

# **Draft Kabul City Master Plan**

- Product of Technical Cooperation Project for Promotion of Kabul  
Metropolitan Area Development  
Sub Project for Revise the Kabul City Master Plan-

June 2011

RECS International Inc.  
Yachiyo Engineering Co., Ltd.

## PREFACE

In response to the request from the Kabul Municipality in the Islamic Republic of Afghanistan, the Japan International Cooperation Agency (JICA) decided to conduct “the Sub-project to Revise the Kabul City Master Plan” as a part of “the Technical Cooperation Project for Promotion of Kabul Metropolitan Area Development”. JICA selected and dispatched a Sub-project Team headed by Mr. Takashi Koyama of RECS International Inc., consisted of experts nominated by RECS International Inc., Yachiyo Engineering Co., Ltd., and CTI Engineering International Co., Ltd. to the Islamic Republic of Afghanistan for a series of fieldworks from June 2010 through June 2011.

The Team held discussions with the officials concerned of the Government of the Islamic Republic of Afghanistan and conducted the Sub-project in close collaboration with the counterpart experts of the Kabul Municipality. In Afghanistan, the Kabul Municipality prepared and maintained office spaces in the municipal buildings in two locations, one in the head quarter and the other one in a branch office used by the Planning and Implementation Department. A planning team was formed consisting of Afghan and Japanese experts and worked closely on a daily basis. Upon the returning to Japan, the Sub-project team conducted further elaborations and prepared this master plan document for submission to the Kabul Municipality as a draft by the planning team.

It has been our honor to serve the people and the country of Afghanistan through the execution of this important project. We would like to take this opportunity to express our deepest gratitude for all involved in this undertaking. We sincerely wish that the drafted Kabul City Master Plan would continue to serve as an important base for organized development of Kabul City. We also hope that this report will contribute to the enhancement of friendly relationship between our two countries.

Finally, we wish to express our sincere appreciation for all the officials concerned of the Government of the Islamic Republic of Afghanistan and other experts for their cooperation extended to the Sub-project.

June, 2011

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### Abbreviations

ACCI	Afghanistan Chamber of Commerce and Industry
ADB	Asian Development Bank
ADT	average daily traffic
AFN	Afghanistan afghani
AGR	average growth rate or annual growth rate
AIDS	acquired immune deficiency syndrome
AIMS	Afghanistan Information Management Service
AISA	Afghanistan Investment Support Agency
AKTC	Aga Khan Trust for Culture
ANDS	Afghanistan National Development Strategy
APPPA	Afghanistan Pilot Participatory Poverty Assessment
AREU	Afghanistan Research and Evaluation Unit
ASEAN	Association of South East Asian Nations
ASMED	Afghanistan Small and Medium Enterprise Development
av.	average
AUWSSC	Afghan Urban Water Supply and Sewerage Corporation
BC	Before Christ
BDS	business development services
BHC	basic health center
BPHS	basic package of health services
BRT	bus rapid transit
BSE	bovine spongiform encephalopathy
CAWSS	Central Authority for Water Supply and Sewerage
CBD	central business district
CHC	comprehensive health center
CIMMYT	International Maize and Wheat Improvement Center
CSO	Central Statistics Office
DABM	Da Afghanistan Breshna Moassea
DABS	Da Afghanistan Breshna Shirkat
DAI	Development Alternatives Inc.
DC	direct current
DCDA	Dehsabz City Development Authority
DEG	Deutsche Investitions-und Entwicklungsgesellschaft mbH
devt.	development
DoS	Department of Sanitation
EC	electrical conductivity
EC	European Communities
EIA	environmental impact assessment
EIRP	Emergency Infrastructure Reconstruction Project
E/P ratio	employment-to-population ratio
EPHS	Essential Package of Hospital Services
est.	estimate(d)
FAO	Food and Agriculture Organization (of the United Nations)
FAR	floor-area ratio
FCI	fixed capital investment
FIRR	financial rate of return
FMD	foot and mouth disease

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FRP	fiber reinforced plastic
GDP	gross domestic product
GIS	gas insulated substation or geographic information system
GLC	Greater London Council
Gov. or gov.	government
GRDP	gross regional domestic product
GTZ	Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
HIV	human immunodeficiency virus
HPP	hydro power plant
HSIDC	Haryana State Industrial Development Corporation
HUDA	Haryana Urban Development Authority
HWL	high water level
ICARDA	International Center for Agricultural Research in the Dry Areas
ICOR	incremental capital-to-output ratio
ICQHS	International Center on Qanats and Historic Hydraulic Structures
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	information and communication technology
ICT	Intercontinental Consultants and Technocrats Pvt. Ltd.
IDP	internal displaced person
IEE	initial environmental examination
IFI	international financial institute
IPDA	Industrial Parks Development Authority
IPDD	Industrial Parks Development Department
ISAF	International Security Assistance Force (of NATO)
ISIC	International Standard Industrial Classification
IT	information technology
IWRM study	Integrated Water Resources Management Study in Kabul River Basin, 2006
JICA	Japan International Cooperation Agency
JS	junction station
JV	joint venture
KCIRR	Kabul city inner ring road
KCORR	Kabul city outer ring road
KED	Kabul Electricity Development
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
KMA	Kabul metropolitan area
KMG	Kabul metropolitan government
KURP	Kabul Urban Reconstruction Program (of World Bank)
LCD	liter per capita per day
LF	landfill
LRT	light rail transit
LTERA	Land Titling and Economic Restructuring Activity (of USAID)
MAIL	Ministry of Agriculture, Irrigation and Livestock
MDG	Millennium Development Goal
mil. (or M)	million
MLSAMD	Ministry of Labor, Social Affairs, Martyrs and Disabled
mo(s).	month(s)
MoC	Ministry of Communication
MoCI	Ministry of Commerce and Industry

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MoE	Ministry of Education or Ministry of Environment
MoEW	Ministry of Energy and Water
MoHaj	Ministry of Haj
MoHE	Ministry of Higher Education
MoI	Ministry of Interior
MOM	Ministry of Mines
MoPH	Ministry of Public Health
MoPI	(Chapter 7, Draft Master Plan Report)
MoPW	Ministry of Public Works
MORRD	Ministry of Rural Reconstruction and Development
MoUD	Ministry of Urban Development
MoWA	Ministry of Women's Affairs
N/A	not available/applicable
NCRK	National Capital Region of Kabul
NEPA	National Environmental Protection Agency
NESPAK	National Engineering Services Pakistan (Pvt) Limited
NGO	nongovernmental organization
NMT	non-motorized traffic
OD	origin-destination
OPGW	optical ground wire or optical fiber composite overhead ground wire
p.a.	per annum
PDT	Peace Dividend Trust
PET	potential evapotranspiration
pop.	population
PPP	public-private partnership
PS	power station
PSD	private sector development
PT	person-trip
PUD	Planned Unit Development
pub.	public
R&D	research and development
ROW	right of way
sch.	school
SDF	Skills Development Fund
SDP	Strategic Development Planning (of MoUD)
sec.	secondary or second
SIDCUL	State Industrial Development Corporation of Uttaranchal
SME	small and medium sized enterprise
SOE	state-owned enterprises
SRTM	Shuttle Radar Topography Mission
SS	substation
SWGR	switchgear
TDM	traffic demand management
TDR	Transfer of Development Right
TRACECA	Transport Corridor: Europe-Caucasus-Asia
TOR	terms of reference
TPP	thermal power plant
TS	transfer station
UAE	United Arab Emirates

UCA	urbanization control area
UFW	unaccounted-for water
UK	United Kingdom
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNHABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UPA	urbanization promotion area
USA	United States of America
USAID	United States Agency for International Development
VT	vehicle trip
WCS	Wildlife Conservation Society
WHO	World Health Organization
WHRB	waste heat recovery boiler
w/o	without
/d	per day
/s	per second
/y	per year

**Units of Measure**

ha	hectare
GWh	gigawatt-hour
kV	kilovolt
kWh	kilowatt-hour
km	kilometer
km <sup>2</sup>	square kilometer
LCD	liter per capita per day
m	meter
m <sup>2</sup>	square meter
m <sup>3</sup>	cubic meter
MCM	million cubic meters
mg	milligram
mm	millimeter
MVA	mega volt-ampere
MW	megawatt
NTU	nephelometric turbidity units
PCU	passenger car unit
tcf	trillion cubic feet
VA	volt-ampere

## **CHAPTER 1: INTRODUCTION**

### **1.1 Background and Objective of Kabul City Master Plan**

Kabul is a city with a long time history. After becoming the capital of Afghanistan in 1775, the population and territory of the city expanded steadily. The city was beautifully shaped with plenty of trees. Since the beginning of the 20th century, the city has experienced rapid growth. From the 1970s to the end of the century, development of the city has been sluggish due to various political turmoil and conflicts. The existing infrastructure was also severely damaged during this period.

Since 2001, the government and people of Afghanistan have been making efforts for reconstruction of Kabul City. International donors are also working for rehabilitation and reconstruction of the capital city of Afghanistan. However, there is no common vision and/or direction of the reconstruction and future development of Kabul City as the city has no working master plan. The absence of the city master plan is affecting the lives of citizens and economic activities of enterprises, because of the unpredictable status of their lands and properties for living and business operation.

There have been two planning studies on Kabul City carried out recently. One is the “Consultancy Services for Preparation of Development Plan for Kabul, Afghanistan”, supported by the World Bank and conducted by Intercontinental Consultants and Technocrats Pvt. Ltd. (Here in after referred to as ICT Study), from 2007 to 2008. Another one is the “Kabul Metropolitan Area Urban Development Master Plan” (hereinafter referred to as KMAUD Master Plan), supported by JICA and conducted from 2008 to 2009. Because of these studies had difference in main objectives respectively, the city master plan of Kabul was not able to be established by outputs of these studies alone. The ICT Study was aiming to identify development projects for Kabul City, while the KMAUD Master Plan was to formulate a regional development plan focusing on harmonized development of the Dehsabz New City and the existing Kabul City.

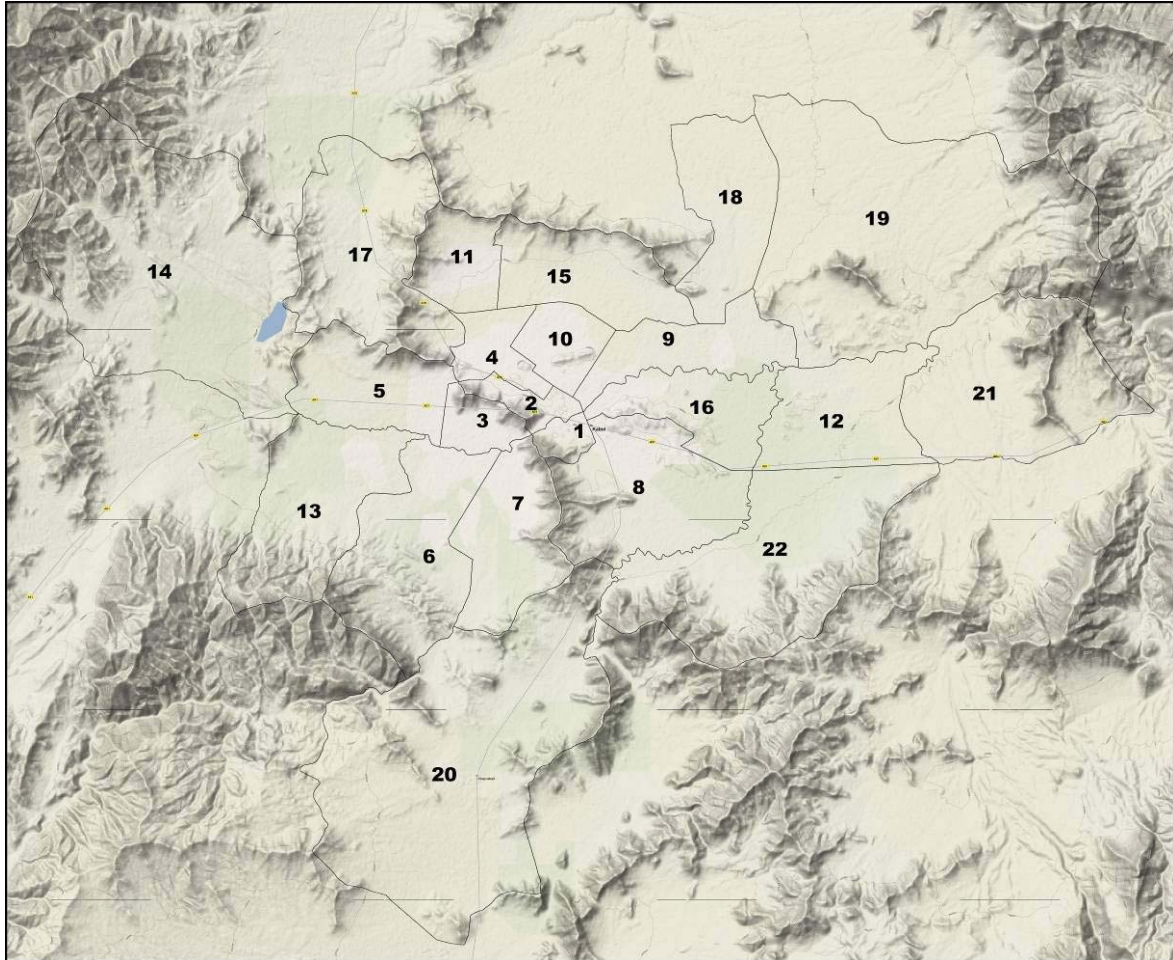
The objective of this master plan is to establish the city master plan of the Kabul Municipality Area by carrying out supplemental analysis and planning works by fully utilizing the results of the ICT Study and the KMAUD Master Plan. This master plan aims to replace the Third Kabul City Master Plan which is the last master plan of Kabul City approved in 1978.

### **1.2 Scope of the Kabul City Master Plan**

#### **(1) Target area**

The target area of this master plan is the entire territory of the Kabul Municipality, consisting of 22 districts, as shown in Figure 1.1. The area is approximately 1023 km<sup>2</sup>, among which the New City Development Area overlaps in the large parts of District 18 and 19.





Note: Numbers represent Districts.

Source: Terrain map from [www.map.google.com](http://www.map.google.com).

**Figure 1.1: Target Area of Kabul City Master Plan**

## **(2) Target year**

The target year of the this master plan is the year 2025 as complying with the KMAUD Master Plan. Key figures of development framework are set for years 2015 and 2020 as well, along with the target image of land and major infrastructure development.

## **(3) Scale**

The scale of the land use plan of this master plan is 1:10,000 which is equivalent to the level of the Third Kabul City Master Plan.

## **1.3 Structure of the Master Plan Document**

The Draft Kabul City Master Plan is structured in the following way.

In Chapter 2, an overview of the existing conditions of the Kabul Municipality area and its surroundings are presented. Natural and socioeconomic conditions are analyzed and urbanization trend of the city is clarified. Estimation of the population and macro-economy is carried out in the course for the year 2008 which is set as the base year for spatial analysis of the city as a detailed GIS database compiled by ICT Study is available for the said year.

In Chapter 3, various planning conditions are analyzed and basic policies for development of Kabul City are established. Major planning conditions include approved national and regional plans (ANDS, KMAUD Master Plan), as well as carrying capacity of the land and water resources

against the urbanization pressure to Kabul City. Major policies for the development of Kabul City include planning concepts and development frameworks.

In Chapter 4, the future land use plan for the Kabul Municipality area is formulated following the establishment of land development policies and strategies. Major land development strategies include shift to the private sector oriented development through quality control by the municipality. Accordingly the land use categories adopted in the land use plan are reexamined from the ones employed in the Third Master Plan and assigned for the entire territory of the municipality.

In Chapter 5, transport infrastructure development plan is established after detailed analysis of existing administration, transport facilities, and traffic characteristics. Traffic forecast is conducted for “Do Nothing” case and “With Project” cases of road network development, introduction of enhanced bus service network over the improved road network, and introduction of mass transit systems.

In Chapter 6, utilities development plans are established for water supply, drainage, sewerage, power distribution, information and communication technology (ICT) network, and solid waste management. Although utilities are not administered by the Kabul Municipality except for the drainage and the solid waste management systems, responsible organizations are fully involved in the planning work. These organizations recognized the change of the future urban structure and land use, and agreed to include the results of this master plan to respective sector development plans and programs.

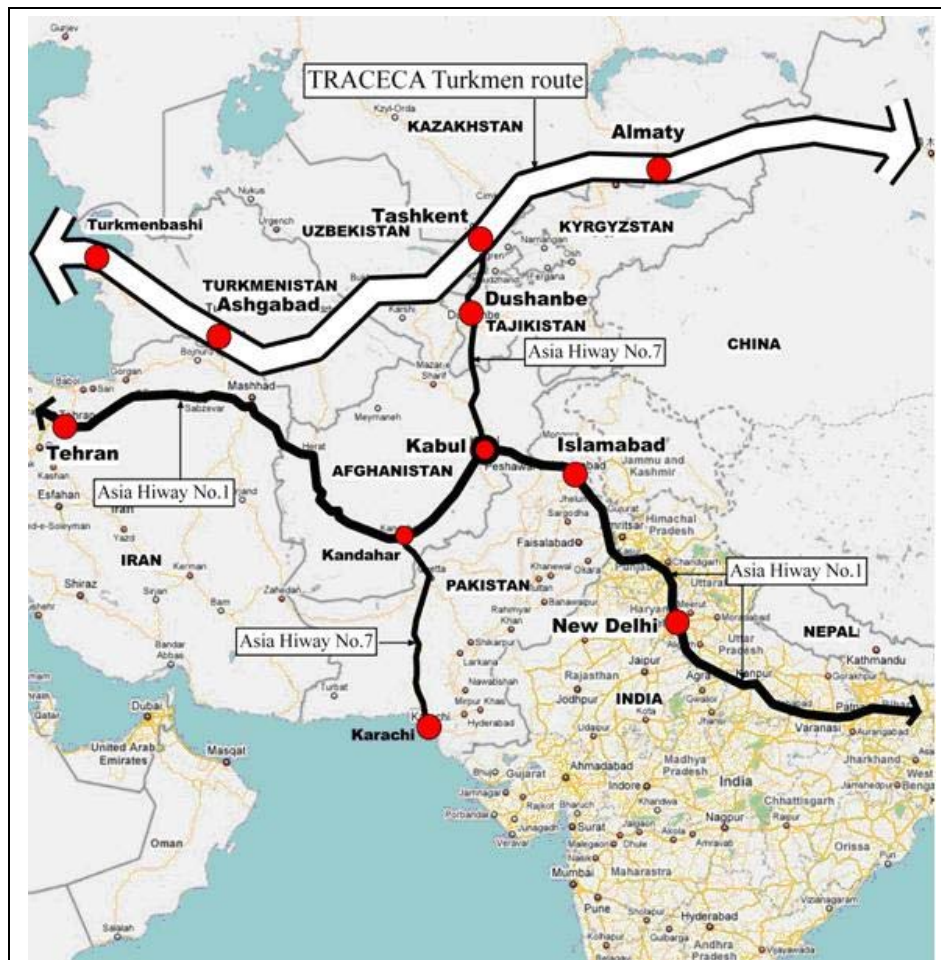
In Chapter 7, key development projects are identified for transport and utilities infrastructures, along with some projects on land development and improvement of informal settlements. Fund requirement for the full development is estimated and an investment plan for these projects is proposed to secure minimum requirements for development.

## CHAPTER 2: EXISTING CONDITIONS OF KABUL CITY

### 2.1 Location and Access to Kabul City

#### 2.1.1 Location of Afghanistan and Kabul City

Afghanistan is a land locked country, located in the central part of Eurasian Continent, with a surface area of around 655,000 km<sup>2</sup>. The country is bordered by six countries: Iran to the west, Uzbekistan, Tajikistan, Turkmenistan and People's Republic of China to the north, and Pakistan to the east and south. The location of the country has strategic importance for Central Asian countries and Russian Federation as the transport corridor in Afghanistan provides shortest route to the sea ports for these countries. Figure 2.1 shows international transport corridor and neighboring counties of Afghanistan.



Source: Map from [www.map.google.com](http://www.map.google.com).

**Figure 2.1: Location of Afghanistan and Kabul**

### 2.1.2 Access to Kabul City

Kabul City is situated in the north-eastern part of the country, at 1800 meters above sea level. The city and its north and south adjacent areas largely consist of a cluster of basins with relatively flat land surrounded by mountain ridges.

Access to Kabul can be made by air and land transport. For air access, there are 17 international and six domestic direct flights to/from Kabul International Airport, as shown in Figures 2.2 and 2.3. For land access, the city is connected with major cities of the country through national road network as depicted in Figure 2.4. Currently there is no railway access available to the city.



Source: Map from [www.map.google.com](http://www.map.google.com).

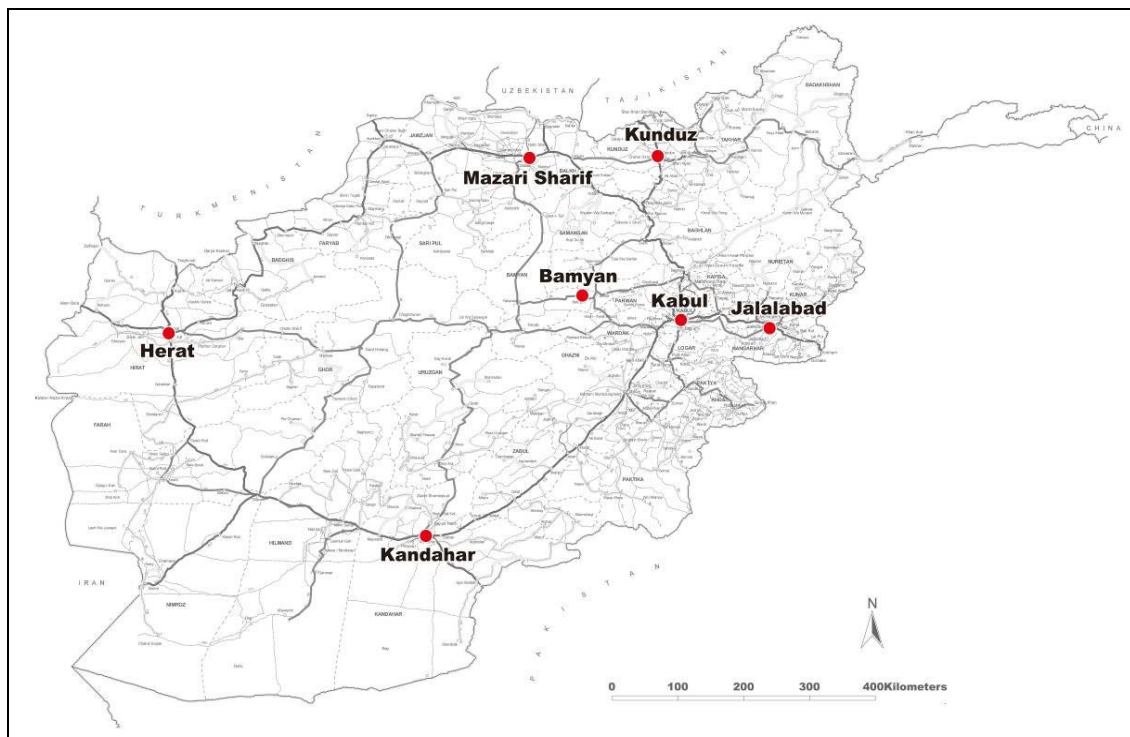
**Figure 2.2: International Air Routes to/from Kabul Airport**





Source: Planning Team

**Figure 2.3: Domestic Air Routes to/from Kabul Airport**



Source: Planning Team

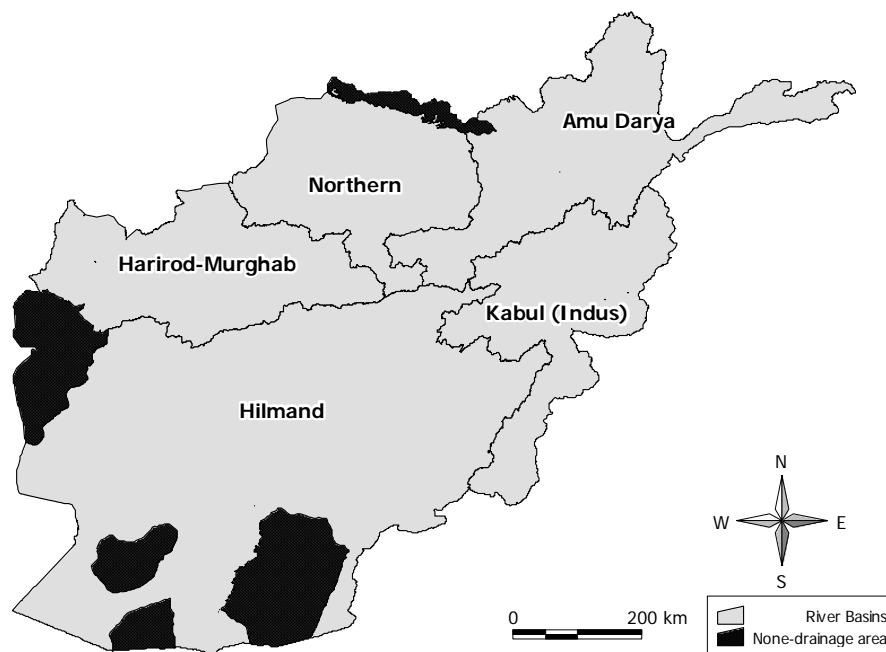
**Figure 2.4: National Road Network in Afghanistan**

## 2.2 Natural Settings

### 2.2.1 Overview

Of the national land area of about 65,000km<sup>2</sup>, over 75% of which is mountainous. The Hindu Kush mountain ranges roughly divide the country from the northeast to southwest and west. Climatic conditions of the country ranges from arid in the south and southwest to semiarid in the other parts of the country. Annual precipitation varies from less than 100mm in low land areas to more than 1,000mm in mountain areas. The precipitation occurs mostly in winter months, particularly in February through April. The temperature ranges from 30°C in summer to -20°C in winter. Annual potential evapo-transpiration varies between 1,200mm and 1,400mm in the northern plains and reaches 1,800mm in the southern and southwestern plains. It is relatively low in the Hindu Kush ranges, where it is less than 1,200mm. In general, potential evapo-transpiration exceeds precipitation except in winter. Available water resources can thereby be produced mainly in winter. In higher elevations, precipitation falls in the form of snow. The snow accumulation and consequent melting process in the higher elevations is one of the important factors for water resources in Afghanistan.

In Afghanistan, the land area is divided largely into five river basins: Amu Darya River Basin, Northern River Basin, Harirod-Murghab River Basin, Hilmand River Basin, and Kabul (Indus) River Basin. Figure 2.5 shows the location of river basins mentioned above.

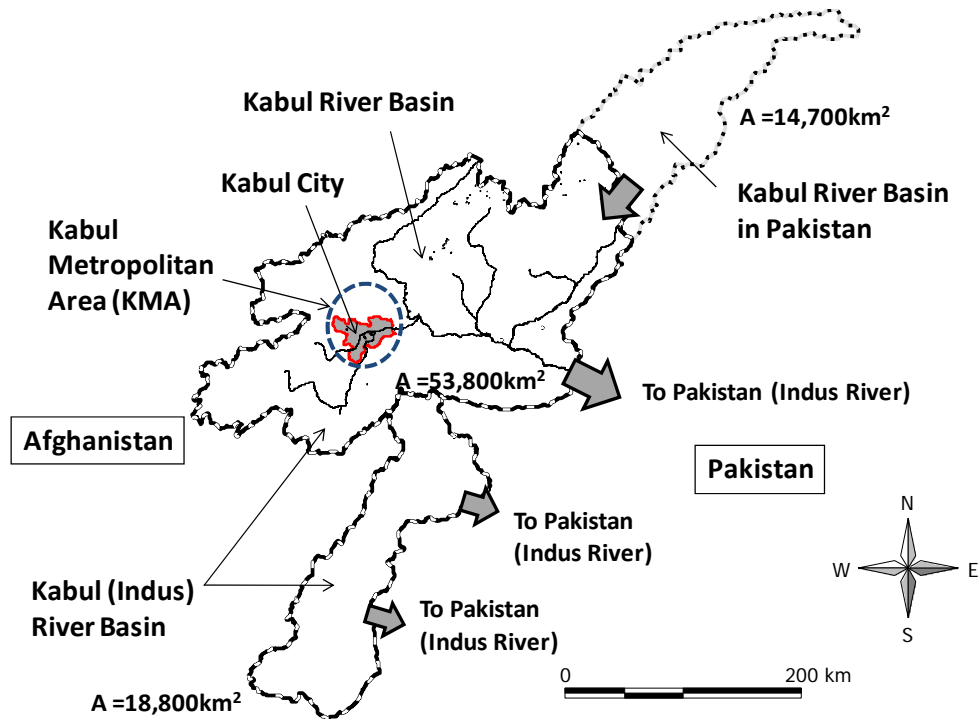


Source: AIMS-GIS data arranged by KMAUD Master Plan

**Figure 2.5: River Basins in Afghanistan**

### 2.2.2 Composition of river basins in and around Kabul City

The Kabul (Indus) River Basin has two separated parts in the territory of Afghanistan as shown in Figure 2.6. One is the northern part, which covers main part of the Kabul River Basin. The other is the southern part that consists of several small tributaries that directly flow to the territory of Pakistan. The Kabul Municipality is located in the northern part of the Kabul (Indus) River Basin, which is generally called as the Kabul River Basin.

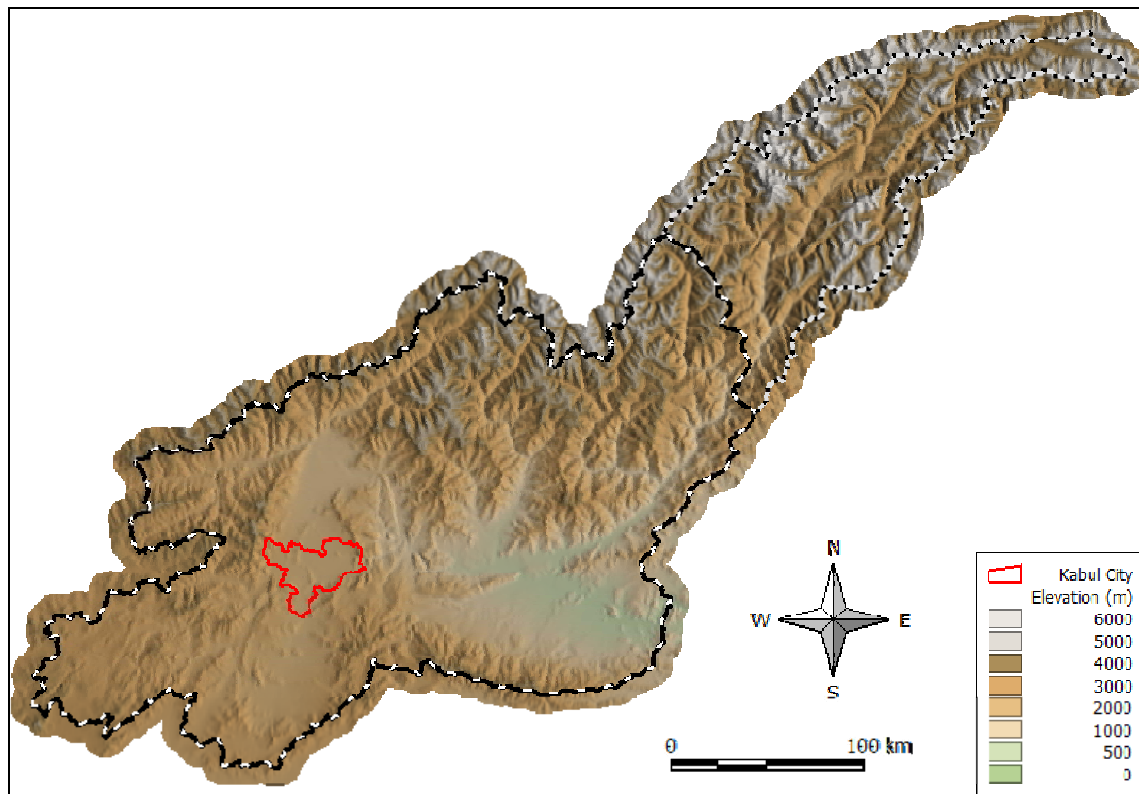


Source: KMAUD Master Plan

**Figure 2.6: Kabul River Basin and Kabul City**

### 2.2.3 Elevation

Figure 2.7 shows distribution of elevation in the Kabul River Basin based on GTOPO30 DEM data. The highest elevation is more than 7,000m (5,800m in the territory of Afghanistan) and the lowest is about 400m. The elevation of the flat land areas in the territory of the Kabul Municipality is 1,780-2,000m, while that of the surrounding ridges is about 4,000m in the west, 3,000m in the east and the south, and 2,200m in the inner ridges. The lower Kabul basin and the Dehsabz basin are connected through a flat narrow corridor at an elevation of 1,775-1,800m.



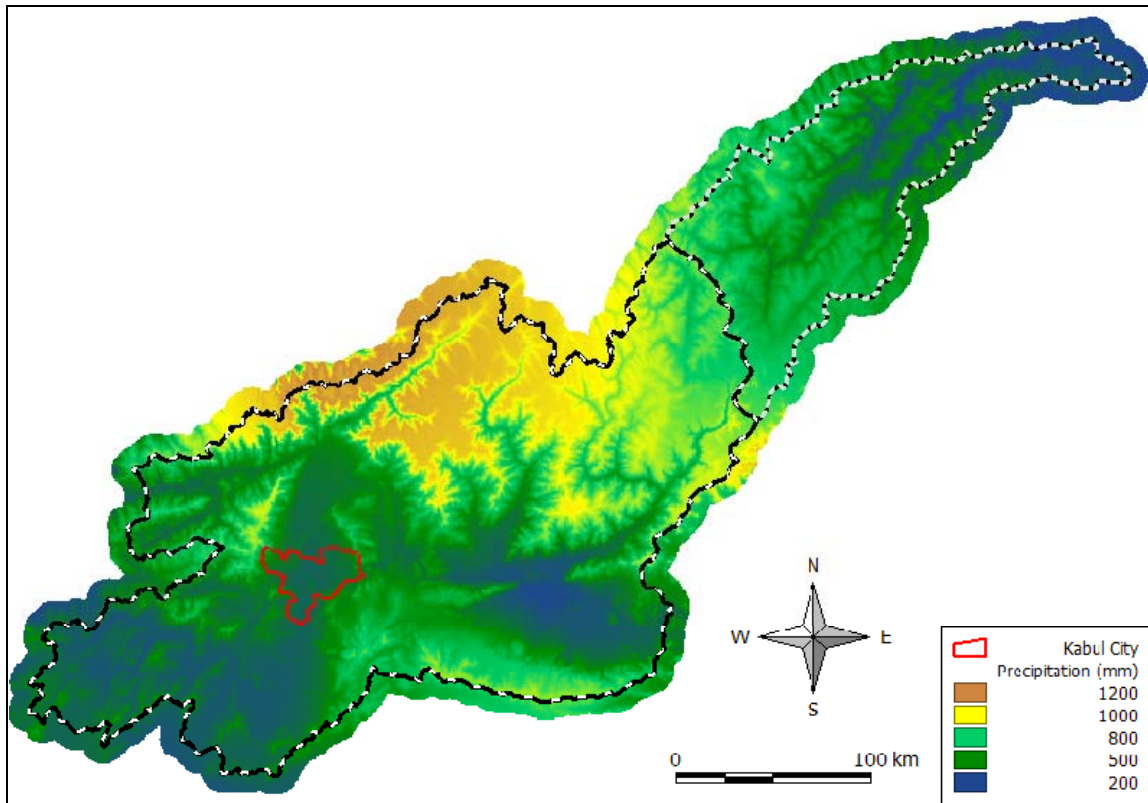
Source: KMAUD Master Plan

**Figure 2.7: Distribution of Elevation in Kabul River Basin**

#### 2.2.4 Climate and meteorological conditions

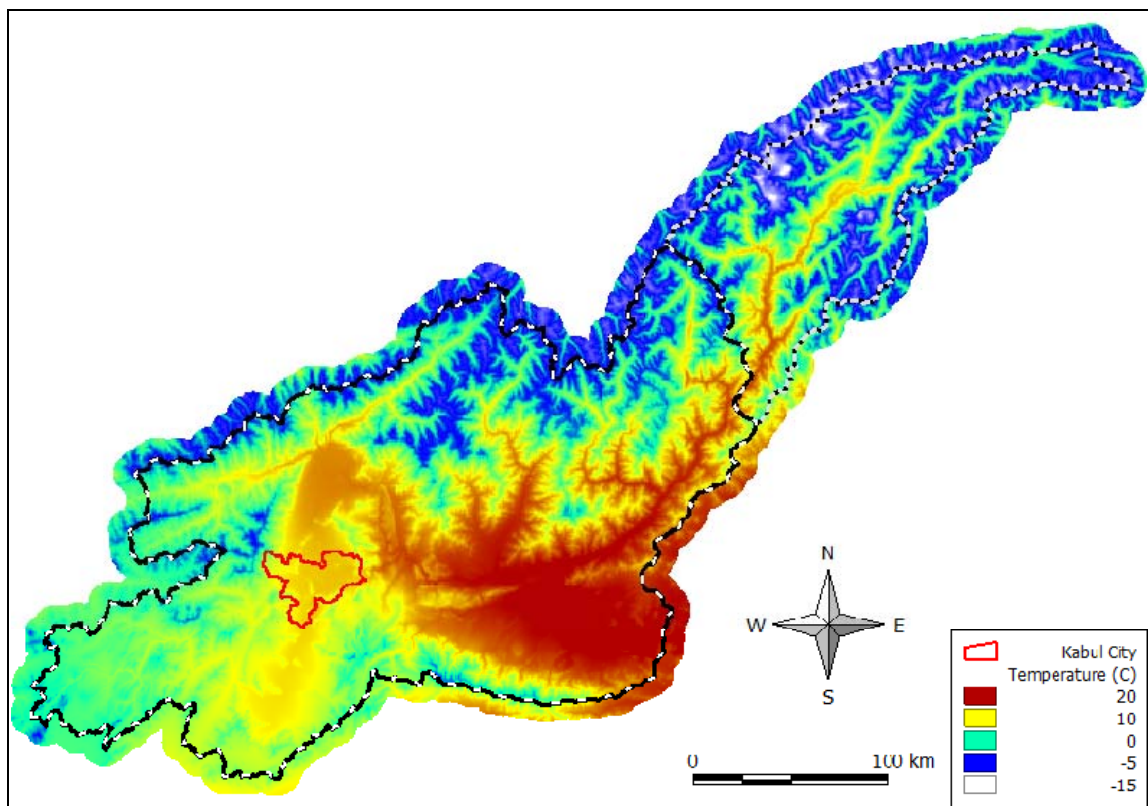
Spatial distribution of meteorological conditions is strongly affected by local geographical conditions, especially by altitude. Spatial patterns of annual precipitation and average air temperature in the Kabul River Basin are shown in Figure 2.8 and Figure 2.9, respectively. The figures are prepared using WORLDCLIM data, which show an average condition during 1950-2000. The WORLDCLIM data contain long-term average 1km mesh monthly precipitation and temperature based on observed data with correction considering altitude. The patterns are similar to the maps shown in Watershed Atlas of Afghanistan, 2004. It should be noted that the precipitation amount in mountainous areas tends to be smaller than that estimated in Integrated Water Resources Management in Kabul River Basin, 2006.





Source: KMAUD Master Plan

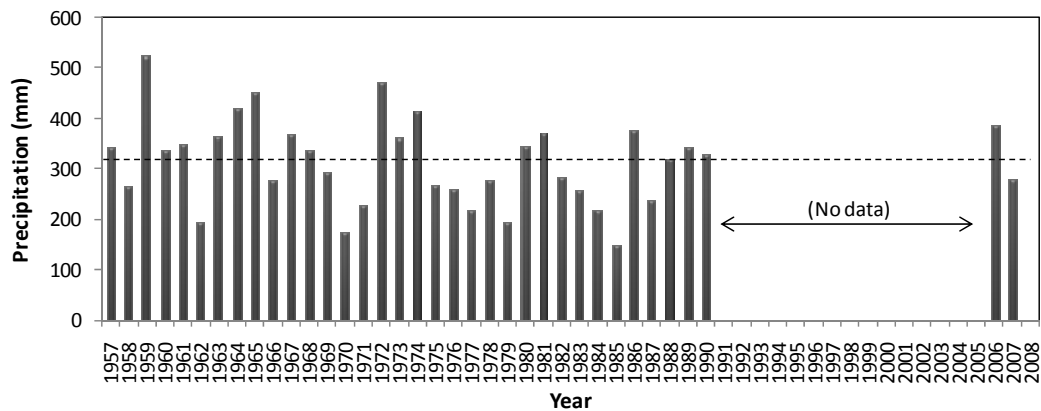
**Figure 2.8: Distribution of Annual Precipitation in Kabul River Basin**



Source: KMAUD Master Plan

**Figure 2.9: Distribution of Average Air Temperature in Kabul River Basin**

Figure 2.10 shows the variation of annual precipitation at the Kabul airport station. The annual precipitation varies from about 200mm to about 500mm. There seem to be drought year(s) with comparatively smaller precipitation once in about 10 years (1962, 1970-1971, 1979, and 1985). It is difficult to judge if any long-term trend exists or not, because of lack of data during 1991-2005.



Source: For 1957-1990, Integrated Water Resources Management in Kabul River Basin, Vol.2, 2006, [http://docs.lib.noaa.gov/rescue/data\\_rescue\\_afghanistan.html](http://docs.lib.noaa.gov/rescue/data_rescue_afghanistan.html), and Kabul River Valley Development Project, Vol. II, 1978; for 2006-2007, AMA

**Figure 2.10: Variation in Annual Precipitation at Kabul Airport Station**

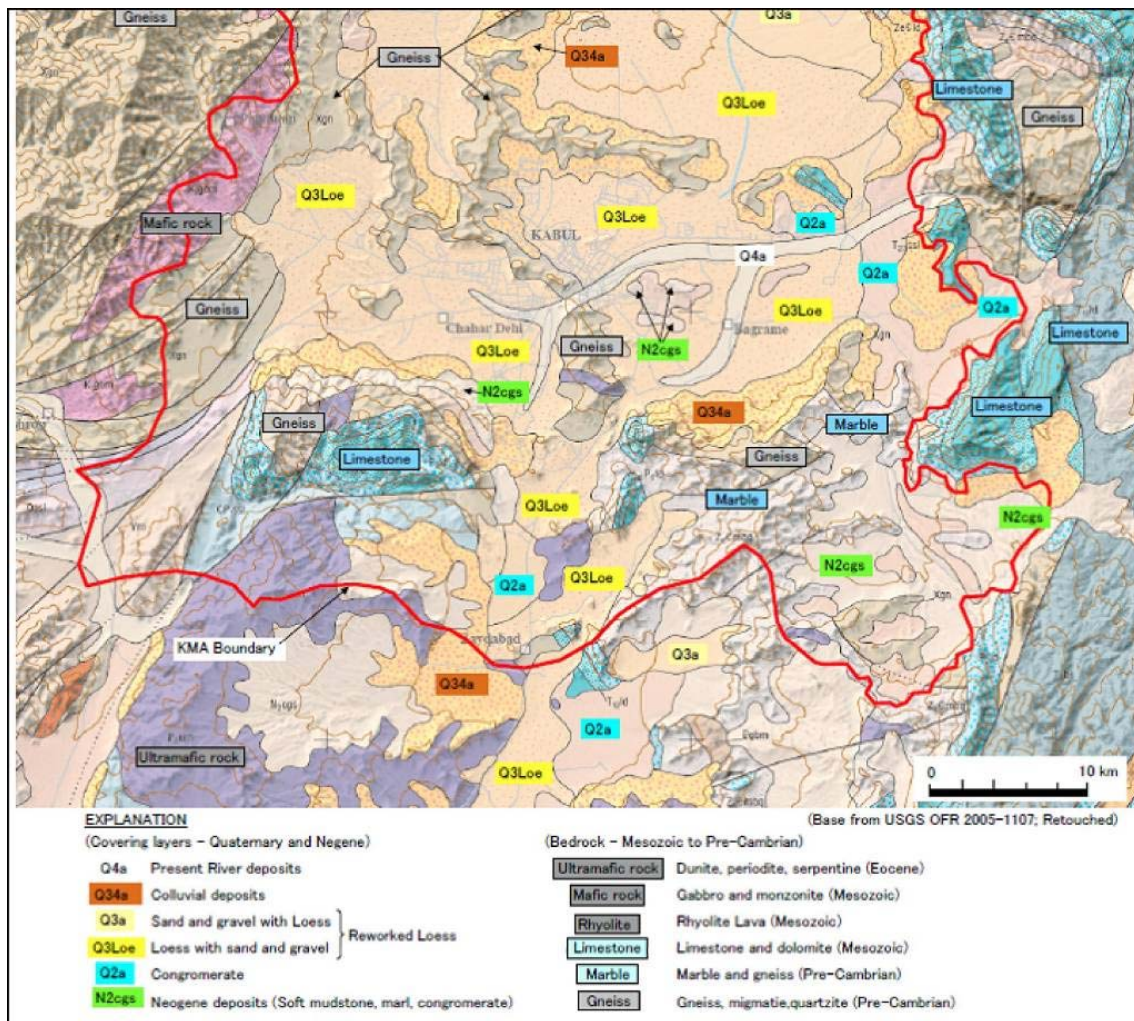
### 2.2.5 Geology

The geologic strata spreading in and around the city are listed in Table 2.1, and the distribution of geological conditions on the ground surface is shown in Figure 2.11. Most of the built-up area in the city consists of reworked loess characterized as highly erosive.

**Table 2.1: Stratigraphy of Kabul Province Geology**

Geologic age	Name of stratum*	Main facies	Max. depth (m)	Distribution
Holocene -Pleistocene	Present river deposits	Gravel, sand, clay	5	Along large rivers
	Swamp deposits	Clay, silt	5	Present & dried-up back swamp of Kabul river & Logar river in Kabul basin
	Colluvial deposits	Detrital materials	15	Foot of ridge & hill
Pleistocene	Reworked loess	Loess with sand & gravel	25	Prevailing widely in flat area.
	Gravel	Gravel with sand & loess	50	Underlying reworked loess
	Conglomerate	Conglomerate, sandstone with loess & gravel	65	Underlying reworked loess & gravel; also spreading at mountain foot
Neogene	Neogene deposits	Soft mudstone, marl, clayey gravel	1,000	Underlying quaternary; constituting flat-topped hills in Kabul
Palaeogene -Precambrian	Bedrock	Gneiss, limestone, marble	-	Constituting ridges & mountains around basin

\* Tentatively given for the ease of understanding the facies and its engineering role – not a geologically proper term

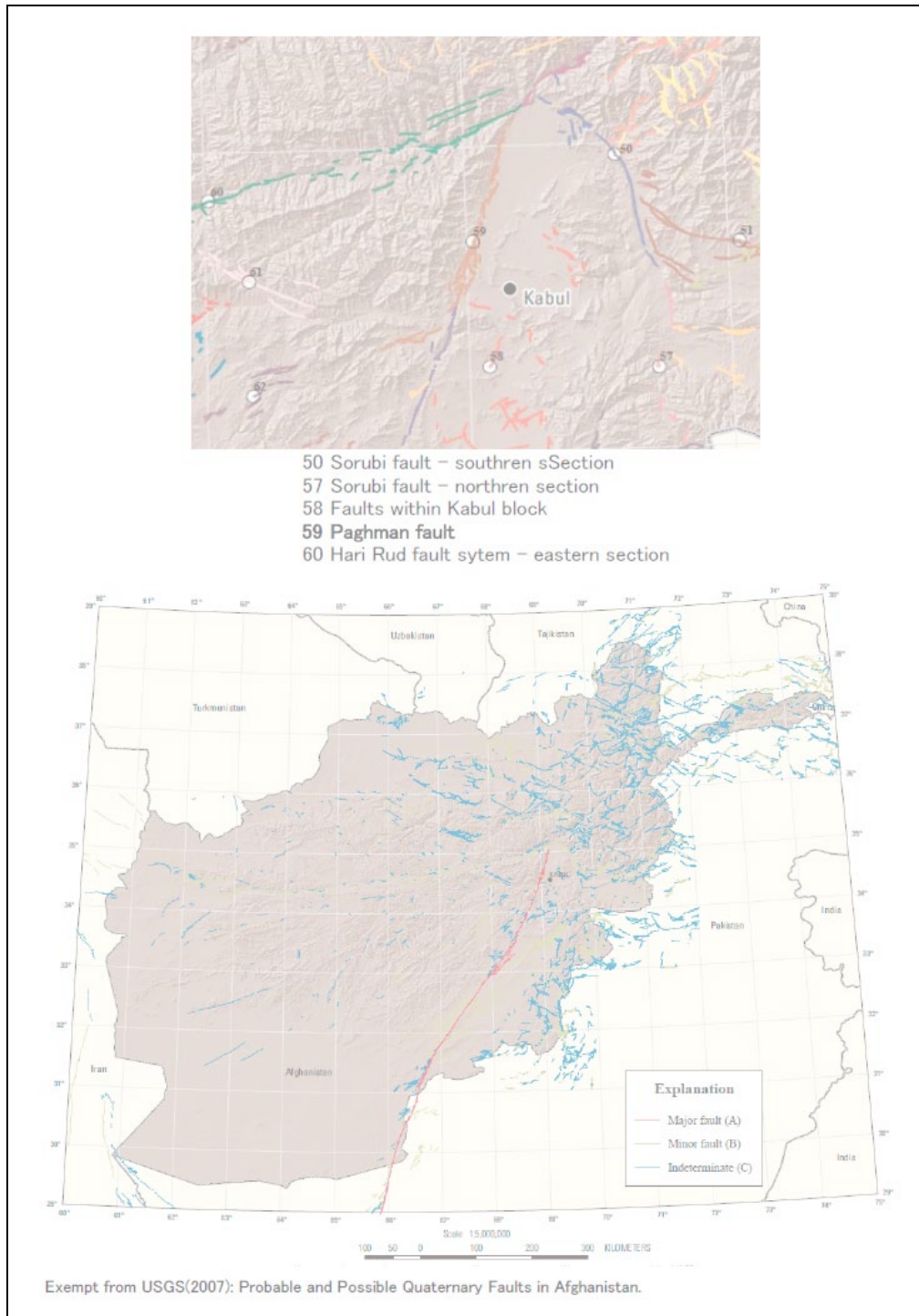


Source: KMAUD Master Plan

**Figure 2.11: Geography of Kabul Area**

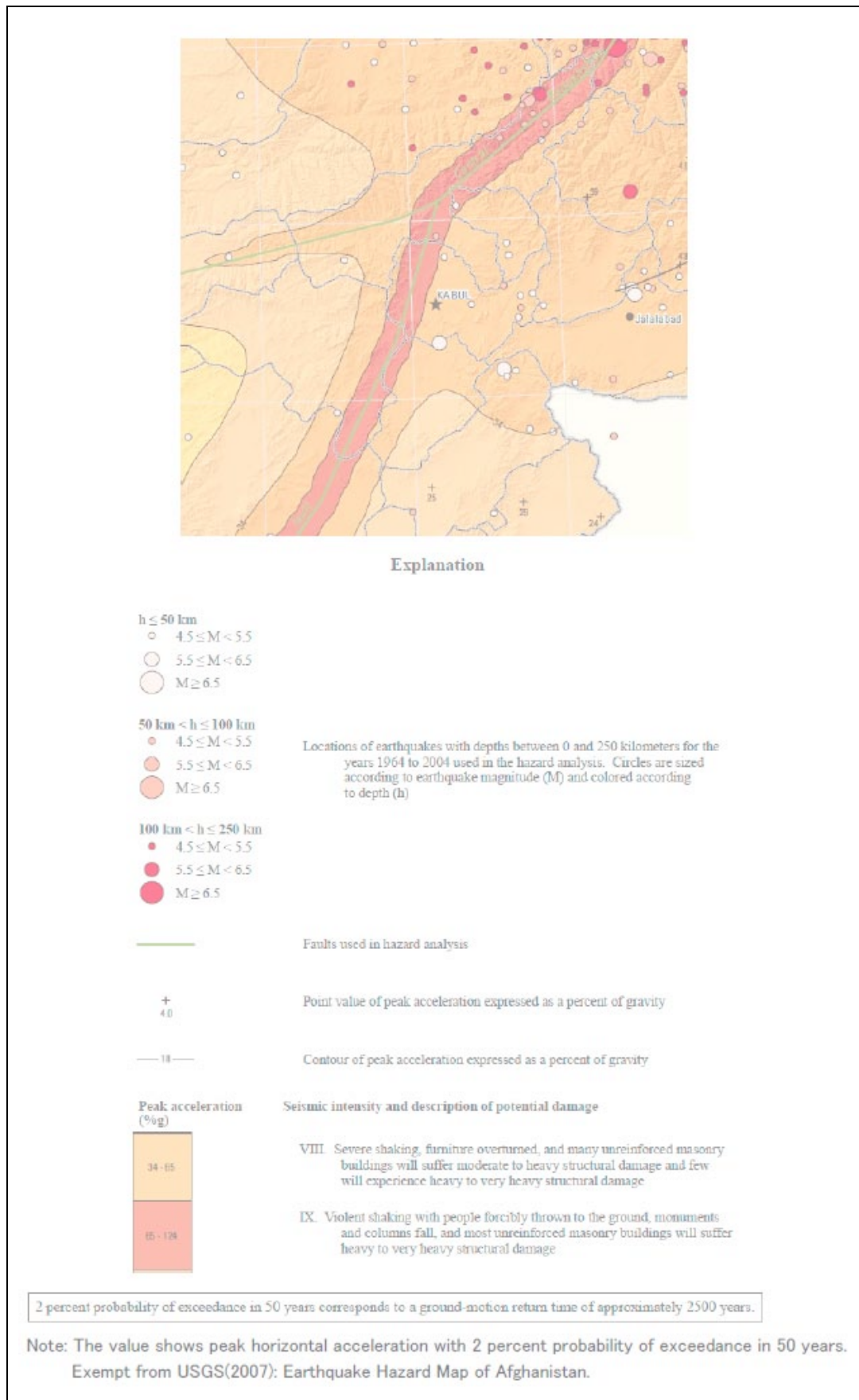
The Paghman fault is located along the foot of Paghman Mountains in the west side of the city as shown in Figure 2.12. The fault is a part of the Chaman fault system, which is considered to be the most major tectonic line in Afghanistan and to be a probable active fault. High seismicity is shown around the city on a hazard map (Figure 2.13), though the probability is small.





Source: KMAUD Master Plan

**Figure 2.12: Probable and Possible Quaternary Faults**



Source: KMAUD Master Plan

**Figure 2.13: Earthquake Hazard Map**

## 2.2.6 Past disasters in Kabul City

In the last five years, Afghanistan experienced several natural disasters of flood, earthquake, avalanche, and landslides, which caused human casualties. Among these natural disasters, floods are most significant as it causes more than 100 deaths by a single event as shown in Table 2.2. In the same period, Kabul City experienced several floods which caused death casualties as shown in Table 2.3. In these cases, the snow-broth raised the water level of the Kabul River and flooded into eastern lower areas roughly along the administrative boundary between Districts 5 and 13 (Figure 2.14).

In addition to floods, some landslides were taken place in the steep slope areas in District 17 within the same period. This event fortunately did not cause any casualties because of low urbanization around the site. A study for hillside areas funded by USAID raised cautions against the rock fall, debris flows, and landslides in the hillside area. Further study needs to be conducted in order to identify specific hazardous areas. It is necessary to establish countermeasures such as restriction of habitation and provision of engineering solutions against these disasters.

**Table 2.2: Major Disasters in Afghanistan in Last Five Years**

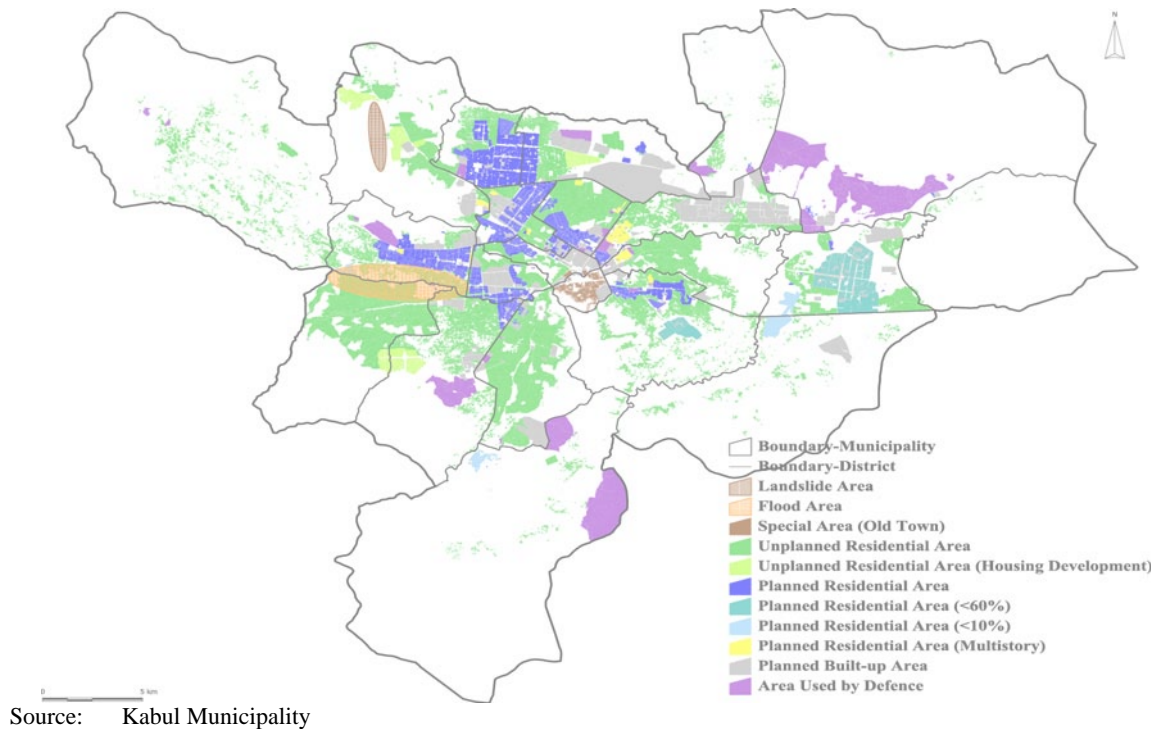
Year	Province	Type of Disaster	Affected Person (person)			Affected Household	Damaged Housing (housing)	
			Missed	Killed	Injured		Partially Damaged	Destroyed
2005	Kapisa	Flood	3	7	7	382	0	0
2005	Logar	Flood	0	8	0	0	24	0
2005	Badakhshan	Flood	25	124	106	1,856	941	350
2006	Badghis	Flood	100	69	50	2,800	6	500
2006	Nangarahr	Flood	0	28	18	2,710	141	134
2006	Kunduz	Earthquake	0	1	7	8	300	23
2007	Kapisa	Flood	0	9	0	150	997	248
2007	Parwan	Flood	5	31	13	4,455	2,340	611
2007	Takhar	Earthquake & Flood	76	17	57	6,862	250	660
2007	Bamyan	Avalanche & Flood	0	45	10		60	107
2010	Samangan	Earthquake & Flood	3	14	19	1,337	600	1,500
2010	Balkh	Landslide & Flood	0	9	15	247	300	1,094

Source: DMIS (Disaster Management Information System), National Anti-Disaster Department

**Table 2.3: Major Disaster in Kabul City in Last Five Years**

Year	Type of Disaster	Affected Person (person)			Affected Households	Affected Housing (housing)	
		Missed	Killed	Injured		Partially Damaged	Destroyed
2005	Flood	0	0	0	90	67	106
2006	Flood	0	12	9	15	150	0
2007	Flood	0	14	10	1721	645	281

Source: DMIS (Disaster Management Information System), National Anti-Disaster Department



### 2.2.7 Vegetation and greenery

There used to be a green belt around the city center with a total area of around 10,000 ha. Most part, however, has been lost and there are only nine green areas exist, which are administered by the Section of Environment, MAIL. All those forests are artificial. Main trees planted are: oleaster (Russian olive), elm, plane tree, pine, and willow. The location of the past green belt is shown in Figure 2.15.



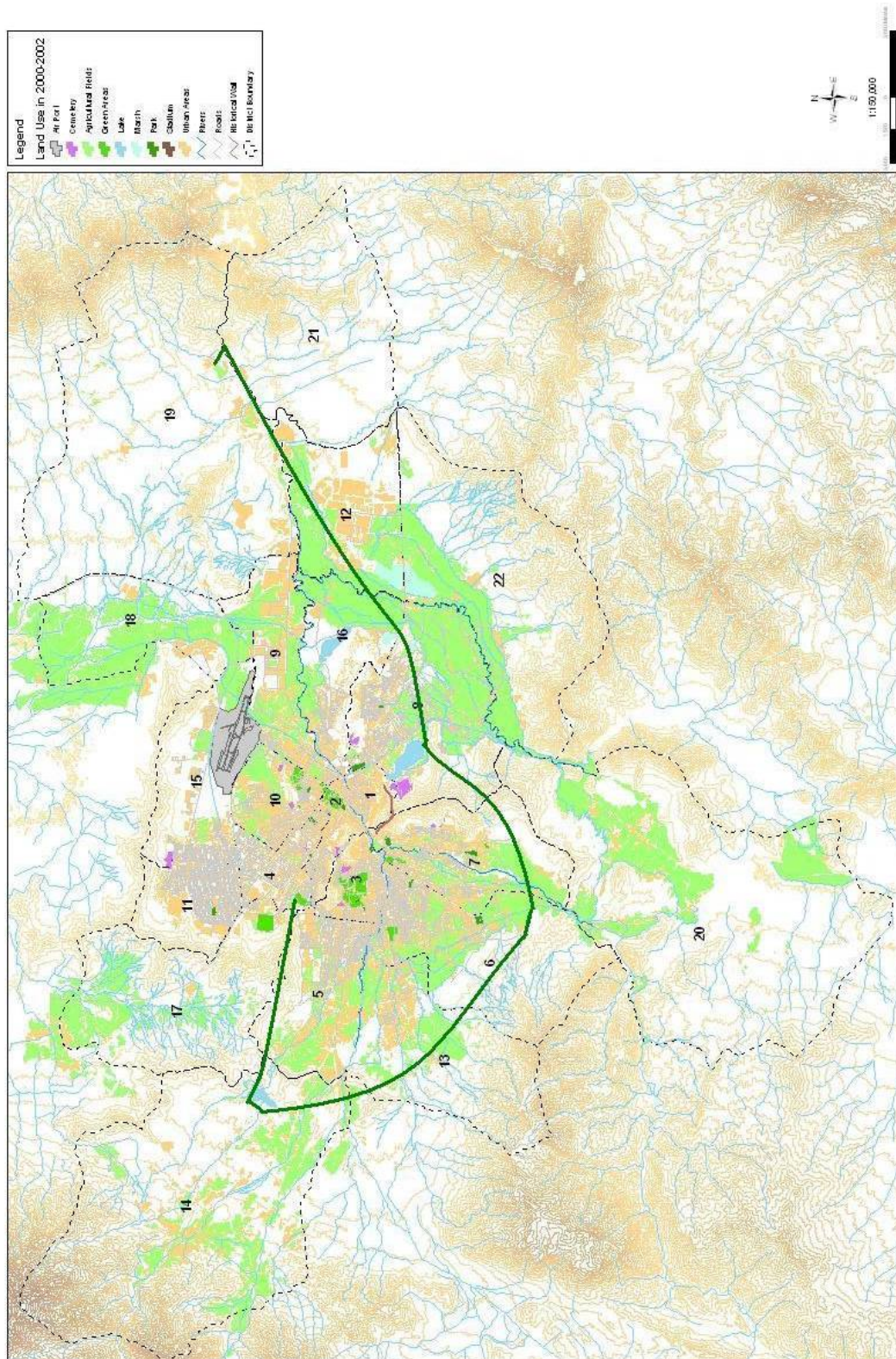


Figure 2.15: Greenbelt in Kabul City in the Past

Source: Section of Environment, MAIL



## **2.3 Socio-economic Conditions**

### **2.3.1 Urbanization in Kabul City**

#### **(1) Historical evolution of Kabul City**

Established as an oasis along the east-west trade route on the plateau now constituting part of Afghanistan, Kabul has its history that is said to date back to some 3,500 years. It was under the control successively of the Great Alexander, Sassanian Persia, the Islam Empire, the Timur Empire, the Mughal Empire, and others. Afghanistan was brought under the authority of the Durrani Dynasty in 1747, and Kabul became its capital in 1775.

After the struggle between the Britain and Russia for dominance and the colonization by the British, Afghanistan won its independence in 1919 with Kabul as its capital. Kabul had a population of some 90,000 in 1925. The basic structure of the present Kabul city was established in the 1940's and 50's, during which residential development actively took place, and the main street of Jadayi Maywand was constructed together with the Kabul University, hospitals and bazaars.

The expansion of the street system and the residential development continued after the 1950's, and Kabul became the largest city in Afghanistan with its population reaching 380,000 in 1962. The first master plan of the city was prepared during 1962-64 by Afghanistan and Russian experts for the planned population of 800,000.

Kabul was entangled in a series of political turmoil in the 1970's through the bloodless coup d'etat in 1973 to establish the republican government, the military coup d'etat in 1978, and the invasion of the Soviet troops in 1979. The occupation by the Soviet troops of as many as 100,000 military personnel continued through 1989. During the civil war following the occupation, many refugees moved into the capital city and the population in Kabul reached 1.5 million in 1992. In 1978, master plan was reviewed and revised for the planned population of 2 million.

During the civil war, particularly after the collapse of the communist regime in 1992, Kabul was devastated not only in its urban infrastructure but also in its social system for education, medical and other services. Human damages after 1992 include a loss of over 50,000 lives in Kabul and several hundred thousand refugees to its suburbs. It is reported that there existed close to 50,000 widows in 1997 in Kabul alone. Most refugees returned to Kabul after the establishment of the Taliban regime, and the population in Kabul was 1.78 million in 1999 according to the UN population survey in 1999-2000 (UN Regional Coordination Office, Population Survey Project, Kabul, January 2001).

#### **(2) Past population growth and expansion of Kabul City**

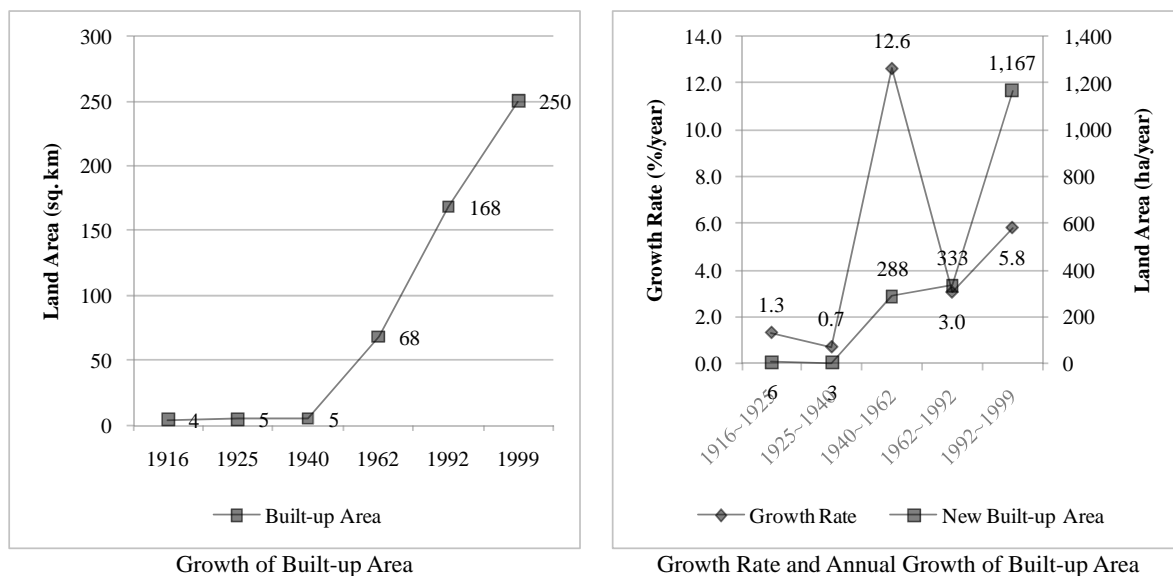
The population growth and the expansion of the territory of Kabul are summarized in Table 2.4 and Figure 2.16. The urbanization of Kabul commenced at the Old Town in District 1 in the range of 400ha in 1916. In the following years of 1940 to 1962, the urbanization has been accelerated and the built-up area was extended to 68km<sup>2</sup>. The urbanization considerably proceeded in the Mujahedin period of 1992~1999. The built-up area was expanded to 25,000ha in 1999. The population increased during this 83-year period at the average annual rate of 4.07% due to inflow of people and the expansion of the city territory. The city area expanded over the same period by 62.5 times.

The population of Kabul City was 2,268,300 in 2005 as estimated by the Central Statistics Office (CSO) for the older city area consisting of 14 districts (Districts 1-16, except Districts 13 and 14). This represents an average annual population growth at 4.0% during 1999-2005. The jurisdiction of the Kabul Municipality area was expanded in January 2005 by the agreement between the Ministry of Interior, the Kabul Province and the Kabul Municipality. By doing this, the population increased to 2,721,000 with 22 districts.

The city population has increased to 4.22 million in 2008 as estimated at this time, representing the annual average increase at nearly 10% over 1999-2008, which is partly caused by the expansion of the territory. The municipality area has expanded over this period by 4.1 times to 1,022.7km<sup>2</sup>.

**Table 2.4: Population Growth and Expansion of Kabul City**

Year	Population	Pop. Growth (% p.a.)	City area (ha)	City development
~1700	10,000	--	--	Became the capital of Afghanistan (1775)
~1878	70,000	--	180	Developed as a bazaar city
~1916	65,000	--	400	Leather and textile industries developed
~1925	90,000	3.7	450	Independence (1919)
~1940	120,000	1.9	500	Housing construction (1930~)
~1962	380,000	5.4	6,840	Main infra. Built; became the largest city in Afghanistan
~1992	1,500,000	4.7	16,830	Communist period (1979~1992): Stable urbanization by capturing public lands. Invasion by USSR; Provincial Council established
~1999	1,780,000	2.3	~25,000	Mujahedin period (1992~1997): Strong urbanization by capturing public lands. Taliban period (1997~2001): Population flowed out from the central part of the city, while expanded in suburbs around the city center.
~2005	2,721,000	4.0	1,022,700	Karzai period (2001~): Rapid urbanization resumed in the city.



Source: ICT

**Figure 2.16: Growth of Built-Up Area in Kabul City**

### (3) Past master plans for Kabul City

To manage the shape of urbanization of the city, three master plans were formulated in the past as listed in Table 2.5.

**Table 2.5: Past Master Plans of Kabul City**

	Approved Year	Horizon Year	Planned Population (Million)	Covered Area (km <sup>2</sup> )
First Master Plan	1962	1987	0.8	237.80
Second Master Plan	1970	1995	1.4	299.00
Third Master Plan	1978	2002	2.0	323.30

Source: Preliminary Study of Land Tenure Related Issues in Urban Afghanistan with Special Reference to Kabul City, UNHABITAT

The First Master Plan was prepared in 1962 by Afghan experts with the support of advisors from USSR. The plan expected 800,000 inhabitants in the area of 23,780 ha within the time frame of 25 years.

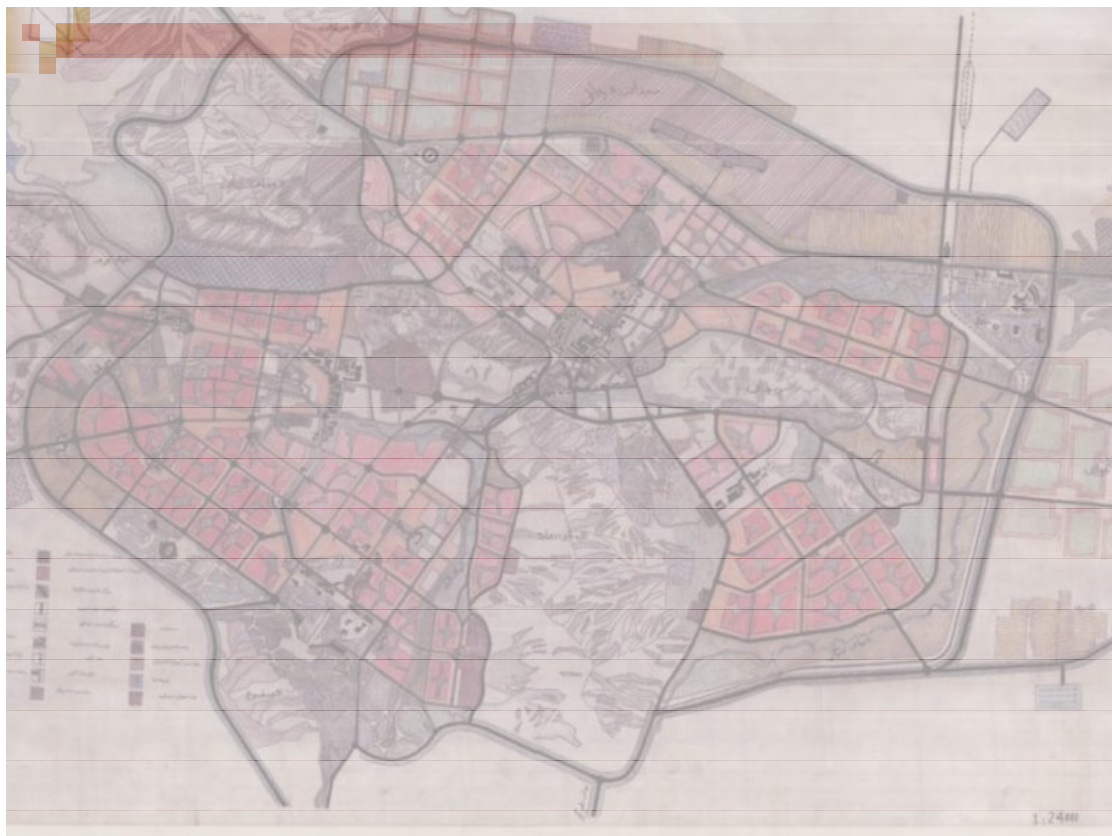
The Second Master Plan was prepared in 1970 with the assistance of Soviet experts and United Nations Educational, Scientific and Cultural Organization (UNESCO). The plan covered 29,900ha to accommodate 1.416 million residents.

Preparation of the Third Master Plan started in 1976, and approved in 1978. The plan covered 32,330ha for the population of two million toward 2002. Proposed land use is shown in Figure 2.17, and the composition of planned land use is summarized in Table 2.6.

In 1999, a special decree was issued on the implementation of the Kabul Master Plan, which included changes to the Third Master Plan. These changes were proposed by the Head of the Municipality, endorsed by the Council of Ministers and approved by the Head of the State. Eventually, a decision was taken to suspend the modified Third Master Plan to look for a more responsive and implementable plan for Kabul City.

**Table 2.6: Proposed Land Use of Kabul City by the Third Kabul Master Plan (1978)**

Land Use	Area (ha)	Share (%)
Roads and Street	2,878	8.90%
Public Structures	679	2.10%
Parks and open space	3,557	11.00%
Individual houses	4,222	13.06%
Commercial and Residential Buildings	4,574	14.14%
Mountains & Rivers	16,428	50.80%
Total	32,338	100.00%



Source: Kabul Municipality

**Figure 2.17: Drawing of the Third Kabul Master Plan (1978)**

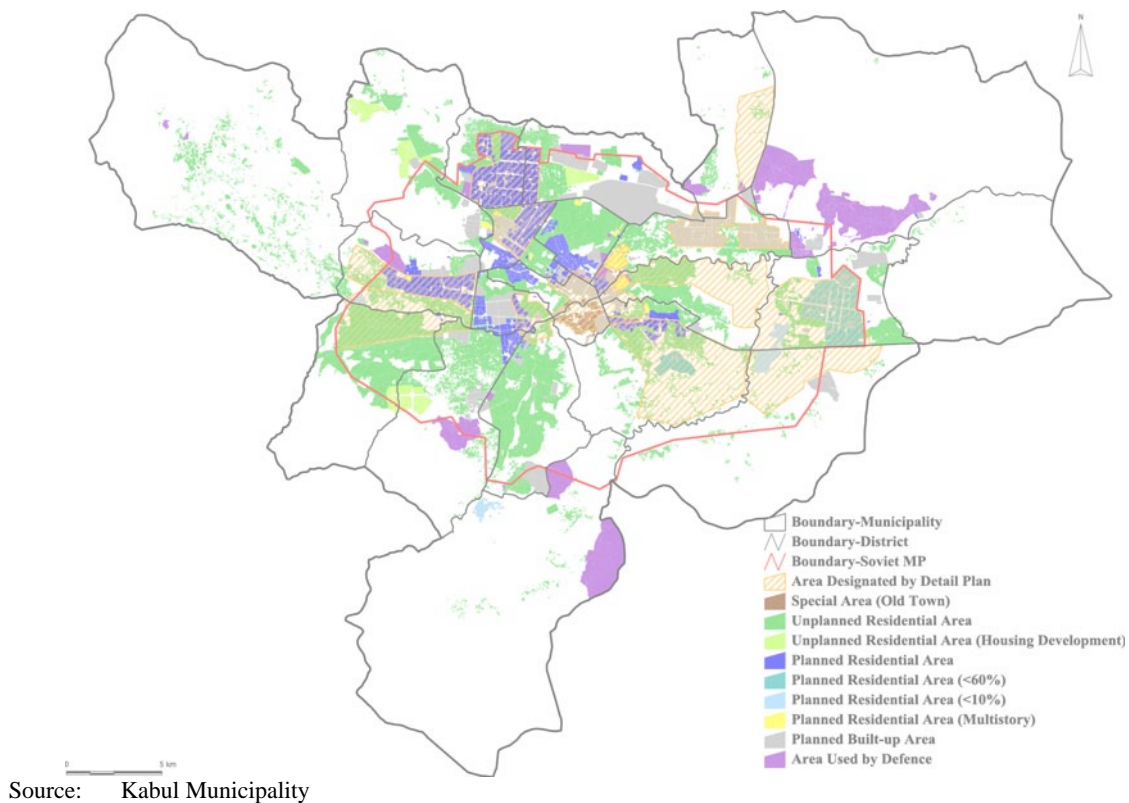
#### (4) Formulation of informal settlement

Following the preparation of master plans, Structure Plans and Detail Plans were prepared for construction of residential and other districts in a planned manner. After the Third Master Plan was approved in 1978, many detail plans were prepared as shown in Figure 2.18. However, strong urbanization under unstable political conditions constrained proper implementation of those plans. Housing areas have expanded mostly within the area of the Third Kabul Master Plan but in the form of informal settlements.

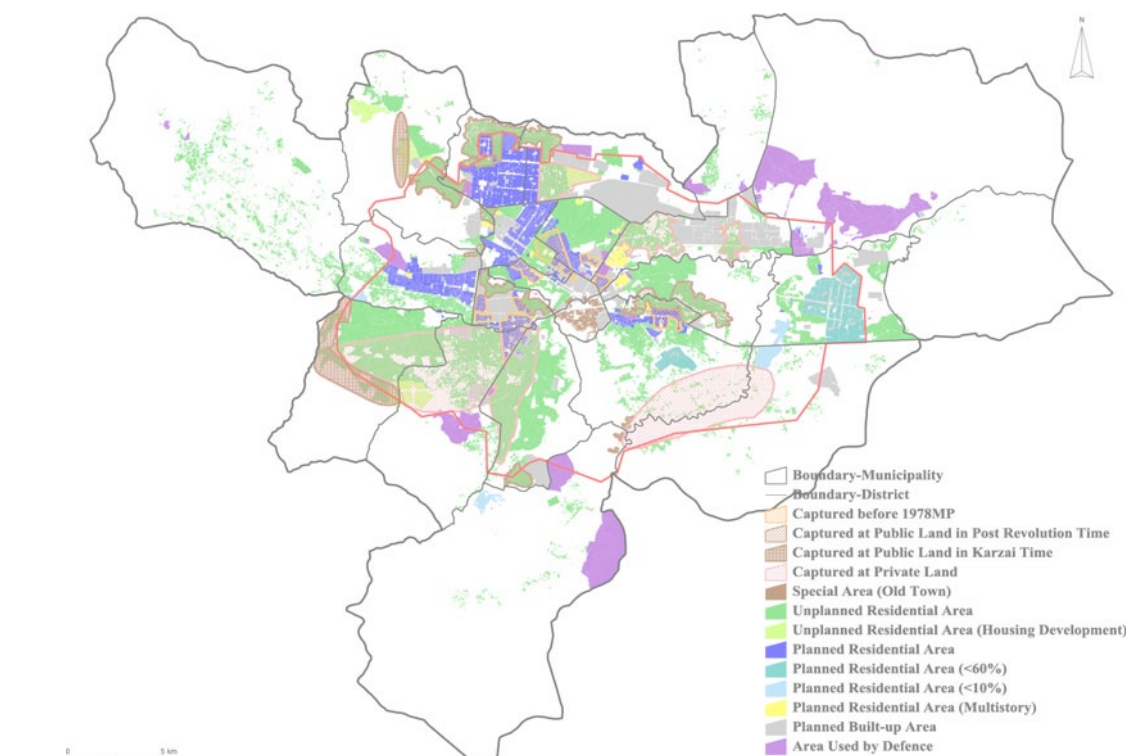
Informal settlements are basically defined as settlements which are built after 1978 without compliance to the Third Master Plan and Detail Plans. The informal settlements occupy 76% of existing residential area in 2008 as shown in Figure 2.19. It is estimated that around 74% of the population resided in the informal settlement area in the same year.

Focusing on the status of the land, the Land Titling and Economic Restructuring Activity (LTERA) funded by USAID identified the following four types of informal settlements:

- 1) Settlements on public lands,
- 2) Settlements where most houses were built on privately owned lands,
- 3) Settlements where most houses were built on lands grabbed directly or bought from land grabbers, and
- 4) Settlements where there is a murky legal situation.



**Figure 2.18: Target Area of the Third Master Plan and Detail Plans**



Source: Kabul Municipality

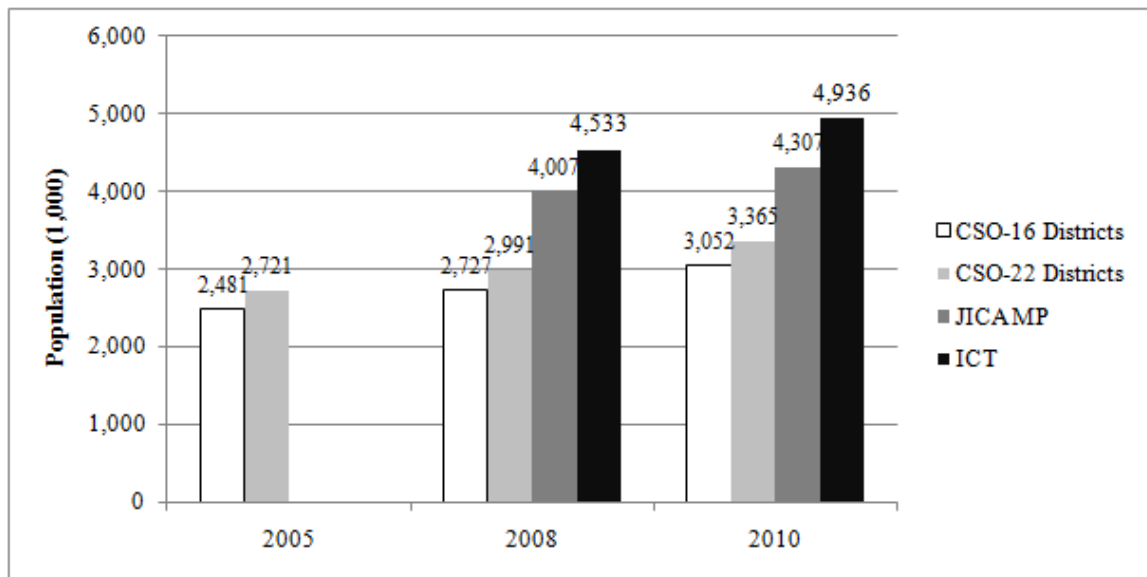
Note: The post revolution time includes Communist period (1979~1992) and Mujahedin period (1992~1997).

**Figure 2.19: Distribution of Planned and Unplanned Residential Area with Classification by Land Capturing**

## 2.3.2 Population

### (1) Population projection by previous studies

Existing and future population in Kabul city was estimated by the Central Statistics Office (CSO), the International Consultants & Technocrats (ICT) in the course of Kabul Development Plan, and the JICA study team in the course of the Kabul Metropolitan Area Development Master Plan. In 2008, CSO estimated the population at 2.7 million in 16 districts which exclude six districts joined to the Kabul municipality, namely: Districts 14, 18, 19, 20, 21, and 22. ICT estimated at 4.5 million for the existing population in 2008 and 8.0 million for the planning year of 2023 (Figure 2.20). The JICA study team estimated at 4.1 million in 2008 and 6.7 million for the metropolitan area, including 1.5 million for the new city, toward 2025.



Note: CSO does not estimate the population in Districts 14, 18, 19, 20, 21 and 22 in 2008 and 2010.

The population of CSO-22 Districts is estimated by assuming the population in those six districts increased from the population in 2005 with the same average growth rate in other 16 districts.

**Figure 2.20: Different Estimation of Existing Population for Kabul City by Various Studies**

As the population provides fundamental conditions for the entire urban planning work, these estimates and projections were carefully verified and revised in this master plan by using available information such as satellite imagery, GIS database, and some sample surveys. Details are presented in Appendix-1.

## (2) Estimated population in Kabul City in 2008

The existing population in Kabul city was estimated at 4.2 million in 2008 as shown in Table 2.7. The population in the unplanned areas occupied 73% of the total population. Table 2.8 shows the existing population by district in 2008.

**Table 2.7: Estimated Population by Type of Built-up Area in Kabul City for 2008**

Category	Flat Area<10%	Hillside Area >10%	Total	%
Planned	1,101,117		1,101,117	26.1
Unplanned	2,502,430	577,835	3,080,265	73.0
Old City	23,943	14,931	38,874	0.9
Total	3,627,490	592,766	4,220,256	100.0

Source: Planning Team

**Table 2.8: Existing Population by District in 2008**

District	District Area (ha)	Residential Area (ha)	Population	District Density (person/ha)	Residential Area Density by (person/ha)
1	483	124	35,402	73	286
2	684	257	83,295	122	324
3	911	414	139,742	153	338
4	1,172	598	204,049	174	341
5	2,845	894	283,489	100	317
6	4,918	957	285,255	58	298
7	3,334	1,478	416,675	125	282
8	4,825	1,124	331,554	69	295
9	2,433	616	188,569	77	306
10	1,303	885	270,157	207	305
11	1,742	829	287,853	165	347
12	3,490	1,221	298,847	86	245
13	4,719	1,660	467,440	99	282
14	11,902	524	147,910	12	282

15	3,253	626	200,465	62	320
16	2,507	713	206,701	82	290
17	5,602	780	248,926	44	319
18	3,388	121	33,958	10	280
19	14,143	11	3,906	0	356
20	14,294	152	31,836	2	210
21	6,395	22	6,040	1	279
22	7,925	258	48,187	6	187
Total	102,270	14,264	4,220,256	41	296

### 2.3.3 Employment and economic structure

#### (1) Estimate for 2006 by KMAUD Master Plan

There is no data available on the gross regional domestic product (GRDP) even at the provincial level. Rough data on employment by sector have been derived from the Strategic Development Plan for National Capital Region of Kabul (2005-2030), 2007) formulated by the then Ministry of Urban Development (now the Ministry of Urban Development and Affairs: MoUDA). The KMAUD Master Plan Study made an attempt to estimate the GRDP by sector of Kabul Province by applying the macro national statistics with modifications.

The statistics on the GDP of Afghanistan in recent years are summarized in Table 2.9. The data on employment by sector are combined with the GDP in 2006/07 to calculate the value added per employment by sector as shown in Table 2.10. As seen from the table, there exists significant variance between different sectors as is the case in most countries.

The value added per employment must be significantly higher in Kabul Province than the national averages for the industry and the services sectors as it contains the capital region. The value added per employment in agriculture should also be higher in Kabul Province than the national average as the province produces comparatively larger amount of fruits rather than grains.

The value added per employment is assumed by sector for Kabul Province, and the GRDP by sector is calculated. The results are summarized in Table 2.11. The estimated GRDP in the province is US\$ 1,166 million, corresponding to 16.2% of the GDP of Afghanistan. This share is slightly larger than the employment share (15.4%) of the province to the national total employment.

The employment structure of Kabul Province is 79.4% agriculture, 5.7% industry, and 14.9% services, while the GRDP structure of the province is 37.6% agriculture, 27.0% industry, and 35.4% services. Although the population in Kabul Province is 80% urban, the majority of people still depend on agriculture. The sizeable agricultural land, 143.2km<sup>2</sup> or 14.0% of the city land, exists even within the city territory.

It should be noted, however, that the agricultural employment includes sizable employment in agricultural services. For instance, if farm product is marketed in urban areas by farmers themselves, this activity represents the services employment, while the farmers are counted in the agricultural employment. This results in considerable underestimation of the services employment as shown above.

#### (2) Estimate for 2008 by KMAUD Master Plan

The population of Kabul Province increased significantly since 2006 due to the large influx of returned refugees and other migrants. The employment and economic structure estimated above for 2006 are updated to 2008. The population in Kabul Province increased from 3.14 million in 2006 to 4.3 million in 2008. The urban population may have increased from 2.55 million in 2006 to 3.6 million in 2008, and the rural population from 0.58 million to 0.7 million during the same period.



The employment by sector is escalated by using the change in the urban population for industry and services, and the change in the rural population for agriculture. The value added per employment by sector is assumed the same in 2008 as in 2006 for conservative estimates. The estimation of the GRDP by sector in 2008 is summarized in Table 2.12. Again, the agricultural employment includes sizable employment in agricultural services.

**Table 2.9: GDP and Employment by Sector in Afghanistan**

Indicators	In current prices (AFN 106)						
	1385 est. 2006/07 est.	Share (%)	1384 est. 2005/06 est.	Share (%)	1383 2004/05	1382 2003/04	1381 2002/03
<b>Agriculture</b>							
Cereals and others	89,175	24.0	102,415	30.3	83,472	81,502	70,144
Fruits	7,839	2.1	7,084	2.1	7,385	6,807	6,035
Livestock	20,263	5.5	19,810	5.9	20,074	16,901	11,431
<b>Subtotal</b>	<b>117,277</b>	<b>31.6</b>	<b>129,309</b>	<b>38.2</b>	<b>110,931</b>	<b>105,209</b>	<b>87,610</b>
<b>Industry</b>							
Mining and quarrying	876	0.2	788	0.2	638	290	264
Manufacturing	62,618	16.9	51,401	15.2	40,634	29,835	29,178
Food, beverage, & tobacco	59,249	16.0	48,575	14.3	38,412	28,061	27,659
Textile, wearing apparel & leather	666	0.2	569	0.2	317	402	277
Wood & wood prod. incl. furniture	107	0.0	91	0.0	91	37	29
Paper, paper prod., printing, publishing	14	0.0	13	0.0	11	12	12
Chemicals & chem. petroleum, coal, rubber, plastic	1,456	0.4	1,206	0.4	1,041	765	820
Non-metallic mineral except petroleum & coal	977	0.3	809	0.2	648	523	369
Metal basic	149	0.0	139	0.0	113	35	12
Electricity, gas, and water	593	0.2	461	0.1	311	280	121
Construction	37,412	10.1	30,135	8.9	20,715	12,240	8,700
<b>Subtotal</b>	<b>101,499</b>	<b>27.3</b>	<b>82,785</b>	<b>24.5</b>	<b>62,298</b>	<b>42,645</b>	<b>38,263</b>
<b>Services</b>							
Wholesale & retail trade, restaurants & hotels	33,139	8.9	28,347	8.4	24,290	20,870	19,282
Wholesale & retail trade	29,986	8.1	25,838	7.6	22,260	19,396	18,035
Restaurants & hotels	3,153	0.8	2,510	0.7	2,008	1,474	1,246
Transport, storage and communication	45,535	12.3	31,384	9.3	24,301	26,596	20,313
Transport & storage	41,517	11.2	29,851	8.8	22,922	25,592	19,554
Post and telecommunications	4,018	1.1	1,533	0.5	1,379	1,003	759
Finance, insurance, real estate and business	5,689	1.5	4,462	1.3	3,381	2,400	1,289
Finance	5,634	1.5	4,409	1.3	3,336	2,364	1,256
Insurance	8	0.0	7	0.0	6	5	4
Real estate and business services	47	0.0	46	0.0	38	31	28
Ownership of dwellings	12,688	3.4	14,918	4.4	13,843	12,042	10,650
Community, social and personal service	3,869	1.0	3,103	0.9	2,819	2,288	2,160
Producers of Government Services	27,543	7.4	21,860	6.5	14,230	12,000	10,000
Other services	12,627	3.4	11,358	3.4	10,606	4,597	4,439
<b>Subtotal</b>	<b>141,090</b>	<b>38.0</b>	<b>115,433</b>	<b>34.1</b>	<b>93,470</b>	<b>80,793</b>	<b>68,133</b>
<b>Total</b>	<b>359,866</b>	<b>96.9</b>	<b>327,526</b>	<b>96.7</b>	<b>266,699</b>	<b>228,647</b>	<b>194,006</b>
Less: Imputed bank service charge							
Taxes on imports	11,579	3.1	11,014	3.3	6,008	4,716	2,570
<b>GDP at market prices</b>	<b>371,445</b>	<b>100.0</b>	<b>338,541</b>	<b>100.0</b>	<b>272,707</b>	<b>233,363</b>	<b>196,576</b>

Source: CSO.

**Table 2.10: Value-added per Employment by Sector in Afghanistan, 2006**

Sector	GDP (US\$106)	Employment	VA/employment (US\$)
Agriculture	2,346	5,281,900	441
Industry	1,282	369,200	3,472
Services	3,570	1,524,200	2,342
Total	7,198	7,175,300	1,003

Source: KMAUD Master Plan



**Table 2.11: GRDP Estimate by Sector in Kabul Province, 2006**

Sector	Employment	Share (%)	VA/employment (US\$)	GRDP (US\$106)	Share (%)
Agriculture	873,000	79.4	500	436.5	36.9
Industry	63,000	5.7	4,000	252.0	21.3
Services	165,000	14.9	3,000	495.0	41.8
Total	1,105,000	100.0	-	1,183.5	100.0

Source: KMAUD Master Plan

**Table 2.12: GRDP Estimate for Kabul Province in 2008**

Sector	Employment	VA/employment (US\$)	GRDP (US\$106)
Agriculture	983,000	500	492
Industry	90,000	4,000	360
Services	236,000	3,000	708
Total	1,309,000	-	1,560

Source: KMAUD Master Plan

### 2.3.4 Other social characteristics

#### (1) Ethnicity

Afghanistan is a Muslim country, with the majority Sunni and most of the remainder Shi'a. The two principal languages are Pashto (the language of the Pashtuns) and Dari (a variant of Persian). The country is culturally highly diverse, with around 20 distinct ethnic groups. Some groups tend to occupy particular areas of the Country, while others are more scattered, or reside mainly in urban areas.

Kabul, as the capital city, accommodates almost all ethnic groups. The central area of the City is more ethnically mixed while the outskirts show more dominance of different ethnic groups. Although traditional tribal rivalries are one of the important factors in the social stability of the country, there are not many of conflicts taken place caused by ethnic issues alone in Kabul city.

#### (2) Livelihood

According to a study based on 526 household interviews in nine different livelihood areas in Kabul city (Action Centre La Faim, Kabul Vulnerability Mapping, Jan.2004), many households rely on the daily work. In seven out of nine survey zones, over 30% of the household's primary income earners rely on daily wage labor. On average 33.6% of households rely on daily work for their primary income.

Another survey (AREU, Urban livelihood in Afghanistan, Aug. 2006) shows the conditions of employment in Kabul city as follows:

- Regular employment: 5%
- Self-employed: 19%
- Casual wage labor: 38%
- Home-based work: 36%

The survey results also indicated that the median number of days of work per year in the city was 131 days and the median monthly per capita income was Afg 446.

Poverty is one of the most serious issues in Afghanistan. The National Risk and Vulnerability Assessment (NRVA) indicated the poverty incidents at 42% or 12 million people were living below the poverty line, with the average income of US\$14/month/capita (2007). Moreover, additional 20% of people were only slightly above the poverty line under highly vulnerable conditions.

Recent researches indicated that urban poverty increased and positively correlated with the growing urban population. Many informal settlements around major cities have been built to

accommodate migrant workers, returnees and others. Insecurity of employment leads to income irregularities and to a chronic shortage of income. Many urban poor households lack finance to smooth out expenses for consumption and are forced to take short-term loans to purchase basic needs such as food and pay house rents. Income fluctuation, job insecurity and high indebtedness are core characteristics of the typical urban poor.

### **(3) Gender**

Gender inequality is an important aspect of poverty in Afghanistan. The vast majority of women do not participate in paid economic activities, making them highly dependent on their husbands or families. The literacy rate among women (19%) is much lower than that for men (40%), and the net primary school enrolment rate for girls (grades 6-9) is around 21%, while it is higher for boys (28%). In Kabul, work participation of women seems higher than national average.

### **(4) Refugees, Returnees and Internal Displaced People**

More than 5 million Afghan refugees have returned to their homes since 2002. However, over 3 million Afghan refugees still remain in Iran and Pakistan. Several hundred thousand others are present in former Soviet Union countries. The majority of those who remain in Pakistan (2.1 million) and Iran (0.9 million) in exile for over 20 years pose a serious constraint for voluntary repatriation. Since 2005, repatriation of refugees has slowed down considerably. This is attributable to a number of factors: 1) the deterioration in the security situation, 2) limited employment opportunities upon arrival, 3) limited access to housing, basic health and education services, and 4) the length of time in exile.

Internally displaced persons (IDPs) are facing the same constraints and challenges as refugees: continuing conflicts, natural disasters and lack of livelihood opportunities. There are approximately 160,000 IDPs mostly in the southern Afghanistan.

In Barikab area located north of Kabul city beyond Dehsabz district, Kabul province, MRRD has been setting up a new town for about 7,000 families (50,000 persons) of returnees. The project aims to provide the land of 300m<sup>2</sup> per family by selling the land at the price of Afg 1500/100m<sup>2</sup>, which is much cheaper than the market price. The Australian government is supporting UNDP, and UNDP is funding this project.

### **(5) Conditions of Kuchis**

There are many nomads in Afghanistan called 'Kuchi'. Their population is estimated at 4,140,000 (690,000 families). The Government is promoting to settle the nomads by preparing plots of lands for them. In nation wide, the poorest Kuchis, however, are those who have settled. Reasons for settling include loss of livestock due to recent droughts and insecurity which have disrupted traditional migratory routes. Moreover, the biggest cause of settlement is the growing number of banditries and local crimes as well as conflicts with settled populations over grazing areas. The failure of local authorities to deal with disputes over traditional pasture rights has resulted in increase in the number of conflicts and rising poverty among Kuchis.

Currently, Kuchis living in the Kabul municipality are mostly settled in Districts 21 and 22. In District 21, there are 25 clans settled at 84,000 plots (each 300m<sup>2</sup>) which have been distributed to them for residential use. Land for schools, clinics and mosques were also provided. Part of family members work as nomads and the rest stay at home to work for other kinds such as trade and daily labor. Their problems are shortages of water and no graveled roads. In District 22, there are 18 clans situated. Their problems are shortages of drinking water, lack of schools, Madrasas (Islamic school), and clinics for both human and animals.

## **CHAPTER 3: DIRECTIONS FOR DEVELOPMENT OF KABUL CITY**

### **3.1 Wider Policy Requirements**

#### **3.1.1 Afghanistan National Development Strategy (ANDS)**

##### **(1) Vision and goals**

The ANDS, completed in early 2008, is the most fundamental and comprehensive policy document that spells out the vision, goals, strategy and broad measures by sector for socio-economic development of Afghanistan towards 2013. The collective aspirations of the people and the Government of Afghanistan are expressed in the ANDS as the vision for 2020 as follows:

- 1) Stable Islamic constitutional democracy at peace with itself and neighbors, standing with full dignity in the international family
- 2) Tolerant, united and pluralist nation that honors its Islamic heritage and deep aspirations toward participation, justice and equal rights for all
- 3) Society of hope and prosperity based on a strong, private sector-led market economy, social equity and environmental sustainability

The vision reflects the positive look at the plural characteristics of the Afghan society, and the unambiguous pursuit of market economy while paying equal attention to social equity and environmental sustainability on the basis of the encouragement and trust for the Afghan people.

The ANDS has established the three main pillars or goals for security, governance and socio-economic development. The security and the governance goals together aim at the realization of nationwide stabilization, lawful state, accountable Government and human rights through democracy. The realization of these ideas would make the third goal of socio-economic development truly worthy for the benefit of the Afghan people in all the sectors and segments of the society.

##### **(2) Socio-economic development**

The socio-economic development aims at poverty reduction, sustainable development through a private sector-led market economy, improvement of human development indicators, and significant progress towards the Millennium Development Goals. Key points of the socio-economic development expressed in the ANDS are noted below.

##### **1) Top priority**

The unambiguous pursuit of market economy, as clarified in the ANDS, is based on the unerring recognition of the geographic position where Afghanistan is placed as well as the worldwide trends of economic globalization and free trade. The ANDS states: “The Government’s top priority will be to improve trade and commercial relations with regional countries, taking advantage of Afghanistan’s strategic location in the region by adopting policies and procedures that facilitate and promote transit and trade.”

## **2) Agricultural and rural development**

As Afghanistan is basically an agrarian society, where almost three quarters of the labor force are engaged in agriculture, the ANDS emphasis on agriculture and rural development is clear. In line with the private sector-led market economy, the ANDS intends to transform agriculture to a high-value commercial agriculture by attracting the private sector investment. At the same time, the growth and employment generation in agriculture are expected to contribute to poverty reduction and provision of alternative livelihoods in rural areas.

## **3) Urban development**

For the urban sector, the ANDS aims: “to ensure increased access to improved services and affordable shelters, while promoting sustainable economic growth through the implementation of the National Urban Program, which includes the National Land Policy and the City Development Plans.” The following outcomes are expected:

- Strengthened municipal capacity to manage urban development and deliver services
- Improved institutional coordination and monitoring of key urban indicators
- Increased access to basic services for urban households
- Phased regularization of tenure for 50% of households living in informal settlements
- Upgrading public services and facilities, including new urban area development, for example, the development of a new city in Dehsabz North of the existing Kabul city
- Increased availability of affordable shelters, including a 50% increase in number of housing units and 30% increase in area of serviced land on the market, coupled with access to affordable finance, and
- Improved urban environment with green areas and open spaces

The urban development by public-private partnership in financing, service provision and management is indicated by the ANDS. Also, the ANDS states: “To alleviate urban sprawl, zoning and new city planning management capacities will be strengthened.”

## **4) Social development**

Throughout the document, the ANDS emphasizes the social program to reduce poverty and support the vulnerable. This includes the social protection for returned refugees, expected to number 2.5 million during the ANDS’ life, full immunization coverage for infants under 5 years, mainstreaming of women, and financial services in rural areas and to small and medium enterprises as well as health and education services for all the Afghans.

## **(3) Macroeconomic framework**

Despite the high growth performance in recent years, the ANDS states that the growth has thus far not contributed sufficiently to poverty reduction and employment creation as it has been driven largely by the influx of foreign aid, which carries with it macroeconomic risks. To pursue more self-reliant growth for reducing poverty and improving development outcomes in favor of the vulnerable, the ANDS has articulated the macroeconomic policy framework. It encompasses maintaining macroeconomic stability, raising domestic revenue, targeting low inflation, maintaining stable exchange rates regime, and engaging social protection programs for the most vulnerable segments of the population.

Specific targets include i) improving the revenue to GDP ratio to 10-11% by 2013 (7.4% in 2006), ii) covering recurrent expenditures with domestic revenue sources, and iii) attaining operating

budget balance (excluding grants). To increase the revenue, measures to broaden the tax base and improve tax administration are to be taken. In the medium term, a broad-based consumption tax is expected to play an important role.

The Government considers the private sector as the source of growth, and is determined to support its development. In particular, the private sector is expected to contribute to increased investment for growth, export drive, and development of mineral and fossil fuel resources.

The increased investment by the private sector will result in higher government revenue, which can be allocated to the social programs. The export is expected to increase at 16-18% per annum during the ANDS' lifetime through diversification of export commodities and high value exports. Expansion in the mining sector and the resulting growth in mining-related export are expected to be a significant source of economic growth along with high value agricultural activities.

### **3.1.2 Strategic Development Plan for National Capital Region of Kabul**

The Strategic Development Plan for National Capital Region of Kabul (NCRK) was prepared by MoUD's Strategic Development Plan Unit (SDPU) in 2008. NCRK consists of some districts of Kabul and four surrounding provinces; Parwan, Kapisa, Maidan and Logar. Basically the region has not been defined due to administrative boundaries of provinces, but it has been defined due to main road accessibility, commuting distance and physiographical feature of the region. Therefore Saroobi District has been excluded from Kabul Province and the following districts from four other provinces have been included:

Parwan Province; Charekar, Saidkhail, Jabulsaraj, Bagram.

Kapisa Province; Mahmood Raqee, Kohistan awal, Kohistane dowom. These districts are located in the same Shamali Valley.

Maidan Wardak; Maidan Shahr.

Logar Province; Pule Alam, Barakibarak, Khoshi, Mohmad Aghah, Kharwar.

All these districts are in the circle of 50km from Kabul, where the other districts are far and beyond the high barrier of mountain ranges. From other aspects, the above defined region is somewhat more depended on each other than other districts of the same provinces.

The plan proposed spatial development strategies targeting the year 2026, covering the following:

- 1) Goals and objectives
- 2) Distribution of economic activities and population
- 3) Map showing proposed economic activities (nature and scale) by settlement using symbols (agro industries, food processing & packaging, milk chilling plant etc.)
- 4) Infrastructure and sector development
- 5) Land use
- 6) Development norms and procedures
- 7) List of potential programs and projects

Figure 3.1 shows key plans of spatial composition, proposed in NCRK.

Potential and Direction for the Development of Cities in the Region			Comprehensive Integrated Development Plan		

Source: Strategic Development Plan for National Capital Region of Kabul, MoUDA

**Figure 3.1: Examples of Spatial Plans Proposed by NCRK**

### 3.1.3 Kabul Metropolitan Area Urban Development Master Plan (KMAUD Master Plan)

The Kabul Metropolitan Area Development Urban Master Plan was formulated in 2009 by assistance of JICA, in order to clarify necessity of developing the new city considered by Afghan Government in Dehsabz district, Kabul province. The study also formulated a regional master plan for the Kabul Metropolitan Area (KMA) consisting of the Kabul municipality area, the new city area, and Baricab area situated at further north. The plan set a regional framework for the metropolitan area as follows.

#### (1) Socioeconomic framework

The GRDP of Kabul province is projected by sector assuming expected growth rates to be attained by agriculture, industry and services as summarized in Table 3.1.

**Table 3.1: Projection of the GRDP and Employment in Kabul Province by Sector**

	GRDP (US\$106)		GRDP growth rate 2008-25 (% p.a.)	GRDP/employment (US\$)		Rate of increase 2008-25 (% p.a.)	Employment (1,000)	
	2008	2025		2008	2025		2008	2025
Agriculture	492	813	3.0	500	750	2.5	983	1,084
Industry	360	1,820	10.0	4,000	5,600	2.0	90	325
Services	708	4,861	12.0	3,000	3,900	1.5	236	1,246
Total	1,560	7,494	9.67				1,309	2,655

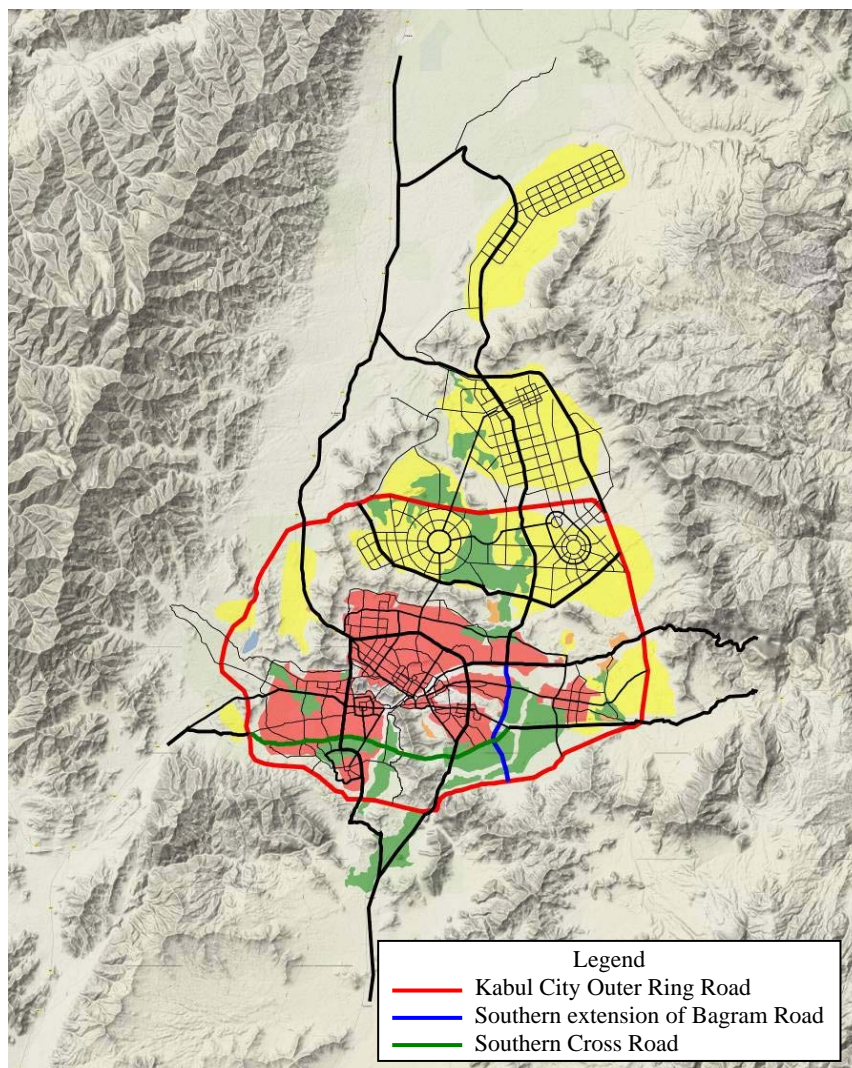
Source: KMAUD Master Plan

## (2) Spatial framework

The regional artery transport system for the metropolitan area was proposed to satisfy the following needs expected to develop along with the region's development (Figure 3.2):

- 1) It should link the segregated urban areas, including the new urban areas to be developed in the new city and other outer areas, to encourage their complementary development.
- 2) It should provide multiple links between the existing Kabul city and the new city to realized integrated development of the capital region having a multi-centric urbanization pattern.
- 3) It should facilitate the inter-regional traffic passing through the KMA, which is expected to increase as the KMA develops.
- 4) It should strengthen east-west and north-south links that would not pass through the central part of the Kabul city.
- 5) It should contribute to pedestrian-friendly urban spaces in the city center by constituting part of a hierarchy of urban road system for the Kabul city.

Particularly instrumental for satisfying these needs are the Kabul city outer ring road, the Bagram road with its southern extension, and the Southern Cross road.



Source: KMAUD Master Plan

**Figure 3.2: Regional Artery Transport System for Kabul Metropolitan Area**

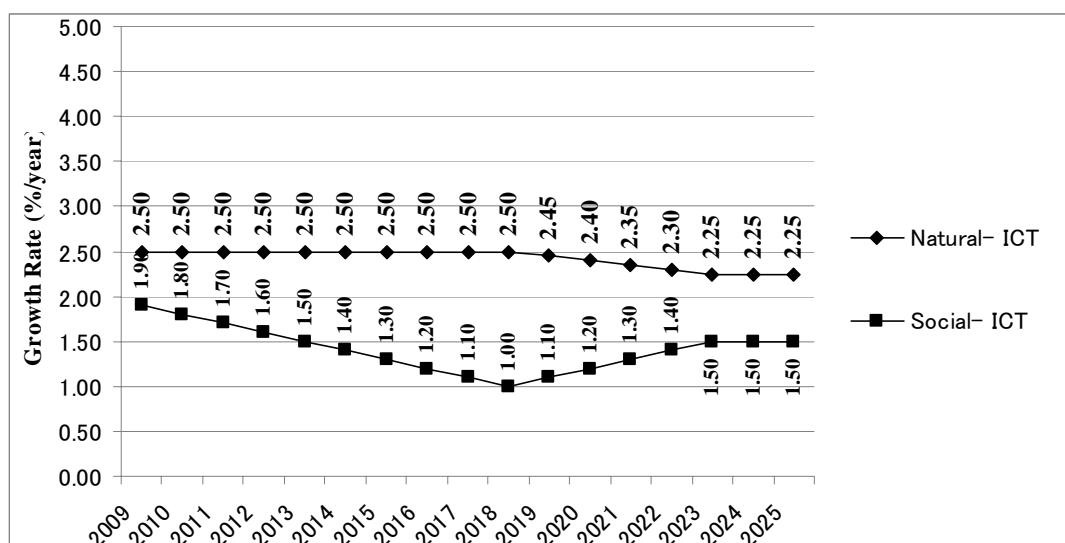
## 3.2 Factors Affecting Development Directions for Kabul City

The urban development of Kabul City would be affected by several major factors, including i) level of urbanization pressure, ii) availability of land for urban use, and iii) access to additional major water sources in accordance with river basin boundaries. Each factor is examined in the following.

### 3.2.1 Urbanization pressure

To assess the level of urbanization pressure, the future population was forecasted. Results of population projection by previous studies are firstly analyzed. Different scenarios were taken by the previous studies, which were reflected to the growth rates used for projections. Major differences in the previous studies are as follows:

- ICT estimated the annual growth rate at 4.4% for 2008~2009, which would decrease by 0.1% every year to 3.5% in 2017~2018. Then, it was assumed that the growth rate would turn around to 3.75% in the subsequent years until 2023. ICT assumed that the social increase rate will gradually decrease for the first 10 years, but will turn upward again, assuming that the city will start to attract immigrants as the economic center (Figure 3.3).
- KMAUD MP employed the average annual growth rate at 3.7% in the first period of 2008~2015. The growth rate was expected to decrease to 2.6% for the subsequent five years of 2015~2020 and to 2.3% for 2020~2025, respectively.



Source: ICT Study, data extracted by Planning Team

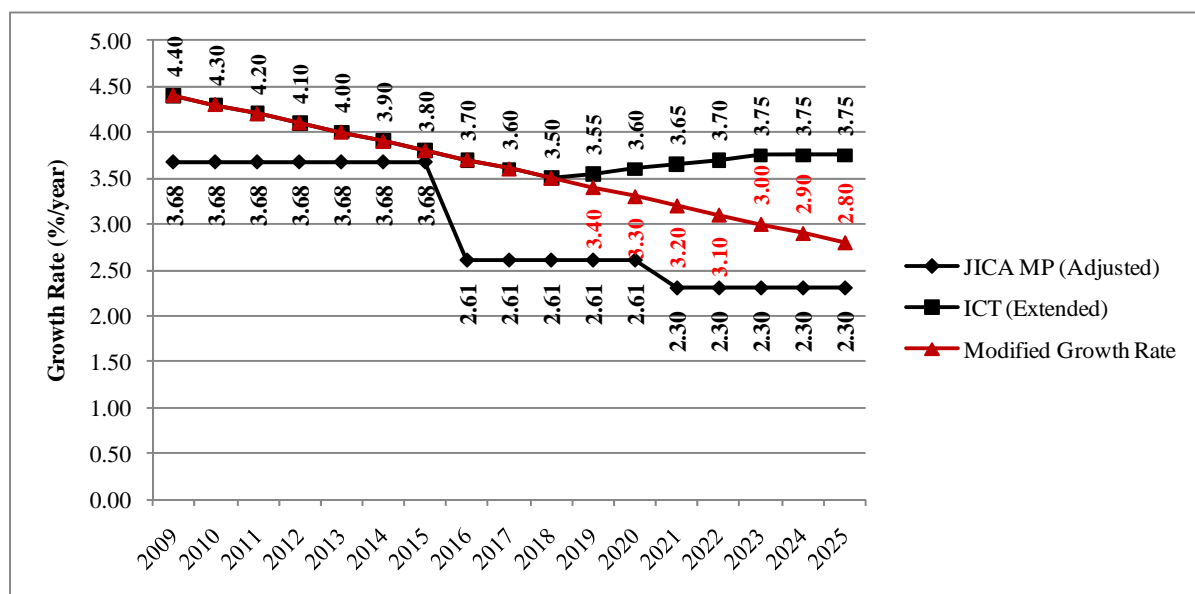
**Figure 3.3: Natural and Social Population Increase Rates adopted by ICT Study**

For this master plan, those annual growth rates employed by the previous studies are modified so as to take the concepts proposed by ICT and JICA MP into consideration. The modified growth rates until 2025 are estimated as follows:

- 1) The growth rate in year 2008 is assumed to be 4.4% as adopted by ICT, which seems high but well corresponds to the performance from 2001-2008.
- 2) The annual growth rate will gradually decrease to 3.5% until 2018 as adopted by ICT.
- 3) The annual growth rate will keep the same pace of decrease to reach 2.8% in 2025, without turning around.



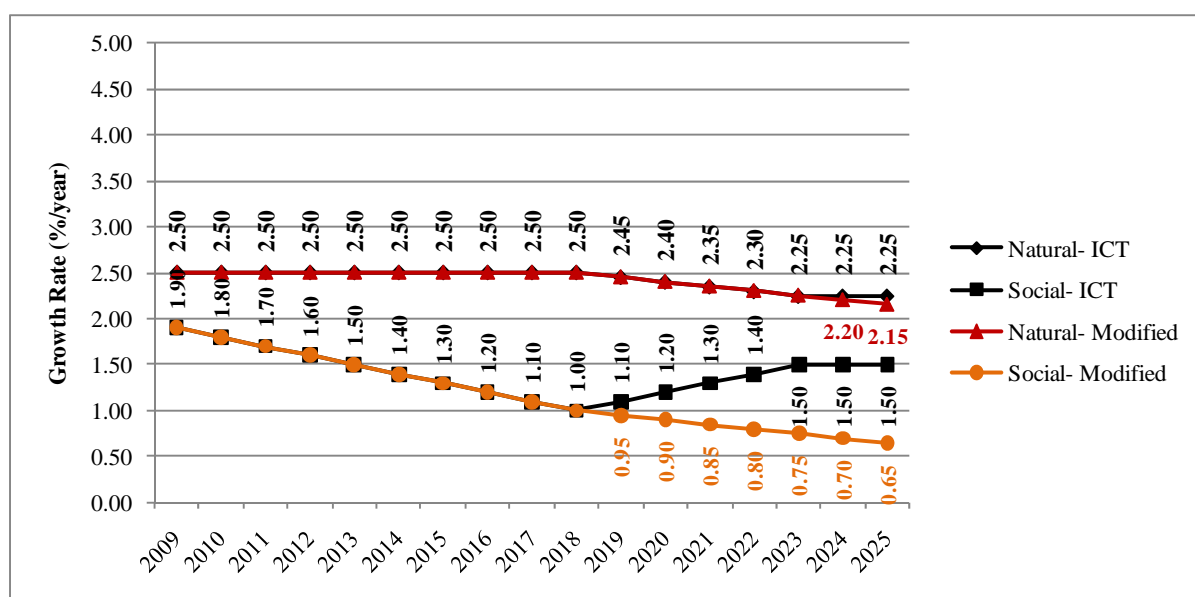
Figure 3.4 shows the comparison of annual growth rates, and Figure 3.5 shows the natural and social increase rates adopted by previous studies, together with modified figures adopted in this master plan.



Source: ICT Study and KMAUD Master Plan, data extracted and modified by Planning Team

Note: Growth rate for ICT after its target year of 2025 was assumed to be the same as 2023.

**Figure 3.4: Estimated Population Growth Rate until 2025 by ICT, JICA MP and JET**



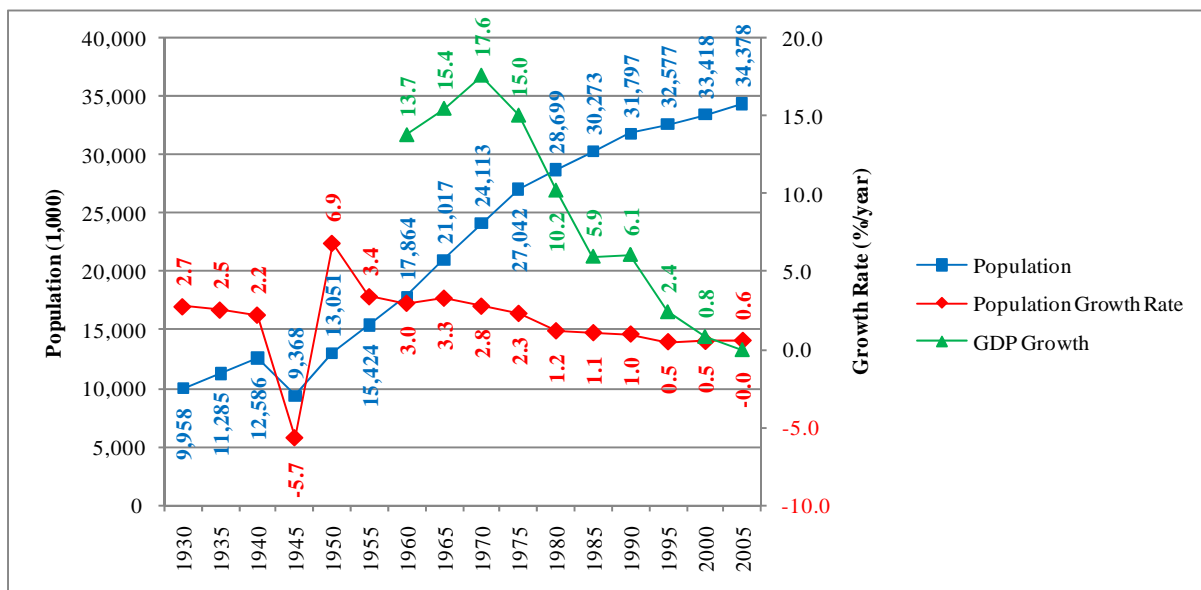
Source: ICT Study and KMAUD Master Plan, data extracted and modified by Planning Team

Note: Growth rate for ICT after its target year of 2025 was assumed to be the same as 2023.

**Figure 3.5: Estimated Natural and Social Growth Rates until 2025 by ICT and JET.**

It should be noted that the turn around of the growth rate as adopted by ITC is not expected in this master plan, based on the analysis on experience in Tokyo, Japan, which had several economic booms after the devastation during the Second World War. As shown in Figure 3.6, Tokyo and surrounding three prefectures experienced an extremely high population increase immediately after the end of World War II in 1945. The average growth rate for the first five years from 1945 to 1950 marked 6.9%/year. This was followed by 3.4% in 1950~1955, 3.0% in 1955~1960, and 3.3% in 1960~1965. The growth rate, thereafter, decreased to 0.5% in 1990~1995 and kept less than 1.0% in the subsequent ten years until 2005. Although there were occasional increases of

population growth rates, it is observed that the overall trend of growth rates is downward due to increase of parent population. Even in the economic miracle during the 1960s, the increase of growth rates was only 0.3 points.

