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LIST OF EXHIBITS

The following exhibits are contained in the main body of the text:

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AED	Additional Executive Director
APD	Academy for Planning and Development
ARC	Accident Research Centre
ADP	Annual Development Program
BBS	Bangladesh Bureau of Statistics
BUET	Bangladesh University of Engineering & Technology
BIAM	Bangladesh Institute of Administration & Management
BRT	Bus Rapid Transit
BRTA	Bangladesh Road Transport Authority
BRTC	Bangladesh Road Transport Corporation
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BR	Bangladesh Railway
BM	Bench Mark
BTTB	Bangladesh Telephone & Telegraph Board
CBD	Central Business Districts
CNG	Compressed Natural Gas
DCC	Dhaka City Corporation
DESA	Dhaka Electric Supply Authority
DID	Dhaka Investment Trust
DITS	Dhaka Integrated Transport Study
DMA	Dhaka Metropolitan Area
DMDP	Dhaka Metropolitan Development Plan
DSP	Dhaka Structure Plan
DTCB	Dhaka Transport Coordination Board
DUTP	Dhaka Urban Transport Project
DMP	Dhaka Metropolitan Police
DSM	Design, Supervision and Monitoring
DOE	Department of Environment
EMME/ 2	Equilibre Multimodal, Multimodal Equilibrium/ 2
ED	Executive Director
EPZ	Export Processing Zone
GDA	Grater Dhaka Area
GDP	Gross Domestic Product
GoB	Government of the People's Republic of Bangladesh
GPS	Global Positioning System
HH	House Hold
HQs	Head Quarters
ICD	Inland Container Depot
IDA	International Development Agency
ITS	Intelligent Transportation System
JMBA	Jamuna Multipurpose Bridge Authority
LGED	Local Government Engineering Department
MIS	Management Information Systems

MOC	Ministry of Communications
MRT	Mass Rapid Transit
NPS	National Pay Scales
NMT	Non-Motorized Transport
NRSC	National Road Safety Council
O-D	Origin Destination
OSA	Outer Study Area
PAD	Project Appraisal Document
PCI	Per Capita Income
PCU	Project Coordination Unit
PD	Project Director
PP	Project Proforma
PCP	Project Concept Paper
RAJUK	Rajdhani Unnayan Katripakkha
RHD	Roads and Highways Department
RPC	Regional Transport Committee
RNG	Sediments Garments
RSC	Road Safety Ceel
SPARSO	Bangladesh Space Research and Remote Sensing Organization
STP	Strategic Transport Planning Project
TAZ	Traffic Analysis Zone
TDM	Travel Demand Management
T LFD	Trip Length Frequency Distributions
ToR	Terms of Reference
TNA	Training Needs Assessment
TS	Transport Strategy
TTS	Traffic Training School
UAP	Urban Area Plan
UNDP	Urban Nation Development Program
UTP	Urban Transport Plan
USD	US Dolor
WASA	Water & Suwarge Authority
WB	World Bank
WHO	World Health Organization

1. INTRODUCTION

1.1 DHAKA OVERVIEW

Dhaka, the capital city of Bangladesh, is the largest and most industrialized city in the country with some 135 million people. Dhaka is the administrative, commercial, and cultural centre of the country and also continues to serve as the traditional centre of wholesale trade. The population of the Dhaka Metropolitan Area is presently estimated to be 12 million people (2004), a number that is expected to more than double by 2024. The population of the six Districts surrounding and including Dhaka City (Dhaka, Gazipur, Manikganj, Munshiganj, Narayanganj and Narsinghdi) is expected to reach 36 million by 2024. The area under consideration is shown in **Exhibit 1-1**.

The demographic trends of the last decade have resulted in rapid population growth and are expected to continue in the coming decades. The impact of such rapid growth has major consequences on the ability of the transport sector to provide mobility for all people as they seek to take advantage of employment, education, health and social opportunities.

The transport sector in Dhaka is comprised of many different modes of travel - both motorized and non-motorized. These diverse modes often use the same road space, resulting in a high level of operational disorder. This lack of discipline significantly diminishes the efficiency and effectiveness of the existing transport system. Dhaka is perhaps the only city of its size without a well organized, properly scheduled bus system or any type of mass rapid transit system. The deteriorating traffic conditions are causing increasing delays and worsening air pollution, and seriously compromise the ability of the transport sector to serve and sustain economic growth and quality of life.

In some ways, Dhaka has unique transport opportunities as well as pressing needs and constraints. The high portion of trips that are made by walking and by non-motorized transport together with the relatively small portion made by private automobiles are an enviable goal for most major urban population centres in both developed and developing countries. Also, the traditional inland waterways, as well as the rivers encircling Dhaka, represent an untapped, albeit challenging opportunity of significant potential and benefit.

While much needs to be done to serve existing transport needs better, much more will be required to serve the transport needs of a rapidly expanding population in the coming decades. The challenge is to establish an overall framework for a multi-modal transport system that effectively serves current and future land uses.

1.2 BACKGROUND

The Government of the People's Republic of Bangladesh (GOB), with the assistance of the International Development Association (IDA) is implementing a major transportation improvement project for the Dhaka Metropolitan Area (DMA) - the Dhaka Urban Transport Project (DUTP). The total estimated cost of the DUTP is USD 140 million, including USD 100 million for civil works. The development objectives of the DUTP are to:

- Improve urban transport services in the Dhaka Metropolitan Area in an economically and environmentally sustainable manner,
- Strengthen institutional and capacity building of the concerned organizations dealing with transport issues, and
- Address long-term transport planning and coordination issues for the Greater Dhaka area.

Implementation of the DUTP is shared among different governmental organizations including Dhaka Transport Co-ordination Board (DTCB); Dhaka City Corporation (DCC); Rajdhani Unnayun Katripakha (RAJUK); Bangladesh Road Transport Authority (BRTA); Dhaka Metropolitan Police (DMP); Roads and Highways Department (RHD) and Local Government Engineering Department (LGED). DTCB provides the overall coordination of various aspects of project preparation and implementation.

The DUTP includes a broad spectrum of projects, programs and actions organized into four project components:

(i) Infrastructure Development;

(ii) Equipment Support;

(iii) Institutional Strengthening and Capacity Building; and

(iv) Policy Support and Future Studies.

Included as part of the fourth project component is a key objective of the project - to establish a sound policy framework to ensure the sustainability of the current and future investments in the transport sector. Critical to this objective, is the preparation of a long term (20 years) Strategic Transport Plan for the Dhaka Metropolitan Area that establishes a multi-modal transport plan based upon an assessment of the inter-relationship between land use and transportation.

As a means to achieve this objective, the Dhaka Transport Co-ordination Board (acting for the Ministry of Communications and representing the Government, signed a contract in March 2004 for consultancy services for the preparation of a Strategic Transport Planning Study.

1.3 SCOPE OF THE STUDY

The primary objectives of the Strategic Transport Plan Study are as follows:

a. Strategic Transport Plan - Develop a coherent long-term Strategic Transport Plan (2004-2024), following and updating the Dhaka Integrated Transport Study (DITS) and other transport related studies, to address projected transportation needs for future developments with special emphasis on integrating the planned land use for the future growth of the city as presented in Dhaka Metropolitan Development Plan (1995-2015) with transport issues in Dhaka Metropolitan Area (DMA) over the next 20 year planning horizon in a phased program for the 20 year period;

b. Urban Transport Policy - Formulate an Urban Transport Policy document for governmental discussion and approval that would guide urban transport development, operations and management in DMA;

c. Institutional Strengthening and Capacity Building - Identify institutional weakness of DTCB, DCC, DMP, RAJUK and BRTA and prepare a specific plan for their institutional strengthening and capacity building in the area of urban transport strategic planning; and

d. Priority Projects - Finalize the scope and Terms of Reference for the priority multi-modal transportation improvement projects identified in the Strategic Transport Plan for the first five years.

The purpose of this report on the Strategic Transport Plan (STP) is to document the procedures, findings and recommendations of the comprehensive STP study. Separate companion reports, document study findings with respect to Urban Transport Policy and Institutional Strengthening and Capacity Building. Documentation for the Priority Projects portion of the study is provided in the form of separate and specific "Terms Of Reference" for the priority projects included in the initial five years period.

1.4 STUDY DOCUMENTS

In addition to this Final Report prepared for this study, a number of Working Papers have also been prepared on a variety of selected topics. These working papers provide more detailed information for those with a need and/or interest on specific technical issues.

The following documents constitute the formal written documentation prepared as part of the Strategic Transport Planning Study.

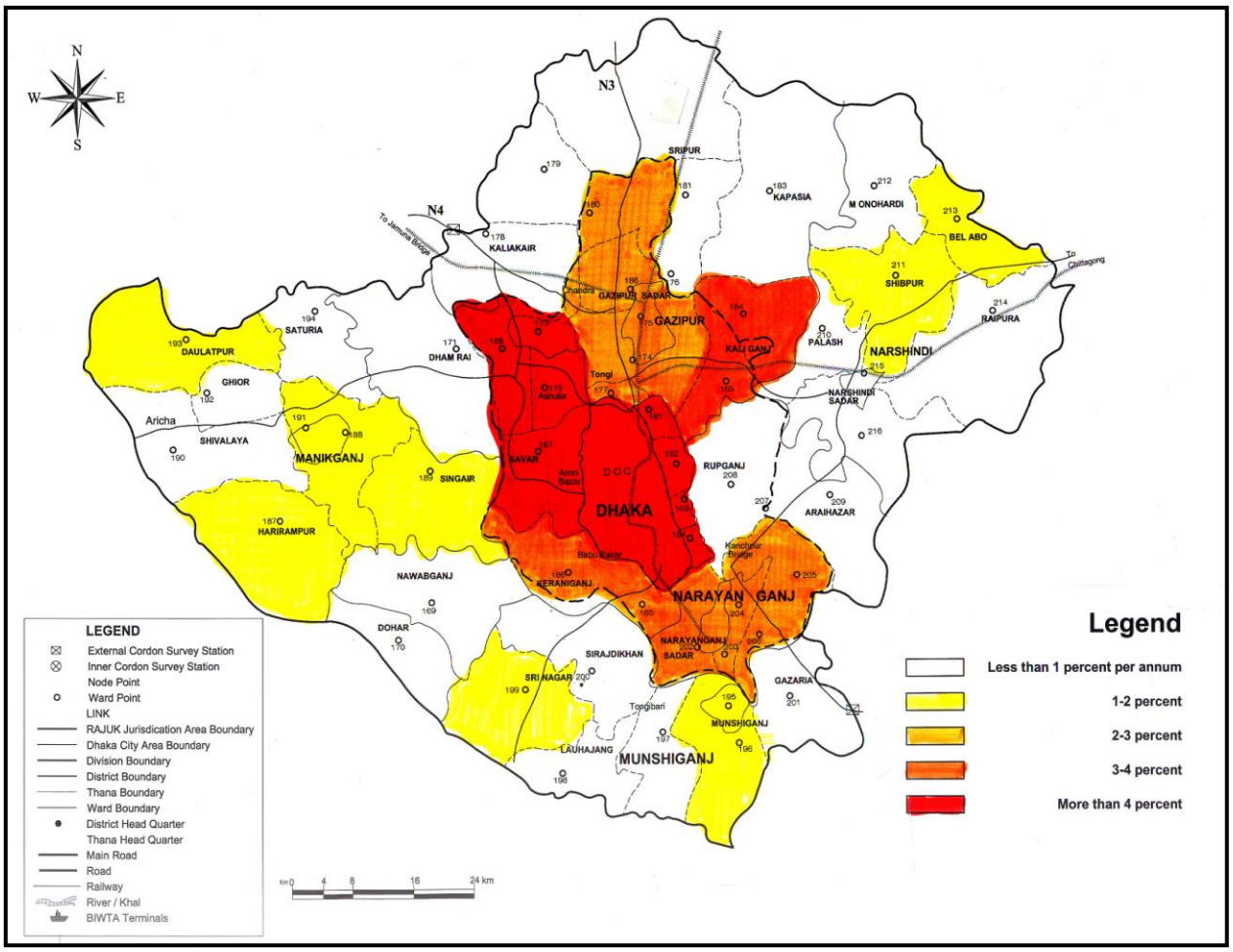
Study Reports:

- Strategic Transport Plan for Dhaka (Content of this report)
- Urban Transport Policy (Companion study report)
- Institutional Strengthening and Capacity Building (Companion study report)

Working Papers:

- WP #1 Survey Design
- WP #2 Land Use Requirements and Scenarios
- WP #3 Population Projections to 2024 in the STP Study Area
- WP #4 Tall Buildings
- WP #5 The Basis of the Development of Urban Transport Policy
- WP #6 Public Transport and Mass Rapid Transit in Dhaka
- WP #7 Report of Surveys
- WP #8 Model Development and Calibration
- WP #9 STP Assumptions

Exhibit 1-1 Location Map of the Study Area



2. DHAKA STUDY AREA

The purpose of this chapter is to present a review of the existing basic characteristics of the Study Area in order to serve as a reference point from which to develop forecasts for the testing and analysis of options for the future. The content of this chapter is organized into the following sections:

- Description of the Study Area
- Socio-Economic Characteristics
- Population Estimate and Forecast
- Existing Land Use
- Existing Travel Characteristics
- Physical and Biological Environment
- Future Land Use Scenarios
- Financial Resources

For the convenience of reading continuity, major full-page exhibits have been located at the end of the chapter; smaller tabular exhibits have been inserted at relevant points in the text.

2.1 DESCRIPTION OF THE STUDY AREA

The Study Area for the Strategic Transport Plan (STP), as illustrated in **Exhibit 1-1**, consists of the area between the Padma and Meghna Rivers in the central part of the country. Within the V-shape formed by the confluence of the two rivers, the outer Study Area is contained wholly within the Dhaka Division and comprised of six Districts (Zilas): Dhaka, Gazipur, Narsinghdi, Manikganj, Munshiganj and Narayanganj Districts. With a total area of 7,440 square kilometres and a population (2001) of 17.3 million persons, the overall density is 2,326 persons per square kilometre.

Most of the area is low, flat, fertile and flood-prone. Much of the area, particularly to the south, east and west, suffers from regular floods during monsoon, but benefits from the deposited silts. In contrast to the flood-prone areas on either side, the north-central portion between the two major rivers (the Padma and Meghna) is slightly crested between two of their tributaries (the Balu and the Turag) along a north-south axis midway between the two. The city of Dhaka is located in the centre of this crested area in the southern-most part of the country that can be considered to be relatively flood-free.

Settlements in the outer rural areas are relatively small market communities and clusters of road-related land uses. Agriculture is the primary land use. Rice is the main crop with wheat, jute, sugarcane, tobacco, oilseeds, pulses, tea, spices, potatoes and vegetables also widely produced. Like most of Bangladesh, the area is composed of relatively flat alluvial plains at elevations that range from less than a meter to 12 meters above mean sea level. Although the soils are typically highly fertile, the agricultural yield per acre of land is low by world standards. Road corridors generally converge on or radiate from Dhaka. Two rail lines traverse the area: one the northwest-southeast Jamuna Bridge to Chittagong line; the other a north-south line that terminates in Narayanganj just south of Dhaka.

Topographic variations, though subtle, are a major determinant of Dhaka's growth patterns. The city is located at the country's southern-most point at which its topography renders it relatively flood-free and within the slightly crested area between the Turag and Balu River systems. The topographic factors that encouraged growth of the city toward the north continued beyond the bounds of the city along the corridor to Mymensingh, both road and railway development generally following a naturally high and less flood-prone path northward.

Dhaka occupies a large part of the relatively small proportion of land which is considered to be "permanently" flood-free. Tongi, approximately 25 kilometres north of central Dhaka, and Savar, approximately 25 kilometres to the northwest are the nearest relatively flood-free areas. The areas to the south, southwest and east are low-lying and under water for many months of the year. Most of the Dhaka Metropolitan Area, as most of Bangladesh, is subject to flooding of various types related to tidal and typhoon conditions, excessive rainfall, flash floods and river flooding arising from conditions in the mountains outside the country. For periods between May and September each year approximately two-thirds of Bangladesh is submerged beneath floodwaters caused by melt water from the Himalayas and monsoon rains.

Dhaka became the national capital of Bangladesh evolving from a provincial capital after Independence in 1971. Since then, the influx of people occurred due to several socio-economic factors, such as growing population pressure in rural areas, frequent and severe natural disasters, law and order concerns in remote and isolated areas, and the availability of more socio-economic opportunities in Dhaka.

The population of Dhaka increased from a modest figure of just over one million in 1971 to more than 10 million in 2001. With such rapid growth, the area of urbanization expanded beyond Dhaka District and Dhaka City Corporation limits. The adjacent districts of Narayanganj and Gazipur have virtually become an integral part of Metropolitan Dhaka as have portions of other surrounding districts of Munshiganj, Narsinghdi and Manikganj.

Exhibit 2-1
FACTS ABOUT DHAKA

Global Location	Latitude: 23^0 30'- $25^0$05' N Longitude: $90^0$15' - $90^0$35'E
Area	1,529 sq. km.
Population	10.0 million
Density	6,545 persons/km^2
Sex Ratio	127
Population Growth Rate	4.2
GDP	US $4.8 billion
Per Capita Income	US $500
Literacy Rate (Adult)	60.3
Child Mortality	96.2
Telephone	20/1000 population
Piped Water	60%
Crime Rate	2.03/1000 population
Informal Settlement	30%
Homeless Population	112.5 thousand (1991)
Tenure Type (1996)	Owned - 32.0% Rented - 54.0% Rent free - 6.5% Others -7.5%
Electricity (%H/H)	90.0

Source: *Bangladesh Country Report, National Habitat Committee, Ministry of Housing & Public Health, Government of Bangladesh, May 2000.*

2.2 SOCIO-ECONOMIC CHARACTERISTICS

2.2.1 Macro-Economic Context

Except for the relative affluence of Dhaka, the macro-economic characteristics of the Study Area are generally reflective of, and are largely predetermined by, the macro-economic characteristics of the country as a whole. These macro-economic conditions, over which Bangladesh has little or no control, have had, and will continue to have, profound effects on future land use and transportation demands in Dhaka and throughout the country. Although they are influenced by actions the government takes to a large degree the forces determining these conditions are and will remain beyond direct control of the government. To plan for the future in a meaningful way, however, the current study has take these factors into account insofar as it is possible to do so. Areas of particular uncertainty must be identified for monitoring so that appropriate adjustments of the transport strategies may be made as the situation emerges. The following is an assessment of the current macro-economic situation, recent trends, forecasts and their land use/transport implications providing a context for the development of land use scenarios and the transport strategy recommendations. Dhaka-specific data is presented in Section 2.2.2. Characteristics of the rural portions of the Study Area are presented in Section 2.2.3.

A. Current Conditions & Trends

The GDP of Bangladesh in 2002 was approximately USD 44 billion. By way of comparison, the Bangladesh economy is more than twice as large as Sri Lanka's, approximately three-fourths the size of Pakistan's and less than one tenth the size of India's. Its Gross National Income (GNI) per capita was approximately USD 400 in 2003 - compared to USD 930, 470 and 530 for Sri Lanka, Pakistan and India, respectively. As a benchmark Hong Kong has a per capita GNI of over USD 25,000 and Singapore is over USD 21,000. Thailand's per capita GNI of USD 2,190 is more than five times that of Bangladesh. Bangladesh ranks 174th in the World Bank's listing of 208 countries[1]. Measured in terms of employment, agriculture is the largest segment of the economy, followed by services, manufacturing and construction in that order. The formal and informal sectors currently account for one-fourth and three-fourths of urban employment, respectively - a ratio which is expected to remain relatively constant for the foreseeable future[2]. Garments account for more than three-quarters of all exports, dwarfing the country's historic cash crop, jute.

Growth of the Bangladeshi aggregate economy in recent years has improved substantially. GDP growth was estimated as roughly 4% in the 1986-1989 period and nearly 5% a year average during the 1990-1998 period[3]. The latest data released by the Bank of Bangladesh suggests that economic activity is accelerating. In 2003, the annual real GDP growth rate was estimated to have reached 5.3%,[4] up from 4.4% in 2002,[5] thus outpacing its South Asian neighbours - but below that experienced by other Asian countries such as Vietnam and China. This is far short of the 7% to 8% necessary to accommodate the two million attempting to enter the job force[6] and reach the goal of reducing poverty by 50% by the year 2010[7]. Much of the economy's recent growth has occurred in the country's two major urban centres (Dhaka and Chittagong). The opening of the Jamuna Bridge in 1998 (and the attendant rail line, highway development and the natural gas pipeline that cross it) has reinforced and given greater definition to what some economists see as a dominant north-west to south-east axis (Rajashahi to Chittagong). This axis crosses the equally significant Dhaka-Mymensingh axis at a point within the DMA at Gazipur Sadar.

Exhibit 2-2

BANGLADESH AVERAGE INCOME & POVERTY DATA

Source of Income (1996)	Households		Average Income (Thaka)	Average Expenditure	Caloric Intake Per Capita/ Day
	Number Surveyed	Percent			
Wages and Salaries	355	11%	5,503	4,599	2,309
Self-Employed Agriculture	907	27%	4,318	3,786	2,396
Employer in Agriculture	239	7%	6,100	4,534	2,434
Agricultural Labourer	828	25%	2,173	2,038	2,165
Self-Employed Non-Agriculture	819	25%	3,402	3,124	2,146
Employed Non-Agriculture	38	1%	5,778	5,143	2,262
Pensioner	7	<1%	6,278	3,958	1,770
Transfer Payments	107	3%	2,708	2,035	2,316
Total	**3,300**	**100%**	**3,778**	**3,284**	**2,262**

Source: Rural Poverty Monitoring Survey, Bangladesh Bureau of Statistics, April 1998, Table 10, page 109.

[1] *World Development Indicators, World Bank, July 2004.*
[2] *Bangladesh 2020: A Long-Term Perspective, World Bank, circa 1997, page 53/54.*
[3] *A Sustainable Future for Dhaka, Bangladesh, Integrated Approaches to Flooding, Water Management and the Urban Poor, Centre for innovation in Landscape, Urbanism and Ecology, Rhode Island School of Design, 2003.*
[4] *Far Eastern Economic Review, Asian Economic Outlook, January 2004, page 49.*
[5] *The Economist Intelligence Unit (EIU).*
[6] *A Sustainable Future for Dhaka, Bangladesh, Integrated Approaches to Flooding, Water Management and the Urban Poor, Centre for innovation in Landscape, Urbanism and Ecology, Rhode Island School of Design, 2003.*
[7] *Bangladesh: Partnership Update, Asian Development Bank, July 2004.*

B. Poverty Indices

Bangladesh has one of the highest incidences of poverty in the world. The incidence of poverty at the national level is estimated by the Asian Development Bank as approximately 48% with more than 55 million people described as "poor"[8]. The most recent estimate of the ratio of rural poor (1995/1996) stood at 47%. The ratio of urban poor stood at 49%. Average household incomes, expenditures and per capita caloric intakes by major sources of income are shown in **Exhibit 2-2**. About a third of the total population is extremely poor (i.e., less than 1,800 calories/person/day).

In spite of the improving economic growth rates, a substantial segment of the country's population remains below subsistence levels. There is a considerable income disparity across the country. Per capita income is highest in the urban centers of economic activity (Dhaka, Chittagong and Khulna). At the Divisional level, in Dhaka Division (the Division in which the STP Study Area is located) roughly one-third of the population is below the lower poverty line as shown in **Exhibit 2-3**. More than half is below the upper poverty line. Poverty levels are significantly higher in the rural areas than in the urban areas.

At the District level, poverty rates in the STP Study Area are estimated to be between 40% and 50% in Gazipur, Kaliganj and Manikganj, between 30% 40% in Munshiganj and Narayanganj and less than 30% in Dhaka District.[9]

Exhibit 2-3

POVERTY PROFILE BY DIVISION

Division	Percent Below Poverty Line Using The Lower Poverty Line Absolute Poverty 1800 K cal/ person per day		Percent Below Poverty Line Using The Upper Poverty Line Absolute poverty 2122 K cal/ person per day	
	Rural	Urban	Rural	Urban
Barisal	44.8	28.9	60.6	47.7
Chittagong	35.3	12.1	47.2	29.2
Dhaka	**41.5**	**10.8**	**58.9**	**33.6**
Khulna	33.2	25.8	51.5	53.3
Rajshahi	44.4	19.2	65.7	33.9
National	39.8	14.3	56.7	35.0

Note: Direct Calorie Intake Method (Head-Count Ratio) *Source: BBS, Household Expenditure Survey, 1995-96*

C. Short-Term Forecasts

Accelerated growth is considered likely to continue in the short term. However, it is still likely to fall short of the 7% to 8% target necessary to follow other Asian economies like Malaysia and Thailand and "*to reach the threshold of a middle-income country by 2010, and achieve middle order status in that group by 2020*."[10] Export receipts in the first three months of 2004 increased by more than 16% above the previous year. In the first quarter of 2004, foreign worker's remittances (just over USD3billion in 2002/03) were 20% higher than in the same quarter the previous year. It is expected that short-term economic growth will be driven in part by a rebound in exports following a contraction of the export sector in 2002/03, and by robust private and public consumption.[11] Exports are expected to rise in response to improved demand in Bangladesh's main trading export markets. However, the increase will be limited by infrastructural weakness and intensified competition in international markets for Bangladesh's principal export of garments. Forecasts indicate that real GDP will grow by 5.8% in 2004 and 5.9% in 2005.[12] CountryWatch's mid-term forecast of the Bangladeshi economy projects an average annual growth rate of 5.3% between 2003 and 2008. The Bank of Bangladesh's Medium Term Macroeconomic Framework projects a speeding up of the real GDP growth rate to 6.5% by Fiscal Year 2006.

[8] *Defined as a consumption of less than 2,122 calories per day.*
[9] *Note: Direct Calorie Intake Method (Head-Count Ratio); Source: BBS, Household Expenditure Survey, 1995-96*
[10] *Bangladesh 2020: A Long-Term Perspective, World Bank, circa 1997, page 19.*
[11] *The Economist Intelligence Unit, Country Report Bangladesh at a Glance 2004-2005.*
[12] *The Economist Intelligence Unit, Country Report Bangladesh at a Glance 2004-2005.*

D. Long-Term Forecasts

These assessments and recent economic performance suggest that the Bangladeshi economy is not likely to reach the 7% to 8% percent annual growth rate benchmark until at least 2010, if not later. Export-oriented manufacturing (especially textiles and to a lesser extent agro-based industries), funded mainly by Foreign Direct Investment (FDI), is foreseen by most analysts as the "engine" of the economy for the foreseeable future. FDI has shown a steady increase: from a mere trickle in the 1980s, increasing to USD308million in 1998-1999 period and grew to USD441 million in Fiscal Year 2003[13]. This is far short of the envisioned "USD2 to 5 billion of FDI" which analysts in the late 1990s estimated "could be flowing in by early in the next century"[14]. External market analyses for the development of Information Technologies Enabled Services (ITES) indicate that while a potential may exist, its contribution to GDP would be slight[15]. Given the expected GDP and FDI growth rates, it can be anticipated that the percentage of those living in poverty and those dependent on the informal sector for livelihoods will remain high. Even on the basis of more optimistic investment assumptions, the World Bank estimated that the split between the formal and informal segments of the economy will remain relatively constant through 2020 and beyond (i.e., one-quarter and three-quarters of the economy, respectively)[16].

E. Land Use Implications

Regional land use patterns, the populations housed in the various parts of the DMA and the locations of jobs will be influenced by the fact that export-oriented manufacturing (especially textiles and to a lesser extent agro-based industries) are expected to drive the economy for the foreseeable future. Given the export nature of the export-oriented industries, jobs based in this section of the economy are likely to be centred in the DMA's Export Processing Zones (EPZs), both existing and future[17]. The success of attracting the FDI necessary to realize these ambitions and the locations and degrees of concentration and/or dispersal of the EPZs will be a key determinant of future land use settlement patterns and their consequent strategic transport needs at the regional level.

Given that the split between the formal and informal sectors of the economy is expected to remain essentially unchanged during the planning period established for the STP Study, urban residential land use patterns are considered likely to remain economically integrated. Given the high rate of urbanization, increasing densities in urbanized areas are likely. Even land with development impediments (e.g., flood-prone areas), in proximity to urban development, are likely to come under increasing pressure. Service sector activities will continue to develop around and within residential areas. Intermingling of income groups and neighbourhood service employment is likely to remain high. Manufacturing activities will continue to grow in importance within the Dhaka area. Firms located within EPZs stand to have the best chance of overcoming the challenges, given the tax and public infrastructure advantages that they hold over other firms in Bangladesh. As a result, one would expect that future population growth will gravitate towards the areas immediately surrounding the EPZs (existing and future) in the Dhaka area. The manner in which that growth is accommodated will be a major determinant of the DMA's future population and settlement pattern and its transport needs.

[13] *The New Nation, 1 August 2004.*
[14] *Bangladesh 2020: A Long-Term Perspective, World Bank, circa 1997, page 5.*
[15] *External Market Analysis, Information Technology Enabled Services - Bangladesh, Carana Corporation on behalf of the United States Agency for International Development (USAID, April 2002.*
[16] *Bangladesh 2020: A Long-Term Perspective, World Bank, circa 1997, page 53/54.*
[17] *EPZs in the DMA are currently located in Dhamsona, in the northern part of Savar Thana and in Gazipur.*

F. Vehicular Ownership Implications

Given that the number of people in the DMA is expected to more than double within the study planning period and the economy is likely to expand significantly (albeit not at the accelerated rate one might hope for), the number of vehicles can be expected to increase significantly. The rate of vehicle ownership per capita, however, is unlikely to change drastically. The number of workers in the informal sector "queuing" to move up are likely to act as a brake on the productivity-enhanced growth in the formal sector wages. Until the pool of unemployment and under-employed labour is fully absorbed by the formal sector, there is little prospect that real wages for unskilled labour will rise over the next 20 years.[18] While large changes in vehicular ownership are unlikely in the absence of real wage increases, some increase is likely to occur. It is anticipated, therefore, that the absolute number of those owning or having access to motorized vehicles will increase, but most of the population will remain dependent on current modes of transport. Rapid increases in motorcycle ownership such as currently experienced by Vietnam and other rapidly expanding economies are considered unlikely.

2.2.2 DMA Urban Economic Characteristics

Dhaka is the economic, as well as the political capital of the country and by far the dominant economic feature in the study area. Its importance in the overall economy of the country has increased as the role of industry and other non-agricultural activities in the national economy have declined. Most of jobs in the area's basic industries[19] are in manufacturing. As of the mid-1990s approximately 60% of its manufacturing jobs were in the broad "textile" category, more than one-third in the garment sector and the remainder generally in jute and cotton textiles. The garment industry has been the source of much of Dhaka's economic growth in the last 15 years employing nearly 570,000 in Dhaka in 2003 and nearly 700,000 in the DMA[20]. Some 80% of the workers are females between the ages of 14 and 29.[21] Other significant industrial activities include frozen fish, leather and leather products, tea, urea fertilizer, and ceramic tableware, sugar, newsprint, pharmaceuticals and fertilizer production.[22] In addition to Dhaka, industrial employment in the study area is largely centered in two primary areas:

- Tongi-Gazipur. Both are municipalities located to the north of Dhaka. Gazipur has one of the DMA's three EPZs and is also the crossing of the country's two primary rail lines: the north-south line to Mymensingh and the northwest-southeast (Jamuna-Chittagong) line.

- Savar-Dhamsona. Dhamsona is the location of the DMA's remaining two EPZs.

The National Government is estimated to be Dhaka's next largest employer in the basic sector of the DMA's urban economy. It must be noted, however, that the basic sector is defined to include only the formal public and formal private sectors of the economy. By contrast, the non-basic or local market sector is largely informal and it is the informal sector that provides most of the jobs in Dhaka. As noted in the DMDP, the spatial distribution of jobs is, by and large, linked to the spatial distribution of population.[23]

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[18] *Bangladesh 2020: A Long-Term Perspective, World Bank, circa 1997, page 54.*
[19] *Defined here as activities serving markets wider than the STP Area in contrast to local industries and services that rely on local population and growth.*
[20] *BGMEA Member's Directory 2003-04.*
[21] *A Sustainable Future for Dhaka, Bangladesh, Integrated Approaches to Flooding, Water Management and the Urban Poor, Center for innovation in Landscape, Urbanism and Ecology, Rhode Island School of Design, 2003.*
[22] *Background Notes: Bangladesh, U.S. State Department, March 2000, page 8.*
[23] *Dhaka Metropolitan Development Plan (1995-2015), Volume 1, Dhaka Structure Plan, December 1995, page 28.*

Within Dhaka, the informal sector provides most of the jobs. This is equally true for both the formal and informal sectors of the economy. Even government employment centres in the central business district (CBD) generally have a housing enclave nearby. The spatial relationship between employment and residential land use is greater for the relatively affluent who are more likely to commute by vehicle and have a greater range of housing options.

2.2.3 DMA Rural Economic Characteristics

Outside the urban areas, agriculture is the dominant economic activity. The agriculture sector employs more than 68% of the labor force. Measured in terms of GDP, agriculture accounted for 24% in 1997, industry 27% and services 49%. Rice, jute and sugarcane are the Study Area's primary corps. Because of its fertile soil and normally ample water supply, rice can be grown and harvested three times a year in many areas. Steady increases in grain production have been achieved despite often unfavorable weather conditions and are attributed to better flood control and irrigation, generally more efficient use of fertilizers, and the establishment of better distribution and rural credit networks. In spite of its fertile lands and recent improvements, yields per acre in Bangladesh are among the lowest in the world.[24] Population pressures place a severe burden on productive capacity, creating a food deficit, especially of wheat.[25] Other than Savar and Gazipur Sadar Thanas (the locations of the EPZs) and the municipal thanas which are wholly or partially within the DCC, only Rupganj Thana indicated significant employment (10,000 jobs) in Ready Made Garment (RMG) industries.

2.2.4 Social Characteristics

A. Demographic & Settlement Patterns

Bangladesh is the most densely populated country in the world, with roughly 800 people per square kilometre (1,280 people per square mile). As a comparison countries generally considered to be densely populated[26] such as Holland and Japan have densities of 523 and 453 per square kilometre respectively. Although birth rates have declined in recent years, the population is nevertheless expected to double to 250 million by the year 2035. This will occur even if fertility declines to a level of replacement (2.2 births per woman) by 2005.[27] It is estimated that 80% of the population lives in rural areas. Dhaka is by far the largest city; followed by Chittagong which is considerably smaller at approximately three million, and Rajshahi at one million.[28] Urbanization is proceeding rapidly, however, and it is estimated that only 30% of the population entering the workforce in the future will be absorbed into agriculture, although many will find other kinds of work in rural areas.[29]

B. Ethnic & Religious Groups

The population of Bangladesh is a mixture of Dravidians, Aryans and Mongolians belonging to the black-haired, dark skinned and short-featured Austo/Mongolian Group.[30] Hill tribes have distinctive features. Ethnic minorities are reported to comprise slightly over 1% of the country's population and are geographically concentrated outside the Study Area except for Gazipur.[31] Because they are Bangladeshi nationals, the Constitution does not formally recognize them as "ethnic minorities" or indigenous groups. The Government has, however, taken cognizance of the tribal communities' need for special attention and placed 14 "special area thanas"[32] under the supervision of the Special Affairs Division of the Prime Minister's Secretariat.

[24] *Inception Report page 1-1*
[25] *Background Notes: Bangladesh, U.S. State Department, March 2000, page 7.*
[26] *Bangladesh Ways, The American Center, Dhaka, undated, circa 2003.*
[27] *World Bank internet download, August 2001.*
[28] *ADB Key Economic Indicators as of July 2001 and Background Notes: Bangladesh, U.S. State Department, March 2000, page 1.*
[29] *Background Notes: Bangladesh, U.S. State Department, March 2000, page 16.*
[30] *Titan's Oxford World Atlas, The Atlas Publishing House, Dhaka, 2001, page 9.*
[31] *The Common Country Assessment – Bangladesh, United Nations, 2000, page 100/101*
[32] *The Common Country Assessment – Bangladesh, United Nations, 2000, page 100/101*

Bangladesh is a secular state. Although Article 2A of the Constitution establishes Islam as the state religion, Article 41 guarantees the freedom of religion and Article 28 assures protection from discrimination on religious grounds. Muslims comprise more than 88% of the population; Hindus more than 10%; Buddhist, Christians other groups comprise the remainder. Generally speaking, Muslims and Hindus are evenly distributed throughout the country. Buddhists are mainly concentrated in the Chittagong Hill Tracts.

C. Family Structures

The Bangladeshi family structure tends to be male-dominated and family needs take precedence over individual concerns. Men are protective of female relatives. Social class plays an integral but diminishing role in Bangladesh. Nonetheless, class is still an important factor in the choice of a marriage partner. One's social image or status is closely guarded.[33] Although more than 80% of the population live in rural villages, even for city dwellers there is a strong connection to the 'home village'. Rural lives are bounded by dependency on the elders of the family, on the employer or the village patron, or to some other authority figure. Loyalty to the group is essential.

At the core of the group is the extended family that forms the basis of social and economic life in Bangladesh and remains the cornerstone. The head of the household assumes much of the responsibility and provides for parents, children and other relatives in rural areas. In rural areas all may occupy one house or a compound area and establish separate kitchens as the family grows and more independence is sought. When a son marries, his wife is brought to the family home and assumes the duties outlined by the mother-in-law. The family is a tightly knit group, not only for economic and protective reasons, but also as the major centre of both recreational and social activities.

D. Gender Equality Indices

Except in upper class society, women generally have a lower status in the society. Gender issues in transport have been recognized in the Dhaka Urban Transport Study, for example. It is also a land use planning issue in areas such as the Savar and Dhamsona EPZs which are under pressure to provide residential facilities for its female employees.

Strict *purdah* is not widely practiced, but is sometimes found in the middle- and lower-class families who tend to be the most conservative element in society. Most of the poorer community cannot afford the practice. Even in the absence of the practice, however, cultural tradition and religious custom serve to keep women within certain bounds and the relationship between men and women is very formal. Unlike other parts of Asia there is generally an absence of women in the marketplaces. Produce sellers and hawkers are generally men.

The UNDP Gender-Related Development Index (GDI) ranks Bangladesh at position 123 out of 174 countries. In rural areas, only 25% of the primary students are females. The female literacy rate in 1997 was slightly more than half that of men and women's real GDP per capita was less than 60% that of men[34]. Women experience higher levels of malnutrition and morbidity (14% higher than men). Households headed by women are among the poorest in the country with 45% of female-headed households living below the poverty line.[35]

[33] *CultureGrams 2001, Oram, Utah, 2001.*
[34] *The Common Country Assessment – Bangladesh, United Nations, 2000, page 25.*
[35] *The Common Country Assessment – Bangladesh, United Nations, 2000, page 26.*

E. Public Health Indices

Because Bangladesh suffers high malnutrition levels, there are related health problems. Major problem areas include childhood protein-energy deficiency, maternal under-nutrition, short stature and anaemia in expectant and nursing mothers. Micronutrient deficiencies, particularly of Vitamin A, iron and iodine affect all ages. In 1996-97, more than half of children under five were moderately or severely underweight, or suffering from moderate or severe stunting. About two million children suffer from iodine deficiency disorder (IDD) and about 40,000 children go blind every year due to vitamin A deficiency. Nine out of ten children are estimated to be malnourished to some degree. Between 35 and 50 of every 100 newborns suffer from low-birth weight. Approximately 70% of mothers are afflicted by nutritional deficiency anaemia.

Exhibit 2-4

BIRTH, DEATH & RELATED INDICATORS

Indicator	1991	1996
Crude Birth Rate/ 1,000	32.0	27.0
Crude Death Rate/ 1,000	13.0	9.0
Total Fertility Rate	4.3	3.4
Infant Mortality Rate	92.0	78.0
Under-Five Mortality Rate	146.0	112.0
Maternal Mortality Rate	4.7	4.4
Life Expectancy	56.1	58.0

Source: *United Nations, The Common Country Assessment, Bangladesh, 2000, page 40.*

Less than 40% of the population has access to modern primary health services beyond immunization and family planning. Only 25% of pregnant women receive ante-natal care, and only 14% of births are attended by someone with formal training. Bangladesh's maternal mortality rate of 4.4 deaths per 1,000 is among the highest in the world.[36]

On a more positive note, Bangladesh has succeeded in reducing its fertility rate from more than seven births per woman in 1975 to about three births per women today. Infant mortality rates have fallen from 140 per 1,000 live births in 1970 to 73 per 1,000. Life expectancy at birth is now equal for males and females at 58 years compared with 43 years for females and 45 years for males in 1970. Child immunization has risen from 10% to 70%. Birth rates, death rates and related indicators for the country as a whole are provided by **Exhibit 2-4**. Research findings indicate that rural morbidity is on the decline in Bangladesh and that while all have benefited, the positive impact has been relatively higher on women and the poor. This has been attributed generally to increases in government and non-government health services, the spread of health education and increased access to safe water and improved sanitation practices.[37]

On a less positive note, however, HIV/AIDS is identified as “a coming epidemic”. The longer-term effects of naturally occurring toxic levels of arsenic in a large percentage of the population's groundwater consumption is also a major public health challenge.[38] Recent press reports (14 June 2004) indicated that 80 million people in 59 of the country’s 64 districts remain at risk.[39]

F. Housing and Land Ownership Issues

Landlessness and inadequate housing are major issues in the Study Area and the country as a whole. Most of the housing facilities in Bangladesh are not properly constructed. It is estimated that approximately 85% of rural dwellings have inadequate protection from wind, rain and floods. The situation is only marginally better in urban areas where 84% of the houses are temporary or semi-permanent constructions made from thatching, bamboo and corrugated iron sheets.

[36] *Bangladesh Country Brief 2000, The World Bank, September 2000, page 2.*
[37] *The Common Country Assessment – Bangladesh, United Nations, 2000, page 40.*
[38] *Bangladesh Country Brief 2000, The World Bank, September 2000, page 3.*
[39] *The Daily Star, 14 June 2004, page 10.*

Poverty and land pressures are the major constraints to increasing access to residential land. Approximately 30% of rural households do not own any homesteads and informal occupation and squatting is reported to have been on the rise in recent years. In urban areas approximately 60% of the houses are owner-occupied, except in metropolitan centres such as Dhaka where the figure drops to 32%. The unequal distribution of real estate ownership is especially evident in urban centres where the high-income group, which comprises 2% of the households, have access to 15% of the residential land. Low income groups, which comprise 70% of the households, on the other hand, have access to only 20% of the residential land. It is estimated that the vast majority (more than 90%) of housing in Dhaka is provided through the private sector, of which most (70%) is within the informal sector, generally through the efforts of individuals building their own home. There are few formal financial mechanisms. Formal sector residential land uses are also found in most areas of the city. Public housing, intended mainly for the government employees is able to meet only 7% of the demand. The problem of housing shortages is exacerbated by a lack of housing finance.[40]

Current land controls are reportedly governed by the Land Reform Act of 1984 which placed a ceiling on the agricultural land holdings at 60 *bighas* (about 20 acres) per family. If one acquires more through inheritance, the government pays compensation and takes the land. A similar ceiling was recommended by the Land Reform Commission for urban landholdings, but has not been made official policy. The law states that agricultural land cannot be converted into non-agricultural use without government permission, but illegal sales, speculation and conversions are reported to be common. Such conversions have an obvious impact on urban land use and the contravention of land use controls. Inheritance practices have led to a highly fragmented land ownership patterns. Within each generation, population densities increase and farm parcels get smaller as they are subdivided and redistributed to family members. The laws of inheritance vary within the country and fall under the umbrella of religious family law.

2.3 POPULATION ESTIMATE AND FORECAST

2.3.1 Introduction

In developing a Strategic Transport Plan for Dhaka, it is important to analyze the trend, nature and size of the population pressures in Dhaka and its surrounding areas. Due to the concentration of major socio-economic activities and facilities as well as employment opportunities, many people migrate regularly from different parts of Bangladesh to Dhaka. The city has been an attraction for the landless rural poor as well as the unemployed who perceive the city as an opportunity for a better livelihood. In addition to the natural growth of population and the in-migration, Dhaka also experiences significant movement within the city due to new area developments having better facilities and amenities. These include transport services and facilities. The movement of people within the city occurs not only for residential purposes, but also for commercial, industrial and business reasons. These actions, which in Dhaka take place continually and rapidly, make urban transport planning a complex matter.

The purpose of this section is to provide summary information and analysis on the following items related to existing population characteristics and population forecasts completed for the study[41].

a. Population concentration in different parts of the Study Area (see section 2.3.3);
b. Population growth in recent decades (see section 2.3.4);
c. Migration behaviour in terms of varied population density (see section 2.3.4);
d. Establishment of a population forecast model (see section 2.3.5); and
e. Population forecasts for the Study Area up to 2024 (see section 2.3.6).

[40] *The Common Country Assessment – Bangladesh, United Nations, 2000, page 38.*
[41] *A more detailed analysis may be found by reference to Working Paper #3.*

The analysis is based mainly on published data from the Bangladesh Bureau of Statistics (BBS). The data used in the present analysis is generally at the "Thana" level (a division of a district administered by a Thana Administration Officer) covering the entire Study Area. However, for the Dhaka City Corporation area, the "Ward" level data are also analyzed so as to obtain more accurate results.

2.3.2 Urbanization in Bangladesh

Prior to 1961, the growth rate of the urban population in Bangladesh was 2% to 4% per annum. However, following independence in 1971, the growth rate started increasing sharply. Due to the war in 1971, the scheduled population census could not be held until 1974. The results of the population census after independence show the growth in urban population in Bangladesh as high as 8.8% per annum. Since then, it has been increasing gradually. The 2001 Census indicates that more than 28.6 million people are living in urban areas (about 23% of the total population). Out of the total urban population in Bangladesh, more than 15.4 million (5%) live in the three major cities of Dhaka (37%), Chittagong (12%) and Khulna (5%). Thus, the population of these three major cities is more than half of the urban population of Bangladesh and approximately 12% of the total population for the entire country. Based on the size of population, the urban areas in Bangladesh have been classified into four categories:-

a. Mega Cities (metropolitan area with population greater than 5 million) – including Dhaka
b. Statistical Metropolitan Areas (SMAs) - Municipal "Corporations and adjacent areas having urban characteristics
c. Paurashavas/Municipality Areas (MAs) - incorporated areas administered by the Government as urban areas under the Paurashava Ordinance (1977)
d. Other urban areas (OUAs) – Upazila headquarters and development centres which have urban characteristics

2.3.3 Population in Study Area

Dhaka became the national capital of Bangladesh evolving from a provincial capital after Independence in 1971. Since then, the influx of people occurred due to several socio-economic factors, including growing population pressure in rural areas, frequent and severe natural disasters, law and order concerns in isolated areas, and the availability of better socio-economic opportunities in Dhaka.

The population of Dhaka increased from a modest figure of just over one million in 1971 to more than 10 million in 2001. With such rapid growth, the area of urbanization expanded beyond Dhaka District and Dhaka City Corporation limits. The adjacent districts of Narayanganj and Gazipur have virtually become an integral part of Metropolitan Dhaka, as have portions of other surrounding districts of Munshiganj, Narsinghdi and Manikganj. **Exhibit 2-5** presents information regarding population, level of urbanization, and population density for each of the six districts that comprise the Study Area.

Exhibit 2-5 Population in STP Study Area in 2001

District	Population (millions)			Urbanization	Area	Density
	Urban	Rural	Total	(percent)	(sq.kms.)	(per/sq km)
Dhaka	7.901	0.717	8.618	91.7%	1,464	5887
Gazipur	0.904	1.119	2.023	44.7%	1,800	1124
Manikganj	0.097	1.205	1.302	7.5%	1,379	946
Munshiganj	0.167	1.122	1.289	13.0%	955	1350
Narayanganj	1.206	0.965	2.171	55.6%	701	3097
Narsinghdi	0.364	1.538	1.902	19.1%	1,141	1667
STP Study Area	10.639	6.666	17.305	61.5%	7,440	2326

Source: Population Census Report, 2001, Table 5.2

2.3.4 Population Analysis

The procedure used to establish the building blocks for the long-term population forecasting model for the Study Area was based on information collected from the latest Census Data from 2001 together with historical Census Data for 1981 and 1991. The trends, nature and size of the population growth were analyzed and evaluated as well as the impact of in-migration.

For the population projection work, the analysis of past and recent trends (trend analysis) is an important component. Data from several publications from BBS was compiled and analyzed at the thana level within the Study Area. The data collected and analyzed included:

a. Population – total, male and female
b. Geographical area
c. Population density
d. Annual population growth rates between 1981-1991
e. Annual population growth rates between 1991-2001

In addition to natural population growth, a significant amount of population increase is attributable to the in-migration of people into the Study Area. This has been particularly noticeable since Independence in 1971, when Dhaka became the national capital. Out of a total of 55 thanas in the Study Area, 39 thanas were found to have administrative areas that did not change during the inter-census periods, and therefore provided useful comparisons for analysis purposes. The following observations provide a brief summary:

a. Population Density in 1981
Out of all the 39 thanas analyzed, only Sreepur and Kaliakair, both located in Gazipur District had a lower population density than the Country's average of 590 persons/sqkm (1981), whereas the thanas in the Dhaka City Corporation area, namely Ramna (15,900), Mohammadpur (18,000), Tejgaon (21,000), Motijheel (36,500) and Sutrapur (74,800), had a much higher population density in terms of persons/square kilometer. Most of the other thanas had a population density below 1,500 persons/sqkm.

b. Population Density in 1991
The 1991 Census data for four thanas, Harirampur, Daulatpur and Shibalaya (Manikganj District) and Sreepur (Gazipur District), shows a population density lower than that of the Country's average of 720 persons/square kilometer. The thanas in the DCC became more populated, as Tejgaon (24,700) Ramna (25,300), Mohammadpur (26,000), Motijheel (45,200) and Sutrapur (77,000) recorded higher densities.

c. Population Density in 2001
The 2001 Census data shows: (i) shifts of thanas from lower population density brackets into higher ones; and (ii) significant increase in population density in DCC thanas. Within the DCC, the thanas of Ramna (33,000), Tejgaon (34,000), Mohammadpur (37,600), Motijheel (54,500) and Sutrapur (88,400) became even more populated in terms of persons/sqkm.

d. Change in Population Density 1981-1991
The annual population growth during the 1981-91 period, for the thanas in the DCC and Gazipur Sadar, Narsinghdi Sadar and Narayanganj Sadar, was higher than the Country's average of 2.18% per annum. Sreepur and Kaliakair thanas, with the lowest population density, experienced growth rates of 2.99% and 3.46% respectively - more than the Country's average. This situation can be attributed to their proximity to Dhaka. Savar (3.7%), Keranigonj (3.9%), Ramna (4.8%) and Mohammadpur (3.7%) experienced high population growth during the 1981-91 period.

e. Change in Population Density 1991-2001
The thanas that observed higher annual population growth rates during 1991-2001 are Savar (4.8%), Gazipur Sadar (4.0%), Narayanganj Sadar (3.9%), Mohammadpur (3.8%), Tejgaon (3.2%) and Ramna (2.8%). Kaliaganj (3.2%) and Narsinghdi Sadar (2.6%) thanas registered significant urbanization in the Study Area.

The analysis of population growth changes provides some understanding of the process of densification in the Study Area. Generally, the rural areas, with low population density, experience only their natural population growth rates; much lower than those of urban areas. Similar characteristics can be seen in highly urbanized or densely populated areas, where further influx of population is usually either not possible or relatively slow. The high incidence of densification in urban areas or adjacent areas of a mega city is most likely to occur where the population density is moderate with growing potential for economic activities.

2.3.5 Population Projections

An established relationship between urbanization and development on a global scale is also apparent in Bangladesh. As shown in **Exhibit 2-6**, the per capita income, growth rate and rank in Bangladesh are significantly higher in those areas where the level of urbanization is high. Based on the per capita income, the ranking shows that the first five districts are all found within the major urban concentrations. Among these, the first three highest ranked districts (Dhaka, Gazipur and Narayangaj) are part of the Study Area.

Since the DMA has high levels of development activity as well as socio-economic facilities, as compared to other parts of the Country, continued growth in urbanization is expected to occur in the DCC area as well as the contiguous regions.

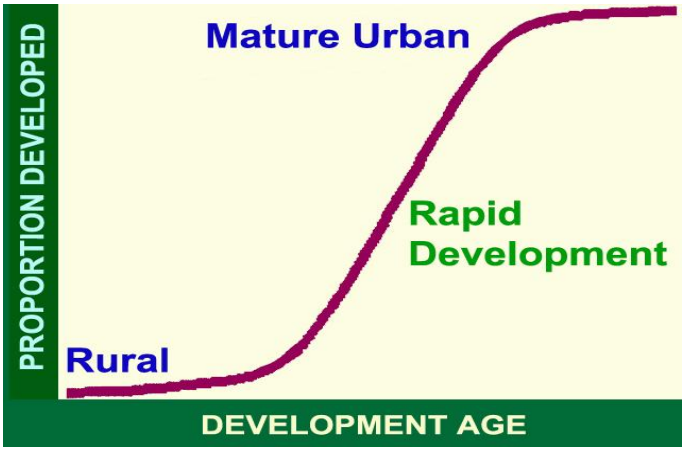
The level of urbanization also depends upon the absorption capacity of a specific area and the type of civic facilities and amenities that are available to attract the growing population. However, the process of densification in a specific area cannot continue forever. Rather, the rate of population growth in such areas will tend to decrease over time. This is based on the fact that lower migration can be definitely observed at a certain level of population density. This is referred to as the saturation level. This occurrence is illustrated in “logit curve” shown in **Exhibit 2-7**.

Exhibit 2-6 Economic Indicators in STP Study Area

District	GDP	Per Capita GDP		Growth Rate	Rank
	(Taka in billions)	(Taka)	(USD)	(4 year average)	(per capita GDP)
STP Study Area Districts					
Dhaka	354.2	43,852	872	5.46	1
Gazipur	69.7	34,875	693	5.17	2
Manikganj	20.8	15,018	299	5.05	37
Munshiganj	19.3	13,791	274	4.67	46
Narayanganj	66	33,040	657	4.8	3
Narsinghdi	36.4	18,290	364	5.24	11
Other Districts (with major urban concentration)					
Chittagong	186.2	28,113	559	5.46	4
Khulna	58.5	23,135	460	5.51	5
Bangladesh	2,370.70	18,269	363	5.36	--

Source: Statistical Year Book of Bangladesh – 2001 (BBS), pp 478-79

Exhibit 2-7 Rate of Development Logit Curve



For the purpose of establishing population projections for the Study Area, an analysis was made of the trend in normal population growth at the thana level as well as population growth due to the in-migration component. A series of matrices were developed showing natural growth rates and the effect of migration on different levels of population density. The annual growth rates at the national level were assumed to experience reductions from the earlier level to 1.4% for the period 2001-04; 1.2% for the period 2004-14; and 1.0% for the period after 2014. This assumption takes into account the overall population policy and on-going plans of the Country.

For the purpose of the present study, there was a need to establish data at the thana level for the base year (2004). Therefore, the growth rates were applied to the 2001 census data, at the thana level, to establish the base year 2004 population. The resultant base year figures at the thana level are shown in summary form in **Exhibit 2-8**.

Exhibit 2-8 Base Year Population (2004)

Districts	Average Growth Rate (% per annum)	Population (1000's)	Density (persons/sqkm)
Dhaka	4.33	9,800	6,696
Gazipur	1.93	2,146	1,232
Manikganj	1.90	1,381	1,001
Munshiganj	2.63	1,393	1,459
Narayanganj	3.31	2,397	3,156
Narsinghdi	2.78	2,068	1,813
Study Area	3.45	19,185	2,579
Bangladesh	1.40	135,568	919

The population projections were established for 2014 and 2024 using the Base Year along with the corresponding growth rates (2004-2014 and 2014-2024) obtained for different levels of population density at the thana level. A summary of the results including population forecasts for each district, as well as the corresponding average growth rate and density for each district for 2014 and 2024 are presented in **Exhibit 2-9**. A graphic illustration of district level population for 2001, 2004, 2014, and 2024 is presented in **Exhibit 2-10** at the end of this chapter.

Exhibit 2-9 Projected Population (2014 and 2024)

Districts	2014			2024		
	Growth Rate (% per annum)	Population (x 1,000)	Density (per/sqkm)	Growth Rate (% per annum)	Population (x 1,000)	Density (per/sqkm)
Dhaka	3.74	14,147	9,666	3.43	19,825	13,545
Gazipur	2.23	2,676	1,537	2.37	3,383	1,942
Manikganj	1.74	1,640	1,189	1.66	1,933	1,402
Munshiganj	2.47	1,778	1,862	2.29	2,229	2,334
Narayanganj	3.67	3,436	4,524	4.12	5,147	6,776
Narsinghdi	2.62	2,679	2,349	2.45	3,413	2,992
Study Area	3.23	26,357	3,543	3.15	35,930	4,830
Bangladesh	1.20	152,743	1,035	1.00	168,724	1,143

2.3.6 Conclusions on Population

The summary population information developed for the STP Study is organized into several levels including: (a) study area; (b) districts; (c) thanas; and (d) variation among thanas. **Exhibit 2-11** provides a summary at the Study Area level. The total population of the Study Area was estimated at 17 million in 2001 and is forecast to increase to 36 million by 2004. As a result of the combined effects of natural growth and in-migration to urban areas, the Study Area share of the national population will increase from 13% in 2001 to 21% in 2024. At the same time, population density in the Study Area will increase from 2,300 persons per square kilometre in 2001 to 4,800 persons per square kilometre in 2024.

Exhibit 2-11 Study Area Summary

	Population Characteristics			
	2001	2004	2014	2024
Study Area Population	17.3 million	19.2 million	26.4 million	35.9 million
Share of Bangladesh Total	13.3 percent	14.2 percent	17.3 percent	21.3 percent
Study Area Density	2,327 per/sqkm	2,579 per/sqkm	3,543 per/sqkm	4,830 per/sqkm

Exhibit 2-12 provides a summary at the district level. The population of Dhaka District was estimated at 8.6 million in 2001 and is forecast to increase to 19.8 million by 2004. The Dhaka District share of the total Study Area will increase from 50% in 2001 to 55% in 2024. At the same time, population density in Dhaka District will increase from 5,800 persons per square kilometre in 2001 to 13,500 persons per square kilometre in 2024.

Exhibit 2-12 District Summary

Districts	2001			2001-04	2004			2004-14	2014			2014-24	2024		
	A*	B*	C*	D*	A*	B*	C*	D*	A*	B*	C*	D*	A*	B*	C*
Dhaka	8.6	50%	5,888	4.3%	9.8	51%	6,696	3.7%	14.1	54%	9,666	3.4%	19.8	55%	13,545
Gazipur	2.0	12%	1,163	1.9%	2.1	11%	1,232	2.2%	2.7	10%	1,537	2.4%	3.4	9%	1,942
Manikganj	1.3	8%	946	1.9%	1.4	7%	1,001	1.7%	1.6	6%	1,189	1.7%	1.9	5%	1,402
Munshiganj	1.3	7%	1,349	2.6%	1.4	7%	1,459	2.5%	1.8	7%	1,862	2.3%	2.2	6%	2,334
Narayanganj	2.2	13%	2,860	3.3%	2.4	12%	3,156	3.7%	3.4	13%	4,524	4.1%	5.1	14%	6,776
Narsinghdi	1.9	11%	1,668	2.8%	2.1	11%	1,813	2.6%	2.7	10%	2,349	2.5%	3.4	9%	2,992
Study Area	17.3	100%	2,327	3.5%	19.2	100%	2,579	3.2%	26.4	100%	3,543	3.2%	35.9	100%	4,830
Bangladesh	130.0	na	881	1.4%	135.6	na	919	1.2%	152.7	na	1,035	1.0%	168.7	na	1,143

A* Population (millions); **B*** Share of Study Area (%); **C*** Density (persons/sq km); **D*** Growth Rate (percent/annum)

It is expected that the process of urbanization will be more at the district headquarters and paurashava level. The densification in the thanas of DCC will be higher, particularly where population density is observed up to 40,000 persons per square kilometer depending upon the civic amenities and facilities, and also economic activities associated with more employment opportunities. Other factors, such as land use planning, flood control and infrastructure development including transport, will have a significant influence in further densification or shifts in population concentration in any new areas within the STP.

Finally, these population projections are meant to establish general control totals for the Study Area. Further sections of this report discuss the manner in which these forecasts are distributed to reflect various future land use scenarios.

2.4 EXISTING LAND USE PATTERNS

As noted in the introductory remarks in Section 2.1, the STP Study Area consists of the area between the Padma and Meghna Rivers in the south-central part of the country. Within the V formed by the confluence of the two rivers, the Study Area is wholly contained within Dhaka Division and comprised of six Districts (Zilas) in their entirety: Dhaka, Gazipur, Narshinghdi, Manikganj, Munshiganj and Narayanganj Districts. The southwest boundary of the Study Area is the northern shore of the Padma River, known as the Ganges in India. All of the Padma within the Study Area is navigable by relatively small ships, but not ocean-going vessels. There are at present no bridges across the Padma, but major ferry ghats are located at Mawa, in the southern part of the Study Area, and two ghats in Manikganj District in the western part. The eastern boundary of the Study Area is the western shore of the Meghna River. It is navigable by relatively small ships, but not ocean-going vessels. It is bridged by the Dhaka-Chittagong Road as it exits/enters the southeast quadrant of the Study Area and the road and rail bridge at Bhairab Ghat in the northeast quadrant of the Study Area. South of their confluence, the combined river systems finger into many branches, all heading south to drain into the Bay of Bengal.

Land uses are discussed in terms of three concentric areas, as illustrated in **Exhibit 2-13** located at the end of this chapter, including:

- Outer Study Area (referred to as the Outer Ring or OSA). Sub-areas in the Outer Ring are referred to as OSA North, OSA East, etc.

- Dhaka Metropolitan Area (referred to as the DMA). The DMA boundaries as discussed by the STP Terms of Reference are essentially the RAJUK boundaries.[42] For STP purposes, the boundaries have been slightly enlarged so as to include thanas in their entirety[43]. The relationship of the DMA as defined for the current study, its relationship to the RAJUK boundaries and to jurisdictions within it are shown in **Exhibit 2-14** at the end of this chapter.

- Greater Dhaka Area (referred as the GDA). The GDA is the inner portion of the DMA and consists of Dhaka City Corporation (DCC) and its immediate environs defined as all thanas either wholly or partially contained within the DCC.

[42] *It thus differs from common usage. DMA is delineated by most area maps as the area defined by the Turag, Buriganga and Balu Rivers and the Narayanganj District boundary. It includes both the Dhaka City Corporation (DCC) Area plus the entirety of the thanas to the north and east of the DCC which are partially within the DCC. World Bank documents, on the other hand, delineate the DMA as the RAJUK boundaries (see for example Report 18339-BD, Project Appraisal Document on a Proposed Credit for Dhaka Urban Transport Project, 17 December 1995) - i.e., the area including the DMA as the term is commonly defined plus all or portions of the neighbouring Savar and Keraniganj Thanas and the majority of Gazipur Sadar, Rupganj and Sonargaon Thanas. For STP purposes, as noted in the text, it has been further refined to include the partially included thanas in their entirety - primarily because census data is available only at the thana level.*

[43] *2001 Census data is available in disaggregated form only to the thana level, not below.*

2.4.1 Existing Land Uses in the Outer Study Area

A. Overview

Detailed discussions of land uses and other characteristics of the districts comprising the Outer Ring of the Study Area are provided in Working Paper #2. Briefly stated, however, with regard to the Outer Ring as a whole, the land uses are largely agricultural. Most of the area is low, flat, fertile and flood-prone. Much of the area, particularly to the south, east and west, suffers from regular floods during monsoon, but benefits from the silts deposited. In contrast to the flood-prone areas on either side, the north-central portion of the OSA between the two major rivers (the Padma and Meghna) is slightly crested between two of their tributaries (the Balu and the Turag) along a north-south axis midway between the two. The city of Dhaka is located in the centre of this crested area in the southern-most part of the country that can be considered to be relatively flood-free.

Settlements in the Outer Ring are relatively small market communities and clusters of road-related land uses in the corridors that traverse the area. Agriculture is the primary land use. Cropping patterns do not vary significantly within the Outer Ring except for a greater amount of upland crops on the higher ground in northern part.

Discussions of the demographic characteristics in the Study Area have been presented in Section 2.3. The Outer Ring contained roughly 48% of the total Study Area population in 1991. By 2001 the percentage dropped to 41%. Only 20% of the population growth in the Study Area occurred in the Outer Ring. As indicated graphically by **Exhibit 2-15** located at the end of this chapter, population growth rates in the Outer Ring at the thana level were consistently below 2% per annum in the 1991-2001 period. Growth rates for most of the Outer Ring thanas were below 1%.

B. OSA North

The northern part of the Outer Ring is shown on **Exhibit 2-16** at the end of this chapter. It consists of all of Gazipur District, other than the two thanas included in the DMA. Land uses in the OSA North are predominantly agricultural with some industrial and other uses along the major road corridors. In spite of its location on the Dhaka-Mymensingh corridor, population growth in DMA North in the 1991-2001 period was less than 1%. The growth rate for Sripur Thana was less than 0.1%. This contrasts with the area immediately to the south which grew at a rate in excess of 2% and with Dhaka City which grew at a rate of more than 4%.

The southern portion of OSA North contains portions of one of the few surviving forest areas in Bangladesh: Bhawal National Park (also known as Rajendrapur National Park). The forested area is located approximately 40 kilometres north of Dhaka. Established in 1974 and encompassing an area of 5,022 hectares, part of the area has been “notified as a protected area in 1982 under the International Union for Conservation of Nature (IUCN’s) protected area Category 5.” The corridor also accommodates both the main north-south road and railroad, both of which traverse the relatively high ground between the Balu River on the east and the Turag River on the west.

The south-west portion of OSA North is traversed by the Jamuna Bridge-Chittagong Corridor and includes the western portion of the railway. Kaliakair, the only significant urban settlement in the corridor is basically an agricultural marketing centre. Land uses along the Jamuna Bridge Corridor are predominantly agricultural. Opened in 1998, the Jamuna Bridge is the only bridge connection across the Jamuna. In addition to the road access developed in conjunction with it, the bridge accommodates the railroad that was re-aligned to take advantage of the river crossing and a natural gas pipeline supplying energy to the northwest part of the country.

C. OSA East

The eastern part of the Outer Ring is shown in **Exhibit 2-17** at the end of this chapter. It is comprised of Narsinghdi District and one thana (Araihazar) in the neighbouring district to the southwest (Narayanganj District) along the boundary with the DMA. Narayanganj Sadar (the District Capital) is the largest urban settlement in OSA East. Two major roads from Dhaka intersect at Narayanganj City, one through Tongi and Kaliganj and the other from Dhaka and generally referred to as the Dhaka-Narshingdi-Sylhet Road. The two converge into one in Narshingdi Sadar and continues through the District exiting to the east at Bhairab via ferry crossings of the Maghna River. The rail line to Chittagong also passes through the Thana and crosses the Meghna via a rail bridge. Growth rates in the 1991-2001 period in the thanas comprising DMA East ranged from 0.59% in Monohardi to 1.24% in Shirpur. Land uses in the components of OSA East are as follows;

- Araihazar Thana. Land uses are predominantly agricultural with rice, jute and sugar cane the major crops. Some industrial land uses are noted, generally in proximity to the Dhaka-Narshingdi-Sylhet Road.
- Narsinghdi District. Land uses in the District are predominantly agricultural with rice, sugar, bananas and sugar cane are noted among its major crops. Textiles, paper and fertilizer are among its industries.

D. OSA South

The southern part of the Outer Ring is shown in **Exhibit 2-18** at the end of this chapter It consists of Munshiganj District and the southern portion of Dhaka District. The urban settlements of note are Srinagar, Munshiganj and Gazaria in Munshiganj District and Dohar and Nawabganj in the Dhaka District portion. The Dhaka-Chittagong Road passes a few kilometres east of Gazaria. Growth rates in the thana's comprising the area in the 1991-2001 period were consistently below 1% with the exceptions of Srinagar and Munshiganj Thanas (at 1.06% 1.01%, respectively). Land use characteristics of the two sub-areas comprising OSA South areas are as follows:

- Munshiganj District. Land uses are predominantly agricultural with potatoes, rice and jut are noted as its major crops. Some industrial land uses (mainly textiles) are reported in the area. A ferry service providing a connection to the south bank of the Padma River and the southwest portion of the country is located at Mewa.
- Southern Portion of Dhaka District. The characteristics of the southern portion of Dhaka District (Nawabganj and Dohar Thanas) are essentially the same as those of the neighbouring Munshiganj District, except that it lacks connections to the south bank of the Padma River.

E. OSA West

The western part of the Outer Ring is shown in **Exhibit 2-19**. It consists of:

- Manikganj District. Manikganj Sadar is the only significant urban settlement in the OSA West. Land uses within this portion of the Outer Ring portion are predominantly agricultural. Manikganj District occupies an area of approximately 1,379 square kilometres. Its 1991 density is reported as approximately 954 persons per square kilometre - one of the lowest densities in the Study Area. Land uses are largely determined by the fact that the area is located in the low and medium low flood plain of the Padma River. Agriculture is the predominant land use with rice, jute and sugar cane among its major crops. Some industrial land uses are found in the district (mainly pharmaceuticals and ceramics industries).

- The Northwest Portion of Dhaka District (Dhamrai Thana). The relatively small portion of Dhaka District also included in OSA West has essentially the same land use character as the Manikganj District. The only significant road passing through the thana is the Dhaka-Archia Road. The population growth rate of Dhamrai Thana was 0.86% in the 1991-2001 period.

2.4.2 The Dhaka Metropolitan Area (DMA)

As noted in the introductory remarks, the Terms of Reference (TOR) for the STP Study require it to "develop a coherent long-term Strategic Transport Plan….with special emphasis on integrating the planned land-use for the future growth of the city mentioned in the Dhaka Metropolitan Development Plan (1995-2015) with transport issues in the Dhaka Metropolitan Area (DMA) over the next 20-year planning horizon…". The term "Dhaka Metropolitan Area (DMA)" is not defined by the TOR, but in this context it clearly refers to the area within RAJUK's jurisdiction (see footnote on page 2-17). The area defined and referred to hereinafter as the DMA as defined for STP Study purposes is shown on **Exhibit 2-14** and **Exhibit 2-20** located at the end of this chapter.

Demographic data was provided in Section 2.3. Briefly, however, it can be noted that roughly 21% of the growth in the Study Area in the 1991-2001 period occurred in the DMA Ring. Roughly 80% in the period occurred within the DMA boundaries.

A. DMA North

The northern portion of the DMA is shown in **Exhibit 2-20** at the end of this chapter. It consists of Gazipur Sadar Thana and Tongi (reported to be now classified as both a Pourashava and a thana). Population in the DMA North grew at a rate of 2.05% in the 1991-2001 period - considerably more than the areas to the north, but half of the rate of the DCC/GDA to the south. Land use characteristics of the two sub-areas comprising DMA North are as follows.

