehole Depth (m)	Borehole Diameter (mm)	Yield (m^3/h)	Static Water Level (m)	Dynamic Water Level (m)	Geology
01	60.0	200	80.0	3.9	5.58	Sand, Dolomite/Limestone
02	100.0	200	80.0	4.3	12.2	Dolomite/Limestone
03	105.0	200×250	50.0	3.4	21.2	Limestone
04	108.0	200×250	92.0	4.9	12.0	Limestone
05	137.0	200×250	50.0	2.8	14.74	Limestone
06	98.0	200×250	106.0	2.1	17.7	Limestone
07	104.0	200×250	100.0	2.9	6.5	Limestone
08	134.0	200×250	75.0	3.3	5.4	Limestone
Average	105.8		79.1	3.5	11.9	

3.5.3 Access

The Garden Park area is located in the northwestern part of downtown Lusaka, approximately 15 minutes by car to the city center. The national road is maintained on the north, west, and south sides of the subject area, and the pavement is in good condition.

The residents use small shared-ride buses (minibuses) and other vehicles that operate along the national highway to get to and from the city.

3.5.4 Electric Power, Means of Communication

Most of Zambia's electricity is generated, transmitted, and distributed by the Zambia Electricity Supply Corporation Limited (ZESCO). According to the U.S. Agency for International Development (USAID), Zambia has an installed generation capacity of 2,800 MW, 85% of which is hydropower. The national average electricity access rate is 31%, with 67% of urban and 4% of rural areas having access to electricity. In Lusaka, the electricity is supplied by ZESCO and is distributed throughout the city, making the electricity situation relatively good.

Cell phones, the Internet, and other means of communication are widely available, and the environment is generally unencumbered.

3.5.5 Safety

The Japanese Ministry of Foreign Affairs (MOFA) has issued a "Level 1: Exercise caution" warning for Lusaka. The number of new cases of the COVID-19 has remained below 50 per day, so the survey can be conducted without any particular concerns.

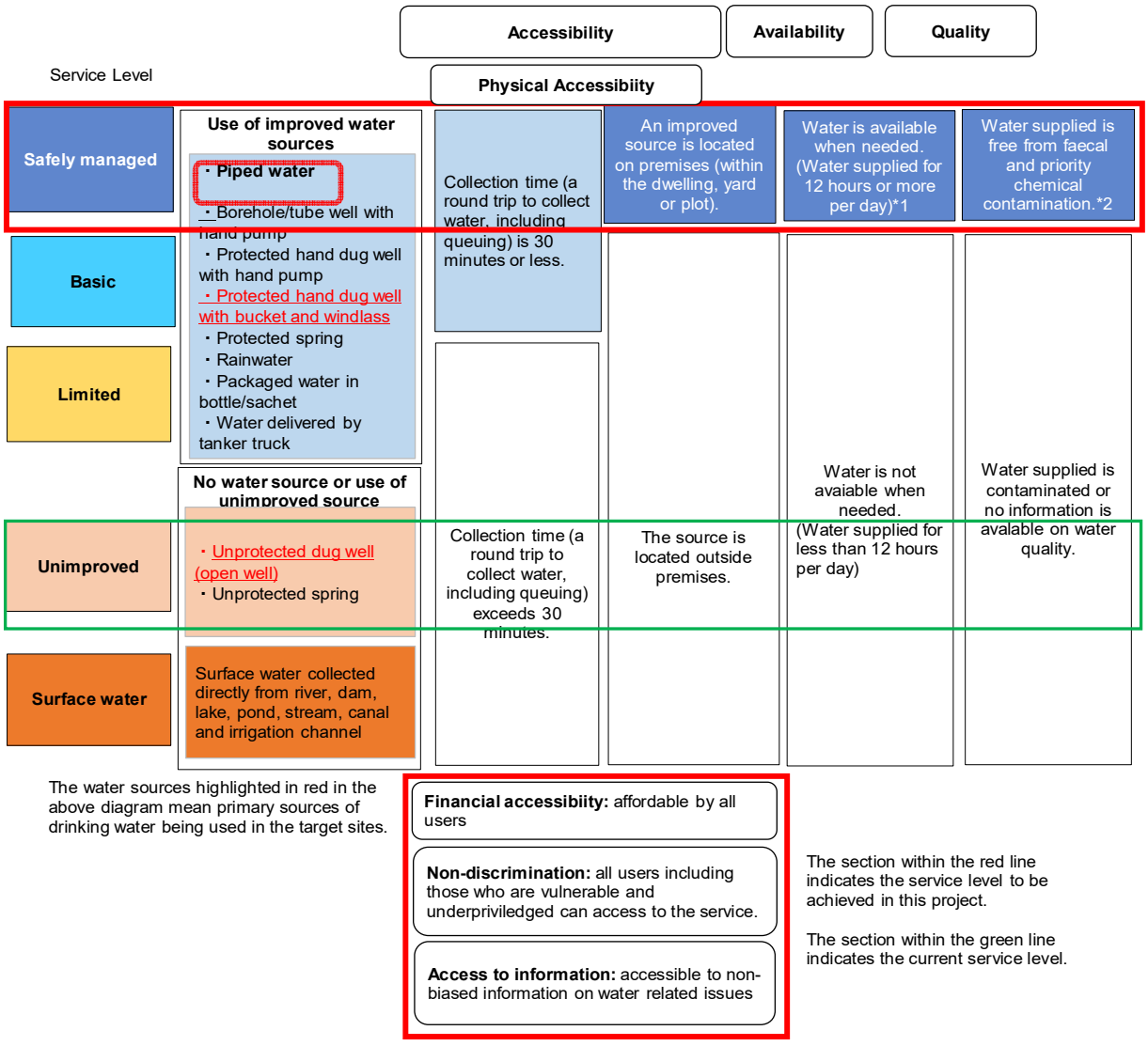
Chapter 4 : Effectiveness and Impacts of the Project

Chapter 4: Effectiveness and Impacts of the Project

4.1 Effectiveness of Project Implementation

4.1.1 Extent of Solving Current Situation of Water Supply Sector

The water supply improvement goal of the Project is shown in the red frame in Figure-35. This figure is based on the Drinking Water Ladder used by the Joint Monitoring Programme (JMP) by World Health Organization (WHO) and United Nations Children's Fund (UNICEF) to monitor SDGs Target 6.1 "By 2030, achieve universal and equitable access to safe and affordable drinking water for all".



Source：Compiled by the Survey Team based on WHO Safely managed drinking water – thematic report on drinking water 2017

Figure-35: Scope of the Project's Water Supply Improvement Achievement Targets

The goal of this project is to achieve "Safely Managed" services. On the other hand, it is necessary to evaluate the details of the current access situation based on the results of the household survey in the future. However, it is considered to remain in "unimproved service (unimproved)" because there is no LWSC service and the field survey confirmed poor installation of concrete well covers and hand pump aprons.

The following section summarizes the quantitative and qualitative effects expected from the implementation of this project. The currently anticipated indicators and associated SDG monitoring indicator numbers are listed below.

(1) Quantitative Evaluation

Table-14: Quantitative Effects expected from this Project

Indicator	Base value	Target value
Population using safely managed drinking water (persons)	0	125,000

(2) Qualitative Evaluation

a) Reduction of diarrheal disease (corresponding to SDG 3.9.2)
b) Reduction of stunting in children (corresponding to SDG 2.2.1)
c) Improve the environmental health of schools and health facilities (health centers)
d) Reduction of time required for fetching water (including waiting time)
e) Reduction of groundwater contamination

4.1.2 Extent of Solving Problems of Drinking Water Supply

Since the project is targeted to unplanned residences that have no piped water supply facilities at all and are at high risk of groundwater contamination, the project is expected to contribute to solving Lusaka City's problem of insufficient capacity of water supply facilities and water contamination of water sources.