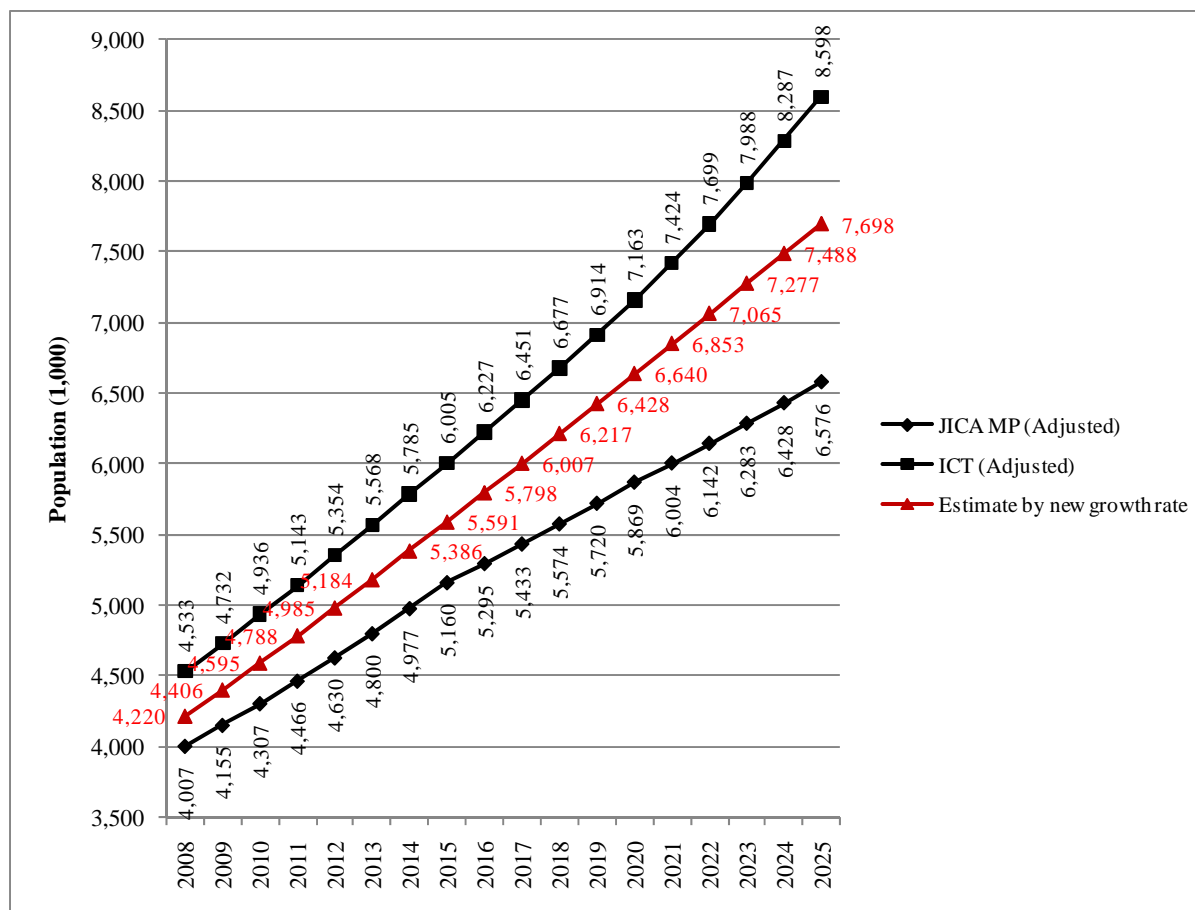


Source: Population Census, Ministry of Internal Affairs and Communications, Japan

Note: Surrounding three prefectures include Chiba, Kanagawa, and Saitama.

**Figure 3.6: Population and its Growth Rate in Tokyo and Three Neighboring Prefectures**

The projected future population was calculated to be 5.6 million in 2015, 6.6 million in 2020, and 7.7 million in 2025, respectively as shown in Figure 3.7.



Source: Planning Team

Note: Growth rate for ICT after its target year of 2025 was assumed to be the same with 2023.

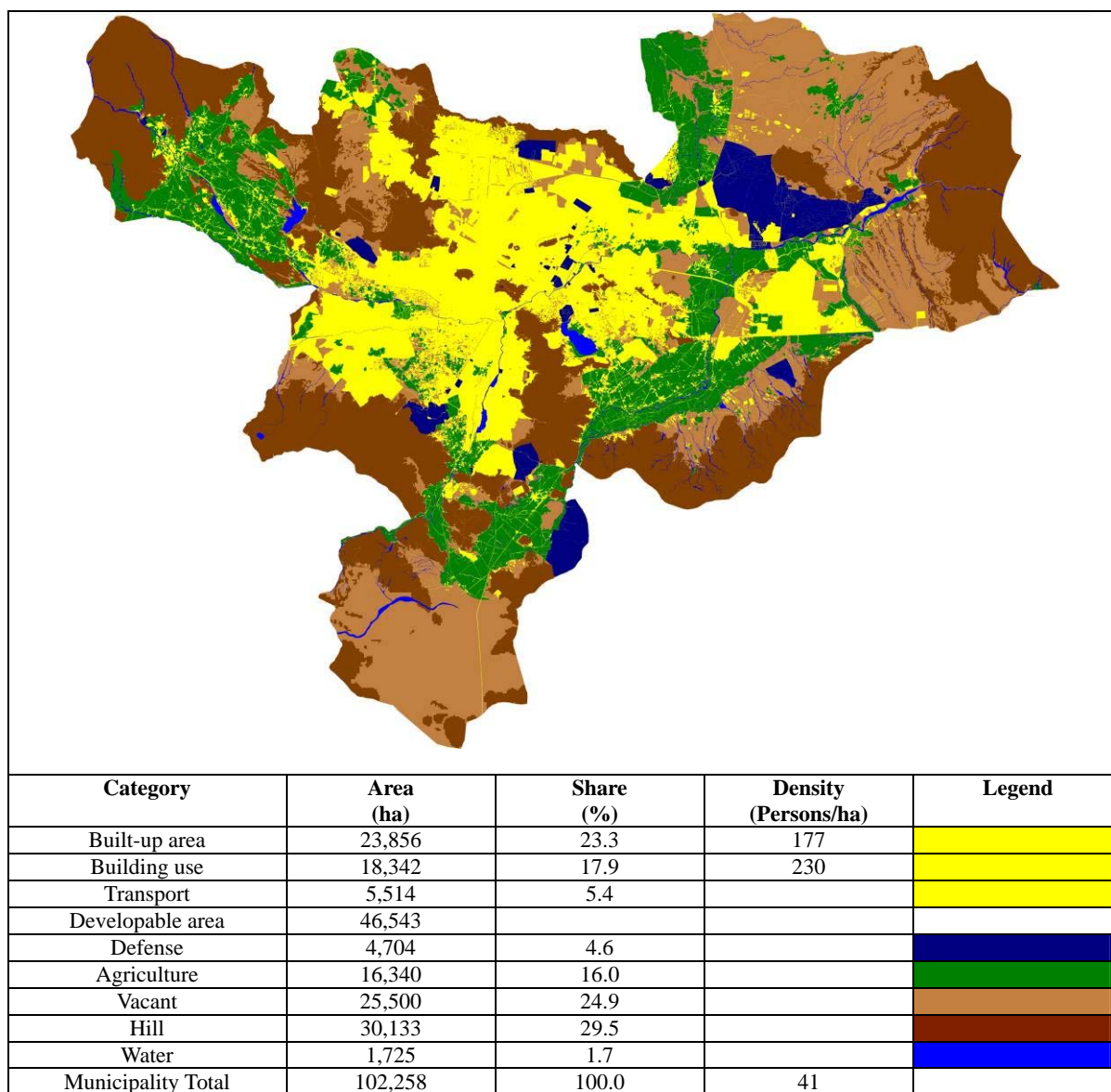
Note: Projection by KMAUD Master Plan excluded the population in villages in the New City area.

**Figure 3.7: Estimated Population until 2025 by ICT, JICA MP and JET**

### 3.2.2 Available land resource

Figure 3.8 shows the existing land use in 2008 by broad category. As seen from the figure, the gross population density was estimated to be 177 persons/ha for all the built-up areas including residential, governmental, commercial, and industrial areas, as well as land for infrastructure such as airport, roads, and parks. If the future urbanization follows the current manner, there seems to be a capacity for additional 4.5 million people by development of vacant land alone. Thus it is safe to say that the land resource will not be a serious factor for the future urbanization of Kabul City, if the entire municipality area can be used for urbanization.

There are, however, some important policies affecting the usage of the municipal territory for the urbanization of Kabul. These include protection of upper stream of major rivers, protection of major groundwater recharge areas. Detailed analysis was made regarding the land availability in Chapter 4.



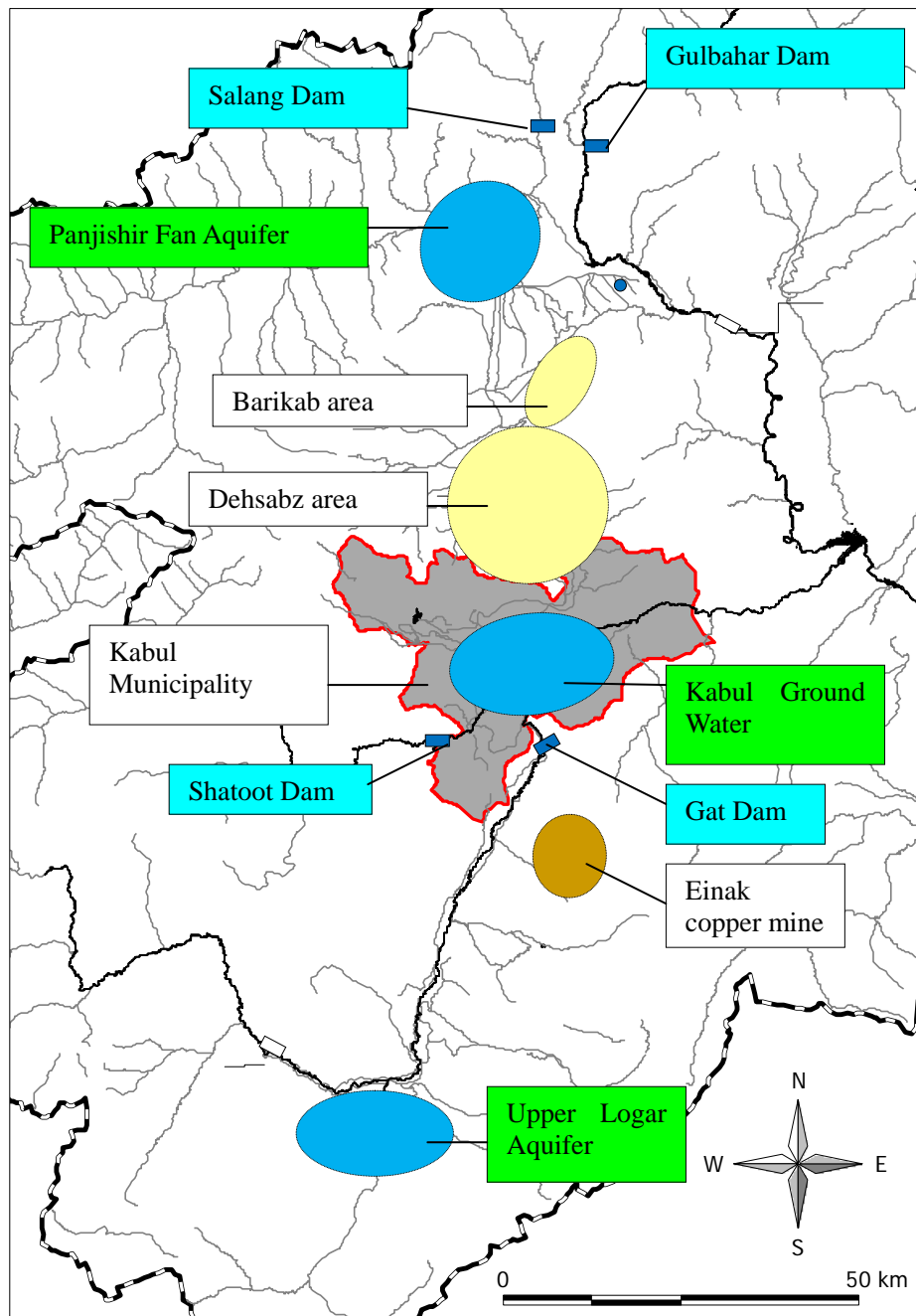
Source: Planning Team

**Figure 3.8: Existing Land Use by Broad Category**

### 3.2.3 Available water resources

The water situations in Kabul City are serious, and the water availability will be the most critical constraint to the development of the capital city. The current water supply in Kabul depends exclusively on local groundwater resources. In the future, the surface water needs to be developed to supply water to the increasing population.

It is desirable that the local water resources be utilized as much as possible rather than transferring water from other basins at much higher costs. Potential water resources situated in the Upper Kabul River Basin are Logal groundwater, Shatoot Dam on the Maidan River, and Gat Dam on the Logar River. In the Panjshir River Basin, Panjshir fan aquifer, Gurbahar Dam, and Salan Dam are under study. Among them, development of Gat Dam and Logal groundwater is facing difficulties due to large impacts on social environment and other factors. Location of these potential water resources are shown in Figure 3.9.



Source: Planning Team

**Figure 3.9: Location of Potential Water Resources**

**(1) Estimated potential of Kabul groundwater**

The estimated groundwater potential of Kabul groundwater is approximately 44 million  $\text{m}^3$  (MCM) per year according to the KfW water study. The estimated local and ready groundwater potential is as shown in Table 3.2. This is only capable to cover some 5 million inhabitants at a modest per capita consumption of 24L/day targeted by MRRD for shallow well users.

**Table 3.2: Readily Available Local Groundwater Potentials**

Aquifer	Water resources availability	
	10 <sup>6</sup> m <sup>3</sup> /year	m <sup>3</sup> /day
Logar	24.64	67,500
Allaudin and upper Kabul	12.48	34,200
Afshar	3.65	10,000
Lower Kabul	3.65	10,000
Total	44.42	121,700

Source: Report by KfW Water Study.

**(2) Expected future water resources in Upper Kabul River Basin**

The Ministry of Energy and Water (MoEW) is responsible to find and develop additional water resources to accommodate the population of the capital city. Several surface water development projects are now under way as shown in Figure 3.9, though the level of maturity varies significantly. Outline of the major water resource development projects with high maturity of preparation are briefly described below.

**Shatoot Dam**

As of 2010, the surface water development on the Maidan River (Shatoot dam construction) is considered as the most appropriate and prioritized project which can be realized within the life time of this master plan. The feasibility study of the surface water development (hereinafter referred to as Shatoot F/S) was completed in February 2010. Currently MoEW endeavors to realize the project by securing necessary funds. Summary of the project is shown in Table 3.3. By the project implementation, it is expected that 94.6 MCM/year as daily maximum and 72.8 MCM/year as daily average will be secured for water supply to Kabul City. Although MoEW is intending to complete the facility construction by 2017, necessary fund has not been secured yet.

**Table 3.3: Summary of Shatoot Storage Dam Project**

Item	Figure
Dam	
Volume of reservoir	250 MCM
Volume of yearly average regulated water	131 MCM
Volume of yearly average regulated domestic water	97.1 MCM
Volume of yearly average regulated irrigation water	20.8 MCM
Volume of yearly average regulated environment water	13.1 MCM
Water treatment plant (WTP)	
Daily maximum raw water to WTP	4000 L/s (126.1 MCM)
Daily maximum treated water	3000 L/s (94.6 MCM)

Source: The Feasibility Study of the Maidan River Surface Water Development, 2010, MoEW

For the planned scale of the water treatment plant (WTP) is 4000L/s (345,600 m<sup>3</sup>/day or 126.1 MCM), it is quite appropriate to include factors of the average regulated domestic water and required daily maximum factor of 1.3 (30% more of average). In addition, assuming 10% of treatment loss including filter washing water, 3600 L/s would be distributed in maximum. Thus average 2770 L/s (239,000 m<sup>3</sup>/day or 87.2MCM: 3600 / 1.3 = 2770) can be expected as distributed drinking water.

It should be noted that the KMAUD Master Plan expected 49.3MCM/year by development of Shatoot Dam. The volume increased to 87.2 MCM/year reflecting the completion of the Shatoot F/S.

**(3) Expected future water resources in Panjshir River Basin****Shah-wa-Arus Dam in Shakardara**

MoEW has a plan to construct Shah-wa-Arus Dam to the northwest of Kabul, around 20km from District 17. Its feasibility study was completed in August 2008 and MoEW has started the detail design through a design-build contract. As of June 2010, the design work is under way, which

covers revision of development scale. According to the latest information by MoEW, it is clarified that the water will be mostly used for agricultural purpose in Shakardara area, and thus, only capable to cover nearby areas for urban use. Water supply to Kabul City is not likely, although it was expected by the KMAUD Master Plan.

#### Gulbahar Dam

MoEW has a plan to construct the Gulbahar Dam on the Panjshir River in the north of Kabul. Its feasibility study is still under way. MoEW and other water related organizations expect the Gulbahar Dam as total solution for chronicle water shortage in Kabul area. Since the water supply capacity of the dam is expected to be 240 MCM, it would be able to become a main water source of the region including Kabul Municipality and the New City.

For implementation, there are still some issues to be examined and resolved. These issues include; existence of an active fault, resettlement of residents, and compensation for agricultural fields. Concerned organizations such as MoEW and DCDA are planning to conduct review of the feasibility study between 2010 and 2012.

Taking the required time for more detailed study and subsequent design and construction process into consideration, it is not appropriate to count Gulbahar Dam as water supply source for Kabul Municipality within the life of this master plan.

#### Panjshir fan aquifer

Use of groundwater in Panjshir fan aquifer is proposed by the KMAUD Master Plan to supply drinking water for the New City. A more detailed water study is under way funded by JICA aiming at development of water resources for the New City. In the KMAUD Master Plan, potential of Panjshir fan aquifer was estimated to be 210 MCM. Deducting the expected demand of 52.3 MCM by the residents in Panjshir fan and 44.6 MCM by the New City, there will be nearly 100 MCM available for use in Kabul City.

Although development of groundwater in Panjshir fan aquifer will be possible in a quicker manner compared to Gurubahar Dam, it is estimated that the operation cost for bringing water to the city will be 10 times higher than that of Shatoot Dam.

#### **(4) Water availability in 2025**

As described above, water resources development projects that can be ready for operation before 2025 is limited to the Shatoot Dam and Panjshir fan aquifer. Preparation of other water resources development is definitely needed, especially in the Upper Kabul River Basin. If there is no other water resources become available for the next 15 years, the city needs to survive with very limited water. It is, therefore, necessary to consider the capacity of population in a cautious manner, by taking the safe-side scenario for water availability.

Until completion of Shatoot Dam together with WTP, available drinking water resource is limited to Kabul groundwater with 44.4MCM/year after enhancement works planned by KfW. When Shatoot Dam starts its operation, the average flow of the Maidan River will be decreased dramatically. Local groundwater availability is expected to be reduced to a level of 33 MCM/year for average. Thus availability of drinking water in 2025 for the city will be 120.4 MCM/y as shown in Table 3.4. This means that some 6.6 million of population may be the maximum capacity in the area of Upper Kabul River Basin, by applying the most conservative target of 50 LCD by MoUDA as the unit par capita water consumption.

**Table 3.4: Availability of Drinking Water Resources**

Resource	Average amount per year
Local and ready water resources (local groundwater)	33.2 MCM (90,000 m <sup>3</sup> /day)
Shatoot dam and WTP	87.2 MCM (239,000 m <sup>3</sup> /day)
Total	120.4 MCM (329,000 m <sup>3</sup> /day)

### **3.3 Direction of Urban Development for Kabul City**

The KMAUD Master Plan pointed out uniqueness of Kabul City and established concepts for development of Kabul Metropolitan Area consisting of Kabul City and the New City. Many aspects of these concepts are addressed to Kabul City and provided a common ground for planning of this master plan. Direction of urban development for Kabul City is established as compliant to the KMAUD Master Plan as follows.

#### **3.3.1 Urbanization Model for Kabul City**

The development of Kabul City over the millennia has been supported, among others, by two most important factors. One is the geographic position along the east-west and the north-south trade routes. The other is the water resources of the Upper Kabul River Basin.

##### **(1) Geographic position of Kabul**

A renewed attention has been paid to the advantageous position of Afghanistan in the globalizing economy, as noted by the ANDS. The ANDS states: “The Government’s top priority will be to improve trade and commercial relations with regional countries, taking advantage of Afghanistan’s strategic location in the region by adopting policies and procedures that facilitate and promote transit and trade.”

At present, the main trade route for Afghanistan and Kabul is through the Khyber Pass that separates Afghanistan from Pakistan and India. A new major international trade and logistic corridor has been conceived linking China in the east, through the Central Asia, to Europe in the west. This corridor passes through parts of Kazakhstan, Kyrgyz, Uzbekistan and Turkmenistan. This corridor, once established, would provide Kabul City and the area along the access route alternative trade route to the east and the west.

##### **(2) Water resources of the Upper Kabul River Basin**

The water resources in the Upper Kabul River Basin are in jeopardy for the first time in the millennia. The shallow groundwater, which is the lifeline for the majority of people in the city, is threatened by pollution and degradation of the groundwater tables. The water resources management of the Upper Kabul River Basin from the upstream to the confluence with the Panjshir River is of utmost importance for the livelihood of the city residents and flora.

Construction of dams in the upstream may help to enhance the water availability by improving the flow distribution, but the groundwater extraction in the downstream would need to be managed to avoid the degradation of groundwater tables. Groundwater recharging areas must be protected from urbanization. Introduction of additional water transferred from the neighboring basin would cause extensive inundation of urbanized areas unless urban drainage is concomitantly improved. The improvement of urban drainage, however, may cause degradation of shallow groundwater tables, which could be detrimental to the livelihood of people and flora.

It has to be recognized that the further development of Kabul City will be based on very delicate balance of water endowment, use and management within the unique hydro-geological regime of the Upper Kabul River Basin. The population in the Upper Kabul River Basin should be controlled within the capacity of water resources available in the Upper Kabul River Basin as a matter of principle. In case where the inter-basin water transfer is judged necessary, the amount of water to be introduced should be kept minimal, and the water balance should be carefully observed.

##### **(3) Need for unique urbanization model**

Many large cities of the 20th century developed along large rivers, often near their river mouths. This is natural as water availability is better and wastes and wastewater are more easily disposed in



such locations. When the urbanization exceeded the level that can be supported by locally and readily available water resources, new water sources in distant locations were identified and the water was transferred to support the ever-increasing urban population.

The improved water supply capacity made it possible for more people to migrate into large cities, resulting again in water shortages. Then, water sources in further distance were developed to support the increased population. This incremental approach resulted in mega cities, which suffer from various social and environmental problems. This is typical 20th century urbanization, observed in many large Asian cities of favorable water endowments due to tropical monsoon climate.

This cannot be a model for urbanization of Kabul City in the 21st century. Kabul City with its unique socio-cultural characteristics, supported by the advantageous geographic position and the unique hydro-geological conditions of the Upper Kabul River Basin is qualified to pursue a unique urbanization model of its own, which may turn out to be a model for the 21st century urbanization.

### **3.3.2 Planning concepts**

Given the unique hydro-geological conditions discussed above as well as the millennia long history and culture, Kabul City will pursue a unique urbanization model of its own. In this light three planning concepts are applied as follows.

#### **(1) Socio-economic diversity**

Afghanistan is a plural society. The ANDS presents a positive view on the plurality as expressed in the vision for 2020. Social diversity is a potential source of dynamism, which applies particularly to urban societies. Kabul City's dynamism should be supported by the mixed culture and mixed ethnicity of people living there. The civil war, however, undermined such characteristics, resulting in somewhat segregated habitation patterns in the city. This should be rectified through planned development to restore the urban society of mixed culture of diverse people.

Provision of diverse economic opportunities attracts people to Kabul City. The existing Kabul City and the New City in Dehsabz together need to offer most diverse economic and employment opportunities with complimentary functional division between them.

#### **(2) Urban-rural complementarity**

In pursuing a unique urbanization model, the Kabul urbanization should take advantage of the presence of rural and agricultural areas within the city boundary. This may be effectively realized by utilizing complementary aspects of its urban and rural areas in many ways.

Kabul City has unique urban landscape with a sort of semi-rural atmosphere. This is due much to many large trees thanks to shallow groundwater. It is undermined only by "modern" architecture with glassy exterior. Kabul City encompasses large agricultural land, accounting for 16% of the total city area. Preserving the agricultural land is essential to ensure open space and greenery, which serve as infiltration area for urban drainage and some sewage. The preservation of agricultural land will help to maintain shallow groundwater, which is critically important as sources of domestic water for the majority of the city residents and as a prerequisite to preserving and enhancing the greenery.

#### **(3) Recycle-oriented eco-city**

On-site treatment of human wastes, sewage and urban drainage should be widely applied in Kabul City and the New City. Digested sludge from existing septic tanks in the Kabul city may be applied to the new city area, if the transport costs justify such application. Regarding the solid wastes management, wastes separation at source and recycling will be pursued.

Use of renewable energy is another aspect of the recycle-oriented eco-city. The concept of waste to energy may also be applied to treat the solid wastes. Organic wastes are separated and used for biogas digestion, and remaining combustible wastes incinerated to generate electricity in both ways.

#### **(4) Cultural city**

Kabul City has a millennia long history. The city has attracted many peoples of widely different backgrounds, which have given the city energy and dynamism for various urban activities. The ANDS presents a positive view of the plurality of the Country, which applies to the Kabul City as well. It is natural for Kabul City to pursue the development of cultural city.

Cultural value is essential for attracting many peoples of different backgrounds. The resultant diversity in cultural value would attract more people. Kabul City should embrace multiple cultures in harmony with the Islam.

Urban and architectural heritage in the city should be effectively utilized to encourage communications between peoples of different backgrounds. For instance, the traditional architecture of courtyard houses may be renovated and used as boarding houses for foreign students, who can communicate with Afghan counterparts in the courtyards or living together. The areas around mosques may be improved with additional facilities into community for residents of various backgrounds. Cultural centers may be established with multiple functions to preserve and enhance the cultural heritage through communication between peoples of varying backgrounds.

Kabul city is and will continue to be the international tourism gateway of Afghanistan. Some high grade social services may be provided, such as advanced education and research, and specialized health care. For these functions, the existing Kabul City and the New City in Dehsabz will compliment each other.

### **3.4 Development Framework**

#### **3.4.1 Population framework and distribution by water basin toward 2025**

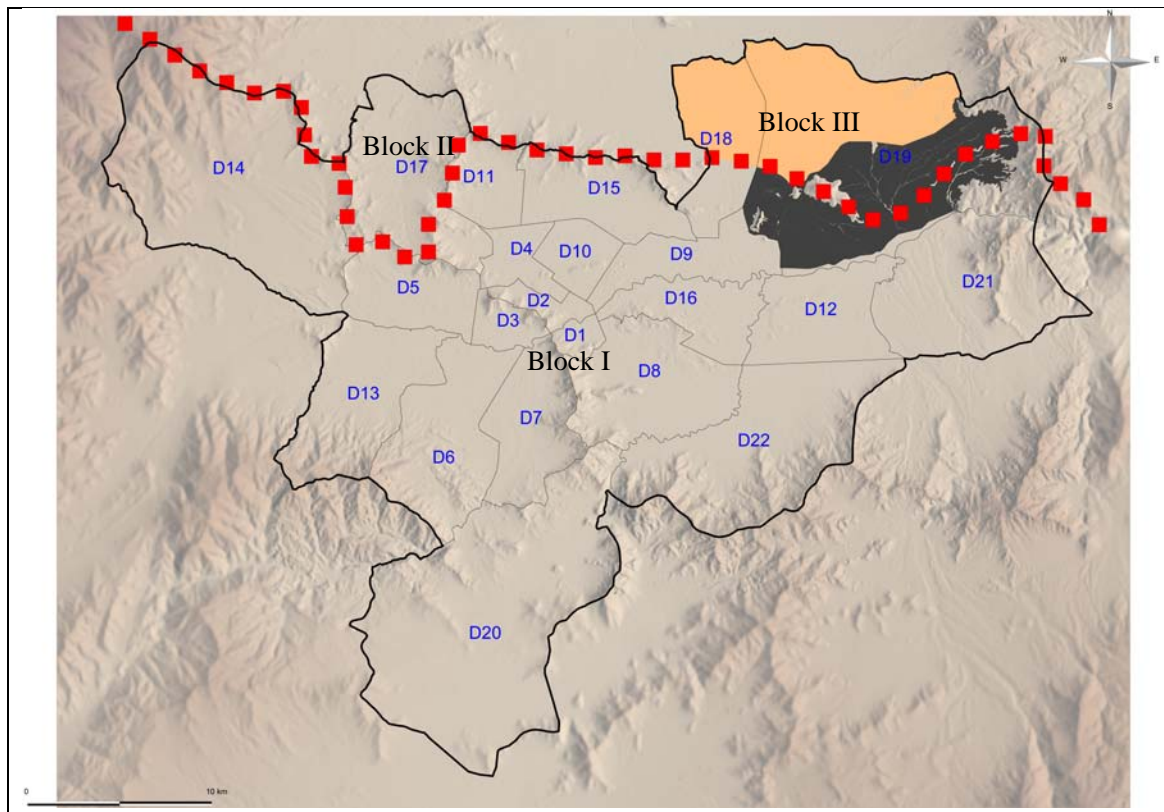
As examined in the previous sub-section, the most critical factor for the future development of Kabul City is the water availability in the area of Upper Kabul River Basin. The future population in Upper Kabul River Basin needs to be suppressed within maximum 6.6 million by taking the ANDS/MoUDA target unit consumption of water for urban population (50LCD). The remaining part of the future population projected in sub-section 3.2.1 has to be accommodated in the area of Panjshir River Basin. Kabul City needs to have a clear policy to distribute the future population in accordance with river basins.

To estimate/assign future population, the administrative area of the Kabul Municipality is divided into three blocks based on the boundary of water basin as follows:

- Block 1: belongs to the Upper Kabul River Basin, and covers most of the urbanized area of the Kabul Municipality. All the administrative areas of Districts 1 to 16 and 20 to 22 are situated within this block. Some small parts of Districts 17 to 19 also belong to this block.
- Block 2: belongs to the Panjshir River Basin, consisting of the majority of the administrative area of District 17, and
- Block 3: belongs to the Panjshir River Basin, consisting of the majority of the administrative areas of District 18 and 19. This block is largely used as a military practice field in

the southern half, while the northern half is included in the New City development area.

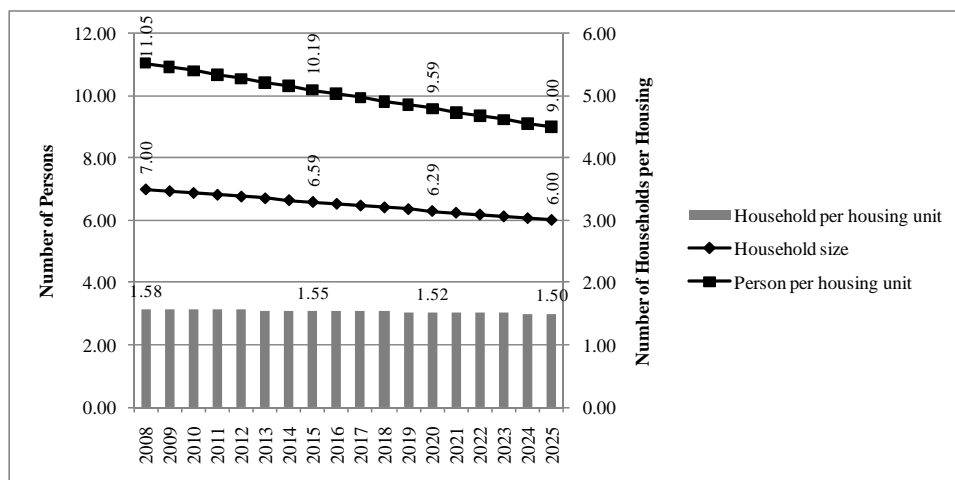
Figure 3.10 shows the location of blocks mentioned above.



Source: Planning Team

**Figure 3.10: Division of Municipality Area by River Basin**

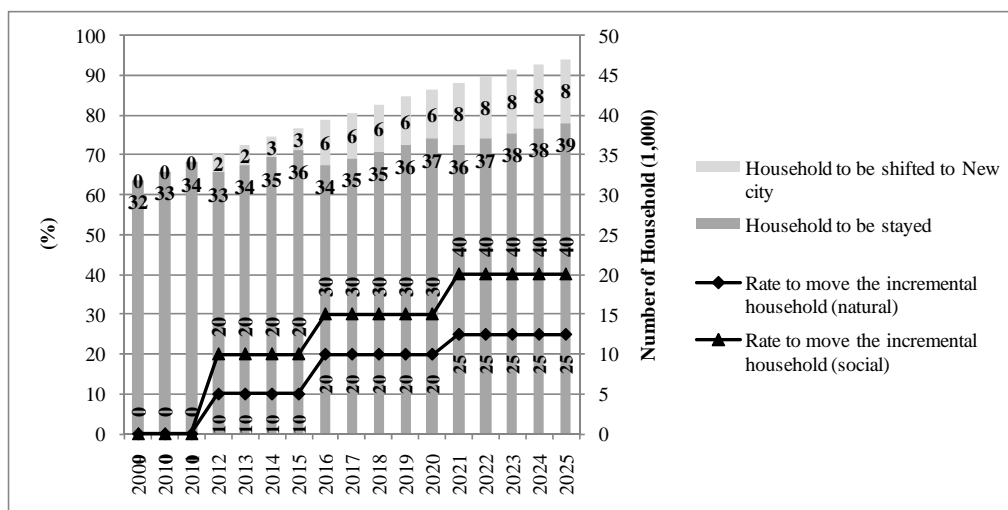
The future population by block was firstly estimated as a base case (Case 1). It is assumed that the incremental population will be largely absorbed in Block 1, while the population in Block 2 and Block 3 will increase mostly by the natural increase. The household size and the number of residents per housing unit are expected to decrease in the future, although the pace will be sluggish. The number of households will increase every year, due to the incremental population by both migration and the reduced household size. Figure 3.11 shows the assumed household size and number of households per housing unit until 2025.



Source: Planning Team

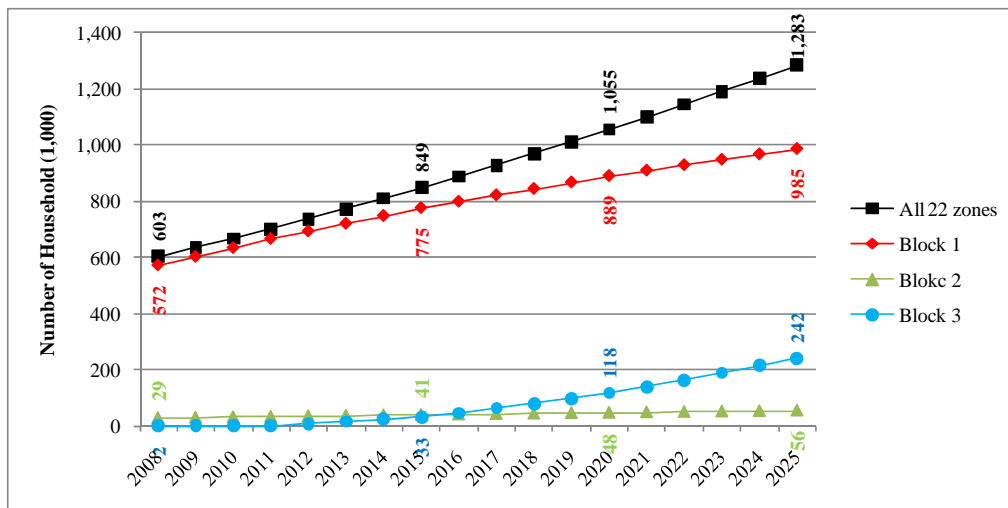
**Figure 3.11: Household Size and Number of Household per Housing Unit until 2025**

The base case was modified to take the impacts of the New City development into account. In this case (Case 2), the move of household from Block 1 and Block 2 to Block 3 is expected. For the planning purpose several assumptions are made as shown in Figure 3.12. It is assumed that some 20% of household migrating into the city will chose the New City area for living during 2012~2015. This will be enhanced in the subsequent years to be 30% during 2016~2020 and 40% during 2021~2025. A series of lower rates is employed for the incremental number of households caused by natural population increase and the reduced household size. Upon these assumptions, the total number of households in Kabul City is estimated to be 1,283,000 in 2025, of which 985,000 will live in Block 1 as shown in Figure 3.13.



Source: Planning Team

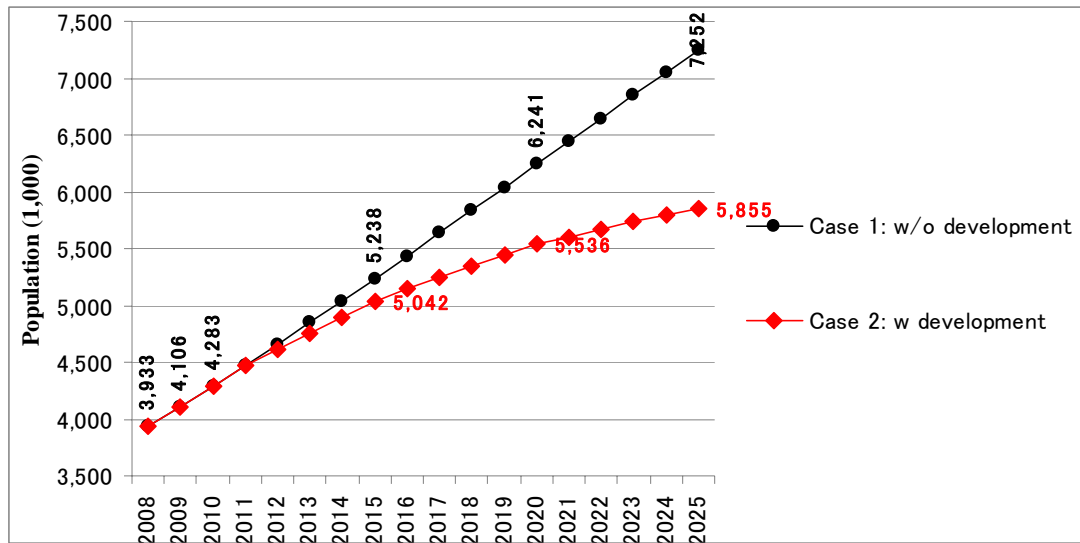
**Figure 3.12: Assumed Rates and Number of Households Moving to Block 3**



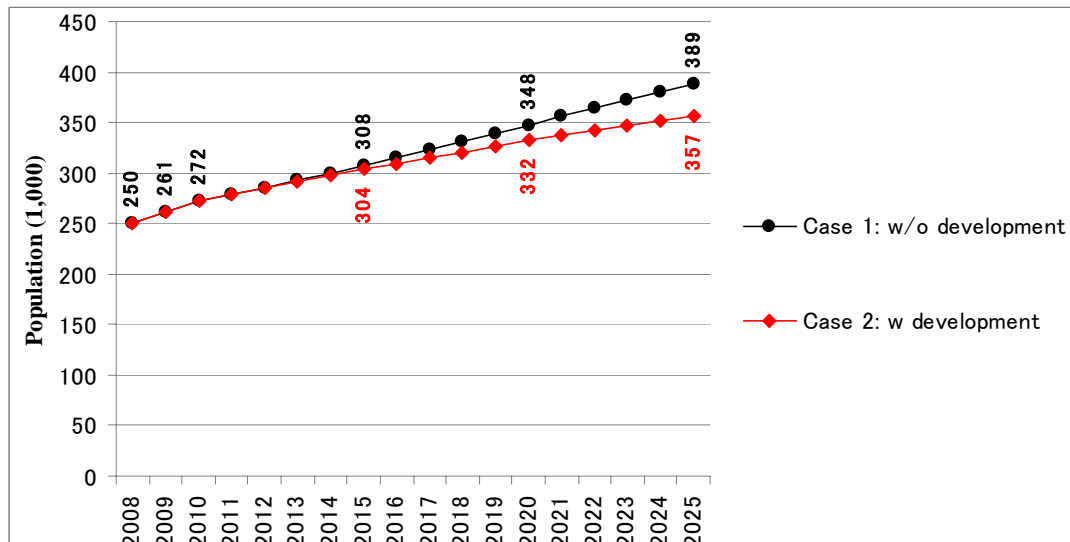
Source: JET

**Figure 3.13: Projected Number of Household by Block until 2025**

Finally, the future population in Case 1 was modified, according to the number of households which will be accommodated in Block 3 estimated in Case 2. The future population in 2025 was estimated to be 5.9 million in Block 1, 0.3 million in Block 2, and 1.5 million in Block 3 as shown in figures from 3.14 to 3.16.

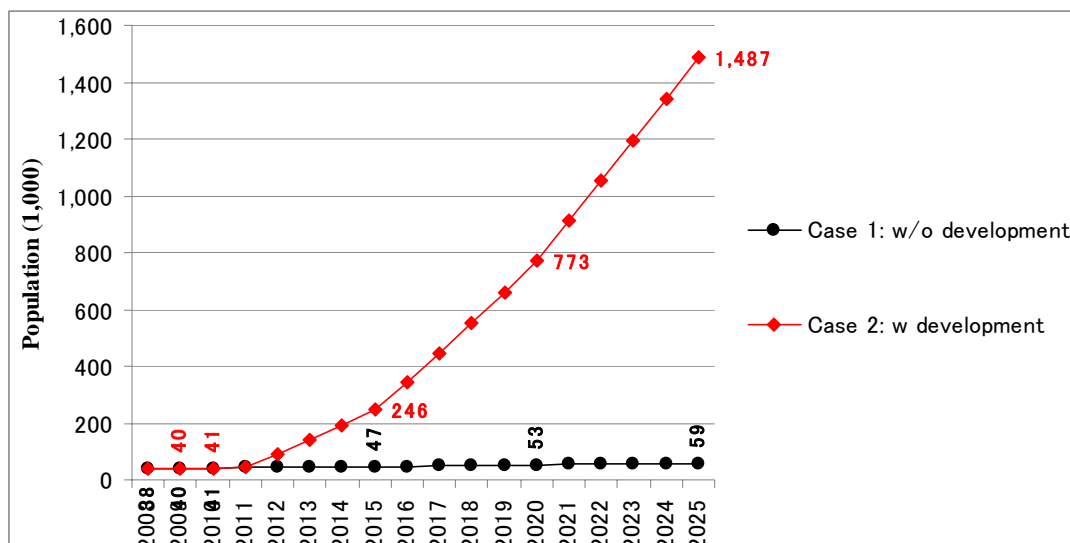


Source: Planning Team

**Figure 3.14: Estimated Population in Block 1 until 2025**

Source: Planning Team

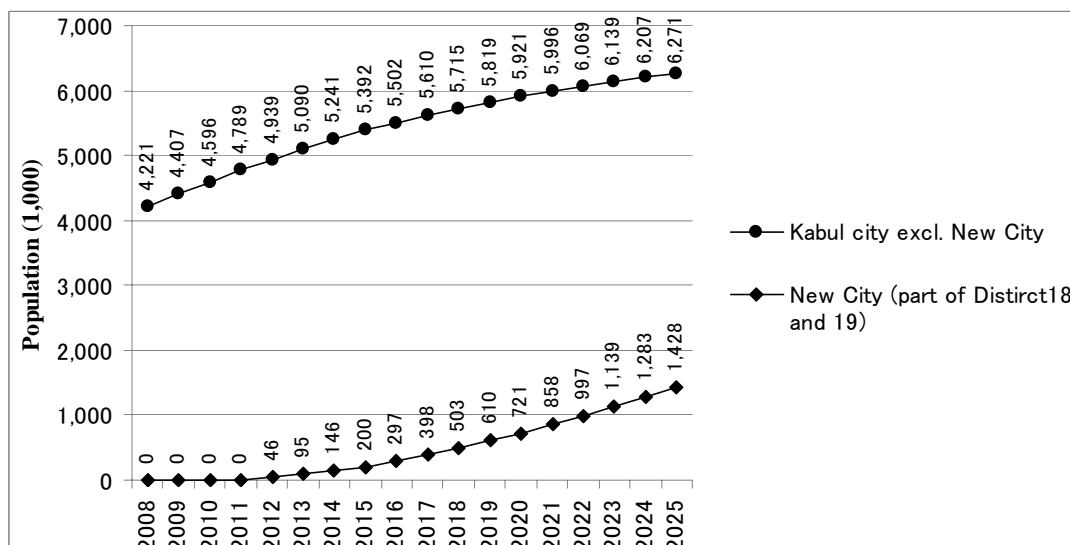
**Figure 3.15: Estimated Population in Block 2 until 2025**



Source: Planning Team

**Figure 3.16: Estimated Population in Block 3 until 2025**

The future population in the administrative area of the Kabul Municipality will be represented mostly by the population in Block 1 and Block 2. Therefore the population in Kabul City in 2025 is estimated to be 6.2 million, while that of the New City is 1.5 million as shown in Figure 3.17. It should be noted that the estimated population in Block-3 will spread in any part of the New City project area not necessarily in the boundary of the Kabul Municipality.



Source: Planning Team

**Figure 3.17: Population Framework for Kabul City and New City toward 2025**

### 3.4.2 Employment and macro-economy

#### (1) Estimation of future employment

The ICT team estimated the rate of existing employment to the total population at 21% in 2008 and 33% in 2025, based on the household survey conducted in the course of the study. It is expected that the employment rate in 2025 will increase due to the expansion of the share of working-age group and along with improvement in job opportunities. These rates were adopted in this master plan. The share of employment by sector was also taken from the survey results by the ICT team, i.e.) 1% for the primary industry, 10% for the secondary, and 89% for the tertiary in 2025.

In this master plan, the tertiary industries were classified into two categories: one is those established services typically operated in the commercial and business areas, while the other is those located in residential areas and provide various services responding to the demand generated by the population. The number of employment was estimated at 886,000 in 2008 and 2,540,000 in 2025 as shown in Table 3.5.

**Table 3.5: Number of Employment in 2008, 2015, 2020, and 2025**

Category	Item	Unit	2008	2015	2020	2025
Population			4,220,256	5,591,000	6,640,000	7,698,000
Rate of employment to the population		%	21	26	30	33
Rate of employment by sector	Agriculture	%	6.2	3.2	1.9	1.1
	Industry	%	10.8	10.8	11.1	11.7
	Service	%	47.3	38.5	39.7	43.5
	Population based	%	35.7	47.4	47.3	43.6
	Total	%	100.0	100.0	100.0	100.0
Number of employment by sector	Agriculture		55,000	47,000	38,000	29,000
	Industry		96,000	156,000	217,000	297,000
	Service		419,000	558,000	777,000	1,106,000
	Population based		316,000	687,000	927,000	1,108,000
	Total		886,000	1,448,000	1,959,000	2,540,000
Number of employment by Block	Block 1 and Block 2		878,469	1,377,949	1,769,237	2,245,449
	Block 3		6,538	70,077	189,423	294,646

Source: Planning Team

## (2) Macroeconomic framework

By applying the projected number of employee to the parameters employed in the KMAUD Master Plan for Kabul province, GRDP of Kabul Municipality was projected as shown in Table 3.6 for reference purpose, as it theoretically includes all the informal economy with unknown features.

**Table 3.6: Projection of GRDP and Employment in Kabul Municipality by Sector**

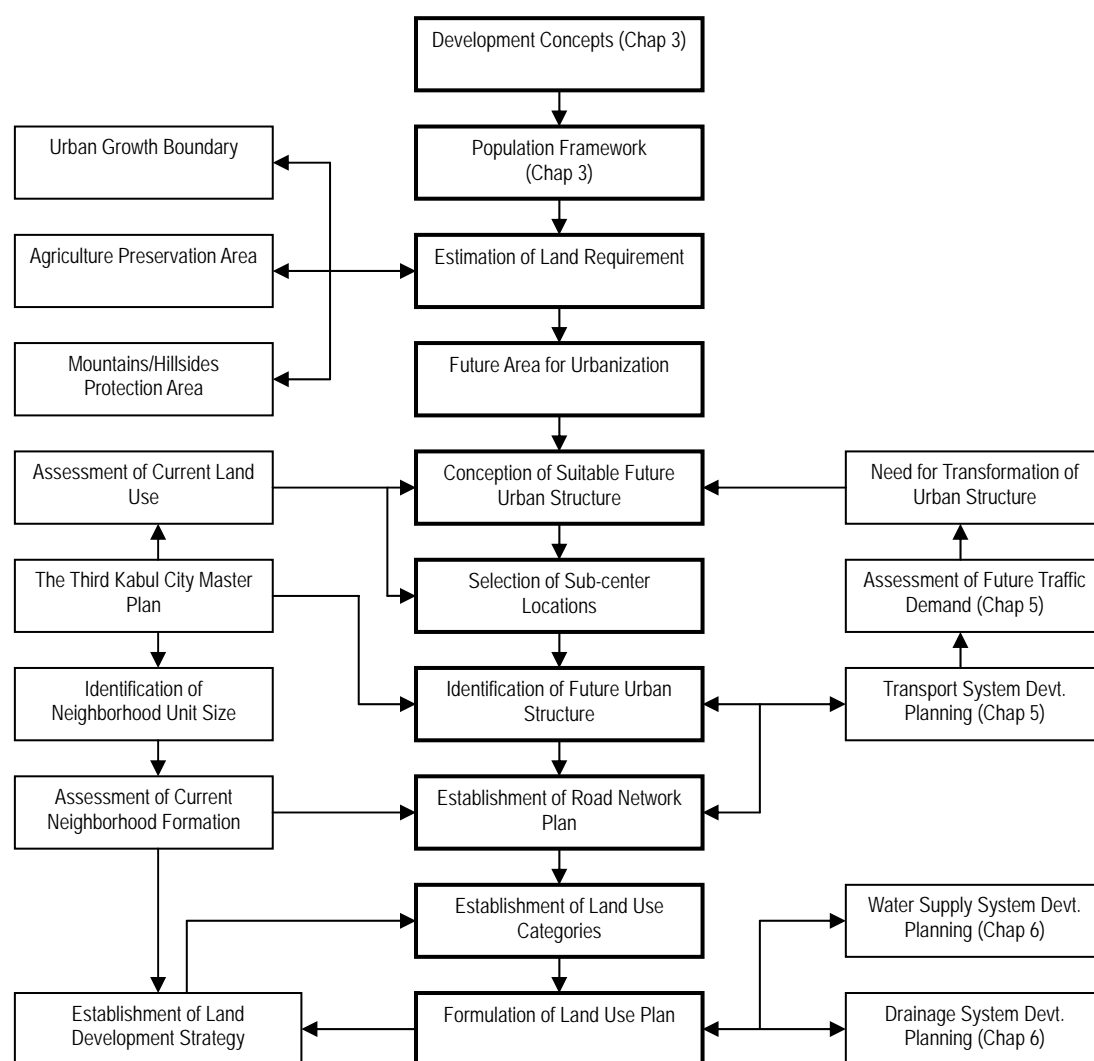
	GRDP (US\$103)		GRDP Growth 2008-25 (% p.a.)	GRDP Per Employee (US\$)		Rate of increase 2008-25 (% p.a.)	Employment		Rate of increase 2008-25 (% p.a.)
	2008	2025		2008	2025		2008	2025	
Agriculture	27,500	21,750	-1.37	500	750	2.41	55000	29,000	-3.69
Industry	384,000	1,663,200	9.01	4,000	5,600	2.00	96000	297000	6.87
Services	2,205,000	8,634,600	8.36	3,000	3,900	1.56	735000	2,214,000	6.70
Total	2,616,500	10,319,550	8.41				886,000	2,540,000	6.39



## CHAPTER 4: LAND USE PLAN AND LAND DEVELOPMENT STRATEGY

### 4.1 Procedure for Land Use Planning

Based on the policies and framework for development of Kabul City discussed in Chapter 3, the land use plan is formulated as presented in the following sub-sections. The planning of land use requires integration of many factors including the feedback from infrastructure planning, such as the road network, water supply and drainage systems development. Figure 4.1 shows procedure for the planning of land use conducted in this master plan.



Source: Planning Team

**Figure 4.1: Work Flow of Land Use Planning**

## 4.2 Directions for Physical Development of Kabul City

The continued influx of population is forcing the expansion of built-up area. Currently, expansion of housing areas is underway in unsuitable locations such as hillside slopes and lowland areas. It is necessary to clarify suitable areas for urbanization from those areas to be controlled or restricted. For clarification of future urbanization areas, protection and enhancement of public interest need to be focused. Specifically, following three factors are critically important for sustainable development of Kabul City:

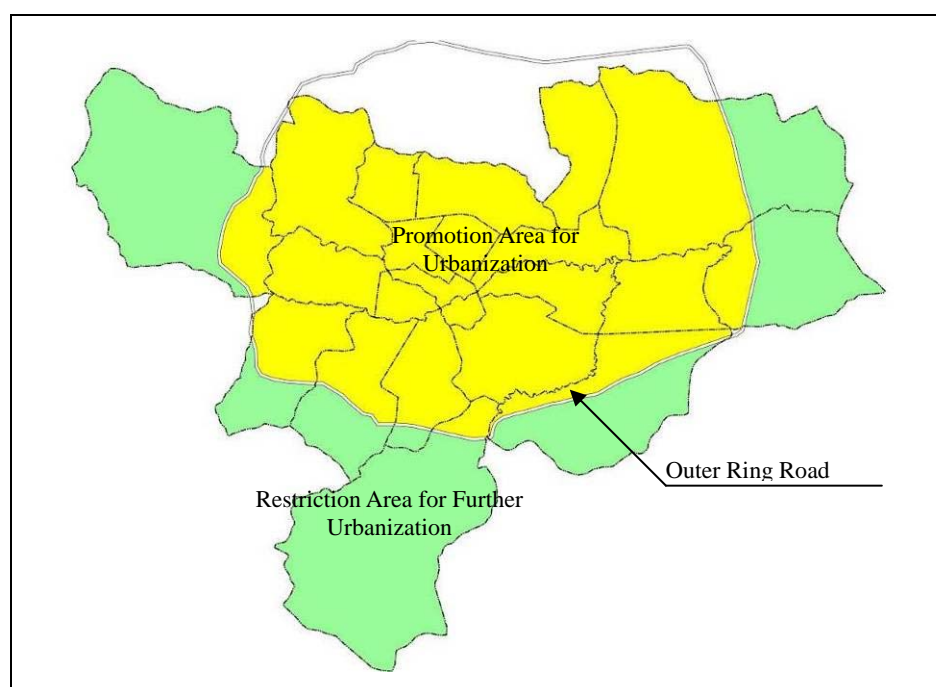
- Setting of the boundaries of the urbanization to keep the city compact;
- Restriction of housing on hillsides to ensure safe lives of citizens, enable efficient provision of public services, and protect the landscape which is a major part of the city's identity; and
- Conservation of agricultural land to ensure rainwater infiltration and groundwater recharge.

### 4.2.1 Basic policies for preservation of municipal land

#### (1) Setting of urban growth boundary (UGB)

Making a city area compact has become a primary urban policy world wide. By keeping the urbanized area compact, the efficiency of infrastructure investment will be increased, while everyday energy consumption by citizens will be reduced. In order to keep the urbanized area compact, it is necessary to change the trend of the urban sprawl taking place in various forms in Kabul City. To this light, it is proposed to introduce the urban growth boundary (UGB) which is to demarcate the city's administration area into two types: i) the urbanization promotion area and ii) the urbanization control area.

For Kabul City, it is proposed that the UGB is set on the alignment of the outer ring road. The future urbanization of the city is to be encouraged inside the outer ring road, while it is controlled or discouraged in outside areas. Figure 4.2 shows a conceptual drawing of the UGB and two kinds of areas for urbanization.



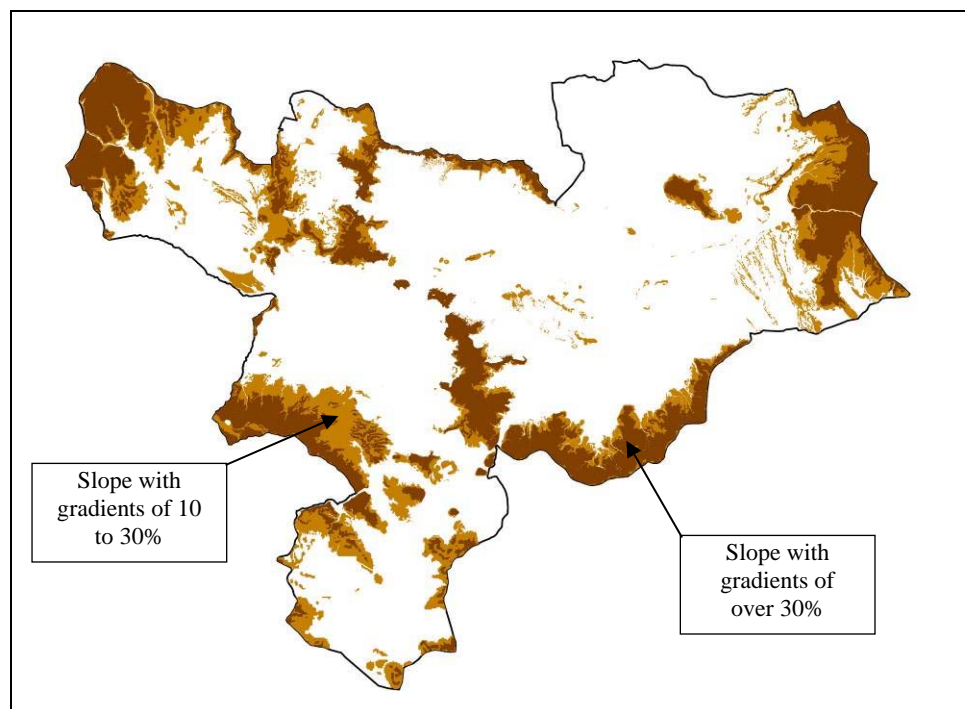
**Figure 4.2: Urban Growth Boundary**

Within the promotion area, urbanization will be guided by the zoning plan(s) which will be prepared to regulate individual's land use activities. Construction of houses will take place by the hands of owners in accordance with the zoning plan and associated regulations. Outside the promotion area,

construction of houses will be basically prohibited, except for the ones to be used as the farmer's own housing.

## (2) Protection of mountains and hillside slopes

Hills and mountains are major parts of the city's identity. Thus, protection of the landscape of these parts is an important public interest. At the same time, it is their own interest for the people living on hillsides, as they are exposed to the safety risks by such as land slides and earthquakes damages. Furthermore, provision of infrastructure and public services are much more difficult and costly for these slope areas. Further urbanization on the hillside, therefore, needs to be stopped and existing dwellers are encouraged to relocate to safer flat areas in a moderate manner. Figure 4.3 shows the location of steep slopes with gradient of over 10% and 30%.



**Figure 4.3: Location of Hills and Mountains in Kabul Municipality**

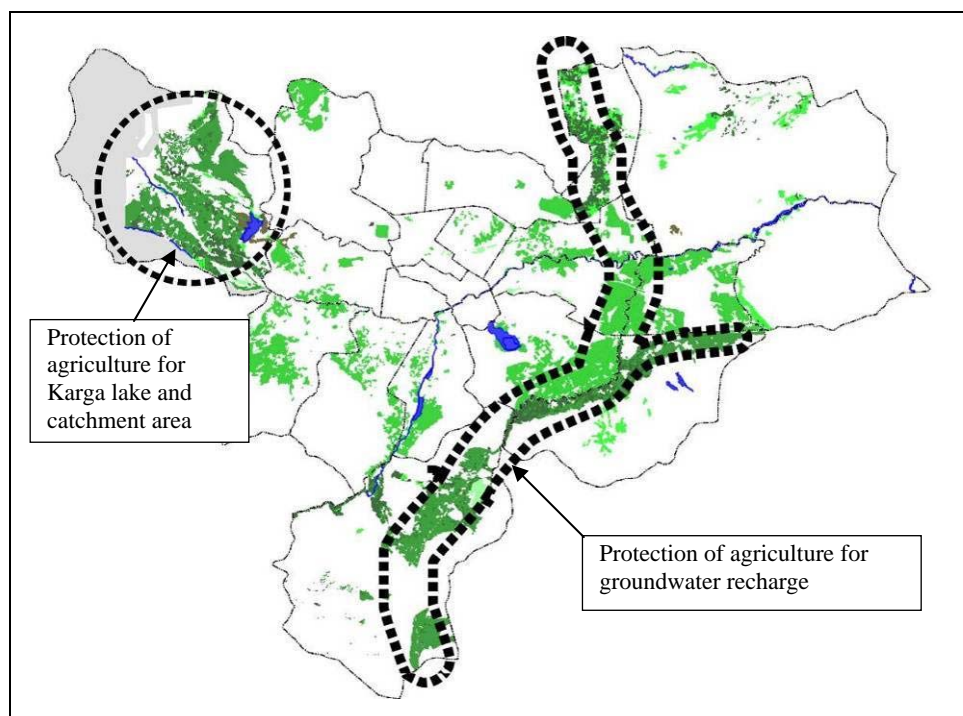
## (3) Preservation of agricultural land

In Kabul City, irrigated farmlands have been well preserved despite the very high urbanization pressure. On the other hand, rain-fed agricultural fields have been constantly threatened by pressure for land use conversion. These rain-fed areas are typically observed in Districts 6, 7, and 13 in the southwest, and in Districts 17 and 19 where ribbon type sprawl is going on to the north direction. A similar phenomenon is observed around the new residential quarters in District 12, especially to the eastern direction.

It is necessary to protect some specific agricultural areas which are functioning as the major groundwater recharge field. The Third Kabul Master Plan designated water recharge areas along the Logal River. This concept needs to be inherited to this master plan. As the administration area of the Kabul Municipality expanded from the time of planning the Third Master Plan, areas for protection of agriculture also need to be expanded. The Kargha Lake area located at upstream of the Paghman River is a major water resources for the city, and now used as a major recreation field for the citizens of Kabul. The lake and its catchment area, thus, need to be protected also. Figure 4.4 is a conceptual drawing that shows areas to be protected from urbanization to keep the agricultural usage.

In general, agricultural lands should be preserved as much as possible to keep green space in the city. However, the number of farmers will decrease in the future as many of them seek better profit from land by converting to urban usages. To encourage farmers to continue agriculture and obtain positive

support for the agriculture preservation policy, it may be necessary to introduce programs to support the enhancement of agricultural productivity.



**Figure 4.4: Location of Agricultural Areas to be Protected**

#### **4.2.2 Verification of land availability with protection/restriction policies**

Based on the above preservation and/or restriction policies, the availability of land is verified in order to assess whether these policies are fully applicable to accommodate all the future population. The outside area of UGB and the area of mountains and hillside slopes are firstly excluded from the area for urbanization. The required land area is estimated to verify the capacity of land in the urbanization promotion area (UPA) in 2025, focusing on the level of protection for agricultural land use.

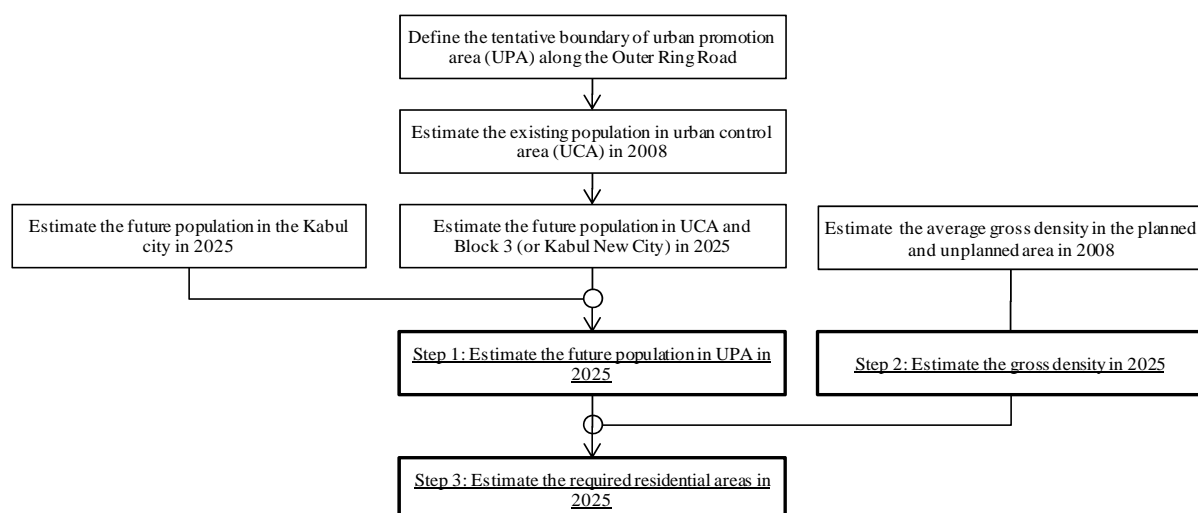
##### **(1) Methodology**

Figure 4.5 shows the work flow to estimate the land requirement for urbanization in the UPA in 2025. The work flow consists of three steps as mentioned below.

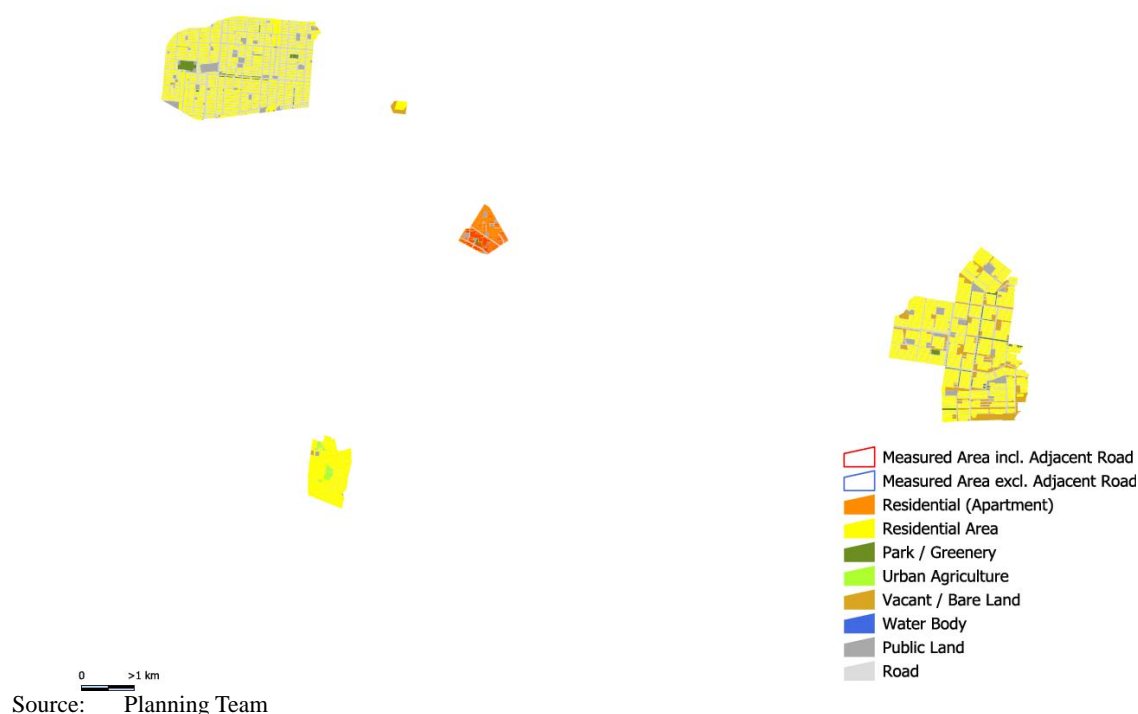
Step 1: To estimate the future population in UPA in 2025 by excluding the expected future population to be settled in the Urbanization Control Area (UCA) and the New City area.

Step 2: To estimate the gross population density in the planned and unplanned residential areas. The average population density is estimated for the existing formal residential areas in District 11 and 12, the multistory housing areas in Macrorayon and newer ones, and an informal area in District 7. Figure 4.6 shows the location of residential areas selected for estimation of the population density. Table 4.1 shows the estimated gross population density in 2008 and 2025. The future population density is set by reducing the existing density due to the decrease in size of household.

Step 3: To estimate the required residential area based on the future population divided by the gross population density.



Source: Planning Team

**Figure 4.5: Work Flow to Estimate the Required Land Area in 2025**

Source: Planning Team

**Figure 4.6: Location of Selected Residential Areas for Estimation of Population Density****Table 4.1: Existing and Future Gross Population Density by Type of Residential Area**

Item		Unit	Planned Area		Unplanned Area
			Detached	Multi-story	
Existing population density	Net	person/ha	379	450	277
	Gross	person/ha	212	368	246
Future population density	Net	person/ha	330	450	240
	Gross	person/ha	180	370	180

Source: Planning Team

**(2) Result of estimation**

For estimation of the land requirement for residential use, the gross population density of detached-house is adopted as it requires larger land area. As a result, the required residential area in UPA in 2025 is estimated to be 32,372 ha. Table 4.2 shows summary of the key results.

**Table 4.2: Required Land Area for Future Urbanization in UPA in 2025**

Category	Item	Formula	Unit	Value
Future population outside the ring road	Existing population outside the ring road	P1	1,000	289
	Future population outside the ring road excluding Block 3	$Pp1 = P2 \times 1.45$	1,000	418
	Future population in Block 3	Pp2	1,000	1,453
	Future population outside the ring road	$Pp3 = Pp1 + Pp2$	1,000	1,871
Future population within the ring road	Planned population in total	Pp4	1,000	7,698
	Future population within the ring road	$Pp5 = Pp4 - Pp3$	1,000	5,827
Required new residential area	Planned population density in new residential area (gross)	D1	person/ha	180
	Required new residential area	$A4 = Pn / D4$	ha	32,372

Source: Planning Team

**(3) Evaluation of land availability in UPA**

The land availability in UPA is analyzed by judging whether it meets the required land area for the future urban areas. Firstly the area of developable lands is estimated by excluding the steep slope areas with gradient of greater than 30%, the area of New City, and the land covered by the outer ring road and water bodies. Then, three cases were examined focusing on the agricultural lands in the different extents as listed below.

Case 1: All agriculture lands and existing public facilities are to be preserved

Case 2: Part of agriculture lands in the range of 1km from the Logal River are preserved

Case 3: Part of agriculture lands in the range of 0.5km from the Logal River are preserved.

Table 4.3 shows the results of estimated developable land area and the gap to the land requirement in each case. Figures 4.7 to 4.10 show the areas for protection corresponding to each case.

**Table 4.3: Estimated Developable Land Area by Range of Agricultural Land Protection**

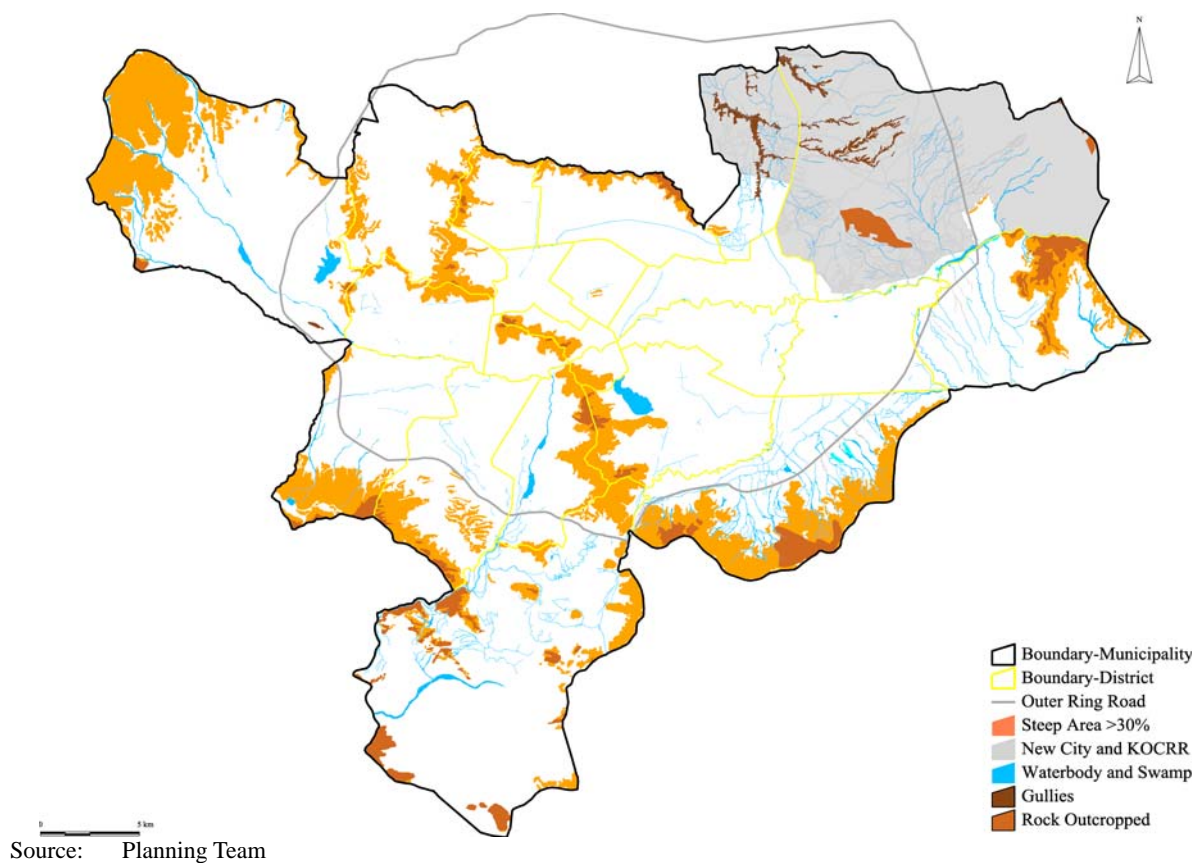
Case	Developable Area (ha)	Gap (ha)
Case 1	26,179	6,193
Case 2	27,895	4,478
Case 3	27,722	4,650

Source: Planning Team

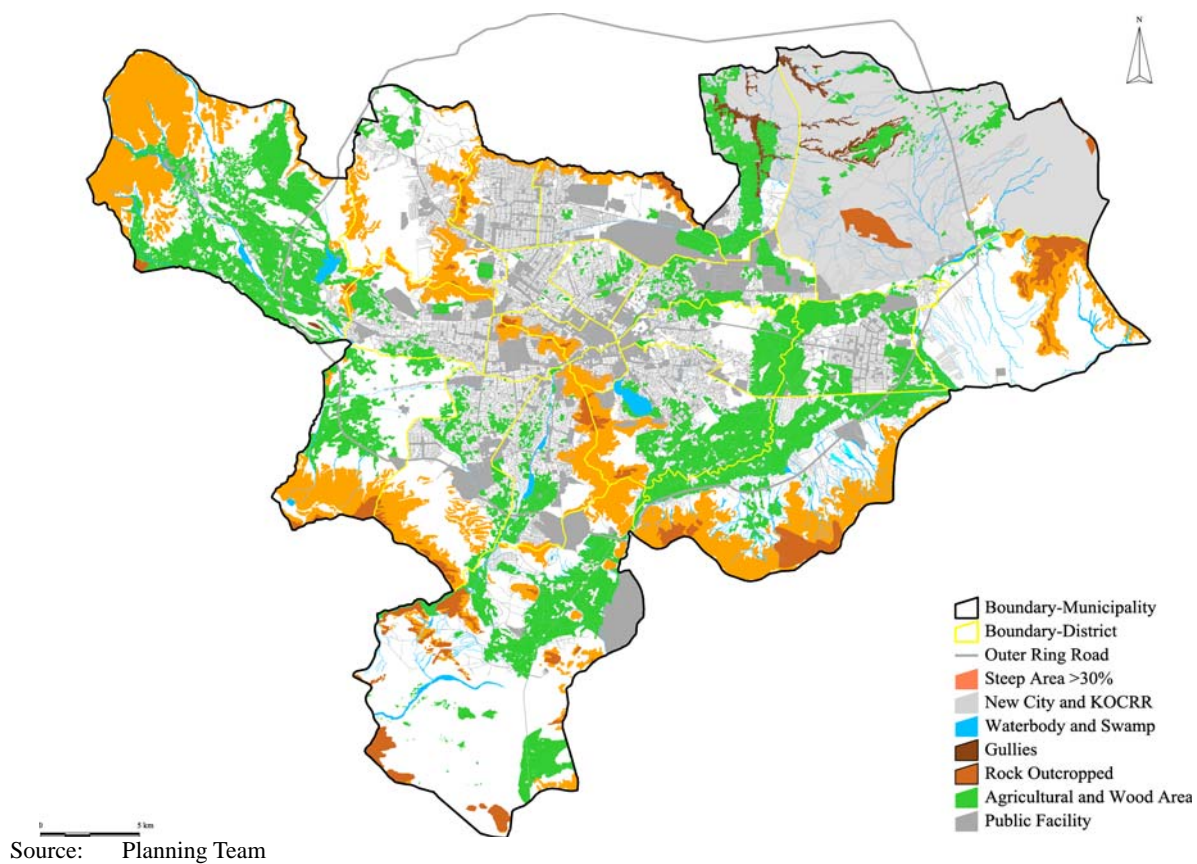
If all agriculture lands are maintained (Case 1), the available lands will be insufficient by the large amount of 6,193ha from the required land area of 32,372ha. Similarly there are gaps to meet the land requirement in Case 2 (4,478ha) and Case 3 (4,650ha). These estimates suggest that enforcement of land preservation policies is generally applicable under following conditions:

- Conversion of some agriculture land to urban use needs to be allowed while irrigated agricultural area along the Logal River is protected.
- Expansion of population in some areas outside the outer ring road needs to be allowed but in a smaller population density.
- Some public lands needs to be converted to urban use. Those public lands used for military and security purposes will be the most likely candidates assuming that the security situation in the city will become better.
- Introduction of some apartment complex with higher density is necessary in order to reduce the total land requirement for residential use.



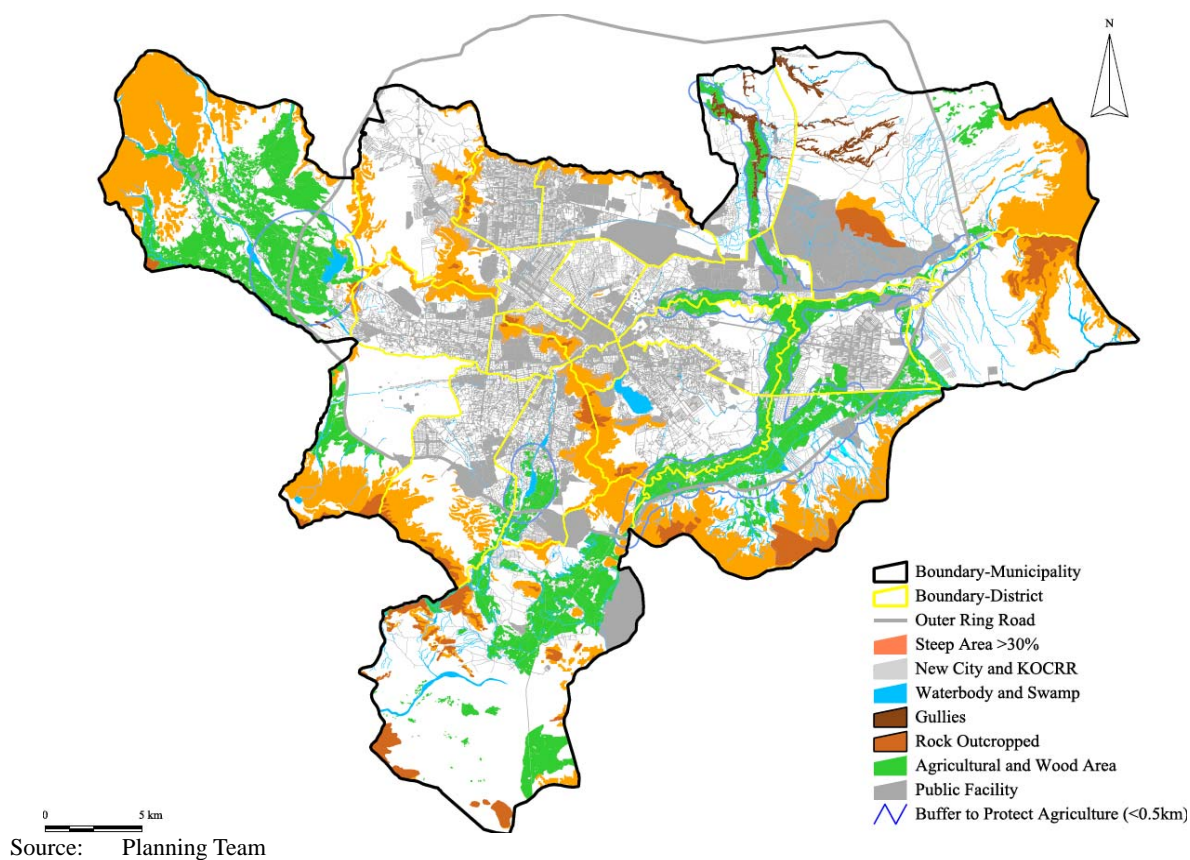
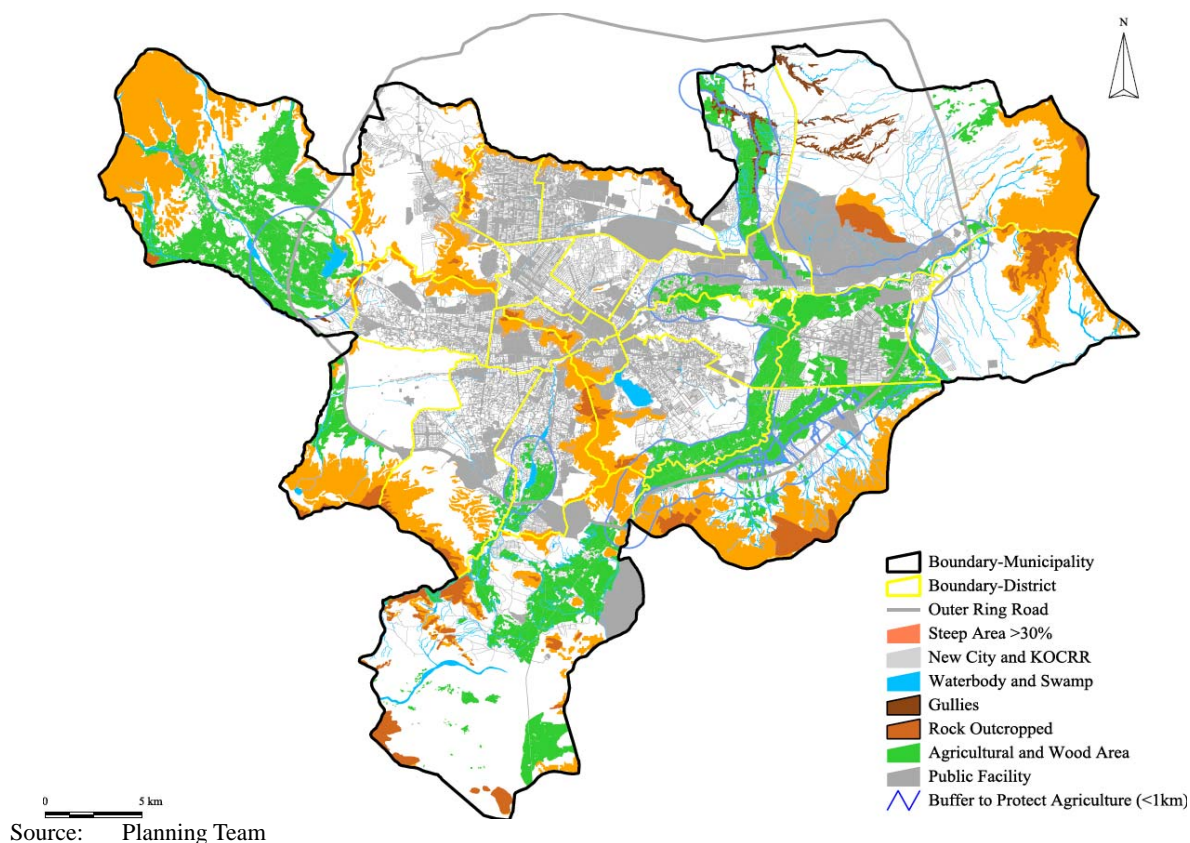


**Figure 4.7: Distribution of Undevelopable Areas**



**Figure 4.8: Distribution of Agricultural Land to be Protected in Case 1**





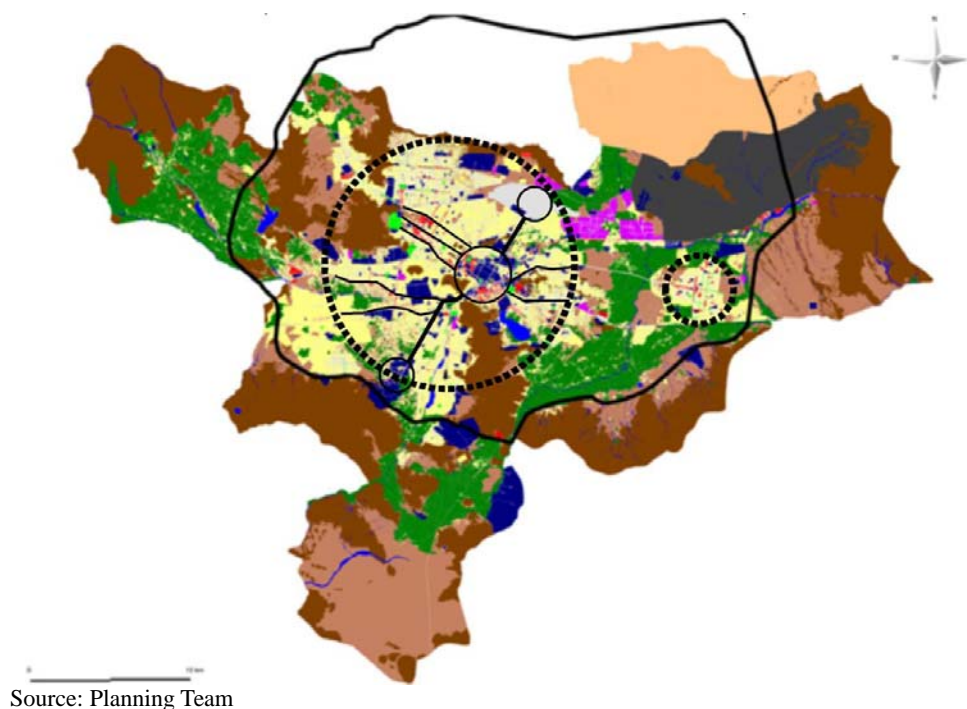
## 4.3 Future Urban Structure of Kabul City

### 4.3.1 Existing urban structure

An urban structure of a city can be defined by extended area of urban land use, important urban nodes, transport links between urban nodes, and urban axes representing growth momentum or accumulation of urban functions and other urban characters if any. The existing urban structure of Kabul City can be characterized by the following:

- The existing densely built-up area in Kabul City forms a circular shape centering on the city center consisting of the Old City and administrative blocks;
- Practically all the major urban functions concentrate in the city center and its vicinity;
- The urbanized circular area is divided into the northeastern and the southwestern parts by the intrusion of hills;
- The urban areas in the north and south are obstructed by mountains;
- The urbanization to the east and the west disappears to the agricultural land which barely forms the greenbelt;
- A large scale residential estate has been officially developed in District 12 to the east of the urbanized circle across the greenbelt of agricultural land;
- The Kabul International Airport is situated in the north and connected to the city center with an arterial road.
- The Darulaman Place is situated in the south and connected to the city center with an arterial road. The Parliament House will be constructed facing the Darulaman Place circle and several central government offices are located along Darulaman road;
- Several east-west roads are functioning as major link to the city center from residential areas. Some small shops and public facilities are located along these roads; and
- North-south roads have not much attracted commercial activities.

Figure 4.11 illustrates the conceptual drawing of the existing urban structure of Kabul City.



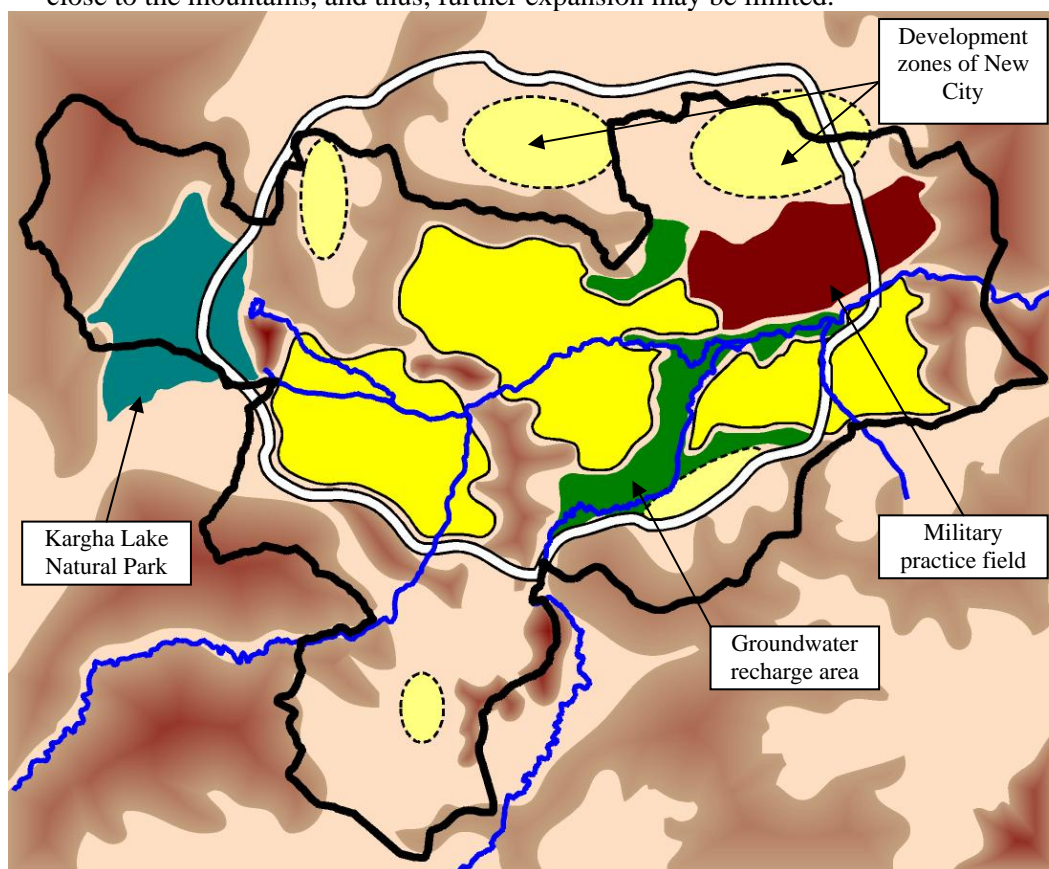
**Figure 4.11: Existing Urban Structure of Kabul City**

### 4.3.2 Need for transformation of urban structure

#### (1) Foreseeable future urban area of Kabul City

The future urban area of Kabul City may shape as illustrated in Figure 4.12, taking the factors of existing urban structure, policies for protection in the municipality area, and ongoing development projects such as outer ring road, the New City and other formal townships into consideration. The future urban area of Kabul City will be characterized by the following:

- The urban area will consist of several blocks (or enclaves) physically separated by mountains and hills, rivers, outer ring road, preserved green belts, and a large scale military practice field;
- The urbanized enclaves situated in the original urban circle will be further developed in the form of two separate parts;
- A new major urban enclave will be formulated including the golden City in District 12 and eastwards;
- Two urban enclaves will be formulated by the New City project within the area enclosed by the outer ring road. Each of these enclaves will have an urban core and the total density will be much lower compared to the ones in the existing Kabul City;
- The flat area in District 17 will be developed as another large urban enclave but will remain relatively low density due to the limited water resources for urban use;
- Although it is far outside the alignment of outer ring road, a small urban enclave will be remained in District 20 as it was developed as a formal residential quarter. The density will be low as it is distant from the city center and water supply will be made with less priority; and
- There will be some urbanized areas along and outside the outer ring road. These areas are close to the mountains, and thus, further expansion may be limited.



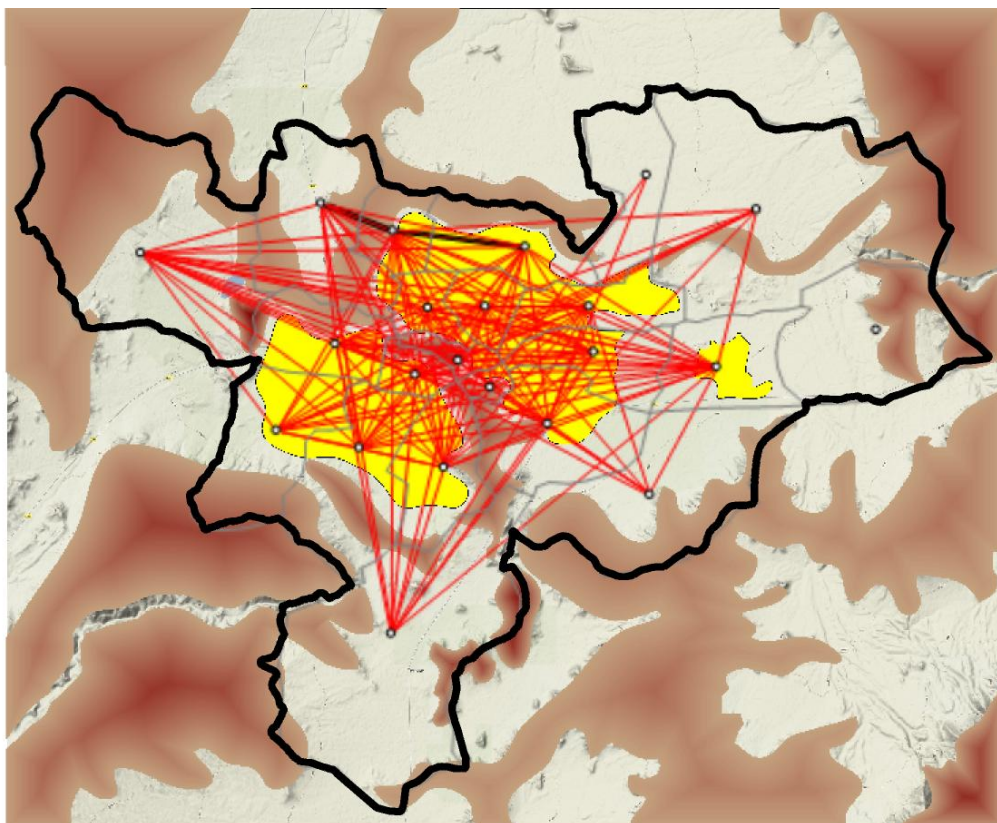
Source: Planning Team

**Figure 4.12: Composition of Future Urban Areas**



## (2) Need for transformation of urban structure

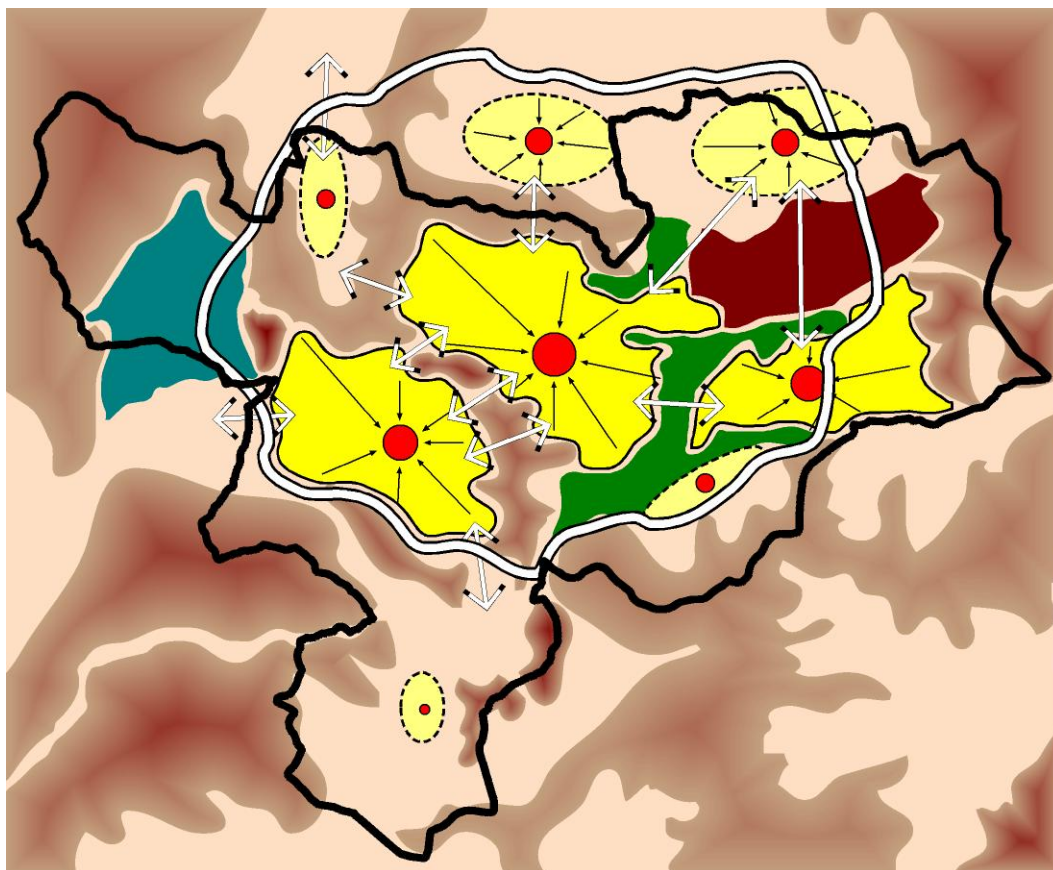
Figure 4.13 shows the desire line of transport in 2008 overlaid on the existing urban area. As observed from this figure, the current transport is concentrated to the city center and many of them are crossing natural barriers created by hills. If the city keeps grow by the existing urban structure characterized by concentric hierarchy of urban functions, the transport demand will be generated across these barriers.



Source: Planning Team

**Figure 4.13: Desire Line 2008 over Existing Urban Areas in Kabul City**

To overcome this inherent disadvantage, the urban structure of Kabul City needs to be transformed to a more polycentric shape, by introducing sub-centers in each urban enclave. This will help transform the urban structure of Kabul City to a more decentralized one, consisting of self sufficient enclaves. Each of these sub-centers needs to have good access from any parts of its coverage area, while urban enclaves need to be connected each other including the ones to be developed in the New City. Figure 4.14 illustrates an image of self sufficient urban enclaves, by introduction of sub-centers.



Source: Planning Team

**Figure 4.14: Image of Self Sufficient Urban Enclaves**

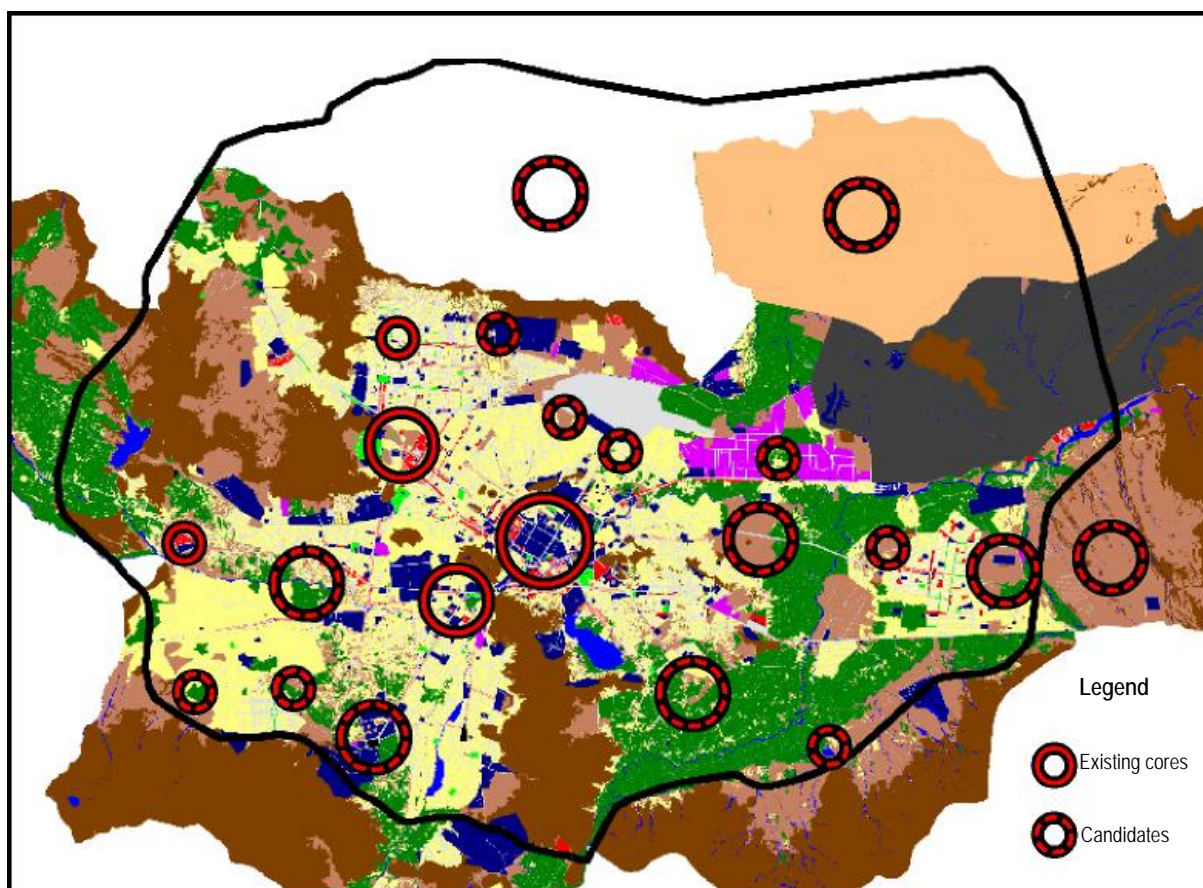
### 4.3.3 Conception of future urban structure of Kabul City

#### (1) Selection of candidate sites for sub-centers

The purpose of introducing sub-centers is to contain the peak time traffic demand originated from residential areas in an urban enclave within the enclave itself. To this end, work places, schools, and daily shops need to be located in each enclave. In case of major three enclaves which will accommodate well over a million population, business offices, higher education facilities, higher referral hospitals, and cultural/recreational facilities can be located as well. Selection of suitable sites for sub-center development requires certain conditions as follows:

- Availability of sufficient size of land block in which existing land use is vacant, agricultural, or scarcely inhabited residential,
- Physical location of the site within the enclave to provide good access from any parts of the enclave itself,
- Access and connectivity by existing arterial roads in the city, and
- Spatially balanced location in terms of relationship to other sub-center candidate sites.

Figure 4.15 shows candidate sites for development of sub-centers, which satisfy the above requirements.



Source: Planning Team

Note: Size of the circle indicates size of available land for development

**Figure 4.15: Location of Potential Sub-center Sites**

## (2) Links between sub-centers

The sub-centers need to be connected by good access for two kinds as follows;

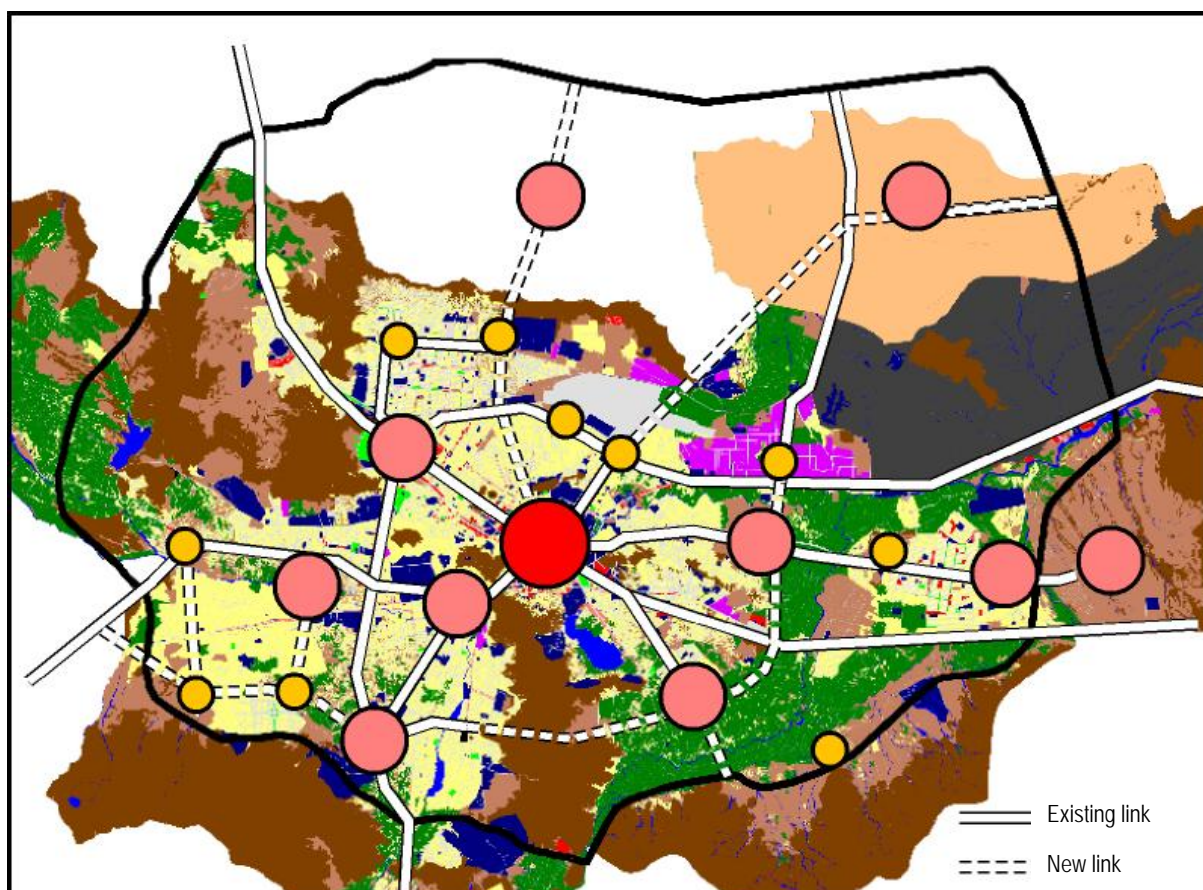
- i) Connection from residential areas of its hinterland, which will be improved in a gradual manner, and
- ii) Connection to/from other sub-centers, which will enhance the locational advantage in a synergetic way.

The latter factor affects foundation of the spatial composition of future urban structure, although both are required for success of the sub-center development at any sites. Links between candidate sub-center sites are examined and identified focusing on the following conditions:

- Integrity with existing arterial road network
- Consistency to the Third Kabul Master Plan and related design works of road development, if still appropriate, and
- Availability of land for new road construction assessed by level of existing land use.

Figure 4.16 shows the identified links between sub-centers, along with the existing city center.





Source: Planning Team

**Figure 4.16: Identified Links between Urban Centers**

## **4.4 Land and Built Environment Development Strategy**

### **4.1.1 Overall land development strategy**

In Afghanistan, it is a primary role of a municipality to develop and distribute lands for citizens. In Kabul City, however, this direct development and provision of lands by the municipality has not met the vast housing demands generated by the large influx of population. This rapid increase of population is expected to continue for some time in the future. To overcome this situation, it is necessary to shift the policy of urban land development and housing supply to a more market oriented system. Funds and knowhow in the private sector can be utilized more effectively, along with the manpower to be mobilized by both individuals and private enterprises. The role of the municipality needs to be sought based on the interrelationship with the private sector players according to the character of development needs, namely: individual detached housing, apartment complex, and non-residential kinds including sub-centers. The following three items are key strategies for the land development of Kabul City.

#### **(1) Promotion of spontaneous housing construction through market mechanism**

Effective utilization of the property market needs to be sought, under appropriate regulation to be managed by the municipal authority. Although it is currently recognized as informal, the citizens of Kabul City have created decent shelters in the form of traditional housing, compared to those shanty towns developed in many large cities in other Asian countries. The frontage road space is usually secured even in the informal residential areas, despite no plans/designs are presented. The ability of building traditional houses is reliable enough in terms of safety of the structure, if the land is situated on safe flat places. Therefore provision of housing plots can be largely entrusted to the already functioning secondary market, and construction of individual houses can be registered even in the



informal areas for the guiding and monitoring purposes. This is a normal practice in Asian cities which experienced rapid urbanization. The level of urbanization is monitored in the areas where there is no detailed land use plan or development project. Provision of most infrastructure and public facilities go after the urbanization based on the priority determined according to the monitoring results.

There are several risks and short comings in the urbanization driven by the spontaneous development, to which the municipality needs to guide to a proper direction. Major risks can be itemized as follows:

- Expansion of residential areas to unsuitable locations for living, such as steep hillside, flood prone low land, and protected green areas including the Kargha Lake catchment and groundwater recharge area. A clear designation of protection areas is thus required, and a set of land use control system needs to be established.
- Excessive construction of houses without securing lands for social and other community level public facilities. Land plots for public facilities need to be identified by introducing the community scale land use plan to be formulated by participation of community residents.
- Creation of labyrinthine residential blocks to which emergency vehicles are not accessible and evacuation from the area is difficult. A clear standard for access to a house needs to be established and presented to the applicants for housing construction as a part of conditions for permission.

## **(2) Promotion of private sector developers**

The planned developments of housing estates also need to be continued, but the private sector developers will have to be the major player in this field. The municipality will provide necessary information for the developers and control the quality of products to be implemented by the developers. In recent years, there are several practices taken place in the city by forming this kind of development in such projects as Golden City and Aria City. In these cases, structure plans and detail plans were prepared by the Kabul Municipality. Preparation of detail plans may be entrusted to the private developers also, once development standards and permission guidelines are established.

## **(3) Concentration of public development to selective strategic areas**

The conventional urban development method through preparation of structure plans and detailed plans will be effectively utilized if focusing on selected strategic areas, such as the core of sub-centers and city level parks and open spaces. These strategic areas will be primarily developed for public facilities and government offices, which are not profitable for private developers. Establishment of these public facilities in the sub-centers will facilitate change of urbanization trends especially for business and commercial functions, and help transform the urban structure to the multi-polar system.

### **4.4.2 Strategy for business and commercial areas development**

The location of business and commercial areas is a most essential factor to form an urban structure. In case of Kabul City, successful formulation of business and commercial areas in sub-centers is critically important as the city has to transform its urban structure to a multi-polar system to avoid over concentration of traffic crossing the inherent bottlenecks. It is also important to reform the existing city center area by improving its overall efficiency and enhancing its attractiveness.

#### **(1) Existing business and commercial area**

##### Existing conditions

The existing central business district is formed mostly by government offices, which have large gardens and small buildings of two or three floors with very small building coverage ratio (BCR) to the land plot. These offices typically maintain large trees and beautiful flower gardens within their

land plot. However, it is usually exclusive for workers and official visitors to enjoy these gardens as gates are controlled for security reasons.

Surrounding areas of these government office blocks are rapidly developing to a busy commercial district. The total floor area ratio in this area is going up these days as high-rise buildings have been actively constructed, in many cases without obtaining proper permissions from the municipality. Standards for the structure and fire safety adopted for these large buildings are not clear. Parking facilities are not put in place even in a commercial building. The landscape shaped by buildings is more and more becoming uncoordinated, because of the construction of different scale of buildings covered by different colors and materials.

Streets in the city center are relatively wide, but suffering from heavy traffic jam during the peak times. This is caused by blockage of traffic on main streets for security purpose, chaotic movements of pedestrians trying to find taxis, over concentration of traffic to specific routes and intersections due to limited number of paved side streets, and so on.

### *Directions and strategies*

As a central area of the capital city, the city center needs to be reformed to the following directions:

- 1) Creation of attractive urban space as a symbol of Kabul City as well as Afghanistan to the world, and
- 2) Enhancement of business environment as an economic center of Afghanistan with strong competitiveness in terms of efficiency in transport and communication.

The major strategies are common for both of above directions as follows:

- 1) Reform of spatial composition

Despite the busy atmosphere, the city center area is one of the places that hold a large number of trees and open spaces, owing to gardening efforts by respective organizations using large land plots. At the moment, it may be advantageous to keep these gardens closed from outside for protection of scarce trees. These areas, however, need to be opened to citizens and visitors from any parts of the world in a gradual manner. This is important because the city center area does not have large vacant land for provision of parks which are necessary to create city's icon and increase amenity.

To this end, it is proposed that some of government offices and public facilities will be relocated to sub-centers, including ones located in the New City. It is hard to identify specific land plots for conversion to public open space at this moment, as making of decision will require some time for the government and concerning organizations. Formulation of relocation plan and program need to be arranged by the Initiative of Kabul City.

- 2) Enhancement of efficiency and amenity

It is desired to enhance efficiency and amenity of the city center to be recognized as a world class business center. To this end, a reliable transport system needs to be secured together with good communication infrastructure. Along with improving the transport system in the city level, it is necessary to focus on the transport space in the city center also. In the light of creating high class business environment, transport space in the city center need to be rearranged to a pedestrian oriented style. Given rather wide ROW secured for streets in the city center area, pedestrian friendly spaces can be created by providing wider walkways with roadside trees to create shading from the summer sunshine, with benches and other resting facilities placed in a regular interval.

In order to rebuild an attractive landscape in the city center, it is necessary to have a common vision for the future image of urban space consisting of both public and private usage. For this purpose, it is ideal to establish a landscape design and associated guideline. A key to

success of materializing the landscaping is to create an ownership among citizens. One effective method is to have a competition of landscape ideas and design, which is open to the public to participate. By doing so, media will be involved and people will pay attention to the process of selection, recognize the intention put into the winner's design, and be conscious to the formation of landscape with sort of ownership.

### 3) Securing quality of buildings

The business and commercial buildings being constructed in an increasing pace need to have certain quality for various factors. Some of large scale buildings started construction without going through proper assessment of its design. It will be an enormous loss for the economy, if the large scale investments in commercial buildings end up with a stock of unqualified structures. Thus, there is a need for establishment of strong building control system supported by legal measures.

Key factors need to be secured include:

- Maximum size of total floor area to avoid excessive load to the transport infrastructure, as well as water consumption,
- Provision of necessary number of parking lots inside the boundary to prevent roadside parking,
- Architectural design and building materials for use of facade to meet landscape design concepts, and
- Structural and fire safety conditions as an essential part.

## (2) Sub-centers development

### Existing conditions

The candidate sites for sub-centers development are selected where accessible by existing or planned roads is good and vacant or rarely inhabited large block of lands are available. The selected sites are not limited to vacant areas but also include low lying land and irrigated agricultural land. These are all facing the risk of conversion to informal residential use. In this light, the objective of the sub-centers development is to conserve the environmentally important areas, along with transformation of the urban structure. Therefore it is critical to secure lands for sub-centers development before being converted to informal settlements.

### Directions and strategies

In the light of the objectives to transform the urban structure of Kabul City, as well as conservation of environment for function of groundwater recharge, the sub-centers will be developed to the following directions:

- 1) Creation of urban area with low building coverage ratio, in order to secure large open space, which is open to the public.

The urban functions to be introduced in each sub-center may differ by location, and thus, overall urban atmosphere will be different site by site. However, it is common to all the sub-center sites that the development of facilities needs to be low density for three strategic reasons:

- Provision of park and greenery to the citizens as major city parks,
- Securing of groundwater recharge functions by utilizing existing irrigation canals, etc., and
- Securing of land reserve for long-term future development, after situation of water resources for the city improved.

- 2) Locating government offices and key public facilities of higher functions such as higher education and referral hospitals.

The facilities to be constructed within the boundaries of respective sub-centers will be limited to those for government and public functions for the following three strategic reasons:

- Creating a magnet for accumulation of industries related to the government functions located in the sub-center,
- Securing the lands for public uses which is not achievable by private sector developers as price of land will be set at low level for the government use, and
- Securing smoother land acquisition enabled by pure public usage after development.

An example of low density development of office park is presented in Figure 4.17 as a model image of sub-centers to be developed in Kabul City.



Source: Maxim Office Park Scotland

Photos: [www.e-architect.co.uk/scotland/maxim\\_office\\_park.htm](http://www.e-architect.co.uk/scotland/maxim_office_park.htm)

**Figure 4.17: Example of Low Density Office Park Development**

Strategies for development of sub-centers are as follows:

- 1) Securing of land for sub-centers development

Success of sub-centers development is fundamental for the future of Kabul City. Securing of land is critically important for successful implementation of sub-centers development. It is ideal if all the land for sub-centers development is acquired before it becomes difficult due to change in land use. Alternatively, a system for restriction of private land use may be established and monitored. Those non-building uses such as farming can be permitted, as well as limited scale of buildings for tentative uses such as tents and pavilions. If the system is established, the land can be obtained only immediately before the implementation.

If the project land is secured well before preparation of project implementation, space of parks and squares can be developed firstly. This will be effectively utilized for tentative purposes such as holding of events, animal market, etc.

- 2) Effective use of conventional development method

The municipality has an accumulation of technical know-how for urban development. This will be fully utilized for the development of sub-centers, since the project can be implemented by established procedure of conventional development method. The technical human resource of the municipality need to be assigned for the sub-center related tasks.

### 4.4.3 Strategy for housing area development

Housing is a basic function of a city, which needs to be ensured by the government. Kabul City has been facing a high demand of housing units beyond the level of investment by the municipality alone. Existing residential areas also require rehabilitation and improvement.

#### (1) Provision of new houses

##### Conditions

Table 4.4 shows key indices for housing in Kabul City until 2025. The number of existing housing units in 2008 is estimated at 382,000 based on the existing population, the household size and the number of household per housing unit. The housing demand in 2025 is estimated to be 696,000 units to meet the future population in the same year. This will require 294,000 housing units additionally. The annual housing demand will be in the range between 16,000 and 21,000.

**Table 4.4: Required Number of New Housing Units until 2025**

Item	Unit	2008	2015	2020	2025
Population	1,000	4,221	5,389	5,917	6,268
Household size	person/household	7.00	6.59	6.29	6.00
Number of household per unit	household/housing unit	1.58	1.55	1.52	1.50
Residents per unit	person/housing unit	11.05	10.19	9.59	9.00
Required Number of Housing Unit	1,000 units	382	529	617	696
Annually Required Number of Housing Unit	1,000 units		21	18	16

##### Directions and strategies

As mentioned in the overall land development strategy, it is impossible to meet the housing demand in Kabul City without the introduction of private capital in various forms. To set the priority for type of private sector investment in housing, it is necessary to take the balance of water into consideration. While it is ideal to promote construction of apartment complex in view of efficient land use, excessive construction of apartments will inevitably call for shortage of water, as it requires flush toilets in each housing unit.

In the land use plan of this master plan, it is proposed that over 3,300 ha to be assigned to the medium-rise high-density category expecting the new construction of apartment complexes. This is a maximum volume of apartment houses complying with the water allocation scheme examined in Section 6.1. If the construction of apartment complexes proceeds in an even pace until 2025, over 200 ha of land will be developed annually. This will provide apartment units for 12,000 households each year. The remaining 4,000 to 9,000 households need to be settled in flat land areas designated to the low-rise medium density residential area in the land use plan, in the shape of detached houses. Construction of detached houses needs to be largely entrusted to private developers and individuals' housing construction.

Strategies for development of new housing are as follows:

#### 1) Control of apartment complex development

A development of apartment complex requires considerably larger investment with higher risks. Yet, private sector developers in Kabul and Afghanistan will have strong interest in apartment complex development, if water consumption is officially approved for the project. Availability of tap water will be the most attractive selling point for these developers, as it is not secured in other type of development. They would provide tap connection by deep well for exclusive use of their customers. Permission of the construction, therefore, needs to be managed in view of progress in water resources and supply system development for the city.

In general, apartments are constructed in areas where land price is too high for average employees to purchase lands for construction of detached houses. Some large scale apartments are being constructed in and around the city center. If this trend continues,

existing infrastructure will be overloaded. The best location for the development of apartment complex will be the adjacent area of proposed sub-centers. The complex may contain offices for private companies and commercial facilities along with apartments. This will help creating momentum for accumulation of business and commercial functions around the sub-centers.

Overall procedure for development can follow the existing system in Kabul City. However, it is proposed that the structure plan and the detail plan can be formulated by private developers. The precious man-power of the municipality needs to concentrate on technical assessment for permission. To this end, establishment of standards are required for the following fields:

- land use planning and infrastructure design for the detail plans, including requirements of land reserve for public facilities,
- structure design and installation of equipment, and
- area specific requirements for architectural planning, such as building coverage ratio, floor area ratio, and maximum height.

2) Promotion of small scale residential estate development

Even if the construction of apartment complexes is proceeded smoothly there will be 4,000 to 9,000 immigrant households to be settled in detached house. These households are likely to be settled in the informal settlement areas. To minimize further expansion of informal settlement areas, development of detached housing estate also needs to be promoted.

Given current difficulty in purchasing large block of lands, the most likely development that the private developers can manage is a kind of smaller scale housing estate consisting of 10 to 25 housing plots. In the experience of Tokyo and other Asian cities, this kind of small scale development is typically called the “mini-development” and created problems as many housing units and plots are constructed beyond the pace of infrastructures and public facilities development by the responsible local governments. However, once standards and permission systems are established, this kind of development has significantly contributed to the provision of housing lands to respective cities.

The key standards include:

- Provision of proper infrastructure inside the estate area for such items as paved frontage road properly connecting to main road of the city, pre-installation of water pipes and ducts for communication and power distribution within the road space, and pre-installation of septic tanks in each land plots, and
- Financial contribution to the municipality or existing community body for appropriate parts of financial burden brought by the development, in such items as construction of schools, health posts, and playgrounds.

The location and pace of this kind of development will be determined by the market, but it is more efficient if these projects are taken place in the areas where piped water system is already available or scheduled to be constructed in parallel.

3) Promotion of traditional housing

Because of the scarce available water throughout the planning period, primary direction for promoting individual housing construction is to encourage construction of traditional courtyard style houses. As these houses use shallow wells, the unit water consumption is the lowest. This will result in more residential units to be accommodated in the city area. Traditional houses tend to be constructed in informal residential areas. Some expansion of informal settlements is thus needed to be acknowledged. To deal with the expansion of

informal settlements, it is more important to guided and monitor the construction activities through permissions and quality control than rejecting the application and ignoring the aftermath. Application for housing construction needs to be imposed to anybody for anywhere, and accepted by the municipality to be examined and guided to locate in more appropriate locations if necessary. To this end, a new concept of permission and monitoring system need to be established in the municipality.

## (2) Upgrading of informal settlement areas

### Existing conditions

Table 4.5 shows estimated population by type of settlement in 2008. It is estimated that approximately 3.1 million people live in the informal settlements out of the total population of 4.2 million in the city. Given the fact that the informal settlement areas are significantly larger than the total area of formal settlements the municipality could provide, it is not realistic to redevelop entire informal settlement areas by total clearance of informal houses as sometimes practiced before. Thus policy needs to be shifted to upgrading of informal settlement from the redevelopment to create formal settlements.

**Table 4.5: Estimated Population by Type of Settlement, 2008**

District	Planned	Unplanned				Total
		<10%	10~30%	>30%	Total	
1	0	21,607	6,784	7,020	35,411	35,411
2	31,560	6,068	13,890	31,780	51,738	83,298
3	78,426	11,134	15,368	34,940	61,442	139,868
4	137,308	59,288	6,209	0	65,497	202,805
5	162,420	109,861	7,887	3,940	121,688	284,108
6	25,695	246,799	12,761	20	259,580	285,275
7	4,579	342,526	50,308	19,250	412,084	416,663
8	103,537	154,838	66,352	5,120	226,310	329,847
9	52,927	137,072	2,313	0	139,385	192,312
10	86,593	176,696	6,801	160	183,657	270,250
11	196,555	24,202	53,273	13,840	91,315	287,870
12	126,204	166,651	5,997	0	172,648	298,852
13	1,778	447,607	14,698	3,360	465,665	467,443
14	104	115,115	31,828	860	147,803	147,907
15	61,022	108,687	24,297	6,460	139,444	200,466
16	13,170	153,924	37,764	0	191,688	204,858
17	9,583	99,528	117,931	22,770	240,229	249,812
18	798	31,799	1,355	10	33,164	33,962
19	3,210	694	0	0	694	3,904
20	1,877	19,190	10,299	480	29,969	31,846
21	0	5,605	437	0	6,042	6,042
22	3,802	35,400	8,881	100	44,381	48,183
Total	1,101,148	2,474,291	495,433	150,110	3,119,834	4,220,982

### Directions and strategies

#### 1) Selection of target areas

Most of the existing informal settlements are subject for upgrading. Exceptions are as follows:



- Areas not suitable for living, such as steep slope areas and flood prone areas, and
- Areas where public interests need to be pursued, including such cases as groundwater recharge areas.