- Gazipur Sadar Thana. As was the case with OSA North, the thana contains portions of one of the few surviving forest areas in Bangladesh: Bhawal National Park (also known as Rajendrapur National Park). Established in 1974 and encompassing an area of 5,022 hectares, part of the area has been "notified as a protected area in 1982 under the International Union for Conservation of Nature (IUCN's) protected area Category 5." For STP land use discussion and population allocation purposes, Gazipur Sadar Thana can be divided into three constituent parts:

  - *Gazipur Pourashava* – with a jurisdictional area of 48 square kilometres and a reported 1991 population of 265,419 and an estimated 2001 population of 413,240. It was established in 1986 as the capital of Gazipur District. A BEPZA EPZ is located in Gazipur. Its capacity for population absorption is rated high.

  - *Gazipur Sadar Thana* - East. The remainder of Gazipur Sadar Thana to the east beyond Gazipur Pourashava is rural and agricultural in character. Agriculture is the main economic activity and industries in the eastern part of the thana include agro-based industries, poultry farms and orchards. Reports indicate that much of the land has been purchased speculating on land in anticipation of urban expansion to the north.

  - *Gazipur Sadar Thana* - West. Agriculture is the main economic activity.

- Tongi Thana. Recently designated as a thana as well as a Pourashava, Tongi is located on the main north-south highway, the main north-south railway, and the northwest-southeast rail line from the Jamuna Bridge to Chittagong. It abuts the northern boundary of the DCC/GDA and is functionally and economically (but not administratively) an extension of Dhaka. Its land uses are predominantly urban along its major roadways and within the town centre. Tongi Pourashava emerged as a largely unplanned industrial district in the 1950s. It is characterized by local planners as disorganized with dispersed residential and commercial uses with very large slums and squatter settlements. These are occupied by industrial workers and informal sector workers employed in Tongi and the neighbouring portions of Gazipur City and Dhaka.

Exhibit 2-21

Tongi Population Data

Tongi	1991	2001
Number of Wards	3	10
Area	32 km^2	32 km^2
Population	264,854	302,040
Households	54,688	71,360
Household Size	4.9	4.23
Density	1,690 Households/ km^2 8,810 persons/ km^2	2,375 Households/ km^2 10,048 Persons/ km^2
Literacy Rate	52.7%	NA

Sources: *Bangladesh Population Census 1991 and 2001 (Provisional), Bangladesh Bureau of Statistics; and Pourashava Statistical Yearbook, 1997-1999, Local Government Engineering Division (LGED).*

Biswa Eztema, a congregation of Muslims from all over the world, is held in Tongi annually and a large site is reserved for this purpose. Large tracts of government land reportedly lie idle in this zone. Away from the main roads its land uses are predominantly agricultural. The lands close to the Turag River are low-lying and flood-prone. Its capacity for population absorption is rated high. Additional data is provided in **Exhibit 2-21**.

B. DMA East

The eastern part of the DMA is shown on **Exhibit 2-20** at the end of this chapter. It consists of Kaliganj Thana (Gazipur District) and Rupganj Thana (Narayanganj District). It lies to the east of the Balu River and is roughly bisected by the Sitralakya River.

- Land uses in Kaliganj Thana are predominantly agricultural. Kaliganj experienced an accelerated growth rate in the 1991-2001 period - an annual rate of 3.14%, compared to a rate of only 0.62% in the neighbouring Rupganj Thana.

- Rupganj Thana (Narayanganj District) area is low-lying and predominantly occupied by agricultural land uses. Its land uses can be best described in terms of its two constituent parts. The northern part of the thana lies in the triangular area between the Balu and Sitalakhya Rivers. In principal, most of Rupganj Thana is designated as a flood retention and uses as an agricultural area pursuant to the stipulations of the Dhaka Metropolitan Area Development Plan (DMDP). The southern portion of the thana lies to the south of the Sitalakhya River and is traversed by the Dhaka Sylhet Road. The road has been upgraded to a relatively high standard and is becoming attractive for industrial development and land investments - particularly in light of the proposed roads and new community development.

The Dhaka Bypass will traverse the southwest portion of Kaliganj Thana. The RAJUK-supported new community of Purbachal with an estimated population of one million persons will straddle the boundary between Kaliganj Thana and Rupganj Thana. Combined with other road proposals to link Purbachal to the Airport Road in Dhaka, considerable development pressure can be expected in this portion of DMA East due to forces already set in motion.

It is interesting to note that the DMDP provided that Rupganj Thana should be devoted to agricultural use and further recommended that Rupganj Thana should be designated as a Water Supply Protection Zone. The concept of Purbachal New Town was opposed by the DMDP Planners. In spite of these recommendations Purbachal is proceeding and, given the current levels of commitment to the project, it is considered to be a "given" for STP Study purposes.

C. DMA Southeast

The southern part of the DMA is shown in **Exhibit 2-20** at the end of this section. It consists of Sonargaon, Bandar & Narayanganj Thanas, all of which are in Narayanganj District. Population in the thanas comprising the DMA Southeast grew in the range from 1.33% to 1.65% in the 1991-2001 period. Existing land use characteristics in the two main components of the area are as follows:

- Sonargaon Thana borders Rupganj Thana to the north and Badar Thana west. Sonargaon Thana is bounded on the east by the Meghna River. The Town of Sonargaon (meaning Golden Town in Hindi) is the only significant urban land use in the area and was the country's first capital. Little remains of the original city, but it is still considered to be of archaeological interest. Sonargaon Thana grew at a rate of 1.57% in the 1991-2001 period.

- Bandar Thana is located between the Sitalakhya River on the west and the Brahmaputra on the east. Land uses in most of the area are predominantly agricultural. Kadamrasul (a Pourasava) is the only urban land use and is directly across the river from Narayanganj Pourasava. Although Kadamrasul is designated as a Pourasava, it is distinctly rural in character. Land uses are predominantly agricultural with a lively marketing centre.

- Most of Narayanganj Thana is highly urbanized and is referred to as the DND Triangle[44]. The area is protected from external flooding by flood embankments that give the area a triangular shape and hence the name. Little of the area was developed prior to 1971, but unplanned development occurred rapidly thereafter, particularly along the DCC boundary and along the highway. Two important land uses in the area include facilities of the Dhaka Water and Sewer Authority (DWASA): the Pagla Sewerage Treatment Plant and the Syedabad Water Treatment Plant.

  Land use development of the area is constrained in the absence of an approved detailed plan for the area (See Section 2.7). It is reported that RAJUK will not issue permissions for building in the area. As a result, low-rise development (which by implication does not require or does not seek permission) is growing very rapidly. There are large slums in the area.

  Narayanganj Pourashava is reported to house one of the busiest ports in the country and the terminus of the branch of the railway line through Dhaka. Textiles are among its major industries. Land uses within the Pourasava are mixed commercial and residential. It considers itself to be one of the oldest communities established during Mughal rule and was officially established as a municipality in 1876. The riverbanks have been used throughout the last hundreds of years for docking of inland vehicles and industries related to ship construction, textile, jute and other major economic activities. Outside the urban areas the land is very rich agriculturally. In spite of its attributes, much of the community has fallen into disrepair Kadamrasul, possibly because of declines in the jute market.

[44] *DND is the area within the development corridors associated with the existing railway line, the Dhaka-Narayanganj Road and the north-south road connecting to the Dhaka-Chittagong Road.*

The DMDP recommended the immediate preparation of a Detailed Area Plan (DAP) for the DND Triangle and the area was identified as a major infill growth area in the first ten years of the plan. The recommendation was based on the premise that infrastructure development would lead rather than follow development in the area and that proper land control regulations would ensure the development of flood retention ponds to the north. Neither premise has proved to be the case.

D. DMA Southwest

The southwest part of the DMAis shown in **Exhibit 2-20** at the end of this chapter. It is delineated as Keraniganj Thana (Dhaka District). Keraniganj Thana grew at a rate of 1.33% in the 1991-2001 period. It lies directly south of Old Dhaka occupying low-lying land south of the Buriganga River on the north and the Dhaleswari River on the south. The community of Jinjira is a one of the historic settlements in the Thana. Maps of the area indicate that a palace was located at Jinjira in Mughal times, one of the few and perhaps the only major palace to the south of the Buriganga. A major road is under construction on the south bank of the Buriganga, roughly parallel to the river and the area is likely to come under increasing development pressure in spite of the fact that it is low-lying and will require extensive fill. RAJUK has undertaken the construction of a project in Jinjira called “Jhilmil” on 150 hectares of land to accommodate 1,800 residential plots and 18,000 apartments. The southern portion of Keraniganj Thana is within the flood area of the Dhaleswari River.

E. DMA West

The western part of DMA is shown in **Exhibit 2-29** at the end of this chapter. It is named as the Savar Thana, a part of Dhaka District). Savar Thana is bounded on the west by the Dhaleswari, the western boundary of RAJUK and the DMA, and on the east by the DCC and the Gazipur Thana. Portions of the area are occupied by the Turag River Wetlands are subject to complete inundation during the monsoon. In spite of that, billboards announcing the development of new communities in the area have been noted. The more western portions of the thana, particularly the northwestern portions, are on natural high ground making it an attractive area for land development companies and cooperatives since the 1960s. The Savar Pourashava is the major settlement in the area and two major Export Processing Zones (EPZs) are located in the Dhamsona Area to the north of Savar Pourashava. Savar Thana was the fastest growing area in the 1991-2001 period, growing at an annual rate of 4.78% compared to 4.10% for the DCC/GDA and 3.14% for Kaliganj, the next fastest growing area.

- The east-west portion of the road corridor traverses a major wetland area. The wetlands are part of a complex system connecting the Dhaleswari river and the Turag River and field investigations indicate that a significant portion of the wetlands are navigable by appropriately sized crafts. Urban land uses occur in strip fashion close to Dhaka.

- The north-south portion of the road corridor traverses the western edge of the relatively high ground designated as an area of high agricultural value. Savar Pourashava is a significant urban settlement located 15 kilometres from Dhaka’s Gabtoli Bus Station in Dhaka. Urban uses are filling the area between the town and the EPZs to the north, including large important establishments such as Jahangir Nagar University, Savar Cantonment and the National Martyrs Monument. Each occupies large tracts of land (several hundred acres). Field investigations indicate that few, if any, provisions have been made for the impacts of the EPZ developments due to the generation of demand for commercial activities along the roads or parking for buses and other vehicles not allowed to enter the EPZs.

- Land uses along the Savar Kaliakair Road are a mix of agricultural, industrial and unplanned commercial uses generated by the EPZs and the population they attract. Portions of the road are densely urbanized as strip developments. Traffic congestion in and around the

EPZs is common. From a land use planning perspective, it can be noted that virtually no provisions have been made to accommodate bus parking related to the EPZs and is a major source of the congestion. The EPZ development includes little or no residential provisions for those working in the area and there is apparently no coordinated planning.

2.4.3 The DCC/GDA

The term Greater Dhaka Area (GDA) is defined as the DCC and all thanas contained fully or partially within the DCC boundaries plus the area designated as Sultan Ganj (Kamrangir Char). The area thus includes the entire area within the area defined by the Turag River, the Buriganga River, the Balu River on the east, and the southern boundaries of Demra and Shyampur thanas.

Exhibit 2-22 at the end of this chapter illustrates Bangladesh Space Research and Remote Sensing Organization (SPARSO) Generalized Land Use Map based on 1984 aerial photographs. It is accompanied by **Exhibit 2-23** which illustrates existing land uses in and around the DCC. The map is also based on data provided by SPARSO, including satellite image data 2003, field observations by members of the study team, and other data sources.

A. Overview

Land uses in Dhaka are a rather remarkable siting of nodal developments each with distinct characteristics. The nodes lie along corridors that radiate to the north from Old Dhaka, the historic nucleus of the city. Briefly stated, observations in regard to particular land use categories and areas of the city with unique land use characteristics are noted below. The discussions are organized under the headings of the SAPPRO land use categories although classification of the area's land uses into such categories needs to be viewed with caution. **Exhibit 2-24** summarizes the uses within the DCC.

B. Traditional Mixed Housing & Commercial Land Use

The Traditional Mixed Housing & Commercial Land Use category is most prominent in Old Dhaka, one of the densest portions of the city and one with intensely intermingled land uses. The traditional heart of the commercial area and historic origins of the city (the Chawk Bazaar and Bangla Bazaar) are the major wholesale distribution centers. Land uses in this category are largely (but not completely) confined to the north bank of the Buringanga River. Its growth has tended to follow a northern axis along the naturally high ground between the Turag River to the west and the generally amorphous wetlands to the east fed by the Balu River. Although more recent in their establishment, land uses in this category are found to the northeast of the Ramna Area, on either side of the western portion of Elephant Road, north of the Karwan Bazaar Area and in smaller pockets around the city.

Exhibit 2-24

Estimated DCC Land Use by Land Use Category

Land Use Category	Percent
Residential	45%
Commercial & Industrial	15%
Administrative & Institutional	20%
Roads & Transport	10%
Open Space	10%

Source: *Centre for Urban Studies and STP Land Use Working Paper.*

C. Formal Sector Commercial Land Uses

Formal sector commercial areas are found primarily in the southern portion of the Ramna Area, within the area considered to be Dhaka's central business district (CBD), along Airport Road, the Karwan Bazaar area and the location of the recently opened Bashundara City. The waterfront area of Old Dhaka is also intensely commercial, along with the newly emerging area on the south bank of the Buriganga River (due to some degree to the relatively recent addition of two bridges across the river). Areas of intense commercial activities are also found at New

Market, the DIT Road-Elephant Road intersection, along the east-west Mohakhali Gulshan Road and the north-south Gulshan Avenue. Smaller strips of formal sector commercial land uses are also evident through within or along the outer perimeter of all planned residential areas. Portions of Tejgaon, which were previously restricted to industrial uses, have been officially opened to, and are converting to, commercial uses, particularly along Shaheed Tujuddin Road.

D. Planned Residential Land Uses

The term "Planned Residential Land Uses" generally refers to residential developments that have been planned in detail by the public sector. Areas which may (or may not) be described as exceptionally well planned by the private sector in a physical and urban design sense are generally not included in this land use category. A reorganization of land use categories is strongly recommended in future land use studies. Given the limitations of the data on which the STP Study is reliant, it can be noted that the most significant areas classified as Planned Residential Land Uses are:

- Wari. Wari was originally developed by the local population during the British period to house local Government employees. According to some reports it was one of the first areas of Dhaka to be laid out using a grid pattern.
- The northern portion of Ramna classified as Planned Residential was first developed after the partition with India as residences of ministers and judges, senior government officials. Much of the area underwent rapid changes in the 1980-90s and is now high-rise apartments and commercial buildings.
- Dhanmondi & Mohammadpur. The Planned Residential land uses of Dhanmondi, designed in the 1950s to house 2,000 families, is reported now to house 20-30 times that number[45]. The Planned Residential area is laid out on a flexible-grid pattern of roads organized around a pre-existing khal (water channel) dug out and extended to form an irregular shaped lake. Although still predominantly residential, the area is gradually being developed into multistory housing along with commercial and various institutional uses such as health, education, and offices. Mohammadpur was originally developed to house migrants from India after partition.
- The Mirpur & Pallabi Planned Residential Areas. are located to the north of Mazar Road in the northwest quadrant of Dhaka.
- Banani, Gulshan & Baridhara Planned Residential areas are laid out in a regular grid pattern and organized around elongated north-south tending lakes between the Dhaka-Mymensingh Road.
- The Khilgaon & Motijhel Planned Areas is mainly a middle class residential neighborhood of high density. Motijhel consists of government staff quarters mainly constructed in prior to 1971 for staff of lower grades.

E. Unplanned Housing

Unplanned housing surrounds and is interspersed with all land uses in the pattern indicated in **Exhibit 2-23** at the end of the chapter. It is not a particularly distinctive land use category since it includes land uses as diverse as the recently developed, high density Japan Garden City in Ward 43 and one-story slum dwellings. It is, however, the best data available to the STP Study. It is estimated that the vast majority (more than 90%) of housing in Dhaka is provided through the private sector, of which most (70%) is within the informal sector, generally through the efforts of individuals building their own homes. There are few formal financial mechanisms. Construction is carried out by informal sector builders and casual labor. Informal sector housing is found throughout the city, including the more up-scale, formal sector residential developments.

[45] *Newsweek, December 2003, page 28.*

F. Industrial Land Uses

Relatively small pockets of Industrial Land Use tend to be clustered along the waterfront and the Old Dhaka Area. The Tejgaon Industrial Area is by far the largest, clearly designated industrial area in the DCC. Ready Made Garment (RMG) industries are scatted throughout the DCC as tabulated in **Exhibit 2-25**.

Industrial land uses include a small but significant industrial land use located along Airport Road. The greatest amount of RMG employment is in Mirpur - nearly 30% of the total for the GDA. The southwestern portion of the DCC is the traditional center of tanneries, a land use that is reportedly slated for relocation. If so, it will free the area for redevelopment. Industrial land uses in the western part of the city also include several large-scale brick factories along the banks of the Turag River.

Exhibit 2-25

DISTRIBUTION OF RMG INDUSTRIES IN THE DCC AND IMMEDIATE ENVIRONS

Thana	No. of Employees
Badda	2,613
Cantonment	13,944
Demra	7,706
Dhanmondi	33,863
Gulshan	65,432
Hazaribagh	3,608
Kafrul	2,370
Khilgaon	44,917
Kotwali	8,702
Lalabagh	5,566
Mirpur	153,931
Mohammadpur	24,774
Motijheel	18,511
Pallabi	2,302
Ramna	15,059
Sabujbagh	24,401
Shampur	10,564
Sutrapur	6,574
Tejgaon	53,585
Uttara	25,882
Total GDA	**524,304**

Source: *BGMEA Members Directory 2003-2004*

G. Military & Institutional Land Uses

University, government and military land uses dominate large parts of the city. Dhaka University and the Bangladesh University for Engineering and Technology (BUET) occupy a large part of the centre city. The University occupies the former administrative buildings - Curzon Hall being one of the most famous. The National Parliament (Sher-e-Bangla Nagar), an internationally known architectural showpiece by the American architect Louis Khan, the neighbouring Residential Model School and College to the west and the National Parade Square (which doubles as the Tejgaon Airport) occupy large areas of land to the northwest. The Military Cantonment Area, technically outside the boundaries of the DCC but virtually surrounded by it, is a major land use and a major impediment to vehicular movement between portions of the DCC.

H. Transport Land Uses

Much has been made of the amount of space within the city devoted to roads. The most commonly quoted figures range from 6% to 10%. SPARSO Land Use Maps are of little value in determining an estimate. Roads are indicated simply as lines with no indication of road width. Comparisons between countries are complicated by the fact that some include parking and garages in their calculations, some do not. Nonetheless, assuming the 10% figure is correct, it compares with a roughly similar figure for most developing countries, 13% for Hanoi and figures that range between 15% and 20% for Western Europe[46]. It is also relevant to note that Dhaka is one of the least motorized cities in the world and the portion of travel by motorized vehicle is low. Dhaka, in fact, has one of the highest percentages of roads to motor vehicles in the world.

In addition to the road and rail rights-of-way, transport land uses in the DCC include major railway stations, an inland customs facility located in the centre city and three major inter-district bus stations (Saidabad, Mohakhali to the north of the Tejgaon Industrial Area, and Gabtali on

[46] *Asian Development Bank, City Profiles circa 1004, Statistics Norway, 20 March 2002 and Horstra University, Jean Paul Rodriguez, Internet Site, circa 2004.*

the western edge of the DCC) and the Tejgaon Airport (which doubles as the national Parade Ground). Zia International Airport, outside the DCC but within the GDA and a major land use consideration, occupies a huge swath of land which severs one portion of the DCC (Uttara) from the remainder. The airport also imposes height and other land use development restrictions.

I. Sports Facilities and Open Space

Major sports facilities and open space include Ramna Park and Suhrawardi Uddon, the open space in the vicinity of the national Stadium and Bhasani Stadium, the Sher-e-Bangla Nagar and the National Zoo and Botanical Gardens in the northwestern part of the DCC. A second national Stadium is also located in the northwest. Additional open space is distributed throughout the city, most notably in conjunction with the lakes in Banani, Gulshan and Dhanmondi. Encroachment of other land uses, both commercial and residential, is evident in many areas.

J. Other Land Use Considerations

Buildings in Dhaka over six stories require special permits. The locations of tall buildings in Dhaka (over seven stories) were surveyed by the STP study and are indicated by **Exhibit 2-26**. The city has approximately 12 buildings taller than 20 stories.

The low-lying nature of areas to the east, south and west of the DCC, and areas of high agricultural value are noted as land use constraints of an environmental-related issue.

Major land uses warranting consideration for relocation and/or reorganization and having significant traffic implications are illustrated by **Exhibit 2-27** at the end of this chapter.

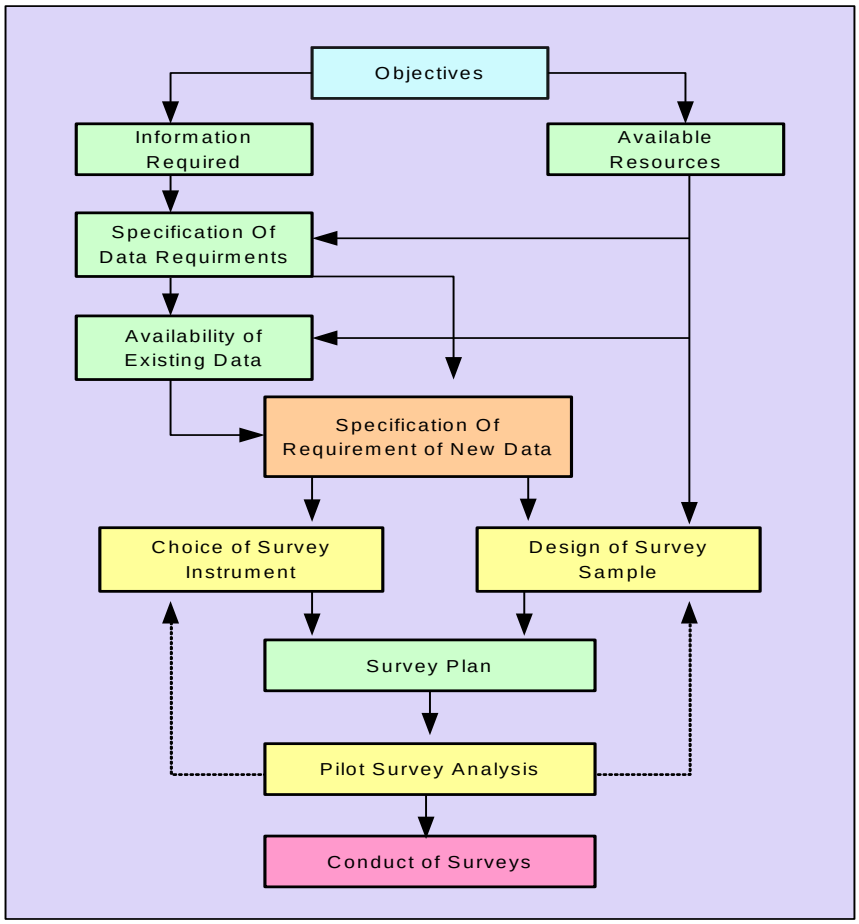
2.5 EXISTING TRAVEL CHARACTERISTICS

2.5.1 Introduction

As part of the STP Study, a data collection program was undertaken. The process, as shown in **Exhibit 2-28** below, involved a determination of what was required, an assessment of what was already available, and the design and conduct of a comprehensive set of field surveys to meet the remaining needs of the current study.

It was concluded that the data available was not sufficient to meet the requirements of the STP study. This was particularly true for the computer modelling exercise, but also for other information.

Exhibit 2-28: Data Collection Process



The specific types of field surveys conducted in mid-2004 include the following:

- Screen Line Survey (vehicles, vehicle occupancy and pedestrians)
- Internal Cordon Survey (vehicles, pedestrians, origin-destination)
- External Cordon Survey (vehicles, pedestrians, origin-destination)
- Household Interview Survey (family members, dwelling, income, trips, travel modes, origin-destination)
- Travel Time Survey (speed and delay)
- Bus Passenger On/Off Travel Time Survey (passenger boarding on/off and travel time)
- Public Transport Terminal Survey (origin-destination, purpose, travel time, cost)
- Traffic Generator Survey (terminals, markets, institutions, centres)
- Parking Survey (inventory, turnover)

This section of the report provides a brief overview of some of the information from these surveys. The reader is referred to Working Paper No. 1: Survey Design, for more in-depth information on the design and content of each survey and to Working Paper No. 7: Report of Surveys for more information on the conduct of the surveys, processing of the data, and the results.

2.5.2 Screen Line Survey Information

Screen line surveys are volume counts of pedestrians, passengers and vehicles crossing designated screen lines established for the study. **Exhibit 2-29** at the end of this chapter, shows the locations of the three screen lines, as well as points where existing roads cross each screen line. At each of these crossing points, counts of the number of people (pedestrians and passengers) and the number of vehicles (by various types) were taken for a period of 24 hours on a normal weekday. Salient facts from this survey are as follows:

- Buses comprise 8% of the vehicle mix that combines all vehicles and pedestrians or 10% if the base includes all vehicles, (pedestrians excluded) and 16% if the base is only motorized vehicles (pedestrians, rickshaws/vans, bicycles and animal drawn carts excluded);
- The large share (38%) that rickshaws/vans comprise of all vehicles;
- The substantial and nearly equal proportion that auto-rickshaws (30%) and Cars/Light Vehicles (32%) comprise of all motorized vehicles;
- The proportion (50%) that Cars/Light Vehicles comprise of 4-wheel motorized vehicles.
- Whereas buses comprise a small proportion (8%) of the mix of all vehicles and pedestrians, bus passengers account for a high proportion (58% - 60%) of all people (passengers in vehicles and pedestrians) crossing the screen line.
- Rickshaws are shown to serve the next highest proportion (14%) of all people (passengers and pedestrians);
- Pedestrians are shown to represent a more modest level (8% - 9%);
- Cars/light vehicles and auto-rickshaws each serve relatively low proportions (6% - 8%);
- Using bus data for the 24 hour period, the proportional shares among minibus/micro-bus/large bus are 41%/30%/13% respectively in terms of vehicles whereas in terms of passengers carried by minibus/micro-bus/large bus, the proportional shares are 31%/23%/33% respectively.

2.5.3 Internal Cordon Survey Information

The internal cordon survey, similar to screen line survey, is comprised of volume counts of pedestrians and vehicles, but crossing a cordon line drawn around the city rather than screen lines drawn through the city. **Exhibit 2-30**, included at the end of this section of the report, illustrates the location of the internal cordon, as well as the ten locations where survey data was collected. At each of these survey collection points, counts of the number of people (pedestrians and passengers) and the number of vehicles (by various types) were taken for a period of 24 hours on a normal weekday.

Observations of interest, comparing this internal cordon data (representing conditions on the periphery of the urban area) with the previous screen line data (representing conditions within the urban area) include:

(i) the proportion of rickshaws/vans remains high;
(ii) the proportion of cars/light vehicles and auto-rickshaws is noticeably lower;
(iii) the proportional shares of buses and trucks is much higher;
(iv) the proportional share mix among minibus/micro-bus/large bus changes from 41%/30%/13% respectively to 32%/16%/32% respectively;
(v) Trucks, comprise a significant share (26%) of the base of 4-wheel motorized vehicles.

2.5.4 External Cordon Survey Information

The external cordon survey, similar to the internal cordon survey comprises volume counts of pedestrians and vehicles crossing a cordon line drawn around the periphery of the entire study area. **Exhibit 2-30**, included at the end of this chapter, shows the location of the external cordon, as well as the six locations where survey data was collected. At each of these survey collection points, counts of the number of pedestrians and the number of vehicles (by various types) were taken for a period of 24 hours on a normal weekday.

Observations of interest, comparing this external cordon data (representing conditions on the periphery of the study area) with the internal cordon data (representing conditions at the periphery of the urban area) include:

(i) the proportion of rickshaws/vans still remains high;
(ii) the proportion of auto-rickshaws is reduced; and
(iii) the proportional shares of buses and trucks increases, with trucks comprising a high proportion (33%) of the 4-wheel motorized vehicle base.

2.5.5 Household Interview Survey Information

The household interview survey is arguably the most important survey of them all. In this survey, trained surveyors visit a sample of households spread across various income groups and located in clusters throughout the urban area. The survey obtains specific socio-economic and travel characteristics information for all members of the household. Information about the number of people in each household, the number of trips that are made, the purpose of each trip, the origin-destination of each trip, the transport mode used for each trip, household income, and other characteristics is gathered. This is then analysed and used as primary input to the development of the travel forecast model that is used to test and evaluate alternative future land use scenarios and transport strategies. A total of 5,772 household interviews were conducted for this study. A summary of some of the results is presented in **Exhibit 2-31**, **Exhibit 2-32** and **Exhibit 2-33**.

Exhibit 2-31 provides a general summary of primary household and travel characteristics information from the data collected as part of the household interview survey.

Exhibit 2-31 Household Interview Survey General Characteristics

INCOME PER HOUSEHOLD (Taka Per Month)

Income Range Tk/mo.	% of Total	Taka/month	USD/month
Low <12,500	44%	8,000	130
Medium 12,500-55,000	51%	25,000	420
High >55,000	5%	100,000	1,670
Average	100%	20,500	340

PERSONS PER HOUSEHOLD

Income Range Tk/mo.	% of Total	Persons/Hh
Low <12,500	44%	3.89
Medium 12,500-55,000	51%	4.79
High >55,000	5%	5.4
Average	100%	4.69

TRIP PURPOSE

Home - Work	31%
Home - Education	29%
Home - Other	31%
Non Home Based	9%
All Purposes	100%

INCOME PER HOUSEHOLD (Taka Per Month)			
Income Range Tk/mo.	**% of Total**	**Taka/month**	**USD/month**

PRIMARY TRAVEL MODE FOR ALL TRIPS	
Walk	22%
Rickshaw	29%
Transit	31%
Motorized (Non-Transit)	18%
Total	**100%**

Observations of interest, for the household interview survey data included in **Exhibit 2-31** include the average number of people per household is 4.7. The primary mode of transport is particularly interesting, with about a third (36%) using rickshaws, another third (34%) using buses; and the final third (30%) comprised of walk and motorized modes. For trips that involve several modes of travel, "primary mode" is defined as the mode used for the longest (distance) part of trip. Also of interest is the proportion of walk trips reported from the household interview survey at 22%.

Exhibit 2-32 provides a summary of trip rate and trip length information from the data collected as part of the household interview survey.

Exhibit 2-32: Household Interview Survey Trip Rates and Lengths

TRIP RATE (Trips per Household per Day)

Trip Purpose		Primary Travel Mode		Monthly Household Income	
Home - Work	2.6	Walk	1.4	Low <12,500	8.9
Home - Education	2.3	Rickshaw	2.9	Medium 12,500-55,000	9.2
Home - Other	3.3	Transit	3.4	High >55,000	15.3
Non Home Based	0.8	Motorized (non-transit)	1.3		
All Trip Purposes	9.0	All Travel Modes	9.0	All Income Levels	9.0

Note: Motorized (Non-Transit) includes car, van, pickup, auto-rickaw, taxi, motorcycle.

TRIP LENGTH (Kilometres)

Trip Purpose		Primary Travel Mode		Monthly Household Income	
Home - Work	9.2	Walk	1.9	Low <12,500	8.6
Home - Education	6.5	Rickshaw	3.8	Medium 12,500-55,000	9.7
Home - Other	9.4	Transit	9.5	High >55,000	17.6
Non Home Based	10.5	Motorized (non-transit)	8.5		
All Trip Purposes	8.9	All Travel Modes	8.9	All Income Levels	9.7

Note: Motorized (Non-Transit) includes car, van, pickup, auto-rickaw, taxi, motorcycle.

Observations of interest, for the household interview survey data included in **Exhibit 2-32** include:

(i) average number (9.0) of trips per household;
(ii) increasing numbers of trips per household with increasing income levels;
(iii) average trip length (5.4 kilometers); and
(iv) variations in trip length among purpose, mode, and income level, as expected.

Exhibit 2-33 (below) provides several different classifications among income level, trip purpose and travel mode data collected as part of the household interview survey.

Exhibit 2-33: Household Interview Survey Income, Purpose & Mode

STP 2004 HOUSEHOLD INTERVIEW SURVEY SUMMARY
INCOME - PURPOSE - MODE

A: FOR EACH TRAVEL MODE USED, *What was the income level of the trip maker?*

Income Level (Tk/mo)	Walk	Rickshaw	Transit	Motorized (Non-Transit)
Low <12,500	56%	36%	39%	20%
Medium 12,500-55,000	28%	61%	58%	68%
High >55,000	16%	3%	3%	12%
	100%	100%	100%	100%

Note: Motorized (Non-Transit) includes car, van, pickup, auto-rickaw, taxi, motorcycle.

B: FOR EACH TRAVEL MODE USED, *What was the purpose of the trip?*

Trip Purpose	Walk	Rickshaw	Transit	Motorized (Non-Transit)
Home - Work	37%	25%	37%	27%
Home - Education	40%	30%	20%	13%
Home - Other	18%	39%	33%	47%
Non Home Based	5%	6%	10%	13%
	100%	100%	100%	100%

Note: Motorized (Non-Transit) includes car, van, pickup, auto-rickaw, taxi, motorcycle.

C: FOR EACH HOUSEHOLD INCOME LEVEL, *What was the purpose of the trip?*

Trip Purpose	Household Income Level			Total
	Low	Medium	High	All Levels
Home - Work	32%	31%	32%	31%
Home - Education	22%	26%	26%	25%
Home - Other	39%	34%	31%	36%
Non Home Based	7%	9%	11%	8%
	100%	100%	100%	100%

Note: Income Level (Tk/mo.) Low <12,500; Medium 12,500-55,000; High >55,000

D: FOR EACH TRIP PURPOSE, *What mode of travel was used?*

Travel Mode	Home - Work	Home - Education	Home - Other	Non Home Based
Walk	14%	19%	6%	6%
Rickshaw	29%	43%	40%	24%
Transit	41%	29%	31%	41%
Motorized (Non-Transit)	16%	9%	23%	29%
	100%	100%	100%	100%

Note: Motorized (Non-Transit) includes car, van, pickup, auto-rickaw, taxi, motorcycle.

2.5.6 Travel Time Survey Information

The Travel Time Speed and Delay Survey collected details of vehicle speeds, travel times and delays on different roads in the network. The survey included surveys at level crossings. The main purpose of the speed/flow survey was to provide input to the computer simulation model. Survey results were processed into two groups, firstly to assess speed/flow relationships and secondly to help calculate the road capacity for calibrating the road networks. It was found that on the primary roads the average capacity per meter of road width was found to be 495 vehicles per hour. On this basis, the average capacity is 1,859 vehicles per hour. The results for old Dhaka showed lower capacity at 1,601 vehicles per lane per hour, while the rest of the city showed higher capacity at 1,881 vehicles per lane per hour.

On secondary roads, average capacity was found to be 1,719 vehicles per lane per hour. For the old part of the city the capacity is constrained to 1,491 vehicles per lane per hour. For the rest of the city the average is 1,979 vehicles per lane per hour.

2.5.7 Passenger Ridership Survey Information

An interview survey of public transport riders was undertaken within the external cordon boundary. The interviews were made at bus stops, train stations, waterway stations mainly in sub-urban areas to collect information on the respondent and his/her family members. The interviewees were asked to provide information on socioeconomic aspects like name and address, age, sex, education level, occupation, employment status, sector employed, income level etc. More importantly he/she was asked to give details of his/her trips as well as active members of family made during the previous day.
The survey was done in 13 locations: (i) Dhamrai, (ii) Dohar, (iii) Gazipur, (iv) Kapasia, (v) Manikganj, (vi) Mauna, (vii) Mawa, (viii) Munshiganj, (ix) Narayanganj, (x) Narsingdi, (xi) Nabinagar, Savar, (xii) Sirajdikhan and (xiii) Tongi.

The total number of valid records available was 3,391 out of 4,000 interviews, representing approximately 26,000 people. Among the interviewed riders 3,312 were male and 79 were female. Some interesting facts from the survey are as follows:

- The educational level of respondents shows that 8.7% are either illiterate or little literacy, 19.7% were secondary school passed, 23.7% were HSC, 27.9% were graduates, 16.1% post graduate and the remaining were technical and otherwise qualified.
- Regarding the occupation of the respondents it was found that 14.7% were engaged in government jobs, 43.8% in private sector employment and 42.6% in business and self-employment. Only 2.6% were unemployed, 4.1% student and 1.8% housewife and others.
- The income distribution of the respondent showed that 12.7% had below Tk. 3,000 per month, 14.2% in between Tk. 3,000 and Tk. 5,000, 35.7% in between Tk. 5,000 and Tk. 10,000, 32.9% in between Tk. 10,000 and Tk. 30,000 and 3.9% between Tk. 30,000 and Tk. 60,000 and only 0.6% above Tk. 60,000.
- Average trip length of all respondents was 34.5 km for a single journey paying Tk.23.4 as fare. The highest distance traveled was by respondents of Dohar via Friendship Bridge at 60kms
- The transport fares were paid to Kapasia Tk.43.7 per trip was the highest;
- The age distribution of the surveyed population showed that 34% of them are below 20 years and 54% between 20-50 years and only 12% are above 50 years.

- The members of the households constitute self (respondent, 24%), wife or husband (20%), children (38%), mother or father (7%), other family members, kith and kin (3%) and other non-family members, domestic aids and drivers (8%).
- As regards literacy and educational status among the total 21% were illiterate, 34% had primary education, remaining 45% are high school and above level educated.
- The most important purposes are (i) home-work (31%); (ii) home-education (25%); (iii) home-others (36%); and (iv) non-home based trips (8%).
- The results revealed that each household makes 9.01 trips per day for all purposes. Home to work constitutes 2.81 trips whereas, home to education 2.21 trips, home to other 3.24 trips and non-home based travel 0.75 trips.

2.5.8 Bus Passenger Surveys

The Bus Passenger On/Off and Travel Time Survey collected information on the boarding and alighting pattern of bus users and delays to bus movements at designated 'Control Points' on the road network. Control Points were selected as bus stops, traffic lights, commercial areas and major stations. All major city routes were covered under the survey. This survey provided information about average trip lengths and bus occupancies as well as travel time necessary for input to the computer simulation model.
To capture the nature of inter-district movements of bus passengers, 9 passenger terminals were surveyed. Passengers were surveyed randomly at terminals either while waiting to travel or arriving from different origins. Terminals surveyed are: Gabtali, Mohakhali, Gulistan, Fulbaria, Saidabad, Kamalapur railway, Tejgaon railway station, Airport railway station and Sadarghat launch terminal. In all 1,703 people were interviewed and data collected on their origin, destination, purpose, distance, fare, journey time required, frequency of travel and their socio-economic parameters. Some useful information is as follows:

- Most of the passengers interviewed were male (98%) and their age varied between 22 to 60 years.
- Most of the respondents are literate (96%) at various education levels- 30% up to SSC, 23% HSC, 27% graduate including technical graduates and 12% postgraduate level. This probably indicates that the mobility of literate persons is more than illiterate persons.
- The purpose of journey from Dhaka was primarily to visit the home village (71%), to residence (11.8%), to work (10.1%) and the remaining trips are for education, social and other purposes.
- The purpose of journey to Dhaka from different destinations is dominated by 39% returning back to residence, work (34%), education (6%), shopping (3.1%), social and recreation (11%) and medical and others (5%).
- The average distance passengers travel from and to the 9 terminals was 169.7 km. Passengers used Gabtali terminal travelled the longest distance at 279.1 km.
- The average fare paid by passenger was Tk105.4 for 169.7 km. This is a rate of Tk.1.7 per km.
- The highest per km fare was recorded at Airport railway station at Tk.2.2.

2.6 PHYSICAL AND BIOLOGICAL ENVIRONMENT

2.6.1 Topography, Soils & Geological Characteristic

Topographic variations, as illustrated in **Exhibit 2-34** at the end of this chapter, though subtle, are a major determinant of Dhaka's growth patterns. The topographic factors encourage growth of the city toward the north and continue beyond the bounds of the city along the corridor to

Mymensingh. The topography of Outer Study Area, along with most of Bangladesh (90%), is comprised of relatively flat alluvial plains at elevations that range from less than a meter to 12 meters above mean sea level (msl)[47]. Soils are typically highly fertile. The Study Area is located within a portion of the country that is ranked as moderately seismically active. Catastrophic earthquakes occurred in 1762, 1782, 1897 and 1950.[48] The possibility of future subsidence issues due to withdrawals of groundwater combined with reduced recharge due to urban development has also been noted.

2.6.2 Surface Hydrology

Three major and several lesser river systems define the hydrology of Bangladesh and, as illustrated in **Exhibit 2-35** at the end of this chapter, all three of the major rivers form portions of the STP Study Area boundaries;

- Padma. Known as the Ganges in India, the Padma begins in the Indian State of Uttar Pradesh, enters Bangladesh from the northwest through the Rajshahi Division. It defines the southern boundary of the Study Area.
- Jamuna. Known as the Bramapautra in India, the Jamuna begins in the Indian Himalayas and flows in a generally north-south direction, converging with the Padma at a point to the west of Dhaka on the southern boundary of the Study Area.
- Meghna. The Meghna River originates to the north-eastern part of the country. With minor exceptions, it is coincident with the eastern boundary of the Study Area. It also joins the Jamuna on the southern boundary of the STP Area.

Four rivers traverse and define significant portions of the Study Area. They are:

- Turag. The Turag forms both the western and northern boundaries of DCC. The Turag is largely contained by embankments along the western edge of the city. Significant wetlands exist along the river.
- Buriganga. The Turag changes its name to the Buriganga at the point at which it changes direction and flows to the southeast, roughly parallel to the Padma. With the exception of the Kamrangir Char at the junction of the two rivers, it forms the southern boundary of the DCC.
- Balu. The Balu flows north-south, roughly parallel to the Turag and is a tributary of the Sitalakhya River which it joins in the Study Area.
- Sitalakhya River. The Sitalakhya River also flows generally north-south and converges with the Buriganga and Meghna Rivers in the south-eastern corner of the Study Area

Significant water bodies within the DCC include the Begunbari Khal, and the Banani, Gulshan and Dhanmondi Lakes, all of which were at one time linked by a system of canals, most of which have been filled and subsumed by urban development.

2.6.3 Flood and Inundation Characteristics

Dhaka occupies a large part of the relatively small proportion of land which is considered to be "permanently" flood-free. The areas to the south, south-west and east are low-lying and under water for many months of the year. Most of the DMA, as most of Bangladesh, is subject to flooding of various types related to tidal and typhoon conditions, excessive rainfall, flash floods and river flooding arising from conditions in the mountains outside the country. Between May and September each year approximately two-thirds of Bangladesh is submerged beneath flood waters caused by melt water from the Himalayas and monsoon rains.

[47] *Impacts of Floods on Water Supply, Sanitation, Drainage of Dhaka City and Mitigation Options, A.N.H. Akhtar Hossain, et. Al., Dhaka Water and Sewer Authority (DWASA), September 2004, page 3*
[48] *Titan's Oxford World Atlas, The Atlas Publishing House, Dhaka, 2001, page 60.*

In spite of occupying the high ground, in recent years continuous flooding in Dhaka has exceeded 70 days with water levels reaching several feet. Embankments around the city protect it from direct onslaught, but as water levels rise in the channels they eventually reach above the elevation of the city (reportedly up to 20 feet above). It becomes inundated by heavy rainfall and a plugged drainage system that can no longer operate by gravity. A significant portion of the recent flooding problems can be attributed to the fact that, in spite of the flood control measures recently put in place in the form of embankments, urban encroachments in natural depressions, wetlands and khals have displaced their water retention abilities.

Generally speaking, the city faces two types of floods namely rainfall and river flooding. The latter is the more serious caused by both rainfall snowmelts upstream in neighbouring countries. Disastrous flooding generally occurs when the three river systems experience high levels of runoff simultaneously - as was the case in the floods of 1988, 1998 and 2004.[49]

2.6.4 Subsurface Hydrology

Dhaka's groundwater levels are seriously declining due to extractions by wells to meet growing demand combined with decreases in recharge rates due to urban development. Water levels are reported to have declined 24 meters since 1996. Artesian wells have been the traditional source of water in the Dhaka area, but the Dhaka Water and Sewer Authority (DWSA) is reportedly turning to the metropolitan area's rivers as the source of water in the future. Utility provisions in Dhaka were not considered by the DMDP to be a critical factor in determining urban growth. The study determined that access to utility services was more income-related than space-related. Few finite physical constraints impede the potential of delivering these services to any particular part of the urban area. Piped water supply systems are generally confined to urban areas. The first piped system in Dhaka was initiated in 1876. Current demand is estimated as 2,000 million litres per day (mld) based on per capita consumption of 160 litres per person per day. DWASA can supply only 1,500 mld resulting in an unsatisfied demand which must be met from other sources.[50]

Groundwater contamination due to unsafe sewage disposal is reported as a major health concern for portions of Dhaka and Narayanganj. Current generation of domestic and industrial sewage in Dhaka City is estimated as 1.3 million cubic metres per day (m^3/day) versus a treatment capacity of 0.12 m^3/day - i.e., roughly one-tenth of the demand.

2.6.5 Wetland Characteristics.[51]

Most of the area along three rivers that frame Dhaka to the west, south and east, the Turag, the Buriganga and the Balu, respectively, are wetlands. It is, in fact largely for this reason that Dhaka has developed as it has - mainly on the north bank of the Buriganga between the Turag and the Balu following a natural north-south axis of high ground on which road are rail development could more easily occur. Another natural upland pocket occurs in the northwest portion of the DMA in the Savar/Dhamsona area. Development in the area was recommended by the DMDP Structure Plan, but growth in the wetland areas to the east was also foreseen as a consequence of population pressures. Continuing losses of wetlands and the concurrent implications for exacerbation of flooding are major environmental issues in the Study Area.

[49] *Impacts of Floods on Water Supply, Sanitation, Drainage of Dhaka City and Mitigation Options, A.N.H. Akhtar Hossain, et. Al., Dhaka Water and Sewer Authority (DWASA), September 2004, page 5*

[50] *Impacts of Floods on Water Supply, Sanitation, Drainage of Dhaka City and Mitigation Options, A.N.H. Akhtar Hossain, et. Al., Dhaka Water and Sewer Authority (DWASA), September 2004, page 7.*

[51] *Wetlands are swamps, bogs, marshes, etc., and are technically defined according to vegetation, soils, hydrology and other characteristics, and are areas usually or periodically inundated by surface water or groundwater with a frequency to support vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction certain types of vegetation. Wetlands involve both water quality issues and, as essential habitat for both plant and animal species, biological issues. Accordingly, wetlands should be considered in concert with biological issues.*

2.6.6 Air Quality

Bangladesh air quality standards are presented in **Exhibit 2-36**.

Air quality is a major issue in Dhaka. Surveys indicate that in the period from 1991 to 1996 the level of Suspended Particulate Matter in Dhaka tripled from 570 to 1,773 micrograms per cubic meter of air. Ambient SO_2 levels in commercial areas are reported to be nearly five times the national standard and nearly ten times the WHO recommended levels. Lead levels in Dhaka are reported to be up to five times the WHO recommended levels. The level of lead in street children was found to be far beyond the WHO recommended levels.

Exhibit 2-36

BANGLADESH AMBIENT AIR QUALITY STANDARDS

Category of Environment	Allowable Pollutant Concentrations [mg/m3]			
	Suspended Particulate Matter (SPM)	Sulphur Dioxide SO2)	Carbon Monoxide (CO)	Nitrogen Dioxide (Nox)
Industrial and Mixed Use	500	120	5,000	100
Commercial & Mixed Use	400	100	5,000	100
Residential and Rural	200	80	2,000	80
Sensitive	100	30	1,000	30

Source: *Environmental Conservation Rule, 1977.*

The air quality situation has improved in recent years, however, due to the conversion of the brick factories found throughout the Study Area from the use of wood as their primary fuel to the use of natural gas and the conversion of "three-wheelers" to natural gas as well.

2.6.7 Noise & Vibration

Ambient noise standards are of relevance to the STP Study in light of the fact that much of the ambient noise is traffic-related. Traffic projects, particularly those funded by multi-lateral development banks are likely to raise the issue of noise barriers in project identification, design and cost estimates. Although Bangladesh has no enacted regulations controlling issues of vibration and building settlement, the Standards of the Richter and Meister Health Impact Evaluation and DIN 4150 for structural vibration impacts are generally adopted as a matter of good engineering practice.

2.6.8 Archaeological and Historic Resources

Bangladesh is exceptionally rich in archaeological wealth, especially of the medieval period during Mogul and pre-Mogul rule. Protection of cultural resources is the responsibility of the Department of Archaeology under the Ministry of Culture. Archaeological and historic preservation issues could be relevant to the STP Study in regard to the identification of immediate action projects and the preparation of project-level Terms Of Reference (TORs).

Exhibit 2-10 Population Estimate (2001) and Forecasts (2004, 2014 and 2024)

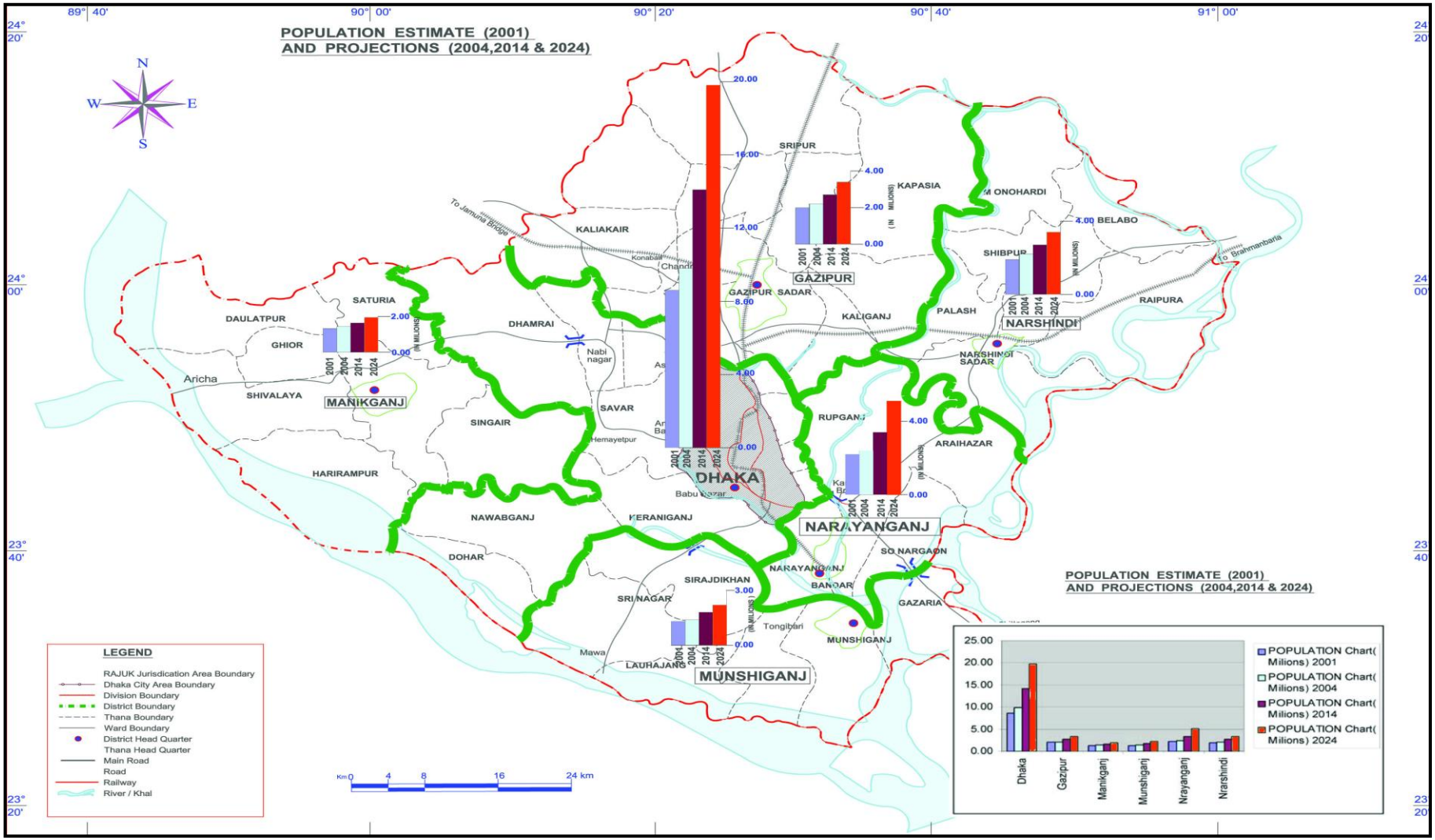


Exhibit 2-13 Delineation of Study Area Sub-Areas

Exhibit 2-14 Study Boundary Relationships

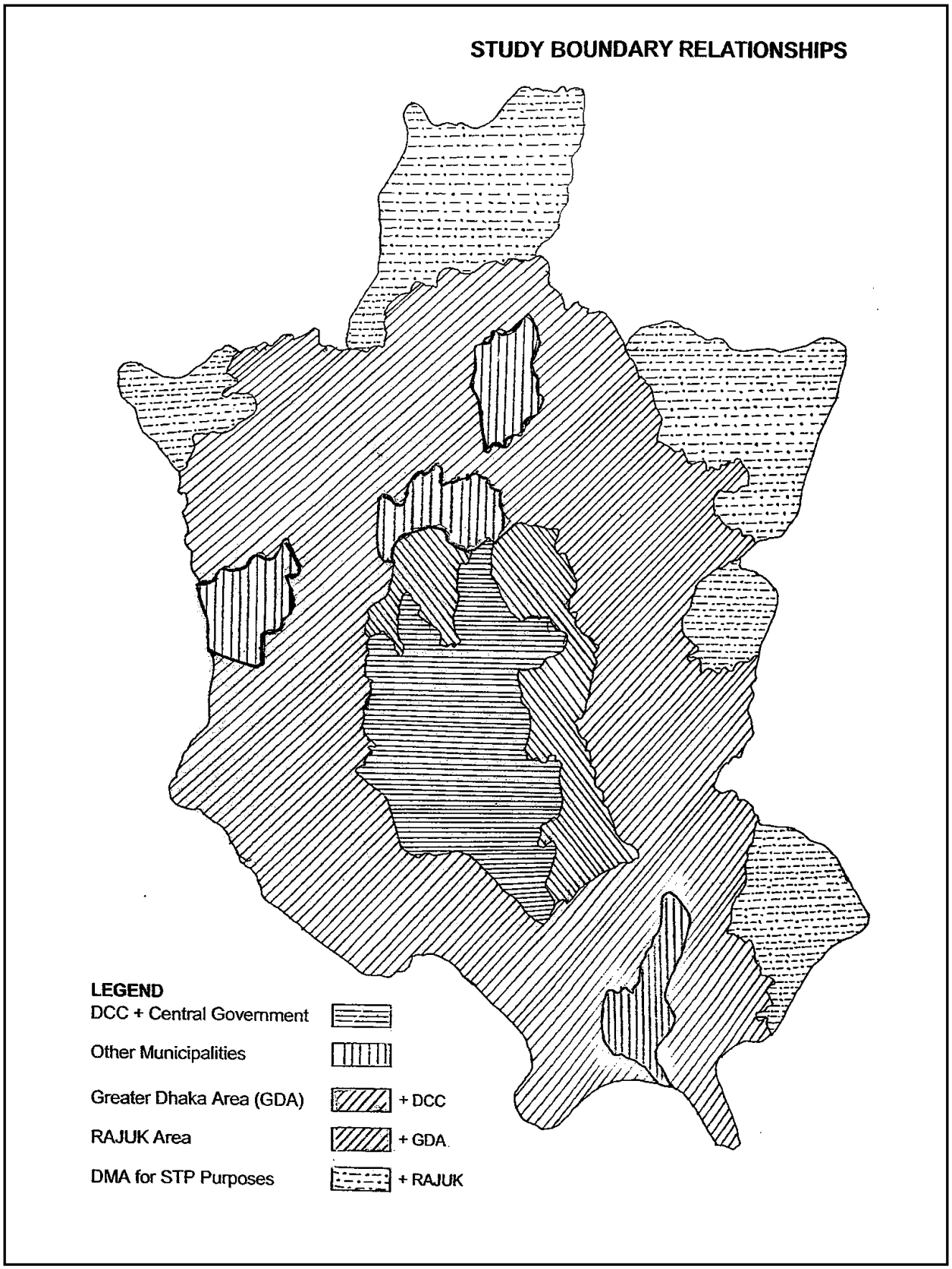


Exhibit 2-15 Growth Rates in Study Area

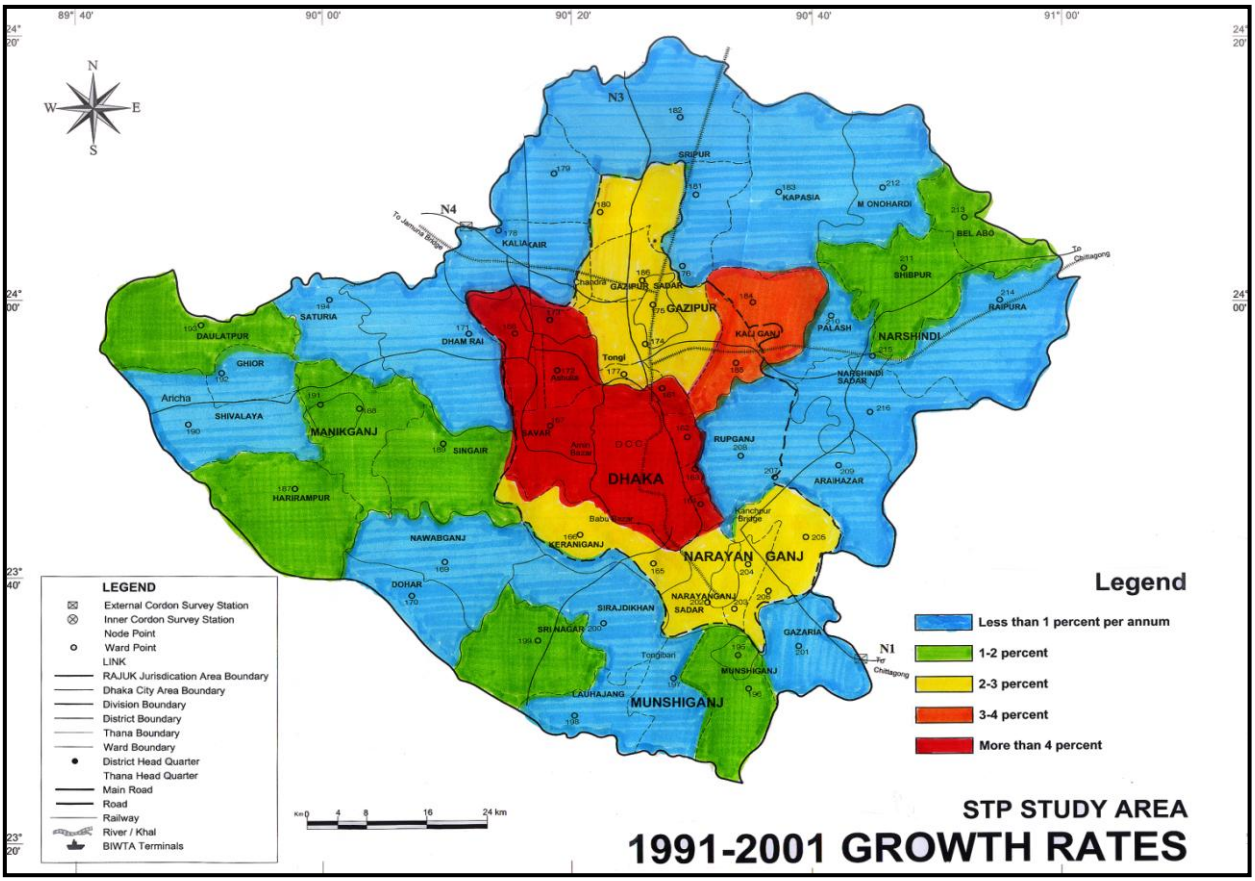


Exhibit 2-16 OSA North

Exhibit 2-17 OSA East

Exhibit 2-18 OSA South

Exhibit 2-19 OSA West

Exhibit 2-20 DMA

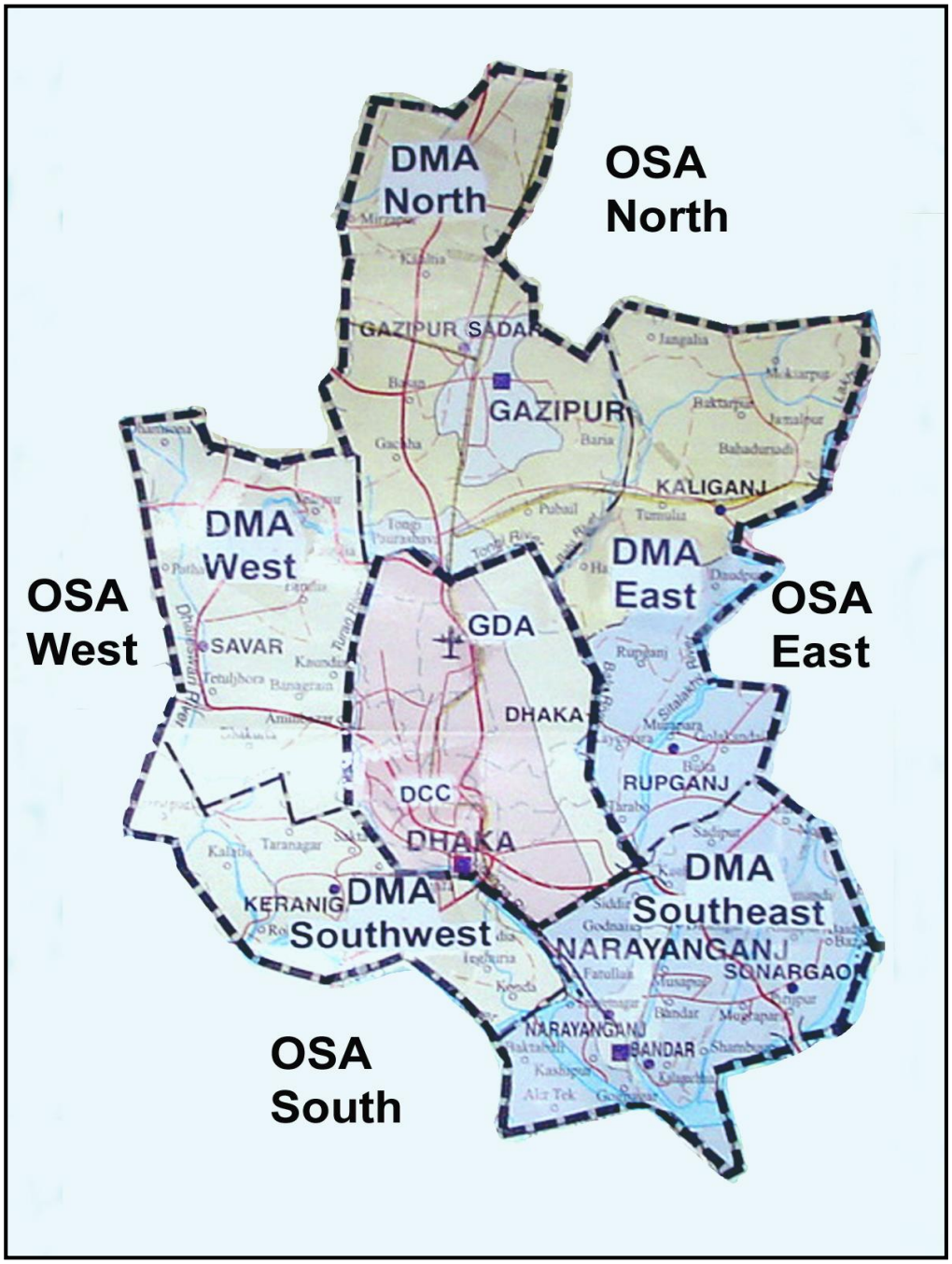


Exhibit 2-22 Generalized Land Use - 1984

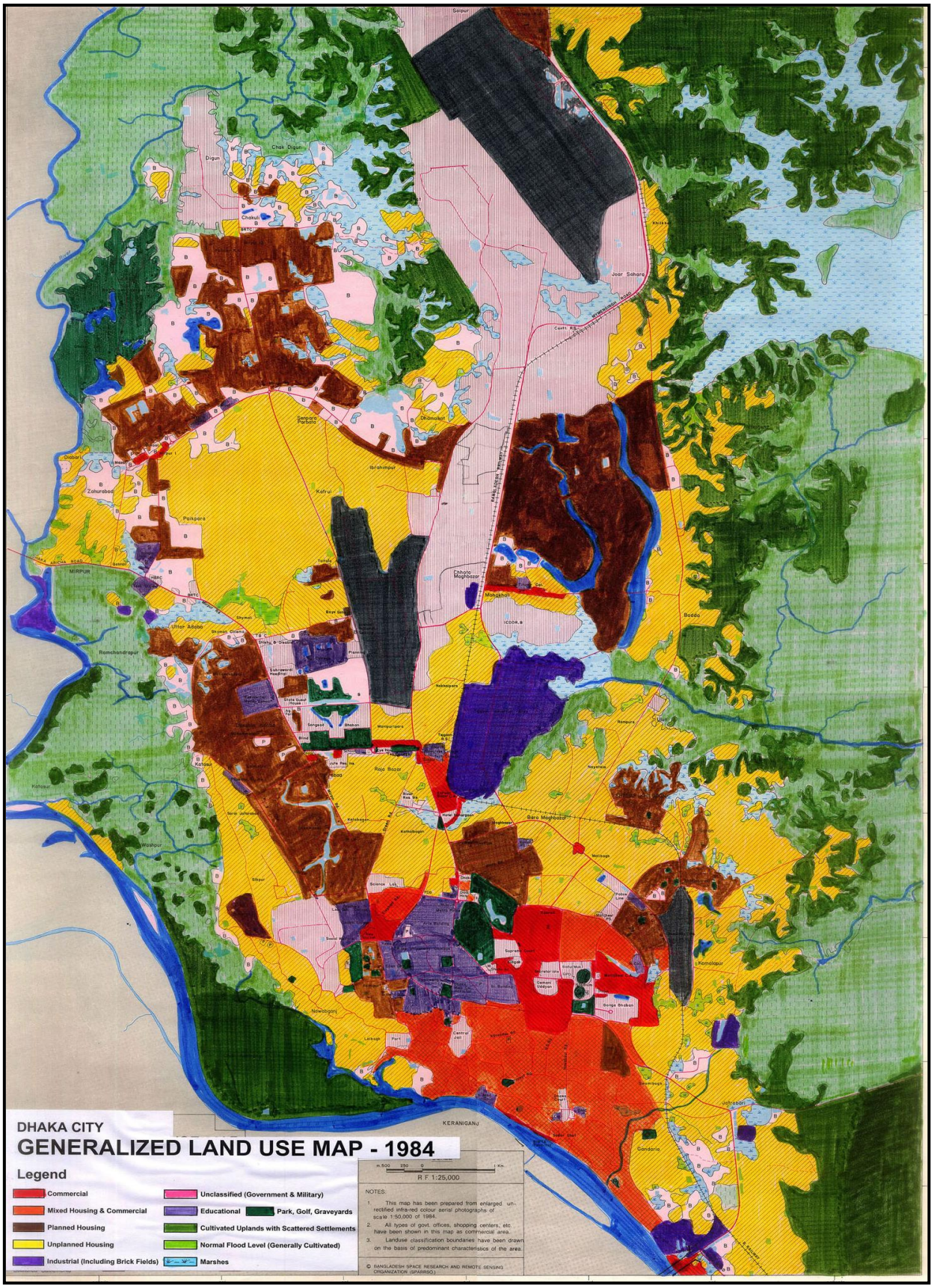


Exhibit 2-23 Generalized Land Use - 2004

Exhibit 2-26 Location of Tall Building

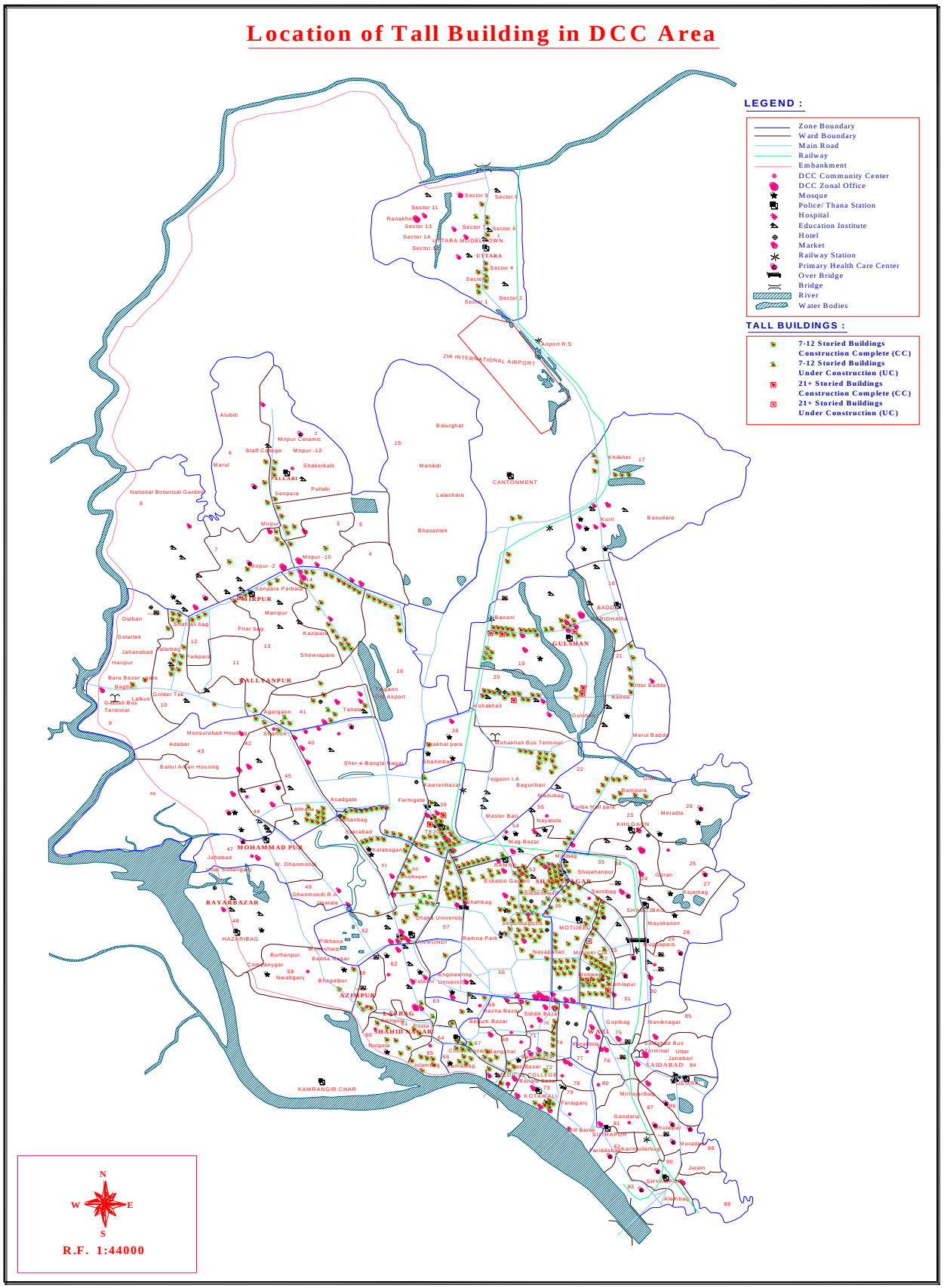


Exhibit 2-27 Land Uses Warranting Consideration for Relocation and/or Reorganization