4.1.3 Extent of Solving Problems related to Sanitation and Waterborne Diseases

Water supply to unserved areas is expected to prevent COVID-19 infection and reduce the number of patients with waterborne diseases.

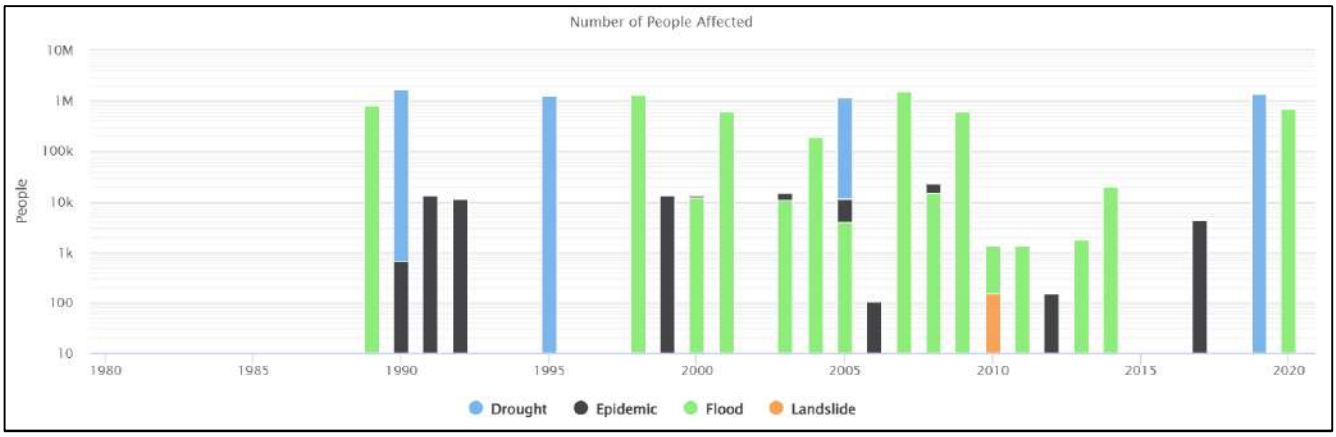
4.2 Impacts from Project Implementation

4.2.1 Political Impact

The National Development Unity Party's (UPND) manifesto on water and sanitation for the period 2021-2026 is anchored on Vision 2030, which aims to ensure that 100% of the population in both urban and rural areas have access to safe drinking water and improved sanitation facilities. Vision 2030 identifies that access to safe water in peri-urban areas is poor, inadequate, and insecure. It would have a high political impact to develop a water supply facility in the Garden Park area since Lusaka City Hall and LWSC have identified the area having the most problems regarding access to safe water.

4.2.2 Social Impact

Climate change is negatively impacting the ongoing efforts of the Zambia in poverty reduction, food security and sustainable ecosystem conservation. As shown in Figure-36, the frequency and intensity of droughts and floods have increased over the past two decades, threatening the natural environment and society in the form of reduced water supply and degraded water quality.



出典：climateknowledgeportal.worldbank.org/country/zambia/vulnerability

Figure-36：Major Natural Disasters (1980-2020)

The main characteristics of climate change in Zambia since the 1960s include a decrease in average annual precipitation but more pronounced variability during the rainy season and an increase in the frequency and intensity of floods caused by extreme weather events. Floods caused by extreme increases in precipitation have resulted in contamination of drinking water and living conditions, and have led to the spread of waterborne diseases such as cholera and diarrheal diseases.

If immediate action is not taken to address the negative impacts that are being caused by the effects of climate change due to global warming, it could lead to epidemics of waterborne diseases such as

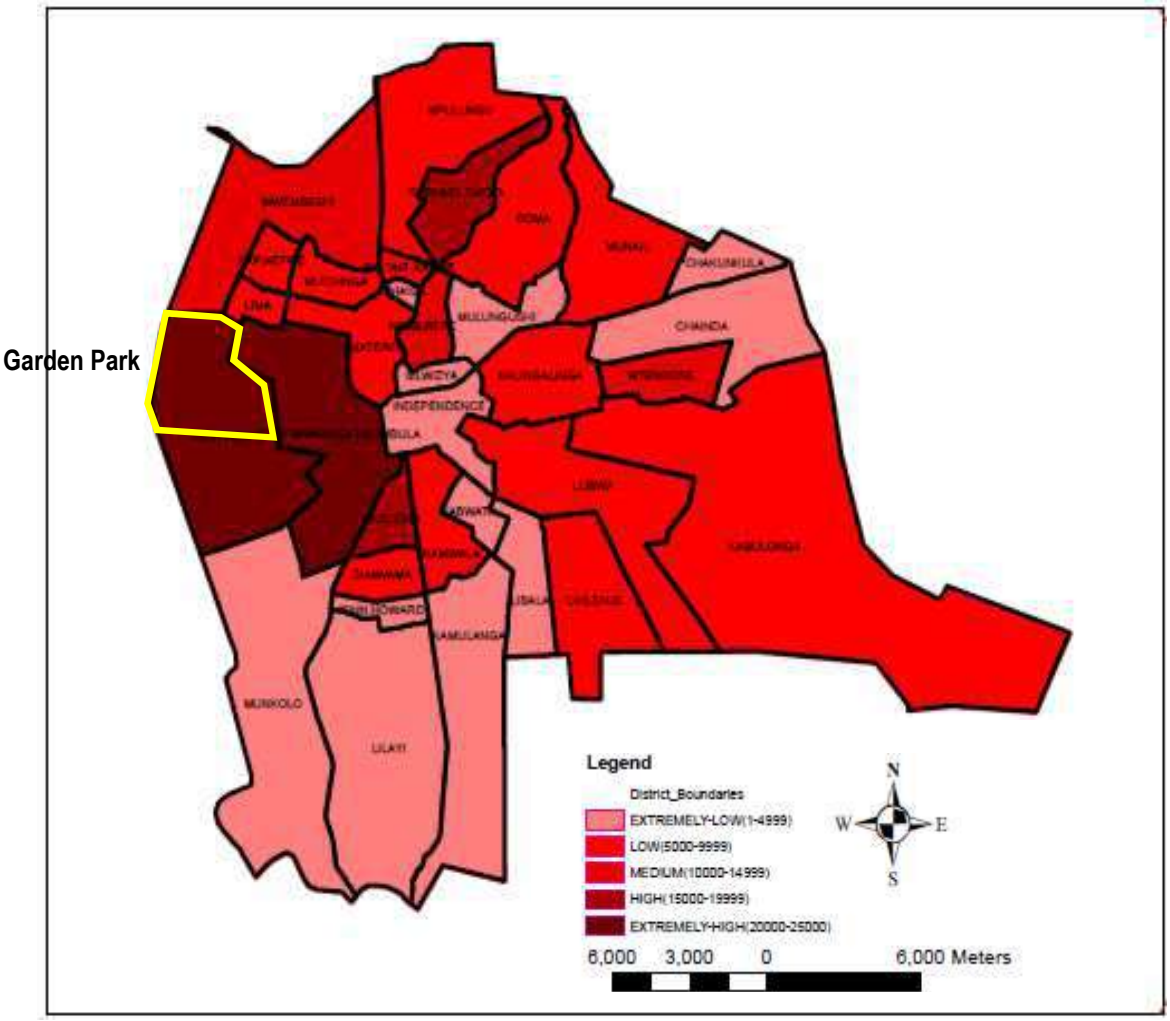
cholera, typhoid fever, dysentery, and other diarrheal diseases, which could adversely affect many aspects of the economy, from urban labor force and education to trade. For the central and local governments of the Zambian, the increased burden of overhead costs for the medical expenses will likely need to be compensated by taking limited financial resources from other critical sectors.