These areas are designated in the land use plan.

As applicable area is vast, it is not possible to complete the upgrading of all the settlements within the life time of this master plan. Also, there is a high possibility of further expansion of informal settlement by new immigrants to the city, as establishment of the system to promote the small scale estate development will take some time. In order to reduce the total area of informal settlement in the city in a gradual manner, it is necessary to upgrade at least 4,000 households annually. This will call for 100 ha of informal settlement area to be invested each year.

All the citizens living in the informal settlements desire early implementation of upgrading in their respective residential areas. However, for the municipality, there is no other way but proceed in a gradual manner. To obtain understanding on this reality, there need to be fair and objective criteria for selection of target settlement. Following conditions need to be presented to the citizens as criteria to set the priority for upgrading.

- Proximity to the city center:  
Distance from the city hall is good indicator for setting the priority. As traffic is concentrated around the city hall, improvement of community roads will help distributing the traffic. Although this will result in mixture of passing through traffic to the residential area, the area close to the city center is more or less commercial.
- Preparation of neighborhood plan by residents:  
As mentioned above, the informal settlements need to be recognized in a formal way for effective control and monitoring of land use. However, because these settlements are not developed according to a plan, some fundamental requirements for a normal township are missing in the area. Typical examples are lands and facilities for schools and playgrounds. In order to secure lands for these public facilities in the informal areas, it is essential to formulate a detailed land use plan in a community scale.

This land use plan needs to be formulated by participation of residents or by the hands of residents themselves, for obtaining the full understanding and agreement on land preservation and acquisition. Although it is a difficult task to arrange various intentions and opinions among residents into a plan, this may be possible if there is a strong motivation to accomplish. A key for this to happen is to set the preparation of the community level land use plan as a condition for implementation of upgrading project by the municipality. Through the planning process, issues of a community will be clarified and community's development efforts will be activated.

## 2) Components of upgrading

As a basic policy, the municipality desires to implement the upgrading projects in as many numbers of areas as possible. To this end, it is necessary to minimize the unit cost for a project by the following factors:

- Setting of appropriate grade for upgrading, and
- Utilization of residents' workforce

The main components for upgrading of an informal settlement are pavement of community roads with roadside ditches, improvement of toilets with proper discharge of waste water

from clear layer in a tank, and confirmation of lands for public facilities which will be constructed by responsible ministries later on.

The grade of these facilities may differ place by place according to the character of the site. However, the basic policy is to utilize the work force of the residents as much as possible. From this point of view, the following are adopted as the common grade for upgrading:

- Stone pavement will be employed as the material can be processed by the hands of the residents with some payment for the work. The raw material, or big stones, will be provided by the municipality.
- Stone masonry will be employed for the structure of road side ditches for the same reason with road pavement. The ditches will be the infiltration type as the lower stream is not properly connected to the main drainage channel for some time.
- Pit latrine will continue to be the main system for the upgrading areas, until the pipe water system is installed to the area. The most important factor in the improvement of wastewater treatment is to establish a proper management system for the use of pit latrines by ensuring periodical collection of waste and preventing the inflow of wastewater to the road side ditches. The system for management can be established in the community.

### (3) Improvement of slope area housing

#### Conditions

In general, steep slopes pose additional development risks, as well as increased costs for infrastructure and services. It often makes vehicular access difficult. Many cities in the world adopt a gradient of 10% as the threshold of hillsides, where any slope areas in excess of 10% are considered to be hillside and subject to special development standards. Many cities also use a maximum percentage of slope gradients to set a limit for urban development. A typical maximum gradient employed to restrict developments is 30%.

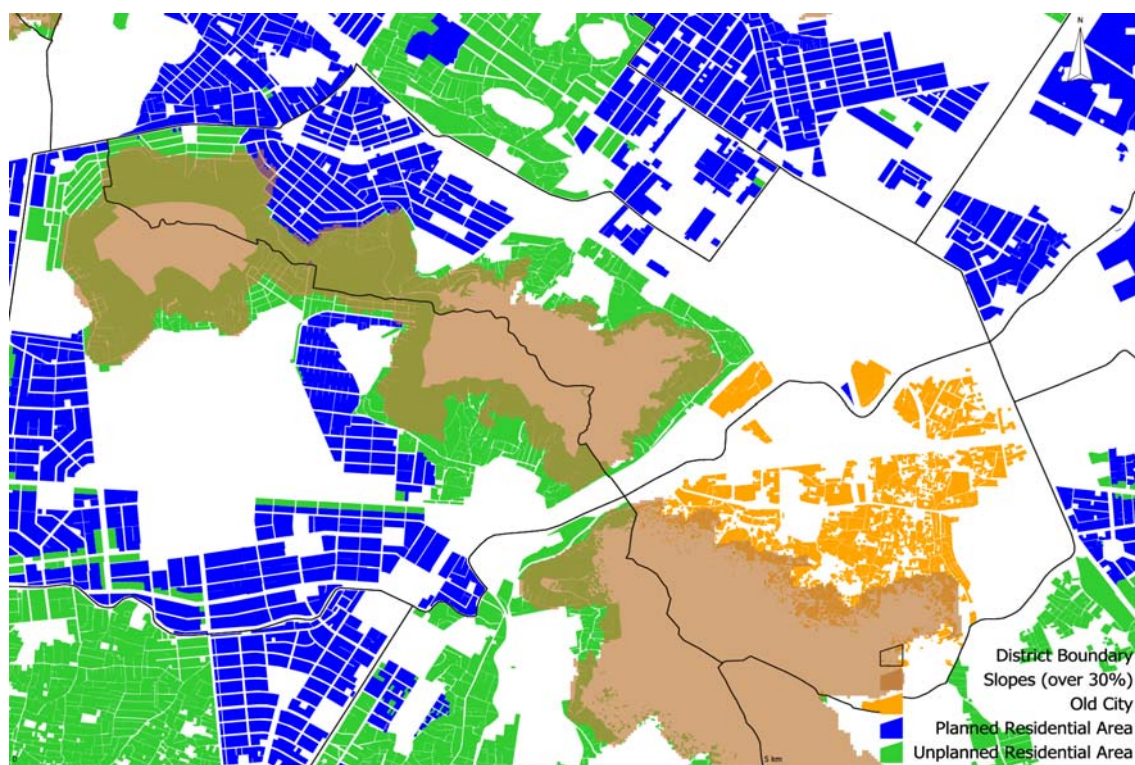
The unit construction cost for the land development increases on the hillside areas. For instance, the unit construction cost at the gradient of 9~18% is 1.7 times larger than that of 5~9% areas as shown in Table 4.6. The unit cost considerably increases at 27% or greater. In addition to the increase of the unit cost, the hillside areas at 30% or greater require special engineering measures against disasters. Hence, the steep slope areas at 30% or greater is defined as the undevelopable lands as a basic criterion of land use assignment.

**Table 4.6: Index of Unit Construction Cost by Slope**

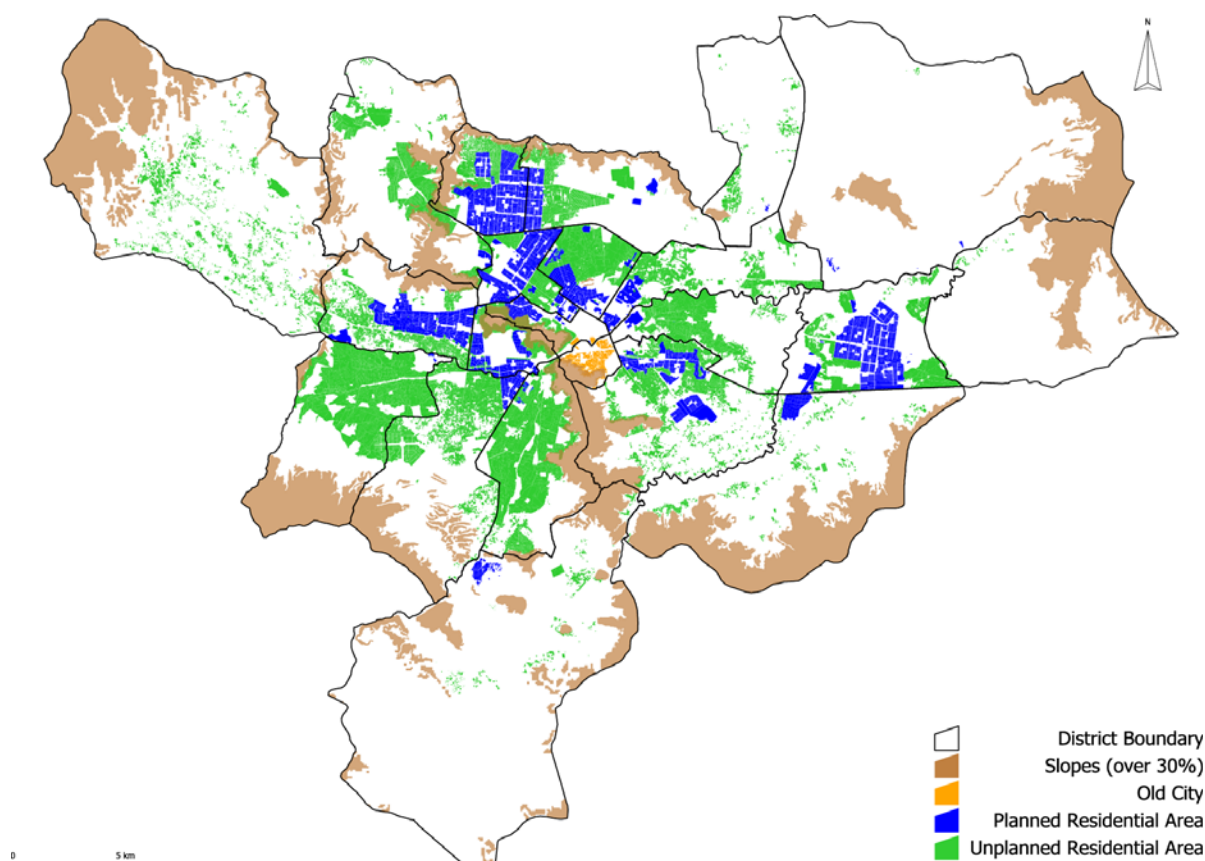
Incline	Gradient	Index of Unit Construction Cost (100 for the slope areas in 3~5 degree)
Flat <3 degree		
3~5 degree	5~9%	100
5~10 degree	9~18%	173
10~15 degree	18~27%	239
15~20 degree	27~36%	386

Source: Standard for Property Evaluation, Tokyo National Taxes Office, 2006

Steep slope areas at 30% or greater are identified based on the digital elevation model (DEM) associated with the SPOT satellite imagery. The Shuttle Radar Topography Mission data (SRTM) is partly used for outer areas where SPOT data are not available. The existing residential areas fall in this category are identified as shown in Figures 4.18 and 4.19. Existing population in the steep slope areas is estimated to be around 83,000. As shown in the figures, formal settlements have mostly avoided the steep slope areas for their development, while informal settlements extend on steeper areas. These are subject for relocation to the safer areas in a gradual manner.



**Figure 4.18: Steep Slope Area at 30% or Greater (Part of District 3)**



**Figure 4.19: Steep Slope Area of Gradient at 30% or Greater in Kabul City**

#### Directions and strategies

The ICT team demarcated the hillside areas into three categories according to the elevation distance from the nearby main road and proposed the strategy for each category. For instance, improvement

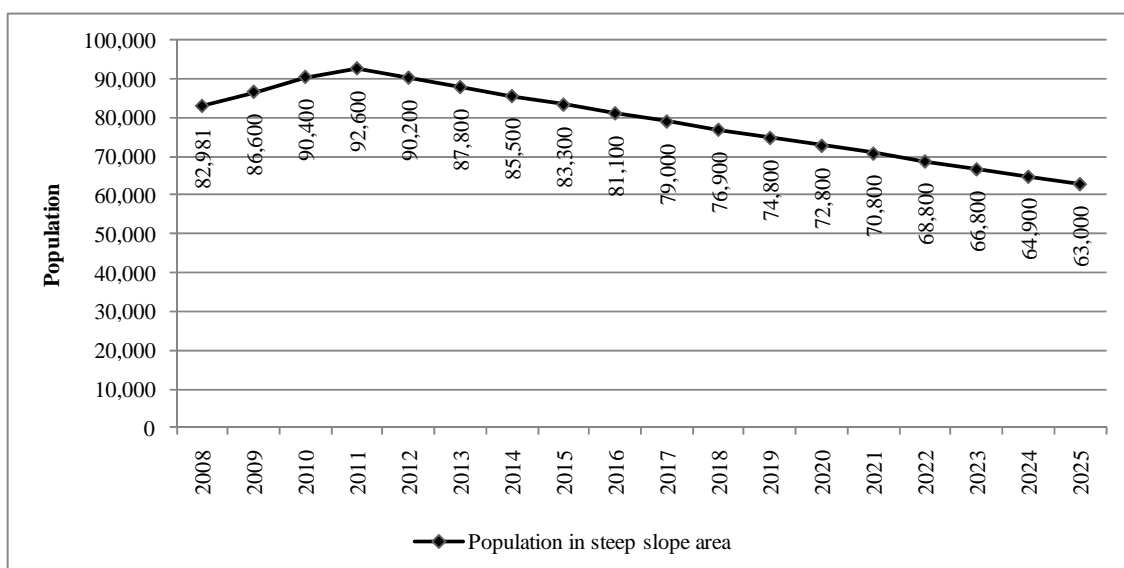
works shall be implemented on the hillside areas if it is within 30m height distance from the existing main road, while it shall be left without any improvement for the areas within 30~80m. The hillside areas higher than 80m shall be relocated and improved by greening. Another team funded by USAID conducted a specific study for the hillside areas. This study followed the strategy proposed by ICT team and deepened the recommendation by extending the restrictions for the new encroachment in the hillside areas. The proposed criteria to restrict the new encroachment are:

- Steep areas at 20% or greater,
- Areas higher than 1,860m which was supposed to be the maximum height of the existing water supply system, according to the ICT's development plan,
- Areas within 50m from mountain ridges, and
- Areas higher than 50m from main roads with no access roads already constructed.

These recommendations well correspond to the factors of safety and cost effectiveness and thus can be adopted as basic conditions. However it is not easy to provide relocation sites in the city. Also establishment of rules to compensate the relocating families will face many objections in the circumstance that the developed land is in a serious shortage. Therefore compulsory relocation of the existing residents is not realistic. The basic direction for the improvement of the steep slope areas is to encourage self-motivated movements to the safer areas. As the majority of the constructed houses on the slope area is made of mud, these houses will face periodical restoration in 15 to 20 years. This periodical restoration can be considered as the opportunity for the residents to move to other places. A simulation of demographic movements is carried out assuming the following conditions:

- The incremental population will depend on the natural increase only without any further social migration,
- Existing households will move to safer places when their houses reach to the time for restoration.
- Actions are taken from the year 2011 to prevent further encroachment of houses on the restricted hillsides.

As a result, the population in the steep slope areas will be decreased to 63,000 in 2025, as shown in Figure 4.20. Because of the moderate pace of movements, there will be still sizable population residing on the restricted slope areas. However it is expected that this trend will be accelerated if moved families obtain stable lives with full title deeds on their properties. Once the population on the restricted area declined to the level of which the community activities do not function effectively, the pace of movement will dramatically increase.



**Figure 4.20: Simulation of Demographic Movement in Steep Slope Areas**

Following are the strategies to create conditions for self- motivated movement:

1) Clear demarcation of restricted areas

Although the concept of slope gradient based criteria is clear, it will face difficulties at delineating the exact location on the site. The boundaries for restricting further encroachment on the steep slope areas need to be defined on site, by installation of fences, etc. This physical boundary will effectively help residents to recognize the status of restriction and discourage new comers to construct new houses.

2) Restriction of new construction and reconstruction

Existing houses are permitted to be used until the time of their major restoration. The area needs to be monitored and restoration works need to be restricted without permission by the municipality after efforts for finding way to relocate. Any new construction is strictly prohibited and demolished once the fences or other shape of boundaries are installed.

3) Provision of support for movements

The residents will have to be assisted for movements in various ways. Following are some examples:

- Provision of information on market prices of land plots and properties at various sites,
- Provision of assistance obtaining the full title deeds with faster and simpler procedure, and
- Provision of a renting service of municipal vehicles to use at the time of relocation at free or very low prices, etc.

#### 4.4.4 Strategies for industrial land development

##### Existing conditions

In Kabul, there are small clusters of industries such as wood product and furniture in Districts 8 and 16 and metal products in District 8 on the roadside or in the residential and commercial area. Although some of these firms enjoy the current conditions such as access to market or clients, most of them want to relocate to other places due to land problems and poor infrastructure and utilities. Also these

workshops cause environmental problems such as untreated wastewater discharge and noise in the residential areas. Based on these facts, the KMAUD Master Plan proposed to relocate these firms to industrial parks. Candidate sites are industrial zone in District 9, the Pule Charkhi industrial park, and the Bagrami industrial park (Phase 2). Proposed development of industrial parks by the KMAUD Master Plan is shown in Table 4.7.

**Table 4.7: Summary of Proposed Industrial Parks by KMAUD Master Plan**

Industrial park	Status	Location	Area (ha)	Features/major sub-sectors	Estimated employment opportunities	Estimated value-added US\$106	Implementation entities & schedule
Pule Charkhi	New (rehabilitation)	District 9	100	Plastic, construction materials	12,400 (additional)	78.4	MoCI 2008-2015
Bagrami (Phase 1 & Phase 2)	Existing Plan	District 16	18	Food and others	1,600	8.7	AISA 2008-2015
Kamari (Phase 1 & Phase 2)	Existing Plan	District 22	90	Food, carpets, light industry	10,000-13,000	59.5	AISA 2008-2015
Kamari (Phase 3)	New	District 22	130	Balanced distribution	16,000	92.6	AISA 2015-2020
West Kabul	New	District 13 and Paghman area	80	Apparel, construction materials	10,000	47.8	AISA 2015-2020

Source: KMAUD Master Plan

### Directions and strategies

The primary direction of industrial land development is to support movement and new locating of industries to the designated industrial parks. The development of industrial parks will be implemented primarily by Afghanistan Investment Support Authority (AISA) and possibly by private sector developers in the future. The municipality needs to allocate suitable areas for development of industrial parks.

The area for industrial parks is designated in the land use plan. Basic considerations are as follows:

#### 1) Provision of large area along regional trunk roads

Although Kabul is not suitably located to be a manufacturing base, the city has been a major international transportation node and will continue to be so. Logistics industry may be a prime sector that grows along with economic development of Afghanistan and surrounding countries. One advantage of logistics sector in Kabul is that it does not require a lot of water for its operation. Another possible advantage is that the productivity of the industry depends on availability of large plot of land supported by high class roads.

Considering these factors, it is ideal to reserve large area in the city for industrial use along the outer ring road and other arterial roads wherever applicable. The adjacent area of planned Kamali industrial park can be allocated as industrial use for this reason.

#### 2) Strategic and balanced allocation of industrial land

Another factor of assigning industrial area is to help promote economically self-sufficient urban enclaves. For this reason adjacent areas of existing factories are designated as industrial use in the land use plan, in order to promote accumulation of industrial activities. Conditions of surrounding areas are the key determinants for setting of the boundary. These determinants include land gradient, accessibility from existing and planned arterial roads, and existence of large settlement in the downstream area.

Effective utilization of the industrial area in the north of the Kabul airport is also proposed. The area is currently used for construction materials industries, but the operation is not so active. Introduction of appropriate sub-sectors such as pharmaceutical industries may be an option in order to utilize the function of the airport.

## 4.4.5 Strategies for parks and open space development

### (1) Parks and greenery

#### Existing conditions

Parks and greenery are indispensable space for raising the level of amenity of a city. Established as an oasis city, green open space and its landscape had been an important factor for the identity of Kabul City. Presently there are 38 parks; one women's park and 14 sports grounds in Kabul City. Among the 38 parks, nine are categorized as the large park to be used by people city-wide. Table 4.8 shows the list of existing large parks.

**Table 4.8: Existing Large Parks in Kabul**

Name	Size
Shar-e-naw	6ha
Wazir Akbarkhan	1ha
Khair Khana	8ha
Muqabil Silo	4ha
Karte Se	5ha
Chamchamast	1ha
Zarnigar	5ha
Azadi	10ha "Independent Park"
Tapa Bibi Mahru	N.A.

Source: The Greenery Department, Kabul Municipality

There are three more large parks which are under construction as follows:

- Bagrami Park (152.5ha), District 12;
- Tapa Paghman (143.6ha), District 16; and
- Park Jahan (70.8ha, to be developed as an international park).

In addition, there are small parks and roundabout greenery (4,046.8m<sup>2</sup>) currently under construction. Many trees have been planted totaling 646,326 trees including 450,000 planted in 2010.

The total park area is estimated to be 750ha which is significantly small in terms of per capita park space, compared to major cities in the world as shown in Table 4.9 below.

**Table 7.9: Par Capita Park Space in Various Cities**

	Year	Par Capita Park Area (m2)
Kabul	2010	1.8
Tokyo	1999	5.3
Seoul	1998	14.9
New York	1997	23.2
Paris	-	10.2
Berlin	1998	29.5
Moscow	1998	7.3

#### Directions and strategies

Construction of parks and green space is an important factor to raise the level of amenity for the urban lives of Kabul City. It is also important in the view point to regain the identity of the oasis city. In order to increase the green space in a fast growing population, it is necessary to combine various areas for recreational use. The following are key areas for greening and development of parks.

- Securing of additional land for development of parks

New park areas for city level need to be designated in the land use plan. In the land use plan of this master plan, 2,309 ha of land are designated as park and green area, including the existing ones. Several large blocks which are currently vacant, but not suitable for creation of sub-centers are designated for multipurpose city parks in the land use plan.



In addition, it is proposed that 60% of the areas designated as sub-centers will be used as parks which is open to the public. By adding this, another 464 ha can be counted as the park area. Combining them 2,773 ha will be secured as large scale open space, corresponding to 4.6 m<sup>2</sup>/person. Further provision of green space can be made by converting/utilizing the grave yard areas for multi-purpose use.

For the community level parks and play grounds, it is necessary to secure land in the course of upgrading of the informal settlements, especially at the planning stage with participation of residents. If targeting the per capita open space to be 6 m<sup>2</sup>/person, around 62 ha of land needs to be assigned in the community level land use plan. This will call for securing of 4.13 ha annually.

## 2) Creation of business area with open gardens

It is desired to open the gardens in the government offices, once security situation become allowable. Relocation of some government facilities will be pursued to convert gardens to public parks. The sub-centers are to be designed open to the public. This kind of parks can be used for several purposes including holding of events and for the animal market at the end of Ramadan.

## 3) Greening of open spaces

There are open spaces which are not suitable for building use. These areas include: river sides, mountains and hillsides, and grave yards. Greening of these areas needs to be pursued as described below:

- River side and other water front areas are first priority to increase green space in the city as soil is relatively wet and groundwater level is close to the surface.
- Mountain foots in the central area will be planted to regain the icon of the oasis city. The work will be started from the side of shekargah-e-Shah Shahid to the direction of Takht-e-Shah Mountain. Planting of the side of Aasmaie Mountain will be more symbolic but it has to follow the pace of relocation of residents examined above.
- Mountain top of the northern end of the city will be planted as wind break forest. As it is hard to bring water to this area at this moment, the priority is rather low. The south side foot of this mountain is largely covered by informal settlements on the steep slope, which is subject to relocation in the long term. Similar to the case of Aasmaie Mountain, the leveled land after relocation of houses will be planted.

## (2) Grave yards

### Existing conditions

Provision of grave yards is another serious concern in Kabul City. The available land for grave yard is beginning to be short in some areas, and sometimes causing conflict between communities. The Third Kabul Master Plan has reserved 260 ha of land for grave yard. Applying the same unit land area for one person, the land requirement for the population of 6.3 million in 2025 would be 815 ha by a very simple estimation. The balance of land for grave yard is calculated adopting the following conditions:

- The annual population growth rate for the past 30 years is assumed to be 4%. By applying this, the population in 1978 can be calculated to be 1.3 million;
- The death rate is assumed to be 20/1000 referring to the results of the household survey conducted by the ICT team. The birth rate was around 45.7 in 2008 from the same survey;

- The unit land requirement for one person was assumed to be 2.6 m<sup>2</sup>; and
- Reuse of grave yard becomes possible after 30 years.

The existing area of land for grave yard was 515 ha in 2008 according to the GIS database. The surplus in 2008 might have been around 100 ha, but will disappear in 2013. The total requirement will be 845 ha in which around 330 ha need to be newly supplied. Table 4.10 shows the major indices and balance of available land for grave yards.

**Table 4.10: Estimated Land Requirement for Grave Yard**

Index	Unit	2010	2015	2020	2025
Population	1,000.0	4,596.2	5,392.4	5,920.7	6,270.8
Natural Growth Rate	%/year	2.5	2.5	2.4	2.2
Birth Rate	birth/1000	45.0	45.0	44.0	41.5
Death Rate	death/1000	20.0	20.0	20.0	20.0
Number of Death	1,000.0	92.0	108.0	118.0	125.0
Unit Land Demand	m <sup>2</sup> /death	2.6	2.6	2.6	2.6
Land Demand	ha	23.5	27.5	30.1	31.9
Existing Grave Yard	ha	515.1	515.1	515.1	515.1
Available New Grave Yard	ha	78.2	-41.7	-171.2	-303.5
Available Grave Yard by Reuse	ha	0.7	2.0	3.7	5.7
Available Grave Yard in Total	ha	78.9	-39.7	-167.5	-297.8
Remaining Grave Yard	ha	55.4	-67.2	-197.6	-329.7

#### Directions and strategies

New area for grave yard needs to be designated in the land use plan. In the land use plan, grave yards are basically designated outside the urban growth boundary. The land area assigned for the grave yard is well beyond the above calculated requirement, because it is assumed that the grave yard will be developed together with the green park as suggested by the Greenery Department of the Kabul Municipality. The existing grave yards in the inner city area will be converted to greenery, although the time and location of availability is not predictable.

### **4.4.6 Strategies for land development of public facilities**

#### Conditions

Public facilities include various kinds. These are generally planned in terms of population based standards. In the planned development of residential estate, land plots for public facilities are reserved as a condition for development permission. In the spontaneous development areas, responsible authority would purchase the land for construction of facilities.

Most of the responsible bodies for the development of social infrastructure are branch offices of line ministries. However, the Kabul Municipality is basically responsible to provide land for these facilities. In many cases, standards and norms for provision of social infrastructure have not been established in most of the responsible organizations. ICT team attempted to propose norms for social infrastructure development from the neighborhood scale to the city wide scale.

#### Directions and strategies

Directions and strategies are common for various public facilities. The city level facilities will be located in the sub-center areas, while lands for community level facilities are to be secured in the planning of community level land use plan to be formulated through participation of residents. For the latter, the formal settlements have already reserved land plots according the planning norms associated in standard for detail plan.

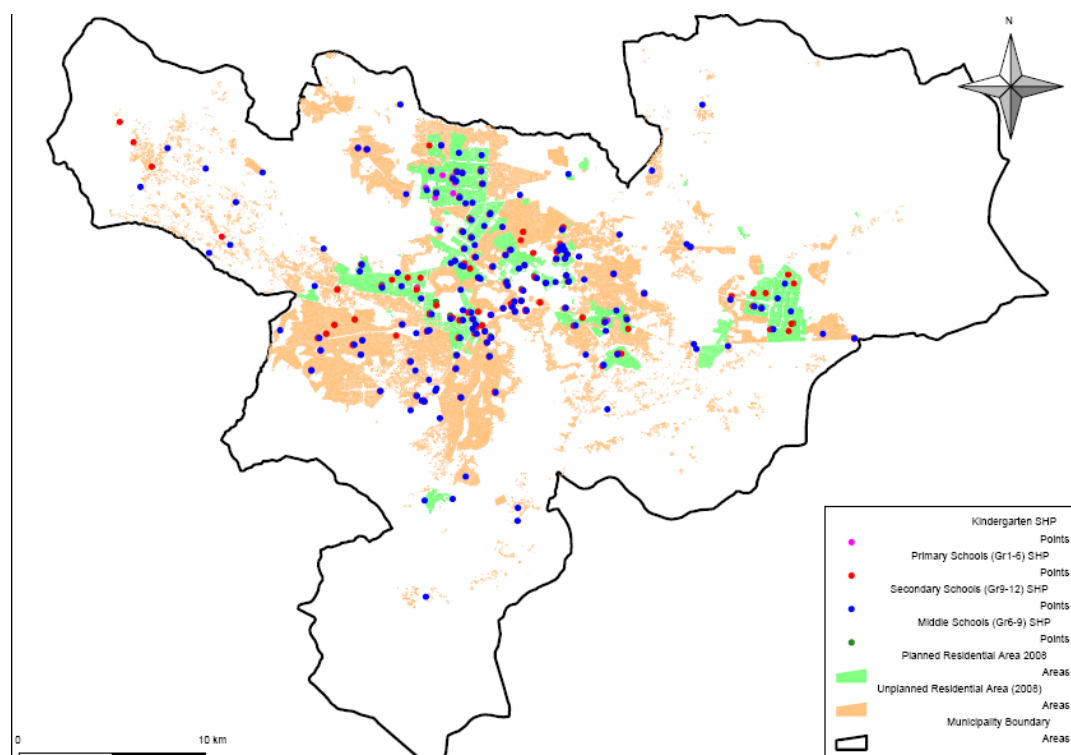
Although there is a priority in the implementation of upgrading projects in the informal settlements, allocation or acquisition of land plots for public facilities may be carried out prior to the implementation schedule as some of the facilities are critical for the lives of residents. Pace of

provision by the responsible organizations needs to be shared among all the municipal staff in charge of upgrading of informal settlements.

Following are existing conditions, basic national policies, and level of land requirement by public facilities.

### (1) Education facilities

There is no complete data available on existing educational facilities. By combining several data sources, distribution pattern of the educational facilities are depicted as shown in Figure 4.21. It is observed that the education facilities are distributed more densely to the formal residential areas.



Source: Education Management Information System, MoE,  
ICT Team GIS database

**Figure 4.21: Distribution of Educational Facilities in Kabul City**

In the education sector, the ANDS presents the basic government policy as follows.

The provision of basic education and reducing illiteracy will remain the top priority for the Government throughout the life of the ANDS. The Government is committed to implement the priority programs endorsed in the National Education Strategic Plan, including: (i) general education (targeting a 60% and 75% enrollment rate for girls and boys, respectively), (ii) improved teacher education and working conditions, (iii) education infrastructure rehabilitation and development, (iv) curriculum development and learning materials, (v) Islamic education, (vi) technical and vocational education and training, (vii) literacy and non-formal education, and (viii) reform and development of education administration.

By applying the standard for educational facilities development, the land requirement by educational facilities are estimated as shown in Table 4.11

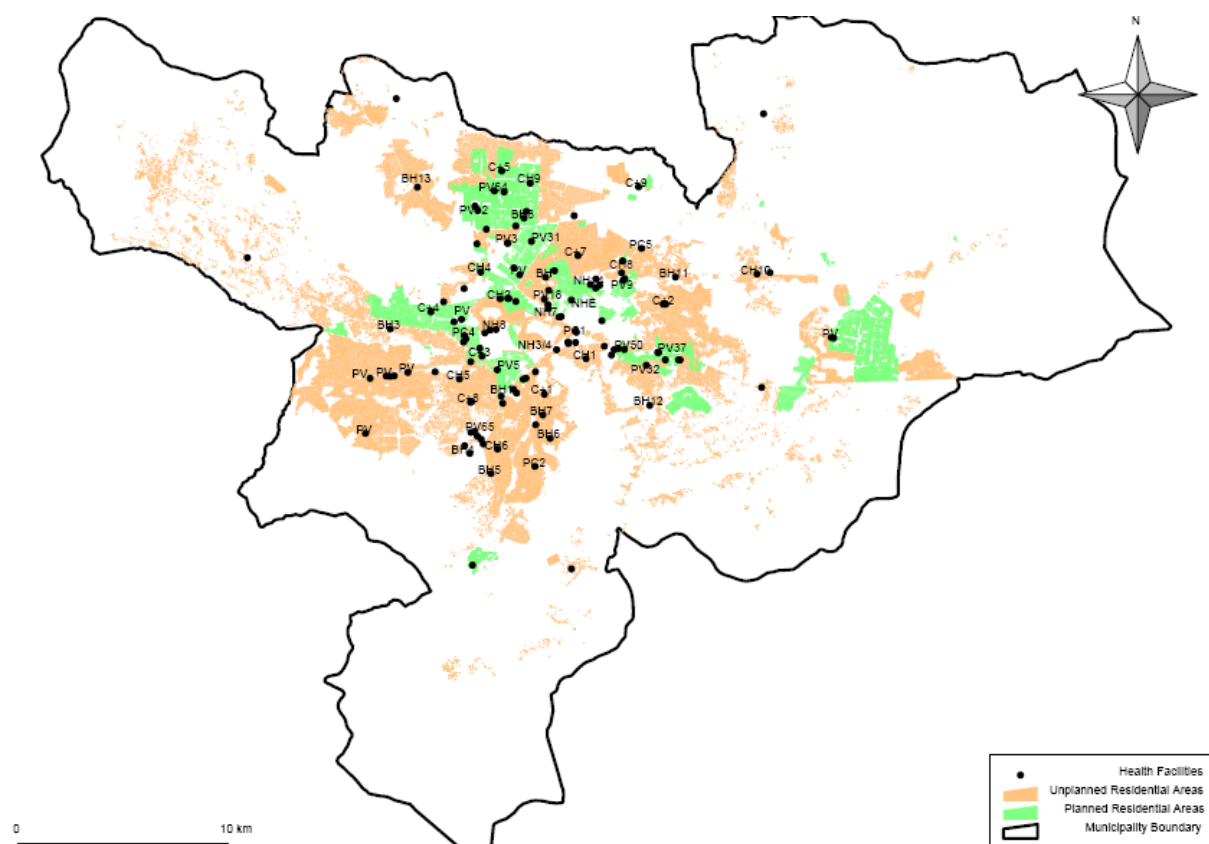
**Table 4.11: Land Requirement for Educational Facilities for 2025**

	Type of Facility	Area Per Unit in sqm.	Standard per Population	No of Services Required	Total Area Required in Ha
1	Kindergarten/Nursery School	400	5000	1,240	49.7
2	Primary School	3000	15000	413	124.1
3	Secondary School	6000	15000	413	248.2
4	High School	8000	15000	413	330.4
5	Management Training / Teachers Training Institute/ Polytechnic	4000	500000	12	4.7
6	School for Mentally Challenged	2000	250000	25	4.7
7	School for Physically Challenged	2000	250000	25	4.7
8	General College	50000	500000	12	62.0
9	Nursing and Paramedic Institute	2000	1000000	6	1.6
10	University Campus	400000	citylevel	3	120.0
11	Medical college cum Hospital	400000	citylevel	3	120.0
12	Engineering College (polytechnic)	400000	citylevel	3	120.0
13	Research Institute	150000	citylevel	1	15.0
14	Police Training College	50000	citylevel	1	5.0
15	Fire Training Institute	50000	citylevel	1	5.0
16	Veterinary Institute	50000	citylevel	1	5.0
	Total			2,572	1,220.1

Source: ICT Team, modified by Planning Team by using the population framework of this master plan

## (2) Health facilities

There is no complete data available on existing health facilities. By combining several data sources, distribution pattern of the educational facilities are depicted as shown in Figure 4.22. It is observed that the health facilities are less evenly distributed to the informal residential areas, compared to educational facilities.



Source Ministry of Health

**Figure 4.22: Distribution of Health Facilities**

In the health sector, the ANDS presents the basic Government policy as follows.

The overarching priority of the health sector is to address priority health issues through a universal coverage of a “basic package of health services”.... Specifically, the Government will focus on strengthening reproductive health services, particularly in the areas of safe motherhood and family planning, improving nutritional status of mothers and children, and controlling communicable diseases, recognizing their adverse impact on the health of all Afghans. To support these health interventions, the Government has developed a comprehensive program of institutional development for health services, designed to organize, manage and monitor the national health system to reduce inequity and improve efficiency, effectiveness, quality of care and accountability at all levels.

By applying the standard for health facilities development, the land requirement by health facilities are estimated as shown in Table 4.12

**Table 4.12: Land Requirement for Health Facilities for 2025**

	Type of Facility	Area Per Unit in Sqm.	Standard per Population	No of Services Required	Total Area Required in Ha
1	Basic Health Center	1000	15000	413	41.3
2	Comprehensive Health Center (100200 beds)	10000	100000	62	61.9
3	Family Welfare Center	2000	100000	62	12.4
	Pediatric Center		100000	62	0.0
	Geriatric Center		100000	62	0.0
	Diagnostic Center		100000	62	0.0
4	Maternity Home (50 beds each)	1500	50000	124	18.6
5	Nursing Home/Polyclinic (50 beds each)	1500	50000	124	18.6
6	District Hospital	30000	500000	12	37.1
7	Veterinary Hospital	2000	500000	12	2.5
8	Care Centre for Physically & Mentally Challenged	1000	500000	12	1.2
9	Nursing and Paramedic Institute	20000	1000000	6	12.4
10	Medical College cum Hospital	400000	1000000	6	248.0
11	National Hospital	400000	1000000	6	248.0
12	Communicable Disease Hospital	50000	1000000	6	31.0
13	Mentally Challenged Hospital	50000	1000000	6	31.0
	Total			1,037	764.0

Source: ICT Team, modified by Planning Team by using the population framework of this master plan

### (3) Other public facilities

Other public facilities include religious, security, sports and culture, and social welfare functions. The standard by ICT team was applied for calculation of land requirement for selected facilities which do not overlap with those proposed in other parts of this master plan. The results are shown in Table 4.13.

**Table 4.13: Land Requirement by Other Socio-Cultural Facilities for 2025**

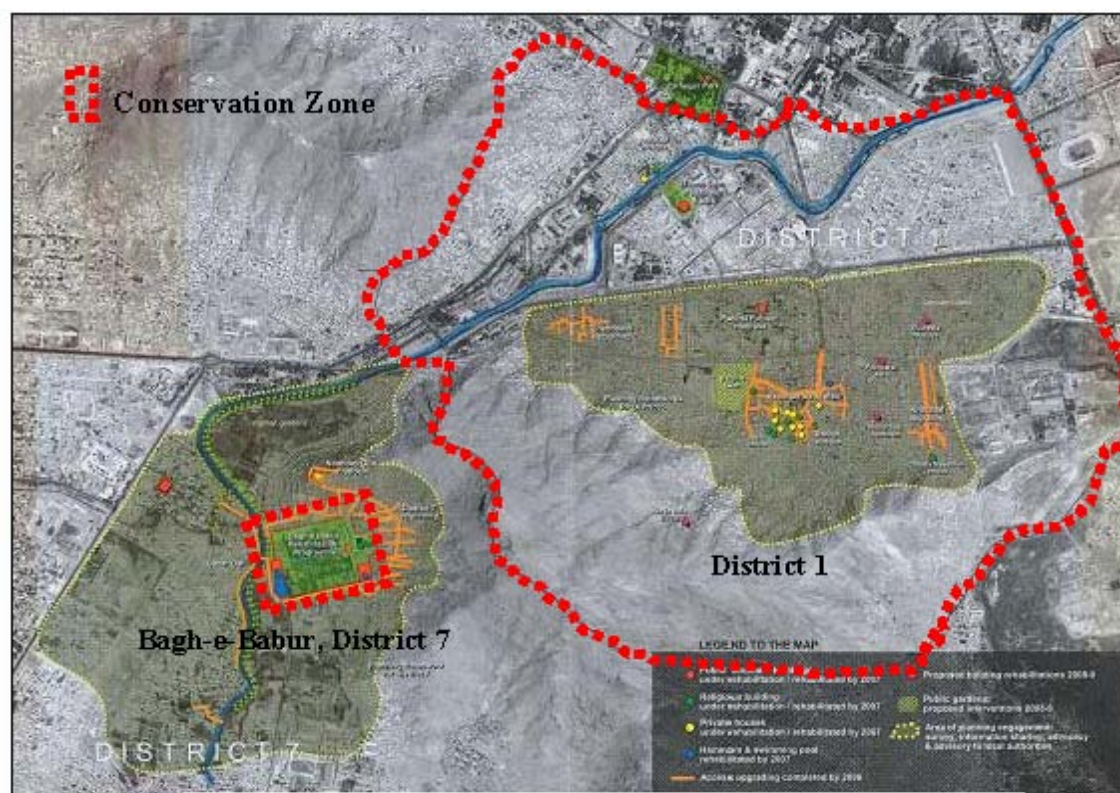
	Facilities	Area Per Unit in Sqm	Standard per Population	No of Services Required	Total Area Required in Ha
1	Religious Building	400	7500	827	33.1
3	Community Hall/Marriage Hal	1500	15000	413	61.9
6	Police Post	1000	100000	62	6.2
7	Community Recreational Club	1500	100000	62	9.3
8	Auditorium	1000	100000	62	6.2
9	Multipurpose Community Hall (Marriage, Public Gathering, Restaurant/Eating Joint, Library, Gym etc.)	1500	100000	62	9.3
13	Police Station	10000	500000	12.4	12.4
14	Old Age Home	1000	500000	12.4	1.2

	Facilities	Area Per Unit in Sqm	Standard per Population	No of Services Required	Total Area Required in Ha
15	Care centre for Physically & Mentally challenged	1000	500000	12.4	1.2
17	Orphan Age/Children Centre/Destitute Home	2000	500000	12.4	2.5
23	Fire Station	20000	1000000	6.2	12.4
24	Disaster Management Center	10000	1000000	6.2	6.2
25	Police Lines	300000	City Level	1	30.0
26	City Jail	400000	City Level	1	40.0
29	Slaughter House	30000	City Level	3	12.0
30	International Convention centre	500000	City Level	1	50.0
31	Religious centre	40000	City Level	1	4.0
33	Exhibition Center	200000	City Level	1	20.0
Total				1,558	317.9

Source: ICT Team, modified by Planning Team by using the population framework of this master plan

#### 4.4.7 Strategies for conservation of historical areas

Presently several areas in Kabul City are designated as heritage area because of their distinct historical and architectural characteristics. These conservation areas are mainly situated in and around the Old City area (district 1 and part of district 2). The MoUDA has clarified a heritage conservation zone covering these historical areas as shown in Figure 4.23.



Source: MoUDA

**Figure 4.23: Heritage Conservation Zone by MoUDA**

Table 4.14 shows an inventory of historical buildings in Kabul City. Many of heritage buildings are ignored and no mechanism is provided for restoration. The ICT team pointed out that “Area around Duraluaman Palace is one of the best example of negligence, as considerable informal settlements have taken place in the surrounding area. Similarly new high rise modern buildings are being built in districts 1, 2, 4 and 7 which spoil the whole ambience.” In the past, Kabul had a reputation for its beautiful landscape and many tourist destinations which attracted international tourists. By the continued conflicts, a large number of historical buildings were damaged or even destroyed.

**Table 4.14: List of Kabul City Heritage**

Number	Heritage Buildings/ Monuments	Year of Construction	Location
1	Shahi Doo Shamshirg Pilgrimage and Mosque	1306	Andrabi Road
2	Temorshah Sharin	-	Temorshahi Road
3	Tamem ansar Sharin	1237	Shuhada Saleheen
4	Chahardu Masum Sharin	1266	Old city
5	Shad shahid Sharin	1183	Shah Shahid
6	Sayeed Mehdi Sharin	947	Wazer Akber Khan
7	Kuaja Ishaq Sharin	-	Deh Afghanan
8	King Ship Palace	-	Presidential palace
9	Arthur Bridge	1303	Arthal Bridge
10	Amir Abul Rahman Grave	1324	Zarnegar park
11	Khawond wali sharin	832	Pahave of Communication
12	Maiwan Tawar	1337	Sare chauk Kabul
13	Eidgah Mosque	1275	Pule Mahmud Khan
14	Choob Froshi Mosque	1262	Kabul old city
15	Ulya Mosque	-	Kabul old city
16	Bala Hesar	1312	Bala nesar
17	Kabul Walles	-	Shirdarwaza mountain
18	Isteqlal tower	1298	Infront of Arg
19	Ilmo Sehil tower	1304	Nawabad dehmazang
20	Abdul Wakil tower	1309	Dehmazang Chowk
21	Saedul Morsalin Sharin	935	Chidawol
22	26 Shahid Pilgrimage	1296	In front of Areana Hotel
23	Pire Akram tower	1262	Baghe Oaze
24	Khoja Safa	1223	In Shirdarwaza mountain
25	Babay Khode	-	Forushga
26	Ali Malang Sharin	1229	Chihelston
27	Chihel ston tower	1328	Chihelston
28	Sakhe sharin	1324	Karte Sakhe
29	Jamaludin Afghny Tomb	1340	Kabul University
30	Shahrara tower	1895	Shahrar Tower
31	Bibi Mahro	-	Bibi Mahro
32	Ashogan Arihan	1226	Ashogan Arihan
33	Shahid tower	1296	Qala Fatula Shahid Stop
34	Bagh Bala Building	-	Bagh Bala
35	Bagh Babar	-	Gozar Gah
36	Marangh Hill	-	Shah Shahid
37	Molamahmod Mosque	-	Shor Bazar
38	3 Dokah Mosque	-	Chindawal
39	Godary Mosque	-	Old City of Kabul
40	Hazrat Mosque	-	Old City of Kabul
41	Paraneh street Bathroom	-	Old City of Kabul
42	Chil stone Palace	1328	Chilston
43	Houses of old city	-	Kabul Old City
44	Soltan Mtilae Heritage	-	Shah shahid
45	Kamary and shewaki hills	-	Sheuaki and Kamary
46	Tajbik Palace	-	Darul Aman
47	Shikh sadudin Ansar Sharin	1182	Deh sabz



Number	Heritage Buildings/ Monuments	Year of Construction	Location
48	North East of Sekandar Hill	-	
49	Bahrmudin Shahid School	-	Nowabad Dehmajang
50	Tawos Pilgrimage	-	
51	Chakary tower	-	Kabul Chakary
52	Kabul military press	-	
53	National Arshif	-	Salang Watt
54	9 Burja (9 Tower)	-	Chihel Ston
55	Malika palace	-	Baghe Babur
56	Baghban Bashe Mosque	-	Malik Asghar Charahy
57	Poli Sokhta	-	District 5

Source: Department for the Preservation of Historic Monuments, Ministry of Culture & Youth

### (1) Strategies for conservation and development of Old City

#### Existing conditions

The Old City is the origin of Kabul City. There are many heritages situated in and around the Old City area. It is the heart of the identity of Kabul City and its residents, along with natural features including the Kabul River and Aasmaie Mountain. Since the establishment of this area, many buildings area demolished and the resident families have changed along with the time sequence. The area was severely damaged during the Mujahideen time, and there are number of vacant land plots these days.

The existence of many vacant plots in the area is not due to stagnation of economic and other activities of the Old City. In fact, the Old City is the most active commercial area in Kabul today. Because of the high potential for commercial use, the land price of this area has soared and speculation taken place. Owners of these vacant lands are living abroad and seeking for opportunity to take transaction and/or development of the land, by leaving it without any utilization.

#### Ongoing efforts

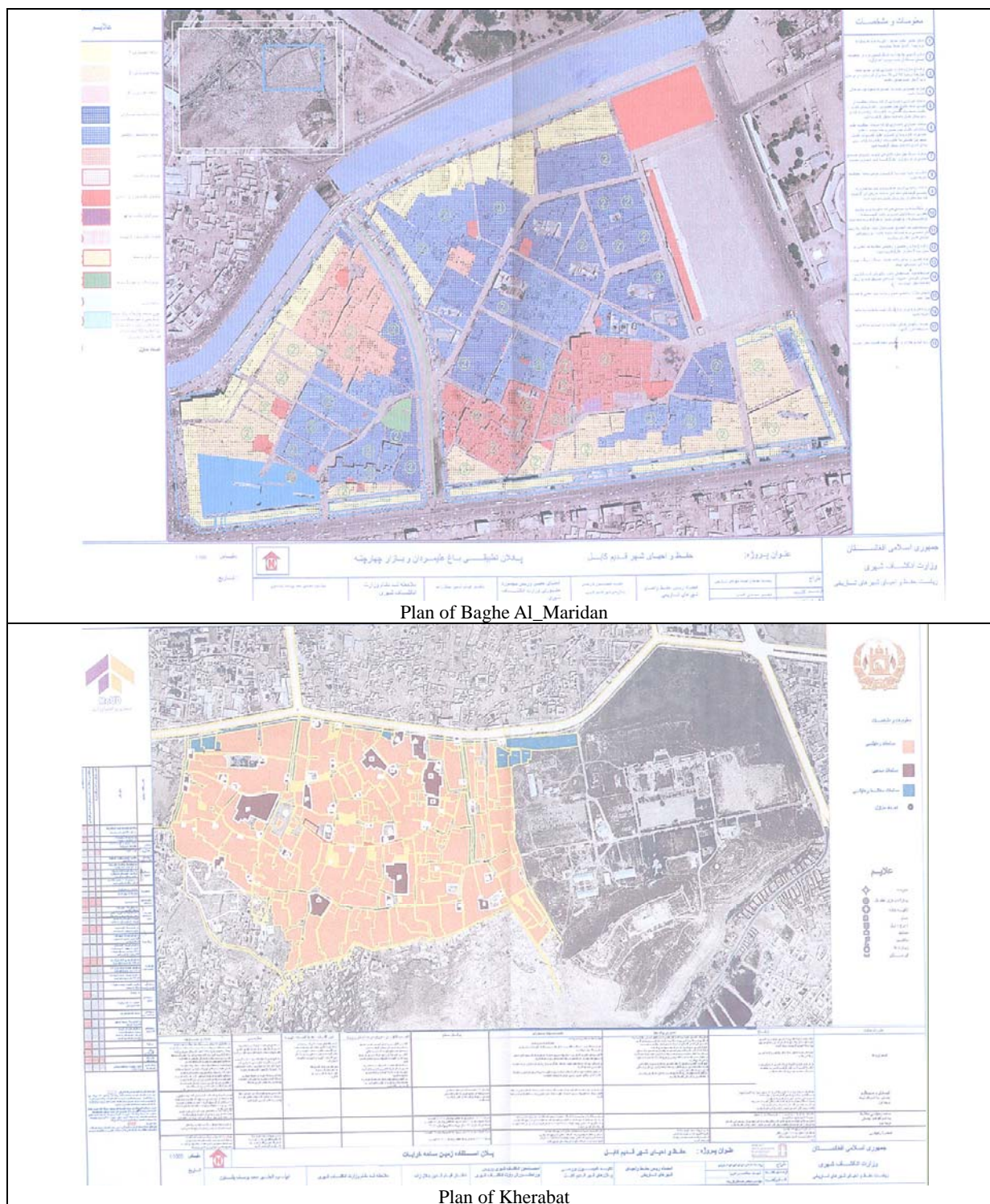
In the Old City area, there are two NGOs actively making efforts related to conservation of heritage:

One is the Aga Khan Trust for Culture (AKTC), which is mostly working in District 1. The goal of AKTC's work in the Old City is to support recovery and promote an appropriate form of development, through safeguarding the historic fabric and improving the living conditions and livelihoods of residents. It is working in close collaboration with community, the Kabul Municipality, the Department for Historic Cities, MoUDA, the Department for the Preservation of Historic Monuments of the Ministry of Culture & Youth, and the Ministry of Haj & Awqaf.

Another important actor in the Old City area is the Turquoise Mountain Trust, which is mostly working in District 2. It has three primary programs: i) education, ii) urban regeneration, and iii) Business Development. Under the three programs it has established the Institute for Afghan Arts and Architecture, which comprises Schools of Woodworking, Calligraphy & Painting, Ceramics and Jewellery & Gem-Cutting, rebuilt homes, laid infrastructure, preserved historic buildings and opened a school and clinic. It is also successful in development of business in the area by selling traditional Afghan arts and crafts in the nation and abroad.

There are meetings regularly held every Wednesday, attended by residents, NGOs, and government representatives including the Municipality. Along with the course of discussion in this regular meeting, the MoUDA has formulated several community level land use plans which are to show the direction of development with heritage conservation in the area, as well as to regulate building construction activities on land plots. Figure 4.24 shows drawings prepared by MoUDA.

Although the legal position of these plans have not fully agreed by authorities concerned, the municipality has been providing guidance for construction of buildings based on these drawings, whenever inquired. These plans, along with the process of formulation, can be recognized as good models of community level land use planning to be prepared in informal settlement areas.



Source: MoUDA

**Figure 4.24: Example of Community Level Land Use Plan in Old City**

### Directions and strategies

In the Old City area, community level land use plans were formulated through participation of residents and a number of stakeholders. From the view points of establishing a new system to upgrade informal settlements, the municipality needs to continue participation to the regular meeting and elaborate the procedure of permission system. Those plans by MoUDA need to be fully respected as they were formulated through such participatory process. At the same time, there is a possibility of overestimating the commercial development potential, when plans are formulated by residents' initiative. This would happen when macro perspective is not efficiently provided by the government side. Because of the lack of master plan in the city, position of the Old City in the future shape of the city has not been imaginable even for the staff of the municipality. On the process of the development of the Old City, it will be required to guide accumulation of suitable functions for appropriate amount taking the change of the position and character of the Old City in the entire city into consideration.

#### 1) Formation of distinctive commercial area

The Old City is now the main commercial area which attracts customers from all the city area. However, the trend of shopping activities of the citizens will change in the future, when commercial centers are established along the trunk roads. The motorization of the city will about to come which will change the preference of shopping areas from the busy crowded area to a convenient road side area equipped with large size car parking. The Old City needs to seek formation of distinctive commercial area, rather than competing with these road side commercial centers.

The Old City has a large potential to be a tourism center of Kabul City. Located in the heart of the city, the Old City has a good access to major tourist attractions in and around Kabul City. The area of the Old City itself is a major tourist attraction. This fact is a critically important point for pursuing the distinctive accumulation of commercial functions in the Old City area. The development of the Old City needs to be pursued in line with tourism infrastructure development.

Type of commodities also needs to be shifted from general goods for everyday use to more value added ones. This will be achieved by the merchants and shop owners by themselves through the market mechanism. The Old City area in the future may be a shopping area known for high quality Afghan traditional goods gathered from all over the country, as will as those manufactured inside the area. Those human based technical know-how for production of traditional goods gained through restoration of heritages seems to be indispensable asset of the town.

#### 2) Pedestrian friendly development

In the Old City it is important to seek development of a pedestrian oriented commercial area, which is in the same line with the requirement for tourism infrastructure development. The area is now a major through point for crossing Aasmaie Mountain to/from the large urban areas in the north and in the southwest. The Old City has enjoyed this location owing to the large number of traffic on the main road crossing the area. This over reliance to the car traffic has to be diminished as a transport policy. It needs to be replaced to a pedestrian oriented traffic pattern supported by gradual introduction of modern public transport systems. This will be enabled by development of ring road and other trunk roads, which provide longer-distance traffic route connecting major urban enclaves each other.

The enhanced bus transport and new public transport system will be introduced centering on the improvement of concentration of traffic to the city center area. The Old City will be focused as one of the most important nodes for these public transport systems. The Old City will be directly connected to Kabul International Airport by public transport as it is very important to attract international tourists. The public transportation mode will change

starting from large buses to BRT and then LRT, according to the sequence of time as described in Chapter 5.

To ensure access by large tour buses, it is necessary to develop bus parking area at the both end of the Old City area to the northeast and southwest. Although those large tour packages will prefer modern hotels located in the business area of the city, package tour tourists are potentially important segment of customers for the shops in the Old City. Securing the land for this purpose in the early stage will be helpful as the land can be used to adjust its functions according to the change of the market trend. For instance, the land can be used as public parking for a while, and then converted to a bus parking, then to another function such as exhibition center of traditional goods, when the volume of road traffic decreased and road side become available for bus parking. The location of the bus parking area may be determined by the regular meeting

## **(2) Strategies for conservation of other heritage**

The importance of heritage conservation is more widely recognized in Kabul City compared to only several years ago. However, it will still require some time to be the mainstream philosophy among the staff related to urban planning and management in both municipal and central government offices. The identity of a city can not be formulated with new developments alone. It is the result of the accumulated past urban activities with layers of new things introduced along with old things maintained.

The old elements of the city may be perceived as inconvenient in general and require more cost for restoration and maintenance. The key for successful conservation of historical heritages is to share the concept of value in having old elements in a city among citizens. In theory, the additional cost required for maintenance of the heritages can be shared by all the citizens by various forms including taxations and donations. This concept is especially helpful if the heritage buildings to be supported are owned by mere residents or families.

While establishment of cost sharing needs to be pursued for restoration and preservation purposes, the awareness among the citizens need to be enhanced for preventing degradation. The following strategy is proposed to conserve and protect heritages in Kabul City.

### **1) Identification of heritages to be conserved**

The basic information needs to be gathered and disseminated. The list of heritages needs to be associated with basic information such as built year and founder, as well as characteristics such as relationship with historical events and the architectural uniqueness. The condition of heritage buildings needs to be assessed and required actions clarified. Required actions include rehabilitation, restoration, and/or alteration. The simple demolition needs to be prohibited.

### **2) Clarification of heritages for rehabilitation**

The level of restoration and/or rehabilitation also needs to be identified to provide clear view for owners including government institutions. Decisions have to be made on whether original materials and design of ornaments will be adopted or replaced by available ones. While this requires highly cultural considerations by experts, the opinion of citizens also needs to be inquired.

### **3) Readjustment of ownership**

In case, the heritage is under use for different purposes from the original function, the change of ownership may be necessary. If the heritage is under government body, the ownership and responsibility of its restoration/maintenance need to be adjusted. If the owner is an individual or a private enterprise, their will and ability of restoration/maintenance need to be confirmed. An exchange or acquisition of the property may be considered if necessary.

## 4.5 Formulation of Land Use Plan

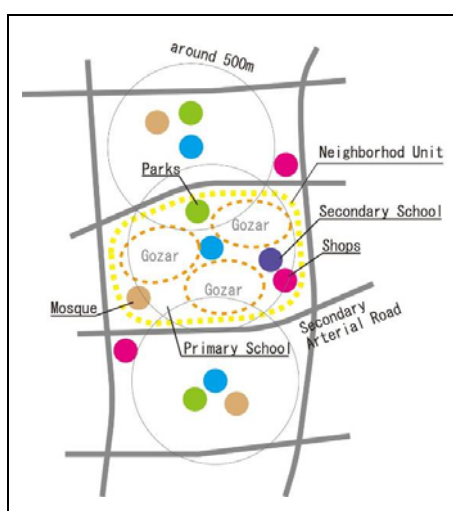
The land use plan is formulated corresponding to the factors discussed in previous sub-sections. The future road network is firstly examined based on the size and shape of neighborhood unit, planned network by the Third Kabul Master Plan, and conditions of existing network with pattern of urban fabric.

### 4.5.1 Road network plan in view of neighborhood unit

#### (1) Setting of neighborhood unit

The concept of neighborhood unit is employed for the planning of road network which will provide the base for land use planning. The major point in the concept of neighborhood unit is to contain functions required for everyday purposes to a unit of a residential area. By doing so, everyday activities of residents can be made without crossing the arterial roads, and thus, safe and quiet living environment will be secured. A neighborhood unit contains community level public facilities such as primary and secondary schools, mosques, playgrounds, and shops for everyday purpose.

Since the Third Kabul Master Plan also adopted the neighborhood unit system, this master plan tried to inherit the size of area and contained population wherever applicable. Consequently a typical neighborhood area is identified as shown in Figure 4.25. It can be characterized by area of 70ha with over 10,000 of population. The shape of a neighborhood unit is defined as enclosed area by existing and/or planned arterial roads.

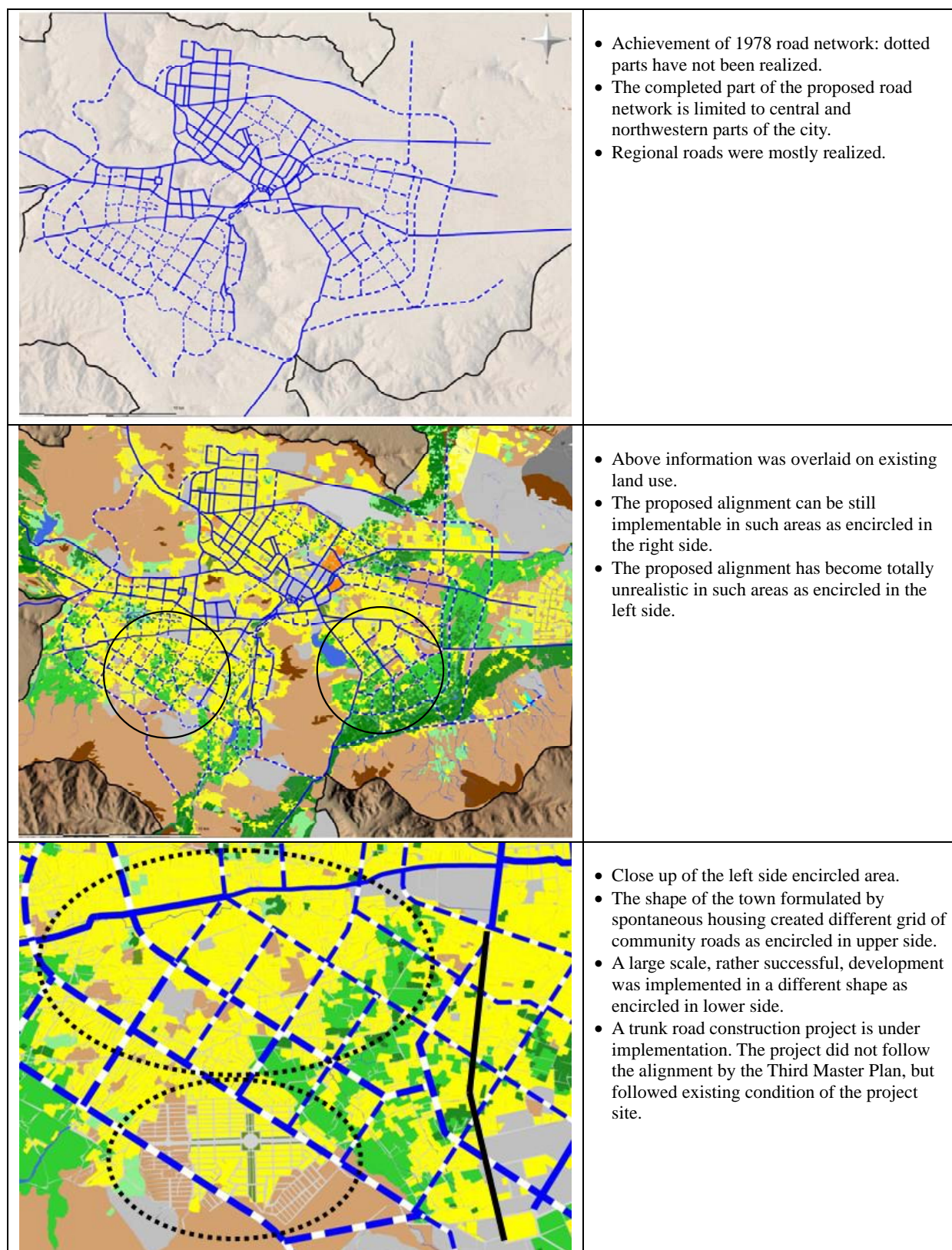


**Figure 4.25: Typical Composition of Neighborhood Unit**

#### (2) Road network planning

The size of neighborhood units in the Third Kabul Master Plan is respected for defining the area of neighborhood units in this master plan. For this purpose, the trunk road network proposed by the Third Master Plan was analyzed and adopted as much as possible. Those trunk roads already constructed are taken as given condition. Alignment of planned but unconstructed roads is also respected if detail plans are prepared on unpopulated areas. As a result, the configuration of the future road network in the southwestern part of the city is largely modified as the area is largely urbanized by spontaneous housing construction, as well as private large housing estate development. Figure 4.26 shows the condition of trunk road network planning reflecting the proposed road network by the Third Kabul Master Plan.





**Figure 4.26: Conditions of Roads Network Proposed by the Third Kabul Master Plan**

## 4.5.2 Setting of land use category

### (1) Scope of land use plan

In this master plan, the land use plan tries to cover several kinds of plans which have different roles and objectives. As a general practice in other countries, different land use plans are formulated for different purposes as listed in Table 4.15:

**Table 4.15: Role and Characteristics of Land Use Plan by Type of Plan**

Type of Plan	Role and Characteristics of Land Use Plan
Urban Master Plan	<u>Role and objective</u> <ul style="list-style-type: none"> <li>• To provide broad vision of future development of a city.</li> </ul> <u>Characteristics</u> <ul style="list-style-type: none"> <li>• Not to control individual building activities</li> <li>• Not combined with legal power</li> <li>• Consisting of broad land use categories only</li> <li>• Urban facilities are not depicted, except for key transport infrastructure, with indicative lines</li> </ul>
Zoning Plan	<u>Role and objective</u> <ul style="list-style-type: none"> <li>• To provide information on accepted building type and shape to the individuals</li> </ul> <u>Characteristics</u> <ul style="list-style-type: none"> <li>• Supported with legal enforcement system</li> <li>• Not suitable to show future vision as it needs to comply with existing situation (because of legal power)</li> <li>• UGB is depicted</li> <li>• Land use categories are defined by laws and/or regulations</li> <li>• Planned city level urban facilities are depicted if already approved</li> </ul>
Community Level Plan	<u>Role and objective</u> <ul style="list-style-type: none"> <li>• To provide information on acceptable building type and shape to the individuals</li> </ul> <u>Characteristics</u> <ul style="list-style-type: none"> <li>• Supported with legal enforcement system</li> <li>• UGB is depicted if it exists in the area</li> <li>• Land use categories are defined by laws and/or regulations</li> <li>• Planned city community level urban facilities are depicted if already approved</li> </ul>

The land use plan in this master plan is to cover the role of the urban master plan with some character of the zoning plan for the following reasons:

- This master plan is to revise the Third Kabul Master Plan to share the renewed future vision among all the concerned, including citizens, private enterprises, various government agencies, international donors, NGOs, etc. The land use plan in this master plan needs to put emphasis on presenting a clear vision rather than corresponding to specific conditions in different areas. A complicated mapping needs to be avoided in this master plan, as it does not aim to control building activities on individual land plot.
- The land use plan of this master plan will have certain legal power as the Third Kabul Master Plan, which is to be replaced by this master plan, had ultimate authority on every land use issues. Thus it is better utilizing this power over the land for restriction and/or protection purposes.
- Lands for some critically important urban facilities need to be clarified and protected from other type of use. These are the city level facilities include trunk roads, large parks, greenery areas, grave yards, and landfill sites. However, the exact boundary of these facilities needs to be clarified by design and/or survey works.



## (2) Land use categories

### Area to be controlled

First, the territory of the Kabul Municipality is divided into two broad categories: one is for urban usage, and the other one is basically not for urban usage. Regarding the latter one, it is further classified into two categories:

- i) Protection area:  
Use of land for building purposes is totally prohibited. This includes a) mountains and hill sides over 30% gradient, b) natural parks, and c) water bodies,
- ii) Restriction area:  
Use of land for urban purposes is prohibited but it is allowed for rural/agricultural purposes. This includes d) the area outside the UGB, and e) groundwater recharge area.

In the restriction area, agricultural activities are rather promoted, and farmers' houses are allowed for building. For households with several income sources, their houses are basically classified as urban usage, and thus prohibited, unless the primary income of the household is depending on agriculture cultivated at nearby farmland.

### Area to be promoted for urbanization

Regarding the promoted area for urbanization, it is further classified into three broad categories according to the urban function, namely: f) residential, g) business and commercial, and h) industrial. These are often sub-divided into more specific categories in zoning plans. For instance, in the zoning system employed in Japan, there are 12 categories in total, among which nine belongs to residential, two to commercial, and three to industrial categories respectively. This detailed categorization is necessary to avoid putting excessive impact over the residents, by classified as unlawful usage and forced for conversion to much the designated land use.

In case of this master plan, only residential function is sub-divided into three more specific categories: f-1) medium-rise high-density, f-2) low-rise medium-density, and f-3) low-rise low-density. This is done because it is necessary to consider the water allocation balance in Kabul City. The night time density is estimated based on the distribution of residential categories for planning of water allocation in Chapter 6. Regarding the business and commercial, and the industrial functions, single category is given for each function in order to promote accumulation of these higher urban functions to designated areas.

It should be noted that the coverage of business and commercial category is different compared to the categorization employed in the Third Kabul Master Plan. In the last master plan, there was a category for government offices, reflecting the philosophy of planned economy. In this master plan, government offices are categorized in business and commercial function, as there is no difference in offices between government and private. Likewise, in the Soviet style land use maps, land for utilities and industrial use often dealt with one category. In this master plan, utilities are regarded as urban facilities which are normally shown in zoning plans but not in land use plan of urban master plans.

### Urban facilities

Some of the major urban facilities need to be depicted in the land use plan, although lands for facilities basically belong to a matter of zoning plans. The city facilities to be depicted in this master plan include i) roads and airport, j) parks and greenery, k) grave yards, l) rivers and main drainage canals, and m) landfills. Although these are shown in the land use map of this master plan, boundaries of these facilities need to be clarified through design and/or survey works. It is especially important to define the ROW of planned roads in order to be practical for control of individual land use activities.

### 4.5.3 Formulation of land use plan

#### (1) Criteria for land use assignment

Conditions and criteria for assignment of land use categories are summarized in Table 4.16.

**Table 4.16: Conditions and Criteria for Assignment of Land Use**

Category	Conditions and Policies of Assignment
<b>Protection Area</b>	
a) Mountain and hill side	<ul style="list-style-type: none"> <li>Mountains and slope of over a gradient of 30%</li> <li>Areas enclosed by steep slope (30%) are considered as mountain</li> </ul>
b) Natural park	<ul style="list-style-type: none"> <li>Catchment area of Kargha Lake inside the UGB</li> </ul>
c) Water body	<ul style="list-style-type: none"> <li>Water surface of existing rivers and lakes on the 2008 SPOT imagery.</li> </ul>
<b>Restriction area</b>	
d) Urbanization control	<ul style="list-style-type: none"> <li>Flat and slope areas under a gradient of 30% outside UGB</li> </ul>
e) Groundwater recharge area	<ul style="list-style-type: none"> <li>Area along the Logal River inside UGB</li> </ul>
<b>Area to be promoted for urbanization</b>	
<b>f) Residential</b>	
f-1) Medium-rise high-density	<ul style="list-style-type: none"> <li>For existing and future apartment and condominium estate</li> <li>Target population density set to 480p/ha</li> <li>Covering existing apartment complexes (Macrorayon and others)</li> <li>New areas set around Sub-centers</li> </ul>
f-2) Low-rise medium-density	<ul style="list-style-type: none"> <li>For existing and future detached housing area</li> <li>Target population density set to 280p/ha</li> <li>Covering existing settlements of both formal and informal inside UGB</li> <li>New areas assigned inside UGB</li> </ul>
f-3) Low-rise Low-density	<ul style="list-style-type: none"> <li>For existing and future detached housing area basically with less water availability</li> <li>Target population density set to 180p/ha</li> <li>Covering existing formal settlements outside UGB and informal settlements in D17 inside UGB</li> <li>New areas assigned in D21 and D22 for no fear of expansion</li> </ul>
g) Business and commercial	<ul style="list-style-type: none"> <li>For areas with dedicated commercial buildings, government buildings incl. government offices, referral hospitals, universities, and other higher urban functions</li> <li>Covering existing city center, commercial areas, university campuses</li> <li>New areas assigned for sub-centers</li> <li>Open space 60%, buildings 20%, parking space 20% for land coverage</li> <li>Average 60% for FAR</li> </ul>
h) Industrial	<ul style="list-style-type: none"> <li>For areas exclusive for Industrial use</li> <li>Covering existing industrial parks</li> <li>New areas along the outer ring road in D13 and D22 for balanced job place</li> <li>Expect manufacturing, distribution industries incl. warehouses, private truck terminals, distribution processing, etc.</li> </ul>
<b>Urban facilities</b>	
i) Transport	<ul style="list-style-type: none"> <li>For existing and planned roads classified as minor arterial road and upper</li> <li>Also covers Kabul Intl. Airport</li> <li>Space reserved according to ROW set in Chap 5.</li> </ul>
j) Parks and greenery	<ul style="list-style-type: none"> <li>For existing and planned city level parks and green space, as well as hills for afforestation</li> <li>New city level parks assigned on large vacant area with catchment area of 2.5 km in radius, 500,000 population, as multi-purpose open space</li> <li>New greenery assigned for hillside for afforestation, existing grave yard, river side and lake side.</li> </ul>
k) Grave yard	<ul style="list-style-type: none"> <li>For grave yard with green open space</li> <li>New grave yard assigned in fringe of each major urban enclave</li> <li>Assign well beyond the demand until 2025 for securing land beyond 2025, and provision of greenery space</li> </ul>
l) Rivers and main drainage canals	<ul style="list-style-type: none"> <li>For rivers and main drainage channels</li> <li>Rivers are practically the same with category c) above</li> <li>Gullies, small tributaries, and irrigation canals are excluded</li> </ul>

Category	Conditions and Policies of Assignment
m) Land fill	<ul style="list-style-type: none"> <li>• For future landfill to start operation before 2025</li> <li>• New areas assigned in east and west ends</li> <li>• Area is much larger than requirement up to 2025</li> <li>• Buffer area is expected inside</li> </ul>

## (2) Drawing style

The drawing style of the Third Kabul Master Plan had a distinguished character reflecting the mechanism of land and buildings development in the planned economy system. The land use category consisted of government offices, medium and low density residential, industrial, infrastructure including land for utilities facilities, parks and greenery, and some protection areas. There was no category for business and/or commercial usage, as these economic activities were recognized as part of government functions. On the other hand, there were drawings of facility development in order to guide the successive works of planning, namely: structure plans and detail plans. The landscape image of these public facilities such as the parliament building, universities, and parks were drawn in the main map of the land use plan. These were often drawn out of scale by emphasizing the philosophy of landscaping, especially for the community level facilities and pedestrian spaces.

These characteristics are useful to transfer ideas to the planners in charge of structure plan and detail plan, but not ideal to instruct individual land owners/users. The municipality, nonetheless, used the Third Master Plan for control of individuals' land use for more than a decade. There have been strong pressures from citizens to provide land for rushing needs such as housing and grave yards. People have requested provision of vacant public land for these purposes. The vacant lands were prepared for public facilities but not yet constructed as originally planned due typically to shortage of fund. The municipality has rejected these requests by showing the map of the Third Master Plan, in which some indicative drawings were presented showing public facility buildings.

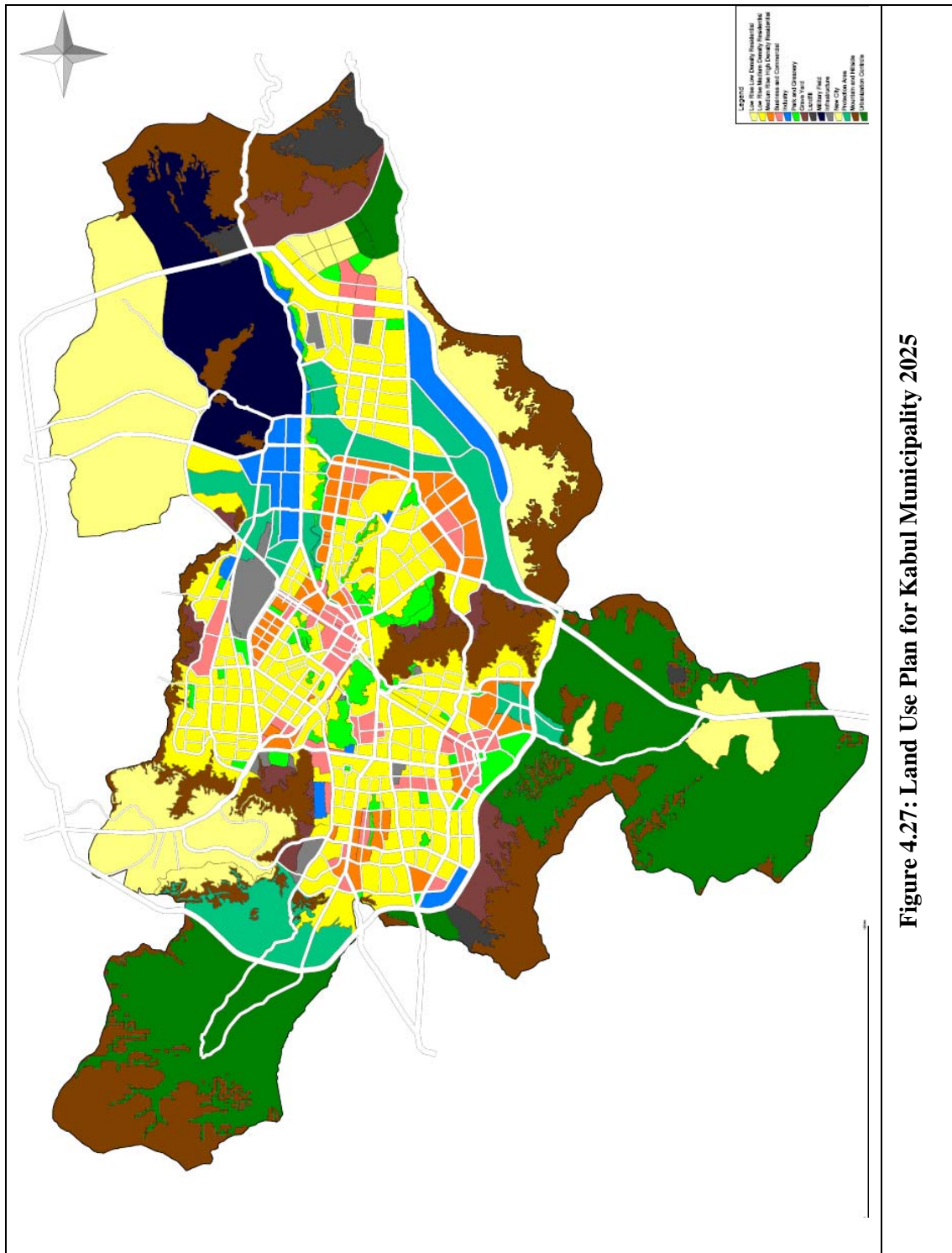
In this master plan, no landscape image is presented in the land use plan, since this would not be suitable for the role of the master plan. Those reserved land for community level public facilities will be secured by preparation of zoning plans with associated regulations. The zoning system needs to be adopted and zoning plans need to be prepared to control the land use of individuals as well as to protect lands for planned public facilities from misuses.

## (3) Land use plan

Figure 4.27 shows proposed land use map drawn based on the criteria described above. Table 4.17 shows composition of land use corresponding to the proposed land use plan.

**Table 4.17: Composition of Proposed Land Use**

Land Use Category	Area (km2)	Share (%)	Land Use Category	Area (km2)	Share (%)
Low Rise Low Density Residential	86	8.4	Grave Yard	30.6	3
Low Rise Medium Density Residential	180.1	17.6	Landfill	16.9	1.6
Medium Rise High Density Residential	33.4	3.3	Mountain and Hillside	178.4	17.4
Business and Commercial	31.5	3.1	New City	75.9	7.4
Industry	28.8	2.8	Military Field	61.1	6
Park and Greenery	23.1	2.3	Protection Area	64.2	6.3
Infrastructure	13.5	1.3	Urbanization Control	199.6	19.5
			<b>Municipality Total</b>	<b>1,023.00</b>	<b>100</b>



## **CHAPTER 5: TRANSPORT INFRASTRUCTURE DEVELOPMENT PLAN**

### **5.1 Existing Condition of Urban Transport Infrastructure**

#### **5.1.1 Overall urban transport needs**

Investment in the road sector of Afghanistan has been stagnated, and construction of new transport infrastructure and their maintenance have been largely neglected. Consequently, most transportation infrastructure has been left deteriorated.

Since 2002, investments by the Government, foreign aids and private funds have started to come in and the regional and national highways including the national ring road connecting Afghan cities and regions were constructed. The national ring road, which was among the early rehabilitated roads, facilitates Afghanistan to link with its neighbors, forming the largest road network in the country to support the national economy. As a result, the rehabilitation works for the inter-regional and national highways connecting Kabul and provincial capitals have been mostly completed.

#### **5.1.2 Transport administration**

There are three organizations responsible for the transport sector in Kabul City:

- 1) The Kabul Municipality:  
is responsible for planning, design, implementation and maintenance of urban transport facilities including streets, bus terminals and others within its territory.
- 2) The Ministry of Public Works (MPW):  
is responsible for planning, design, implementation and maintenance of transport infrastructure including roads and railways. Most transport projects are funded by foreign aids.
- 3) The Ministry of Transport and Civil Aviation (MOTCA):  
is responsible for making transport policies and also administering public transport services for trucks, buses, aviation and others operated under the government management.

In Kabul area, Millie Bus enterprises are operating fleet buses in the city and surrounding areas. These enterprises are publicly owned and funded by the government. Millie Buses have been functioning as a transport entity for the past 40 years in Afghanistan and their capacity have been enhanced by donated vehicles from various countries including Japan and India.

The Ministry of Interior is responsible for commercial and private-use vehicle issues, provision of drivers' license and safety inspections.

#### **5.1.3 National transport system**

The transport sector in Afghanistan is basically composed of three modes: roads, railways and air transport.

##### **(1) Roads**

It is estimated that Afghanistan has a road network of about 135,000 km including rural roads. More than 85% of them are in bad condition, having non-passable segments by motor vehicles.

The regional, national and provincial road networks identified for development include 46,338 km. This excludes the rural roads which are under responsibility of MRRD.

## (2) Railways

Railway links in Afghanistan play important role in the national economy as bulk commodities are brought to country firstly to the borders by rail. These commodities are then transshipped to trucks for movement and distribution to the remaining parts of the country. As rail transport costs of bulk commodities over long distances are typically cheaper than road, extension of railway system is desired. Table 5.1 shows a list of railway projects under various stages.

**Table 5.1: On-going and Proposed Railway Projects**

Project	Stage	Remarks
from Herat to Iran border	Under construction	
from Mazar-e-Sharif to Uzbekistan border (Hayratan)	Under construction	
from Kandahar to Pakistan border (Chaman)	Under Feasibility Study(F/S)	
from Herat to Kandahar	F/S Completed	30 years ago
from Sherkhan to Baghalan to, Bamyan to Kabul and , Jalalabad	Under contract between Afghanistan government and Chinese Company	Copper mine, Coal mine
from Jalalabad to Pakistan border (Torkham)	Under F/S	ADB project
from Sherkhan to Tajikistan border (Ghondo)	F/S Completed	

## (3) Air Transport

Air Transport is another important transport mode in Afghanistan being a landlocked and mountainous country. There are seven cities accommodating airports: Kabul, Kandahar, Jalalabad, Thincot, Bamyan, Herat and Mazar-e Sharif. Among them, two cities have international airports: Kabul International Airport and Kandahar Airport. Others are for domestic services only.

Kabul International Airport is located at the north of the center of the city. There is an idea to construct a new airport in Logar area, south of the city, but not actively discussed as it require significant amount of investment.

### 5.1.4 Road conditions in Kabul City

#### Road network

#### 1) Administrative road classification

Roads in Afghanistan are classified into five types by administrative bodies responsible for them (Table 5.2). Kabul Municipality is responsible for city roads located in its administrative area.

**Table 5.2: Road Type and Responsible Organization**

Road Type	Responsible Organization
Regional Highway	Ministry of Public Work(MPW)
National Highway	Ministry of Public Work(MPW)
Provincial Roads	Ministry of Public Work (MPW)
City Roads	In Kabul City, Kabul Municipality
Rural Roads	Ministry of Rural Road Development (MRRD)

#### 2) Functional road classification

Including those fall in the category of regional and national highways described above, existing roads in Kabul City are classified into the following five categories.

##### a) Main Arterial Roads:

Three regional highways and one national highway radiating from the city center form the main frame of the city road system as well. The carriageways are composed of no less than two lanes, and paved with asphalt concrete.

- b) **Minor Arterial Roads:**  
minor arterial roads supplement the four main arteries to inter-connect districts in the city. Most arterial roads have common names of their own. The carriageways are composed of no less than two lanes and paved with asphalt concrete.
  - c) **Secondary roads:**  
Secondary roads connect communities with the artery roads. They have width of no less than two lanes, and most of them are paved with asphalt concrete.
  - d) **Community roads:**  
Community roads having no less than two lanes and form town blocks. Many of the community roads are not paved and without side drains.
  - e) **Other roads:**  
Other roads are those forming town blocks in areas not designated for use by urban planning. Most of them are narrow unpaved roads often with only one lane, and difficult to distinguish from private roads.
- 3) **Kabul urban road network**

The road network in the city extends in a radial form from the city center to the north, northwest, west, southwest, south and east directions, comprising of national and regional highways and provincial roads as listed in Table 5.3. Of these, all the national and regional highways are paved two-lane roads.

**Table 5.3: Highways and Roads Constituting Kabul City**

Road No.	Section
RH01	Kabul-Kandahar
RH04	Kabul-Puli Khumri
RH05	Kabul-Torkhum
NH08	Kabul- Gardez
PR	Kabul-Bagrami
PR	Kabul-Paghman
PR	Kabul-Paghman
PR	Kabul-Bagram

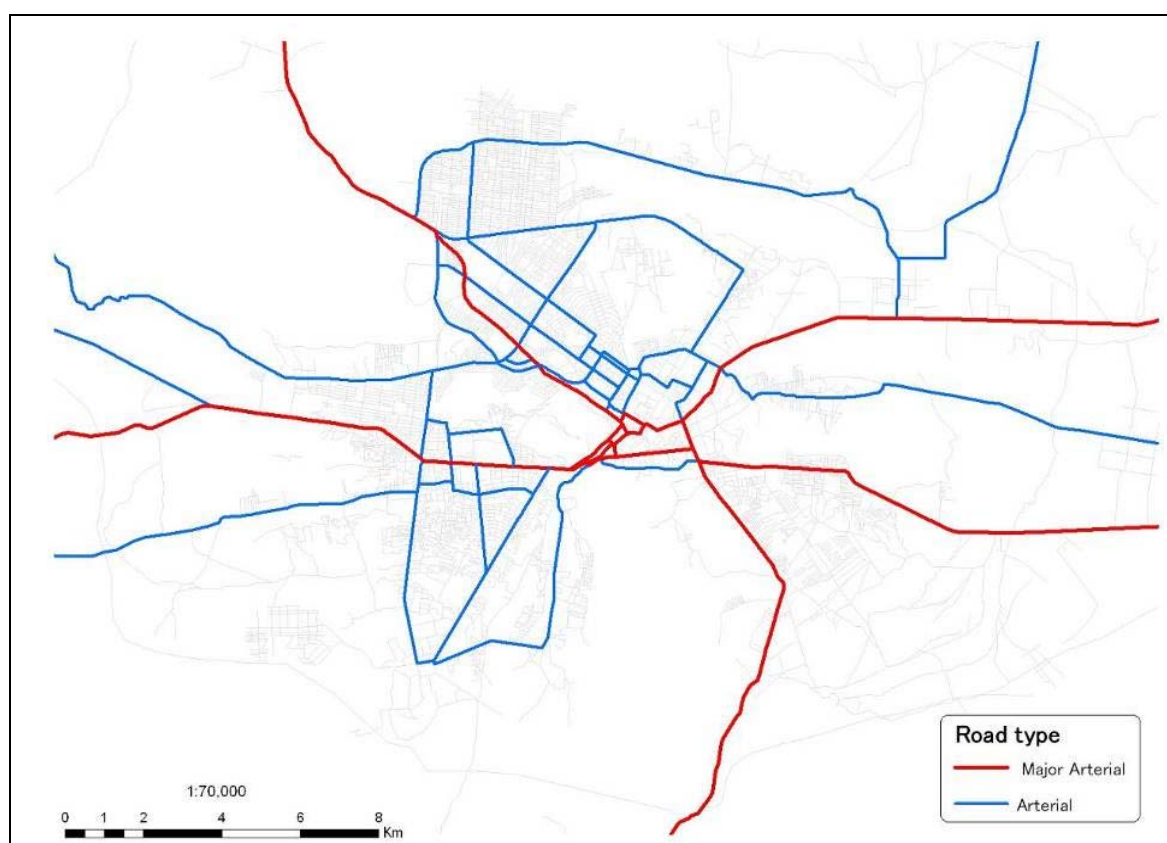
Note: RH=Regional Highway;  
NH=National Highway;  
PR=Provincial Road

The configuration of existing artery road network in Kabul city is shown in Figure 5.1. The total length of the arterial road network is 330.7 km as shown in Table 5.4.

**Table 5.4: Arterial Road Lengths in Kabul City**

Road Type	Length (km)
Major Arterial	137.4
Arterial	193.3
Total	330.7





Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.1: Existing Arterial Road Network Configuration in Kabul City**

*Road length and density by district*

The road length and density in each district of Kabul Municipality by road classification are summarized in Table 5.5. The overall road density varies widely between districts. The lowest is less than  $5.0\text{km/km}^2$  in Districts 17 through 22 in outer areas. Among those districts where planned/formal urban areas are dominant, Districts 6, 9, 12 and 15 have relatively low density, followed by Districts 8 and 16. The density of formal roads except “other roads” also varies widely. The road density is very high in Districts 3, 4, 5, 10, 11 and 15, where medium-rise apartments are dominant. In general, it is low in outer area districts, except for District 18, which is a semi-urban area developed earlier.

**Table 5.5: Road Length and Densities by District in Kabul City**

Dist. No.	Road class					Total	(Unit: km)	
	Main arterial	Arterial	Secondary	Community	Other		Density1 (Km/Km <sup>2</sup> )	Density2 (Km/Km <sup>2</sup> )
1	0.3	3.2	3.3	2.0	67.6	76.3	16.2	2.2
2	6.9	1.8	3.6	17.4	55.1	84.8	12.5	3.3
3	5.6	1.1	9.2	39.9	61.9	117.7	12.1	1.7
4	6.9	12.3	7.0	52.3	125.1	203.6	17.6	3.0
5	18.3	0.7	1.2	97.1	231.5	348.8	12.0	1.0
6	0	19.6	10.1	49.5	322.6	401.8	8.2	0.5
7	0	15.7	5.7	27.4	343.8	392.6	12.1	0.3
8	7.5	11.6	10.4	59.8	400.4	489.7	10.1	0.9
9	10.1	7.2	3.4	23.2	195.7	239.6	9.8	1.1
10	0	14.7	7.3	78.6	121.2	221.8	17.1	1.2
11	1.4	10	2.6	57.9	226.2	298.1	17.1	1.7
12	0.0	19.3	4.8	36.2	285.1	345.4	9.9	0.8
13	0.0	7.5	19.4	58.2	442.7	527.8	11.3	0.6
14	3	24.5	3.0	55.0	239.8	325.3	2.6	0.2
15	0	25.5	5.3	128.3	89.8	248.9	7.8	0.8

Dist. No.	Road class					Total	Density1 (Km/Km <sup>2</sup> )	Density2 (Km/Km <sup>2</sup> )
	Main arterial	Arterial	Secondary	Community	Other			
16	0.4	13.4	4.2	9.8	228.1	255.9	10.2	0.8
17	9.6	0.0	8.1	12.2	245.8	275.6	4.9	0.3
18	0	14.1	18.0	54.0	38.8	124.9	3.7	0.4
19	15.5	0.0	24.1	36.2	220.1	295.8	2.1	0.3
20	17.8	0.0	7.9	81.9	148.8	256.4	1.8	0.2
21	10.9	0.0	7.0	35.8	3.4	57.1	0.9	0.03
22	0	8.8	17.6	52.8	189.4	268.6	3.4	0.00
Total	114.1	211.0	183.2	1,065.4	4,282.8	5,856.5	5.7	1.5

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

Note: Density 1 : Total Road Network Density

Density 2 : Core Road Network Density (except "Other Road")

### Road conditions

Asphalt concrete is commonly used for road pavement. Road surface conditions are generally damaged due to age, snow and frost, lack of proper drainage as well as insufficient maintenance. Pavement conditions are summarized in Table 5.6. The main arterial and arterial roads have better surface conditions as they have been rehabilitated recently with asphalt concrete pavement. However, due to insufficient maintenance works, many sections have deteriorated surface. Community roads and other roads are mostly unpaved.

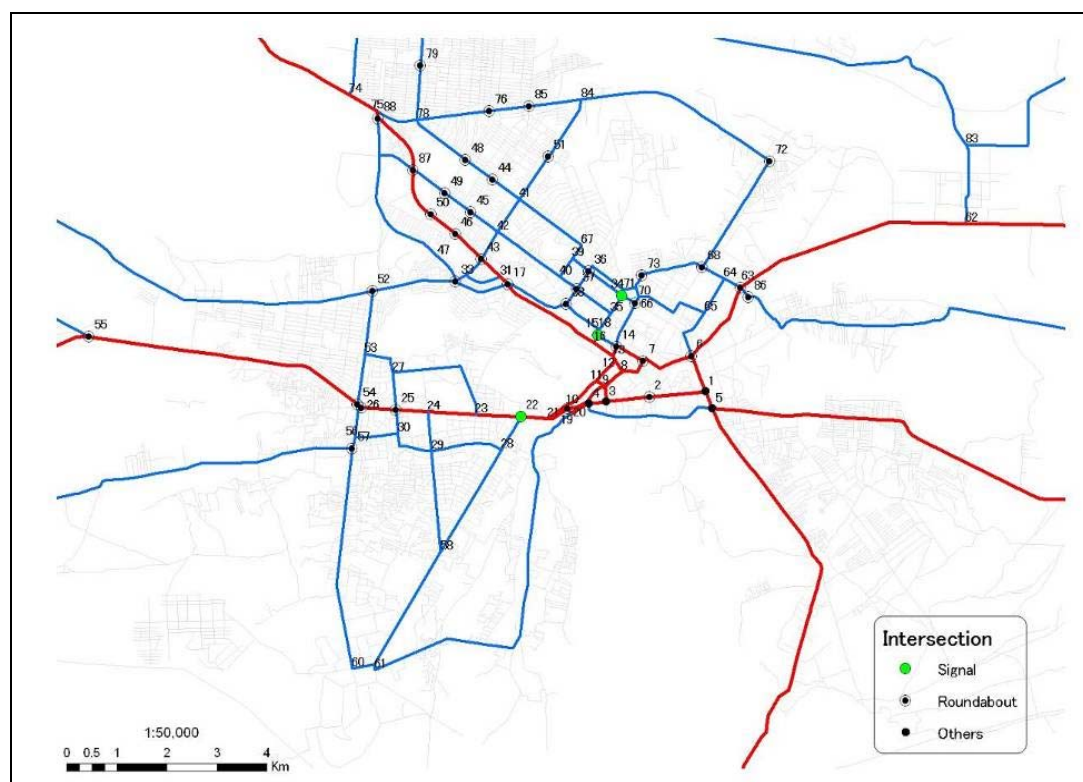
**Table 5.6: Surface Conditions of Main Arterial, Arterial and Secondary Roads**

Road class	Good	Fair	Poor	Very poor	Total (km)
Main arterial	96.7	6.5	5.6	5.3	114.1
Arterial	29.5	23.7	109.3	38.5	211.0
Secondary	-	16.8	11.5	154.9	183.2

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

### Intersections

Intersections in the city do not have signals except two intersections. Locations of intersections of different types are shown in Figure 5.2.



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.2: Locations of Intersections in Kabul City**

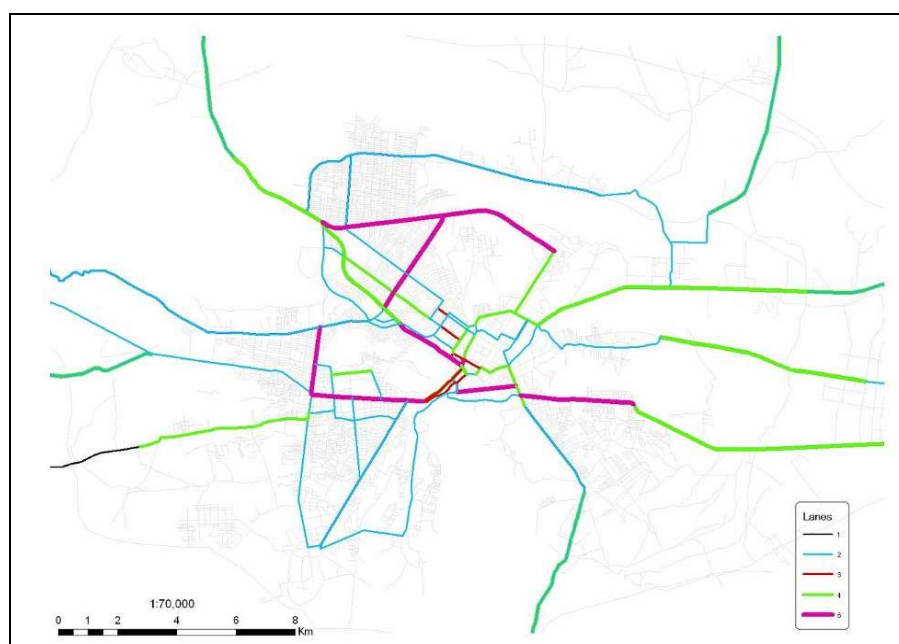
Number of lanes

No road markings are provided in terms of indicating the separation of lanes. Thus the number of lanes was estimated from the road width including shoulders. The road arrangements by the number of lanes are shown in Figure 5.3, and the road lengths by the number of lanes are summarized in Table 5.7.

**Table 5.7: Road Lengths by Number of Lanes of Arterial Road Network**

	1 lane	2 lanes	3 lanes	4 lanes	6 lanes	Total (km)
Major arterial	-	87.0	4.2	33.8	12.4	137.4
Arterial	7.6	143.3	1.9	34.6	5.9	193.3
Total	7.6	230.3	6.1	68.4	18.3	330.7

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009



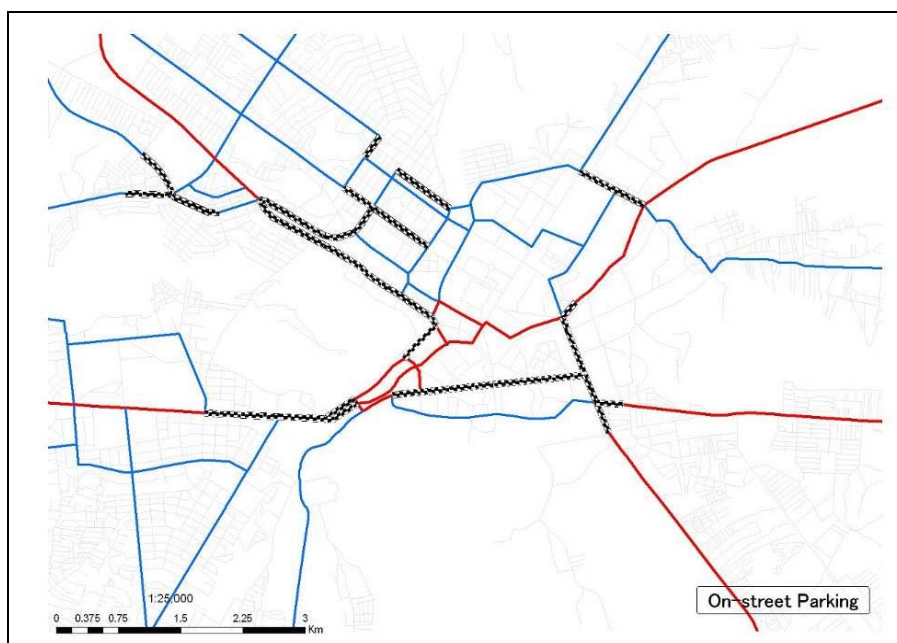
Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.3: Arterial Road Network with Number of Lanes**Roadside parking

The roadside parking on main roads is reducing the traffic capacity significantly. Many roadside parking is observed in the city center and surrounding urbanized areas, except in restricted areas where police, guards or others are controlling actively. The current situation of roadside parking is illustrated in Figure 5.4. The length of roads with or without roadside parking is summarized by road class in Table 5.8.

**Table 5.8: Lengths of Roadside Parking on Arterial Roads**

	Encroachment	No	Total (km)
Major arterial	11.2	126.2	137.4
Arterial	25.2	168.1	193.3
Total	36.4	294.3	330.7

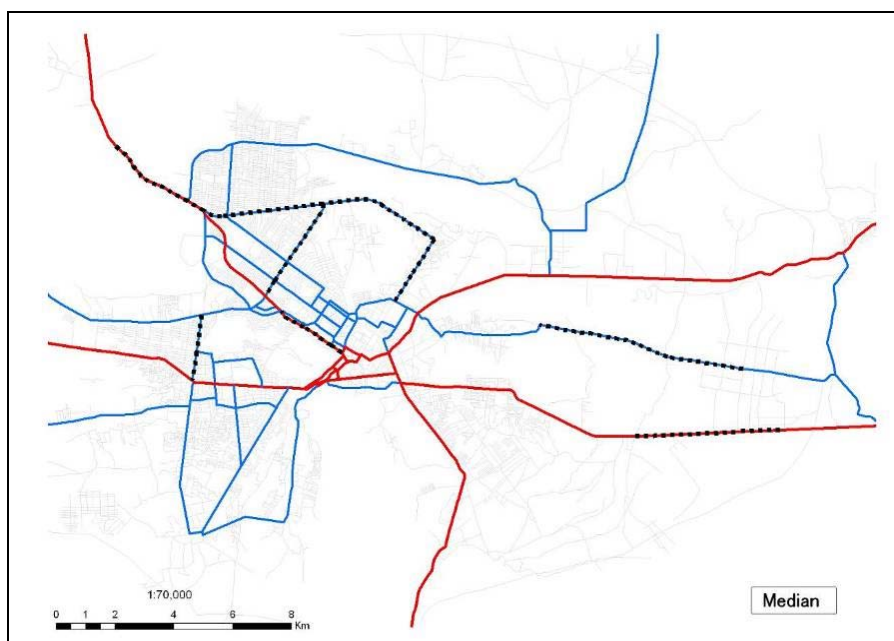


Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.4: Current Situation of Roadside Parking**

### Medians

Roads with medians that separate directional traffic flows are shown in Figure 5.5. The lengths of roads with or without medians are summarized in Table 5.9.



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.5: Roads with Medians of Artery Road Network**

**Table 5.9: Lengths of Roads with/without Medians**

	With	Without	Total (km)
Major arterial	11.2	126.2	137.4
Arterial	25.2	168.1	193.3
Total	36.4	294.3	330.7

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

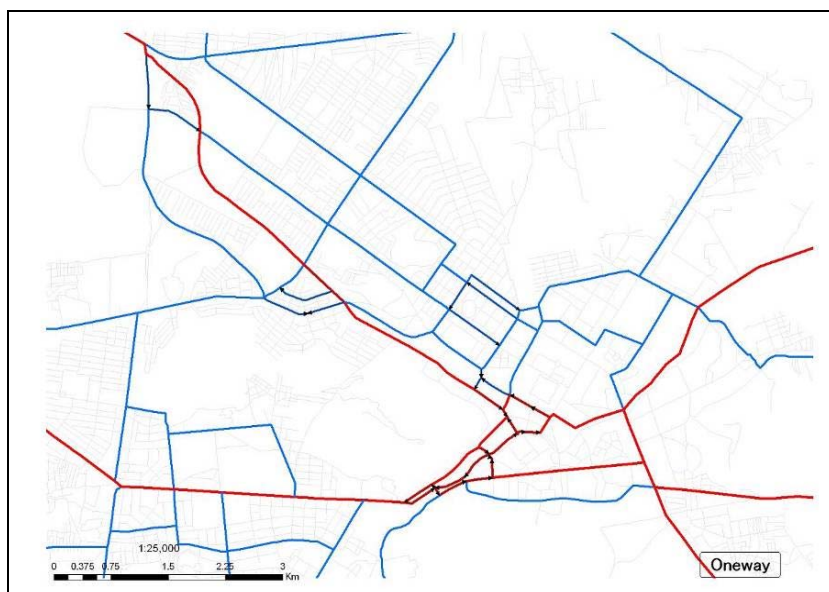


### One-way roads

Road sections restricted for one-way traffic are shown in Figure 5.6. The lengths of one-way roads by road class are summarized in Table 5.10.

**Table 5.10: Lengths of One-way Roads by Road Class in Kabul City**

	One-way	Other	Total (km)
Major arterial	6.1	131.3	137.4
Arterial	6.9	186.4	193.3
Total	13.0	317.7	330.7



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.6: One-way Roads in Kabul City**

### **5.1.5 Public transport**

The public transport supplied in the city is dependent upon various types of modes. The requirements for operation of these services are not well regulated. Enforcement of regulations is generally poor. Various types of vehicles are used for public transport services, including standard size buses, mini buses, minivans, shared taxis, and motor-rickshaws. These are generally in very bad conditions because of old fleets and poor maintenance.

#### **(1) Buses**

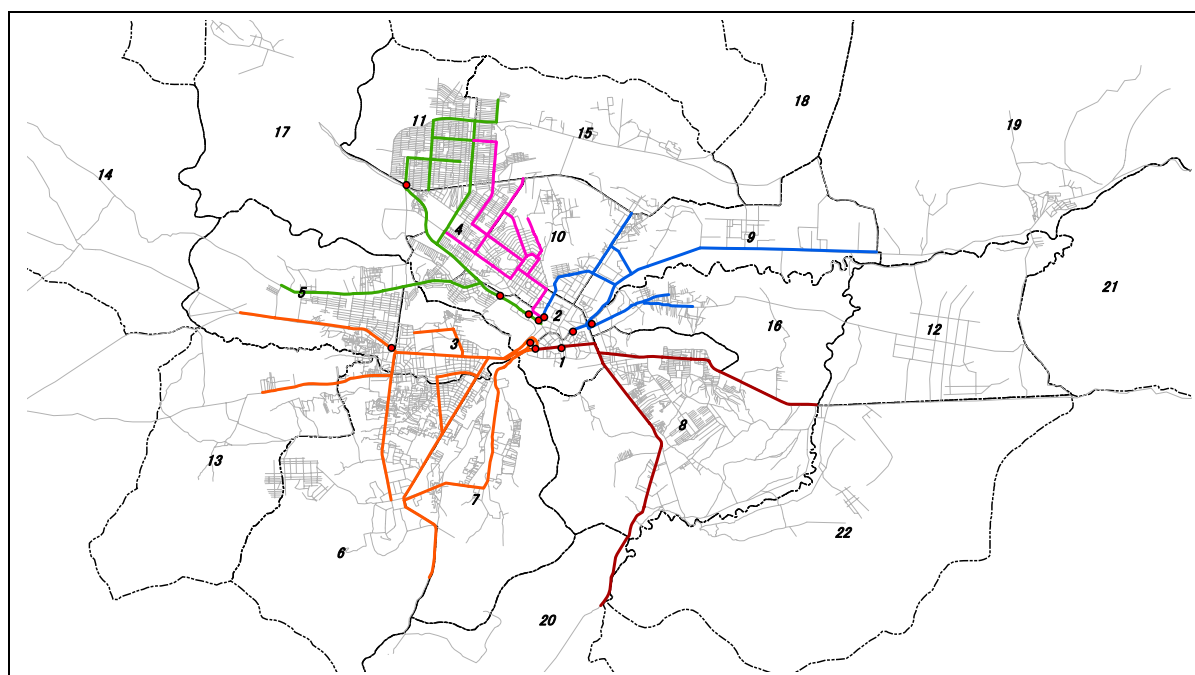
The bus system in Kabul is operated by state and private bus companies individually. The bus routes mostly start from the city center and extend towards suburbs. The city bus service consists of 54 routes based on 10 terminals throughout the city. The total length of these bus services is 473 km, making the average service length at around 8.8 km for each route (Table 5.11 and Figure 5.7).

The density of serviced length is 1.6km/km<sup>2</sup>, close to the average density of arterial roads in the city.

**Table 5.11: Present Bus Service in Kabul**

Routes (n)	Total length (km)	Ave. trip (km/route)	Routes from 1 terminal (n)
54	473	8.8	5.4

Source: Development Plan for Kabul Phase-II Report (2008), ICT



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.7: Present Bus Routes Network and Major Bus Terminal**

1) Millie buses

The Millie Bus enterprise is a public body, similar to those observed in many countries. The enterprise is financially supported by the Government which is responsible to provide cheap transportation services for low income citizens. The enterprise has been functioning as a transport service provider for the past 40 years in Afghanistan under various regimes. After the establishment of the republic, it has been headed for corporatization.

Its fleet has been enhanced recently by donation of buses by several donor countries as summarized below:

**Table 5.12: Number of Buses Donated to Millie Bus Enterprise**

Donor	Number of Buses
India	600
Japan	111
Iran	50
Pakistan	100

The enterprise is currently providing cheap transportation services with its 900 buses in 32 provinces. In Kabul alone, the enterprise operates 601 buses, although only 358 buses are operational due to shortage of drivers. Being the cheapest means of urban transport, the Millie Bus is the primary choice of travel for the poor citizens.

2) Private buses

There are no statistic data available for the number of private buses operating in Kabul. The registered number of privately owned buses was 44,924 in Kabul out of the total registered buses of 48,513 in the entire country. Assuming that 20 to 30% of fleet operation are in and around the city area, the number of privately owned buses would be 10,000 to 15,000.

(2) Taxis

Around 4,800 taxi cars are operated in Kabul with private ownership according to the official data provided by MoTCA. However, the real number of such taxi cars operating in and around Kabul

is said to be as high as 30,000. The number of registered taxis at national level was 62,373 in 2006-07 as per the Afghan Statistical Yearbook 2007 (reported as the countrywide vehicle registration data of MoTCA). The country-wide registered number of such taxis has been reported as 29,131 in 2002. Thus, a substantial increase is taking place with 16-20% per annum.

### 5.1.6 Ongoing and planned projects

In Kabul City, roads and transportation projects have been studied and planned by several bodies. These are mostly supported by international organizations. On-going projects studied by MPW and the Kabul Municipality are summarized in Table 5.13 and illustrated in Figure 5.8. Most of these ongoing projects aim at urgent rehabilitation and improvement of roads, and thus, are planned to mitigate the existing traffic congestions.

**Table 5.13: Ongoing Road Project in Kabul City**

Project	Implementing Agency	Stage
Outer Ring Road	MPW	Planning
US Funded Project	Kabul Municipality	Planning
Afghanistan Government Funded Project	Kabul Municipality	Ongoing
Emirates Funded Project	Kabul Municipality	Ongoing
KURIP-WB Funded Project	Kabul Municipality	Ongoing
Turkey Government Funded Project	Kabul Municipality	Ongoing



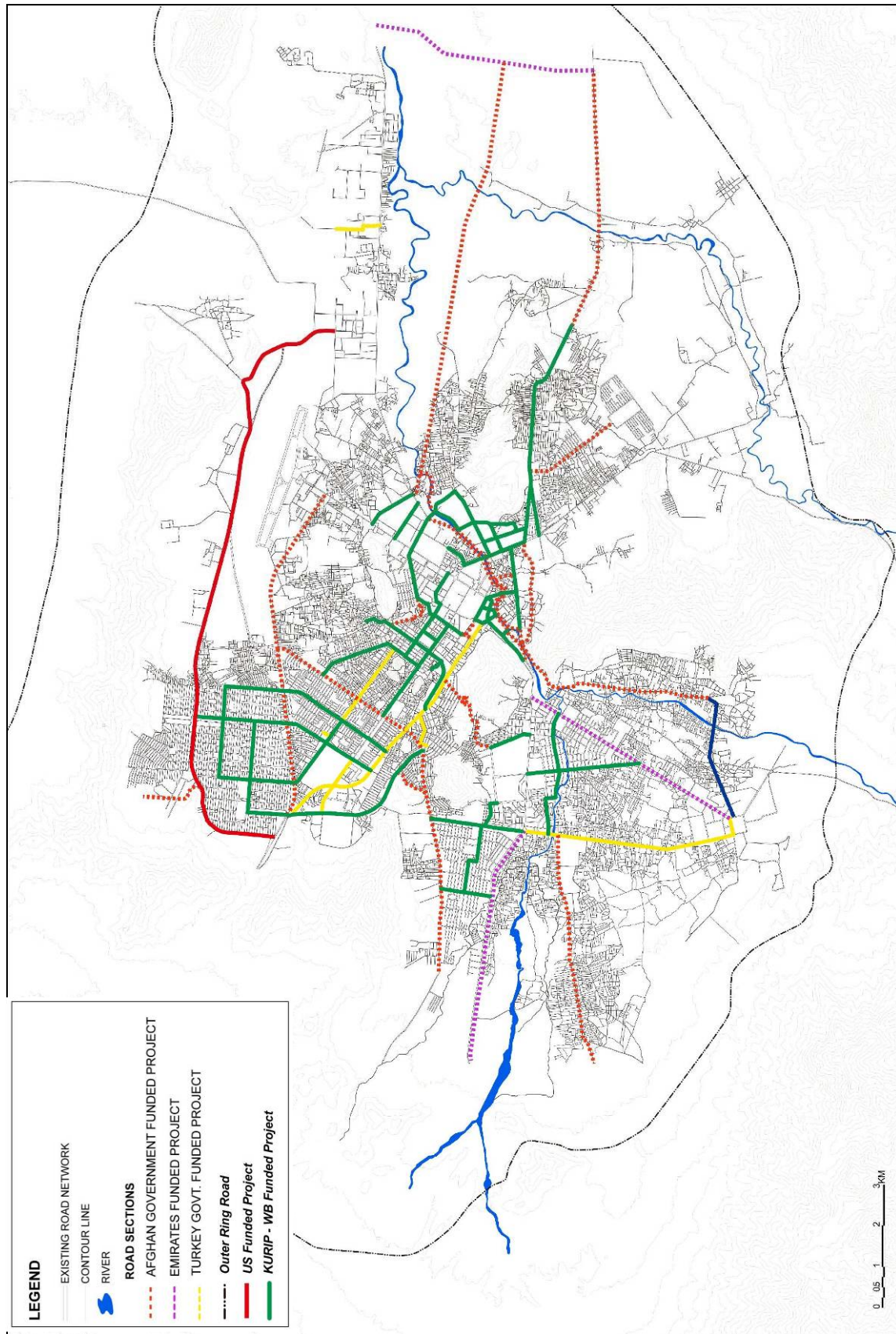


Figure 5.8: On-going and Planned Road Projects

## 5.2 Road Traffic Characteristics

Characteristics of road traffic in Kabul were examined based on the results of person trip survey conducted by KMAUD Master Plan.

### 5.2.1 Outline

#### (1) Total trips

The total number of trips in a day related to Kabul City in 2008 was 3.35 million trips, of which 1.02 million trips were on foot within the city (Table 5.14). Trips by vehicles moving inside the city are 2.12 million trips. Among the traffic connecting inside and outside the city, the largest was in the direction towards Jalalabad with 100,000 trips, followed by the direction towards Kandahar with 40,000 trips (Figure 5.9). A total of some 30,000 trips were connecting Kabul City and the northern regions.

The traffics passing through Kabul city in east-west direction and north-south direction were 1,000 and 700 trips respectively. Between Jalalabad and northern region, there were 400 trips, while 100 trips were between Kandahar and northern region. Overall, the volume of passing through traffics is rather small.

**Table 5.14: Number of Trips Related to Kabul City**

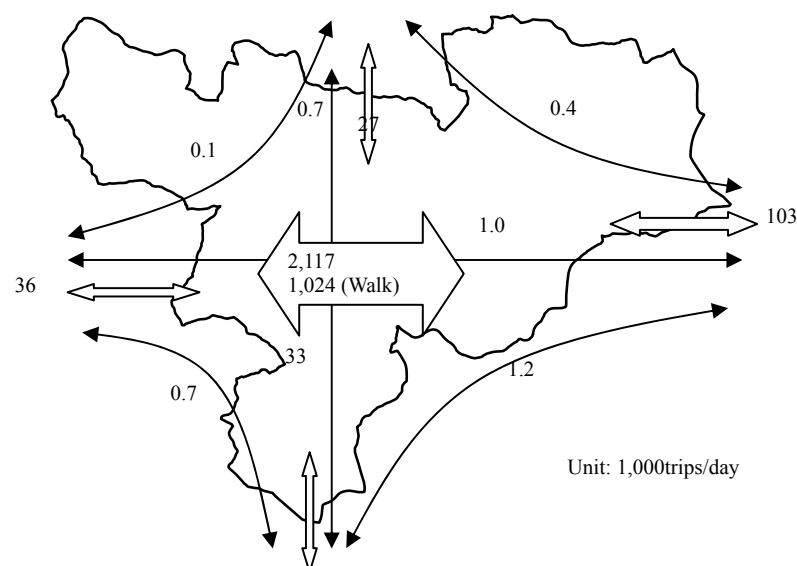
Table 3.17: Number of Trips Related to Kabul City

(Unit: trips/day)

		Kabul City	Outside East	Outside South	Outside West	Outside North	Total
Kabul City	Walk	1,024,016	-	-	-	-	1,024,016
	Public transport	1,552,313	37,948	16,756	20,160	15,126	1,642,303
	Private transport	564,972*	65,170	16,316	15,622	12,688	674,768
	Public + Private	2,117,285	103,118	33,072	35,782	27,814	2,317,071
Outside East	Public Transport	-	-	246	400	146	792
	Private Transport			944	630	228	1,802
	Public + Private			1,190	1,030	374	2,594
Outside South	Public transport	-	-	-	336	286	622
	Private transport				374	400	774
	Public + Private				710	686	1,396
Outside West	Public transport	-	-	-	-	22	22
	Private transport					84	84
	Public + Private					106	106
						Non-vehicle	1,024,016
						Vehicle	2,321,167
						Total	3,345,183

\*Including Kabul Airport users and international donors

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

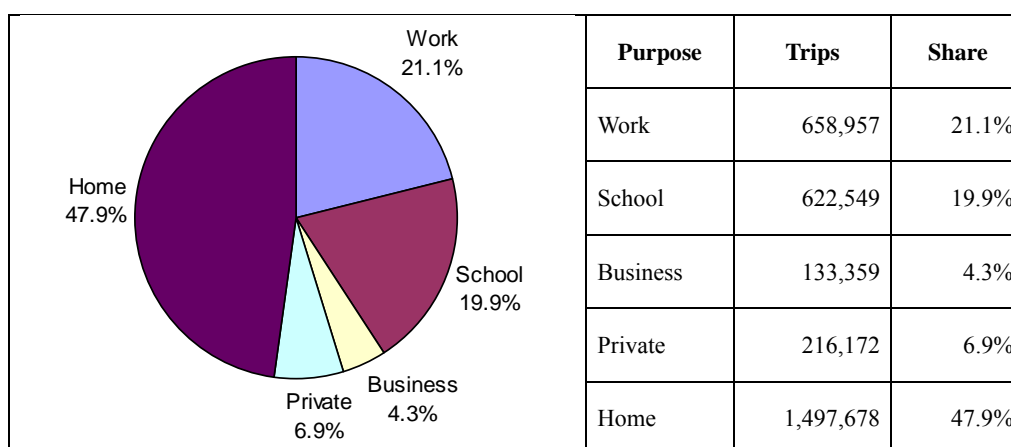


Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.9: Daily Trips in Kabul**

## (2) Trip purposes

The purposes of the trips by the inhabitants of Kabul city were 21% for commuting, 20% for schools, 4% for business and 7% for private purposes (Figure 5.10). Trips with purpose of returning home shared the half of the total trips, implying that most inhabitants are returning home after going to respective destinations.

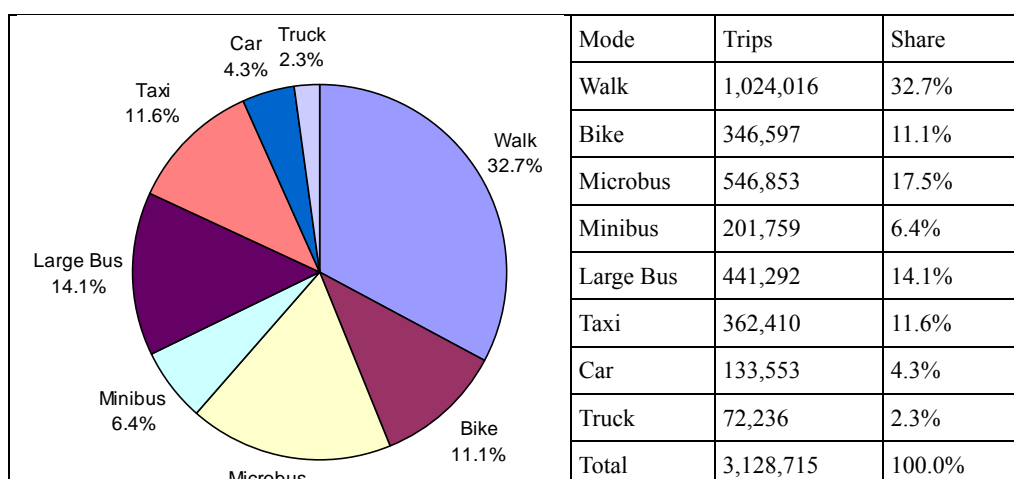


Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.10: Trip Composition by Purpose**

## (3) Main transport mode

Among the transport modes, “walking” had the largest share of 33%, followed by microbus 18% and large-scale bus 14% (Figure 5.11). Public transportation including buses and taxis shared 50%, implying that public transport is the important mode for the Kabul habitants.



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

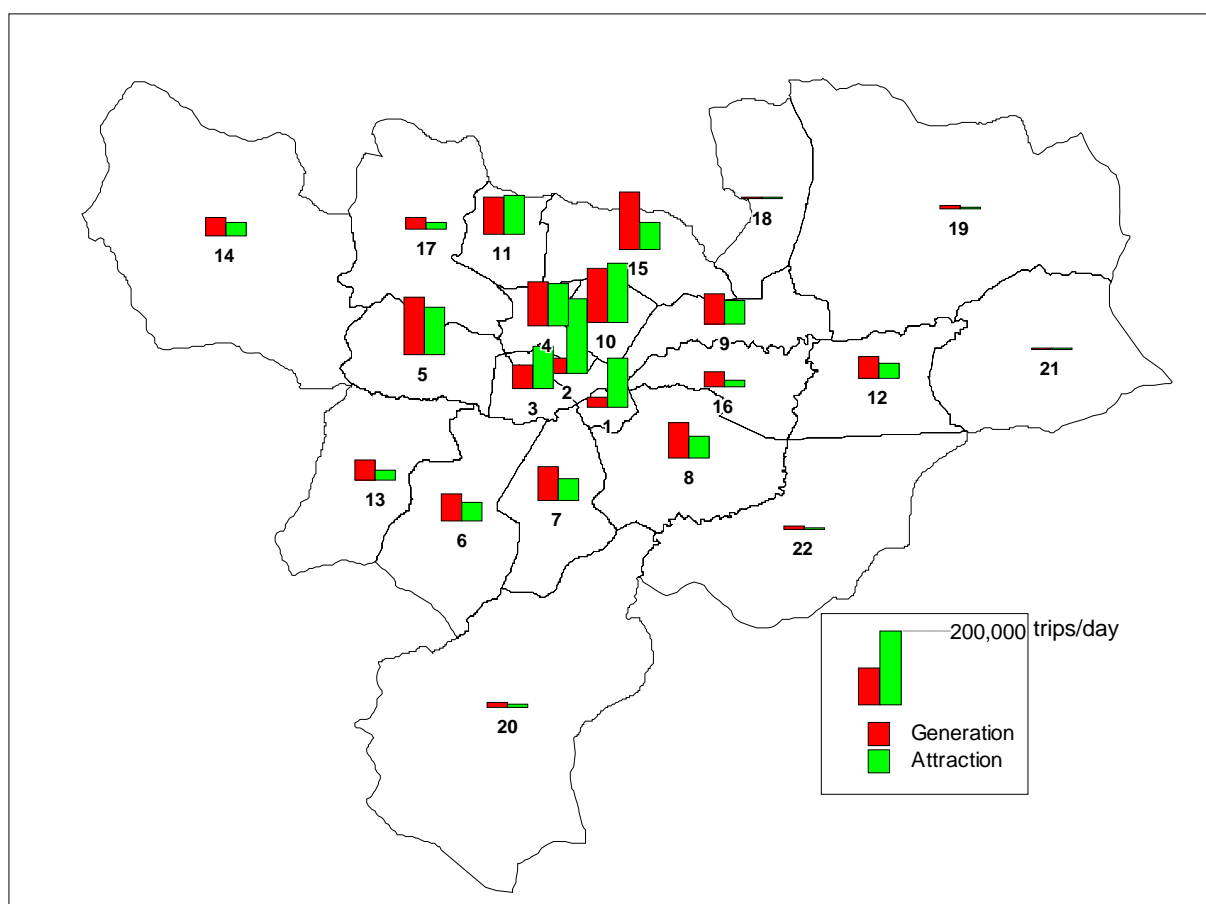
**Figure 5.11: Trip Composition by Main Transport Mode****5.2.2 Trip generation and attraction****(1) Trip generation and attraction by purpose**

Observing the number of trips excluding the returning trips home, the concentration was more than generation in Districts 1, 2, 3, 19 and 11, indicating that trips from other districts are concentrated in these districts, especially in District 1 and 2 (Table 5.15 and Figure 5.12). In Districts 4, 5, 10, 11 and 15, generation was high compared to other Districts. Especially in District 15, the generation was almost twice the attraction, reflecting the fact that the District 15 is becoming a residential area. On the other hand, both the generation and the attraction are small in Districts 14, 17, 18, 19, 20, 21 and 22, which indicates small population and limited employment opportunities in the area.