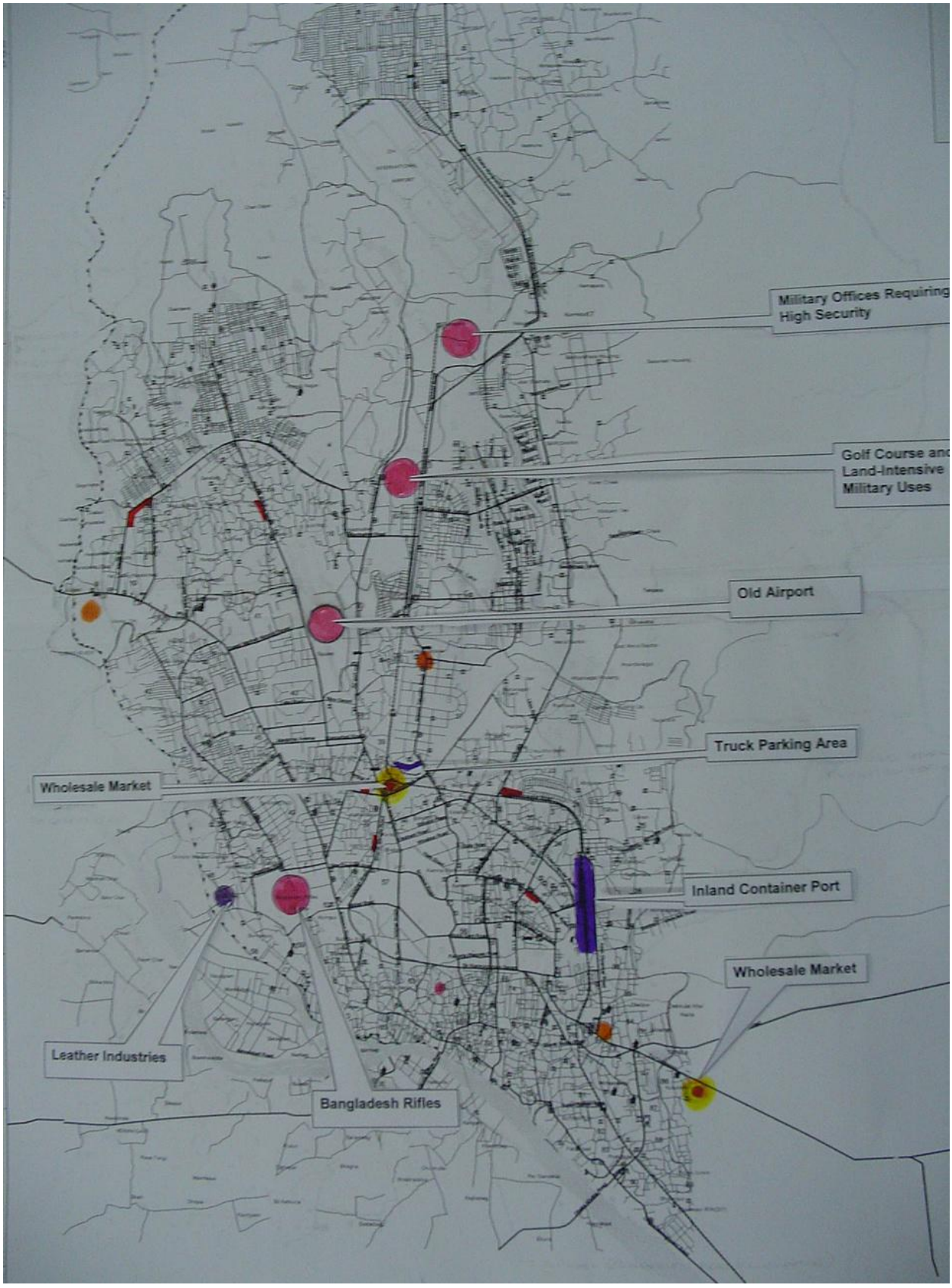


Exhibit 2-29 Screen Line Survey Location

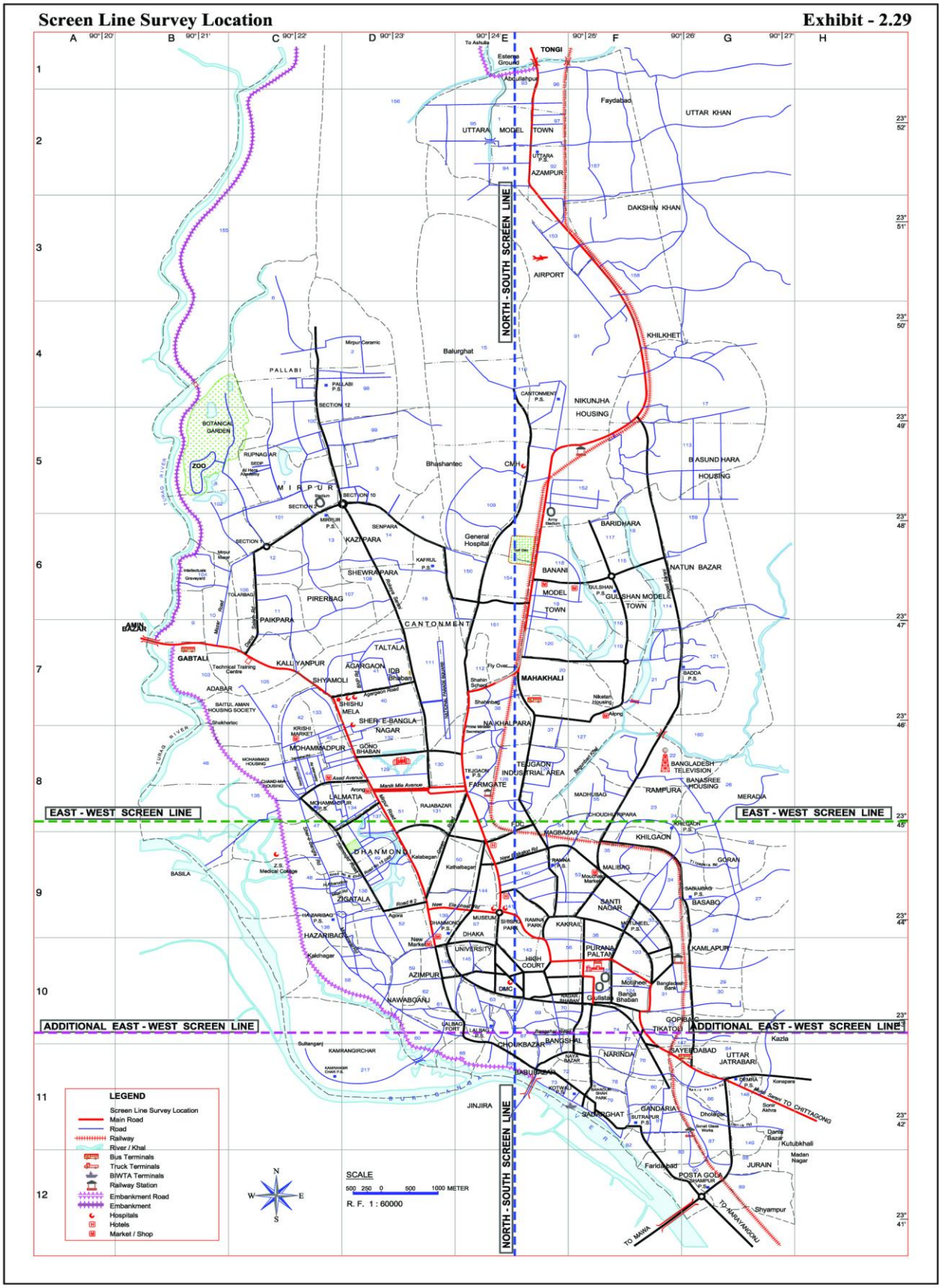


Exhibit 2-30 Internal and External Cordon Survey Location

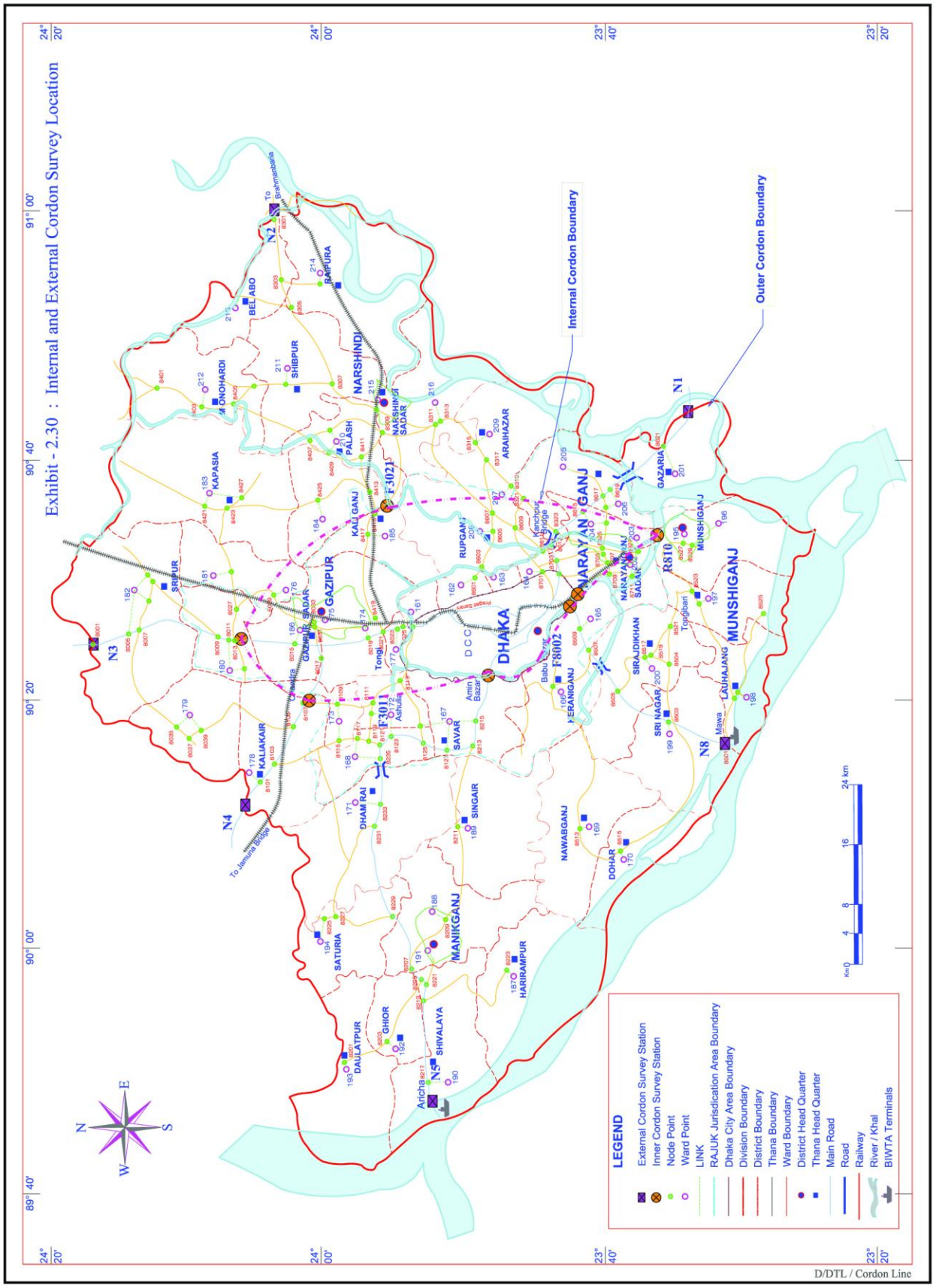


Exhibit 2-34 Topography

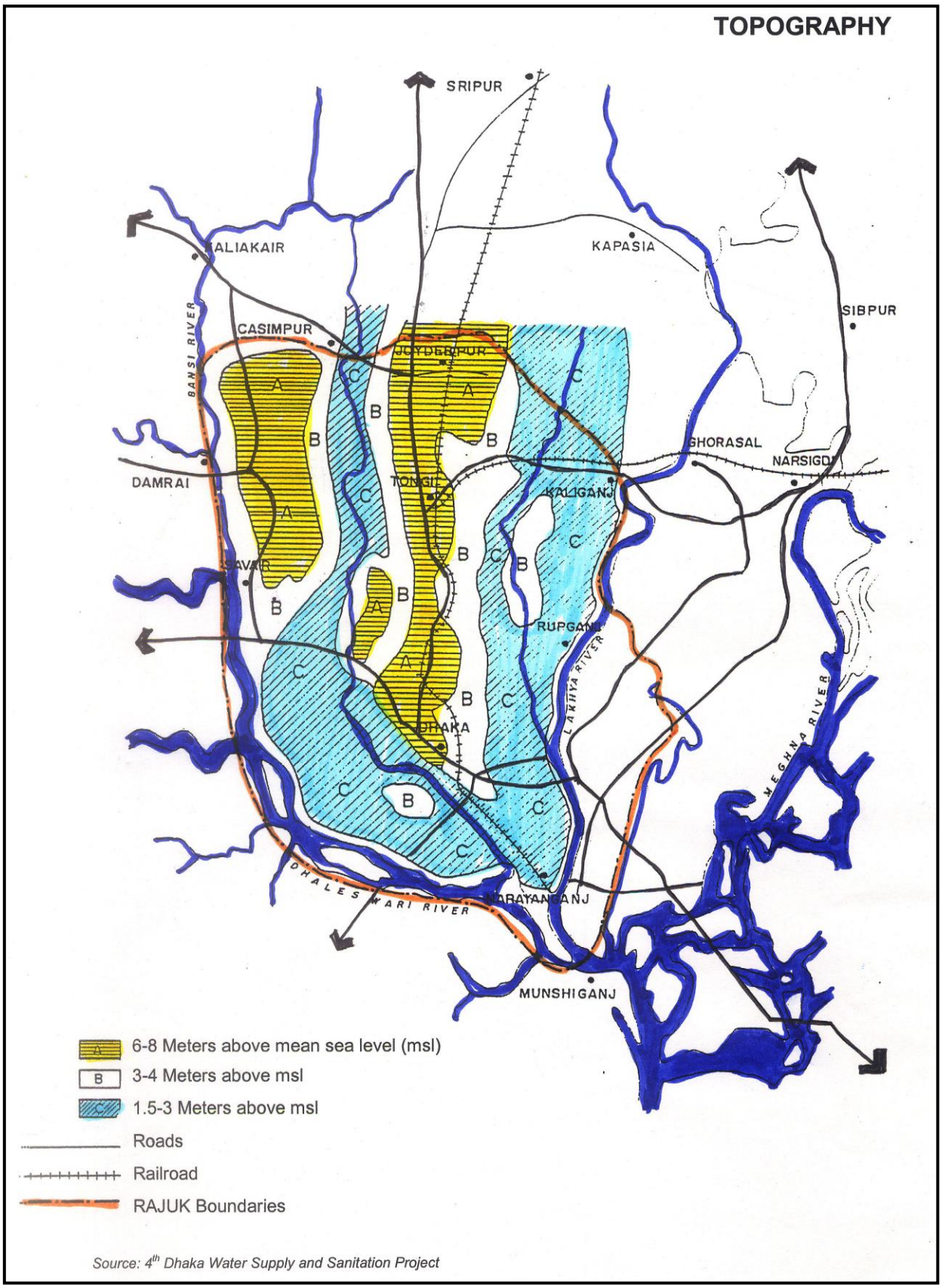
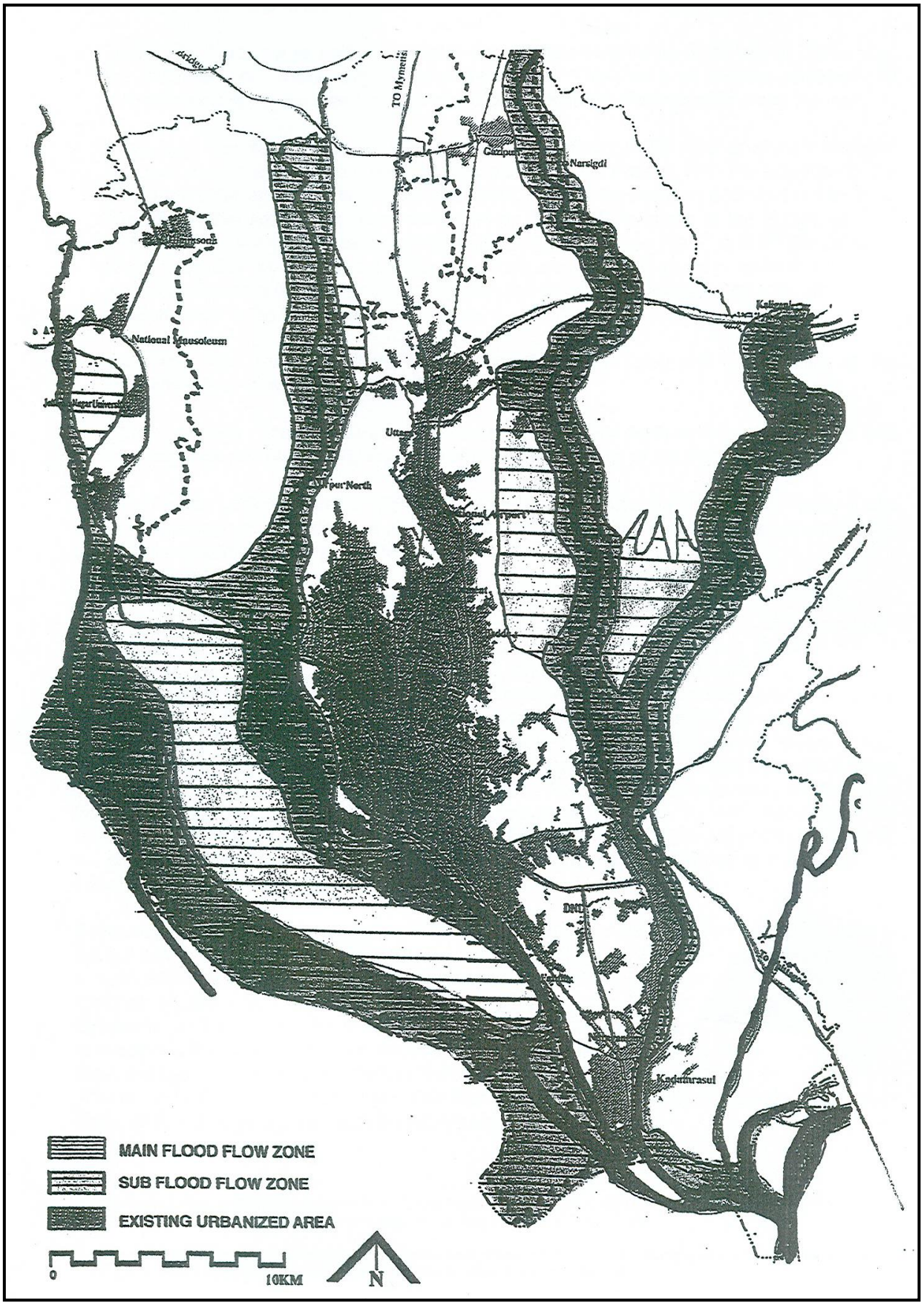


Exhibit 2-35 Hydrology



3. EXISTING TRANSPORT CONDITIONS

3.1 INTRODUCTION

One of the primary objectives of the STP study is to establish an overall transport strategy for Greater Dhaka for the year 2024. The analysis and evaluation of future needs must include an understanding and consideration of conditions reflected in the existing transport system. The future will evolve from the present.

This chapter provides an understanding and assessment of the present transport services and facilities in Dhaka.

3.2 PEDESTRIANS

Walking is a commonly used mode of transport in Dhaka. The proportion of trips made by walking is substantial and, for some people walking is a matter of choice and convenience. However, the reality is that, for many people, walking is a matter of economic necessity.

Despite a high preponderance of walking, suitable pedestrian facilities have been neglected and have, in most cases, only been added as an afterthought to road improvements. In all, there are only about 400 kilometres of footpath within the DCC area. Where footpaths have been built, frequently there are obstructions that block or otherwise reduce their overall usefulness. Such obstructions include: -

- Temporary vender stations and hawkers who occupy portions of the footpaths;
- Parked cars
- Building materials and debris that are stored or abandoned on the footpath; and
- Holes, surface irregularities and water accumulation.

According to certain estimates, nearly 40% percent of the footpaths are being occupied illegally. In spite of a High Court ruling (February 11, 2001) ordering that the responsible agencies make all footpaths free from illegal occupation, no significant change or improvement is evident. As a consequence, pedestrians are often forced to walk in the street instead of on the footpaths, even in areas where footpaths are provided. Pedestrians walking on the road increases the risk of traffic related pedestrian injuries and also has the adverse effect of the reducing the capacity of the road and thereby increasing congestion. Available information indicates that pedestrians are involved in half of all road collisions in the city. Two-thirds of all traffic related fatalities are pedestrians.

As part of the current STP study, pedestrian volume counts[1] were taken on a series of Screen Lines see **Exhibit 2-29** previously. The data collected includes:

(a) the number of pedestrians during each of three eight hour periods comprising a full day,
(b) the total number of pedestrians for a full twenty-four hour day, and
(c) the number of pedestrians during the peak hour.

Pedestrian volumes of 10,000 to 20,000 per day are common and reach as high as 30,000 to 50,000 per day in the Old City area. During the peak hour pedestrian counts of 1,000 to 3,000 per hour are common and reach as high as 5,000 in the Old City area.

[1] *The conduct and results from these and other surveys can be sees in Working Paper # 7.*

3.3 BICYCLES

As a mode of transportation, bicycles are convenient. They provide on-demand, door to door transport. They are economical and efficient in terms of use of road space, and create no adverse environmental consequences.

Bicycles are a major component of the transport system in many cities around the world including developed countries such as Denmark, the Netherlands, Sweden, and other European Countries, as well as Japan, and developing countries such India and China.

In Dhaka, however, bicycles are not being used as a significant mode of transport. Information from the Household Interview Survey conducted for this study indicates that only about 2% of the households interviewed owned a bicycle. Information from the Screen Line Surveys conducted for this study indicates that bicycles comprised 2% of all vehicles counted. At the Internal Cordon Line, bicycles also accounted for 2% of all vehicles while at the External Cordon Line, bicycles as a percentage of all vehicles increased to 4%.

Several factors contribute to the low usage of bicycles:

a. Cost: The cost of bicycles is high, considering the relatively low income levels of the sector of the population that is most likely to use them as a mode of transport.

b. Safety: No designated bicycle lanes or facilities are provided on roads that are often narrow, crowded and dangerous. In addition, the poor condition of the surface of many roads represents a serious hazard for bicycles.

c. Status: Persons who can afford the cost of a bicycle are sometimes embarrassed to be seen on one.

d. Culture: Cultural norms suggest that it is neither suitable nor appropriate for women to use bicycles.

e. Security: Suitable means to park and leave a bicycle unattended with an expectation that it will be there upon ones return, are not readily available.

As an example, it was reported that bicycle assemblers and importers presently pay 30% import duty, 15% value added tax and 8.5% other taxes on all categories of bicycle and other cycles, parts and accessories. In addition, there is a 40% supplementary duty on bicycles and other cycles and a 20 percent supplementary duty on cycle chains and spare parts.

Until such time as significant change occurs with respect to such factors, the role of the bicycle as a mode of transport will remain limited to those groups who currently use them (i.e. students, clerical grade office workers, mechanics, shopkeepers, etc.). It is unlikely that regular use will reach a significant level in terms of overall urban transport. The provision of designated bicycle lanes would be an important part of affecting this change.

3.4 NON-MOTORIZED TRANSPORT

Rickshaws are a very significant mode of transport in Dhaka. In addition, rickshaws represent an important source of employment and income. Conceptually, rickshaws offer a high degree of individualized service, in a relatively cost efficient manner, using renewable energy with no adverse environmental impacts[2]. An alternative view, however, is that rickshaws are inefficient, inhumane and unsafe as a means of transport and should be replaced by motorized vehicles such as auto-rickshaws and buses.

[2] *Actually of course by their very presences in such large numbers they create congestion and hence pollution.*

In addition to rickshaws, there are two other forms of non-motorized transport that are generally included in the category of NMT's. The rickshaw van is a bicycle type vehicle similar to a rickshaw, but with a flat carriage intended to carry goods and materials rather than passengers. The other form of transport included in the category of NMT is the "thela" which is basically a push cart used for carrying goods and materials, normally with one person pulling it and one or more persons pushing it. The number of rickshaw vans and thelas in Dhaka City is relatively modest (about 1%) in comparison with the number of rickshaws.

The 2004 STP Household Interview Survey data collected for this study indicates that rickshaws are the primary travel mode for 36% of all person trips in Dhaka. The corresponding value, as reported in the 1998 Greater Dhaka Metropolitan Area Integrated Transport Study (DITS) was 19% of all person trips in Dhaka. In addition, the 2004 STP Household Interview Survey data also indicates that the average length of all trips made by rickshaws is 2.3 kilometres and 61% of all rickshaw trips are made by people in the middle income levels (Tk 12,500 – 55,000 per month).
Despite the important role that rickshaws now play in the Dhaka transport sector, there are continuing efforts to limit the number and the manner in which they operate. While a large number of people use rickshaws for their daily travel needs and another large segment of the population depends upon them for their source of income, the appropriate role and future of rickshaws, in the context of Dhaka's urban transport systems, continues to be debated[3].

Rickshaws provide the convenience of door-to-door service and are well suitable for individual (1 or 2 persons) travel, for diverse trip purposes and to diverse locations. Rickshaw travel typically involves the use of local roads within neighborhoods as well as collector roads connecting residential neighborhoods with areas providing commercial, employment, educational and other services. In addition, rickshaws are well suited to the very narrow roads that exist throughout much of Old Dhaka as well as the large informal neighborhoods that have developed more recently.

In the past, as a means to limit the number of rickshaws in Dhaka, the DCC established regulations that restricted the number of rickshaw licenses issued to approximately 80,000. In reality, however, there is no effective mechanism for enforcement of the license requirement and as a result the number of rickshaws plying the streets of Dhaka is many times the limit established by DCC. While there is no effective means to determine the actual number of rickshaws currently in operation, estimates indicate that there are more than 500,000 rickshaws plying the streets of Dhaka. This results in the fact that some 80% of the fleet is operating illegally. Available information indicates that nearly 40% of the loaded rickshaws are being used by women and children, or people with goods. Another 30% of users are students. Most of the rickshaw passengers come from upper-middle to lower-middle income groups. Rickshaw volumes of 20,000 to 40,000 per day are common and reach as high as 60,000 in the Old City area. During the peak hour, rickshaw volumes of 2,000 to 4,000 per hour are common.

The cost of a new rickshaw is around Tk 8,000 ($133); the cost for a rickshaw van is around Tk 6,000 ($100); and the cost for a thela is around Tk 5,000 ($83). About 5% of the rickshaw drivers own their own vehicles. The other 95% are owned by a number of investors, a majority of which are influential people in society. In addition to the owners and the drivers, there is a significant number of people employed in ancillary activities such as rickshaw repairs, manufacture, sales, spare parts.

The normal rental charge that a driver/non-owner pays to the owner for the use of a rickshaw for an entire workday (about 16 hours) is between Tk 60 and Tk 80 ($1.00 to $1.33). For an 8 hour

[3] *STP has drafted a Rickshaw Policy which has been widely circulated and is published in the "Urban Transport Policy" report, a companion report to this STP report.*

shift, the rental charge is about Tk 40 ($0.67). Net earnings of a rickshaw driver/non-owner are estimated to be around Tk 3,800 ($63) per month.

The fare structure for rickshaws, rickshaw vans and thelas varies somewhat. Rickshaws charges are around Tk 5 ($0.08) for one kilometre of travel, Tk 8 ($0.13) for two kilometres of travel, and then approximately Tk 2 ($0.03) for each additional kilometre. Based upon this rate structure, the total fare for a trip of 5 kilometres would be Tk 14 ($0.23). While such travel costs may at first seem rather modest, they are in fact beyond the range of affordability for many. Comparative bus fares for a 5 kilometre trip are around Tk 4 ($0.07) depending somewhat upon the type and quality of service.

The design of the rickshaw has not changed significantly from the time they were first introduced. There are a number of technology improvements in rickshaw design (such as improved performance in mixed traffic, night time safety, and passenger comfort as well as reduced driver effort) which are being used elsewhere (e.g. Delhi, Agra) but which have not yet been adopted in Dhaka. The introduction of these technological improvements could ease the plight of rickshaw operation.

In 2002, the DCC initiated the implementation of an "*NMT-Free Arterial Network – Phased Implementation Plan"*. The plan calls for the phased withdrawal of NMTs from 11 major roads in Dhaka City, over a period of two years (2004 & 2005). **Exhibit 3-1** illustrates the roads that are to become NMT-free under this plan, as well as the current schedule for phased implementation.

Due to various concerns and political sensitivity associated with the removal of NMT from the major roads, the implementation has been curtailed. The IDA is now considering a program to compensate rickshaw divers who have been affected by these proposals.

3.5 TAXI & AUTO-RICKSHAW

3.5.1 Taxis

The introduction of taxi service in Dhaka has been relatively recent in 1998. At the present time, there are around 12,000 taxis in operation. This includes 2,000 which were added during a period of one week in April 2004, when the Government relaxed the limit established previously at 10,000 taxis for Dhaka city.

At the present time, there are 60 companies operating taxis in Dhaka. The requirement for starting a taxi company is a capital fund reserve of Tk 10 lakh ($16,700), a minimum of 20 taxis, and registration as either a public or private company. Currently, the largest taxi company is Cab Ex with 4,000 taxis; the second largest being Anudeep with 2,200 taxis. New companies are in the process of entering the taxi service market in the near future, for example Greenarrow Express with 600 Indian Maruti 800 cc vehicles.

The taxi companies do not directly operate the taxis. Rather, they rent the taxi to drivers who operate the vehicles and pay the cost of fuel. The drivers pay Tk 950 per day ($16) for 24 hour use of an air-conditioned taxi and Tk 650 per day ($11) for 24 hour use of a non air-conditioned taxi (black taxis). Recently, with the introduction of CNG-fuelled taxis and the resultant fuel cost savings to the drivers, the owners of the air-conditioned taxis using petrol have had to lower the daily rental fee from Tk 950 per day ($16) to Tk 850 per day ($14) in order to try to retain and attract drivers.

With the taxi driver renting the vehicle from the taxi company and thereafter providing all aspects of the service to the public, the quality of the service and the security of the passengers is largely dependent upon the drivers. Lack of good taxi drivers is a chronic problem in

Bangladesh because of the ready availability of fake licenses. As a means to try and improve the quality of taxi services and improve driver conduct and discipline, the Cab Association has requested BRTA to introduce a separate licensing system for taxi drivers. The proposal was to introduce a driver re-training procedure wherein properly identified drivers would complete an organized 15 day retraining program at a cost of Tk 3,000 ($50). However, taxi drivers expressed their opposition to such a proposal and the requirement could not be enforced due to lack of cooperation among owners of the taxi companies.

Many of the pioneering taxi companies did not establish suitable workshop and repair facilities to ensure proper maintenance and servicing of their vehicles. As a result, the useful service life of the vehicles is shortened. There are many instances in which sizeable vehicle fleets of several hundred vehicles are no longer operable, due to inadequate maintenance. At the same time, some larger companies that have set up proper maintenance facilities and service scheduling are able to maintain their taxis in good operating condition.

The taxi fare structure is established by the government and varies depending upon whether or not the vehicle has air-conditioning. Actual fares are determined by meters installed in each taxi. The fare structure established in 1997, and still in effect today is the following:

a. Air-conditioned taxi – Tk 20 (USD 0.33) for the first 2 kilometres and Tk 8 (USD 0.13) per kilometre for the remaining portion of the trip.

b. Non air-conditioned taxi – Tk 15 (USD 0.25) for the first 2 kilometres and Tk 6 (USD 0.10) per kilometre for the remaining portion of the trip.

The cost of operations has gone up considerably since the present fare structure was established in 1997. Therefore, there is a need to review the fare structure in light of current conditions in order to provide a viable financial environment reflecting the users' willingness and ability to pay for services provided, the drivers right to fair compensation and the owners' need to realize a suitable return on their investment.

3.5.2 Auto-Rickshaws

Auto-rickshaws (also known as baby taxis or CNGs) are another form of taxi-type service offering individualized, motorized, point to point transport, at the convenience of the user. The vehicle investment cost and the quality of service for the auto-rickshaw are less than that provided by regular taxis and, therefore, the cost to the user is lower. Auto-rickshaws are a widely used form of public transport throughout the Dhaka urban area, particularly for people who are traveling further distances than normally covered by rickshaws and who want the convenience of door to door service at a lower cost than regular taxis.

Prior to December 2001, there were some 40,000 auto-rickshaws in Dhaka, most of which operated with 2-stroke, petrol-fuelled engines. Because of the severe pollution that was being caused by these 2-stroke vehicles, a bold move was made to eliminate them from the metropolitan area by the end of 2001. The decision was subsequently and effectively implemented. In order to help fill the gap created by the withdrawal of 40,000 2-stroke vehicles, the Government approved the introduction of 12,000 four-stroke, CNG-fuelled auto-rickshaws in January 2002. Since that time the CNG vehicles built by Bajaj Company from India have been gradually introduced into service. In addition, training was arranged for around 1,000 mechanics in order to provide repair and maintenance services.

Traffic surveys at several screen lines in the Dhaka urban area, indicate that auto-rickshaws account for 30% of all motorized vehicles. This same traffic data shows that the number of auto-rickshaws was two and half times greater than the number of taxis. Therefore, while the number of licensed auto-rickshaws is officially set at 12,000, (a number equal to the number of

regular taxis), actual field surveys as well as casual observation indicate that there are many more in actual operations than regular taxis.

Unlike taxis, CNGS are owned by individuals rather than companies. The owners in turn, rent the vehicles out to drivers at a cost of Tk 500 ($8) for a 24 hour period. Usually two drivers share the operation of an auto-rickshaw, roughly for 12 hours each.

The fare structure for the auto-rickshaws, established by the Government in January 2002, is Tk 12 (USD 0.20) for the first 2 kilometres and Tk 5 (USD 0.08) per kilometre for the remaining portion of the trip. Actual fares are suppose to be established by meters installed in each auto-rickshaw/baby taxi. However, drivers generally operate on the basis of negotiated fares and do not use the meter.

3.6 AUTOMOBILES

The number of automobiles[4] has increased steadily during the past decade. Available figures indicate that the number has increased by about 10,000 each year, from 80,000 in 1994 to 166,000 in 2003. While the number of vehicles added each year is considered reasonably accurate, the uncertainty surrounding the number of removed from operational status each year vehicles clouds the knowledge of how many vehicles there really are in operation.

Best guesses at the degree of motorization are obtained from BRTA and BBS figures. The total vehicle fleet registered is , and the population is approximately 12 millions. This results in an auto ownership of approximately 16 per 1,000 population and a vehicle ownership (inc Buses, Trucks, Taxis, CNGs) close to 100 per 1,000.

Information collected as part of the STP 2004 Screen Line Counts indicates that automobiles represent 17% of all trips excluding walk mode, 29% of all motorized vehicles, and 45% of all 4-wheeled motorized vehicles.

Since Bangladesh does not have any automobile manufacture or assembly plants, all vehicles are imported. In 2001, nearly 80% of imported automobiles were used vehicles. However, since 2002, as a result of a change in government policy which reduced the depreciation allowance for used vehicles, the proportion of new vehicles has increased. Currently, the proportion of used vehicles imported is about 60%.

In addition to the import duties and taxes levied by customs at the port of entry, automobile owners are required to pay a number of taxes and fees before the vehicle can be used on the street. These taxes and fees include:

a. Registration Fee: A one time fee that varies from Tk 14,000 ($ 230) to Tk 100,000 ($1,700) depending upon the type of vehicle and size of the engine.
b. Road Tax: An annual fee that varies with the number of seats in the vehicle (e.g. Tk 4,500 [$75] for a regular size car; Tk 6,000 [$100] for a medium size van).
c. Fitness Tax: An annual fee that depends upon the vehicle classification (Tk 300 [$5] for all vehicles, except heavy vehicles and Tk 600 [$10] for heavy vehicles.
d. Fitness Fee: An annual fee (Tk 300 [$5] for checking registration, ownership change, fitness, etc.). Vehicle inspection, carried out on an annual basis, is a visual inspection only and does not included any technical or mechanical testing.

[4] *This includes cars, Jeeps, station wagons, pick-up trucks and small vans.*

Fuel cost is a major component of vehicle operating costs. Three types of fuels are in use in Bangladesh - petrol, diesel and Compressed Natural Gas (CNG). On a cost per kilometre basis, petrol engine vehicles average about Tk 4 to 6 per kilometre, depending upon the size of the engine, diesel engine vehicles average about Tk 2 to 3 per kilometre and CNG vehicles average about Tk 1.5 to 2 per kilometre. So, fuel costs are substantially lower for CNG-fuelled vehicles than for petrol-fuelled vehicles, even though the cost of petrol per litre is quite modest compared with prices elsewhere. The cost to covert a petrol engine to one that uses CNG is around Tk 32,000 ($530) to Tk 40,000 ($670), depending upon the size of the engine.

Vehicle insurance is available, but most owners have only “third-party insurance” which is compulsory. The cost of third party insurance is around Tk 500 ($8) for a full year, for a car with a value of Tk 500,000 ($8,000). Some owners of new vehicles have comprehensive insurance, which can cost between Tk 30,000 to 100,000 ($500 to 1,700) per year, depending upon the value of the car. Even with comprehensive insurance, owners sometimes face considerable difficulties in having the insurance company pay for the damage, when a collision occurs.

3.7 BUSES

3.7.1 Introduction

Bus transport is a very important mode of transportation in Dhaka. Volume and vehicle classification count data collected at 69 locations along three screen lines established for the STP study indicates that bus passengers represent 58% of all people crossing the three screen lines. In terms of vehicles, buses accounted for 10% of all vehicles, 16% of all motorized vehicles and 25% of all 4-wheeled motorized vehicles crossing the screen lines. The general category of bus transport includes a variety of different vehicle types including minibuses (41%), micro-buses (30%); large buses (13%), auto tempo/laguna maxi (12%) and staff and school buses (4%).

3.7.2 Bus Characteristics

a) Large Buses

Large buses are defined according to regulations as buses with more than 32 seats, but more generally large buses are considered to be ten meters or more in length.

Probably the most significant change in the bus fleet composition in the last 18 months is the increase in the number of large buses. This trend began with Sino Dipon in early 2003. They are now operating on four routes with 105 buses. Green Express, which began operations in April 2004 with 20 buses, currently has 50 buses in operation on two routes, and will shortly add 50 more buses. Bevco, commenced operation with 20 large buses on the Uttara to Motijheel route in August 2004. Dhaka Paribahan, a major minibus operator in Dhaka, has recently imported 10 large CNG buses from China, which will likely be used to replace existing minibuses. All of these new buses are running on CNG.

There are currently around 100 CNG buses in operation in Dhaka but this figure is growing as new CNG bus operators enter the market and are given priority in the award of route permits as part of a government policy to encourage the use of CNG buses. A new 10 meter CNG bus imported from China, similar to those operated by Sino Dipon, costs approximately Tk 22 Lakh (USD 37,000). Green Express CNG buses from Tata in India cost about Tk 34 Lakh (USD 57,000).

The BRTC, which operates under immunity from regulation by licensing authorities, owns a total of 306 buses operating on 15 routes in Dhaka. Of these, 203 are double-decker buses (older Ashok Leyland and newer Volvo) and the remainder are standard 12 meter single decker buses. BRTC does not actually operate the buses, but sub-contracts out the operations to private operators.

b) Minibuses

Minibuses are defined as buses with a 15 to 32 seats capacity. Most minibuses are around 8 meters in length, with locally manufactured bodies on Isuzu, Hino or Tata chassis and engines. A new minibus, with the body manufactured locally, costs about Tk 11 Lakh (USD 17,000).

The number of minibuses has increased rapidly since 2000. Current numbers are imprecise, but various estimates indicate that around 5,000 are in operation in Dhaka. It is also estimated that around 2,000 of these are operating without permits or in contravention of allocated routes.

Since April 2004, the Road Transport Committee (RTC) has resolved to limit the issuance and duration of new route permits to minibuses running on diesel fuel or under individual management. Although the permit system has only a limited relevance to the number of buses actually plying on the road, this change in policy approach appears to be having some effect, as new operators are beginning to use large buses.

c) Human Haulers (Microbuses)

Human haulers are 9 to 15 seat microbuses generally in the form of a converted pickup truck with two benches added for passenger seating. Most have diesel engines, although some are petrol fuelled and a small number have converted to CNG. A total of 1,609 route permits operating on 45 routes had been awarded to human haulers as of June 2004.

Human haulers have been allowed to increase rapidly at the same time as the two-stoke auto-rickshaws were phased out, in order to help meet the demand for public transport. However, the government, through the Road Transport Committee, is currently discouraging new human hauler route permit applications.

3.7.3 Fares

a) Current Fares [5]

There is conflicting information on fare levels. Surveys of 1,500 bus passengers at terminals revealed an average bus fare of around Tk 1 ($0.017) per kilometre. However, interviews with operators indicate a lower fare. Field observations indicate that bus fares vary between operators, but that competitive forces ensure that the variation is not large. The exception is air-conditioned premium services for which fares are around double the price of other services. Most fares, even for the newer bus operators, are around Tk 1 ($0.017) per kilometre for trips up to 8 kilometres, with longer distance charged at a substantially cheaper rate of around Tk 0.33 ($0.006) per kilometre.

It is noteworthy that despite inflation, rising fuel costs and deteriorating traffic operating conditions, bus fares have not increased substantially since 2000 and in some cases appear to have actually fallen. Operators attribute this decline in fares to competitive forces, and cite the low fares as a major obstacle to financial sustainability of operations.

b) Fare Setting Criteria and Procedures

Fares are reviewed periodically by the government in a process of negotiation with operators. They are officially established by the government for fixed route public transport. In reality, however, a de facto deregulation of urban bus fares has occurred, with the official fare applying

[5] *The September 2004 revised fare table of Green Express, for example, indicates a charge of Tk 3 (USD 0.05) for a short distance trip from Kamalapur to Motijheel, a minimum Tk 5 ($0.08) for all other short distance trips, and a sliding scale up to a maximum Tk 14 ($0.23). A trip from Uttara to Motijheel (20 kilometres) costs Tk 12 ($0.20). A trip from Kamalapur to College Gate, a distance of around 24 kilometres, costs Tk 14 ($0.23).*

only to intercity travel. The government review of fares generally is not based on a systematic or regular evaluation of operating costs, as the structure of regulation means the government is generally not equipped with detailed information about bus operations.

The official fares were set at Tk 0.32 per kilometre for buses and Tk 0.35 per km for minibuses between 1989 and 2003. In the intervening period, the operators raised fares at least twice, to Tk 0.47/0.50 per km for buses/minibuses in 2000, and to Tk 0.62/0.65 per km for buses/minibuses in 2001. Further rises took place until in February 2003, the government set fares at Tk 0.72 per km for buses and Tk 0.75 per kilometre for minibuses, bringing official fares in line with the reality of fares actually being charged. Further slight fare increases were implemented in August 2004 to account for recent substantial fuel prices increases.

c) Fare Collection

For major bus and minibus operators, fare collection is conducted outside the bus at small ticket booths located at bus stops. At some bus stops there are up to as many as 12 ticket booths, depending on the number of major operators serving the route. The rationale for the ticket booth is not so much to speed up boarding of buses, but rather to enable the larger bus operators to reduce revenue leakages by avoiding cash transactions on buses. Given the low cost of labor (a ticket counter worker is paid around Tk 2,700 (USD 45) per month), this system also functions as a source of information for passengers, enables a distance-based fare system and provides verification of fares paid by alighting passengers. One operator with a fleet of around 100 buses employs 400 ticket booth workers at 80 locations along 4 urban routes.

Individually owned buses and minibuses as well as human haulers, are operated with conductors who collect fares in the vehicle. Smaller buses generally have one driver and one conductor who collect the fares from passengers. Minibuses and large buses that operate under individual ownership have a driver, a conductor who collects fares, and a helper. Buses and minibuses run by companies with ticket booths at the stops have a helper but no conductor. Some large buses, such as the newer Volvo double-decker BRTC buses and the premium air-conditioned services operate without conductors or helpers.

With wage rates as low as they are, the added cost of employing conductors, helpers and ticket booth operators is relatively small, compared with the cost of installing, operating and maintaining automated fare collection devices in the buses.

3.7.4 Regulatory and Institutional Arrangements

Government regulatory arrangements have undergone changes in the past year. These changes include a more prominent role of the Dhaka Transport Coordination Board in bus sector regulation, a more active policy-making role of the Regional Transportation Committee, and the declining influence of the bus and minibus operators' association.

A. Bus sector Regulatory Institutions

a. Regional Transportation Committee (RTC)

The Regional Transportation Committee (RTC) was established under Section 54 of the Motor Vehicles Ordinance 1983 to carry out public transport regulatory functions for the whole of the DMA. The RTC is responsible for planning routes, establishing limits on the number of buses allowed on routes, allocating the number of vehicles to serve a route, and determining the number and configuration of routes. The RTC is chaired by the Commissioner of Metropolitan Police, meets either monthly or bi-monthly and focuses on broad policy issues rather than detailed individual cases.

b. Bangladesh Road Transport Authority (BRTA)

BRTA was created in 1987 and given responsibility for the overall management, control and supervision of the road transport system in Bangladesh. BRTA is directed by a Board of Management comprising a Chairman (who also serves as the full-time Chief Executive Officer) and up to eight members drawn from relevant ministries. The current responsibilities of BRTA include:

- Registration of motor vehicles
- Issuance of driving licenses
- Mechanical inspections and issue of roadworthiness certificates
- Issuance of route permits for buses and other commercial vehicles
- Collection of road user fees and taxes
- Negotiations with commercial vehicle owners and drivers

BRTA's main activities in the public transport sector do not involve planning bus routes and monitoring services, but are primarily related to the administration of the current system of issuing route permits. The "*Bus Route Franchising Study",* completed for the DTCB in 2003, highlighted the fact that the BRTA has limited personnel with planning capability and regulatory experience in the bus sector.

c. Dhaka Transport Coordination Board (DTCB)

DTCB was established in 2001 within the scope of the World Bank funded Dhaka Urban Transport Project in response to the need for a body to coordinate transport policy, infrastructure and strategic planning. Recently, the DTCB has taken on a wider role, including for example the implementation of a bus route franchising demonstration project. The Board of DTCB is chaired by the Mayor of Dhaka, and DTCB is managed by an Executive Director. The objectives of the DTCB are:

- To advise on the creation of a safe and integrated transport system for Dhaka
- To plan transport infrastructure, taking into consideration the structure plan of Dhaka
- To develop a strategic transport plan and ensure cooperation and coordination between the various transport related authorities and agencies

The DTCB is currently limited under its statute to policy formulation and coordination. Even so amendments to the Motor Vehicles Ordinance are currently being considered which would expand DTCB's authority in the bus sector.

d. Dhaka City Corporation (DCC)

DCC currently has only a limited role in public transport planning and regulation in Dhaka. The Mayor of DCC serves as Chairman of the board of DTCB and DCC is responsible for public transit infrastructure items like bus shelters, bus turnouts and bus terminals.

e. Dhaka Metropolitan Police (DMP)

DMP serve the duel functions of both criminal and traffic enforcement. The DMP exercises a strong influence over public transport policy through their chairmanship of the RTC and influence over BRTA, as well as their on-street traffic enforcement activities. This strong influence, however, is concerned primarily with administering the current system of route permits and does not include service planning.

f. Ministry of Communications (MOC)

The MOC is responsible for providing clear policy leadership. The MOC has recently developed a National Land Transport Policy that is being incorporated into a broader Integrated Multi-Modal Transport Policy. In practice, however, a specific public transport policy does not yet exist and policy initiatives seem to be initiated by the RTC and DTCB as well as the Ministry of Communications, Police, and even the BRTC. The latter, for example, recently re-introduced additional 'women only' buses serving selected morning and evening peak routes.

g. Bus Operators' Association

The Bus Operators' Association has historically been highly influential in the bus sector, largely reflecting the highly fragmented nature of the bus industry. The Association's influence was exercised in such issues as detailed considerations of route permit allocations, fare schedules, and other policy issues effecting urban bus operations. The Association still exercises considerable influence, especially in the allocation of route permits by the RTC (of which the association is a member), but is perceived mainly to represent the interests of the fragmented minibus sector. The newer large bus operators either have not joined the Association, or are operating largely outside its influence.

B. Bus Route Licensing

The legal basis of route permit allocation has been well documented in previous studies, in particular in the "*Bus Route Franchising Study of 2003"*, and is, therefore, not repeated here. The salient points to note include:

- Decisions on permits are made by the RTC and implemented by the BRTA
- Permits are granted on an individual rather than a corporate basis
- Permits are granted on an individual vehicle basis, rather than on a fleet-wide basis
- Permits are granted for 3 years but no minimum service standards are enforced
- Each route is given an upper limit for the number of vehicles permitted to operate

New operators are given an initial 4 month permit on a test basis, followed by a regular 3 year permit. There appear to be no clearly defined criteria for deciding whether an operator passes the 'test period'. The weaknesses of the current system of allocation of route permits is that they are awarded without systematic route network planning, and on an individual operator and individual vehicle basis.

C. Planning Procedures

As in many other cities in the region, systematic bus route planning based on a cycle of monitoring, planning, and implementing adjustments to the network is not in place in Dhaka. Rather, network changes are made on an incremental basis with changes generally instigated by operators rather than by the government.

While this approach to planning may be sufficient on a limited street network and with a relatively small city, it will not be effective in meeting the needs of a rapidly growing mega-city such as Dhaka. In order to plan the bus system effectively, Dhaka needs to establish a planning unit, and use current transit network planning tools such as the EMME/2 model developed as part of the STP study.

3.7.5 BRTC

The Bangladesh Road Transport Corporation (BRTC) is a state owned Corporation established under Government Ordinance No.7 of 1961 dated 4th February, 1961. BRTC owns 306 large buses operating in Dhaka, of which 203 are double decker buses and operates in the following business sectors:

- International bus service (Dhaka – Kolkata and Dhaka – Agartala)
- Volvo bus service (double-decker buses within Dhaka)
- City bus service (double and single-decker buses)
- Inter-district bus service
- Bus service for women (previously attempted but discontinued; more recently, BRTC has started operating ten women-only buses)
- Two workshops, including one with a production capacity of 100 large bus bodies per year, and heavy repairs.
- Training
- Research and development

BRTC's financial performance deteriorated between 2000 and 2003. Revenues have more than doubled, but costs have nearly tripled over this period. The loss for the year ending 30 June 2003 was Tk 38.5 crore ($6.4 million). However, if depreciation and interest payments are not included, BRTC revenues exceed short term operating costs. Revenues from all areas rose substantially but costs increased at an even greater rate in the same period.

3.7.6. Private Operators

a. Driver and other Staff Working Arrangements

Working arrangements for drivers and other staff can be divided into two distinct categories:

The first category applies to the majority of the bus fleet - some large buses, most minibuses, and all human haulers. Drivers and crew in this category either own the vehicle individually, rent the bus on a daily or monthly basis, or work for a bus owner on an incentive basis. They then operate the vehicle either at their own revenue risk, requiring enough passengers per day to repay the bus rental fee, cover fuel and basic maintenance costs, and make a profit. Those drivers that are directly employed by bus owners are under similar pressure to carry sufficient passengers in order to meet all operational expenses as well as salary incentives tied to any profit that is made. No employment guarantees or professional management is provided and the driver and crew handle all fare payments on the bus.

The second category applies to the professionally managed bus operators. Drivers, crew and other staff working for the professional operators typically work on a more secure employment basis and are paid not according to how many passengers they carry, but according to the number of trips made. The professional bus operators also typically employ administrative and managerial staff, maintenance staff, ticket booth operators, and marketing and sales staff. These operators are distinguished by the fact that they maintain ticket booths in order to collect fare payments. This allows drivers to concentrate on driving, rather than continually seeking to chase additional passengers.

b. Policies to Encourage Industry Consolidation

Precise figures are not available from regulatory authorities, but there are estimated to be 10 private bus operators with fleets of 30 or more buses, predominantly in the large bus sector but also including some minibus operators. Outside these larger operators, buses are under

individual ownership. Microbuses are under fragmented ownership with individual rather than company operation. Regulators readily acknowledge that it is very difficult to control bus operators on an individual basis. Coinciding with the entry of new large bus operators [such as Sino Dipon, Green Express and Bevco on the route from Uttara to Motijheel], is the implementation of a government policy to encourage consolidation of the industry into larger operating units operating under a company basis rather than on an individual basis.

The government's moderately successful, ongoing recent efforts to promote bus industry consolidation into larger operating units has not resulted from major changes to legislation or large scale bus route franchising but rather a range of approaches including:

- Discouraging route permit applications by individuals,
- Reducing the span of permits from 3 years to 1 year for the more fragmented diesel minibuses and human haulers,
- Encouraging through less formal means at meetings of the Road Transport Committee,
- Shifting human haulers and diesel minibuses off the main arteries to the side roads.

Some minibus and human hauler operators have recognized the commercial reality that customers will tend to choose the new, larger buses and have agreed voluntarily to move to smaller roads. Others have resisted, but the government policy is to remain consistent and over time insist that minibuses and human haulers move off the main roads, starting with New Airport Road. The Road Transport Committee is instructing small operators to form cooperatives. Individual applications for a route permit are not encouraged, and company applications are given preference.

3.7.7 Current Bus Service Characteristics

a) Bus Routes

The coverage and concentration of official bus routes in Dhaka is illustrated in **Exhibit 3-2** placed at the end of this chapter.

Bus and minibus routes tend to be concentrated along the limited number of arterial roads, in a generally north-south orientation. Human hauler routes are more dispersed, penetrating narrower roads and include more east-west linkages.
Bus frequency surveys conducted in August 2004 showed that there is a discrepancy between the official route permits and the buses actually operating, both in terms of the routes followed and the number of buses operating.

Some buses have the starting and ending point of routes written on the bus, some the route number only, others the number and route and many others have neither the route nor the number written on them. These buses are identified by the passengers through familiarity and through the conductor shouting the destinations when the bus approaches the stopping area. For this reason it is often very difficult to identify which route a particular bus is serving.

In addition to buses operating without permits it is also common for intercity buses to ply in the city. Estimates are that some 1,200 intercity buses are in fact operating within the city. For example, many intercity buses continue past Tongi all the way to Mohakhali and Fulbaria via the New Airport Road corridor. Current operators on this corridor, who are adversely affected by these buses, argue that they do not have permits for urban services and should not be permitted to operate south of Tongi.

b) Bus Frequencies

The volume of buses along selected high demand corridors (identified as those with peak demand more than 10,000 passengers per hour per direction) approaches 500 buses per hour per direction at several locations, results in a high capacity, low speed bus system. In general, for roads radiating from the city center, volumes show peaks in the morning, are lower between 10am and 3pm, and rise again in the evening peak period. For roads within the city center, morning and afternoon peaks are more difficult to discern.

c) Public Transport Passenger Flows

An analysis of peak passenger volumes was made using peak period bus occupancy rates of 65 passengers per large bus, 35 passengers per minibus, and 15 passengers per human hauler. Based on these occupancy assumptions, the resulting peak bus passenger flows at twenty-four locations with flows of more than 10,000 passengers per hour indicate volumes in the range of 10,000 to 20,000 passenger at about half of the locations.

d) Passenger Information

Passenger information, in terms of route maps, schedules, or service time coverage, is virtually non-existent. Many buses are not clearly identified by route number. Some are identified with display boards showing the origin and destination of the route. Some of the newer 'premium' services provide a diagram of the bus route at the ticket booth and the larger and more organized operators tend to display a route number and/or the origin and destination point of the route.

3.7.8 Bus Terminals

Dhaka has three bus terminals serving intercity buses: Gabtoli, Saidabad and Mohakhali. BRTC has its own depots at several locations including areas such as Pallabi, Kallyanpur and Tajgaon. Currently, improvements to these three intercity terminals are being implemented as part of the Dhaka Urban Transport Project (DUTP), funded by the World Bank.

City buses do not use these terminals; instead they park along roads at various points throughout the city. The different operators congregate on the roadside at particular locations. Salsabil minibuses, for example, can be seen parked along the Dhaka Narayanganj Road in Shyampur. Several Green Express buses can be seen at night parked outside the company's head office in Banani. Sino Dipon similarly keeps the majority of its fleet on the roadside at night. Many bus routes congregate along the road approaching the BRTC depot at Pallabi. Others are parked at different points along Mirpur Road, along roads near the three inter-district bus terminals, and in the Fulbaria area. These bus waiting areas are also used by drivers and crew to wait, rest, eat and socialize and, in many cases, for carrying out repairs to buses - activities which have in some cases led to complaints from nearby communities. **Exhibit 3-3** at the end of this chapter shows the general location of the various bus terminals.

3.7.9 Summary

There have been significant recent improvements in the bus system in Dhaka, including increases in bus numbers, more high quality buses and a shift to cleaner buses and more organized operations. However, the bus system still has many deficiencies and offers a generally poor level of service. The impacts of a poor bus system include those felt by passengers, drivers, crews, operators, regulators and the wider community. It is important that current efforts to re-organize the existing bus system and provide better service to the users be continued and increased so that bus transport remains an important and significant part of a multi-modal transport system for Dhaka.

3.8 RAILWAY

The 1998 Greater Dhaka Metropolitan Area Integrated Transport Study (DITS) states that:

> *"The contribution of Bangladesh Railways to urban public transport is very small. The main inter-city line entering from the north carries minimal commuter traffic. The branch line to Narayanganj, wholly within the study area, is entirely devoted to local traffic but is grossly under-utilized.*"

Little appears to have changed in the intervening years. Railway-related facilities and services in Dhaka are provided, operated and maintained by Bangladesh Railways (BR), under the authority of the Bangladesh Railway Authority, as part of the Ministry of Communications. Nationwide, there are about 2,900 route kilometres of railway. Some segments are Metre Gauge (1,000 millimetres), other segments are Broad Gauge (1,676 millimetres), and some segments are constructed as Dual Gauge which is a three rail system that accommodates both Metre Gauge and Broad Gauge operating equipment.

Within Dhaka, the railroad passes in a north-south direction from its southern most terminus point in Narayanganj, northward to Tongi where the railroad (i) branches eastward with service to Sylhet and Chittagong, (ii) continues northward with service to Mymensingh Junction and points beyond, and (iii) branches westward toward Tangail, the Jamuna Bridge river crossing, and much of nowestern Bangladesh.

Between Tongi in the north and Narayanganj in the south, there are ten existing stations:

- Tongi Junction
- Biman Bandar (Airport)
- Dhaka Cantonment
- Banani
- Tejgaon
- Kamalapur (main Dhaka station)
- Gandaria
- Fatullah
- Chashara
- Narayanganj

All of the stations, within Dhaka, are generally well served by a variety of transport modes including buses, taxis, auto-rickshaws and rickshaws.

Kamalapur Railway Station is the main railway station for Dhaka and serves about 28,000 passengers per day. Adjacent to the Kamalapur Railway Station is an Inland Container Depot (ICD) that handles about 70,000 containers per year. Two container trains per day operate between Chittagong and the Inland Container Depot.

A total of 18 passenger trains per day (9 inbound and 9 outbound) stop at the Teijgaon Railway Station serving about 40,000 passengers per month. Primary origins and destinations are Chittagong and Sylhet. Tejgaon Railway Station is also the destination for all freight railway shipments with the exception of the trains that carry containers to the Inland Container Depot at Kamalapur. Presently, there are two freight trains per day operating from this station - one inbound carrying primarily food grains and timber, and one outbound that is generally empty. From Teijgaon Railway Station some of the freight is off-loaded onto trucks for distribution throughout the city while other portions are transported onward to various other local area railway stations (e.g. Narayanganj) by a local shuttle train. Teijgaon Railway Station also serves as a marshalling yard and workshop for all freight wagons. Adjacent to the Tejgaon Railway

Station, and located illegally on railway land, is the Tejgaon Truck Terminal. Due to limited space and the large number of trucks that are parked, stored, being repaired and other related activities, congestion on the surrounding roads is particularly severe.

The segment of railway between Tongi Railway Station and Kamalapur Railway Station is approximately 23 kilometres in length. Along this segment, there are two sets of tracks (both are Metre Gauge), and the condition is classified as "good" by Bangladesh Railways. There are 16 at-grade crossings of important roads which cause considerable delay and congestion for vehicular traffic using the road crossings. The segment of the railway between Kamalapur Railway Station and Narayangani Railway Station is approximately 14 kilometres in length. There is only one set of tracks (Metre Gauge) and the condition of the rail line is classified as "fair", by Bangladesh Railways. There are also several at-grade crossings, including major roads that serve as primary entry points to Dhaka to the east and the south. At the present time there are 20 passenger trains per day operating between Kamalapur and Narayanganj Railway Stations.

Bangladesh Railways, as the national carrier and the provider of an essential transport life line to some areas, has an obligation to transport all types of freight, including low rated essentials, to remote areas of the country, at an affordable rate. As such, they do not have the same flexibility as private transport modes which can be somewhat more selective about what freight they choose to transport (high revenue verses low revenue). At the present time, Bangladesh Railways is facing tough competition from other modes of transport for high rated freight transport, which pays more revenue.

What this means in terms of urban transport in Dhaka, is two fold. Firstly, Bangladesh Railways will likely continue to require substantial financial resources for infrastructure and operational costs throughout all of Bangladesh, thereby limiting their level of financial investment within Dhaka to something more modest than the concepts and plans that might otherwise be envisioned. Secondly, the primary responsibility of Bangladesh Railways is, and should remain, the transport of goods and passengers on a national scale. Given the enormity of such a responsibility in terms of on-going services and needed improvements, the likelihood of Bangladesh Railway taking on the added responsibility for developing and operating any type of urban mass rapid transit or high capacity commuter rail service for the Dhaka area is outside the realm of reasonable expectation.

In 2004, a project was discussed, regarding a proposal to relocate the existing segment of the railway between Kamalapur Railway Station and the Airport. Bangladesh Railway has submitted a Project Concept Paper (PCP) to the Planning Commission indicating that the relocated rail line would be elevated on an embankment with a series of grade separated underpasses.

A related project, that creates some uncertainty regarding the future of the current Inland Container Depot at Kamalapur Railway Station, is a proposed project by BIWTA to construct an Inland Container Terminal (ICT) on the south side of the Buriganga River at Pangaon.

Other railway related project proposals that have been made over recent years and continue to exist in a state of ambiguity include:

(a) a proposal to add two more sets of tracks north of Kamalapur Railway Station (to Tongi) and one more set of tracks to the south (to Narayanganj);
(b) a proposal to build an Underground Railway Line or a Railway Mass Transit System in Dhaka;
(c) a proposal to construct a Circular Railway Line around Dhaka, preferably using the city's flood protection embankment where available; and
(d) a proposal for an Elevated Mass Transit System for Dhaka.

None of these proposals appear to have had the benefit of a serious assessment of their viability.

In summary, the most important aspects of the existing railway as they relate to the planning and development of urban transport in Dhaka are the following:

- The significant underuse of the railroad as a transport mode for passengers and freight.
- The serious and disproportionate adverse impact of the railroad on other land based transport modes, due to the number of existing at-grade crossings.
- The important value that such a linear right-of-way represents within a dense urban environment for any one of a number of possible uses.
- The high cost of major changes to the railway.

In considering this further, the STP study has addressed the following issues in as far as they affect strategic planning concepts: -

a. Relocation of the existing Inland Container Depot (ICD).

b. Relocation of the railway to an alignment east of Pragati Sharani and use of the existing alignment for other transport related purposes possibly some type of a mass rapid transit system.

c. Terminating the rail line, and all rail services, at an appropriate northern point, establishing suitable station facilities (passenger and freight) and relying upon intra-urban modes to distribute and collect passengers and goods throughout the Dhaka urban area.

d. Elevating the railway along the existing alignment and substantially upgrading the services, possibly including urban commuter rail service (Gazipur – Dhaka – Narayanganj).

e. Reuse of the existing railway alignment for some type of mass rapid transit system, if the railway alignment is relocated and/or service is terminated at a suburban entry point.

In 2005, BR has taken the initiative to undertake a feasibility study in to the options for (a) curtailing (b) moving or (c) grade separating the existing line. Expressions of interest have been invited and further studies are eagerly awaited.

3.9 TRUCKS

3.9.1 Introduction

Dhaka is the commercial, industrial, and governmental center of the country. The rapid expansion of the city has brought with it a rapid growth in the quantity of goods being transported. Water transport provides one important means for transporting such products and to a lesser extent rail, but the major growth has been in the use of large trucks. After delivery to the metropolitan area by river craft, rail and inter-city trucks, goods are delivered to end users mostly by rickshaw vans and thelas, in the case of consumable goods, and by two-axle trucks in the case of building materials.

Old Dhaka, with its numerous godowns (warehouses), is the traditional center of wholesale trade for the nation. It still performs this function and continues as the main center for foodstuff wholesale supplies for Dhaka. Basic foodstuffs that used to be transported to the Old City by water, are increasingly being transported by trucks.

Registration information, from BRTA, indicates that the number of trucks has increased from around 28,000 in 1995 to just over 52,000 in 2003, an average growth rate of about 8.5% per annum. However, the number of trucks actually operating in Dhaka is uncertain, because trucks typically obtain route permits that allow them to operate throughout the entire country. According to representatives of a voluntary association of truck owners (Bangladesh Truck Malik Samity), there are around 60,000 trucks in all of Bangladesh – 20,000 operating in Dhaka (local), 20,000 operating to and from Dhaka (inter-district), and 20,000 operating in other parts of the country outside Dhaka.

3.9.2 Regulations

Truck operations in Dhaka are regulated by order of the Metropolitan Police Commissioner. Regulations change periodically in response to changing traffic flow conditions and the operational needs of the truck operators. Current operating regulations restrict trucks and tractor trailers from moving within the DCC limits between the hours of 0700 and 2000. Covered trucks are prohibited between 0700 to 1000 and 1600 to 2000.

There are no restrictions on the movement of trucks within the DCC limits on Fridays and other holidays.

The regulation of truck weights is an on-going concern in Dhaka. The general consensus is that trucks are often overloaded but currently there is no apparent means or effort to control it. Government officials are concerned because the overloading contributes to increased numbers and severity as well as causing serious damage to roads and bridges. Information indicates that the Government has plans to install weigh stations at several locations including: Kachpur, Dhaka-Mawa corridor, Mirpur, Ashulia Road, Ghazipur Road and Sylhet Road.

3.9.3 Truck Volume Counts

Traffic surveys at several screen lines drawn through the centre of the urban area, indicate:

(i) the volume of trucks in operation during the normal day time hours is very low;

(ii) most truck activity occurs during the hours of 2100 and 0600;

(iii) the peak period for truck volumes is from midnight to 0200; and

(iv) trucks constitute about 7% of all 4-wheeled motorized vehicles on a 24 hour basis. By contrast, at the periphery of the urban area trucks account for 26% of all 4-wheeled motorized vehicles on a 24 hour basis, and at the outer boundary of the Study Area the proportion increases to 33%.

3.9.4 Ownership

Unlike the bus fleet, where single bus ownership is common, there are a number of truck fleet owners with 100 trucks or more. The number of companies having 20 to 30 trucks is about 100, while nearly 300 owners have small fleets of 5 to 10 trucks. It is rare to find single truck owners.

The total fleet of trucks operating in Dhaka is comprised of the following:

a. Six wheel, rigid frame, 5 tonne carrying capacity trucks (mostly Bedford and Hindustan brands) comprise nearly 75% of the total fleet.

b. Six wheel, rigid frame 7 tonne carrying capacity trucks (mostly TATA and Ashok Leyland brands) comprise around 25% of the total fleet.

c. Ten wheel, rigid frame, 15 tonne carrying capacity trucks (TATA and Ashok Leyland brands) numbering approximately 500, generally operate as inter-district transport.

d. Older trucks, that are affected by the Government ban on the operation of trucks older than 20 years, are converted to covered trucks and currently number about 6,000.

e. Tractor-trailers, numbering about 200, are used to transport containers between the Inland Container Depot at Kamalapur Railway Station to the Export Processing Zone at Savar and various garment and other commercial establishments within the greater Dhaka area.

3.9.5 Operations

The movement of goods is primarily accomplished through the use of a transport agency that serves as an intermediary and facilitator between the customer and the truck provider. The agencies handle the customers and make arrangements with the truck owners to transport the goods. Transport agencies also execute long-term contracts with corporate customers for carriage of their cargo, but the truck owners generally provide the trucks. There are also a number of manufacturing units, and large commercial enterprises that own their own fleet of trucks and operate outside the purview of this arrangement.

There is a very low level of use of both non-motorized and motorized goods vehicles. Many vehicles operate for only 3 to 4 hours per day. This is the result of a fragmented industry, poor communication facilities and a need for many goods vehicles to be dispersed around the city to meet the demands of the commercial sector. Also, due to the restrictive timing of movements of trucks within the city, a local truck cannot travel more than 50 to 70 kilometres per day. Current estimates indicated that there is a significant oversupply of trucks for local transport in Dhaka, with about 40% of the total truck fleet being unused on a daily basis.

Dhaka is a major break-bulk centre. Most of the large importation of commodities is located in Dhaka. Therefore, most of the commodities that are imported first arrive in the wholesale market warehouses of the importers and the commodity is then broken down into smaller portions for reshipment to various other destinations.

The types of commodities being transport include:

a. Local transport: construction materials, products of various industries going to markets, local vegetables and other food items, garment industry items, medicine, etc. as well as containers from the Inland Container Depot to industrial and commercial units in the city and the Savar Export Processing Zone.
b. Inter-district transport: mostly import and export items like garment products, engineering products, food stuff and other basic items as well as supplies of fresh produce and products like vegetables, fish, cows, poultry, etc.

3.9.6 Terminals

In the early 1990's there were around 14 truck terminals which were operating and catering to both inter-district and intra-district truck services. Although there are these two different types of truck services operating in the city, the terminals have not developed separately. The exception is Amin Bazar, which is a designated as an inter-district truck terminal. Other truck terminals which have been operating as inter-district truck terminals include Tejgaon and Dayagaonj. Over the years some intra-district truck terminals have become established although these are not officially recognized with the exception of Dayagaonj truck terminal. Most of the terminals are used both by inter-district trucks and local trucks. Some terminals are used specifically by the trucks used in the carriage of construction materials. **Exhibit 3-3** at the end of this chapter shows the general location of the truck terminal areas.

The management of the terminals is through the Truck Malik Samity and the truck workers association. The three primary truck terminals are:

a. Tejgoan: This is the largest truck terminal in the city with a parking capacity of about 2,000 trucks and about 5,000 to 7,000 trucks operating from this terminal.

b. Amin Bazar: This terminal has come into operation in the last few years. The terminal has parking space for about 500 to 700 trucks and about 3,000 trucks operate from this terminal.

c. Syedabad: Syedabad is the third largest terminal of the city with a parking capacity of about 500 trucks and about 2,000 trucks operate from this terminal.