The poor in unplanned settlements will be adversely affected at the household and individual level as well, as they will be unable to work due to the increase in these diseases and will have to increase their expenses due to high medical costs. The risk of disease outbreaks is considered particularly high in densely populated areas where there is no access to safe water and sewage facilities and where waste disposal are underdeveloped.

In Zambia, HIV/AIDS is a major challenge that undermines child survival and other development outcomes, with a very high national HIV prevalence rate of 11.3% (2018) among adults aged 15-49. Women are particularly disadvantaged. According to the Zambia Population Health Survey (2018), the HIV prevalence rate for women aged 15-49 is 14.2%, compared to 7.5% for men of the same age group, with women nearly double the prevalence rate compared to men. The epidemic is more prevalent in urban areas than in rural areas, with a particularly high incidence in Lusaka among other cities in the country.

People living with HIV/AIDS are at higher risk of developing diarrheal disease due to their compromised immunity, which makes them more likely to develop more frequent and severe disease and to die. Therefore, WASH is an important intervention for people living with HIV/AIDS in certain settings.

Figure-37 shows the estimated number of HIV/AIDS patients in each ward in Lusaka, showing that the Kanyama ward, to which Garden Park and Kanyama belong, is classified as Extremely High and Ward with the highest number of HIV/AIDS patients.



Source：Lusaka City Council 2022

Figure-37: Area with the Highest Number of HIV/AIDS Patients

By providing safely managed drinking water in the target areas where HIV/AIDS patients are particularly prevalent, the project is expected to significantly reduce diarrhea among HIV/AIDS patients, improve their quality of life, and enable their anti-HIV medications to work effectively. In addition, access to safe water is also expected to have far-reaching social benefits that will reduce the burden on caregivers and allow them to devote more time to other activities, such as school and income-generating activities.

4.2.3 Economic Impact

The city of Lusaka, the main city in Zambia, has been experiencing stable economic growth, but it is inadequate in terms of water supply. It is feared that the current level of water service will be a hindrance to growth. The construction of facilities to meet the growing demand for water is essential for economic growth.

4.2.4 Technical Impact

Through a series of construction works, including water source (borehole) construction, water pipe installation, water distribution reservoir construction, and water supply facility construction, the technical impact on the local community is expected to be significant. The technical transfer of water supply system design and application capabilities through Japanese cooperation will be meaningful not only for LWSC, but also for the water supply sector in Zambia.

4.2.5 Diplomatic and Public Relations Impact

In recent years, China, which has been promoting infrastructure exports under its "One Belt, One Road" giant economic zone concept, has been more emphasizing its presence in Zambia by aggressively financing public construction projects and large-scale infrastructure development projects in the country.

Improving access to safe water in the peri-urban areas of Lusaka, the capital of Zambia, is a project that will directly contribute to the economic development and improvement of people's lives, which is a challenge for Zambia.

The project in the high-profile capital city of Lusaka will further increase the presence of Japan's contribution, and is expected to have a great impact diplomatically and in terms of public relations.

Chapter 5 : Project Feasibility

Chapter 5 : Project Feasibility

5.1 Results of Comparison with Main Alternatives

There are no alternative plans for this project.

5.2 Organizational Relevance and Sustainability of Project Implementation

5.2.1 Organizational Capacity for Management

LWSC's income and expenditures are in an improving situation, and the company is considered to have sustained appropriate management according to various circumstances.

Table-15 shows the major operation and maintenance costs, including labor, chemicals, maintenance, and energy costs, and the ratio of operation and maintenance costs to total revenues from 2014 to 2021. It should be noted that electricity costs in 2020 are about 240% higher than in 2019 due to the impact of electricity price increases, but total revenues are able to cover operation and maintenance costs due to corporate efforts such as reducing labor costs.

In addition, operation and maintenance expenses exceeded total revenues in 2014 and 2015, partly due to an increase in maintenance expenses in response to a major water leakage, etc. However, since 2015, LWSC has been able to suppress unexpected expenditures and has been able to cover operation and maintenance expenses with revenues.

Table-15: LWSC Operation and Maintenance Expenses and Total Revenue (in thousands ZMW)

Year	Personnel expenses	Chemicals	Electricity	Maintenance cost	Other Expenses	Total O&M Expenses	Total Revenue/ O&M expenses
2021	159,228	14,678	149,312	4,987	44,552	372,758	106%
2020	162,734	8,623	115,940	5,458	38,952	331,707	112%
2019	169,424	8,821	48,028	5,319	43,868	275,460	102%
2018	151,964	9,274	41,632	6,071	37,110	246,051	127%
2017	130,221	6,824	31,333	4,799	28,167	201,344	134%
2016	143,767	7,289	29,655	3,618	34,554	218,883	122%
2015	132,313	4,445	19,255	20,000	59,272	235,285	88%
2014	123,671	3,988	22,993	10,453	69,895	231,000	98%

Source：NWASCO　Urban and Peri-urban Water Supply and Sanitation Sector Report 2014-2021

5.2.2 Organizational Capacity during Construction

Although the input of the engineers to be involved in construction supervision is to be borne by the

donor agency, LWSC, as the executing agency, is to assign staff to supervise the construction in cooperation with the dispatched engineers.

5.2.3 Organizational Capacity during Operation and Maintenance

In addition to the usual planning, design, construction, and facility operation and maintenance functions, the LWSC has geographic information systems (GIS), mapping capabilities, computer networks, state-of-the-art supervisory control and data acquisition (SCADA) systems, and administrative functions such as governance, management, human resources, fees, collections, disbursements, and finance. In terms of staffing efficiency, "staff per 1,000 water connections," as shown in Table-16, LWSC has shown consistent improvement since 2013, improving to a rating of 5.8 in 2021, a good rating on a 3-point scale (good, fair, and poor).

Table-16: Efficiency of LWSC

Year	Staff per 1,000 Connections	Collection/Staff /month ('000ZMW/month)	Av. personnel cost/Staff /Month('000ZMW/month)	Staff Cost in Relation to Billing and Collection
2021	5.8	50.7	17.6	0.35
2020	6.4	38.6	17.6	0.46
2019	7.7	32.2	15.9	0.49
2018	8.0	28.1	14.0	0.50
2017	9.0	24.3	11.8	0.49
2016	9.0	23.3	13.3	0.57
2015	9.0	20.2	12.4	0.61
2014	9.0	21.3	12.2	0.57
2013	10.0	21.2	10.1	0.48

Source：NWASCO Urban and Peri-urban Water Supply and Sanitation Sector Report 2013-2021

In order for a water utility to be sustainable, the amount paid to each employee must be lower than the revenue that the employee brings to the company. For labor costs related to the collection of water charges, 0.4 or less (or 40%) is considered desirable, and in FY2021, of the 11 CUs in Zambia, only LWSC meets this benchmark.