**Table 5.15: Trip Generation and Attraction by Purpose**

(Unit: Trips/day)

District	Generation						Attraction					
	Work	School	Business	Private	Home	Total	Work	School	Business	Private	Home	Total
1	11,179	5,568	3,469	11,851	128,529	160,596	80,168	16,138	22,691	32,223	28,598	179,818
2	15,275	11,411	4,144	14,591	201,597	247,018	116,065	30,906	28,246	54,626	41,277	271,120
3	29,821	26,747	4,320	13,325	127,009	201,222	40,437	66,455	5,520	20,117	69,893	202,422
4	63,015	41,587	13,280	20,603	119,376	257,861	57,422	47,190	10,116	14,764	125,205	254,697
5	64,011	67,568	23,236	23,281	135,581	313,677	56,065	61,203	11,598	18,313	154,860	302,039
6	31,994	39,307	3,494	8,132	57,557	140,484	18,764	35,418	2,470	3,375	79,433	139,460
7	42,006	39,468	7,568	14,048	66,473	169,563	22,965	38,069	3,790	5,439	95,522	165,785
8	40,588	45,195	13,388	11,106	63,042	173,319	19,806	35,983	3,958	7,253	96,889	163,889
9	39,284	41,576	2,748	9,611	73,428	166,647	33,029	35,408	2,768	4,991	90,471	166,667
10	66,913	60,232	15,822	23,747	165,182	331,896	88,155	59,031	17,232	17,996	150,892	333,306
11	49,937	43,747	8,918	14,132	108,393	225,127	42,728	52,645	11,691	13,020	107,816	227,900
12	27,401	30,178	2,805	5,425	45,341	111,150	17,769	25,327	116	2,245	63,004	108,461
13	24,618	25,458	5,555	5,096	28,888	89,615	7,770	16,207	2,234	4,911	55,172	86,294
14	21,961	22,259	5,742	6,722	39,830	96,514	15,755	20,475	2,578	3,600	50,942	93,350
15	78,694	72,910	7,283	19,239	81,375	259,501	25,318	48,895	4,057	7,162	170,843	256,275
16	20,518	20,855	3,518	4,170	20,931	69,992	5,070	13,391	694	2,470	45,543	67,168
17	16,036	15,984	1,965	2,543	17,473	54,001	7,303	8,585	1,126	1,585	34,563	53,162
18	1,737	840	322	937	1,346	5,182	333	630	35	383	3,514	4,895
19	3,113	2,036	728	5,373	2,943	14,193	213	1,891	133	839	10,522	13,598
20	5,987	5,349	3,696	1,605	8,240	24,877	2,730	4,791	1,674	719	12,941	22,855
21	552	563	144	173	1,004	2,436	401	516	63	87	1,288	2,355
22	4,317	3,711	1,214	462	4,140	13,844	691	3,395	569	54	8,490	13,199
Total	658,957	622,549	133,359	216,172	1,497,678	3,128,715	658,957	622,549	133,359	216,172	1,497,678	3,128,715



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.12: Trip Generation and Attraction (All purposes except returning Home)**

## (2) Trip generation and attraction by transport mode

From the generation and attraction by transport mode in the districts, there are no big differences between generation and concentration (Table 5.16). This indicates that people are using the same mode of transport for going and returning.

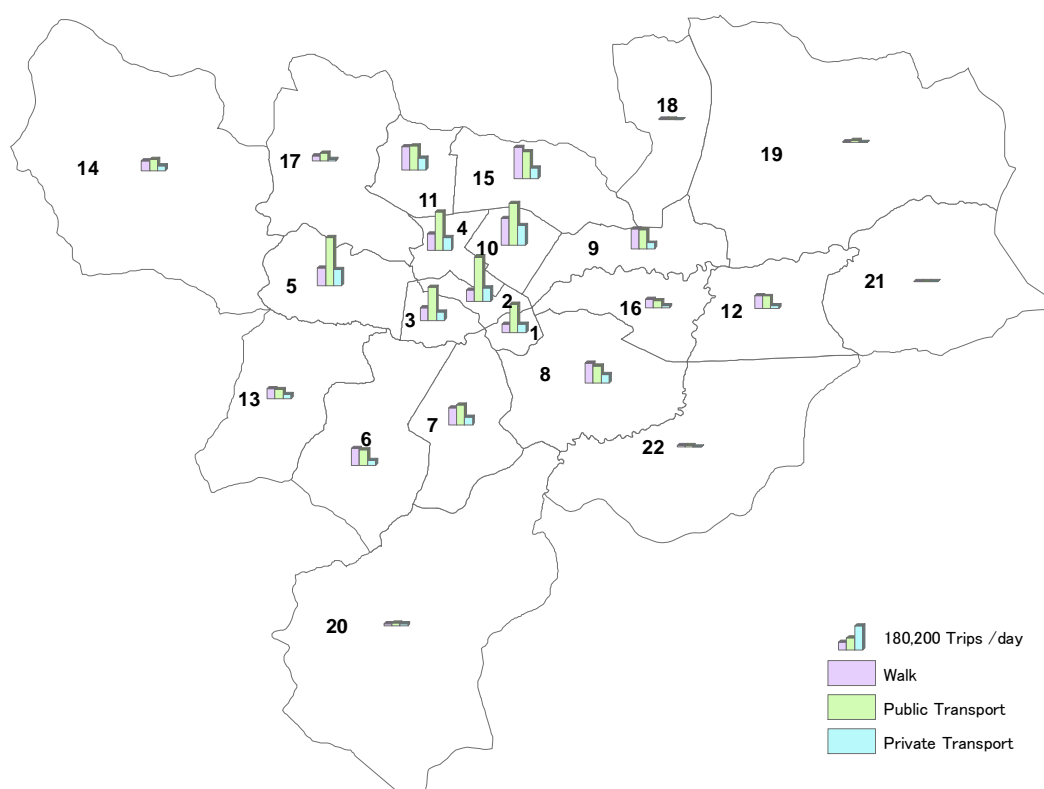
Figure 5.13 shows the number of trips by transport modes. It is observed from this that many trips use public transport in Districts 1, 2, 3, 4, 5 and 10, which are urban areas. This indicates that many people are coming to these Districts by public transport. In District 10, the share of trips using private transport mode was also high. In contrast, the share of trips on foot was high in Districts 6, 7, 8, 9, 11, 12, 13, 15 and 16, which are in the suburbs.

**Table 5.16: Trip Generation and Attraction by Transport Mode**

(Unit: Trips/day)

District	Generation				Attraction			
	Walk	Public transport	Private transport	Total	Walk	Public transport	Private transport	Total
1	31,454	101,682	27,460	160,596	32,277	113,586	33,955	179,818
2	42,695	158,510	45,813	247,018	42,715	175,637	52,768	271,120
3	46,300	122,956	31,966	201,222	45,869	125,322	31,231	202,422
4	63,013	147,495	47,353	257,861	62,427	144,305	47,965	254,697
5	65,792	183,424	64,461	313,677	65,965	179,511	56,563	302,039
6	62,699	58,433	19,352	140,484	63,164	57,428	18,868	139,460
7	63,556	76,209	29,798	169,563	63,341	72,709	29,735	165,785
8	73,478	64,915	34,926	173,319	73,577	61,292	29,020	163,889
9	74,507	70,910	21,230	166,647	74,315	70,773	21,579	166,667
10	100,991	158,454	72,451	331,896	101,664	155,471	76,171	333,306
11	89,452	89,462	46,213	225,127	89,909	93,050	44,941	227,900
12	50,257	48,905	11,988	111,150	50,257	46,308	11,896	108,461

District	Generation				Attraction			
	Walk	Public transport	Private transport	Total	Walk	Public transport	Private transport	Total
13	36,772	36,260	16,583	89,615	36,671	33,361	16,262	86,294
14	36,648	42,671	17,195	96,514	36,590	41,149	15,611	93,350
15	116,783	103,141	39,577	259,501	115,516	100,289	40,470	256,275
16	32,387	27,747	9,858	69,992	32,339	26,017	8,812	67,168
17	18,203	30,869	4,929	54,001	18,272	29,884	5,006	53,162
18	1,713	3,075	394	5,182	1,713	2,788	394	4,895
19	3,603	8,709	1,881	14,193	3,603	8,114	1,881	13,598
20	6,548	11,780	6,549	24,877	6,548	9,242	7,065	22,855
21	926	1,081	429	2,436	926	1,039	390	2,355
22	6,239	5,625	1,980	13,844	6,358	5,038	1,803	13,199
Total	1,024,016	1,552,313	552,386	3,128,715	1,024,016	1,552,313	552,386	3,128,715



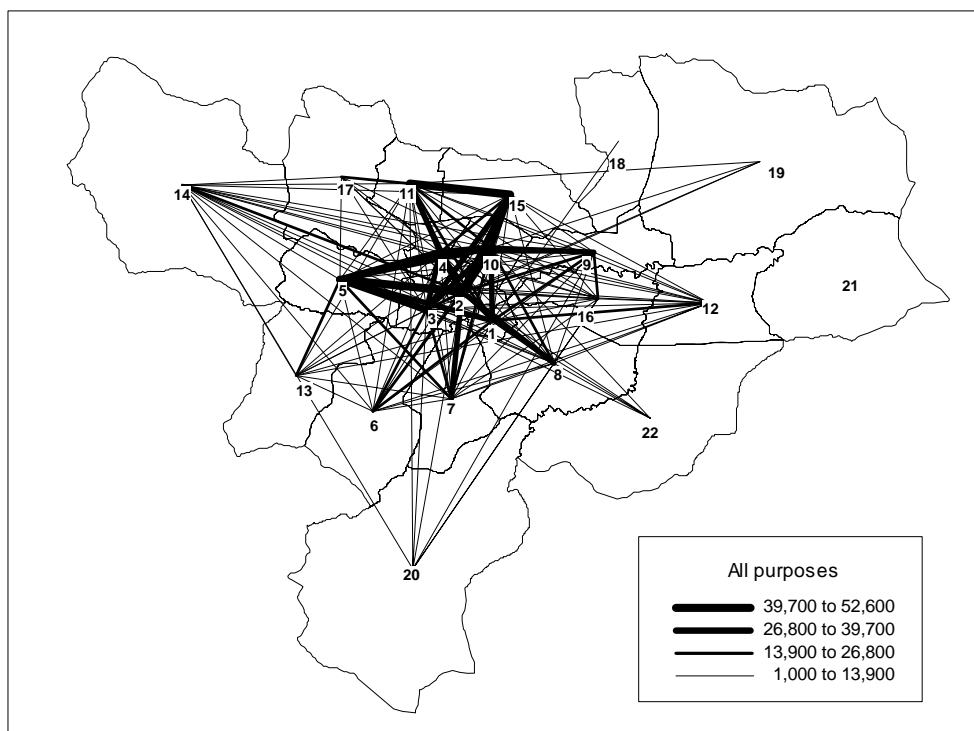
Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.13: Trip Generation + Attraction by Trip Mode**

### 5.2.3 Trip distribution

#### (1) Distribution by all purposes

There was a large amount of trips between the Kabul city center (District 1, 2, 3, 4 and 10) and the other districts (Figure 5.14). There was also a large amount of trips between District 11 and 15.

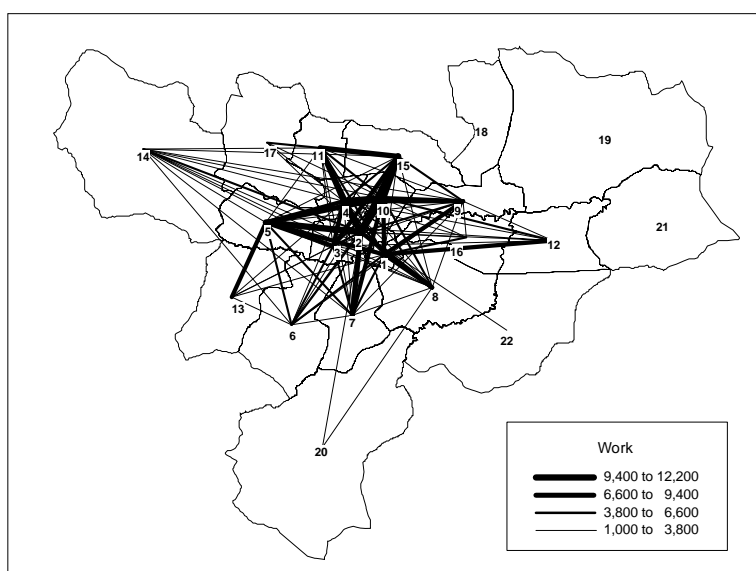


Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.14: Desired Line (All purposes)**

## (2) Distribution by each purpose

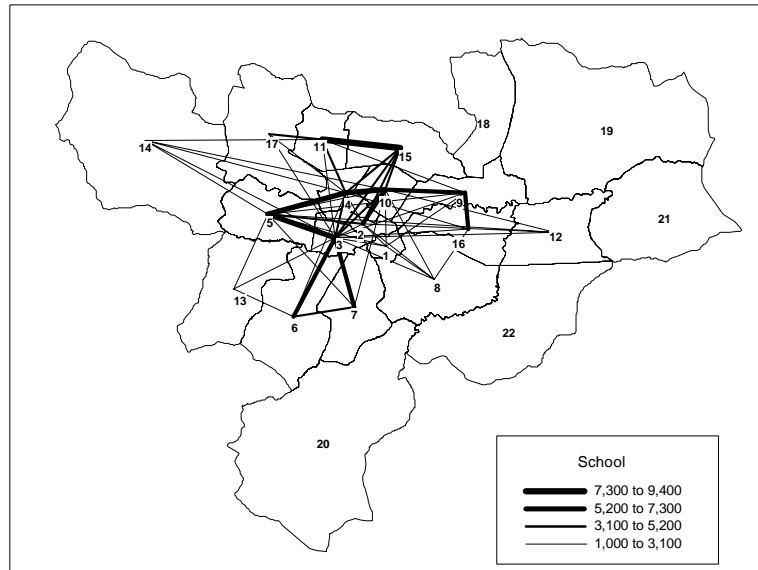
As for the trip distribution by each purpose, there was a large amount of trips between the city center and the other districts as well as between District 11 and District 15 (Figures 5.15 through 5.18). For commuting purposes, District 5 in the southwestern part of Kabul city, where business core is located, had concentration of trips from surrounding districts. Furthermore, many school going trips were concentrated in District 3 and District 5, where the Kabul University and the Kabul Polytechnic University are located.



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

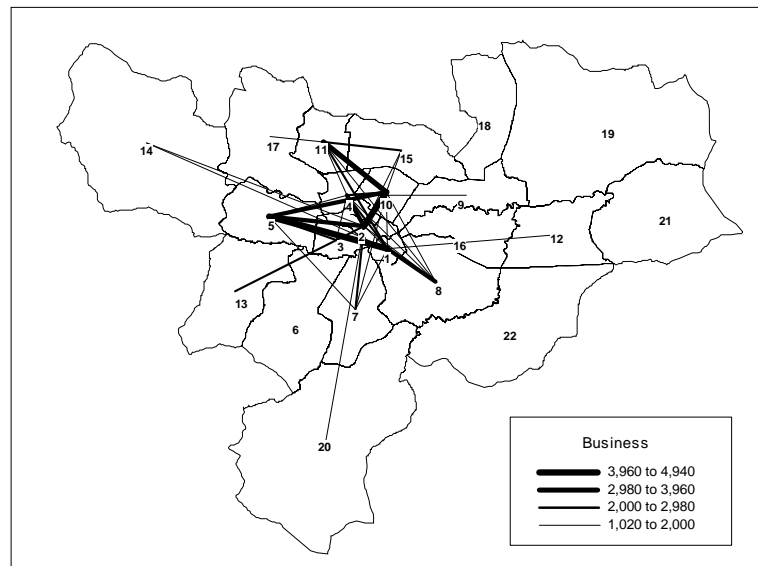
**Figure 5.15: Desired Line (Work)**





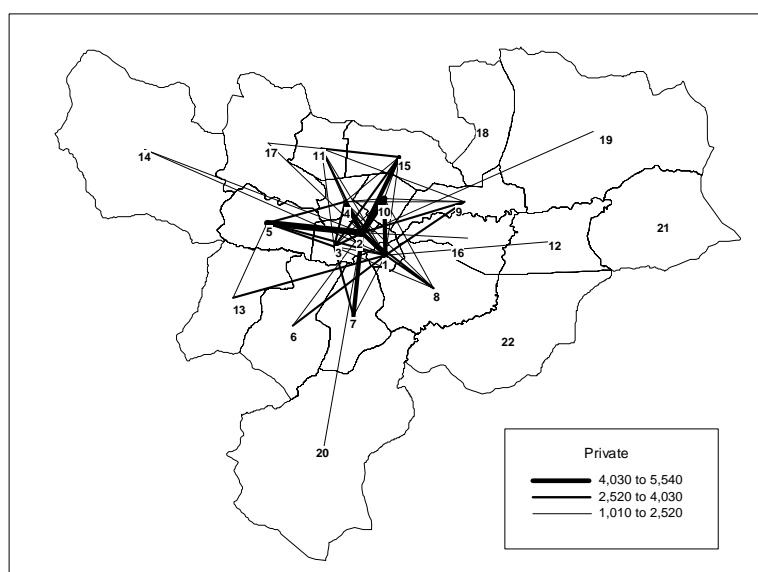
Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.16: Desired Line (School)**



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.17: Desired Line (Business)**



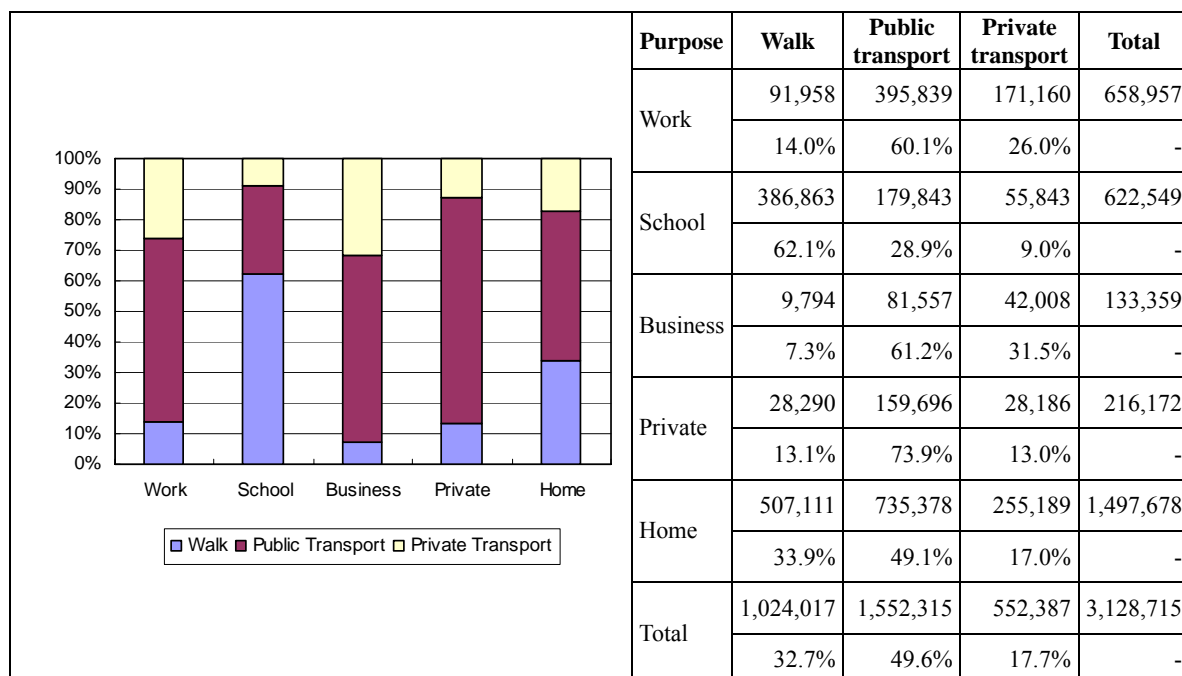
Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.18: Desired Line (Private)**

## 5.2.4 Modal split

### (1) Modal split by purpose

The share of public transportation for the commuting purposes was 60%, followed by private transport mode such as passenger cars, motor bikes, etc (Figure 5.19). Trips-on-foot shared 62% for the way to schools, followed by the trips with public transport sharing 29%. For business trips, the share of trips on foot was smaller compared to other purposes and the share of private transport modes was higher instead. The share of public transport was high for the trips of private purpose such as shopping compared to other purposes.

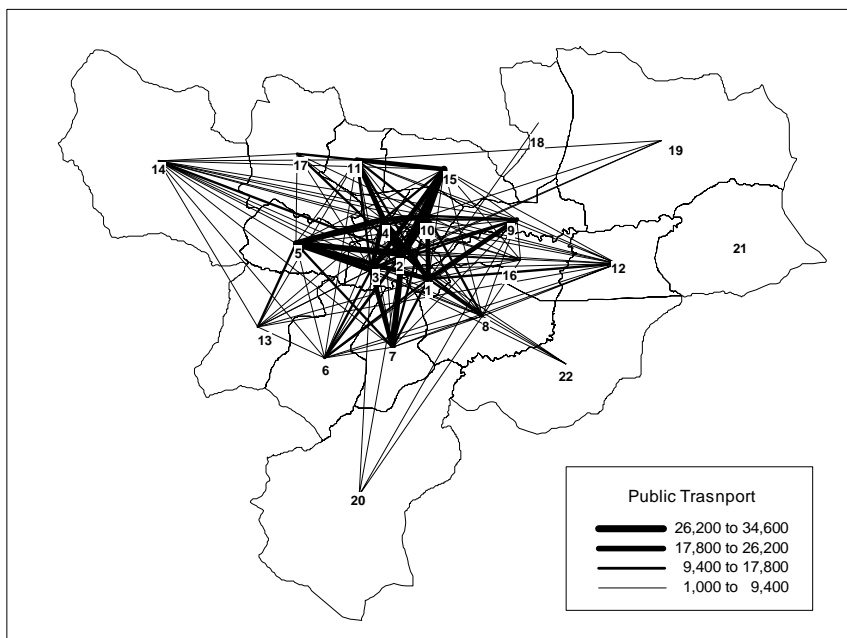


Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.19: Modal Split by Purpose**

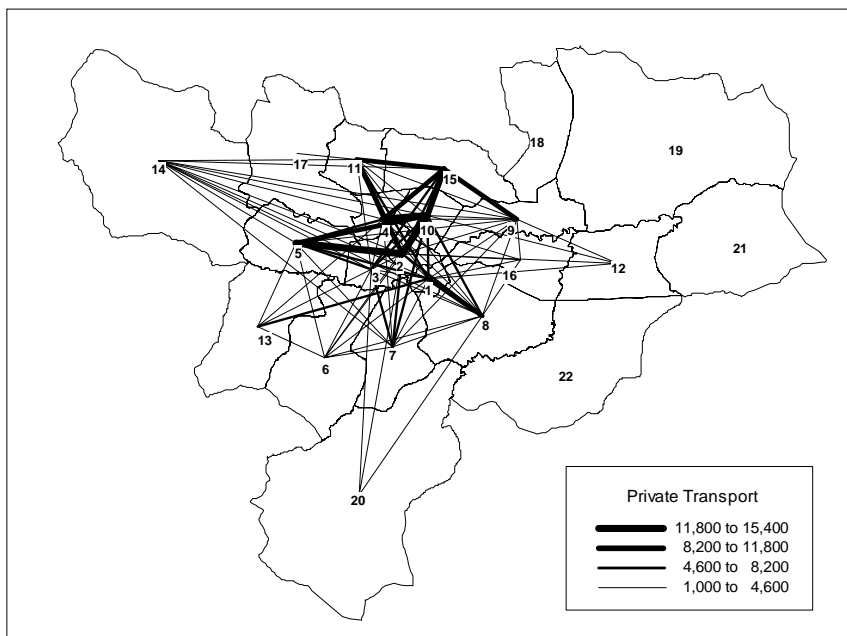
## (2) Distribution by mode

It is apparent that the desired lines for the public transport, which is the main transportation mode, were concentrated on the trips connecting the Kabul city center from the surrounding districts (Figures 5.20 and 5.21). On the other hand, the desired lines for private transport mode concentrated between areas in the city center, and the trips between the city center and suburbs were smaller.



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.20: Desired Line (Public Transport)**



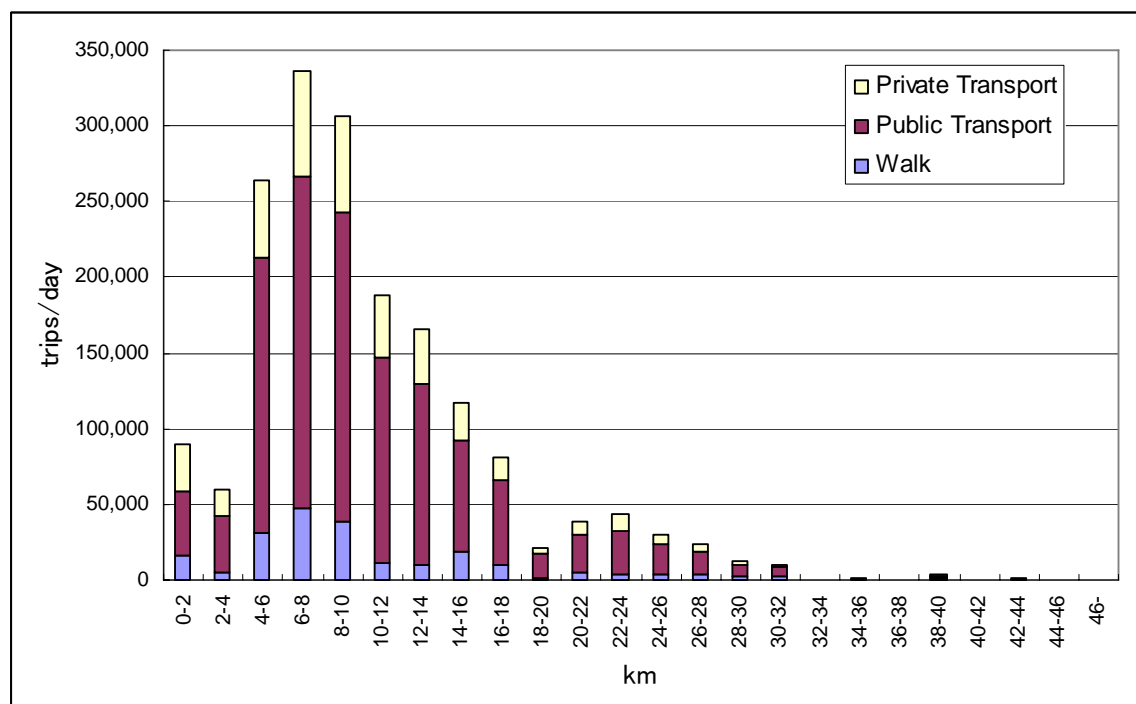
Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.21: Desired Line (Private Transport)**

## (3) Share of transportation mode by trip distance

The trip distance discussed here means the shortest distance between gravity centers of districts measured along the trunk road networks. Therefore, it should be noted that the trip distance within the district is unclear, the distance measured along the trunk road may not be the shortest

route, and the trips distances for the inhabitants living far from the gravity center may be longer than actual trip distances. The share of trips-on-foot within the district, 61% was the highest. The average distance of trips on foot is 2.9km (Figure 5.22 and Table 5.17).



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.22: Number of Trips by Travel Distance**

**Table 5.17: Modal Split by Travel Distance**

Distance	Trips (trips/day)				Share		
	Walk	Public transport	Private transport	Total	Walk	Public transport	Private transport
Intra District	811,306	360,719	163,429	1,335,454	61%	27%	12%
0-2	15,893	42,638	31,616	90,147	18%	47%	35%
2-4	5,348	36,554	17,272	59,174	9%	62%	29%
4-6	31,721	181,469	50,698	263,888	12%	69%	19%
6-8	47,423	219,655	69,694	336,772	14%	65%	21%
8-10	38,456	203,842	63,606	305,904	13%	67%	21%
10-12	10,835	136,244	41,409	188,488	6%	72%	22%
12-14	10,219	118,955	36,136	165,310	6%	72%	22%
14-16	18,821	73,275	24,398	116,494	16%	63%	21%
16-18	10,417	55,229	15,361	81,007	13%	68%	19%
18-20	863	16,994	3,393	21,250	4%	80%	16%
20-22	4,422	25,478	8,155	38,055	12%	67%	21%
22-24	4,180	27,839	11,549	43,568	10%	64%	27%
24-26	3,885	19,658	5,759	29,302	13%	67%	20%
26-28	4,128	15,099	4,291	23,518	18%	64%	18%
28-30	2,032	8,520	2,493	13,045	16%	65%	19%
30-32	2,345	6,178	2,021	10,544	22%	59%	19%
32-34	192	142	77	411	47%	35%	19%
34-36	126	1,050	42	1,218	10%	86%	3%
36-38	0	0	0	0	-	-	-
38-40	840	1,833	538	3,211	26%	57%	17%
40-42	100	123	12	235	43%	52%	5%
42-44	298	529	353	1,180	25%	45%	30%
44-46	166	290	84	540	31%	54%	16%
46-	0	0	0	0	-	-	-
Total	1,024,016	1,552,313	552,386	3,128,715	33%	50%	18%
Av. length	2.9 km	8.3 km	7.3 km	6.4 km	-	-	-

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

The number of people using public transportation tends to increase when the trip distance exceeds 2km and shares not less than 60% in most of the ranges. The average trip distance of public transport users was 8.3km. The number of private transport mode users also tends to increase when the trip distance exceeds 2 km and share around 20% in most of the ranges. The average trip distance by private transport was 7.3 km that is shorter than that of public transport.

The shares of each transport mode were almost constant in most of the ranges except for the trips within the district. This is because that most of the trips are concentrated in the city center regardless of trip distance (whether from districts close to or far from the center).

## 5.2.5 Trip flow

### (1) Traffic volume in Kabul city

According to the screen line survey conducted in the KMAUD Master Plan, the largest traffic volume was observed on the Jadayi Sehi Aqrah road (S2) with 49,800 vehicles for both ways in 12 hours, followed by the Baghbala road (S1) and the Gozarga road (S3) with 41,200 and 14,400 vehicles, respectively (Figure 5.23). As for type of vehicles, the highest was the passenger cars sharing 41%, followed by taxi and microbus on S1 (Table 5.18). The highest share on S2 was 33% for the passenger cars followed by motorbike and taxi. On S3, the highest was the motorbikes sharing 36% followed by passenger cars and microbus.

**Table 5.18: Traffic Volumes by Vehicle Type on Screen Line (1/2)**

(Unit: vehicles)

Survey point		Hour	Bike	Microbus	Minibus	Large bus	Taxi	Car	Truck	Total
S1	Inbound	12h	2,801	3,080	364	185	4,880	9,934	1,498	22,742
	Outbound	12h	2,851	2,680	380	280	3,631	7,060	1,565	18,447
S2	Inbound	16h	8,901	5,088	1,174	788	5,450	9,798	1,292	32,491
		12h	5,535	4,225	879	556	4,746	8,466	1,133	25,540
	Outbound	16h	6,676	4,562	1,246	806	4,503	8,898	1,057	27,748
		12h	6,042	3,874	1,133	627	3,913	7,786	921	24,296
S3	Inbound	12h	2,579	1,262	271	94	1,045	1,729	163	7,143
	Outbound	12h	2,552	1,186	300	66	1,102	1,878	183	7,267

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Table 5.18: Traffic Volumes by Vehicle Type on Screen Line (2/2)**

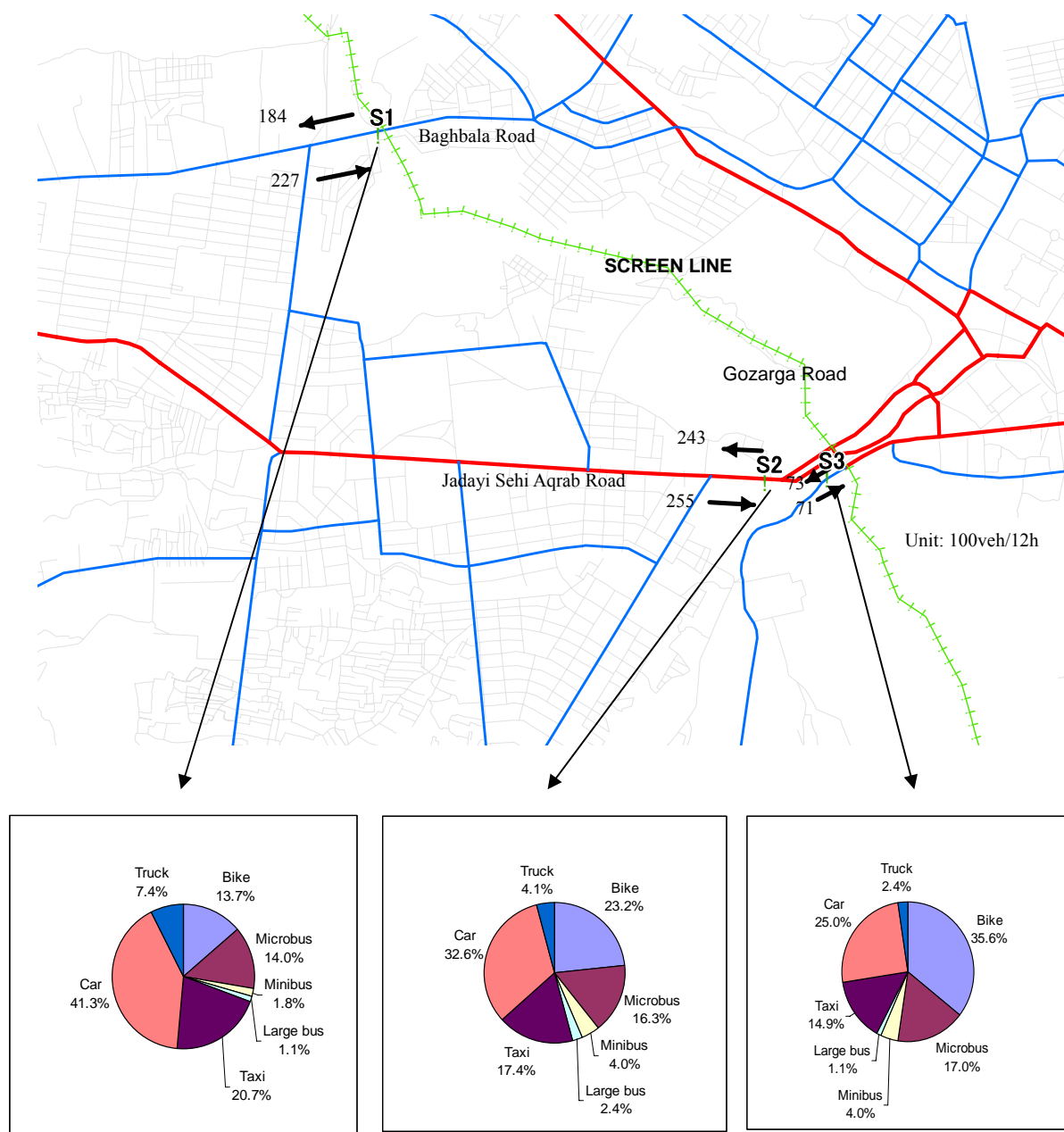
(Unit: Vehicles/12h)

P	HH	Inbound							Outbound						
		Bike	Micro bus	Mini-bus	Large bus	Taxi	Car	Truck	Bike	Micro bus	Mini-bus	Large bus	Taxi	Car	Truck
S1	7	523	308	45	36	353	909	127	46	153	78	11	470	685	198
	8	442	323	35	20	607	1,091	178	170	271	41	24	538	1,105	117
	9	202	227	16	9	476	663	149	274	255	19	30	316	847	141
	10	259	312	24	11	635	816	151	200	267	11	16	286	588	120
	11	122	224	22	8	392	869	156	159	258	13	14	210	542	137
	12	103	190	19	8	298	652	139	192	224	12	9	202	287	111
	13	109	160	12	12	328	357	127	159	172	8	17	228	446	126
	14	105	183	6	7	310	805	89	220	240	28	24	290	545	175
	15	168	250	38	17	341	708	106	154	146	22	21	173	319	80
	16	225	345	72	37	386	1,159	136	308	201	48	31	249	493	114
	17	283	361	36	10	419	1,467	74	503	333	66	27	435	684	149
	18	260	197	39	10	335	438	66	466	160	34	56	234	519	97
S2	7	1,367	460	100	131	670	1,311	93	362	373	87	92	492	1,253	73
	8	851	435	41	119	709	1,170	195	259	333	73	36	446	953	78
	9	629	413	80	37	545	773	99	149	332	57	77	444	1,160	90
	10	446	270	65	18	527	844	118	274	299	56	79	687	1,158	123
	11	200	261	33	19	246	712	80	104	206	39	59	163	639	60
	12	84	77	23	22	74	131	33	151	128	21	15	170	261	32
	13	78	75	21	16	117	275	41	129	214	62	49	140	312	99
	14	312	285	154	29	298	625	84	316	232	83	33	272	380	81
	15	573	479	189	80	350	674	133	169	190	94	28	198	125	69
	16	327	421	59	35	797	956	107	1,860	1,083	316	83	380	553	100

P	HH	Inbound							Outbound						
		Bike	Micro bus	Mini-bus	Large bus	Taxi	Car	Truck	Bike	Micro bus	Mini-bus	Large bus	Taxi	Car	Truck
S3	17	337	313	78	33	298	780	111	731	318	106	44	260	499	49
	18	331	736	36	17	115	215	39	1,538	166	139	32	261	493	67
	7	839	212	65	22	89	299	16	133	134	23	3	49	101	9
	8	545	157	33	5	108	220	18	163	129	33	4	49	102	9
	9	123	65	13	5	100	112	17	139	94	21	4	82	133	21
	10	202	106	19	6	116	158	11	187	128	13	7	107	128	22
	11	67	88	17	7	95	99	17	203	96	26	5	112	176	20
	12	102	71	11	10	77	87	13	155	80	19	4	121	143	28
	13	102	55	9	5	73	74	7	149	61	17	3	50	85	6
	14	134	73	18	5	68	110	18	126	49	23	2	95	142	15
	15	144	107	18	3	73	119	11	165	73	25	9	95	188	16
	16	144	105	31	6	89	124	17	348	110	62	16	96	188	5
	17	140	157	28	9	100	177	9	382	131	24	6	136	295	10
	18	37	66	9	11	57	150	9	402	101	14	3	110	197	22
T	7	2,729	980	210	189	1,112	2,519	236	541	660	188	106	1,011	2,039	280
	8	1,838	915	109	144	1,424	2,481	391	592	733	147	64	1,033	2,160	204
	9	954	705	109	51	1,121	1,548	265	562	681	97	111	842	2,140	252
	10	907	688	108	35	1,278	1,818	280	661	694	80	102	1,080	1,874	265
	11	389	573	72	34	733	1,680	253	466	560	78	78	485	1,357	217
	12	289	338	53	40	449	870	185	498	432	52	28	493	691	171
	13	289	290	42	33	518	706	175	437	447	87	69	418	843	231
	14	551	541	178	41	676	1,540	191	662	521	134	59	657	1,067	271
	15	885	836	245	100	764	1,501	250	488	409	141	58	466	632	165
	16	696	871	162	78	1,272	2,239	260	2,516	1,394	426	130	725	1,234	219
	17	760	831	142	52	817	2,424	194	1,616	782	196	77	831	1,478	208
	18	628	999	84	38	507	803	114	2,406	427	187	91	605	1,209	186

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009





Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.23: Outline of the Traffic Volume on the Screen Line**

## (2) Hourly fluctuations

Figure 5.24 shows the total passenger car unit (PCU) converted from the accumulated number of vehicles by hour, by direction and by type passing through the three locations on screen line. The conversion factors for PCU are given in Table 5.19.

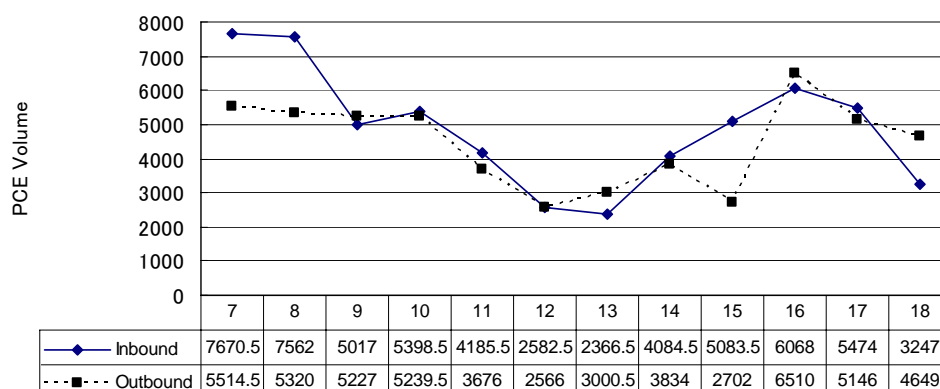
**Table 5.19: Passenger Car Unit**

(Unit: PCU/Vehicle)

Bike	Microbus	Minibus	Large Bus	Taxi	Car	Truck
0.5	1.0	2.0	3.0	1.0	1.0	3.0

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

The peak of inbound traffic from the western area to the eastern area (city center) was observed at around 7:00 am, while the peak of outbound traffic was at around 16:00 pm. There is not much difference in the traffic pattern between inbound and outbound traffic.

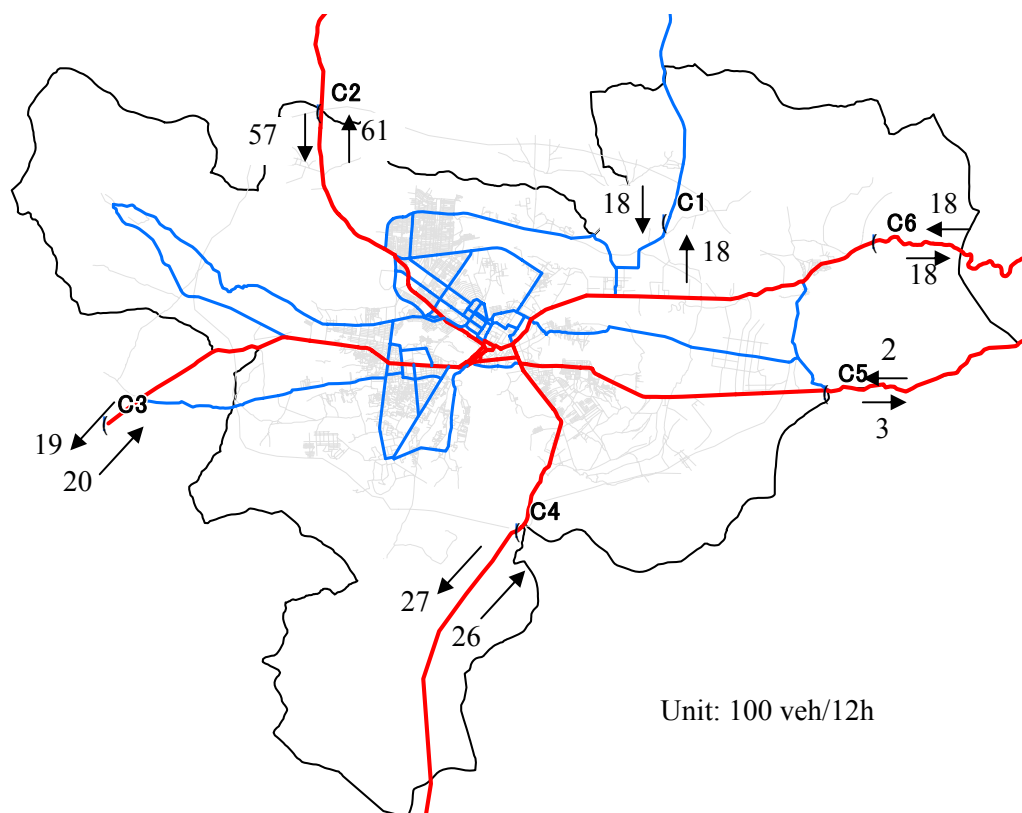


Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.24: Hourly Traffic Fluctuation Measured by Passenger Car Unit**

### (3) Traffic volume in Kabul city border

The total traffic volume coming into and going out of the Kabul city is 28,600 vehicles per 12 hours, of which the largest traffic volume of 11,800 vehicles per 12 hours was observed on the Bagram road (C2), followed by 5,300 vehicles per 12 hours on the Logar road (C4) (Figure 5.25). As for the traffic volume by each vehicle type, the passenger cars have the highest rate of 48%, followed by trucks sharing 20% (Table 5.20).



Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

**Figure 5.25: Traffic Volume in Kabul City Border**

**Table 5.20: Traffic Volumes by Vehicle Type on Cordon Line**

(Unit: Vehicles/12h)

Point	Direction	Bike	Microbus	Minibus	Large bus	Taxi	Car	Truck	Total
C1	Inbound	84	138	15	8	134	498	921	1,798
	Outbound	99	161	13	2	178	536	839	1,828
C2	Inbound	195	653	41	49	387	3,738	589	5,652
	Outbound	197	683	97	35	712	3,680	707	6,111
C3	Inbound	79	358	34	48	345	556	538	1,958
	Outbound	83	398	23	28	425	488	467	1,912
C4	Inbound	112	315	20	21	681	1,142	291	2,582
	Outbound	112	331	35	40	734	1,125	295	2,672
C5	Inbound	43	18	0	1	18	59	77	216
	Outbound	32	34	4	2	32	72	87	263
C6	Inbound	25	217	75	21	167	972	359	1,836
	Outbound	30	220	77	11	151	851	427	1,767
Total	Inbound	538	1,699	185	148	1,732	6,965	2,775	14,042
	Outbound	553	1,827	249	118	2,232	6,752	2,822	14,553
	Inbound + Outbound	1,091	3,526	434	266	3,964	13,717	5,597	28,595
	Share	3.8%	12.3%	1.5%	0.9%	13.9%	48.0%	19.6%	100.0%

Source: Kabul Metropolitan Area Urban Development Master Plan, JICA, 2009

## 5.3 Issues and Strategy for Transport Development in Kabul City

### 5.3.1 Major Transport Issues in Kabul City

#### (1) Regional transport network development

The national and regional highways constituting the main artery road network are radial roads extending from the Kabul city center, and no circular road exists at present. Due to the topographic conditions as well as planned urbanization, Kabul city consists of several segregated urban areas. This urbanization pattern is generally less efficient for the provision of various urban services than the corridor type urbanization or conurbation. These segregated urban centers should be effectively linked to enhance efficiency of urban spaces.

The new city is expected to develop complementary to the existing Kabul city. The effective link with the new city would help to realize improved urban spaces in Kabul city through relieving the urbanization pressure. To realize these conditions, the regional transport network should be developed with a ring road and stronger east-west and north-south axes. The Kabul outer ring road has been proposed for some time, and a new alignment was proposed by KMAUD master plan.

The existing Bagram road provides the main connection to the new city. This should be utilized to strengthen the north-south axis for the regional transport network. For this purpose, the Bagram road needs to be extended to the south in the east of the city center.

Four roads would connect to the extended north-south axis. These are 1) artery road in the north side of the airport, 2) Jalalabad road, 3) Ahmad Sha Baba Mina road under construction, and 4) Karte new road. The north-south axis would extend beyond the future Karte new road to connect to the southern section of the Kabul outer ring road. The extension of the north-south axis should be carefully aligned to avoid the recharging area of the lower Logar aquifers.

#### (2) Urban road system development

##### 1) Establishment of road hierarchy

Four national and regional highways are radiating from the city center, forming the main frame of the urban area, and the district blocks are connected with these roads. Districts roads separate the blocks, and main urban roads connected with district roads ensure the transportation between districts. District roads form the secondary arterial network though many of the roads are

fragmented with relatively short length. District blocks are formed by community roads that are mostly unpaved, and some are not connected with neighboring districts. Consequently, daily traffic tends to concentrate on the main arterial roads. It is necessary to establish a road hierarchy and introduce a road system that satisfies the transportation functions required in the area.

## *2) Urban road system development*

Artery roads together with the main artery highways connect districts of Kabul City, and district roads as secondary arteries connect communities to the artery roads. Many district roads are short and not well connected each other. Community roads to form blocks within each district are mostly unpaved and some are not connected to district roads. Consequently, daily traffic tends to concentrate on the main and other artery roads. It is necessary to establish a clear road hierarchy so that each class roads would serve expected functions respectively.

In developing the urban road system for Kabul City, it is important to improve links between the southwest and the northeast parts of the city, currently separated by hills and the Kabul River. There exist three routes connecting these areas, of which two are the main artery roads carrying the traffic volume of 56,000 PCU/day at present. This corresponds to 85% of the traffic capacity. As the traffic demand will further increase, the structure of the urban road system should be transformed by the following measures.

### Inner ring road

To increase the traffic capacity of roads connecting the southeast and the northwest parts of the city, an inner ring road should be established by improving the connections between existing roads. In particular, two missing links need to be resolved: links between Kotesangi in the east of the Polytechnic University and the existing main artery road in the northwest, and links between the Jalalabad road and the Karte new road by extending the road in the south of the airport.

### East-west axes

Two existing routes are functioning currently as the east-west axes: the Kandahar-Karte new road, and the Jalalabad-Mazar-e-Sharif road. Both of these roads pass through the city center, creating bottlenecks for traffic. Especially for the Kandahar-Karte new road route, there is no alternative diversion road connecting the southwest and the northeast parts. An elevated road from the Darulaman circle crossing the Kabul river up to the intersection with the Karte new road would be necessary.

### City roads in the existing CBD

It has already been planned to improve some roads in and around the city center. Many other roads need to be improved for pavement and other physical conditions. Some missing links should be resolved to improve the traffic circulation and to encourage diversion of daily traffic from the artery roads.

### Secondary roads

Missing links in the secondary road network should also be resolved to improve the links between districts. Many secondary roads need improvement for pavement and other road conditions.

### Intersections

Most intersections in Kabul City are roundabouts, which are not most effective in dealing with increasing traffic. Traffic signals should be introduced based on priority to be assessed.

## *3) Improvement of traffic control in the Kabul city*

The traffic congestion in Kabul city is caused mainly by the inadequate structure of urban road system, delayed rehabilitation of secondary and community roads, on-road parking and poor traffic control. The on-road parking undermines the safety of residents as it hampers the movement of emergency vehicles. Enforcement of ban on roadside parking needs to be strengthened. An area

traffic control system may be introduced together with the rehabilitation of secondary road network.

#### *4) Improvement of public transport capacity*

Public transport capacity should be much enhanced to reduce traffic congestion with increasing traffic. The following measures should be considered.

##### Large-size vehicles

Dominant means for public transport at present are shared taxis and mini buses, which combined have a 37% share of the total traffic in the city. Use of large size buses for selected routes would contribute to the significant reduction of traffic.

##### City circular bus

Once the inner ring road is established, bus priority lanes may be introduced to operate a circular bus services with large size buses. Regular and fast services following schedule would attract passengers like fixed track public transportation.

##### City bus services

The routes of city bus operation should be improved, and a transfer system established between different routes and also with the circular bus route. Bus exclusive lanes may be introduced on selected main artery roads.

##### Bus terminals

At present, both city terminals and inter-city bus terminals are located in the city center or congested areas. Their location should be optimized in relation to the circular bus services on the inner ring road.

#### *5) Parking facilities*

Parking capacity of the city needs to be much expanded. New parking facilities should be provided associated with greenery and urban parks to be also expanded, public bus terminals, and new residential complex development. Even for individual buildings to be newly constructed, provision should be made for parking spaces.

### **5.3.2 Strategy for transport development**

#### **(1) Road network development to mitigate traffic congestion**

The existing traffic congestion in Kabul city should be mitigated by the following.

##### Bottleneck alleviation

There are several physical and natural bottlenecks in the Kabul city such as the Asamay mountains, Kabul river, Bibimaru hill, Kabul airport and others. The road capacity passing through these sections should be expanded.

##### Separation of through traffic

Since the current major arterial roads are concentrated into the city center, District 1 and District 2, even inter-regional traffic passes through the city center. The through traffic should be separated from the city traffic as much as possible.

##### Resolution of missing links

There are many missing sections on secondary artery roads in Kabul city, and most of them create traffic bottlenecks. They should be resolved in steps.

Establishment of road hierarchy and appropriate road design standards

Current road classification is not adequately reflected in road design. The road hierarchy should be established and road design improved in accordance with the road classification.

Improvement of community roads

The excessive traffic volumes on the artery roads currently observed are due in part to poor conditions of feeder roads in communities. The community roads should be improved so that they would serve as feeder roads.

**(2) Road development for urban expansion areas**

The road network should be expanded especially in the east and the west of the existing urbanized area of Kabul City to serve new urban areas to be developed along the existing radial roads.

**(3) Road Infrastructure for Mass Transit System**

The modal share of public transport by small sized buses, taxis and other means in Kabul is around 50% at present. Since the number of private vehicles is expected to increase as the economy grows, high quality public transport services should be established to suppress the increase in private traffic. Improvement in road infrastructure should make provision for the introduction of facilities related to the high quality public transport services such as bus exclusive lanes.

**5.3.3 Strategy for public transport development****(1) Improvement of efficiency for public transport***1) Increasing transport capacity*

The share of public transport excluding taxis is about 40%, of which only 14% is shared by large-size buses. Use of large-size should be increased to reduce traffic congestion, road-side parking and other problems. Many of both the Millie and private bus services start and end in the city center, and there exist duplicated service route by Millie and the private buses. Bus routes should be reorganized by establishing a hierarchy of service routes and zones.

*2) Reorganizing service routes*

All the bus routes operated by Millie bus services start from, and go to the city center, and private bus operators generally follow this pattern. Therefore, there are doubled routes especially near the city center, which causes heavy traffic on streets. As the urban area expands further with the new city and new urban areas, the traffic volume will much increase, and bus routes may become more complicated. The adequate hierarchy for bus routes such as trunk routes on main roads and feeder services should be established not only for efficient operation but also for traffic safety and reduced congestion.

**(2) Up-grading of level of services by public transport***1) Introduction of exclusive or priority bus lanes*

In order to control the expected future increase of private passenger cars, it is necessary to strengthen the public transport system and its services. Especially, the speed up and punctuality of bus services would be the key factors to attract passengers to the public transport. The traffic congestion in the city center especially during morning and evening peak hours is extreme so that it is desired to take measures for converting the traffic to public transport as soon as possible. To realize this, prior lanes or exclusive lanes for buses should be introduced.

*2) Further reinforcement for mass transit system*

If bus exclusive lanes are provided on particular routes and bus services are provided much more frequently with high density, a mass transit system is effectively established with larger capacity than ordinary bus services. This is called the bus rapid transit (BRT) system. However, as the BRT uses the same size buses as ordinary ones, the maximum number of passengers per vehicle will be limited. Depending on the future demand, introduction of the light rail transit (LRT) services may be an alternative option, when the traffic increases significantly.

**(3) Mitigation of impact on road traffic conditions in the city center**

The existing bus route network is basically starting from the urban area, extending to the suburban areas and coming back to the urban area. Therefore, many bus terminals are located adjacent to the center of urban area and parked buses are obstructing the traffic flows in the city. Although it is the trend that the destinations of most passengers are in the city centers, it is not desirable to locate too many bus terminals with lots of stand-by buses in the urban area. The bus terminals in the urban area should be relocated to the suburban area as far as possible, and only bus stops on the route will be provided in the urban area.

**5.3.4 Strategy for road facilities and traffic management****(1) Removal of bottlenecks of traffic flow***1) Dealing with on-street parking*

The roadside parking in commercial areas is obstructing the traffic and extremely reducing the traffic capacity of the roads. Wherever the demand for parking is high, roadside parking facilities should be provided to permit temporally roadside parking as far as possible, considering the traffic volume and the road space. In other areas, roadside parking should be prohibited as a matter of principle.

*2) Flyover/under-path at intersections*

The critical bottlenecks for the traffic flow are at the intersections. There are many trunk roads with more than four lanes in the Kabul city, while no grade separated intersections exist. Considering the local site conditions in or close to the city center, it will be difficult to provide grade separation at intersections. As a basic policy, it is desirable to promote grade separation at intersections in the suburban area, where trunk roads of not less than four lanes intersect.

*3) Improvement of roundabout system and traffic signals*

Most intersections in the Kabul City are of rotary type of various sizes depending on road classification and local conditions. In general, rotaries located in the central urban area are small with traffic already exceeding the capacity, and thus it is no longer functioning as rotary. Therefore, small and medium size rotaries in the urban area should be abandoned gradually and the installation of traffic signals promoted. It is also desirable to install traffic signals at some rotary intersections, where trunk roads with high traffic volume intersect or link with another trunk road.

*4) Left turn pockets and median divides on wide roads*

As there is no provision of left turn lane at non-rotary intersections, a long queue of vehicles waiting for left turn is often created to cause congestion. Furthermore, median is not provided on some wide roads so that vehicles turning left to enter the facilities along such roads are obstructing the following vehicles in the middle of the roads. An extra lane for left turn vehicles should be provided at non-rotary intersections where traffic volume is large as well as medians on trunk roads having four or more lanes.

**(2) Improvement of road safety**

Non-motorized transport (NMT) facilities are not provided in the existing Kabul City, and many roads lack sufficient width for safe passage by pedestrians. Consequently, on some roads, NMT is using the carriageways, causing conflicts with vehicles. This situation reduces the traffic capacity and increase risks to NMT as well. Furthermore, crossing facilities including road marking for NMT is insufficient. Especially on the trunk roads with high traffic volume, it is extremely dangerous for NMT to cross the roads without such facilities. Road marking should be undertaken immediately for such roads, and more NMT facilities should be provided in steps throughout Kabul City.



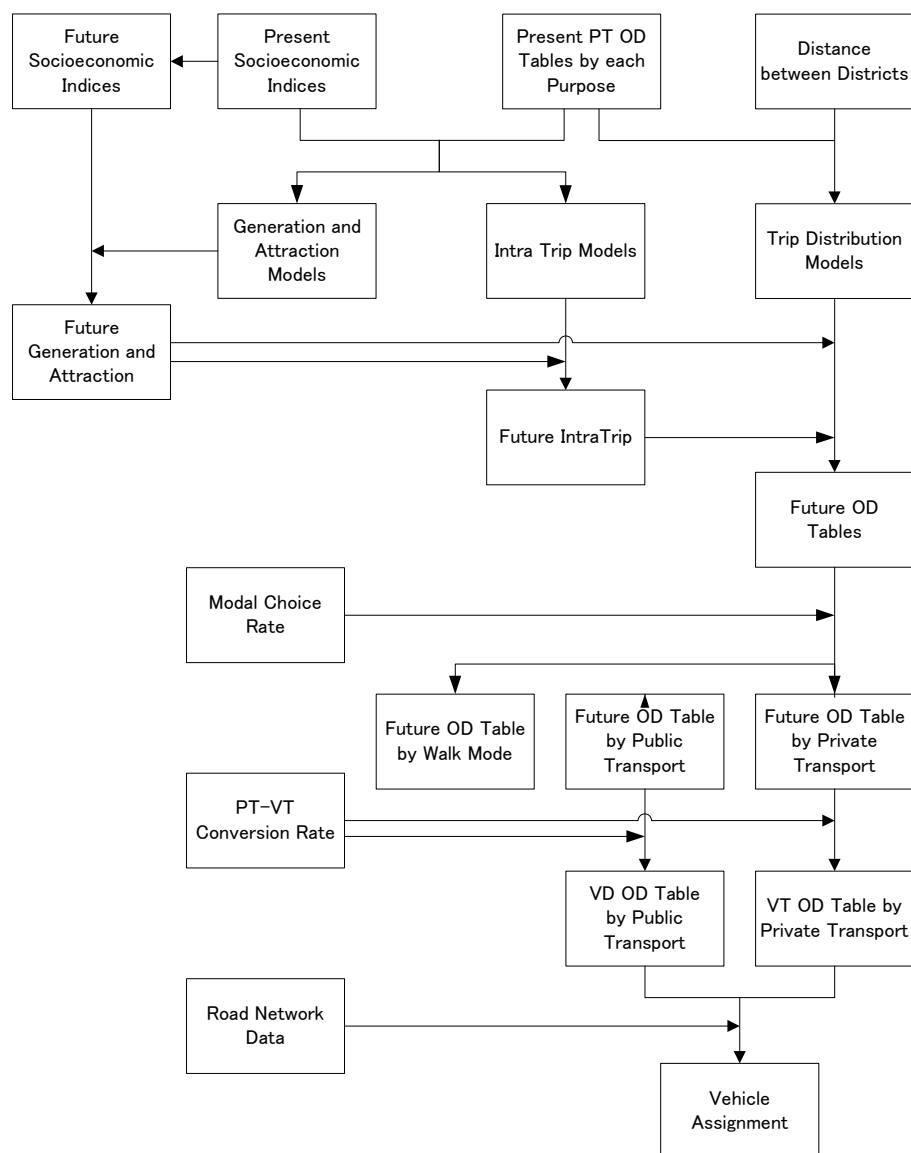
## **5.4 Traffic Demand Forecast**

### **5.4.1 Approach**

#### **(1) Method**

The traffic demand forecast is carried out using the “four-step model” shown in Figure 5.26. Forecast of traffic demand was made using traffic models (formula) which were developed by KMAUD Master Plan. The following steps are taken.

- 1) Based on the present origin-destination (OD) table and the present socioeconomic indices, a generation and attraction model by each purpose was established by KMAUD Master Plan. The future generation and attractions are estimated by applying the future socioeconomic indices to the model formula (section 5.4.2).
- 2) Using the present OD table and the shortest route distances on the roads between the gravity centers of the districts, a distribution volume model by each purpose was established in KMAUD Master Plan. The future OD table is constructed by applying the future generation and attraction to the model formula (section 5.4.3).
- 3) The traffic of non-inhabitants (cordon OD, Kabul Airport users OD and donors OD) are estimated separately in accordance with the growth of GDP and other indices.
- 4) From the present OD table by purpose and distances between zones, a mode-sharing model was established in KMAUD Master Plan. Similarly, the public transport OD table and private transport OD are extracted from the future OD table by purpose (section 5.4.4).
- 5) After converting the public transport OD table and private transport OD table from PT base data to vehicle trip (VT) base data, OD table based on number of vehicles are prepared and assigned on the road network(section 5.4.5).



Source: Planning Team

**Figure 5.26: Traffic Demand Forecast Process****(2) Zoning system**

The zoning system is shown in Figure 5.27 and Table 5.21.

**Table 5.21: Zoning System of the Study Area**

Small Zone No.	Zone Name	Large Zone No.	Large Zone Name	Area
1	Dis.1-1	1	District 1	Kabul City
2	Dis.1-2			
3	Dis.2-1			
4	Dis.2-2	2	District 2	
5	Dis.2-3			
6	Dis.2-4			
7	Dis.2-5			
8	Dis.3-1			
9	Dis.3-2	3	District 3	
10	Dis.3-3			
11	Dis.3-4			
12	Dis.3-5			
13	Dis.4-1	4	District 4	
14	Dis.4-2			

Small Zone No.	Zone Name	Large Zone No.	Large Zone Name	Area
15	Dis.4-3			
16	Dis.4-4			
17	Dis.4-5			
18	Dis.4-6			
19	Dis.5-1	5	District 5	
20	Dis.5-2			
21	Dis.5-3			
22	Dis.5-4			
23	Dis.5-5			
24	Dis.6-1	6	District 6	
25	Dis.6-2			
26	Dis.6-3			
27	Dis.6-4			
28	Dis.6-5	7	District 7	
29	Dis.7-1			
30	Dis.7-2			
31	Dis.7-3			
32	Dis.7-4			
33	Dis.7-5	8	District 8	
34	Dis.8-1			
35	Dis.8-2			
36	Dis.8-3			
37	Dis.8-4	9	District 9	
38	Dis.9-1			
39	Dis.9-2			
40	Dis.9-3			
41	Dis.9-4	10	District 10	
42	Dis.10-1			
43	Dis.10-2			
44	Dis.10-3			
45	Dis.10-4	11	District 11	
46	Dis.11-1			
47	Dis.11-2			
48	Dis.11-3	12	District 12	
49	Dis.12-1			
50	Dis.12-2	13	District 13	
51	Dis.13-1			
52	Dis.13-2			
53	Dis.13-3	14	District 14	
54	Dis.14-1			
55	Dis.14-2	15	District 15	
56	Dis.15-1			
57	Dis.15-2			
58	Dis.15-3	16	District 16	
59	Dis.16-1			
60	Dis.16-2			
61	Dis.16-3	17	District 17	
62	Dis.17-1			
63	Dis.17-2			
64	Dis.17-3	18	District 18	
65	Dis.18-1			
66	Dis.18-2	19	District 19	
67	Dis.19-1			
68	Dis.19-2	20	District 20	
69	Dis.20-1			
70	Dis.20-2	21	District 21	
71	Dis.21-1			
72	Dis.22-1	22	District 22	
73	Dis.22-2			
74	Dis.22-3			
75	Deshabz South (excl. Dis 18 & 19)	31		New City

Small Zone No.	Zone Name	Large Zone No.	Large Zone Name	Area
76	Deshabz North	32		
77	Paymonar(excl. Dis 18)	33		
78	Baribab	34		
79	Outside North (Mazar-e-Sharif, Kunduz, etc.)	23		Afghanistan
80	Outside East(Jalalabad)	24		
81	Outside South(Logar, Gardiz, Khost, etc.)	25		
82	Outside West(Kandahar, Herat, etc.)	26		
83	India, Pakistan, China	27		Others
84	Iran	28		
85	Tajikistan, Uzbekistan, Turkmenistan	29		
86	Kabul Airport	30		



Source: Planning Team

**Figure 5.27: Zoning System of the Study Area (Zone 1 ~ 78)**

## 5.4.2 Forecast trip generation and attraction

### (1) Trip generation and attraction model

Future trip demand is estimated by trip purpose. The trip generation and attraction model are expressed by the linear regression equation as follows:

$$(\text{Generation, Attraction}) = a_1 X_1 + a_2 D_1 + a_3 D_2 + a_4 D_3$$

Model parameters are defined in Tables 5.22 and Table 5.23.

**Table 5.22: Parameters of Trip Generation/Attraction Models**

Purpose		1st		2nd		3rd		4th		5th		Correlation coefficient
		Variable	Parameter	Variable	Parameter	Variable	Parameter	Variable	Parameter	Variable	Parameter	
Work	Gen.	V1	0.1755	Do1	-15,538.9							0.99
	Att.	V2	0.8409	D1	-106,587.1	D10	43,089.7	Do2	-22,911.1	Do3	-15,762.4	0.97
Study	Gen.	V1	0.1657	D4	-32,981.9	D5	5,427.3	Do4	-5,567.8	D18	-1,397.1	0.97
	Att.	V1	0.1435	D13	-16,807.4	Du1	30,709.2	Do5	-4,328.9			0.95
Business	Gen.	V1	0.0472	Do6	-9,076.7	Do7	-5,137.2					0.94
	Att.	V2	0.1658	D1	-14,123.2	Du2	6,516.4	Do8	-5,216.9			0.96
Private	Gen.	V1	0.0493	D13	3,901.1	Du3	7,171.2	D19	3,156.0			0.97
	Att.	V2	0.3831	D1	-52,864.8	Do9	-13,305.3	Do10	-8,856.4	Do3	-7,196.3	0.99

Source: Planning Team

Where V1: Population

V2: Employment at Workplace

DistXX: Dummy Variable (XX: District number 1-22)

DoZZ: Dummy Variable for over-estimated districts (ZZ: Dummy number 1-10)

DuYY: Dummy Variable for under-estimated districts (YY: Dummy number 1-3)

**Table 5.23: Dummy Parameters**

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D22
Do1				1									1								
Do2								1					1	1		1	1			1	
Do3																		1			1
Do4	1																		1	1	
Do5																			1	1	
Do6				1					1						1						
Do7			1			1	1					1	1								
Do8								1	1					1		1	1				
Do9				1				1	1					1							
Do10						1	1					1	1			1	1			1	
Du1		1	1																		
Du2					1					1	1										
Du3	1	1	1		1																

Source: Planning Team

**(2) Future trip generation and attraction****1) Total trips in Kabul city**

Table 5.24 shows the total trips in Kabul City by purpose in 2008 and in 2025. The total trips of 3,296,000 trips/day in 2008 will increase to 7,363,000 trips/day or 2.23 times, which is larger than the population increase by 1.56 times. The work trips will increase by 2.48 times, school trips 1.61 times, business trips 2.57 times, and private trips 3.19 times.

**Table 5.24: Total Trips in Kabul City by Purpose**

(Unit: trips/day)

Year	Work	School	Business	Private	Home	Total	Population
2008	694,120	655,769	140,475	227,707	1,577,596	3,295,668	4,221,000
2025	1,724,505	1,056,328	360,455	726,139	3,495,231	7,362,658	6,577,000
2025/2008	2.48	1.61	2.57	3.19	2.22	2.23	1.56

Note: # of trips = Generation + Attraction

**2) Trip generation and attraction by zone**

Future trip generation and attraction by district were estimated based on the socio-economic data shown in Table 5.25. In the central districts of Kabul City (Districts 1, 2, 3, 4, 5, 11 and 15), the trip generation and attraction increases by less than 2.2 times from 2008 to 2025. In other districts surrounding the central districts (Districts 6 through 17), they increase by up to 3.5 times. In District 18 overlapping with Paymonar of the new city and District 19 overlapping with Dehsabz south, the increase rates are about 10 and 30 times, respectively. The largest increase is observed in District 21 at about 30 times (Table 5.26).

**Table 5.25: Socio-economic Framework by Zone in Kabul City**

Zone	Population			Employment at Workplace		
	2008	2025	2025/2008	2008	2025	2025/2008
1	27,515	44,916	1.6	57,639	78,364	1.4
2	121,195	134,035	1.1	29,951	92,589	3.1
3	91,157	73,323	0.8	34,136	60,258	1.8
4	201,692	177,880	0.9	37,870	102,553	2.7
5	277,589	381,127	1.4	46,707	155,428	3.3
6	291,034	287,026	1.0	45,561	147,549	3.2
7	377,142	520,063	1.4	56,870	142,398	2.5
8	374,885	756,346	2.0	59,559	188,782	3.2
9	186,360	193,083	1.0	97,501	182,548	1.9
10	274,373	222,384	0.8	34,828	79,898	2.3
11	288,842	260,661	0.9	33,316	45,797	1.4
12	302,203	532,525	1.8	54,030	98,433	1.8
13	448,624	423,615	0.9	43,560	101,026	2.3
14	158,429	257,686	1.6	26,271	43,830	1.7
15	198,750	215,378	1.1	60,881	120,718	2.0
16	191,747	443,910	2.3	35,248	126,437	3.6
17	253,913	393,053	1.5	42,814	74,065	1.7
18	33,958	69,402	2.0	17,130	55,780	3.3
19	4,642	344,126	74.1	13,570	118,944	8.8
20	67,313	269,464	4.0	33,171	42,441	1.3
21	3,379	199,598	59.1	5,181	112,308	21.7
22	45,514	377,861	8.3	19,213	174,294	9.1
Total	4,220,556	6,577,462	1.6	885,007	2,344,440	2.6

Source: Planning Team

**Table 5.26: Trip Generation and Attraction by Zone in Kabul City**

(Unit: trips/day)

Zone	Generation			Attraction		
	2008	2025	2025/2008	2008	2025	2025/2008
1	125,503	171,137	1.4	141,994	188,252	1.3
2	123,119	241,481	2.0	136,545	256,012	1.9
3	109,547	147,124	1.3	111,353	150,318	1.3
4	87,939	191,565	2.2	87,768	192,894	2.2
5	253,350	499,640	2.0	246,501	498,441	2.0
6	212,405	392,553	1.8	213,061	396,028	1.9
7	276,128	500,698	1.8	272,798	502,068	1.8
8	242,167	665,144	2.7	231,385	642,787	2.8
9	231,032	386,229	1.7	233,476	389,688	1.7
10	265,573	319,583	1.2	269,490	318,052	1.2
11	220,493	228,244	1.0	225,543	227,308	1.0
12	233,226	428,280	1.8	229,963	433,401	1.9
13	239,508	329,341	1.4	233,044	332,596	1.4
14	73,267	154,553	2.1	71,606	149,574	2.1
15	198,983	314,102	1.6	198,564	313,848	1.6
16	111,303	401,319	3.6	107,929	387,197	3.6
17	156,234	281,965	1.8	155,415	274,266	1.8
18	19,775	199,436	10.1	18,875	199,668	10.6
19	23,895	640,975	26.8	23,132	635,712	27.5
20	50,406	168,717	3.3	46,793	167,593	3.6
21	10,995	301,545	27.4	10,741	299,015	27.8
22	30,821	399,026	12.9	29,692	407,941	13.7
Total	3,295,668	7,362,658	2.2	3,295,668	7,362,658	2.2

Source: Planning Team

### 5.4.3 Forecast of trip distribution

#### (1) Trip distribution model

The trip distribution model was developed by applying the gravity model. The parameters by trip purpose are shown in Table 5.27.

$$T_{ij} = k \cdot G_i \alpha \cdot A_j \beta / D_{ij} \gamma$$

Where

$T_{ij}$ : Trips between zones i, j

$G_i$ : Generated trips from zone i

$A_j$ : Attracted trips to zone j

$D_{ij}$ : Distance between zones i, j

$k, \alpha, \beta, \gamma$ : Parameter

**Table 5.27: Parameters of Trip Distribution Models**

Purpose	k	$\alpha$	$\beta$	$\gamma$	Correlation coefficient
Work	0.0000738	0.7896	0.8553	0.2723	0.92
Study	0.00455	0.6019	0.6360	0.5103	0.85
Business	0.0000614	0.8650	0.9150	0.1159	0.93
Private	0.0000327	0.8769	0.8955	0.0533	0.92

Source: Planning Team

## (2) Intra-trip model

The intra-trip model by purpose was developed by linear regression analysis, and the variables and parameters are shown in Table 5.28.

$$T_{ii} / A = a_1 (Gen / A) + a_2 (Att / A) + a_3 (Dummy)$$

Where

$T_{ii}$  Intra-zone trips in zone i

A Urban Area of zone i

Gen Generated trips from zone i

Att Attracted trips to zone i

$a_1$ - $a_3$  Parameter

**Table 5.28: Parameters of Intra-Trip Models**

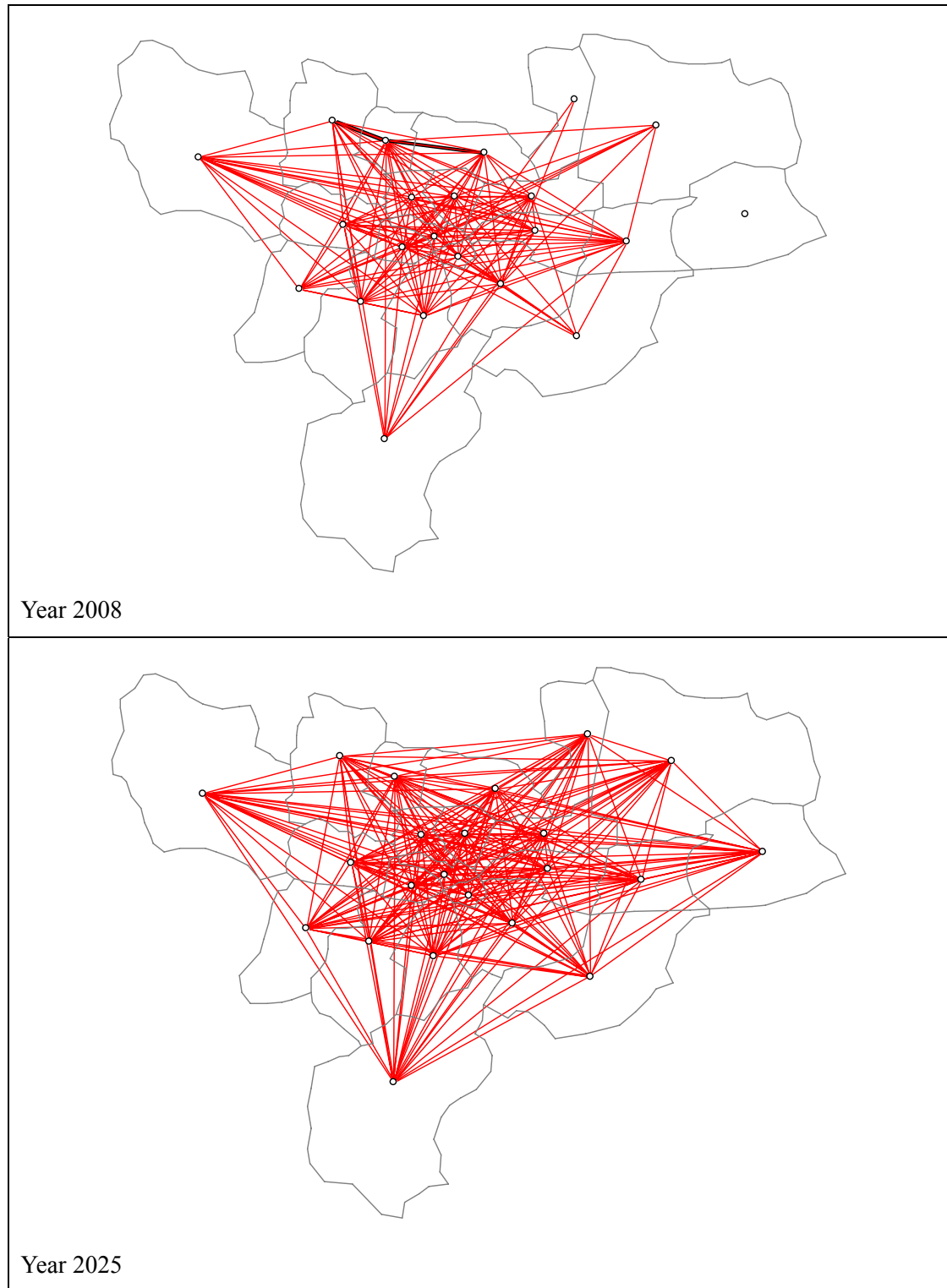
Purpose	Parameter		Dummy variable		Correlation coefficient
	Gen/A	Att/A	District	Parameter	
Work	0.2834	0.0185	D4, 15	-418.12	0.95
Study	0.6663	0.0073	D10, 15	-119.07	0.99
Business	0.2224	0.0197	D3, 14	-106.39	0.99
Private	0.2802	0.0119	D3, 15	-198.39	0.97

The district 18 and 19 including the New City area was prepared by adopting higher intra trip rates than other district, since the New City will be constructed as a self contained city.

## (3) Future trip distribution

The desired lines of traffic for all purpose trips are shown in Figure 5.28. As expected, many trips will start and/or end at nodes in the New City such as Dehsabz (D19) in the future.





Source: Planning Team

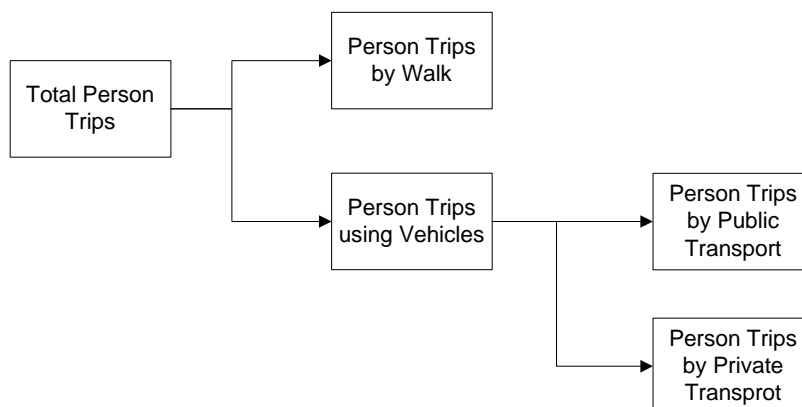
**Figure 5.28: Desire Line**

#### **5.4.4 Forecast of modal split**

##### **(1) Modal choice model**

In order to separate the future OD table by purpose obtained as described above, the sharing by transport mode has to be made. A binary model (Figure 5.29) was established by first separating

the whole trips into trips on foot and trips with vehicles and second separating the trips with vehicles into those by public and private transports.



Source: Planning Team

**Figure 5.29: Binary Type Modal Choice Structure**

## (2) Modal share of trips by Walk

The size of district is large and the trip distances between districts tend to be calculated much longer than the actual ones so that no clear relation between the trip distances and the share of trips of foot was observed. A model formula for the modal share of trips on foot within district by purpose is prepared assuming the maximum as well as the sharing rate for distance not less than 10 km will become almost 0% (see Tables 5.29 and 5.30, and Figure 5.30).

$$P_{ij} = \frac{1}{1 + e^{(aD_{ij}+b)}}$$

where

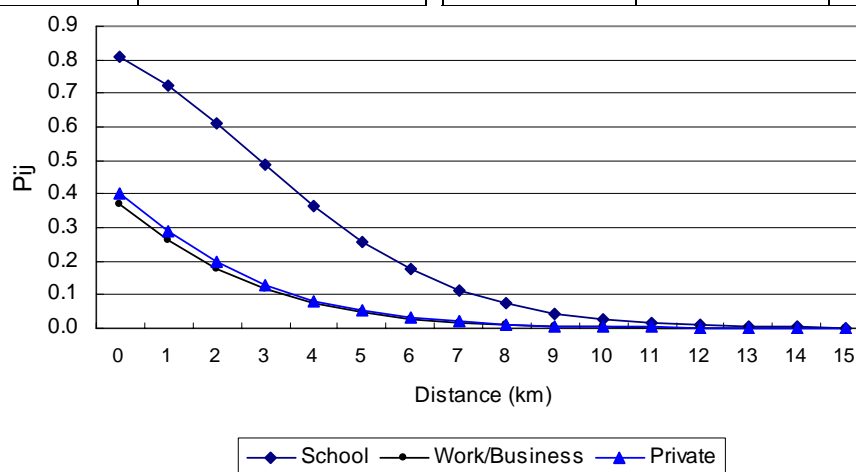
- $P_{ij}$  Modal Share  
 $D_{ij}$  Distance between i and j district (km)  
 $a, b$  Parameter

**Table 5.29: Modal Share of Trips on Foot (within District)**

Purpose	Walk
Work	37%
School	81%
Business	37%
Private	40%

**Table 5.30: Parameters of Modal Choice Model**

Purpose	a	b
Work	0.5	0.5322
School	0.5	-1.4500
Business	0.5	0.5322
Private	0.5	0.4055



Source: Planning Team

**Figure 5.30: Modal Sharing Curve of Trips on Foot**

### (3) Public transport/private transport modal sharing

The future share rates were determined considering the increase of registered numbers of vehicles. The registered number of vehicles for private transport (passenger cars + motor bikes + trucks) per population of 1,000 will increase by 44 vehicles from 31 in 2008 to 75 in 2025 ( $44/31 = 1.42$  times) so that the modal share rate of public transport will decrease.

Viewing the trips by commuting purpose, for instance, 75% are using public transport while 25% are using private transport at present. In future, the share of private transport will increase by 1.42 times from 25% to 35.5% and public transport will decrease instead to 64.5% (see Table 5.31).

**Table 5.31: Modal Shares of Public and Private Transport by Purpose between 2008 and 2025**

Purpose	Modal share in 2008 (%)				Modal share in 2025 (%)			
	Public transport		Private transport		Public transport		Private transport	
	Intra trip	Inter trip	Intra trip	Inter trip	Intra trip	Inter trip	Intra trip	Inter trip
Work	67.0	75.0	33.0	25.0	53.1	64.5	46.9	35.5
School	72.0	83.0	28.0	17.0	60.2	75.9	39.8	24.1
Business	71.0	78.0	29.0	22.0	58.8	68.8	41.2	31.2
Private	81.0	89.0	19.0	11.0	73.0	84.4	27.0	15.6

### (4) Trip distribution by mode in 2025

The modal share of transport in 2025 will be 51% for public transport and 25% for private vehicles as shown in Table 5.32. Compared with the present modal split, the shares of public and private transport will decrease by two points and six points respectively, while that of walking will increase by 8 points. Excluding the trips on foot, the use of public transport will decrease from 74% in 2008 to 67% in 2025.

**Table 5.32: Modal Choice of Transportation between 2008 and 2025**

(Unit: trips/day)

Year	Walk	Public	Private	Total
2008	1,077,683	1,634,651	583,333	3,295,668
(Except walk)	32.7%	49.6%	17.7%	100.0%
2025	1,767,038	3,754,956	1,840,665	7,362,658
(Except walk)	24.0%	51.0%	25.0%	100.0%
2025-2008 (Point)	-8.7	+1.4	+7.3	-

Source: Planning Team

Note: Cordon OD, OD for Kabul Airport users and OD of Donors not included

## 5.4.5 Traffic assignment

### (1) Traffic assignment model

The traffic assignment is carried out by the following procedure.

- 1) A future OD table is constructed by adding on the PTOD table for public and private transport, other OD tables for future cordon, the Kabul Airport and donors related trips.
- 2) The PTOD table is converted to a vehicle trip based OD (VTOD) table and PCU is calculated.
- 3) A traffic assignment network is prepared, and the relationship between the road capacity and traveling velocity (QV formula) is established for each link.
- 4) The traffic of the VTOD table is assigned to each link by using an incremental assignment model.

### (2) Prediction of other OD tables

Of the OD tables other than that prepared from the person trip survey, the future cordon OD table and the Kabul Airport OD table is expanded in accordance with the growth rates of population and the GDP. Assuming that public transport increase in accordance with the population growth of the

Kabul City, and private transport increase in accordance with the growth of the GRDP/capita (Table 5.33), the OD in 2025 will be 1.4 times and 3.4 times of those in 2008 respectively. It is also assumed that the donors OD table will not change from the present one.

**Table 5.33: Expansion Rate for Other OD Tables**

	Public transport	Private transport
Cordon OD	1.4	3.4
Kabul Airport OD	-	3.4
Donors OD	-	1.0

Source: Planning Team

*1) Cordon OD table*

The cordon OD table in 2025 was obtained by multiplying the factors 1.4 and 3.4 for public transport and private transport respectively on the cordon OD table of 2008.

*2) Kabul airport OD table*

Some 1,000 people are currently using the Kabul Airport every day. Therefore, it is estimated that 3.4 times of the present or 3,400 residents of Kabul City will use the airport in 2025 (Table 5.34). From the population ratio, 700 people from the new city will use the airport as well. Therefore, the future Kabul Airport OD table is prepared adopting the future population rate by zone on the total 4,100 users.

**Table 5.34: Kabul Airport Users in 2025**

	Y2008	Y2025
Kabul City	1,000	3,400
New City	-	700

Source: Planning Team

*3) Donors OD table*

The total number of people of donors in 2025 is assumed as 5,300, which is the same as in 2008. The future donors OD table is prepared by adopting the future population rate by zone on this figure.

*4) Preparation of future PTOD table*

Summing up the future cordon OD table, Kabul airport OD table and donors OD table on the public and private transport PTOD table obtained as described in the previous clause, the PTOD table is prepared.

**(3) Preparation of VTOD table**

*1) Conversion from PT to VT*

To convert the PTOD table into VTOD table, the average number of passengers obtained from the screen line survey is used (Table 5.35).

**Table 5.35: Average number of passengers**

	Public transport	Private transport
Traffic volume (veh/12h)	40,759	64,676
Trip volume (person/12h)	382,893	126,014
Average number of passengers	9.4	1.9

Source: Planning Team

*2) PCU conversion*

To convert the VTOD table into PCU values, the traffic volume obtained from the screen line survey and the passenger car conversion factors obtained from that by type of vehicles shown in Table 5.36 is used.

**Table 5.36: Traffic in Passenger Car Unit**

	Public transport	Private transport
Traffic volume (veh/12h)	40,759	64,676
PCU volume (PCU/12h)	47,702	64,422
Passenger car unit	1.2	1.0

Source: Planning Team

**(4) Road traffic capacity**

The road traffic capacity is estimated in accordance with the geometric design elements such as design speed and road width, and roadside conditions such as land use and number of intersections. In order to apply this to actual road facilities, it is necessary to adjust it with types of passing vehicles, traffic variation by time, directional traffic rates, traffic flow characteristics and other factors.

*1) Service level and Q-V relationship*

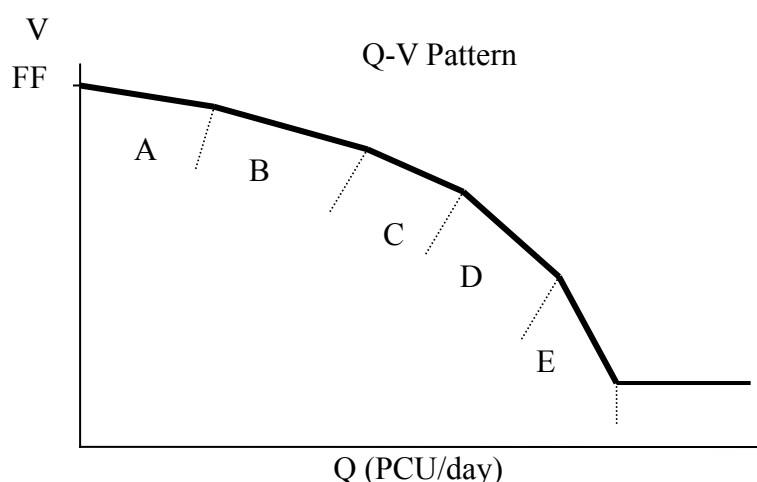
Service level is defined as criteria to express the degree of traffic congestion on the road. Q-V table expresses the relationship between each service level and the relevant traffic volume and travel speed. Table 5.37 shows the relationship between the service level and travel speed and traffic density given in the Highway Capacity Manual 2000.

**Table 5.37: Relationship between Service Level and Travel Speed and Traffic Density**

Service level	Travel speed (km/h)	Density range (pc/km/ln)
A	100-90	0-7
B	90-70	7-11
C	70-50	11-16
D	50-40	16-22
E	40-25	22-28
F	< 25	>28

Source: Planning Team

From these relationships, the maximum traffic flows expressed in passenger car units per hour per direction on each level of service (LOS) will be estimated in the form of Q-V curve (Figure 5.31). Also, those figures will be converted into daily traffic flows with peak hour factor, peak ratio and directional flow rate.



Source: Planning Team

**Figure 5.31: Q-V Curves***2) Free flow speed*

The free flow speed is calculated from the following formula given in Highway Capacity Manual 2000.

$$FFS = BFFS - F_{ls} - F_{lc} - F_m - F_n - F_a$$

Where

FFS	=	estimated FFS (km/h)
BFFS	=	base FFS (km)
F <sub>ls</sub>	=	adjustment for lane width and shoulder width
F <sub>m</sub>	=	adjustment for median type
F <sub>n</sub>	=	adjustment for number of lane
F <sub>a</sub>	=	adjustment for access point

### 3) Determination of Q-V

As described above, the Q-V pattern expressing the road connectivity characteristic can be determined from the design velocity, speed limitation, geometrical elements, roadside land use, traffic flow characteristics, and other factors. In other words, different Q-V patterns for each road link can be prepared in accordance with the combination of each governing factor for determination. This work can become very complicated. Q-V patterns are used in the traffic flow simulation, and the number of patterns can be simplified when matching the accuracy with other traffic data. In this study, the number of Q-V patterns is 28 using four road classifications, two land-use classifications and lane number classification (including directional limitation) as presented in Table 5.38.

**Table 5.38: QV Table**

(Unit: PCU/day)

		CBD Area					Other Area				
		LOS A	LOS C	LOS D	LOS E	LOS F	LOS A	LOS C	LOS D	LOS E	LOS F
Expressway	Velocity (km/h)	-	-	-	-	-	110	68	48	32	20
	2 lanes	-	-	-	-	-	0	24,000	32,000	36,000	37,800
	4 lanes	-	-	-	-	-	0	46,500	62,000	69,700	73,300
	6 lanes	-	-	-	-	-	0	69,800	93,000	104,500	110,000
CLASS I	Velocity (km/h)	72	56	32	30	26	72	56	32	30	26
	2 lanes	0	19,300	25,700	28,900	30,400	0	16,200	21,600	24,200	25,500
	4 lanes	0	38,600	51,400	57,800	60,800	0	32,300	43,100	48,400	51,000
	6 lanes	0	57,800	77,100	86,600	91,200	0	58,200	77,600	87,200	91,800
	8 lanes	0	77,100	102,800	115,500	121,600	0	64,700	86,200	96,900	102,000
CLASS II	Velocity (km/h)	50	35	27	20	15	50	35	27	20	15
	2 lanes	0	17,200	22,900	25,800	27,100	0	15,500	20,600	23,200	24,400
	3 lanes	0	25,800	34,400	38,700	40,700	0	23,200	30,900	34,700	36,600
	4 lanes	0	34,400	45,900	51,600	54,300	0	30,900	41,200	46,300	48,800
	6 lanes	0	51,600	68,800	77,300	81,400	0	46,400	61,900	69,500	73,200
CLASS III	Velocity (km/h)	40	28	21	16	7	45	32	24	28	7
	2 lanes	0	15,200	20,300	22,800	24,000	0	13,800	18,400	20,700	21,800
	4 lanes	0	30,400	40,600	45,600	48,000	0	27,600	36,800	41,400	43,500
	6 lanes	0	45,700	60,900	68,400	72,000	0	41,400	55,200	62,000	65,300
CLASS IV	Velocity (km/h)	30	21	16	12	5	40	28	21	16	5
	2 lanes	0	13,300	17,800	20,000	21,000	0	11,900	15,800	17,800	18,700
	3 lanes	0	20,000	26,600	29,900	31,500	0	17,800	23,700	26,700	28,100
	4 lanes	0	26,600	35,500	39,900	42,000	0	23,700	31,600	35,600	37,400
	6 lanes	0	39,900	53,300	59,900	63,000	0	35,600	47,500	53,300	56,100

Source: Planning Team

### (5) Conditions of traffic assignment calculation

For traffic assignment calculation, incremental assignment method was used with the following repetitive calculation. The assignment of public transport was calculated first and the private transport was calculated afterwards.

Public transport:	two times (50% 50%)
Private transport:	five times (30% 20% 15% 15% 10% 10%)

## (6) Results of traffic assignment

For the purpose of the transport planning, the traffic condition in the future is estimated in case that no improvement would be made, which is called “Do-Nothing” case analysis. The traffic assignment results in 2008 and in 2015, 2020 and 2025 in Do-Nothing cases are shown in Figure 5.32 and summarized in Table 5.39.

**Table 5.39: Vehicle Assignment Results in Do-Nothing Case**

	Year 2008	Year 2015	Year 2020	Year 2025	Ratio 2025/2008
Total Vehicle Trips (PCU)	494,350	762,062	964,538	1,209,786	2.45
PCU-km('000)	3,671	7645	11,472	14,354	3.91
PCU-Hour	95,699	267,758	512,107	757,377	7.91
Volume / Capacity	0.47	0.97	1.44	1.81	3.85
Average Speed (km/h)	38.4	28.6	22.4	19.0	0.49

It is apparent that the important corridors will become heavily congested in the future. The following points are noted:

### 1) Traffic indicator

The future traffic situation is evaluated by the changes in number of vehicle trips, PCU-hr, PCU-km and average speed. The vehicle trips are forecasted to increase from 494 thousand trips in 2008 to 1,210 thousand in 2025 by 2.5 times. The PCU-hr and PCU-km also increase, especially the PCU-hr increases from 96,000 PCU-hr in 2008 to 757,000 in 2025 by 7.9 times. As a result, the average travel speed will decrease from 38.4 km/hr in 2008 to 19.0 km/hr in 2025, facing an economically and environmentally serious situation.

### 2) Traffic congestion

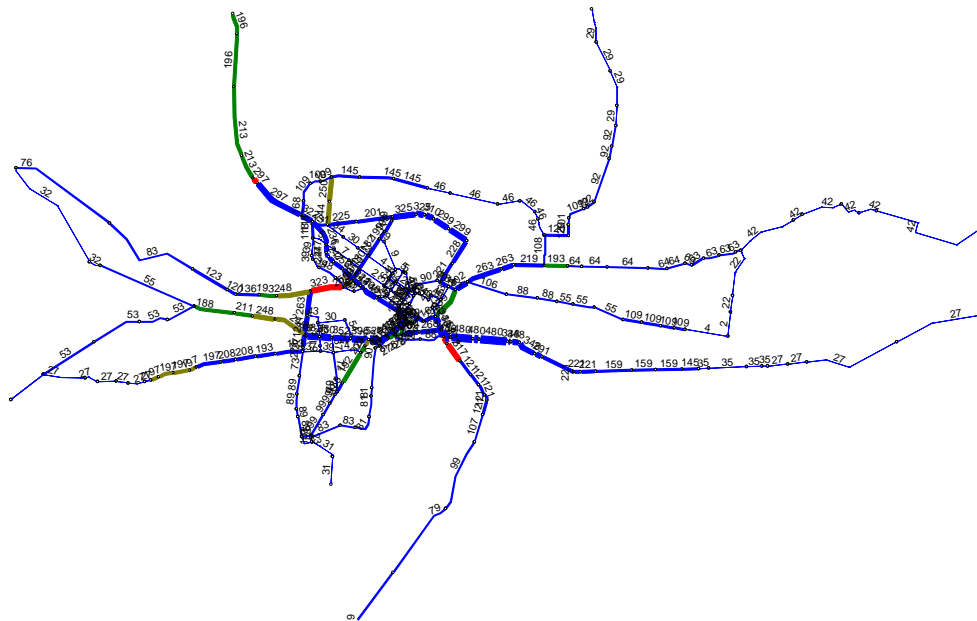
The volume to capacity ratio (V/C) is calculated to evaluate the road congestion. The average V/C in 2008 is 0.47, which is a fairly good value, while the traffic in 2025 will be at an unacceptable level with the average V/C of 1.81.

### 3) Summary

If no countermeasures against traffic congestion are implemented in the transport the road congestion will apparently occur at most links, which will seriously affect the city function. Especially on the Bagram road connecting the New City and Kabul City, the traffic volume will increase to 266,000 PCU/day which is 104 times the present traffic and actually not passable. Consequently, construction of new road or widening of existing road is necessary.

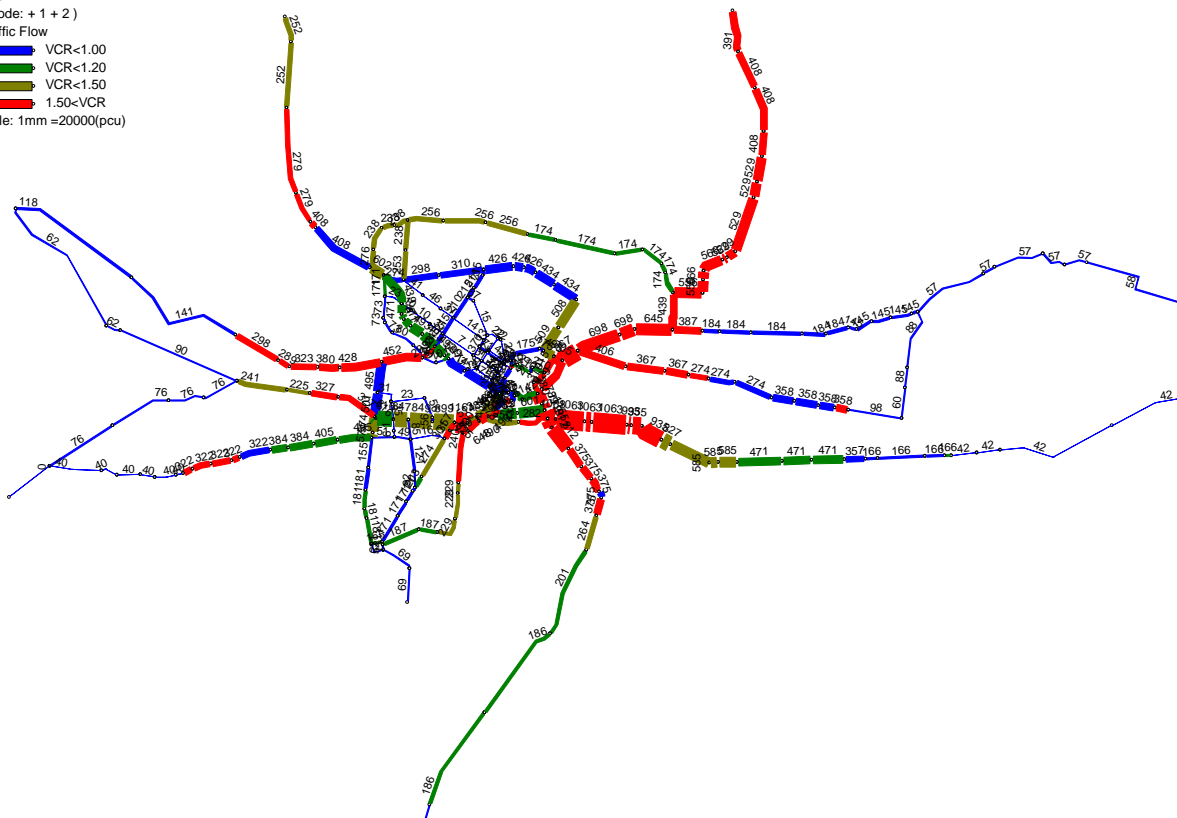


LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm =20000(pcu)



Present Traffic Assignment(2008)

LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm =20000(pcu)

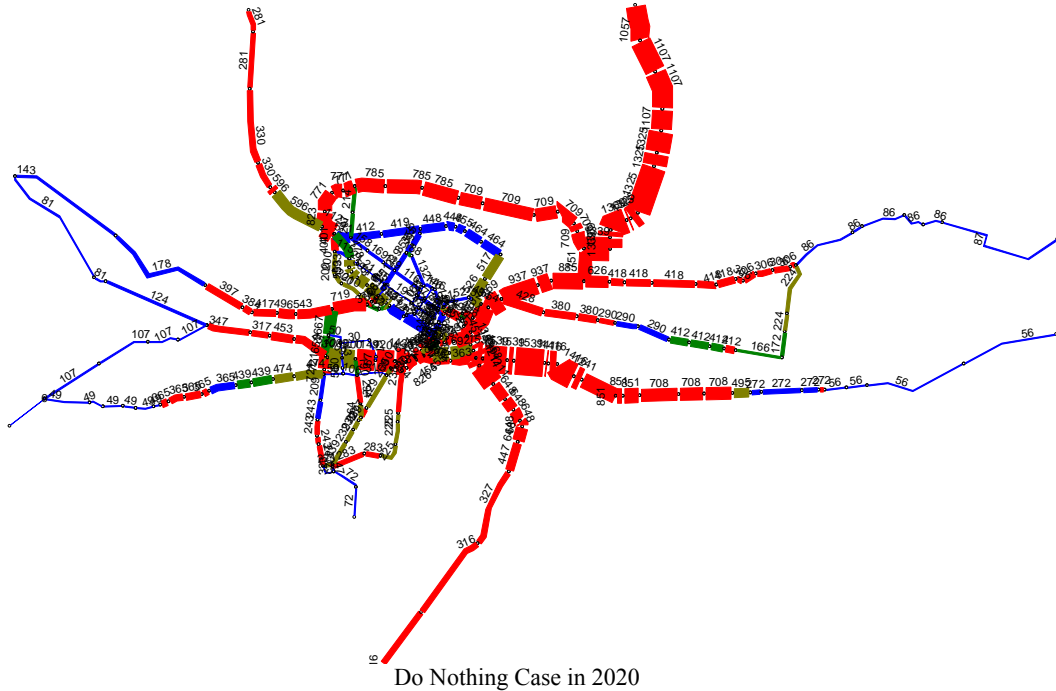


Do Nothing Case in 2015

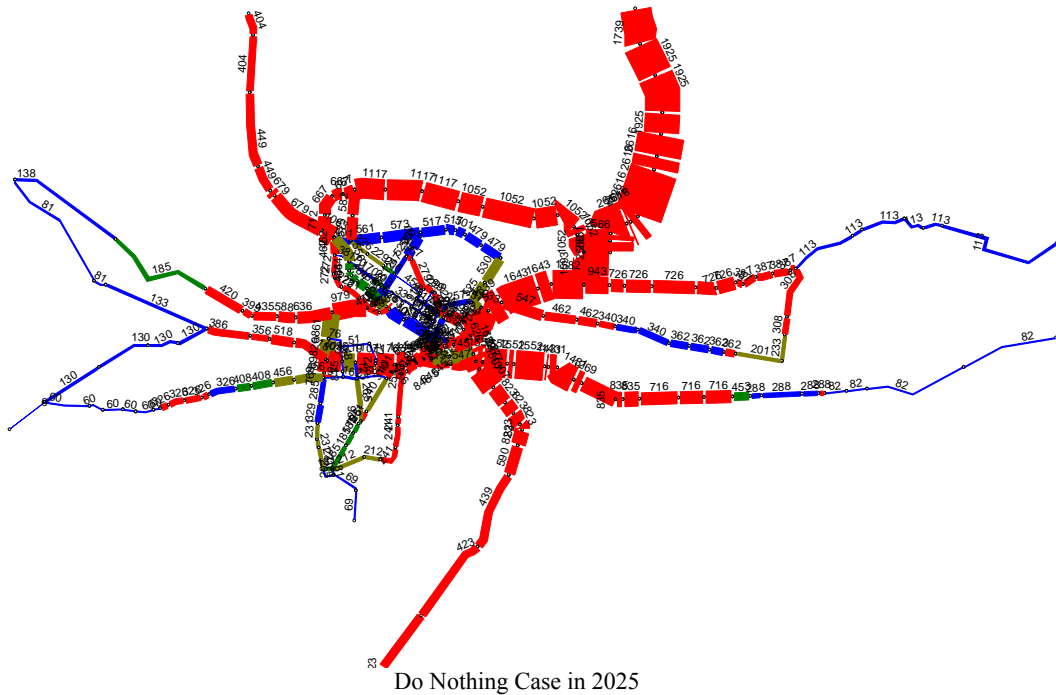
Source: Planning Team

**Figure 5.32: Traffic Flow of Do-Nothing Case (1/2)**

LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm =20000(pcu)



LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm =20000(pcu)



Source: Planning Team

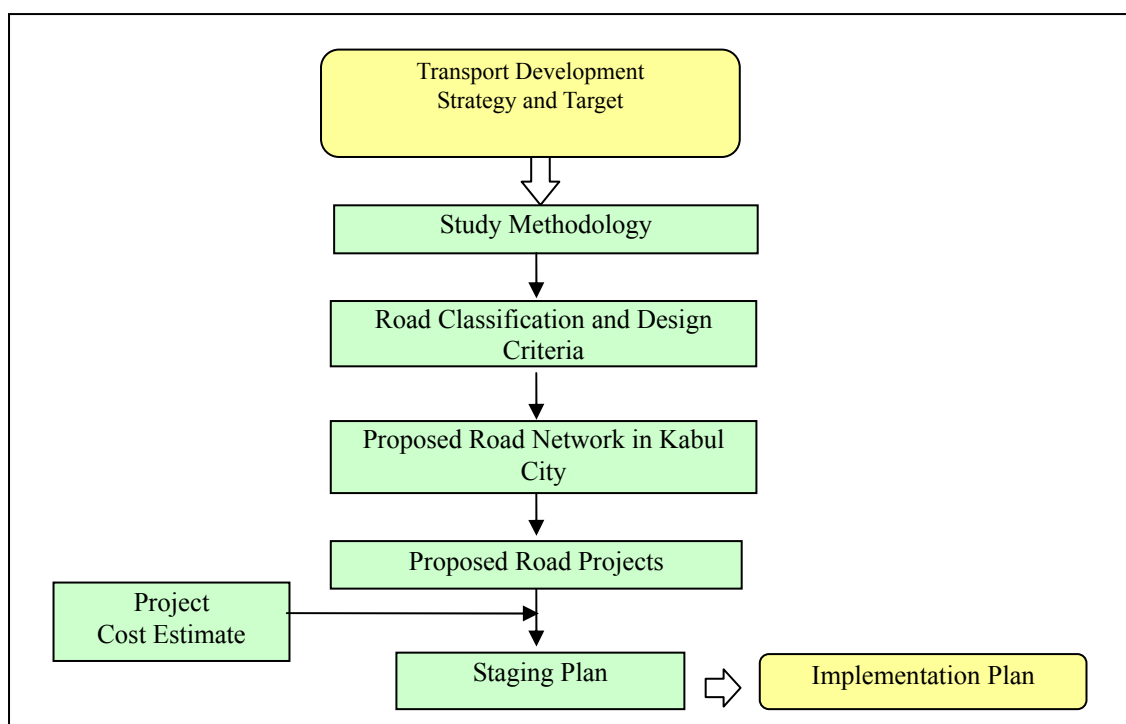
Figure 5.32: Traffic Flow of Do-Nothing Case (2/2)

## 5.5 Road Network Development Plan

### 5.5.1 Methodology

#### (1) Planning procedure

The process of the transport study to formulate the road network development plan is shown in Figure 5.33.



Source: Planning Team

**Figure 5.33: Study Procedure**

#### (2) Planning Concept

To realize the above strategy, the basic direction of road network development plan is as follows:

- Introduction of radial and circumferential road network system
- Hierarchical and functional road network
- Maximum utilization of existing network
- Inducement of proper urbanized area expansion
- Harmonized development with public transport

### 5.5.2 Road classification

Roads are categorized from the viewpoints of road functions and road design. Functional classification is divided into five categories from major roads to local roads. Design classification has five categories including expressways based on Afghan standards.

The relationship between the functional classification such as arterial roads and others and design classes such as expressways is not clear in the present road classification in Afghanistan. Consequently, a road at higher functional category serving for inter-provincial traffic tends to be treated in a low design class if the present traffic is small. Many city roads may be categorized as expressways based only on large traffic (see Table 5.40). Moreover, the category names of design classes such as expressway, major road and minor road are not clearly defined, causing confusion with functional classification.

**Table 5.40: Road Design Standard of Afghanistan**

Afghan standard	ROW (m)	ADT (PCU/day)	Design speed* (km/h)	Lanes (n)
Expressway Type 2	100	Over 30,000	120/100/80	More than 4
Expressway Type 1	50	30,000 - 13,000	120/100/80	4
Major road	30 (Rural)	13,000 - 5,000	100/ 80/ 50	2
	19 (Urban)			
Minor road	30 (Rural)	5,000 -	60/ 50/ 40	2
	18 (Urban)			
Non-standard	-	-	-	-

\*Design speed: Flat/Rolling/Mountainous terrain

Source: Interim Road and Highway Standard, 2005, MPW

Road design classes may be renamed more clearly, and design classes can be defined by factors of classification and the area of service introduced as the area specification factor. Relationship between the road classification and the area of service is given in Table 5.41 and modified road design standards (with renaming) are proposed in Table 5.42.

**Table 5.41: Relationships between Functional Classification and Design Classes**

Functional classification	Area specification	
	Rural	Urban
Expressway	S	S
Major arterial	I or II	I or II
Arterial	II or III	III or IV
Secondary	III or IV	III or IV
Community	IV	IV

Source: Planning Team

**Table 5.42: Modification of Road Design Standard (Urban Area)**

Design class	Design speed (km/h)	ROW (m)	Default (signals/km)
I	70-60	40-70	0.5-2.0
II	60-40	30-60	2.0-4.0
III	60-40	20-30	4.0-6.0
IV	30	8-20	4.0-6.0

Source: Planning Team

### 5.5.3 Standard cross section

#### (1) Design criteria

The proposed functional road classification and design criteria are shown in Table 5.43. It is recommended to consult the following manuals/guidelines for the details of design:

- Interim Road and Highway Standard, 2005, Ministry of Public Works, Government of Afghanistan
- A Policy on Geometric Design of Highways and Streets, the American Association of State Highway and Transport Officials (AASHTO)
- Road Structure Guidelines, Japan Association of Roads, February 2004
- Guide for Design of Pavement Structure, AASHTO
- Highway Capacity Manual, Fourth Edition, Transportation Research Board, National Research Council, Washington DC

**Table 5.43: Proposed Road Functional Classification and Design Criteria**

	Major arterial	Arterial	Minor Arterial	Others
Function	- Intercity trunk road	- Primary distributor - District distributor	Access road connecting to local streets distributor.	Other minor roads for local access.
Flow Condition	Possibly uninterrupted flow except at intersection	Possibly uninterrupted flow except at intersection	Interrupted flow	Interrupted flow
Design Speed (km/h)	60~70	50~60	40~50	30
Target Speed (km/h)	40	40	30	20
Level of Service	C	C	D	D
ROW range (m)	40-70	40-60	20-50	10-20
No. of Lane	6~8	4~6	2~4	1~2
Lane Width (m)	3.5	3.5	3.5	3.0
Median (m)	3.0-5.0	3.0-5.0	1.0-3.0	-
Shoulder (m)	2.5(outside) 0.5(inside)	2.5(outside) 0.5(inside)	2.5(outside) 0.5(inside)	0.5~2.0
Sidewalk 1) (m)	2.0-3.0	2.0-3.0	2.0-3.0	(2.0-3.0) or shoulder
Bicycle Lane (m)	2.0(If required)	2.0(If required)		
Greenbelt 2) (m)	2.0-4.0	2.0-4.0	1.0-3.0	If required

Source: Planning Team

## 1) Sidewalk

Sidewalk with a width of 2.5-3.0m is proposed to accommodate pedestrians and non-motorized transport (NMT) modes. In the design of sidewalks, the requirements for physically challenged people (PCP) shall be taken into consideration.

## 2) Greenbelt

A 2.0-4.0m greenbelt space for trees and vegetation is provided between traveled way and sidewalk to secure the safety of pedestrians and enhance the aesthetic value of the road and environment.

1) *Right-of-way*

Standards for the road right-of way (ROW) may be determined according to the functional classification of roads as shown in Table 5.43. Consideration of right-of-way in Afghanistan is provided in the road design standards. In this master plan, the right-of-way is defined as shown in Table 5.44 taking into account the expected number of lanes and with or w/o service road in relation to road classification.

**Table 5.44: Road Functional Classification and Right of Way (ROW)**

Classification	No. of Lanes	ROW (m)
Major arterial	6-8	40-70
Arterial	4-6	40-60
Minor Arterial	2-4	20-50
Others	1-2	8-20

Source: Planning Team

2) *Carriageway*

The width of road carriageway in each class and road shoulders are determined following the Afghan standards (see Table 5.45).

**Table 5.45: Width of Lane and Shoulder**

Road class	Median (m)	Lane width (m/lane)	Shoulder (min) (m)
Major arterial	3.0-5.0	3.5	2.5(outside)/0.5(inside)
Arterial	3.0-5.0	3.5	2.5(outside)/0.5(inside)
Minor arterial	1.0-3.0	3.5	2.5(outside)/0.5(inside)
Others		3.0	2.5(outside)/0.5(inside)

Source: Planning Team

3) *Provision for NMT*Basic conditions for NMT facilities

Since pedestrian and bicycle uses involve very different styles and speeds than automobiles, it is basically desirable to provide exclusive spaces for the NMT. However, it is not economical to

provide such spaces on all roads. Therefore, it is important to decide on the provision for the NMT based on traffic volumes, traffic speed differences and roadside conditions, and other factors.

Since it is dangerous for bicycles to run on carriageways, and this also impedes the vehicle traffic, the minimum requirement is to separate the two. On the other hand, in the case where pedestrians and bicycles drive in the same space, there is a risk that friction occurring between the two will adversely affect the safety and comfort of passage for both. Accordingly, in cases where bicycle traffic volume is extremely large, it is considered necessary to develop the bicycle exclusive lanes.

The ownership of bicycles in Kabul city is not so high. It is, therefore, not economical to build bicycle exclusive lanes. Accordingly, it is considered appropriate for bicycles to utilize the same spaces as cars or pedestrians. In the case where the car traffic volume is heavy and it is too dangerous for bicycles to use carriageways, it is appropriate to adopt bicycle and walkways that can be shared by bicycles and pedestrians. In case where bicycles and pedestrians use the same spaces, the volume of bicycle traffic should be small enough. Only when there is some impediment to passage by pedestrians and bicycles, it may be desirable to adopt exclusive bicycle ways.

#### NMT width structure

NMT facilities in the urban area should be established on all these roads as a matter of principle. Accordingly, minimum width shall be set upon taking Afghanistan and Japanese standards as shown in Table 5.46.

**Table 5.46: Minimum Width of Walkway (Japanese Standard)**

Bicycle	Pedestrian	Bicycle/Pedestrian traffic	
		Little	Heavy
2.0m	2.0m	3.0m	4.0m

Source: Road Design Standard, Japan Road Association

#### Strategy for NMT provision

Based on the considerations above, the following strategy is suggested for walkways and bicycle-ways according to road classification. Local roads are generally used only by local residents and traffic volumes are quite limited. Accordingly, local roads should be shared with pedestrians and, in principle; there should be no provision of walkways. In cases where walkways and bicycle cum walkways are installed, they should basically be constructed beside roads. The minimum widths and standards for walkways and bicycle ways are determined by road classification as shown in Table 5.47.

**Table 5.47: Recommended Standards of Walkway Development**

Road class	Car traffic	Ped. traffic	Walkway	Min. width	Note
Major arterial	Heavy	Heavy	Bicycle and pedestrian	3.0m	Separate pedestrians from cars
Arterial	Heavy	Heavy			
Minor arterial	Medium	Heavy			
Others	Medium Few	Heavy Little	Pedestrian (shoulder)	3.0m* -	Not separate pedestrians from cars

Source: Planning Team

Notes: Walkway basically for both sides;

Minimum 0.5m-wide utilities space to be reserved on each roadside

\* Minimum 2.0 required for width but Afghan minimum standard adopted

#### **(2) Standard cross section**

Typical cross-sections proposed for each class of road are shown in Table 5.48. The service utilities shall be contained within the limits of the right-of-way.

Table 5.48: Proposed Standard Cross Sections

Major Arterial Road	<p>ROW = 70m ( 8 Lanes with Service Road)</p>	<p>ROW = 50m ( 8 Lanes)</p>
Arterial Road	<p>ROW = 60m ( 6 Lanes with Service Road)</p>	<p>ROW = 40m ( 6 Lanes)</p>
Arterial Road	<p>ROW = 50m ( 4 Lanes with Service Road)</p>	<p>ROW = 30m ( 4 Lanes)</p>
Minor Arterial Road	<p>ROW = 16m ( 2 Lanes )</p>	<p>ROW = 11m ( 2 Lanes )</p>

Source: Planning Team



### 5.5.4 Proposed road network development

#### (1) Principles for road network improvement planning

Principles for the planning of road network improvement are as follows:

- To establish a hierarchical and functional road network
- To form a radial and circumferential road system
- To guide and coordinate the future land use plan
- To utilize existing roads as much as possible

#### (2) Proposed Road Network

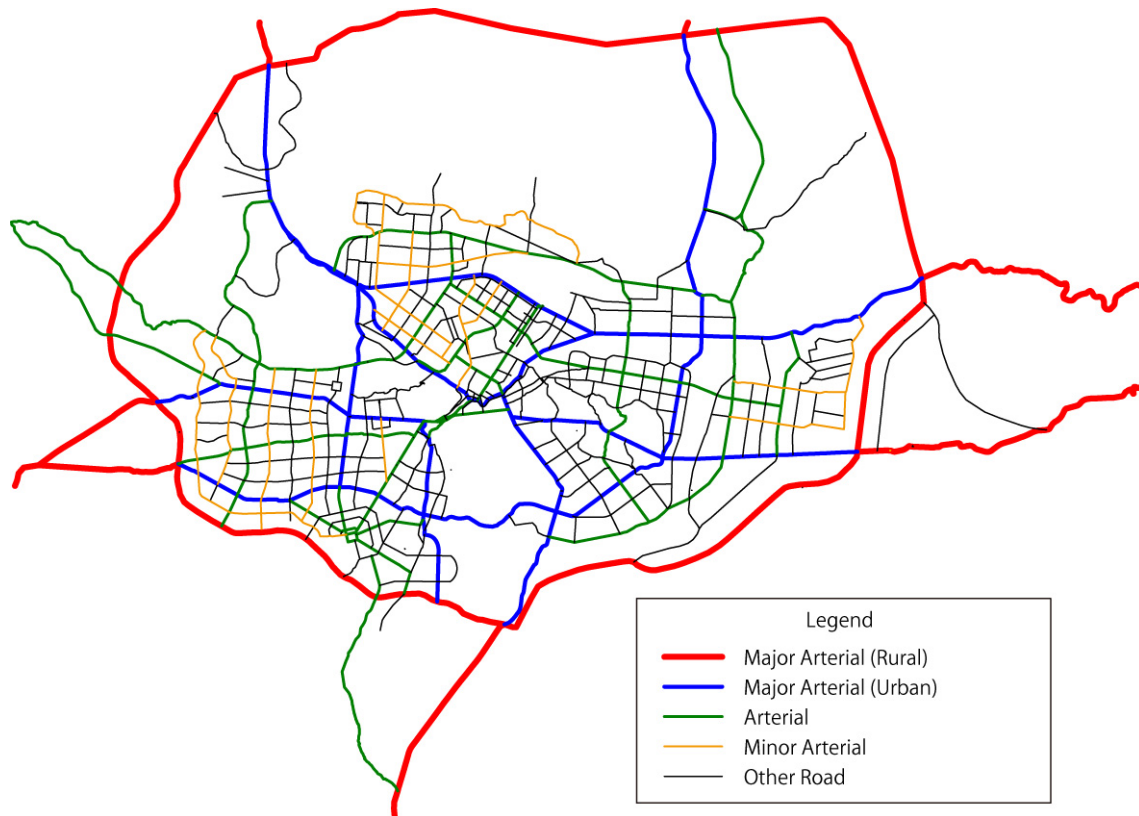
The proposed road network in Kabul city is shown in Figure 5.34. Composition of road standards is described below.

- (i) Major arterial roads  
It is proposed to form an major arterial road network of radial and circumferential type. Radial roads are major arterials from the center of Kabul urban area to outer areas in radial direction connecting to major roads, while circumferential roads are major distributors connecting radial roads. Radial roads consist of five roads and circumferential roads consist of two roads: Kabul City Inner Ring Road (KCIRR) and Kabul City Outer Ring Road (KCORR).
- (ii) Arterial roads  
Arterial roads supplement the major arterial roads to inter-connect districts in the city.
- (iii) Minor arterial roads  
Minor arterial roads are local distributors inside the blocks divided by arterial roads.
- (iv) Other roads  
Other roads are roads providing local access.

**Table 5.49: Total Road Length of Proposed Road Network**

Road Class	Length(km)
Major Arterial Road	143.2
Arterial Road	196.7
Minor Arterial Roads	99.3
Other roads	364.0
Total	803.2

Source: Planning Team



Source: Planning Team

**Figure 5.34: Proposed Future Road Network of Kabul City**

#### 5.5.5 Identification of required road improvement

Table 5.50 shows the necessary improvement works to complete the road network by section shown in Figure 5.35. Table 5.50 shows the Right of Way (ROW) required to accommodate expansion of number of lanes, frontage road, public transport facilities (LRT, BRT) and/or widening sidewalk. Based on the road class and particular improvement shown in the table below, the proposed ROW is identified as shown in Figure 5.36.