Proposals have been made that would establish a formal designated inter-district truck terminal at each of the following four entry points:

a. Katchpur Bridge (from Chittagong and Sylhet routes)

b. Mirpur Bridge (from Aricha/Savar and North Bengal routes)

c. Tongi Bridge (from Mymensing and North Bengal routes)

d. China-Friendship Bridge along Mawa route (for South – West Bengal)

3.9.7 Institutions

BRTA has the responsibility for administering the Motor Vehicle ordinance including registration of motor vehicles, driving licenses, route permits, and issuance of certificates of road worthiness. It is also responsible for road safety, overload control, and setting up emission standards.

The Bangladesh Truck Malik Samity, a voluntary association of truck owners, is the dominant group that controls nearly all truck operations in Dhaka, and also manages the truck terminals, in conjunction with the workers unions. There is also a Covered Truck Owners Association and a Long Truck Owners Association, although their influence is significantly less than the Bangladesh Truck Malik Samity.

3.10 WATERWAYS

One of the resources that Dhaka has in abundant supply is waterways. The Buriganga River, the Turag River, the Balu River, and the Sitalakhya River together, encircle all of Dhaka City. They also serve nearby areas that are in the process of being developed and are most likely to experience significant development in the future. At one time, there were also a number of open water canals and inland lakes throughout Dhaka. However, many of these canals and lakes have been filled-in or blocked.

At the present time, a very substantial amount of water transport-related activity occurs along the portion of the Buriganga River that borders on the southern edge of the old city area (see **Exhibit 3-4** at the end of this chapter). At one level such activity consists of innumerable small boats (human powered) that ferry people and goods across the river between the old city area and the southern bank of the river. At another level, there are a many large passenger launches that transport people to distant locations outside the Dhaka area normally as overnight travel and primarily to locations south of Dhaka. At a third level, there are a variety of river craft that transport goods and materials to and within the Dhaka area.

Sadarghat on the bank of Buriganga River is the main river port in Dhaka. The main terminal at Sadarghat, which has berthing capacity for 40 vessels, serves an average of 100 arrivals and 100 departures each day. There are also a number of other terminals and landing stations, some formal, others less so, in this same area. These terminals are located in a congested area of the Old City. Approach roads are narrow and road traffic moves very slowly because portions of the roads are occupied by traders and parked vehicles.

In addition to the significant water transport related activity on the Buriganga River, adjacent to the Old City area, there is also a moderated level of activity northward along the Turag River on the west side of Dhaka as well as the Bula River on the east side of Dhaka.

The Bangladesh Inland Waterways Transport Authority (BIWTA) is already proceeding with the development of a Circular Waterways System around Dhaka, for the transport of people and goods (see **Exhibit 3-4**). The concept of a Circular Waterways System is one wherein increased emphasis is given to the development and use of water transport as a means to serve passenger and freight transport needs. The plan envisions a network of landing stations positioned along the Buriganga, Turag, and Balu Rivers providing passenger and freight access to a variety of water-borne transport vehicles. In addition to the landing stations, land based transport services to and from the landing stations are required. Also required, is a major dredging effort, in some areas, in order to establish and maintain sufficient depth for navigational purposes.

Information from the BIWTA study indicates (i) a substantial level of existing (2001) passenger and freight volume already using the western section of the Circular Waterway between Ashulia and Sadarghat, and (ii) a substantial increase is projected for the future target years (2010 & 2020). The data also indicates that the most important landing station with respect to passengers is Swarighat, accounting for approximately 38% of all passengers, while the four designated major landing stations (Swarighat, Amin Bazar, Gabtali, and Ashulia), together account for approximately 95% of all of the freight traffic. An initial study to evaluate the feasibility of such a concept was completed in 2001, for the western section of the Circular Waterway (Ashulia to Sadarghat). The feasibility study included hydrographic surveys, soil investigations, landing station locations and designs, and projected levels of passenger and freight use.

Since the completion of the feasibility study, BIWTA has proceeded with the implementation of the recommendations for the western section of the Circular Waterways System, including dredging and construction of landing stations. Cost information, associated with the implementation of landing stations in the western section, indicates that the total cost to construct the four major landing stations is Tk 2.5 crore ($416,000) or an average of Tk 6.25 million ($104,000) per major landing station. Similar information for the four minor landing stations is a total cost of Tk 1.5 crore ($250,000) or an average of Tk 3.75 million ($63,000) per minor landing station. The cost of constructing one of the other landing stations (concrete steps and toll office is Tk 12 lakhs ($20,000) per location. Recent reports indicate that the Sadarghat to Ashulia portion of the Circular Waterway, including 10 landing stations, will be completed and opened by the end of 2004. The total cost of this portion of the System is approximately Tk 36 crore ($6 million).

BIWTA has initiated another feasibility study for the eastern section of the Circular Waterways System (Ashulia to Demra), including waterway linkages to some of the existing canals. While the feasibility study for the eastern section is not yet complete, one estimate of the cost of completing all of the necessary actions (surveys, dredging, landings, and related items) for the implementation of the Circular Waterway system from Ashulia to Kachpur through Tongi over a five year period (2004-2009) is Tk 147 crore ($25 million). This includes provision for 15 landing stations plus improvements at Tongi River Port and redevelopment of three canals.

Recently, the scope of the eastern portion of the Circular Waterways System was expanded from a BIWTA-only project to include Local Government Engineering Department and Dhaka City Corporation, both with responsibility for the construction of 15 roads connecting to the landing stations. The estimated cost of the project has been increased to Tk 294 crore ($49 million) with anticipated financing to include 30% from the Government of Bangladesh and 70% from donor agencies.

3.11 TRAFFIC MANAGEMENT

Traffic Management is the maximum use of existing road space, using traffic operations enforcement, materials and equipment to achieve safe and efficient movement of people and goods. An example of the absence of good traffic management is the chaotic disorder that exists in many areas of Dhaka today.

3.11.1 Need for Traffic Management

Rapid population growth and poor economic conditions have contributed to the lack of control of the public rights-of-way in many areas. There is also a high level of operational disorder, which significantly diminishes the efficiency and effectiveness of the existing transport uses. One of the major untapped transport-related assets of Dhaka, is the substantial additional unused capacity in the existing highway system that is now being squandered through inappropriate use and behaviour.

Examples that illustrate this point include the following:

Prob. Identification

a. Encroachment by vendors and hawkers who illegally occupy public land causing sever negative impacts to traffic operations on roads as well as blocking pedestrian movements.
b. Pedestrian walkways that are either non-existent or in poor physical condition, or blocked by various obstacles, thus forcing pedestrians to walk on the road.
c. Buses that stop to take on passengers at will without using recognized bus stops, and often blocking two or three travel lanes.
d. Motor vehicle drivers who do not abide by basic driving rules and regulations because they do not understand them, or do not care.
e. Poor road surface conditions and inadequate drainage that cause disruption to the smooth flow of traffic as well as safety hazards.
f. Little or no effective enforcement of traffic laws.
g. Vehicles of all types park on the roadsides thereby reducing capacity.
h. Widespread lack of concern for the rule of law undermining any attempt to improve enforcement.
i. Blockage of through travel lanes by right turning vehicles, due to poor driver knowledge and absence of proper channelization.

It is difficult to make an accurate technical assessment of the degree to which road capacity is being wasted. Educated guessing suggests that the amount of additional road capacity that could be achieved from improved traffic management is something in the order of 50%. The means to achieve this additional capacity is to address the types of issues highlighted above. In areas where these types of situations exist, significant additional capacity can be achieved. This type of traffic management improvement and the resultant additional capacity is the least costly and economically, the most beneficial action that can be implemented – particularly in an environment of limited resources. Making the best use of what already exists is a fundamental step that even more developed countries employ.

3.11.2 Traffic Management Program

An overall traffic management improvement program would typically be comprised of several elements, including:

a. Traffic Engineering – Enhancements to enable more effective use and management of existing physical infrastructure. These enhancements typically include better road markings, signs, traffic signals, channelization at intersections, turn restrictions and separation barriers, space for bus stops, and parking/waiting areas for public transport vehicles (buses, rickshaws, auto-rickshaws, taxis, etc.).

b. Driver Training - Improved testing and licensing procedures for all drivers and re-training for offending drivers. Since most drivers work for someone else, the influence that owners exert by either condoning or reinforcing poor driving habits or insisting and demanding good driving habits is substantial and should not be under estimated.

c. Roadside Interference – Measures that move in a positive and definitive manner to reclaim the full potential capacity of the existing road by relocating or removing inappropriate and illegal non-transport related activities from the public right-of-way. In some cases this may involve the need to help relocate or establish alternative sites for such activities.

d. Public Awareness - Initiatives to improve the ability of road users to adopt behavioral patterns which lead to more efficient and safer transport services. Typically, this will involve programs to alter community attitudes and invoke a greater willingness to accept better discipline by all users and providers of the transport services.

e. Enforcement – Increased level of enforcement of traffic rules to ensure a greater compliance with community desired road user behaviour. Enforcement actions can involve formal policing as well as informal pressure on individuals to adopt community norms of behaviour and should include the involvement of community leaders.

If it were easy, it would already have been done. If it were impossible, other cities would not have been able to establish and maintain a reasonable level of good use of their existing roads. So it is possible, but is just not easy. This is true for Dhaka as it is elsewhere.

Imagine, a situation where driving habits are orderly and disciplined, rickshaws stay in their designated space, pedestrian walkways are provided and maintained in good condition and are used for their intended purpose, parking takes place only in designated areas, and hawkers and vendors do not occupy public right-of-way space that is intended for transport uses. This is not some abstract vision for the future, but a reality that already exists, today, in Dhaka - within the Cantonment area. One asks therefore, why there and not elsewhere? The answer is clearly evident. There is good organisation and enforcement levels such that violators will be caught.

Ah! But the Cantonment area is different. Yes and no. Basically, it is an area where people choose to abide by a sense of law and order, and not do whatever they please. It is the same people and the same vehicles that choose to behave properly inside the Cantonment area but choose to act differently elsewhere. So it seems evident that they know what should be done in terms of behaviour, proper driving, and obedience of traffic rules and regulations, they just choose to do it inside the Cantonment area and choose not to do it elsewhere.

So, why the difference. The number of traffic enforcement personnel is not particularly high in the Cantonment area and is certainly lower than elsewhere in the city. The Cantonment area is not a harsh, threatening, inhospitable place that people have reason to fear, but rather one in which they have cause to be responsible and show respect. Other areas of the city are much

more harsh, threatening and inhospitable due to the consequences of a misguided sense that one is free to do as one pleases. Freedom, carries with it a responsibility to act and behave in a lawful and orderly manner, for the common good of the many, at the expense of some individual freedom to act in one's own self interest.

The primary difference is an acknowledged and accepted sense that in the Cantonment area, law and order will prevail, and for those who choose otherwise, consequences are likely to occur, whereas elsewhere there is an acknowledged and accepted sense that people can do whatever they choose with impunity. The fundamental difference is enforcement. Ironically, when the threat of enforcement is real, the need for it actually diminishes. Whereas, no level of enforcement will suffice, if there is no sense that it will be used. A program of education, awareness and positive reinforcement, coupled with the assurance of effective enforcement, will result in more efficient use of existing transport services and facilities, as well as benefits in other facets of daily life.

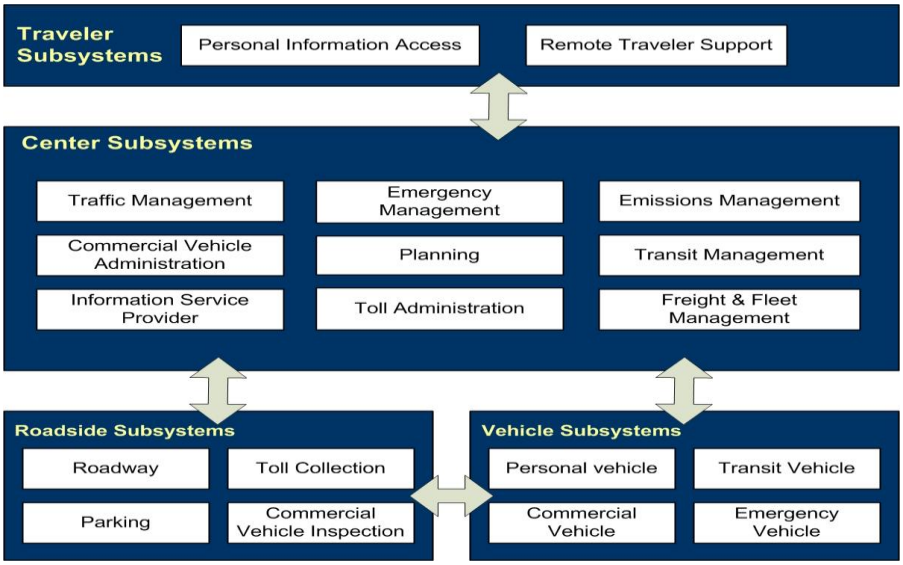
3.11.3 Intelligent Transportation Systems (ITS)

The term Intelligent Transportation Systems (ITS) or other similar related terms embracing the use of "Intelligent" terminology, are programs that involve integrated applications of advanced surveillance, communications, computer display and control process technologies, both on board the vehicle and on the road. The essence of ITS is to make significant improvements in mobility, safety, and productivity by building transport systems that draw upon advanced electronic technologies and control software. ITS is not a mode of transport, but rather a way of making modes of transport work better, or more smartly. It involves a very high level of interagency coordination, information sharing, technological sophistication and financial resources. The results, as demonstrated in a wide ranging set of applications in many countries is truly impressive, as illustrated in the following examples:

- Traffic signal operation has gone from non demand-responsive fixed time cycles, to systems that now can monitor the traffic on each intersection approach and adjust the cycle timing to serve the current conditions on a real time basis.
- Traffic flows in corridors are electronically monitored so that when one road experiences excess congestion and delay, advisory information messages are displayed to alert drivers and provide the option of diverting to alternative routes.
- Payment of toll charges to use roads and bridges can now be electronically deducted from a prepaid account as a vehicle equipped with a transponder passes under a detection device without the need to stop. Similar fare collection systems are used by bus and metro systems. The savings in time, reduced toll collection personnel, increased security, reduced revenue loss, and increased efficiency and productivity are very significant.
- Vehicle driver information systems that are able to determine and monitor the position of a vehicle (often using GPS) and provide real time accurate directions to any desired destination.
- Similar systems and technology that are able to detect when a vehicle is involved in a serious incident and rescue personnel are immediately deployed to the precise location has meant the difference between life and death.

These examples are but a small sample of the many ways in which technology is being used in all aspects of the traveller, roadside, vehicle, and control center subsystems to improve efficiency, safety, convenience and productivity of the existing transport system. **Exhibit 3-5** provides an illustration of both the scope and the inter-relationship among various subsystems.

Exhibit 3-5 Example of ITS Architecture and Sub-systems



The purpose of this brief reference regarding the use of advanced technology to improve transport system services and performance is not to suggest that there is a meaningful role for such applications in Dhaka at the present time, but rather to indicate a sense of what ITS involves and how it is being used elsewhere. However, it seems clear that Dhaka should increase its knowledge of ITS technology so as to be prepared for the coming 20 years.

For Dhaka, the practical reality at the present time and foreseeable future is that the need and opportunity to achieve improvements through more basic and traditional means is vastly more important and significant. No amount of ITS-type advanced technology applications will make up for the lack of a basic level of traffic management that is sorely absent.

3.11.4 Summary

In summary, for Dhaka, the opportunities and potential benefits from better, more efficient use of the existing transport services and infrastructure are very high. It is also the most cost effective means to address and resolve operational and system capacity problems. The untapped reserve of additional capacity potential represents a valuable resource that can and should be used effectively as a major component of a comprehensive multi-modal approach to existing and future transport needs for the metropolitan area. The role and use of advanced technology may represent a future possibility, but only if and when basic levels of traffic management are first achieved.

3.12 TRAVEL DEMAND MANAGEMENT

Most transport related projects and actions focus on providing new and improved transport infrastructure, services and operations that effect the supply of transport. Travel Demand Management (TDM), by contrast, is an approach that focuses on travel demand, rather then transport supply.
The concept of TDM is to address the need for transport in ways that help reduce traffic problems, primarily through measures that fall into three basic categories:

(a) reduction in the need to travel;
(b) rescheduling the time of travel; and
(c) use of more efficient modes of travel.

Such measures cover a variety of potential programs and actions, which can be implemented on a voluntary basis, through incentive programs or made mandatory by ordinance/regulation. The type of measures included in TDM are listed below, along with typical examples of actions:

a. Reduce the need to travel (examples include telecommuting, internet purchases, land use integration of residence, employment and shopping).
b. Reduce the length of a trip (examples include land use integration of residence, employment and shopping).
c. Promote non-motorized transport (examples include walking and bicycling as well as rickshaws for local area circulation and feeder service).
d. Promote public transport (examples include new and improved services, reduce wait times, travel allowance for use of public transport, bus priorities etc.),
e. Promote ridesharing (carpooling) (examples include travel matching services, provision of vehicle to share, preferential parking and lanes for HOVs).
f. Shifting peak-hour travel (examples include staggered work hours, flexible work hours and flexible working week)
g. Pricing actions (examples include peak hour area congestion charges to influence diversion to more efficient transport modes and/or change the time of travel to off-peak period).

From a local perspective, Dhaka in fact provides an impressive picture of TDM type measures that more developed countries strive to achieve even if this has occurred organically rather than by design. The concept of living close to ones place of work in order to be able to walk to work, is one such example. The level of use of non-motorized transport is another example. The regulation that prohibits trucks from using city roads during periods of high traffic volume and congestion is a further impressive achievement. The concept of spreading a portion of the peak hour volume to periods of the day when traffic volumes are lower is well established as reflected in the surprising consistence in traffic volumes throughout the 07:00 to 22:00 period of each day.

While some of these achievements may be unintended consequences of poor economic conditions rather than planned transport related actions, they are in effect reducing travel demand. As a cautionary note, however, the local situation is one wherein economic conditions, are in effect enforcing a suppression of travel demand. Therefore, when economic conditions improve, it should come as no surprise if the amount of travel increases significantly, thereby creating further pressure on the transport system.

Transport planning and development in Dhaka should, therefore, carefully consider the potential future role of Travel Demand Management type measures and how to sustain their effectiveness, within the context of changing economic conditions. For example, the transition from the current situation in which people, who for economic reasons are forced to use poor quality bus services, to a future situation in which people use high quality bus and mass rapid transit services, as a matter of choice is important. The transition from the current situation in which people, some of whom for economic reasons are forced to endure poor quality pedestrian facilities while others avoid walking altogether, to a future situation in which people enjoy walking on good quality safe pedestrian walkways, as a matter of choice is also important. The point being is one of deciding to manage such transitions, rather than waiting for it to happen. Singapore is a good example of managing such transitions in an efficient and beneficial manner. Los Angeles, along with many other major cities in the United States, is an excellent example of not managing such transitions effectively and realizing too late that many of the desirable transport related attributes that once existed had been lost and needed to be recreated and re-established at considerable expense and with limited success.

3.13 ROADS

3.13.1 Development of Roads in Dhaka

The development of the existing road network in Dhaka is an amalgam of actions and inactions that have evolved over a long time in distinct and often disparate ways that prevailed at such times. For example:

- Much of the "road system" in Old Dhaka follows the same footpaths established in the very early days when Dhaka was a small trading village. Thus, the existence of many narrow roads, poorly suited for motorized vehicles, as well as many alleyways, footpaths, and passageways, that function well for walk trips, but are so narrow as to prohibit passage of any motorized vehicle. Superimposed over this warren of historical pathways that have evolved over centuries, effectively interlinking all sectors of the Old City, are a few more conventional type roads (North South Road, English Road, Nawab Eusuf Road, etc) that have been inserted into the mix at great effort in terms of physical destruction, social disruption and financial expense.

- The areas immediately surrounding the Old City area have a more modern and substantial road system that, conceptually, is reasonably well suited to vehicular traffic. It does not serve that function very well, due to poor traffic operations and management as well as high traffic volumes.

- Well planned, formal, residential areas (e.g. Dhanmondi), with well conceived, designed, and implemented road networks to serve low density residential development are now reeling under the adverse impacts that are the consequence of much higher density residential development coupled with the effects of excessive commercial activity.

- Unplanned, informal, residential areas (e.g. Mirpur and Bahsaboo), where little or no planning for roads has occurred, and existing roads are a disorganized agglomeration of narrow, circuitous alleys first established on an ad hoc basis when settlement first started.

- Current developments (e.g. Bashundhara Housing and Uttara Model Town) that are built with extensive grid networks, the adequacy and suitability of which will only become evident when fully developed. In the case of Bashundhara Housing, while the internal road network is substantial, the only existing access linkage to/from Pragati Sharani is inadequate.

The major roads in Dhaka include: Mirpur Road (north-westerly); Begum Rokeya Sharani (northwesterly); Airport Road and Pragati Sharani (northerly); Dhaka-Chittagong Road (easterly) and Sylhet Road (north-easterly); Dhaka-Narayanganj Road (south-easterly); and Mawa Road (southerly), all leading toward and/or into the main areas of the city centre where these and other roads take on various names that frequently change along their respective alignments. Within Dhaka City, the primary orientation of the major roads is in the north-south direction. The lack of sufficient east-west connections and capacity creates the need to travel longer distances, thereby overloading existing roads, unnecessarily. **Exhibit 3-6** at the end of this chapter shows the Dhaka Road network.

3.13.2 Road Network Functional Classification

The primary purposes and functions of roads are to provide for the movement of traffic and to provide access to properties. While most roads provide some measure of each, the two functions are, in reality, competing rather then complementary. Roads with a high level of

access to abutting properties do not function particularly well in terms of traffic movements. Roads that do function well in terms traffic movement, normally provide very limited access to abutting properties.

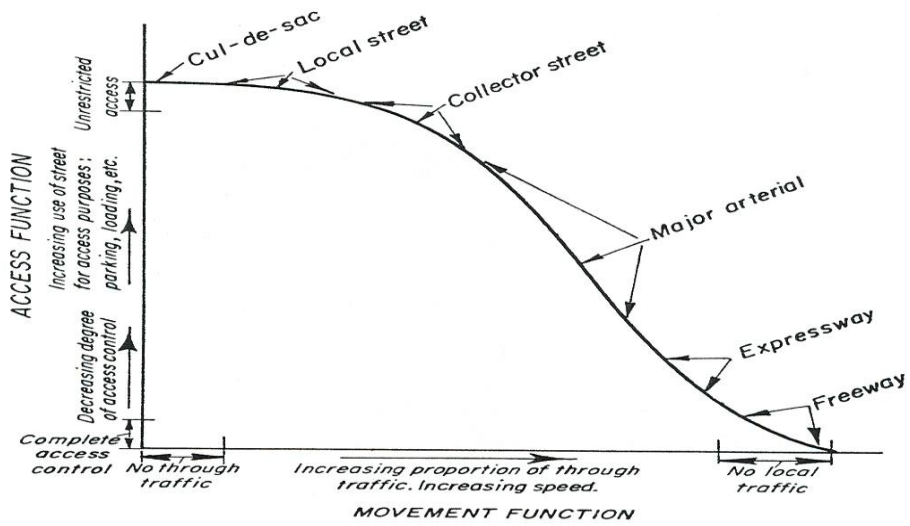
In urban areas, both functions – traffic movement and property access – are important. One approach to meet this dual, but conflicting need is to have all roads serve both functions. However, experience has repeatedly shown that the result is normally a situation in which neither function works well. A generally accepted, better approach is one that establishes a hierarchy of roads wherein the primary purpose of one category of roads is the movement of traffic, the primary purpose of another category of roads is access to properties, and intermediate categories that have varying levels of emphasis of for the two functions.

Therefore, roads are often classified according to the relative importance of the movement and access functions assigned. This permits the establishment and application of design and operational standards that reflect the particular function of a road in terms of the balance and trade-off between movement and access.

For example, roads designated primarily for movement of traffic are designed and operated in a manner that facilitates traffic movement and restricts access. Roads designated primarily for access to property are designed and operated in a manner that facilitates access to properties and not movement of traffic.

Exhibit 3-7 illustrates this general relationship between access and movement. The important concept here is the changing levels of emphasis between access function and movement function for different categories of roads, and not the particular names assigned to such categories (e.g. expressway, arterial, etc.)

Exhibit 3-7 Relationship Between Access Function and Movement Function



3.13.3 Dhaka City Road Classification

As part of the Dhaka Urban Transport Project (DUTP) a Road Referencing Database of the Road Network of DCC, was prepared in 2002. The preparation of the database included the classification of 1,286 kilometres of survey roads into five categories, base upon a functional hierarchy as follows:

a. Primary Roads: Inter-zonal roads; access control; full restriction of non-motorized traffic and grade separation at major intersections.

b. Secondary Roads: Intra-zonal roads; access control; segregation of motorized and non-motorized traffic.

c. Connector Roads: Intra-zonal roads; full frontage access; partial segregation of motorized and non-motorized traffic; and segregation of opposing traffic flow.

d. Local Roads: Full frontage access; no segregation of traffic; and provision for the possibility of using some traffic calming measures.

e. Narrow Roads: Short segments providing access to small areas; predominantly for non-motorized traffic and pedestrians; and bituminous, brick paved, and earthen surface.

A classification of roads made by DITS comprising the DMA is shown in **Exhibit 3-8**.

Exhibit 3-8 Road Network Classification (DMA)

ROAD CATEGORY		
Category	**Kilometers**	**%**
Primary	200	7%
Seconday	110	4%
Feeder	150	5%
Narrow	2,540	85%
Total	3,000	100%

Source: Dhaka Integrated Transport Study

3.13.4 Organizations Responsible for Roads

A number of agencies and jurisdictional organizations have some responsibility for the provision, operation and maintenance of roads. These include:

- RAJUK: Responsible for construction of new roads and widening of important existing roads in the DMA as well as construction of roads in newly developed housing estates. Maintenance of roads constructed by RAJUK becomes the responsibility of DCC.
- DCC: Responsible for construction of some roads and maintenance of all roads within the DCC jurisdictional area.
- RHD: Responsible for construction and maintenance of National Highways, Regional Highways and Zila Roads throughout the country.
- LGED: Responsible for construction and maintenance of feeder roads and Upazila roads and some Union roads.
- Pourashava: Responsible for construction and maintenance of certain roads within their respective jurisdictional areas.
- Zila Parishad: Responsible for construction and maintenance of smaller category roads within their respective jurisdictional areas.
- Union Parishad: Responsible for construction and maintenance of earthen Union roads and village roads.

3.14 SAFETY

Despite the economic and social benefits derived from transport systems, there is a serious cost that society pays in terms of the numerous collisions and loss of life that are associated with the movement of people and goods. While most people are aware and accept the fact that no form of transportation can ever be completely risk-free, it is equally clear that more can and should be done in order to reduce the number and severity of crashes and injuries particularly on roads.

3.14.1 Road Accidents[6] in Bangladesh

Reported road accidents in Bangladesh for the period 1982-2000, indicate that:

(i) the number of accidents increased 43%;
(ii) the number of fatalities increased 400%;
(iii) the number of injuries increased 5%;
(iv) the number of casualties (fatalities plus injuries) increased 100%; and
(v) the fatality rate increased from 126 to 163 fatalities per 10,000 vehicles (an increase of 30%).

Such data suggest that in addition to a moderate increase in the number of incidents (which normally might be expected with increasing numbers of people and motorized vehicles), there is an alarmingly large increase in their severity both in terms of total number of fatalities as well as the fatality rate[7].

The occurrence of traffic incidents, injuries and deaths, and the associated economic loss in terms of property damage, medical costs and lost productivity is unacceptably high. Traffic incidents in Bangladesh in 2000 are reported to have caused approximately 4,000 deaths and 2,300 injuries, and accounted for Tk 39 billion ($650 million) in property damage, medical costs and lost productivity. This represents an amount that is greater than the annual expenditures for all transport related projects throughout Bangladesh, as allocated through the Annual Development Program (ADP).

3.14.2 Safety Improvements

Improved safety requires a multi-dimensional comprehensive approach involving issues related to road conditions, regulations, enforcement, driver training, vehicles, public education, awareness, incident response and information, all of which should be applied in a systematic manner over time and with adequate funding.

a) Road Safety Initiatives

Effective road safety action requires the involvement of may different disciplines and the cooperation of a wide range of government, private and civil entities. A basic requirement for improvement in road safety is the preparation of a multi-sector plan. In order to coordinate road safety activities, the National Road Safety Council (NRSC) was established in July 1995. Secretarial services to NRSC (including planning, monitoring, training etc.), NRSC Secretariat (NRSCS) was established in September 1997 within BRTA. NRSCS was converted to the Road Safety Cell (RSC) in March 2001.

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[6] *The term "Accident" has become common usage for a series of events leading to collisions causing damage, injury or death. It is used badly resulting in a situation in which the individual perceives that accidents are random events. In this section, the word "accident" has been replaced with the word "incident" or "collision" since these words define the event more precisely.*

[7] *For general reference, the fatality rate in most developed countries is around 2.5 to 3.5 fatalities per 10,000 vehicles. In many developing countries, the number falls within a range of 10 to 50 fatalities per 10,000 vehicles. Compare these figures with Bangladesh where the numbers are 163 fatalities per 10,000).*

The First Two-Year Road Safety Strategic Plan was produced in July 1997. Since not much progress was made under the first plan, the present "Revised Strategic Action Plan" was developed to take a general view of the progress made in the first plan and to complete the unfinished actions. The revised plan for the period 2001-2004 was approved by NRSC in November 2001. The revised Plan is organized into nine sectors (planning, data system, engineering, legislation, enforcement, driver training, vehicle safety, awareness, health). For each sector, minimum output, lead agency and timing has been specified. The outputs indicated in the Plan, in most cases, are broad based and not focused and additional work is required to agree on measurable targets.

The Accident Research Centre (ARC) was established in 2002, at Bangladesh University of Engineering and Technology (BUET), in order to carry out scientific study and research regarding causes of collisions and developing remedial measures. ARC has started taking initiatives in transferring knowledge and technologies to road safety professionals.

National level initiatives that have been undertaken in Bangladesh in order to address concerns about accidents and safety include:

- Creation of National Road Safety Council (NRSC)
- Establishment NRSC Secretariat (Road Safety Cell)
- Establishment of operational systems for a National Road Accident Database at BRTA
- Adoption of National Road Safety Action Plans
- Adoption of National Land Transport Policy
- Creation of Road Safety Design Unit within RHD
- Establishment of Accident Research Center in BUET
- Adoption of road safety Design Standards Manual for RHD
- Adoption of Traffic Signs Manual by BRTA
- Adoption of Road Safety Audit policy by RHD
- Road safety improvement projects by RHD
- Establishment of Metropolitan Road Safety Committees
- Establishment of District Road Safety Committees
- Establishment of Upazila Road Safety Committees

While such actions to create the institutional structures and technical standards appear to be substantial, the overall effectiveness appears to have been rather limited. Adequate funding for road safety, or rather the lack of it is one important factor that has not yet been resolved.

b) Traffic Law Enforcement

Traffic law enforcement is needed to encourage safer road use and orderly traffic flow. Enforcement of various regulations, such as speed limits, use of seat belts, wearing of motorcycle safety helmets etc. have led to reductions of associated deaths and injuries in many countries. Effective enforcement of traffic regulations require training of the traffic police force in many traffic related areas, including incident investigation, highway patrolling, motorcycle riding and car driving and management skills.

c) Driver Training and Testing

The behaviour of drivers, particularly of commercial vehicles, is generally considered to be chaotic and does not reflect consideration for others. Commercial vehicles are involved in a majority of incidents. Effective driver training and testing is important for achieving a long-term reduction in the statistics. To ensure that road user behavior becomes safer, improvements in the training and testing of all drivers is required. A "motivational" training program for all drivers, organized with the involvement and support of the vehicle owners and professional associations is one example of the type of training that would be beneficial.

A large number of drivers have fake licenses, while others have obtained regular licenses through improper means. Because of a poor education level, most of the professional drivers cannot qualify for a written test, thereby fostering a market for fake driving licenses. The introduction of new laminated photo licenses in 1999, with new higher security features such as a hologram, are efforts to try and improve the situation. Improved detection of false driving licenses is required to discourage forgery attempts.

d) Education and Publicity

To develop safe road user behavior, children need to be taught skills (i.e. how to cross a street safely, how to use traffic signals properly, how to watch for and anticipate driver behavior, etc.) rather than focusing simply on rules, regulations and knowledge of traffic signs. To be effective, road safety education requires a clear structure within a recognized curriculum with a planned, sustained and coherent program of learning, based on sound educational principles. This is still not the case in Bangladesh. Children learn a lot from observation of others. The impact on children, of poor driving habits – those they observe as well as those they experience directly as they are transported about – is a serious systemic problem which will contribute significantly to future generations of poor drivers.

Road safety publicity for the general public is equally important. Road safety education is a long-term intervention, aimed at developing positive attitudes in children such that they become safer road users in the future. Publicity is an indispensable part of any nation's road safety strategy.

e) Vehicle Safety

Substandard, often overloaded, vehicles using roads that facilitate increasingly higher speeds, invariably will lead to increased incidents. Poor vehicle condition is widely accepted in Bangladesh to contribute to the number and severity of road collisions.

Despite inspection forms and manuals having been produced under a recent aid project, little priority has gone into their use. While inspection monitoring procedures are thorough, no use is made of the data nor concern shown over the unrealistically high pass rate. Vehicle inspection is treated perfunctorily and the minimal inspection procedures reflect this attitude. This sector has made little significant progress and is unlikely to do so without substantial support. Motivational training of the officials concerned and strict enforcement of inspection procedures is needed. Five computerized vehicle inspection stations have been built and equipped with the assistance of loan from the ADB and these are awaiting commissioning.

f) Medical Services

Lack of first aid and prompt transportation to adequate medical support facilities contribute to what medical professionals call the 'second accident', where injury severity is worsened for lack of proper care and quick transport services. Payment in advance is often required before a driver will transport an injured person. While major hospitals have ambulances, they are primarily used for non-emergency situations and rarely if ever respond to a road incident scene. In addition, hospital facilities and rehabilitation services are inadequately equipped to provide needed medical attention. As a consequence of such factors, the death rate is higher and the severity of injuries of those who survive is higher than it would otherwise be.

Initial, on the spot first aid care can contribute greatly to reducing morbidity and injury severity by ensuring the victim is kept breathing, bleeding reduced and shock controlled. Improvements in at-the-scene first aid care.

g) Information and Data

In order to improve road safety, it is important to determine the causes of road based collisions. At present, the focus of data is on number of incidents and on their severity, in terms of fatalities, injury and casualties. There is a need to establish a mechanism to analyze the cause following every incident. Some of the investigation undertaken in connection with major incidents revealed that major causes include:

a. Irresponsible and careless behaviour of drivers – excessive speed; overtaking without proper precautions; overloaded vehicles; and allowing passengers on the roof-top.

b. Careless movement of pedestrians – at traffic intersections in urban areas; and around market places, which have grown at certain places on the highway.

c. Poor road geometry – insufficient road width; sharp bends; and narrow bridges.

d. Poor condition of vehicles - including brake failures; and lack of proper maintenance.

e. Poorly trained drivers - a large number have only fake licenses, while others have obtained regular licenses through improper means. As a result, they are often poorly trained, unfamiliar with basic traffic laws and often act improperly, thereby contributing to an increased number of incidents.

h) Summary

Once the causes are clearly determined, countermeasures can be used to improve safety. Actions such as a motivational training program for all drivers who are already engaged in driving buses and trucks; greater awareness among pedestrians in urban areas and in market areas; fencing of footpaths at traffic intersections; pedestrian over bridges or underpasses; physical barriers built along the market places, separating the fast moving traffic lanes from the service lanes are but a few countermeasures that could, when properly applied, reduce the number and severity of incidents.

3.15 PARKING

At present, parking is not a well developed, defined, or regulated part of the transport system in Dhaka. This is due in large part to the relatively limited role that automobiles have filled in serving transport needs. It is also compounded by the fact that many families and companies that use automobiles for personal and business reasons have drivers who drop them off and pick them up. As a result they do not personally and directly experience the inconvenience and adverse impacts of having to find their own parking space. The drivers, however, do need to park their vehicles and lacking provision of suitable space, regularly occupy pedestrian walkways and road space intended for traffic flow and other purposes.

Existing parking supply is comprised of on-street parking, surface parking lots, parking structures and underground parking provided with large high-rise buildings. Parking in the areas that have been informally developed is generally very limited or non-existent, but the need is similarly quite limited. In residential areas that were developed several decades ago (e.g. Dhanmondi) there is a sever imbalance between parking demand and parking supply. This imbalance is due in part to significant residential densification that has occurred, but also to the intrusion of commercial and educational uses into residential areas and the relative prosperity of the area with its associated reliance on the use of automobiles. In newer residential areas (e.g. Gulshan) adequate parking is generally provided on site for residential properties (single family homes as well as six floor apartment buildings). However, when such properties are used for commercial uses, parking becomes grossly inadequate. Also, the amount of parking provided in designated commercial areas and buildings is inadequate.

One of the direct and immediate consequences of increased automobile ownership is the need for the provision of parking facilities, particularly in commercial areas. As new developments are constructed, the issue of provision of adequate parking is a major consideration. Bashundhara Shopping Centre is an example of a large new development that has provided a substantial amount of on-site parking as a means to attract and serve clientele who have access to an automobile.

3.16 PRICING

Pricing, the cost charged for something, is an important mechanism for payment and repayment of initial capital costs as well as on-going maintenance and operating costs. It is also an effective mechanism for regulating the use of a service or facility. Lower cost results in an item or service being more affordable by more people and therefore purchased and used more frequently. Higher cost results in an item or service being less affordable and therefore purchased and used less frequently. This basic concept is as equally true for such things as housing, food and appliances as it is for components of the transport sector. The cost to own and operate an automobile, the cost of bus and taxi services, the toll charge to use a bridge or expressway, the fee to park a vehicle, the charge to transport goods and materials are but a few examples.

While it sounds rather simple, reality has a way of making it a rather complex matter. In theory, the cost of something should be the true economic cost, including environmental costs and other externalities. Sometimes cost is distorted by the imposition of taxes, duties and fees collected as a means to support unrelated investments. Sometimes, cost is distorted by governments granting exclusive rights or franchises to individuals or businesses without proper controls, thereby creating an opportunity for excess profit or gross inefficiency. Other times, cost is distorted by government subsidization whereby monies from unrelated sources are used to offset a portion of the true cost. Some urban areas (for example Singapore and more recently London) use pricing effectively as a means to regulate the use of private automobiles in dense areas, by imposing a surcharge for access into a designated area. Surcharges on parking are another form of regulation on the use of private automobiles. European countries, for a long time, have imposed high taxes on vehicles and fuel in order to try and control and limit the growth in automobile usage in favor of public transit.

Collection of tolls for the use of major bridges and selective segments of roads is a form of pricing in use in Bangladesh. The two major bridges crossing the Buriganga River and Ashulia Road are examples of where tolls are collected in Dhaka.

The Roads and Highways Department, which is responsible for these bridges and roads, awards a lease (1 to 3 years long) through a competitive bidding process. The selected bidder pays the amount of the bid which is then deposited in the government treasury, and becomes part of the government's resources. The successful bidder is responsible for collection of the tolls. However, the amount of the toll charge is established by the government. Reportedly, there are some irregularities in the bidding process, wherein certain pressure is applied in a manner that discourages bidders from participating in the bidding process. This lack of transparency will kill off attempts in the STP to encourage participation by the private sector.

Import duties and related charges on new and used automobiles is another form of pricing used in Bangladesh to regulate the number and type of vehicles, as well as a means to raise revenue. Import duties and taxes on vehicles vary according to the size of the engine. The bigger the engine, the higher the rate of duty and taxes.

Exhibit 3-1 NMT Free Arterial Network

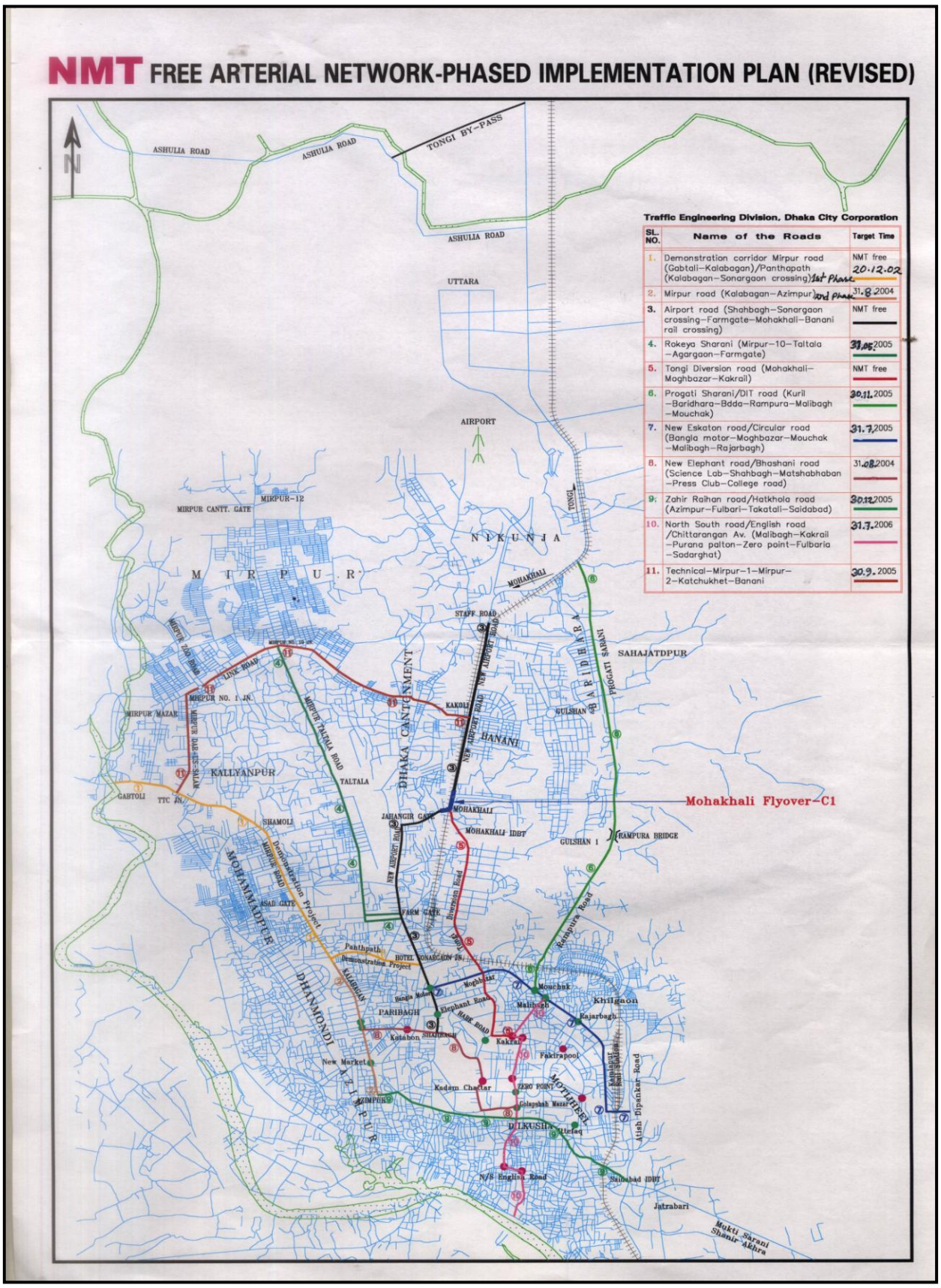


Exhibit 3-2 Bus Route Summary

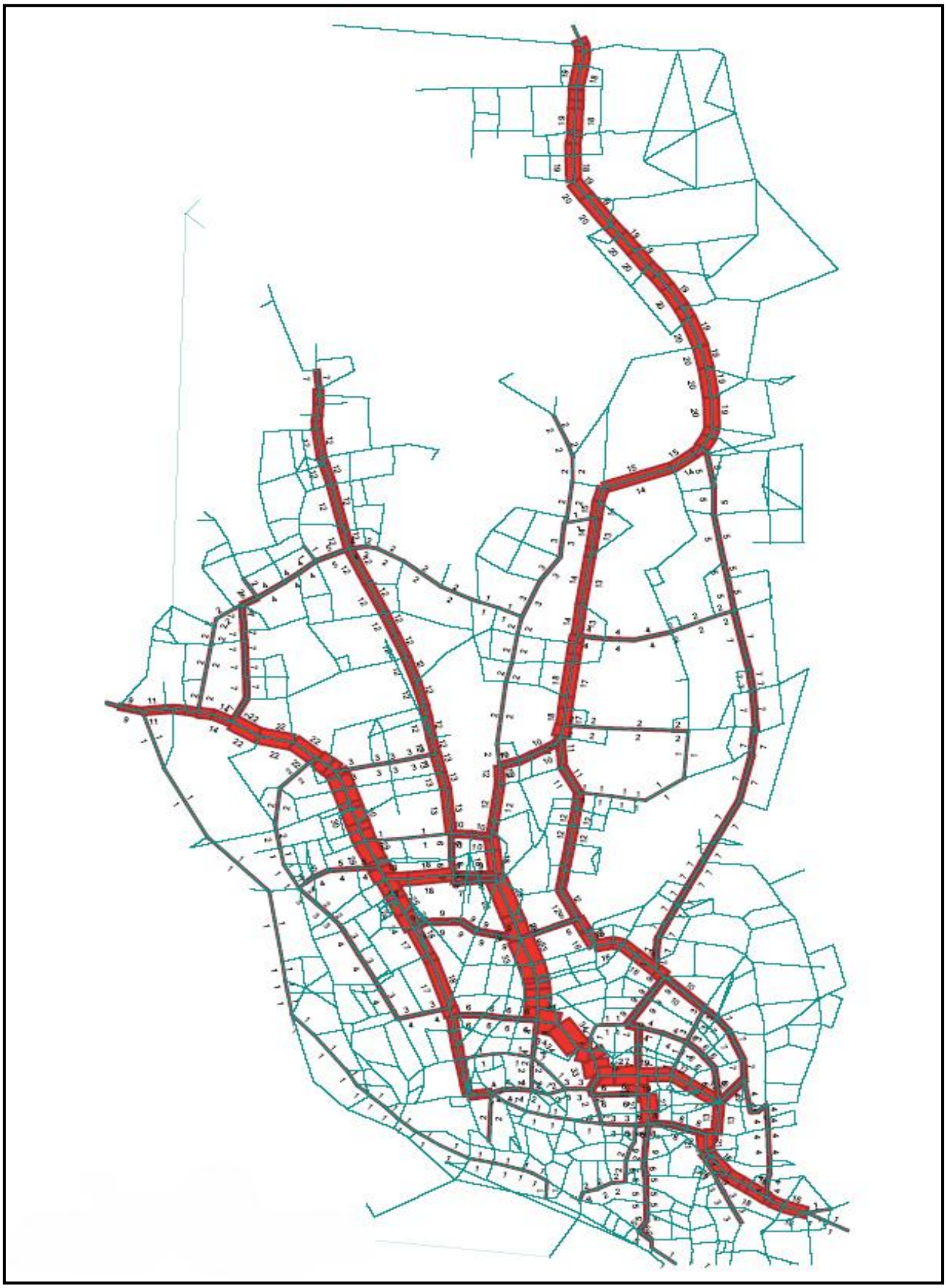


Exhibit 3-3 Terminals, Depots & Wait Areas

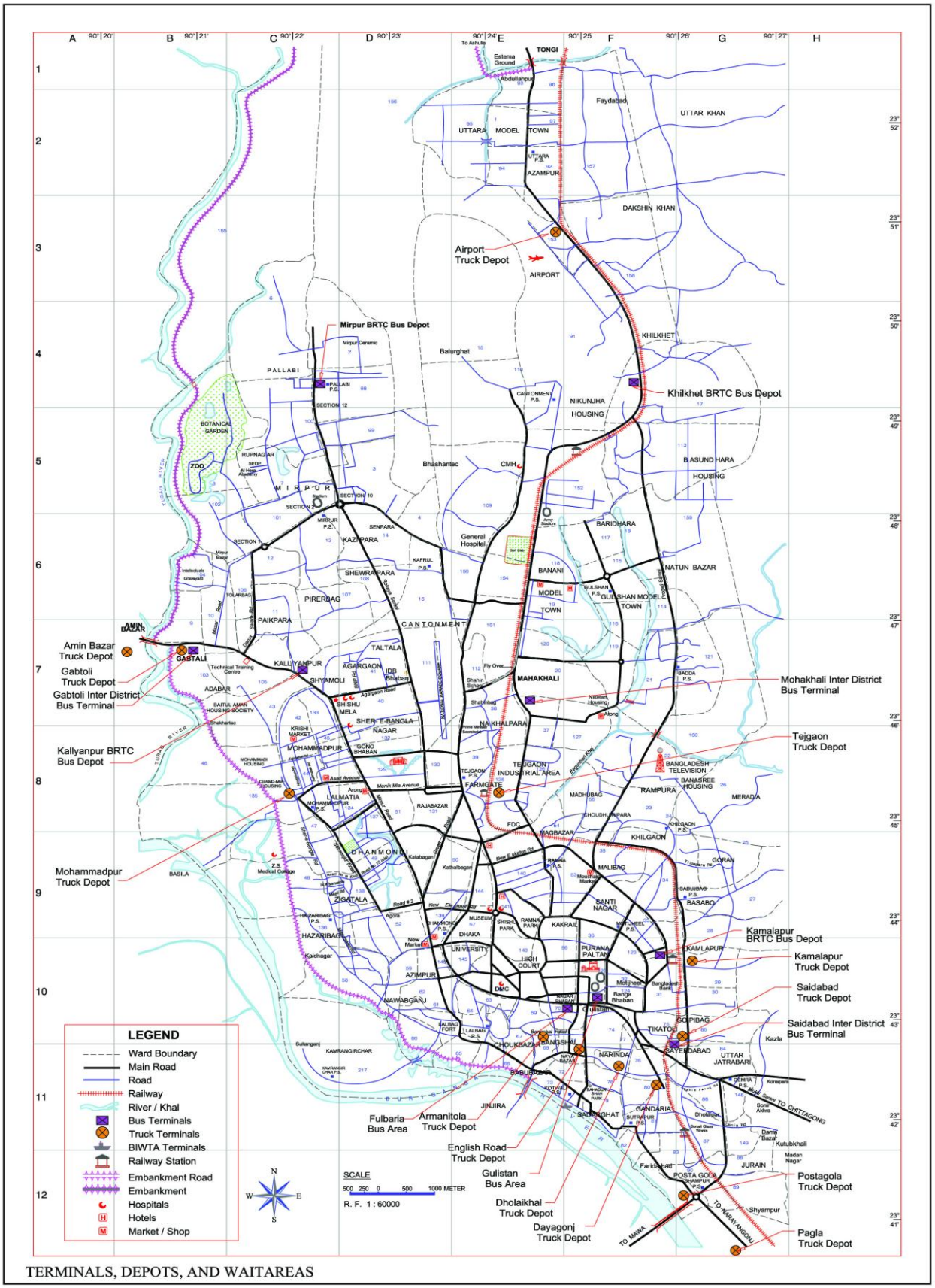


Exhibit 3-4 Circular Waterways System

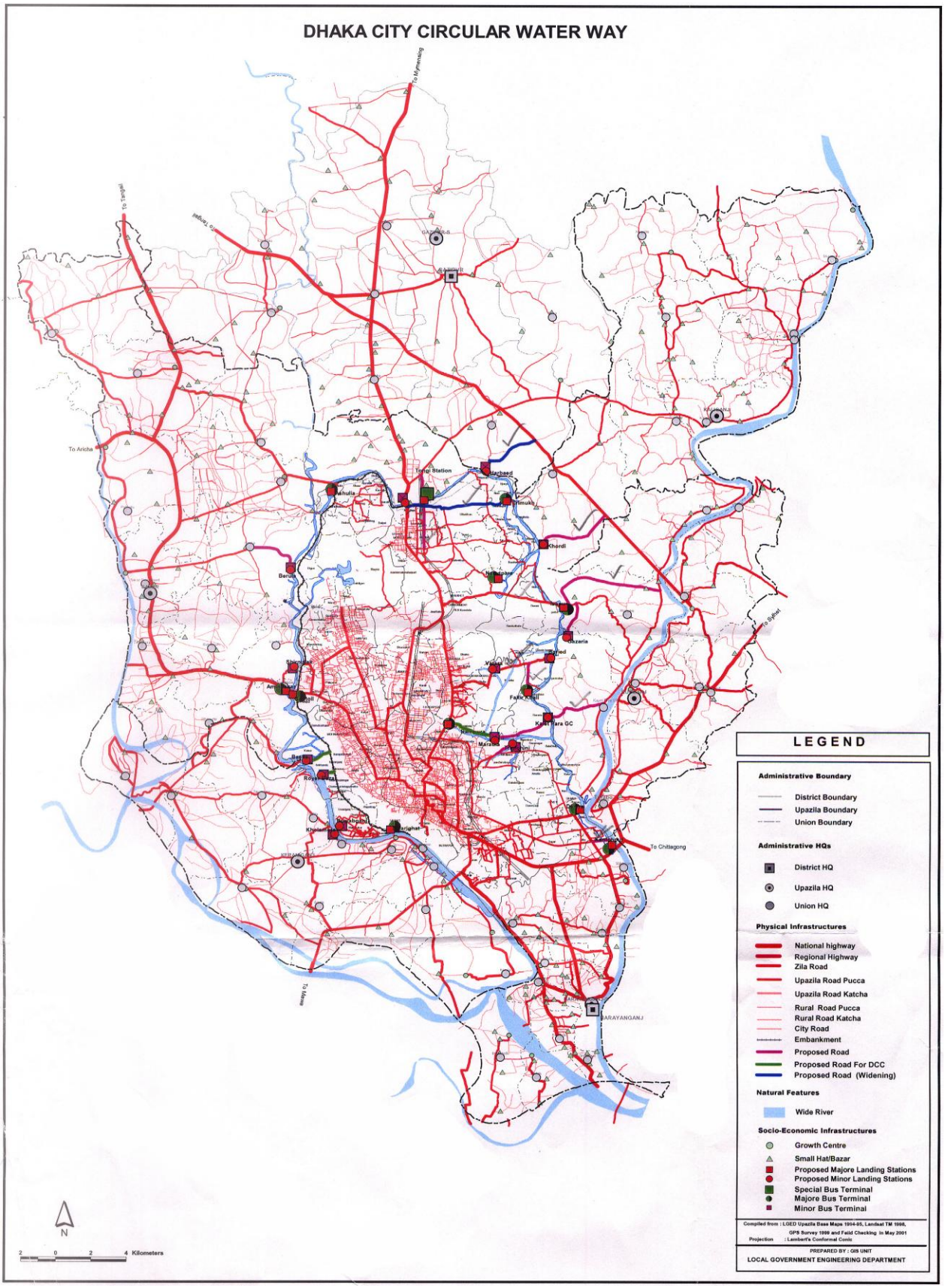
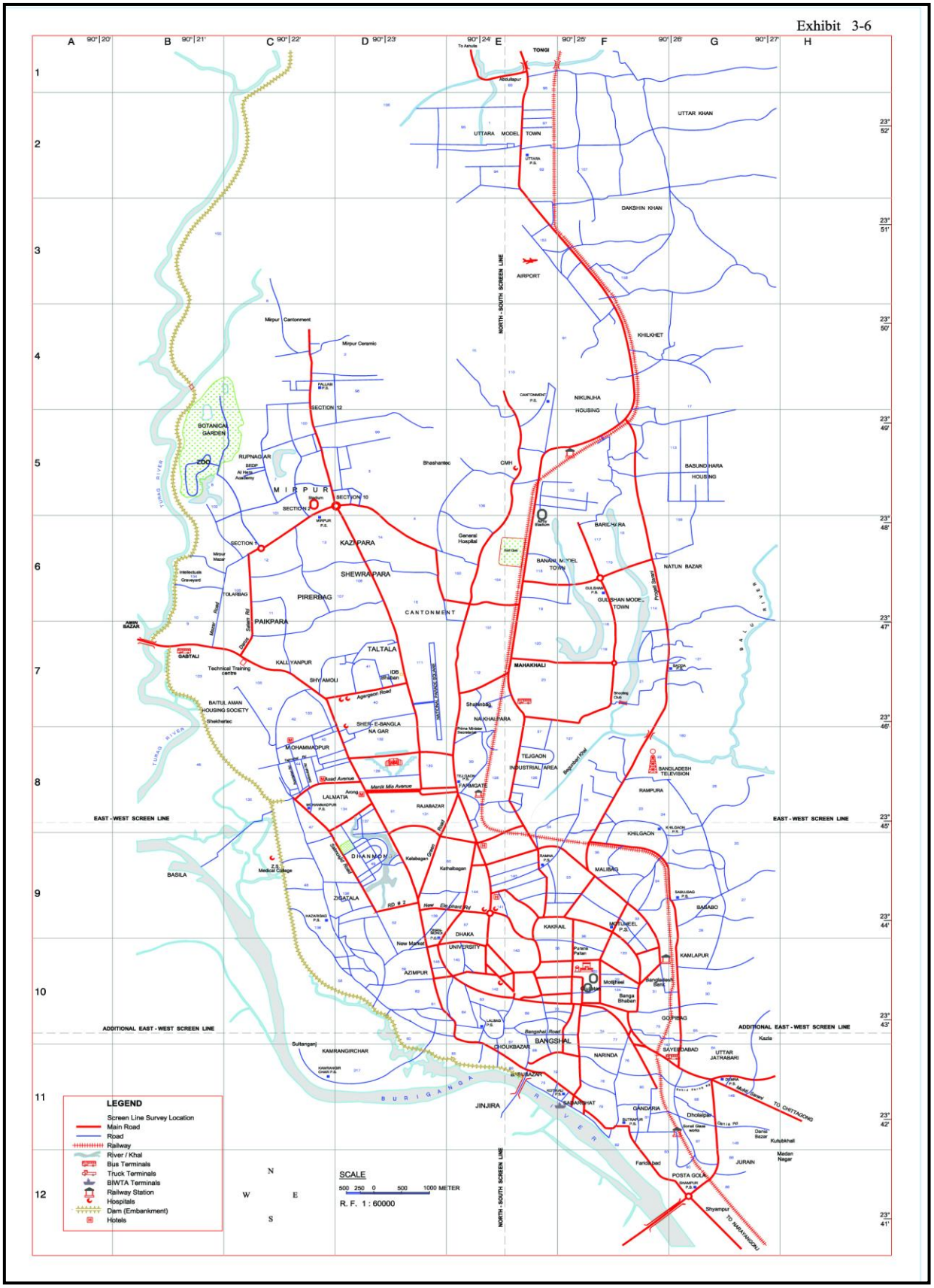


Exhibit 3-6 Dhaka Road Network



4. LAND USE SCENARIOS AND FORECASTS

4.1 FUTURE LAND USE SCENARIOS

4.1.1 Introduction

The primary purpose of the STP Study is to develop, test and evaluate alternative transportation strategies in order to select a preferred strategic plan that best serves the needs of the greater Dhaka area for the next 20 years. The process for doing this involves two fundamental variables – land use and transport. The analytical tool that is used to test and evaluate the overall consequences and inter-relationships between land use and transport is referred to as a Travel Demand Forecast Model. The model used for the STP Study is described in Chapter 5. The transport strategies are described in Chapter 7. The purpose of this specific section of the report is to describe the land use scenarios developed.

4.1.2 Determination of Land Use Inputs

The approach adopted for the determination of land use inputs for the STP Study was to proceed simultaneously along two tracks: a global track from the theoretical to the specific (a top-down track) and a Dhaka-specific (bottom-up) track from the detailed to the overall. The global track brought to bear theoretical urban planning concepts and experience based on those theoretical concepts. Moving toward the more concrete, the top-down track incorporated those factors having a bearing on Dhaka's current and future land use patterns over which it has little control such as the macro-economic framework and the demographic pressures to which it will be subjected. The bottom-up track is based upon detailed documentation of existing conditions. This has been followed by a documented review of historic and current land use plans and practices, including the Dhaka Metropolitan Development Plan, 1995-2015 (DMDP) and committed land use projects. The basic validity of the Plan has been assessed and confirmed and mid-plan modifications, necessary to bring it into alignment with current and projected circumstances, were incorporated.

The relevant spatial planning concepts, together with the macro-economic and demographic factors, were combined with the opportunities and constraints presented by the realities of Dhaka - its existing land uses and its topography, hydrological and other environmental circumstances. The resultant assessments of potential spatial development and population distribution patterns provided the basis for establishment of the Baseline Forecasts and three Land Use Scenarios based on different urban planning concepts.

4.1.3 Review of Current Land Use Plans & Practices

Any development of land use scenarios for Dhaka must emerge from what went before and what already exists. It is essential to build such scenarios on a foundation that includes an understanding of the history, planning and development practices of the city.

The nucleus of Dhaka (generally referred to as Old Dhaka) is located on the north bank of the Buriganga River. The general area has been the site of urban settlements from as early as the 4th Century B.C. Dhaka grew to prominence in the Mughal era when Islam Khan (1608-1613) was appointed the first Mughal Viceroy of Bengal. Under the rule of Ibrahim Khan the city attained great commercial importance and became a trading centre for South East Asia. European traders arrived in 1616. European settlers, largely Portuguese, Dutch, English and French traders, arrived in significant numbers in the late 17th century. Old Dhaka continues to be in part a product of its times with narrow passages best suited to pedestrian movement.

Dhaka declined in importance at the end of the Mughal rule and the inception of British dominance in 1765 while Calcutta grew in importance in the British administrative structure. Dhaka's fortunes reversed, however, in 1830 with the founding of the Dhaka Committee, the forerunner of what eventually became the Dhaka Investment Trust (DIT) and later the Dhaka Capital Development Authority known by the name RAJUK, an acronym of its Bengali name, *Rajdhani Unnayan Kartipakha.* During this period Dhaka's urban area increased to 14.5 square kilometres. Urbanization moved away from the waterfront and encroached northward towards the Pleistocene terrace high lands known today as Ramna, Paribagh and Shahbagh. The city was electrified in 1878. Piped water supply was first offered to the residences in 1874. The city was connected to Narayanganj by railways in 1885 and in 1886 the railways extended to Mymensingh. In July 1905, during the Governor Generalship of Lord Curzon, Bengal was partitioned and Dhaka was declared the provincial capital. The population at that time was less than 100,000 inhabitants. Its fortunes reversed once again, however, when the Partition of Bengal was annulled in 1911 and Dhaka once more lost its administrative role. As compensation, Dhaka University was established and occupied the former administrative buildings - Curzon Hall originally built as a government building and now used by Dhaka University being one of the most famous. Dhaka University remains one of the major and largest land uses in central Dhaka to this day.

The first formal plan for Dhaka is said to have been prepared in 1917 by Patrick Geddes, a much respected British Town Planner and proponent of what has become known as the Garden City Concept - a concept most evident in the romantic street patterns and gardens of the Ramna area. From that time until 1947, Dhaka City functioned primarily as a district headquarters, trade centre and university town.

Along with the partitioning of British India, Dhaka became the capital of East Pakistan on 14 August 1947 and faced the problem of housing increasing numbers of migrants from India. A Master Plan was prepared in 1960 by a British firm (Minoprio, Spencely and Macfarlane). It covered approximately 830 square kilometres (320 square miles). The population at the time the Plan was prepared is reported to have been approximately one million, with 0.5 million living in the core area, 0.1 million in Narayanganj, and the rest in the surrounding areas. Expansion of the city was largely predicted towards the north and northwest leading toward Tongi and Mirpur. The Plan suggested broad planning principles and zoned the urban area accordingly for various activities. The Master Plan was prepared with a 20-year (1960-1980) horizon. The ten-year population projection for the core area to 1970 was estimated as 1.5 million. This was an increase of 40% at a compound growth rate of 1.75% per annum. As it happened, the population of Dhaka stood at 1.6 million in 1974[1] indicating that the expectations of the planners and actual growth rates were in comparative alignment up to that time.

After Liberation in 1971, however, the annual growth rate increased to 10%. In spite of the rapid growth rate after 1971, the 1960 Master Plan continued to guide the development of Dhaka until the adoption of the Dhaka Metropolitan Development Plan in 1995 (see section 4.4). By 1980 the population had grown to approximately three million. Swamps and other wetlands of the city started to disappear as new areas of residential, administration, business and commercial importance developed. Slums and unplanned low-income residential areas and squatter housing grew. A strategic plan for Dhaka was prepared (but not adopted) in 1981 under the auspices of the Dhaka Metropolitan Area Integrated Urban Development Plan (DMA-IUDP). In spatial planning terms, its provisions were similar to the 1960 Master Plan with growth along the northern axis and the periphery.

In the early 1990s, the Government, with a view to democratizing the city corporation, declared that the Mayor and the Commissioners were to be elected by direct election on the basis of adult franchise. The City area was divided into 90 wards, each represented by one

[1] *Census of Bangladesh, 1974.*

Commissioner, elected directly, from each ward with 18 seats reserved exclusively for women Commissioners elected by the Mayor and other Commissioners. The Wards are overlaid by a network of thana boundaries with which they are coincident. Most (but not all) of the thanas contained in the DCC are wholly within the DCC (and referred to as municipal thanas). The exceptions are the thanas to the north and east of the city. By 1991 the city had an officially designed area of 360 square kilometres and the area now defined as within the RAJUK boundaries (an area of nearly 1,530 square kilometres) was estimated to have a population of 9.3 million.

4.2 DMDP: THE CURRENTLY PREVAILING PLAN

The Dhaka Metropolitan Development Plan (DMDP) (1995-2015) was prepared with joint funding from the government of Bangladesh, and the UNDP/UNCHS(HABITAT). It is the prevailing plan for the STP Study Area and, nominally at least, the context for public and private investment decisions. The study leading to the DMDP addressed urban planning issues at three geographic levels: sub-regional, urban and sub-urban, and covered the area now defined as the RAJUK Area. It is contained wholly within the Dhaka Division and contains portions of three districts:

- Dhaka,
- Narayanganj and
- Gazipur.

In addition to the DCC and all of the thanas contained partially or wholly within the DCC (of which there are 21), the RAJUK area includes all or portions of eight surrounding non-municipal thanas:

- Gazipur Sadar and Kaliganj Thanas in Gazipur District;
- Rupganj, Sonargaon, Bandar and Narayanganj Thanas in Narayanganj District;
- Keraniganj and Savar Thanas in Dhaka District.

It contains five municipalities (*Pourashavas*):

- Savar,
- Narayanganj,
- Kadamrasul (in Bandar Thana),
- Gazipur Sadar, and
- Tongi.[2]

It also contains the area known as Kamrangir Char (or Sultan Ganj) which is appended to the DCC and sometimes included in lists of DCC thanas, but which, according to the information obtained during this study and verified by the Census of Bangladesh, is not part of the DCC.

The DMDP was prepared by a consortium of international firms (Mott Mac Donald Ltd., & Culpin Planning. Ltd., in association with local firms, Engineering & Planning Consultants Ltd., Consociates Ltd., and Development Administration Group). It was published by Gazette notification in August 1997 to be used as the guideline for the development of the Dhaka City. The DMDP is not intended to present a single land use master plan describing plot based land use zoning. Rather it was intended to address long-term strategies and short-term implementation guidelines along with a set of policies and programs. At the time DMDP was prepared, the study boundaries did not conform precisely to RAJUK's boundaries. Likewise, neither conforms precisely to the boundaries established for the STP Study which are somewhat larger and conform with thana boundaries. In spite of whatever significance the boundary complexities may have administratively, for strategic transport planning purposes, the differences are not significant.

[2] *Tongi has recently been given status as a thana as well as a Pourashava.*

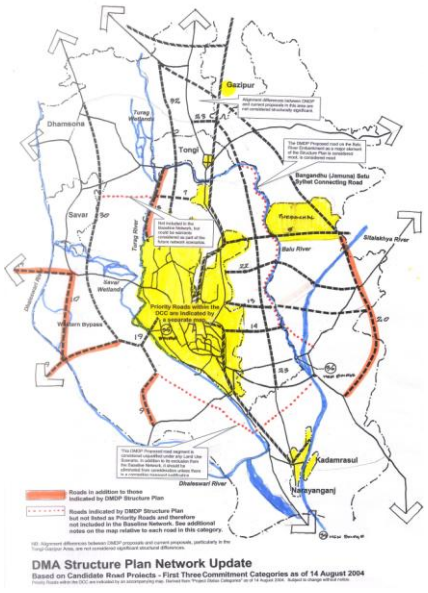
DMDP recommendations were structured to address planning issues on three levels in the form of three subsidiary plans as follows:

- Dhaka Structure Plan (DSP) was prepared to provide a long-term (20-year) strategy for development of Greater Dhaka. It projected a population of 15 million by 2015. DSP defines a broad set of policies to achieve he overall plan objectives. Its supporting documentation proposed actions for the preservation of high quality wetlands, agricultural lands and watercourses. It highlighted the need for ponds around the city limits for rain water retention and maintenance of an ecological balance and a healthy environment. DSP also called for the adoption of land use controls and building regulations that would make its storm water retention and other recommendations meaningful (see Section 4.3 below). The DSP called for plan reviews every five years. Regrettably, no formal plan review or revision has occurred since the publication of the Structure Plan. This is in spite of the fact that at least one of its major features (the Eastern Bypass) has been downgraded with profoundly different land use implications. Another major feature with structural implications has been added. Purbachal is a planned new town located in contradiction to the DMDP recommendations. Therefore, the STP Study has undertaken a review and prepared a draft revision of the Structure Plan for STP Study purposes.

- Urban Area Plans (1995-2005) (UAPs) were developed for the DCC and its major expansion areas, including the area to the east of the DCC, the DND Triangle and for the Tongi, Gazipur, Savar, and Dhamsona areas (see **Exhibit 4-1** alongside. The UAPs were intended to provide interim mid-term strategies for a 10 year period and were conceived as "nested" within the overall Structure Plan. Unfortunately, although the UAP for Dhaka covers a smaller area and is drawn at a larger scale, its level of specificity is no different from the Structure Plan.

- Detailed Area Plans (DAPs) were intended to be part of an on-going planning process as well as to provide more detailed planning proposals for specific sub-areas compliant with the Structure Plan and the Urban Area Plans. Plans were intended to be produced for 26 Strategic, Spatial Planning Zones (SPZ). A Draft DND Triangle DAP was prepared, but met with opposition and has been withdrawn.

Exhibit 4-1
Dhaka Urban Area Plan



4.3 DMDP RECOMMENDED STRATEGIES

Taken in its entirety, DMDP envisioned that most growth would occur in the following manner:

- Densification of the Already Urbanized Area. The preferred strategy included *"an acknowledgement of continued densification throughout the whole planned period in both the older established urban areas and in those developed since the 1980s*". Comparisons of the 1991 and 2001 Census data indicate that extensive densification has occurred in the existing urban area in virtually every ward. Unfortunately, the recommended infrastructure consolidation programs have not occurred in parallel.

- Infill Development. Infill development was foreseen particularly in the DND Triangle noted as the first priority for adoption of a Detailed Area Plan (DAP). A DAP for the area has been drafted, but has not met with approval. A comparison of the past (1984) and present (2004) existing land use maps confirms that a high degree of infill has occurred.