5.2.4 Relationships with Local Residents

(1) Relationships with Local Residents

Although the project involves the construction of boreholes and water supply facilities, it is not a plan to relocate residents or construct facilities on farmland, so it is not expected to incite new opposition from residents. According to interviews with the implementing agency, since cholera outbreaks frequently occur in the project area, there is a high level of understanding and expectation for this project, and it is very unlikely to cause opposition from residents.

(2) Possibility of involuntary resettlement, etc.

The planned pipe line is to be laid on land managed by the government of Zambia. Although the site for the planned reservoir area has not yet been determined, priority will be given to selecting land that is not in use, and procedures for land acquisition will be initiated once the necessary land area has been determined. Therefore, it is considered that there will be no problems such as involuntary resettlement.

5.3 Financial Viability and Sustainability of Project Implementation

5.3.1Source of Funds to be Borne by Zambian Side

The main burden of this project is to secure the land. It will be necessary to secure land for the construction of boreholes and water reservoirs, which, if privately owned, will be covered from the LWSC budget.

5.3.2 Current Status of Water Supply Service Indicators

Table-17 shows LWSC's water service indicators for 2021. The overall ranking is 3rd out of 11 CU, but LWSC is rated as the most improved public corporation. LWSC is also rated as the best CU in terms of staff efficiency and fee collection efficiency, and as the most improved CU in terms of water supply rate (%).

Table-17: LWSC Water Service Indicators (2021)

	NRW(%)	Water Quality compliance (%)	Metering Ratio [%]	Water Service Coverage [%]	Hours of Supply	Staff Efficiency	Collection Efficiency [%]	O+M Cost Coverage by Collection	Domestic Ranking
2021	47	80<95	71.7	93.7	16	0.37	100.0	103	3
Benchmark	25	95	100	95	18	0.4	90.0	100	

Source：NWASCO　Urban and Peri-urban Water Supply and Sanitation Sector Report 2021

5.3.3 Trends in Financial Ratios

As shown in Table-18, the average net profit margin over the most recent five years is 0.3%, confirming that the company has hardly secured any profit. On the other hand, the current ratio averaged 220% over the last five years, and the ratio of current assets to current liabilities exceeded 200%, indicating a high level of safety.

Table-18: Financial Ratios

Year	Net Profit Margin (%)	Current Ratio (%)	Non-Current Asset Turnover
2021	-17.00	275	0.56
2020	-23.00	167	0.27
2019	6.00	204	0.35
2018	8.73	200	0.71
2017	26.75	256	0.61
2016	-11.60	134	0.64
2015	-14.93	143	0.57
2014	-17.00	148	0.57
2013	-1.00	170	0.68

Source：NWASCO Urban and Peri-urban Water Supply and Sanitation Sector Report 2013-2021

5.3.4 Projected Financial Balance

As mentioned above, the LWSC is barely profitable, with an average net profit margin of 0.3% over the last five years. However, as noted in 2.1.4 (2) Water Rates, LWSC is able to gradually raise water rates about 30% in 2023 and about 18% in 2024 and 2025 respectively. Therefore, the financial balance is expected to improve.

5.4 Technical Feasibility and Sustainability of Project Implementation

5.4.1 Consistency with Technical Level of Zambia

In 1999, Japan's Grant Aid for the construction of water supply facilities in the George area in Lusaka City was implemented, and even now, more than 20 years later, LWSC continues to operate and maintain the facilities. The facilities to be constructed under this project will be very similar to the existing facilities. Therefore, there will be no concern in terms of consistency with the technical level of LWSC.

5.4.2 Staff Allocation and Employment Status

According to LWSC's annual report (2019), the Table-19 confirms that the actual number of personnel assigned including fixed term staffs is higher than the planned number, In addition, it has been confirmed that many LWSC personnel who received training during the construction of water supply system in the George area through Japan's grant aid in 1999 have been still working as LWSC staff.

Table-19: LWSC Staff Assignments

Division	A. Approved Establishment	B. Actual Establishment	C. Difference (B-A)	D. Fixed term staffs	E. Total Staff Complement (B+D)
Executive Management	7	6	-1	0	6
HR & Admin-istration	22	30	8	0	30
Finance	52	51	-1	5	56
Commercial	250	265	15	99	364
General Management	40	24	-16	0	24
Engineering	478	348	-130	35	383
Infrastructure	28	33	5	4	37
Grand Total	877	757	-120	143	900

Source：LWSC Annual Report 2019

5.4.3 Operation and Maintenance Status of Facilities and Equipment

As shown in Table-20, with respect to O&M of LWSC's water facilities, the percentage of planned preventive maintenance implemented is above 80%, with the exception of 2017. As for the planned maintenance against unplanned maintenance, the rate fell below 60% in 2017 due to an increase in the quantity of unplanned maintenance, but since then, more than 90% of the maintenance has been planned maintenance. Therefore, it can be said that maintenance is being performed systematically.

Table-20: Planned Maintenance

Year	Planned Maintenance Implemented (%)	Planned vs Unplanned Maintenance Work (%)
2021	83.00	90
2020	87.00	93
2019	95.00	98
2018	98.00	98
2017	26.00	58
2016	70.00	97

Source：NWASCO　Urban and Peri-urban Water Supply and Sanitation Sector Report 2016-2021

5.5 Environmental Considerations

5.5.1 Expected Environmental Impacts

In this project, borehole drillings, new pipe installations, and construction of water distribution centers are planned. Since there are no rare animals or plants living in the project area and along the proposed

pipe laying route, and also, residents do not need to be relocated, serious impacts should not occur. Based on these results, this project is considered to fall under the following Category B of Environmental and Social Considerations.

Category A: If these are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts.

Category B: If the potential adverse impacts on the environment and society are less than those of Category A projects.

Category C: If these are likely to have minimal or little adverse impacts on the environment and society.

Category FI: JICA's funding of projects is provided to a financial intermediary or executing agency; the financial intermediary or executing agency substantially undertakes the selection and appraisal of sub-projects under the projects, only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval for the funding (or prior to JICA's appraisal of the project); and those sub-projects are expected to have potential impacts on the environment and society.

Other possible impacts on society and the environment are shown in Table-21. As negative impacts on society due to the construction, there is a possibility of the spread of infectious diseases and occupational accidents due to the influx of workers from outside the area, noise and dust, and traffic accidents. In addition, as negative impacts on the environment due to the operation of the facilities, there are possibilities of disturbance on the hydrologic cycle and land subsidence.

Preventive measures need to be taken in order to minimize or eliminate the impacts on society. For environmental impacts, monitoring should be conducted, and if widespread or localized land subsidence is expected to occur, the expected damage should be identified and the water source should be changed to another source such as surface water in the future.

Table-21: Social and Environmental Impacts

Impact Type	Impact on Society	Impact on Environment
Positive Impact	● Stable supply of water ● Improving the health of infants and children ● Creation of employment opportunities ● Increase in volume of water distributed to slum areas around the city.	● Effective use of water resources (reduction of water leakages)
Negative Impact	● Spread of infectious diseases due to influx of workers from outside the	● Disturbance on hydrologic cycle (increased pumping rate)

Impact Type	Impact on Society	Impact on Environment
	region ● Occurrence of occupational accidents ● Generation of noise, dust, etc. ● Occurrence of traffic accidents, etc.	● Decreased flow in the lower reaches of tributaries

5.5.2 Assessment of Environmental Impacts

The magnitude of environmental and social impacts related to this project is assessed by referring to the Environmental and Social Consideration Guidelines of the Japan International Cooperation Agency.