**Table 5.50: Necessary Improvement Works**

No.		Project name/Category	Project Component	Length (km)	ROW	No.of Lane
1. Major Arterial Roads						
MA-1	Bagram	Bagram Road Up-grading	Widened fm 4lane to 8lane+2lane frontage	10.8	100	8
MA-2		Extension of Bagram Road (KCCIR)	New 6lane+2-lane frontage road	8.7	60	6
MA-3	West East	West-East Axis (Qula-i-jabbar Section) (KCCIR)	New 6lane + frontage road	5.2	60	6
MA-4		West-East Axis (Asmay Tunnel Section) (KCCIR)	New 6lane tunnel	5.5	40	6
MA-5		West-East Axis (Bagrami Section)	New 4lane + frontage road	12.4	60	6
MA-6	Ring Road	KCORR (Existing City)	New 4lane + frontage road	83.7	100	2
MA-7		KCORR (New City)	New 4lane + frontage road	18.8	100	2
MA-8		KCIRR (North Section)	New 6lane + frontage road	2.6	60	6
MA-9		KCIRR(Jalalabad Road)	Widened fm 4lane to 6lane	4.5	60	6
MA-10		KCIRR (West Section) -1	New 6lane + wide sidewalk	3.9	50	6
MA-11		KCIRR (West Section) -2	Widened fm 2lane to 6lane + wide sidewalk	4.0	50	6
MA-12	Radial Arterial	Mazar-e Sharif Road Up-grading	Widened fm 2lane to 4lane + wide sidewalk	13.5	40	4
MA-13		Jalalabad Road	Widened fm 2lane to 4lane	10.3	30	4
MA-14		Bagrami Road	Widened fm 4lane to 6lane	4.4	40	6
MA-15		Logar Road	Widened fm 2lane to 6lane	15.8	40	4
MA-16		New Road	New 4lane	7.3	30	4
MA-17		Barikab Road	New 6lane + frontage road	11.9	70	6
		Barikab Road (tunnel)	New 6lane	2.5	70	6
2. Arterial Rods						
A-1	Arterial	Airport Road(West Section)	New 6lane	16.0	60	6
A-2		Airport Road(East Section)	New 4lane	2.8	30	4
A-3		Arterial Road	New 4lane	5.4	30	4
A-4		Arterial Road	New 4lane	7.9	30	4
A-5		Arterial Road	New 4lane	5.6	30	4
A-6		Arterial Road	New 4lane	12.0	50	4
A-7		Arterial Road	New 2lane	11.2	30	2
A-8		Arterial Road	New 4lane	11.7	30	4
A-9		Arterial Road	New 4lane	12.6	40	4
A-10		Arterial Road	New 4lane	16.6	30	4
A-11		Arterial Road	Widened fm 2lane to 4lane	10.4	30	4
A-12		Darulaman Road	Widened fm 2lane to 4lane	5.0	60	4
			New 2lane	12.3	20	2
A-13		Arterial Road	New 4lane	3.2	30	4
A-14		Arterial Road	New 4lane	4.9	40	4
A-15		Arterial Road	New 2lane	6.1	30	2
A-16		Arterial Road	New 2lane	6.7	30	2
A-17	Arterial Road	New 2lane	3.0	20	2	
3. Minor Arterial						
M-1	Minor	Minor Arterial Roads	New 2lane	99.3	16	2
4. Other Road						
O-1	Pavement	Pavement of Other Roads	New 2lane	364.0	11	2

Source: Planning Team



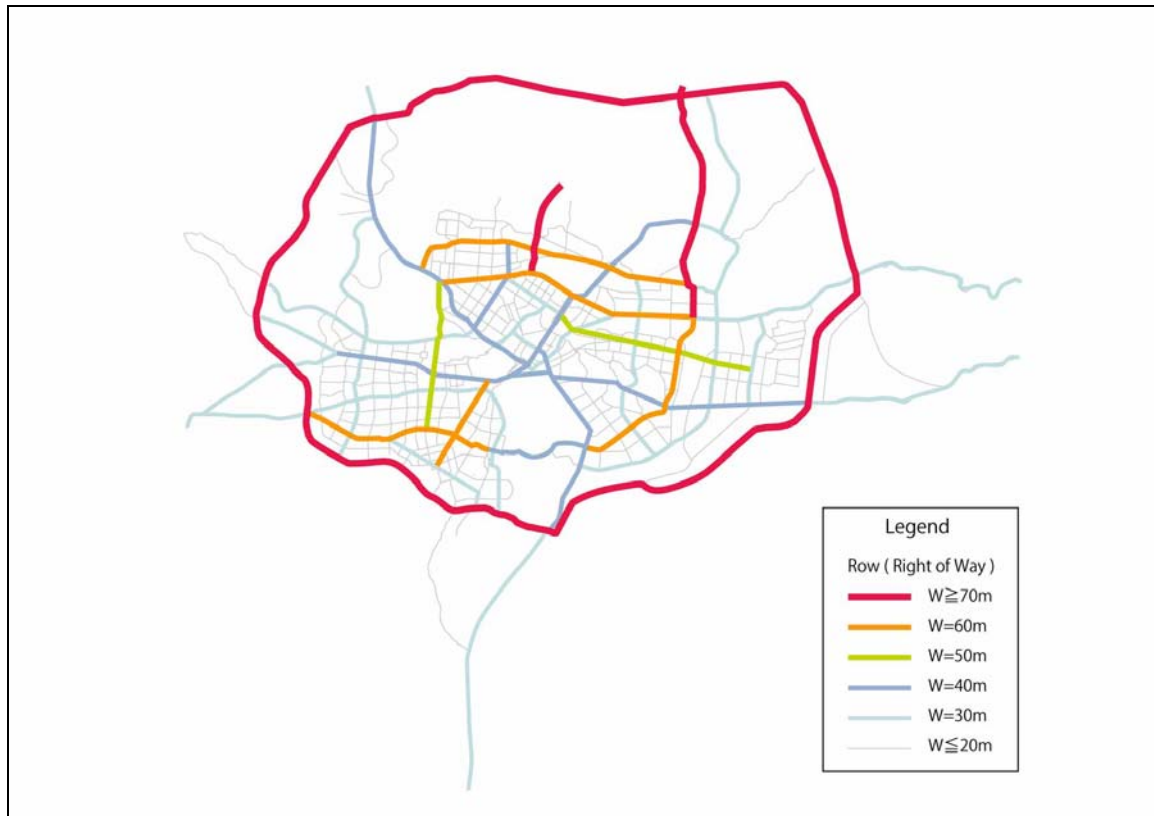
Sectioning of Major Arterial



Sectioning of Arterial

Source: Planning Team

**Figure 5.35: Sectioning of Arterial Roads**



Source: Planning Team

**Figure 5.36: Proposed Right of Way (ROW)**

## 5.5.6 Project Implementation Frame and Traffic Condition

### (1) Implementation Terms

The project implementation terms are defined as follows:

- Phase 1      20011-2015(5 years)
- Phase 2      2016-2020(5 years)
- Phase 3      2021-2025(5 years)

### (2) Project implementation frame

The implementation frame is proposed as shown in Table 5.51, Table 5.52, and Figure 5.37.

**Table 5.51: Major Project Implementation Frame**

	Phase-1 (2011-2015)	Phase-2 (2016-2020)	Phase-3 (2021-2025)
1.North-south and east-west axes	Bagram Ext.(KKCIRR east sec.)	Bagram road-upgrade West-East Axis (KCCIR south sec.)	
2.Ring roads	KCORR (2lane) KCIRR (north and west section)		KKCORR (4lane) KCIRR (south section)
3.Radial roads widening	Mazar-e Sharif road-upgrade Bagrami road-upgrade	Logar road-upgrade	Jalalabad road-upgrade
4.Other arterial road	Airport road-new construction		
4.Minor arterial roads	30km (mainly existing area)	30km (existing area and development area)	39.3km (mainly development area)
5.Other roads	120km (mainly existing area)	120km (existing area and development area)	124km (mainly development area)

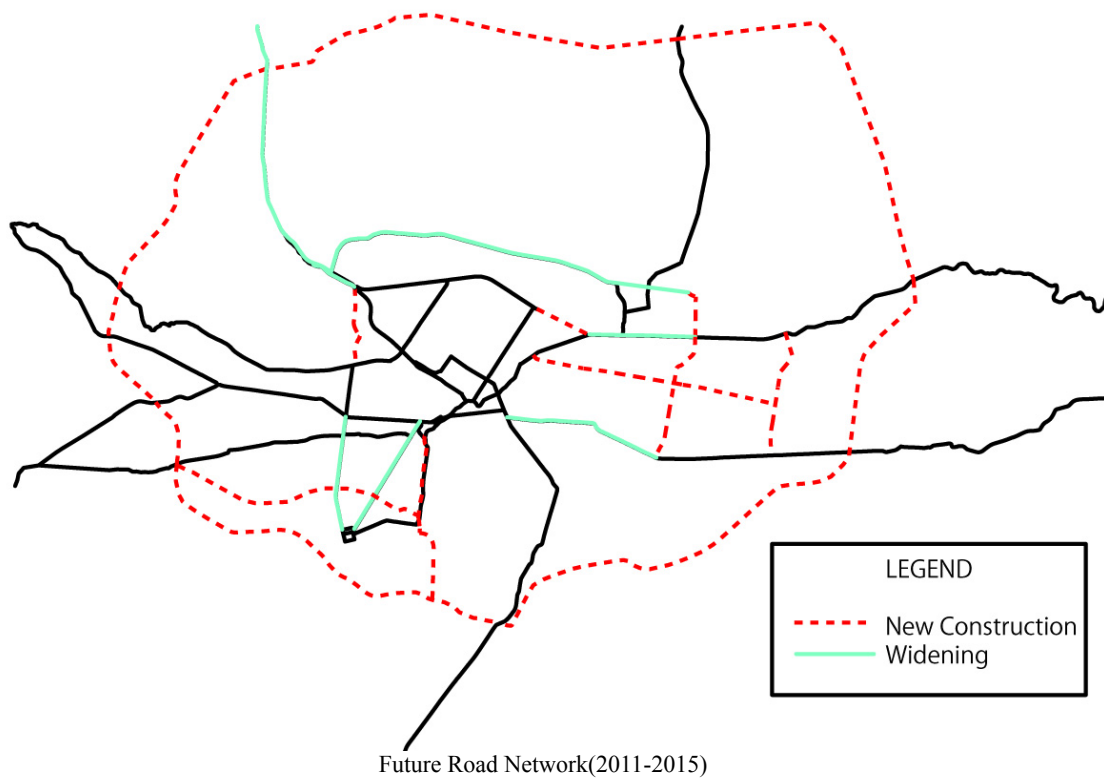
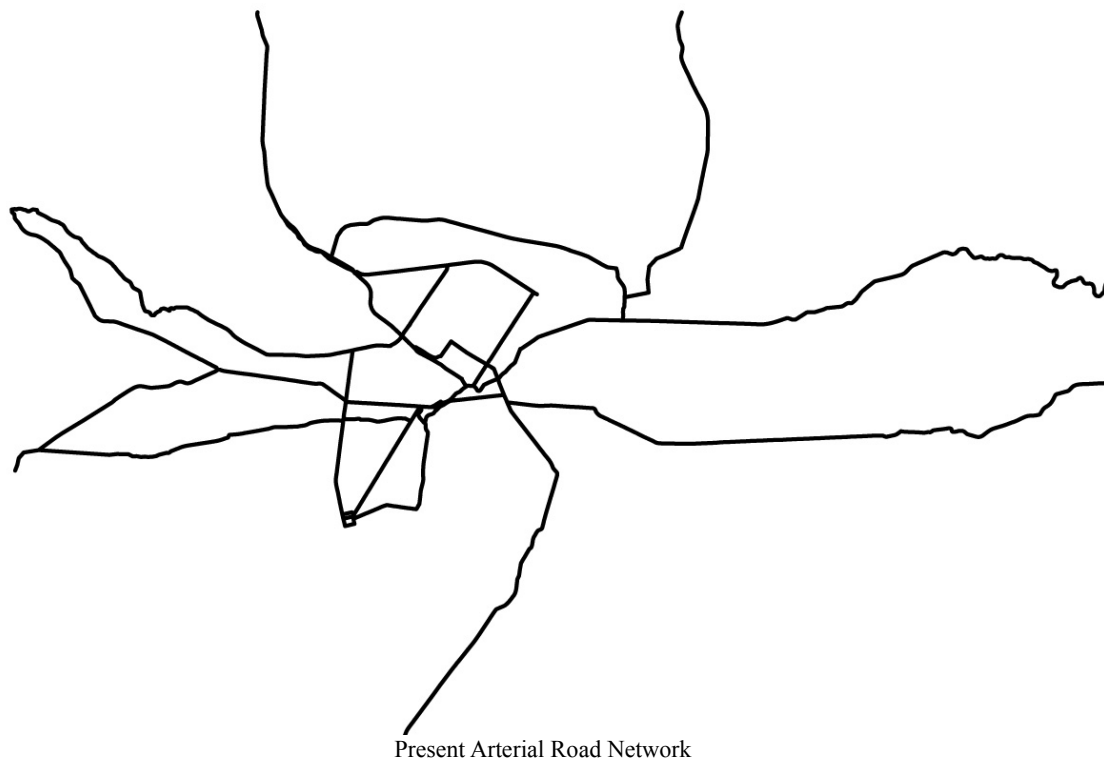
Source: Planning Team

Note: KCORR; Kabul City Outer Ring Road, KCIRR; Kabul City Inter Ring Road

**Table 5.52: Project Implementation by Road Section**

No.		Phase	Project name/Category	Project Component	Length (km)	
MA-1	Bagram	2	Bagram Road Up-grading	Widened fm 4lane to 8lane	10.8	
		3		2-lane frontage road	10.8	
MA-2		1	Extension of Bagram Road (KCCIR)	New 6lane	8.7	
		3		2-lane frontage road	8.7	
MA-3	West East	2	West-East Axis (Qula-i-jabbar Section) (KCCIR)	New 6lane + frontage road	5.2	
MA-4		3	West-East Axis (Asmay Tunnel Section) (KCCIR)	New 6lane tunnel	5.5	
MA-5		1	West-East Axis (Bagrami Section)	New 4lane + frontage road	12.4	
MA-6	Ring Road	1	KCORR (Existing City)	New 2lane	83.7	
		3		widened fm 2lane to 4lane	83.7	
MA-7		1	KCORR (New City)	New 2lane	18.8	
		3		widened fm 2lane to 4lane	18.8	
MA-8		1	KCIRR (North Section)	New 6lane + frontage road	2.6	
MA-9		1	KCIRR(Jalalabad Road)	Widened fm 4lane to 6lane	4.5	
MA-10		1	KCIRR (West Section) -1	New 6lane + wide sidewalk	3.9	
MA-11		1	KCIRR (West Section) -2	Widened fm 2lane to 6lane + wide sidewalk	4.0	
MA-12		Radial Arterial	1	Mazar-e Sharif Road Up-grading	Widened fm 2lane to 4lane + wide sidewalk	13.5
MA-13	3		Jalalabad Road	Widened fm 2lane to 4lane	10.3	
MA-14	1		Bagrami Road	Widened fm 4lane to 6lane	4.4	
MA-15	2		Logar Road	Widened fm 2lane to 6lane	15.8	
MA-16	1		New Road	New 4lane	7.3	
MA-17			3	Barikab Road	New 6lane + frontage road	11.9
			3	Barikab Road (tunnel)	New 6lane	2.5
A-1	Arterial	1	Airport Road(West Section)	New 6lane + frontage road	16.0	
A-2		2	Airport Road(East Section)	New 4lane	2.8	
A-3		2	Arterial Road	New 4lane	5.4	
A-4		3	Arterial Road	New 4lane	7.9	
A-5		1	Arterial Road	New 4lane	5.6	
A-6		1	Arterial Road	New 4lane + frontage road	12.0	
A-7		2	Arterial Road	New 2lane	11.2	
A-8		3	Arterial Road	New 4lane	11.7	
A-9		3	Arterial Road	New 4lane + wide sidewalk	12.6	
A-10		2	Arterial Road	New 4lane	16.6	
A-11		3	Arterial Road	Widened fm 2lane to 4lane	10.4	
A-12		1	Darulaman Road	Widened fm 2lane to 4lane + frontage road	5.0	
		3		New 2lane	12.3	
A-13			2	Arterial Road	New 4lane	3.2
A-14			3	Arterial Road	New 4lane	4.9
A-15			2	Arterial Road	New 2lane	6.1
A-16			3	Arterial Road	New 2lane	6.7
A-17			3	Arterial Road	New 2lane	3.0
M-1		1	Minor Arterial Roads	New 2lane	30.0	
		2		New 2lane	30.0	
		3		New 2lane	39.3	
O-1		1	Pavement of Other Roads	New 2lane	120.0	
		2		New 2lane	120.0	
		3		New 2lane	124.0	

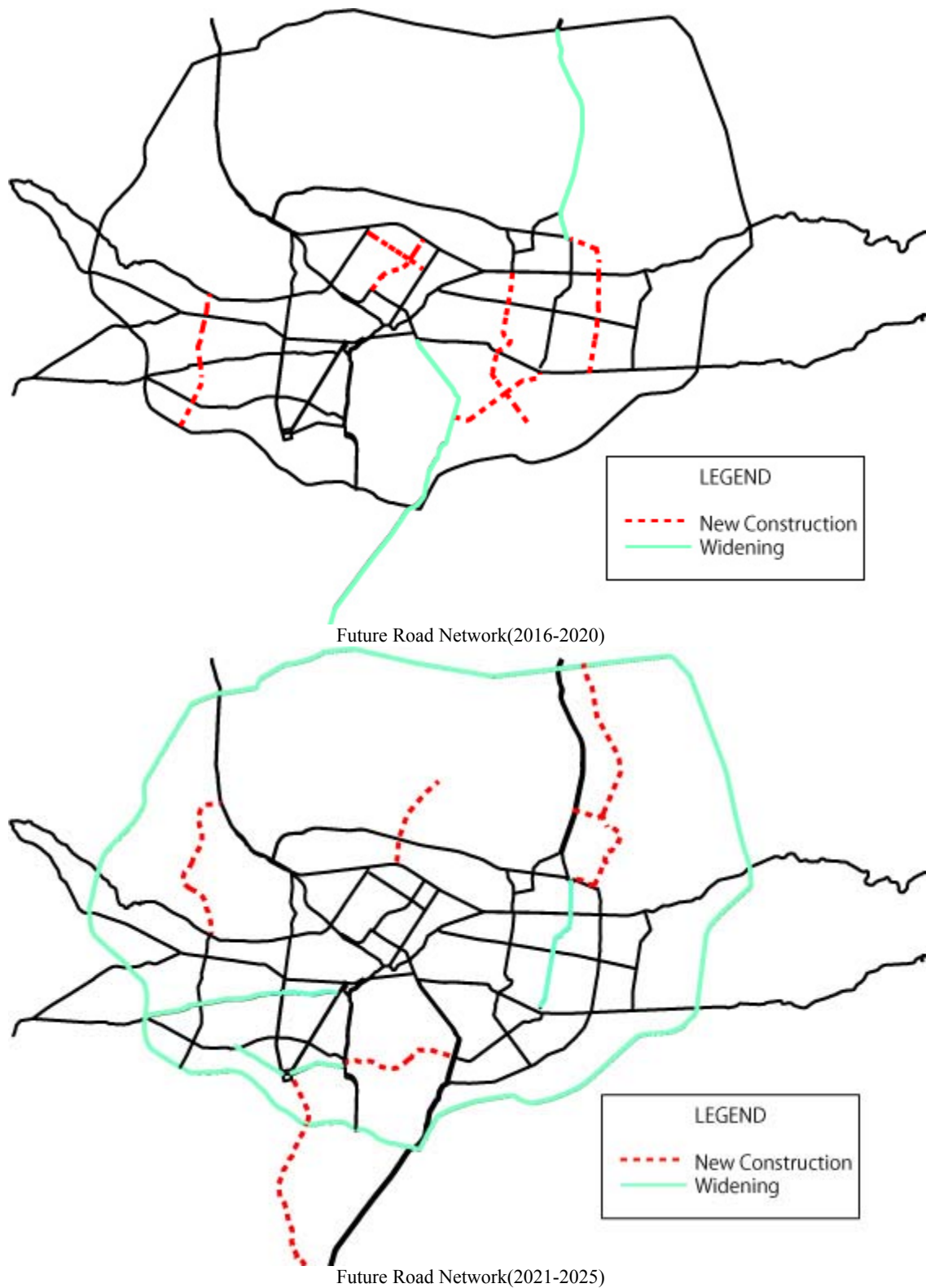
Source: Planning Team



Source: Planning Team

**Figure 5.37: Staging Plan of Road Network (1/2)**





Source: Planning Team

**Figure 5.37: Staging Plan of Road Network (2/2)**

**(3) Traffic demand forecast in with-project case**

Traffic volume was estimated assuming that the projects are implemented in accordance with the proposed road network and staging. Results of the traffic forecasts are summarized in Table 5.53.

**Table 5.53: Summary of Traffic Assignment in With-Project Case**

	Year 2008 (a)	Year 2025 With project (b)	Ratio 2025/2008 (c=b/a)	Year 2025 (Do Nothing Case)
Total Vehicle Trips (PCU)	494,350	1,209,786	2.45	1,209,786
PCU-km('000)	3,671	9,649	2.63	14,354
PCU-Hour	95,699	218,936	2.29	757,377
Volume / Capacity	0.47	0.54	1.15	1.81
Average Speed (km/h)	38.4	44.1	1.15	19.0

Source: Planning Team

Figure 5.38 shows the forecasted traffic volume in 2025 for with-project case. The volume to capacity ratio in 2008 is 0.47 in average, which is expected to increase to 0.54 in 2025. Average travel speed in the whole network will increase in the future because of higher design speed. Thus, if the projects are implemented in accordance with the proposed implementation frame, it is possible to keep the traffic condition in the future at almost the same level as present, although traffic volume will drastically increase in the future.

There are, however, some congested roads sections to be observed in the future. Introduction of public transport system will be necessary to reduce traffic on these congested segments. This is especially true on the link roads connecting the existing Kabul City and the New City. (see Section 5.6.2)

LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm=30000(pcu)



Source: Planning Team

Note: No public transport project are considered

**Figure 5.38: Result of Traffic Assignment for With-Road Projects in 2025**

## 5.6 Public Transport and Logistics Development Plan

### 5.6.1 Proposed bus transport system

The public transport for Kabul City will continue to depend on bus transport. The following improvements are planned for the bus transport system.

**(1) Expansion of bus services to newly urbanizing areas**

Bus services will be provided equally to all the areas to satisfy the role of public transport. Thus, newly urbanizing areas will be equally covered by the bus services.

**(2) Improvement of bus services**

Provision of better services will attract and increase the passengers and improve the operational revenue. The key indices of services to be improved include expansion of bus service network, assuring speed and punctuality, provision of comfortable vehicles and waiting spaces, provision of dense frequency and suitable operation hours, and adequate fare system. In view of the present conditions of bus services in Kabul, the expansion of bus network to provide the services equally to all areas as well as the improvement in speed and punctuality to raise the credibility as public transport are most important factors. However, improvement exceeding the range of adequate fare system will obstruct the effective operation. Improvement of operational efficiency is essential.

**(3) Improvement of operating efficiency**

It is necessary to study how to provide equivalent services to all the areas with least cost without lowering the overall service quality. The key factor will be provided measures to assure the equivalent transportability at least cost, covering the entire service area.

**(4) Reduction of adverse impact on road traffic conditions**

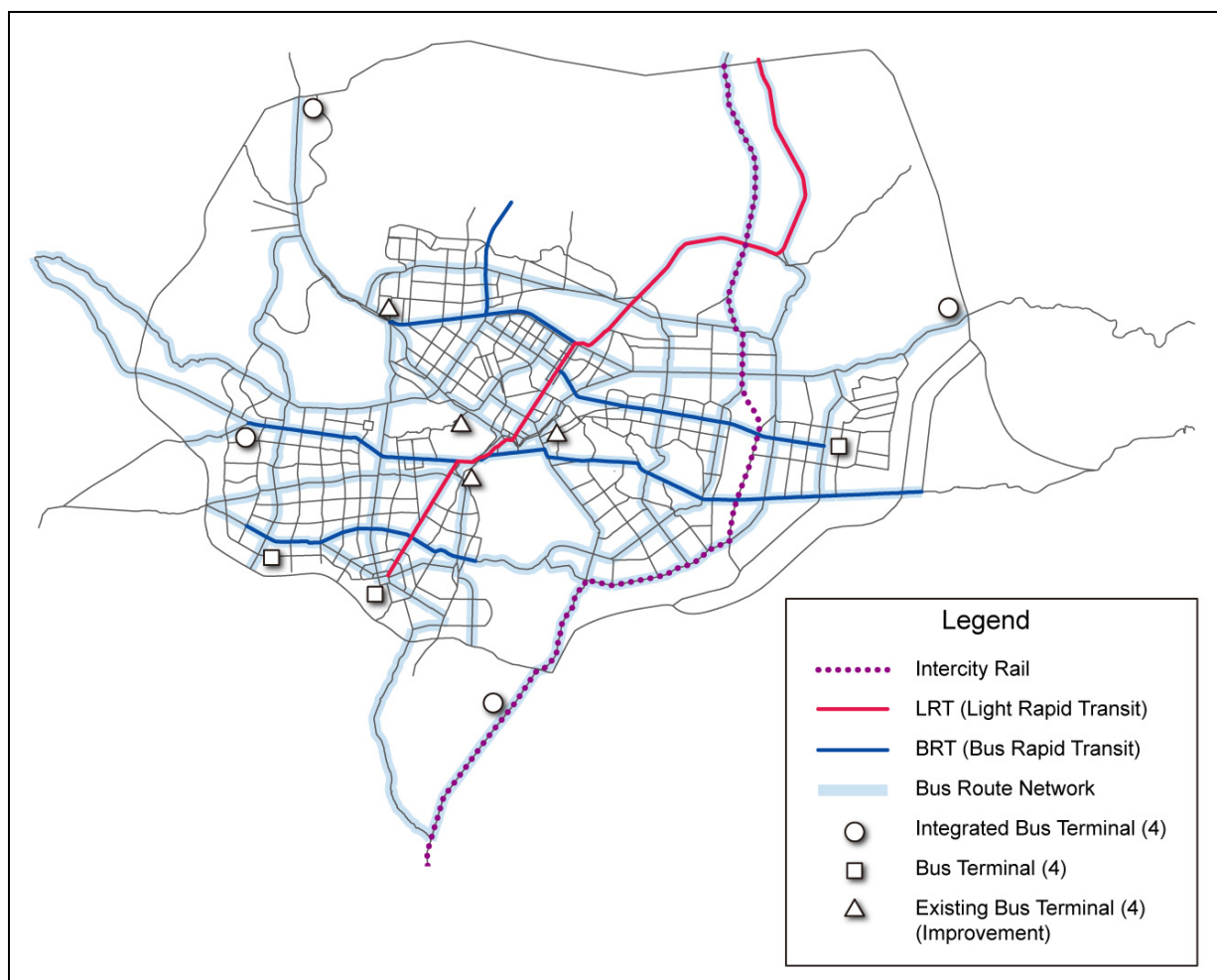
The major issue is the traffic congestion in the city center of Kabul especially during the morning and evening peak hours. If the bus operation including traveling, stopping and waiting obstructs the traffic on the roads, the justification for the improvement of traffic conditions is lost. Measures to satisfy the spatial requirements for traveling as well as stopping are necessary.

## **5.6.2 Public transport development projects**

**(1) Outline of public transport project**

In order to improve the conditions for public transport users, the following projects are identified. Figure 5.39 shows the public transport projects.

- Use of large size vehicles
- Bus route re-organization with hierarchy
- Bus exclusive or priority lanes
- BRT (Bus Rapid Transit) introduction
- Bus terminal
- Railway and LRT (Light Rail Transit) introduction



Source: Planning Team

**Figure 5.39: Location of Public Transport Projects****(2) Public transport demand**

In order to identify the effectiveness of public transport project, traffic assignments are conducted. In this study, four (4) alternative case of the public transport are assumed as follows. Table 5.54 shows the assumed modal share of public transport.

Alternative 1	Present public transport pattern	No consideration of new public transport projects
Alternative 2	Use of large size vehicle	In order to improve the efficiency of bus transport operation, large size bus will be introduced in major arterial roads.
Alternative 3	Introduction of BRT system	Introduction of three BRT lines (see Figure 5.40 (2/2)) + alternative 2
Alternative 4	Introduction of BRT and LRT system	Introduction of LRT connecting Deshab new city and Darulaman city via city center + alternative 3 (see Figure 5.40 (2/2))

**Table 5.54: Assumed Modal Share of Person Trip**

Case		Public Transport Strategy	Private Vehicle	Public Transport					Unit: Trips/day	
				Taxi	Microbus	Bus	BRT	LRT	Walk	Total
Year2008			18%	12%	17%	21%	0%	0%	33%	100%
Year 2025	Alternative1	Present Pattern	24%	12%	18%	21%	0%	0%	25%	100%
	Alternative2	Large bus	23%	10%	16%	26%	0%	0%	25%	100%
	Alternative3	Alt2+BRT	21%	9%	14%	26%	5%	0%	25%	100%
	Alternative4	ALT3+LRT	19%	8%	12%	26%	5%	5%	25%	100%

Source: Planning Team

Based on above modal share, OD tables are prepared then traffic assignments of future road network are conducted. Traffic assignment results in 2025 for each alternative case are shown in Figure 5.40 and summarized in Table 5.55.

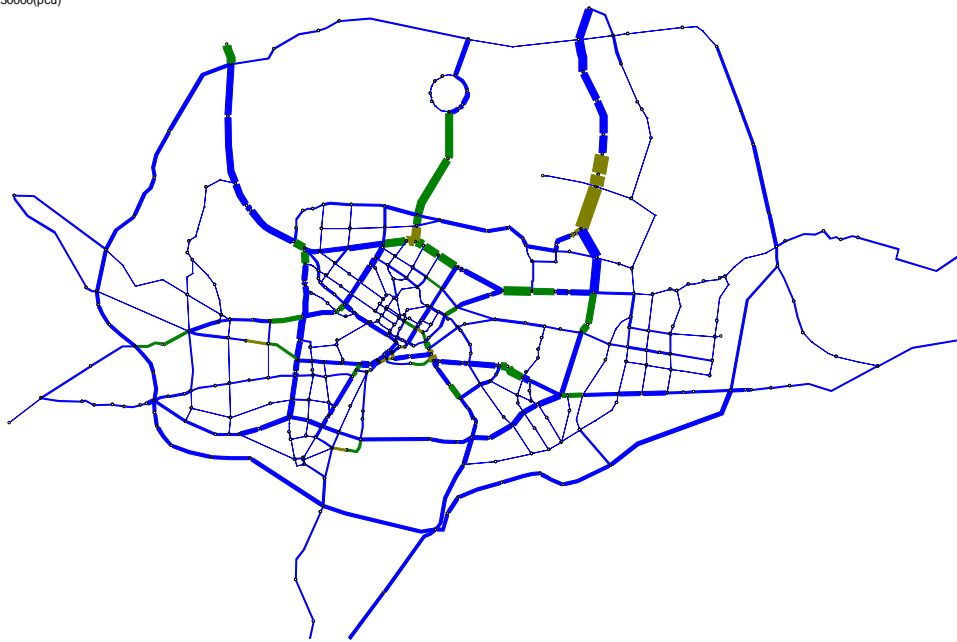
**Table 5.55: Traffic Assignment Result of Public Transport Alternative (Year 2025)**

Case	PCU*km ('000)	Total PCU*hr	VCR	Speed (km/h)
Do Nothing (No road improvement and public transport plan)	14,354	757,377	1.81	19.0
Alternative 1 (Road Improvement only, no public transport plan)	9,649	218,936	0.54	44.1
Alternative 2 (Alt.1 + Large Bus Introduction)	9,270	208,572	0.52	44.4
Alternative 3 (Alt.2 + BRT Introduction)	8,183	180,555	0.46	45.3
Alternative 4 (Alt.3 + LRT Introduction)	7,260	158,031	0.41	45.9

Source: Planning Team

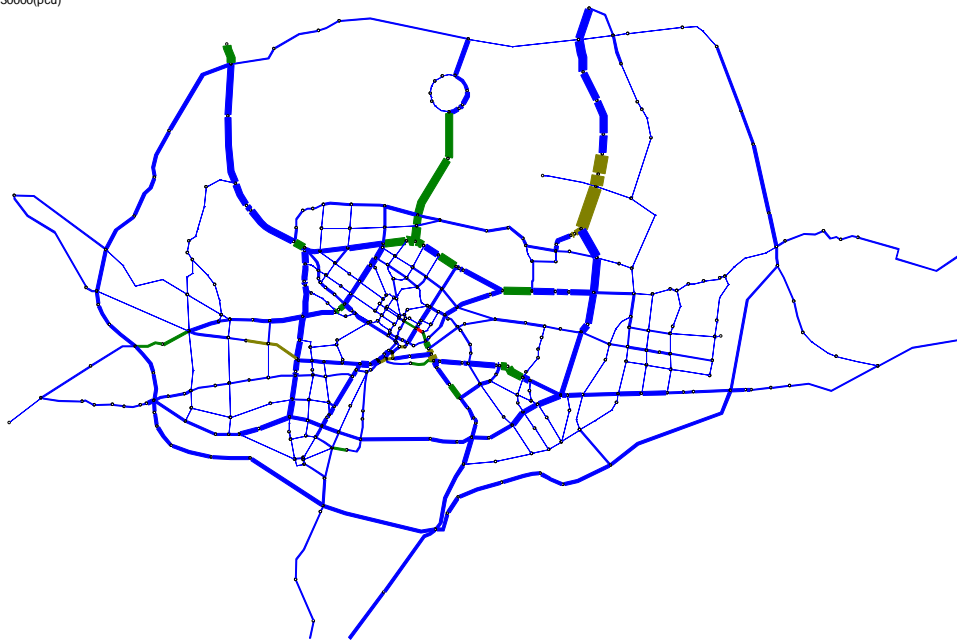
Without public transport projects (Alternative 1), some very congested sections are observed as mentioned above. If BRT and/or LRT systems are introduced in year 2025, traffic conditions will be improved on those roads connect the New City and the existing Kabul City. In this master plan, the alternative-4 is selected as the public transport development plan, based on the above demand forecast results.

LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm =30000(pcu)



Alternative 1 (No Public Transport Project)

LEGEND :  
( Mode: + 1 + 2 )  
Traffic Flow  
VCR<1.00  
VCR<1.20  
VCR<1.50  
1.50<VCR  
scale: 1mm =30000(pcu)

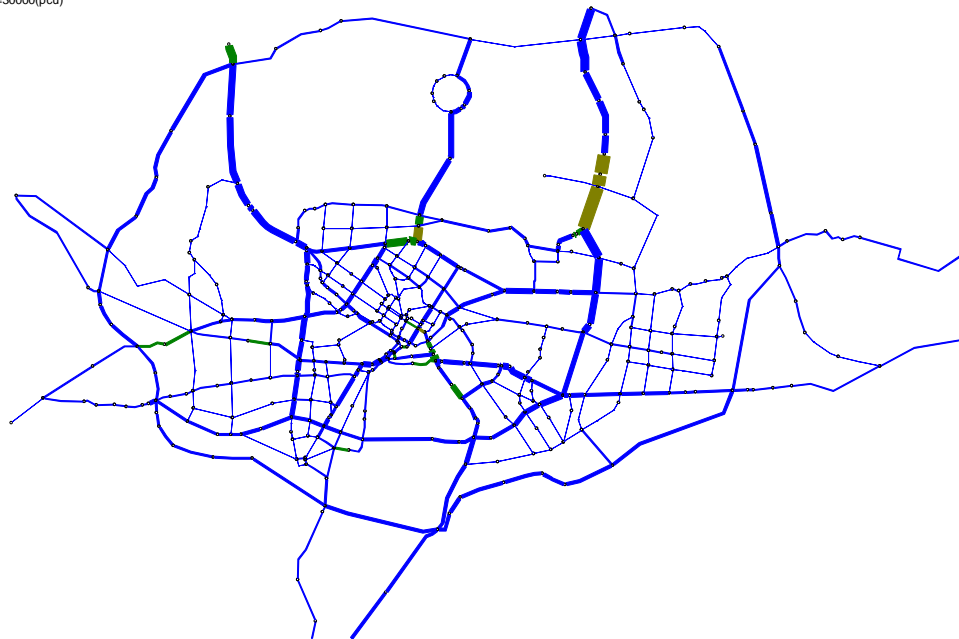


Alternative 2 Large Bus Introduction

Source: Planning Team

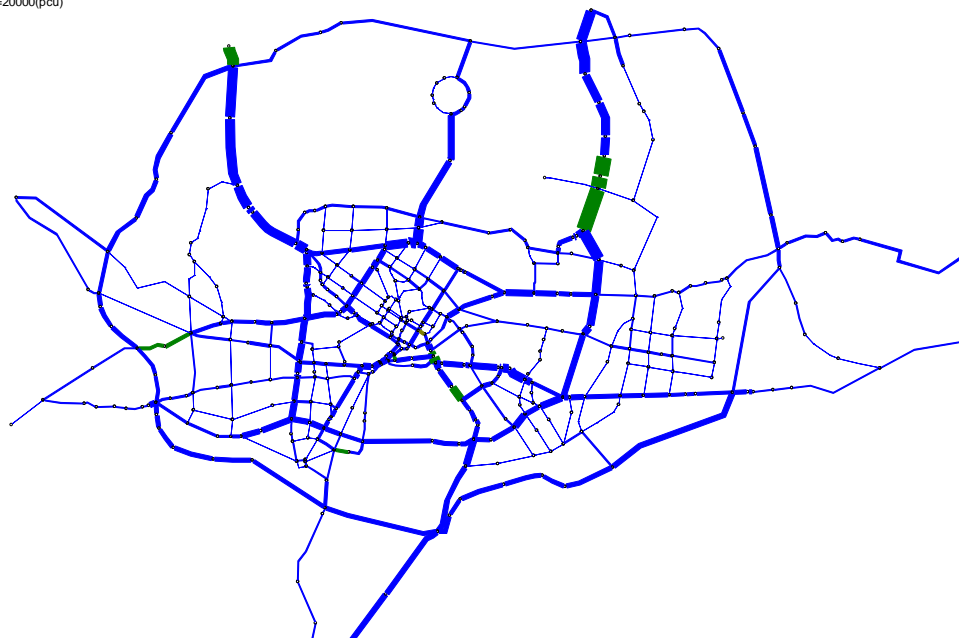
**Figure 5.40: Traffic Assignment of Alternative Case (1/2)**

LEGEND :  
 ( Mode: + 1 + 2 )  
 Traffic Flow  
 VCR<1.00  
 VCR<1.20  
 VCR<1.50  
 1.50<VCR  
 scale: 1mm =30000(pcu)



Alternative 3 (Alt2 + BRT Introduction)

LEGEND :  
 ( Mode: + 1 + 2 )  
 Traffic Flow  
 VCR<1.00  
 VCR<1.20  
 VCR<1.50  
 1.50<VCR  
 scale: 1mm =20000(pcu)



Alternative 4 (Alt3 + LRT Introduction)

Source: Planning Team

**Figure 5.40: Traffic Assignment of Alternative Case (2/2)**

### (3) Use of large size vehicles

#### 1) Justification

As part of efforts to improve efficiency of bus transport operation, larger size buses will be introduced in the areas with large demand. For instance, the fuel cost per passenger by minibus



and large size vehicle will be 30 to 35% and 40 to 44% respectively of the fuel cost by microbus provided that the buses are operated with full passengers as shown in Table 5.56. The use of large size vehicles will contribute also to reducing traffic.

**Table 5.56: Fuel Consumption by Bus Size**

Speed (km/h)	Passenger Car (cc/km*p)	Bus(cc/km*passenger)			Fuel saving	
		Microbus ( a )	Minibus ( b )	Large bus ( c )	Minibus/Microbus (d=(a-b)/a)	Large bus/Microbus (e=(a-c)/a)
40	20.9	18.1	11.7	10.2	35%	44%
60	18.0	15.6	10.2	8.9	35%	43%
80	18.3	15.8	11.1	9.7	30%	40%

Notes: # of passengers: 3.0 for passenger car, and 8, 25 and 60 for others;

Vehicle weight: 1.5t for passenger car, 2.2t for light, 3.4t for medium and 6.6t for heavy vehicles;

Unit weight of passengers: 0.065t/person

Source: Unit fuel consumption by vehicle classification, Ministry of land Infrastructure, Japan

The share of buses operated in Kabul City at present are 18% for microbus, 6% minibus and 14% large bus. As shown in Table 5.57, considering the constant number of passengers, the passenger car equivalent of microbus, minibus and large bus will be 12.5 PCU, 8.0 PCU and 5.0 PCU, respectively, which indicates that the impact to the traffic will be less when larger buses are introduced.

**Table 5.57: PCU Comparison by Bus Type**

	Passenger(n)	Capacity (n/veh.)	Passenger car Equivalent	PCU
	( a )	( b )	( c )	(d=a/b*c)
Microbus	100	8	1.0	12.5
Minibus	100	25	2.0	8.0
Large bus	100	60	3.0	5.0

Source: Planning Team

Note: # of passengers (Passenger) and Capacity are value-assumed.

## 2) Development plan

The upper part of Table 5.58 summarizes the number of trips per day using buses (microbus, minibus and large bus) at present and the estimated number of buses by type. To reduce the traffic volume of the same trip characteristics by 20%, it will be necessary to increase the transport by large buses by 72% from the present fleet.

**Table 5.58: Comparison for PCU of each Bus Vehicles**

		Microbus	Minibus	Large bus	Total
Vehicle capacity	( a )	8	25	60	-
PCE	( b )	1.0	2.0	3.0	-
Present					
Trips	( c )	546,853	201,759	441,292	1,189,904
Vehicles	(d=c/a)	68,357	8,070	7,355	83,782
PCU	(e=d/b)	68,357	16,141	22,065	106,562
Target					
Trips	( f )	281,239	151,319	757,346	1,189,904
Vehicles	(g=f/a)	35,155	6,053	12,622	53,830
PCU	(h=f/b)	35,155	12,106	37,867	85,128
Change (%)	(1-h/e)*100	-49	-25	+72	-20

Source: Planning Team

At present (in 2007), the number of Millie buses in operative conditions is 467 (358+109) as shown in Table 5.59. The number of buses actually operating is 358, while the requirements are 258(=358\*0.72) busses. Out of operating busses, 109 busses are deemed to be operational, implying that it will be necessary to introduce the balance 150 large buses to improve the current situation of bus services in the existing city area.

**Table 5.59: Millie Buses**

	Number	Note
Operating daily	358	Available
Without driver	109	Available
With technical defects	134	Not available
Total	601	

Source: Report on financial, technical and exploitation problems of Millie Bus Enterprise, 2007, Ministry of Transport

#### (4) Bus route re-organization with hierarchy

##### 1) Justification

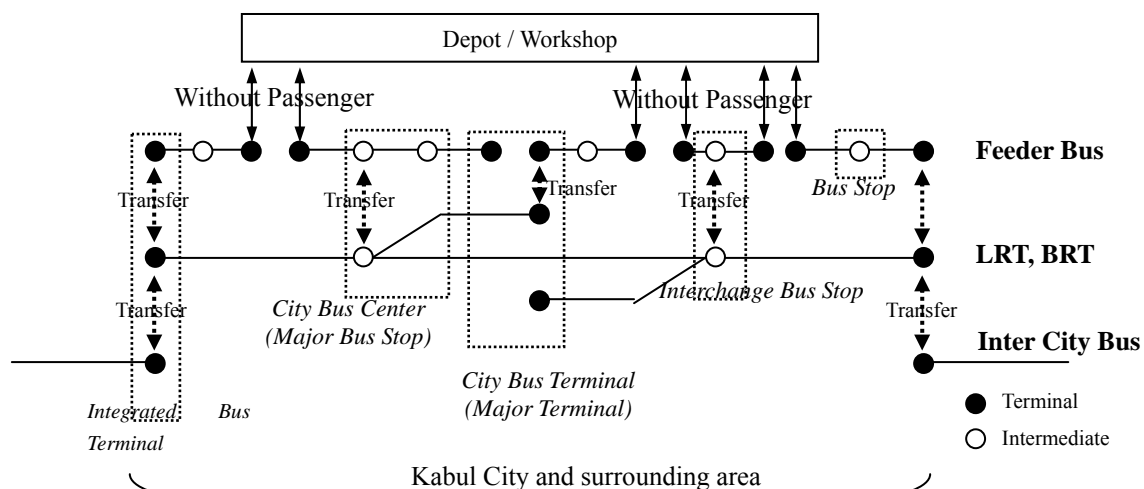
The bus system in the Kabul City is operated by each bus company and the routes mainly start from the city center and extend towards suburbs. With such a unified system of bus service routes, the operation distance of each route will increase to cope with the expanding urban area, and the number of routes will also increase gradually. This will create complication of bus routes and increase traffic congestions in the central part. In order to solve this problem, it will be desirable to establish region-wide trunk routes connecting major points in the region together with feeder bus routes in the surrounding area of each point on the trunk routes.

Combination of the region-wide trunk routes and feeder routes will enable to transport mass passengers on the region-wide trunk routes as well as to transport passengers in the surrounding area. It will be appropriate to strengthen the bus system with exclusive lanes for bus rapid transit (BRT) as the region-wide trunk services complemented by the feeder bus transport system.

##### 2) Development plan

The BRT will be established linking the existing Kabul City with Dehsabz and Barikab. The BRT network will cover some part of the existing urban area as well. Feeder services from the BRT stations will cover the entire city area effectively. Terminals for inter-city bus services will be located in the suburbs, and linked to the city center by the BRT or feeder services.

In addition to the city bus network of Kabul, inter city bus connecting Kabul with other cities will be provided. The starting points of inter city buses will be provided in the suburbs of Kabul City connected with the BRT or feeder buses. It will be noted that bus services in the central urban areas will be carried out by feeder buses only. The proposed hierarchy of bus routs and stops are illustrated in Figure 5.41.



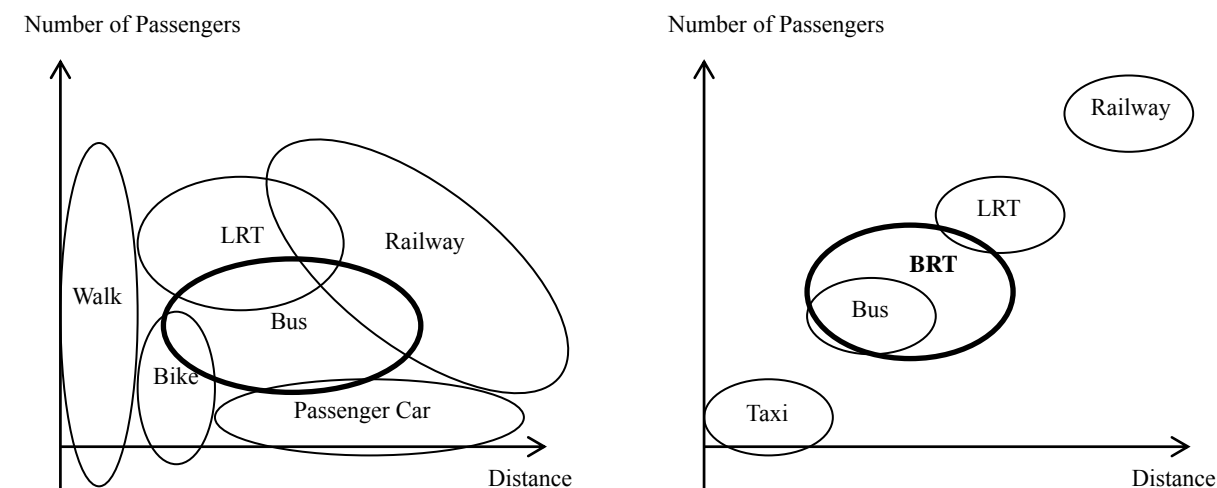
Source: Planning Team

**Figure 5.41: Future Proposed Bus Network and Bus Stop hierarchy**

## (5) BRT and LRT introduction

### 1) Characteristics of public transportation

Characteristics of public transportation are analyzed by the number of passengers and the average transit distance as schematically shown in Figure 5.42. Different modes of public transport are compared in Table 5.60. As seen from the table, railway mass transit such as trains and subways fit to transport of a large number of passengers over long distances, and the LRT such as trams fits to medium transport over medium distance. The BRT have functions similar to the LRT with exclusive bus lanes for medium transport needs. Considering the relatively long distance, 30-50km, between Kabul City and the New City, particularly Barikab and Dehsabz north, introduction of rail-based transport may become necessary.



Source: Planning Team

**Figure 5.42: Service Scope of Various Public Transport Means**

**Table 5.60: Comparison of Public Transport Modes**

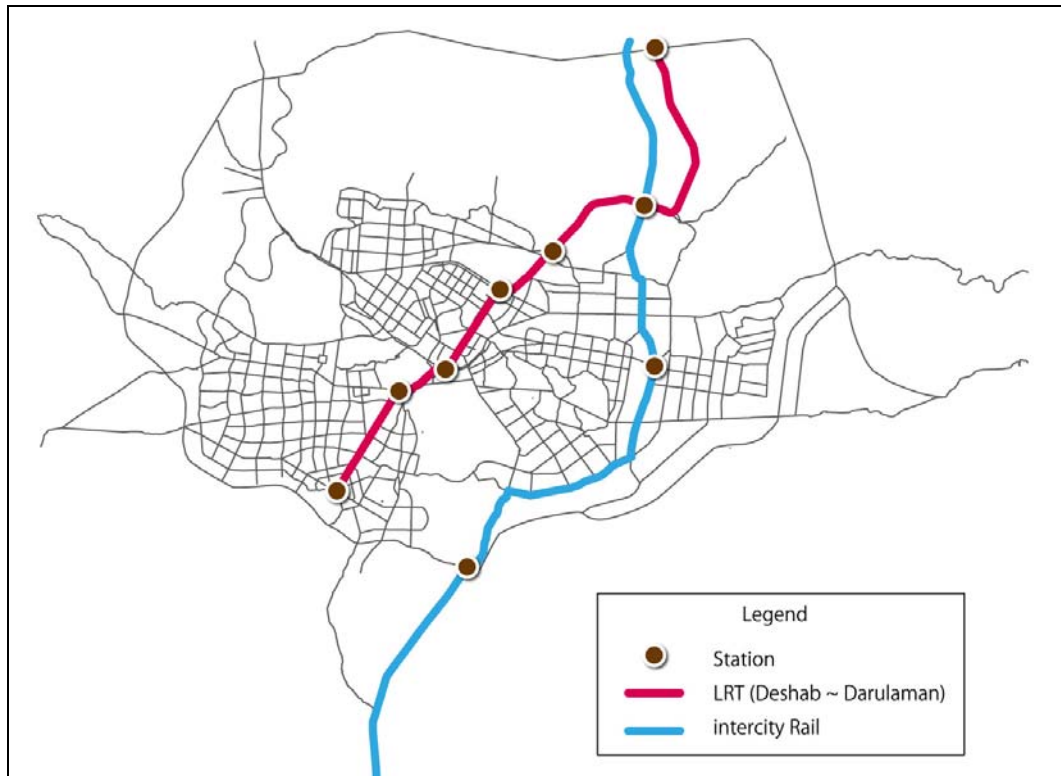
System	Railway (underground)	LRT	BRT	Bus
Ground speed (km/h)	20 - 50 km/h	30 km/h	15 - 30 km/h	5 - 15 km/h
Ave. station interval (m)	700 - 2,000 m	400 - 1,000 m	800 - 1,000 m	300 - 500 m
Max capacity (passengers/hour)	10,000 - 80,000	6,000 - 20,000	3,000 - 7,000	2,000
Max slope (%)	35	80	60	90

Source: Kabul Metropolitan Area Development Master Plan, 2009, JICA

### 2) Development Plan

The proposed rail-based transport network is illustrated in Figure 5.43. The alignment of inter rail is almost the same alignment of the Third Kabul Master Plan. This railway will be connected to the freight line being constructed by Chin.

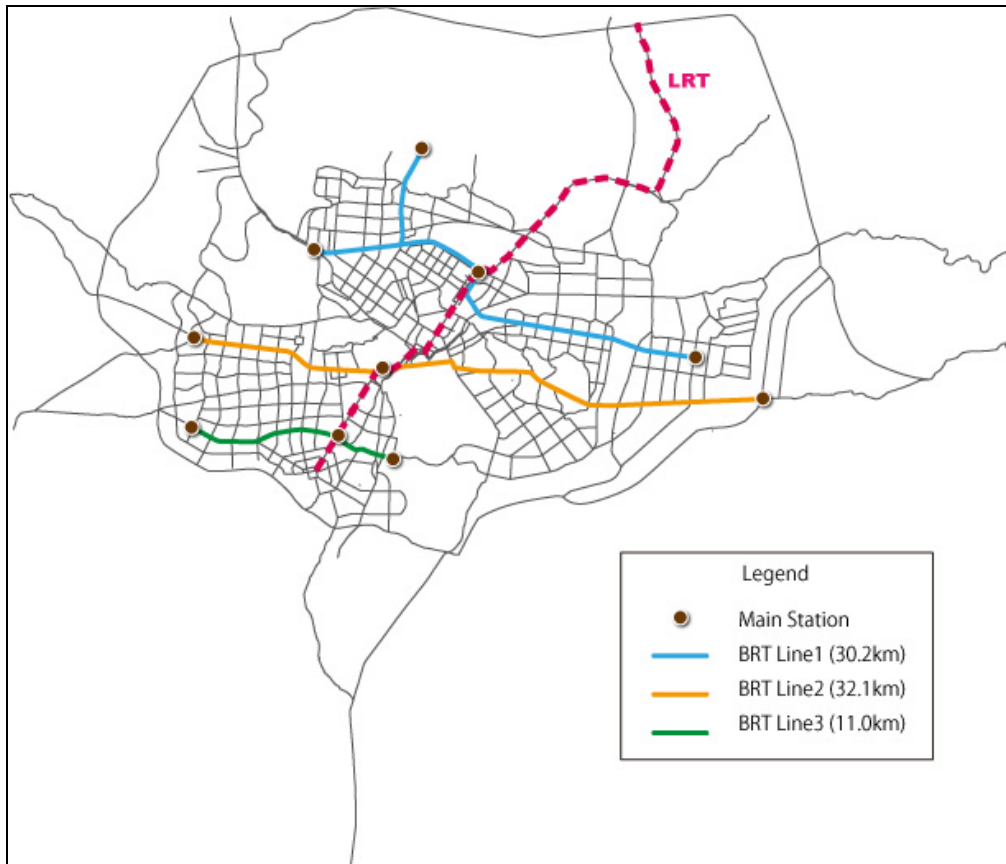
The introduction of the LRT may become necessary between New City (Deshab) and existing Kabul City in the future. The LRT may be introduced first to the BRT sections linking the New City to the city center, then BRT in these sections will be converted to the LRT. The access between the New City and the urbanized areas of Kabul City will be strengthened by the LRT around year 2025. Subsequently, the sub-centers in the New City will be linked by the LRT so that the entire Dehsabz area is integrated as well as connected to Kabul City.



Source: Planning Team

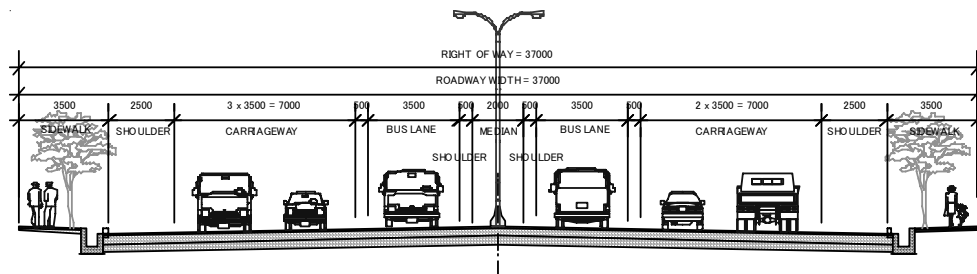
**Figure 5.43: Proposed Routes of LRT**

Figure 5.44 shows the proposed BRT network. There are three BRT lines running east-west and all of them are connected to the proposed BRT/LRT for smooth movement of passengers. The longest line runs for 32 km while the shortest lines stretch for 11 km. Figure 5.45 shows the typical cross section of road accommodating the BRT line.



Source: Planning Team

**Figure 5.44: Proposed BRT Project Routes**



Source: Planning Team

**Figure 5.45: Typical Cross Section with BRT lane in City Center**

## (6) Bus terminals for suburban areas

### 1) Justification

The starting points of bus routes are mostly in the city center and concentrated in the adjacent areas. The most of the terminals are located on the roadside occupying the areas illegally and obstructing the traffic flows. The city center is the first ranked area concentrated with business and commercial activities, which are expected to be developed under efficient land use. To provide spaces to allow parking of many large size vehicles such as buses in the area is unproductive use of land from economical point of view. From the traffic point of view, it will be better to provide terminals in the suburban areas in the vicinity of radial roads and ring roads. They will function as important points for transportation. Such locations will also ensure smoother services and are easier for expansion. The relocation of terminals from the central areas will induce more productive uses of precious land resources in the city center.

## 2) Development plan

Two types of bus terminals will be established: i) integrated bus terminals which will serve as the linking nodes between the inter-city bus and city bus services and ii) city bus terminals used mainly as the nodes between the BRT and feeder services. At major bus stops for the BRT, inter-change bus stops will be provided to facilitate the transfer between the BRT and feeder services. The inter-city bus terminals will be located along the KCORR and radial arterial road.

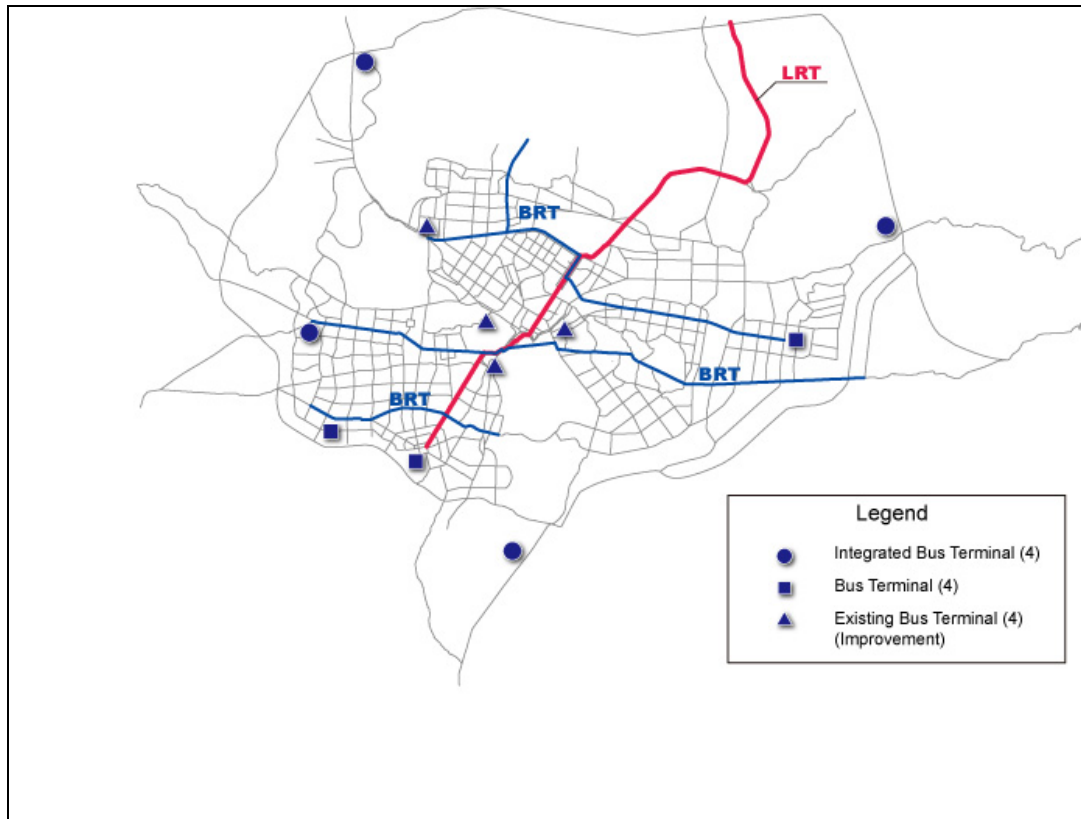
The existing terminals occupying the road area due to the lack of parking space will be abolished. The four existing terminals, including those at Macrorayon, Khushal Khan Mena and Kowaja Bughara, having some depot functions will be upgraded to function fully as respective bus terminals. All the proposed bus terminals are shown in Figure 5.46.

## 3) Required functions and scale

Functions and scale required at each bus terminal are summarized in Table 5.61. Images of integrated bus terminal in the suburbs and interchange bus stop for the BRT are illustrated in Figure 5.47 and Figure 5.48, respectively.

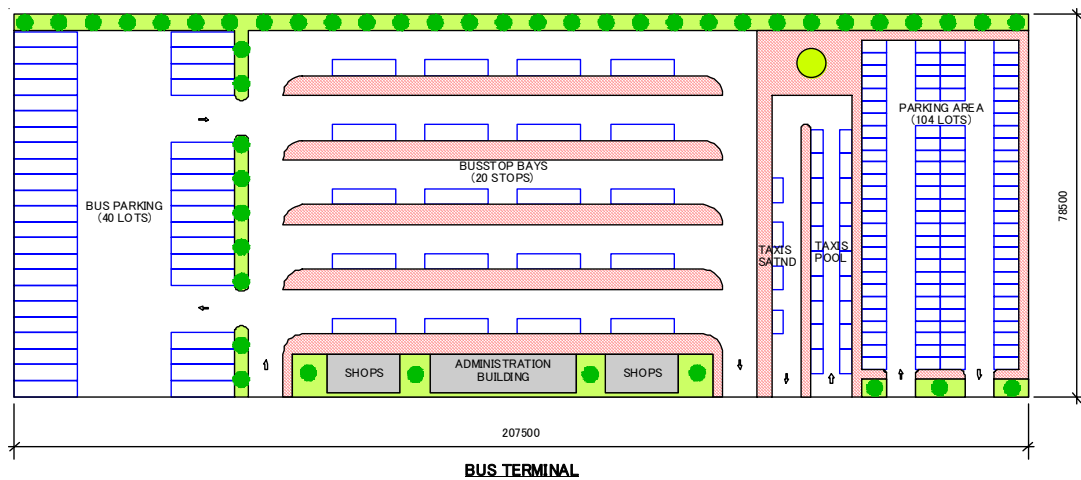
**Table 5.61: Required Functions of Bus Terminal**

	<b>Integrated bus terminal</b>	<b>City bus terminal</b>	<b>Interchange bus stop</b>
Function	<ul style="list-style-type: none"> <li>- Transfer between Inter city bus and city bus</li> <li>- Parking space for inter city bus, city bus and feeder bus</li> </ul>	<ul style="list-style-type: none"> <li>- Station and transfer of BRT, and feeder bus</li> <li>- Parking space for BRT and feeder bus facilities</li> </ul>	<ul style="list-style-type: none"> <li>- Transfer between Inter city bus and city bus</li> </ul>
Facilities	<ul style="list-style-type: none"> <li>- Bus stop (departure)</li> <li>- Bus stop (arrival)</li> <li>- Parking (bus)</li> <li>- Parking (passenger cars)</li> <li>- Operation building</li> <li>- Guard room</li> <li>- Passenger terminal</li> <li>- Maintenance depot</li> <li>- Office</li> </ul>	<ul style="list-style-type: none"> <li>- Bus stop (departure)</li> <li>- Bus stop (arrival)</li> <li>- Parking (bus)</li> <li>- Operation building</li> <li>- Guard room</li> <li>- Passenger terminal</li> <li>- Office</li> </ul>	<ul style="list-style-type: none"> <li>- Bus stop (departure &amp; arrival)</li> </ul>
Area	10ha/location	3 ha/location	



Source: Planning Team

**Figure 5.46: Proposed Locations of Bus Terminals**



Source: Planning Team

**Figure 5.47: Image of Integrated Bus Terminals in Suburban Area**



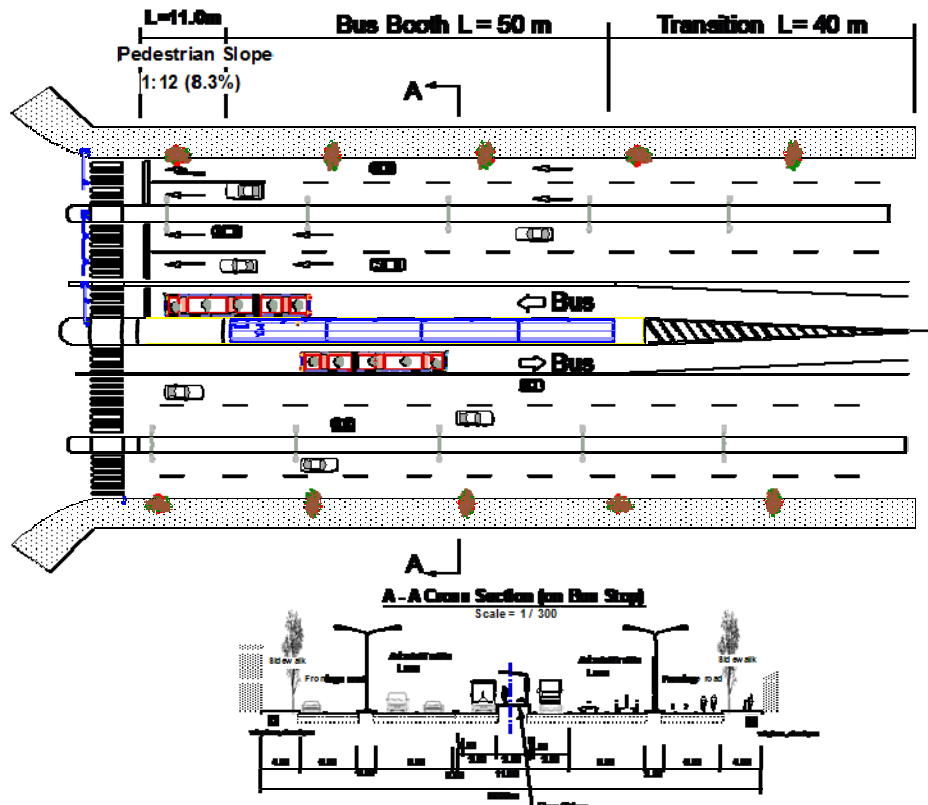


Figure 5.48: Image of Interchange Bus Stop for BRT and Feeder Bus Services

### 5.6.3 Logistics development plan

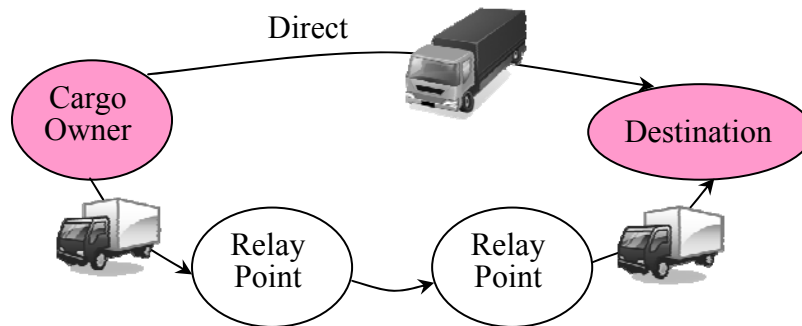
#### (1) Justification

Most cargo volumes related to Kabul City are transported by land transportation based on trucks at present. This will continue for a foreseeable future as the rail transportation through Kabul City is still at a preliminary planning stage. Under this cargo transportation system, each owner of goods transports them by truck to destination individually. The total volume of such cargoes will cause heavy traffic burden for road capacity in the future. To improve the transport efficiency of cargo transport by trucks, public truck terminals will be constructed. The purposes of developing truck terminals are as follows:

- To improve the transportation efficiency
- To control the heavy traffic flow into Kabul City area
- To bring up and support the transportation industry

#### (2) Overall cargo transportation system

Two types of cargo transportation are observed in Afghanistan. One is simple transportation by individual owners by using their own or hired trucks of transportation companies, which is the dominant way at present. The other is mixed transportation style by a group of owners who contract with transportation companies. In case of simple transportation, direct door-to-door services from owners to respective destinations are common style of cargo transportation. In case of mixed transportation, round transportation via several relay points such as loading facilities is undertaken linking owners to destinations (Figure 5.49).



Source: Planning Team

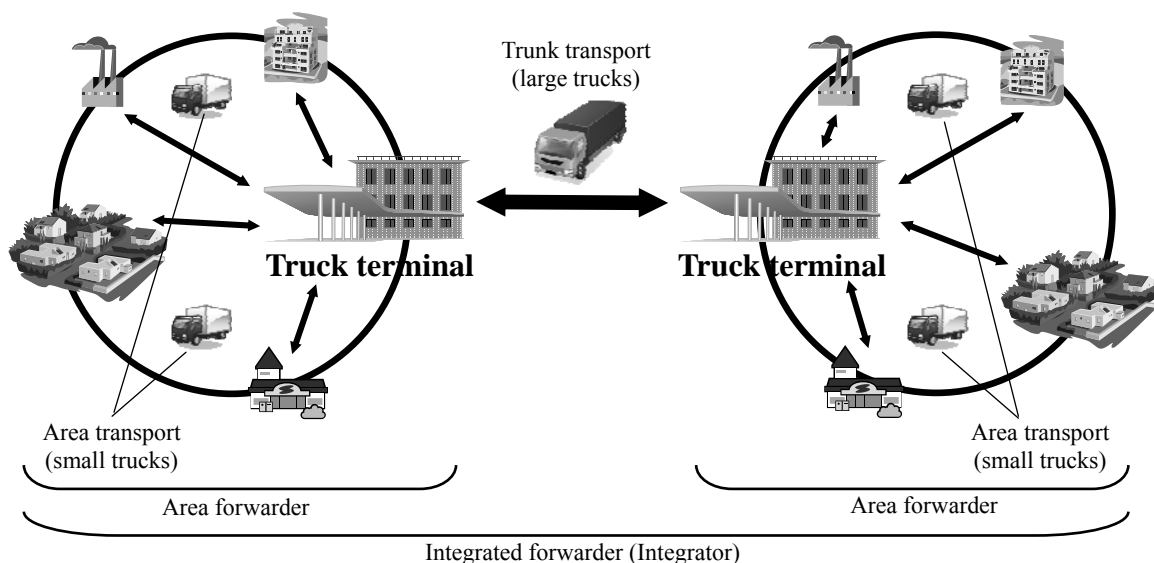
**Figure 5.49: Cargo Transportation Patterns**

In general, the simple transportation results in low efficiency due to inefficient use of loading spaces, and increase in the number of trucks to be used. This also cause heavier load on road traffic and adverse environmental effects. The mixed transportation for multiple cargoes may realize higher efficiency by the allocation of trucks according to cargo volume and the use of large size trucks on artery transport to reduce the total number of trucks.

It is desirable that the conversion from the present dominance of simple transportation to mixed transportation by consigned transport companies will be encouraged. Following the hierarchy of transport system as shown in Figure 5.50, transport companies may be classified into area forwarders servicing local areas and integrated forwarders for arterial transport together with area transport. It is proposed that public truck terminals be established in the peripheries of the urbanized area, where loading/unloading, transfer and sorting of cargoes related to Kabul City will be undertaken.

### (3) Roles of public truck terminals and their operation

Public truck terminals will control the unnecessary inflow of arterial transport cargoes into the Kabul urban area, and allow the transfer of cargoes on small trucks to larger trucks for transport efficiency. The truck terminals may be used by private forwarders for area transport services, warehouse operators, and other private firms having high demand for cargo transport with other regions. At present, few firms may establish their own terminals, but the use of the terminals by those mega integrated forwarders and other mega firms will be restricted. The public truck terminals will be allocated as much as possible to small and medium size forwarders for integrated and area transport services to support their development.



Source: Planning Team

**Figure 5.50: Cargo Transport Hierarchies**

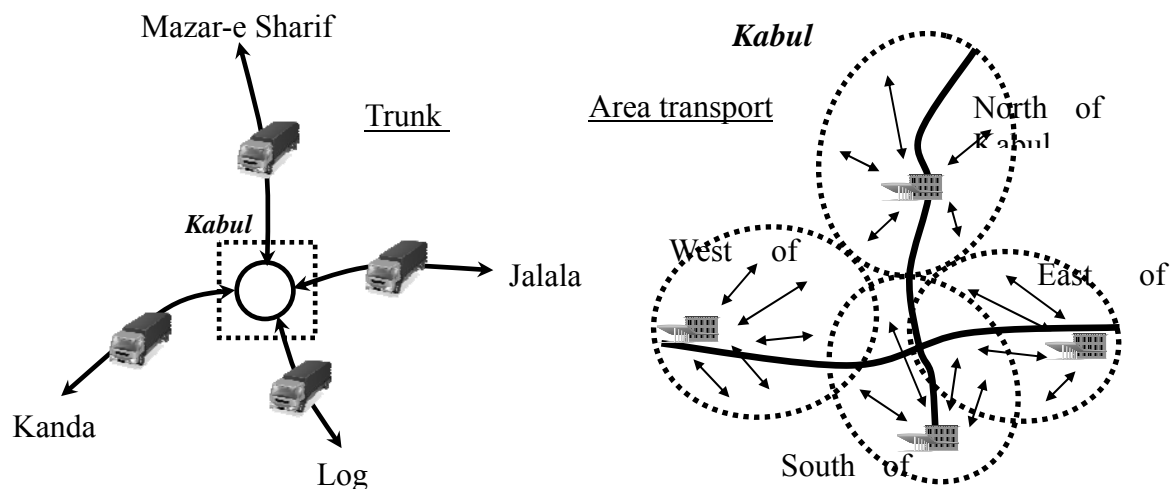
#### (4) Development plan

It is desirable that a public truck terminal will be located along each of radial arterial roads extending from the city center to the east, west, south and north. They may be located near the intersection between Kabul City outer ring road and the radial arterial roads in consideration of the boundaries of Kabul City and accessibility. The terminal location along the north-south axis of the Bagram road will be justified in view of the future development of rail transport system and introduction of cargo transport by rail. These locational considerations are common to the establishment of an inter-city bus terminal described earlier, and the public truck terminal may be located near the bus terminal.

Facilities to be required at a public truck terminal include truck berths for cargo transfer and sorting, temporary storage facilities, management and disaster prevention center, parking space, container yard, repair workshop, fuel station and others. Initially, logistic functions will be emphasized with cargo handling and temporary storage facilities, but sufficiently large land will be secured from the beginning to accommodate the expansion of logistic functions and the establishment of simple import/export processing functions in the future.

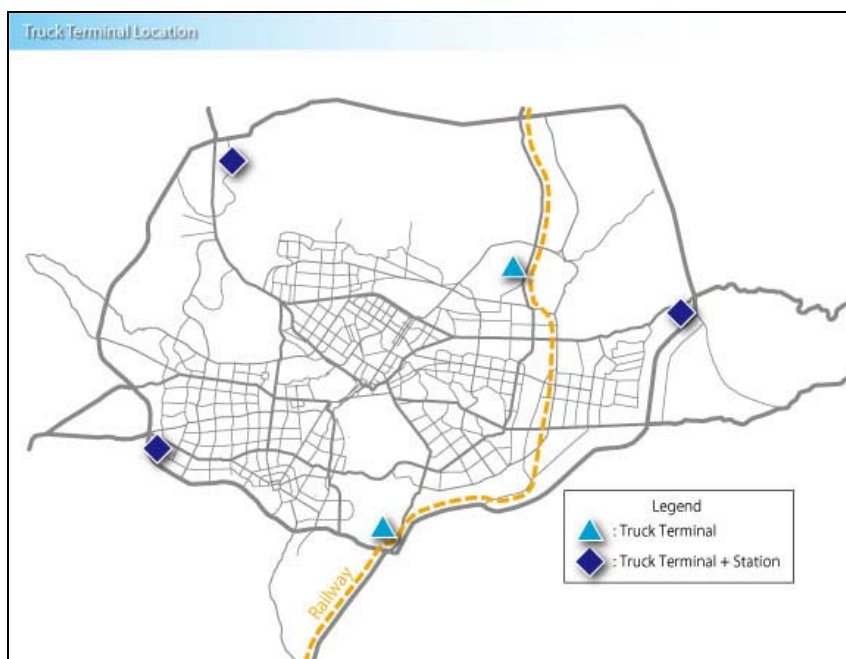
According to the previous traffic surveys in 2008, the number of trucks coming from the outer areas into the Kabul City was about 3,500 vehicles/day. This is projected to increase by 2.9 times to become 10,150 vehicles/day by 2025. Each of the five planned truck terminal will have to accommodate an average of 2,030 vehicles/day. Assuming each truck carries 10 tons on average, the ratio of trucks utilizing any terminal at 60%, and unit land area required at 40m<sup>2</sup>/ton, the total land area required for each terminal is estimated to be 50ha.

The proposed cargo transport system with the public truck terminals for Kabul City and surrounding area is illustrated in Figure 5.51 and Figure 5.52. Functions and specific facilities at each terminal are summarized in Table 5.62.



Source: Planning Team

**Figure 5.51: Case of Around Kabul City (Cargo Transport Hierarchy)**



Source: Planning Team

**Figure 5.52: Proposed Location of Truck Terminal****Table 5.62: Required Functions and Scale for Truck Terminal in Suburban Area**

Functions	Specific facilities
Loading Facilities	Truck berth with platform for dividing and reloading
Warehouse	Temporary storage for cargo
Administrative office	Administrative center, control center, restroom
Office building for private	Office spaces for forwarder and other private company
Parking lot	For truck and passenger car of staffs and customer
Container spaces	Temporary stock yards for container
Gas station	Gas and diesel station (CNG in future)
Repair workshop	Inspection, easy maintenance factory
Pathway	Road for truck and passenger car
Green spaces	Pocket park, planting, reserve area for future expansion

**(5) Benefit of introduction of cargo transport system**

The benefits of cargo transport system including truck terminal project was estimated. Reduced number of truck of the field test in Tokyo was 66%. Since the reduction rate of truck in Tokyo was so higher, it is assumed that the reduction rate in Kabul City is set as 40% to have it in safety side in case of truck terminal's construction. Based on the current traffic component, traffic volume in Kabul City will be reduced by about 6%.

**Table 5.63: Benefit of Joint Transport in Keihin Truck Terminal**

<Benefit>
No. of Trucks: Reduced by 66%
Total Cost: Reduced by 50%
Load factor :Improved by 8%
CO2 emissions: Reduced by 38%

Source: Tokyo Association of Truckers," Research Report on Joint Transport at an Ordinary Truck Terminal" 1998

**Table 5.64: Estimated Traffic Volume of Truck Terminals in Kabul**

Vehicle Type		Traffic Survey In 2009	W/O truck terminal(2009)	With truck terminal(2009)
	PCE (a)	Veh/12h (b)	PCU/12h (c=a*b)	PCU/12h (d=a*b)
Bike	0.50	22,360	11180	11180
Microbus	1.00	16,307	16,307	16,307
Minibus	2.00	3,327	6,654	6,654
Large bus	3.00	1,808	5,424	5,424
Taxi	1.00	19,317	19,317	19,317
Car	1.00	36,853	36,853	36,853
Truck	3.00	5,463	16,389	9,833 (=16,389*0.6)
Total		105,435	112,124	105,568
W-W/O truck terminal				- 6,556 (-6%)

Source: Planning Team

Note: Traffic data is based on the screen line survey (three stations) of KMAUD Master Plan, 2009, JICA

PCE; Passenger Car Equivalence

## 5.6.4 Operation system

### (1) Public transport facilities for passengers

#### 1) Overview of operation

Considering the current economic conditions of Afghanistan, the management of transport services involving large investments for their facilities will have to be initiated by the public sector. Consequently, the development of private transportation firms tends to be suppressed by such a public entity having large investment capacity, organizational strength and support by the Government. At the same time, any public organization with monopolizing power will be involved in political issues and tend to expand its organization and operating costs by incorporating inefficient activities. This will force the public organization to fall into unhealthy management relying on government subsidies to compensate for insufficient revenues from the inefficient activities. To avoid such situations to occur, the activities of such public organizations will be kept at the minimum necessary to guide the development of the industry, and its operation will be transferred in steps to private firms, which can become self reliant.

The utilization of private sector capacity is vitally important for urban development, which cannot be undertaken by the public sector alone.

#### 2) Feeder bus services

Private bus transport services tend to concentrate on those routes that will ensure high profits. Under competitive market conditions, high levels of services will be ensured as many private firms enter the market. In view of the current economic conditions in Kabul, the provision of inexpensive bus services throughout the city area is the responsibility of the public sector as part of the civil minimum needs. Therefore, the public sector will cover such services areas that may not be naturally covered by private companies, while public and private entities co-exist to provide comprehensive services. Also, the public organization will establish tariff structure affordable by the city residents and undertake good maintenance of bus fleets that will provide models for the private companies.

#### 3) BRT services

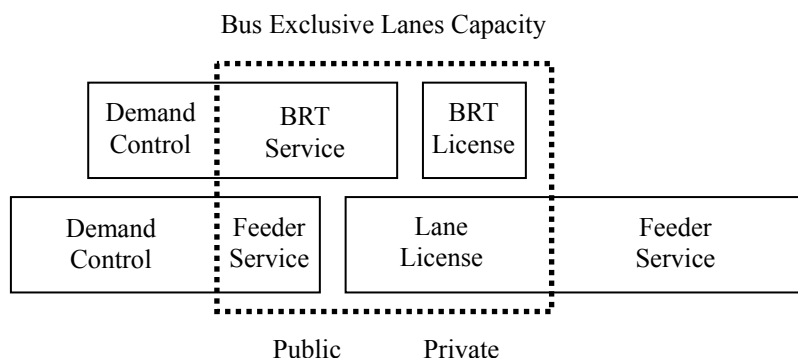
The BRT services will be provided on main routes of Kabul City and New City as arterial transport services, and thus high demand is expected. Therefore, the private sector is expected to enter the market in a substantial way together with the public organization. A license system will be introduced for the arterial transport by the BRT, and only such private firms that are capable of providing services with sufficient quality will be allowed to join the market.

The management of bus exclusive lanes will be done by the same entity responsible for road management. Also, the use of such lanes by feeder service providers will be allowed by permit, which will be controlled by the public sector (Figure 5.53). The use of bus exclusive lanes by the private firms will be permitted only to such firms that can satisfy certain conditions for bus fleet and service levels. Specifically, only large size bus vehicles will be permitted to encourage the private firms to convert from smaller to larger bus vehicles for efficiency of the operation and minimization of adverse environmental effects. At the same time, low interest loans may be introduced to support the small firms to make investments in improving their bus fleet, and the dominance by the public organization will be prevented.

#### 4) *Bus terminals or centers operation*

The bus terminals or centers will be used by a large number of public and private entities. For their operation, a separate entity may be established by the contribution of public fund by the bus services provider and local governments and the participation of private bus companies for the management. This third sector entity will be transformed in steps to private firms in the future.

Bus terminals constitute part of facilities essential for providing bus services, and thus their operation will be based on the revenues from bus fares in principle. They will become public spaces that can be used by many citizens, and additional revenues from renting for shops within the terminal buildings can be expected in the future.



Source: Planning Team

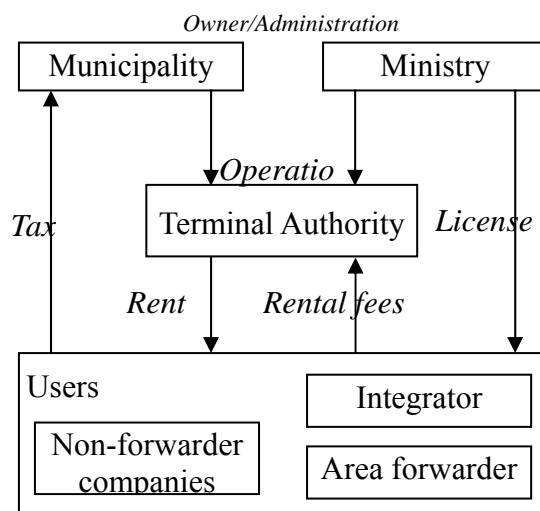
**Figure 5.53: Outline of Shared Use of Bus Exclusive Lanes**

#### 5) *LRT*

The BRT route with high demand will be converted to the LRT routes in the future. In this case, it may be natural that the operation entities for the BRT will also undertake the LRT operation. It is recommendable that private companies take responsibility for the LRT operation, supported by contributions from bus operators and developers as well as some public fund.

#### (2) **Truck terminals**

The public truck terminals will be established by local governments in respective urban areas in cooperation with the relevant ministry of the Government. It is desirable that their operation will be entrusted to the corresponding local governments or a separate authority to be established by the Government. It is highly desirable that the authority be managed as an autonomous entity. The establishment of such an authority will be subject to the establishment of relevant enabling law. The structure of management and operation of freight services with truck terminals is illustrated in Figure 5.54.



Source: Planning Team

**Figure 5.54: Cargo Transport Hierarchy around Kabul**

The necessary legislations for the establishment of public truck terminals are as follows: law on transport business in general, law on the establishment of truck terminals and related regulations for their operation and use, and regulations to restrict large size vehicles entering the Kabul urban area by utilizing the public truck terminals as control points to enforce the regulations (Table 5.65).

**Table 5.65: Required Institution related to Public Truck Terminal**

Category	Institution	Contents
Transport	Forwarder law	- License of forwarder - Definition of forwarder
Terminal operation	Law for terminal operation	- Agreement of facilities users - Operation body and structure - Criteria for terminal rent
Traffic control	Regulations for road transport in Kabul City	- Traffic flow control for large vehicles into city center

Source: Planning Team

## 5.7 Traffic Management System Development Plan

### 5.7.1 General

One of the advantages of traffic management is to implement various countermeasures to alleviate the transportation problems in a short term and at low cost. The necessity of traffic management is summarized as follows:

- Existing traffic facilities in Kabul urban area are not used effectively at present. If traffic management and operation were improved, it would contribute to the effective use of existing facilities and traffic capacity would substantially increase.

Traffic management in Kabul urban area in road facilities, traffic operation and traffic safety plan is still at the developing stage. The aim of traffic management is to assure safe, comfortable and speedy traffic movement. Among these aims, traffic safety is the fundamental requirement for the citizens.

The objective of the traffic management plan is to prepare comprehensive measures to provide a safe, smooth and comfortable traffic environment for road users. The measures will be prepared based on a careful study of the traffic problems currently occurring and expected to occur in the future in order to cope with these problems. The following measures of traffic operation issues in Kabul urban area are studied.

- Improvement of Intersections
- Parking System

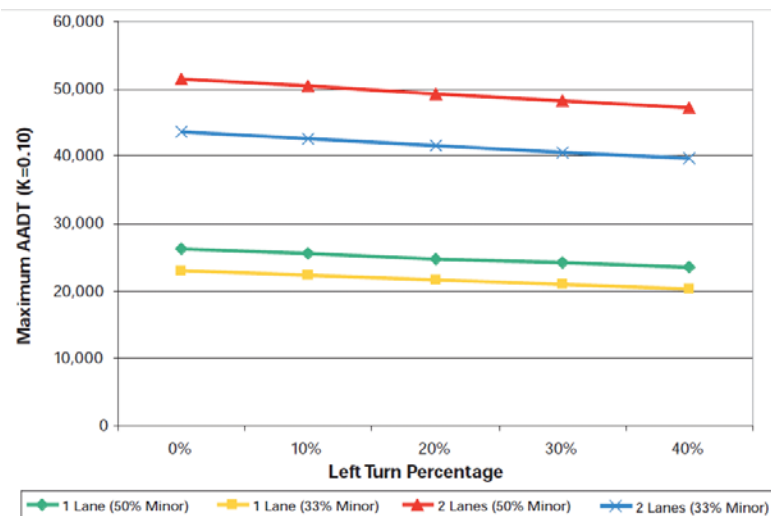


- Road Safety
- Other measures

## 5.7.2 Improvement of intersections

### (1) Justification for roundabout improvement and signalization

Roundabouts are considered safer as vehicles slow down as they enter the intersections and proceed without the time loss when the traffic is relatively small. The capacity of roundabout to deal with the traffic is smaller than signalized intersections. The maximum traffic that can be handled by a roundabout with four roads of single lane in one direction is limited to 20,000-25,000 vehicles (Figure 5.55). The roundabout can handle 500-600 vehicles per direction per hour. The signaled intersection can handle 900-1,000 vehicles per direction per hour. Roundabouts with increasing traffic will be converted to signaled intersections.



Source: Roundabouts: An Informational Guide, 2000, US Department of Transport

**Figure 5.55: Maximum Traffic Volume at Roundabout**

The crossings of roads with heavy traffic in urban areas or of the arterial roads in suburban areas will be improved as intersections with flyover or underpass. Moreover, the crossing points without signals where increasing traffic volume is expected from the road hierarchy will be improved with the installation of signals as soon as possible. Roundabouts may remain at the following intersections:

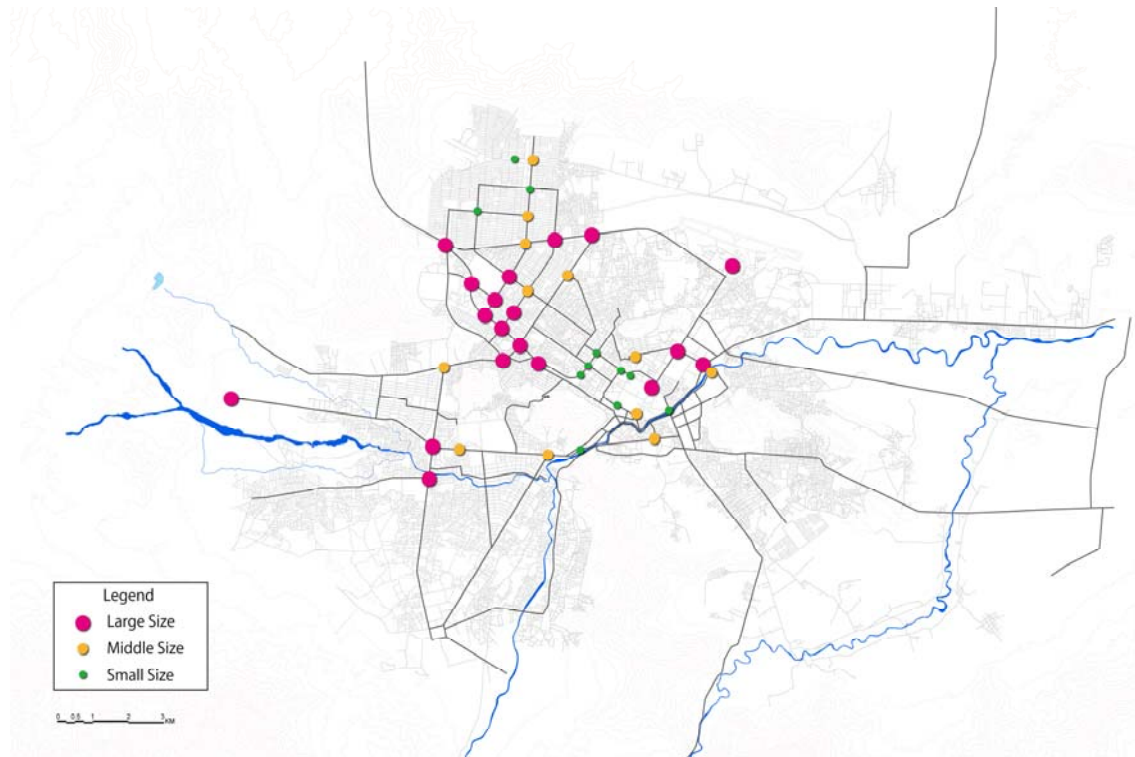
- Within residential areas where safe and quiet living spaces area expected
- Where the road classification or function changes such as at the entrance to a residential area to indicate the changes to drivers
- In suburbs where traffic is not heavy and control of vehicle speed is desirable

The following principles may be applied to roundabouts existing in different areas (Figure 5.56).

- Roundabouts in residential areas of District 11 and surrounding areas will remain.
- Smaller roundabouts inside the KCIRR will be converted to signalized intersections as traffic will increase in the future.
- Roundabouts outside the KCIRR will remain.
- Roundabouts connecting the KCIRR with arterial roads will be converted to signalized intersections.
- Large roundabouts inside the KCIRR will be signalized.

Major intersections except exiting roundabouts will be improved by installing signals in the existing urban area as follows.

- (a) Traffic signals will be installed at crossing points of major arterial roads, arterial roads and minor arterial inside the KCIRR in the existing urban area in principle. However, this will not apply to intersections in residential areas.
- (b) Traffic signals will be installed at crossing points of major arterial roads, arterial roads and minor arterial except crossing points between two minor arterial roads outside the KCIRR as a matter of principle. However, intersections in residential areas will be excluded.



Source: Planning Team

**Figure 5.56: Existing Roundabouts in Existing City Area Classified by Scale**

## (2) Evaluation of existing roundabout

The roundabouts are evaluated on the basis of traffic situation, geometric design, environmental and social impacts, operation and maintenance and traffic safety. Firstly, a rough Volume-Capacity Ratio (VCR) analysis was applied. This bases on the estimated traffic volume (Year 2015) in any given peak hour versus the capacity of junction based on the number of lanes applicable. The following are the evaluation procedure in this analysis;

- The daily traffic volume was converted to peak hour volume by simply applying assumed peak hour ratio of 0.065 (based on the traffic survey result).
- Assumed capacity of carriageway (approach lane and exit lane) is fixed at 1,500 PCU (Passenger Car Unit) per hour per lane for the intersection. For the roundabout, assumed capacity of circular lane is fixed at 2,000 PCU per hour per lane.
- For roundabout, the capacity of junction is determined by the number of circular lanes, and traffic volume passing through the intersection is determined by the sum of entering traffic from all approach legs.
- For intersection (non-roundabout), the capacity of junction is determined by the number of approach lanes, and traffic volume passing through the intersection is determined by the

sum of higher entering traffic between corresponding opposed legs (i.e. either north or south bound traffic whichever is higher, plus either east or west bound traffic whichever is higher).

The estimated traffic in year 2015 is shown in Table 5.66. The evaluation results are shown in Table 5.67. According to this rough VCR analysis, Koteh Sangi (No.12) has the highest VCR(1.82). Deh Kipak (No.1) and Abdolhaq (No.10) are higher than 1.5. Based on this result, these roundabouts are recommended to be converted to flyover or signalized intersection for smooth traffic flow during peak hour as soon as possible.

**Table 5.66: Estimated Traffic (Year 2015) of 16 Selected Roundabout**

Unit: 100PCU

No.	Name	No. of legs	North	South	West	East	Diagonal	Section Total
1	Deh Kipak	5	35,600	25,500	14,500	9,400	14,500	99,500
2	Shahid Panah	4	25,500	26,900	1,200	700		54,300
3	Parawan Se	3	0	0	26,900	26,900		53,800
4	Parawan Do	4	12,600	14,500	28,000	25,500		80,600
5	Dane Bagh	4	700	6,300	29,300	26,400		62,700
6	Sarake Panj	4	0	0	15,700	16,200		31,900
7	Shahid Hangarha	4	0	11,100	16,200	22,300		49,600
8	Shir Poor	4	10,200	10,700	2,000	0		22,900
9	Masood	4	24,900	0	7,800	24,200		56,900
10	Abdolhaq	4	44,200	24,000	28,400	0		96,600
11	Chawk	4	0	0	31,800	32,700		64,500
12	Koteh Sangi	4	25,800	29,000	40,700	16,600		112,100
13	Deh Bori	4	1,700	0	40,700	42,200		84,600
14	Pole Sokhta	4	29,000	8,000	20,300	10,100		67,400
15	Deh Mazang	3	0	17,700	44,200	57,200		119,100
16	Kohia Adad	3	0	25,800	21,400	24,500		71,700

Source: Planning Team

**Table 5.67: Result of Evaluation for 16 Selected Roundabouts**

No.	Name	No. of legs	Roundabout		Intersection						Recommended Configuration	Phase	Remarks
			No. C. Lanes	VCR	No. of Approach Lanes					VCR			
					N	S	W	E	D				
1	Deh Kipak	5	2	1.62	3	3	2	2	2	1.13	F/O	Phase I	When Inner Ring Road is constructed, Flyover is recommended.
2	Shahid Panah	4	2	0.88	2	2	1	1		0.63	I/S	Phase II	With Signal
3	Parawan Se	3	2	0.87	2	1	2	3		0.58	I/S	Phase II	With Signal
4	Parawan Do	4	2	1.31	3	2	3	3		0.71	I/S	Phase II	With Signal
5	Dane Bagh	4	2	1.02	3	1	3	3		0.69	I/S	Phase II	With Signal
6	Sarake Panj	4	2	0.52	1	2	3	3		0.23			
7	Shahid Hangarha	4	2	0.77	2	2	3	3		0.56			
8	Shir Poor	4	2	0.37	2	2	2	2		0.27			
9	Masood	4	2	0.92	3	3	3	3		0.71	I/S	Phase II	With Signal
10	Abdolhaq	4	2	1.57	3	3	3	3		0.84	I/S	Phase I	With Signal
11	Chawk	4	2	1.05	2	2	3	3		0.47	I/S	Phase I	With Signal
12	Koteh Sangi	4	2	1.82	3	3	3	3		1.01	F/O	Phase I	Underconstruction
13	Deh Bori	4	2	1.37	2	2	3	3		0.65	I/S	Phase I	With Signal
14	Pole Sokhta	4	2	1.10	3	3	2	2		0.86	I/S	Phase II	With Signal
15	Deh Mazang	3	3	1.29		3	4	4		0.88	I/S	Phase I	With Signal
16	Kohia Adad	3	2	1.17		2	3	3		0.91	I/S	Phase II	With Signal

  : VCR>1.5    
   : 1.0<=VCR<=1.5    
   : 0.8<VCR<=1.0

Source: Planning Team

Note: R/A (Roundabout), I/S (Intersection), F/O (Flyover)

### (3) Preparation of countermeasures

The countermeasures necessary for these roundabouts are as follows:

- Installation and improvement of traffic signal

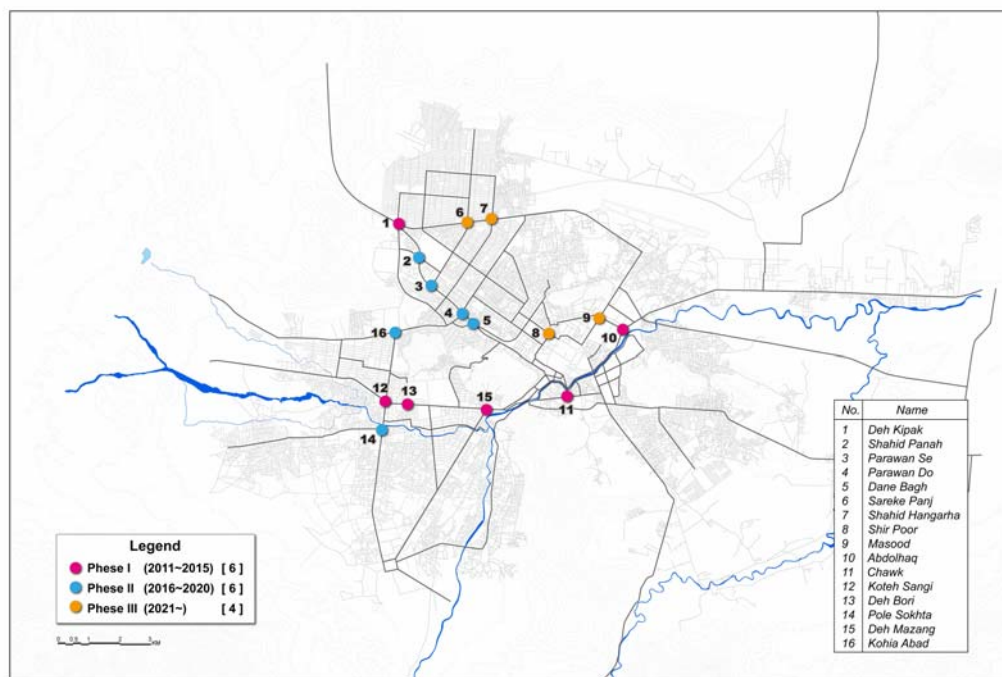
- Geometric improvement (from roundabout to intersection type)
- Pavement Marking
- Traffic Signs

Regarding the timing of implementation, it is proposed that three phases are introduced as shown in Table 5.68 and Figure 5.57. According to the traffic analysis, the Deh Kipak (No.1) and Kotha Sangi (No.12) will be needed to convert to the flyovers and other roundabout will be needed to convert to the signalized intersections.

**Table 5.68: Proposed Implementation Phase of Existing Roundabout**

Term	Year	No. of Intersection Improvements
Phase I	2011-2015	6(No.1,10,11,12,13,15)
Phase II	2016-2020	6(No.2,3,4,5,14,16)
Phase III	2021-	4(6,7,8,9)

Source: Planning Team



Source: Planning Team

**Figure 5.57: Roundabout to be Improved in Phase I to Phase III**

It is noted that the purpose of this analysis is to give a rough idea on the implementation plan of intersection improvement. The detailed study of countermeasures is necessary by checking the peak hour's traffic volume and queue length of each roundabout before roundabouts are improved. It is recommended to check the peak volume and capacity of the above roundabouts after the KURIP project is completed.

### 5.7.3 Parking system

On-street parking poses serious problems in the urbanized area of Kabul, but it has not received adequate attention so far as compared with road development. On-street parking and resultant overflow of vehicles on the streets create unsightly scenes in Kabul City. They also obstruct various economic activities, while it is difficult that buildings for offices, shops, hospitals, schools and other purposes to supply parking spaces necessary to meet the demand. Therefore, it is necessary to provide parking facilities in a balanced way with effective use of road spaces, parking facilities by the public sector and parking spaces provided by large-scale buildings by the private sector.

## (1) Public off-street parking

### 1) Justification

In the existing urban area, most governmental buildings have parking lots, but there are almost no buildings with parking spaces in commercial areas except large-scaled shops like the Kabul Center that exclusive parking lots are provided by themselves. Therefore, many vehicles are parked in the commercial areas where small shops are located, causing neighboring traffic congestion every day. The public parking with large capacity should be constructed at several locations in the urban area in order to meet parking demand in the city center.

### 2) Development plan

The public parking is proposed at seven (7) locations, which can be developed as at- parking lots (Table 5.69 and Figure 5.58). These locations are identified based on high demand in the central areas as follows.

Proposed locations for public parking lots

- Commercial area or many shops located along narrow roads
- High demand of the on-street parking cars and congested sections due to on-street parking

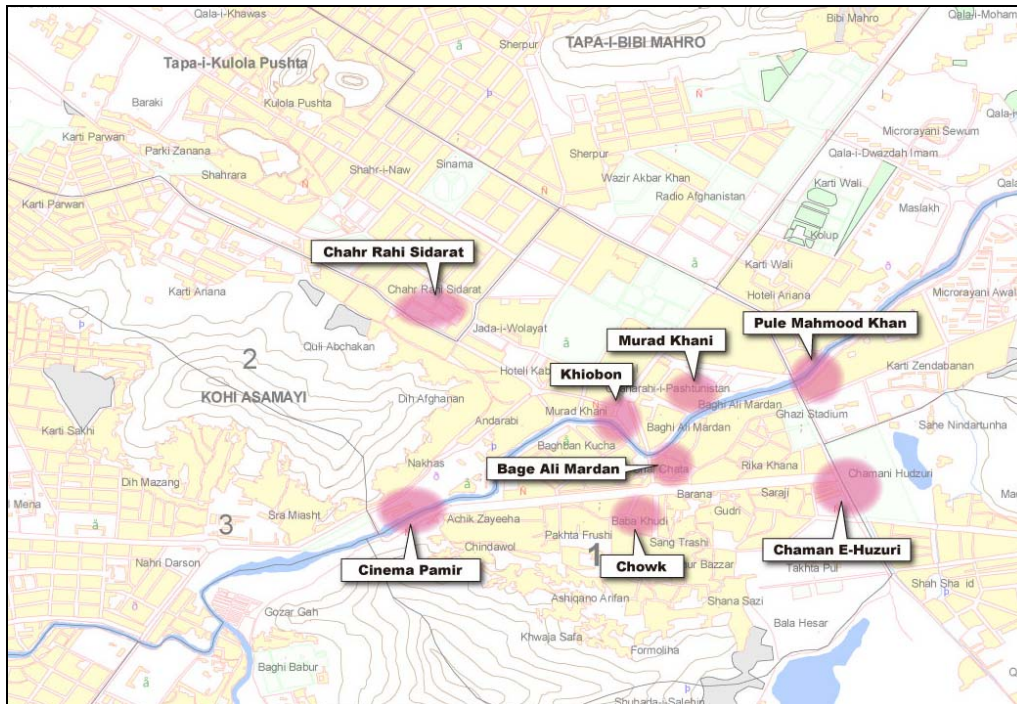
The proposed parking spaces are currently vacant. A proper detailed plan will be needed to negotiate the land owner and other related authorities/agencies. At-grade parking would be provided in each location for 200 cars respectively in the area of about 6,000m<sup>2</sup>. An indicative plan of the parking is given in Figure 5.59.

**Table 5.69: Outline of Public Off-street Parking**

Location	Type	Parking lots (n)	Required area (m <sup>2</sup> )
1. Cinema Parmir	At-grade parking	200	6,000
2. Chowk (Maiwand Memorial)			
3. Chaman-e-Huzuri			
4. Bage Ali Mardan			
5. Murad Khadi			
6. Char Rahl Sidarat			
7. Pule Mahmoad Khar			

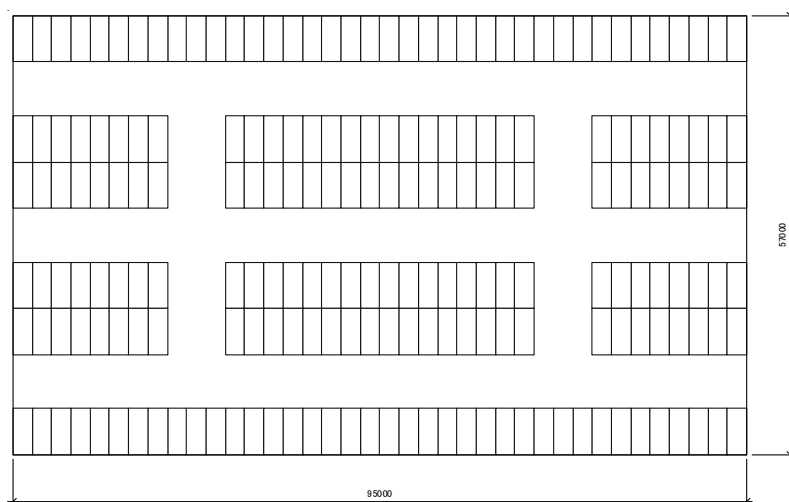
Source: Planning Team





Source: Planning Team

**Figure 5.58: Proposed Sites for Public Off-street Parking in City Center Area**



Source: Planning Team

**Figure 5.59: Image of Public Off-street Parking**

## (2) Compulsory parking for buildings

### 1) Justification

There are large parking demands for various purposes in the existing urban area but the existing parking facilities are very limited. Consequently, many cars are parked on the streets everyday, causing traffic congestion on neighboring roads as well. Since the most parking demand is generated from buildings for offices or shops, these buildings should be required to develop their own parking facilities for employees, customers and other visitors, depending on the size and use of buildings. The compulsory parking facilities for buildings is the system for each building to prepare parking lots for demand generated from the building itself.

### 2) Development plan

Compulsory parking provision for new buildings and developments would apply to various commercial, business and public facilities.

Most parking demand in urban areas in Japan is covered by compulsory lots that the local government establishes. The commercial and its surrounding areas are targeted as control areas for parking, and buildings there are divided into two categories: specific buildings from which many vehicles traffic is generated, and others for non-specific buildings. The buildings with the floor area exceeding some standard are subject to compulsory parking. The required number of parking lots is defined by the kind of buildings and its scale.

The unit rates for parking lot provision vary for different cities. The rates are naturally lower for cities where public transport is well developed. The criteria and standards applicable to different facilities are shown in Table 5.70. More specific criteria and standards would be developed in order to fit the conditions in Kabul City.

**Table 5.70: Examples of Compulsory Parking Facilities for Buildings**

*Building classification*

Class	Category	Example
Specific	Office	Government office, bank
	Warehouse	Logistics center, distribution center
	Theater	Hall
	Accommodation	Hotel
	Restaurant	Café, restaurant
	Exhibition	Museum, zoo, botanical garden
	Amusement	Casino, gamble
	Gym	Sports club, training field
	Hospital	More than 20 beds
Non specific	University	
	Others	

*Building under restrictions*

Classification	Commercial zone	Surrounding area
Target area definition	Floor area of Specific building Floor area of non specific $\times 0.5$	Floor area of Specific building
Area (m <sup>2</sup> )	1,000	2,000

*Unit area for parking lot*

Building	Unit area	
	Parking restricted zone	Surrounding area
Department, office	200m <sup>2</sup>	200m <sup>2</sup>
Warehouse, factory	250m <sup>2</sup>	300m <sup>2</sup>
Other specific building	250m <sup>2</sup>	250m <sup>2</sup>
Non-specific building	550m <sup>2</sup>	-

Source: Standard for Compulsory Parking Facilities for Buildings, Yokohama, Japan

### (3) Parking operation system

#### 1) Parking operation

Parking facilities are effective in reducing the incoming traffic into the city center, and thus should be operated properly with inflow control and fee collection for incoming vehicles. The size of the facilities should be determined to be just sufficient to reduce the incoming traffic at a necessary level. Their operation may be by public fund, the operating organizations of the LRT, or private companies to be established with contributions by private companies.

#### 2) Control of illegal parking

The traffic congestion in the city center is caused partly by on-street parking. The reduction of in-coming vehicles presents a fundamental solution, and the introduction of the BRT and LRT would contribute to it. To encourage the conversion from private vehicles to public transportation, control of illegal parking would be enforced together with the incentives to make the public transportation attractive.

#### **5.7.4 Road safety**

##### **(1) Medians for wider roads**

###### *1) Justification*

Since many wider roads in Kabul City do not have medians, vehicles make turns at any point along the roads, causing traffic congestion and threat to pedestrian safety. Provision of medians on wider roads would facilitate NMT crossing.

###### *2) Development plan*

Medians should be provided on existing roads with four or more lanes. The total road length of 33.5km would be covered. Some medians may take a form of separation by simple concrete blocks, but protective structure for NMT should be provided as much as possible.

##### **(2) Pedestrian Facility**

###### *1) Justification*

Very limited pedestrian crossings are provided in Kabul City. Even the road marking for pedestrian crossings is limited or faded away. Without signalization, pedestrians and bicycles have difficulties in crossing roads of heavy traffic. In the city center, many pedestrians waiting the public transport, especially taxi are disturbing the smooth traffic flow.

###### *2) Development plan*

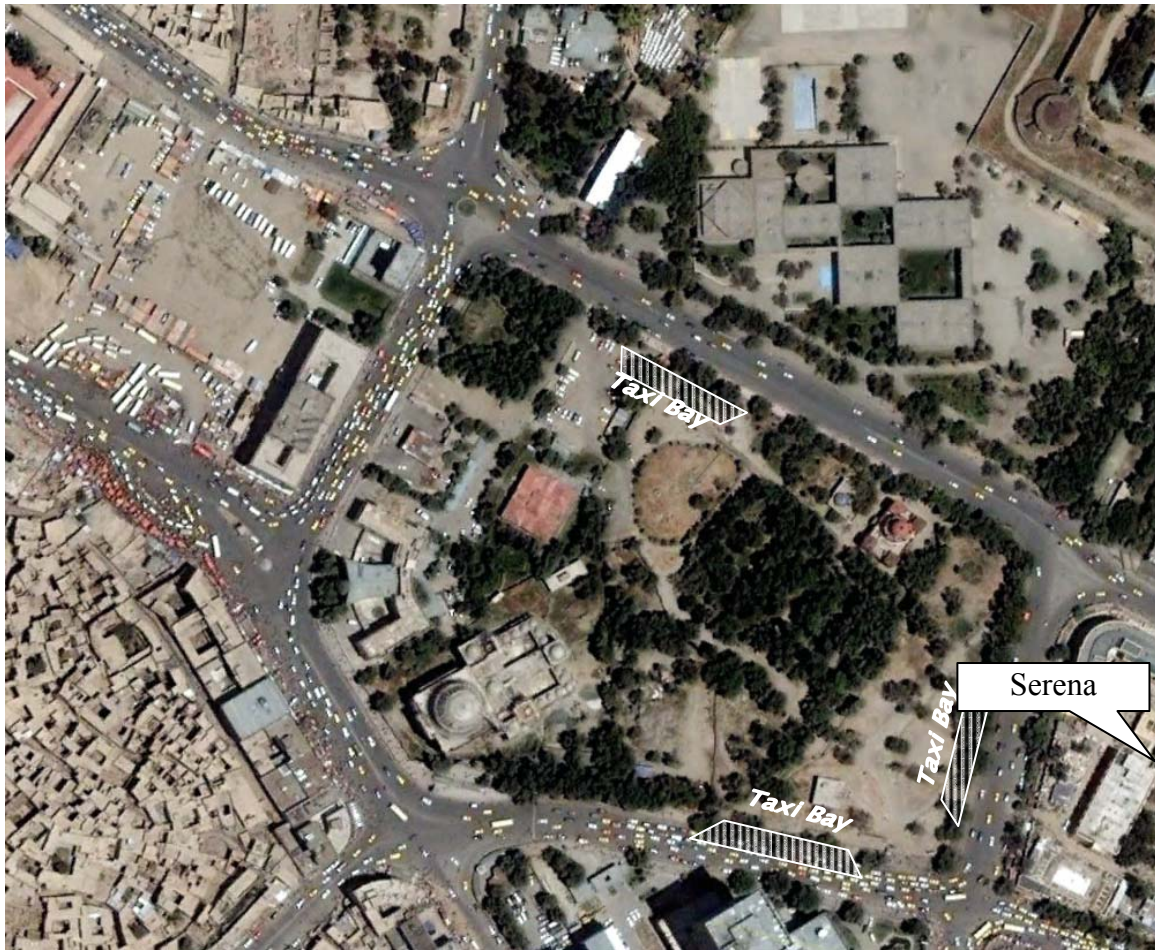
It is recommended that all junctions to be provided with pedestrian crosswalk at all approaches, which is part of the improvement in geometry and control at junctions. At intersections with heavy traffic, pedestrian bridges will be installed.

###### **CBD**

In the city center, many pedestrian crossings or commuters waiting for taxi disturb the smooth flow of vehicle and reduce the capacity of the road during the peak hours. It is therefore proposed to construct taxi bay or waiting pool along the road. The location map of taxi bay or waiting pool is illustrated in Figure 5.60. It is also necessary to enforce the following traffic regulation for pedestrians.

- No entry to the carriageway while waiting for public transport
- No crossing of the road except at the pedestrian crossing



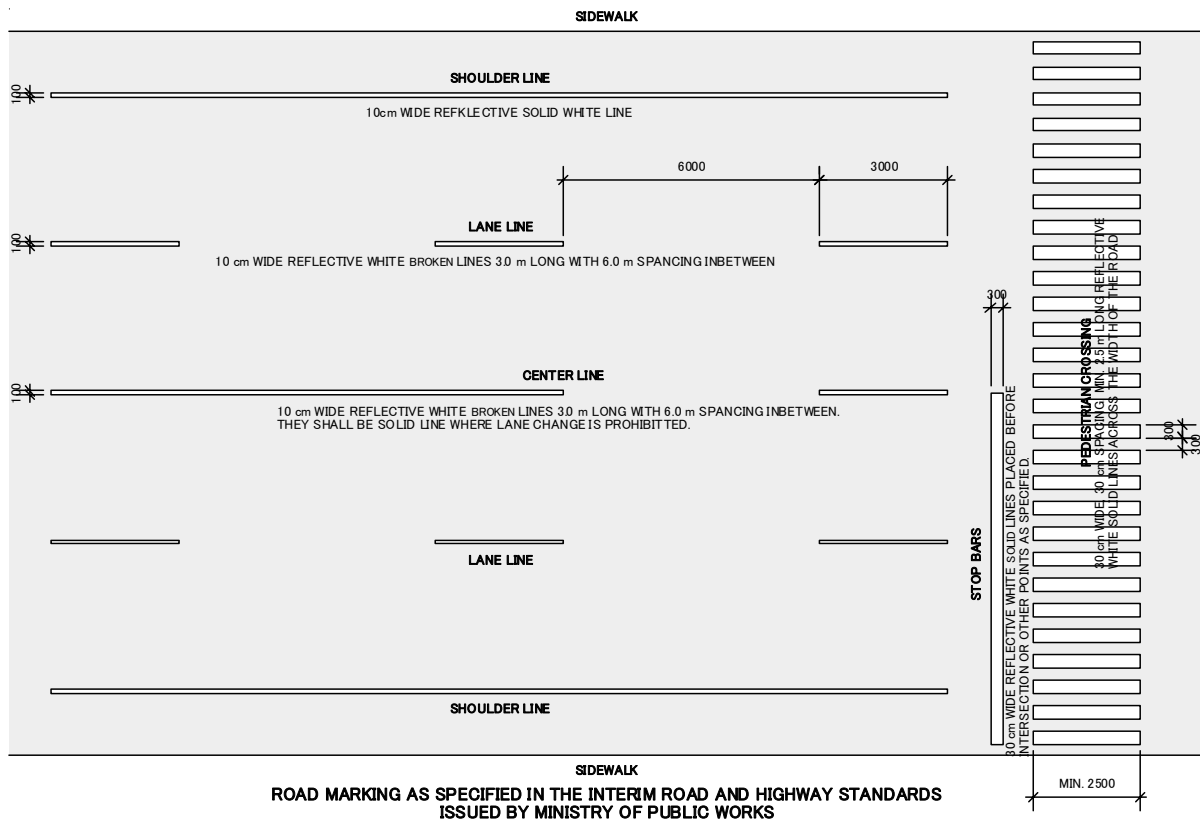


Source: Planning Team

**Figure 5.60: Taxi Bay / Waiting Pool in the City Center**

#### Sub Urban Area

In the suburbs, NMT crossings will be provided in areas where the development is taking place by either as marking or pedestrian bridges if the traffic is heavy. However, since the vehicles travel at high speed on arterial roads with few signals, it is desirable to develop the pedestrian bridges along the roads especially on those with heavy traffic. A sample marking of pedestrian crossing is illustrated in Figure 5.61.



Source: Planning Team

**Figure 5.61: Road Marking and Pedestrian Crossing Marking**

### 5.7.5 Other Measures

#### (1) Resolution of road blocking

The traffic on some major roads is blocked in several locations in Kabul City for security reasons. These include such as the areas around the Presidential residence, government offices and diplomatic facilities. The proposed plan for road development is based on the resolution of these blocks.

#### (2) One-way control of traffic

One-way traffic control is employed extensively in the existing urbanized areas in the city. This is considered effective for smooth flow of traffic, given the present complicated road network, especially in commercial areas.

More elaborate traffic control would be necessary as the LRT may be introduced in the future. In particular, traffic ban on roads in the central commercial areas would be enforced to allow the LRT and public transport to operate effectively. Pedestrian zones would be established centering on the LRT facilities in the central areas including the Old City to provide safe and comfortable corridors for walking.

## **CHAPTER 6**

### **UTILITIES INFRASTRUCTURE DEVELOPMENT PLAN**

#### **6.1 Water Supply System Development**

##### **6.1.1 Existing conditions of water supply**

###### **(1) Development history of piped water supply in Kabul**

The first water supply system for Kabul City was established in 1881 during the era of the Abdur Rahman Khan kingdom. It consisted of brick canals from springs located in the upper Kabul River to the Old City. The residents used to take water from the canal. The system had been operated until 1911.

As the city developed, the residents required more convenient and systematic water supply. In the 1910s, a new water supply system consisting of pipelines and a water reservoir was constructed assisted by British engineers. The system was to supply the water from the Kargha karez, springs along the Paghman River, to the city. This system is still operational. The Kargha karez water was diverted exclusively to drinking water upon the completion of the Kargha Dam, and a decision was made to allocate the reservoir water for agriculture. However, the system has not satisfied the demand of residents.

The first groundwater supply system was constructed during of 1954-1965. It constitutes a major part of the existing Allaudin system. At the beginning of the 1980s, the second and the third groundwater supply systems were completed in the Afshar and the Logar well fields. These groundwater developments now constitute largely the current water supply system.

Besides these systems, there is a development of independent system for the apartment complex of Macrorayon. The area is equipped with systems of water supply and sewerage.

From 2002 to 2004, to rehabilitate and expand the water supply, a “Feasibility Study for the Extension of the Kabul Water Supply System (hereinafter referred to as the KfW water study)” was conducted under the cooperation of KfW. This is the most recent and comprehensive water supply development plan and utilized as a master plan toward 2015.

###### **(2) Water supply implementing agencies**

Afghan Urban Water Supply and Sewerage Corporation (AUWSSC) is now the implementing agency for water supply and sewerage in Afghanistan. It is a public corporation established in 2008 to pursue the improvement of the services through independent business. Since 2008, property and business of former implementing body, the Central Authority for Water Supply and Sewerage (CAWSS), have been transferred to AUWSSC, and the water supply business for Kabul City was transferred in 2009. AUWSSC administrates the services for the entire Afghanistan through their provincial branch offices.

The Kabul Municipality manages water supply and sewerage in the Macrorayon area, although it is in the AUWSSC service area. The Macrorayon Maintenance Department is responsible for managing the water supply and sewerage system there, including the sewers and sewage treatment

facilities. The department, as a public maintenance company in reality, is mandated to operate by its tariff income and pay 10% of the revenue to the government.

The AUWSSC service area is confined to the planned urbanization areas. In Kabul City, only Districts 1 through 16 are presently covered by AUWSSC. The water supply for other areas is managed by the Ministry of Rural Reconstruction and Development (MRRD). In these areas, water is supplied through private and community wells. Even hand pump wells located in the AUWSSC service area are under MRRD's responsibility. MRRD responsibilities for these areas would be transferred to AUWSSC, once the urban master plan is extended to cover these areas. A major task of MRRD is policy formulation and construction of water supply facilities for unplanned areas and management of NGO activities.

### (3) Tariff systems

#### 1) AUWSSC

The current tariff of AUWSSC is given in Table 6.1. As 25% of customers have no water meters, the fixed rates are applied in addition to the rates per consumption. Customers having meters pay an additional rental fee for them at AFN 300/year. According to AUWSSC, a disconnection policy for defaults by customers to pay the tariffs is being strengthened. AUWSSC presently collects tariffs more than 75% according to financial report for 1388 (in Islamic calendar, March 2009 - March 2010 in Gregorian calendar).

According to AUWSSC, the average water tariff is AFN 4/m<sup>3</sup>, while the average production and operation cost of water supply is AFN 7.44/m<sup>3</sup> (excluding depreciation).

#### 2) Macrorayon

The Macrorayon system has no water meter, and therefore the tariffs are charged according to the floor area. Currently, the rate of AFN 1/m<sup>2</sup> of floor area is applied. As the revenue is short of operation and maintenance cost, estimated by the Macrorayon Department at AFN 6/m<sup>3</sup>, it is requesting the tariff revision to AFN 6.6/m<sup>3</sup>.