- Contiguous Expansion into the area between the DCC boundary and the Balu River. According to the plan this expansion was to be contained within an embankment providing the right-of-way for a limited access road known as the Eastern Bypass. Development in the Eastern Fringe was also predicated on the adoption of planning and land use controls that would ensure realization of the storm water retention recommendations. Neither the Eastern Bypass nor the recommended land use controls have been realized.

- Accelerated Contiguous Growth in the Eastern Fringe, DND Triangle, the Western Fringe and the Airport Area. The Study determined that Dhaka's normal growth pattern has been to provide infrastructure services (including roads and other transport services) after demand has been realized. The study concluded that doing so prevented the development of the land in reaching its full capacity. In addition to the priority afforded to the DND Triangle, the Eastern Fringe and the Airport area were noted as the largest, most important and least accessible of the expansion areas. As noted above, the embankment and Eastern Bypass were perceived as the major elements of infrastructure needed to open the Eastern Fringe to rational development in a controlled manner. The Eastern Bypass along the embankment, which DMDP viewed as the key strategy to development of the Eastern Fringe, has been downgraded in favour the Dhaka Bypass now under construction several kilometres to the east. There is considerable merit in that decision, but at the same time providing access for rational development of the Eastern Fringe remains an issue.

- Satellite Communities. The DMDP foresaw eventual, more intensive, new community development in Tongi, Gazipur and the Savar/Dhamsona Areas as major growth and population absorption centres. The Tongi/Gazipur and Savar/Dhamsona areas have been developed as Export Processing Zones (EPZs) under the auspices of BEPZA. However, coordinated community development to accommodate the concentrations of workers and logically organize traffic patterns has not occurred. In addition to not addressing rapid growth where it is occurring, the public sector is encouraging new community development in a manner diametrically opposed to the DMDP recommendations.

- Retention Ponds in the DCC Fringe. Both the Structure Plan and the UAP for Dhaka indicate retention ponds in the Eastern and Western Fringe areas. Realization of the retention ponds assumed that requirements would be incorporated in land sub-division and land use controls. That has not come to pass. Much, perhaps most, of the development in the fringe areas has been and will continue to be a result of informal land development activities that undergo no formal review or permitting procedures.

4.4 STP STUDY'S MID-PLAN REVIEW OF THE DMDP

The STP Study is required by its Terms of Reference to "*develop a coherent long-term Strategic Transport Plan….with special emphasis on integrating the planned land-use for the future growth of the city mentioned in the Dhaka Metropolitan Development Plan (1995-2015) with transport issues in the Dhaka Metropolitan Area (DMA) over the next 20-year planning horizon*…". Given this mandate, it is important to:

- Understand DMDP intentions and the integration of its land uses with transport issues;
- Make an independent assessment of the validity of its recommended strategies;

- Assess the degree to which growth in the years since its adoption has occurred relative to its recommendations; and
- Suggest what revisions may be necessary to reflect intervening events and prepare for the DMA's future to 2024, the planning horizon for the STP Study.

A review of the existing land uses and the prevailing plan for the DMA indicates that:

a. Population absorption is generally occurring in the locations foreseen by DMA Structure Plan.

b. Purbachal will be a major exception to this generality.

c. Although growth is generally occurring where proposed, it is not occurring in the manner recommended. Generally speaking, and with the notable exception of the RAJUK-proposed Purbachal New Town, growth in the years since the development of the Structure Plan is occurring in the recommended locations.

d. Immediate action is necessary in the following two critical areas:

- Reservations of Critical ROWs. One of DMDP's major and largely unrealized strategies was the early development of infrastructure to enable early population absorption capacity. The DMDP recommended building infrastructure services early to support high densities as opposed to allowing land to develop initially at low densities and become dense later. Provision of a basic level of transport access to newly developing areas and the reservations of ROWs for future upgrading are not insurmountable obstacles and reservations for the major proposed roads is strongly recommended.

- Creation of retention ponds in the Eastern and Western Fringe Areas. Storm water retention provisions were recommended by the Structure Plan. The Structure Plan did not recommend the acquisition and development of the retention ponds by the government. Instead it recommended that these be provided by land use development controls. These actions are highly recommended. The STP Consultants have concluded, however, that adoption of sub-division regulations to control large scale, formal sector development activities by itself is a necessary but ultimately insufficient step in addressing the drainage problems inherent in the fringe areas. Sound development of fringe areas in these circumstances make it essential for the public sector to create retention ponds in these areas.

e. The DMA population is growing faster than foreseen in the DMDP. Interpolating the DMDP projections to obtain its projected 2004 population [11.4m] and adjusting the STP Study estimate of the Base Year (2004) population figures for the same year [14.1m] shows a population figure roughly 25% greater than that anticipated by DMDP.

f. Appropriate modifications of the Structure Plan are necessary to reflect the reality of the Dhaka Bypass and the addition of Purbachal.

4.5 UPDATE OF DMDP FOR STP STUDY PURPOSES

A formal update and projection of the DMDP Structure Plan to 2024 requires extensive consultations with stakeholders and incorporation of their views. The following, therefore, presents only the assessment of the Consultant's findings.

a. Major DMDP land use recommendations remain valid. Given that DMDP is now at the ten-year mark, formal updating of the DMDP is highly recommended. Doing so formally with the appropriate amount of interaction with the agencies and stakeholders involved is beyond the scope of the STP Study but some updating assumptions are necessary.

b. Structural changes in the Projected Road Network. Given that the original concept for the Eastern Bypass has been changed the DMDP strategy of using it as an organizational device for land use development in the Eastern Fringe is significantly altered. Consultations have been undertaken to compile a list of long-term candidate road projects. These are unofficial candidate projects and not commitments to include these roads in future plans. Additional roads not foreseen as candidates by respondents, but determined advisable for strategic reasons have also be identified. Nonetheless, for the purposes of constructing scenarios for the future, the road network of the candidate roads suggests changes to the existing Dhaka Structure Plan as shown in **Exhibit 4-2 and Exhibit 4-3**.

4.6 ASSUMPTIONS FOR LAND USE SCENARIOS AND FORECASTS

Land use is only one aspect of developing land use scenarios. The scenarios need to be grounded in reality and not simply flights of fancy or dreams. They need to based upon a reasonable assessment of what could be. Certain conditions that will have an impact on the future land use and transport seem reasonably predictable and provide the basis for the land use scenarios put forward later. They include the following assumptions:

a. Poverty will continue to be a major determinant of Dhaka's land use pattern. By all estimates, the economy of Bangladesh must grow at a rate between 7% and 8% a year to achieve a rough balance between the number of jobs and the number of people entering the work force. Last year the economy of Bangladesh grew at a rate of 5.2% and was better than most of the preceding years. It is assumed for STP Study purposes that the growth rates will continue in the 5% to 6% range. Some segments of the population will benefit greatly. But the fact remains that many will not. The land use/transport situation this implies will remain a major planning determinant.

b. A large percentage of the population will walk, cycle or use some other form of low-cost transport for most trips. The poverty situation is such that the percentage of people who walk or use short-range low cost transport to their places of employment is likely to remain high. This implies continued mixed land use developments rather than segregated land uses and dormitory communities.

c. Land use patterns in which much of the population lives and works in a relatively small radius will continue. This land use pattern is likely to remain a dominant characteristic of Dhaka for the foreseeable future. Dhaka is likely to spawn more of these nodes, but most people, except for the affluent, will tend to live and work in the same node.

d. Increasingly higher densities will occur. The change in many of Dhaka's neighbourhoods from bucolic garden settings to a much more dense and frenetic land use pattern is widely noted and reported upon by the local press. It is the Consultant's view that the city's rate of growth, combined with pedestrian movement as a significant mode of transport, a severe shortage of flood-free buildable land on which to expand and market forces make increasing densities a virtual certainty.

e. In-fill and redevelopment densification within the existing DCC will continue and absorb much of the population increase particularly in the first ten years of the STP Study period. The densities of some parts of the city are such that they may be reaching the point of saturation in the absence of major clearance and redevelopment programs. Many parts of the city, however, are extremely vulnerable to redevelopment at higher densities - including both its high-income and lower-income areas.

f. The western part of the DCC will see large scale development and high levels of population absorption. Developments like Japan Garden City in Ward 43 are likely to become increasingly common. Within the next 20 years, proposals for relocation of leather and tanneries in Hazaribag are likely to be realized. New embankments will support large scale development in these areas in the near-term.

g. Purbachal will be developed. The likelihood of Purbachal's development is an acknowledgement of the seemingly inevitable, not an endorsement. Purbachal will establish a growth pattern in the north-eastern part of the DMA that by 2024 will be relatively low density suburban and will render aspects of DMDP moot.

h. The central Dhaka railroad right-of-way may be released for alternative transport development sometime before 2014. Relocation of the existing railway and release of the rail ROW is deemed to be a possibility. In the event that it is relocated, it is assumed that goods transport by rail will be achieved either via a new rail ROW east of the city - or all goods and long distance passenger rail services will terminate in a new rail facility located to the north of the city on the Jamuna-Chittagong line, perhaps at Tongi.

i. Pressures will build for the relocation of the land-consumptive uses. Such uses include Tejgaon Airport and low-density military uses in the heart of the city. The results of this increasing pressure are highly unpredictable and treated as a variable in the scenarios which follow.

j. The Eastern Fringe will be developed. High rise, up-scale development is already underway in these areas in spite of their lack of suitable road access and severe flooding. Given the population pressure to which the city is subjected, growth into this area within the next 20 years is assumed. Whether it occurs in a planned or uncontrolled way is a variable. If it is planned it will develop in a compact form. If it is uncontrolled, much of the development will probably be initially low density and will eventually change to higher densities as population pressures continue to mount.

k. Strategic proposals emanating from the STP Study are **unlikely** to have any significant impact on regional land uses until 2014 or later. Re-directing the growth of Dhaka will take a long time before the effects are realized. It does not negate the fact that many recommendations may be forthcoming that will have significant micro-level near-term impacts on current traffic patterns. Given the lead time necessary for long-term strategic improvements, plus the time necessary to realize those improvements, significant impacts on overall land use patterns are likely to be long-term.

l. The road network illustrated by **Exhibit 4-3** is assumed to represent the updated DMDP Structure Plan as an input to the STP Study planning process. STP Study findings and recommendations may completely alter this perception. The updated Structure Plan network is an input not an outcome. It provides the initial framework for the construction of scenarios which follow.

4.7 THE BASELINE FORECAST

The Baseline Forecast is a projection of the future situation, which assumes:

- The basic economic assumptions from STP.
- A Study Area population as projected for the STP Study.
- That public goals and policies remain relatively consistent and in accordance with Government policy statements.
- A continuation of all current land use control stipulations and levels of enforcement.
- A relatively unimpeded real estate market able to respond to market demands.
- No significant incentive or disincentive programs to influence market responses to real estate demands.

Unlike the Scenario Forecasts which follow, the Baseline Forecasts assumes:

- The continued absence of a regional planning agency responsible for long-term structure planning (incorporating but not limited to both land use and transport).

- Major land uses such as the existing airport and the military Cantonment Area in the northern part of the city remain in place.
- A road-based transit system operating within public rights-or-way remains the basis of the public transport system (i.e., no significant expansions of rail, dedicated bus rights-of-ways or similar strategies are adopted).

Based on the Baseline Forecast assumptions, the development pattern likely to emerge in the DMA within the STP Study 20-year planning horizon implies:

- Contiguous Urban Growth Many cities, particularly ones with regulatory environments as lax as Dhaka's, grow in a contiguous fashion (i.e., the incremental development of the city in the "*path of least resistance*"). This form of growth is not necessarily undesirable. It can be undesirable, however, if the growth occurs in areas with inherent problems.

- Densification - Some cities grow continuously outward horizontally. Others redevelop in various ways - filling in previous open space, converting structures to more dense land uses, tearing down low density structures and redeveloping at higher densities that absorb growth within the same basic "*footprint*". In Old Dhaka buildings which once housed a single household, now hold several times that number and the replacement of traditional buildings with much taller buildings is becoming evident. In Banani, the previous pattern of low-rise single family houses is increasing being supplanted by taller multi-family structures.

4.8 THE ROLE OF ALTERNATIVE LAND USE SCENARIOS

Different Land Use Scenarios have been developed within the context provided by the update of DMDP for STP study purposes. The Alternative Scenarios are spatial variations illustrating the way in which the overall strategies of the Structure Plan could be met. They imply different shifts in population distributions, and will lead to transport infrastructure needs.

Methodologically, the approach adopted, was to project future land uses first on the basis of current trends (assuming "business as usual" and incorporating committed projects and agreed-upon factors such as gradually declining population growth rates, for example). The alternative land uses were then subsequently projected on the basis of alternative assumptions in a "reiterative" fashion - i.e., a non-linear process in which alternative land use patterns and the transport strategies necessary to support them are tested in tandem.

Three Land Use Scenarios, developed within the context of the updated Structure Plan were prepared. The conceptual basis is presented for each Scenario, together with a discussion of its applicability to the DMA. It should be particularly noted that all Scenarios presuppose the creation of a structure planning agency [later introduced and referred to as "The Unitary Authority"] with responsibility for the structural elements of urban development, including transport and land use.

4.8.1 Land Use Scenario 1: Urban Corridor - Strong Central Spine Scenario

Conceptual Basis

Many cities have been developed pursuant to what are referred to as Urban Corridor planning principles. These principles have provided the basis for plans of the regions surrounding many of the world's major cities including, most notably, Chicago, Paris, Copenhagen, Stockholm and Washington. These corridor planning principles strive to:

a. Organize and concentrate future development along strong transportation spines. Such spines generally radiate from existing urban settlements. When possible the approach links major conurbations so that the corridor development relates to both.

b. Confine urbanization to the corridors defined by the spines. Doing so leads to efficient settlement since it facilitates movements of goods and people, infrastructure provisions and efficient land uses, including intensification of agricultural land uses in the "wedge areas" between the corridors.

c. Develop symbiotic relationships between urban and rural environments. In these relationships urbanization in the corridors serves and is closely related to the economy of rural areas through which the corridors pass. Wedge areas, for example, can be devoted to growing fruits and vegetables and can provide sites for dairy farms whose products are supplied to the adjacent urban markets. Intensive cropping can be concentrated near urban nodal points within the corridors, with agro-based industrial uses providing the interface between the two.

d. Maximize the return on investments within the corridors. The concept of maximizing the return on investments applies not only to road and rail investments, but also to other infrastructure and development investments (both public and private) that tend to occur in conjunction with them. Future urban development does not occur in a vacuum or on a "clean page".

e. Accept and mold the natural trend for development to occur along corridors. This implies that planners and governments must take the steps necessary to ensure that development occurs in a planned and coordinated way, making the most efficient use of development pressures rather than attempting to counter them.

Application to the DMA

Dhaka's growth may be viewed as a form of urban corridor development dictated by the circumstances and realities of its site. Dhaka's growth has been constrained to the southwest, east and west by flooding and most of its growth has occurred within a corridor along the northern axis from the historic origins of the city northward toward Gazipur and beyond.

Adopting the Urban Corridor Approach yields a scenario referred to as the Strong Central Spine Scenario in which the strong north-south axial characteristics of Dhaka are recognized and used as a spatial organizational device for the future growth and absorption of population in the Study Area. Within the scenario the dominance of Dhaka's central axis is reinforced by the opportunities resulting from exploitation of the existing rail ROW through the heart of the city.

The application of Urban Corridor Planning Principles to Dhaka leads to what is referred to as Strong Central Spine Scenario as illustrated in **Exhibit 4-4** located at the end of this chapter.

4.8.2 Land Use Scenario 2: Growth Pole-Satellite Community Scenario

A. Conceptual Basis

The growth pole development approach is one which has seen many applications throughout the world in both advanced and developing economies. Its origins are generally traced to Perroux, a French economist who, borrowing from earlier theories of innovations, identified the idea of sets of industries capable of generating dynamic growth. Such industries were seen by Perroux as strongly related to each other via input-output relationships around a leading or propulsive industry. The ready made garment (RMG) industries in and around Dhaka are often discussed in exactly these terms.

The major principles of the strategy as it has evolved in current planning practice may be summarized as follows:

a. Geographic Clustering - i.e., the assembly of economic and social activities in concentrated areas.

b. Agglomeration Economies - i.e., economies realized through the clustering of activities as a result of greater interactions, more efficient infrastructure provisions, shared use of facilities and technologies, etc.

c. Emphasis on Input-Output Relationships - i.e., "forward and backward linkages" between industries and other economic activities. These linkages are, in part, responsible for the benefits of clustering. Those sectors of the economy that give the greatest "spin-off" or "propulsion" effect are the most effective in achieving the benefits of the growth pole approach.

d. Concern for Growth Pole/Hinterland or "Spread" and "Backwash" Effects. Much of the theoretical literature concerns itself with descriptions and attempts to quantify relationships between growth poles and their surrounding hinterlands and to derive mathematical relationships of urban hierarchies. "Backwash" or "polarization" is a measure of how strong the pull of the city becomes versus the "spread" or "hinterland" effects which measure how economic benefits radiate to the surrounding areas and secondary cities. Notable differences exist between those factors in advanced economies (like Europe) and a developing country (such as Bangladesh).

e. A Concentration in One or A Few Places. The philosophy of concentrating on one or a few places is based on the perception that resources are always finite and it is therefore best to concentrate investments where they can be most effective.

f. A Bias toward Urban Areas. This bias is based on the assertion that economic and social development advances most rapidly in relatively large urban places (due to agglomeration) and spreads across these places to the surrounding regions. The Growth Pole Approach does not ignore agricultural development. Agricultural development is often considered an important part of overall development in the application of the theory. Nonetheless, the principles of the Growth Pole Approach are distinctly urban in emphasis.

g. Long-Term Planning Horizons. Within the Growth Pole approach to socio-economic development there is the perception that the likelihood of establishing relatively self-sustaining economies and the "spin-off" and "spread" effects that go with them may require a decade or more before success of the approach can be judged.

h. Inter-Regional Balance. In most countries, certain areas lend themselves more readily to economic development than others. The Growth Pole Approach is often adopted to designate certain locations in less developed regions for investment attention on the assumption that their achievement of self-sustaining economic development will eventually benefit the entire region, putting them on a par with the more favoured areas. The use of growth poles as "counter-magnets" to primate city development is a common application of the principle.

i. Preferential Treatment to Certain Areas. Affording some areas preferential treatment is believed to lead to greater economic efficiency, greater overall wealth and, therefore, greater economic benefit for all in the long run. In practice this might mean that it is better to capitalize on the sunk investment in declining areas like Narayanganj than to treat all areas equally.

j. Self-sustainable rather than dormitory communities. Dormitory communities are not growth pole communities. Communities built on the growth pole concept are relatively self-contained communities.

Application to the DMA

The Growth Pole Approach is one that can profitably be applied to planning and investment decisions at the national level - the balance of investments between Dhaka and Chittagong, for example. For the purposes of the STP Study, however, the principles are applied at the regional level within the bounds of the Study Area. Application of the principles also presupposes that larger settlements outside Dhaka proper are desirable and that arguments of economies of scale, agglomeration economics, etc., are moot. The approach taken is to determine those settlements within the next highest potential to achieve efficiency, and agglomeration economies.

By definition, the application limits the number of potential growth pole candidates and gives greater weight to efficiency and potentials than to a more balanced territorial distribution of economic and social benefits. This provides as sharp a distinction as possible between this approach and that of Dispersed Settlements (Scenario 3 below). The application also provides an opportunity to address depressed areas such as Narayanganj which have significant locational advantages, but which are currently in decline due to obsolete facilities.

To a degree, the DMA has poorly recognized growth pole developments in the form of the Export Processing Zones located in Savar/Dhamsona and Tongi/Gazipur. Given the findings of the macro-economic assessment that export-oriented industries and foreign direct investment (FDI) will be the "engine" of the DMA future development they could become the nuclei of well conceived communities employing the strengths of both the public and private sectors.

The application of Growth Pole Theory to Dhaka leads to the what is referred to as the Regional Growth Centres Scenario, as illustrated in **Exhibit 4-5** placed at the end of this Chapter.

4.8.3 Land Use Scenario 3: Dispersed Settlement Development Scenario

Conceptual Basis

The Dispersed Settlements Development Concept is generally based on "central place theory" which postulates that the size of a settlement is a function of the size of the hinterland it serves and of its hierarchical relationship to other settlements. Dispersal is taken to mean a greater number of smaller settlements rather than a few large ones and distinct settlements rather than undifferentiated, sprawled, contiguous urbanization. The notions of agglomeration economies and economies of scale are discounted in favour of greater equity in all areas. Its theoretical underpinnings as a planning approach draw from sources as diverse as Frank Lloyd Wright's "Broadacre City", the "Agropolitan Approach" espoused by John Friedman and many others.

Its emphasis is much more territorial than the other approaches. It makes a conscious attempt to deal with issues of equality, fairness and balance, together with other planning considerations, in terms of places, rather than abstract economic principles. Major principles of the approach include:

a. Emphasis on meeting basic needs in all areas equally. This includes job creation, vocational training, provision of equipment, supporting services, housing, social services and facilities in all areas.

b. Emphasis on balance. This includes balance among regions and sub-regions, between urban and rural settlements and between agricultural and industrial sectors.

c. Encouragement of self-reliance at all levels. This includes self-reliance at the national, regional and local levels, even if it implies some loss of economic efficiency and implies some degree of "territorial closure" - meaning, for example, a policy that a given area will strive to supply its own building materials from local resources even if they cannot be produced locally as cheaply as importing them from outside the area. It does so on the premise that it leads to more balanced development in the long run and achieves social goals beyond purely economic considerations. This contrasts quite markedly with the ideologies of free trade, comparative advantage and regional specialization. It is the antithesis of the globalization concept.

d. Maximum diversification of the territorial economy. The approach is based on the perception that diversification fosters a high degree of self-reliance and promotes greater adaptability to changing circumstances. This aspect of the approach avoids problems associated with market changes suffered by areas specializing in particular products.

e. Emphasis on domestic markets and linkages that lessen centrality and excessive concentrations. Some analysts have concluded for instances that if the countryside is endowed with basic infrastructure and if an internal communications and transport network were built up to connect districts and regions with each other, large cities will lose their overwhelming advantage.

f. Dispersal of industry as opposed to concentrations for the sake of agglomeration economies. The principles of the approach include less emphasis on large-scale urban concentrations, less differentiation in urban hierarchical relationships, less of a distinction between urban and rural lifestyles.

g. Emphasis on networking. This emphasis includes "honeycombing" the area with a fine mesh of infrastructure and communications networks to supply all portions of a given region with electrical energy, radio and telephone communications, regular water supply, drainage and transport. A cellular, spider web pattern of development is considered to be preferable to one which reinforces centrality.

h. A dense secondary road network. Dispersed settlement development is by definition poly-nucleated development and generally implies a relatively dense network of road connections between outlying communities. Compared with the road patterns indicated by highly dominate primate cities where all roads lead to the centre in a radial fashion, the networked communities concept has very different implications for road investments. Priority is given to roads (or other transport connections like rapid transit) between outlying communities rather than the urban centre. The pattern is intended to encourage development of the outlying communities rather than continuous intensification of the urban core - and to encourage specializations and land use developments within the outlying communities so that one does not have to travel to the urban centre for all high level services.

Application to the DMA

The Dhaka Metropolitan Area has relatively little networking of any kind among its smaller communities. Virtually all roads lead to Dhaka. A trip from Banani to Mirpur, for example, requires travelling towards the centre along one urban radial, connecting to another radial and travelling out. Such patterns have the effect of constantly reinforcing the dominance of the urban centre rather than encouraging a more balanced growth pattern.

A dense network of roads linking secondary communities and seriously lessening the dominance of Dhaka may be overly ambitious. The Dhaka Bypass currently under construction, however, may offer opportunities for the development of agro industries and investments to encourage the emergence of strong, but more balanced, satellite developments and community specializations.

The application of Dispersed Settlement Development to Dhaka leads to the what is referred to as the DMA Dispersed Settlements Scenario, as illustrated in **Exhibit 4-6** placed at the end of this chapter.

4.9 THE POSSIBILITY OF A GREENBELT WITHIN THE SCENARIOS

The possibility of incorporating a "greenbelt" (a ring of land in which development is restricted, generally in an effort to contain the growth of a city) has been suggested. To a degree, the wetland areas provide a natural green buffer to the east, south and west of the city. A greenbelt could be conceived to encircle the city and incorporated in one or all of the scenarios and the preferred scenario once it is selected. As has been the case in most previous applications of the concept, it is unlikely to contain the growth of Dhaka. It could, however, provide needed open space and park land at the same time as preserving wetlands, and provide greater definition to the perceived limits of the city.

4.10 SCENARIOS SUMMARY

Most large cities, including Dhaka, have areas that incorporate all of these concepts to some degree. Old Dhaka, for example, is clearly an area of intensely centralized development with a strong urban core. The Ramna-Motijheel area emerged as an adjacent development in the form of a romantic garden city with curving streets and large open areas. Growth thereafter involved the development of nodes like the Tejgaon Industrial Area, Banani, Gulshan and other developments along a strong north-south axis, basically a form of urban corridor developed along the infrastructure services provided by the railroad and the area's main north-south roadways. Other nodes of development include the airport, Uttara and development continues along the corridor in Tongi and Gazipur.

All of these land use concepts also have transport implications. Nodal development along urban corridors often implies a rail-based transport system in which the most intensive development occurs at stations (nodes) spaced relatively far apart. Dispersed urban corridor development implies a road-based system used by either private transport or public transit systems that provide the same level of service along the length of the corridor.

In considering the future land use scenarios, therefore, it is important to be mindful of the fact that, particularly at the level of strategic transport planning, land use and transport are best conceived as two sides of the same coin. Old Dhaka developed as it did because of the dominant transport system at the time of its development. Garden city land use configurations such as the Ramna area are an import, but one made possible by changing modes of transport. Outlying communities are viable because of their transport connections. Land uses change in response to accessibility. The STP Study methodology and travel demand forecast model, therefore, has been developed in such a way as to incorporate the inter-relatedness of land use and transport and thus yield an integrated transport plan.

4.11 FUTURE POPULATION AND EMPLOYMENT DISTRIBUTION

A necessary and important precursor to the testing and evaluation of various transport strategies with respect to the three land use scenarios, is the representation of the three land use scenarios in terms of distribution patters of future population and employment.

4.11.1 Population

Section 2.3 describes the process of establishing control totals for the future population of the study area. The next step in the process is to distribute the future population throughout the study area in a manner that suitably represents the distinct concepts entailed in the land use scenarios while at the same time maintaining the overall population control totals for the study area.

The study area was divided into over two hundred (200) analysis zones. These were established for the travel demand model and are generally referred to as Traffic Analysis Zones (TAZ). A unique population distribution among the analysis zones was established for each land use scenario. The distribution of the population among the analysis zones was accomplished in an iterative manner. Each land use scenario was first graphically superimposed over the analysis zones and initial population numbers were thereafter assigned to each analysis zone, in accordance with the unique development pattern of each land use scenario. The initial population distribution among the analysis zones was then reviewed and adjustments were made to improve the intent of each land use scenario. After repeated iterations, a suitable distribution of population among the analysis zones was established for each land use scenario.

The following exhibits provide visual and tabular representations of the distribution of population for each of the three land use scenarios.

a. **Exhibit 4-7**: provides an illustration of the distribution of population for a number of sub-areas within the study area.
b. **Exhibit 4-8**: provides the population numbers for the sub-areas of the study area, as well as the share that each sub-area has of the total population for the study area.
c. **Exhibit 4-9**: provides an illustration of the distribution of population for the DCC plus the area generally referred to as the Eastern Fringe Area.
d. **Exhibit 4-10**: provides the population numbers for each Thana within the DCC. The population numbers of the Thana along the eastern boundary of the DCC include the population numbers for the Eastern Fringe Area.

4.11.2 Employment

Employment figures are used in the travel demand forecast model to determine the number of trips that are attracted to a given area (TAZ). The number of jobs by type (e.g. primary, secondary and tertiary economic sectors) and the number of students enrolled in educational institutions (by level of education) are primary data used for this purpose.

For the present study, employment data for each analysis zone was not available from any source. However, information was collected on major employment centres such as the Export Processing Zones and any other major concentrations of employment. In addition, enrolment in educational institutions was also available. Using this information, the employment for each analysis zone was determined as a function of the population with a weighted increment assigned to areas with known concentrations of jobs, and consistent with the distinct concepts entailed in each of the three land use scenarios.

The employment distribution among the analysis zones was accomplished in an iterative manner similar to the population distribution. The initial employment distribution among the analysis zones was reviewed and adjusted in conjunction with population adjustments, as well as the distinct employment related characteristics reflected in the land use scenarios. After repeated iterations, a suitable distribution of employment among the analysis zones was established for each land use scenario.

4.12 FINANCIAL RESOURCES

Planning is a process of developing a course of action based upon:

(i) an understanding of needs and options,
(ii) consideration of opportunities and constraints, and
(iii) evaluation of options and tradeoffs in order to determine an appropriate balance that best serves the established objectives.

Consideration of the costs and benefits associated with the implementation of any plan component is part of such a process. In addition, an assessment and understanding of future financial resource availability is an important parameter in developing a realistic plan. One useful benchmark for establishing an understanding of the level of financial resources that might reasonably be expected to be available in the future, is an assessment of what financial resources have been spent in the recent past years. While future expenditures may not necessarily be constrained to levels reflected in recent years, it does provide a valid and useful reference point.

Financial resources for transport purposes in Dhaka fall into three general budget categories: (1) Development (new projects); (2) Revenue (maintenance); and (3) Emergency. For the purpose of this study, the Development category is of primary interest.

The Annual Development Program (ADP), approved by the Government, is a compilation of all financial resources for all transport-related development projects and was judged to be the best available source for the information. Each fiscal year, an Annual Development Program is approved, showing the approved budget for the current fiscal year, as well as an estimate of expenditures for the previous year. These funding levels include all relevant donor agency funds, whether shown separately (i.e. DUTP) or combined with local funding. They do not include private investment projects.

From the ADP, the approved budget and estimated expenditure amounts for all agencies involved in transport related development were tabulated for (a) all of Bangladesh and (b) for the Dhaka area, for the following fiscal years:

- Fiscal Year 1999/00 Expenditures only
- Fiscal Year 2000/01 Budget and Expenditures
- Fiscal Year 2001/02 Budget and Expenditures
- Fiscal Year 2002/03 Budget and Expenditures
- Fiscal Year 2003/04 Budget and Expenditures
- Fiscal Year 2004/05 Budget only

The following exhibits provide the information and analysis of the budget and expenditure figures derived from the Annual Development Programs.

a. **Exhibit 4-11** provides a tabulation for each fiscal year showing the budget and expenditure amounts for various agencies involved in transport related development in the Dhaka area.

b. **Exhibits 4-12** and **4-13** provide a summary of total budget and expenditure amounts for each fiscal year and the average over a five year period and a four year period.

While figures such as these can be interpreted in any one of several ways, the following conclusions are relevant to this current study.

a. There are some 25 agencies that receive and spend money on transport related projects in Bangladesh, and some 14 agencies within the Dhaka area only.

b. The Dhaka area share is about 10% to 11% of the total amount spent on transport related projects in all of Bangladesh.

c. The amount budgeted for transport related development over the last five years is about Tk 500 crore per year (USD 86 million). The amount actually expended is about 10% less.

d. If only the most recent four fiscal years are considered, the amount that has been budgeted for transport related development increases to about Tk 550 crore per year (USD 93 million).

e. Since the four year period reflects a more consistent pattern, it is judged to be more suitable for use as a benchmark.

Based upon the preceding information and analysis, a sum of Tk 600 crore per year (USD 100 million) is a suitable representation of what financial resources would be available in the future, if budget and expenditure levels similar to the past four years continues.

Amounts greater than Tk 600 crore per year (USD 100 million) would require additional funding from one or more potential sources including:

(a) new or expanded sources of local funding;
(b) an increase in the Dhaka share of the total for Bangladesh;
(c) a redistribution of funds from other sectors to the transport sector;
(d) new sources of donor funding;
(e) higher levels of existing donor funding; and
(f) private investment in transport projects.

Exhibit 4-2 DMDP/DITS Road Network Vis-à-vis Current Candidate Road Projects

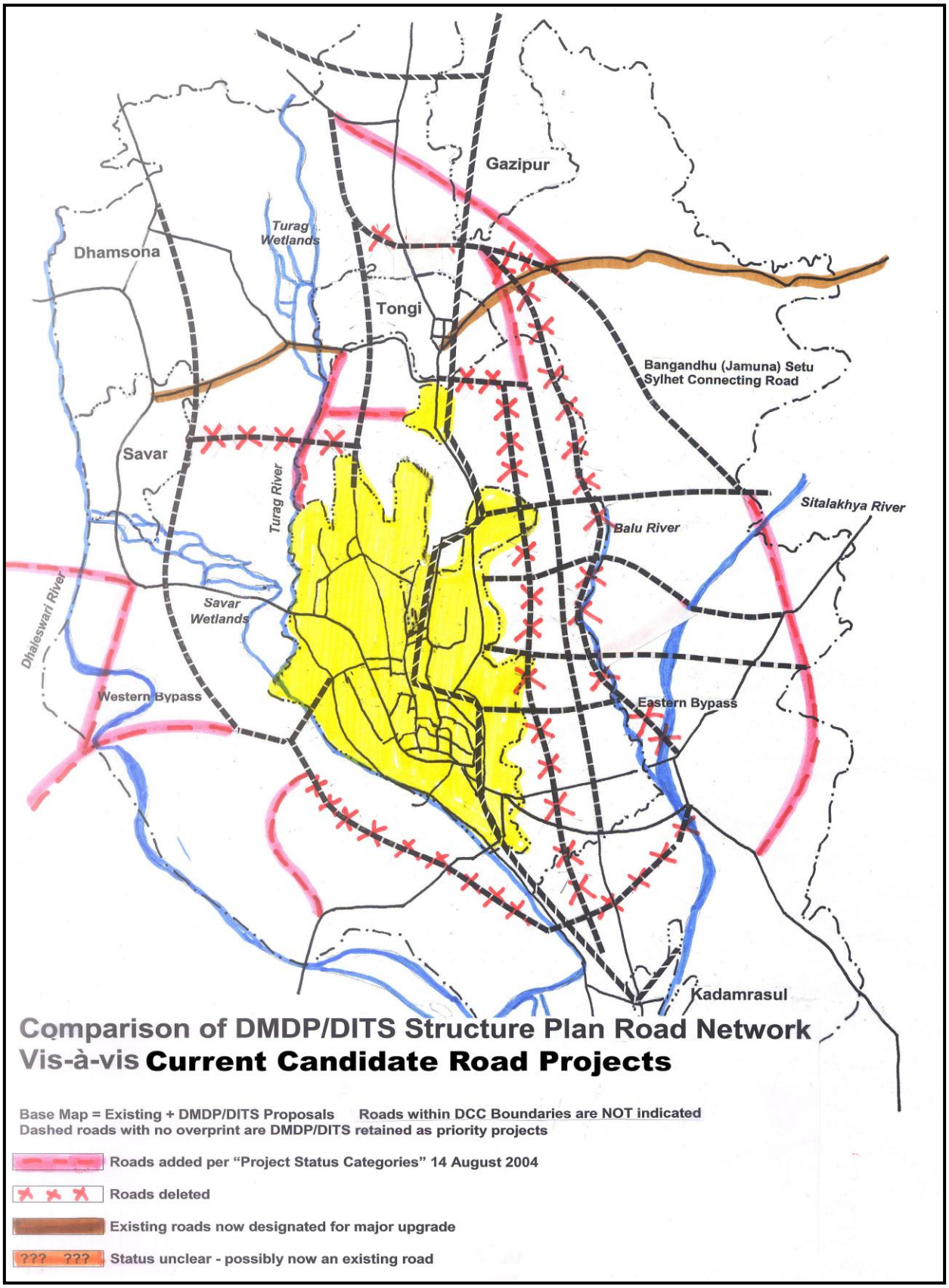


Exhibit 4-3 DMA Structure Plan Road Network Update for STP Study Purposes

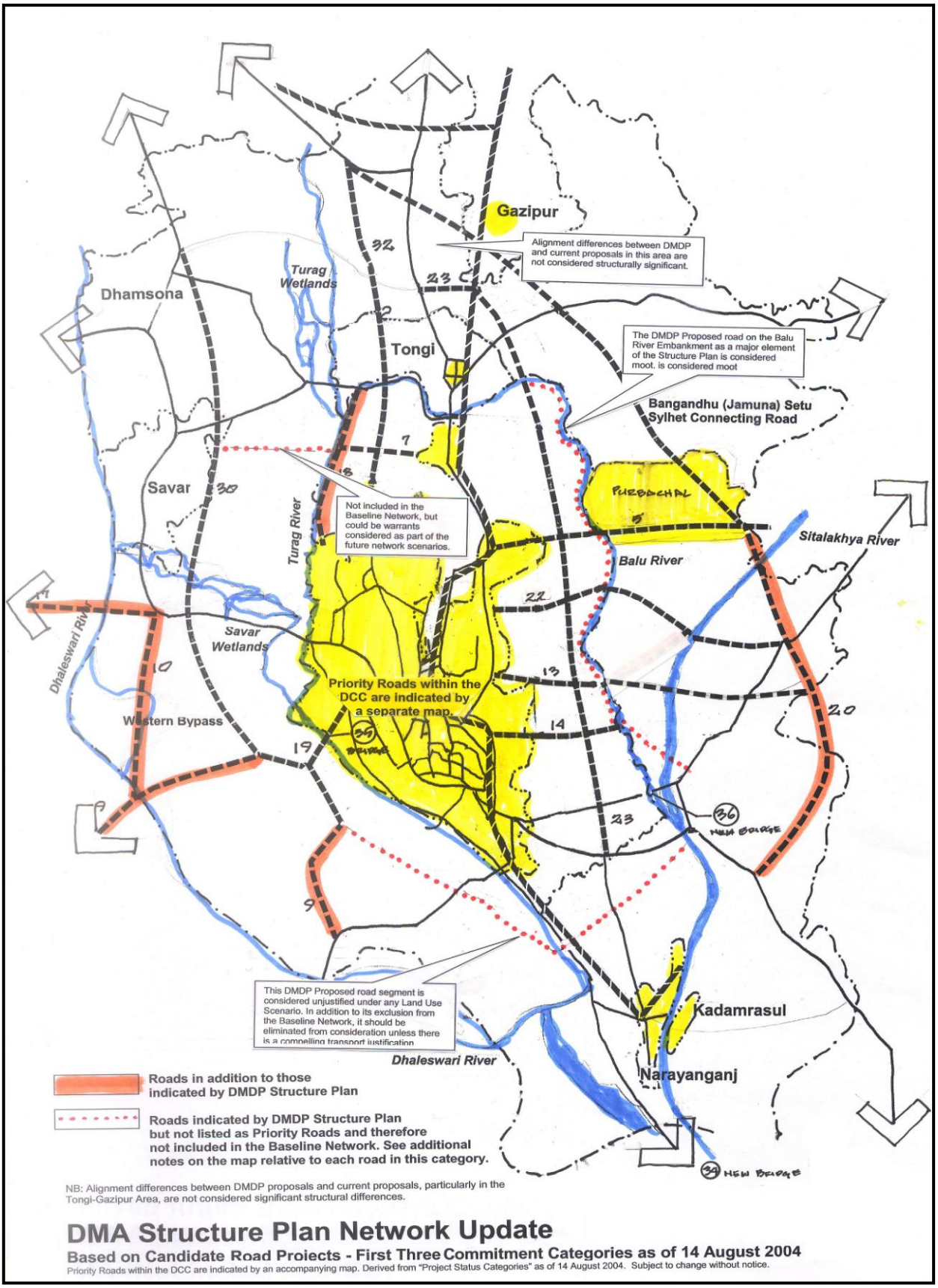


Exhibit 4-4 Strong Central Spine Scenario (Land Use Scenario 1)

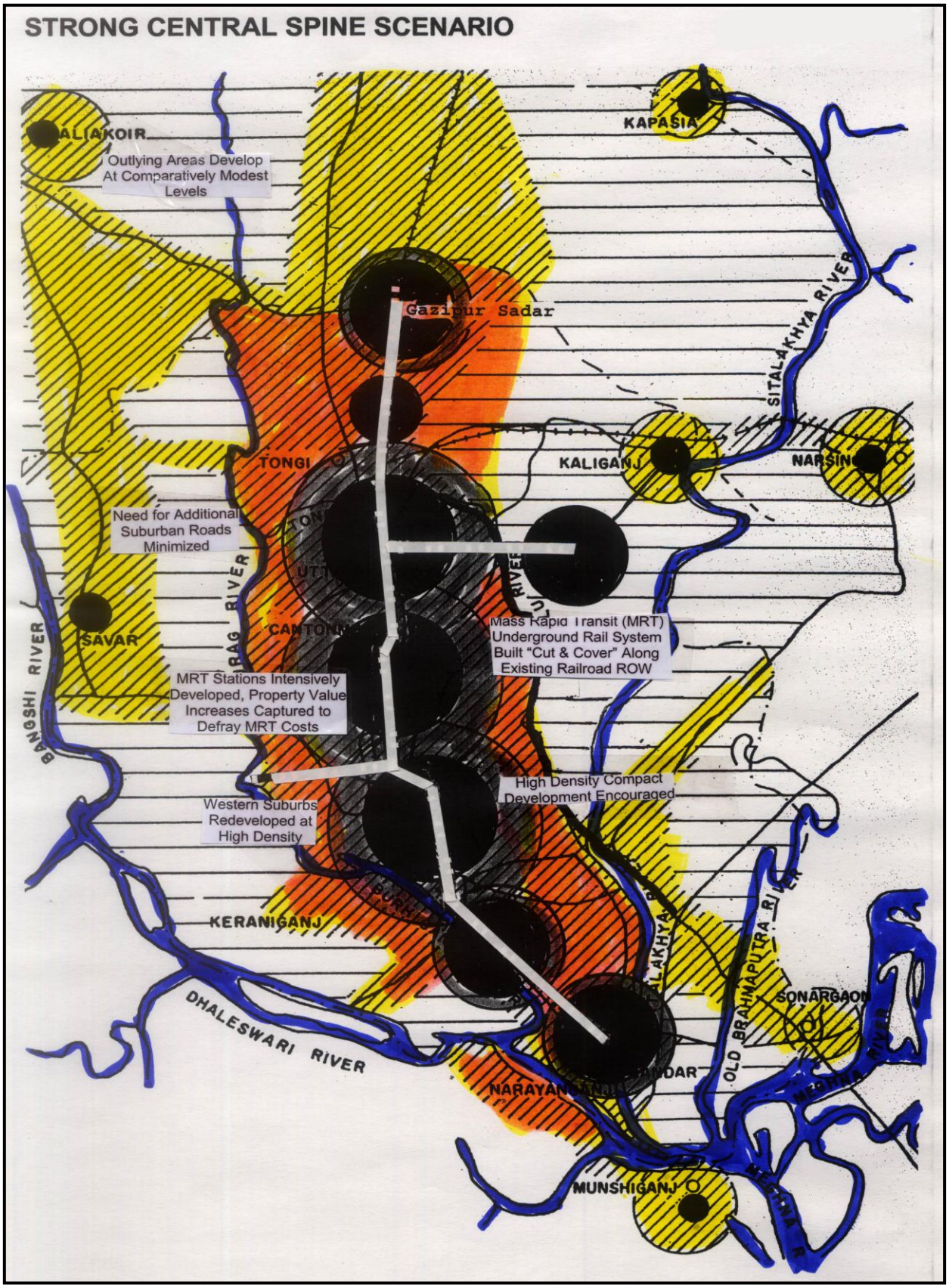


Exhibit 4-5 Growth Pole/Satellite Community Scenario (Land Use Scenario 2)

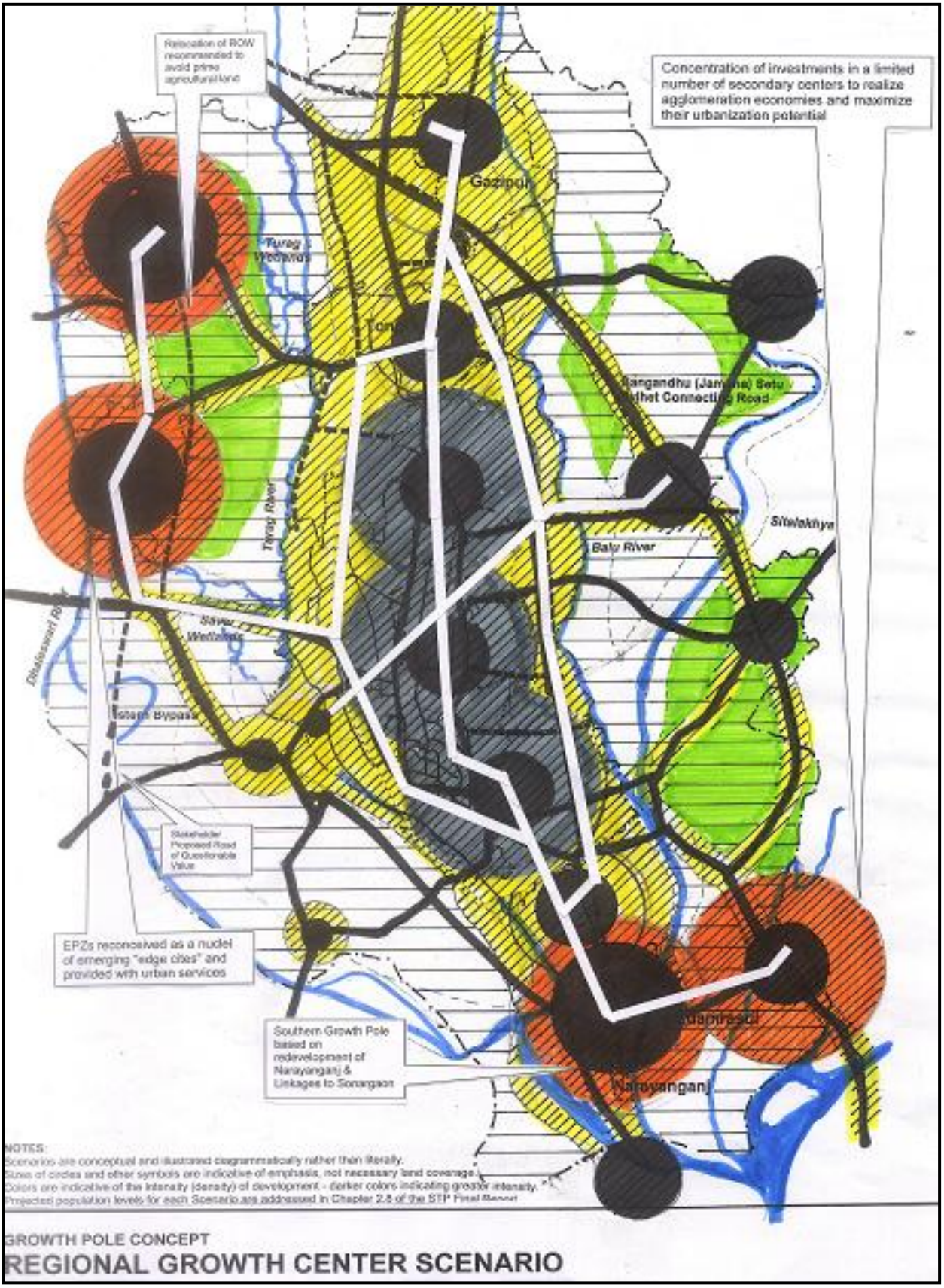


Exhibit 4-6 Dispersed Settlements Scenario (Land Use Scenario 3)

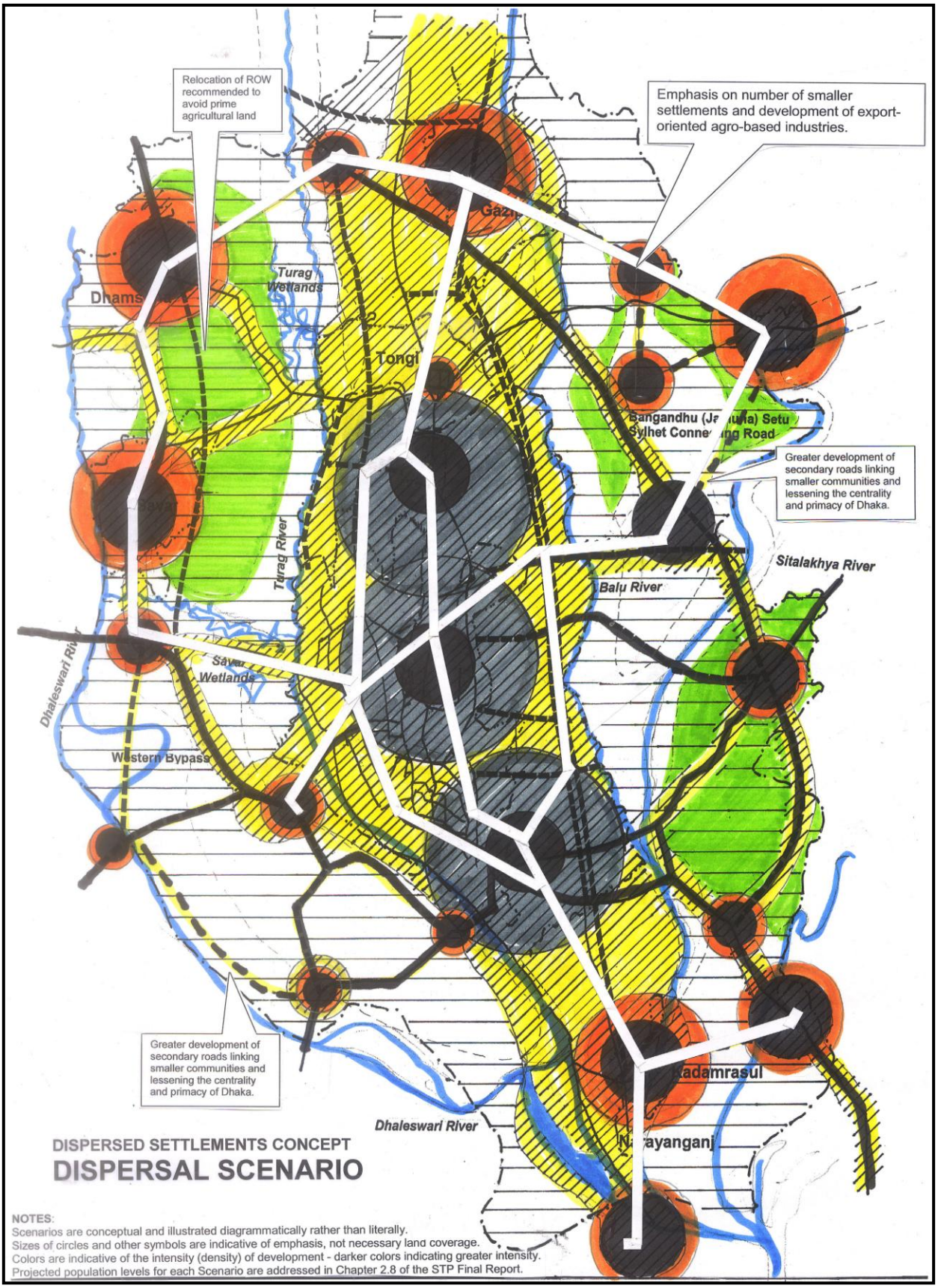


Exhibit 4-7 Population Distribution for Study Area Sub-Areas

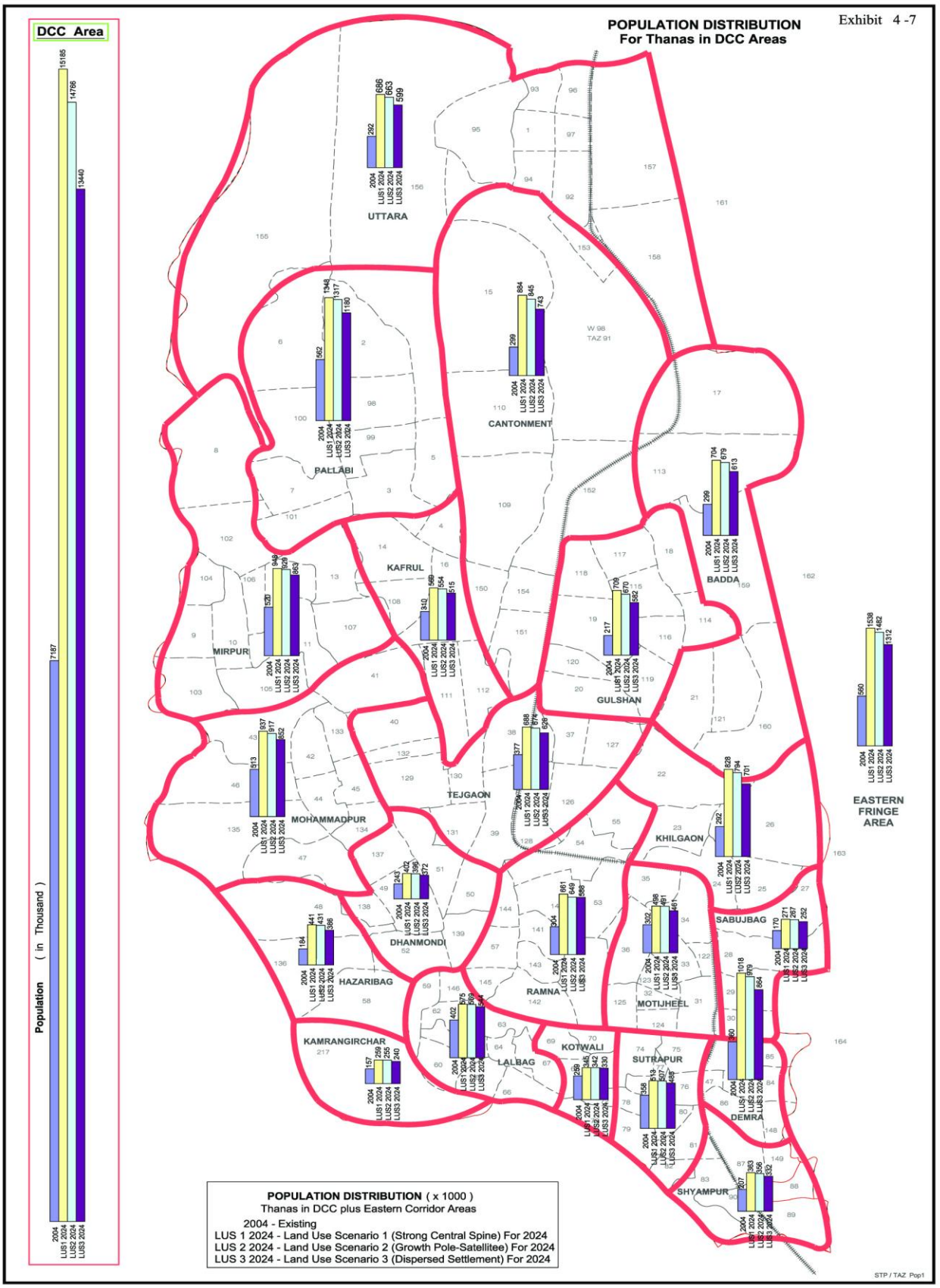


Exhibit 4-8 Population Distribution Among Study Areas Sub-Areas

AREAS & SUB - AREAS		2004	2014 LUS 1	2014 LUS 2	2014 LUS 3	2024 LUS 1	2024 LUS 2	2024 LUS 3
Area of GDA/DCC+	**A**	**7.19**	**10.56**	**10.49**	**9.95**	**15.19**	**14.76**	**13.44**
DMA West	**B**	0.66	1.22	1.38	1.22	2.19	2.77	2.19
DMA North	**C**	0.79	1.55	1.37	1.48	1.44	1.29	1.38
DMA East	**D**	0.83	1.28	1.41	1.36	1.71	2.01	1.89
DMA Southeast	**E**	1.59	2.38	2.37	2.24	3.74	3.63	3.26
DMA Southwest	**F**	0.66	0.89	0.89	0.85	1.33	1.30	1.19
Inner Area (Sub-Total)		**11.72**	**17.89**	**17.91**	**17.11**	**25.60**	**25.75**	**23.36**
OSA West	**G**	1.74	2.07	2.06	2.02	2.46	2.43	2.33
OSA North	**H**	0.94	1.02	1.01	1.02	1.03	1.03	1.03
OSA East	**I**	2.40	3.05	3.04	3.96	3.93	3.86	6.51
OSA South	**J**	2.40	2.38	2.37	2.30	2.97	2.92	2.77
Outer Area (Total)		**19.19**	**26.40**	**26.40**	**26.40**	**36.00**	**36.00**	**36.00**

POPULATION PERCENTAGE DISTRIBUTION

AREAS & SUB - AREAS		2004	2014 LUS 1	2014 LUS 2	2014 LUS 3	2024 LUS 1	2024 LUS 2	2024 LUS 3
Area of GDA/DCC+	**A**	**37%**	**40%**	**40%**	**38%**	**42%**	**41%**	**37%**
DMA West	**B**	3%	5%	5%	5%	6%	8%	6%
DMA North	**C**	4%	6%	5%	6%	4%	4%	4%
DMA East	**D**	4%	5%	5%	5%	5%	6%	5%
DMA Southeast	**E**	8%	9%	9%	8%	10%	10%	9%
DMA Southwest	**F**	3%	3%	3%	3%	4%	4%	3%
Inner Area (Sub-Total)		**61%**	**68%**	**68%**	**65%**	**71%**	**72%**	**65%**
OSA West	**G**	9%	8%	8%	8%	7%	7%	6%
OSA North	**H**	5%	4%	4%	4%	3%	3%	3%
OSA East	**I**	12%	12%	12%	15%	11%	11%	18%
OSA South	**J**	12%	9%	9%	9%	8%	8%	8%
Outer Area (Total)		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Exhibit 4-9 Population Distribution for Thanas in DCC Area

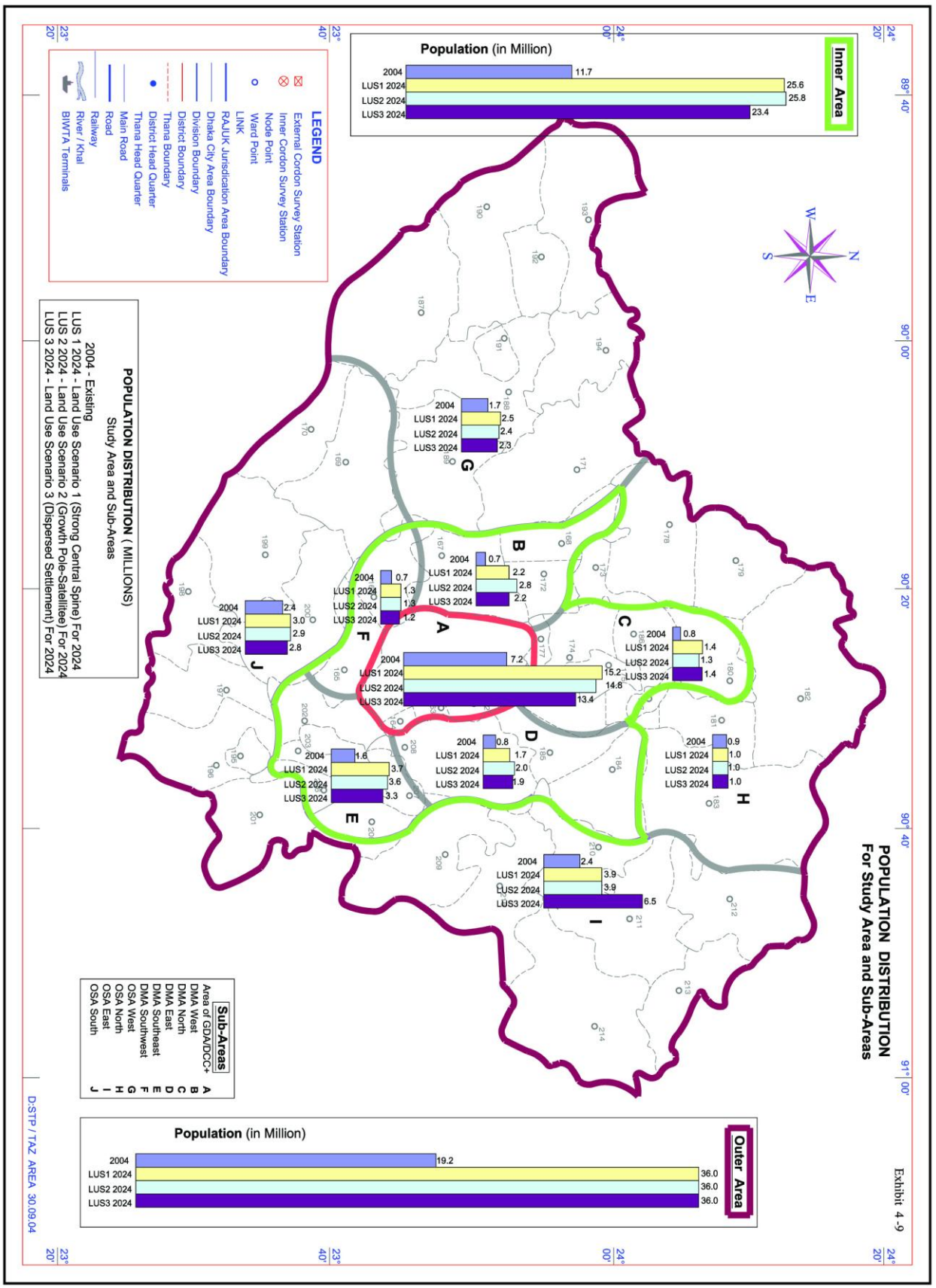


Exhibit 4-10 Population Distribution at Thana Level in DCC

	POPULATION ESTIMATE AND FORECAST						
THANA	2004	2014 LUS 1	2014 LUS 2	2014 LUS 3	2024 LUS 1	2024 LUS 2	2024 LUS 3
Uttara	292,000	429,000	425,000	404,000	686,000	663,000	599,000
Pallabi	562,000	998,000	992,000	918,000	1,348,000	1,317,000	1,180,000
Kafrul	310,000	423,000	418,000	401,000	569,000	554,000	515,000
Mirpur	520,000	702,000	700,000	671,000	948,000	929,000	863,000
Cantonment	299,000	491,000	483,000	453,000	884,000	845,000	743,000
Badda	299,000	441,000	435,000	413,000	704,000	679,000	613,000
Gulshan	217,000	396,000	383,000	355,000	709,000	670,000	582,000
Khilgaon	292,000	470,000	465,000	436,000	828,000	794,000	701,000
Sabujbag	170,000	227,000	226,000	218,000	271,000	267,000	252,000
Motijheel	302,000	407,000	406,000	390,000	498,000	491,000	461,000
Tejgaon	377,000	509,000	508,000	487,000	688,000	674,000	626,000
Mohannandpur	513,000	693,000	691,000	663,000	937,000	917,000	852,000
Hazaribag	184,000	327,000	325,000	301,000	441,000	431,000	386,000
Dhamondi	243,000	328,000	327,000	314,000	402,000	396,000	372,000
Ramna	304,000	540,000	537,000	497,000	661,000	649,000	588,000
Lalbag	402,000	494,000	493,000	479,000	575,000	569,000	544,000
Kotwali	259,000	304,000	304,000	297,000	345,000	342,000	330,000
Sutrapur	358,000	441,000	440,000	427,000	513,000	507,000	485,000
Derma	360,000	576,000	573,000	538,000	1,018,000	979,000	864,000
Shyampur	207,000	276,000	275,000	264,000	363,000	356,000	332,000
Kamrangir	157,000	212,000	211,000	203,000	259,000	255,000	240,000
Eastern Corridor	560,000	879,000	875,000	823,000	1,538,000	1,482,000	1,312,000
TOTAL (million)	7.2	10.6	10.5	10.0	15.2	14.8	13.4

	POPULATION PERCENTAGE DISTRIBUTION						
THANA	2004	2014 LUS 1	2014 LUS 2	2014 LUS 3	2024 LUS 1	2024 LUS 2	2024 LUS 3
Uttara	4.1%	4.1%	4.1%	4.1%	4.5%	4.5%	4.5%
Pallabi	7.8%	9.4%	9.5%	9.2%	8.9%	8.9%	8.8%
Kafrul	4.3%	4.0%	4.0%	4.0%	3.7%	3.8%	3.8%
Mirpur	7.2%	6.6%	6.7%	6.7%	6.2%	6.3%	6.4%
Cantonment	4.2%	4.6%	4.6%	4.5%	5.8%	5.7%	5.5%
Badda	4.2%	4.2%	4.1%	4.2%	4.6%	4.6%	4.6%
Gulshan	3.0%	3.8%	3.7%	3.6%	4.7%	4.5%	4.3%
Khilgaon	4.1%	4.5%	4.4%	4.4%	5.5%	5.4%	5.2%
Sabujbag	2.4%	2.2%	2.2%	2.2%	1.8%	1.8%	1.9%
Motijheel	4.2%	3.9%	3.9%	3.9%	3.3%	3.3%	3.4%
Tejgaon	5.2%	4.8%	4.8%	4.9%	4.5%	4.6%	4.7%
Mohannandpur	7.1%	6.6%	6.6%	6.7%	6.2%	6.2%	6.3%
Hazaribag	2.6%	3.1%	3.1%	3.0%	2.9%	2.9%	2.9%
Dhamondi	3.4%	3.1%	3.1%	3.2%	2.6%	2.7%	2.8%
Ramna	4.2%	5.1%	5.1%	5.0%	4.3%	4.4%	4.4%
Lalbag	5.6%	4.7%	4.7%	4.8%	3.8%	3.9%	4.0%
Kotwali	3.6%	2.9%	2.9%	3.0%	2.3%	2.3%	2.5%
Sutrapur	5.0%	4.2%	4.2%	4.3%	3.4%	3.4%	3.6%
Derma	5.0%	5.5%	5.5%	5.4%	6.7%	6.6%	6.4%
Shyampur	2.9%	2.6%	2.6%	2.7%	2.4%	2.4%	2.5%
Kamrangir	2.2%	2.0%	2.0%	2.0%	1.7%	1.7%	1.8%
Eastern Corridor	7.8%	8.3%	8.3%	8.3%	10.1%	10.0%	9.8%
TOTAL	100%	100%	100%	100%	100%	100%	100%

Exhibit 4-11 Budget and Expenditure – Dhaka Area Only

ANNUAL DEVELOPMENT PROGRAM (ADP) BUDGET AND EXPENDITURE SUMMARY FOR TRANSPORT RELATED PROJECTS (DHAKA AREA ONLY)													
AGENCIES		FY 1999/2000		FY 2000/2001		FY 2001/2002		FY 2002/2003		FY 2003/2004		FY 2004/2005	
		Budget	Expend.	Budget	Expend.	Budget	Expend.	Budget	Expend.	Budget	Expend.	Budget	Expend.
1.0	**Roads**												
1.1	Roads & Bridges(RHD)	na	104.2	85.3	106.3	112.2	100.8	144.0	110.7	118.0	229.5	198.7	na
1.2	Bus & Related(BRTC)	na	77.5	1.9	79.0	42.9	41.5	53.4	9.0	0.0	0.0	34.6	na
1.3	DTCB/DUTP	na	41.2	51.8	51.2	53.0	54.5	205.0	157.0	197.0	222.8	147.6	na
1.4	Jamuna Bridge Auth.	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.5	BUET Research	na	0.0	0.0	0.0	0.0	0.1	2.0	0.0	0.0	0.6	1.0	na
1.6	LGED	na	4.3	15.0	2.0	5.0	2.3	5.0	9.0	7.9	29.7	20.2	na
1.7	Food for Work	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.0	na
1.8	BMDA	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.9	Rajuk	na	0.0	34.3	25.0	6.0	3.8	3.5	3.5	5.6	4.8	4.8	na
1.10	CDA	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.11	KDA	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.12	RDA	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.13	DCC	na	64.1	63.0	124.5	267.1	88.1	68.2	76.3	140.4	145.3	57.1	na
1.14	CCC	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.15	KCC	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.16	RCC	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
1.17	PWD	na	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	0.0	0.0	na
1.18	Zila Parishad	na	4.9	4.9	4.9	4.5	4.5	4.5	4.5	5.3	5.3	9.0	na
1.19	Uposila	na	13.6	13.6	13.6	13.6	13.6	12.1	12.1	10.6	10.6	11.5	na
1.20	Paurosova	na	4.7	4.7	4.7	4.7	4.7	4.3	4.3	3.6	3.6	4.7	na
2.0	**Railways**	na	3.3	49.0	44.0	32.0	35.6	53.0	30.0	40.4	47.7	30.0	na
3.0	**CAAB (Aviation)**	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
4.0	**BIWTA (Waterways)**	na	0.0	1.5	1.2	4.0	2.7	11.8	7.4	7.9	22.2	21.2	na
5.0	**DOS (Shipping)**	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
6.0	**BLPA (Land Ports)**	na	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	na
TOTAL Taka (crore)		na	317.7	325.0	456.4	545.0	352.1	566.8	424.0	538.2	726.1	544.2	na
TOTAL USD (millions)		na	52.9	54.2	76.1	90.8	58.7	94.5	70.7	89.7	121.0	90.7	na
	Expenditure/Budget		na		140%		65%		75%		135%		na

Exhibit 4-12 Five (5) Year Summary

SUMMARY OF BUDGET AND EXPENDITURES
FOR TRANSPORT RELATED PROJECTS
AS SHOWN IN THE ANNUAL DEVELOPMENT PROGRAM (ADP)
(5 YEAR PERIOD)

TAKA VERSION

	BUDGET		
	Bangladesh (Taka - Crore)	Dhaka (Taka - Crore)	Percent
2004/05	5125	544	11%
2003/04	5022	538	11%
2002/03	4897	567	12%
2001/02	4905	545	11%
2000/01	4032	325	8%
1999/00	na	na	na
Average	**4796**	**504**	**11%**

USD VERSION

	BUDGET			
	Bangladesh (USD - Millions)	Dhaka (USD - Millions)	Percent	Exchange Rates
2004/05	854	91	11%	60:1
2003/04	851	91	11%	59:1
2002/03	844	98	12%	58:1
2001/02	846	94	11%	58:1
2000/01	707	57	8%	57:1
1999/00	na	na	na	57:1
Average	**821**	**86**	**10%**	

TAKA VERSION

	EXPENDITURE		
	Bangladesh (Taka - Crore)	Dhaka (Taka - Crore)	Percent
2004/05	na	na	na
2003/04	5420	726	13%
2002/03	4465	424	9%
2001/02	4321	352	8%
2000/01	4911	456	9%
1999/00	3954	318	8%
Average	**4614**	**455**	**10%**

USD VERSION

	EXPENDITURE			
	Bangladesh (USD - Millions)	Dhaka (USD - Millions)	Percent	Exchange Rates
2004/05	na	na	na	60:1
2003/04	919	123	13%	59:1
2002/03	770	73	9%	58:1
2001/02	745	61	8%	58:1
2000/01	862	80	9%	57:1
1999/00	694	56	8%	57:1
Average	**798**	**79**	**10%**	

	TAKA		USD	
1 year	500 crore	1 year	83 million	
5 years	2,500 crore	5 years	416 million	
10 years	5,000 crore	10 years	833 million	
20 years	10,000 crore	20 years	1,667 million	(1.7 billion)

	TAKA		USD	
1 year	550 crore	1 year	92 million	
5 years	2,750 crore	5 years	458 million	
10 years	5,500 crore	10 years	917 million	
20 years	11,000 crore	20 years	1,833 million	(1.8 billion)

	TAKA		USD	
1 year	600 crore	1 year	100 million	
5 years	3,000 crore	5 years	500 million	
10 years	6,000 crore	10 years	1,000 million	(1.0 billion)
20 years	12,000 crore	20 years	2,000 million	(2.0 billion)

Exhibit 4-13 Four (4) Year Summary

SUMMARY OF BUDGET AND EXPENDITURES
FOR TRANSPORT RELATED PROJECTS
AS SHOWN IN THE ANNUAL DEVELOPMENT PROGRAM (ADP)
(4 YEAR PERIOD)

TAKA VERSION

	BUDGET		
	Bangladesh (Taka - Crore)	Dhaka (Taka - Crore)	Percent
2004/05	5125	544	11%
2003/04	5022	538	11%
2002/03	4897	567	12%
2001/02	4905	545	11%
2000/01	0	0	0%
1999/00	na	na	na
Average	**4987**	**549**	**11%**

USD VERSION

	BUDGET			
	Bangladesh (USD - Millions)	Dhaka (USD - Millions)	Percent	Exchange Rates
2004/05	854	91	11%	60:1
2003/04	851	91	11%	59:1
2002/03	844	98	12%	58:1
2001/02	846	94	11%	58:1
2000/01	0	0	0%	57:1
1999/00	na	na	na	57:1
Average	**849**	**93**	**11%**	

TAKA VERSION

	EXPENDITURE		
	Bangladesh (Taka - Crore)	Dhaka (Taka - Crore)	Percent
2004/05	na	na	na
2003/04	5420	726	13%
2002/03	4465	424	9%
2001/02	4321	352	8%
2000/01	4911	456	9%
1999/00	0	0	0%
Average	**4779**	**490**	**10%**

USD VERSION

	EXPENDITURE			
	Bangladesh (USD - Millions)	Dhaka (USD - Millions)	Percent	Exchange Rates
2004/05	na	na	na	60:1
2003/04	919	123	13%	59:1
2002/03	770	73	9%	58:1
2001/02	745	61	8%	58:1
2000/01	862	80	9%	57:1
1999/00	0	0	0%	57:1
Average	**824**	**84**	**10%**	

	TAKA
1 year	500 crore
5 years	2,500 crore
10 years	5,000 crore
20 years	10,000 crore

	USD	
1 year	83 million	
5 years	416 million	
10 years	833 million	
20 years	1,667 million	(1.7 billion)

	TAKA
1 year	550 crore
5 years	2,750 crore
10 years	5,500 crore
20 years	11,000 crore

	USD	
1 year	92 million	
5 years	458 million	
10 years	917 million	
20 years	1,833 million	(1.8 billion)

	TAKA
1 year	600 crore
5 years	3,000 crore
10 years	6,000 crore
20 years	12,000 crore

	USD	
1 year	100 million	
5 years	500 million	
10 years	1,000 million	(1.0 billion)
20 years	2,000 million	(2.0 billion)

5. TRAVEL DEMAND MODEL AND ASSUMPTIONS

5.1 INTRODUCTION

Over the next 20 years, the population of the Dhaka metropolitan area is expected to more that double, reaching 36 million by 2024. In the normal pursuit of their individual lives, these 36 million people will collectively make more than 70 million person trips each and every day of the year. Some of these trips will be work related, some education related, while others will be for shopping, health care, recreation and a myriad of other purposes. Where these people will live and where they will choose to make those 70 million trips is determined in a large part by the transport options they have available to them. Good transport means more choices about where to live, work, shop and do other things - more choices means more opportunities. Poor transport means limited choices regarding jobs and places to live and less opportunity to take advantage of facilities and services that an urban area, such as Dhaka, has to offer. At the same time, during this same next 20 year period, something in the region of Tk 18,000 to Tk24,000 crore (USD 3 to 4 billion), will very likely be invested just in the provision of new and improved transport infrastructure in the Dhaka area.