(1) Location of the project site, scale and contents of the project

1) Project site: Lusaka City, Lusaka Province

2) Type of project: New Construction

3) Scale and contents of the project

The scale and contents of the project are shown in Table-22.

Table-22: Project Scale and Description

Facility	Item	Number/Capacity
Borehole (New)	Number of facilities	10 boreholes
	Pumping Capacity	Average 35 m^3/h × 5 boreholes × 16hr＝5,600m^3/day
	Static/dynamic water level	Average: Static water level = 3.5 m, Dynamic water level = 11.9 m
Distribution Reservoir Area （New）	Number of facilities	5 locations (5 Elevated water tanks)
	Facility Capacity	V=300m^3 each
Pipeline	Pipe removal	None
	Pipe renewal	None
	New pipe laying	about 85 km

(2) Project Summary

As described in "3.3 Contents of the Project" of this report.

(3) Necessity of the Project (High-level and related plans)

As described in "2.2.2 High Level and Related Plans for Project Area" of this report.

(4) Zero options and alternative plans

As described in "5.1 Results of Comparison with Main Alternatives" of this report.

(5) Status of stakeholders consultations

The Table-23 shows the status of consultations with stakeholders.

Table-23: Status of Consultations with Stakeholders (Legend：■YES□NO)

Target	Held or Not Held	Contents of Consultation
Relevant Ministries and Agencies	■	Information on this project is shared with MWDS, the supervisory organization.
Local Residents	□	Although we have received requests from residents for water supply, we have not yet held any consultations in order to avoid creating extra expectations regarding this project.
NGOs	□	Same as above
Others	□	Same as above

(6) Residents' feelings toward similar past projects

■ No complaints

□ Have complaints

(7) Names and procedural status of environmental impact assessment laws or guidelines

Law or Guideline: Environmental impact assessment in Zambia is regulated by "The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations".

Procedural status:

□Approved (without additional conditions)

□Approved (with additional conditions)

□Under review

■Procedure not yet started

□Other

(8) Permit Application System and Procedural Status

In Zambia, before starting any development projects, the projects need to be screened and classified under 2 categories, where any project under the First Schedule requires the submission of an Environmental Project Brief (EPB) and those under the Second Schedule must submit an Environmental Impact Statement (EIS).

This project falls under First Schedule only since the above conditions for Second Schedule do not apply. Therefore, only an environmental project brief needs to be submitted while an environmental impact statement is not necessary.

□Acquired

□Required but not yet acquired: To be applied after the project details are finalized.

■Not required

□Other (not considered necessary, but needs to go through a formal review process)

(9)Whether the Project falls under a sensitive sector or not (Legend:■YES□NO)

□1) Mining development (including oil and natural gas development)

□2) Pipeline

□3) Industrial development

□4) Thermal power generation (including geothermal)

□5) Hydropower, dams and reservoirs

□6) Power transmission lines, power distribution (involving large-scale involuntary resettlement, large-scale deforestation, submarine power lines)

□7) River and erosion control

□8) Roads, railways, and bridges

□9) Airports

□10) Ports

■11) Water supply, sewage and wastewater treatment (having sensitive characteristics or located in sensitive areas)

□12) Waste treatment and disposal

□13) Agriculture

(10) Applicable characteristics likely to have impacts (Legend:■YES□NO)

□Large-scale involuntary resettlement (scale: household members)

□Large-scale groundwater pumping (scale: more than 2 million (m^3/s))

□Large-scale land reclamation, land development, and land clearing (scale: ha)

□Large-scale deforestation and logging (scale: ha)

(11) Applicable sensitive areas (Legend:■YES□NO)

□National parks, nationally-designated protected areas (coastal areas, wetlands, areas for ethnic minorities or indigenous peoples, cultural heritage sites, etc. designated by national governments)

□Areas that are thought to require careful consideration by the country or locality

(12) Potential of the Project to have environmental and social impacts

■YES

□NO

□Do not know.

Chapter 6 : Conclusion

Chapter 6 : Conclusion

6.1 Particular Remarks

When considering the construction of water supply facilities using groundwater as the water source in Japan's General Grant Aid, the most important factor is whether sufficient quantity and quality of water can be secured from boreholes. As described above in "3.5.2 Natural Conditions," the geology of the project site consists mainly of dolomite and limestone, and in the George area, which is adjacent to the northern part of the project area, there are also eight successful boreholes drilled with previous Japan's General Grant Aid assistance, and the average pumping rate was relatively high at 79.1 m^3/h. Therefore, it is expected that a similar amount of water can be secured at the target site of this project, and the groundwater potential is considered to be relatively high.

Japan's Development Cooperation to Lusaka has relatively long history and multifaceted in a variety of areas, including education, health care, water supply, agriculture, economy, and transportation infrastructure. The support provided by Japan is highly appreciated and friendly relations have been established. In particular, in the health sector, hospital construction and capacity building projects are being implemented, and a mother and child hospital is being constructed with Japan's General Grant Aid in areas adjacent to the project area. Diarrhea is the leading cause of death among children under 5 years old in Lusaka District, which includes Lusaka City. Cholera is often prevalent in the project area, and the improvement of the water supply and sanitation environment through this project is expected to have a synergistic effect with the above-mentioned hospital constructed with Japanese assistance. In addition, the project is expected to contribute to the realization of water security for the hospital's medical activities when rainfall is low during the dry season or heavy rainfall/flooding due to climate change.

6.2 Notes on Project Implementation

(1) Assistance to Long Term Projects

This project proposal is for a high priority short-term project.

In the long term, it is essential to implement a large-scale facility construction and rehabilitation from multiple perspectives to meet the growing water demand, such as active use of surface water from the Kafue River and reduction of the current high non-revenue water (about 50%).

(2) Groundwater Pollution

In the target area, unprotected shallow wells are mainly used for domestic purpose, and they are located in close proximity to on-site sanitation due to limitation of residential plot area. A recent cholera outbreak is believed to have been caused in part by contamination of shallow groundwater from

shallow wells used for domestic purposes. This water pollution is limited to shallow groundwater and is thought to be the result of large amounts of untreated domestic wastewater and excreta seeping into the ground, far exceeding the self-cleaning capacity of the soil. Therefore, if safely managed drinking water is provided by this project, the use of highly contaminated shallow groundwater should be stopped.

6.3 Concluding Remarks

Although Lusaka City faces a variety of challenges, including urbanization, environmental pollution, and climate change, the need and urgency for water supply infrastructure development for the peri-urban areas are clear. Despite the high population growth rate and density in the peri-urban areas, water supply facilities are lagging behind, which is a major cause of deterioration in the living conditions. The service coverage rate of the LWSC is 0%, and the residents are dependent on unprotected shallow wells.

In recent years, extreme increases in precipitation due to climate change have become more frequent, and flooding has caused contamination of water sources, resulting in direct health hazards such as cholera and diarrheal diseases. As a result, many aspects of the economy, from urban labor and education to trade, have been negatively affected, requiring urgent action by the Zambian government.

Droughts have been endemic in Zambia, occurring in 1987/88, 1991/92, 1994/95, 1997/98, 2001/03, 2004/05, 2011/12, 2015/16, and 2018/2019, and their frequency is projected to increase in the future due to climate change. Decreased rainfall and warmer temperatures are projected in river basins, likely leading to increased evapotranspiration and decreased river runoff. In addition, it is predicted that higher temperatures will result in greater loss of water stored in reservoirs from increased evapotranspiration, which may further reduce the effectiveness of water storage.