**Table 6.1: Current Water Tariff System of AUWSSC**

Contract category			Rate (AFN)	Unit
Stand pipe (public tap)			N/A	
Non urban planned area		Metered	4	per m <sup>3</sup>
		Un-metered	600	per year
Urban planned area	1/2"connection	Metered	6	per m <sup>3</sup>
		Un-metered	960	per year
	3/4"connection	Metered	8	per m <sup>3</sup>
		Un-metered	1,920	per year
	1"connection	Metered	10	per m <sup>3</sup>
		Un-metered	3,840	per year
Commercial area	Urban area		20	per m <sup>3</sup>
	Non urban area		7,680	per year

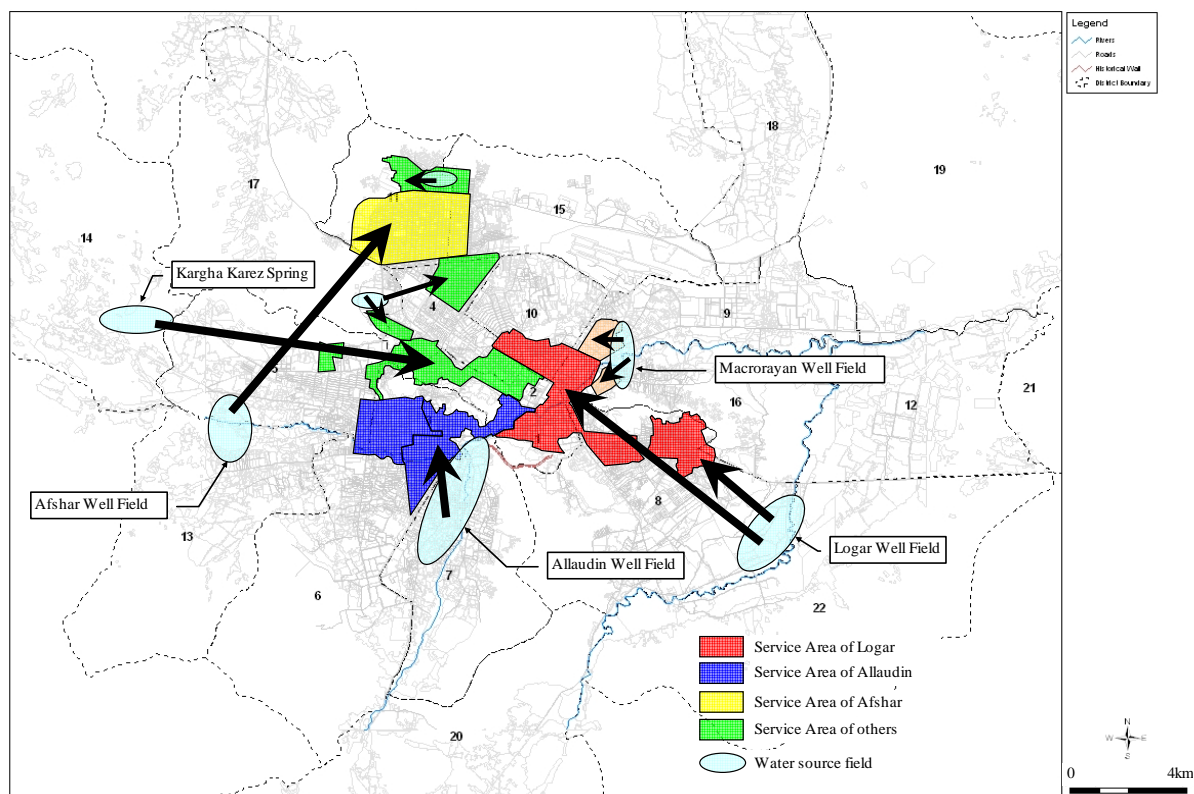
Note: 1/2", 3/4" and 1" are diameters of service pipe in inch.

Source: AUWSSC.

### (4) Present conditions of piped water supply in Kabul

#### 1) Water supply service area and service population

The present service area of piped water supply is confined to the central part of Kabul City as shown in Figure 6.1. AUWSSC has no accurate data on service population. The total number of beneficiaries is estimated roughly to be 1.0 million, including public tap users and office workers. According to AUWSSC, there are 39,207 house connections and 392 public taps as of the end of 2009. Of the house connections, 37,714 are categorized as domestic customers (Table 6.2).



Source: KfW Water Study (simplified by Planning Team)

**Figure 6.1: Schematic Presentation of Existing Water Supply System and Service Areas**

The number of connections by domestic users does not coincide with the number of families connected to the piped water supply, as there are many cases where multiple families are served by a single connection. AUWSSC estimates that one domestic contract serves currently 10-15 persons. Applying 12 persons per domestic connection, the direct service population is calculated to be 450,000. For public taps, it is assumed that one public tap serves 1,500 persons.

The service population by public taps is, therefore, 580,000. Accordingly, the total domestic beneficiaries are calculated to be some 1,030,000 as shown in Table 6.3, which is consistent with the AUWSSC estimate of the 1.0 million.

**Table 6.2: AUWSSC Customers by Category**

Category	Number
Domestic user	37,714
Holly place	168
Commercial	704
Government/institution	621
Total	39,207
Public tap	392

Source: AUWSSC Financial report 1388

**Table 6.3: AUWSSC Domestic Users**

Category	Connection (n)	Pop./connection	Total
Domestic User	37,714	12	450,000
Public Tap	392	1,500	580,000
Total			1,030,000

Source: Planning Team

The Macrorayan Department estimates the service population of its system at 100,000. The total service population of piped water supply is thus estimated at some 550,000. This corresponds to 13% of the city population. This corresponds well with the KfW study, which concluded that 13% of households covered by its interview survey had house connections.

If the total number of beneficiaries or 1.1 million, served directly and indirectly by the piped water supply is taken, the service coverage is calculated to be 26.1%. AUWSSC notes that some informal users utilize water through house connections, and therefore the actual service coverage would be higher.

## 2) Water supply service quality

### Supply suspension

Even where the piped water is supplied, the supply is suspended frequently. According to AUWSSC, the water is supplied for 5-7 hours/day in general, although the frequency of suspension is varied depending on water sources and service areas. Furthermore, there are service areas, where the supply is provided every other day. During the water suspension, residents obtain groundwater from wells placed in housing plots or on street side. According to the interview survey of the KfW water study, approximately 26% of houses have private drinking water tanks to keep the domestic water. In addition, the number of electrical pumping systems for private wells is increasing.

Reasons for the frequent water suspension are not only water resources conditions. AUWSSC is trying to control intentionally the amount of water sales as they are afraid that customers may face difficulty for payment if the water consumption increases too much.

### Water quality

Both AUWSSC and the Department of Macrorayon Maintenance are weak in water quality monitoring capacity due to shortages of equipment and reagents. Their own monitoring activities are very limited, and they judge the safety of water based on available data of groundwater quality.

## 3) Volume of water supply and consumption

### AUWSSC system

Water meters have been recently installed on most water sources. The latest data on water production, including some estimation, show the total production of 14 MCM/y or 39,000m<sup>3</sup>/day as shown in Table 6.4.

**Table 6.4: Water Production of AUWSSC for 1388 (Mar 2009 – Mar 2010)**

Month in FY1388	Hamal	Saur	Jawza	Saratan	Asad	Sonbullah
(Mar2009 - Mar2010)	Mar-Apr	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep
Monthly production (m <sup>3</sup> /m)	1,034,530	1,254,644	1,255,036	1,332,253	1,339,941	1,122,985
No of day in month	31	31	31	31	31	31
Month in FY1388	Mezan	Aqrab	Qaws	Jady	Dalwa	Hoot
(Mar2009 - Mar2010)	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan	Jan-Feb	Feb-Mar
Monthly production (m <sup>3</sup> /m)	1,234,429	1,242,001	1,197,659	1,099,170	1,071,718	1,053,830
No of day in month	30	30	30	30	30	29
Yearly production (m <sup>3</sup> /y)	14,238,196					
Ave monthly Production (m <sup>3</sup> /m)	1,186,516					
Ave daily production (m <sup>3</sup> /d)	39,009					

Source: AUWSSC financial report 1388

Water consumption data are more difficult to estimate due to insufficient installation of water meters. AUWSSC estimates that about a half of supply is billed, and the other half is considered as unaccounted for water (UFW). According to the AUWSSC financial report 1388 (Table 6.5), rate of UFW reaches around 50%. This does not represent physical losses as the UFW includes

the consumption by informal connections and meter inaccuracies. AUWSSC estimates the actual losses at some 35%.

**Table 6.5: AUWSSC UFW Analysis**

Consumption/Loss Item	Volume (m <sup>3</sup> /period)	UFW	Consumption / loss
Billed and metered	3,415,791	Accounted	Authorized
Billed and un-metered	2,186,790	51%	61%
Un-billed and metered	827,846	Unaccounted	
Un-billed and un-metered	299,512	(UFW)	
Meter inaccuracies	307,421	49%	Unauthorized
Illegal connection	50,914		3%
Loss in trans/distribute system	3,877,146		Physical loss
Leak of tank	2,835		36%
Service connection leak	45,222		
Total	11,013,477	100%	100%

Remark: Analysis was done for 9 months period in 1388.

Source: AUWSSC financial report 1388

The water supply and consumption situations are estimated as shown in Table 6.6.

**Table 6.6: Water Supply and Consumption Estimates**

	Water volume		Ratio
	m <sup>3</sup> /mo.	m <sup>3</sup> /day	%
Water production	1,200,000	40,000	100
Water consumption			
Accounted	600,000	20,000	50
Unaccounted	180,000	6,000	15
Total	780,000	26,000	65
Physical loss	420,000	14,000	35

#### Macrorayon system

There is no meter on the Macrorayon water supply system. The Macrorayon Maintenance Department estimates the volume of water supply at 16,000 m<sup>3</sup>/day, based on its wells' pumping operation. As for the consumption, no data are available. Assuming the loss rate at 25%, the consumption is calculated to be 12,500 m<sup>3</sup>/day.

#### 4) *Per capita water supply and consumption*

Based on the data and the estimates presented above, the per capita water supply and consumption is calculated as follows.

- The unit water supply by AUWSSC is estimated at 40LCD and calculated to be 91LCD on the accounted basis.
- The unit consumption of AUWSSC piped water is calculated to be 26LCD on the estimate basis and 32LCD on the accounted basis.
- The unit water supply by the Macrorayon system is calculated to be 160LCD and the unit consumption 125LCD.
- For the combined water supply for Kabul city as a whole, the unit water supply is calculated to be 51LCD on estimate basis and 104LCD on the accounted basis.
- The overall unit consumption is calculated to be 35LCD on the estimate basis and 49LCD on the accounted basis.



### 5) *Sources of water supply and supply systems*

The piped water supply in Kabul City relies exclusively on groundwater resources. Three major well fields exist for AUWSSC, namely, Logar, Allaudin and Afshar. These well fields are located close to the Logar, Kabul and Pagman rivers, respectively. AUWSSC also has smaller supply sources and systems for specific areas. Over 50 wells are operated by AUWSSC. In addition, the Macrorayon system is based on 12 wells along the Kabul River.

The depth of wells is generally 40-50m, although the wells of the Macrorayon system are deeper in 80-120m. The groundwater is pumped up by submersible pumps and transmitted to reservoirs. All the reservoirs are ground tanks of varying size. Disinfection with chlorine is to be done at water reservoirs, but rarely practiced due to the difficulty to procure chlorine. From the reservoirs, the water is distributed to customers through pipelines by gravity. The water reservoirs are located on hillsides to ensure sufficient water heads. The Logar, Allaudin and Macrorayon systems have booster pump stations to transmit the water.

### 6) *Existing development plan*

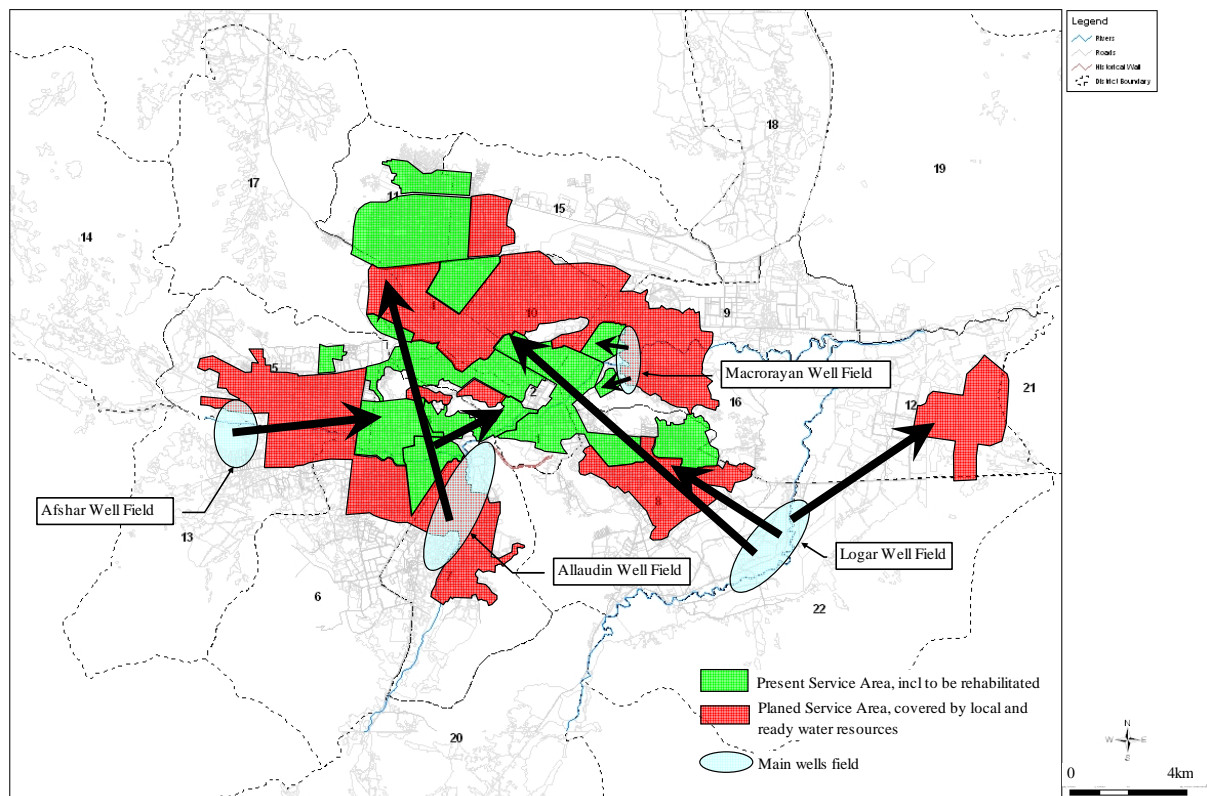
As described before, the results of the KfW water study is effectively utilized as a master plan for water supply in Kabul city toward 2015. The study estimated that the population and the required water production are 4,089,000 and 123.4 million m<sup>3</sup>/year, respectively for 2015. While 123.4 million m<sup>3</sup>/year of water is required, the study estimated that the groundwater potential in Kabul City is approximately 44 million m<sup>3</sup>/year (120,000 m<sup>3</sup>/day), capable to cover some 2 million inhabitants at a modest per capita consumption of 50L/day. The study recommended, therefore, developing remote surface water. The recommended plan was to convey the water from the Gat Dam to be constructed on the upper Logar River and/or from the Panjshir River. The dam project in the Upper Kabul Basin is now substituted to the Shatoot Dam on the Maidan River.

Since the surface water development requires further feasibility studies, the study prepared an action plan based on the use of local and ready water resources, i.e.: local groundwater. The action plan aims at increasing local water production up to the potential yield and supplying to possible service areas. Accordingly, the planned service areas are still limited within the former boundary of the municipality with 16 districts.

The planned service areas and a schematic transmission system are shown in Figure 6.2. It is expected that 40% of population of the city will have house connections at 67 LCD of average unit consumption in 2009. The cost for the project was estimated at EUR 105 million. This action plan is named "Projekt09" by the KfW study. Its implementation is not conducted as scheduled. As for the portion of 2010, it seems to be completed in 2015 or later.

The KfW water study assumed that residents would continue to obtain water from private or communal wells even after they have house connections. Considering it and expecting future surface water development, the unit consumption and service coverage assumed by the KfW water study are summarized in Tables 6.7 and 6.8, respectively.





Note: Showing main systems only

Source: KfW Water Study (simplified by Planning Team)

**Figure 6.2: Concepts of Current Action Plan of AUWSSC Water Supply Expansion up to 2015**

**Table 6.7: Increase in Unit Water Consumption Assumed by Action Plan**

Source	Type of users as of 2003				
	User in traditional dwellings			High standard user	User living flats
	Outside well user	Private well user	House connection customer	House connection customer	House connection customer
Outside well	15-15-15	0-0-0	0-0-0	0-0-0	0-0-0
Private well	0-0-0	33-25-17	20-15-10	125-87-50	0-0-0
House connection	0-0-0	17-25-33	30-35-40	25-63-100	100-112-125
Total	15-15-15	50-50-50	50-50-50	150-150-150	100-112-125

Note: Figures show the evolution for the years of 2005, 2010 and 2015.

Source: KfW Water Study

**Table 6.8: Increase in Service Coverage Assumed by Action Plan**

Items	2005	2010	2015
Population (1,000)	3,042.4	3,527.5	4,088.8
Service population (1,000)	395.5	2,222.3	3,148.4
Service coverage rate (%)	13	63	77

Source: Report of KfW Water Study (data on population and coverage rates).

### (5) Present conditions of non-piped water in Kabul

Hand pump wells are distributed throughout the city even in the service areas of piped water supply. They are installed in residential plots and street sides. They are private or public, depending on their management responsibilities. Since hand-pump wells are managed by residents or communities, it is difficult to obtain accurate data on distribution and water consumption. While AUWSSC applies 15 LCD to these wells for estimate of water consumption, MRRD is trying to maintain the target of 25 LCD and aims to increase it to 40 LCD.

### 1) *Private wells*

Private wells are installed in housing plots and managed by residents. According to the interview survey conducted in the KfW water study, about 50% of households had private shallow wells of 4-6m depth. It is reported that many residents suffer from water shortages and fear contamination of well water by wastewater.

### 2) *Public wells*

There are more than 3,000 public wells in Kabul city. MRRD has no accurate data on them despite their efforts of inventory. Their conditions are generally better as they are deeper. According to the interview survey by the KfW water study, 46% of households utilized such wells as main water sources.

MRRD is trying to improve the water accessibility to 60 minutes of round trip. Accordingly, MRRD plans to sink 300 more boreholes and to introduce piped water supply as well.

## **(6) Issues for Water Supply in Kabul**

### 1) *Summary of water supply situations in Kabul city*

The service population accounted for the piped water supply in the Kabul city is estimated at 550,000. Its coverage is estimated at 13.7% of the city's population. However, the unaccounted service population is estimated at 550,000, including public tap users. Considering the unaccounted population, the service population of the piped water supply is estimated at 1.1 million, representing 27.5% of the city's population.

The total of 56,000 m<sup>3</sup>/day of water is supplied through pipelines. Out of this, 38,500 m<sup>3</sup>/day is estimated to be delivered to residents. The balance of 17,500 m<sup>3</sup>/day is considered as physical loss. The delivered water per capita is calculated at 35 LCD on average. For house connections, the unit consumption is estimated at a level of 30-40 LCD for users living in villas and traditional dwellings and at 100-125 LCD for users living in flats. The unit consumption of public tap users may be at a level of 15-25 LCD. The levels of water consumption at 15-25 LCD or 30-40 LCD are considered quite low. Most residents extract groundwater from shallow wells located throughout the city although the volume is not measured.

The remaining 3.1 million people do not have the access to the piped water supply. No data are available for their unit consumption. MRRD indicates the unit water consumption at 25 LCD for the residents having no house connections as a planning criterion. Assuming that 3.1 million persons extract the groundwater at 25 LCD, the total water consumption is estimated to be 77,500 m<sup>3</sup>/day.

In total, the present groundwater extraction is estimated to be more than 120,000 m<sup>3</sup>/day, which exceeds the local groundwater potential.

### 2) *Issue on water supply and challenges*

Piped water supply is considered a key urban infrastructure to ensure the healthy and modern urban life. MoUDA and AUWSSC have a target of piped water supply coverage at 100% for urban areas by 2024. While this policy target should be respected, they have no clear target for the unit water supply/consumption to be attained by 2024, reflecting the difficulty in ensuring water resources development.

This master plan is, therefore, required to determine a target of unit water supply/consumption in consideration of the requirements of residents, development of sanitation system and natural resources capability. As groundwater resources are insufficient to extend water supply further, surface water development is necessary together with possible inter-basin water transfer.

The coverage by piped water supply should be extended in steps. Still, uncovered areas would remain for a foreseeable future. The residents in such areas will continue to rely on private and public wells, which are susceptible to groundwater contamination due to delay in expansion of sewerage. The sewerage system should be improved together with water supply expansion as a matter of principle.

The high rates of UFW should be improved. As few meters are installed, exact causes of UFW are difficult to define. However, it is due generally to 1) leakage, 2) measurement errors and 3) informal connections. It is necessary to start the rehabilitation from wherever possible.

### **6.1.2 Water Supply System Development Plan**

#### **(1) Strategy for water supply development**

##### *1) Allocation of drinking water sources*

The Shatoot dam and local groundwater could provide 87.2 and 33.2 MCM/year, respectively as drinking water sources. Allocation of these available water resources was considered as follows:

- The local groundwater source should provide the water for both piped water supply customers and shallow well users. Major part of local groundwater availability should be secured for shallow well users. AUWSSC should reduce their groundwater extraction to secure the lives of shallow well users.
- AUWSSC should look for alternative water resources. This chapter assumes using water from the Shatoot Dam. However, if for some reason the required amount of water cannot be obtained from the Shatoot Dam, AUWSSC should consider a contingency plan mentioned in 6.1.5.
- The water from the new water resources should all be distributed to piped water service areas after treatment. The present local groundwater well fields should help the distribution by a little share of water supply.

##### *2) Piped water supply system (AUWSSC system)*

The service area should be urbanized areas of Kabul City, not limited to the planned areas. Piped water supply would still consist of house connection and public tap services. House connection will be increased within the limit of ready and available water resources so that users of shallow wells and public taps are able to obtain 40 LCD of water. Further house connection needs to be considered according to other additional development of water resources.

AUWSSC should complete Project 2015 at first. Then the networks should be expanded to other urbanized areas according to the progress of Shatoot Dam construction.

##### *3) Shallow wells*

In rural areas and low population density areas are to be covered by shallow wells. Even in urbanized areas (middle and high population density area), some population would not be able to connect house connection due to financial capability. Those populations also would be shallow well users.

#### **(2) Clarification of basic conditions for water supply**

##### *1) Calculation of water supply volume*

##### Average water supply (demand)

The water supply volume (demand) is the key parameter for the design of water supply facilities. It is defined as follows:

$$\text{Average Water Supply} = \text{Average Water Consumption} / \text{Effective Ratio (\%)} \\ \text{Effective Ratio (\%)} = 100 (\%) - \text{Physical Loss Ratio (\%)}$$

Physical loss is the volume not captured and not counted as consumption. Most portion of the physical loss is due to illegal connections and leakages. Reduction of the physical loss was expected by improvement in leakages and elimination of illegal connections. For the planning purpose the physical loss rate was assumed to be 20%.

Regarding shallow wells, it is not necessary to consider the physical loss. In this case, “Average Water Supply = Average Water Consumption” should be applied.

#### Average water consumption

The average water consumption is provided as follow:

$$\text{Average Water Consumption} = \text{Average Unit Water Consumption} \times \text{Service Population}$$

The average unit water consumption should be determined from local experiences and planning criteria of water supply authority, considering service population and water resources endowment.

Currently, consumption data by customer, by activity, by business category, or by public tap are not sufficient to evaluate the average consumption as well as service population. It is thus difficult to establish appropriate criteria from local experience data.

#### Daily maximum water supply

Daily maximum (Dmax) water supply is a parameter reflecting seasonal fluctuation. It is the planning parameter for sizing of water production and storage facilities. This parameter should also be estimated by local experiences. However, it is difficult under current and unstable water supply conditions. For the planning purpose, Dmax peak factor was assumed to be 1.3 by taking an opinion of AUWSSC into consideration.

$$\text{Dmax Water Supply} = \text{Average Water Supply} \times 1.3$$

#### Hourly maximum water supply

Hourly maximum (Hmax) water supply is a parameter reflecting hourly fluctuation in addition to the seasonal fluctuation. It is the planning parameter for sizing of water supply pipelines and distribution pump stations. It is also difficult to estimate by local experience data. Again taking an opinion of AUWSSC into consideration, Hmax peak factor was assumed to be 1.3.

$$\text{Hmax Water Supply} = \text{Dmax Water Supply} / 24\text{hours} \times 1.3$$

#### 2) *Unit water supply and consumption*

By construction of Shatoot dam, which is under preparation by MoEW, available water for drinking purpose will increase to 120.4 MCM/year from 44.4 MCM/year. This scale of water resources will contribute to improvement of water supply conditions as well as water availability of shallow well users. However, the average unit consumption would be only 55 LCD if shared by the population in 2025. It is thus impossible to achieve the target of AUWSSC (120LCD). A simulation was made to determine a realistic water supply scheme.

#### Expected conditions for piped water supply in 2015

The Project09 was taken as a base for the simulation. The completion of construction works of the project is expected to be around 2015. Based on the report of the KfW water study, expected achievements by Project09 in 2015 is summarized in Table 6.9.

**Table 6.9: Expected Achievements by Project 09 in 2015**

Type of household and activity	Population		Consumption		Supply *1	
	Number	Ratio	M <sup>3</sup> /day	LCD	m <sup>3</sup> /day	LCD
Villas (house connection)	58,000	3%	3,182	55	3,978	69
Blocks and flats (house connection)	205,000	10%	23,115	113	28,894	141
Traditional dwellings (house connection)	1,176,000	57%	42,208	36	52,760	45
Public taps	634,000	31%	9,514	15	11,893	19
Commercial activity (house connection)			10,142		12,678	
Governmental activity (house connection)			6,850		8,563	
Industrial activity (house connection)			1,450		1,813	
Subtotal for house connections *2	1,439,000	69%	86,947	60	108,684	76
Subtotal for public taps	634,000	31%	9,514	15	11,893	19
Total covered by piped water supply	2,073,000	100%	96,461	47	120,576	58
(Analysis by the JICA team)						
Total population of Kabul city *3	3,424,000	Piped water coverage rate:			61%	
Total population of Kabul city *4	4,400,000	Piped water coverage rate:			47%	

\*1 Added by JICA study team by 20% of loss; \*2 Including non domestic water in water consumption

\*3 Figure estimated by KfW Water Study for 2009; \*4 Figure assumed by JICA study team for 2015

Source: KfW Water Study (analyzed by Planning Team)

The Project09 aims at supplying 120,000 m<sup>3</sup>/day (96,000 m<sup>3</sup>/day on consumption basis) for the service population of 2 million, which includes the public tap users of 600,000. The share of house connection is 70% of the service population. Planned and average unit water consumption is 60 LCD for house connections including non-domestic customers, 15 LCD for public tap users and 47 LCD on average per service population. Although the coverage was planned at 60% for 2009, it would be approximately 50% in 2015 due to population increase.

#### Minimum requirements adopted for simulation

Based on water supply conditions established after the Project09, the following requirements were set for the simulation of water conditions in 2025:

- i) The coverage of piped water supply were kept at 50%
- ii) The unit water consumption were set at 25LCD for shallow well users and at 25LCD for public tap users, respecting urgent target of MRRD
- ii) The unit water consumption was set at 60LCD for house connection customers, including commercial, governmental and small scale industrial consumption

#### Setting of target unit water consumption/supply

Table 6.10 shows the results of the simulation for 2025. The planned available water will be able to cover all the piped population (3.5 million), and 25% of the total population will be covered by public taps. Per capita water consumption will be 40 LCD for public tap users and 72 LCD for house connection users. Accordingly, it has to target water supply of 90 LCD for house connection users and 50 LCD for shallow public tap users as shown in Table 6.11. These were adopted as the target unit water consumption/supply for Kabul City toward 2015.

**Table 6.10: Possible Water Allocation and Consumption for Kabul City**

Category	Population	Supply				Consumption	
		LCD		m <sup>3</sup> /d		LCD	m <sup>3</sup> /d
Shallow well	2,650,000	25		66,250		25	66,250
House connection	1,755,000	95	78	166,725	257,025	76	133,380
Public tap	1,505,000	60		90,300		40	60,200
Total	5,910,000			323,275			259,830

Source: Planning Team

Note: 20% of loss is considered between amount supplied and amount consumed for piped water supply.

**Table 6.11: Recommended Design Unit Water Supply / Consumption**

Category		Unit supply (LCD)	Unit consumption (LCD)
Piped water users to be supply by AUWSSC	House connection	95	76
	Public tap	50	40
Shallow well users		25	25

Source: Planning Team

Note: These LCD consist of it for residential and employed.

### 3) *Quality of piped supply water and necessity of treatment*

Target quality of drinking water was set in accordance with WHO standards. Based on the review of existing reports, the groundwater is considered basically suitable for domestic water after chlorination. The surface water, whose turbidity is generally higher than the drinking water standards, will have to be treated by a treatment plant. Considering cases of heavy rain conditions, which increase the turbidity, chemical sedimentation combined with rapid sand filter method will be necessary for treatment. Thus, the following treatment was assumed to be required.

Water source	Required treatment
Local groundwater aquifers	Only chlorination
Shatoot dam	Chemical sedimentation and rapid sand filter

### 4) *Water storage capacity*

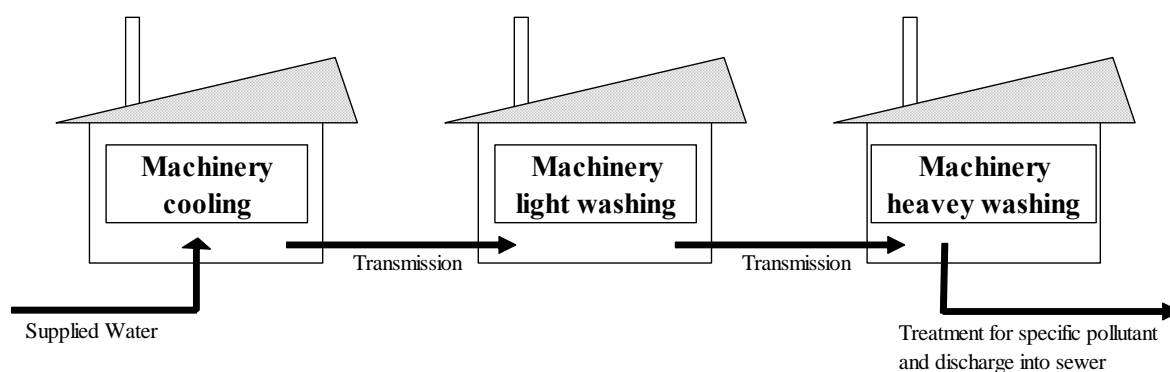
The Japanese standard requires the storage of drinking water for 12 hours of Dmax water supply. This is the ideal figure to make water distribution stable, considering hourly fluctuation of peak season. However, as the rapid construction of water supply facilities is difficult, it is adopted to secure 8 hours storage for piped water supply for the Kabul system. The reservoirs consist of key reservoirs and several service reservoirs in service zones.

### 5) *Industrial water supply*

Water demand for small-scale industries located throughout the city was included in the average water consumption examined above. However, bulk demand for industrial parks was excluded from the demand estimate. As the industrial water needs to be supplied through pipelines, AUWSSC is responsible for water supply management.

Since the number and the type of industries to be established in industrial parks cannot be determined at this stage, it is decided to secure 10 MCM/year for use of industry as recommended in the KMAUD Master Plan by JICA, determined through discussion with AISA and other agencies responsible for industrial development. The industrial activities need to be managed within this water availability.

As industrial parks develop, the demand for industrial water will increase. However, the industrial development in a park will enable establishment of water reuse system within the park. Figure 6.3 shows the concept of water reuse system of industrial parks.



Source: Planning Team

**Figure 6.3: Example of Industrial Water Reuse**

In general, industries require much lower quality water than water for drinking purpose. Turbidity of 15 NTU would be sufficient for industrial water supply. Factories requiring more purified water should have private treatment facilities. Thus, the water could be directly distributed in case of supplying the groundwater. In case of utilizing surface water, sedimentation process without filtering is required to secure the 15 NTU level turbidity.

The water of the Kabul River is recommended to be applied for industrial uses, because the river will have a steady flow and will be a stable source of water, after the completion of the Shatoot Dam. The water intake should be located at lower reach than the confluence with the Logar River in order to secure the environmental maintenance flow of the Kabul River. At this intake point, it is possible to keep taking 10 MCM/year, according to the water resources study report contained in the KMAUD Master Plan.

Since the source is surface water, sedimentation facilities are required. A simple sedimentation process for eight hours would reduce the turbidity by 50%. Assuming the ordinal turbidity of the Kabul River at 30 NTU, no chemical process is required. However, in heavy rain conditions, the turbidity will increase dramatically. To supply the stable quality of water, the sedimentation facilities should be equipped with chemical (coagulant) dosing system. Thus, the chemical sedimentation facilities should also be installed.

### (3) Water supply plan

#### 1) Water allocation and service population

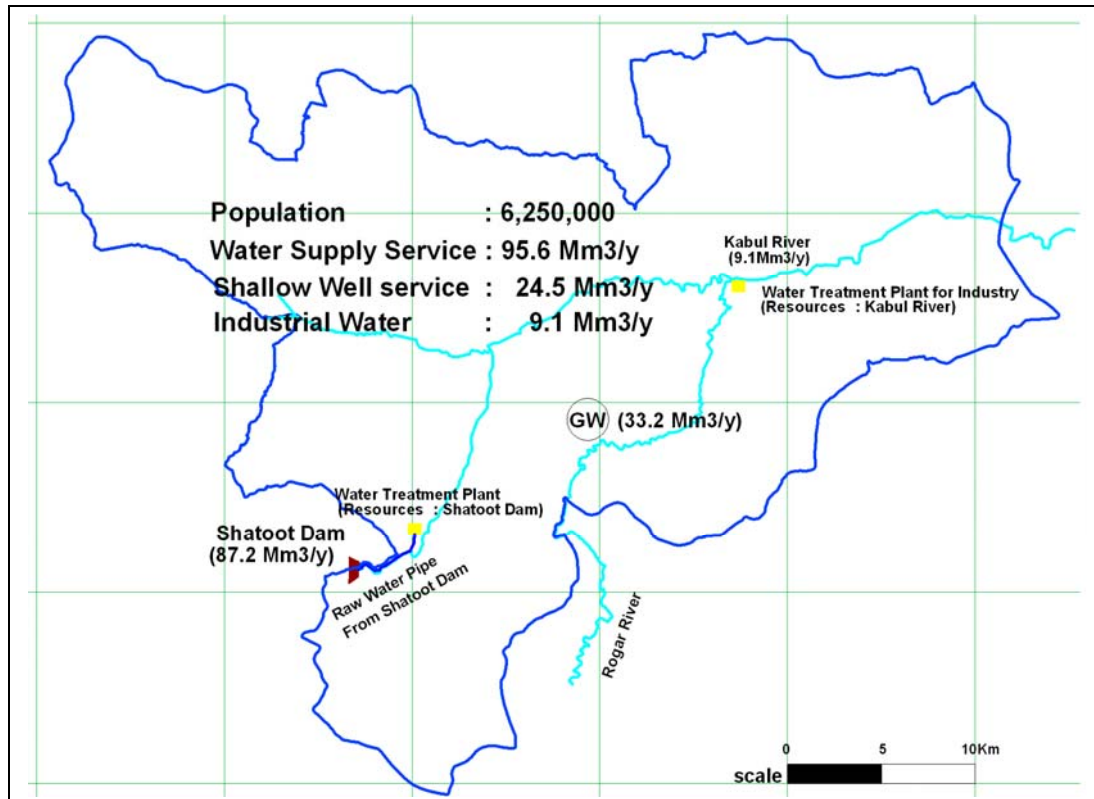
Table 6.12 and Figure 6.4 show general water allocation for 2025. This allocation was verified to be within the availability. Details of the allocation are described in following sections.

**Table 6.12: Water Allocation for Kabul city, 2025**

Category	Population		Water sup. (Mm <sup>3</sup> /y)	Water sup. (LCD)	Water resources (Mm <sup>3</sup> /y)
House connection	1,775,000	30%	95.6	71	LGW: 8.4, Shatoot: 87.2
Public tap	1,505,000	25%			
Shallow well	2,650,000	45%	24.5	40	LGW: 24.5
Industrial water	-----		120.1		Kabur river: 9.1

Source: Planning Team

LGW: Local groundwater



Source: Planning Team

**Figure 6.4: Water Allocation for Kabul city**

## 2) *Drinking water allocation*

Until completion of Shatoot dam, piped water supply should be managed by local groundwater. In order to allocate the water to shallow well users, piped water should be managed within 82,000 m<sup>3</sup>/day of supply. It is a little smaller than the level of service planned by the Project.

By 2020, Shatoot Dam construction will be completed and ready for use. Along with the construction of Shatoot dam, extension of the water supply network will be undertaken. The dam's water will be delivered to the existing and extended network. By doing this, piped water will cover 3.3 million by 2020. In 2025, the population of 3.8 million will benefit from piped supply by further extension of network. Evolution plan of the water supply is shown in Table 6.13.



**Table 6.13: Water Allocation and Evolution of Water Supply (2015) (1/5)**

Table 015: Water Allocation and Evolution of Water Supply (2015-2016)															
Target Year : 2015			House Conection				Public Tap				Shallow Well				
		Residential Pop	Employed Pop	for Residential		for Employed		for Residential		for Employed		for Residential		for Employed	
District Population	1	33,240	59,439	14,931	45%	18,134	31%	18,248	55%	22,164	37%	61	0%	19,141	32%
	2	128,511	42,890	20,739	16%	14,789	34%	25,348	20%	18,076	42%	82,424	64%	10,025	23%
	3	83,817	37,583	37,696	45%	16,905	45%	46,073	55%	20,662	55%	48	0%	16	0%
	4	199,691	54,771	89,685	45%	24,568	45%	109,616	55%	30,028	55%	390	0%	175	0%
	5	345,009	82,344	78,068	23%	12,779	16%	95,416	28%	15,619	19%	171,525	50%	53,946	66%
	6	304,359	80,285	0	0%	0	0%	0	0%	0	0%	304,359	100%	80,285	100%
	7	491,621	96,294	35,684	7%	4,705	5%	43,613	9%	5,750	6%	412,324	84%	85,839	89%
	8	582,834	116,369	116,435	20%	24,881	21%	142,310	24%	30,411	26%	324,089	56%	61,077	52%
	9	200,106	124,720	30,673	15%	9,010	7%	37,490	19%	11,013	9%	131,943	66%	104,697	84%
	10	264,938	51,547	87,889	33%	18,041	35%	107,420	41%	22,050	43%	69,629	26%	11,457	22%
	11	278,234	43,888	72,635	26%	12,304	28%	88,777	32%	15,038	34%	116,822	42%	16,546	38%
	12	491,366	87,376	50,734	10%	9,325	11%	62,009	13%	11,397	13%	378,623	77%	66,654	76%
	13	460,151	73,398	13,436	3%	1,597	2%	16,422	4%	1,951	3%	430,293	94%	69,850	95%
	14	200,280	36,475	0	0%	0	0%	0	0%	0	0%	200,280	100%	36,475	100%
	15	201,988	74,611	25,641	13%	3,920	5%	31,340	16%	4,791	6%	145,007	72%	65,900	88%
	16	321,810	70,194	39,552	12%	11,333	16%	48,342	15%	13,852	20%	233,916	73%	45,009	64%
	17	330,669	61,560	14,507	4%	2,085	3%	17,731	5%	2,548	4%	298,431	90%	56,927	92%
	18	106,982	37,388	0	0%	0	0%	0	0%	0	0%	106,982	100%	37,388	100%
	19	152,786	69,772	0	0%	0	0%	0	0%	0	0%	152,786	100%	69,772	100%
	20	137,967	37,942	0	0%	0	0%	0	0%	0	0%	137,967	100%	37,942	100%
	21	105,522	41,111	0	0%	0	0%	0	0%	0	0%	105,522	100%	41,111	100%
	22	169,256	68,069	0	0%	0	0%	0	0%	0	0%	169,256	100%	68,069	100%
	Total		5,591,137	1,448,026	728,307	13%	184,376	13%	890,153	16%	225,349	16%	3,972,677	71%	1,038,301
Supply Unit (LCD)				40		15		15		15		15		15	
Water Supply (MCM)				10.63		1.01		4.87		1.23		21.75		5.68	
Total Supply (MCM)								45.17							

Note: D17, D19, D20 is covered by water potential of the Kabul river basin before development of Panjshir ground water.

Source: Planning Team

**Table 6.13: Water Allocation and Evolution of Water Supply inside Kabul River Basin (2020) (2/5)**

Target Year : 2020				House Conection				Public Tap				Shallow Well			
		Residential Pop	Employed Pop	for Residential		for Employed		for Residential		for Employed		for Residential		for Employed	
District Population	1	39,326	64,595	31,437	80%	36,357	56%	7,859	20%	9,089	14%	30	0%	19,149	30%
	2	131,605	62,702	32,843	25%	40,709	65%	8,211	6%	10,177	16%	90,551	69%	11,816	19%
	3	78,859	44,144	55,185	70%	30,885	70%	23,651	30%	13,237	30%	24	0%	22	0%
	4	190,609	76,046	133,126	70%	53,138	70%	57,054	30%	22,773	30%	429	0%	135	0%
	5	371,974	114,163	171,288	46%	37,504	33%	154,080	41%	35,280	31%	46,606	13%	41,379	36%
	6	296,244	109,224	53,529	18%	23,660	22%	65,425	22%	28,917	26%	177,290	60%	56,647	52%
	7	516,944	119,100	155,067	30%	34,226	29%	159,362	31%	37,631	32%	202,515	39%	47,243	40%
	8	691,042	153,197	264,129	38%	61,086	40%	230,095	33%	47,850	31%	196,818	28%	44,261	29%
	9	196,911	150,176	38,132	19%	17,517	12%	25,421	13%	11,678	8%	133,358	68%	120,981	81%
	10	246,427	64,693	136,475	55%	36,287	56%	104,527	42%	26,374	41%	5,425	2%	2,033	3%
	11	269,732	45,619	106,100	39%	19,293	42%	78,607	29%	14,269	31%	85,025	32%	12,057	26%
	12	522,676	95,385	68,444	13%	13,214	14%	45,629	9%	8,810	9%	408,603	78%	73,361	77%
	13	443,917	86,178	33,529	8%	4,264	5%	30,066	7%	3,822	4%	380,322	86%	78,092	91%
	14	230,219	40,780	0	0%	0	0%	0	0%	0	0%	230,219	100%	40,780	100%
	15	209,051	93,481	49,666	24%	8,216	9%	42,516	20%	7,048	8%	116,869	56%	78,217	84%
	16	394,642	97,324	155,738	39%	37,063	38%	150,446	38%	31,172	32%	88,458	22%	29,089	30%
	17	60,879	20,025	19,343	32%	2,974	15%	12,895	21%	1,983	10%	28,641	47%	15,068	75%
	18	62,033	16,032	0	0%	0	0%	0	0%	0	0%	62,033	100%	16,032	100%
	19	1,144	36,811	0	0%	0	0%	0	0%	0	0%	1,144	100%	36,811	100%
	20	206,544	41,540	0	0%	0	0%	0	0%	0	0%	206,544	100%	41,540	100%
	21	156,368	73,113	4,968	3%	20,613	28%	6,073	4%	25,193	34%	145,327	93%	27,307	37%
	22	278,077	116,119	0	0%	0	0%	0	0%	0	0%	278,077	100%	116,119	100%
	Total		5,595,223	1,720,447	1,508,998	27%	477,005	28%	1,201,917	21%	335,303	19%	2,884,308	52%	908,139
Supply Unit (LCD)				85		30		50		30		20		15	
Water Supply (MCM)				46.82		5.22		21.93		3.67		21.06		4.97	
Total Supply (MCM)								103.67							

Note 1: Part of the population of D17 is not including.

Note 2: Part of the population of D19, D20 shall be considered by the New City.

Source: Planning Team

**Table 6.13: Water Allocation and Evolution of Water Supply outside Kabul River Basin (2020) (3/5)**

Target Year : 2020			House Conection			Public Tap			Shallow Well					
	Residential Pop	Employed Pop	for Residential		for Employed	for Residential		for Employed	for Residential		for Employed			
Pop of D17	303,946	48,790	212,762	70%	34,153	70%	60,789	20%	9,758	20%	30,395	10%	4,879	10%
Supply Unit (LCD)			85		30		50		30		20		15	
Water Supply (MCM)			6.60		0.37		1.11		0.11		0.22		0.03	
Total Supply (MCM)							8.44							

Source: Planning Team

**Table 6.13: Water Allocation and Evolution of Water Supply inside Kabul River Basin (2025)**  
(4/5)

Target Year : 2025				House Conection				Public Tap				Shallow Well			
		Residential Pop	Employed Pop	for Residential		for Employed		for Residential		for Employed		for Residential		for Employed	
District Population	1	44,916	78,364	35,933	80%	47,362	60%	8,983	20%	11,841	15%	0	0%	19,161	24%
	2	134,035	92,589	28,827	22%	63,538	69%	7,207	5%	15,885	17%	98,001	73%	13,166	14%
	3	73,323	60,258	51,326	70%	42,158	70%	21,997	30%	18,068	30%	0	0%	32	0%
	4	177,880	102,553	124,191	70%	71,733	70%	53,225	30%	30,743	30%	464	0%	77	0%
	5	381,127	155,428	174,248	46%	46,571	30%	160,395	42%	45,326	29%	46,484	12%	63,531	41%
	6	287,026	147,549	85,894	30%	56,855	39%	104,981	37%	69,490	47%	96,151	33%	21,204	14%
	7	520,063	142,398	155,771	30%	41,117	29%	157,769	30%	45,600	32%	206,523	40%	55,681	39%
	8	756,346	188,782	323,035	43%	86,913	46%	296,280	39%	69,233	37%	137,031	18%	32,636	17%
	9	193,083	182,548	35,458	18%	24,611	13%	23,638	12%	16,407	9%	133,987	69%	141,530	78%
	10	222,384	79,898	125,273	56%	46,260	58%	95,544	43%	33,110	41%	1,567	1%	528	1%
	11	260,661	45,797	100,553	39%	19,103	42%	74,747	29%	14,160	31%	85,361	33%	12,534	27%
	12	532,525	98,433	176,484	33%	30,172	31%	177,679	33%	29,344	30%	178,362	33%	38,917	40%
	13	423,615	101,026	47,771	11%	6,684	7%	47,473	11%	6,741	7%	328,371	78%	87,601	87%
	14	257,686	43,830	0	0%	0	0%	0	0%	0	0%	257,686	100%	43,830	100%
	15	215,378	120,718	63,730	30%	41,221	34%	60,476	28%	47,398	39%	91,172	42%	32,099	27%
	16	443,910	126,437	182,094	41%	50,986	40%	168,358	38%	40,635	32%	93,458	21%	34,816	28%
	17	58,330	20,213	19,343	33%	3,072	15%	12,895	22%	2,048	10%	26,092	45%	15,093	75%
	18	80,945	17,092	0	0%	0	0%	0	0%	0	0%	80,945	100%	17,092	100%
	19	0	58,641	0	0%	0	0%	0	0%	0	0%	0	100%	58,641	100%
	20	269,464	42,441	0	0%	0	0%	0	0%	0	0%	269,464	100%	42,441	100%
	21	199,598	112,308	25,700	13%	36,392	32%	31,411	16%	44,479	40%	142,487	71%	31,438	28%
	22	377,861	174,294	0	0%	0	0%	0	0%	0	0%	377,861	100%	174,294	100%
	Total	5,910,156	2,191,597	1,755,630	30%	714,749	33%	1,503,059	25%	540,506	25%	2,651,467	45%	936,342	43%
Supply Unit (LCD)				85		30		50		30		20		15	
Water Supply (MCM)				54.47		7.83		27.43		5.92		19.36		5.13	
Total Supply (MCM)								120.14							

Note 1: Part of the population of D17 is not including.

Note 2: Part of the population of D19, D20 shall be considered by the New City.

Source: Planning Team

**Table 6.13: Water Allocation and Evolution of Water Supply outside Kabul River Basin (2025) (5/5)**

Target Year : 2025			House Connection				Public Tap				Shallow Well			
	Residential Pop	Employed Pop	for Residential		for Employed		for Residential		for Employed		for Residential		for Employed	
Pop of D17	334,723	53,852	234,306	70%	37,696	70%	66,945	20%	10,770	20%	33,472	10%	5,385	10%
Supply Unit (LCD)			85		30		50		30		20		15	
Water Supply (MCM)			7.27		0.41		1.22		0.12		0.24		0.03	
Total Supply (MCM)									9.29					

Source: Planning Team

### 3) Water allocation and service area for industrial water supply

Water for industrial use will be secured as shown in Table 6.14. Industrial water will only be available after Shatoot dam development. The Kabul River water should be allocated for industrial use after completion of the Shatoot dam. A total of 9.1 MCM/year is within allowable volume to supply from the Kabul River. The river water should be treated before supply.

**Table 6.14: Demand Evolution of Industrial Water for Kabul City**

Name of Industrial Park	Average Demand (MCM/year)	
	2020	2025
Pule Charkhi	5.2	5.2
Bagrami 1&2	0.3	0.3
Kamari 1&2	1.3	1.3
Kamari 3	2.1	2.1
West Kabul	0.2	0.2
Total	9.1	9.1

### 4) Piped water supply development plan

After the Shatoot Dam completion, the available water would nearly tripled from the present level. It will contribute to increase the water consumption level for already piped residents as well as the number of population to be served by extension of piped serviced area.

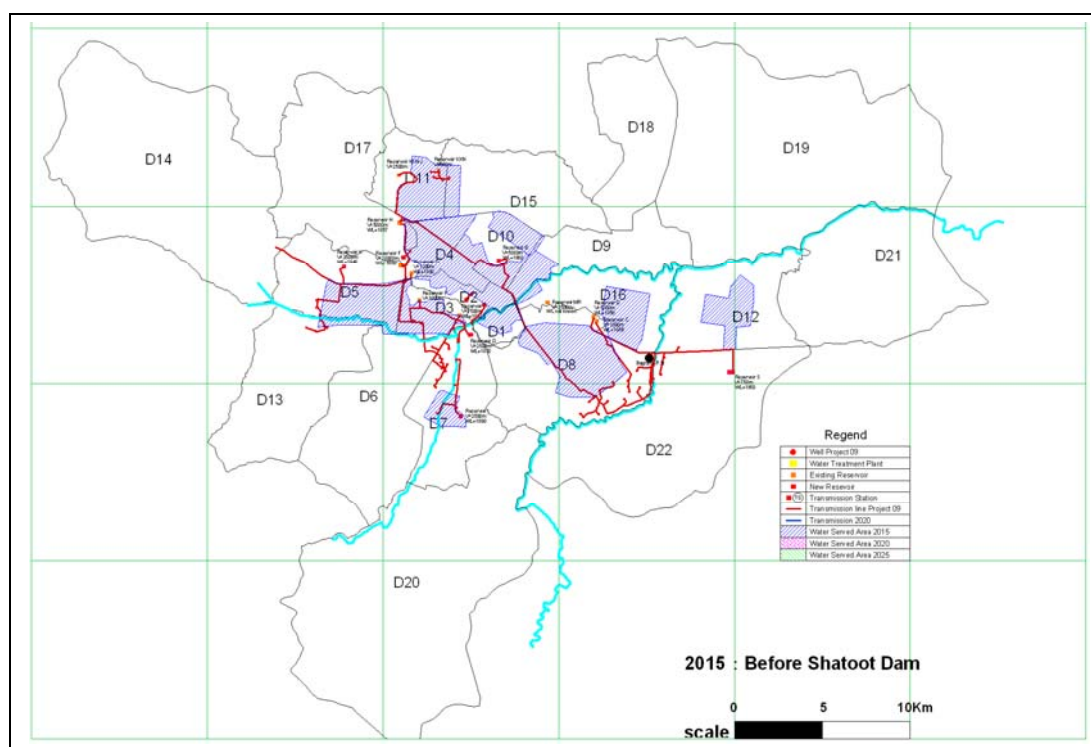
A water treatment plant receiving the water of the Shatoot Dam will feed the purified water at 87.2 MCM/year on average to the existing distribution network and additional service areas. In addition, the existing and/or newly developed wells of AUWSSC will feed the groundwater to the

network at 8.4 MCM/year on average. The local groundwater will be saved by 24.5 MCM/year due to the piped water supply. The saved water will be utilized for shallow well users.

#### Development upto 2015

The Shatoot dam will not be ready in 2025. The city has to be maintained by local groundwater with 45.4 MCM/year. The average supply of piped water was set not more than 30 LCD, when piped water service population reaches 1.6 million. Shallow well users will be able to consume 15 LCD. Table 6.15 shows planned water allocation in 2015.

Regarding the expansion of piped water distribution network, most of the Project09 components will be completed including MTP-3 according to the AUWSSC's action plan. However, the full completion of MTP-3 will cause excessive water consumption by the service population of piped water, because of the change in the expected population. To conserve the water resources to allocate the water for shallow well users, services for some target areas by MTP-3 will need to be deferred until the completion of Shatoot Dam. These areas should be clarified by the detail design stage of MTP-3, reflecting the actual growth of population and service performance by MTP-1 and MTP-2.



Source: Planning Team

**Figure 6.5: Piped Water Supply Development for Kabul city in 2015**

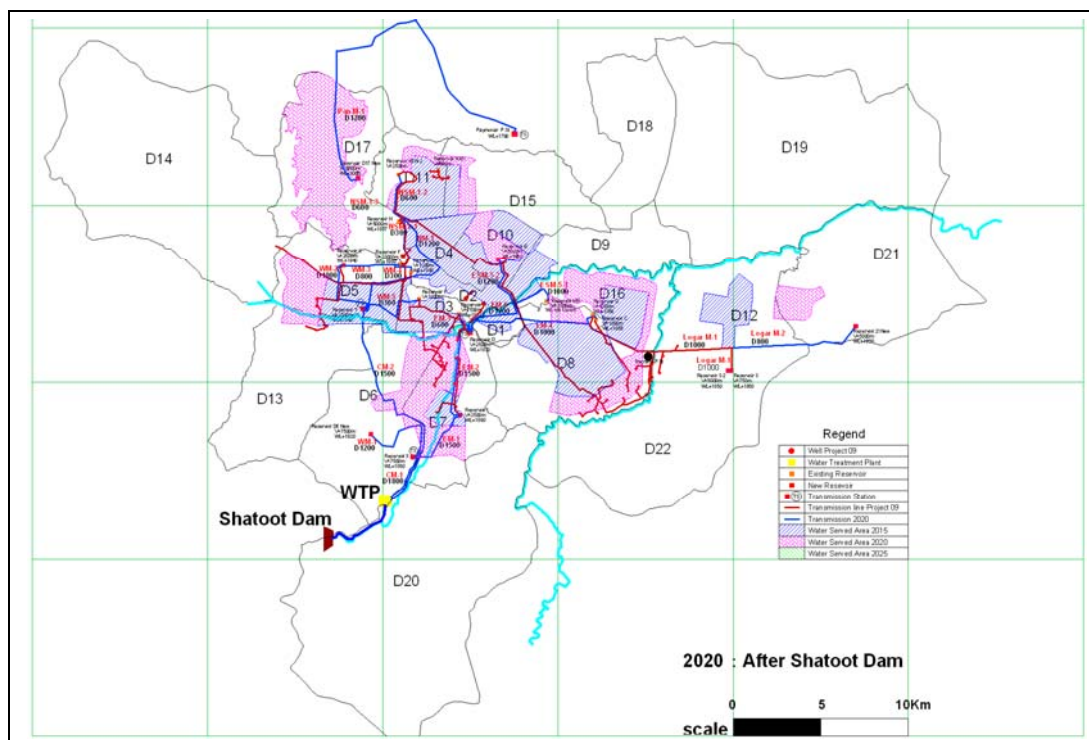
**Table 6.15: Water Supply Volume in 2015**

Category			Population	Pop. Share	Consumption		Supply for verification		
					LCD	m3/d	LCD	m3/d	MCM/y
Non piped service area (Non AUWSSC service)		for Residential	3,972,677		15	59,590	15	59,590	
		for Employed	1,038,301		15	15,575	15	15,575	
		Total Average		71.2%	19		19		27.4
Piped water service area (AUWSSC service)	House connection	for Residential	728,307		32	23,306	40	29,132	
		for Employed	184,376		12	2,213	15	2,766	
		Total Average		13.0%	35		44		11.6
	Public tap	for Residential	890,153		12	10,682	15	13,352	
		for Employed	225,349		12	2,704	15	3,380	
		Total Average		15.8%	15		19		6.1
Total		for Residential	5,591,137		17	93,578	18	102,075	
		for Employed	1,448,026		14	20,491	15	21,720	
		Total Average		100%	20		22		45.1

*Development up to 2020*

The Shatoot Dam and required treatment facilities will be in operation, along with some additional distribution facilities. All service areas mentioned in the Project09 will be covered by piped water supply. In addition to the areas covered by the Project09, the service for districts 17 and 21 will be started by piped water supply. The water resource for district 17 will be the Panjshir River basin, where district 17 is located.

The average unit consumption will reach 76 LCD for house connection, 47 LCD for public tap and 25 LCD for shallow well users, as shown in Table 6.16. In addition, the average unit consumption for district 17 will be kept at the same level of the Kabul River basin. Although water resources will have a certain amount of excess, the mentioned supply volume and allocation should be maintained to prepare for further demand increase toward 2025.



Source: Planning Team

**Figure 6.6: Piped Water Supply Development for Kabul city in 2020**

**Table 6.16: Water Supply Volume in 2020**

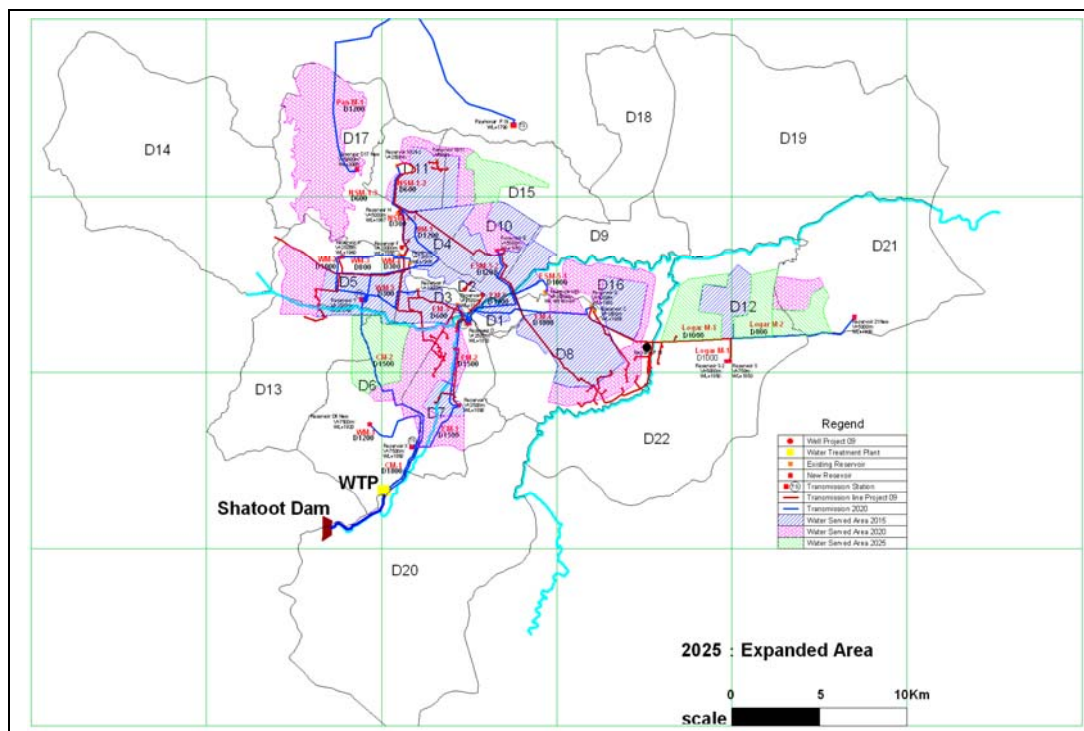
Category			Population	Pop. Share	Consumption		Supply for verification		
					LCD	m3/d	LCD	m3/d	MCM/y
Non piped service area (Non AUWSSC service)		for Residential	2,884,308		20	57,686	20	57,686	
		for Employed	908,139		15	13,622	15	13,622	
		Total Average		51.8%	25		25		26.0
Piped water service area (AUWSSC service)	House connection	for Residential	1,508,998		68	102,612	85	128,265	
		for Employed	477,005		24	11,448	30	14,310	
		Total Average		27.1%	76		94		52.0
	Public tap	for Residential	1,201,917		40	48,077	50	60,096	
		for Employed	335,303		24	8,047	30	10,059	
		Total Average		21.0%	47		58		25.6
Total		for Residential	5,595,223		37	208,375	44	246,047	
		for Employed	1,720,447		19	33,117	22	37,991	
		Total Average		100%	43		51		103.6

Note: It is excluded D17

Source: Planning Team

### Development up to 2025

The whole planned urban area will be covered by piped water. In addition to the service area of 2020, district 13 and extended areas of districts 12, 15, and 21 will be covered by the piped water supply. The average unit water supply could be kept unchanged to the same level of 2020 as shown in Table 6.17. The average unit supply for district 17 will be kept at the same level of the Upper Kabul River Basin.



Source: Planning Team

**Figure 6.7: Piped Water Supply Development for Kabul city in 2025**

**Table 6.17: Water Supply Volume in 2025**

Category			Population	Pop. Share	Consumption		Supply for verification		
					LCD	m3/d	LCD	m3/d	MCM/y
Non piped service area (Non AUWSSC service)		for Residential	2,651,467		20	53,029	20	53,029	
		for Employed	936,342		15	14,045	15	14,045	
		Total Average		44.3%	25		25		24.5
Piped water service area  (AUWSSC service)	House connection	for Residential	1,755,630		68	119,383	85	149,229	
		for Employed	714,749		24	17,154	30	21,442	
		Total Average		30.5%	78		97		62.3
	Public tap	for Residential	1,503,059		40	60,122	50	75,153	
		for Employed	540,506		24	12,972	30	16,215	
		Total Average		25.2%	49		61		33.3
Total		for Residential	5,910,156		39	232,535	47	277,411	
		for Employed	2,191,597		20	44,171	24	51,703	
		Total Average		100%	47		56		120.1

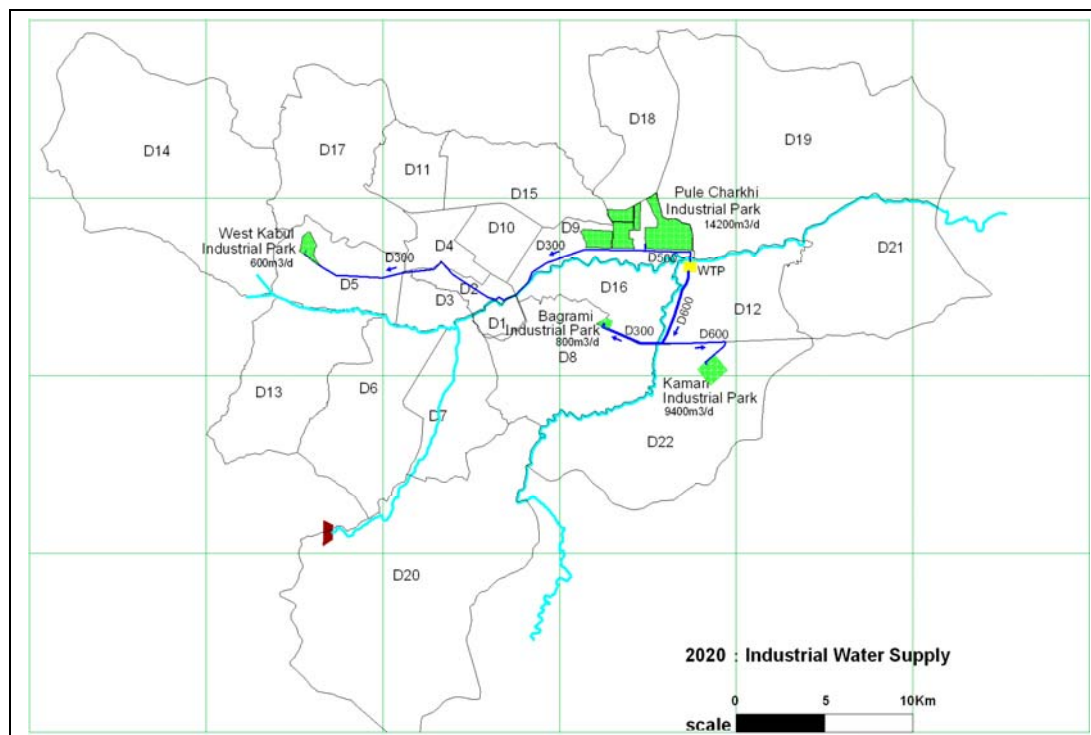
Note: District 17 is excluded

Source: Planning Team

#### 5) Plan for industrial water supply

Figure 6.8 shows the plan for industrial water supply. Water treatment facilities will be completed by 2020 with capacity to supply 9.1MCM/year on average. The water supply systems for Pule Charkhi, Bagrami 1, 2, Kamari 1, 2 and 3 will be completed by 2020 to be ready for promotion activities to locate factories expected to be operating in 2025. To reduce the construction load to a manageable level, the construction of water supply system for the West Kabul industrial park will be deferred for some extent, although it is expected to start operation by 2020.

The Kabul river water should be treated before supply. As mentioned earlier, the treatment plant should be equipped only with a chemical sedimentation process. To be able to supply 9.1 MCM/year or 25,000 m<sup>3</sup>/day on average, the plant will have a capacity of 33,000 m<sup>3</sup>/day for treatment to accommodate daily maximum supply. The distribution load of industrial water supply system depends on the level of activities of located factories in the park. It is difficult to construct facilities such as water reservoir and the supply network before the type of factories are clarified in each industrial park. Those facilities will be constructed upon factory invitation at the cost of industrial parks development.



Source: Planning Team

**Figure 6.8: Industrial Water Supply Development**

#### 6) Key facilities required for water supply development

A schematic drawing for distribution block system is presented in Figure 6.9, indicating the water demand, serviced population, reservoir capacity, reservoir elevation, and pipe diameters. Outline of key facilities are as follows.

##### Drinking water treatment plants

The surface water of Shatoot dam has to be treated by chemical sedimentation and rapid sand filter process. The water treatment plant (WTP) should be equipped with a treated water reservoir and water transmission pumps.

To supply 87.2 MCM/year or 239,000 m<sup>3</sup>/day on average, the capacity of more than 311,000 m<sup>3</sup>/day need to be secured in order to meet the Dmax supply demand. In accordance with Shatoot F/S, a WTP with capacity of 4000 L/s (345,600 m<sup>3</sup>/day) will be constructed at Tangi Saidan. Regarding the treatment process, this master plan recommends horizontal flow clarifier with mechanical flocculation, which is simpler and easier for operation compared to the sludge blanket system recommended in the Shatoot F/S. The system should be carefully examined in the coming design stage.

##### Industrial water treatment plants

Construction of a water treatment plant is necessary to treat surface water for industrial use. The treatment plant will be equipped with a treated water reservoir and water transmission pumps. Standard sedimentation process will be adopted. The system should be equipped with chemical sedimentation also to be able to treat in higher turbidity condition of raw water in case of flood. To supply 9.1 MCM/year or 25,000 m<sup>3</sup>/day on average, the plant need to have 33,000 m<sup>3</sup>/day capacity to meet the requirement of Dmax supply. Pule Charkhi in district 9 is selected as the location of the plant.

Water transmission main

The treated water need to be transmitted to key reservoirs located in various areas by pumps and pipelines. The ductile cast iron pipe is preferred as material for the transmission main. Pipe diameters were designed in accordance with the demand for 2025 by verifying pressure losses by the Hazen Williams formula showing below:

$$H = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$$

Where

H: Pressure Loss (m)

C: Hazen Williams Factor = 110

D: Diameter (m)

Q: Water Flow (m<sup>3</sup>/sec) (Dmax Water Supply)

L: Pipe Length (m)

The results of the calculation are given in Table 6.20.

Water Transmission Station

A water transmission station will have to be constructed to transmit treated water to key water reservoirs by pressure. The main transmission station will supply water to two different areas; one is the east area, and the other one is the west and north area of the city. The remaining areas will be covered by different systems. Districts 12 and 21 are to be served by the Logar well system, and thus separated. Also, district 17 will be managed by the Panjshir River basin system. The coverage areas of proposed transmission stations are summarized in Table 6.18.

**Table 6.18: Covered Districts by Proposed Transmission Stations**

Main Transmission Station	Second Transmission Station	Covered District
Transmission station for the east system		D1, D2, D3, Part of D4, D6, D7, D8, D9, D10, D13, D16
	Transmission station for central Kabul	D1, D2, D3, Part of D4, D8, D9, D10, D16
Transmission station for the west & north system		Part of D4, D5, D11, D15, D17 in Kabul Basin
Transmission station in Paymonar (Dehsabz)		District 17 in Panjisir Basin

Source: Planning Team

Key water reservoirs

Key water reservoirs need to be constructed in service sub-zones according to the urbanization and water distribution development. The storage capacity of these key reservoirs needs to be planned to cover eight hours of the Dmax water supply in respective service areas. Assuming that the water treatment plant and/or the water transmission station have capacity for four hours, the key water reservoir would have to secure four hours capacity. The Shatoot F/S recommends constructing a reservoir of 20,000 m<sup>3</sup> at the site of WTP. This is calculated to be about 1.5 hours of capacity, which is not sufficient compared to the above requirements (four hours, 52,000 m<sup>3</sup>).

For industrial parks, key reservoirs will be constructed by factories according to their water demand and demand distribution.

Table 6.19 shows a list of proposed key water reservoir development. The table includes reservoirs recommended in the water treatment plant and the water transmission station.

**Table 6.19: Key Water Reservoir Development**

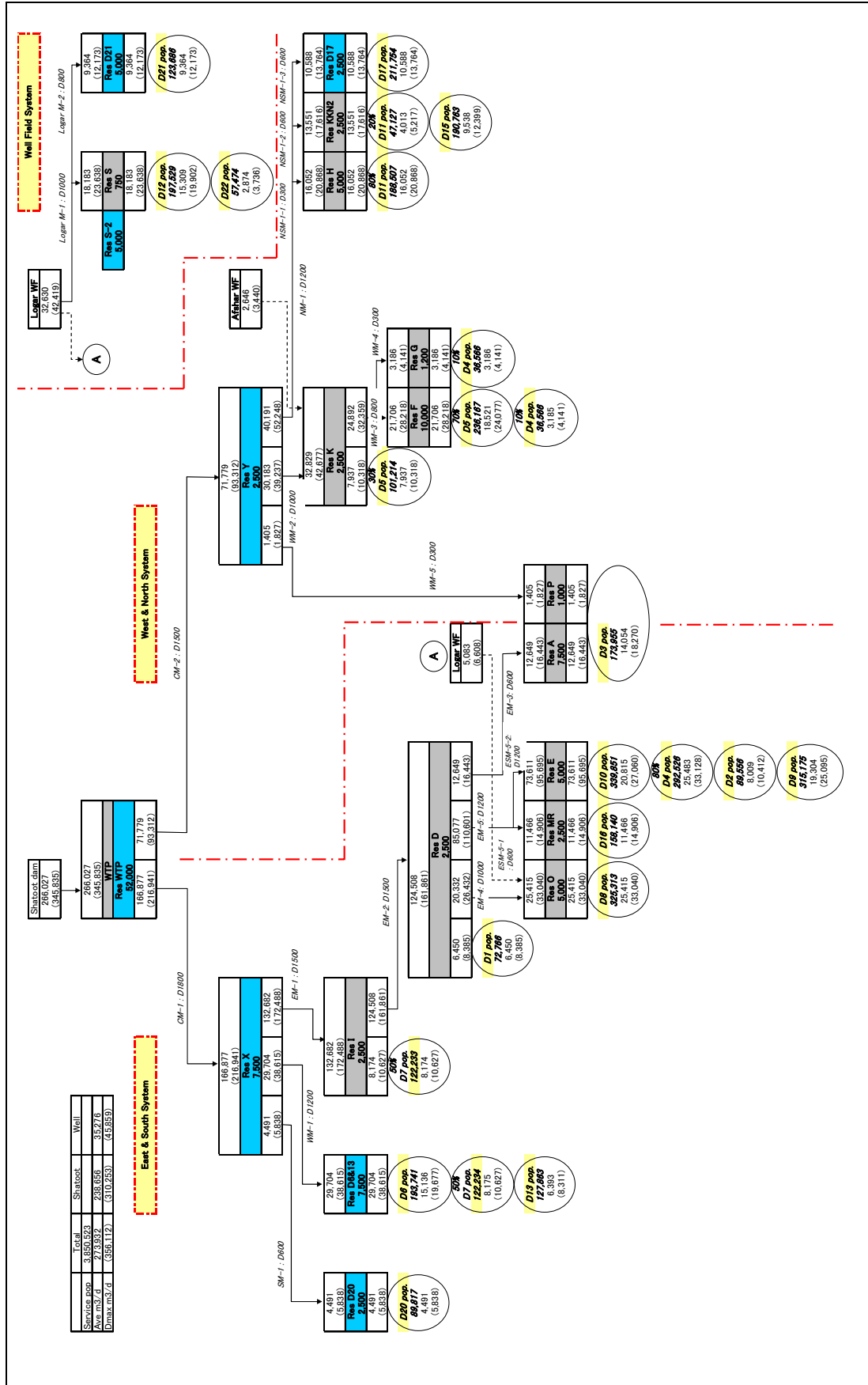
Category	Location	Capacity (m <sup>3</sup> )	Note
Drinking Water	Allaudin water treatment plant	1 x 52,000	Treated water reservoir in water treatment plant



Category	Location	Capacity (m <sup>3</sup> )	Note
	District 6 (Reservoir X)	1 x 5,000 1 x 2,500	Transmission station for East & South Distribution System
	District 6 (Reservoir D6)	1 x 5,000 1 x 2,500	
	District 5 (Reservoir Y)	1 x 2,500	Transmission station for West & North Distribution System
	District 21 (Reservoir D21)	1 x 5,000	
	District 22 (Reservoir S-2)	1 x 5,000	For District 12
	District 17 (Reservoir D17)	1 x 5,000	
Industrial Water	Water treatment plant in Pule Charkhi	1 x 5,500	Treated water reservoir in water treatment plant

#### Distribution network

Details of distribution network should be planned and designed at later stages by AUWSSC. Distribution pipelines should not be connected directly to the transmission main. It should be originated from key reservoirs.



**Figure 6.9: Schematic Drawing of Water Distribution Block**

Table 6.20: Result of Pipe Diameter Calculation

	Cover Zone	Route	Start Point	Destination	Hazen Williams C	Diameter D(m)	Supply Q(m <sup>3</sup> /d)	Flow rate Q(m <sup>3</sup> /s)	Distance L(m)	Head Loss H(m)	Sub Total H(m)	Note
East & South	D20,D6,D7,D13,D1,D8,D16,D10,D4(80%),D2,D9,D3(90%)	CM-1	WTP	R-X	110	1.80	216,941	2.511	2,900	1.7	1.7	Gravity (Water Head=10m > 1.7m)
	D20	SM-1	R-X	R-D20	110	0.60	5,838	0.068	14,700	2.2	2.2	
	D6,D7(50%),D13	WM-1	R-X	R-D6&13	110	1.20	38,615	0.447	8,500	1.5	1.5	
	D7(50%),D1,D8,D16,D10,D4(80%),D2,D9,D3(90%)	EM-1	R-X	R-1	110	1.50	172,488	1.997	3,900	3.5	3.5	
	D1,D8,D16,D10,D4(80%),D2,D9,D3(90%)	EM-2	R-1	R-D	110	1.50	161,861	1.874	5,700	4.6	4.6	Gravity (Water Head=20m > 4.6m)
	D3(90%)	EM-3	R-D	R-A	110	0.60	16,443	0.191	1,300	1.4	1.4	Gravity (Water Head=13 > 1.4m)
	D8	EM-4	R-D	R-O	110	1.00	26,432	0.306	7,900	1.6	1.6	Gravity (Water Head=10m > 1.6m)
	D16,D10,D4(80%),D2,D9	EM-5	R-D	Before R-MR	110	1.20	110,601	1.281	3,800	4.5	4.5	
	D16	ESM-5-1	Before R-MR	R-MR	110	0.60	14,906	0.173	2,700	2.3	2.3	
	D10,D4(80%),D2,D9	ESM-5-2	Before R-MR	R-E	110	1.20	95,695	1.108	3,100	2.8	2.8	
West & North	D3(10%),D5,D4(20%),D11,D15,D17	CM-2	WTP	R-Y	110	1.50	93,312	1.080	14,000	4.0	4.0	Gravity (Water Head=30m > 4.0m)
	D5,D4	WM-2	R-Y	R-K	110	1.00	39,237	0.455	4,200	1.8	1.8	
	D5(70%),D4(20%)	WM-3	R-K	R-F	110	0.80	32,359	0.375	3,100	2.7	2.7	
	D4(10%)	WM-4	Before R-F	R-G	110	0.30	4,141	0.048	1,100	2.6	2.6	
	D3(10%)	WM-5	R-Y	R-P	110	0.30	1,827	0.022	4,400	2.4	2.4	
	D11,D15,D17	NM-1	R-Y	Before R-H	110	1.20	52,248	0.605	9,600	2.8	2.8	
	D11(80%)	NSM-1-1	Before R-H	R-H	110	0.30	20,868	0.242	100	4.6	7.4	
	D11(20%),D15	NSM-1-2	Before R-H	R-KKN-2	110	0.60	17,616	0.204	3,000	3.5	6.3	
	D17	NSM-1-3	Before R-KKN-2	R-D17	110	0.60	13,764	0.160	3,900	2.9	5.7	
	D12,D22	Logar M-1	Bagrani P.St	R-S	110	1.00	35,811	0.415	5,700	2.0	2.0	
Well Field	D21	Logar M-2	Before R-S	R-D21	110	0.80	12,173	0.141	7,500	1.1	1.1	
Industry		KIM-1	WTP	Pule Charki	110	0.50	19,240	0.223	3,100	10.1	10.1	
		KIM-2	Pule Charki	West Kabul	110	0.30	780	0.010	22,000	2.8	12.9	
		KIM-3	WTP	West Kabul	110	0.50	13,260	0.154	4,300	7.1	7.1	
		KISM-3-1	Before Kamari	Kamari	110	0.50	12,220	0.142	1,200	1.7	8.8	
		KISM-3-2	Before Kamari	Bagrani	110	0.30	1,040	0.013	3,700	0.8	7.9	

Note: WTP: Water Treatment Plant

R: Reservoir

CM: Central Main pipe

EM: East area Main pipe, ESM: East area Sub Main pipe

SM: South area Main pipe

WM: West area Main pipe

NM: North area Main pipe, NSM: North area Sub Main pipe

Logar M: Logar well field Main pipe

KIM: Kabul Industry Main pipe

KISM: Kabul Industry Sub Main pipe

Schedule for key facilities development

Facilities required to achieve the expected functions of water supply systems for different zones are listed in Tables 6.21.

**Table 6.21: Key Facilities for Water Supply**

No.	Facility	Operation	Purpose
1.	New wells, transmission mains, reservoirs and distribution network, which are described in Project 09. Refer to KfW Water Study for details.	2015	To have groundwater supply capacity at 44 million m <sup>3</sup> /y on average. To cover 1.6 million population with piped water supply system.
2.	Allaudin Water Treatment Plant (WTP) Capacity: 4,000 L/s	2017	
3.	Transmission System of water from Allaudin WTP to existing network	2017	To supply the water from Allaudin WTP to the area covered by Project 09 for 2025.
4.	Switching of Transmission System of water from Logar Well Field and Water Distribution Network District 21	2020	To distribute the water in 48% of population for 2020 and 55% for 2025.
5.	Expansion of distribution network	2020	
6.	Expansion of distribution network	2025	To distribute the water of District 6,15, 12 and 21 for 2025
7.	Kabul Industrial Water Treatment Plant and Industrial Water Transmission System Chemical Sedimentation: 33,000 m <sup>3</sup> /d	2017 PH1 2020 PH2	To supply the industrial water 8 million m <sup>3</sup> /y on average from Kabul river to industrial parks for 2025.

Note 1: Service areas could be modified in accordance with water supply amount.

Source: Planning Team

**7) Sludge management**

A water treatment plant generates certain amount of sludge in sedimentation and filtering processes. The sludge has to be removed from sedimentation and filtering tanks and may be sun-dried. The sludge generated in the water treatment plant would not be appropriate for agriculture use, since the sludge contains some aluminum, which is added in chemical sedimentation process. The sludge should, therefore, be disposed as solid wastes.

To sun-dry the sludge, the treatment plant needs to be equipped with sludge thickener and sun-drying bed. The sun-drying process requires time for around one week, depending on the climate. Once the sludge is sun-dried up to 80% of water content (de-watered cake), it would be transportable by trucks. The transport of dried sludge should be undertaken daily basis as a part of the plant management.

The amount of sludge depends on the raw water quality (river water quality). Assuming the suspended solid (SS) of raw water at 30 mg/L, the volume of sludge generated at proposed plants would be 7.17 t/day in Allaudin plant and 0.75 t/day in the plant for industrial water, as shown in Table 6.22. The volume of de-watered cakes will be 30 m<sup>3</sup>/day to be transported out as solid wastes.

**Table 6.22: Sludge Generated by Water Treatment Plant**

Plant	Ave. water treatment (m <sup>3</sup> /day)	SS of raw water (mg/l)	Sludge generation rate (%)	Generated solid sludge (t/day)	Dewatered cake (80% water m <sup>3</sup> /d)
Allaudin WTP	239,000	30	100	7.170	28.68
Kabul industrial WTP	25,000	30	100	0.750	3.00

**6.1.3 Water supply development project**

The project for water supply development consists of several large scale facilities and some combination of smaller facilities. The project profile for water and sewerage is shown in Table 6.23.

**Table 6.23: Project Component for Water Supply Development**

Project ID/ Title	Location	Key Facilities
WK-1: Water distribution network extension project for Central Kabul, amendment of current plan “Project 09”	City central part (District 1,2,3,4,5,6,7,8,9,10,11,12,16)	Well, Pipe line, Reservoir based on “Project 09”
WK-2: Shatoot dam and Allaudin Water Treatment Plant construction project	Whole city	Shatoot Dam and Water treatment Plant 4,000L/s
WK-3: Water supply improvement project for Kabul city (water transmission project from Allaudin Water Treatment Plant)	Whole city	Transmission Main D=1.2~1.8m, L=70.5km D=0.8~1.0m, L=31.1km D=0.3~0.6m, L=9.9km
WK-4: Water supply improvement project for District 5 ( water distribution and reservoir project)	District 5	Reservoir Y and distribution network in District 5
WK-5-1: Water supply improvement project for District 6 Phase-1( water distribution and reservoir project)	District 6 & 7	Reservoir X and distribution network in District 6&7
WK-5-2: Water supply improvement project for District 6 Phase-2 ( water distribution and reservoir project)	District 6 & 13	Reservoir D6&13 and distribution network in District 6&13
WK-6: Water supply improvement project for District 8( water distribution and reservoir project)	District 8	Distribution network in District 8
WK-7: Water supply improvement project for District 10&11 ( water distribution and reservoir project)	District 10 & 11	Distribution network in District 10&11
WK-8: Water supply improvement project for District 12 ( water distribution and reservoir project)	District 12	Reservoir S2 and distribution network in District 12
WK-9: Water supply improvement project for District 15 ( water distribution and reservoir project)	District 15	Distribution network in District 15
WK-10: Water supply improvement project for District 16 ( water distribution and reservoir project)	District 16	Distribution network in District 16
WK-11: Water supply improvement project for District 17 ( water distribution and reservoir project)	District 17	Reservoir D17 and distribution network in District 17
WK-12: Water supply improvement project for District 21 ( water distribution and reservoir project)	District 21	Reservoir D21 and distribution network in District 21
WK-13: Industrial treatment plant project for Industrial Parks	District 12	Industrial treatment plant 33,000m <sup>3</sup> /d
WK-14: Industrial water supply project for Industrial Parks	From treatment plant to industrial park	Transmission main to Pule Charkhi D=0.5m, L=3.1km to Bagrami D=0.3m, L=3.7km to Kamari D=0.6m, L=9.7km to West Kabul D=0.3m, L=22.0km

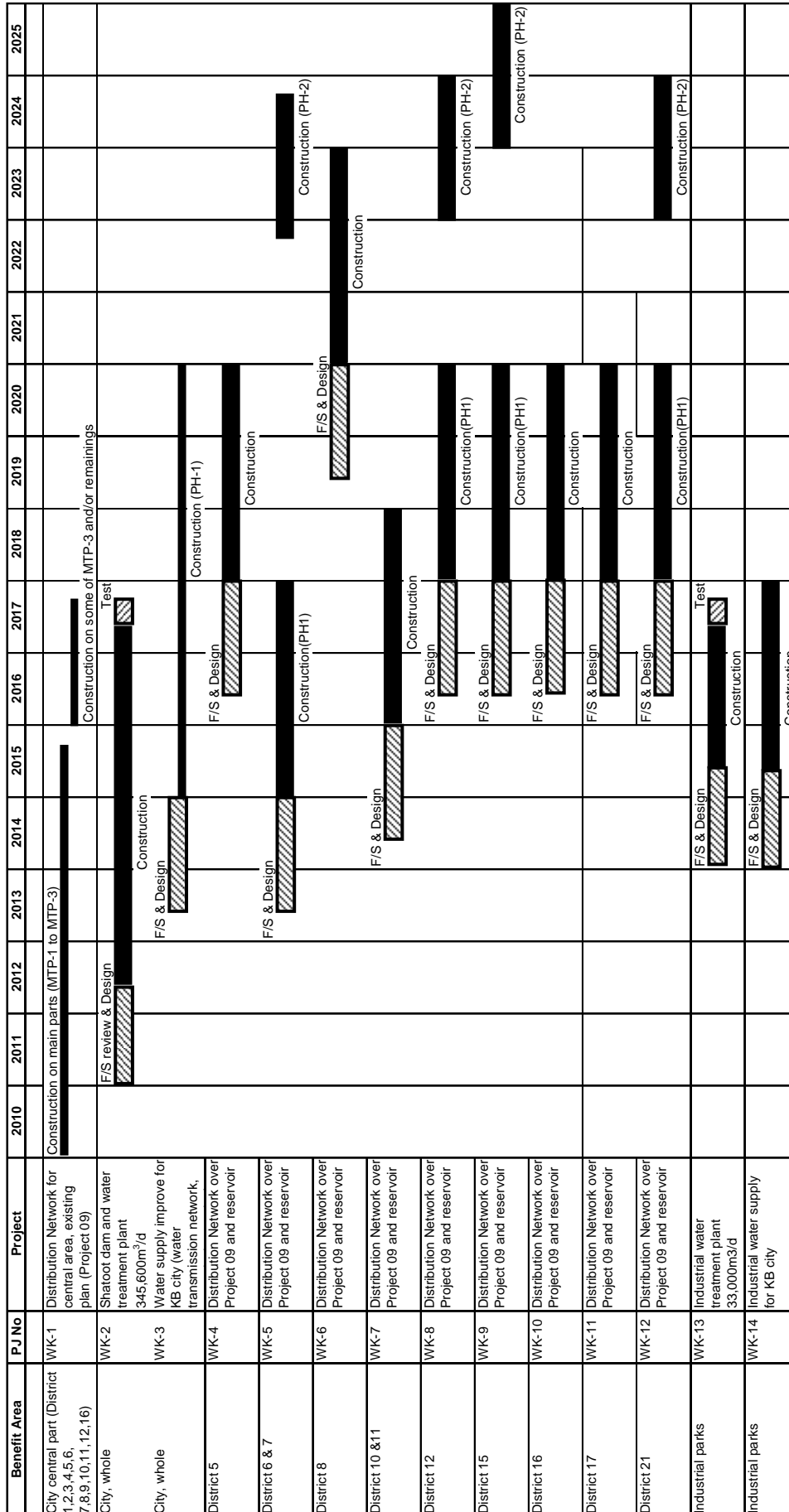


Figure 6.10: Implementation Schedule for Water Supply Development Project

### 6.1.4 Contingency plan for water supply

The above water supply plan was undertaken under uncertain future conditions of various kinds. To cope with unforeseen events or higher water demand than projected for the planning, a contingency plan was prepared.

#### (1) Drinking water resources for long term period

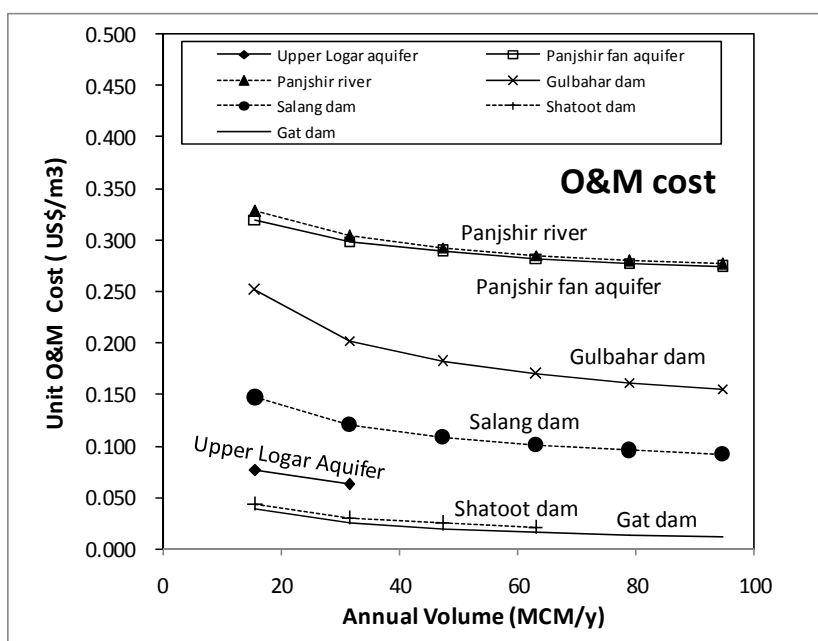
The plan proposed for the city will not achieve the level of water supply targeted by AUWSSC in terms of the unit water consumption. Moreover, there will be a population of 2.6 million remained without piped water supply. To achieve the full coverage by piped water and house connections at 120 LCD of unit water consumption eventually, it is required to develop water resources large enough to cover 222 MCM/year additionally in 2025 and beyond.

The Panjshir River basin supposed to have sufficient capacity to supply this amount. It will be physically possible once the surface water development of the Panjshir River is realized. The water conveyance to Kabul City would be through the New City. The upper Logar aquifer should be also studied as another new water resource for drinking water supply.

These alternative water resources should be carefully examined. Once any of alternative water resources development plan become matured, the water supply system proposed in this master plan should be revised.

#### (2) Drinking water resources for medium term period

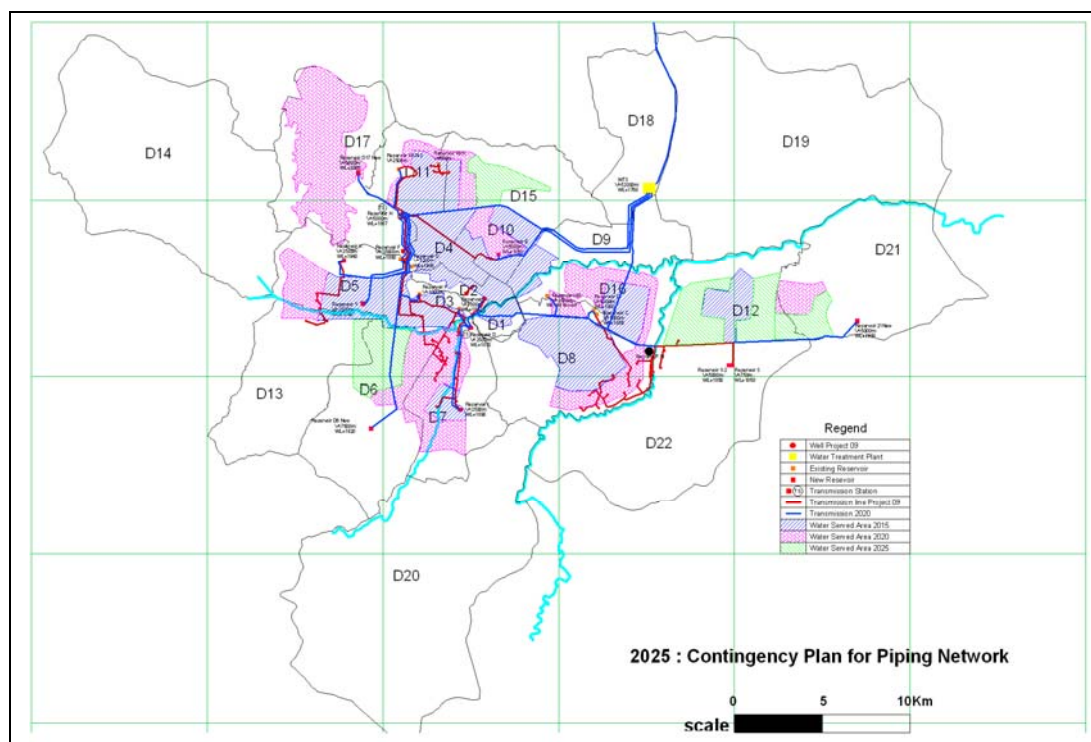
The completion of Shatoot Dam was taken as prerequisite to the water supply system proposed in this master plan. If it becomes difficult to realize the development of Shatoot Dam by any reasons, the city will face significant shortage of water to survive. A preliminary plan was formulated to be prepared for this situation as presented in Figure 6.12. In this plan, the Panjshir ground water was adopted as the alternative water source, although the annual cost for operation and management would become a significant burden as shown in Figure 6.11.



Source: KMAUD Master Plan, JICA, 2009

**Figure 6.11: Comparison of Annual Unit O&M Cost by Water Resource**

Under this plan, the water conveyance pipe will be placed along Bagram road and construction of a transmission station will be required in District 18.



Source: Planning Team

**Figure 6.12: Contingency Plan for Piping Network by Water Resources of Panjisir Basin**

### (3) District 17 of Kabul city

To cover the whole area of District 17 with house connections, the proposed water supply system should be revised by adopting additional water resources from the southwest part of the New City development (the Paymonar development area), after surface water development of the Panjshir River. The extension of the new city's water supply system should also be examined.

### (4) Industrial water

An industrial zone was proposed in District 21, expecting accumulation of distribution related facilities. The water for this area should be secured in accordance with the pace of development, although the water demand will be not significant if the type of industry remains as planned. Candidate water sources may be surface of the Kabul river or groundwater on river banks. A careful analysis need to be made on river and groundwater conditions upon construction of intake facilities.

## 6.2 Rainwater Drainage System

### 6.2.1 Existing conditions

#### (1) Institutional conditions

The rainwater drainage is planned and implemented by the Planning and Implementation Department of the Kabul Municipality. No section has been established dedicated to the drainage issue. Since the rainwater drain management is not an income generating activity, it is not appropriate to be undertaken by AUWSSC.

#### (2) Present conditions of rainwater drainage

Most of rainwater drain is developed at the time of road construction and rehabilitation. Integrated and efficient systems are not established. Rainwater is collected by road side ditches, which are connected to main drains consisting of the following:



- North: Wazir Abad channel,
- West: Paghman River,
- Southwest and center: Maidan River
- Center and east: Kabul River, and
- Southeast: Logar River.

Many of the drains are not properly connected to these main drains due to deterioration and/or delay of improvement/construction of roads. Accordingly, many streets are often submerged by storm water. In addition, as wastewater is discharged into road side ditches, solid wastes are accumulated and causing flow disturbance. These clogged drains are raising the risk of hygiene issues as well.

### **(3) Existing development plan**

The “Emergency Infrastructure Reconstruction Project, Sanitation Improvements in Kabul City” funded by the World Bank (hereinafter referred to as EIRP study) prepared a master plan for the storm water drainage system toward 2030 together with a master plan for the sewerage system. The EIRP divided the city area into following four zones according to topographic conditions.

- Zone 1 for North: Wazir Abad channel,
- Zone 2 for West: Paghman river,
- Zone 3 for South, Center and East: Maidan and Kabul river, and
- Zone 4 for Southeast: Logar river.

## **6.2.2 Rainwater drainage system development plan**

### **(1) Strategy for rainwater drainage**

In general, the rainwater drainage system should be managed in small areas separately in order to avoid constructing a huge sewerage system. Also, the rainwater should be separated from wastewater as it is indispensable source of groundwater recharge. In this light, it is essential for Kabul City to promote infiltration of rainwater into ground. Following are the basic strategy for the development of drainage system in Kabul City:

- Pursue implementation of the EIRP master plan. the main ditches should be constructed as planned.
- Continue construction of road side ditches at the time of road construction/rehabilitation as it is practiced presently. Since runoff ratio is high in urban areas, proper guide of water to the main drain needs to be established even though the infiltration of rainwater is promoted.
- Promote installation of infiltration equipment in land plots including private properties. This is necessary as there are less vacant areas, while more paved road surface and buildings cover the land surface in urban areas. Storage of rainwater by tanks is also promoted as it will contribute to increase domestic water.

### **(2) Modification of drainage areas**

Although it is a basic policy to follow the EIRP to develop the drainage system in Kabul City, extension/exclusion of some areas needs to be considered as the new urban areas are introduced while some areas are categorized as conservation area in the future land use plan proposed in this master plan. Following areas were affected and thus different policies were adopted.

### 1) District 21

Development of District 21 area was newly introduced in this master plan. A drainage system has to be established along with the urban development program. According to the topographic condition, rainwater will flow into the Buthak Canal running through south to north and finally be discharged to the Kabul River.

### 2) District 20

Although District 20 is not covered by the EIRP, there is a residential area developed through preparation of detail plan. This area was assigned as low rise low density residential area in this master plan, situated in the urbanization control area. Rainwater in this area will be basically infiltrated into ground on site and through the agricultural use, but the surplus water need to be led to the Logar River.

### 3) District 17, 18 and part of District 19

District 17, 18 and north of district 19 belong to the Panjshir River Basin. Therefore these areas can be excluded. The rain water treatment in this area is under consideration by the New City development project.

### 4) District 14

Some limited area in District 14 is covered in the EIRP as the Zone-2. However, District 14 is designated as conservation area and urbanization control area in this master plan. Thus all of district 14 can be excluded from the urban drainage system. The rainwater in this area will infiltrate into ground or recharge to the Paghman River after agricultural use.

Based on the above modifications, the urban drainage area was divided into the following five zones. The major change from the drainage zones proposed by the EIRP is introduction of the Zone 5. The area division of the urban drainage system is shown in Figure 6.13.

- Zone 1 for North: Wazir Abad channel,
- Zone 2 for West: Paghman river,
- Zone 3 for South, Center and East: Maidan and Kabul river
- Zone 4 for Southeast: Logar river, and
- Zone 5 for East: Buthak canal and Kabul river

## (3) Main drain system

The main routes of the rainwater drainage were proposed based on the condition of existing drainage system, the EIRP, and planned roads and streets in this master plan. As a general rule, road side ditches will be connected to existing canals or rivers.

Size of the ditches has to be determined along with the detail design of roads, by which important factors for ditch design, such as vertical slope, will be clarified.

## (4) Enhancement of water retention function

While one goal of the drainage system development is to discharge rainwater to the city's main drains quickly, another goal is to retain it for groundwater recharge as much as possible. Seeking the latter goal is especially important in Kabul City as the shortage of water is critical for its development. Following are programs to enhance the water retention function of the urban area of the city.

- Promote stone pavement in community roads. The stone material can be obtained easier, while it is stronger than other material such as bricks.

- Impose installation of on-site infiltration facilities in housing and other building plots.

Although adoption of infiltration trenches is a common choice to enhance infiltration of rainwater in a city, it is not recommendable to practice in the present condition of Kabul City. This is because a large amount of wastewater will be mixed in the rainwater as household septic tanks are not properly managed. A program of onsite-sanitation management has to be initiated along the road prior to the installation of infiltration trench.



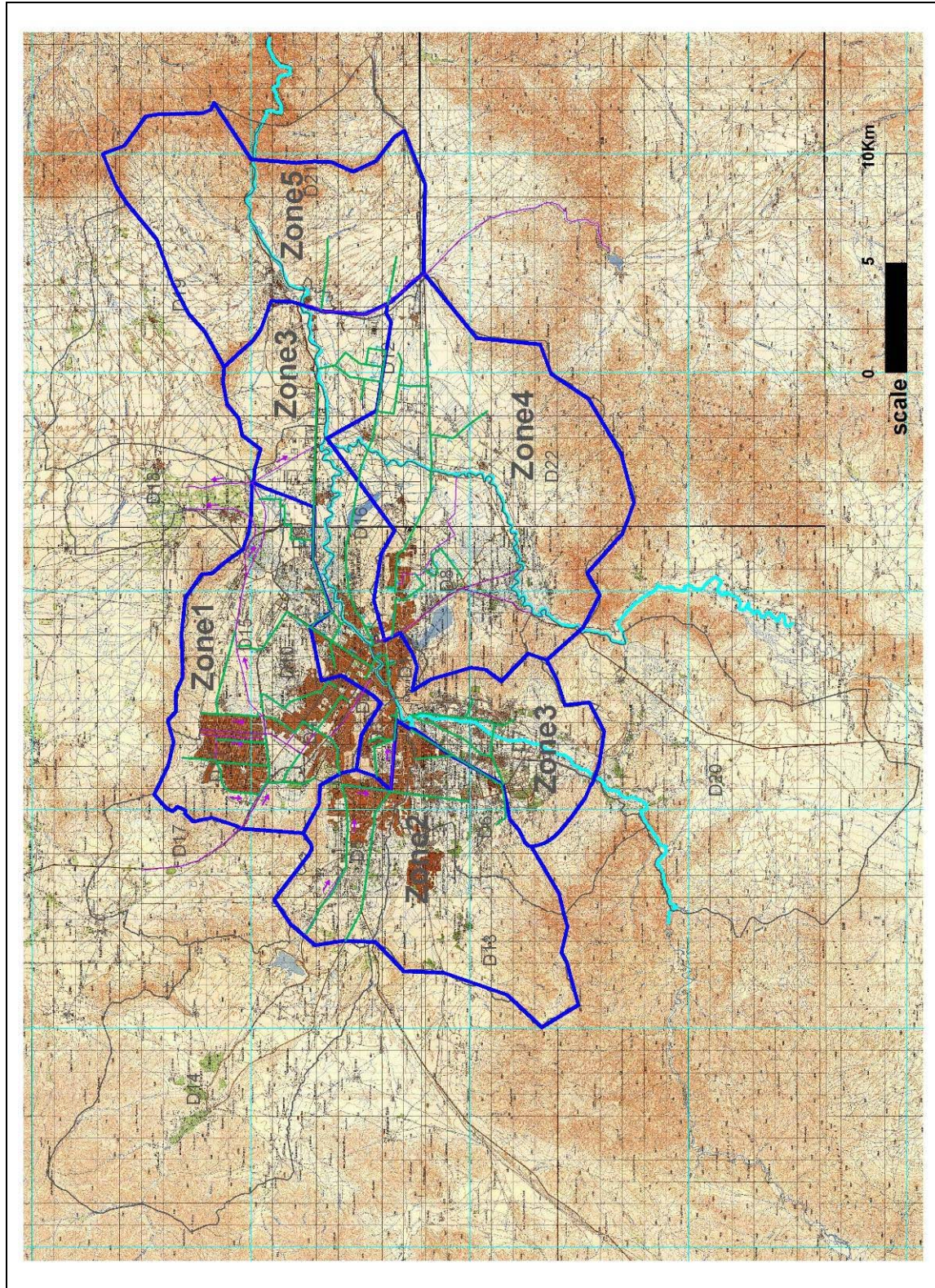


Figure 6.13: Drainage Area in Kabul City



## 6.3 Sewerage System

### 6.3.1 Existing conditions

#### (1) Implementing agencies

AUWSSC is theoretically responsible for sewerage as well as water supply in urbanized areas. However, it has presently no sewage-related activity since there is no sewerage system established except for the Macrorayon area. The Macrorayon area has a sewerage system, including a sewage treatment plant. Currently, facilities are managed by the Macrorayon Maintenance Department of the Kabul Municipality, together with the water supply.

#### (2) Tariff system

The Macrorayon system collects tariffs for sewerage service. It is charged according to the floor area at AFN 1/m<sup>2</sup>/month. The Macrorayon Maintenance Department is trying to increase it to AFN 4.4/ m<sup>3</sup>/month.

#### (3) Present Conditions of Sewerage in Kabul

##### 1) Present sewerage in Kabul

There is no centralized sewerage in Kabul City. Most residents use pit latrines or septic tanks for human wastes, and discharge miscellaneous wastewater to streets or city drains. Sewer lines and/or sewage treatment plants are operated only in specific areas and facilities. Generally, apartment complexes have some sewer lines. Those lines, except the Macrorayon area, are connected to communal septic tanks or city drains. Only the Macrorayon system has a complete sewerage with treatment plants.

According to a report of “Emergency Infrastructure Reconstruction Project, Sanitation Improvements in Kabul City” funded by World Bank (EIRP), there are three other areas equipped with sewage treatment plants: the Kabul University, the ISAF camp and a military school. These facilities are categorized as private and thus not available for the public use.

##### 2) On-site sanitation

Waste treatment by pit latrines and septic tanks is categorized as on-site sanitation. Sewage of pit latrines is vacuumed up periodically and disposed at a solid waste landfill site or in agriculture land as fertilizer. Treated liquid by septic tanks infiltrates into ground on site. Sludge of septic tanks is vacuumed up periodically and disposed also at the solid waste landfill site. Conditions of the on-site sanitation are not adequate, as overflow of sewage on streets is often observed. Miscellaneous wastewater from kitchens, bathrooms and elsewhere is discharged to road ditches or into city drains, threatening the quality of groundwater in the city.

Residents are responsible for management of pit latrines and septic tanks. They call contractors when they notice the necessity of vacuuming them up. The contractors vacuum the sewage and/or sludge up for fees. They bring such sewage and sludge to the solid waste landfill sites for disposal. Most contractors, however, sell the sludge to farmers and/or dispose it into city drains.

Septic tanks are installed generally for flush toilets. Due to shortages of water, switching to septic tank systems is difficult for most residents. According to the interview survey by the KfW water study, traditional toilets (pit latrines) are used by 86% of the city residents.

##### 3) Macrorayon system

The Macrorayon system is the only public sewerage existing in Kabul city. There are two sewage treatment plants; one for northern and the other for southern parts of the area. The sewage is transported to treatment plants by pipelines through a lifting pump station. The combined design

capacity is 15,000 m<sup>3</sup>/day, almost the same as the volume of water production. The systems suffer from unstable electricity supply and 30 year old facilities. The treatment efficiency is not known as the laboratory of the Macrorayon Maintenance Department is out of order and cannot analyze the quality of raw or treated sewage.

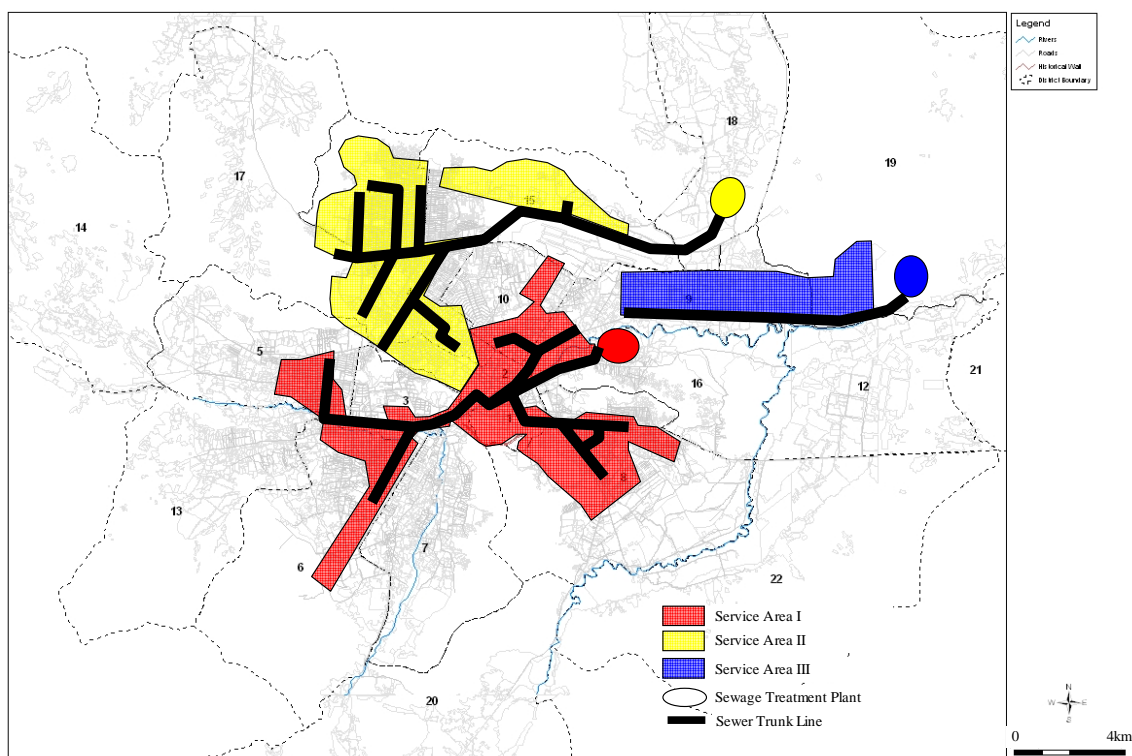
#### 4) Existing development plan

The EIRP study includes a master plan for sewage toward 2030, although it covers only the 16 districts of the municipality. The planned service area is depicted in Figure 6.14.

The unit wastewater flow is estimated in line with the KfW water study, which is effectively used as the master plan for water supply extension. The EIRP assumed the unit wastewater flow at 80% of water consumption. However, the planned sewerage service area does not correspond completely to the planned water supply service area due to the topographic conditions, operation safety, system adaptability and others.

The EIRR planned to divide the city into three areas, each to be equipped with sewer networks and a treatment plant. It expected that the existing sewage treatment plant in the Macrorayon area would serve as the main sewage treatment plant for the city after rehabilitation and expansion. The service population in 2030 was estimated at 1.4 million. Remaining areas were expected to be managed by on-site treatment.

As the sewerage service areas cover the high population density area, the plan satisfies the basic aim of sewerage, which is to minimize risks to the public health, pollution of groundwater, and influence for downstream at the minimum cost.



Source: EIRP Study (simplified by Planning Team)

**Figure 6.14: Planned Service Areas of Sewerage for 2030**

#### (4) Issues for sewerage in Kabul

The completion of planned sewerage facilities according to the EIRP master plan is a matter of urgency. Securing the budget for the estimated investment cost of US\$ 96 million holds a key for

the implementation. A sewage tariff system should be introduced for the entire service area, aiming at covering the O&M costs.

The service coverage by the master plan is confined to the central area of the city. The remaining areas are to be covered by on-site sanitation systems. However, rules and regulations for on-site sanitation have not been clearly established. Furthermore, finance for the improvement/replacement of on-site sanitation facilities has not been secured at present. Regulations of on-site sanitation may be effective if they are incorporated in building codes or standards currently in preparation.

### **6.3.2 Sewerage Development Plan**

#### **(1) Strategy for sewerage development**

##### *1) Service area for sewerage*

Once the piped water supply is extended, volume of wastewater will dramatically increase. When the piped water supply is extended, the sewerage should cover the service area of piped water supply. It is part of the basic strategy for the sewerage development. The sewerage service area, however, should be expanded in steps, considering the construction cost and topographic conditions, as well as planned water consumption. In such areas, where the sewerage coverage becomes behind the expansion of piped water supply and/or by public taps only, on-site sanitation should be adopted as a transitional solution.

##### *2) On-site sanitation*

Considering the limited water endowments and the short period until 2025, it is difficult to cover the whole area by house connection water supply. Rural areas and surroundings of urban areas should be covered by public taps and/or shallow wells. Sewerage is not appropriate in those areas and it should be covered by on-site sanitations.

It should be noted that in Kabul overflow and/or leakage from pit latrines and septic tanks affect the groundwater quality. Replacement or improvement of the facilities is required. On-site sanitation system should be transitional in a process of sewerage extension or introduction of advanced on-site sanitation system. In the long term beyond 2025, on-site sanitation system shall be replaced with advanced system having aeration device or sewerage in accordance with extension of piped water supply.

##### *3) Sludge management for on-site sanitation*

On-site sanitation facilities also generate sludge. Such sludge should be removed and transported to sewage treatment plant for proper treatment. To ensure efficient and reliable transportation, a regulation system needs to be established. As the treated sludge is useful as compost for agriculture, some transaction system to the surrounding agriculture areas need to be established in cooperation with related entities.

#### **(2) Clarification of basic conditions for sewerage development planning**

##### *1) Calculation of wastewater flow*

##### Average wastewater flow

More than 90% of consumed water would be discharged as wastewater. The Japanese standards recommend applying 100% of water consumption as wastewater flow for facility design. In this master plan, the following assumption was employed:

$$\text{Average Wastewater Flow} = \text{Average Water Consumption}$$

Daily maximum wastewater flow

Daily maximum (Dmax) wastewater flow is a parameter reflecting seasonal fluctuation. It is the planning criterion for sizing of sewage treatment facilities. This figure should be the same as Dmax water consumption. In accordance with the water supply development plan, the following was employed:

$$\text{Dmax Wastewater Flow} = \text{Average Wastewater Flow} \times 1.3$$

Hourly maximum wastewater flow

Hourly maximum (Hmax) wastewater flow is a parameter reflecting hourly fluctuation in addition to the seasonal fluctuation. It is the planning criterion for sizing of sewer lines and pump stations. This Figure should be the same as Hmax water consumption, and thus the following was employed:

$$\text{Hmax Wastewater Flow} = \text{Dmax Wastewater Flow} / 24\text{hours} \times 1.3$$

For a process of pipe diameter determination, it is necessary to considering unforeseen sewer volume over the Hmax flow. Such excess volume should be estimated usually from local experiences. However, there is no such record available in Kabul. For the planning purpose, the following factors were adopted based on the Japanese standards.

Pipe diameter	Additional flow to be considered
Under 700mm	100% of Hmax flow
Over 700mm Under 1,650mm	75% of Hmax flow
Over 1,650mm Under 3,000mm	35% of Hmax flow

2) *Sewer network*

The sewer network should be a separate system from rainwater drains to minimize the scale of sewerage facilities. The rainwater should be drained by roadside ditches, conveyed and finally drained to rivers.

3) *Sewerage system*Examination of the exiting master plan

The master plan prepared by EIRP should be respected basically. The plan is prepared for 2030. Planning criteria by EIRP are as shown in Table 6.24. This is to cover 950,000 people for 318,000 m<sup>3</sup>/day (3,687L/s) of daily maximum sewage in 2025. In terms of capacity, it seems sufficient to cover the service area of house connection.

**Table 6.24: Planning Criteria by EIRP Master Plan**

Area	Catchment area (EIRP #)	Planned population				Design flow (Max L/s)			
		2015	2020	2025	2030	2015	2020	2025	2030
Southern Area	2, 3, and 4	178,514	373,611	534,053	701,796	608	1,241	1,930	2,808
Northern Area	1 and 5	82,812	215,540	416,023	681,316	282	672	1,420	2,685
Eastern Indust. Area	6	0	0	0	0	40	146	337	742
Total		261,326	589,151	950,076	1,383,112	930	2,059	3,687	6,235

Source: Report of EIRP

Proposed sewage treatment methods for the above design flow is as follows:

Southern Area	Activated Sludge at Macrorayan
Northern Area	Stabilization pond at north-east of Airport
Eastern Industrial Area	Stabilization pond at Pule Charkhi (north side of Kabul river)

This EIRP master plan is well prepared through various surveys and discussions with relevant authorities. However, it is necessary to modify some parts according to the change of conditions as follows:



- i) Shatoot dam construction is not considered in the EIRP master plan and the design flows are not corresponding to water supply conditions planned in this master plan.
- ii) Location of the sewage treatment plant for northern area is adjacent to planned urban area for the new city. However, the stabilization pond, which needs vast land and generates odors, is recommended as a treatment method.
- iii) Northern service area covers low water consumption area such as District 15 and behind the airport. Sewerage for such area is not urgent until full coverage of house connection.
- iv) Southern service area extends on both banks of Pagman and Kabul rivers. The sewer trunk line crosses rivers twice at least. As a result of examination of possible location of sewage treatment plant, a simpler system may be possible.
- v) The EIRP master plan recommends the sewer network to cover the existing city center, in accordance with the present urban plan. The governmental residential area of Pule Charkhi and other new urban areas, which are under development or to be developed, are not planned to be covered by sewerage. An additional sewerage system should be formulated for the eastern area (south side of the Kabul river) in District 12 and 21.
- vi) The EIRP master plan recommends the sewerage system for industrial parks. Although it is one of the major incentives when inviting factories to locate, industrial wastewater can also be managed by enterprises also. Thus it should be reconsidered in this master plan.
- vii) Major part of the city should be divided into two, i.e. north and south. In addition to these, one zone for District 12 and 21 should be established separately. Totaling, three zones need to be provided.
- viii) A sewage treatment plant should be provided by the zone.
- ix) The sewage should be principally transported to sewage treatment plants by gravity along rivers to minimize pumping facilities.

#### 4) Sewage treatment plant

##### Target quality of treated sewage

To prevent the river pollution, the sewage should be treated to a level of 20 mg/L in BOD (biological oxygen demand). To realize this level of quality, aerobic decomposition process is required. A treatment system should be selected among various options such as stabilization pond, oxidation ditch and conventional activated sludge methods, considering land space available, influence to neighboring residents, easiness of operation and construction costs.

The treated sewage would be applied to agriculture. The quality of treated sewage should be noticed to farmers. As the treated sewage contains a certain amount of nitrogen and phosphorus, fertilizing control is required. An education system for watering and fertilizing should be established in parallel with facilities construction. In case that the influence of nitrogen and phosphorus is too high, the treatment plant should be improved to an advanced system.

##### Treatment system

The treatment system should be selected from typical ones, i.e. stabilization pond, oxidation ditch and conventional activated sludge methods. Characteristics of the three systems are shown in Table 6.25 and summarized below.

Stabilization pond:	Aeration is made by natural photosynthesis. Few electro-mechanical devices are required. Operation and maintenance is very simple. As shallow pond and longer retention period (1-2 mo.) are required, vast land is necessary. Prevention of
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	environment from odors and mosquitoes is difficult. Location should be further from residential area. As natural and vertical circulation is required in the pond, it is difficult to secure ideal efficacy in winter. (In winter, circulation is prevented since the surface layer is cold, sometime frozen, and the deeper layer is always warm.)
Oxidation ditch:	It is basically a developed system of stabilization pond until 1-2-day retention period. To facilitate the aerobic decomposition, mechanical aeration and activated sludge is utilized. It is categorized in activated sludge methods. Operation is relatively simple. Required land space is much smaller than stabilization pond. The pond could be covered, thus, it is easier to prevent the environment from odors and mosquitoes as well as temperature control. The system is effective for nitrogen removal. Mechanical aerator would be large in scale, power consumption is accordingly larger. The system requires sludge removal and disposal.
Conventional activated sludge:	It is the most proven system in technology. As it has sedimentation process before aeration, retention time is much shorter than others. The pond could be covered, thus, it is easier to prevent the environment from odors and mosquitoes as well as temperature control. Operation and maintenance is the most complicated among the options. Mechanical systems require the electrical power. The system requires sludge removal and disposal.

Land space is generally prioritized in urban areas for the selection of sewage treatment method. However, the municipality has enough spaces for sewage treatment plants. The land space is not the most prioritized condition, except for the central area of Kabul city. Accordingly, easiness of operation and maintenance should be considered as priority criteria since the introduction of a sewage treatment plant is the first attempt for Kabul. For comparison, main factors to be discussed are as follows:

- i) Preventability of environment from odors and mosquitoes (requirement of neighboring resident)
- ii) Stability of quality of treated sewage (requirement of user of treated sewage, i.e. agricultural activity)
- iii) Construction, operation and maintenance costs (requirement of sewerage authorities, i.e. AUWSSC)
- iv) Available land space (requirement of land-use plan and socio-economic activity)

**Table 6.25: Characteristics of Sewage Treatment Options**

Item	Stabilization pond	Oxidation ditch	Conventional activated sludge
Mechanism	Aerobic decomposition by natural photosynthesis. Retention time: around 1-2 months.	One of the activated sludge methods. No primary sedimentation and longer aeration. Retention time: 1-2 days for aeration and 6-12 hours for final sedimentation, total 2-2.5 days.	Aerobic decomposition by activated sludge. Retention time: 1.5 hours for primary sedimentation, 6-8 for aeration and 1.5 hours for final sedimentation, total 0.5 days.
Advantage	Very low cost for construction and O&M. Simple O&M. Little sludge. Little energy consumption.	Medium land space. Relatively simple operation. Relatively effective for nitrogen reduction. Less generated sludge.	Small land space. Proven technology. Stable and controllable operation. Less electric power than oxidation ditch. Higher adaptability of advanced treatment.
Disadvantage	Very large land space. Generation of odor & mosquito. Difficult to keep efficiency in winter.	Higher electricity consumption.	Numerous facilities. More complicate O&M. More generated sludge.
Land (rough area of tanks under av. depth 4m)	C 240ha (only tank, in case of 240,000m <sup>3</sup> /d capacity)	B 20ha (only tank, in case of 240,000 m <sup>3</sup> /d capacity)	A 4ha (only tank, in case of 240,000 m <sup>3</sup> /d capacity)
Construction cost	B	C	C
Operate cost	A	C	C
Sludge volume	A	B	C

Item	Stabilization pond	Oxidation ditch	Conventional activated sludge
Easiness O&M	A	B	C
Odor Prevent	C	A	A
Initial evaluation on treatment quality and O&M	C	A	B

Source: Planning Team

The stabilization pond is advantageous by the cost criteria. On the other hand, the oxidation ditch is advantageous for environmental preventability, stability and sludge recycling. This master plan recommends paying attentions to environmental preventability and stability more than the costs. Accordingly, it is proposed to apply the oxidation ditch method. In case when available land is limited for required treatment capacity, conventional activated sludge is to be adopted.

#### 5) On-site sanitation

In case of on-site sanitation, it is difficult to achieve the same level as treatment plant for treated sewage quality. The pit latrine is only to store the excreta. The septic tank is only to facilitate anaerobic decomposition of wastewater. To prevent the deterioration of groundwater quality, it is important not to concentrate the wastewater at a specific point. The concentrated wastewater will cause over capacity condition for natural decomposition of the ground.

The pit latrine is effective for traditional dwellings. Assuming the amount of excreta at 5 LCD, 10 persons in a household, one month's storage capacity and safety allowance factor at 1.3, 2 m<sup>3</sup> of capacity is required to prevent the groundwater quality from overflow. In addition to the requirement of capacity, sealing conditions should be improved. Fiber reinforced plastic (FRP) made is the most preferable.

For houses or buildings having flush toilets, septic tanks should be installed. The septic tank should be constructed according to proper guidelines or related standards. In the construction, capacity should be considered as well as sealing conditions. To secure adequate efficiency of treatment, two or three rooms type is recommended. According to the Japanese standards, the capacity of septic tank is provided as follows:

$$V \text{ (m}^3\text{)} > 1.5 + (n-5) \times 0.1$$

Where:

V: Capacity (m<sup>3</sup>)

n: Population

In case of 10 persons of household, 2 m<sup>3</sup> of capacity is required.

#### 6) Management of industrial wastewater

Industrial wastewater should be treated by each factory and/or by the operation body of industrial parks under the responsibility of respective enterprises. Since the industrial wastewater may contain toxic pollutants, guidelines should be published to all the enterprises for wastewater treatment and discharge as well as establishment of regulations and monitoring system. Considering the landlocked conditions, sewer lines should be established as a public and basic infrastructure. This sewer system should be separated from domestic sewers and directly connected to rivers. The sewers should receive the treated wastewater only.

#### 7) Recycling of sludge

The sludge removed from on-site sanitation and generated in treatment process will be effectively utilized for soil improvement of agriculture land and organic base agriculture. This master plan encourages this recycling to agriculture. To promote effectiveness, composting is recommended.

Composting facilities should be introduced but only in steps, confirming marketability of compost. Considering no-continuity of fertilizing season, compost should be stored at least for three months. The storing capacity for three months is, therefore, required at the sewage treatment plant. Composting should be commenced in steps from pilot implementation.