So the questions arise, how does one go about predicting where 36 million individual people will collectively be making over 70 million trips, each and every day of the year? How can the resources available for investment in new and improved transport be directed toward transport infrastructure projects and transport services that best serve the collective needs and interests of everyone? One way is to guess at what needs to be done and proceed in an ad hoc manner with the implementation of transport improvements. A better way is to follow a systematic process of information gathering, data analysis and testing of options in order to develop an understanding of the benefits and consequences of various actions, and then, and only then, draw some conclusions and make recommendations about what projects and services to implement. That better way, referred to as the “Transport Planning Process” is described in the following sections.

5.2 TRANSPORT PLANNING PROCESS

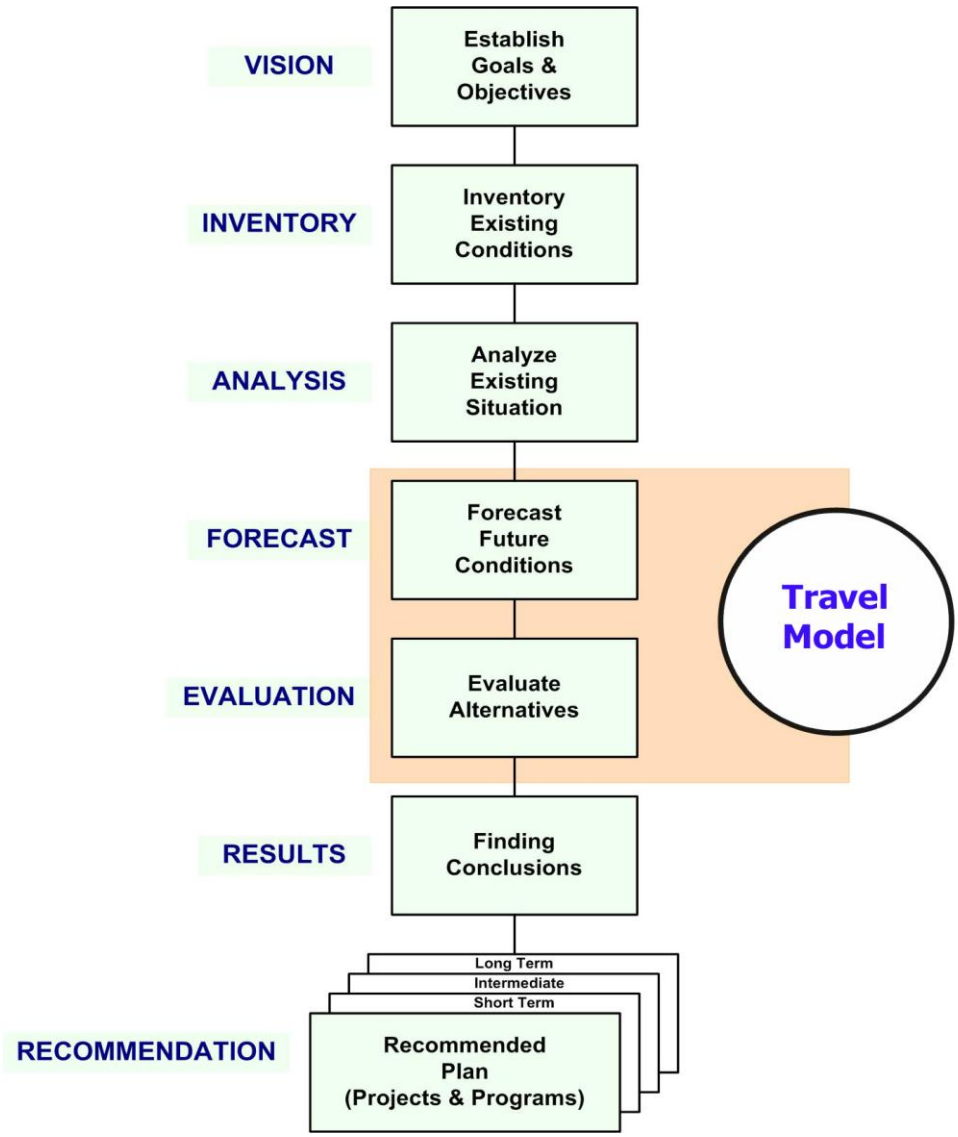
The transport planning process, as shown in **Exhibit 5-1**, is a systematic approach to the development of a set of recommendations based upon a rational understanding of the needs, options, and consequences.

1. The first step is one of VISION – the establishment of an understanding of the goals and objectives toward which to strive. Looking into the future to predict ways in which the city might develop in terms of location of population and employment. Without a general sense of direction, there can be no systematic progress toward achievement. Goals and objectives generally relate to the categories of economic, environmental, social and transport.

2. The next step is one of INVENTORY – the collection of information and data about what things are like at the present time. Subjects typically include land use, population, economic activity, travel characteristics, transport facilities and services, and financial resources, along with others.

3. The next step is one of ANALYSIS – the analysis of existing information and data to develop a factual understanding of existing conditions, including various characteristics and indicators, problems and opportunities, and assets and deficiencies.

Exhibit 5-1 Urban Transport Planning Process



4. The next step is one of FORECAST – the preparation of information about land use, socio-economic and travel characteristics for some future period (in this case 20 years).

5. The next step is one of EVALUATION – the testing, analysis, and evaluation transport options and then retesting of different transport options as well as changes in land use and population and employment distributions.

6. The next step is one of RESULTS – the findings and conclusions that become self evident from the testing and evaluation of transport and land use options.

7. The final step is one of RECOMMENDATION – specify and describe the recommended plan in terms of specific projects, services and policies along with scheduling, financing and implementation information.

In order to respond to these requirements of the planning process, an urban transport planning model (UTP) was developed[1] and used to produce forecasts of future travel demand resulting from a selected future land use scenario and a number of alternative transportation strategies. The model was used to predict the performance of the existing, committed and alternative transportation strategies. In preparing the Strategic Transport Plan (STP), the uses of the model are:

- analyzing the existing baseline urban transport situation;
- forecasting future travel demand under alternative targets for future population growth and land development;
- identifying future urban transport needs;
- determining future travel demand in priority corridors;
- evaluating the performance of the existing and committed urban transport systems;
- evaluating the performance of alternative strategies; and
- providing information for preparation of the prioritized plan.

The UTP model was built in the STP office using proprietary software purchased specifically for the study. The EMME/2 transportation planning software was used and is a macro-level traffic model highly suitable for strategic planning. This simulation model will be the property of the government after the STP study closes and will be used for further strategy development and testing.

5.3 TRAVEL DEMAND FORECAST MODEL

The Travel Demand Forecast Model is the fundamental analytical tool used in the planning process in order to produce the information needed to develop an informed understanding regarding transport options and investment decisions. It is also an essential requirement for serious private sector investment interest.

As part of this study, a comprehensive program of transportation and travel demand surveys and other data collection activities was carried out[2]. The information obtained from these surveys was used to identify and measure the essential characteristics of the existing demand for travel and also to determine the existing supply, operation and use of the various urban transport services.

The data collected for 2004 was analyzed and the results were used to develop and calibrate the travel model. Once the travel model is able to replicate existing conditions, it is then used, together with forecasts of future land use, population and economic activities, to forecast passenger travel demand up to the year 2024.

There are a number approaches available for forecasting future travel demand. They range from simple growth factor models to sophisticated models that simulate the inter-action between transportation and land use. The selection of the appropriate type of model for a particular application depends on several factors such as the nature of the project, availability of data for model estimation, the level of interaction between the transport demand and the land-use policies, etc.

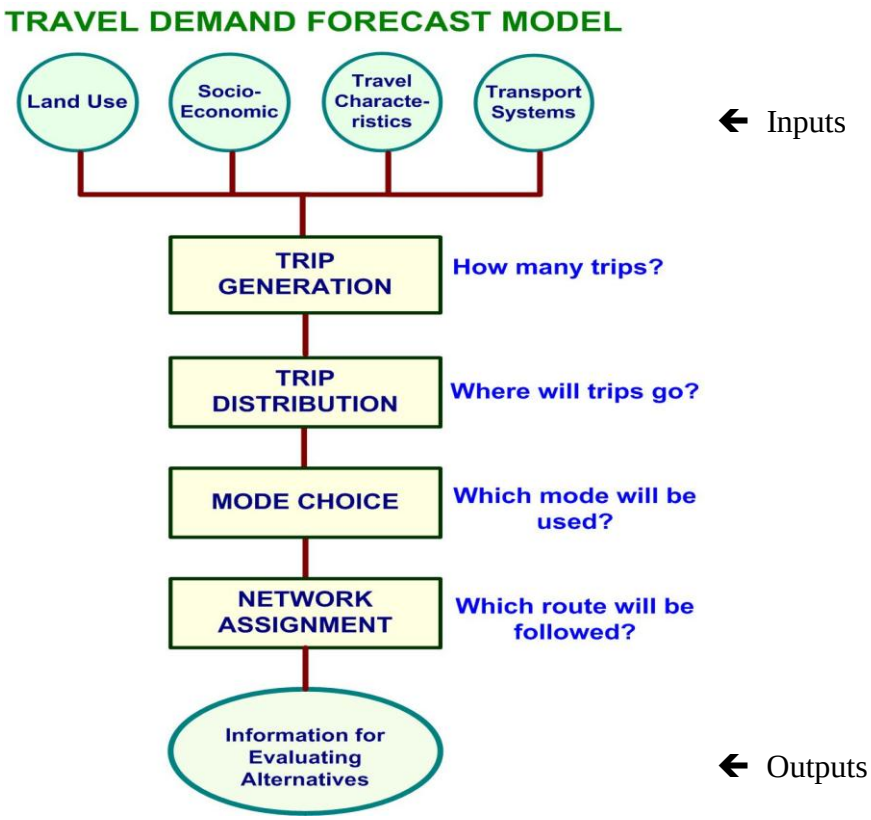
[1] This chapter provides brief information on the model development and calibration. It also provides information on the assumptions made when developing the model. However, further detail may be obtained from two Working Papers (Numbers 8 and 9) published during the period February to April of 2005.
[2] A detailed account of these surveys and the results is provided in Working Paper No: 7.

The travel demand forecast model for Dhaka EMME/2 is a state-of-the-art, transportation-land use interactive simulation model that provides a comprehensive and flexible set of tools for modeling peoples' travel behaviour. It is also capable of testing and evaluating multi-modal transport network options and land use scenarios in a systematic and quantitative manner.

The travel demand forecast model is a behavioural model – that is, one that is able to simulate the decision making that goes on by over 36 million people as they make over 70 million trips each day of the year. The model is able to simulate the choices people will make (behaviour) when new and improved transport system options are introduced. Choices about where they travel, how they travel, and why they travel can be assessed. Whereas the model can not predict what any one individual person is likely to do, when studied in aggregate the model is able to make reasonable simulations of travel decisions by categories and groups of people and provide useful comparative information for a wide range of potential transport options.

The development of a Travel Demand Forecast Model is shown in **Exhibit 5-2**.

Exhibit 5-2 Travel Demand Forecast Model



5.3.1 Inputs to Model

The inputs to the travel model include information about different types of land uses and socio economic parameters such as population, employment, income, and vehicle ownership. Travel related information such as number of trips, purpose of trip, origin and destination of trip and mode of travel are introduced largely from purpose-designed surveys. Transport network information for roads, buses and other modes is obtained and used to form a facsimile of the available systems.

5.3.2 Model Area

The area modelled by the UTP covers the DCC and its surrounding areas and the transport network extends outward from the DCC to include the Districts of Narayanganj, Tongi, Savar, Munshiganj, Narsingdi, Gazipur and Manikganj. With respect to the surrounding areas mentioned, the scope of the STP is limited to addressing only the corridors connecting them to Dhaka not with detailed study of the areas themselves.

In the modelling process, the journeys on the network are considered to have their origin and destination centred within a series of zones. These are referred to as Traffic Analysis Zones (TAZ) and they subdivide the complete study area. The area covered by the model was divided into 230 TAZ of which 154 lie within the DCC, 19 cover the remainder of Dhaka District, 44 cover the surrounding Districts of Gazipur, Manikganj, Munshiganj, Narayanganj, and Narsingdi and 13 are external TAZ. When defining the boundaries, the following ideas were considered:

- using boundaries of census and administrative jurisdictions (Thanas and Wards),
- including the entire STP study area and extending outward to include the five surrounding Districts,
- having each TAZ on one side or the other of the screen lines cutting the study area (see **Exhibit 5-5** at the end of this chapter),
- having the TAZ small enough to avoid the possibility of a large percentage of their trips being intra-zonal trips,
- having the TAZ as geometrically uniform in shape as possible to enable the TAZ centroids to give a realistic representation of the centre of trip-generating activity for the TAZ,
- having TAZ with a relatively uniform land uses, and
- having TAZ boundaries follow the alignments of major roads and railway lines.

Within the TAZ are centres of activity (centroids) which represent the concentration of network travel created by the land use activities within the TAZ. The logic of the model assumes that all trips from or to a TAZ originates or terminates at its centroid. TAZ centroids are connected to the road network by centroid connector links, which do not necessarily correspond to actual roads but serve the purpose of representing an average travel time and distance between the TAZ and the road or public transport network.

5.3.3 Trip Generation

Reference to **Exhibit 5-2** will show that Trip Generation is the first module of the travel model. It addresses the question of “How many trips are made?”. Trip generation analysis is concerned with relating the land use, population, and other socio-economic characteristics for a defined set of zones to the number of daily person trips that originate and terminate in each zone.

The purpose of the trip generation model is to determine the number of trips that are made from a TAZ (produced) and to a TAZ (attracted) by the people who live, work and shop in each zone. Initially, the number of trips is determined for the base year conditions. The number of trips that will be made by study area residents is then predicted for some future years (2024 in this case).

The trip generation module computes the number of trips leaving a TAZ (trip productions) and arriving at a TAZ (trip attractions) for each zone in the study area, during a specified time period. For example the peak hour or a full day could be used. In the case of the STP, the model analysis was based on the peak hour. The model may include trips by all modes of travel (including walking), or it may be limited to just the motorized modes, or possibly only the public transport modes, depending upon the nature and purpose of the analysis. For the STP, the strategic nature of the assessment meant that the model was designed for main corridor movements of people using mechanised modes.

5.3.4 Trip Distribution

Trip distribution is the second module of the travel model. It addresses the question of "For each trip, where does it start and where does it end?" It is used to determine the geographical distribution of trips among all pairs of zones in the study area.

The trip distribution model produces an origin and destination table (a trip matrix) containing the number of trips between each possible combination of zones during a specified period of time for an existing or future year.

Trip distribution was accomplished by developing a relationship which predicts the destinations of trips originating in each zone. The basis of the computation is the trip productions and attractions derived from the trip generation module and the travel times or travel distances between all combinations of zones. The output of the trip distribution module is a set of zone to zone trip matrices, one for each trip purpose, mode and for each analysis year.

5.3.5 Travel Mode Choice

Mode choice is the third module in the travel model. It addresses the question of "What mode of travel will be selected to make the trips?".

The objective of the modal choice model is to determine the number of trips which would use a specific transport mode (e.g. passenger car, taxi, bus, train, metro, etc.), for a given trip purpose, for travel between each pair of analysis zones. The choice people make about which mode of travel to use is determined for a set of specific conditions, which vary from one option to another. Therefore, the number of trips using each mode of travel also changes.

The mode choice model divides a zone to zone trip matrix (derived from the trip distribution module) into separate matrices, one for each mode of travel. Each output matrix contains the number of trips between each combination of zones, during a specified time period and for an existing or future year and for a specific mode of travel.

5.3.6 Network Assignment

Network assignment is the fourth module in the travel model. It addresses the question of "What route will each trip follow for the transport mode selected?". It is used to determine the volume of travel that will occur on each of the various transport systems and networks included in the analysis (e.g. roads, bus system, rapid transit system).

The network assignment module loads the travel mode-specific trip matrices (derived from the mode choice model) onto mode-specific networks in order to establish the number of persons and vehicles using each link in a specific network during a specified time period (a 24 hour day or a peak hour period) and for a particular analysis year (existing and future).

The network assignment module produces information about the numbers of trips on each link of each travel mode network as well as a variety of travel-related summaries and indicators that are useful in evaluating the performance of each transport option as well as comparisons among different transport options.

5.3.7 Outputs from Model

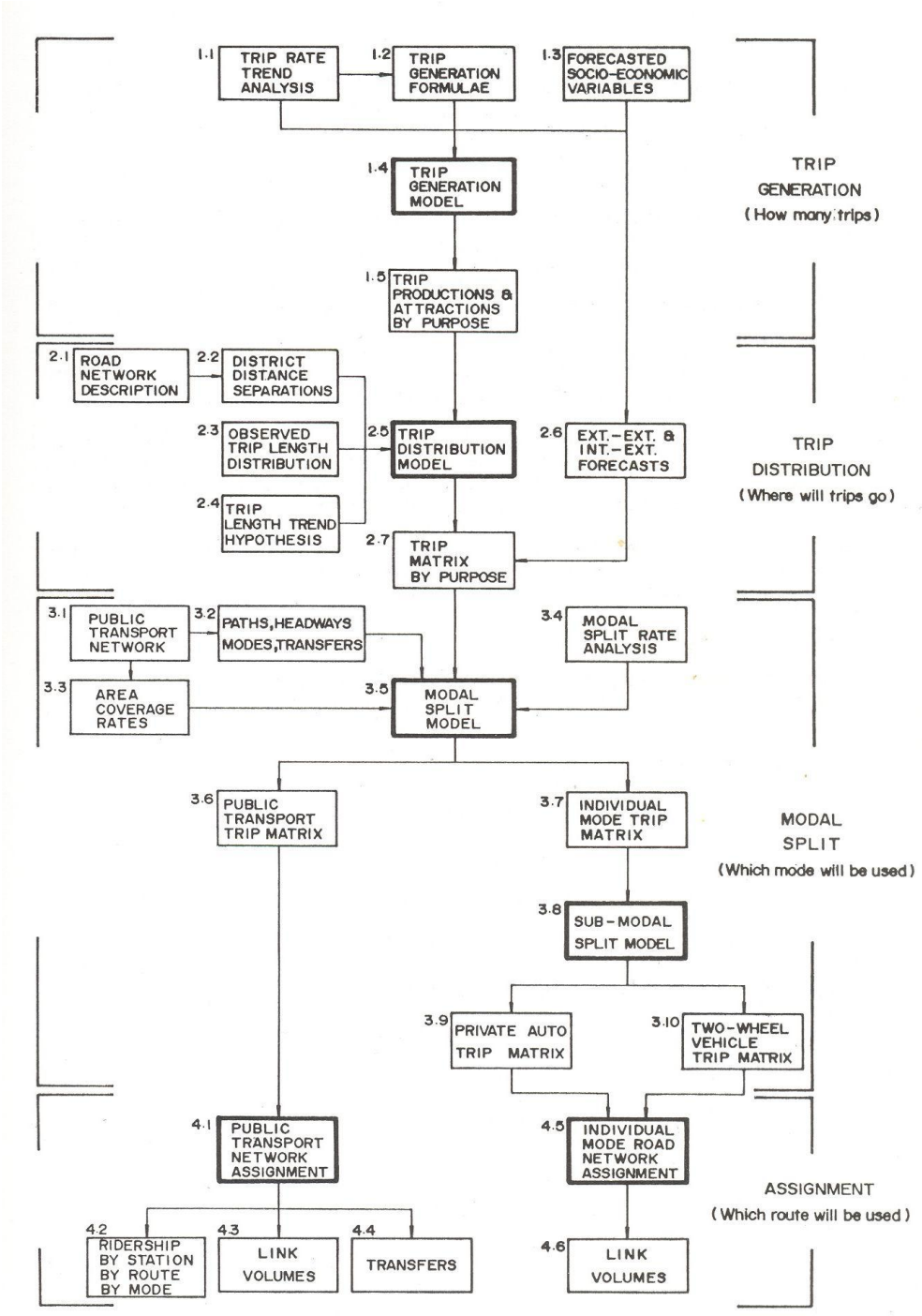
The outputs from the model provide information about:-

(a) the number of passengers using each link of a bus route,

(b) the number of passengers on each station-to-station segment of a mass rapid transit line,
(c) the number of vehicles using each roadway link, and
(d) the number of people transferring between different public transport modes (for example waterway transport and land transport at designated stations),
(e) plus a host of related details and summaries that form the analytical basis for evaluation of transport and land use issues and options.

Exhibit 5-3 is a detailed representation of the travel model process.

Exhibit 5-3 Typical Travel Demand Forecast Model



5.4 ASSUMPTIONS USED IN TRAVEL DEMAND FORECAST MODEL

5.4.1 Population Predictions

The population resident in each TAZ was based on the year 2001 census data as reported by the Bangladesh Bureau of Statistics for each Thana and for each Ward within the DCC. The division from the Thana/Ward level into TAZ was allocated in proportion to land area. Because some of the more urbanized TAZ have higher densities of population than other TAZ in the same Thana, in allocating Thana population among the TAZ within the Thana the land area of the more urbanized TAZs were given weightings that were double their land area.

The base line population forecast[3] is based on an approach by which the population growth rate increases as population density (population/sq km) increases from a low level. When population density reaches a higher level the growth rate begins to tail off.

The population of the study area was first forecast from 2001 to 2004, the Base Year for the STP study. Although forecasts were made separately for each District the overall growth rate was 3.45%. From a study area 2001 population of 17.3 millions, the 2004 population was forecast at 19.2 millions.

The next forecast was made to the year 2014 again using forecasts by Districts resulting in an overall growth estimated of 3.23%. This lead to a 2014 population of 26.4 millions. For the period from 2014 to 2024 the increase was estimated as 3.15% overall resulting in a population estimate of 36 million in the year 2024.

5.4.2 Household Predictions

A “household” is defined by the Bangladesh Bureau of Statistics as “a person or persons having relationship or not, living together and taking food from the same kitchen”. The BBS made a Household Expenditure Survey in 1991-92 and again in 1995-1996. This survey showed that the average household size for urban residents in Bangladesh decreased by 0.25% per annum during that four-year period. The STP also assumed that the average number of persons per household will decrease at the average annual rate of 0.25% per annum. This assumption was also used for households outside DCC area because the outer study area is influenced more by the Dhaka urban area characteristics than by characteristics of rural areas.

The trip generation sub-model within the UTP applies trip rates to the number of households by Household Income Group in each TAZ. For this reason the population in each TAZ is converted to the number of households. The number of households was forecast to increase from 3.5 million in 2001 to 7.9 million by the year 2024.

5.4.3 Income Groups

The input to the UTP model regarding income was based largely upon information obtained from the household survey. The STP undertook a survey of more than 6,000 households sampled across Dhaka. Household income was defined as the total income of all members of the household in Tk/month. This survey indicated that there were three primary Income Groups. The households sampled by the household survey were distributed by Income Group as follows:

- Low Income Group (LIG) having less than Tk 12,500/month = 43.4% of all households.
- Medium Income Group (MIG) ranging from Tk 12,500 to Tk 55,000/month = 52.5% of all households.
- High Income Group (HIG) with more than Tk 55,000/month = 4.1% of all households.

[3] *Details of this are contained in Working Paper No: 3*

In the absence of any official long-range forecast for increasing household incomes, an assumption was made that household incomes will increase at the average annual rate of 1% per annum. GDP has been growing at between 4% and 5% in recent years and, due to the reduction on household size, the real growth in personal income is about 2%. On this basis, if household incomes for all income ranges were to increase at an average annual rate of 1% per annum during the years from 2004 to 2024, by year 2014 the percentage of households in each HIG will be:

- LIG – 36.4% of all households
- MIG – 57.2% of all households
- HIG – 6.4% of all households

By year 2024 the change in income groups was projected as follows:

- LIG – 34.9% of all households
- MIG – 57.3% of all households
- HIG – 7.8% of all households

5.4.4 Trip Rates

From the household surveys, it was found that trip rates varied between household types with HIG making 10.40 trips per day, MIG making 9.35 trips per day and LIG making 7.84 trips per day. On average 8.73 trips per household was derived. Of the 8.73 trips, transit trips were found to be 3.94 and other motorized modes accounted for 0.73. Thus, non-motorized modes account for 4.06 trips per household or 48% of all trips within the households sampled.

Trip rates for each income group were kept constant for the future. Although this may prove to be not quite true, there is no evidence to decide if the rates should change and if they were to do so, how they would change. Even so, the change in the percentage distribution of households among the three income groups was incorporated to reflect the influence of increasing income.

5.4.5 Household Size

The average household size was found to be 4.12 persons, with a distribution of 3.83 in LIG, 4.32 in MIG and 4.83 in HIG.

5.4.6 Trip Purpose

Trip rates by purpose were found from the household survey and were as follows:-

Home to Work	2.69
Home to Education	1.12
Home to Other	4.12
Non-Home Based	0.80
All trips	8.73

5.4.7 Trip Lengths

The lengths of trips were found to vary by income group with HIG travelling 4.46 kms on average, MIG travelling 5.98 kms and LIG travelling 5.38 kms. The average trip length for all income groups was 5.51 kms.

The trip length frequency distribution was derived from the HIS and was used for EMME/2 model calibration input.

5.4.8 Future Land Use Scenario

Although STP is an on-going study, certain conditions that will have an impact on the future land use seemed to be reasonably predictable. The following assumptions were made when creating the future land use scenario:

- Major land uses such as the Cantonment area will not be available for development as part of the 20 year plan, however use of existing and proposed new roads was assumed to be permitted.
- The hoped-for economic growth of 7% will not be realized. Instead the economic growth will continue in the 5% to 6% range.
- A large percentage of the population will continue to use some form of low cost transport such as – Walk, Cycle or NMT.
- Mixed land use development will continue to be a feature of the area reinforcing the habit of living and working close to home and in the same TAZ.
- Densification will continue even if strong interventions are employed.
- For the first 10 years of the study period, there will be little opportunity to influence the dispersion of population and employment and the growth will be in the existing metropolitan areas.
- The new planned community at Purbachal will proceed and was accepted as a given even if the location is not ideal.
- The Eastern embankment will be built in order to permit the development of land east of the existing built-up area.
- The railway right of way will be released at some point for use as other forms of transport, either commuter rail or mass transit of another form.
- Suitable infrastructure and other incentives will be developed in order to support and encourage the growth pole concept.

5.4.9 Basic Network Assumptions

The existing network was built for the year 2004 and included 3,860 links totaling 3,455 kms in length. Only main roads are considered in the network and for areas outside Dhaka, only arterial roads connecting the surrounding towns with Dhaka are considered in the road network. This is because the scope of the STP is “strategic” in nature and secondary roads are only included for completeness and to ensure continuity of the network and a reasonable facsimile of the existing road network.

- There are 4 railway lines included having 198 links totalling 352 kms in length,
- There are 11 inland waterways lines with 390 links connecting to 8 terminals and totalling 1,341 kms in length.
- There are 78 BRTC transit lines totalling 2,913,757 route-kms,
- Human Haulers – 40 lines totalling 531 route-kms,

Each network scenario contains data identifying and describing the scenario including - nodes, links, turns and the transit lines and segments. Each road network (the auto mode) link record contains:

- Link length and an identification of the travel modes that can operate on the link;
- Link type code number, used to identify links located along specific corridors;
- Number of travel lanes on the link;
- Index number for the volume-delay function applicable to the link; and
- Three user-defined data items namely: - width of travel way, average lane width and number of buses per hour.

5.4.10 Effects of Non-motorized Traffic

The existence of Non-Motorized Traffic on some roads affects lane capacity and operational speed. The study undertook surveys to establish the capacity for the three most important road categories - primary, secondary and collector roads. From observations and using the UN-ESCAP report (Integration of Non-Motorized Transport in the Urban Transport System of Dhaka, 1997), it was found that the impact of NMTs (particularly rickshaws) on road capacity and speed varied according to their volumes in the traffic stream.

Considering the above and the higher percentage of NMTs observed in Old Dhaka, it was considered that at least six sets of road capacity values would be used. The model used three types of roads (primary, secondary and collector) and two areas (old Dhaka and the rest of the city) would be necessary to represent the travel conditions correctly. However, only the road capacity at the most aggregated level was considered with three sets of road capacity values for primary, secondary and collector roads.

As determined from the household survey, the distribution of person-trips travel is 52% by motorized modes (individualized motorized transport modes and transit) and 48% by non-motorized travel modes (walk, rickshaw, bicycle). Of the 52% of total person-trips by motorized modes, the distribution is 85% by transit and 15% by individualized motorized transport modes (private vehicle, taxi and auto rickshaw).

5.4.11 Intersection Turning Penalties

In urban road traffic conditions travel time not only depends on the volume/capacity ratio but also on signal phasing. Two-phase signals reduce link capacity by more than 50%, three-phase by more than 66% and so on. The UTP model treats these impacts within the identification of turns and the definition of what is termed “Turn-Penalty Functions”.

The impact of signalized intersections and other causes of delay at specific nodes in the network was estimated by defining turns and the use of Turn Penalty Functions. Turns were defined in the road network at 92 road intersections and 51 at-grade railway crossings. Turn penalty functions were determined from observations of several intersections and were defined as follows:

- left turn = 0.25 minute
- through movement = 0.2 minute, and
- right turn = 0.35 minutes.

Intersection delays for un-signalized or police-controlled junctions were incorporated within the road segment delays by using the congested speed as opposed to using the un-congested travel speed. Additional intersection delays were added at railway/road at-grade crossings and at signalized intersections.

5.4.12 PCU Values

Passenger Car Units are conversion factors for different vehicle types defining how they impact on the capacity of a road as compared with the impact of a passenger car. For the STP study the PCU equivalent values were used as follows:-

Car/Jeep/Taxi	1.0
Small Bus	1.5
Large Bus	2.0
Truck	2.0
Auto-Rickshaw	0.7
Rickshaw	0.4

At a limited number of locations, the team made counts of vehicles by type that passed at a time when the capacity of the roadway was being fully used. These observed flows of vehicles by type per minute of time were the basis for setting the PCU values for each vehicle type.

5.4.13 Peak – Daily Factors

From survey information, the various factors relating to proportions of vehicles moving throughout the day were estimated. It was found that 80% of the daily traffic moved in the 16 hour period from 0600 to 2200, and 48% moved in the 8 hour period between 0800 and 1600. Travel demand was measured in terms of the number of person-trips and was later converted to vehicle-trips. The transport network was used to route or "assign" travel between combinations of TAZ. The travel demand analyzed and forecasted within the UTP Model represents the daily travel demand for a typical workday of the week. For assignment to the transport network, the daily travel demand was converted to peak hour travel demand. The factors to convert from daily to hourly total were 7.0% of total daily demand for the auto network travel and 10% of total daily demand for the transit network.

A further important decision was to continue the current ban on the movement of commercial vehicles during the peak period. Whilst this may not continue forever, it seems reasonable to assume it will continue for some time especially in view of the recommendations on Demand Management.

5.4.14 Railway Crossings

For at-grade road/rail crossings, the time penalty or delay was defined as 0.83 minutes. With 4 trains passing during the peak hour and with an average of a 5 minute road closure for each passing train, the probability of a road being blocked at any time is 0.33. With the road vehicles that are forced to stop averaging 2.5 minutes delay each, the average delay for all road vehicles during the hour is 0.83 minutes.

5.4.15 Public Transport Factors

Bus travel times are 10% longer than the auto link travel times with their assigned traffic loads. The transit time functions calculate bus travel times in minutes on each base network link along the transit line as a function of link travel time resulting from the auto assignment. A transit line was defined as a regular transit service with fixed frequency and travel times on a fixed itinerary, such as bus routes, railway services and inland waterway transport services. The itinerary was defined as a sequence of transit segments, identified by the node numbers encountered by the transit line on its route.

Bus transit lines were identified from the licensed permits issued within the DCC by the Bangladesh Road Transport Authority (BRTA). The licensed permits included services offered by the Bangladesh Road Transport Corporation (BRTC) and private operators for buses, minibuses and 'human haulers'. A total of 78 bus lines and 40 human hauler lines were included in the base network.

Average dwell times were determined from surveys along selected bus lines recording travel times and the number of boarding and alighting passengers and dwell times at bus stops. Bus frequency was assumed to be 5-minute headway on average.

Inland waterways lines were determined from the "Time Table Guide of Passenger Service Launches, Bangladesh Inland Water Transport Authority, BIWTA, June 1997". Eleven inland waterway lines serving existing and proposed terminals were included in the base network. Inland waterways are included as transit lines and segments and, where they exist, provide transit service that can connect with or compete with the other transit modes. As with other transit lines, outputs from the model provide the number of predicted passengers using each

Inland Waterway line and segment and the number of passengers boarding and alighting at each stop. Transfers are also provided.

Commuter rail service included stops by inter-city trains at stations within the STP study area and was provided by four lines, representing the existing railway network. Information describing the lines was obtained from visit to the Bangladesh Railways at the Kamalapur Train Station. Commuter rail was included as transit lines and segments and, where they exist, provide transit service that can connect with or compete with the other transit modes. The network in the UTP data bank includes 4 railway lines.

Human haulers occupancy was assumed as 11.2 passengers obtained from surveys undertaken as part of STP.

5.4.16 Trip Length Frequency Distributions

The model uses a three-dimensional matrix balancing to produce balanced matrices that satisfy trip productions and attractions and trip length frequency distributions. These distributions are produced for trips by each Trip Purpose and by members of each Household Income Group. Trip length frequency distributions for motorized person-trips for each Trip Purpose were determined from data obtained from the Household Interview Survey.

The trip generation productions and attractions predicted for the TAZ together with the trip length frequency distributions determined from the complete Household Interview Survey results were input to the Three Dimensional Matrix Balancing module which created trip origin and destination matrices for each of the four trip purposes and three Household Income Groups

The Trip Length Frequency Distributions from the Household Interview Survey O-D matrices were created in the UTP model data bank containing the number of person-trips identified by the Household Interview Survey from TAZ of origin to TAZ of destination. For each Trip Purpose and Household Income Group, listings of the number of person-trips of each 1-km interval of minimum path travel distance were made.

The Trip Length Frequency Distributions were kept constant through time. This was partly because there was no logical scientific basis for making alterations. At the same time, developments in new areas (such as the satellite cities) will be populated by the same people as live elsewhere and it is assumed that employment will be provided to accommodate the population. In this way the residents will behave in a similar way to the existing population.

5.4.17 Modal Split Model Form

The selected modal choice modal definition was a multinomial logit model with time, cost and income group as the relevant variables. The multinomial logit model estimated the probability of choosing a specific mode based on the maximization of the utility of choosing that mode. The forms of the utility functions used in the model definition are as follows:

- U (auto network mode) = B * time + C * cost
- U (transit mode) = A + B * time + C * cost

In connection with the factors A, B and C above the following coefficients were used:-

A	LIG	3.1549	MIG	1.4877	HIG	0.8610
B	LIG	0.0018	MIG	0.0102	HIG	0.0581
C	LIG	0.0029	MIG	0.0003	HIG	0.0018

5.5 CALIBRATION OF THE UTP MODEL

5.5.1 Introduction

The model calibration process is the gradual adjustment of model parameters until flow predictions replicate on-ground conditions to the degree necessary for the study purposes. As calibration proceeds, various adjustments to the model parameters are made in order to improve the performance of the model. There are a number of important issues which should be explained at the beginning of this process:

- The STP study is essentially a "strategic" study and the model has been designed for the assessment of the effects of network changes at a conceptual level.
- The model is essentially a useful tool with which the transport planners work in order to help them reach conclusions and make recommendations. It is not an end product in itself.
- Models are never perfect and are always in a state of continual development and refinement over a long period of time, as more, new and better information becomes available and time and resources are made available for further development work.
- As the modelling specialists work with the model on a daily basis, they are able to identify parameters in which the model is deficient or could benefit from further development.
- Again as the modelling specialists work with the model on a daily basis, they are able to identify areas of the city where the model is over-predicting or under-predicting flows.

The main purpose behind these introductory remarks is to emphasize why and how the model is put to use. Since the model specialists are very familiar with the day to day running of the model, they are able to indicate to the transport planning specialist where the model is performing satisfactory as well as where the output of the model is less accurate and where the outputs should be used more cautiously. With this knowledge, the transport planners can adjust the network improvements in full knowledge of the model's strengths and weaknesses. Thus, whereas the model may be seen to be "inaccurate" in some areas or corridors, the end product (a network improvement) will have suitable compensations made by the planners.

5.5.2 Input Data

As described previously, the sources of information for development of inputs to the UTP model included the following:

- Official Government sources of mapping coordinates used to define network nodes and political boundaries;
- Inventories of the road network carried out by the STP staff engineers;
- Public transit lines, locations, stops, headways, and vehicle types obtained from visits to transit operators;
- Population and household data from the 2001 Census;
- School enrolments; and
- Surveys undertaken by STP including notably the Household Interview Survey and the Screen Line Survey.

5.5.3. Basis of Calibration

The matching of the model output with the on-ground conditions is achieved by comparing two main parameters:

- The Trip Length Frequency Distributions (TLFD).
- The flows across the screen lines.

The TLFD is a measure of how travel moves in the study area and essentially controls the distribution of journeys according to their lengths. The on-ground conditions in relation to the TLFD were established from the Home Interview Survey (see section 5.4.16) and express the numbers of journeys taking place with certain trip lengths. Hence, once the model is constrained and calibrated to distribute trips in the same proportion as the measured conditions, there will be an acceptable distribution of journeys by distance. The comparisons of these actual and modelled TLFDs are shown in **Exhibit 5-4**. As shown, the match between actual and simulation is very good, thus indicating that the distribution of trips within the modelling process is essentially equal to the distribution of actual trips presently being made, as determined from the survey data.

5.5.4 Screen Lines

Three screen lines cutting across the network area were defined. Manually classified traffic volume counts were taken on the major "strategic" roads crossing these screen lines (see **Exhibit 5-5**). Objectives used to defining the screen line locations were:

- to divide the study area into four quadrants of approximately equal size in order to have the screen lines intercept a high number of study area trips;
- to avoid, or at least minimize, the probability of trips making double crossings of any one screen line; and
- to have, as much as possible, each TAZ entirely on one side or the other of screen lines.

The North-South screen line is located just to the west of the main north-south corridor Dhaka-Gazipur-Mymensingh Road and connecting Uttara, Zia International Airport the Second Buriganga Bridge. The north-south screen line is a straight line cutting through the centre of Dhaka passing through about 25 TAZ and also cuts about 25 road network links.

The East-West screen line is located just to the south of the axis formed by Asad Avenue, Manik Mia Avenue and Farmgate. This is a straight line cutting through the centre of Dhaka passing through about 20 TAZ and also cuts about 20 road network links.

The North-South and East-West screen lines divide the study area into four quadrants having about equal 2001 population residing in each of the four quadrants. To the south of the East-West screen line and just south of the government centre of the DCC, an additional East-West screen line was located.

About 40% of the person-trips reported in the Household Interview Survey crossed the North-South (38.5%) and the East-West (41.4%) screen lines, while only 19% crossed the additional East-West screen line in the old part of the city.

For the base year (2004), the trip distribution sub-model predicted that 13% of the total daily person-trips have their origins in TAZ on one side of the North-South screen line and their destinations in TAZ on the opposite side of the North-South screen line. With respect to the East-West screen line, the trip distribution sub-model predicted that 13% of the total daily person-trips have their origins in TAZ on one side of the screen line and their destinations in TAZ on the opposite side of the screen line.

5.5.5 Trip Lengths

Responses from the Household Interview Survey determined that the average trip length by motorized travel modes was 8.7 km. The survey also determined that there was some variation in average trip length by the different trip purposes with:

- home-work trips averaging 8.63 km,
- home-education trips averaging 6.55 km,
- home-other trips averaging 10.05 km, and
- non-home based trips averaging 8.82 km.

For home-work trips by motorized travel modes, there was little difference in average trip lengths among the three Household Income Groups. For home-education and non-home based trips by motorized travel modes, average trip lengths were slightly longer for residents of households of the High Income Group.

5.5.6. Mode Choice

For the UTP Model, person-trips by motorized travel modes are classified as either Individualized Motorized Vehicle trips or Public Transit trips. Individualized Motorized Vehicle (IMV) trips are those that transport individual passengers or small groups of passengers from point to point without following a specific fixed route usually by private vehicle, taxi and auto rickshaw. Public Transit trips are regularly scheduled buses, railway trains or inland waterway vessels operated along fixed routes.

Many person-trips involve the use of a series of travel modes (walk, rickshaw, auto rickshaw, bus, etc.) by the trip-maker to reach his destination. For the UTP model, the following classification of trips by mode was used:

- trips using public transit buses for any part of the journey are defined as transit trips,
- trips not using public transit buses for any part of the trip but using an IMV are defined as IMV trips,
- trips not using any motorized modes but using rickshaw for any part of the journey are defined as rickshaw trips, and
- trips made entirely by walking are defined as walk trips.

As determined from the Household Interview Survey, the overall distribution of person-trips between motorized and non-motorized travel is 52% by motorized modes (IMV and public transit) and 48% by non-motorized travel modes (walk, rickshaw, bicycle). Of the 52% of total person-trips by motorized modes, the distribution is 85% by public transit and 15% by IMV. This varied by Household Income Group with household members of the Low Income Group making 6% of their motorized trips by IMV, Medium Income Group making 18% by IMV, and High Income Group 53%.

Output from the Mode Choice sub-model of the Dhaka UTP Model predicted 17.8% of all motorized trips by IMV (compared with the counted value of 15%) and 82.2% by public transit (compared with the counted value of 85%). Thus the predictions of the mode choice sub-model compare very closely with the mode choice of the overall population as sampled by the Household Interview Survey.

5.5.7 Traffic Assignment

The assignment of base year (2004) travel to the existing network as predicted by the model is one of the primary methods of comparing how closely the model assignment results replicate the actual traffic, as determined from screen line traffic counts.

For year 2004, the model predicts a total 2,139,235 IMV trips per day. For the peak hour assignment to the road network, 7% of the 24-hour total (97,841 IMV trips) is assigned which accounted for 861,355 vehicle kilometres of travel (VKT). With an estimated 285,000 IMV vehicles registered in the study area, the average number of trips per day per IMV is 7.5 and with an average trip length of 7.8 km, the total annual travel per IMV vehicle is 21,000 km.

5.5.8. Observed Traffic Crossing Screen Lines

The total number of peak hour motorized vehicles crossing the North-South Screen Line on the 13 road links where counts were made was 17,317 vehicles per hour. For the 5 locations where counts were made along the East-West Screen Line the volume was 17,334 vehicles per hour (see **Exhibit 5-6**). The total number of peak hour motorized vehicles crossing this additional East-West Screen Line was 4,105 vehicles for the peak hour. Although the centre of the city is seen as more congested than the newer areas in the north of the city, the actual number of vehicles passing a point of a road link is not as high as the number of vehicles passing a point on a road in the newer areas of the city.

Comparison of all three screen lines indicates that the model output of 39,194 vehicles per hour is very close (within 1%) to the observed field survey counts totalling 38,757 vehicles per hour.

Comparison of the North-South Screen Line indicates that the model output of 15,721 vehicles per hour is quite close (within 9%) to the observed field survey counts totally 17,317 vehicles per hour.

Comparison of the north portion of the North-South Screen Line indicates that the model output of 9,236 vehicles per hour is quite close (within 3%) to the observed field survey counts totally 9,520 vehicles per hour.

Comparison of the south part of the North-South Screen Line indicates that the model output of 6,485 vehicles per hour is about 17% lower than the observed field survey counts totally 7,797 vehicles per hour

Comparison of the East-West Screen Line indicates that the model output of 16,847 vehicles per hour is again quite close (within 3%) to the observed field survey counts totally 17,334 vehicles per hour.

Comparison of the Additional East-West Screen Line indicates that the model output of 6,626 vehicles per hour is about 61% higher than the observed field survey counts totally 4,104 vehicles per hour, indicating that the model is somewhat over predicting traffic volumes in the old city area. This level of over prediction by the model is probably due to the fact that in Old Dhaka, the trip production rates per household as well as trip attractions are not as high as the newer sections of Dhaka to the north. It should also be pointed out that the volume of 4,104 vehicles crossing the Additional East-West Screen Line is only 11% of the total number of vehicles crossing all three screen lines (38,757 vehicles).

Comparison of the model output traffic volumes with observed field survey counts for individual links is variable, depending upon the particular link. Considerations such as balancing between two parallel and proximate links and very low volumes on some links contribute to this variability. For strategic planning purposes, this variability is not critical.
The traffic assigned by the model to road links crossing the cordon around the DCC is substantially higher than the sum of the actual traffic survey counts on the road links crossing this cordon. Again, this indicates that in the more rural TAZ located outside the DCC, the trip production rates per household as well as trip attractions are not as much as in the DCC as a whole. This is one of the areas of refinement that can be addressed in later stages of model development.

In summary, the Dhaka UTP Model tends to under-predict link volumes slightly in the north of the city and over-predict volumes in the older, southern section of the city. Summing all three screen lines, the model flows match to within 1% of the counts. The North-South screen line matches to within 9% and the East-West screen line matches to within 3% of the counted volumes. Thus, for the majority of the city the match is very good and the Consultants are confident of the validity of the model as a useful tool for strategic planning in Dhaka. In fact, it has been surprising how closely the model is able to replicate existing travel bearing in mind that one of the key input parameters (i.e. the number of jobs by type located in TAZ) was not available and proxy values had to be assumed.

5.5.9 Adjustments to the Model

For the record, investigations were made on a number of parameters in order to improve the performance of the model. Within the trip generation sub-model, trip production rates per household were reduced for the more rural areas outside of the DCC and trip attractions were reduced for TAZ located in the southern part of the city and in the TAZ located in the more rural areas outside the city.

Within the trip distribution sub-model, the assumed trip length frequency distribution obtained from tabulation of results from the Household Interview Survey was smoothed to ensure that trips have the opportunity within the Three-Dimensional Matrix Balancing Module to be distributed to all TAZ.

The model has proved its usefulness for strategic planning and shows the relative differences in total network performance with alternative transport development strategies.

5.5.10. Network Travel Times

Average travel speed, as measured by surveys during the STP project, were found to be 26 kph on Primary roads and 20 kph on Secondary roads. For public transit buses, surveys determined the average travel speed to be 17 kph. Surveys conducted by the 2001 DUTP Bus Study determined that bus speeds averaged 15.3 kph.

From the model, the assignment for the year 2004 peak hour IMV trips to the existing transport network produced an overall network travel speed of 21.2 kph, which is close to actual conditions from the survey results and constitutes a valid result.

5.5.11. Possible Improvements

As noted earlier, transport models are never perfect. They are always in a state of continual development and refinement over a long period of time, as more, new and better information becomes available and time and resources commitments are made to further development. In addition, the purpose for which the model is used is a important consideration. For example, while the current transport model developed for the STP study is suitable for strategic planning, additional development and refinement is required if it is to be used for more detailed planning applications such as sub-regional areas, corridor studies, and local area analyses.

In order to assist and guide the follow-on model development and refinement work to be done by BUET, the Consultant has identified the following areas where further work would be most beneficial:

A. The most obvious improvement needed for the Dhaka UTP Model is to obtain an inventory of employment by economic sector (primary, secondary and tertiary or an even more detailed Standard Industrial Classification) by TAZ. This would provide independent variables for predicting person-trip attractions for home-work, home-other and non-home based trips and would improve several components of the model.

B. Other improvements that could be made to the model are:-

- from results of the roadside interview surveys made at cordons around the DCC, add the externally generated travel demand;
- include cargo travel demand;
- improve the performance of the trip distribution sub-model in the outer areas surrounding the city; and
- additional analysis of seasonal and daily volume variations as well as Peak Hour Factor and Passenger Car Unit factors.

C. Improvements that could be made to the base network data are:-

- checking and updating the descriptions of bus transit lines (for example, service headways and the number of vehicles serving each line); and similarly
- the descriptions of the waterway lines.

Exhibit 5-4 Trip Length Frequency Distribution

Exhibit 5.5 Screen Line Survey Location

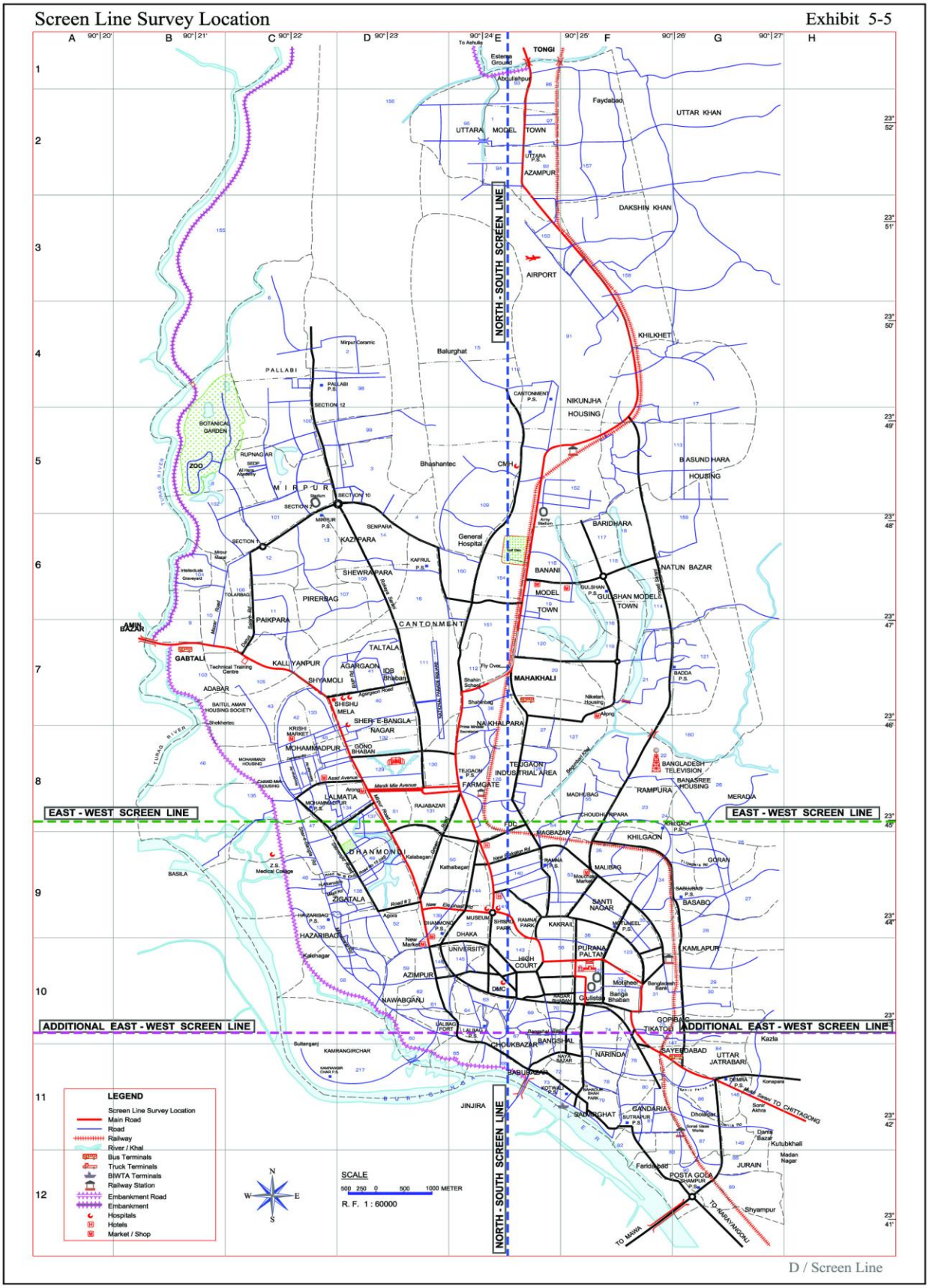


Exhibit 5-6 Screen Line Comparisons: Peak Hour Assignments & Traffic Counts

Location	I-Node	J-Node	Ratio: Assign / Counts		Assign 2-way	Counts Light Pax Vehs	Assign I-J	Assign J-I	Buses from PT Lines	Buses counts
All 3 screen lines			1.01	437	39,194	38,757			5,160	8,381
North-South Screen Line			0.91	1,596	15,721	17,317			1,680	2,862
Part North			0.97	284	9,236	9,520			576	1,185
Part South			0.83	1,312	6,485	7,797			1,104	1,677
East-West screen line			0.97	487	16,847	17,334			2,424	3,561
Additional East-West screen line			1.61	2,521	6,626	4,105			1,056	1,958
N-S (north) + E-W			0.97	771	26,083	26,854			3,000	4,746
North-South Screen Line										
NS	3017	6101	0.96	13	288	301	133	155	0	32
NS	1169	2121	1.25	545	2,708	2,164	1,368	1,340	0	166
NS	2120	6021	0.88	324	2,368	2,692	1,167	1,201	408	488
NS	1193	2115	0.43	1,655	1,234	2,889	610	624	168	218
NS	1196	4079	1.79	1,164	2,638	1,474	1,335	1,303	0	281
NS	1198	6203	0.48	449	418	867	247	171	0	75
NS	1199	6205	0.17	3,272	649	3,921	129	520	0	403
NS	1207	5031	1.01	7	724	717	415	309	912	959
NS	1213	6081	0.57	600	795	1,395	451	344	96	138
NS	1540	1753	1.24	74	381	307	190	191	24	30
NS	3077	3078	5.47	382	467	85	218	249	48	7
NS	1361	1363	28.73	738	765	27	384	381	24	2
NS	1127	8509	4.78	1,808	2,286	478	1,143	1,143	0	64
East-West screen line										
EW	1479	1481	1.42	793	2,695	1,902	1,363	1,332	120	253
EW	1419	1421	1.21	748	4,351	3,603	2,187	2,164	936	986
EW	1305	1307	0.50	2,744	2,797	5,541	1,550	1,247	576	1,291
EW	1187	1189	0.92	406	4,443	4,849	2,241	2,202	456	502
EW	1069	1071	1.78	1,121	2,561	1,440	1,270	1,291	336	529
Additional East-West screen line										
EW2	1356	1357	4.43	749	968	219	482	486	0	86
EW2	3076	3077	6.81	497	582	85	273	309	48	7
EW2	1570	3081	1.95	692	1,424	732	708	716	72	297
EW2	1575	1577	3.95	383	513	130	265	248	144	7
EW2	1147	1149	3.13	1,404	2,062	658	1,035	1,027	120	336
EW2	1093	1094	0.46	506	439	945	439		600	576
EW2	1547	1549	0.48	699	638	1,337		638	72	650
Outer Cordon			1.36	276	1,050	774			24	870
	8501	8502	2.27	45	80	35	40	40	0	78
	8619	8621	0.64	67	120	187	60	60	0	307
	8005	8007	0.18	213	46	259	23	23	0	177
	2156	8307	3.81	292	396	104	198	198	0	128
	8217	8219	2.30	88	156	68	78	78	24	118
	2143	8103	2.07	130	252	122	126	126	0	62
Inner Cordon			3.44	7,595	10,707	3,112			120	2,305
	8613	8323	2.85	646	996	350	498	498	0	618
	6039	8536	4.49	1,536	1,976	440	988	988	0	104
	1127	8509	4.60	1,789	2,286	497	1,143	1,143	0	64
	8709	8679	13.71	1,986	2,142	156	1,071	1,071	24	61
	8013	8015	2.37	408	706	298	353	353	0	416
	1365	6039	4.15	1,385	1,825	440	917	908	0	104
	8213	8668	0.92	23	252	275	125	127	96	438
	8105	8107	1.01	1	116	115	58	58	0	170
	2150	8325	0.00	150	0	150	0	0	0	0
	8111	8653	0.20	186	48	234	25	23	0	266
	2152	8415	2.30	203	360	157	180	180	0	64

Source: Traffic Volume Counts made during Year 2004 for the STPP and the Dhaka UTP Model

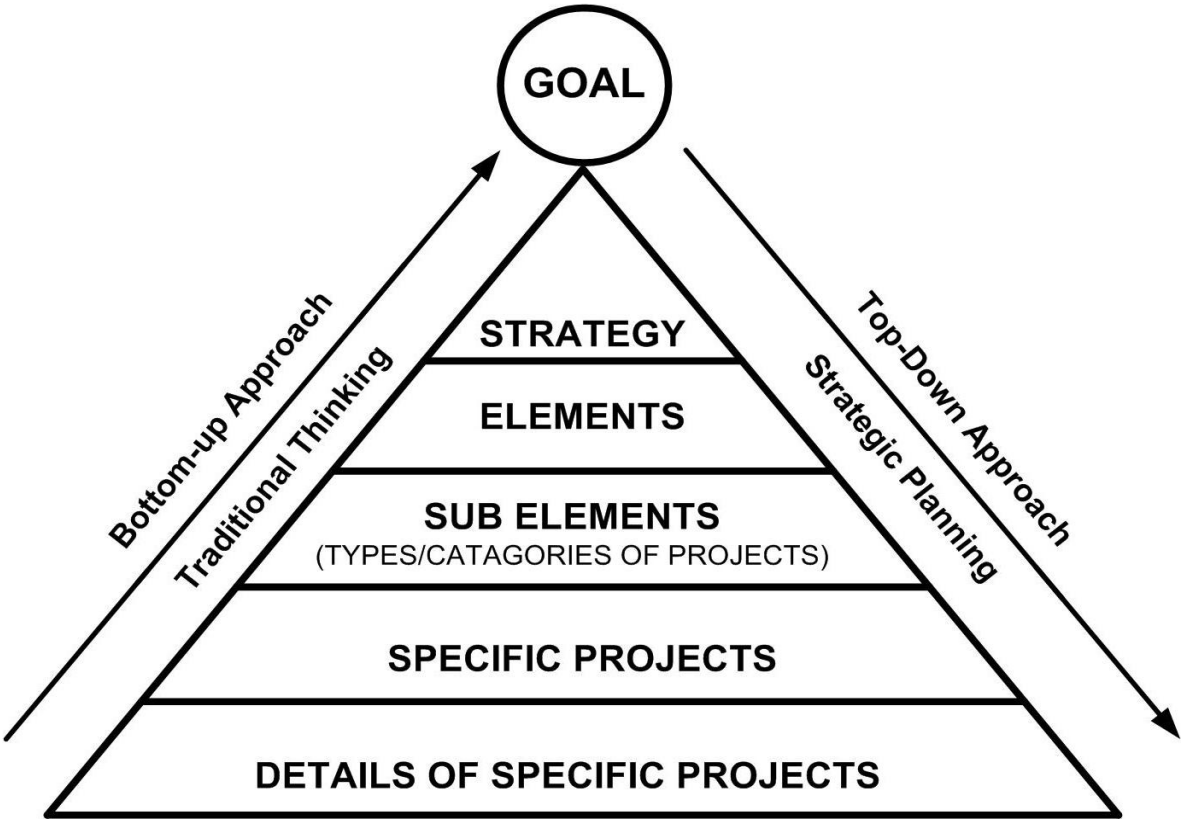
6. STRATEGIC PLANNING APPROACH

6.1 INTRODUCTION

As a general rule in developing transport systems, there is a natural tendency to think in terms of specific projects, programs and actions, because that is the level at which more time, attention and effort is normally spent. Within such a context, the development of transport strategies typically follows a bottom-up approach (i.e. from the specific to the general). In this manner, an accumulation of projects, programs and actions evolves into a so called "strategy", wherein some of the projects, programs and actions may complement each other and others may conflict with one another. While such an ad hoc approach may serve a particular purpose at a given time, it is in fact only a list of projects, programs and actions; it is not a strategy.

Strategic planning implies a different approach, one that follows a top-down approach (i.e. from the general to the specific). First identifying the desired endpoint (goals), next establishing the preferred direction or approach (strategy) and then developing specific ways and means (projects, programs and actions) for implementation that are consistent with the strategy and lead toward the goal. **Exhibit 6-1** illustrates this differentiation between a bottom-up approach (from specific to the general) and a top down approach (from the general to the specific).

Exhibit 6-1 Development of Transport Strategies



Strategic planning is a multi-step process which includes:

- establishing goals and a vision for the future,
- selecting a general direction or approach (strategy) that is intended to move toward the achievement of the vision and goals, and then
- developing specific actions (e.g. projects, programs) that are consistent with the strategy, and are aimed at achieving the vision and goals.

As time passes and progress occurs, specific actions may need to change in order to reflect changing conditions and unanticipated opportunities or constraints. The end point (vision/goals) and the general strategy for moving towards that end point, however, continue to serve as a valid framework for investment and service decision making, until such time as a revised or different end point is properly constituted.

6.2 SCOPE & PURPOSE

The purpose of a Strategic Transport Plan is to provide an overall comprehensive framework for achieving local, regional and national goals by efficiently managing the operation and maintenance of the transport sector and guiding decision makers in the allocation of financial, technical and administrative resources.

6.3 VISION/GOALS/OBJECTIVES

At the present time, Dhaka has a substantial and notable transport sector, comprising a unique mix of transport modes and conditions. To imply otherwise, fails to recognize the fact that each day, in a densely populated urban centre, some 12 million people carry on a myriad of businesses and other important and necessary functions. These activities take place in a dynamic and creative manner, reflecting much of the same creativity and entrepreneurial qualities, as exist in more developed countries, albeit at a different level. Many cities in the "developed" world would envy a situation wherein a very high portion of all trips are made by walking and by non-motorized means, and only a small portion by private automobile.

As Dhaka moves forward into a future that is expected to include rapid continued growth and development, the vision is to create a safe, efficient, and effective multi-modal transport system that serves the needs and interest of everyone.

> ***VISION*:** *To develop and maintain a sustainable multi-modal transportation system, serving the mobility needs of society by ensuring a safe and efficient transport system that supports social and economic development as well as international competitiveness, ensures a healthy and secure environment for all of its residents and contributes towards the poverty alleviation.*

The strategic issues facing the transport sector reflect, for the most part, those that face the Dhaka Metropolitan Area as a whole. These issues necessitate a reconsideration of policies and planning in the light of current realities. Dhaka is entering a period in which major challenges will need to be faced, and in which the approaches of the past decade, albeit helpful, are not sufficient in terms of effectiveness and efficiency.

Examples of such changes that necessitate a re-thinking of transport policy include:

- The demographic trends of the last decade that have resulted in rapid population growth are expected to continue in the coming decades. The impact of such rapid growth has

major consequences on the ability of the transport sector to provide mobility for all people as they seek to take advantage of employment, education, health and social opportunities.

- The rapid population growth has resulted in a lack of control of the public rights-of-way (e.g. roads, pedestrian walkways, railroad etc.) and a high level of operational disorder. This lack of control significantly diminishes the efficiency and effectiveness of the existing transport uses. One of the major untapped transport related assets of Dhaka, is the substantial additional unused capacity in the existing road system that is now being wasted through inappropriate use and behaviour. A major challenge is to move forward in a positive and definitive manner to reclaim the full potential capacity of the existing road space by relocation and removing inappropriate uses and by organizing and improving the operational practices of appropriate uses.

- In addition to Old Dhaka, where streets are very narrow, much of the rapid growth and development that has occurred during the past decade has occurred in an informal, unplanned manner, resulting in large residential areas with narrow circuitous lanes that are poorly suited for motorized traffic. These areas provide housing and services to very high concentrations of people, many of whom have very limited resources. The challenge for the transport sector is to develop options that provide a reasonable level of mobility and accessibility for these and other groups that are too often overlooked.

- The good news is that Dhaka has a very large number of rickshaws. The bad news also is that Dhaka has a very large number of rickshaws. So goes the argument, in the seemingly endless debate regarding this important mode of transport and what its appropriate role should be within the dense urban context of Dhaka[1].

- Poverty alleviation is a national goal of the utmost importance. As Dhaka continues to assimilate a continuing influx of the rural populace, many of whom find themselves in poor economic and living conditions, it is essential that the planning and provision of transport services addresses this issue in a positive and pro-active manner that provides good opportunities for improved economic and living conditions for the poor.

- Land use and development is the major determining factor of transport needs as well as the manner and efficiency of transport services. Apart from the laudable earlier efforts which resulted in the Dhaka Structure Plan, land use planning together with the regulation and control of development occur now on an ad hoc basis, seemingly at the whim of whomever has sufficient influence to impose their will. Without a more rigorous approach to the establishment and adherence to approved plans, controls and regulations, the opportunity to provide efficient and effective transport services is seriously compromised. While transport has the potential to influence and support land use in a positive way, it cannot offset a lack of proper land use planning and development control, except in a superficial and inefficient manner.

- Dhaka, a metropolitan area of some 12 million people, needs some form of mass rapid transit to provide good quality transport at an affordable cost for a large number of users. As the area continues its growth to some 36 million people in 2024 and beyond, the need for such a system will become even more acute. The challenge for the transport sector is to deliver a system that is affordable, achievable, and available to a large segment of the population.

[1] *The STP study has provided a suggestion for a policy for the future role and control of Rickshaws. This is included in a separate report entitled "Urban Transport Policy".*

These and other issues and considerations lead to the following set of eight primary goals for the transport sector. While several other organizational groupings and/or headings could be made, this set of eight primary goals is a comprehensive and balanced approach that considers the multi-modal aspects of the transport sector, the priority areas of need and concern within the transport sector, and the overall scope and intent of the Strategic Transport Plan for Dhaka.

6.4 STRATEGIC GOALS

The primary goals which help define the strategic plan have been identified and refined over a long period of consultation involving many stakeholders. The consultation process took the form of informal meetings and more formalised Workshops and Round Table Seminars. The following eight primary goals were identified:

1. *Efficiency*

   Ensure that the maintenance, operation, reliability and expansion of the transport sector services and facilities occur in an efficient and effective manner with emphasis on maximizing the use of existing resources and investments.

2. *Mobility & Accessibility*

   Provide a basic level of mobility and accessibility for all segments of society to ensure reasonable access to employment, education, health, social and other services and opportunities.

3. Safety

   Develop and implement a coordinated and comprehensive set of safety improvement measures addressing all aspects of the transport system to reduce the number of transportation related deaths and the number and severity of transportation related injuries and property damage.

4. Affordability

   Ensure a suitable balance between the transport sector's financial requirements for maintenance, operations and capital investments and anticipated financial resources.

5. Achievability

   Develop transport operations and capital investment projects and services that fit within the skills, capabilities and constraints of the institutions responsible for implementation.

6. Economic Development

   Support economic growth and competitiveness, both domestically and internationally.

7. Social Development

   Support programs and efforts directed toward the alleviation of poverty and the promotion of self-sufficiency together with the provision of opportunities and services that serve the requirements of both women and men, equally.

8. *Environment*

   Minimize the transport sector's negative impact on the environment and create increased transport-related environmental awareness in society.

For each of these eight primary strategic goals, a set of sub-goals is presented to help define the scope and focus of each. For example, the definition of the primary goal entitled "Efficiency" is too "high level" and general to provide a meaningful insight or understanding of the intent. Therefore, sub-goals are presented as a way of defining and clarifying this primary goal. These sub-goals deal with road use, demand management, land use and transport inter-relationship, privatisation, system performance, inter-modal linkages, and pricing. Furthermore, for each sub-goal, a set of general objectives is presented to provide further clarification of the current thinking and understanding associated with each sub-goal. Specific objectives with corresponding activities and performance measures are not included as part of the current study but would be the next logical step as work continues within the context of the framework of the Strategic Transport Plan.