Approximately 45% of the water used in Lusaka City is surface water from the Kafue River, but from the above, access to safe water is likely to be severely compromised during droughts. Therefore, as a response to drought, the project plans to provide a stable supply of safe drinking water by using groundwater from relatively deep aquifer, which are less affected by rainfall fluctuations.

Based on an understanding of the current situation and after examining plans to resolve the issues, we proposed grant aid projects having a high priority and impact that would contribute to enhancing Japan's presence.

6.4 Final Remarks

We have the impression that the Zambian side has a very high level of satisfaction, partly because the piped water supply systems in the George area that were implemented more than 20 years ago with previous Japan's General Grant Aid assistance are still in operation without any problems. Through the field survey, LWSC's willingness to implement the subject project was very high, and we were able to smoothly carry out mutual communication and discussions with related organizations.

Zambia continues to experience extreme weather events such as floods and droughts due to the adverse effects of climate change. Since the 2019 drought, Zambia still faces severe food insecurity, lack of safe drinking water, high chronic malnutrition, and energy shortage. The water supply for Lusaka city, which is under the jurisdiction of LWSC, meets only 50% of the water demand, and there are severe water shortages, especially in the peri-urban areas. Due to the urgency of the situation, the expectations of Zambian side for the realization of this project are high. In particular, we believe that the impact of this project to be implemented in Lusaka, the capital of Zambia, will be significant, as the target area is basically not serviced by the water supply and sanitation utility.

Annexes

Annex-1 : Schedule

Date		Schedule			Accomod.
2022/10/17	Mon	Departing from Narita (Tokyo)			Flight
2022/10/18	Tue	Arrival in Lusaka		Departing Mozambique, Arrival in Lusaka	Lusaka
2022/10/19	Wed	Courtesy calls and meetings: Embassy of Japan, JICA, Ministry of Water Development and Sanitation, LWSC			Lusaka
2022/10/20	Thu	Discussions with LWSC: outline of plan, organization of objectives Report to Embassy of Japan and JICA Site visit of existing facilities in the George area and Garden Park area, and visit to the LWSC office			Lusaka
2022/10/21	Fri	Inspection of existing facilities in the Kanyama area, operator interviews Discussions with LWSC: Outline of the plan, identification of overall problems and issues, and discussion of project contents.			Lusaka
2022/10/22	Sat	Inspection of existing facilities in the Kabanana area Inspection of existing facilities in the Bauleni area			Lusaka
2022/10/23	Sun	Departing Lusaka	Desk work		Lusaka/ Flight
2022/10/24	Mon	Arrival in Tokyo	Confirmation of component and dimensions of the water supply facilities	Collecting database of boreholes in Lusaka, visit to drilling companies	Lusaka
2022/10/25	Tue		Visit to Health Facilities in the Kanyama area LWSC Per-urban South Branch Office Consultation	Meeting with Department of Water Affairs and Data collection	Lusaka
2022/10/26	Wed		Inspection of SOS district, confirmation of current operation and maintenance status	Estimation of Project Cost: related to groundwater development	Lusaka
2022/10/27	Thu		Project effectiveness studies, guidance on preparation of Application for new Project		Lusaka
2022/10/28	Fri		Report: LWSC, Embassy of Japan and JICA Departing Lusaka	Report: LWSC and JICA	Lusaka
2022/10/29	Sat		Via Dubai	Departing Lusaka Arrival in Mozambique	Flight
2022/10/30	Sun		Arrival in Tokyo		

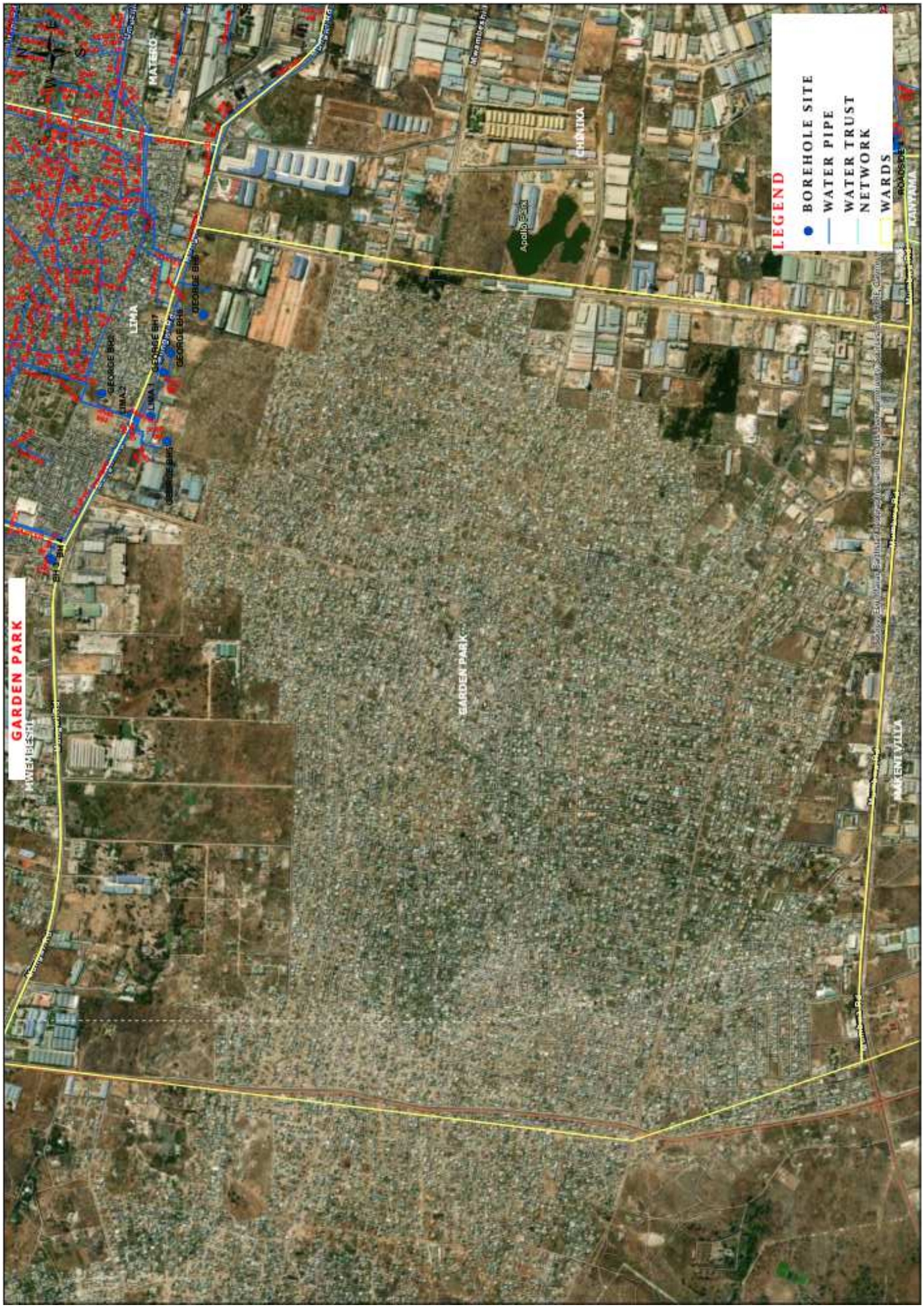
Annex-2: List of Persons Visited or Interviewed