### (3) Sewerage system development plan

Generation of a certain amount of wastewater flow would justify the sewerage development. A sewerage system would not be applicable to the areas to be covered mainly by public taps and shallow wells. These areas should be covered by on-site sanitation.

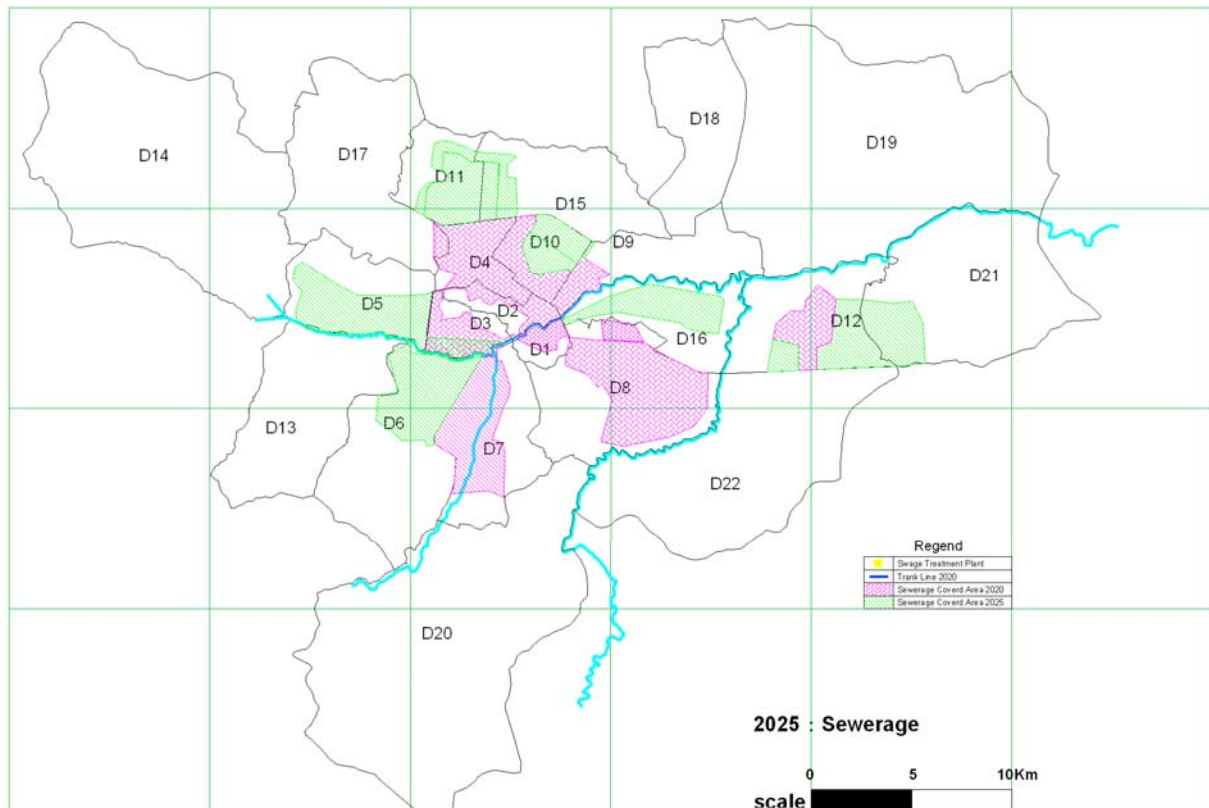
#### 1) Service area and wastewater flow

This master plan recommends sewerage service areas to be the same as the corresponding house connection water service areas. The sewer lines should be laid from down flow. Moreover, it is after Shatoot Dam construction that water consumption volume is dramatically increased. Sewerage coverage is not, therefore, required much for 2015. The planned coverage and wastewater flow are shown in Table 6.26 and Figure 6.15. The population of 3 million (nearly 50%) would be covered by sewerage in 2025. Average wastewater flow would reach 167,000 m<sup>3</sup>/d (61 MCM/year).

**Table 6.26: Sewerage Coverage and Average Wastewater Flow for 2020 and 2025**

Dist.	Planned Population				Sewerage Coverage					
	2020		2025		2020			2025		
	for Residential	for Employed	for Residential	for Employed	Share	Service pop	Ave sewage (m3/d)	Share	Service pop	Ave sewage (m3/d)
Total	5,595,223	1,720,447	5,910,156	2,191,597	17%	1,260,573	89,197	30%	2,415,925	166,410
1	39,326	64,595	44,916	78,364	65%	67,794	3,763	68%	83,295	4,475
2	131,605	62,702	134,035	92,589	38%	73,552	4,013	41%	92,366	4,356
3	78,859	44,144	73,323	60,258	70%	86,070	5,617	70%	93,484	5,627
4	190,609	76,046	177,880	102,553	70%	186,264	12,910	70%	195,924	12,708
5	371,974	114,163	381,127	155,428	0%	0	0	41%	220,820	16,208
6	296,244	109,224	287,026	147,549	0%	0	0	33%	142,749	9,007
7	516,944	119,100	520,063	142,398	30%	189,294	14,208	30%	196,888	14,474
8	691,042	153,197	756,346	188,782	39%	325,215	24,284	43%	409,948	30,065
9	196,911	150,176	193,083	182,548	16%	55,649	3,767	16%	60,068	3,752
10	246,427	64,693	222,384	79,898	56%	172,762	12,689	57%	171,533	12,036
11	269,732	45,619	260,661	45,797	0%	0	0	39%	119,655	9,120
12	522,676	95,385	532,525	98,433	13%	81,658	6,214	33%	206,656	15,906
13	443,917	86,178	423,615	101,026	0%	0	0	0%	0	0
14	230,219	40,780	257,686	43,830	0%	0	0	0%	0	0
15	209,051	93,481	215,378	120,718	0%	0	0	31%	104,951	6,654
16	394,642	97,324	443,910	126,437	0%	0	0	41%	233,080	17,008
17	60,879	20,025	58,330	20,213	28%	22,317	1,733	29%	22,415	1,736
18	62,033	16,032	80,945	17,092	0%	0	0	0%	0	0
19	1,144	36,811	0	58,641	0%	0	0	0%	0	0
20	206,544	41,540	269,464	42,441	0%	0	0	0%	0	0
21	156,368	73,113	199,598	112,308	0%	0	0	20%	62,091	3,276
22	278,077	116,119	377,861	174,294	0%	0	0	0%	0	0

Source: Planning Team



Source: Planning Team

**Figure 6.15: Sewerage Zone for Kabul**

## 2) Sewerage Development Plan

The Study Team has examined the following four options to determine the appropriate sewerage system, considering the EIRP master plan as well as other factors such as ease of land acquisition for a sewage treatment plant.

### Option-1

The service area is divided into three service sub-zones. Three sewage treatment plants are required in District 16, 19 and 21. The system was basically as planned by EIRP according to approved land for sewage treatment plants. It is one of the most concentrated systems for operations of sewage treatment plants. As the number of sewage treatment plants is fewer, however, it is preferable for lower construction, and operation and maintenance costs. This is an advantage on this option. Land acquisition would be easier for this option than other options.

However, the system applies river crossing at two points at least for the trunk sewer from the southwestern area in order to avoid the sewage treatment plant to locate in the city center. The sewer system is not the simplest for the local topography. From the viewpoint of water basin management, this system is not recommended since the sewage treatment plant in District 19 should discharge the treated sewage into the Panjshir river basin. The wastewater should better be managed within the same basin, in principle. These are disadvantages of this option.

### Option-2

This option is the simplest with respect to the local topography of all the options. The service area is firstly divided into four service sub-zones by river. The northern area is further divided into two, i.e. the belt along the Paghman and the Kabul rivers and the northern flat area. Five sewage treatment plants are required in District 7, 9, 16, 19 and 21. The advantage of this option is that it respects the local topography.

The system, however, requires five sewage treatment plants, leading to higher costs for land acquisition, construction and operation. Especially, the sewage treatment plant for southwest area would be located in the city center (District 7). Furthermore, the system will not solve the problem of the treated sewage discharge into the Panjshir river basin.

### Option-3

Option-2 recommends conveying the north area sewage to District 19, following the EIRP. Option-3 recommends the conveyance to the Kabul River. This is an improvement from Option-2. As the area is flat, sewage flow in either direction would require pump facilities and the both may be applicable. Four sewage treatment plants are required in District 7, 9, 16 and 21. Finally, this option can lead to reduction of number of sewage treatment plants, through merging the northern area and the belt along the Paghman and the Kabul rivers together. This option, therefore, is better than Option-2 in view of water basin management and number of sewage treatment plants.

In terms of costs, however, this option is less preferable than Option-1 and Option-4. Also, it still requires the sewage treatment plant in the city center (District 7). Since the northern area is composed of one sub-zone, the sewage treatment plant in District 9 should become larger than the case under Option-2.

### Option-4

This option represents further improvement based on the evaluation results of the above three options. Key improvements are as follows:

- i) No conveyance of the sewage to the Panjshir River Basin
- ii) Avoidance of a sewage treatment plant in District 7
- iii) Better conformity with the topography
- iv) Minimal river crossings and number of sewage treatment plants

The service area is firstly divided into two, i.e. north and south of the Paghman and the Kabul rivers. Also, District 12 and 21 located in the east of Logar River is further separated from the south sub-zone. Finally, the three sub-zones compose the sewerage service area, and three sewage treatment plants are required in District 9, 16 and 21. In view of number of sewage treatment plants, this option is advantageous among all the options as Option-1 for construction and operation costs.

However, a trunk sewer of this system should cross the Maidan River from the west to the east in order to convey the sewage of the southwest area to District 16. The sewage treatment plant in District 9 should be at the same scale as for Option-3. These are disadvantages.

The Option-4 was selected as the optimum option for the following reasons:

- Considering the operation of sewage treatment plants and capacity of AUWSSC as well as construction costs, the number of sewage treatment plants should be kept minimal.
- The need for a siphon system for river crossing would not be a key factor in selection of option.
- The sewage treatment plant in District 7 should be avoided, considering its influence to urban and socio-economic activities.
- Option-4 is better than Option-1 in view of water basin management and the number of river crossings.

The wastewater flow is calculated by sub-zone as shown in Table 6.27. The recommended system is shown in Figure 6.16. The capacity of sewage treatment plants was planned as follows:

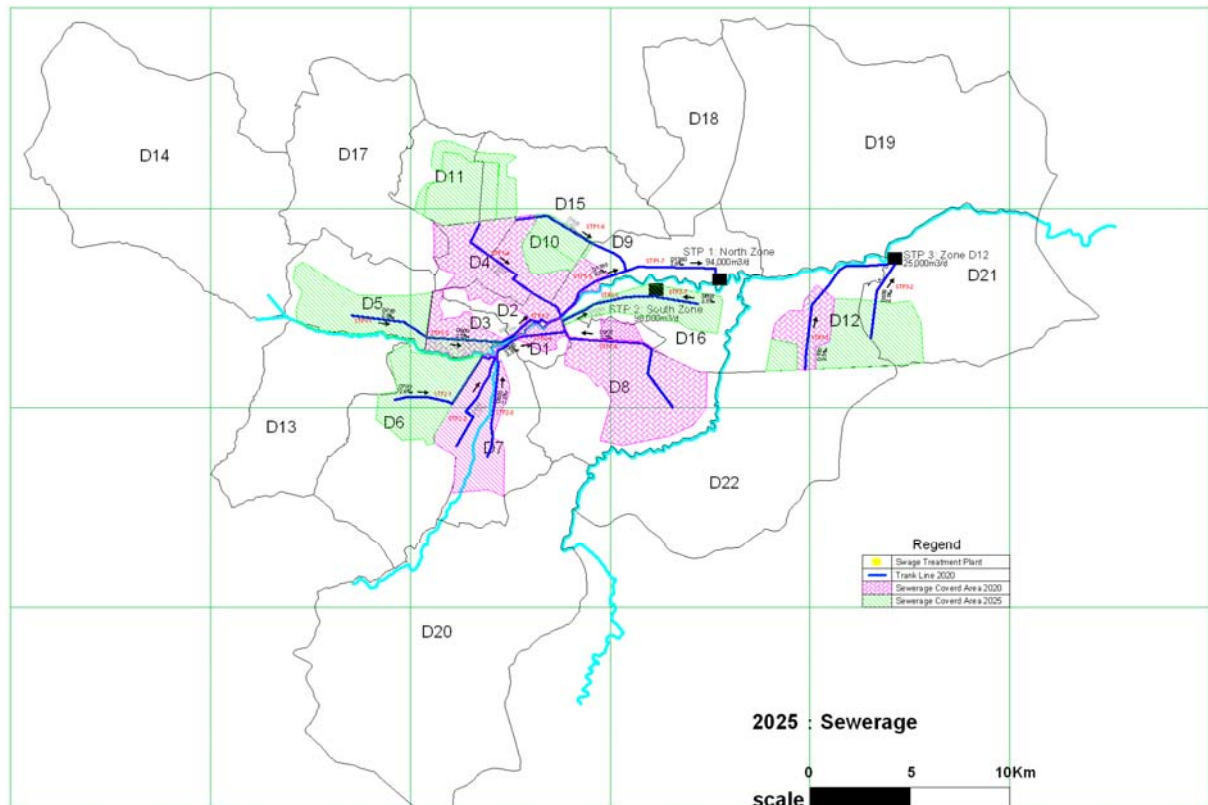
- North zone: 94,000 m<sup>3</sup>/day in 2025
- South zone: 98,000 m<sup>3</sup>/day in 2025
- Zone D12&21: 25,000 m<sup>3</sup>/day in 2025

**Table 6.27: Dmax Wastewater Flow and Sewage Treatment Plant Capacity**

Zone	Dist	2020			2025		
		Population	Ave sewage (m3/d)	Dmax sewage (m3/d)	Population	Ave sewage (m3/d)	Dmax sewage (m3/d)
North	2	73,552	4,013	5,217	92,366	4,356	5,663
	3	86,070	5,617	7,302	93,484	5,627	7,316
	4	186,264	12,910	16,783	195,924	12,708	16,521
	5	0	0	0	220,820	16,208	21,071
	9	55,649	3,767	4,897	60,068	3,752	4,878
	10	172,762	12,689	16,496	171,533	12,036	15,647
	11	0	0	0	119,655	9,120	11,856
	15	0	0	0	104,951	6,654	8,650
	17	22,317	1,733	2,253	22,415	1,736	2,257
	total	596,613	40,729	52,948	1,081,217	72,199	93,859
	STP			<b>55,000</b>			<b>94,000</b>
South	1	67,794	3,763	4,892	83,295	4,475	5,818
	6	0	0	0	142,749	9,007	11,709
	7	189,294	14,208	18,470	196,888	14,474	18,816
	8	325,215	24,284	31,569	409,948	30,065	39,085
	16	0	0	0	233,080	17,008	22,110
	total	582,302	42,254	54,931	1,065,960	75,029	97,538
	STP			<b>55,000</b>			<b>98,000</b>
D12&21	12	81,658	6,214	8,078	206,656	15,906	20,678
	21	0	0	0	62,091	3,276	4,259
	total	81,658	6,214	8,078	268,748	19,183	24,937
	STP			<b>10,000</b>			<b>25,000</b>
Total		1,260,573	89,197	115,957	2,415,925	166,410	216,334
	STP			<b>120,000</b>			<b>217,000</b>

Note: STP means Sewage Treatment Plant

Source: Planning Team



Source: Planning Team

**Figure 6.16: Sewerage Development Plan for Kabul City**

### 3) Development schedule

#### Development up to 2020

All sewage treatment plants should be ready for operation at the capacity to accommodate the demand expected in 2020. The sewage treatment plant for the north zone should be located in District 9 on the left bank of the Kabul River and in front of the Pule Charkhi industrial park. Application of the conventional activated sludge is proposed to minimize necessary land. For the south zone, the sewage treatment plant will be located at the site of the exiting Macrorayon plant and adjacent to it. As the land area is sufficient, the oxidation ditch method is proposed. The exiting Macrorayon plant will be rehabilitated for oxidation ditch and extended to serve the whole south zone. The recommended location of sewage treatment plant for Districts 12 and 21 is on the right bank of the Kabul River to facilitate discharge of treated sewage into the river. As for treatment process, oxidation ditch is also recommended.

Sewers will be constructed from the down flow side. Consequently, areas closer to the treatment plant should be constructed earlier. The sewers will, therefore, be constructed for a half of the service zones by 2020. Another half should be expanded up to 2025. However, the piped water supply development will have to be considered to determine the timing of the sewerage service area development.

For the north zone, it is proposed to cover District 2, 3, 4, 9, 10, 17 by 2020. The service population is estimated to be 600,000 in 2020. Regarding the south zone, Districts 1, 7, and 8 are to be covered by 2020. The service population is estimated to be 580,000 in 2020. Also, a half of District 12 will be covered by 2020 for 82,000 of service population. Totally, the population coverage will be 1,262,000 in 2020, which would be 17% of the city's population.



To cover the service population in 2020, the required capacity of sewerage treatment plant will be 55,000 m<sup>3</sup>/day for the north zone, 55,000 m<sup>3</sup>/day for the south zone and 10,000 m<sup>3</sup>/day for Zone D12&21.

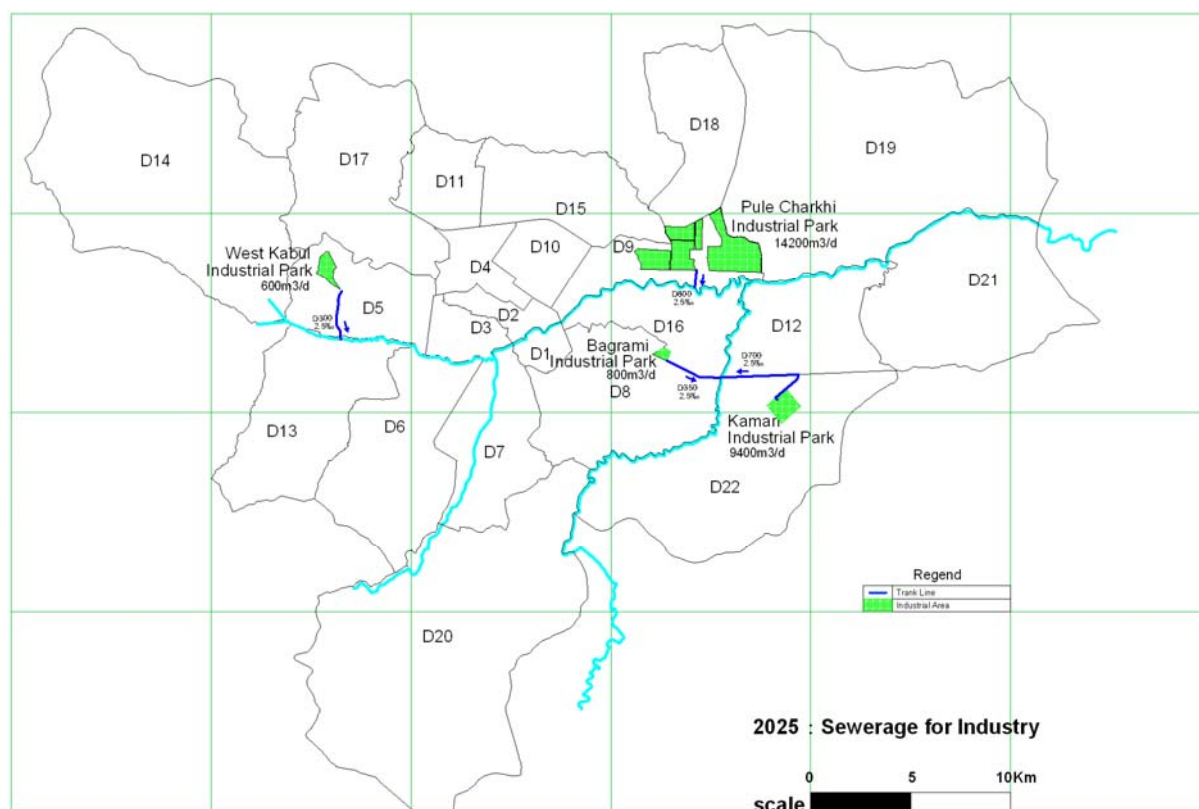
#### Development up to 2025

All the planned sewers will be completed by 2025. The total service population will be about 2.5 million in 2025. This service population corresponds to approximately 30% of city population. To cover the service population in 2025, the required capacity of sewerage treatment plant will be expanded to 94,000 m<sup>3</sup>/day for the north zone, 98,000 m<sup>3</sup>/day for the south zone and 25,000 m<sup>3</sup>/day for Zone D12&21. Service will cover whole house connection water supply areas.

#### 4) Sewerage development plan for industrial parks

As mentioned above, industrial wastewater will be treated by each factory and/or the parks' operators. Construction of branch sewers will be designed and managed by each factory. As industrial parks are developed, introduction of water reuse system would be necessary within the parks to reduce the raw water utilization.

The recommended trunk sewer system is as shown in Figure 6.17.



Source: Planning Team

**Figure 6.17: Plan for Trunk Sewer System for Industrial Wastewater**

#### 5) Key facilities required for sewerage development

##### Sewage treatment plants

The wastewater should be properly treated at sewage treatment plants. The plants required in Kabul City are as follows.

- i) For the North zone of existing Kabul city: To treat the 72,199m<sup>3</sup>/day of average wastewater, a treatment plant of 94,000m<sup>3</sup>/day capacity is required. Oxidation ditch is appropriate as the treatment process.
- ii) For the South zone of existing Kabul city: To treat the 75,029m<sup>3</sup>/day of average wastewater, a treatment plant of 98,000m<sup>3</sup>/day capacity is required. Oxidation ditch is appropriate as the treatment process.
- iii) For Zone D12&21 of existing Kabul city: To treat the 19,183m<sup>3</sup>/day of average wastewater, a treatment plant of 25,000m<sup>3</sup>/day capacity is required. Oxidation ditch is appropriate as the treatment process.

#### Sewer trunk line

The sewer trunk line will be installed between sewerage service areas and sewage treatment plants. A gravity system could be basically applied. Concrete pipes are appropriate materials. Pipe diameters need to be designed according to the Hmax wastewater flow in 2025 by the Manning formula as shown below:

- Design flow = Hmax Wastewater Flow
- = Dmax Wastewater Flow / 24hour x 1.3
- $Q = A \times V = A \times \frac{1}{n} \times R^{-2/3} \times S^{1/2}$

Where:

- Q: Flow Capacity (m<sup>3</sup>)
- A: Wetted Area (m<sup>2</sup>)
- V: Velocity (m/s)
- N: Manning Friction Coefficient
- R: Hydraulic Radius (m)
- = Wetted Area/ Wetted Perimeter
- S: Slope (‰)

Result of calculation is shown in Table 6.28. Piping route is shown in Figures 6.18 and 6.19. In case of that the depth of excavation is more than approximately five meters, it is difficult to lay on the pipe by open cut method. Therefore it is necessary to select jacking method or lift pump such as manhole pump. In this master plan, lift pump is selected on this case.

**Table 6.28: Result of Pipe Diameter Calculation in Existing Kabul City**

Route Number	Inlet Pipe	Outlet pipe	Population		Route extension		Sewage Quantity	Plan of Sewage line				Note
			Part	Total	Part	Total		Diameter	Slope	Velocity	Flow Volume	
			Person	Person	m	m		mm	permillage	m/s	m <sup>3</sup> /s	
STP1-1		STP1-2	220,820 (D5)	220,820 (D5)	4,050	4,050	0.43	700	2.5	1.204	0.464	
STP1-2	STP1-1	STP1-3	93,484 (D3)	314,304 (D5,3)	3,750	7,800	0.58	800	2.5	1.316	0.662	
STP1-3	STP1-2	STP1-5	92,366 (D2)	406,670 (D5,3,2)	3,600	11,400	0.69	900	2.5	1.423	0.905	
STP1-4		STP1-5	528,712 (D11,15,4,10 <sub>50%</sub> )	528,712 (D11,15,4,10 <sub>50%</sub> )	7,300	18,700	0.96	1,000	2.5	1.526	1.198	Lift Pump
STP1-5	STP1-3	STP1-7	60,068 (D9)	995,450 (D5,3,2,11,15,4,10 <sub>50%</sub> ,9)	4,200	22,900	1.75	1,350	2.5	1.864	2.667	
STP1-6		STP1-8	85,767 (D10 <sub>50%</sub> )	85,767 (D10 <sub>50%</sub> )	6,500	29,400	0.19	600	2.5	1.086	0.307	Lift Pump
STP1-7	STP1-5	STP1		1,081,217 (D5,3,2,11,15,4,10,9)	4,850	34,250	1.91	1,350	2.5	1.864	2.667	Lift Pump
STP2-1		STP2-4	142,749 (D6)	142,749 (D6)	6,700	6,700	0.24	700	2.5	1.204	0.464	
STP2-2		STP2-1	98,444 (D7 <sub>50%</sub> )	98,444 (D7 <sub>50%</sub> )	5,200	11,900	0.22	600	2.5	1.086	0.307	
STP2-3		STP2-4	98,444 (D7 <sub>50%</sub> )	98,444 (D7 <sub>50%</sub> )	5,000	16,900	0.22	600	2.5	1.086	0.307	
STP2-4	STP2-1	STP2-6	83,295 (D1)	422,932 (D6,7,1)	4,000	20,900	0.74	900	2.5	1.423	0.905	
STP2-5		STP2-6	409,948 (D8)	409,948 (D8)	7,900	28,800	0.8	900	2.5	1.423	0.905	Lift Pump
STP2-6	STP2-4	STP2	116,540 (D16 <sub>50%</sub> )	949,420 (D6,7,1,8,16 <sub>50%</sub> )	5,300	34,100	1.76	1,200	2.5	1.724	1.950	
STP2-7		STP2	116,540 (D16 <sub>50%</sub> )	116,540 (D16 <sub>50%</sub> )	2,200	36,300	0.26	600	2.5	1.086	0.307	Lift Pump
STP3-1		STP3	206,656 (D12)	206,656 (D12)	8,000	8,000	0.05	700	2.5	1.204	0.464	
STP3-2		STP3	62,091 (D21)	62,091 (D21)	3,300	3,300	0.1	500	2.5	0.960	0.188	
Pule Charkhi Ind		River			1,500	1,500	0.49	800	2.5	1.316	0.662	
Babrami Ind		River			3,000	3,000	0.04	350	2.5	0.757	0.073	
Kamari Ind		River			6,000	6,000	0.33	700	2.5	1.204	0.464	
West Kabul Ind		River			3,000	3,000	0.03	300	2.5	0.686	0.049	

Note: STP: Sewage Treatment Plant

Source: Planning Team

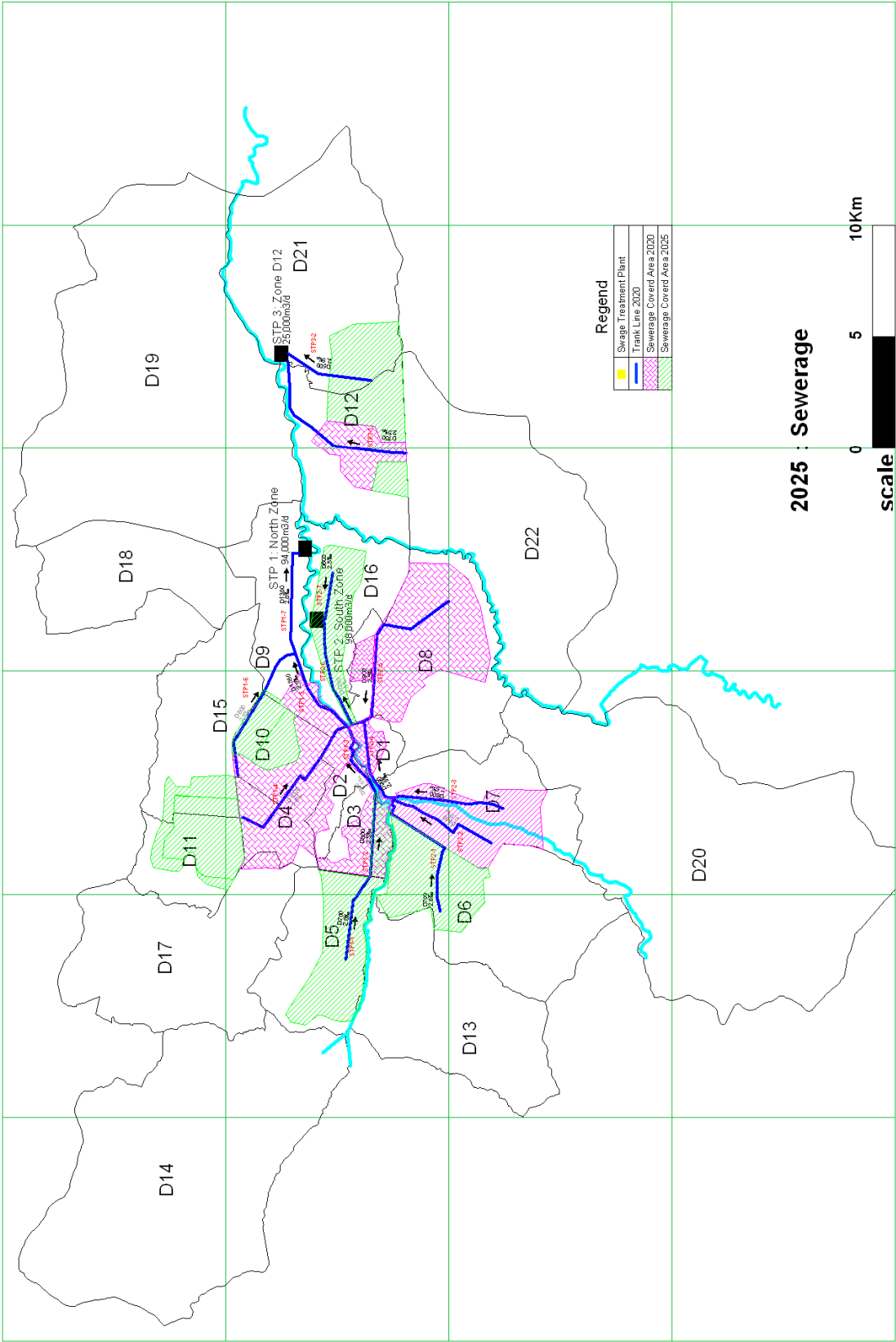


Figure 6.18: Sewerage Development in Kabul City

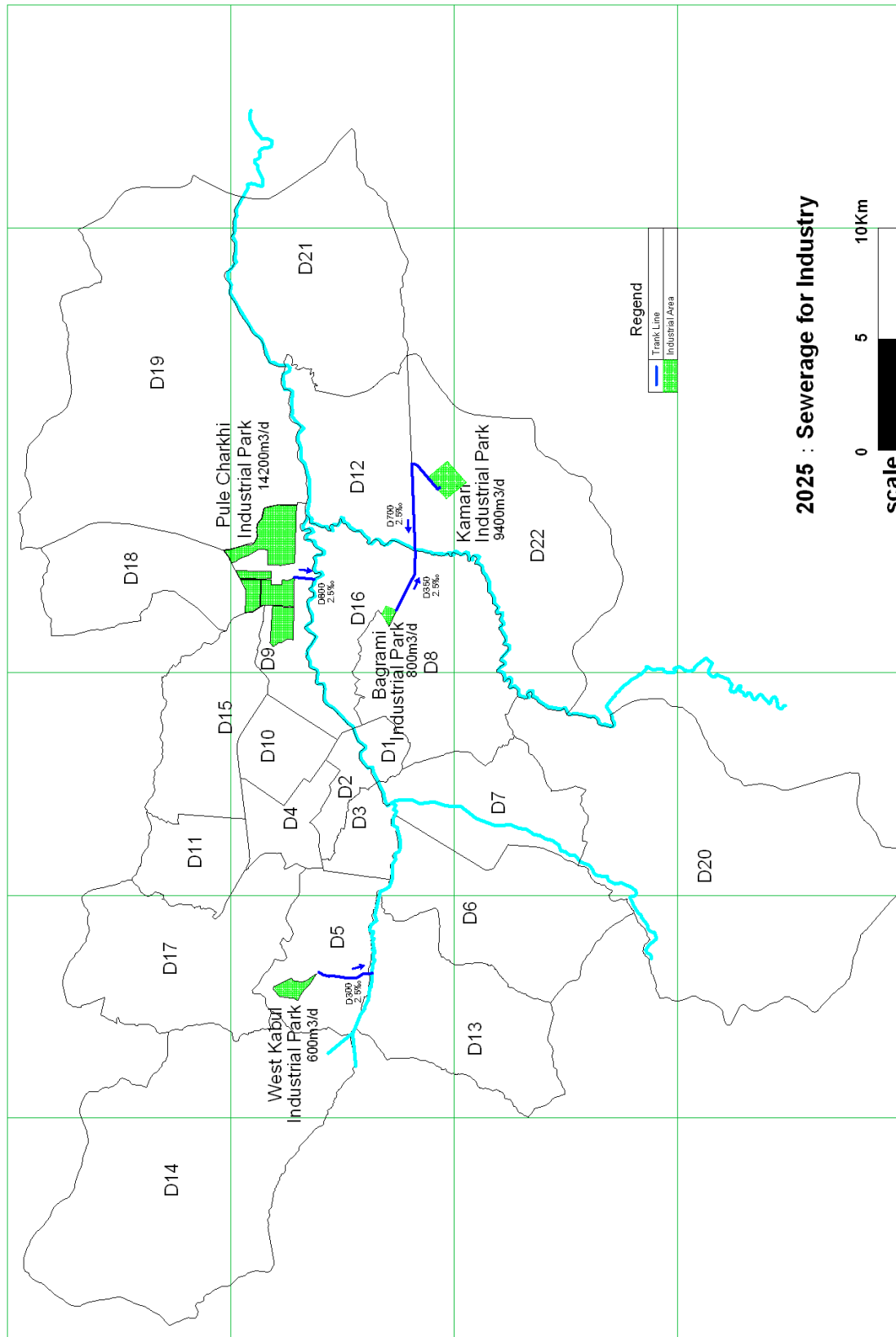


Figure 6.19: Industrial wastewater Development in Existing Kabul City

Construction of some pump stations will be necessary. However, necessity of lifting pumps and/or manhole pumps should be examined in details in the later stage such as feasibility study and detail design as well as detail topographic surveys.

Schedule of key facilities construction

Facilities required to achieve the expected functions of sewerage systems for different zones are listed in Table 6.29.

**Table 6.29: Key Facilities for Sewerage**

No.	Facility	Operated by	Purpose
1.	Sewage treatment plant (STP) for North zone Capacity: 55,000m <sup>3</sup> /d by 2020 and expanded to 94,000m <sup>3</sup> /d by 2025	2020 PH1 2025 PH2	To treat sewage of North zone for 2025
2.	Sewer network for Northern zone	2020 PH1 2025 PH2	To transport sewage from North zone to STP for 2025
3.	Sewage treatment plant (STP) for South zone Capacity: 55,000m <sup>3</sup> /d by 2020 and expanded to 98,000m <sup>3</sup> /d by 2025	2020 PH1 2025 PH2	To treat sewage of South zone for 2025
4.	Sewer network for South zone	2020 PH1 2025 PH2	To transport sewage from South zone to STP for 2025
5.	Sewage treatment plant (STP) for Zone D12&21 Capacity: 10,000 m <sup>3</sup> /d by 2020 and expanded to 25,000 m <sup>3</sup> /d by 2025	2020 PH1 2025 PH2	To treat sewage of Zone D12&21 for 2025
6.	Sewer network for Zone D12&21	2020 PH1 2025 PH2	To transport sewage from Zone D12&21 to STP for 2025
7.	Sewer network for industrial parks	2020 PH1 2025 PH2	To conduct treated sewage to rivers

Source: Planning Team

**6.3.3 Sewerage development project**

Based on the requirement for construction of key sewerage facilities, projects for the sewerage system development for Kabul City is identified as summarized in Table 6.30. Desired implementation schedule for these projects is depicted in Figure 6.20.

**Table 6.30: Project Component for Sewerage System Development**

Project ID/ Title	Location	Key Facilities
SK-1-1: Sewerage Treatment Plant construction project for North zone	District 9	Sewerage Treatment Plant 55,000m <sup>3</sup> /d
SK-1-2: Sewerage Treatment Plant extension project for North zone	District 9	Sewerage Treatment Plant 94,000m <sup>3</sup> /d
SK-2-1: Sewerage Treatment Plant construction project for South zone	District 16	Sewerage Treatment Plant 55,000m <sup>3</sup> /d
SK-2-2: Sewerage Treatment Plant extension project for South zone	District 16	Sewerage Treatment Plant 98,000m <sup>3</sup> /d
SK-3-1: Sewerage Treatment Plant construction project for District 12&21 zone	District 21	Sewerage Treatment Plant 10,000m <sup>3</sup> /d
SK-3-2: Sewerage Treatment Plant extension project for District 12&21 zone	District 21	Sewerage Treatment Plant 25,000m <sup>3</sup> /d
SK-4-1: Sewer network improvement project for North zone Phase-1	North zone	Sewer trunk line D=1.35m, L=9.05km D=1.0m, L=7.3km D=0.9m, L=3.6km D=0.8m, L=3.75km Sewer branch line 3,500ha
SK-4-2: Sewer network improvement project for North zone Phase-2 (Extension)	North zone	Sewer trunk line D=0.7m, L=4.05km D=0.6m, L=6.5km Sewer branch line 3,400ha
SK-5-1: Sewer network improvement project for South zone Phase-1	South zone	Sewer trunk line D=1.2m, L=5.3km D=0.9m, L=11.9km D=0.6m, L=10.2km Sewer branch line 4,100ha
SK-5-2: Sewer network improvement	South zone	Sewer trunk line

Project ID/ Title	Location	Key Facilities
project for South zone Phase-2 (Extension)		D=0.7m, L=6.7km D=0.6m, L=2.2km Sewer brunch line 2,500ha
SK-6-1: Sewer network improvement project for D12&21 zone Phase-1	District 12&21 zone	Sewer trunk line D=0.7m, L=8.0km Sewer brunch line 700ha
SK-6-2: Sewer network improvement project for D12&21 zone Phase-2 (Extension)	District 12&21 zone	Sewer trunk line D=0.5m, L=4.0km Sewer brunch line 1,800ha
SK-7: Sewer network improvement project for Industrial Parks	From industrial parks to river	Sewer trunk line D=0.8m, L=1.5km D=0.35m, L=3.0km D=0.7m, L=6.0km D=0.3m, L=3.0km

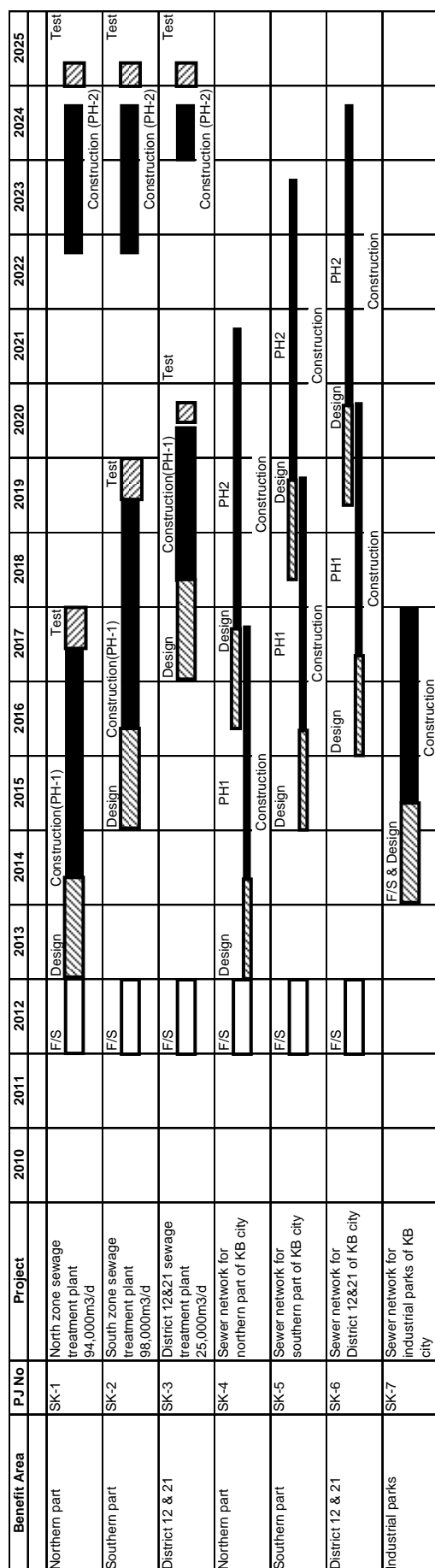


Figure 6.20: Implementation Schedule for Sewerage System Development



### 6.3.4 Contingency plan for sewerage

Since Kabul City has smaller water supply amount due to limited water resources, the sewerage system is planned in accordance with water supply plan for 2025 in this master plan. If new water resources were found additionally, sewerage could be further developed as well as water supply. By way of example, additional land of city center will be more efficient solution for additional sewage treatment plant. In this case, treated water shall be utilized in center of city.

### 6.3.5 Sludge management

Sludge removed from on-site sanitation and generated in treatment process will be effective for soil improvement for agricultural land and organic base agriculture. To promote its effectiveness, composting is recommended. Composting process requires around one month of period. As vast land and some facilities are required, it is not recommended to introduce it quickly. Composting facilities should be introduced in steps, while confirming marketability of compost.

As the fertilizing season is limited, compost should be stored at least for three months. The storage capacity for three months is, therefore, required at the sewage treatment plant. Composting should be commenced in steps from pilot implementation.

On-site sanitation facilities also generate sludge. Such sludge should be removed and transported to a sewage treatment plant to be treated. To secure efficient and stable transportation, regulations and a system should be established.

#### Sludge generated in sewage treatment plants

Sewage treatment plants generate the larger amount of sludge in aeration and sedimentation processes. This master plan recommends mechanical de-watering of the sludge since sludge volume would be huge and vast area is necessary for sun-drying. The sludge removed from aeration and sedimentation tanks should be thickened first and de-watered mechanically. Dewatered sludge with 80% of water content could be transported by truck as de-watered sludge cakes.

The sludge generated in sewage treatment plants would be applicable for agriculture. It is encouraged to re-cycle it for agriculture. Assuming SS of raw sewage at 250 mg/L and generated rate by oxidation ditch at 75%, the sludge would be generated at a sewage treatment plant as shown in Table 6.31. Totally 125m<sup>3</sup>/day of de-watered cakes are generated.

While it is ideal to compost the de-watered cakes, this master plan recommends a further study on market of compost products as a compost plant requires further planning for plant operation. The master plan recommends distributing the de-watered cakes to potential buyers/farmers at their responsibility. Fertilizing frequency is varied according to agricultural products and seasons. It is not always required by farmers throughout a year. Storing the dewatered cake would, therefore, be necessary for around three months at each sewage treatment plant. In the largest case, 3 ha of land is necessary to store the de-watered cakes, assuming average storing height at 50cm.

For sewage treatment plants in the existing Kabul City, an exclusive area should be secured at each plant since no land for future plant extension is recommended. For those in the New City, future extension area should be utilized for the storage until the extension. Sludge management beyond the extension should be considered later. The area required to store the sludge is shown in Table 6.32.

**Table 6.31: Sludge Generated by Sewage Treatment Plant**

Plant	Ave. sewage treatment (m <sup>3</sup> /d)	SS of raw sewage (mg/l)	Sludge generation rate (%)	Generated solid sludge (t/day)	Dewatered cake (80% water m <sup>3</sup> /d)
North zone STP (Kabul)	72,000	250	75	13.500	54.00
South zone STP (Kabul)	75,000	250	75	14.063	56.25
Zone D12&21 STP (Kabul)	20,000	250	75	3.750	15.00

**Table 6.32: Area Required to Store the Sludge at Sewage Treatment Plant**

Plant	Dewatered cake (80% water m <sup>3</sup> /d)	Amount to be stored (m <sup>3</sup> /3 mos.)	Storage area (m <sup>2</sup> )
North zone STP (Kabul)	120.00	4,860	9,720
South zone STP (Kabul)	41.25	5,063	10,126
Zone D12&21 STP (Kabul)	15.00	1,350	2,700

***Further Study for Composting***

Feasibility of composting should be confirmed in a pilot project through the analyses on selection of composting process, product quality, price and marketability. It is recommended to conduct such a study after construction of a sewage treatment plant.

**6.3.6 On-site sanitation**

By on-site sanitation, it is difficult to achieve the same level of treatment for treated sewage quality that is attained by treatment plants. The pit latrine is only to store the excreta. The septic tank is only to facilitate anaerobic decomposition of wastewater. To prevent the deterioration of groundwater quality, it is important not to concentrate the wastewater at any specific points. The concentrated wastewater will cause the natural decomposition capacity of the ground exceeded.

Pit latrines are effective for traditional dwellings. Assuming the amount of excreta at 5 LCD, 10 persons in a household, one month's storage capacity and safety allowance factor at 1.3, 2 m<sup>3</sup> of capacity is required to prevent the overflow to degrade the groundwater quality. In addition to the requirement of capacity, sealing conditions should be improved. Fiber reinforced plastic (FRP) made is the most preferable.

For houses or buildings having flush toilets, septic tanks should be installed. Septic tank should be constructed according to WHO guideline or related standards. In the construction, capacity should be considered as well as sealing conditions. To secure adequate efficiency of treatment, a 2-3-room type is recommended.

To improve the on-site sanitation facilities, especially for the existing Kabul City, some subsidy system may be required from the governmental authority to general public. Moreover, establishment of standards and regulations are required for the on-site sanitation. Such standards or regulations should be incorporated in the building code.

**6.4 Power Distribution System Development Plan****6.4.1 Present conditions of power supply****(1) Administrations, policies and plans for power development in Afghanistan*****1) Power administration***

The power supply in Afghanistan is the responsibilities of three ministries: the Ministry of Energy and Water (MEW) in charge of bulk power supply covering generation, transmission and distribution, the Ministry of Rural Reconstruction and Development (MRRD) in charge of small independent generation (smaller than 50kW) and distribution, and the Ministry of Mines (MOM) in charge of power supply for fertilizer and cement companies. The power supply for Kabul city is

undertaken by the Kabul Electric Department (KED) which is a part of Da Afghanistan Breshna Sherkat (DABS), an independent and autonomous company.

## *2) Power sector policy and master plan*

The Power Sector Policy Paper issued in 2003 has set the general direction of the sector's reform. It proposed the separation of policy formation and services provision, establishment of the Power Regulatory Authority, commercialization of DABM (which is now changed to DABS), utilization of the private sector and other measures. The paper and the Power Sector Master Plan are reflected in the report "Securing Afghanistan's Future" prepared in January 2004.

The power development in Afghanistan has been following largely these documents. The master plan spelled out the following for stage-wise power development in Afghanistan:

- i) Rehabilitation of the existing power facilities as the urgent measures (up to 2005)
- ii) Implementation of three priority projects (2005-10), consisting of a) the northern transmission lines (220kV) between Termez and Kabul for power import from Uzbekistan, b) the construction of the Baghdara hydropower plant (280MW) for the Kabul-Ghori-Balkh region and the Kajaki II (100MW) for the Kandahar region, and c) the construction of a gas turbine plant in the Sheberghan area
- iii) Development of the Surobi II (180MW), and other hydropower plants on the Kunar and the Kokcha rivers

## *3) Afghanistan National Development Strategy*

The Afghanistan National Development Strategy (ANDS) has reviewed the master plan and set targets and priority for power sector development as part of the national energy strategy. In line with the private sector-led market oriented economic development, the ANDS has established the government priority to privatize key state-owned enterprises. DABS will be corporatized to increase the efficiency in this line.

The targets for the medium term national development include the following related to power and energy development by 2010:

- i) Electricity will reach at least 65% of households and 90% of non-residential establishments in major urban areas, and 25% of households in rural areas.
- ii) At least 75% of the costs will be recovered from users connected to the national power grid.
- iii) A strategy for the development and use of renewable energy will be pursued.

More specific measures to expand the power supply capacity are spelled out in the ANDS. In addition to major infrastructure projects such as Baghdara, Gulbahar, Kokcha, Kunar, Surobi II and Sheberghan gas and oil fields, promotion of renewable energy such as micro-hydro, solar, wind, biomass and diesel power is mentioned to increase access to rural energy.

## *4) Power supply system in Afghanistan*

There are four major individual power supply systems covering the national territory: North, East (including Kabul city), South and West areas. The power supply system for the West relies on power import from Iran and Turkmenistan.

The North and the East systems are connected by 220kV transmission lines in the beginning of 2009 and also this system is connected to Uzbekistan by 110/220kV international transmission lines. The South system is partially connected to Iran.

Outline of the route map of transmission lines and location information of Power Station (P/S) for North East Power System (NEPS) is shown in Figure 6.21. Figure 6.22 shows the electrical system diagram for NEPS.





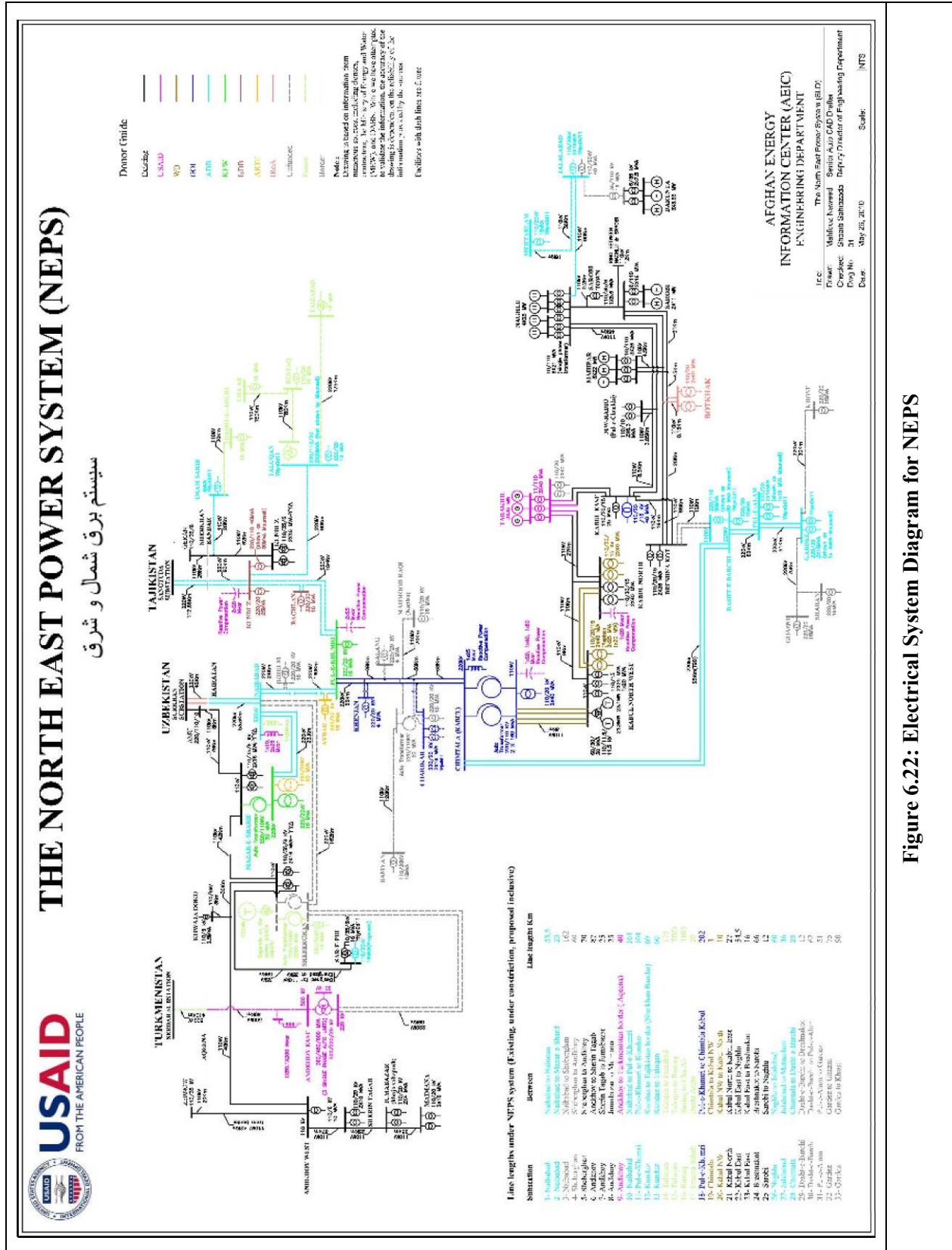


Figure 6.22: Electrical System Diagram for NEPS

## (2) Existing power supply in Kabul City

### 1) Power supply system

There are two separate power supplies to the Kabul city. One is from Uzbekistan through Chimtala S/S and the other is from five P/Ss which located in the Kabul province. The power supply for general public is still limited in 11 districts and district 20 has no power supply. The power supply system for the Kabul province is outlined as follows:

#### Generating facilities

The total installed capacity of P/S is 341 MW which consists of 188 MW (55%) by hydro and the rest by thermal (gas and oil) P/Ss which are located in the Kabul City. Some of them can not continuously operate because of lack of water and high fuel cost. All hydro power stations are decrepit and negatively affecting the reliable power supply. The existing power generating facilities are summarized in Table 6.33.

**Table 6.33: Outlines of Existing Generating Facilities**

Plant name	Generating method	Year	Output (MW)		Remarks
			Installed	Available	
Mahipar	Hydro	1967	66 (3x22)	19-35	Operate from October to April
Naghlu	Hydro	1967	100 (4x25)	100	
Surobi	Hydro	1957	22 (2x11)	16.5	Operational in Nov. to Mar: 75% output
North West	Gas turbine	1985	45 (22+23)	40	Peak operation
	Gas Turbine		50(25+25)		To be commissioned in End of 2010
Tarakhil DEG	Diesel	2008	108 (6x18)	100	Peak operation
Total			341	275-291	

Source: MEW

#### Transmission and substation system

There are two 220kV transmission lines between Pul-e-khumri and Chimtala S/S which supply the power from Uzbekistan to Kabul through Naibabad, Pul-e-khumri and Chimtala S/S. The main transmission lines operating in the Kabul system are of 110kV, extending over 355km as depicted in Figure 6.23.

There are six substations (S/Ss) with the total capacity of about 800MVA. Outline of substations capacity are shown in Table 6.34 excluding old transformers with rated voltage of 15kV. All the step-down transformers listed is capable for dual rating such as 15/20kV.

**Table 6.34: Outlines of Existing Substations**

Name of S/S	Voltage	Capacity (MVA)	Remarks
North-West	15/20/110 kV	2x40, 1x60	
North	15/20/110kV	2x40	
East	15/20/110kV	1x40	
Breshna Kot	15/20/110kV	2x25	
Chimtala	20/110/220kV	2x40, 2x160	Connected to Pru-e-khumri S/S by 220kV
Botkhak	20/110kV	2x40	
Total		790	

Source: MEW

#### Distribution system

The distribution voltage is 15/20kV stepped down by distribution transformers to 400/230V, 50Hz. There are twelve junction stations that have a total capacity of about 250MVA. The total length of 15/20kV distribution line is around 600km and the number of distribution transformers is about 1,300 with total capacity of about 500MVA. The current distribution system with location information of related power supply substations is shown in Figure 6.23.

In the latest report on distribution system analysis by MEW, the total required capacity of new distribution transformer will be 165MVA until 2012 and recommends two new 110/20kV substations to be installed for the central and the Southwest systems in Kabul City.

Load sharing occurs every day during peak demand from 6 to 8 pm, and some distribution transformers are over-loaded. Electrical design standards and codes are not finalized yet. The Kabul system supplies the power to Charikar City, Parwan province, by 20kV distribution lines.



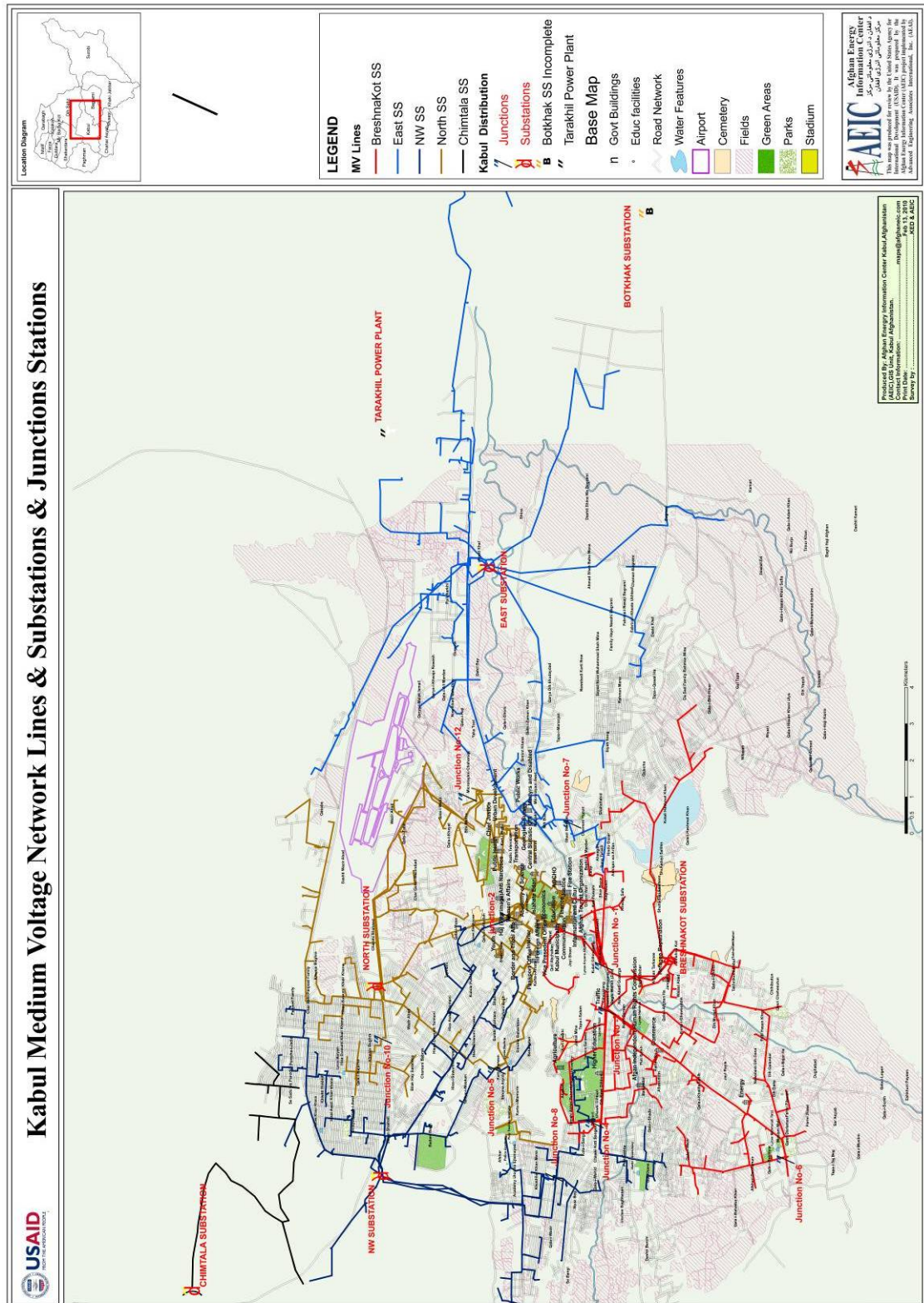


Figure 6.23: Location of Power Distribution Lines and Substations

Generating cost

The generating cost by various types of power generation in Afghanistan is shown in Table 6.35.

**Table 6.35: Comparison of Generating Costs, 2007**

No.	Generating method	Av. estimated unit price (US¢/kWh)	Remarks
1	Hydro	2.29	
2	Thermal	27.12	Kabul NW PS
3	Imported	2.62	
4	Diesel	29.53	All provinces
5	Hydro and diesel	5.19	
6	Hydro, thermal and diesel	6.47	
7	Natural gas	2.8-3.5	Based on Sheberghan
8	Coal	N/A	

Source: Energy Sector Strategy, January 2008, MEW

Electric tariff

The electric tariff revised in Oct. 2007 before fuel adjustments is shown in Table 6.36.

**Table 6.36: Electric Tariffs**

Range (kWh)		Price (Afs/kWh)				Remarks
From	To	Residential	Commercial	Industrial	Government	
0	300	1.5	---	---	---	
301	700	4.0	---	---	---	
701		6.0	---	---	---	
0 ~		---	10.0	6.0	10.0	

(Source: DABS)

2) *Consumers and demand*Consumers

The number of consumers by use category in recent years is summarized in Table 6.37. The number of residential consumers was about 94% followed by commercial (5%). The residential consumers increased by 30,000 during 2008-2009, which includes waiting customers.

From 2005 to 2009, the number of residential consumers increased by 17.2% annually. The number of residential users with access to power supply was about 250,000 in 2009, forming the electrification rate at about 51% in Kabul City, assuming nine persons per household.

**Table 6.37: Numbers of Consumers, 2005-2009**

Category of Customers	2005	2006	2007	2008	2009	Average Annual increase Rate (%)
Residential	132,976	138,599	172,297	219,700	249,566	17.2
Commercial	5,934	6,092	7,479	14,303	13,461	22.7
Government	954	973	1,341	2,599	974	0.6
Holy places	140	140	20	1,713	1,868	91.1
Industrial	-	326	367	1,570	117	-29.0
Total	140,004	146,130	181,504	239,885	265,986	32.4

Source: DABS

Table 6.38 shows more detailed information of power users with energy consumption and other major indices. The import of energy supply started from January 2010. In 2009, the imported energy was about 400GWh, or 40% of total demand, and energy losses were about 32%.

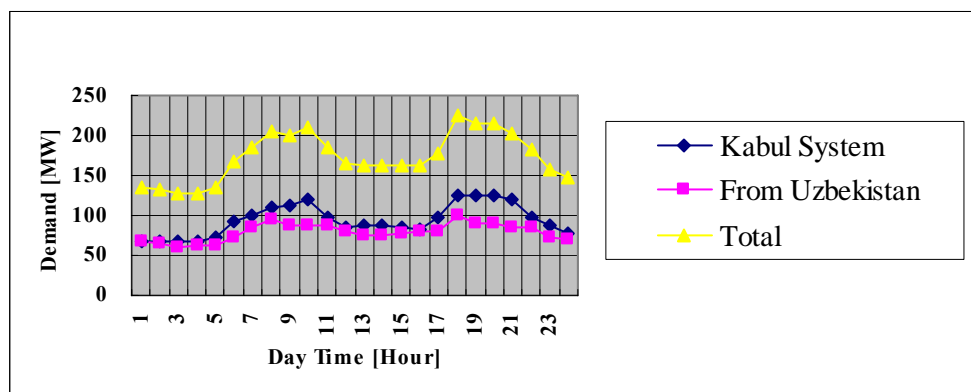
Table 6.38: Consumers and Energy Consumption, 2005-2009

No.	Description	Unit	2005 (1384)	[%]	2006 (1385)	[%]	2007 (1386)	[%]	2008 (1387)	[%]	2009 (1388)	[%]	AAIR	Remarks
<b>A: Consumers</b>														
1	Residential		132,976	95.0	138,599	94.8	172,297	94.9	219,700	91.6	249,566	93.8	17.2	
2	Commercial		5,934	5.4	6,092	4.2	7,479	5.6	14,303	6.0	13,461	5.1	22.7	
3	Government		954	0.7	973	0.7	1,341	0.7	2,599	1.1	974	0.4	0.6	
4	Holy Places		140	0.1	140	0.1	20	0.7	1,713	0.7	1,868	0.7	91.1	
5	Industry		0	0.0	326	0.2	367	0.2	1,570	0.7	117	0.0	-29.0	AAIR is from 2006.
6	Internal Use of DABS		8	0.0	10	0.0	14	0.0	14	0.0	0.0	0.0		Use at JS (No P/S & S/S)
	<b>Total</b>		<b>140,012</b>	<b>100.0</b>	<b>146,140</b>	<b>100.0</b>	<b>181,518</b>	<b>102.2</b>	<b>239,899</b>	<b>100.0</b>	<b>265,986</b>	<b>100.0</b>	<b>32.4</b>	
<b>B: Energy Consumption (MWh)</b>														
1	Residential		235,646	66.0	222,448	62.2	272,137	63.5	214,987	55.1	491,173	69.9	20.2	
2	Commercial		4,022	1.1	6,764	1.9	6,790	1.6	46,715	12.0	74,528	10.6	107.5	
3	Government		80,205	22.4	86,203	24.1	100,183	23.4	70,073	18.0	98,621	14.0	5.3	
4	Holy Places		25,143	7.0	28,713	8.0	33,420	7.8	38,656	9.9	6,750	1.0	-28.0	
5	Industry		12,189	3.4	12,998	3.6	15,315	3.6	18,841	4.8	32,036	4.6	27.3	
6	Internal Use of DABS		90	0.1	225	0.1	876	0.2	931	0.2	0.0	0.0		Use at JS
	<b>Total</b>		<b>357,295</b>	<b>100.0</b>	<b>357,351</b>	<b>100.0</b>	<b>428,721</b>	<b>100.0</b>	<b>390,203</b>	<b>100.0</b>	<b>703,108</b>	<b>100.0</b>	<b>18.5</b>	
<b>C: Average Consumption per category (kWh/Year)</b>														
1	Residential		1,772	---	1,605	---	1,579	---	979	---	1,968	---	2.7	
2	Commercial		678	---	1,110	---	908	---	3,266	---	5,537	---	69.1	
3	Government		84,072	---	88,595	---	74,708	---	26,962	---	101,254	---	4.7	
4	Holy Places		179,590	---	205,092	---	1,670,982	---	22,566	---	3,613	---	-62.3	
5	Industrial		1,523,661	---	39,872	---	41,731	---	12,001	---	273,812	---	-34.9	
6	Internal Use of DABS		11,214	---	22,478	---	62,552	---	66,513	---	0.0	---		
<b>D: Others</b>														
1	Daily use of Residential (kWh/day)				4.4	---	4.3	---	2.7	---	5.4	---	7.0	AAIR is from 2006.
2	Generated Energy (MWh)				537,933	100.0	649,074	100.0	625,712	93.3	640,005	61.6	6.0	
3	Imported Energy (MWh)				0	0.0	0	0.0	44,716	6.7	399,438	38.4	794.0	AAIR is from 2008.
4	Energy Sold (MWh)				357,126	66.4	427,845	65.9	389,662	58.1	703,108	67.6	25.3	
5	Energy Losses (MWh)				180,582	33.6	220,353	34.1	635,487	41.9	336,335	32.4	23.0	
6	Number of Residential (Houses)						440,000		469,000		490,000		18.4	Estimated by JICA Team
7	Electrification Rate (%)						39.2		46.8		50.9		22.4	AAIR is from 2007.
8	Peak Demand (MW)						167		170.5		225.0		16.0	AAIR is from 2007.
<b>Remarks:</b>														
1. AAIR: Average Annual Increasing Rate														
2. (*) means No. 3 of Naghlu HPP had been rehabilitated during 2008.														
3. Financial year is from 21 <sup>st</sup> of March to 20 <sup>th</sup> of March next year.														

Source: DABS

### Peak demand

The peak demand of 225MW recorded at 18:00 on 16th February 2010 took place under condition of the power supply from Uzbekistan, partial load sharing and some waiting consumers. Figure 6.24 shows the daily load curve on that day.



Source: MEW

**Figure 6.24: Daily Load Curve of Kabul City (Feb. 16, 2010)**

The peak demand in 2009 increased by 32% from the level of 2008 (171MW). This significant increase reflected continuous power supply from Uzbekistan and improvement of distribution system. However, there are many waiting consumers who have internal cabling facilities installed in their houses but no branch lines connected from the distribution system.

The peak demand by user category is estimated in Table 6.39. The total demand of waiting consumers was estimated to be 2MW based on load sharing schedule at the end of June 2010.

**Table 6.39: Outline of Peak Demand Composition**

Category/Hour	1:00	7:00	9:00	16:00	18:00
Residential	132.0	178.5	188.2	151.2	219.1
Commercial	1.1	3.6	3.6	3.6	3.6
Government	0.1	0.1	5.3	5.3	0.5
Holy places	1.7	1.7	1.5	1.5	1.7
Industrial	0.1	0.1	1.4	1.4	0.1
Total	135	184	200	163	225

Source: Planning Team

### Others

The electric energy consumption in the Kabul province is shown in Table 6.40. As seen from the Table, about 70% was consumed as residential use. The commercial use shows the highest average annual increase rate (107.5%).

**Table 6.40: Electric Energy Consumption: 2005-2009**

Category of Customers						(Unit: GWh)
	2005	2006	2007	2008	2009 (%)	Annual rate of increase (%)
Residential	236	222	272	215	491 (70)	20.2
Commercial	4	7	7	47	75 (11)	107.5
Government	80	86	100	70	99 (14)	5.3
Holy places	25	29	33	39	7 (1)	-28.0
Industrial	12	13	15	19	32 (4)	27.3
Total	357	357	427	390	704 (100)	18.5

Source: DABS

### (3) Power supply projects

#### 1) Ongoing power supply projects

Ongoing power supply projects related to the Kabul City are listed in Table 6.41 for power generation projects. Table 6.42 shows the transmission and distribution systems.

**Table 6.41: Ongoing Power Projects**

Project name	Specification	Total capacity (MW)	Expected completion
elagai	Hydro	60	2015, Bagram province
Upper Kokcha	Hydro	200	2020,
Kama	Hydro	45	2020, Nangarhar province
Baghdara	Hydro	180 - 380	2020, Parwan province
Surobi-II	Hydro	120 - 180	Until 2020
Gulbahar	Hydro	180	2020
Aynak TPP	Thermal (coal)	400	Until 2020 by MOM

Source: MEW

**Table 6.42: Ongoing Transmission and Substation Projects**

Description	Specification	Expected Completion
Kabul Distribution	15kV to 20kV	
MEW 300/2	District-11 and 16	By 2011
MEW 300/3	District-1 and 2	By 2011
MEW 300/4	District-1, 2, 3 and 17	By 2011
By Decom		By 2011
MEW/S-500, Lot-1	Transmission system interconnection between Chimtala and Kabul	By 2011
MEW/S-500, Lot-2	Upgrade Kabul North and North West Substations	By 2012
Dasht-e-Barch S/S	With 220kV and 20kV lines	By 2012

Source: MEW

#### 2) Planned international transmission lines

The following international transmission line routes are to be established.

- i) Uzbekistan-Afghanistan: 220kV (2 150MW)
- ii) Turkmenistan-Afghanistan: 500kV (300MW)
- ii) Tajikistan-Afghanistan: 220kV (2 150MW, from March to September, 2010)
- iv) Kyrgyzstan (after 2016)-Tajikistan (117km)-Afghanistan (562km)-Pakistan (71km): 500kV (1 1,300MW)  
The Tajikistan line to Afghanistan will be DC 500kV because of the elevation along the line route.
- v) Iran-Afghanistan-Tajikistan

### (4) Other potential energy resources

#### 1) Renewable energy in Afghanistan

Hydropower potentials were estimated to total about 18GW, and wind power potentials about 158GW. Generating cost of some of them was estimated to be around 9US¢/kWh.

## 2) *Natural gas*

Reserves are estimated to be about 3,530 billions cubic feet in 2005 at Seberghan gas field in Jawzjan province.

## 3) *Crude oil*

The total oil reserves could be as much as 270 billion barrels as estimated by the US government, and gas reserves may be between 1 and 15-20 trillion cubic feet (tcf).

## 4) *Geothermal*

Some geothermal reserves are located in the Hindu Kush mountains and the northern Heart-Panjsheer fault line, at approximately 50km from Kabul City. These reserves may be tapped for heating systems.

## 5) *Solar energy*

An average peak of daily radiation was estimated to be  $700\text{W/m}^2$  in the Kabul region. It should be noted that the Kabul area is significantly dusty.

## 6) *Waste to Energy*

This system is suitable around urban areas where large amount of solid wastes are regularly available. The power generation may be combined with a heating system which seems suitable to Kabul City. A prerequisite for this application would be dependent on the establishment of proper collection and separation system for solid wastes. This generating system may be operated by the municipality as collection and separation of wastes are responsibility of the municipality. Outline of Waste to Energy is described in Section-6.4.3.

# 6.4.2 Power and energy supply development plan

## (1) Strategy for Distribution System

The power supply for Kabul City should follow generally the power development policies and plans in Afghanistan outlined above. As part of the national power development plan, the power supply for the new urban areas may be planned by extending the existing or planned power supply network from the nearest substation. In line with the national power sector policy, however, the power supply for the Kabul city should utilize the private sector as much as possible. A separate power supply company may be established.

In line with the development and planning concepts of this master plan, use of hydraulic power plant and imported energy shall be encouraged. A public utility duct such as power, gas, telecommunication, city water, drainage systems, may be considered in the central areas of Kabul City.

In order to increase access to electricity supply and upgrade living standards, following targets may be applied to the distribution system;

- 1) Reduce energy losses of distribution lines and step-down transformers by 2015,
- 2) Improvement of systems and promotion of rural electrification by 2020, and
- 3) Establishment of reliable and secure distribution system.

## (2) Framework for distribution system planning

The main objective of distribution system plan is to prepare a plan to secure the distribution system and ensure the reliability, and also free access to the power supply. The output of the distribution system plan for Kabul City consists of the following:

- i) Demand forecast for 2015, 2020 and 2025,
- ii) Power balance for 2015, 2020 and 2025, and
- iii) Conceptual Distribution System covering the municipality.

The following parameters are used for the conceptual design:

Power demand and number of persons per household

The power demand generally increases as the income levels grow. The MEW adopted 100W per capita for all Afghanistan in 2010 and expects to grow to 150W per capita by 2025 for the residential uses. For the Kabul City, 1kW was adopted for 2015. The number of persons per household was assumed to be seven up to 2015 and six up to 2025.

Peak demand

The current peak demand is from 6 to 7 pm made by residential consumers. The peak demand will increase as the population grows, and the unit per capita demand increases along with the economic development.

Considering the peak demand of 225MW recorded in 2009 dominantly by the residential demand, the following average annual rates of increase are assumed as the peak demand:

- i) 2010-2015: 5%
- ii) 2016-2020: 3%
- iii) 2021-2025: 3%

In the future, the nature of the peak demand may change: as the economy develops, industrial and commercial demand in the daytime will become the dominant peak demand, while the peak of the residential use takes place in the night time.

Power supply points

The power supply for Kabul City will be through the existing supply network already established. Only the supply capacities for transmission and distribution with substations as well as power sources need to be increased. Especially transmission capacity between Pul-e-khumri and Chimtala 220 kV S/S shall be increased by 2015.

At district 18 and 19 area the power supply to the New City shall be also considered which is currently underdeveloped. Therefore, Dehsabz south and Paymanor S/S shall be considered serving for both Kabul City and the New City. Some new facilities have to be installed to ensure high reliability and low energy losses. To establish high reliable power supply system to Kabul City, it is proposed to install the following six new substations up to 2025:

- i) Dasht-e-Barch S/S,
- ii) Dehsabz South S/S,
- iii) Central S/S,
- iv) South East S/S, and
- v) Paymanor S/S.

Transmission lines and distribution systems

General requirement to transmission and distribution method is shown in Table 6.43. In general, overhead transmission line is adopted for high voltage lines. Part of transmission/distribution within urbanized areas may adopt underground lines. The transmission lines method from the power supply points to demand centers are recommendable to apply under ground cables and also for distribution lines with consideration of capital area.

For the new urban areas, it is recommendable to install the gas insulated switchgear (GIS) in new substations, considering the natural conditions such as heavy dust, high elevation, and seasonal changes.

**Table 6.43: Transmission and Distribution Method**

Description	Overhead	Underground and/or indoor	Note
220kV line	---	0	Gas Insulated Switchgear (GIS)
220/20kV S/S	---	0	
110kV line	---	0	
110/20kV S/S	---	0	GIS
20kV line	---	0	
400/220V	0	0	

#### Substation facilities

Transformers shall be of low loss type and all electrical facilities such as street lightings shall be of energy saving types. Heat-pump for air conditioning shall be applied for the substation buildings. Communication systems shall adopt minimum three methods such as OPGW on 110/220 kV transmission lines, telephone and micro-wave systems.

The power supply systems for the city consists of a transmission system with double transmission lines and dual bus-bar with back-up (50%) power supply feeders to neighboring substations, and a distribution system with junction stations having ring connections.

### **(3) Demand forecast**

#### Recorded peak demand

The recorded peak demands were 167 MW, 171 MW and 225 MW in 2007, 2008 and 2009 respectively. The average annual increasing rate was about 17%, reflecting the recent improvement in supply and distribution systems.

#### Latent demand

There exists latent demand as the load sharing is practiced. Also there are some waiting customers, for which the total demand was about 29MW in 2009 according to the MEW's estimation. There are many power consumers, especially industrial ones, having their own generating facilities, totaling 10MW of generating capacity in 2009 (MEW). They would rely exclusively on the grid power once the supply conditions such as supply reliability and stable voltage are improved. Thus, it is safe to assume that some of these also constitute the latent demand.

The total demand of the waiting customers is assumed to be 10MW for 2010 and 5MW for 2011, as the load sharing caused by inadequate line size and private DEG sets will be connect to the Kabul system.

#### Residential demand

The number of residential customers having access to power supply was about 250,000 as of 2009. Some waiting consumers are to be connected within 2010. The new residential demand in Kabul province was assumed to be about 30,000 per annum and they may be connected to the Kabul system. The peak demand was assumed to be generated by the residential use for the time being, as it recorded in the evening time. It is assumed that the new residential consumers of 30,000 per



annum may be connected to the Kabul system by 2015. Also it is assumed that the number of persons per house is nine up to 2015, and 8.5 and 8.0 up to 2020 and 2025 respectively.

#### Demand projection

The power demand will increase as the income levels increase and also as the supply reliability improves. For Kabul City, about 70, 90 and 97% service coverage is expected by 2015, 2020 and 2025 respectively. By applying the population framework for Kabul City, the total domestic demand was projected to reach 512MW by 2025.

The power demand for industrial, commercial and public uses is roughly estimated based on the economic structure and planned distribution of various economic activities in the city. The unit power demand was set to be 2 MVA/km<sup>2</sup> of the land area in 2025.

The peak demand of Kabul province will reach more than 380 MW in 2015 with average increasing rate of 5%. Demand forecast for Kabul City is shown in Table 6.44.

The MEW conducted the Kabul City Medium Voltage (MV) and Low Voltage (LV) Distribution System Assessment Study in 2007. This study need to be updated because of the significant change in the current distribution system.

Table 6.44: Demand Forecast for Kabul City, 2007-2025

No.	Description	[Unit]	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	Remarks
A:	Increasing Rate	[%]		2.0	31.6	5	5	5	5	5	5	3	3	For Kabul city
B:	Demand	[MW]			*1									For New City
1	Kabul City		167	171	225	268	292	311	330	353	383	443	514	
2	New City							3	6	12	23	37	60	
3	Waiting Consumers		4	54	30	10	5							
	Total		171	225	255	278	297	314	336	364	406	481	574	
C:	Population for NCRK (National Capital Region of Kabul)													
1	Population	[Thousand]												
1)	Kabul City			4,221	4,407	4,596	4,789	4,939	5,090	5,241	5,392	5,921	6,271	
2)	New City							46	95	146	200	721	1,428	
	Total		3,562	4,221	4,407	4,596	4,789	4,985	5,185	5,387	5,592	6,642	7,699	
D:	Population of Kabul City													
1	Population	[Person]		4,221,000	4,407,000	4,596,000	4,789,000	4,939,000	5,090,000	5,241,000	5,392,000	5,921,000	6,271,000	
E:	Analysis (Residential)													
1	Family Member	[Head/House]	9	9	9	9	9	9	9	9	9	8.5	8.0	
2	No. of House	[House]	440,000	469,000	490,000	511,000	532,000	554,000	576,000	599,000	621,000	781,000	962,000	
3	Electrified	[House]	172,297	219,700	249,566	280,000	310,000	340,000	370,000	400,000	430,000	680,000	930,000	
4	Electrification Rate	[%]	39.2	46.8	50.9	54.8	58.3	61.4	64.2	66.8	69.2	87.1	96.7	
5	Consumption per day													
1)	Per Person	[Wh/Head]	481	490	645	678	712	747	784	824	865	1,104	1,409	
2)	Per House	[Wh/House]	4,327	4,414	5,809	6,099	6,404	6,724	7,060	7,413	7,784	9,383	11,271	
F:	Waiting Residential	[House]	1,000	20,000	10,000	2,000								
G:	New Residential	[House]		10,000	20,000	28,000	30,000	30,000	30,000	30,000	250,000	250,000		
	Remarks:													
	*1: Including Charikar area (Parwan Province)													

Source: Planning Team

#### (4) Power Balance

The demand and supply balance of electricity in Kabul City will have a close relationship to that of the new city which covers district 18 and 19. Therefore, power balance of Kabul City shall have to be taken into consideration of the New City.

Power sources can be categorized into three categories as follows;

1) Power stations in Kabul Province:

The existing five power stations are connected to the Kabul system. However, only Naghlu and Surobi-1 can operate continuously, with total capacity of 122MW. Other power stations can be operated seasonally or for the peak operations because of the shortage of water or the high price of fuel. For the planning purpose, it is assumed that these power stations will generate 30% of their designed capacity by the partial and emergency operations.

2) Power supply by 220kV transmission lines:

The Kelagai hydro power plant in Baghlan province is expected to start operation by 2015 with 60 MW of generating capacity. Generated energy by other P/Ss located in other provinces including Kelagai HPP will be supplied by 220 kV transmission lines connected from Pul-e-khumri to Chimtala S/S, which are double circuits and 400 MW of transmission capacity. It is assumed that 50% of generated energy in other provinces can be available for Kabul City.

3) International connection:

Power from three neighbor countries will be connected to Kabul city as follows:

Uzbekistan:

No. 1 line is under operation with 150MW. The No. 2 line is expected to start operating by 2012. This power is conveyed via Naibabad, Pul-e-Khumri S/S, and Chimtala S/S.

Tajikistan:

Expected to operate 150MW by 2011 and another 150 MW by 2015. This power is conveyed via Kunduz, Pul-e-Khumri S/S, and Chimtala S/S

Turkmenistan:

Expected to operate 300MW by 2012. This power will be conveyed via Sheberghan, Naibabad S/S, and Chimtala S/S through Pul-e-Khumri. It is assumed that 70% of the total imported power can be available for Kabul city.

The development of power supply capacity is determined following the implementation schedule of the on-going and planned projects mentioned above. Of the power generated by new plants and transmitted by planned international connections of transmission lines, only 50-70% is assumed for use of Kabul City. Distribution losses which may be decreasing are neglected. Based on these conditions and assumptions, the power balance is planned as shown in Table 6.45.

**Table 6.45: Power Balance for Kabul City**

Description	(Unit: MW)			
	2009	2015	2020	2025
1. Peak demand	254	363	462	600
2. Power supply				
a) Power plants	175	217	725	725
b) Transmission lines	104	630	630	630
Subtotal	279	847	1,355	1,355
Power balance	+25	+484	+893	+755

Source: Planning Team

Detail of power balance is shown in Table 6.46. As seen from Table 6.46, no power shortage will happen once the power transmission lines from neighboring countries are connected to the system. However it shall be remarkable that those power supplies depend on the capacity of 220 kV transmission lines connected between Chintala S/S and Pul-e-Khumri S/S. That is, if this 220 kV transmission line has shut down, then terrible power crisis will happen in the Capital.

**Table 6.46: Power Balance for Kabul City, 2007-2025**

No.	Description	[Unit]	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025	Remarks
A:	Increasing Rate	[%]		2.0	31.6	5	5	5	5	5	5	3	3	For Kabul City
B:	Peak Demand	[MW]			*3				100	100	100	10	10	For New City
1	Kabul City		167	171	225	268	292	311	330	353	383	443	514	Up to 2014: including demand for new city
2	New City							3	6	12	23	37	60	Including demand for 26 Delwa Project
3	Waiting Consumer		4	54	30	10	5							Assumed by MEW
	<b>Total</b>		<b>171</b>	<b>225</b>	<b>255</b>	<b>278</b>	<b>297</b>	<b>314</b>	<b>336</b>	<b>364</b>	<b>406</b>	<b>481</b>	<b>574</b>	
C:	Power Supply System	Rated												
C1:	Power Station	Output												
C11	Kabul System	[MW]												
	1. Naghlu	100	100	100	100	100	100	100	100	100	100	100	100	
	2. Surobi-1	25	22	22	22	22	22	22	22	22	22	22	22	
	3. Mahipar	66	33	33	33	33	33	33	33	33	33	33	33	Partial Ope.: from Dec. to Feb. at 50 % output
	4. Kabul North West GTG	45	45	45	45	45	45	45	45	45	45	45	45	Emergency Operation. Studying CCGT
	5. New GTG in NW	50				40	40	40	40	40	40	40	40	Emergency Operation.
	6. Tarakhil (DEG)	105			100	100	100	100	100	100	100	100	100	Emergency Operation.
	7. Surobi-2	180										180	180	(between 90 to 210 MW)
	<b>Sub-total</b>		571	200	200	300	340	340	340	340	340	520	520	
C12	Other System (*1)	[MW]												
	1. Kelagai HPP	60									60	60	60	Multipurpose dam, Baghlan Prov.
	2. Upper Kokcha HPP	200										200	200	
	3. Kama HPP	45										45	45	Multipurpose dam, Nangarhar Prov.
	4. Aynak TPP	200										200	200	(by MOM)
	5. Baghdara HPP	180										180	180	(between 180 to 360 MW)
	6. Gulbahar HPP	30										30	30	Multipurpose dam (between 30 to 120 MW)
	<b>Sub-total</b>		715	0	0	0	0	0	0	0	60	715	715	
C2:	Transmission Lines	[MW]												International Connections
	1. Uzbekistan to Naibabad-1	150		67	130	150	150	150	150	150	150	150	150	
	2. Uzbekistan to Naibabad-2	150						150	150	150	150	150	150	
	3. Tajikistan to Pul-e-Khumri-1	150					150	150	150	150	150	150	150	
	4. Tajikistan to Pul-e-Khumri-2	150									150	150	150	
	5. Turkmenistan to Naibabad-1	150						150	150	150	150	150	150	Receiving from March to September
	6. Turkmenistan to Naibabad-2	150						150	150	150	150	150	150	Receiving from March to September
	<b>Sub-total</b>			67	130	150	300	750	750	750	900	900	900	
D:	Power Balance (Not including Emergency and seasonal operation units)													
D1	Available power to Kabul city	[MW]												
	1. By Kabul System			145	175	187	187	187	187	187	217	725	725	Including 30% of peak/emergency operation P/S
	2. By Transmissions (*2)			40	104	105	210	525	525	525	630	630	630	*4
	<b>Sub-total</b>			185	279	292	397	712	712	712	847	1,355	1,355	
D2	Power Balance	[MW]												
	<b>Item (D1) - Item (B)</b>			<b>-39</b>	<b>24</b>	<b>15</b>	<b>101</b>	<b>398</b>	<b>377</b>	<b>348</b>	<b>442</b>	<b>874</b>	<b>781</b>	
	Remarks:	*1: Assumed that Kabul city can receive 50 % of power supply from other power stations located outside of Kabul system. *2: Assumed that Kabul city can receive 70 % of imported energy from International connections. *3: Including Charikar area (Parwan Province) *4: 220kV transmission lines capacity from Pul-e-Khumri to Chintala S/S shall be increased by 2015.												

Source: Planning Team

## (5) Power Supply Plan

### 1) Proposed distribution system

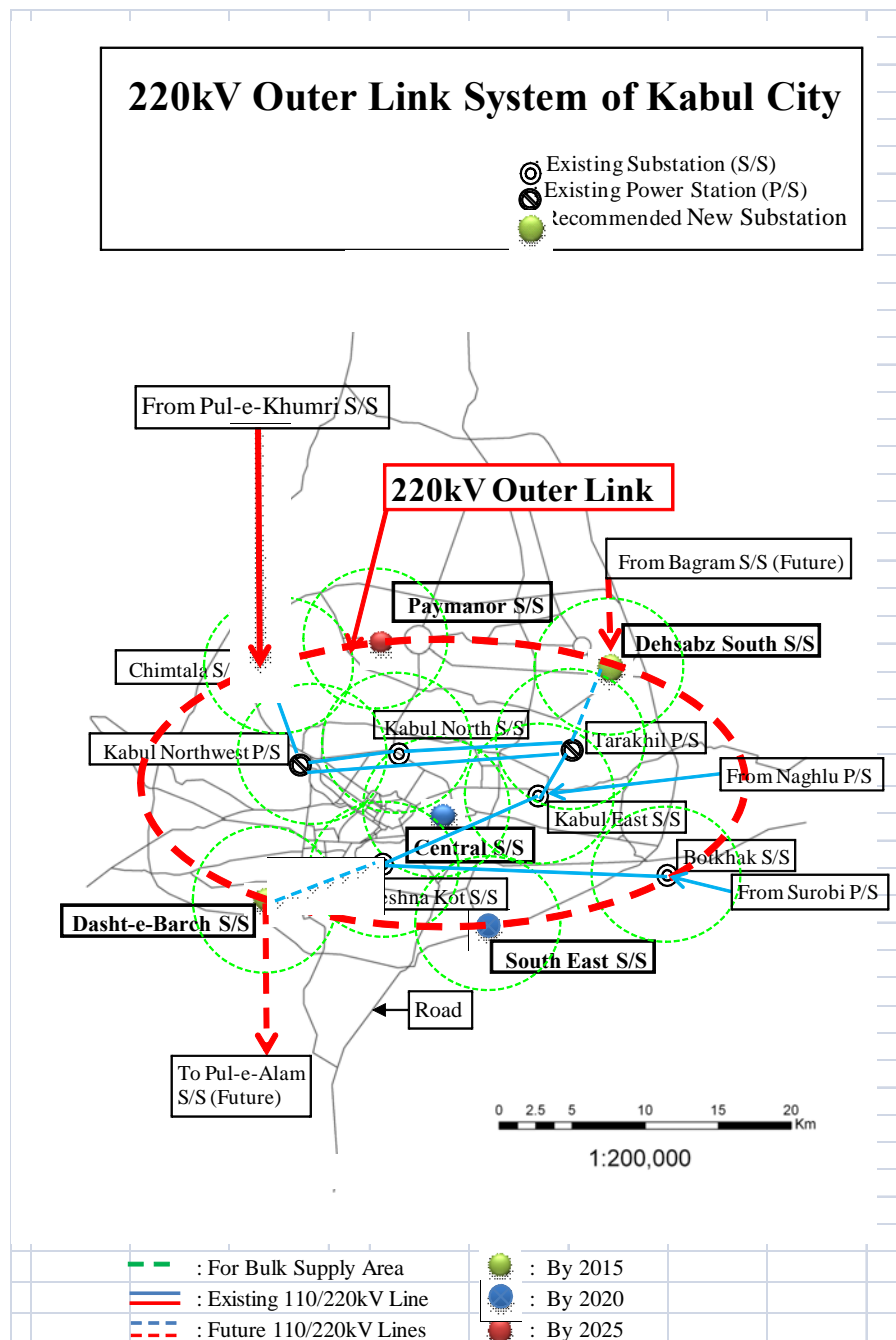
The power supply system to Kabul city has to take new urban development areas taken into consideration. The trunk substations need to be placed at the center of load as much as possible. A conceptual power supply system for Kabul City was prepared reviewing the distribution system analysis conducted in 2007 and other related studies by MEW, in order to enhance the level of reliability.

A conceptual location map of S/Ss and P/Ss for Kabul City is illustrated in Figure 6.25 with coverage area of 20 kV bulk power supply. It is proposed that the 220 kV outer and 110 kV inner link systems are to be established at an early stage to establish a reliable and secure power supply to the capital of Afghanistan. It should be noted that the Dasht-e-Barch S/S is gateway to

Pul-e-Alam S/S which is located in Logar Province and Botkhak S/S shall be connected to Jalalabad S/S in Laghman Province.

Major components of the proposed system to be implemented in each phase are as follows:

- i) By 2015: Construction of the Dasht-e-Barch and Dehsabz South S/S with 20/0.4kV distribution network
- ii) By 2020: Construction of the South East and Central S/S with 20/0.4kV distribution network
- iii) By 2025: Construction of the Paymanor S/S and expansion of Botkhak S/S for the completion of 220kV outer link with 20/0.4kV distribution network



Source: Planning Team

**Figure 6.25: Conceptual Location Map of S/S and P/S for Kabul City**

## 2) System and other requirements

### System requirements

Dehsabz and Paymanor S/Ss are planned to be the 220 kV system to meet the demand generated by the new city, while seeking smaller energy losses. The Central, the South West and the South East S/Ss may be the 110 kV system corresponding to the existing transmission systems. All the new 220 kV S/Ss are expected to be designed as the underground composite cable for the SCADA and for telecommunication systems as well.

For the 220 kV S/Ss are planned to be the double bus-bar system and/or 1.5 CB configuration to ensure reliable system. The bus-tie system is expected to be applied for 20 kV main SWGR with enough spare feeders.

In order to establish secure and reliable distribution system, link and/or loop system shall be established not only for 110/220 kV but also for 20 kV systems with adequate Junction Stations. These junction stations need to be designed considering coverage areas and reducing energy losses with analysis of power flow. Also the remote operation by SCADA should be taken into consideration.

### Other requirements

The central S/S has to be constructed underground at a park area because of the limitation of available land area. Equipment of all new S/Ss' shall be installed inside the buildings as much as possible to match circumstances such as dust, limited available space, easier maintenance and safety purposes.

Design standards need to be established for easier operation and maintenance also. It is desirable that these building facilities adopt an energy saving technologies such as heat-pumping system and the light emitting diode (LED) lightings.

The number of 20 kV feeders in a junction station needs to be at least 10 for a block to cope with the future expansion. The underground cable system shall be applied as much as possible. The following points shall be taking into consideration.

- i) A loop system shall be applied for load transfer with adequate section points on the link to minimize the distribution losses and establish reliable power supply.
- ii) Loads among feeders should be balanced and power factor shall be more than 0.85 as much as possible.
- iii) Conductor size should be standardized with specifications.
- iv) The capacity of interconnection lines may be determined for 66% load as normal peak load considering emergency power supply.
- v) Priority feeders should be considered for load shedding at substation side in case of emergency.

### **6.4.3 Key projects for power supply**

As the basic power supply system established, the most critical issue of the power supply system to Kabul City is to develop stable power distribution system. The key to this is to construct four S/Ss, by which possibility of accidental power down can be reduced. Cost and schedule of implementing these S/Ss are summarized in Table 6.47. It should be noted that construction of Dasht-e-Barch S/S is not included in the table as the S/S is already under construction.

**Table 6.47: Outline of Key Sub-stations for Power Distribution**

No.	Name	Expected Completion	Remarks
1.	Dehsabz South S/S	2015	D19
2.	Central S/S	2020	D1 or D2
3.	South East S/S	2020	D8
4.	Paymanor S/S	2025	

Note: Sub-stations which simply converts 220 kV outer lines and additional installation are not included  
Facilities for 20 kV distribution system are excluded

#### **6.4.4 Development of other sources of energy**

##### **(1) Renewable energy**

Hydropower potentials in Afghanistan are estimated to total about 18 GW, and wind power potentials about 158 GW. Generating costs of some of them are estimated to be around US¢ 9 /kWh. Wind power generation may not be suitable for installation near residential areas because of noise pollution, unless the latest technology of facilities with little noise is introduced. An average radiation of solar energy is estimated to be 700 W/m<sup>2</sup> in the Kabul region, which is smaller than in other regions.

##### **(2) Power generation by solid wastes**

This system is suitable for urban areas, where large amount of solid waste is regularly generated. The power generation may be combined with a heating system. A prerequisite for this application would be the establishment of proper collection and separation system for solid wastes. A possible scheme is shown in the Box below.

### Box: Waste to Energy

#### 1. System outline

A waste to energy generation is a kind of thermal power generation by utilizing solid wastes as fuels. The steam to be generated by solid wastes combustion is converted by turbine into electricity. The type of incinerator with a boiler should be selected according to the composition of the wastes. The environmental conditions should be satisfies for the following:

- (1) Exhaust gas contents with fly ash such as toxic gas, dioxin, etc.
- (2) Bottom ash such as heavy metals, dioxin, etc.

#### 2. Main components

The waste to energy system consists mainly of the following components:

- 1) Waste receiving facilities
- 2) Incineration facilities
- 3) Flue gas cooling facilities including waste heat boiler and ancillary equipment
- 4) Flue gas cleaning facilities
- 5) Draft facilities
- 6) Heat utilization facilities such as steam turbine and generator
- 7) Ash treatment facilities
- 8) Waste treatment facilities
- 9) Mechanical and electrical auxiliary systems

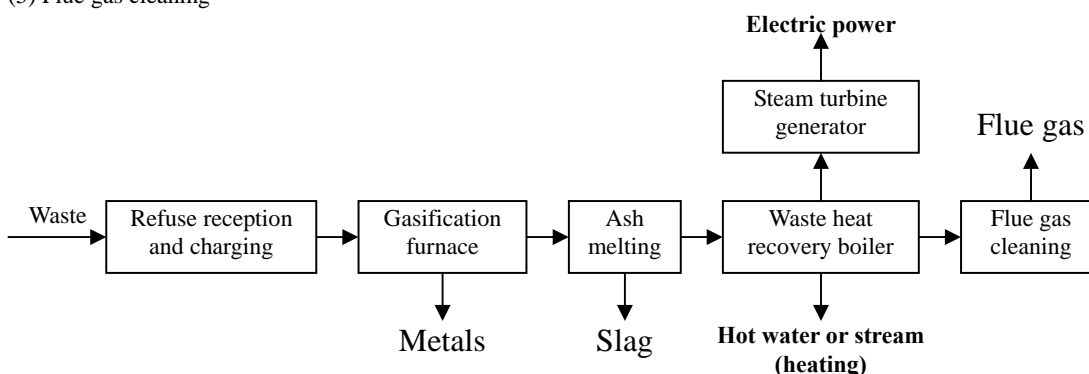
#### 3. Basic conditions for implementation

In order to operate this system smoothly, an adequate solid waste separation system should be established. The success and failure of this separation system depends on the understanding and cooperation of residents. Treatment of possible adverse environmental effects is another essential condition for the successful introduction of the system. Recently, a gasification-melting furnace system is applied to realize proper treatment of dioxin.

#### 4. Outline of gasification system

The system component as shown in the Figure below consists of the following major facilities.

- (1) Refuse reception and storage
- (2) Gasification
- (3) Ash melting
- (4) Waste heat recovery boiler
- (5) Flue gas cleaning



Refuse is automatically charged into the gasification furnace and changed to combustible gas. The gas and carbon powder from the gasification furnace are fed to ash melting furnace and are burned at high temperature of around 1,300 C. Ash in the refuse is melted by high temperature combustion gas and is recovered as molten slag in the ash-melting furnace. Waste heat of the flue gas is recovered as steam by the waste heat recovery boiler (WHRB) and electric power is generated by the steam turbine generator.

The flue gas after the WHRB is clarified by the gas cleaning facility and is emitted to atmosphere. Most dust collected by the gas cleaning facility is fed back to ash melting furnace and is re-melted.

This system, for which preferable combustion temperature is over 900C, should be operated continuously to minimize the emission of dioxin and other toxins, and periodical monitoring to fly and bottom ashes should be conducted.



## 6.5 Telecommunication and ICT

### 6.5.1 Existing conditions

#### (1) Administration and major private service providers

Currently there are five national telecommunication service providers operating in Afghanistan. One is a government organization called Afghan Telecomm managed by the Ministry of Communications and other four are private companies operating under the license from the Afghanistan Telecommunication Regulatory Authority (ATRA).

The Afghan Telecom was established in 2005 as a fixed and CDMA telecom operator. From the year 2005 to 2006, licenses have been issued to three local fix line service providers. There are four GSM companies and 20 internet service providers in operation at present.

The Ministry of Communications (MoC) is the responsible authority for national telecommunications activities in Afghanistan. ATRA is the only regulatory authority for the management, supervision and control of the governmental and private companies in Afghanistan.

#### (2) Existing Telecommunication systems in Afghanistan

##### International connection system

A 3600km national optical fiber network is being laid along national highways of Afghanistan in the form of a ring (Figure 6.26). The country is already connected to Tajikistan, Iran and Pakistan as well as to other international optical fiber routes such as TAE, SEWEME. This network will link Central and South Asian countries. Implementation of 3100km optical fiber cable is in progress covering 16 provinces in the ring. This will enhance connection to the neighboring countries of Uzbekistan, Tajikistan, Turkmenistan and two links with Pakistan.

In Kabul city, only satellite links can be used as the international gateway at present. Some private mobile networks have their own international gateways through satellite links.

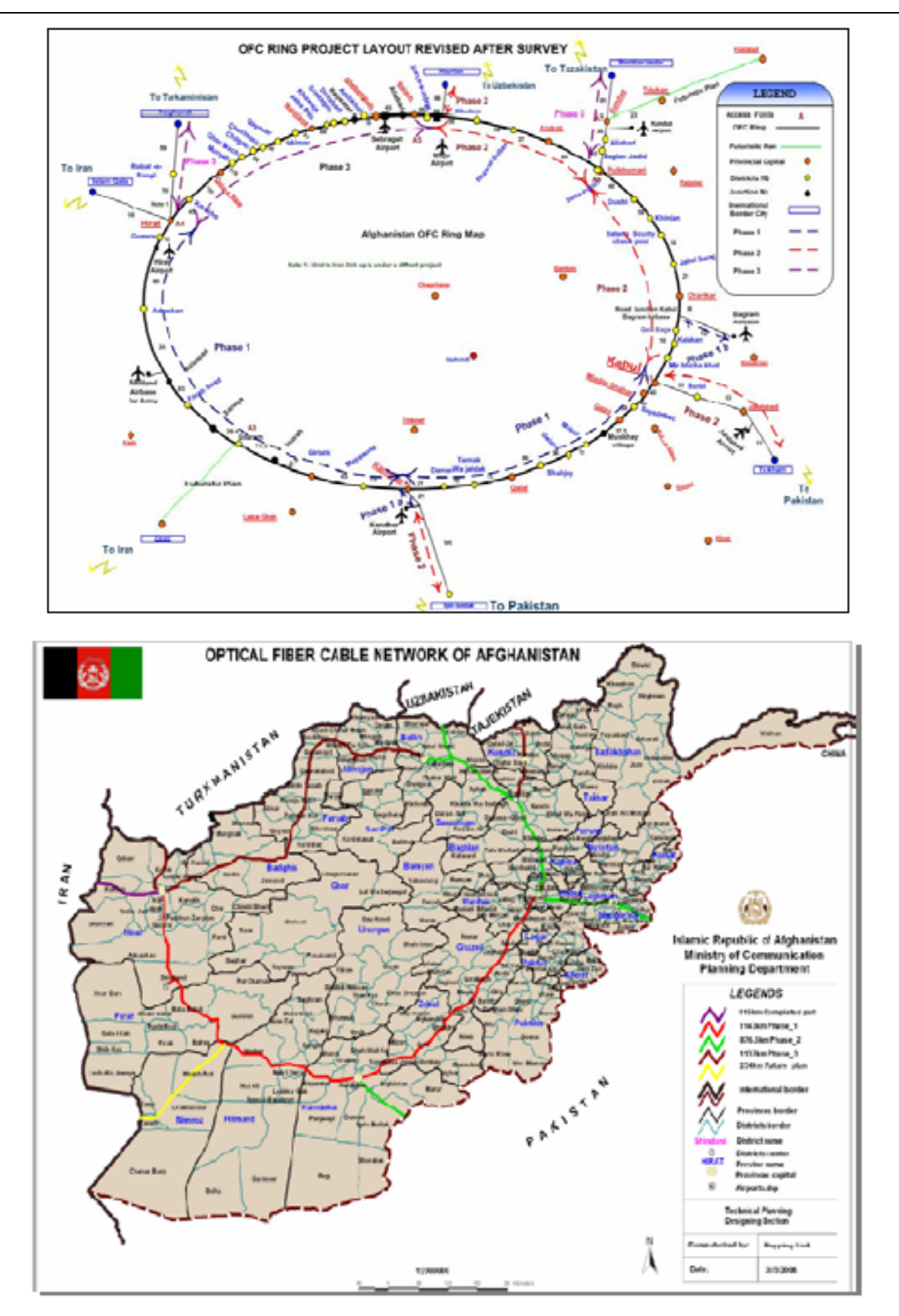
##### Donor supports

MCIT has been working extensively with both the donor community and the private sector since 2002. The primary donor relationship has been with USAID and the World Bank, but there have also been projects and activities supported by the ITU, UNDP, JICA and the Governments of China, India, Iran and Korea. The list of private sector partners is even more extensive. The primary ones include the four nationwide mobile licensees (Areeba, AWCC, Etisalat and Roshan), as well as GSI, Motorola, Samsung, Huawei and ZTE.

Furthermore, the private sector “window” of the international financial institutions is also very active:

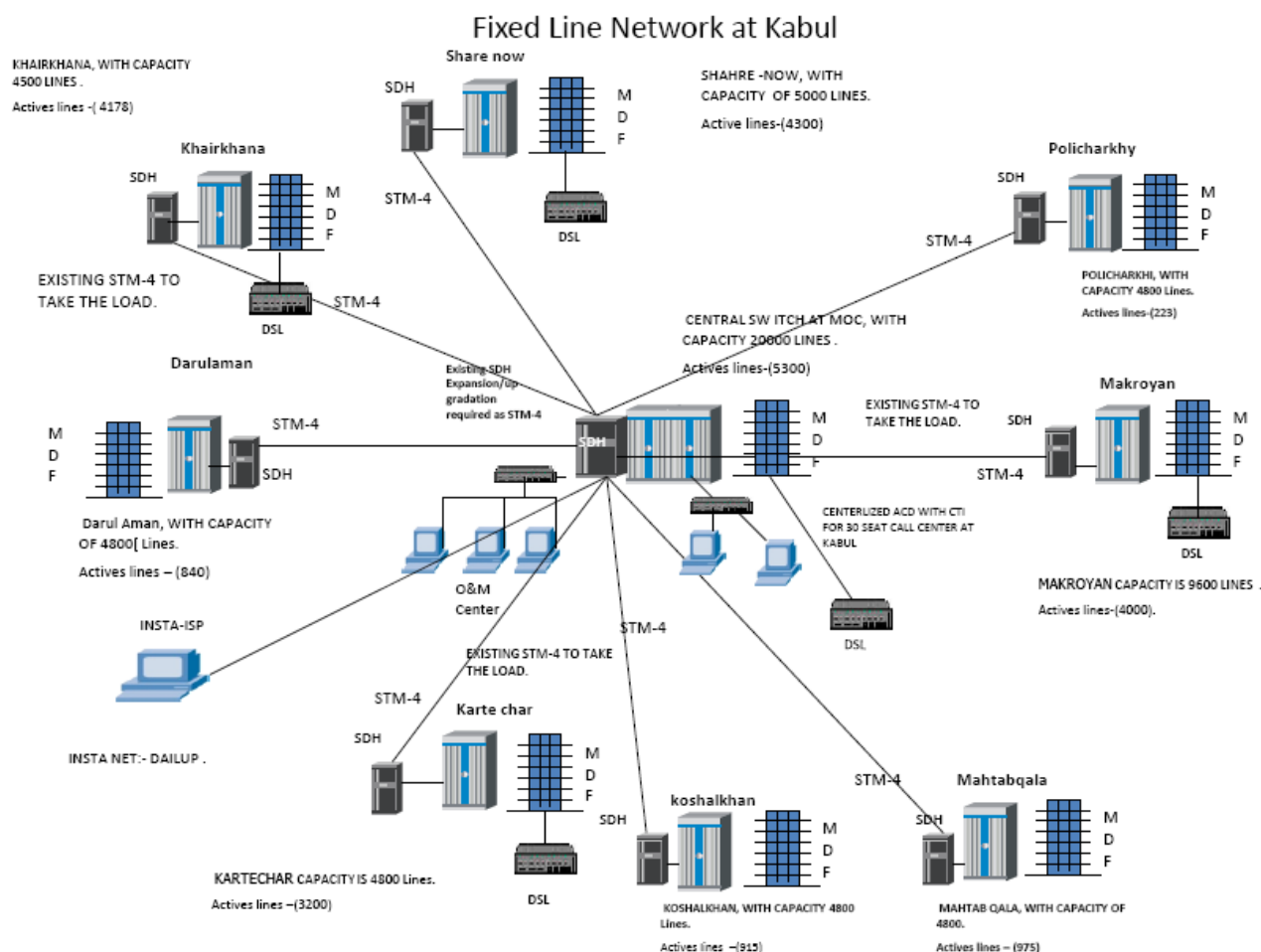
- Asian Development Bank (lending US\$75 million to Roshan)
- International Finance Corporation (lending US\$40 million to Areeba)

If aid effectiveness is measured on the basis of return on investment, the role of the donors in the rapid development of the ICT in Afghanistan can be deemed exceptionally high.



### (3) Existing telecommunication systems and services in Kabul city

There are nine telephone exchanges located in the municipality area. Figure 6.27 shows the typical exchange link in the city. Details of these exchanges are summarized in Table 6.48.



**Figure 6.27: Fixed Line Network in Kabul Area**

**Table 6.48: Exchange Capacities**

No	Exchange Name	MDF Cap.	Primary Cap.	Secondary Cap.	Number of Manhole	Switch Capacity	Active Lines
1	Karte Char	15,000	18,500	23,000	50	4,800	3,200
2	Darolaman	4,000	4,800	6,000	29	4,800	840
3	Mahtab Qala	5,000	6,000	7,500	30	4,800	975
4	Khoshal Mina	10,000	12,000	15,000	33	4,800	915
5	Makrooyan	10,000	13,500	16,500	51	9,600	4,000
6	Pole Charkhi	2,000	2,400	3,000	22	4,800	223
7	Share naw	10,500	12,600	15,750	43	5,000	4,300
8	Taimani	8,500	10,200	12,750	34	3,300 *	
9	Markaz	15,000	18,000	22,500	40	20,000	5,300
10	Khair Kahan	18,000	21,600	27,000	70	4,500	4,178
11	Karte naw	4,000	4,800	6,000	22	0 *	
Total		102,000	124,400	155,000	424	66,400	23,931

Note: \* mark shows Taimani and Kartenaw exchanges are under consideration and capacity could be about 3,300 (combined). Locations of those exchanges (Taimani & Karte naw) have not concluded yet.

Source: MCIT

All are of digital exchanges and are connected with the central exchange via optical fiber as a shape of star link. Two FOC loops are formulated and another one is under construction. The type of

services provided by these exchanges are voice, facsimile and internet related. The boundaries, cable/duct routes and location of those exchanges are shown in Figure 6.28.

At present, the Afghan Telecom is the only provider of fixed basic telephony. The Afghan Telecom operates telephone and fax services, and will soon offer internet services, based on a mix of land-line and CDM-based wireless local loop networks being deployed in all provincial capitals. The existing services are offered on a post-paid basis, but pre-paid services will be introduced later in 2005. CDMA-based services are offered on a limited-mobility basis, thus the customers can make calls only within the cell his address falls in.

**Figure 6.28: Existing Exchange boundaries and existing Cable / duct routes in Kabul Area**

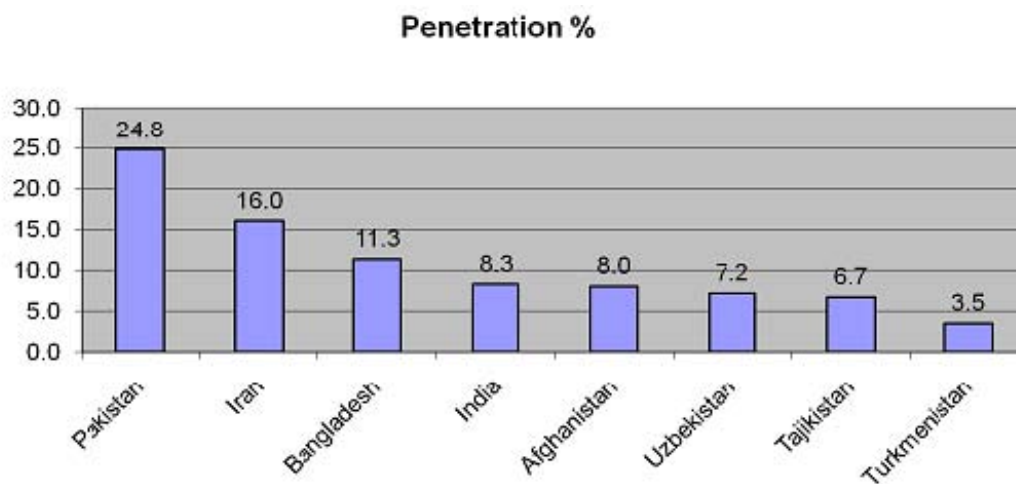
Based on the present available data the study concluded the following to achieve the targeted objectives stipulated in ANDS.

**Table 6.49: Projected Demand in Kabul City including New City**

Year	GRDP	Population (Mil)	No.of DEL / 100	Total Demand
2010	258	4.22	164,168	1,084,899
2015	505	5.59	268,933	1,162,398
2020	752	6.64	355,913	1,238,837
2025	999	7.69	442,628	1,338,761

It is understood that there is a gap of 929,899 in demands at present. The future development in sub-urban areas such as Districts 14, 21 and 22 were not included in the existing network. Thus a substantial gap of supply and demands exists. From the urban development project the future demands will come up and to be catered for.

Based on 2006 year's data, telecom network digitalization in Afghanistan was compared with Regional neighbors and shown as below.

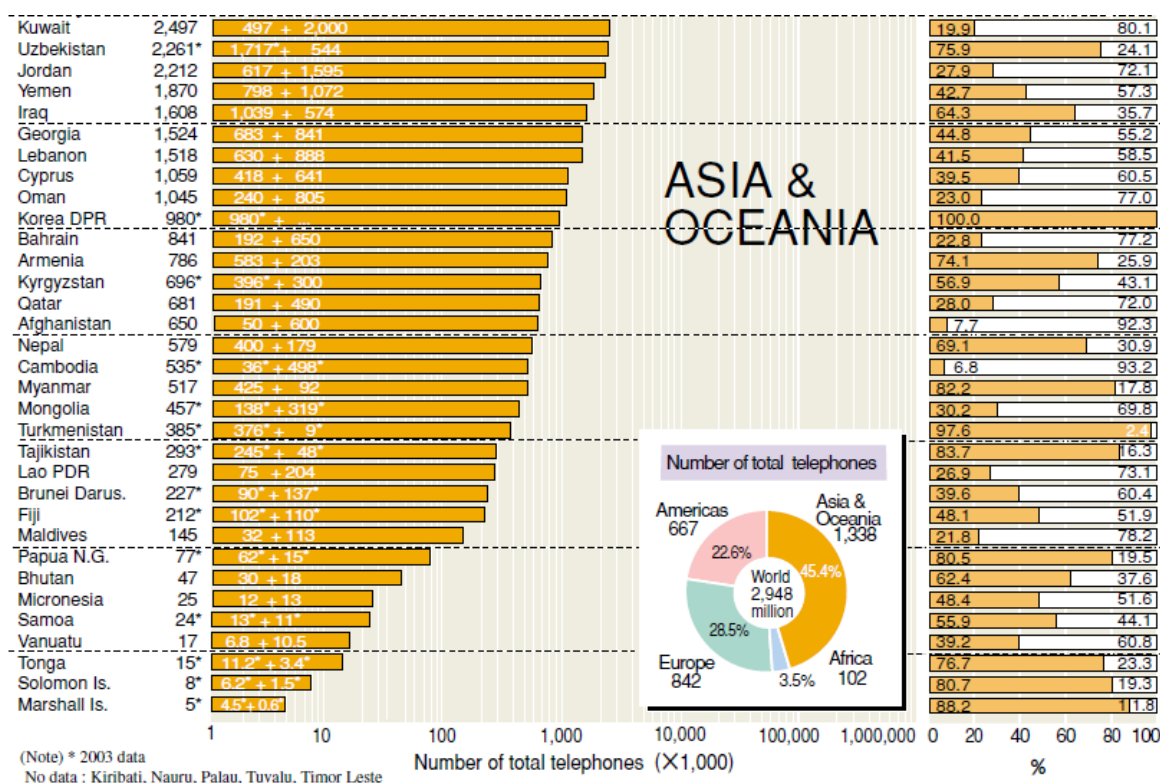


Source: MCIT

**Figure 6.29: Comparison with Neighboring Countries**

The following statistical data are also taken into consideration to make demand forecast for future growth of Kabul area.





Source: International Telecommunication Union, 2010. Updated on 18 June 2010.

**Figure 6.30: Global Telephone Indices**

## (5) Existing Policies and ongoing projects

### 1) Afghanistan National Development Strategy (ANDS)

The ANDS stipulates the followings targets as the ICT sector. The strategy carries forward two elements that were adopted in the Interim ANDS (I-ANDS) with adding up the third as follows:

- Telecom access to 80% geographic coverage of populated areas by 2010, ensuring equitable access to most of the population, including women
- US\$100 million revenue contribution to treasury by 2010
- Transforming Afghan society into information based society by 2013

The approach taken to achieve the first target is wireless service. From July 2003 to July 2007, the total number of mobile subscribers has grown from 1,800 to over 4 million and from 6 to over 250 urban areas. Afghanistan now has five nationwide mobile service providers plus three regional licensees. Competitive incentives will continue to spur the expansion of access to ever more remote areas. For the next five years, MoC policies, working through the ATRA will also deploy satellite solutions to the less populated areas where personal mobile is too costly. The current program is to reach at least 3000 villages by 2010. Plans are also underway to issue new licenses for the provision of fixed wireless access for broadband internet.

The second target has been materialized by the Ministry of Finance. The ICT sector is already the most heavily taxed, primarily because it is comprised of the largest law-abiding enterprises in Afghanistan, and therefore an easy target for collections. As more licensees enter the legitimate market, greater care should be given to reduce the burden on the sector. A World Bank study is being prepared which will provide guidance to the ICT Council, and ultimately the cabinet, on improving the tax regime to avoid placing an unfair burden on this.

## 2) Other plans and policies

The ICT Policy by MoC containing objectives, policies and action plans, aims at building a society fully benefiting from ICT. In view of this, a nation-wide ICT infrastructure will be developed to ensure that information can be used by citizens to facilitate their endeavors and enhance democratic values for sustainable human development. The following three objectives are central to the vision of the National ICT policy:

### Network Access

The universal access at reasonable cost to ICT networks will be an important factor in prompting employment, economic growth and social well-being. In the Telecommunication and Internet Policy Paper, the government has declared that it is a fundamental right of all citizens to have access to diverse means of communication.

Although it has to be acknowledged that this is a very long-term objective, the government will support all immediate steps to meet its ultimate goal. The regulatory commission shall develop specific indicators of ICT access, and shall identify targets for moving toward universal access nationwide within an achievable time frame.

### Information and knowledge access

Just as there should be universal access to the network, so should there be universal access to information and knowledge. In the knowledge economy, success will depend on learning new and more efficient ways to gain access to a variety of information and knowledge-based resources. In the same vein lifelong learning will become imperative in a society where individuals must cope with ever-present change. ICT will become the medium that provide Afghans in all parts of the country the opportunity to acquire knowledge and skills.

### Government Use of ICT

The role of government as a model user of ICT is significant to the successful broadening of ICT applications. The government has already begun to use ICT to modernize and improve the way it operates by the implementation of the Afghanistan Information Management System for information management and donor tracking. Significant savings and improved quality of service may be possible for the government through use of ICT. The government must find best practice solutions in delivering e-government programs and services to spur the growth of ICT and national development. The strategic use of public ICT procurement can stimulate development and innovation.

Keeping in mind to achieve the ICT infrastructure objectives and policies in Kabul area, a reference of global telecom indicators at 2009 is presented in Table 6.50.

**Table 6.50: Global Telecom Indicators for World Telecommunication Services**

Year	Number (million)					Per 100 inhabitants				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Fixed telephone lines										
Developed	570	565	547	534	527	46.9	46.3	44.6	43.5	42.7
Developing	689	715	725	717	692	13	13.3	13.3	12.9	12.3
World	1'259	1'280	1'272	1'251	1'219	19.3	19.4	19	18.5	17.8
Mobile cellular subscriptions										
Developed	1'001	1'139	1'255	1'341	1'422	82.3	93.4	102.5	109.1	115.3
Developing	1'216	1'615	2'102	2'696	3'251	22.9	30	38.5	48.7	57.9
World	2'217	2'755	3'358	4'037	4'673	33.9	41.7	50.2	59.6	68.2
Mobile broadband subscriptions										
Developed	57	132	238	341	491	4.6	10.8	19.4	27.8	39.9
Developing	16	27	53	103	176	0.3	0.5	1	1.9	3.1



Year	Number (million)					Per 100 inhabitants				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
World	73	159	291	444	667	1.1	2.4	4.2	6.6	9.7
Estimated Internet users										
Developed	620	654	718	768	822	51	53.6	58.6	62.5	66.6
Developing	417	506	656	835	1'011	7.8	9.4	12	15.1	18
World	1'036	1'159	1'375	1'603	1'833	15.9	17.5	20.5	23.7	26.8
Fixed broadband subscriptions										
Developed	145	187	224	254	279	11.9	15.3	18.3	20.7	22.6
Developing	71	96	127	161	200	1.3	1.8	2.3	2.9	3.6
World	216	283	352	415	479	3.3	4.3	5.3	6.1	7
Fixed telephone lines										
Africa	10	11	11	11	12	1.4	1.5	1.5	1.4	1.5
Arab States	30	31	33	35	34	9.4	9.5	9.9	10.3	9.8
Asia & Pacific	571	592	592	575	546	15.5	15.9	15.7	15.1	14.2
CIS	64	69	71	72	72	23	24.9	25.6	26	26
Europe	273	273	266	260	256	45.2	45	43.6	42.5	41.6
The Americas	291	284	278	278	278	32.8	31.7	30.7	30.4	30.1
Mobile cellular subscriptions										
Africa	88	129	174	246	295	12.4	17.7	23.3	32.1	37.5
Arab States	85	126	174	209	251	26.6	38.5	52.1	61.3	72.1
Asia & Pacific	825	1'061	1'362	1'755	2'161	22.3	28.4	36.1	46	56
CIS	166	227	267	313	354	59.7	81.9	96.4	113	127.8
Europe	550	610	677	721	731	91.1	100.5	111	117.8	118.9
The Americas	469	564	663	750	836	52.9	62.9	73.2	82	90.4
Mobile broadband subscriptions										
Africa	-	1	2	8	17	-	0.1	0.3	1	2.2
Arab States	-	1	3	11	20	-	0.3	0.9	3.2	5.7
Asia & Pacific	43	86	124	165	207	1.2	2.3	3.3	4.3	5.4
CIS	-	-	2	5	53	-	-	0.7	1.8	19.1
Europe	24	55	95	148	203	4	9.1	15.6	24.2	33
The Americas	4	13	56	93	149	0.5	1.5	6.2	10.2	16.1
Estimated Internet users										
Africa	16	22	27	45	69	2.2	3	3.6	5.9	8.8
Arab States	26	35	44	55	64	8.1	10.7	13.2	16.1	18.4
Asia & Pacific	347	394	510	628	744	9.4	10.6	13.5	16.5	19.3
CIS	30	36	51	69	99	10.8	13	18.4	24.9	35.7
Europe	277	300	340	367	387	45.9	49.4	55.7	60	62.9
The Americas	322	351	382	417	447	36.3	39.2	42.2	45.6	48.3
Fixed broadband subscriptions										
Africa	-	-	1	1	1	-	-	0.1	0.1	0.1
Arab States	1	2	3	4	6	0.3	0.6	0.9	1.2	1.7
Asia & Pacific	78	101	124	149	177	2.1	2.7	3.3	3.9	4.6
CIS	2	4	6	12	18	0.7	1.4	2.2	4.3	6.5
Europe	66	89	111	127	138	10.9	14.7	18.2	20.8	22.4
The Americas	63	81	99	115	132	7.1	9	10.9	12.6	14.3

Source: International Telecommunication Union, 2010. Updated on 18 June 2010.

### 3) Ongoing projects

Following projects are in progress.