6.5 STRATEGIC GOAL #1: EFFICIENCY

Ensure that the maintenance, operation, reliability and expansion of the transport sector services and facilities occur in an efficient and effective manner with emphasis on maximizing the use of existing resources and investments.

Dhaka's transportation system is a myriad of facilities, services, rules and regulations. All of these are operated and administered by a variety of public and private organizations, striving to serve the multiple and diverse needs of a large and complex society within a very densely populated urban setting. Under such circumstances, the opportunities for improved efficiency and cost effectiveness are very significant. For Dhaka, in particular, the opportunities and potential benefits from better, more efficient use of the existing transport services and infrastructure are very high. More efficient usage is also the most cost effective means to address and resolve operational and system capacity problems. Fortunately, the transport system in Dhaka has an untapped reserve of capacity. This untapped reserve represents a valuable resource that can be used as a major component of any comprehensive multi-modal approach by creating immediate new supply to the existing and subsequently the future transport needs for the metropolitan area.

Seven sub-goals address the primary issues of better road use, demand management, relationship of land use and transport, privatisation, system performance, inter-modal linkages and connections, and pricing.

Sub-Goal 1A - Improve the use and efficiency of existing public right-of-way and road space and capacity.

- *Develop an integrated traffic management plan (e.g. traffic operations, driver training, public education and awareness, enforcement).*
- *Remove or relocate non-transport related activities from public right-of-way.*
- *Improve bottlenecks in the transport infrastructure.*
- *Increase passenger carrying capacity of transport system.*
- *Emphasize schemes that make walking easier, less hazardous and less stressful, so that walking (as a complete trip, or as access to/from other modes of travel) becomes a preferred choice rather than a necessity.*
- Encourage the use of bicycles as a transport mode, by providing suitable facilities.

Sub-Goal 1B - Use demand management as a means to influence travel characteristics in order to improve transport efficiency.

- *Develop an integrated travel demand management plan focusing on reducing the number of low occupancy motorized vehicle trips, particularly during the peak period.*
- *Increase passenger carrying capacity of transport system.*

Sub-Goal 1C - Relate transport investment and land use development decisions.

- *Establish comprehensive land use and transportation plan development procedures that include provision for periodic review, evaluation and revision so as to reflect changing conditions.*
- *Establish procedures whereby decisions regarding major transport service and infrastructure investments are based upon comprehensive project feasibility studies.*
- *Use traffic impact analyses (TIA) to determine transport related impacts and to establish mitigation requirements and improvements for significant new development and redevelopment projects.*

Sub-Goal 1D - Encourage and facilitate private sector involvement.

- *Privatise existing government transport services whenever feasible.*
- *Promote schemes for private funding of transport facilities and new infrastructure.*
- *Encourage private sector involvement in the development and application of advanced technologies within the transport sector.*
- *Provide necessary legal and regulatory framework to encourage and facilitate private sector participation.*

Sub-Goal 1E - Improve overall performance of transport service providers, both public and private.

- *Establish minimum performance standards and monitor performance of service providers.*
- *Develop human resources in all fields of transportation.*
- *Improve organizational, administrative and managerial functions.*
- *Provide necessary legal and regulatory framework for efficient operation by service providers.*
- *Promote scientific activity, informational exchange and advanced technology applications.*

Sub-Goal 1F - Provide linkages/interconnections between transport modes that encourage their use and facilitate overall integration.

- *Develop physical features (access, service, space and facilities) at locations where transfers and connections between and within travel modes is important.*
- *Establish service coordination (schedules, fares, information) to facilitate transfers and connections between and within travel modes.*

Sub-Goal 1G - Rationalize pricing and cost recovery.

- *Monitor operating cost and revenues of service providers.*
- *Rationalize the system of direct and indirect subsidies in the transport sector.*
- *Establish pricing policies according to future needs and reflecting the economic costs (including externalities) of transport services.*

6.6 STRATEGIC GOAL #2: MOBILITY & ACCESSIBILITY

Provide a basic level of mobility and accessibility for all segments of society to ensure reasonable access to employment, education, health, social and other services and opportunities.

While the proportion of trips that are made by walking is quite high and seemingly quite desirable in the context of a dense urban environment, the reality is that for many, it is not a question of choice, but rather one of necessity. Many of these people are in such a low economic state that they cannot afford even the relatively modest fares charged for public transit services. They simply have no other choice available to them, and therefore have a very

limited degree of mobility and accessibility to services and opportunities. Other groups of people have special needs that limit their mobility and accessibility. Still others are only able to take advantage of the most basic level of accessibility and lack the choice and means to expand their opportunities. Providing opportunities and options to people is a basic part of a healthy economic system and an improved quality of life. Another important aspect of mobility and accessibility includes ways in which the transport sector is readily available for a variety of potential uses in the unexpected event of emergency and security situations that occur periodically.

Three sub-goals address the primary issues of access and mobility needs for all segment of society, disaster response, and security.

Sub-Goal 2A - Meet mobility requirements of all segments of society.

- *Supply all areas with good transport services.*
- *Provide a basic level of transport services to the poorest people.*
- *Serve transportation needs of the disabled and handicapped.*
- *Provide good access to educational institutions and employment opportunities.*
- *Provide alternative transportation modes and options within major travel corridors.*
- *Emphasize schemes that make walking easier, less hazardous and less stressful, so that walking becomes a preferred choice rather than a necessity.*

Sub-Goal 2B - Meet access and mobility needs for natural and man made disasters.

- *Maintain readiness of transport resources to assist in emergency rescue and restoration of services in the event of disasters.*
- *Provide preventive measures that off-set or reduce the adverse consequences of natural and man made disasters.*
- *Work with disaster relief agencies to develop emergency rescue and evacuation plans.*

Sub-Goal 2C - Implement measures that meet mobility needs for national defence.

- *Establish and use infrastructure design standards that include security and defence requirements.*
- *Ensure readiness and capability of all modes of commercial transport to meet national security needs.*
- *Develop contingency plans for evacuation of public when necessary.*

6.7 STRATEGIC GOAL #3: SAFETY

Develop and implement a coordinated and comprehensive set of safety improvement measures addressing all aspects of the transport system to reduce the number of transportation-related deaths and the number and severity of transportation-related injuries and property damage.

The incidence of road crashes, injuries and deaths, and the associated economic loss in terms of property damage, medical costs and lost productivity on roads is unacceptably high, compared with other countries in the region and developed western countries. Road crashes in all of Bangladesh in 2000 are reported to have cause approximately 4,000 deaths and 25,000 injuries, and accounted for some Tk39 billion (USD650 million) in property damage, medical costs and lost productivity each year. Comprehensive programs that address all elements of traffic safety are acutely needed at the national as well as local level.

Six sub-goals address the primary issues of vehicle/driver/infrastructure, enforcement, safety systems and regulations, better information and data, and safety awareness.

Sub-Goal 3A - Improve vehicle/driver/infrastructure components of road safety.

- *Establish and update design standards to incorporate current safety features.*
- *Implement maintenance practices to improve safety.*
- *Establish and maintain up-to-date vehicle equipment standards.*
- *Develop safety standards for all transport vehicles.*
- *Establish and improve vehicle inspection program.*
- *Strengthen driver education and training.*
- *Develop program for handling repeat violators.*
- *Enhance driver/occupant awareness.*

Sub-Goal 3B - Increase enforcement of existing laws and regulations.

- *Strictly enforce existing traffic laws and regulations.*
- *Implement periodic roadside safety inspections.*
- *Review levels of penalties and revise.*

Sub-Goal 3C - Improve system safety and regulations.

- *Develop incident response and management system*
- *Establish road information, services, and emergency assistance.*
- *Review and revise existing regulations to reflect new information and standards.*
- *Develop new regulations as needed (hazardous materials, school transport, traffic citations and fines, etc.)*
- *Introduce/enhance compulsory vehicle insurance at least for third parties.*

Sub-Goal 3D - Improve safety related information and data.

- *Develop usable and consistent incident reporting procedures.*
- *Establish working relationships and information sharing among agencies concerned with incident investigation, reporting, assistance and the provision of medical care.*
- *Implement a comprehensive and coordinated incident information and data system that can be shared by all concerned agencies.*

Sub-Goal 3E - Institute a comprehensive continuous safety awareness campaign.

- *Develop safety-related materials and information communicating safe practices for pedestrians, bicyclists, non-motorized and motorized transport drivers.*
- *Incorporate safety awareness and safe practices as part of the school curriculum.*
- *Conduct a multi-media campaign emphasizing safety, on a periodic basis.*

Sub-Goal 3F - Undertake a Safety Audit of all Arterial Highways.

- *Develop a set of Safety Audit requirements.*
- *Undertake an audit of all roads classified as arterial highways.*
- *Undertake improvements to links and inter-sections in order to comply with the findings of the audits.*

6.8 STRATEGIC GOAL #4: AFFORDABILITY

Ensure a suitable balance between the transport sector's financial requirements for maintenance, operations and capital investments and anticipated financial resources, including full consideration of governmental investments, private sector participation, user charges and other means for cost savings, revenue generation, and investment attraction.

Bangladesh is very dependent upon international aid and subsidized loans. This has tended to skew the decision making process toward the higher visibility, more capital cost intensive projects, at the expense of the day-to-day tasks of managing existing services and infrastructure. In a related sense, there is also a serious imbalance between a proliferation of ideas and concepts and suggestions for transport projects and the likely level of available resources. This has the consequence of causing confusion, uncertainty, and indecision rather than the focus, direction, and coordination needed to move forward. One of the important purposes of the Strategic Transport Plan is to provide the understanding and consensus needed to establish and maintain focus, direction and coordination in the transport sector.

Four sub-goals address the primary issues of costs, financial planning, and budget - resource balance.

Sub-Goal 4A - Develop transport projects and systems that use low to medium cost methods.

- *Give preference to infrastructure development programs that are more labor intensive rather than dependent on imported materials or more mechanized high cost procedures.*
- *Develop transport projects that provide good service and capacity at lower costs.*
- *Minimize the initial investment requirement for project implementation.*
- *Minimize the need for government financing.*
- *Emphasize schemes that make walking easier, less hazardous and less stressful, so that walking becomes a preferred choice rather than a necessity.*
- *Encourage the use of bicycles as a transport mode, by providing suitable facilities.*

Sub-Goal 4B - Develop financial plans that fully consider a broad range of potential means and sources for project financing.

- *Reduce project costs (e.g. land costs, construction costs, operating costs).*
- *Attract private investment (e.g. operating contracts, public/private partnership, BOT/BTO/BLT concessions).*
- *Increase public funding (e.g. grants, development rights, loan guarantee, revenue guarantee).*
- *Use other sources (e.g. multi-lateral and bi-lateral financial institutions, supplier country loans, land development, Bond flotations, special levies).*

Sub-Goal 4C - Constrain the list of recommended projects and services to fit within reasonably anticipated resources.

- *Prioritize projects based upon approved criteria.*
- *Establish a first level set of recommended projects and services for which funding can be anticipated.*
- *Establish a second level set of recommended projects and services (beyond the anticipated resources) to serve as substitutes and/or supplements in order to respond to changing conditions and opportunities*.
- *Avoid the natural tendency to over-subscribe the number of projects relative to the availability of resources.*

Sub-Goal 4D - Organize fare structures at a level which is affordable to all the populations.

- *Establish a basic fare structure to allow sustainable public transit operation.*
- *Identify sectors of the population, which need subsidizing.*
- *Create a method of subsidies that is equitable and focussed*.

6.9 STRATEGIC GOAL #5: ACHIEVABILITY

Develop transport operations and capital investment projects and services that fit within the skills, capabilities and constraints of the institutions responsible for implementation.

In addition to financial resource constraints, it is prudent to acknowledge and assess other limitations and constraints that have a significant influence on the ability to achieve success in the implementation of projects. Projects that provide the opportunity for organizations and individuals to develop and advance their skills and capabilities are a particularly important benefit in a developing country. Achievability is also influenced by the degree of inter-dependency of one project with another project. Projects for which implementation requires major decisions and actions by others have an associated higher level of risk in terms of achievability.

Three sub-goals address the primary issues of organizational capabilities, project inter-dependencies, and project simplicity.

Sub-Goal 5A - Ensure that technical, organizational and logistical skills and requirements to build, operate and maintain transport projects and services are available and/or achievable.

- *Develop technical staff resources within implementation agencies.*
- *Use the private sector to provide and supplement technical skills and capabilities.*

Sub-Goal 5B – Reduce or avoid the inter-dependency of project implementation with the need for implementation of other major projects.

- *Identify inter-dependencies for project implementation and assess the risk involved.*
- *Establish project options and means that reduce the degree of inter-dependency.*
- *Give preference to projects with lower levels of inter-dependency.*

Sub-Goal 5C - Emphasize simplicity in the planning and design of transport projects and programs to reduce uncertainties and complexities.

- *Rely upon means that have a high probability of success in Bangladesh***.**
- *Avoid overly sophisticated, technologically advanced approaches.*
- *Emphasize simplicity in the project conceptualization, planning and design stages.*

6.10 STRATEGIC GOAL #6: ECONOMIC DEVELOPMENT

Support economic growth and competitiveness both domestically and internationally.

The transport sector serves an integral role in the economic growth and development within the Dhaka Metropolitan Area. A rapidly expanding population creates many challenges and opportunities for change and improvement within the transport sector. These changes are also affected by the need to expand and diversify the economic base. At the same time, there is a need to reduce governmental control and regulation and increase private sector participation. For the foreseeable future, diversifying the economic base will require adequate transport infrastructure. This will act to encourage the development of agro-industries near sources of raw materials and export-oriented industries at locations attractive to investors in these industries. Workers will require adequate transport provisions to access these employment centres in a safe and efficient way.

Three sub-goals address the primary issues of economic growth, areas for growth, and international and regional integration.

Sub-Goal 6A - Promote growth and diversification of the economic base.

- *Complete infrastructure projects needed for economic development in a timely and efficient manner.*
- *Reduce transport-related time and cost factors for movement of goods/freight and people.*
- *Expand catchment areas from which companies can draw workers and customers.*
- *Enhance access to areas with high recreational and tourist potential.*

Sub-Goal 6B - Support planned and balanced growth in designated areas of the metropolitan region.

- *Improve transport services for existing development centres.*
- *Plan and develop transport needs for new development centres.*

Sub-Goal 6C - Support national policies and actions to enhance international and regional integration.

- *Reduce transport-related time and cost factors, within the Dhaka Metropolitan Area, for the movement of goods/freight and people with international destinations.*
- *Harmonize operational and infrastructure standards.*

6.11 STRATEGIC GOAL #7: SOCIAL DEVELOPMENT

Support programs and efforts directed toward the alleviation of poverty and the promotion of self-sufficiency together with the provision of opportunities and services that serve the requirements of both women and men equally..

Poverty alleviation, self-sufficiency and provision of opportunities for women are important, clearly stated, national goals for Bangladesh. As such, transport planning and the provision of services must include the identification, consideration and inclusion of means to address these goals in a positive and pro-active manner.

Five sub-goals address the primary issues of affordable options, fare considerations, pedestrian improvements, suitability of transport, and equal opportunity.

Sub-Goal 7A - Develop affordable transport options for low income groups to provide access to additional employment opportunities and other services.

- *Provide good transport services to areas with concentrations of low income groups.*
- *Provide good pedestrian facilities to encourage and facilitate walking.*

Sub-Goal 7B - Establish fare policies that include special consideration of low income groups and others (students, elderly).

- *Provide discounts or subsidies for those who have established needs, especially the poor.*
- *Encourage travel during off-peak or low-peak periods with special fares.*

Sub-Goal 7C - Emphasize schemes that make walking and bicycling easier, less hazardous and less stressful.

- *Make walking a mode of choice, rather than necessity.*
- *Create physical environments that favour pedestrians and encourage walking.*
- *Encourage the use of bicycles as a transport mode, by providing suitable facilities.*
- *Create multi-media campaign to promote walking and cycling as preferred modes of transport.*

Sub-Goal 7D - Ensure that all transport services are suitable for use by all persons, particularly women and selective societal groups (children, disabled, elderly, etc.).

- *Provide random on-board monitoring to prevent harassment and enhance security.*
- *Create an extensive media campaign to promote awareness, educate, and mobilize public sentiment and support.*

Sub-Goal 7E - Ensure that the organization and administration of transport programs and services are conducted in a manner that provides equal opportunity for women.

- *Establish standards, regulations and guidelines.*
- *Institute appropriate measures in the governmental sector.*
- *Require appropriate measures in private sector, as part of government oversight and regulation (licensing, franchising, concessions).*
- *Establish base line and monitor and report on progress on an annual basis.*

6.12 STRATEGIC GOAL #8: ENVIRONMENT

Minimize the transport sector's negative impact on the environment and create increased transport-related environmental awareness in society.

While the transport sector has played a vital role in supporting the economic and social development of Dhaka, it has also brought with it environmental concerns and consequences that need to be addressed. Environmental impacts associated with the motorized portion of the transport sector include: -

(a) levels of gaseous and particulate emissions that pollute the ambient air,

(b) accumulation and disposal of waste products like used batteries and tires, engine oil and coolant, old vehicles, and

(c) dust, dirt and noise resulting from passing vehicles.

Establishment and enforcement of vehicle emission standards (carbon dioxide, nitrogen oxide, hydro-carbons, lead, etc.) have been shown elsewhere to result in dramatic improvements in air quality and reduced health problems, without serious adverse impacts on economic development. The success achieved in Dhaka, with the replacement of the highly polluting two-stroke engine version of the three wheeled baby taxis/auto-rickshaws with natural gas (CNG) versions, is a testament to the benefits and the achievability of such efforts. The current heavy reliance on walking and rickshaws as a means of transport in Dhaka is environmentally beneficial and should not be discouraged. The need and importance of adherence to such standards becomes increasingly evident as the urban population grows, travel and mobility increase, and health problems worsen.

Four sub-goals address the primary issues of reducing negative impacts, use of environmentally valuable resources, use of environmentally harmful substances, and the importance of creating environmental awareness.

Sub-Goal 8A – Control or reduce the negative impacts from transportation operations.

- *Reduce the amount of transportation related pollutants and greenhouse gases released into the environment.*
- *Reduce noise pollution.*
- *Reduce surface and ground water pollution.*

- *Reduce littering along transport facilities.*
- *Protect and enhance neighbourhood/residential amenities.*
- *Use traffic impact analyses (TIA) to determine transport and environmental impacts and to establish mitigation requirements and improvements for significant new projects.*

Sub-Goal 8B – Reduce or avoid consumption of environmentally valuable resources in transport projects.

- *Identify environmentally valuable resources and available alternatives.*
- *Develop standards and classification schemes.*
- *Prepare project level environmental assessments for all transport projects.*
- *Consider environmental and ecological issues in the design and construction of transport infrastructure.*

Sub-Goal 8C - Reduce consumption of environmentally harmful substances and materials.

- *Restrict the use of harmful materials.*
- *Promote and apply environmentally friendly products and technologies in all fields of transportation.*
- *Control disposal of environmentally harmful substances.*

Sub-Goal 8D – Create or enhance environmental awareness in society.

- *Develop environmental training and expertise within governmental agencies.*
- *Include environmental issues more significantly in school curricula.*
- *Use all forms of media information to generate greater awareness of environmental issues.*

6.13 THE WAY FORWARD

The goals and sub-goals described above have significance in the later consideration of transportation alternatives. It will become apparent that the relative achievement of the goals by each alternative strategy contributes to the selection process. Specifically, the goals and sub-goals are used in the subjective evaluation described in Section 8.4.

7. ALTERNATIVE TRANSPORT STRATEGIES

7.1 INTRODUCTION

The first step in the process as used in the STP was to identify a limited set of discreet transport strategies representing a broad range of ways in which the development of the transport sector for Dhaka could proceed. The four transport strategies selected at this early stage were characterized as follows:

a. Transport Strategy One (TS1) – Auto/Roadway Emphasis
b. Transport Strategy Two (TS2) – Bus/Transit Emphasis
c. Transport Strategy Three (TS3) – Auto/Roadway & Bus/Transit Mix
d. Transport Strategy Four (TS4) – Continuation of Current/Recent Practices

Exhibit 7-1 Alternative Transport Strategies

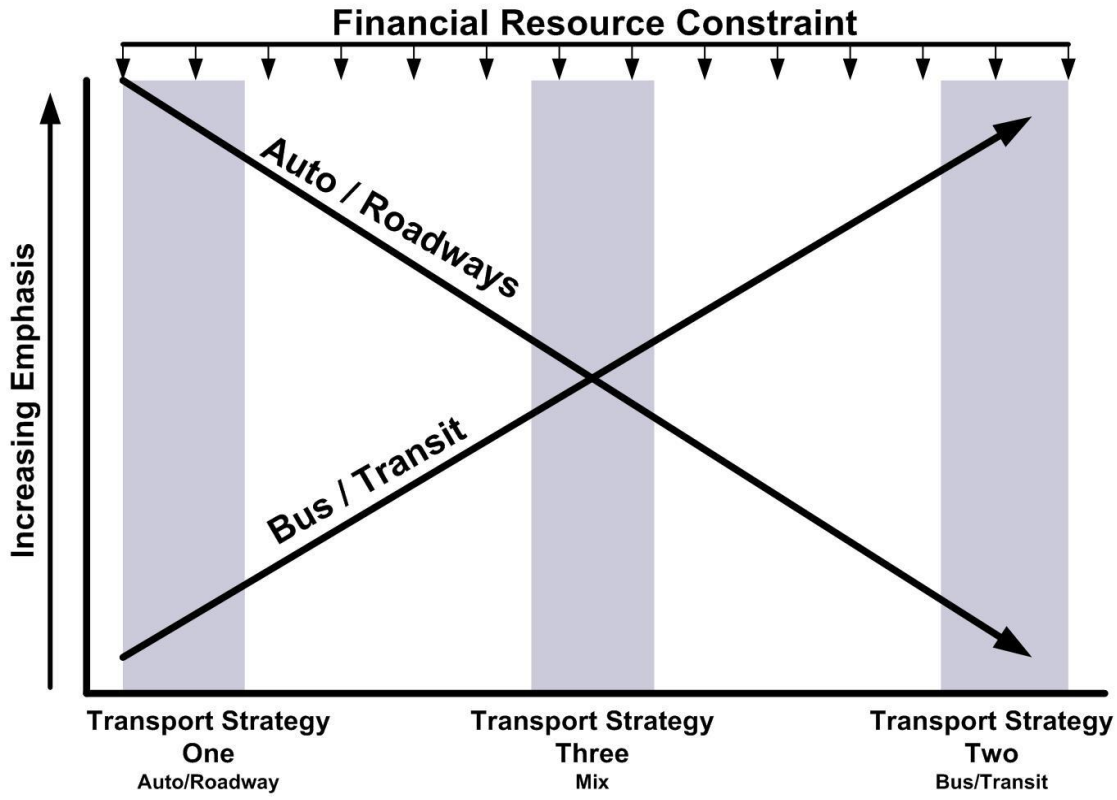


Exhibit 7-2 shows the relationship among the first three strategies. The figure depicts each of the three strategies in relation to the varying levels of auto/road emphasis and bus/rapid transit emphasis. For example, Transport Strategy One (TS1) has a high level of auto/road emphasis and a low level of bus/rapid transit emphasis. Transport Strategy Two (TS2) is the reverse, with a high level of bus/rapid transit emphasis and a low level of auto/road emphasis. Transport Strategy Three (TS3) is a mix of both auto/road and bus/transit, albeit each at only a moderate level of emphasis.

The fourth strategy, is a continuation of current and recent practices. It is intended to provide an understanding of what conditions would be like in the future (2024), with significant population growth, if transport related service and investment decisions were to continue in a manner similar to that occurring now and in the recent past. This is a laissez fare approach without significant interventions. While the results and conditions are not expected to be particularly favourable or desirable, the information will serve as a useful point of reference with respect to what Dhaka would be like if things continue as they have in the recent past. It would also represent a realistic representation of the future if, for example, there is significant resistance or inability to make changes. Hopefully, it will serve as a catalyst for change and motivate the consensus and coordination required for a preferred strategy.

An additional important point, as illustrated in **Exhibit 7-1**, is the concept of a financial resource constraint. This constraint represents a realistic assessment of the amount of financial resources that could reasonably be anticipated for investment in the transport sector, during a given period of time. Without including some consideration of a realistic level of financial resource availability, anything and everything becomes possible. This leads to a proliferation of project and program proposals that become a wish list, rather than a cohesive achievable package. As a consequence, the focus and consensus that is needed in order to accomplish something specific is replaced by a sense of confusion and uncertainty. For example, while it might be natural to think in terms of an additional transport strategy that would combine a high level of both auto/road emphasis and mass rapid transit emphasis, the introduction of consideration of financial resource availability is likely to make such a transport strategy infeasible and unachievable.

7.1.1 Transport Modes and Programs

While the previous discussion focuses upon alternative transport strategies, it is also important to understand that any given strategy is defined by a package consisting of various transport modes and related programs, herein after referred to as “transport elements”. Any given transport strategy is not solely based on auto/road and mass rapid transit definitions, but rather a composite of a number of additional modes and programs, all of which can work together in a coordinated manner to achieve a goal. Conversely, the modes can conflict with one another and work at cross purposes, if not properly planned. The transport elements which are being addressed in this STP study include the following:

Transport Elements

a. Pedestrians
b. Bicycles
c. Non-Motorized Transport
d. Taxi/auto-rickshaw
e. Automobiles
f. Buses
g. Rapid Transit
h. Railroad
i. Trucks
j. Waterways
k. Traffic Management
l. Demand Management
m. Roadways
n. Parking
o. Pricing

For example, Transport Strategy One (TS1) is defined as placing a high level of emphasis on automobile travel, roads and parking improvements. However, it also includes some transit improvements, albeit at a lower level of emphasis, as well as some level of emphasis for each of the other transport elements. Transport Strategy Two (TS2) on the other hand is defined as placing a high level of emphasis on mass rapid transit. However, it also includes some road improvements, as well as some level of emphasis for each of the other transport elements.

7.1.2 Other Transport Strategies

The presentation of the transport strategies was purposely simplified in the early stages to a small number of discreet options. Realistically, however, within each of these transport strategies, there are multiple options. In addition, the blank areas depicted between the strategies (**Exhibit 7-1**) are also comprised of multiple options representing differing levels of emphasis and mix. This generalized approach is used initially to help understand and identify the concept and content of distinct transport options. During the period of analytical evaluation and analysis, (using the travel demand model) the focus centred upon testing a variety of options for each of the transport strategies, in order to determine the best possible combination of elements for each. With this evaluation work fully completed, the resultant information forms the basis for a meaningful consideration of the best combination of elements for each transportation strategy and the selection of the preferred transportation strategy can be accomplished in an orderly and structured manner.

7.2 COMPOSITION OF INITIAL TRANSPORT STRATEGIES

7.2.1 First Level Definition

The next step in the development of each initial transportation strategy was to begin to define them in terms of the fifteen elements listed in section 7.1.1. The first level of refinement was done on the basis of a High – Medium – Low classification as shown in the table referred to as **Exhibit 7-2**. Each transportation strategy was defined in terms of a high, medium or low level of emphasis for each of the fifteen elements. For example, Transport Strategy Two (TS2) has a high level of emphasis on buses and mass rapid transit as well as related modes like pedestrians and non-motorized transport, but a low level of emphasis on roads and parking. Transport Strategy One (TS1), on the other hand, has a high level of emphasis on roads and parking, but a low level of emphasis on buses and mass rapid transit.

Exhibit 7-2 First Level Definition of Transport Strategies

Transport Elements	Transport Strategies			
	TS1 *Auto/Roadways*	**TS2** *Bus/Transit*	**TS3** *Mix*	**TS4** *Current*
Pedestrian	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Bicycle	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Non-Motorized Transport	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Taxi & Auto-rickshaw	*HIGH*	*MEDIUM*	*MEDIUM*	*MEDIUM*
Automobile	*HIGH*	*LOW*	*MEDIUM*	*MEDIUM*
Buses	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Mass-Rapid Transit	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Railroad	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Trucks	*HIGH*	*MEDIUM*	*MEDIUM*	*LOW*
Waterways	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Traffic Management	*HIGH*	*MEDIUM*	*MEDIUM*	*LOW*
Demand Management	*LOW*	*HIGH*	*MEDIUM*	*LOW*
Roads	*HIGH*	*LOW*	*MEDIUM*	*LOW*
Parking	*HIGH*	*LOW*	*MEDIUM*	*LOW*
Pricing	*LOW*	*HIGH*	*MEDIUM*	*MEDIUM*

7.2.2 Second Level Definition

A further refinement, in the development of each transportation strategy, was then completed in a manner that first identified subsets for each of the fifteen elements and then related them to the High – Medium – Low classification for each transportation strategy as shown in **Exhibit 7-3** at the end of this chapter. This Exhibit provides a more specific definition of the role of each transport element for each strategy. For example, the Bus Element is divided into three subsets, representing different levels of improvement (major, intermediate and basic) to reflect differing levels of emphasis and resource commitment. Applying this to the transport strategies, Transport Strategy Two (Transit), with respect to the Bus Element, is classified as "High", which is then further defined as "Major Improvements", whereas Transport Strategy One, with respect to the Bus Element, is classified as "Low", which is then further defined as "Basic Improvements".

In a similar manner, the Road Element is divided into nine subsets representing different levels of improvement, again reflecting differing levels of emphasis and resource commitment. Applying this to the transportation strategies, Transport Strategy Two (Transit), with respect to the Road Element is classified as "Low", which is then further defined as relatively modest improvements involving primarily maintenance, safety, and basic roads in new areas, whereas Transport Strategy One (auto/road), with respect to the Road Element, is classified as "High" which is then further defined as including major improvements such as road widening, flyovers and elevated expressways.

Each of the primary Transport Elements were divided into subsets to reflect distinguishable levels of emphasis and resource commitment, and in a manner that best suited the particular Transport Element. For some of the Transport Elements (e.g. roads and parking), the subsets represent general categories of specific types of projects. For other Transport Elements (e.g. traffic management), the subsets represent varying levels of emphasis and commitment to a combination of several projects and programs.

7.2.3 Third Level Definition

The next step in the development of each transport strategy was to make further definitions of the content of each subset shown for each transport element, in terms of potential projects, programs, and actions. This process was organized into the following two categories.

Category A: The first category involved the preparation of a list of all known previously proposed specific projects and programs some of which are in advanced stages of design and approval and others that have not yet advanced beyond the concept or idea stage of development. Such projects include plans and proposals for an elevated expressway, additional flyovers, many new and upgraded roadways and missing links, mass rapid transit system(s) serving multiple corridors of high demand, commuter rail service, major improvements to bus transport services, full implementation of the circular waterway system including land based transport linkages, significant improvement in traffic management with consequent capacity improvements and other such projects. As an example, a list of 77 highway projects and five (5) corridors for rapid mass transit were identified as candidates for further evaluation.

Category B: The second category was new additional projects and programs (in addition to those in Category A) which were identified as required to meet the needs of the deficiencies that are identified in the transport model testing and evaluation process.

Once the transport model identifies specific transport system deficiencies, the testing and evaluation of various projects, programs, services and actions that address these deficiencies were made as outlined in the next section.

7.3 TESTING INITIAL TRANSPORT STRATEGIES

The procedure for testing and evaluation of transport strategies was organized into a five step process as follows:

- STEP 1 Establish Base Line Information
- STEP 2 Test Transport Strategies for One Land Use Scenario[1]
- STEP 3 Test Transport Strategies for Second Land Use Scenario
- STEP 4 Test Transport Strategies for Third Land Use Scenario
- STEP 5 Other Testing as Required

7.3.1 STEP 1: Establish Base Line Information

The first step included three tests which provided understanding of existing land development with respect to the existing transport systems as well as the potential improvement that a high level of improved traffic management would have on existing conditions of land use and transport. Both of these tests represent the basic reference point for starting the analysis. Also included is testing of the existing transport system plus committed transport projects as well as the additional impact of a high level of improved traffic management for the selected land use scenario.

7.3.2 STEP 2: Test Transport Strategies for Selected Land Use Scenario

The second step in the initial testing included the process of testing and refining each of the four transport strategies for one selected land use scenario. Using the information from Step 1 to help identify where the most critical problems are located, an initial set of transport improvement projects that address these problem areas was identified for initial testing. In the case of Transport Strategy One, emphasis was given to road projects, but other types of projects (include bus) are also included, albeit at a lower level of emphasis. In the case of Transport Strategy Two, emphasis was given to bus and rapid transit projects, but other types of projects (including roads) were also included, albeit at a lower level of emphasis. In the case of Transport Strategy Three, emphasis was given to a mixture of some road projects and some bus and mass rapid transit projects as well as other types of projects.

Each of these tests is in fact an iterative procedure, with the first iteration producing an initial set of results. Following a review of the initial results, some adjustments were made and a second iteration completed. Following a review of the new results, some adjustments were again made and a third iteration was completed. This iterative procedure continues until the best final package was determined.

Once the best final package was determined for Transport Strategy One, the same iterative procedure was repeated for Transport Strategy Two and repeated again for Transport Strategy Three with corresponding different levels of emphasis on the types of projects included for consideration.

7.3.3 Completion of Initial Tests

The completion of the initial strategy testing program was a series of assignments having varying levels of road and mass rapid transit elements combined. These assignments were reviewed and a single strategy was selected as being the best balance between road and mass rapid transit investment. The selected strategy [known then as 2b)] was put forward in the Draft

[1] *Part way through the process of scenario development a presentation was made to the Steering Committee with the result the study was requested to develop only one scenario - representing a Growth Pole development with mass transit emphasis.*

Report published in January 2005. For completeness, the description of this strategy is contained in Annex A at the end of this report.

However, it should be understood that the proposal for the initial Strategy 2b was made as an interim measure in order to commence discussions and derive knowledge on what were the aspirations of various stakeholders. Whilst these discussions were taking place, the development work on the strategy testing proceeded in parallel. The team was also continuing to refine the UTP model to the benefit of future tests.

7.4 MAIN STRATEGY DEVELOPMENT

The evaluation of the alternative transportation strategies provides a broad range of information to guide and support the decision making process. The information is presented in more detail in Chapter 8 following. Actually, any of the strategies included in the testing would serve the needs of Dhaka, albeit in different ways and at different costs. The "best" solution lies with the individual or group making the decision and reflects their own personal interest and professional responsibilities, as well as the evaluator's bias and self-interest.

Based upon an initial assessment of the technical information from the travel demand model (the basis for the recommendation presented in the draft STP report dated January 2005), a series of ten alternative transportation strategies were identified. These strategies are distinguishable from each other and include a broad range of road investment, transit investment and various mixes of both road and transit investments, together with other multi-modal transportation components comprising the diverse system that serves Dhaka.

7.4.1 Strategy Elements

The ten transportation strategies developed and tested are identified as follows:

Base Case	ROADS	NO BRT	NO METRO
Alternative 1a	ROADS +	ALL BRT	NO METRO
Alternative 1b	ROADS +	BRT	METRO
Alternative 1c	ROADS +	NO BRT	ALL METRO
Alternative 2a	ROADS ++	ALL BRT	NO METRO
Alternative 2b[2]	ROADS ++	BRT	METRO
Alternative 2c	ROADS ++	NO BRT	ALL METRO
Alternative 3a	ROADS +++	ALL BRT	NO METRO
Alternative 3b	ROADS +++	BRT	METRO
Alternative 3c	ROADS +++	NO BRT	ALL METRO
Alternative 3d	ROADS +++	NO BRT	NO METRO

The Base Case is not a real strategy. Instead it provides a point of reference by showing what conditions would be like in the future if no significant actions were taken with respect to transportation investment. In the Base Case, the highway package is referred to as Roads and includes 13 projects most of which were completed within DUTP and generally referred to previously as Group A.

[2] *This strategy is similar to that presented in the Draft Report presented in January 2005.*

The ten strategies are described in terms of three distinct levels of increasing road investment (termed - ROADS+, ROADS++, and ROADS+++) and three distinct levels of transit investment (by varying the BRT and METRO components). Diagrams showing all of these aspects are contained in Chapter 8.

7.4.2 Components of Alternative Transportation Strategies

Within each of the strategies, there is a large number of components which combine in different ways and at different levels of investment. The primary variants are: -

- The level of road investment;
- The type and amount of mass transit investment;
- Other forms of public transport;
- Traffic management;
- Pedestrian facilities; and
- Non-motorised transport.

Importantly, all of the strategies include assumptions on the need for two other main components namely:

- The completion of the eastern portion of the Circular Waterway and
- Major improvements to the railway system.

Exhibit 7-3 Second Level Definition of Transport Strategies

Transport Elements		Transport Sub - Elements	Levels of Emphasis: *Auto*		*Mix*		*Transit*
			LOW		MEDIUM		HIGH
PEDESTRIANS			1	2	3	4	5
	a.	Major improvement	NO		NO		**YES**
	b.	Moderate improvement	NO		**YES**		NO
	c.	Basic improvement	**YES**		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			LOW		MEDIUM		HIGH
BICYCLES			1	2	3	4	5
	a.	Major improvement	NO		NO		**YES**
	b.	Intermediate improvement	NO		**YES**		NO
	c.	Current system	**YES**		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
NON-MOTORIZED TRANSPORT			LOW		MEDIUM		HIGH
			1	2	3	4	5
Bus/transit feeder	a.	Major improvement	NO		NO		**YES**
Local area circulation	b.	Intermediate improvement	NO		**YES**		NO
Missing links	c.	Basic improvement	**YES**		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
TAXI & AUTO-RICKSHAW			HIGH		MEDIUM		LOW
			5	4	3	2	1
	a.	Major improvement	**YES**		NO		NO
	b.	Intermediate improvement	NO		**YES**		NO
	c.	Basic improvement	NO		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			HIGH		MEDIUM		LOW
AUTOMOBILE			5	4	3	2	1
	a.	Major improvement	**YES**		NO		NO
	b.	Intermediate improvement	NO		**YES**		NO
	c.	Basic improvement	NO		NO		**YES**

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			LOW		MEDIUM		HIGH
BUSES			1	2	3	4	5
Better buses	a.	Major improvement	NO		NO		**YES**
Bus terminals	b.	Intermediate improvement	NO		**YES**		NO
Consolidations	c.	Basic improvement	**YES**		NO		NO

Exhibit 7-3 (Continued) Second Level Definition of Transport Strategies

Transport Elements		Transport Sub - Elements	Levels of Emphasis: *Auto*		*Mix*		*Transit*
MASS-RAPID TRANSIT			**LOW**		**MEDIUM**		**HIGH**
			1	**2**	**3**	**4**	**5**
Bus Rapid Transit	a.	Extensive coverage	NO		NO		**YES**
Light Rail Transit	b.	Basic coverage	NO		**YES**		NO
Metro Rapid Transit	c.	No coverage	NO		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			LOW		**MEDIUM**		**HIGH**
RAILROAD			**1**	**2**	**3**	**4**	**5**
	a.	Relocate	**YES**		NO		NO
	b.	Extensive upgrade	NO		NO		**YES**
	c.	Basic upgrade in place	NO		**YES**		NO
	d.	Current level of service	**YES**		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			HIGH		**MEDIUM**		**LOW**
TRUCKS			**5**	**4**	**3**	**2**	**1**
Terminals	a.	Major improvement	**YES**		NO		NO
Regulations	b.	Intermediate improvement	NO		**YES**		NO
	c.	Current system	NO		NO		**YES**

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			LOW		**MEDIUM**		**HIGH**
WATERWAYS			**1**	**2**	**3**	**4**	**5**
	a.	Extensive system	NO		NO		**YES**
	b.	Intermediate system	NO		**YES**		NO
	c.	Current system	**YES**		NO		NO

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
TRAFFIC MANAGEMENT			**HIGH**		**MEDIUM**		**LOW**
			5	**4**	**3**	**2**	**1**
Enforcement	a.	Major improvement	**YES**		NO		NO
Traffic operations	b.	Intermediate improvement	NO		**YES**		NO
Driver training	c.	Current system	NO		NO		**YES**
Roadside interference							

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
DEMAND MANAGEMENT			**LOW**		**MEDIUM**		**HIGH**
			1	**2**	**3**	**4**	**5**
Area pricing	a.	Major emphasis	NO		NO		**YES**
Licensing schemes	b.	Intermediate emphasis	NO		**YES**		NO
High occupancy vehicles	c.	Current system	**YES**		NO		NO
Staggered work hours							

Exhibit 7-3 (Continued) Second Level Definition of Transport Strategies

Transport Elements		Transport Sub - Elements	Levels of Emphasis: *Auto*		*Mix*		*Transit*
			HIGH		MEDIUM		LOW
ROADS			5	2	3	4	1
	a.	Elevated expressways	**YES**		NO		NO
	b.	Flyovers	**YES**		NO		NO
	c.	Widen existing roads	**YES**		NO		NO
	d.	Missing links	**YES**		**YES**		NO
	e.	Intersection widening	**YES**		**YES**		NO
	f.	More roads in new areas	**YES**		**YES**		NO
	g.	Basic road to new areas	**YES**		**YES**		**YES**
	h.	Safety improvements	**YES**		**YES**		**YES**
	I.	Road maintenance	**YES**		**YES**		**YES**

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			HIGH		MEDIUM		LOW
PARKING			5	4	3	2	1
	a.	Public parking structures	**YES**		NO		NO
	b.	Public parking lots	**YES**		**YES**		NO
	c.	Commercial Dev. Require	**YES**		**YES**		NO
	d.	Residential Dev. Require.	**YES**		NO		NO
	e.	On-street parking	**YES**		**YES**		**YES**

Elements		Sub - Elements	*Auto*		*Mix*		*Transit*
			LOW		MEDIUM		HIGH
PRICING			1	2	3	4	5
	a.	Tolls	NO		**YES**		**YES**
	b.	Parking charge	NO		**YES**		**YES**
	c.	Fares	NO		**YES**		**YES**
	d.	Import duty	NO		NO		**YES**
	e.	Vehicle regis./license	NO		NO		**YES**
	f.	Fuel tax	NO		NO		**YES**
	g.	Subsidies	NO		**YES**		**YES**

8. EVALUATION OF ALTERNATIVE TRANSPORTATION STRATEGIES

8.1 INTRODUCTION

This section describes the methodology used in, and the results from the evaluation of the alternative transportation strategies. It provides the basic information required to guide the decision making process leading toward the selection of a recommended Strategic Transport Plan for Dhaka. The process uses a number of measures to assess the features and characteristics attributable to each of the alternative transportation strategies including: -

(i) The assessment of existing conditions as described in Chapters 2 and 3;
(ii) The concept of the Growth Pole/Satellite Cities Land Use Scenario as described in Chapter 4;
(iii) The use of the travel demand model described in Chapter 5 to quantify future transportation needs and characteristics;
(iv) The use of the goals and objectives as presented in Chapter 6; and
(v) The definition of a set of distinguishable alternative transportation strategies comprised of a broad range of multi-modal components which serve Dhaka, as described in Chapter 7.

The evaluation of the alternative transportation strategies provides a broad range of information to guide and support the decision making process. The information is presented in as objective a manner as possible and, consequently does not lead toward any one of the strategies as being the "best" solution. Realistically, any of the strategies included in this evaluation would serve the needs of Dhaka, albeit in different ways and at different costs, both financial and social. The "best" solution is in the eye of the beholder and reflects his own personal interest and professional responsibilities, as well as the evaluator's bias and self-interest. By open and informed discussions, based in part upon this evaluation information for each of the strategies, a consensus regarding the "right" alternative, or variation thereof, will emerge as the Strategic Transportation Plan for Dhaka. The process should, therefore, lead toward obtaining the support and ownership needed in order to garner and motivate the human and financial resources needed to move forward with implementation.

The evaluation of the strategies is presented in the following parts:

Part A: Description of Alternative Transportation Strategies (see section 8.2) – Identification and description of ten (10) distinguishable alternative transportation strategies covering a range of emphasis on roads and transit, and including other elements of a multi-modal transportation system for Dhaka as described in Chapter 7.

Part B: Objective Evaluation of Alternative Transportation Strategies (see section 8.3) – Use of technical output regarding future travel characteristics and patterns from the travel demand model as described in Chapter 5 in order to assess travel characteristics and patterns for the future population in accordance with the Growth Pole/Satellite Cities land use and development pattern as described in Chapter 4.

Part C: Subjective Evaluation of Alternative Transportation Strategies (see section 8.4) – Use of the goals and objectives defined for the STP study and described in Chapter 6 as the framework.

Part D: Descriptive Evaluation of Alternative Transportation Strategies (see section 8.5) - A written summary of basic indicators describing each alternative transportation strategy in a concise manner.

8.2 DESCRIPTION OF ALTERNATIVE TRANSPORTATION STRATEGIES

8.2.1 Identification of Strategies

Based upon an initial assessment of the technical information from the travel demand model (the basis for the recommendation presented in the draft STP report dated January 2005), a series of ten alternative transportation strategies were identified. These strategies are distinguishable from each other and include a broad range of road investment, transit investment and various mixes of both road and transit investments, together with other multi-modal transportation components comprising the diverse system that serves Dhaka.

The ten transportation strategies evaluated are identified as follows:

Base Case	ROADS	NO BRT	NO METRO
Alternative 1a	ROADS +	ALL BRT	NO METRO
Alternative 1b	ROADS +	BRT	METRO
Alternative 1c	ROADS +	NO BRT	ALL METRO
Alternative 2a	ROADS ++	ALL BRT	NO METRO
Alternative 2b[1]	ROADS ++	BRT	METRO
Alternative 2c	ROADS ++	NO BRT	ALL METRO
Alternative 3a	ROADS +++	ALL BRT	NO METRO
Alternative 3b	ROADS +++	BRT	METRO
Alternative 3c	ROADS +++	NO BRT	ALL METRO
Alternative 3d	ROADS +++	NO BRT	NO METRO

The Base Case is not a real strategy. Instead it provides a point of reference by showing what conditions would be like in the future if no significant actions were taken with respect to transportation investment. In the Base Case, the highway package is referred to as Roads and includes 13 projects most of which were completed within DUTP and generally referred to previously as Group A.

The ten strategies are described in terms of three distinct levels of increasing road investment (termed - ROADS+, ROADS++, and ROADS+++) and three distinct levels of transit investment (by varying the BRT and METRO components). A number of graphics are shown to illustrate these components clearly referred to in the text and contained at the end of the chapter.

8.2.2 Components of Alternative Transportation Strategies

Within each of the strategies, there is a large number of components which combine in different ways and at different levels of investment. The primary variants are: -

- The level of road investment in which four levels have been investigated;
- The type and amount of mass transit investment including blends of BRT and Metro;
- The level of demand for other forms of public transport;
- The extent of traffic management required to support other assumptions;
- The degree to which pedestrian facilities are required to complement the other forms of transport; and
- The level of investment and control applied to non-motorised transport.

[1] *This strategy is similar to that presented in the Draft Report presented in January 2005.*

Importantly, all of the strategies include assumptions on the need for two other main components namely: -

- The completion of the eastern portion of the Circular Waterway and
- Major improvements to the railway system.

The definition of what constitutes each of these categories as well as accompanying related components is shown in tabular form as Exhibit 8-1 below.

Not included in Exhibit 8-1 are the two major investments, which are considered to be common to all future strategies. These are: -

- **CIRCULAR WATERWAY**

  It has been assumed that the eastern portion of the Circular Waterway would be completed during the 20 year project life at an estimated cost of US$50 millions

- **BANGLADESH RAILWAY**

  A major decision is required in connection with the national railway system in as far as it affects the study area. The railway is currently operating at below acceptable standards and decisions are required either to eliminate it from the equation or to include a major investment program. The necessary improvements have been included as a common factor in all strategies at a cost of US$1 billion. However, so as not to confuse the evaluation process, the railway costs have been separated. Further information can be found in section 9.3 of this report.

Exhibit 8-1 Description of Components of Strategies

Component	Description	Cost ($)	Ref
ROADS	All main roads in study area plus 13 projects already opened for traffic or under construction and referred to previously as Group A projects.	149m	Exhibits 8-2 & 8-3
ROADS+	All roads included in Roads (above) together with a number of other basic access projects. In all a total of 52 projects.	800m	Exhibits 8-4 & 8-5
ROADS++	All roads included in Roads+ (above) plus several additional important access roads (most notably the Eastern and Western Bypasses). In all a total of 60 projects.	1.1bn	Exhibits 8-6 & 8-7
ROADS+++	All roads included in Roads++ (above) plus a comprehensive elevated express system for the DCC area and additional basic access in rural areas. In all a total of 78 projects.	2.0bn	Exhibits 8-8 & 8-9
ALL BRT / NO METRO	An extensive BRT system serving the DCC area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 200 kms of BRT mass transit.	1.0bn	Exhibits 8-10 & 8-11
BRT and METRO	A two line (36 kms) metro system plus a moderate BRT system (174 kms) serving the DCC area and reaching to the satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 210 kms of mass transit.	3.6bn	Exhibits 8-12 & 8-13
ALL METRO NO BRT	A three line Metro system serving the DCC area with a total line length of 63 kms.	4.7bn	Exhibits 8-14 & 8-15

Component	Description	Cost ($)	Ref
BUSES (regular services) NO METRO NO BRT	This is a strategy favouring road construction and relying on stage carriage buses for public transport. There will be investment at different levels noted as follows: Major Improvements – High Level Intermediate Improvement – Medium/High Moderate Improvement – Medium Basic Improvement – Low Current Situation – Zero investment	 100m 75m 50m 25m zero	
TRAFFIC MAN'GMENT	This element provides varying levels of traffic management in order to support the other aspects of each strategy. There will be investment at different levels noted as follows: Major Improvements – High Level Intermediate Improvement – Medium/High Moderate Improvement – Medium Basic Improvement – Low Current Situation – Zero investment	 30m 20m 15m 5m zero	
PED'TRIAN	This element provides varying levels of investment in pedestrian facilities in order to support and complement the other aspects of each strategy. There will be investment at different levels noted as follows: Major Improvements – High Level Intermediate Improvement – Medium/High Moderate Improvement – Medium Basic Improvement – Low Current Situation – Zero investment	 15m 10m 7.5m 2.5m zero	
NMT	This element provides varying levels of investment in NMT in order to complement the other aspects of each strategy. There will be investment at different levels noted as follows: Major Improvements – High Level Intermediate Improvement – Medium/High Moderate Improvement – Medium Basic Improvement – Low Current Situation – Zero investment	 15m 10m 7.5m 2.5m zero	

8.2.3 Description of Alternative Transportation Strategies

Referring back to section 8.2.1 and Exhibit 8-1, each of the alternative transportation strategies is described below in terms of its respective components: -

Base Case Condition includes - ROADS plus NO BRT plus NO METRO

The Base Case strategy is used in the evaluation process in order to provide a comparison between what would happen to transportation systems in a situation where the minimum work was undertaken (referred to as a "Do minimum" situation) and what would happen as a result of making the improvements in each different strategy (each of them referred to as a "Do something" situation). For the Base Case, the assumptions are that only those projects already under construction would be included. For this study therefore, the 13 projects which have been referred to previously as Group A projects have been included. This is the group of projects terms "Roads" in Exhibit 8-1 and is shown graphically in Exhibits 8-2 and 8-3. No further improvements are included in any other component. All strategies include these projects as a given and then add variations for the evaluation process.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

Component	Description	Cost ($)
ROADS	The 13 road projects described previously as constituting Group A – largely built or under construction mostly as part of DUTP.	149.4m
No BRT/No Metro	The public transport system will rely on the current bus system albeit upgraded from time to time by the operators themselves.	zero
Buses Regular Services	Current services will continue and upgrading will take place by the operators.	zero
Traffic Management	No change in the current situation.	zero
Pedestrian Facilities	No change in the current situation.	zero
NMT Transportation	No change in the current situation.	zero
Circular Waterway	No change in the current situation.	zero
Bangladesh Railways	No change in the current situation.	zero
	Total Cost	**149.4m**

Strategy 1a includes - ROADS+ ALL BRT NO METRO

The strategies with a prefix 1, all contain the series of road projects referred to as Roads+ in Exhibit 8-1 and shown graphically in Exhibits 8-4 and 8-5. These constitute 52 road projects of varying lengths and widths. Primarily they form the basic access needs for the study area and complete a number of east-west routes thereby forming a basic grid of strategic roads.

The main feature of the strategy is that there will be a comprehensive mass transit system based exclusively on BRT technology and as shown on Exhibits 8-13 and 8-14. The system will cover 200kms and will extend to the neighbouring satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj.

There will be no Metro system in this strategy.

The current regular bus services will receive a moderate improvement leading to an upgrading of the current situation and aimed at providing organized feeder services together with new routes provided for areas not being served by the BRT system.

In order for the BRT system to work efficiently, there will need to be a major expenditure and effort made to create a high quality traffic management system at least on those roads which will carry the BRT lines. The Terms of Reference for this work will be written by the STP team for implementation by others and will include – signing (both boards and lane markings), channelization at intersections and on links, street lighting, median additions, clearly defined stop lines, high visibility pedestrian crossings, controls on parking and removal of obstructions to both carriageway and footpaths. An integral part of this traffic management program will be a high level of infrastructure provision and operational control for both pedestrians and non-motorized vehicles. The strategy will provide for continuous footpath routes and safe crossings for pedestrians and will encourage and plan for the feeder services by NMT traffic.

The strategy assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

1a Components	Description	Cost ($)
ROADS +	The 52 road projects which together will form a basic access for the study area.	800m
ALL BRT No Metro	An extensive BRT system serving the study area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 200 kms of BRT mass transit.	1.0bn
Buses Regular Services	Medium investment leading to a moderate improvement in services.	50m
Traffic Management	Major effort and investment at least on those roads designed to carry the BRT Lines.	30m
Pedestrian Facilities	Major effort and investment on arterial roads and those used heavily by pedestrians.	15m
NMT Transportation	Major effort and investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	15m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**3.0bn**

Strategy 1b includes ROADS+ BRT METRO

As with 1a, the strategy includes a series of road projects referred to as Roads+ in Exhibit 8-1 and shown graphically in Exhibits 8-4 and 8-5. These roads constitute 52 road projects of varying lengths and widths. Primarily they form the basic access needs for the study area and complete a number of east-west routes thereby forming a basic grid of strategic roads.

The main feature of the strategy is the inclusion of a comprehensive mass transit system based on a blend of BRT and Metro and as shown on Exhibits 8-15 and 8-16. The system will cover 210kms and will extend to the neighbouring satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. There will be a two line Metro system serving the Airport Road and Mirpur Road corridors amounting to 36kms, most of which will be grade separated. The BRT network will complement the Metro network and there will be interchanges at frequent locations.

As with strategy 1a, the current stage carriage bus services will receive a moderate improvement leading to an upgrading of the current situation and aimed at providing organized feeder services together with new routes provided for areas not being served by the Metro and BRT systems.

Due to the fact that the Metro will be largely grade separated, the extent of the traffic management on the arterials will be reduced. This will mean a reduction in the lengths of arterials which will need to receive the necessary traffic management improvements. There will be a parallel reduction in the investments in pedestrian and NMT organization to an intermediate level.

As with all other strategies, strategy 1b assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

1b Components	Description	Cost ($)
ROADS +	The 52 road projects which together will form a basic access for the study area.	800m
BRT METRO	An extensive mass transit system based on a blend of both Metro and BRT serving the study area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 210 kms of mass transit.	3.6bn
Buses Regular Services	Medium investment leading to a moderate improvement in services.	50m
Traffic Management	Intermediate investment at least on those roads designed to carry the BRT Lines.	20m
Pedestrian Facilities	Intermediate investment on arterial roads and those used heavily by pedestrians.	10m
NMT Transportation	Intermediate investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	10m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**5.5bn**

Strategy 1c includes - ROADS+ NO BRT ALL METRO

As with 1a, the strategy includes a series of road projects referred to as Roads+ in Exhibit 8-1 and shown graphically in Exhibits 8-4 and 8-5. These roads constitute 52 road projects of varying lengths and widths. Primarily they form the basic access needs for the study area and complete a number of east-west routes thereby forming a basic grid of strategic roads.

The main feature of the strategy is the inclusion of a comprehensive mass transit system based entirely on Metro technology and as shown on Exhibits 8-17 and 8-18. The system will cover 63kms extending primarily to the outskirts of the city and serving the main traveled corridors. There will be three lines most of which will be grade separated.

The regular bus services will need to play a more active role in this strategy. They will be reorganized to serve surface transit needs and will link to the stations on the Metro providing clean interfaces. This will require a relatively high investment leading to an associated increase in service provision.

Due to the fact that the Metro will be largely grade separated, the extent of the traffic management on the arterials can be reduced. Nevertheless, there will need to be a basic level of traffic management to achieve efficiency in the existing road network. There will be a parallel reduction in the investments in pedestrian and NMT organization to a moderate level.

As with all other strategies, strategy 1c assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

1c Components	Description	Cost ($)
ROADS +	The 52 road projects which together will form a basic access for the study area.	800m
No BRT ALL METRO	An extensive mass transit system based on Metro technology with three lines serving the main urban areas of the city and high travelled corridors. In all 63kms of mass transit.	4.7bn
Buses Regular Services	Intermediate investment leading to a medium to high improvement in services due to no surface mass transit.	75m
Traffic Management	Moderate investment to ensure that bus services will have priorities.	15m
Pedestrian Facilities	Moderate investment on arterial roads and those used heavily by pedestrians.	7.5m
NMT Transportation	Moderate investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	7.5m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**6.7bn**

Strategy 2a includes - ROADS++ ALL BRT NO METRO

The three strategies with the designation 2a, 2b and 2c all include the group of roads referred to as Roads++ and described in Exhibit 8-1 above. Roads++ includes all roads which form the Roads+ together with several additional important access roads as shown in Exhibits 8-6 and 8-7. Most notable amongst these additional roads are the Eastern Bypass and the Western Bypass. In all there are a total of 60 projects included in these strategies and the service to the area beyond the immediate built up area is considerably improved.

The main feature of the strategy is that there will be a comprehensive mass transit system based exclusively on BRT technology and as shown on Exhibits 8-13 and 8-14. The system will cover 200kms and will extend to the neighbouring satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj.

There will be no Metro system in this strategy.

The current stage carriage bus services will receive a moderate improvement leading to an upgrading of the current situation and aimed at providing organized feeder services together with new routes provided for areas not being served by the BRT system.

In order for the BRT system to work efficiently, there will need to be a major expenditure and effort made at creating a high quality traffic management system at least on those roads which will carry the BRT lines. The Terms of Reference for this work will be written by the STP team for implementation by others and will include – signing (both boards and lane markings), channelization at intersections and on links, street lighting, median additions, clearly defined stop lines, high visibility pedestrian crossings, controls on parking and removal of obstructions to both carriageway and footpaths. An integral part of this traffic management program will be a high level of infrastructure provision and operational control for both pedestrians and non-motorized vehicles. The strategy will provide for continuous footpath routes and safe crossings for pedestrians and will encourage and plan for the feeder services by NMT traffic.

The strategy assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

2a Components	Description	Cost ($)
ROADS ++	The 52 road projects which were included in Roads+ together with and additional 8 projects thereby increasing access in the wider study area.	1.1bn
ALL BRT NO METRO	An extensive BRT system serving the study area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 200 kms of BRT mass transit.	1.0bn
Buses Regular Services	Medium investment leading to a moderate improvement in services.	50m
Traffic Management	Major effort and investment at least on those roads designed to carry the BRT Lines.	30m
Pedestrian Facilities	Major effort and investment on arterial roads and those used heavily by pedestrians.	15m
NMT Transportation	Major effort and investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	15m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**3.3bn**

Strategy 2b includes - ROADS++ BRT METRO

As with 2a, strategy 2b includes the group of roads referred to as Roads++ and described in Exhibit 8-1 above. Roads++ includes all roads which form the Roads+ together with several additional important access roads as shown in Exhibits 8-6 and 8-7. Most notable amongst these additional roads are the Eastern Bypass and the Western Bypass. In all there are a total of 60 projects included in these strategies and the service to the area beyond the immediate built up area is considerably improved.

The main feature of the strategy is the inclusion of a comprehensive mass transit system based on a blend of BRT and Metro and as shown on Exhibits 8-15 and 8-16. The system will cover 210kms and will extend to the neighbouring satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. There will be a two line Metro system serving the Airport Road and Mirpur Road corridors amounting to 36kms, most of which will be grade separated. The BRT network will complement the Metro network and will interchange at frequent locations.

As with strategy 1a, the current stage carriage bus services will receive a moderate improvement leading to an upgrading of the current situation and aimed at providing organized feeder services together with new routes provided for areas not being served by the Metro and BRT systems.

Due to the fact that the Metro will be largely grade separated, the extent of the traffic management on the arterials will be reduced. This will mean a reduction in the lengths of arterials which will need to receive the necessary traffic management improvements. There will be a parallel reduction in the investments in pedestrian and NMT organization to an intermediate level.

As with all other strategies, strategy 2a assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

2b Components	Description	Cost ($)
ROADS ++	The 52 road projects which were included in Roads+ together with and additional 8 projects thereby increasing access in the wider study area.	1.1bn
BRT METRO	An extensive mass transit system based on a blend of both Metro and BRT serving the study area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 210 kms of mass transit.	3.6bn
Buses Regular Services	Medium investment leading to a moderate improvement in services.	50m
Traffic Management	Intermediate investment at least on those roads designed to carry the BRT Lines.	20m
Pedestrian Facilities	Intermediate investment on arterial roads and those used heavily by pedestrians.	10m
NMT Transportation	Intermediate investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	10m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	5.8bn

Strategy 2c includes - ROADS++ NO BRT ALL METRO

As with 2a, strategy 2c includes the group of roads referred to as Roads++ and described in Exhibit 8-1 above. Roads++ includes all roads which form the Roads+ together with several additional important access roads as shown in Exhibits 8-6 and 8-7. Most notable amongst these additional roads are the Eastern Bypass and the Western Bypass. In all there are a total of 60 projects included in these strategies and the service to the area beyond the immediate built up area is considerably improved.

The main feature of the strategy is the inclusion of a comprehensive mass transit system based entirely on Metro technology and as shown on Exhibits 8-17 and 8-18. The system will cover 63kms extending primarily to the outskirts of the city and serving the main traveled corridors. There will be three lines most of which will be grade separated.

The regular bus services will need to play a more active role in this strategy. They will be reorganized to serve surface transit needs and will link to the stations on the Metro providing clean interfaces. This will require a relatively high investment leading to an associated increase in service provision.

Due to the fact that the Metro will be largely grade separated, the extent of the traffic management on the arterials will be reduced. Nevertheless, there will need to be a basic level of traffic management to achieve efficiency in the existing road network. There will be a parallel reduction in the investments in pedestrian and NMT organization to a moderate level.

As with all other strategies, strategy 2c assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

2c Components	Description	Cost ($)
ROADS ++	The 52 road projects which were included in Roads+ together with and additional 8 projects thereby increasing access in the wider study area.	1.1bn
NO BRT ALL METRO	An extensive mass transit system based on Metro technology with three lines serving the main urban areas of the city and high travelled corridors. In all 63kms of mass transit.	4.7bn
Buses Regular Services	Intermediate investment leading to a medium to high improvement in services due to no surface mass transit.	75m
Traffic Management	Moderate investment to ensure that bus services will have priorities.	15m
Pedestrian Facilities	Moderate investment on arterial roads and those used heavily by pedestrians.	7.5m
NMT Transportation	Moderate investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	7.5m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	6.9bn

Strategy 3a includes - ROADS+++ ALL BRT NO METRO

The four strategies within the 3 series all include the highways package referred to as Roads+++ as noted in Exhibit 8-1 above and are shown graphically in Exhibits 8-8 and 8-9. The package includes all existing roads and projects already under construction and other basic access projects together with several additional important access roads, most notably the Eastern and Western Bypasses. In addition the main feature of the Roads+++ package is a comprehensive elevated express system together with additional basic access roads in the nearby rural areas. The elements of the elevated expressway system are shown in Exhibit 8-10.

For convenience, the composite system including all roads packages is shown as Exhibits 8-11 and 8-12.

Aside from the elevated expressway system, the main feature of the strategy is that there will be a comprehensive mass transit system based exclusively on BRT technology and as shown on Exhibits 8-13 and 8-14. The system will cover 200kms and will extend to the neighbouring satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj.

There will be no Metro system in this strategy.

The current stage carriage bus services will receive a moderate improvement leading to an upgrading of the current situation and aimed at providing organized feeder services together with new routes provided for areas not being served by the BRT system.

In order for the BRT system to work efficiently, there will need to be a major expenditure and effort made at creating a high quality traffic management system at least on those roads which will carry the BRT lines. The Terms of Reference for this work will be written by the STP team for implementation by others and will include – signing (both boards and lane markings), channelization at intersections and on links, street lighting, median additions, clearly defined stop lines, high visibility pedestrian crossings, controls on parking and removal of obstructions to both carriageway and footpaths. An integral part of this traffic management program will be a high level of infrastructure provision and operational control for both pedestrians and non-

motorized vehicles. The strategy will provide for continuous footpath routes and safe crossings for pedestrians and will encourage and plan for the feeder services by NMT traffic.

The strategy assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

3a Components	Description	Cost ($)
ROADS+++	The 60 road projects which were included in Roads++ together with a comprehensive elevated expressway system covering the urban area and main corridors.	2.0bn
ALL BRT NO METRO	An extensive BRT system serving the study area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 200 kms of BRT mass transit.	1.0bn
Buses Regular Services	Medium investment leading to a moderate improvement in services.	50m
Traffic Management	Major effort and investment at least on those roads designed to carry the BRT Lines.	30m
Pedestrian Facilities	Major effort and investment on arterial roads and those used heavily by pedestrians.	15m
NMT Transportation	Major effort and investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	15m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**4.2bn**

Strategy 3b includes - ROADS+++ BRT METRO

The four strategies within the 3 series all include the highways package referred to as Roads+++ as noted in Exhibit 8-1 above and are shown graphically in Exhibits 8-8 and 8-9. The package includes all existing roads and projects already under construction and other basic access projects together with several additional important access roads, most notably the Eastern and Western Bypasses. In addition the main feature of the Roads+++ package is a comprehensive elevated express system (see Exhibit 8-10) together with additional basic access roads in the nearby rural areas.

A second main feature of the strategy is the inclusion of a comprehensive mass transit system based on a blend of BRT and Metro and as shown on Exhibits 8-15 and 8-16. The system will cover 210kms and will extend to the neighbouring satellite cities of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. There will be a two line Metro system serving the Airport Road and Mirpur Road corridors amounting to 36kms, most of which will be grade separated. The BRT network will complement the Metro network and will interchange at frequent locations.

As with strategies 1a and 2b, the current stage carriage bus services will receive a moderate improvement leading to an upgrading of the current situation and aimed at providing organized feeder services together with new routes provided for areas not being served by the Metro and BRT systems.

Due to the fact that the Metro will be largely grade separated, the extent of the traffic management on the arterials will be reduced. This will mean a reduction in the lengths of arterials which will need to receive the necessary traffic management improvements. There will

be a parallel reduction in the investments in pedestrian and NMT organization to an intermediate level.

As with all other strategies, strategy 3b assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

3b Components	Description	Cost ($)
ROADS+++	The 60 road projects which were included in Roads++ together with a comprehensive elevated expressway system covering the urban area and main corridors.	2.0bn
BRT METRO	An extensive mass transit system based on a blend of both Metro and BRT serving the study area and reaching to the satellite towns of Narayanganj, Savar, Dhamsona, Gazipur and Kaliganj. In all 210 kms of mass transit.	3.6bn
Buses Regular Services	Medium investment leading to a moderate improvement in services.	50m
Traffic Management	Intermediate investment at least on those roads designed to carry the BRT Lines.	20m
Pedestrian Facilities	Intermediate investment on arterial roads and those used heavily by pedestrians.	10m
NMT Transportation	Intermediate investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	10m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**6.7bn**

Strategy 3c includes - ROADS+++ NO BRT ALL METRO

The four strategies within the 3 series all include the highways package referred to as Roads+++ as noted in Exhibit 8-1 above and are shown graphically in Exhibits 8-8 and 8-9. The package includes all existing roads and projects already under construction and other basic access projects together with several additional important access roads, most notably the Eastern and Western Bypasses. In addition the main feature of the Roads+++ package is a comprehensive elevated express system (see Exhibit 8-10) together with additional basic access roads in the nearby rural areas.

A second main feature of the strategy is the inclusion of a comprehensive mass transit system based entirely on Metro technology and as shown on Exhibits 8-17 and 8-18. The system will cover 63kms extending primarily to the outskirts of the city and serving the main traveled corridors. There will be three lines most of which will be grade separated.

The regular bus services will need to play a more active role in this strategy. They will be reorganized to serve surface transit needs and will link to the stations on the Metro providing clean interfaces. This will require a relatively high investment leading to an associated increase in service provision.

Due to the fact that the Metro will be largely grade separated, the extent of the traffic management on the arterials will be reduced. Nevertheless, there will need to be a moderate level of traffic management to achieve efficiency in the existing road network. There will be a parallel reduction in the investments in pedestrian and NMT organization to a moderate level.

As with all other strategies, strategy 3c assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

3c Components	Description	Cost ($)
ROADS+++	The 60 road projects which were included in Roads++ together with a comprehensive elevated expressway system covering the urban area and main corridors.	2.0bn
NO BRT ALL METRO	An extensive mass transit system based on Metro technology with three lines serving the main urban areas of the city and high travelled corridors. In all 63kms of mass transit.	4.7bn
Buses Regular Services	Intermediate investment leading to a medium to high improvement in services due to no mass transit system.	75m
Traffic Management	Moderate investment to ensure that bus services will have priorities.	15m
Pedestrian Facilities	Moderate investment on arterial roads and those used heavily by pedestrians.	7.5m
NMT Transportation	Moderate investment on arterial roads and those used by NMT traffic especially in the form of organizational changes.	7.5m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**7.9bn**

Strategy 3d includes - ROADS+++ NO BRT NO METRO

This alternative is one that has a high emphasis on roads development and a low emphasis on mass transit, with regular bus services providing the main public transport service.

The strategy includes the highways package referred to as Roads+++ as noted in Exhibit 8-1 above and are shown graphically in Exhibits 8-8 and 8-9. The package includes all existing roads and projects already under construction and other basic access projects together with several additional important access roads, most notably the Eastern and Western Bypasses. In addition the main feature of the Roads+++ package is a comprehensive elevated express system (see Exhibit 8-10) together with additional basic access roads in the nearby rural areas.

The public transport in this strategy is based on a major improvement to the regular bus services. This will include improvements in bus priorities and preferences such as bus only lanes and signal priorities. There will be major efforts to streamline services and routes.

The traffic management on the arterials will be reduced since the bus priority program will take the major part in providing priorities. Nevertheless, there will need to be a basic level of traffic management to achieve efficiency in the existing road network. There will be a parallel reduction in the investments in pedestrian and NMT organization to a low level.

As with all other strategies, strategy 3d assumes that the Circular Waterways project will be completed. It also assumes that there will be a major investment in Bangladesh Railways.

The table below summarizes the components which were included in this strategy together with the estimated investment cost.