Affiliation	Name	Position
Embassy of Japan in the Republic of Zambia	Mr. Ryuta Mizuuchi	Ambassador Extraordinary and Plenipotentiary
	Mr. Yasunori Saiki	Second Secretary
Japan International Cooperation Agency (JICA)	Mr. Norihito Yonebayashi	Chief Representative
	Mr. Keita Izumi	Senior Representative
	Mr. Shinichiro Futami	Representative
	Ms. Mwaba Mumba – Chisala	Senior Program Officer- Former Refugees, Water Environment & Training Sectors
Ministry of Water Development and Sanitation （MWDS）	Mr. Oswell Katooka	Director Water Supply and Sanitation
	Mr. Abel Manangi	Assistant Director Water Supply and Sanitation
	Mr. Paul Mboshya	Technical Adviser WASH/Nutrition
	Mr. Willick Nsama	Senior Water Supply and Sanitation Engineer
	Mr. Charles Mwale	Principal Engineer – Rural Water
Lusaka City Council （LCC）	Mr. Victor Kagoli	Director Public Health
	Mr. Kachikoti Banda	Assistant Director Public Health
Lusaka Water Supply & Sanitation Company （LWSC）	Eng. Jilly Chiyombwe	Acting Managing Director
	Mr. Dennis Malambo	Director Commercial Service
	Ms. Yvonne Siyeni	Manager-Peri-urban department
	Eng. Wycliff Kunda	Manager-Infrastructure, Planning and Design
	Mr. Mwiche Sekeleti	Manager- Corporate Planning
	Mr. Telfer Ndumba	Senior Engineer Planning and Design
	Mr. Kennedy Mayumbelo	Project Manager
CARE International	Mr. Henry Loongo	Program Director/Emergency Coordinator

Annex-3: List of Collected Information

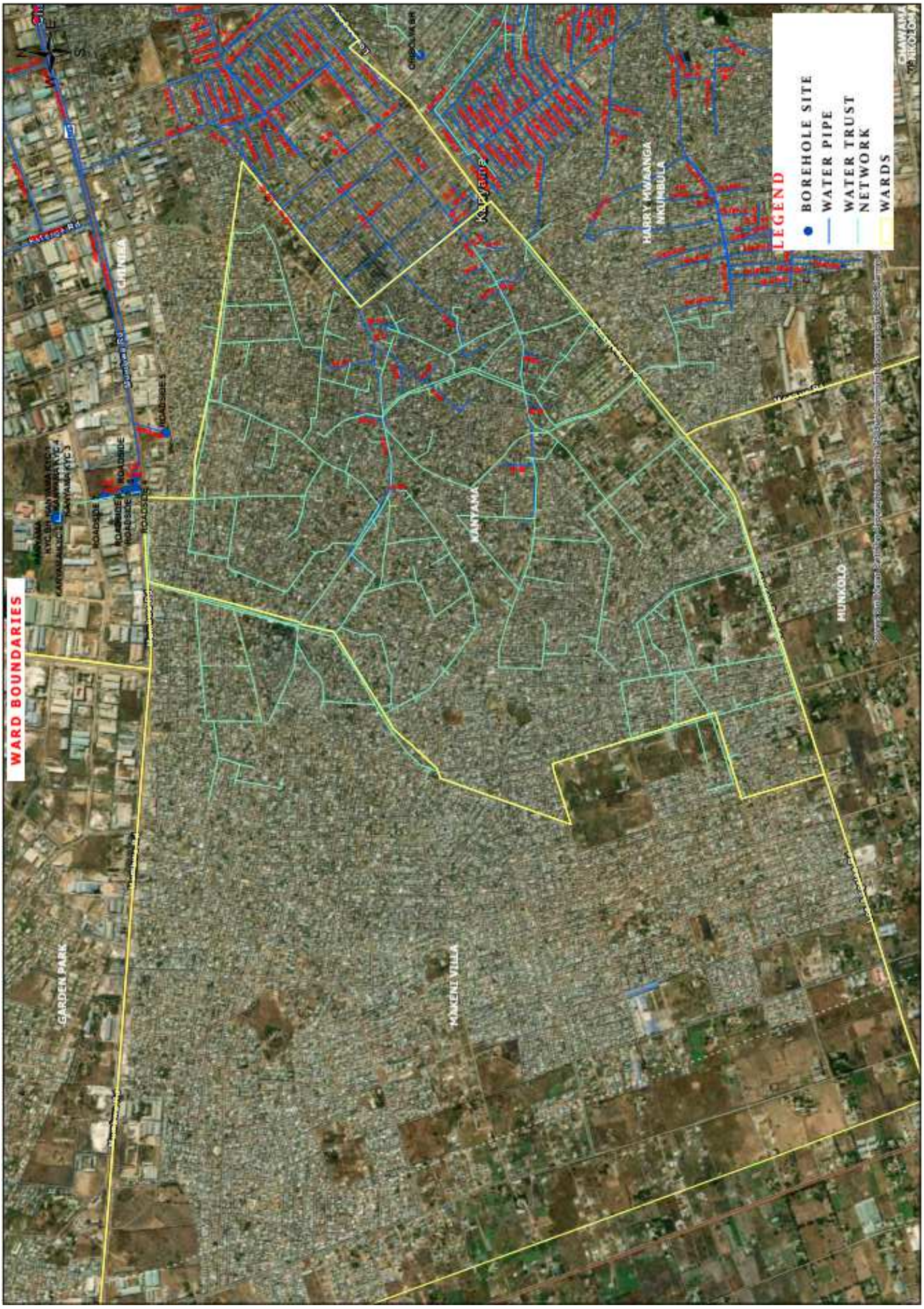
No.	Document Name	Issuing Organization/Author	Published Year
1	VISION 2030	Government of Zambia	2006
2	Eighth National Development Plan（2022-2026）	Ministry of Finance and National Planning	2022
3	Seventh National Development Plan（2017-2021）	Ministry of Finance and National Planning	2017
4	LWSC 2023-2027 Draft Strategic Plan	LWSC	2022
5	National Water Supply and Sanitation Policy	Ministry of Water Development, Sanitation and Environmental Protection	2020
6	National Water Supply and Sanitation Programme (2011-2030)	Ministry of Local Government and Housing	2011
7	Urban Onsite Sanitation and Faecal Sludge Management: Framework for Provision and Regulation in Zambia	NWASCO	2018
8	LWSC Peri-urban Policy	LWSC	2018
9	LWSC Annual Reportr, 2019	LWSC	2020
10	LWSC Strategic Plan 2018 – 2022	LWSC	2017
11	The Water Supply and Sanitation act 1997	Government of Zambia	1997
12	Water Supply Investment Master Plan Lusaka, Zambia	Government of Zambia	2011
13	Sanitation Master Plan Lusaka, Zambia	Government of Zambia	2011
14	National Urban and Peri-Urban Sanitation Strategy (2015 - 2030)	Ministry of Local Government and Housing	2015
15	Urban and Peri-urban Water Supply and Sanitation Sector Report	NWASCO	2012-2021