- Technical and Administration Buildings (Afghan Govt. Grant)  
The main objective of this project is to house the technical departments and Administrative functions in one place to facilitate easy operation.
- Improvement of the Capacity and Policy of MoC (USAID Grant)  
The main objective of this project is to establish policy and procedure and to strengthen legal frame works of ICT

- Extension of IT (E-Governance) (Afghan Govt. Grant)  
Under this project the main objective is to create Afghanistan Network Information Center.
- Development of Fiber Optic Cable Network and Copper Cable Network (Afghan Govt. Grant)  
This project aims at rehabilitation and upgrading the existing fiber and copper cable network.
- Development of National Digital Telephone's Network in Kabul & Provinces (Afghan Govt. Grant)  
Under this project the main objective is to upgrade the existing network by introducing the digital switches for providing new services such as internet and other information services.
- Foundation of Afghan Telecom (World Bank Loan)  
This project is to make the Afghan Telecom to achieve the privatization of ICT service.
- Development of Telephone Networks in Provinces & Districts (Afghan Govt. Grant)  
The project is to study how to improve the ICT services in Provinces all over the country.

#### 4) Newly planned projects

- Project Coordination Unit (Afghan Govt. Grant)  
Under this project the main aim is to develop capacity to coordinate projects of various services (such as road, electricity, water, drainage, and many other fields).
- Project of Quick Development in Communication of Afghanistan (Afghan Govt. Grant)  
The project aims to make quicker actions in case of emergency and/or natural disaster.

### 6.5.2 Telecommunication and ICT system development plan

#### (1) Demand Analysis

##### 1) General concepts of demand forecast

In this master plan, forecasts for telecommunication demands have been carried out as follows:

- i) Estimate the number of telephone and facsimile subscribers in the existing exchanges at the following two levels:
  - Regional
  - Exchange
- ii) Distribute the estimated number of subscribers at the following two levels.
  - Regional
  - Exchange
- iii) In forecasting, the following steps are taken:
  - Step1: Collection of data and information on telecommunication, economics, etc;
  - Step2: Time-series and regression analyses of Step 1.
  - Step3: Determination of the appropriate models for the long-term forecasting of ICT subscriber lines;
  - Step4: Distribution of the ICT demands by region and exchange;

Step5: Estimation of the direct exchange lines (DELs) for every five-year period, i.e.; 2015, 2020 and 2025

## 2) Approach to forecasting

There are two different approaches to forecast future demand of ICT, namely; macro-approach and micro-approach, as briefly mentioned below.

- i) Macro-approach (top-down method) to estimate the number of main subscriber lines. In this case, present telephone or facsimile/telex density (or penetration factor) must be obtained.
- ii) Micro-approach (top-down method) to estimate the number of households and the different kinds of business activities, based on the results of in-depth field survey by area.

Although it is desired that results of these approaches are coordinated to ensure accurate figures, the macroscopic approach was only carried out due to the limited time and manpower resources.

## 3) Forecasting Method

According to the earlier studies by CCITT GAS 5 (Economic Studies at the National Level in the Field of Telecommunications, 1977-1980), a fairly close relationship is observed between the number of telephone lines (or DEL = Direct Exchange Line) per 100 inhabitants and the GDP per capita in various countries of the world. The following formulas (regression lines) have been adopted to obtain main station densities:

for 1974:  $\log Q = -3.6825 + 1.3720 \log X$ .

for 1976:  $\log Q = -3.4612 + 1.3466 \log X$ .

for 1977:  $\log Q = -3.7260 + 1.3570 \log X$ . (Applied in this MP)

where,

Q: the number of DELs main station per 100 inhabitants.

X: the GRDP per capita.

These equations are quite similar and do not vary much over the period. The future demand forecasting, therefore, has been made as follows:

- i) Estimate the total regional population.
- ii) Refer to GRDP value at a certain time, or future economic activity.
- iii) Estimate the telephone density using GRDP as a single independent variable.

## 4) Data Analysis

### Basic Formula for Long-Term Forecasting

In the demand forecast, the following analyses are generally carried out to cross-check the results:

- Time series analysis; and
- Regression analysis.

The time series analysis is effective to know the past trends and normally applied to estimate a short-term over 2-3 years ahead by using extrapolation method as one of the standard methods for the forecasting. The regression analysis is applied for the long-term forecasting to estimate over 15 year period, using the elastic model as referred to in equation (Item 3).

### Time Series Analysis

The Table below shows the historical data on the main telecommunications services as well as economical and demographic figures from 1980 to 2006.

**Table 6.51: Selected Macro Socio-economic Indicators of Afghanistan**

	1980	1990	2000	2001	2002	2003	2004	2005	2006
GDP (current US\$ mil.)	3,642			2,462	4,037	4,582	5,952	7,306	8,399
GDP growth (real % year)						15.7	8	14	53
GDP structure -Agriculture (%)					49.8	48.5	37.2	36.1	32.6
Industry (%)					20.1	21.3	24.4	24.5	28.2
Services (%)					30.1	30.2	39.3	39.4	39.2
Per capita GDP (real US\$)									372
Population (mil)	13.9								22.6
Export (% of GDP)					32.4	11.1	11.5	12.4	5
Import (% of GDP)					66.2	71	55.7	55.7	32.6
GDP deflator (%)					6.42	17.03	11.9	11.9	9.71
Revenue excluding grants (% of GDP)									7.44
Gross capital formation (% of GDP)					28.1	33.5	31.1	25.1	
Primary completion rate (%)								37.7	
Ratio of girls and boys in prim.&sec. schools(%)						54.8	41	55.6	54.2
Births attend by skilled health staff(%)			12.4			14.3			
Total fertility rate(#)	7.76								
Immunization rate - measles (%of children age 12-23 mos.)	11	20	35	46	44	50	61	64	68
Improved sanitation facilities(%of urban pop.)		7	30				49		
life expectancy at birth(years)		4	21				39		
Life expectancy at birth(yaers)	39.3								44
Mortality rate under age 5 (per 1,000)	280						210	210	210
HIV infection (% of pop. Age 15-49)						0.1		0.1	
Fixed & mobile phone subscribers (per 100 people)	0.19	0.29	0.14	0.14	0.26	1.02	2.7	5.09	10.29
Internet users (per 100 people)						0.09	0.1	1.2	2.05
External debt (current US\$ mil)									1,771
Official debt assistance (current US\$ mil.)	33	122	136	405	1,300	1,591	2,171	2,752	3,000
Short-term debt outstanding (current US\$ mil.)									10.5

Source: Afghanistan Statistical Yearbook 2007, Central Statistics Office.

According to the table above, a significant growth trend can be observed in the telephone densities from 2003 to 2006, combined both mobile and fixed lines.

### Regression Analysis

Regression Analysis has been applied to the long-term forecasting adopting the following figures:

- Total Population in Kabul province: 4.22 million
- GRDP: USD 258
- Total DELs (MoC present data): 155,000

### 5) Demand distribution

The outlines of a total demand generated in Kabul city was forecasted by every five years period as follows:

Planned year	2015	2020	2025
Total Demand to be satisfied	1,162,398	1,238,837	1,338,761

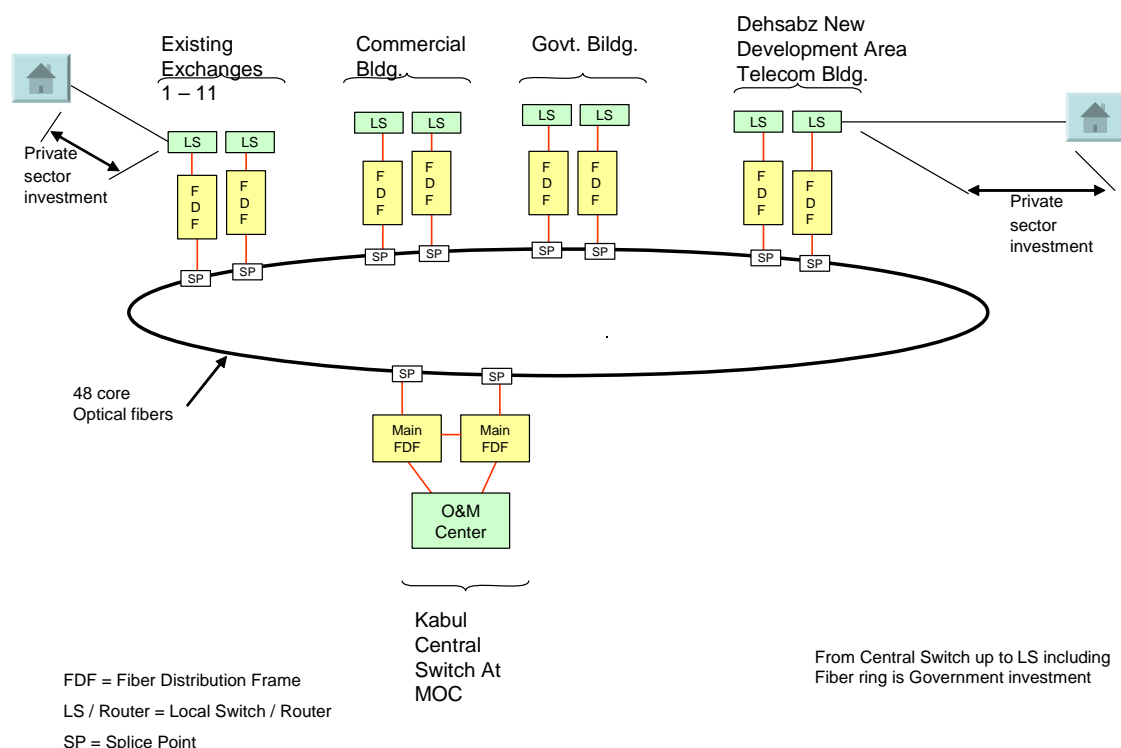
### (2) Schematic ICT system plan and work demarcation

Taking the planned Outer Ring Road alignment into consideration, a schematic ICT system plan was formulated focusing on laying an optical fiber cable (OFC) network along the road. The ring will connect commercial and government buildings as well as any service providers and user access networks. By doing this, full redundancy of the ICT network could be achieved. If this OFC

ring is once completed, the following interconnections capacity will be secured to meet the requirement by ANDS.

- Enables Afghan Telecom's ANS (access network services) with different licensed ICX (interconnection exchange) service providers
- Afghan Telecom's ICX network with different ANS (fixed, mobile and WLL) operators' network and IGW (international gateway) service providers
- Afghan Telecom's IGWs with other licensed ICX providers
- Increase the capacity of IGW exchange(s)
- Increase the capacity of broadband network, including FTTB/FTTH and xDSL/ADSL systems
- Enable to introduce NGN (next generation network) and IP (internet protocol) capability in Afghan Telecom's network
- Introduce wireless access by CDMA WLL (code division multiple access wireless local loop) and WiMAX (worldwide interoperability for microwave access) capability in the Afghan Telecom network
- Increase the capacity of Afghan Telecom's IN (intelligent network) for enabling introduction of new VAS (value added system)
- Enable to install a NOC (network operation centre) for the Afghan Telecom network
- Enable to install computerized accounting system in the Afghan Telecom network.

## Kabul City Area Fiber Network Architecture and Work Demarcation



**Figure 6.31: Recommended Fiber Network System**

### (3) Phased ICT development plan

To meet the requirement in phased urban development of Kabul City in line with the Afghanistan's goals for the telephone network development, the basic requirement for ICT facilities by phase and by coverage areas of exchanges are examined as presented in Table 6.52. The overall framework is set as follows:

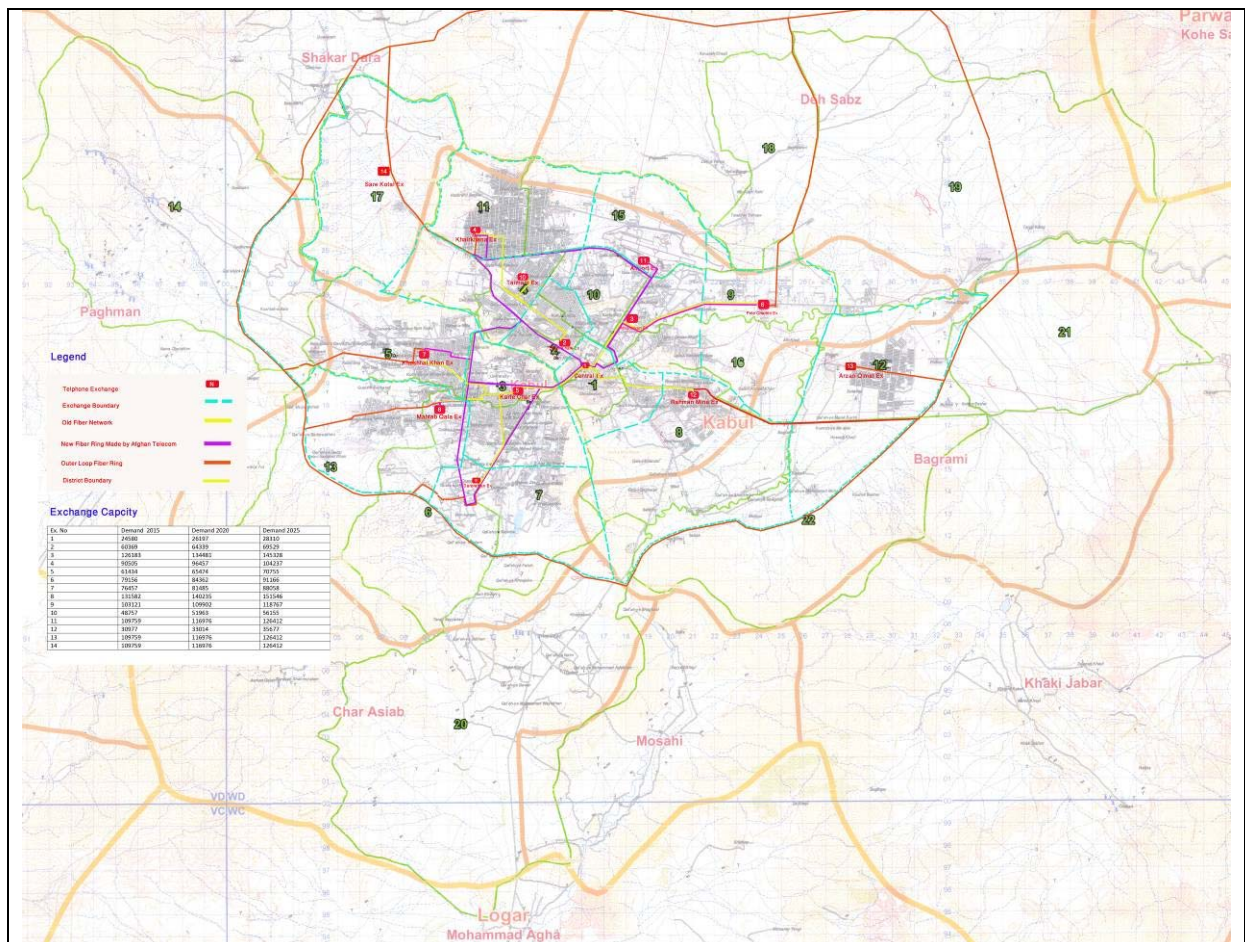
Project	Planned period	Demand to be satisfied	Exchange capacity	No. of DELs	Regional Density /100
Phase I	2015	1,162,400	172,743	259,115	10.00
Phase II	2020	1,238,840	222,740	334,112	12.06
Phase III	2025	1,338,760	295,130	442,693	12.95

**Table 6.52: Population and Demand by Exchange wise in Kabul City**

Exchange	Population				Demand			
	2010	2015	2020e	2025	2010	2015	2020	2025
Total	4,220,256	5,591,137	6,640,170	7,697,879	1,084,899	1,162,398	1,238,837	1,338,761
1	89,243	118,231	140,415	162,781	22,942	24,580	26,197	28,310
2	219,180	290,376	344,858	399,790	56,344	60,369	64,339	69,529
3	458,127	606,942	720,819	835,637	117,770	126,183	134,481	145,328
4	328,592	435,330	517,008	599,362	84,471	90,505	96,457	104,237
5	223,044	295,496	350,938	406,839	57,338	61,434	65,474	70,755
6	287,388	380,741	452,178	524,205	73,879	79,156	84,362	91,166
7	277,589	367,759	436,760	506,331	71,360	76,457	81,485	88,058
8	477,727	632,909	751,658	871,390	122,809	131,582	140,235	151,546
9	374,396	496,013	589,077	682,910	96,246	103,121	109,902	118,767
10	177,020	234,522	278,524	322,890	45,506	48,757	51,963	56,155
11	1,195,484	1,583,817	1,880,980	2,180,600	307,322	329,276	350,929	379,235
12	112,466	148,998	176,954	205,141	28,912	30,977	33,014	35,677

Figure 6.32 shows the spatial development plan of the ICT network for Kabul city. Although the current fixed telephone service is small due to the fast growth of mobile phones, demands for information network (internet, facsimile, network access by educational organizations, government offices, commercial development, etc.) will increase dramatically. The MoC has expressed adoption of duct routes to facilitate faster installation of optical fiber network. Thus the ICT external plant network consisting of duct routings and FOC installation are the first priority.

The priority areas for the ICT external plant network development are the core urban development areas as these areas accommodate many government offices and public facilities, surrounded by offices and commercial buildings. If the service facilities are implemented in advance, the connection of FOC link could be made in shorter time upon request/application from the subscribers to be located in these core areas.



Source: Planning Team

**Figure 6.32: Phased ICT Network Development Plan**

### 6.5.3 ICT network development project

Key facilities and equipment to complete the future ICT network are summarized in the table below, together with rough cost estimation covering construction of PVC ducting, manholes, hand holes and optical fiber cable placement. Although the Phase I project is the most important one, every effort should be made to complete the succeeding Phase II-III within the planned periods.

Each project consists of the following major components:

- Rehabilitation and expansion of ICT outside planned network
- Rehabilitation and expansion of transmission network facilities
- Rehabilitation and expansion of international communications facilities

**Table 6.53: Key Facilities for Overall ICT Development Project**

Item	Volume/Quantity
Total Length of the Network route	120km
Total Length of PVC Ducts	480km (120 x 4)
Total Number of Manholes	300 Nos. (Under Carriage way)
Total Number of Hand holes	150 Nos. (Under Footway)
Total Length of FOC	170km
Total Number of Splice box	60 Nos.
Sub-total 1	
As for Tools and equipments for testing and operation:	
OTDR (Optical Time-Domain Reflectometer)	3 (three) sets
Fiber splicing machine	3 (three) sets
Fiber Cutter	3 (three) sets
Power Meter	3 (three) sets
Optical Telephone set	3 (three) sets
Sub-total 2	
Grand Total	

Note: 1) Did not include contingency and Consultant cost

2) The cost estimation based on work demarcation shown in item 3.5 (Schematic ICT system plan and work demarcation)

To achieve the above planning goals, each project should be implemented smoothly and efficiently, which means trying to avoid carry-over from the preceding projects. For this purpose, a well-balanced project implementation plan should be designed. To this end, a project management unit should be established by MoC and Afghan Telecom.

Sufficient financing sources need to be identified at the planning of implementation schedule. According to the information by MoC, it receives USD20 million from the Ministry of Finance every year for the ICT development projects of the whole country. This is not enough to carry out proposed above. Seeking of donors' financial support is necessary for implementation of the proposed projects.

All the projects should be implemented on a turn-key basis and in accordance with technical fundamental plans to be produced by a team of experts.

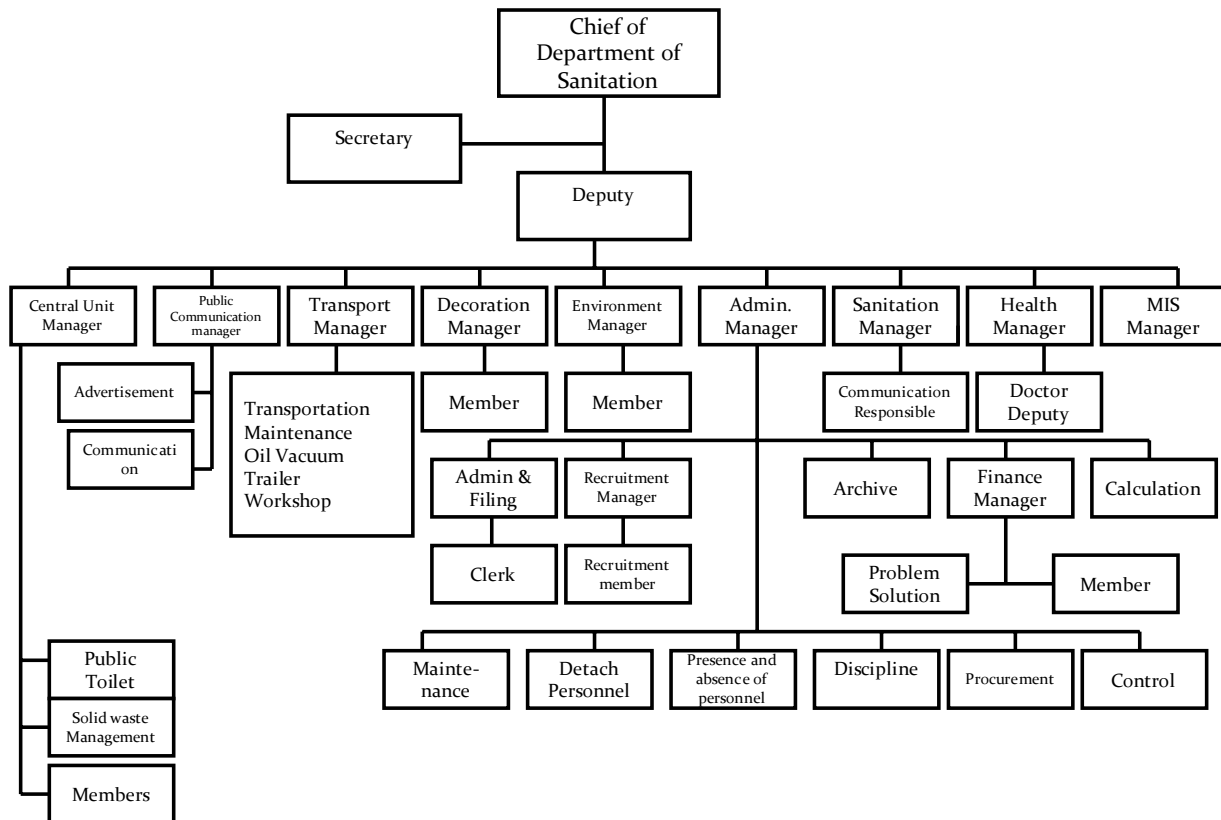
## **6.6 Solid Waste Management System Development Plan**

### **6.6.1 Present conditions of solid wastes**

#### **(1) Organization**

The Department of Sanitation (DoS) is in charge of solid waste management in Kabul City. It has 3,331 staff members, out of this, 122 are working within the administration. The remaining members are working as mechanics in the DoS workshop, waste collectors (approximately 2,500 people), road sweepers, etc. The organization chart of the DoS is shown in Figure 6.33.





Source: DoS

**Figure 6.33: Organization of Department of Sanitation (DoS)****(2) Domestic waste**

The residents discharge their waste at their nearest collection points, which spread in the city at around 7000 locations. The collection cars pick up the waste from these collection points and carry them to the landfill site directly. The collection frequency differs from three times/day to twice/week, depending on the situations.

The collected waste was 749,585m<sup>3</sup> in 2009. The estimated composition was: soil and compost (40%), construction waste (20%), animal and human waste (15%), metal, glass and organic wastes (25%).

In some areas, waste containers are used at the collection points. The size of these containers is 1.1 m<sup>3</sup>. Currently there are 500 collection points with waste containers, and additional 1,500 containers are planned to be provided. As residents are not accustomed to use of waste containers, there are some wrong uses frequently take place. One typical case is that the burning of waste in the container. Stealing of the container's steel tires is another problem often reported.

The waste generated in offices, shops, restaurants, and other business entities is collected in the same line with domestic ones. All the collected waste is carried to Gazak landfill in district 21, which is only 2 km away from the nearest human settlement. The Chamtala landfill had been used for the past several years until filled up to its full capacity. The World Bank assisted rehabilitation and expansion of the Chamtala landfill, but the site is now facing a strong protest by the nearby communities.

The material recovery from waste for the recycle is practiced only in a small scale by some private sector handlers. The collected material is exported to other countries for recycle use, as there are no recycling factories located in Afghanistan yet.

### (3) Human waste

Approximately 70% of the population use traditional toilets, by which the liquid goes to the ditches without any treatment. It is private sector that collects night soil from these toilets. The collected waste is thrown away mainly to agricultural lands, but sometimes to the Kabul River or some vacant lands. Sometimes, those collected human wastes are thrown to waste collection points, mixed with domestic wastes, and making them unrecyclable.

The remaining 30% of the population use flush toilets. The waste is stored in a tank, which can be classified into two types: one type is made of concrete and lined, thus lets the liquid matter remain in the tank, the other type is made of stone or brick, and lets the liquid go out from the tank. These are called septic tanks in Kabul, although they are only functioning as reservoirs.

The human wastes in those tanks are emptied by the Kabul Municipality. The municipality has 20 vacuum trucks, each with 9m<sup>3</sup> capacity, and dispatches them to empty the tanks upon request (Af. 1,200 per tank of 1-2 m<sup>3</sup> capacity). The DoS has a plan to buy 20 more trucks. Apart from these collection services, some households empty their septic tanks by themselves to apply the wastes to farmland as fertilizer.

### (4) Medical waste

The Ministry of Public Health (MoPH) is in charge of medical waste management. The medical waste is hazardous and requires special system to collect, transport, treat and dispose, though the amount is not large. However, there are no regulations/guidelines for the treatment of medical waste management in Afghanistan. Only a few hospitals have incinerators to burn the medical wastes. Almost all the medical waste is collected and carried to the landfill with other domestic waste.

Volume of medical wastes might be 3.7 t/day based on the following estimation.

The numbers of beds and medical facilities in Kabul City are estimated as follows:

Total number of beds: 4137  
Total number of facilities: 42

Those are based on the data below.

	Hospital	Other facility
Governmental		
No. of facility	21	42
No. of bed	2537	NA
Private		
No. of facility	68	NA
No. of bed	1600 *	NA
Total		
No. of facility	89	42
No. of bed	4137	NA

Source: JICA Expert Team on Public Health  
Health Management Information System

\* Proportional allotment based on the survey result that 48 hospitals have 1113 beds.

The unit medical waste generation in medical facilities can be estimated as below based on the data in Turkey.

Hospitalizing institution: 0.8 kg/bed/day  
Non- hospitalizing institution: 10 kg /facility/day

	Hospitalizing institution (unit: kg/bed/day)	Non-hospitalizing institution (unit: kg/insti./day)
City 1	0.77	10.60
City 2	0.83	9.25
Average	<b>0.80</b>	<b>9.93</b>

Source: The Study on Regional Solid Waste Management for Adana-Mersin in the Republic of Turkey

Therefore, the medical waste in Kabul city is:

$$0.8 \text{ kg/bed/day} \times 4137 \text{ beds} = 3310 \text{ kg/day}$$

$$10 \text{ kg /facility/day} \times 42 \text{ facilities} = 420 \text{ kg/day Total } 3730 \text{ kg}$$

## (5) Waste flow

### 1) Unit waste generation of domestic waste

The following conditions in 2009 were applied to estimate the present unit waste generation, according to the information by the DoS and estimated population in this master plan.

- Yearly collected waste: 750,000 t/year
- Specific gravity of waste: 1
- Population: 4,500,000
- Collection rate: 68%

The unit waste generation was calculated as below:

$$750,000 \text{ t/yr (yearly collected waste)} / 365 = 2055 \text{ t/day (daily collected waste)}$$

$$2055 \text{ t/day} / 0.68 \text{ (collection rate)} = 3022 \text{ t/day (daily generated waste)}$$

$$3,022,000 \text{ kg} / 4,500,000 \text{ persons} = 0.67 \text{ kg/person/day (unit waste generation)}$$

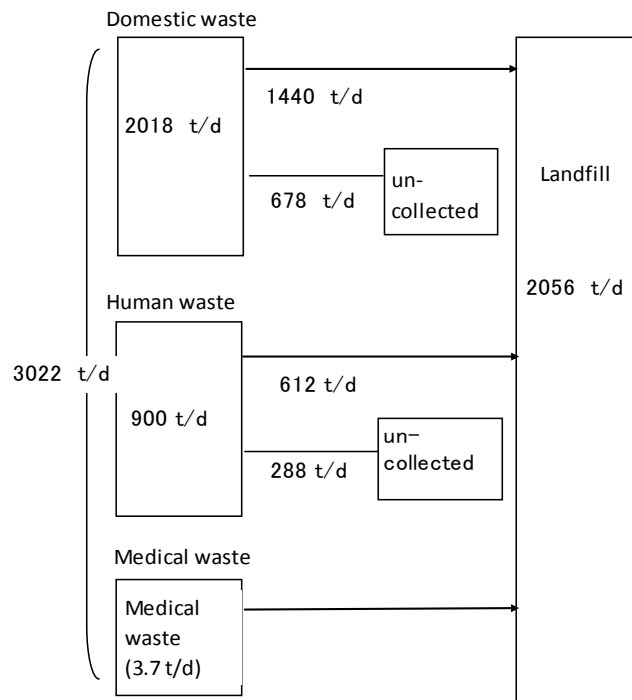
Out of 0.67 kg/person/day, night soil is estimated to be about 0.2kg/person/day.

### 2) Medical waste generation

Daily medical waste generation is estimated as 3.7 ton/day. The procedure of estimation is shown in Annex 1.

### 3) Waste flow

The present waste flow can be estimated as shown in Figure 6.34, based on the collected and estimated data/information from the DoS.



Source: DoS, estimated by Planning Team.

**Figure 6.34: Estimated Present Waste Flow**

#### (6) Vehicles

The vehicles owned by the DoS can be sorted out as in Table 6.54. Those dump trucks totaling 121 are used for waste collection, with the total capacity of 696 m<sup>3</sup>. Therefore, it was estimated that those vehicles are used approximately in three shifts:

$$2052 \text{ m}^3 \text{ (total collected waste)} / 696 \text{ m}^3 \text{ (total capacity of trucks)} = 2.95$$

**Table 6.54: Vehicles Owned by DoS of Kabul Municipality**

No.	Vehicle Type	Active	Capacity/Tonnage	Mark	Model	Age (y)	Made in
1	Dump truck	36	4-cu-m	Zeel-130	1987	21	Russia
14	(Solid waste) dump truck	1	5-cu-m	Oral	2000	8	Russia
2	Dump truck	20	5-cu-m	Hino	1996	12	Japan
8	Dump truck	3	7-cu-m	Honda	2003	5	Korea
4	Dump truck	27	8-cu-m	Tata	2002	6	India
5	Dump truck	5	10-cu-m	Tata	2002	6	India
10	Dump truck	4	15-cu-m	Hyoko	2002	6	Germany
15	Dump truck	1	8-cu-m	Isuzu	NA	NA	Japan
21	Dump truck	2	2-cu-m	Fiyat	1996	12	Italy
3	Isher	22	4-cu-m	Isher	2001	7	India
16	Water tanker	3	6500 Liter	Zeel-130	1987	21	Russia
6	Water Tanker	1	12000 Liter	Tata	2002	6	India
17	Fire fighter tanker	1	12000 Liter	Bedford	Previous	NA	England
9	Vaccum truck	1	3700 Liter	Hino	1996	12	Japan
7	Vaccum truck	9	7000 Liter	Tata	2002	6	India
11	Vaccum truck	8	8700 Liter	Maz	2006	2	Russia
13	Container truck	1	7.5-cu-m	Maz	2006	2	Russia
12	Container truck	3	12-cu-m	Kamaz	2006	2	Russia
18	Fuel tanker	2	3200 Liter	Isher	2001	7	India
19	Tractor	3	3-cu-m	Tractor	2000	8	Italy
20	Road sweeper	10	5.1-cu-m	Isuzu	2001	7	China
22	Repair truck	1		Kamaz	2006	2	Russia
23	Excavator	2	1-cu-m	Kamaz	2007	1	Russia
24	Grader excavator	1	0.50-cu-m	Geb	2003	5	India
25	Wheel Loader	2	2-cu-m	Honda	2003	5	Korea
27	Wheel Loader	1	2-cu-m	T18	Previous	NA	Russia
26	Wheel Loader	1	250-cu-m	T18	2005	3	Russia
28	Buldozer	2		T130	Previous	NA	Russia
29	Bus	2	25 rider passenger	Tata	2006	2	India
30	Pick-up	2	5 rider passenger	Toyota/Isuzu	Previous	NA	Japan
	Total	177					
<b>The upper (177) vehicle and machinery are prepared and presented.</b>							

Source: DoS (in 2008)

In 2010, there are 30 new trucks purchased (20 with 25 m<sup>3</sup> and 10 trucks with 7 m<sup>3</sup>), enabling the classification as in Table 6.55.

**Table 6.55: Vehicle Types for Solid Waste Management in Kabul City**

Type	Vehicles (n)	Ratio (%)	Note
Dump truck	151	72.9	Waste collection
Water tank	4	1.9	
Vacuum truck	18	8.7	Sludge collection
Container truck	4	1.9	Container collection
Road sweeper	10	4.8	
Others	20	9.7	For disposal works, bus and others
Total	207	100	

Source: DoS

## 6.6.2 Solid waste management system development plan

### (1) Planning conditions

#### 1) Basic policies

The principles of the solid waste management are as follows:

- i) Avoid all negative impact on human bodies and environment, and
- ii) Save resources such as energy, materials and land as much as possible.

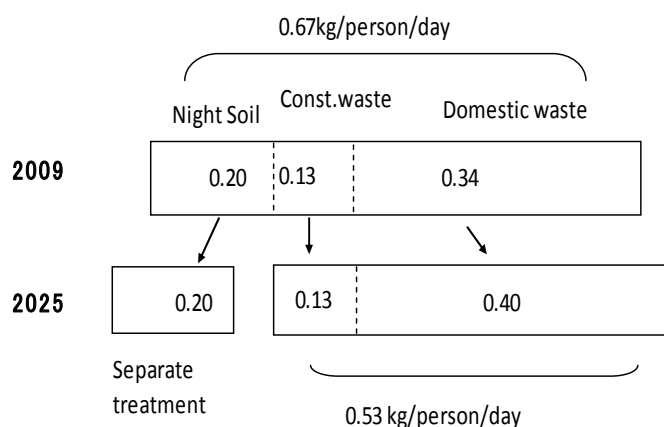
To realize them, the followings policies need to be adopted for the future solid waste management:

- i) Secure sanitary landfill sites, which do not pollute environment including soil and groundwater,
- ii) Secure facilities and systems to treat human waste in a sanitary way,
- iii) Secure facilities and systems to treat medical wastes so as to avoid infections, and
- iv) Conduct recycling so as to prolong the life of landfill sites and to use the materials effectively.

#### 2) Waste generation

##### Domestic waste generation

Out of the present unit generation, construction waste is estimated to be 0.13 kg/person/day as it occupies 20% of the total waste, according to the information provided by the DoS. As it is expected that the construction of large-size buildings will be restricted by the Kabul Municipality, increase of construction waste will be restricted at the current level. As for the domestic waste, it was estimated to be 0.34 kg/person/day in 2009, and is expected to increase to 0.40 kg/person/day, which is the same level with Damascus, Syria, one of the countries in the state of more developed countries, with similar diet habit, climate, etc., to those in Kabul. By separating the night soil, the unit generation of domestic waste in 2025 was estimated to be 0.53 kg/person/day as shown in Figure 6.35.



Source: Planning Team

**Figure 6.35: Estimate of Unit Waste Generation**

The following conditions were applied to estimate the total generation in 2025.

- Specific gravity of waste: 1
- Population: 6,000,000
- Collection rate: 100 %

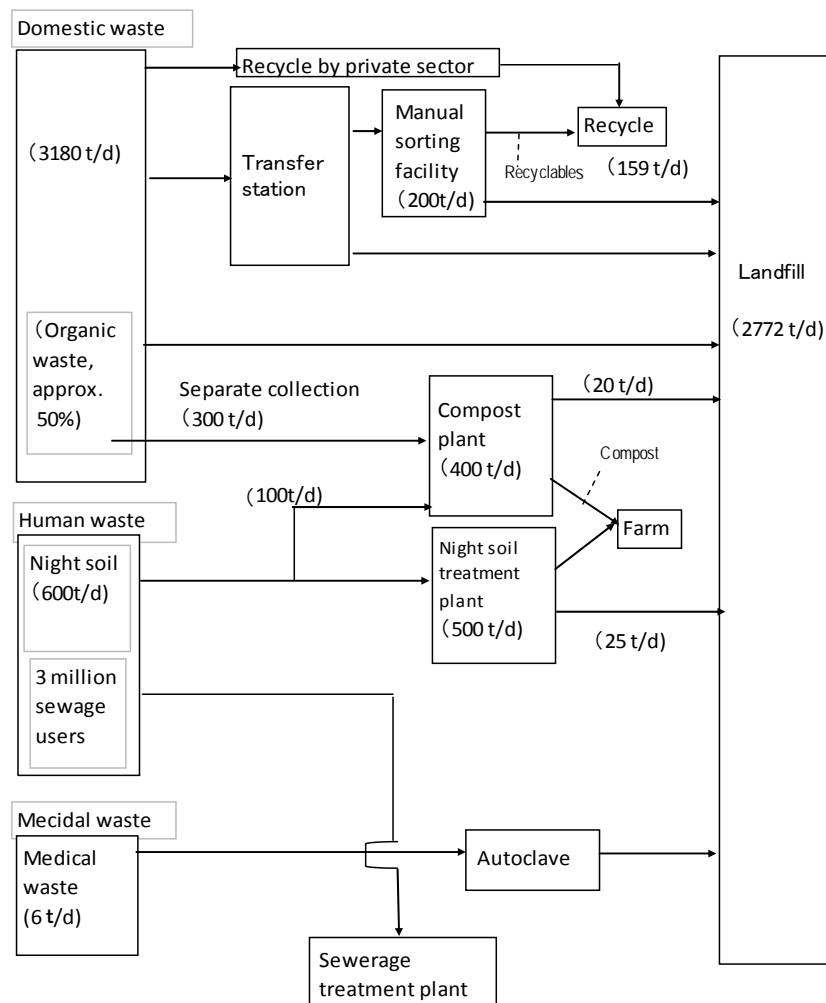
### Medical waste generation

Yearly medical waste generation in 2009 was estimated to be 3.7 ton/year. The generation in 2025 was estimated to be 5.8 ton/year based on the general tendency that it increases in proportion to that of domestic waste and population.

## (2) Solid waste management plan

### 1) Waste flow

For the future waste management, the following waste flow is proposed.



Remarks (unit: t/day)

1) Total generation:  $3180 + 600 + 6 = 3786$

2) For recycle: -159

3) By compost plant:  $-400 + 20$  (residue) = -380

4) By night soil treatment plant:  $-500 + 25$  (residue) = -475

5) To landfill =  $3786 - 159 - 380 - 475 = 2772$

Source: Planning Team

**Figure 6.36: Proposed Waste Flow**

### 2) Collection

The waste collection will be done at the collection points with a greater number of locations according to the expansion of urban areas. The separate collection of organic waste will be

established, starting from areas where much organic waste is generated. These include areas with many restaurants, vegetable markets, and large hotels. The high income residential areas may also be categorized in this category.

The human waste will be collected separately in the strict manner. The collection will be done directly by the Kabul Municipality, or registered private sector entities. The waste will be conveyed to the designated facilities; the compost plant or the night soil treatment plant.

The required number of waste containers and collection vehicles are estimated based on the following conditions.

- Waste containers of 1.1 m<sup>3</sup> capacity are used at all the collection points.
- The life time of vehicles is 20 years.
- Compactor garbage trucks with 8 m<sup>3</sup> capacity will be introduced as collection cars, replacing the present vehicles after their life time.
- A collection car is used in two and a half shifts a day.
- A new arrangement of waste containers and collection vehicles will be necessary when the separate collection of organic waste is started. Some of existing containers and vehicles will be appropriated for this purpose in this occasion, without procuring additional equipment.

The estimated equipments to be procured are shown below. It should be noted that the estimated figures are the minimum requirement. Additional vehicles may be required depending on the change of conditions in the sequence of time.

**Table 6.56: Equipments to be Procured**

	2020	2021	2022	2023	2024	2025
Waste container (1.1 m <sup>3</sup> )						
No. of containers	300	50	60	60	60	350
Total capacity (m <sup>3</sup> )	330	55	66	66	66	385
Collection vehicle (8 m <sup>3</sup> vehicle)						
No. of vehicles	1	14	44	6	3	20
Total capacity (m <sup>3</sup> )	8	112	352	48	24	160

Note: Collection vehicles for human waste are excluded.

Source: Planning Team

### 3) Transfer station (TS)

A transfer station (TS) is a place where the waste is transferred from small collection vehicles to the big ones so as to decrease the traffic to the landfill site by improving transport efficiency. If the distance from a waste collecting point to the landfill is short, it is better transport the waste directly. In general the critical distance is 20 km.

At the same time the distance from a collecting point to the TS should be considered. If it is short it is better to use the TS. The critical distance is generally 5 km in this case (Table 6.57). In the practice, other factors such as traffic conditions, routing and other conditions need to be considered. The optimal way will be figured out after some trials and errors.

**Table 6.57: General Rule for Decision of Use of Transfer Stations**

		Distance to the landfill	
		< 25 km	25km<
Distance to the TS	< 5km	Depending on circumstances	Use of a TS is better
	5km <	Direct transport is better	Depending on circumstances

Source: Planning Team

For the future transfer stations for Kabul City, three locations are proposed as shown in Figure 6.41. The capacity of each TS were set to be 200 t/day assuming that 25% of collected wastes would use these stations.



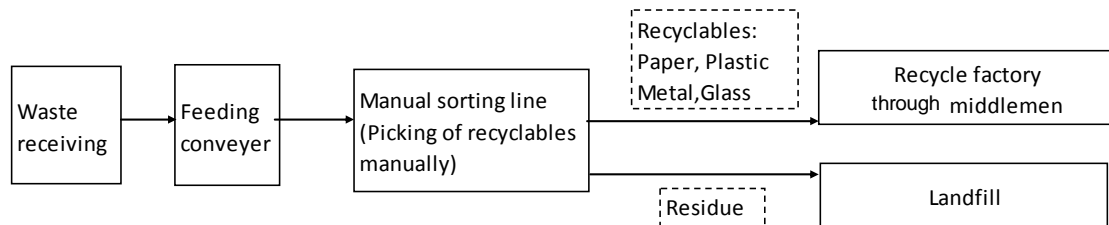
The proposed transfer method is that a collection vehicle on a platform drops collected waste to a container vehicle directly. Thus the following facility/equipment is required at each station.

- Platform for transfer
- Trailer (approx. 40 m<sup>3</sup> capacity)

#### 4) Material recovery

A significant volume of construction waste is mixed in the whole waste in Kabul City. These materials include debris and mud, estimated to occupy around 20%. The mixture of construction waste materials has been a burden for solid waste management as they are heavy and shorten the life of landfill. Thus removal and reuse of these construction wastes is desirable.

For promotion of recycling, it is proposed to introduce manual sorting facilities to be located adjacent to each landfill. Recyclable materials such as paper, plastic, metal, and glass will be picked up manually in this facility. The process of materials recovery is shown in Figure 6.37. Materials recovery from the waste is estimated to be around 5% of the whole waste.



Source: Planning Team

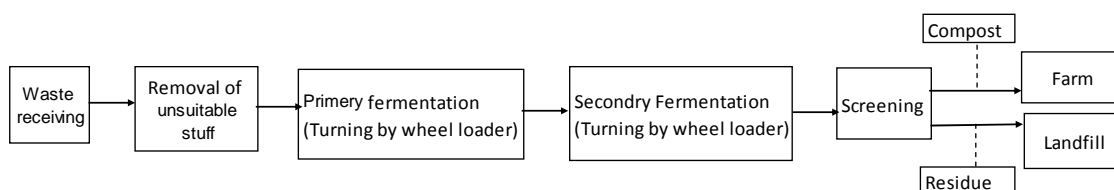
**Figure 6.37: Flow of Manual Sorting Facility**

Major facilities and equipment required for this procedure are as follows:

- Truck weight scale
- Receiving hopper
- Feeding conveyer
- Conveyor for sorting
- Handcart
- Wheel loader
- Dump truck
- Sorting building

#### 5) Composting

A composting plant was introduced in Kabul as a pilot project supported by the World Bank in 2007. This will be further strengthened and extended to be located at each landfill, with full utilization of the experience obtained in the pilot project. Figure 6.38 shows the process of composting carried out in the plant.



Source: Planning Team

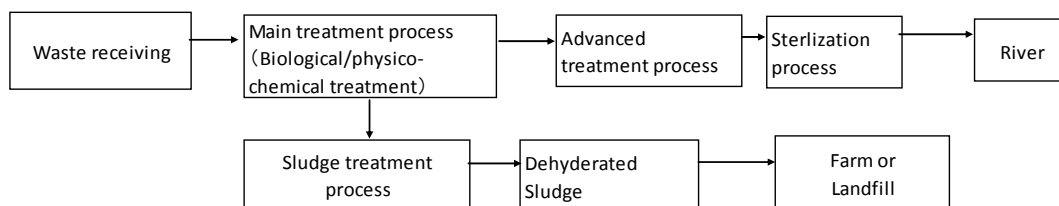
**Figure 6.38: Flow of Composting Facility**

Major facilities and equipment required for this procedure is as below.

- Truck weight scale
- Receiving hopper
- Feeding conveyer
- Conveyor for sorting
- Handcart
- Wheel loader
- Dump truck
- Sorting building

#### 6) Night soil treatment

A night soil treatment plant is proposed to be located adjacent to the landfill. The flow is shown in Figure 6.39.



Source: Planning Team

**Figure 6.39: Flow of Night Soil Treatment Plant**

#### 7) Handling of medical waste

The easiest way of handling the medical waste is to burn them in an incinerator installed in each hospital. However, this method is not recommendable because burning in small incinerators likely to generate toxic gas such as dioxin, and the smell and smoke often become nuisance for the nearby residents. Thus the following process is proposed to handle the medical waste in the Kabul city.

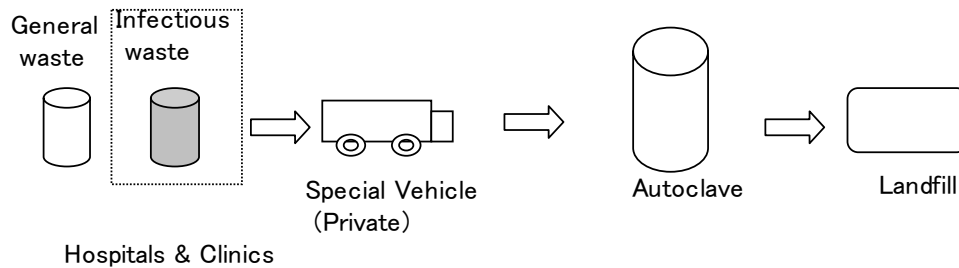
- i) The infectious waste will be separated by hospitals/clinics in a strict manner.
- ii) The separated infectious waste will be transported to an autoclave for treatment by registered medical waste transporter upon request from hospitals/clinics.
- iii) The treated infectious waste is carried to the landfill by general way.

Flow of the process is shown in Figure 6.40.



**Autoclave:** a device to sterilize equipment and supplies by subjecting them to high pressure saturated steam at 121° C or more. It is recently used for treatment and sterilization of waste material such as pathogenic medical waste.

Photo: An example of an autoclave (source: ECODAS homepage)



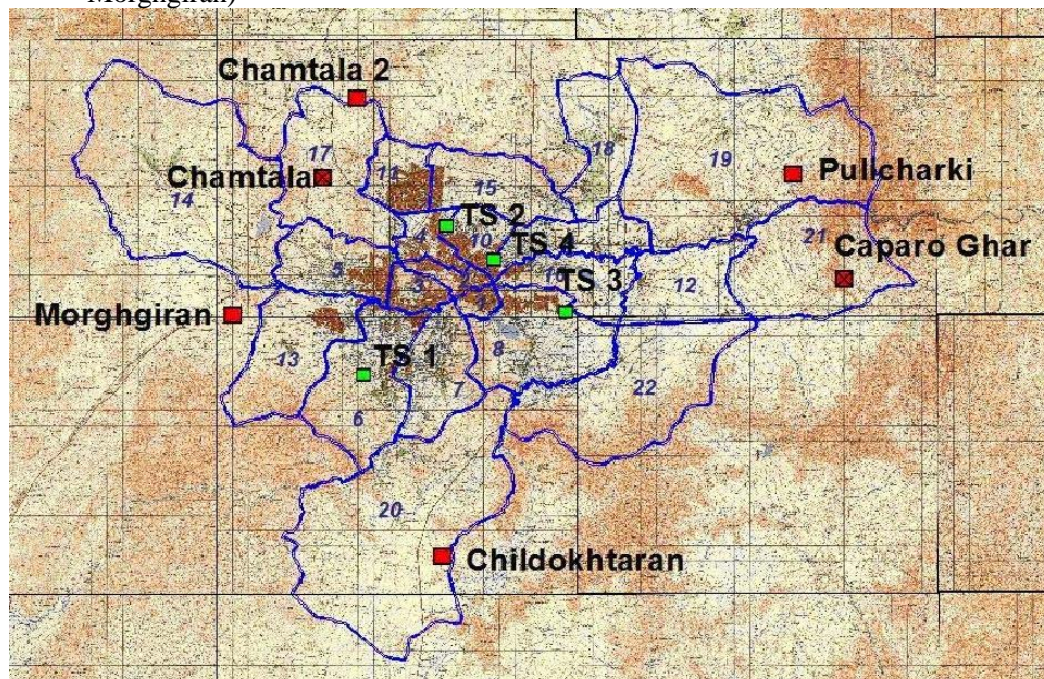
**Figure 6.40: Proposed Flow of Medical Waste**

#### 8) Final disposal

The Gazak final disposal site under use will be full in three years. The Chamtala final disposal site had been used for the past several years. Its rehabilitation and expansion was completed supported by the World Bank but hard to start operation because of the residents' objection. Besides, the life time of Chamtala will be only one year according to the current practice. Therefore, it is an urgent matter to prepare a new final disposal site.

Figure 6.41 shows the candidate sites for landfill and transfer stations (TSs) selected by the KMAUD Master Plan, through a series of technical meetings with the Kabul Municipality. Both parties jointly visited these sites and confirmed as the candidate sites as follows:

- TSs: four sites (TS1, TS2, TS3 and TS4)
- Landfills: six sites (Chamtala, Chamtala 2, Pulicharki, Caparo Ghar, Childokhtaran, and Morghgiran)



Source: KMAUD Master Plan, JICA, 2009

**Figure 6.41: Candidate Sites for Transfer Stations and Landfills**

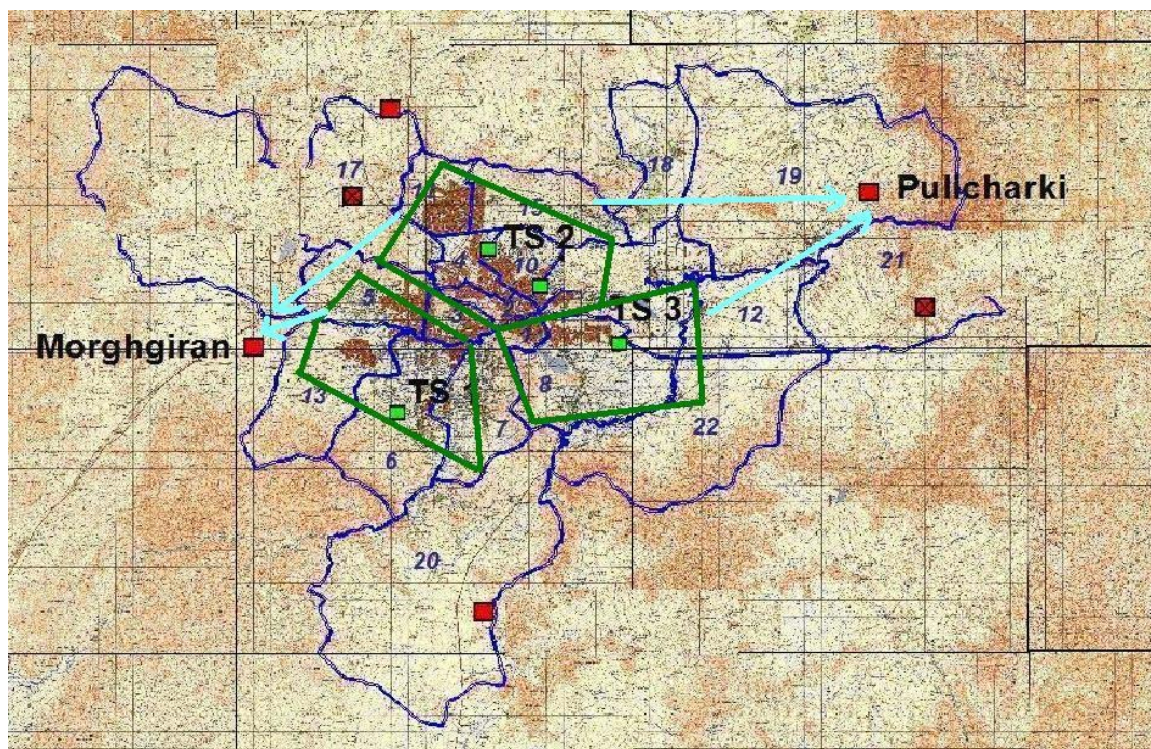
Out of six landfill candidate sites, the Chamtala site need to be excluded as its lifetime will be only for a year. The Caparo Ghar should also be excluded as it was once in used but closed because of the residents' objection. The Chamtala 2 site has also difficulty for use as mentioned earlier,



although a study was carried out in the name of the Koh-e-Badasia site. The World Bank has once shown interest for funding but suspended as there is a risk of polluting the groundwater.

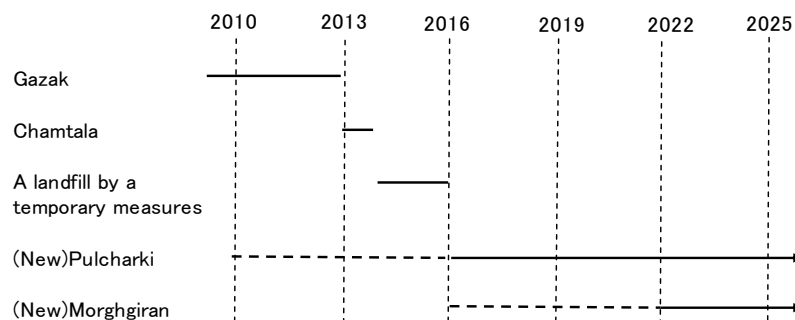
Therefore, there are three sites, namely; Pulicharki (east), Childokhatara (south), and Morghgiran (west), remain as candidates for the future landfill for Kabul City. As the administration area spreads across the mountains, it is desirable to have two landfills to cover the area; one in the west and one in the east. In this light, priority should be put on Pulicharki (east) and Morghgiran (west). The required area for those landfill candidates has to be determined by detailed studies.

The central part of Kabul City can be broadly divided in three areas by the hills and rivers, and it is realistic to have one TS in one area. The waste in the west area would go to Morghgiran landfill, and that in the east area to Pullcharki. The waste in the north area may go either of those two landfills (Figure 6.42).



**Figure 6.42: Example of Waste Transportation in 2025**

The construction of a new landfill generally takes three years for preparation works (land survey, geological survey, consultation with stakeholders, EIA, etc.), and another three years for design and construction. Thus the preparation of a new landfill must be started as soon as possible. Some temporary measures have to be taken for years 2014 and 2015 as there will be no landfills available, even if a new landfill become available in 2016. Possible temporary measures are expansion of Gazak or Chamtala. The other option is to resume the use of Caparo Ghar, which was once closed due to the residents' objection. Thus necessary measures need to be taken to mitigate the negative impacts that caused residents' objection. Close consultation with the residents is also necessary. Figure 6.43 shows proposed time scheme of landfill preparation for Kabul City



**Figure 6.43: Scheme for Available and Necessary Landfills**

The new landfills have to be sanitary ones with the following facilities and equipment.

#### Facilities

In the landfill area

- Liner
- Leachate collection facility
- Leachate treatment facility
- Rainwater collection facility
- Gas exhaust equipment
- Operation road

Around the landfill area

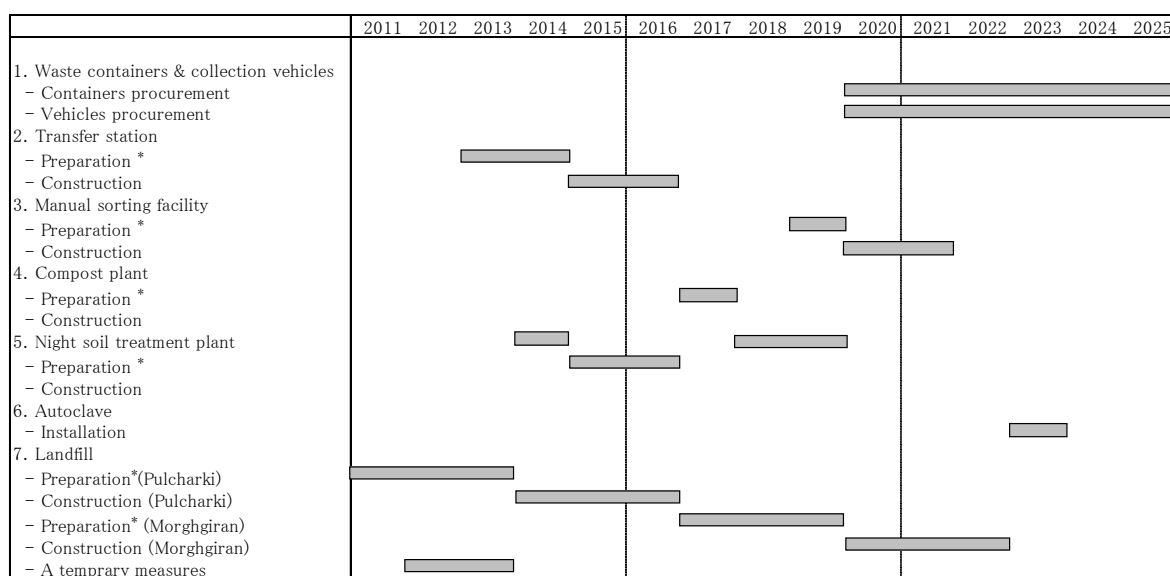
- Access road
- Fence
- Truck scale
- Monitoring facility
- Controlling building

#### Equipment

- Bulldozer
- Excavator
- Wheel loader
- Dump truck
- Water tanker

### 6.6.3 Solid waste management system development project

Based on the development plan described in sub-section 6.6.2, key projects are identified and listed in Figure 6.44 with desired implementation schedule.



\* Preparation includes survey, consultation with stakeholders, design, and other works to be done before construction.

Source: Planning Team

**Figure 6.44: Implementation Schedule**

## CHAPTER 7: PROJECT COST ESTIMATE

### 7.1 Total Project Cost

In Chapters 4 to 6, key projects are identified by sector. Required costs for the full implementation of projects proposed in this master plan are summarized in Table 7.1 by sector. In general, proposed projects are limited to those largely dependent on the government sector investments, including those to be implemented by public enterprises. Most of the utilities development projects which can be implemented by private enterprises are not much focused in this master plan. Projects of power supply and ICT are thus limited to several key facilities development, assuming that connection to the end users can be realized by private companies with tariff based financing schemes. Projects for water supply and sewerage systems development are proposed with more details, although this also applies as observed in some housing estate developments by private developers.

**Table 7.1: Estimated Cost for Full Implementation of Proposed Projects**

Sector	Cost (US\$ 10 <sup>6</sup> )
Urban development and improvement	1,403.0
Transport	2,116.9
Water supply	16,333.9
Sewerage	473.4
Power distribution	147.0
ICT network	2.4
Solid waste management	94.5
<b>Total</b>	<b>20,571.1</b>

### 7.2 Project Cost by Sector

Breakdown of estimated costs are presented in the following.

#### 7.2.1 Urban development and management

There is an enormous need for implementation of urban development and improvement. The project in this sector, however, is not necessarily implemented within the horizon of this master plan. In order to grasp the entire investment needs, total cost is estimated for full implementation of sub-centers development, upgrading of informal settlements, and development of large parks and greenery. Phasing of the project implementation is made on an equal percentage basis. Table 7.2 shows the cost estimation for the urban sector projects.

**Table 7.2: Cost Estimation for Transport Projects by Phase**

No.	Project	Components	Cost (US\$10 <sup>6</sup> )			Total
			Phase 1	Phase 2	Phase 3	
UR-1	Sub-centers development <sup>1)</sup>	Total land area for building use: 183.1ha	51.9	51.9	51.9	155.6
UR-2	Upgrading of informal settlements <sup>2)</sup>	Total area: 10,905.0ha Total public area: 2,181.0ha (20% of total area)	218.1	218.1	218.1	654.3
UR-3	Parks and greenery <sup>3)</sup>	New large park area: 2,366.1ha New small park area: 62.0ha	197.7	197.7	197.7	593.1
			467.7	467.7	467.7	1,403.0

Note: 1) Buildings in sub-centers are assumed to be constructed by responsible government entities.

2) Drainage system improvement is included.

3) Planting of road side trees is excluded.

### 7.2.2 Transport infrastructure

The total amount of project costs for all the proposed transport sector projects is shown by category in Table 7.3. The total project cost amounts to US\$ 2,116.9 million. The investment costs are allocated to different phases according to the implementation schedule ideal for the transport sector development presented in Chapter 5. The total investment cost in each phase is 23.7% in Phase 1, 23.4% in Phase 2 and 52.9% in Phase 3.

**Table 7.3: Breakdown of Cost Estimation for Transport Projects by Phase**

No.			Project name/Category		Phase	Project Component	Length (km)	ROW	No.of Lane	Unit Price (US\$ Mil./km)	Initial cost (US\$10 <sup>6</sup> )			
											Phase 1	Phase 2	Phase 3	Total
MA-1	Bagram	Bagram Road Up-grading	RD	2	Widened fm 4lane to 8lane	10.8	100	8	2.12		22.9		22.9	
				3	2-lane frontage road	10.8	100	8	3.16			34.1	34.1	
MA-2		Extension of Bagram Road (KCCIR)	RD	1	New 6lane	8.7	60	6	3.42	29.8			29.8	
				3	2-lane frontage road	8.7	60	6	3.88			33.8	33.8	
MA-3	West East	West-East Axis (Qula-i-jabbar Section) (KCCIR)	RD	2	New 6lane + frontage road	5.2	60	6	3.42		17.8		17.8	
MA-4		West-East Axis (Asmay Tunnel Section) (KCCIR)	RD	3	New 6lane tunnel	5.5	40	6	15.30			84.2	84.2	
MA-5		West-East Axis (Bagrami Section)	RD	1	New 4lane + frontage road	12.4	60	6	3.03	37.6			37.6	
MA-6	Ring Road	KCORR (Existing City)	RD	1	New 2lane	83.7	100	2	1.57	131.7			131.7	
				3	widened fm 2lane to 4lane	83.7	100	4	1.86			155.9	155.9	
MA-7		KCORR (New City)	RD	1	New 2lane	18.8	100	2	1.85	34.7			34.7	
				3	widened fm 2lane to 4lane	18.8	100	4	2.34			44.0	44.0	
MA-8		KCIRR (North Section)	RD	1	New 6lane + frontage road	2.6	60	6	3.42	8.9			8.9	
MA-9		KCIRR (Jalalabad Road)	RD	1	Widened fm 4lane to 6lane	4.5	60	6	1.68	7.6			7.6	
MA-10		KCIRR (West Section) -1	RD	1	New 6lane + wide sidewalk	3.9	50	6	3.42	13.3			13.3	
MA-11		KCIRR (West Section) -2	RD	1	Widened fm 2lane to 6lane + wide sidewalk	4.0	50	6	1.68	6.7			6.7	
MA-12		Radial Arterial	Mazar-e Sharif Road Up-grading	RD	1	Widened fm 2lane to 4lane + wide sidewalk	13.5	40	4	0.84	11.4			11.4
MA-13			Jalalabad Road	RD	3	Widened fm 2lane to 4lane	10.3	30	4	0.84			8.7	8.7
MA-14	Bagrami Road		RD	1	Widened fm 4lane to 6lane	4.4	50	6	1.68	7.4			7.4	
MA-15	Logar Road		RD	2	Widened fm 2lane to 6lane	15.8	40	6	0.84		13.3		13.3	
MA-16	New Road		RD	1	New 4lane	7.3	30	4	1.93	14.1			14.1	
MA-17	Barikab Road		RD	3	New 6lane + frontage road	11.9	70	6	3.42			40.7	40.7	
				3	New 6lane	2.5	40	6	15.30			38.3	38.3	
A-1	Road Project	Airport Road(West Section)	RD	1	New 6lane + frontage road	16.0	60	6	2.57	41.0			41.0	
A-2		Airport Road(East Section)	RD	2	New 4lane	2.8	30	4	1.45		4.1		4.1	
A-3		Arterial Road	RD	2	New 4lane	5.4	30	4	1.45		7.8		7.8	
A-4		Arterial Road	RD	3	New 4lane	7.9	30	4	1.45			11.4	11.4	
A-5		Arterial Road	RD	1	New 4lane	5.6	30	4	1.45	8.1			8.1	
A-6		Arterial Road	RD	1	New 4lane + frontage road	12.0	50	4	1.89	22.7			22.7	
A-7		Arterial Road	RD	2	New 2lane	11.2	30	2	1.32		14.8		14.8	
A-8		Arterial Road	RD	3	New 4lane	11.7	30	4	1.45			16.9	16.9	
A-9		Arterial Road	RD	3	New 4lane + wide sidewalk	12.6	40	4	1.52			19.1	19.1	
A-10		Arterial Road	RD	2	New 4lane	16.6	30	4	1.45		24.0		24.0	
A-11		Arterial Road	RD	3	Widened fm 2lane to 4lane	10.4	30	4	0.63			6.6	6.6	
A-12		Darulaman Road	RD	1	Widened fm 2lane to 4lane + frontage road	5.0	60	4	0.63	3.2			3.2	
				3	New 2lane	12.3	20	2	1.32			16.2	16.2	
A-13		Arterial Road	RD	2	New 4lane	3.2	30	4	1.45		4.6		4.6	
A-14		Arterial Road	RD	3	New 4lane	4.9	40	4	1.52			7.4	7.4	
A-15		Arterial Road	RD	2	New 2lane	6.1	30	2	1.32		8.1		8.1	
A-16		Arterial Road	RD	3	New 2lane	6.7	30	2	1.32			8.8	8.8	
A-17	Arterial Road	RD	3	New 2lane	3.0	20	2	1.32			4.0	4.0		
S-1	Minor Arterial	Minor Arterial Roads	RD	1	New 2lane	30.0	16	2	0.70	21.1			21.1	
				2	New 2lane	30.0	16	2	0.70		21.1		21.1	
				3	New 2lane	39.3	16	2	0.70			27.6	27.6	
C-1	Pavement	Pavement of Other Roads	RD	1	New 2lane	120.0	10	2	0.35	42.2			42.2	
				2	New 2lane	120.0	10	2	0.35		42.2		42.2	
				3	New 2lane	124.0	10	2	0.35			43.6	43.6	
PT-1	Public Transport and Logistics	Bus Terminal	PT/LG	1	4 Terminals					12.0			12.0	
PT-2		Bus Terminal	PT/LG	1	4 Terminals					7.5			7.5	
PT-3		Existing Bus Terminal Improvement	PT/LG	1	4 Terminals					6.9			6.9	
PT-4		BRT (Line1) 30.2km	PT/LG	2		30.2			10.00		302.0		302.0	
PT-5		BRT (Line2) 32.1km	PT/LG	3		32.1			10.00			321.0	321.0	
PT-6		BRT (Line3) 11.0km	PT/LG	3		11.0			10.00			110.0	110.0	
PT-7		LRT	PT/LG	4		26.0			30.00			78.0	78.0	
PT-8		Logistics	Public Truck Terminals	PT/LG	3					15.0	5.0	5.0	25.0	
TM-1	Traffic Management	Parking	TM	1	7 Parkings					1.6			1.6	
TM-2		Intersection	Improvement of Roundabout ( incl. traffic signal)	TM	1,2,3					5.0	5.0	5.0	15.0	
TM-3		Improvement of Roundabout (flyover of KCIRR)	TM	1,2	1 flyovers					10.0			10.0	
TM-4		Others	Road Safety and Pedestrian Crossing	TM	1,2					2.3	2.0		4.3	
Total			-							501.8	494.7	1,120.3	2,116.9	

Note: KCORR: Kabul city outer ring road; KCIRR: Kabul city inner ring road; BRT: bus rapid transit;

LRT: light rail transit; RD: Road; PT/LG: public transport; TM: traffic management

The investment cost for LRT is estimated only up to 2025. Additional US\$ 702 million will be needed beyond 2025.

Source: Planning Team



### 7.2.3 Water sector infrastructure

Table 7.4 shows estimated costs for water supply projects with desired implementation schedule. The total cost for the full development is estimated to be US\$ 16,333.9 million including the construction of Shatoot Dam and the “Project09” components. The total investment cost in each phase is 32.9% in Phase 1, 55.6% in Phase 2 and 11.5% in Phase 3.

**Table 7.4: Breakdown of Cost Estimation for Water Supply Projects by Phase**

No.	Benefit Area	Project	Initial cost (US\$10 <sup>6</sup> )			
			Phase 1	Phase 2	Phase 3	Total
WK-1	District 1-12 & 16	Distribution Network for central area, existing plan (Project 09)	104.4	34.8	0.0	139.2
WK-2	City, whole	Shatoot dam and water treatment plant 345,600m <sup>3</sup> /d	330.7	155.6	0.0	486.3
WK-3	City, whole	Water supply improve for KB city (water transmission network, transmission station)	38.6	147.0	0.0	185.6
WK-4	District 5	Distribution Network over Project 09 and reservoir	0.0	50.0	0.0	50.0
WK-5	District 6 & 7	Distribution Network over Project 09 and reservoir	45.9	72.8	72.8	191.5
WK-6	District 8	Distribution Network over Project 09 and reservoir	0.0	2.2	41.7	43.9
WK-7	District 10 & 11	Distribution Network over Project 09 and reservoir	1.7	30.0	0.0	31.7
WK-8	District 12	Distribution Network over Project 09 and reservoir	0.0	53.0	32.4	85.4
WK-9	District 15	Distribution Network over Project 09 and reservoir	0.0	31.4	19.2	50.6
WK-10	District 16	Distribution Network over Project 09 and reservoir	0.0	56.7	0.0	56.7
WK-11	District 17	Distribution Network over Project 09 and reservoir	0.0	195.2	0.0	195.2
WK-12	District 21	Distribution Network over Project 09 and reservoir	0.0	36.3	22.2	58.5
WK-13	Industrial parks	Industrial water treatment plant 33,000m <sup>3</sup> /d	13.3	35.1	0.0	48.4
WK-14	Industrial parks	Industrial water supply for KB city	2.7	8.2	0.0	10.9
Total			537.3	908.3	188.3	1,633.9

### 7.2.4 Sewerage system development

Table 7.5 shows estimated costs for sewerage projects with desired implementation schedule. The total cost for the full development is estimated to be US\$ 473.4 million. The total investment cost in each phase is 16.9% in Phase 1, 51.7% in Phase 2 and 31.4% in Phase 3.

**Table 7.5: Breakdown of Cost Estimation for Sew Projects by Phase**

PJ No	Benefit Area	Project	Initial cost (US\$10 <sup>6</sup> )			
			Phase 1	Phase 2	Phase 3	Total
SK-1	Northern part	North zone sewage treatment plant 94,000m <sup>3</sup> /d	35.5	28.0	36.5	100.0
SK-2	Southern part	South zone sewage treatment plant 98,000m <sup>3</sup> /d	8.0	55.5	36.5	100.0
SK-3	District 12 & 21	District 12&21 sewage treatment plant 25,000m <sup>3</sup> /d	2.1	27.6	13.3	43.0
SK-4	Northern part	Sewer network for northern part of KB city	25.8	62.1	11.8	99.7
SK-5	Southern part	Sewer network for southern part of KB city	6.7	54.5	33.6	94.8
SK-6	District 12 & 21	Sewer network for District 12&21 of KB city	1.8	16.9	16.8	35.5
SK-7	Industrial parks	Sewer network for industrial parks of KB city	0.2	0.3	0.0	0.5
Total			80.1	244.9	148.5	473.4

### 7.2.5 Power distribution

As the basic power supply system has been mostly established as of year 2010, the most critical issue of the power supply system in Kabul City is to develop stable power distribution system. The key to this is to construct four S/Ss, by which possibility of accidental power down can be reduced. Cost and schedule of implementing these S/Ss are summarized in Table 7.6. It should be noted that construction of Dasht-e-Barch S/S is not included in the table as the S/S is already under construction.

**Table 7.6: Cost Estimation for Key Power Distribution Construction Project by Phase**

No.	Benefit Area	Project	Initial cost (US\$10 <sup>6</sup> )			
			Phase 1	Phase 2	Phase 3	Total
PW-1	KM East and New City	Dehsabz South S/S	29.0			29.0
PW-2	Kabul City center	Central S/S		27.0		27.0
PW-3	South East of Kabul City	South East S/S		26.0		26.0
PW-4	KM North and New City	Paymanor S/S			65.0	65.0
Total			29.0	53.0	65.0	147.0

Note: Sub-stations which simply converts 220 kV outer lines and additional installation are not included  
Facilities for 20 kV distribution system are excluded

## 7.2.6 ICT network

Costs for construction of key facilities and installation of equipment for components the proposed ICT network development project are summarized in Table 7.7. The estimate covers construction of PVC ducting, manholes, hand holes and optical fiber cable placement, as key network development components. The remaining parts of the network, including so called the last-one-mile portion, are expected to be developed by private sector service providers and end users. Table 7.8 shows the implementation schedule, assuming a constant pace of investment by responsible authorities.

**Table 7.7: Breakdown of Cost Estimation for ICT Development Project**

Item	Volume/Quantity	Cost (US\$)
Total Length of the Network route	120km	
Total Length of PVC Ducts	480km (120 x 4)	564,700
Total Number of Manholes	300 Nos. (Under Carriage way)	176,400
Total Number of Hand holes	150 Nos. (Under Footway)	88,200
Total Length of FOC	170km	1,400,000
Total Number of Splice box	60 Nos.	42,300
Sub-total 1		2,271,600
As for Tools and equipments for testing and operation:		
OTDR (Optical Time-Domain Reflectometer)	3 (three) sets	60,000
Fiber splicing machine	3 (three) sets	75,000
Fiber Cutter	3 (three) sets	4,500
Power Meter	3 (three) sets	3,000
Optical Telephone set	3 (three) sets	2,100
Sub-total 2		144,600
Grand Total		2,416,200

Note: 1) Did not include contingency and Consultant cost

2) The cost estimation based on work demarcation shown in item 3.5 (Schematic ICT system plan and work demarcation)

**Table 7.8: Cost Estimation for ICT Development Project by Phase**

No.	Benefit Area	Project	Cost (US\$ 10 <sup>3</sup> )			
			Phase 1	Phase 2	Phase 3	Total
ICT-1	Entire City	ICT network development	805.4	805.4	805.4	2,416.2
Total			805.4	805.4	805.4	2,416.2

## 7.2.7 Solid waste management

The estimated cost for solid waste management projects identified in section 6.6 is shown in Table 7.7.

**Table 7.9: Cost Estimation for Solid Waste Management Project by Phase**

No.	Benefit Area	Project	Cost (US\$ 10 <sup>3</sup> )			
			Phase 1	Phase 2	Phase 3	Total
SWM-1	Entire City	Waste containers & collection vehicles	0	233	4,916	5,148
SWM-2	Ditto	Transfer station	2,500	2,500	0	5,000
SWM-3	Ditto	Manual sorting facility	0	1,850	1,850	3,700
SWM-4	Ditto	Compost plant	0	3,000	0	3,000
SWM-5	Ditto	Night soil treatment plant	1,000	1,000	0	2,000
SWM-6	Ditto	Autoclave	0	0	1,300	1,300
SWM-7	Ditto	Landfill	13,333	14,333	14,933	42,600
Total			16,833	22,916	22,999	62,748

### 7.3 Project cost to be implemented by Kabul Municipality

Among all the projects listed in section 7.2, some are responsible for implementation by the Kabul Municipality, while others are by various forms of central government agencies or public enterprises. Costs for projects to be implemented by the Kabul Municipality are estimated in this section. These projects are identified by sector and by size or function of facilities. Table 7.10 shows fund requirement for full implementation of proposed projects to be invested by the Kabul Municipality.

**Table 7.10: Estimated Cost for Municipal Projects by Phase**

Sector	No.	Project	Cost (US\$10 <sup>6</sup> )			
			Phase 1	Phase 2	Phase 3	Total
Urban	UR-1	Sub-centers development1)	51.9	51.9	51.9	155.7
	UR-2	Upgrading of informal settlements2)	218.1	218.1	218.1	654.3
	UR-3	Parks and greenery3)	197.7	197.7	197.7	593.1
		<i>Subtotal</i>	<i>467.7</i>	<i>467.7</i>	<i>467.7</i>	<i>1,403.1</i>
Transport	A-1	Airport Road(West Section)	41.0			41.0
	A-2	Airport Road(East Section)		4.1		4.1
	A-3	Arterial Road		7.8		7.8
	A-4	Arterial Road			11.4	11.4
	A-5	Arterial Road	8.1			8.1
	A-6	Arterial Road	22.7			22.7
	A-7	Arterial Road		14.8		14.8
	A-8	Arterial Road			16.9	16.9
	A-9	Arterial Road			19.1	19.1
	A-10	Arterial Road			24.0	24.0
	A-11	Arterial Road			6.6	6.6
	A-12	Darulaman Road	3.2		16.2	19.4
	A-13	Arterial Road		4.6		4.6
	A-14	Arterial Road			7.4	7.4
	A-15	Arterial Road		8.1		8.1
	A-16	Arterial Road			8.8	8.8
	A-17	Arterial Road			4.0	4.0
	S-1	Secondary Roads	21.1	21.1	27.6	69.8
	C-1	Pavement of Community Roads	42.2	42.2	43.6	128.0
	TM-1	Public Off-Street Parking	1.6			1.6
	TM-2	Improvement of Roundabout ( incl. traffic signal)	5.0	5.0	5.0	15.0
	TM-3	Improvement of Roundabout (flyover of KCIRR)	30.0	30.0		60.0
	TM-4	Road Safety and Pedestrian Crossing	2.3	2.0		4.3
		<i>Subtotal</i>	<i>177.2</i>	<i>139.7</i>	<i>190.6</i>	<i>507.5</i>
Solid waste	SWM-1	1. Waste containers & collection vehicles	0.0	0.2	4.9	5.1
	SWM-2	2. Transfer station	2.5	2.5	0.0	5.0
	SWM-3	3. Manual sorting facility	0.0	1.9	1.9	3.7
	SWM-4	4. Compost plant	0.0	3.0	0.0	3.0

Sector	No.	Project	Cost (US\$10 <sup>6</sup> )			
			Phase 1	Phase 2	Phase 3	Total
	SWM-5	5. Night soil treatment plant	1.0	1.0	0.0	2.0
	SWM-6	6. Autoclave	0.0	0.0	1.3	1.3
	SWM-7	7. Landfill	13.3	14.3	14.9	42.6
		<i>Subtotal</i>	<i>16.8</i>	<i>22.9</i>	<i>23.0</i>	<i>62.7</i>
<b>Grand total</b>			<b>661.7</b>	<b>630.3</b>	<b>681.3</b>	<b>1,973.3</b>

## **SUPPLEMENTALY REPORT**

### **1. Recommendations for Future Urban Planning and Management System in Kabul City**

There are various kinds and levels of urban problems taking place in Kabul city. While there is a serious security issues, citizens face difficulty in their everyday lives caused by traffic jams, unstable water and power supply, lack of access to education, health, and other public services, etc. These are mostly attributable to the delay of infrastructure development, as it is generally the case in any developing countries.

In the case of Kabul City, however, a very rapid growth of population has been taking place, on top of the needs for rehabilitation of existing infrastructure, almost all of which were heavily damaged during the time of conflicts. As a result, the majority of the city's built-up area is now covered by unplanned settlements, causing further difficulty for infrastructure development.

As it is often pointed out by various entities, the current urban planning and management system adopted in Kabul is not functioning effectively to resolve these vast and serious urban development issues.

#### **1.1 Characteristics of the Conventional System**

##### **(1) Formal procedure for obtaining building permission**

The conventional urban planning and management practiced in Kabul is basing on the system developed in former Soviet Union. In this system, the master plan (general plan) is firstly formulated to provide general guidance to the structure plans and detail plans, which are to be prepared seeking smooth super-block estate development. After implementation of such estate development, the government would distribute land plots to applicants who seek lands mostly for their housing needs. The process of building permission would be followed for these officially obtained land plots before construction of buildings.

##### **(2) Problems in conventional system**

Various infrastructures related government entities have been formulating their own development plans in their responsible sector. In this process, policies established by the last master plan were largely ignored, as it does not fit the current urban situation. As a result, almost all the structure plans prepared in earlier stage, but not implemented, become obsolete. Existing detail plans also become obsolete and not practical as the occupancy of land expands in the target areas. These call for revision of both structure plans and detail plans.

The revision and preparation of these plans, however, require significant time and financial resources as they have to comply with the standards for planning, which were originally taken from the Soviet's planning standard (SNiP). As a result, the preparation of detail plans and its implementation proceeded at very marginal speed against the increasingly rushing demands for housing plots caused by rapid population increase.

Consequently, people started to avoid taking the official procedure to obtain their land. Lands and buildings are grabbed, or purchased directly from farmers, land grabbers, etc. and formed a vital property market, backed by large housing demand. For lands obtained in this manner, the owners construct houses and/or other buildings without obtaining building permissions from the municipality, resulting in the formulation of unplanned areas.

In conclusion, the direct supply of land plots by the municipality did not meet the demand and will continue to be so, as the conventional system takes significant time for technical and administrative reasons, as well as shortage of funds for the estate development.

## **1.2 Need for coping with market mechanism**

### **(1) Missing functions in urban planning and management in Kabul**

The current rapid population growth is expected to continue for some time. This will inevitably call for further demands for housing and infrastructure development. To meet this requirement, it is necessary to shift the policy to largely rely on the efforts by citizens and private developers on the land obtained through the property market. The main role of the urban planning and management, thus, has to shift from the direct provision of developed land by the government to the control and guidance of land use practiced by the private entities.

### **(2) Need for establishment of workable land use control mechanism**

As the conventional system was primarily designed for the direct provision of lands, the mechanism to control the private land use is not well integrated, although the 1998 master plan was used for this purpose for some time. A set of land use control system needs to be introduced in the urban planning and management system in the current and future urban areas of the municipality.

## **1.3 Proposed Urban Planning and Management System in Kabul**

### **(1) Introduction of Zoning Plan and Regulation System**

The land use control system developed and adopted in many cities in the world generally consists of two kinds: 1) a master plan, and 2) zoning plan.

The master plan generally provides the future vision of the city depicted by indicative maps showing areas for urban use, urban nodes and envisaged transport infrastructure. The plan aims at sharing a common view of the future of the city with its citizens and other entities practicing urban activities. The policy of major changes in the future urban structure is vitally drawn, as it affects people's lives and business activities. The plan shows changes and differences from the existing land use and other urban conditions as it is not aiming at directly controlling the land use of individual land plots.

The zoning plan, on the other hand, provides information of regulations imposed on any part of the land in its coverage area. The plan aims at explaining how the one's land plot can be used with what size and shape, etc. The plan is legally binding, and thus, has strong power over the right of land owners. Although the plan also seeks changes for the future needs, it usually does not impose changes to the existing land use in a drastic way. The plan needs to hold sequential policy consistency as it affects the right of the citizens and their property value. Thus the change of land use in the zoning plan is revised in a gradual manner.

There are several ways adopting these two kinds of plans. In many countries, one master plan with several zoning plans by different area is adopted, as it is simple and easy to be understood by citizens. There are countries/cities adopting hierarchical zoning maps; one for larger area, and another for smaller areas by sub-dividing the large area with smaller areas equipped by maps with more detailed restrictions. The advantage of the hierarchical system is that it is faster to introduce a minimum requirement to the city's entire urban area, while preparing more detailed regulations for smaller areas with participatory method, which calls for longer period of time.

## **(2) Introduction of Neighborhood Plan**

In the light of the present conditions of Kabul City, it is more suitable to adopt the hierarchical zoning system for the following reasons:

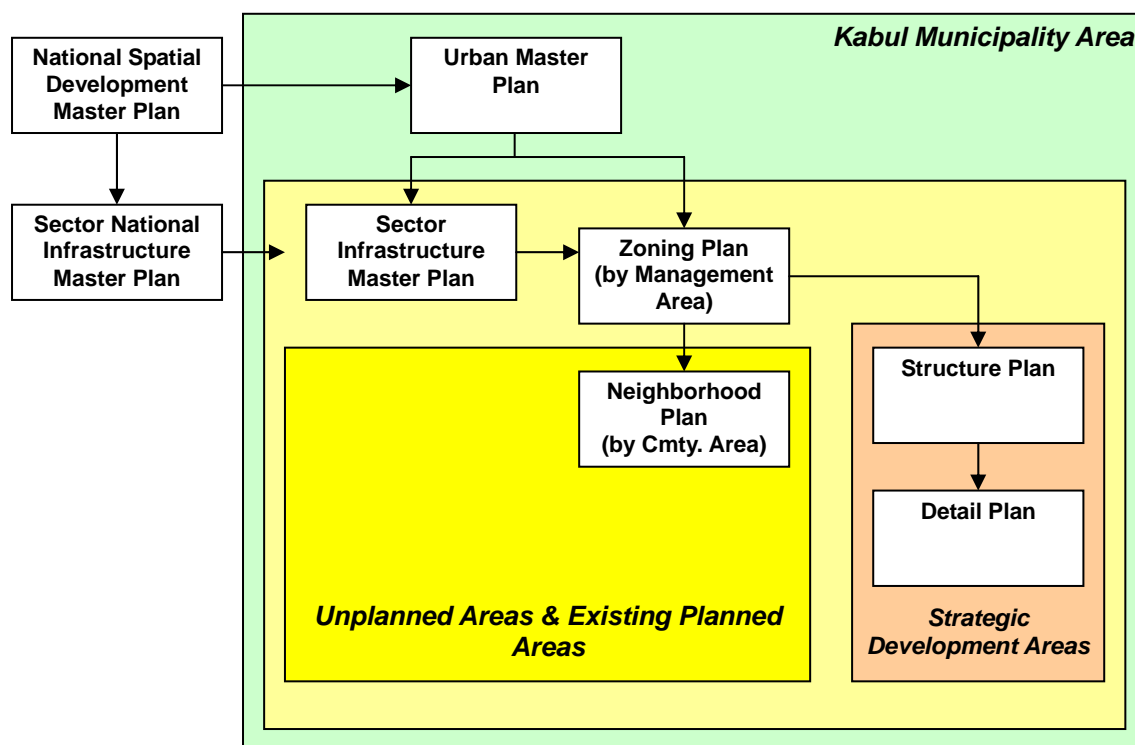
- 1) It is necessary to start controlling the vast unplanned areas as soon as possible, calling for quick preparation of large area zoning map with minimum restrictions, and
- 2) It is necessary to secure land for public purposes (general education, basic health care, etc.) in order to improve living environment of unplanned areas. This will inevitably require participation and agreement of communities.

Thus neighborhood plan system should also be introduced in Kabul City.

## **(3) Effective and efficient use of conventional methods**

The existing system for the estate development by the government should be remained and utilized by more effective and efficient manner. The system will play significant role if focusing on some strategic parts of the city to develop. By doing so, it could be a major factor to promote the change of urban structure by creating magnets for the urban activities. The experience of the direct development by the Kabul Municipality in the past will be fully applied to the systematic and quick implementation of key urban nodes.

The following Figure shows the composition of urban plans to be introduced in Kabul municipality.



**Figure S-1: Proposed Urban Planning and Management Structure for Kabul Municipality**

#### (4) Function of City Master Plan after introduction of Zoning System

The primary objectives of the city master plan for the Kabul Municipality are as follows:

##### Provision of future visions;

The long-term vision of the future of Kabul City remains undefined for some time. It is especially true after the project of the Dehsabz New City development was authorized and became on the track. The master plan needs to figure out the realistic and achievable shape of the city to the citizens, by clarifying at least the following factors:

- which parts of the city will become the new commercial nodes,
- which parts of the city will become residential areas, and
- what will be the transport system to connect these areas, as well as existing nodes and townships.

##### Provision of basic information for infrastructure planning and development

There are many government agencies responsible for infrastructure/utilities planning and implementation. The master plan needs to provide basic information with certain level of accuracy to enable planning of various infrastructure and public facilities by these entities. To this end, it is necessary to figure out the distribution of population in day time and night time. It is also important to show the time frame of the achievement of these distributions of population.



## **2 Recommended Components of the Zoning Map and Regulations**

### **2.1 Zoning Regulations in Urbanization Promotion Area**

The land use zoning is the most fundamental system of building control in urbanization promotion areas. The land use zoning regulates type of use, density, height and other restriction items relating to buildings. It is the most fundamental pillars in the land use regulation system of urban planning which is widely practiced in cities in the industrialized countries. The followings are the main objectives of the land use zoning system:

- i) To prevent problems caused by mingle of uses and to maintain or promote a favorable environment that accords with the characteristics of the target urban area.
- ii) To provide guidelines for appropriate allocations and rational density of residential, commercial, industrial and other uses in accordance with the future vision of the entire city and thus ensure efficiency in urban activities.

For Kabul City, six categories of the land use are defined to classify the characteristics of the built-up areas in the urban promotion areas. Two of them are dominantly for residential areas, while one for commercial, and another for industrial use. The remaining two categories are specified to promote the mixed use of residential and commercial activities. Acceptable uses of buildings are stipulated according to the level of protection of the residential environment.

**Table S-1: Characteristics by Land Use Zones**

Land use zone	Future Image	Target are to be designated
Low-rise residential	<ul style="list-style-type: none"> <li>i This zone shall be designated for the low-rise housings.</li> <li>ii The permitted buildings shall include facilities related to daily lives, such as daily shops, post offices, and schools.</li> <li>iii Small retail shops and office shall be allowed to occupy the part of housing.</li> <li>iv Individual buildings for business and commercial shall not be permitted.</li> </ul>	<ul style="list-style-type: none"> <li>i Areas dominantly occupied by low-rise housings in planned areas</li> <li>ii Unplanned areas to be directed to promote low-rise residential areas</li> <li>iii New built-up areas with mainly low-rise housings</li> </ul>
Middle-rise residential	<ul style="list-style-type: none"> <li>i This zone shall be designated for the middle-rise housings.</li> <li>ii The permitted buildings shall include facilities related to daily lives, such as daily shops, post offices, and schools.</li> <li>iii Commercial and offices shall be permitted at the ground and/or first floors, though individual buildings for those facilities shall not be allowed.</li> <li>iv Factories shall not be permitted.</li> </ul>	<ul style="list-style-type: none"> <li>i Areas dominantly occupied by middle-rise housings in planned areas</li> <li>ii New built-up areas with mainly middle-rise housings</li> </ul>
Low-rise mixed	<ul style="list-style-type: none"> <li>i This zone shall be designated for the mixed use of residential, commercial, and industrial.</li> <li>ii Individual buildings for business and commercial shall be permitted.</li> <li>iii Factories, which shall not cause the negative environmental impact without hazardous objects, shall be permitted.</li> </ul>	<ul style="list-style-type: none"> <li>i Unplanned areas which shall be remained with the mixed use</li> </ul>
Middle-rise mixed	<ul style="list-style-type: none"> <li>i This zone shall be designated for the mixed use of residential, commercial, and industrial.</li> <li>ii Individual buildings for business and commercial shall be permitted.</li> <li>iii Factories, which shall not cause the negative environmental impact without hazardous objects, shall be permitted.</li> </ul>	<ul style="list-style-type: none"> <li>i Mixed use of residential and commercial along main roads such as: <ul style="list-style-type: none"> <li>- Periphery of the middle-rise residential areas in planned areas</li> <li>- Unplanned areas along main roads</li> </ul> </li> </ul>
Commercial	<ul style="list-style-type: none"> <li>i This zone shall be designated to promote the commercial areas.</li> </ul>	
Industrial	<ul style="list-style-type: none"> <li>i This zone shall be designated for the industrial use including factories causing the negative environmental impact with the hazardous objects.</li> <li>ii This zone shall not permit the residential use and buildings related to the daily lives such as schools and libraries.</li> </ul>	<ul style="list-style-type: none"> <li>i Industrial parks, logistic parks, and others related to manufacturing and processing</li> </ul>

**Table S-2: Control of Building Use by Land Use Zones**

Purpose of Building		Low-rise residential	Middle-rise residential	Low-rise mixed	Middle-rise mixed	Commercial	Industrial
Residential	Housing						
	Housing with small-scale shop and office <50 m <sup>2</sup> and half of total floor area <sup>1)</sup>						
Public facility	Kindergarten, elementary, secondary, and tertiary schools						
	University and vocational school						
	Library						
	Religious						
	Clinic and nursery school						
	Hospital						
	Post office and police station						
	Tax office, police office, health care center, and fire station						
Commercial and Business	Commercial and office <500 m <sup>2</sup> in total at the ground and first floors						
	Commercial and office <500 m <sup>2</sup>						
	Commercial and office >500 m <sup>2</sup>						
	Hotel						
	Sport (bowling, swimming, etc.)						
	Theater						
	Warehousing business						
Industry	Car parking (individual building)						
	Car parking attached to a building						
	Car maintenance factory						
	Factory with causing very limited environmental impact						
	Factory with environmental impact						
	Factory with very limited hazardous objects						
	Factory with hazardous objects						
Other	Wholesale market, crematory, slaughter, cemetery	To be designated in a master plan					

Note

■ Not permitted to build.

- 1) Small-scale shop and office with the floor area not greater than 50 m<sup>2</sup> shall be permitted in a house.
- 2) Commercial use for a supermarket with the floor area not greater than 500 m<sup>2</sup> shall be permitted.

Each category of land use zone designates some technical requirements to regulate the form of a building. They include building coverage ratio (the maximum ratio of building area to a site), floor area ratio (the maximum ratio of the total floor area of a building to a site), maximum height of a building, minimum setback from a frontage road, and minimum size of a land plot.

- 1) Low-rise residential: The floor area ratio (FAR) in the existing residential areas situated in the planned area is estimated at the favorable level at 120% (= 60% of the building coverage ratio x two floors in average). The FAR of the low-residential area shall be set at 150% to succeed this favorable density. Construction of three-stories buildings may be allowed. The BCR shall be set at 60%.  
The size of a land plot in the existing residential areas in the planned area varies from 300 to 400 m<sup>2</sup> with the average at 330 m<sup>2</sup>. Most (more than 95%) of land plots in the unplanned areas have the land area of more than 260 m<sup>2</sup>. Thus, the minimum size of the land plot shall be set at 250 m<sup>2</sup>.
- 2) Middle-rise residential: The Microrayon complex is formed with the FAR at 80% and the BCR at 16% respectively. Those indices express that the middle-rise housing complexes have been developed with the plenty of open spaces. Thus, the middle-rise residential shall be designated with the FAR at 30% and the BCR at 100%, respectively.
- 3) Commercial: The FAR shall be set at 400% with the BCR at 80% to allow the five-stories buildings.
- 4) Middle-rise mixed: The FAR shall be set at 300% with the BCR at 60% to be relatively stricter than those of the commercial.
- 5) Low-rise mixed: The FAR shall be set at 200% with the BCR at 60% to be lower density than the middle-rise mixed.
- 6) Industrial: Existing industrial area is formed with the BCR at 20%. The FAR and BCR shall be set at 30% and 100% to permit the extension of existing buildings in the future.

**Table S-3: Floor Area Ratio, Building Coverage Ratio**

	Low-rise residential	Middle-rise residential	Low-rise mixed	Middle-rise mixed	Commercial	Industrial
Floor area ratio (%)	150	100	200	300	400	100
Building coverage ratio (%)	60	30	60	60	80	30
Height of building (m)	12	-	-	-	-	-
Setback from front road (m)	-	-	-	-	-	2
Minimum size of a land plot (m <sup>2</sup> )	250	-	-	-	-	-

Following figures are example of the zoning map prepared for existing formal and informal settlement areas in Kabul City.

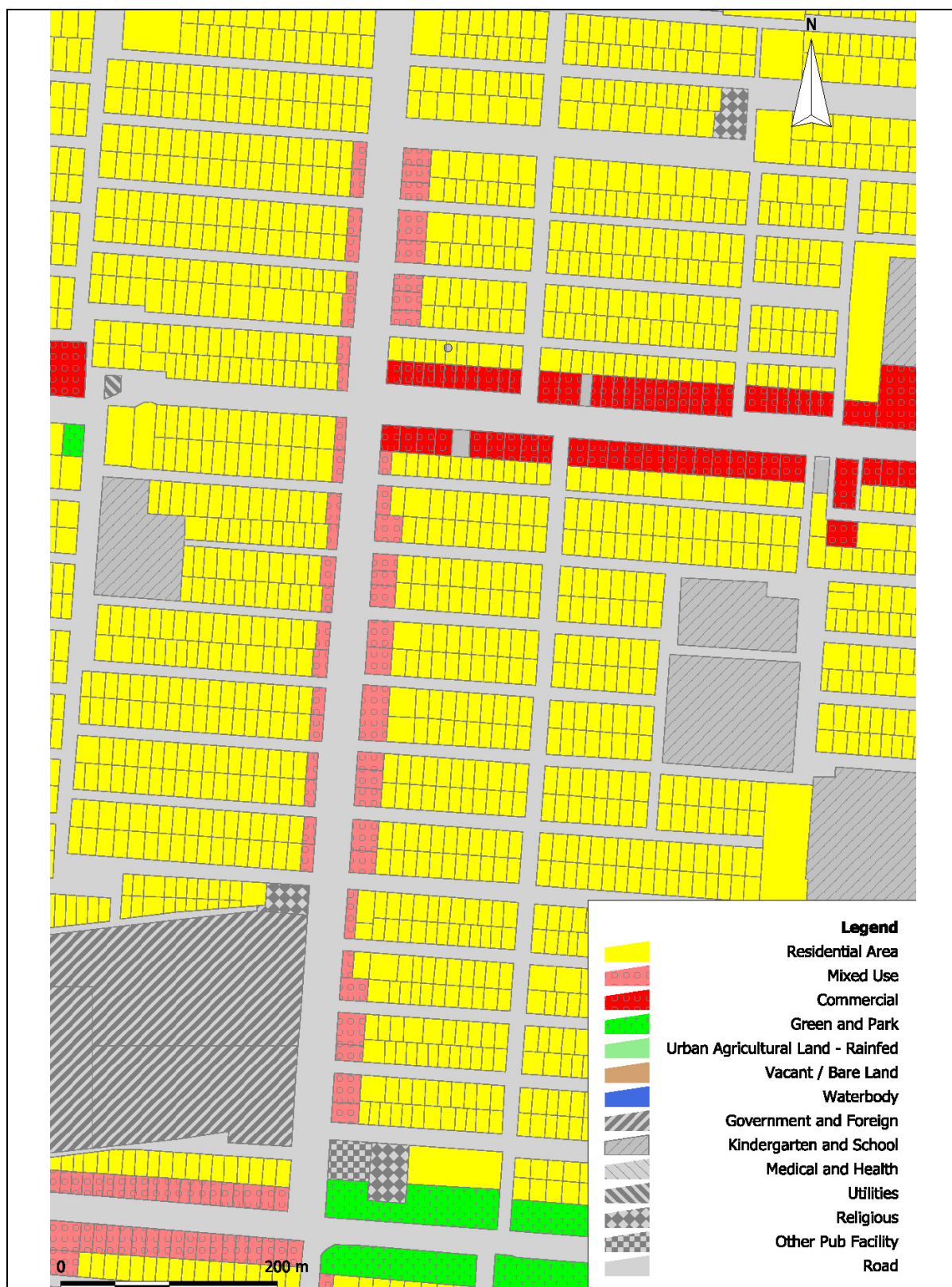


Figure S-2: Existing Land Use of Formal Settlement Area



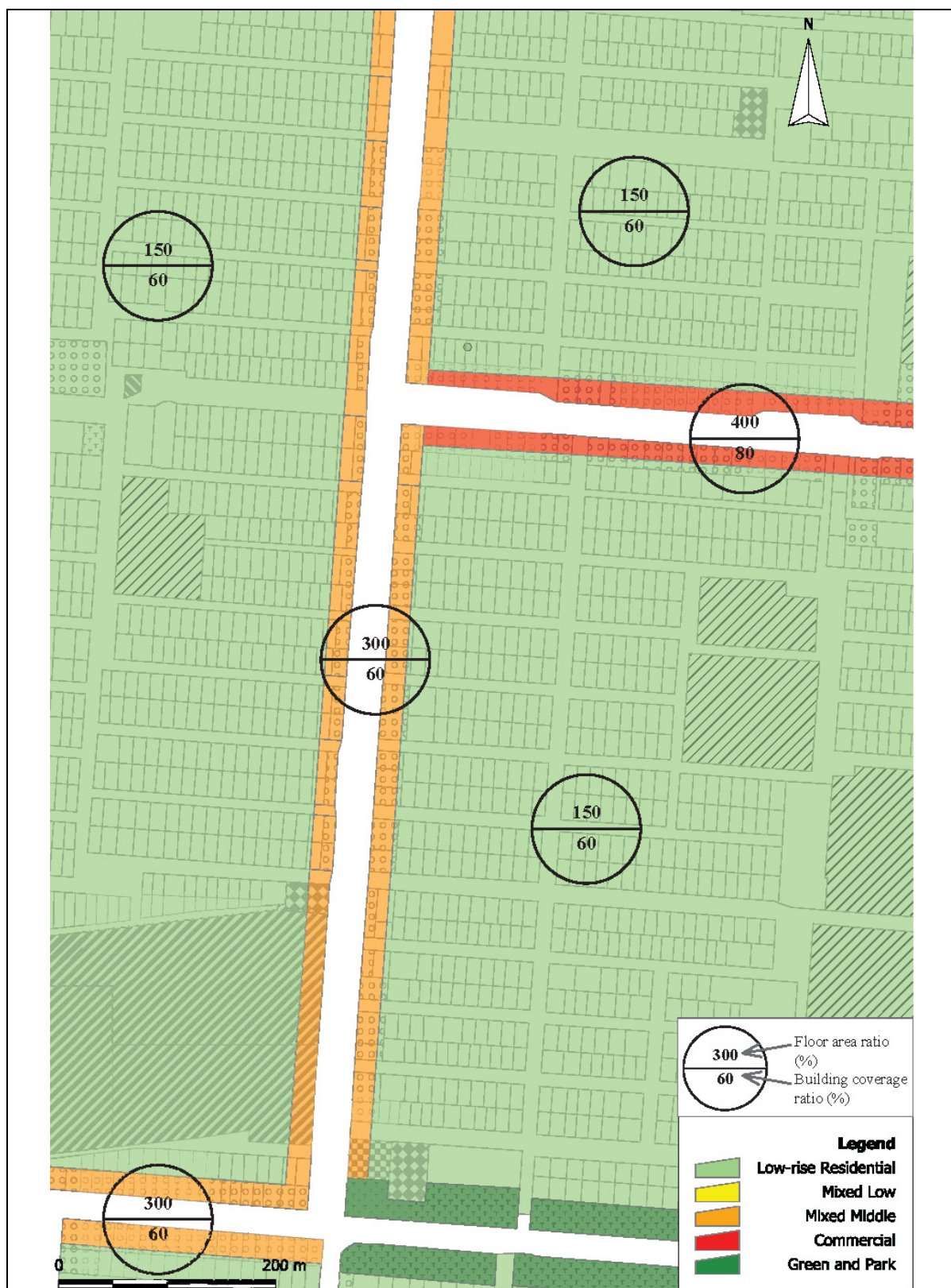


Figure S-3: Example of Zoning Map for Existing Formal Settlement Area

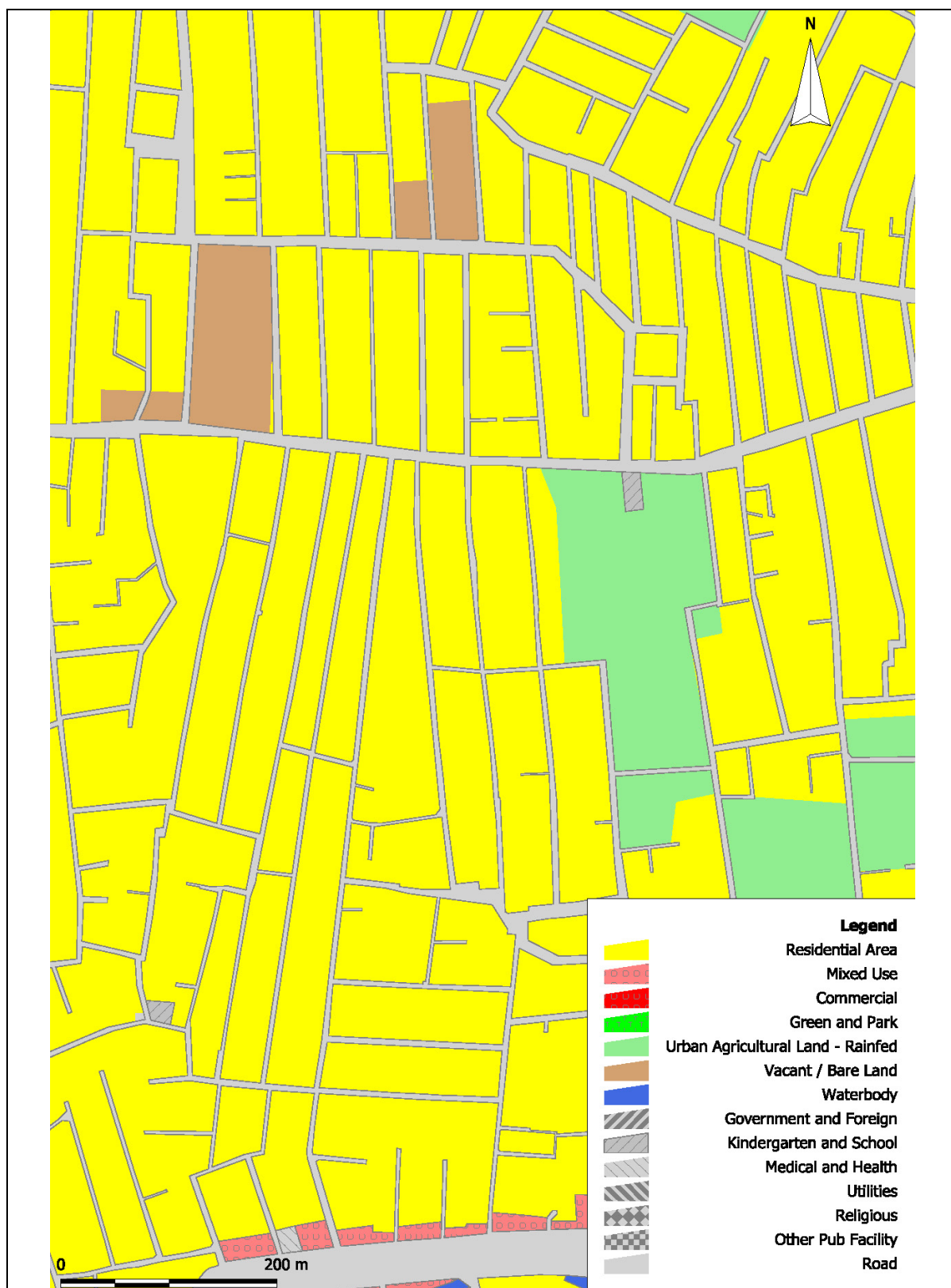


Figure S-4: Existing Land Use of Informal Settlement Area

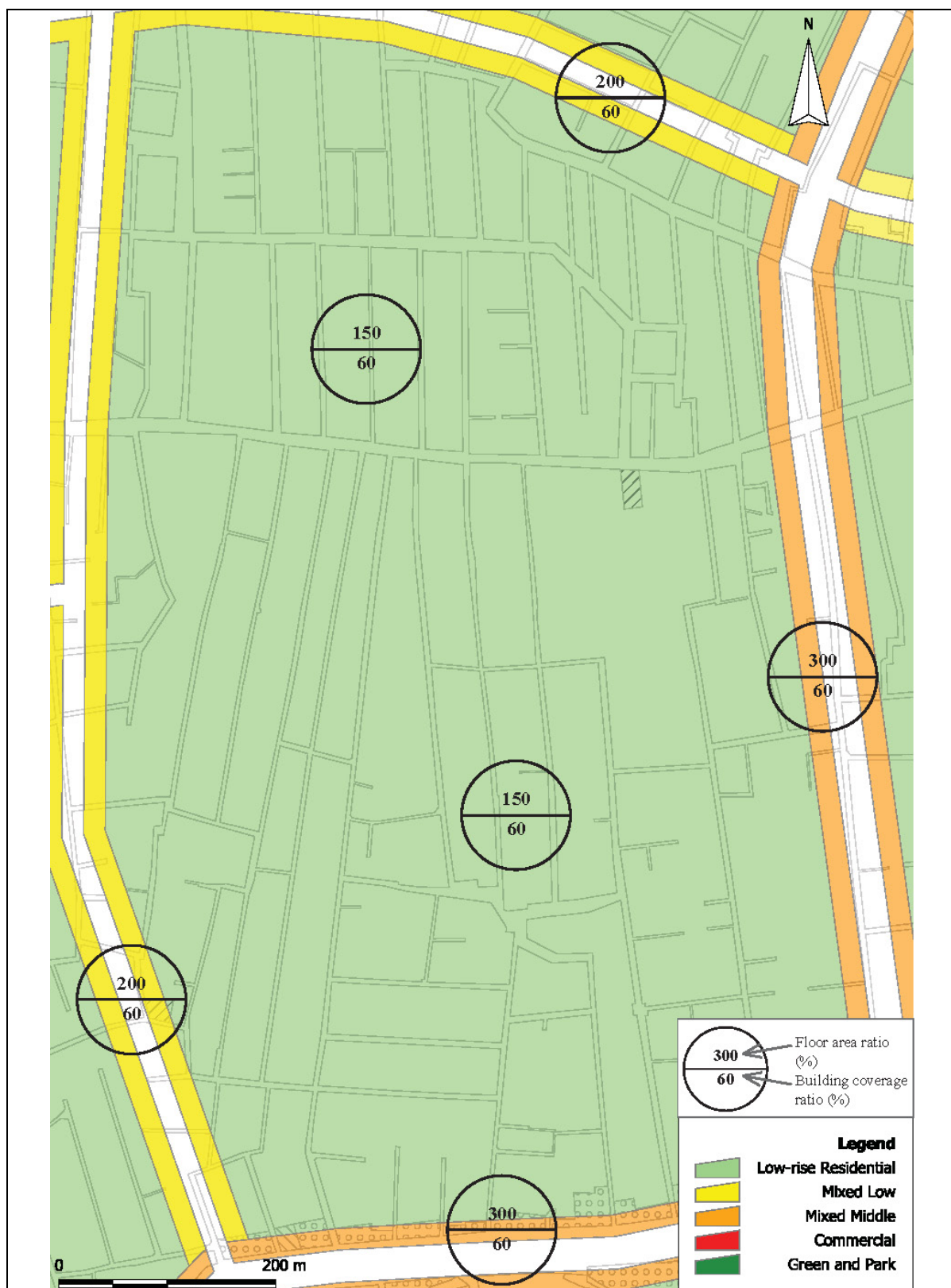


Figure S-5: Example of Zoning Map for Existing Informal Settlement Area



## 2.2 Requirements for Car Park, Wastewater Treatment, and Infiltration Pit

### (1) Car park

The capital cities in the developing countries have experienced a rapid growth in the number of private vehicles. Its growth exceeds over the capacity of the road network and causes heavy traffic jam. In many cases, the private cars parked along streets hinder the traffic movement and deteriorates the level of traffic safety for the pedestrians. The countermeasure for arrangement of car parks shall be required to improve the traffic conditions in the early stage. The technical requirements of car parks for detached housing, multi-story housing, and special kinds of buildings are examined in the following.

- 1) Detached housing shall be designed to allocate a car park for at least one car.
- 2) Multi-story housing with more than 2,000 m<sup>2</sup> of the total floor area shall be designed to allocate a car park for at least 30% of the number of housing units.
- 3) Special buildings used by a number of people shall be designed to have a car park. The special building shall include theaters, public halls, exhibition halls, wedding halls, funeral halls, hotels, restaurants, amusement parks, bowling halls, department stores, gymnasiums, offices, hospitals, wholesale markets, and stock yards. The car park shall be designed to accommodate an estimated number of cars on the basis of the following equations:

i)  $A_e = A_s + A_o \times 3/4$

Where;

A: Total floor area of a building

A<sub>s</sub>: Floor area for special uses (m<sup>2</sup>)

$$= A - A_o$$

$$= A_c + A_{so}$$

A<sub>c</sub>: Floor area for commercial (m<sup>2</sup>)

A<sub>so</sub>: Floor area for special uses other than commercial (m<sup>2</sup>)

$$= \sum A_i + A_{office} \times C_{office}$$

(A<sub>i</sub>: Floor area for each special use other than office,

A<sub>office</sub>: Floor area for office,

C<sub>office</sub>: Coefficient

$$= 1.0 (A_{office} < 10,000 \text{ m}^2)$$

$$= 0.7 (A_{office} < 50,000 \text{ m}^2)$$

$$= 0.6 (A_{office} < 100,000 \text{ m}^2)$$

$$= 0.5 (A_{office} > 100,000 \text{ m}^2)$$

A<sub>o</sub>: Floor area other than special uses (m<sup>2</sup>)

A<sub>e</sub>: Floor area for estimation

If A<sub>e</sub> is greater than 1,500 m<sup>2</sup>, the required number of car parking lots shall be estimated by the following equation.

ii)  $N = (A_c/200 \text{ (m}^2) + A_{so}/250 \text{ (m}^2) + A_o/300 \text{ (m}^2)) \times C$

Where;

N: Number of cars to be parked (car)

(minimum two cars)

C: Coefficient

$$\text{If } A \text{ is } 6,000 \text{ m}^2 \text{ or less, } C = (1,500 \text{ (m}^2) \times (6,000 \text{ (m}^2) - A \text{ (m}^2))) /$$

$$(6,000 \text{ (m}^2\text{)} \times A_t \text{ (m}^2\text{)} - 1,500 \text{ (m}^2\text{)} \times A \text{ (m}^2\text{)})$$

If A is more than 6,000 m<sup>2</sup>, C=1.

- 4) Special buildings shall be designed to allocate a car park for logistics, if the floor area for special uses (As) is greater than 2,000 m<sup>2</sup>.

$$N = (A_c/2,500 \text{ (m}^2\text{)} + A_b/5,500 \text{ (m}^2\text{)} + A_y/2,000 \text{ (m}^2\text{)} + A_o/3,500 \text{ (m}^2\text{)}) \times C$$

Where;

N: Number of cars to be parked (car)

(maximum ten cars)

A: Total floor area of a building (m<sup>2</sup>)

$$= A_s + A_o$$

As: Floor area for special uses (m<sup>2</sup>)

Ac: Floor area for commercial (m<sup>2</sup>)

Ab: Floor area for office (m<sup>2</sup>)

Ay: Floor area for stock yard (m<sup>2</sup>)

Ao: Floor area other than special uses (m<sup>2</sup>)

C: Coefficient

$$\text{If A is less than 6,000 m}^2, C = (6,000 \text{ (m}^2\text{)} - A) / (2 \times A)$$

## **(2) Wastewater treatment**

A building shall be equipped with the wastewater treatment system to meet the following conditions.

- 1) If a central wastewater treatment system covers a site within its service area, the wastewater of a building in the site shall be discharged into the sewage collection pipes of the treatment system.
- 2) If the central wastewater treatment system is not available, the following measures shall be adopted to treat the wastewater generated in the building.
  - i) If a piped water supply system covers the site within its service area, a septic tank shall be installed in the building to treat the wastewater to meet the water quality standard for the treated wastewater.
  - ii) If the piped water supply system is not available, a pit latrine shall be installed to meet the related technical standards.

## **(3) Rainfall infiltration pit**

A rainfall infiltration pit shall be installed at a site to reduce the peak discharge of the surface water into drainage channels and recharge the groundwater for stable water use. The pit shall be porous pipes and basement according to the related standards.

### **3. Recommended Actions for Establishment of New Urban Planning and Management System**

#### **3.1 Completion/finalization of zoning map**

In practice, all the boundary lines shown in the zoning map has to be reproducible on the real ground or any topographic map with greater scale. To this end, definitions of boundaries need to be clarified for each line. The most critical and resource consuming task will be the work defining ROWs of non-existing roads introduced in the master plan. For this purpose, a level of outline-design work shall be carried out for all the new roads to determine firm alignment. At the same time, other types of boundaries also need to be determined. These boundaries include; seb-centers development areas, urban parks, hill-side bottoms, grave yards, etc.

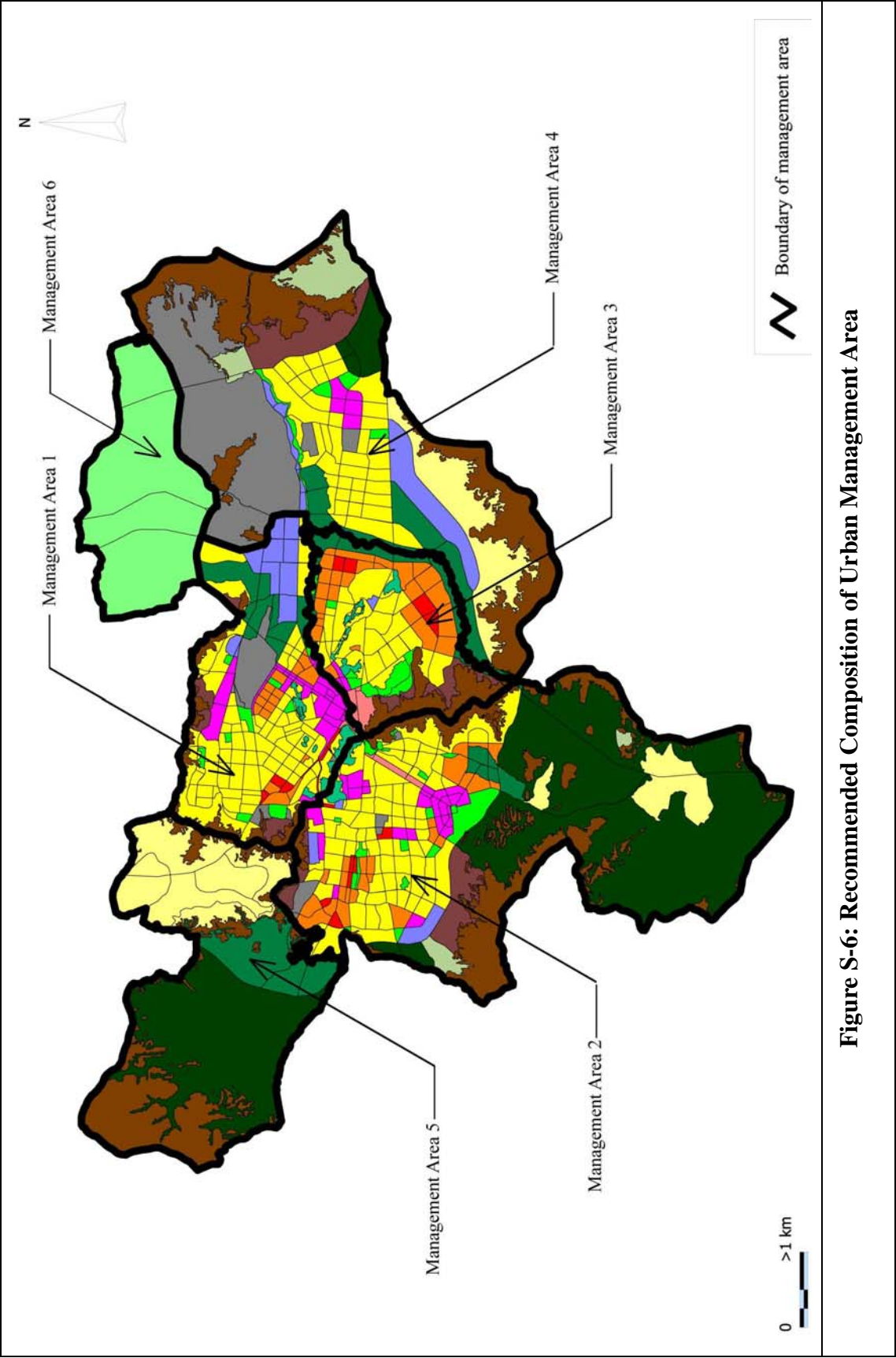
It is recommended that the topographic map with scale 1:5,000 shall be used for final presentation and delivery of the zoning maps. For the preparation of final zoning maps, it is ideal to assign the staff of the sections of Planning, Road Design, and the Survey of the Planning and Implementation Department, assisted by some foreign experts. If it is impossible to carryout by assignment of staff only, an out sourcing may be required.

#### **3.2 Establishment of building/development control system**

To bring life in the zoning maps and neighborhood improvement plans, it is necessary to establish a new system to assess, instruct, and issue permissions to the applicants who wants to build houses, buildings, or seeking large-scale urban development. It will be more practical to introduce a layered assessment system, as the number of applications will be very large.

In the master plan, it is decided to encourage people to build the traditional style houses as much as possible. For this type of buildings, it will be enough to check consistency to the requirement of usage, shape, volume, and installation of key equipment such as septic tanks. These checks can be done by the district level staff, if the check sheets are once established properly.

For non-traditional houses with three floors or less, the check of safety for structure need to be carried out, on top of the general checks similar to those for traditional houses. These can be achieved by rather small number of structure experts in the Municipality, assigned to work for specific management area covering the zoning map. A recommended management area is shown in Figure S-6, prepared based on the character of technical requirements taken into consideration.



For buildings with more than three floors, a series of more technical checks and assessment is required. Establishing a unit of professional staff covering structure, electric, mechanical, and fire safety system is necessary. Some foreign regulations and technical standards must be clarified to let the applicants to comply with until the preparation of the city's own standard documents is completed.

To ensure the citizens to submit applications, it is effective to set the obligation to the licensing system for the construction industry, such as design offices and contractors. For this purpose, cooperation with AISA may be necessary.

For ensuring the application of traditional houses, the system has to involve the community system, such as Gozar. The head of a Gozar would have an obligation to report the new construction and/or major reform activities in his/her area to the District office covering the area.

### **3.3 Establishment of neighborhood improvement planning system**

Although the formalization of informal settlements is a very important issue, there must be certain conditions for formalization: lands for minimal public facilities (community roads, elementary schools, etc.) need to be secured to guarantee the future improvement of the community area.

To meet these conditions, a law-binding land use plan need to be prepared. As the zoning map cannot cover the new facilities for the community level, it is necessary to prepare a Neighborhood Improvement Plan for each neighborhood area defined by the trunk road network. The plan has to be prepared through participatory approach, as it is impossible to define land plots for public facilities otherwise.

The selection of areas for the target community require careful considerations, since the population size of a Gozar may be around 5,000, while typical neighborhood defined in the master plan may be over 12,000.

For implementing the preparation works, it is necessary for the municipality to dispatch a few personnel to facilitate and provide technical consultation services. The staff in charge must have communication skills rather than technical knowledge. Thus fresh employees may be recruited.

### **3.4 Establishment of strategic cores development system**

The conventional land development system through the structure plan and detail plan continue to be important, although direct provision of housing plots by the government will be abolished. The large-scale developments from now on will be broadly divided into two types; i) the private sector developers' housing estate developments, and ii) the public sector developers' core areas development.

In the former case, the private developers will follow the structure plan prepared by the public sector, but formulate detail plan by themselves, as practiced in recent projects. As many of the structure plans may become unrealistic caused by the change of surrounding conditions, it will be more practical to shift to the committee style assessment, attended by persons belonging to various agencies. Considerations may be required to avoid complexity for the developers.

For the latter case, the products of development are not salable as they are public facilities (government offices, referral hospitals, parks, etc.), thus have to be developed by the public developers. Some modern financial techniques may be introduced. These include PFI, PPP, Land Readjustment, etc.