ANNEX 4-1 : Existing Water Supply System in Garden Park Area



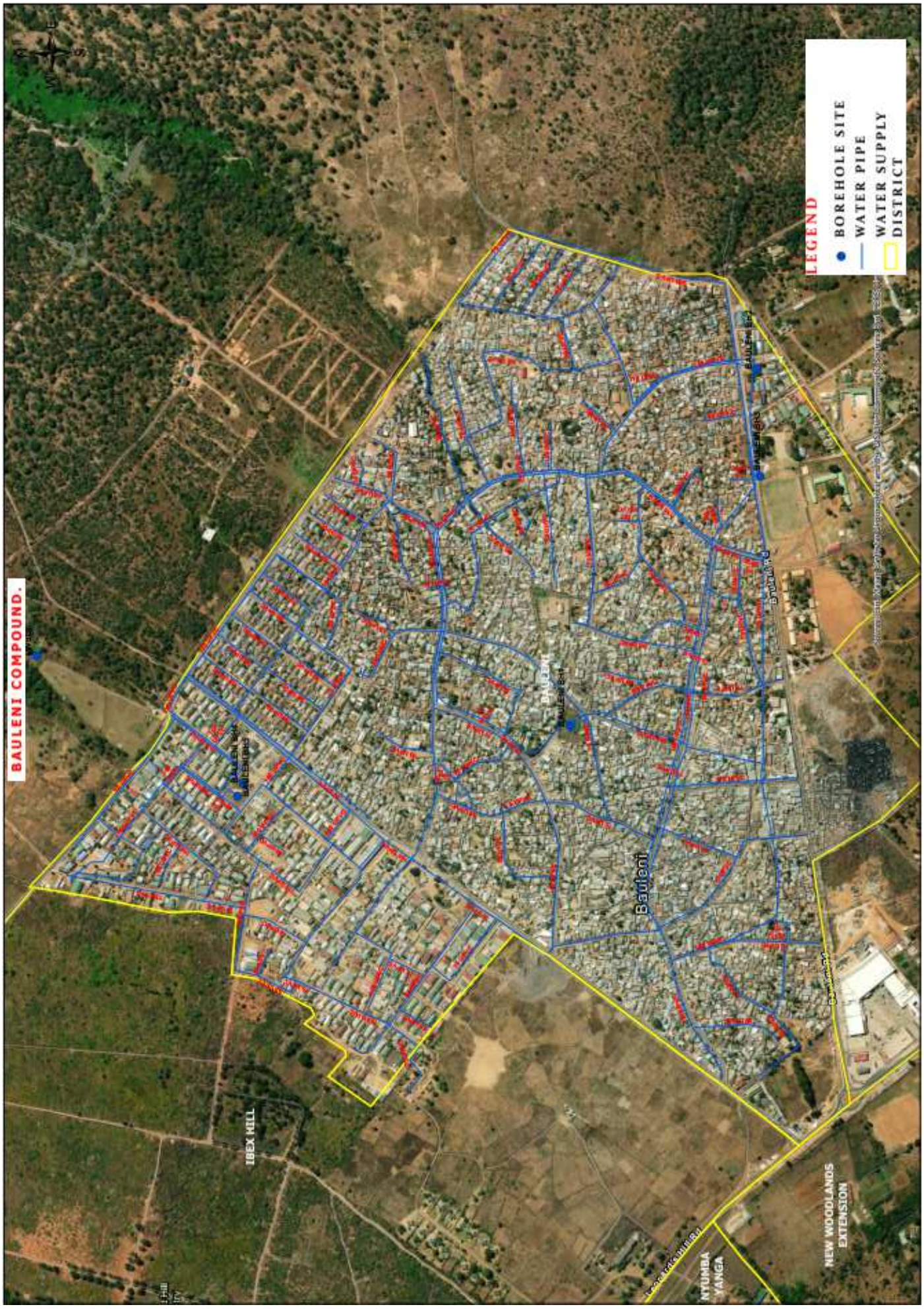
Source : LWSC

ANNEX 4-2 : Existing Water Supply System in Kanyama Area



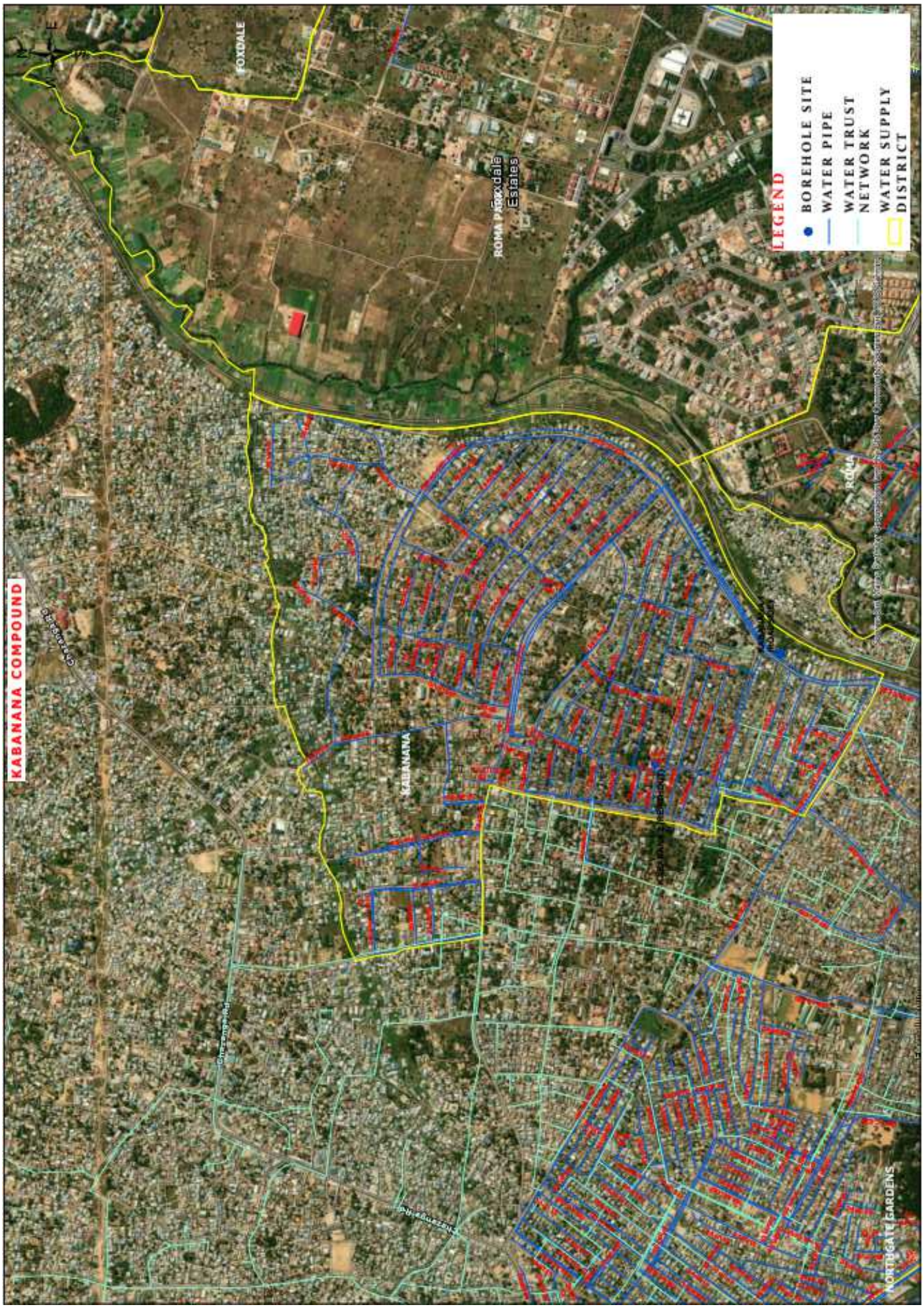
Source : LWSC

ANNEX 4-3 : Existing Water Supply System in Bauleni Area



Source : LWSC

ANNEX 4-4 : Existing Water Supply System in Kabanana Area



Source : LWSC

ANNEX 4-5 : Existing Water Supply System in SOS Area

Source : LWSC