3d Components	Description	Cost ($)
ROADS+++	The 60 road projects which were included in Roads++ together with a comprehensive elevated expressway system covering the urban area and main corridors.	2.0bn
NO BRT NO METRO	No major investment in any mass transit system and reliance on regular bus service	zero
Buses Regular Services	High investment leading to a large improvement in services due to no surface mass transit.	100m
Traffic Management	Low investment to assist regular bus services with priorities.	5m
Pedestrian Facilities	Basic improvements on arterial roads and those used heavily by pedestrians.	2.5m
NMT Transportation	Basic improvements on arterial roads and those used by NMT traffic especially in the form of organizational changes.	2.5m
Circular Waterway	Completion of the eastern portion of the project.	50m
Bangladesh Railways	Completion of a program of major improvements to the railway system including track, signaling and operations.	1.0bn
	Total Cost	**3.2bn**

8.3 OBJECTIVE EVALUATION OF ALTERNATIVE TRANSPORTATION STRATEGIES

Using the forecasts of future population and related activities, the travel demand model developed for this study was used to determine: -

(i) Future levels of travel;
(ii) The use of various modes of travel, and
(iii) The resultant characteristics for each of the alternative transportation strategies.

Exhibit 8-19 provides a summary of the basic measures for each of the alternative transportation strategies as determined from the output of the travel demand model. The operational measures output from the model include:

- Person Trips – the total number of trips by people
- Person Kilometres – the total number of kilometres travelled by people
- Person Hours – the total time spent travelling by people
- Vehicle Trips – the total number of trips by vehicles
- Vehicle Kilometres – the total number of kilometres travelled by vehicles
- Vehicle Hours – the total time spent travelling by vehicles
- Travel Speed – the overall average travel speed for the whole system

Person-related measures reflect the travel of each individual person, whereas vehicle measures reflect the travel of the vehicles in which the people are travelling. There are more people than there are vehicles, the difference being the occupancy factor which is relatively low for auto type vehicles and relatively high for transit type vehicles. Person-related measures are useful in assessing differences among the alternative transportation strategies with respect to a number of indicators including:

(a) the total number of trips being served reflecting the coverage, accessibility and mobility provided (more is better);

(b) the travel mode share between auto and transit reflecting the tradeoffs between more or less individualized travel; and

(c) the total hours of travel, which in and of itself is non-productive time and represents an economic cost (less is better).

Vehicle-related measures are useful in assessing the differences among the alternative transportation strategies with respect to a number of indicators including:

(a) the total number of kilometres travelled by autos, for example, thus reflecting some of the environmental impacts associated with transportation and
(b) the total time spent travelling by vehicles, again indicating non-productive time that represents an economic cost to society.

Travel speed is a measure that reflects the overall performance of the system (faster is better) incorporating numbers of trips, distances travelled and time spent travelling, including an indication of the relative severity of congestion among the alternative transportation strategies. Relatively small changes in the average travel speed among the alternative transportation strategies, when applied to all trips over an extended period of time, can become substantial and significant.

It is worth noting that the values shown for the various indicators in Exhibit 8-19 are for the peak hour. Although the differences might appear to be quite small, when they are expanded to a full day (Peak Hour = 7% for auto and 10% for transit) then a full year, and finally a period of many years, the differences among the alternative transportation strategies are substantial and important. For example illustrated below is a comparison between strategies 2a and 2b. Strategy 2a is more efficient in terms of person-hours than 2b, the difference (which are savings) of 21,000 person-hours. This translates into 61 million hours on an annual basis or 1.2 billion hours during the 20 year planning period of the STP.

Person Hours	Transit	Auto	Total
a. 2a (Peak Hour)	627,000	260,000	887,000
b. 2b (Peak Hour)	658,000	250,000	908,000
c. 2b – 2a (Peak Hour)	31,000	-10,000	21,000
d. Peak Hour Factors	10%	7%	
e. 2b – 2a (Daily)	310,000	-143,000	167,000
f. 2b – 2a (Annually)	113,150,000	-52,195,000	60,955,000

In addition to the numerical values presented in Exhibit 8-19, the same information is presented in graphic form in the following series of exhibits.

Exhibit 8-20 Person Trips
Exhibit 8-21 Person Kilometres
Exhibit 8-22 Person Hours
Exhibit 8-23 Vehicle Trips
Exhibit 8-24 Vehicle Kilometres
Exhibit 8-25 Vehicle Hours
Exhibit 8-26 Travel Speed
Exhibit 8-27 Travel Speed (2)

In reviewing this information presented as the objective evaluation of alternative transportation strategies, some observations are noted on the graphic representations for each of the individual measures. In addition, the following more general observations are considered to be pertinent:

Observation #1: Those strategies incorporating All BRT/No Metro (1a, 2a, 3a) all serve more trips with fewer person hours of travel than any of the other strategies, irrespective of which level of road investment is considered. This reflects the good service area coverage and the good quality of service associated with the BRT system

Observation #2: The travel speeds are the highest and the person hours of travel are the lowest for the alternative Strategies with the highest level of road investment (3a, 3b, 3c), irrespective of which type of mass rapid transit is considered. The travel speed for Strategy 3d is low and the person hours are high in spite of a high level of road investment, because there is no mass rapid transit system, only a good quality regular bus service.

Observation #3: Using vehicle kilometres (auto) and vehicle hours (auto) as an indicator of the relative environmental impact among the strategies, the Group 3 strategies (3a, 3b, 3c) are all better than the others in respect to significantly lower vehicle kilometres and vehicle hours and higher travel speeds. Fewer vehicle kilometres, less vehicle hours, and higher travel speeds (reduced congestion) indicates lower fuel consumption and less air pollution.

Observation #4: The estimated cost for the alternative strategies with All BRT/No Metro (1a, 2a, 3a) are substantially lower than the other alternatives (except Strategy 3d) and represent a moderately aggressive expectation regarding availability of future potential financial resources. The estimate cost of the other alternative Strategies (except 3d) are excessively high in terms of future financial resource achievability. This is particularly relevant when one considers that the country has a number of competing needs in other sectors, all of which require substantial resources.

Observation #5: The impact and consequences that future population growth and related development activity is going to have on overall transportation and mobility within the Dhaka metropolitan area is very significant. If little or nothing is done for the transportation sector and the population increases as expected, the level of congestion and delay and the non-productive time that people spend travelling will increase significantly. All ten alternative transportation strategies are shown to offer dramatically improve conditions in the future (2024).

8.4 SUBJECTIVE EVALUATION OF ALTERNATIVE TRANSPORTATION STRATEGIES

The next part of the evaluation process is a subjective evaluation of alternative transportation strategies. The procedure that was followed, was to make a subjective assessment of how well each of the alternative transportation strategies was likely to support/achieve the goals and objectives previously developed for the STP study (see Chapter 6). A set of eight primary goals was established as representing a comprehensive and balanced approach that considers the multi-modal aspect of the transportation sector, the priority areas of need and concern within the transportation sector, and the overall scope and intent of the Strategic Transportation Plan for Dhaka. These eight goals are:

Efficiency

Ensure that the maintenance, operation, reliability and expansion of the transportation sector services and facilities occur in an efficient and effective manner with emphasis on maximizing the use of the full potential of the existing resources and investments.

Mobility & Accessibility

Provide a basic level of mobility and accessibility for all segments of society to ensure reasonable access to employment, educational, health, social and other programs, services and opportunities.

Safety

Develop and implement a coordinated and comprehensive set of safety improvement measures addressing all aspects of the transportation system to reduce the number of transportation related deaths and the number and severity of transportation related injuries and property damage.

Affordability

Ensure a suitable balance between the transportation sector's financial requirements for maintenance, operations and capital investments and anticipated financial resources.

Achievability

Develop transportation operations and capital investment projects and services that fit within the skills, capabilities and constraints of the institutions responsible for implementation and have a higher probability of implementation and operational success.

Economic Development

Support economic growth and competitiveness, domestically and internationally.

Social Development

Support programs and efforts directed toward the alleviation of poverty and the promotion of self-sufficiency and the provision of opportunities and services that serve the requirements of both women and men, equally.

Environment

Minimize the transportation sector's negative impact on the environment and create increased transportation related environmental awareness in society.

For each of these eight primary strategic goals, a set of sub-goals was established to help define the scope and focus of each primary goal. For example, the primary goal entitled "Efficiency" is too "high level" or general to provide a meaningful insight or understanding of the intent. Therefore, seven sub-goals, dealing with road use, demand management, land use and transportation interrelationship, privatisation, system performance, inter-modal linkages, and pricing are presented as a way of defining and clarifying this primary goal. Furthermore, for each sub-goal, a set of general objectives is presented to clarify and define the current thinking further and promote a better understanding of each sub-goal. The information below provides an example of one (Sub-Goal 1A) of the seven sub-goals developed for one (Efficiency) of the eight of the goals, along with the six objectives established for this particular sub-goal.

Efficiency

Ensure that the maintenance, operation, reliability and expansion of the transportation sector services and facilities occur in an efficient and effective manner with emphasis on maximizing the use of the full potential of the existing resources and investments.

Sub-Goal 1A

Improve the use and efficiency of existing public right-of-way and road space/capacity for transportation and related purposes.

- *Develop an integrated traffic management plan (e.g. traffic operations, driver training, public education and awareness, enforcement).*
- *Remove or relocate non-transportation related activities from public right-of-way.*
- *Improve bottlenecks in the transportation infrastructure.*

- *Increase passenger carrying capacity of transportation system.*
- *Emphasize schemes that make walking easier, less hazardous and less stressful, so that walking (as a complete trip, or as access to/from other modes of travel) becomes a preferred choice rather than a necessity.*
- *Encourage the use of bicycles as a transportation mode, by providing suitable facilities.*

Chapter 6 provides a detailed presentation on the 8 goals, 35 sub-goals, and 125 objectives established for the STP study and used in the subjective evaluation of the strategies.

The subjective evaluation proceeded in a manner that rated each alternative transportation strategy as to how well it support or helped to achieve each of the 125 objectives using a rating scale of 1 – 2 – 3 – 4 – 5. The numbers were used to represent the following, depending upon the nature and wording of each particular objective.

- 1 = low, 3 = medium, 5 = high
- 1 = poor, 3 = average, 5 = good
- 1 = not likely, 3 = likely, 5 = very likely

The approach that was followed was: -

(a) to read and understand the particular objective,

(b) pick the strategy that best served that particular objective and give it a score of 4,

(c) pick the strategy that least served that particular objective and give it a score of 2,

(d) assign a score of 2, 3 or 4 to each of the remaining alternatives based upon how well that strategy serves the particular objective in relation to the ones identified in actions (b) and (c).

Note: Scores of 5 and 1 were used for special instances when a strategy was thought to serve either especially well or especially poorly a particular objective. For several objectives, the differences among the alternative transportation strategies was judged to be indistinguishable, either because they were not applicable or were essentially equal, and therefore, no rating was made for those particular objectives.

Exhibit 8-28 provides a summary of the results of the subjective evaluation of strategies. A complete set of the subjective rating for each of the 10 alternative transportation strategies with respect to the 8 goals, 35 sub-goals, and 125 objectives is provided in Appendix 8-1. In reviewing the information in Exhibit 8-28 and Appendix 8-1, it is important to understand that while a comparison among the alternative transportation strategies is valid and useful, a comparison of the numbers among the goals for any one strategy is not appropriate, because the number of sub-goals and objectives is neither balanced nor weighted.

In reviewing this information presented as the subjective evaluation of alternative transportation strategies, the following observations are considered to be pertinent:

Observation #1: In terms of Efficiency, Strategies 1a and 1b score the highest, Strategies 2a and 2b are nearly equal and Strategy 3d is the lowest, scoring only half as much.

Observation #2: In terms of Mobility and Accessibility, Strategy 3a is the highest, reflecting particularly high scores for Disaster Mobility Needs (Sub-goal 2B) and Defence and Security (Sub-goal 2c). Strategy 3d is again the lowest.

Observation #3: In terms of Safety, Strategies 1a and 2a are the highest, and all the others are quite similar, except for Strategy 3d which is the lowest, scoring only half as much as the highest.

Observation #4: In terms of Affordability, Strategy 1a is notably the highest, Strategy 2a is the next highest, reflecting the much lower cost of BRT compared to Metro. Strategy 3c is the lowest, scoring less than half of the highest.

Observation #5: In terms of Achievability, Strategy 3d is the highest, reflecting the existing experience base and relative simplicity of construction of elevated expressways and other roads as compared to the lack of experience with BRT systems and the lack of experience and complexities inherent to a Metro system.

Observation #6: In terms of Economic Development, Strategy 3a is the highest, Strategies 1a and 2a are close, and Strategy 3d is the lowest.

Observation #7: In terms of Social Development, Strategies 1a and 2a are notably the highest, and Strategy 3d is the lowest.

Observation #8: In terms of Environment, Strategy 2c is the highest, Strategies 1c, 2a and 2b are close, and Strategy 3d is the lowest, scoring less than a third of the highest.

Observation #9: Overall, Strategy 1a has the highest score, but Strategy 2a is nearly the same. All other things being equal (which they are not), given the close score of these two alternatives, Strategy 2a is a better alternative because it includes some important roads (i.e. Eastern and Western Bypasses) not included in Strategy 1a. Strategy 3d is the lowest.

Observation #10: Strategies 1a and 2a score the highest overall, they also have the most high scores with respect to the individual goals, and they have no lowest scores. Strategies that include All METRO/No BRT (1c, 2c, and 3c) contain some lowest scores, attributable primarily to the high cost and complexities of Metro systems. Strategy 3d has the lowest overall score, the lowest scores with respect to six of the eight individual goals, but the highest score for achievability.

Observation #11: The respective overall scores for Strategies 1a, 1b and 1c, compared with Strategies 2a, 2b, and 2c, are essentially equal. The respective overall scores of Strategies 2a, 2b, and 2c, are about ten (10) percent higher than those of Strategies 3a, 3b, and 3c.

Observation #12: Strategy 2a is 15% better (higher) than Strategy 2b, and 29% higher than Strategy 2c.

8.5 DESCRIPTIVE EVALUATION OF ALTERNATIVE TRANSPORTATION STRATEGIES

The third and final part of the evaluation process is a descriptive evaluation of the alternative transportation strategies. This is a concise summary of the most pertinent features, indicators and characteristics of each strategy. The text boxes below provide a brief descriptive summary for each of the alternative transportation strategies.

BASE CASE ROADS NO BRT NO METRO

Current situation of bus service, no mass rapid transit system (No BRT, No Metro)
Completion projects already being constructed (13 road projects)

Average travel speed is very low for users of public transportation and users of individual type transportation

Poor performance with respect to all specified goals

Low initial investment (USD 0.2 billion); substantially less than potential financial capability
No annual operating subsidy for Metro or BRT components

STRATEGY 1a ROADS + ALL BRT NO METRO

Good quality mass rapid transit system (All BRT)
Basic level of road improvements (52 road projects)

Serves more trips with fewer person hours of travel
Highest service to users of public transportation, lowest service to users of individual type transportation
Average travel speed is high for public transportation users, low for users of individual type transportation
Lowest number of vehicle trips (auto)
Highest number of vehicle hours (auto)

Highest ratings for Efficiency, Safety, Affordability, and Social Development Goals

Moderate initial cost (USD 3.0 billion); within potential financial capability
Extensive BRT system providing good area coverage and service characteristics

STRATEGY 1b ROADS + BRT METRO

High quality mass rapid transit system (BRT and Metro)
Basic level of road improvements (52 road projects)

Intermediate service to users of public transportation, lowest service to users of individual type transportation
Average travel speed is high for public transportation users, low for users of individual type transportation

Highest rating for Efficiency Goal

High initial cost (USD 5.6 billion); exceeding potential financial capability
Annual operating subsidy: large for Metro component, small for BRT component

STRATEGY 1c ROADS + NO BRT ALL METRO

Highest quality mass rapid transit system (All Metro)
Basic level of road improvements (52 road projects)

Lowest service to users of public transportation, lowest service to users of individual type transportation
Average travel speed is moderate for both public transportation users & users of individual type transportation

Lowest ratings for Achievability and Economic Development Goals

High initial cost (USD 6.7 billion); exceeding potential financial capability
Annual operating subsidy: large for Metro component

STRATEGY 2a ROADS ++ ALL BRT NO METRO

Good quality mass rapid transit system (All BRT)
Basic level of road improvements plus several additional important access and circulation roads, most notably the Eastern and Western Bypasses (60 road projects)

Serves more trips with fewer person hours of travel
Highest service to users of public transportation, lowest service to users of individual type transportation
Average travel speed is high for public transportation users and low for users of individual type transportation

Highest rating for Safety and Social Development Goals

Moderate initial cost (USD 3.3 billion); with potential financial capability
Annual operating subsidy: small for BRT component

STRATEGY 2b ROADS ++ BRT METRO

High quality mass rapid transit system (BRT and Metro)
Basic level of road improvements plus several additional important access and circulation roads, most notably the Eastern and Western Bypasses (60 road projects)

Average travel speed is high for public transportation users, moderate for users of individual type transportation
Highest number of person kilometres of travel

No highest or lowest ratings for any of the goals

High initial cost (USD 5.8 billion); exceeding potential financial capability
Annual operating subsidy: large for Metro component, small for BRT component

STRATEGY 2c ROADS ++ NO BRT ALL METRO

Highest quality mass rapid transit system (All Metro)
Basic level of road improvements plus several additional important access and circulation roads, most notably the Eastern and Western Bypasses (60 road projects)

Serves more trips with fewer person hours of travel
Average travel speed is moderate for both public transportation users & users of individual type transportation
Highest number of vehicle kilometers (auto)

Highest for Environmental Goal and lowest for Achievability and Economic Development Goals.

High initial cost (USD 7.0 billion); exceeding potential financial capability
Annual operating subsidy: large for Metro component

STRATEGY 3a ROADS +++ ALL BRT NO METRO

Good quality mass rapid transit system (BRT)
Basic level of road improvements plus several additional important access and circulation roads (most notably the Eastern and Western Bypasses) plus a comprehensive elevated expressway system for the DCC area and additional basic access in rural areas (78 road projects)

Serves more trips with fewer person hours of travel
Highest combined travel speed
Average travel speed is high for public transportation users, moderate for users of individual type transportation Lowest number of person hours of travel
Lowest number of vehicle kilometers (auto)

Highest for Mobility/Accessibility Goal

Moderate initial cost (USD 4.1 billion); within potential financial capability
Annual operating subsidy: small for BRT component

STRATEGY 3b ROADS +++ BRT METRO

High quality mass rapid transit system (BRT and Metro)
Basic level of road improvements plus several additional important access and circulation roads (most notably the Eastern and Western Bypasses) plus a comprehensive elevated expressway system for the DCC area and additional basic access in rural areas (78 road projects)

Average travel speed is high for public transportation users, high for users of individual type transportation
Lowest number of person trips served

No highest or lowest ratings for any of the goals

High initial cost (USD 6.7 billion); exceeding potential financial capability
Annual operating subsidy: large for Metro component, small for BRT component

STRATEGY 3c ROADS +++ NO BRT ALL METRO

Highest quality mass rapid transit system (All Metro)
Basic level of road improvements plus several additional important access and circulation roads (most notably the Eastern and Western Bypasses) plus a comprehensive elevated expressway system for the DCC area and additional basic access in rural areas (78 road projects)

Average travel speed is moderate for public transportation users, high for users of individual type transportation
Highest number of vehicle trips (auto)
Lowest number of vehicle hours (auto)

Lowest for Safety Goal

High initial cost (USD 7.9 billion); exceeding potential financial capability
Annual operating subsidy: large for Metro component

Strategy 3d ROADS +++ NO BRT NO METRO

Comprehensive regular bus service, no mass rapid transit system (No BRT, No Metro)
Basic level of road improvements plus several additional important access and circulation roads (most notably the Eastern and Western Bypasses) plus a comprehensive elevated expressway system for the DCC area and additional basic access in rural areas (78 road projects)

Lowest overall travel speed
Average travel speed is low for both public transportation users and users of individual type transportation
Highest number of person trips served
Lowest number of person kilometers of travel
Highest number of person hours of travel

Lowest for six of the eight goals considered

Moderate initial cost (USD 3.2 billion); within potential financial capability
No annual operating subsidy for Metro or BRT components

8.6 SUMMARY

The information presented in this chapter provides a comprehensive assessment of the features and characteristics attributable to each of 10 alternative transportation strategies. The information does not necessarily point to a single "best" solution, but rather provides information and indicators regarding various aspects of each strategy. Each strategy has some strong points and some weak points, with respect to other strategies. Each strategy could serve the travel needs of Dhaka, albeit in different ways, and at different costs, both financial and social.

During the study process, the view was often expressed that financial resource constraints should not be an important consideration in the development of a strategic plan. The study consultant, however, has difficulty in sharing this view. In order for any strategic plan to serve as an effective framework and guide for investment decision making, it must fit within the context of reasonableness with respect to anticipated resources. To this end, earlier in the study an assessment was made of the probable financial budget which could be likely to be made available for transport infrastructure in the Dhaka area. This figure was estimated by the STP team at $100 million per year or $2 billions over the 20 year life of the study program. Excluding the estimated $1 billion required for the improvement of the railway system, only strategies 1a, 2a and 3d would fall close to this figure. Increasing the budget by 50% would allow strategy 3a to be considered. All other strategies would require more than twice the previous budget to be allocated.

As a final comment however, ultimately it is the people of Bangladesh, and Dhaka in particular, through their elected representatives, and not the study consultants, who must decide what is the right strategy for the Strategic Transportation Plan for Dhaka. Then and only then will there be the support and ownership needed to garner and motivate the human and financial resources needed to move forward with implementation, which ultimately is the overriding purpose of the Strategic Transportation Plan.

As noted the final decisions lie with the government. However, the Consultants were requested to draw on their collective knowledge and experience and make a reasoned recommendation. This recommendation for a preferred strategy is described in Section 9.3.

Exhibit 8-2 "ROADS" Package - Inner Area

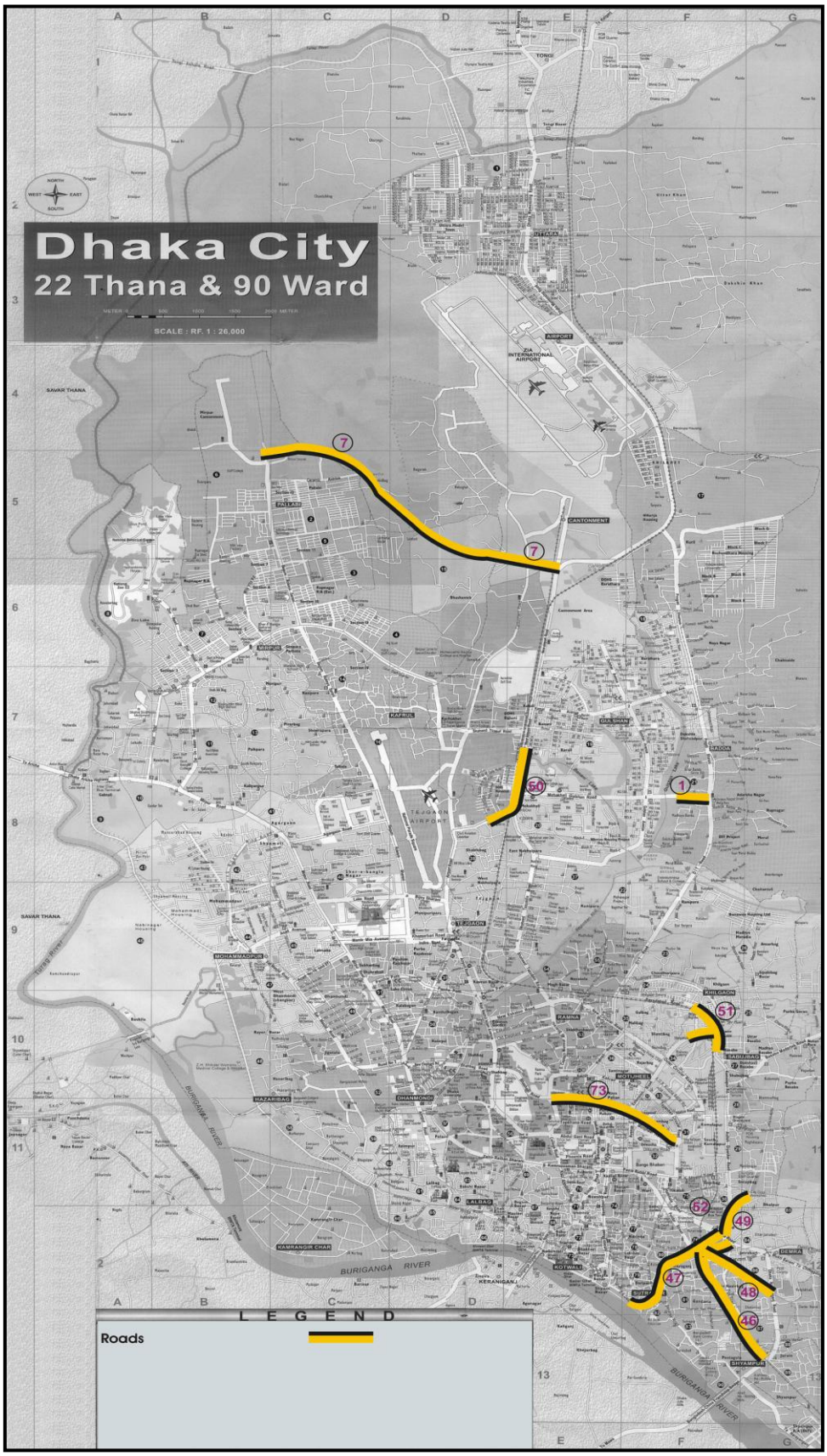


Exhibit 8-3 "ROADS" Package - Outer Area

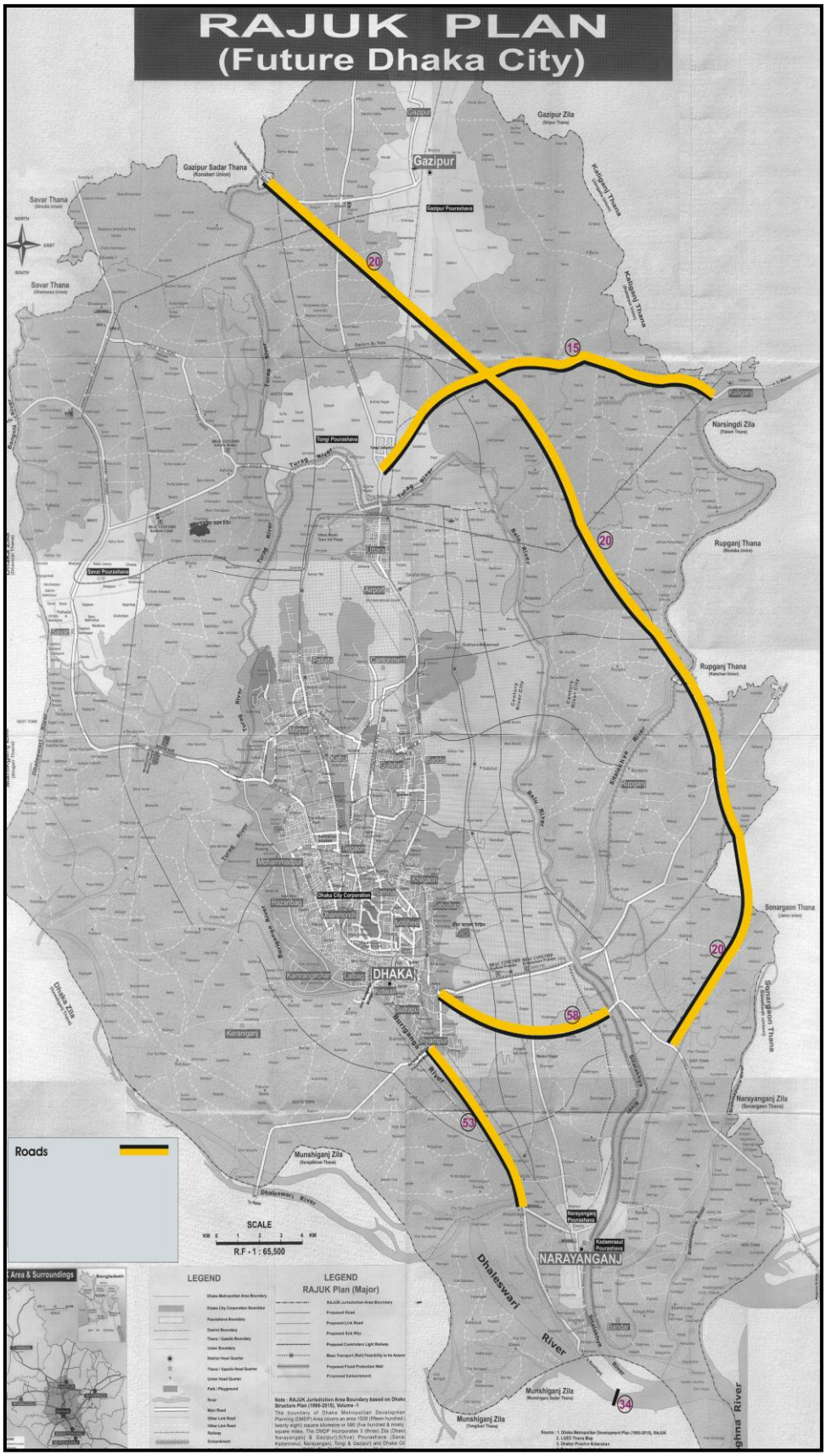


Exhibit 8-4 "ROADS +" Package - Inner Area

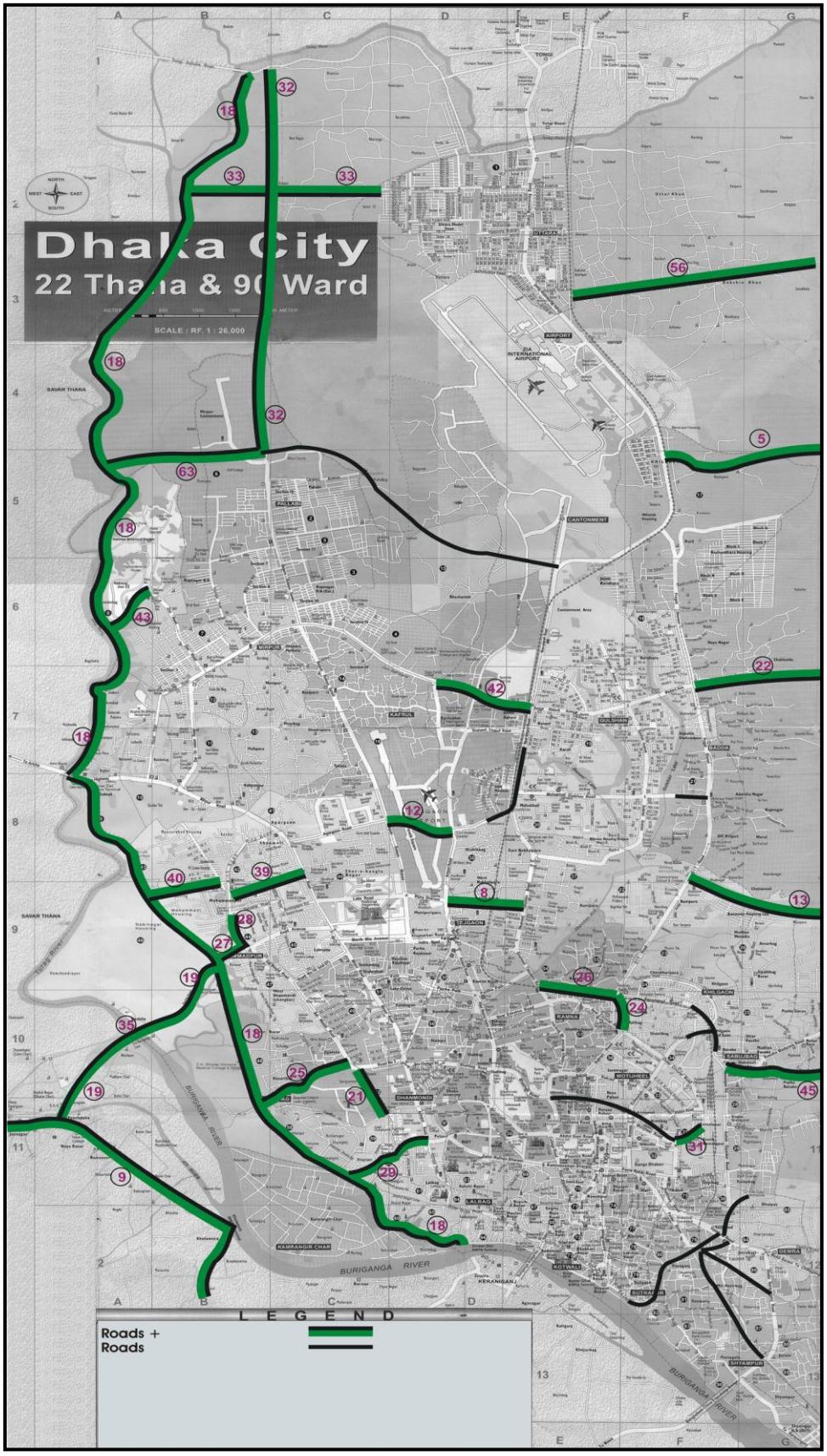


Exhibit 8-5 "ROADS +" Package - Outer Area

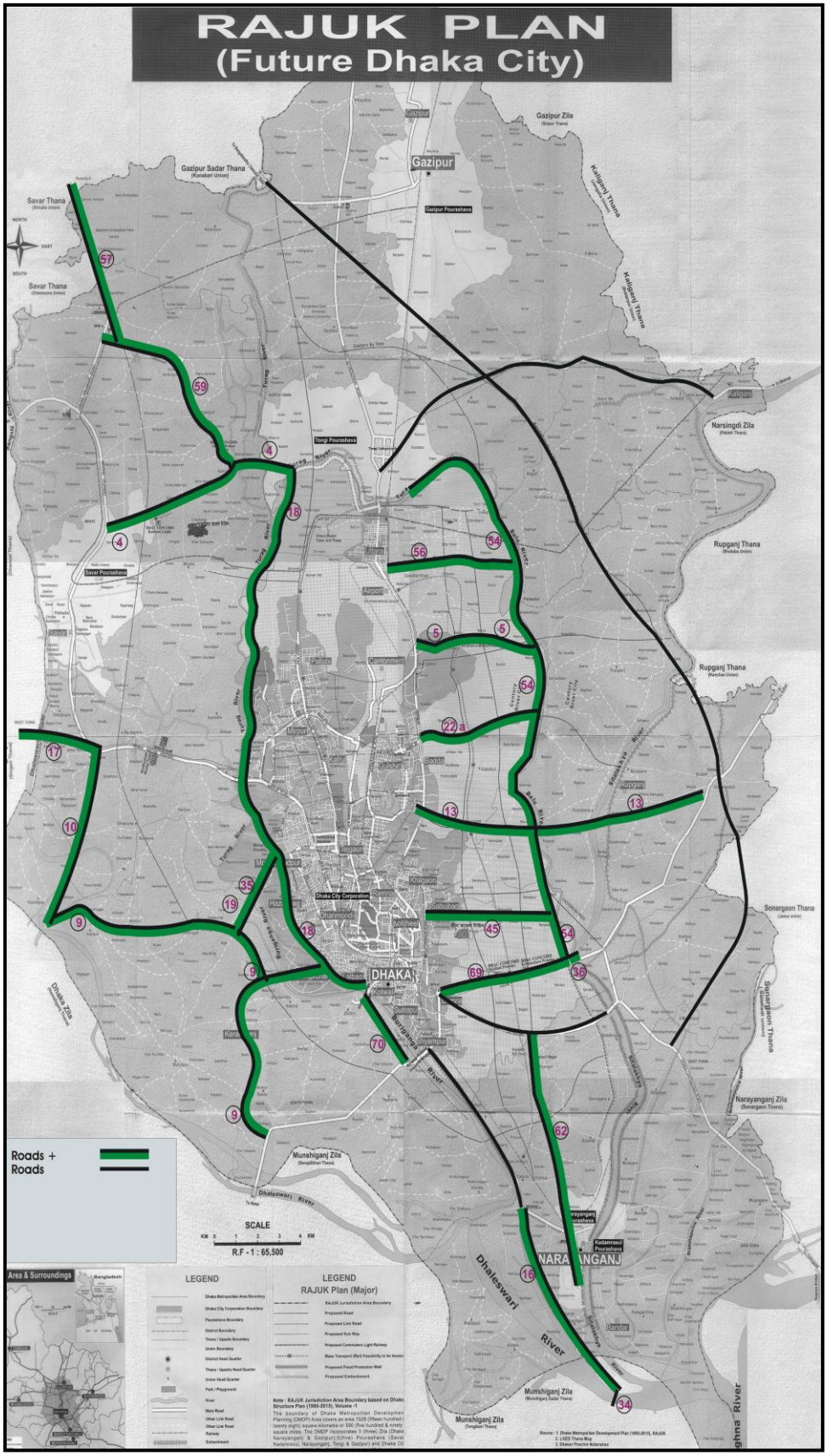


Exhibit 8-6 "ROADS ++" Package - Inner Area

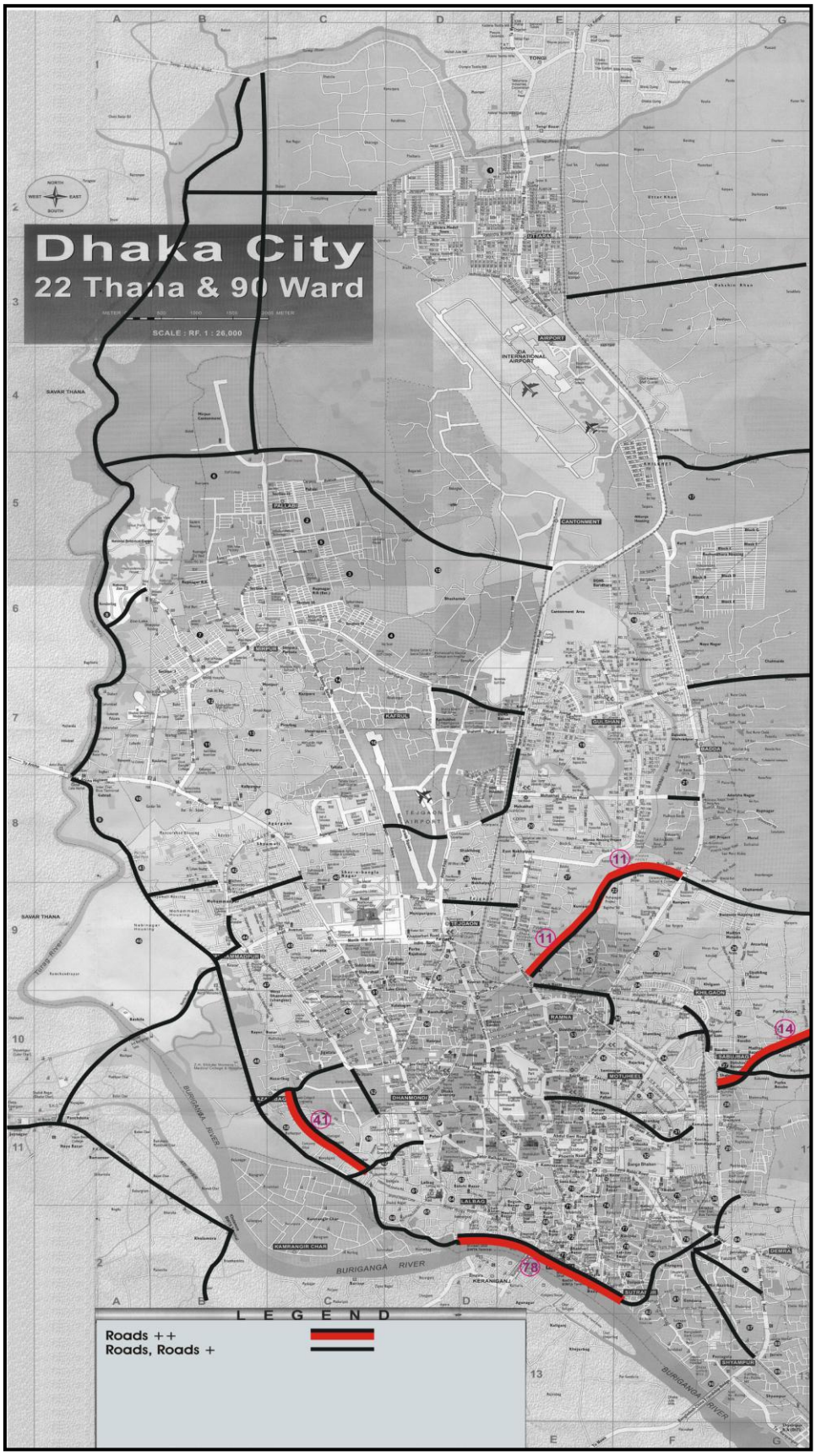


Exhibit 8-7 "ROADS ++" Package - Outer Area

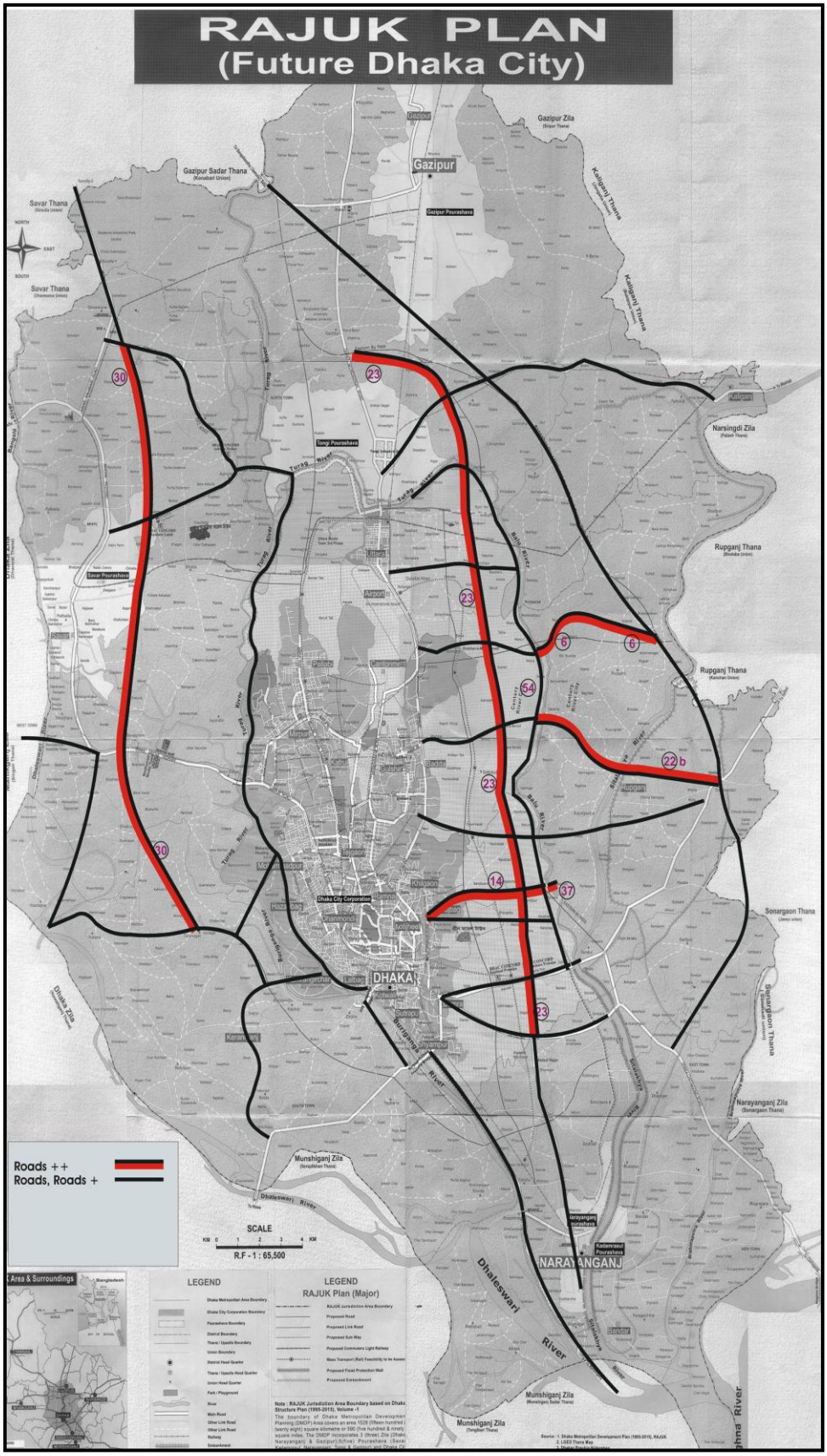


Exhibit 8-8 "ROADS +++" Package - Inner Area

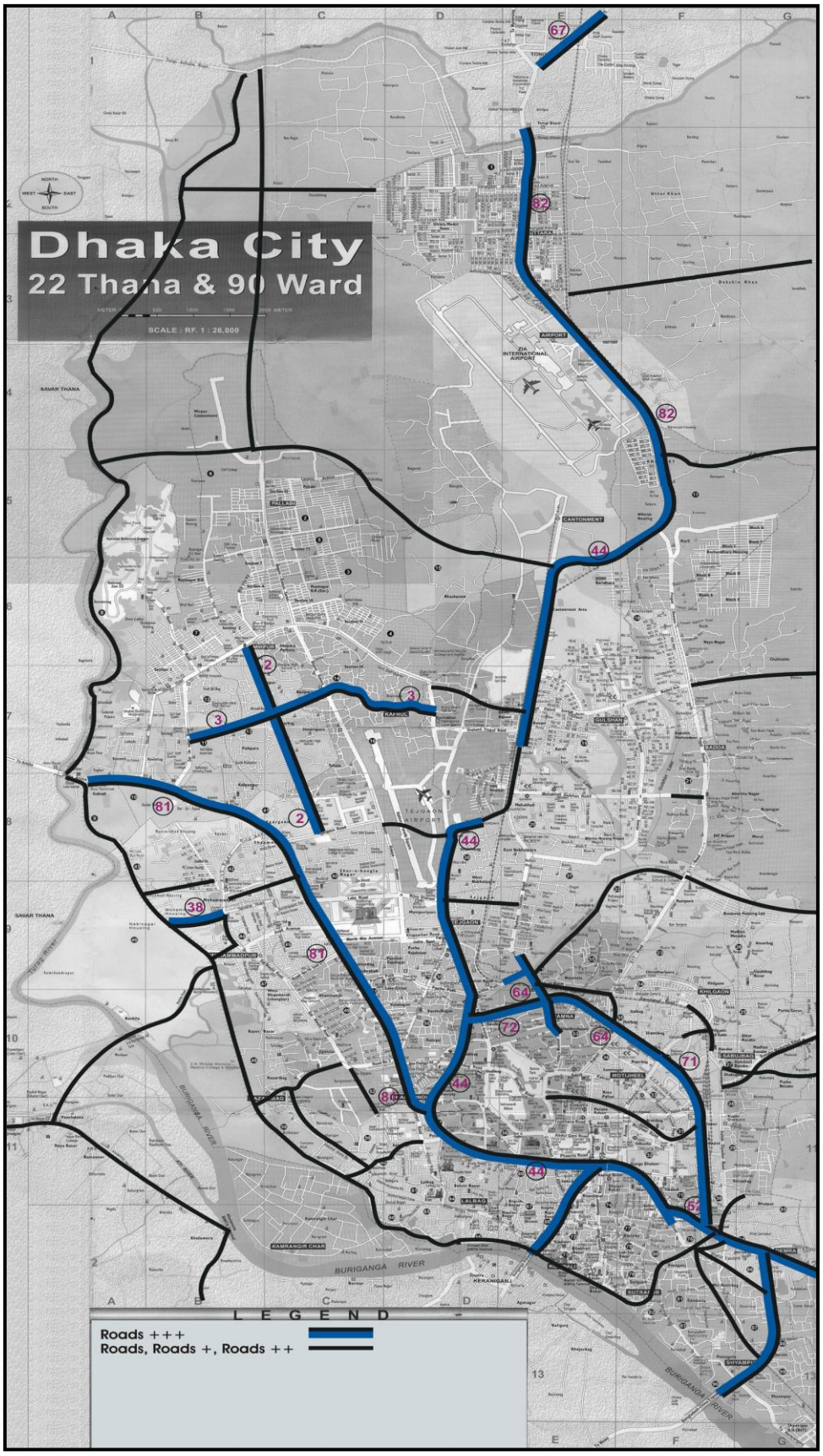


Exhibit 8-9 "ROADS +++" Package - Outer Area

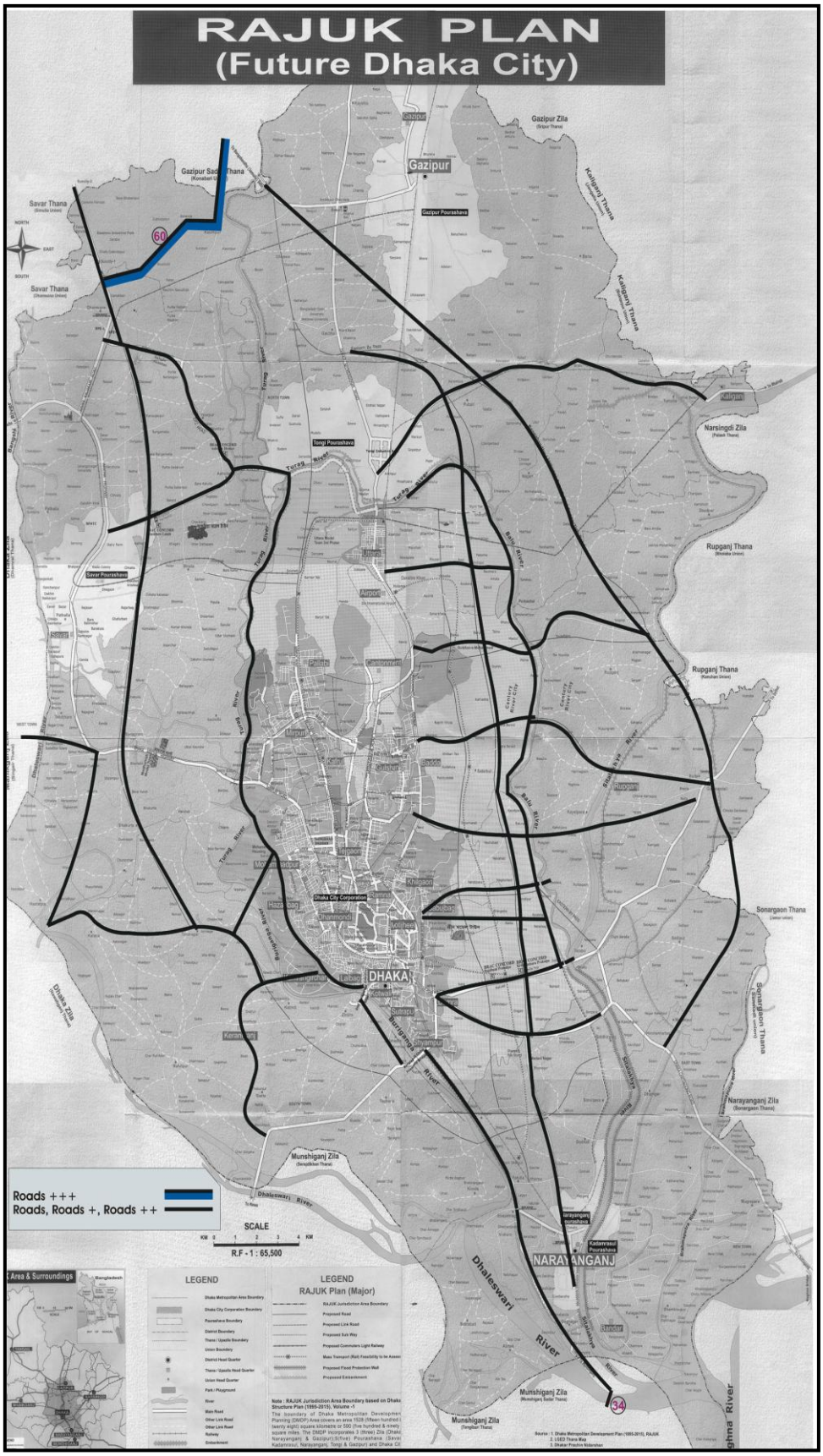


Exhibit 8-10 Elevated Expressway System

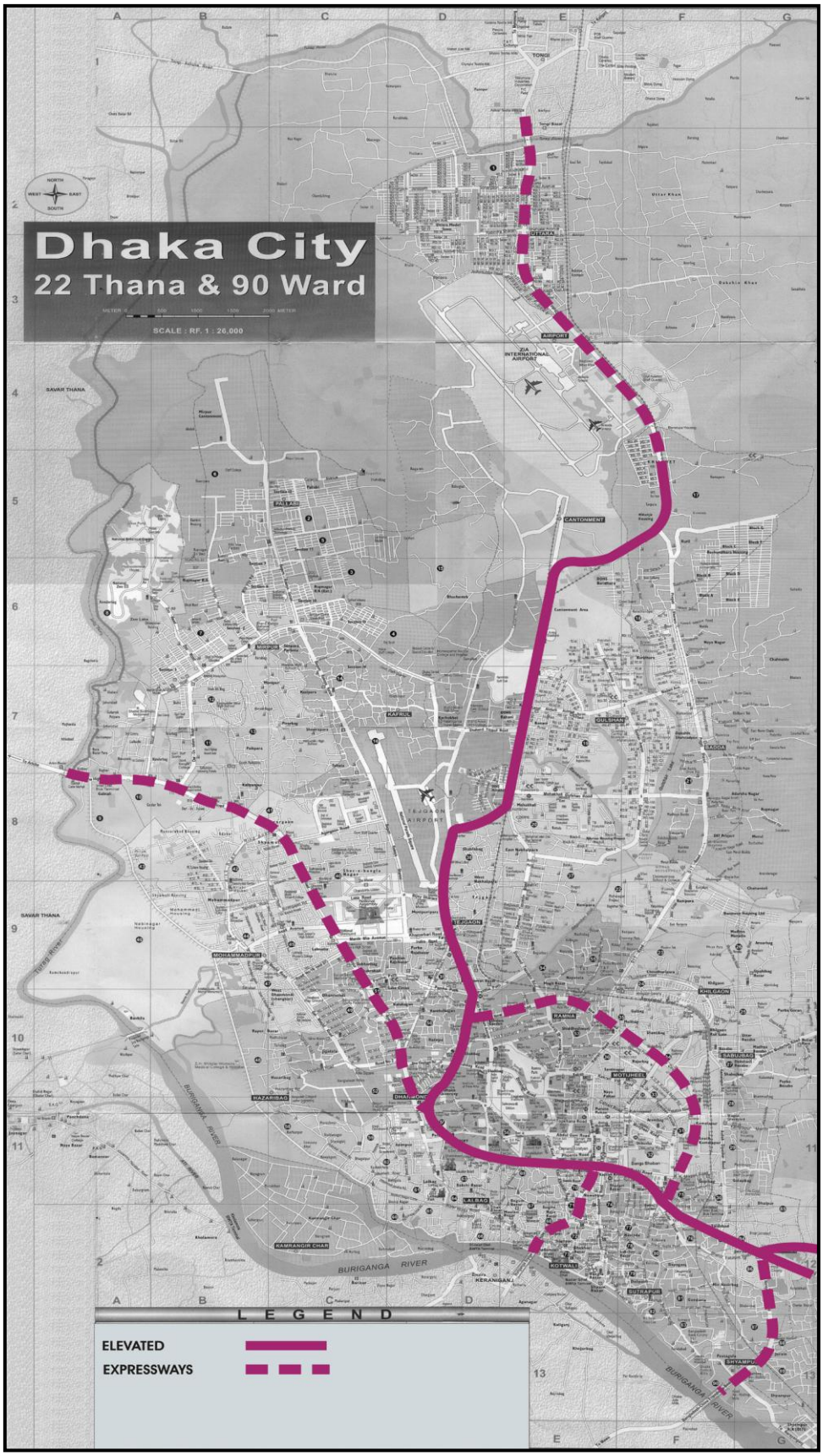


Exhibit 8-11 Combined "ROADS" Package – Inner Area

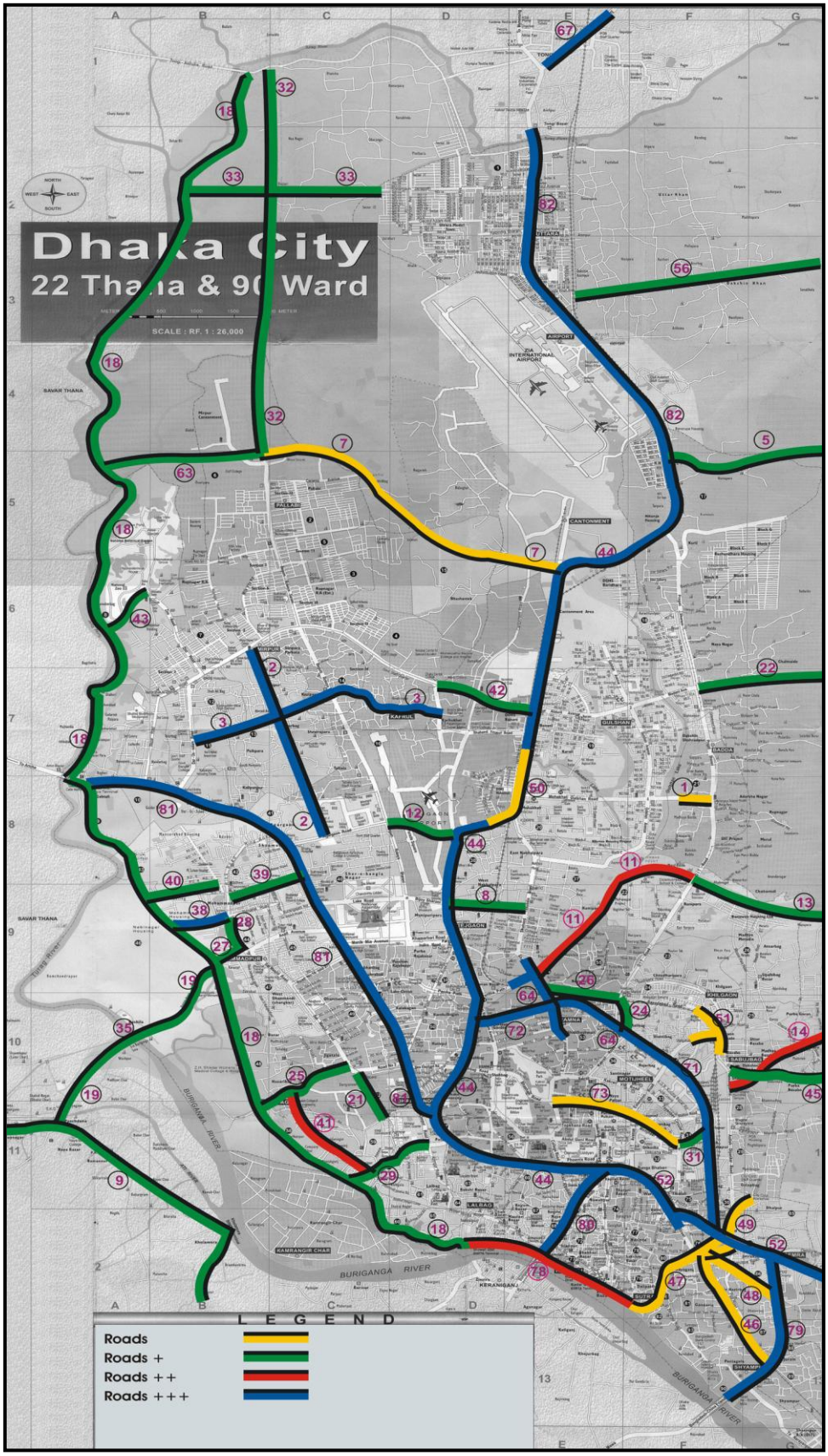


Exhibit 8-12 Combined "ROADS" Package – Outer Area

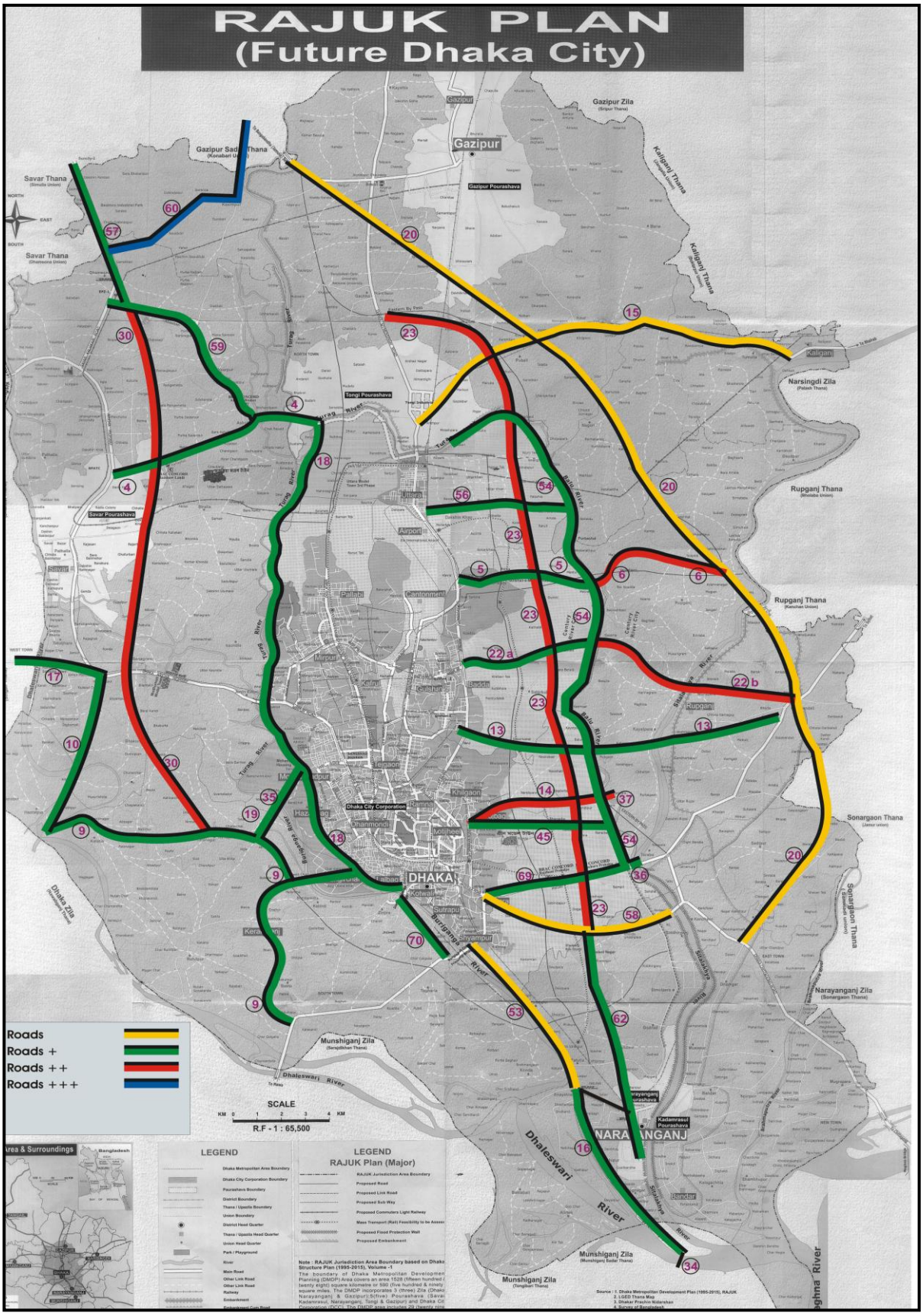


Exhibit 8-13 ALL BRT/ NO METRO – Inner Area

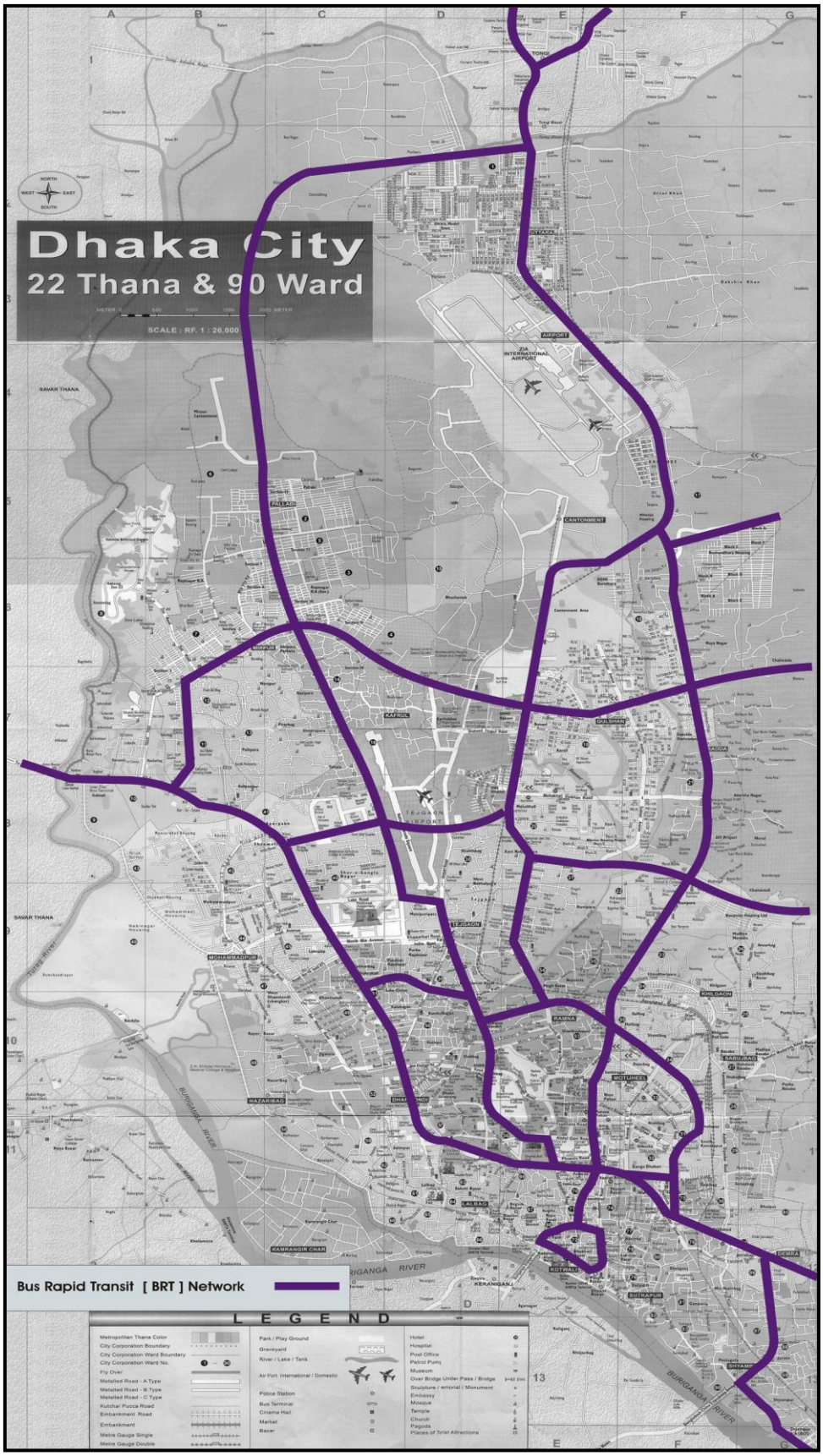


Exhibit 8-14 ALL BRT/ NO METRO – Outer Area

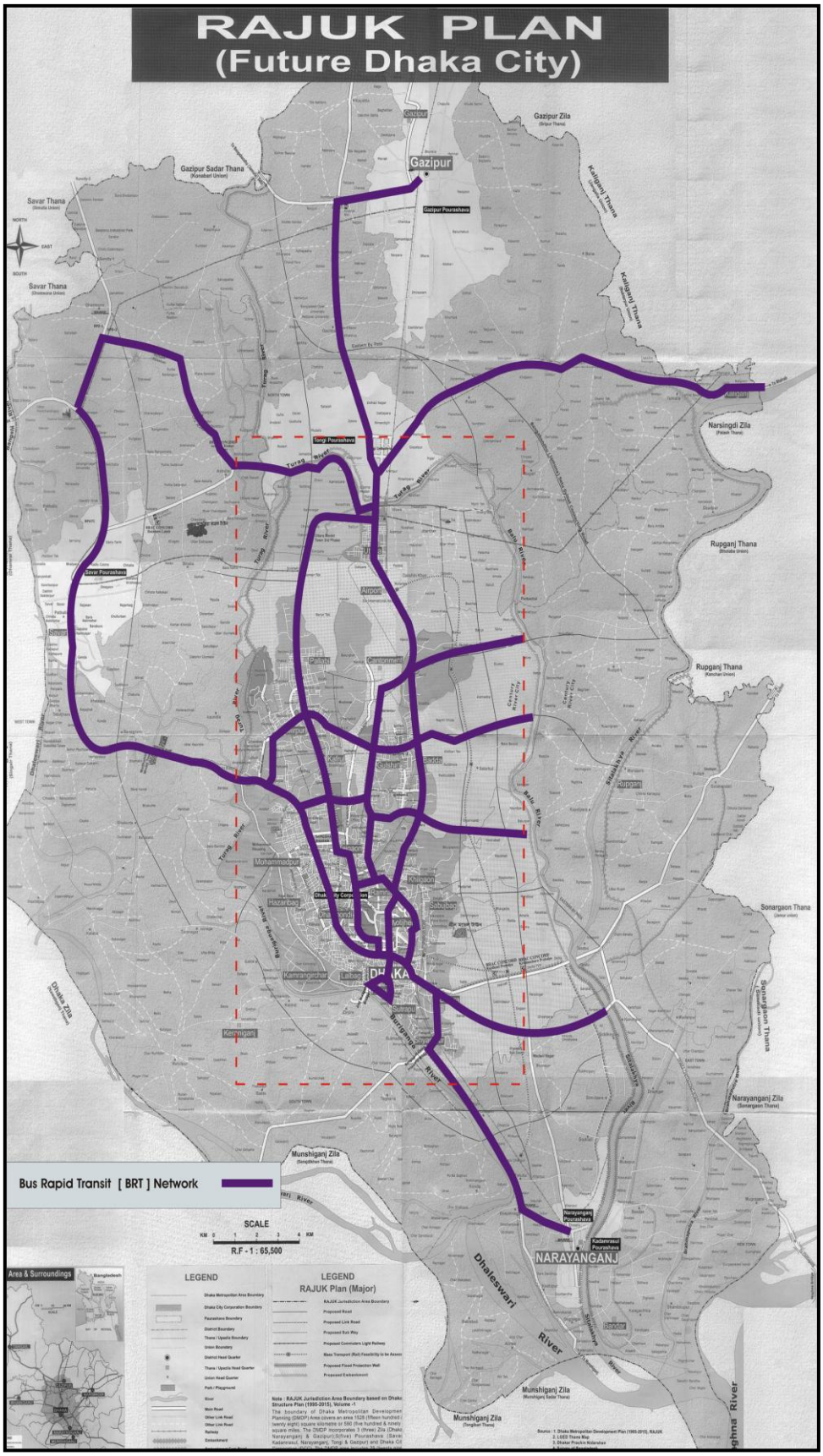


Exhibit 8-15 Blend of BRT and METRO – Inner Area

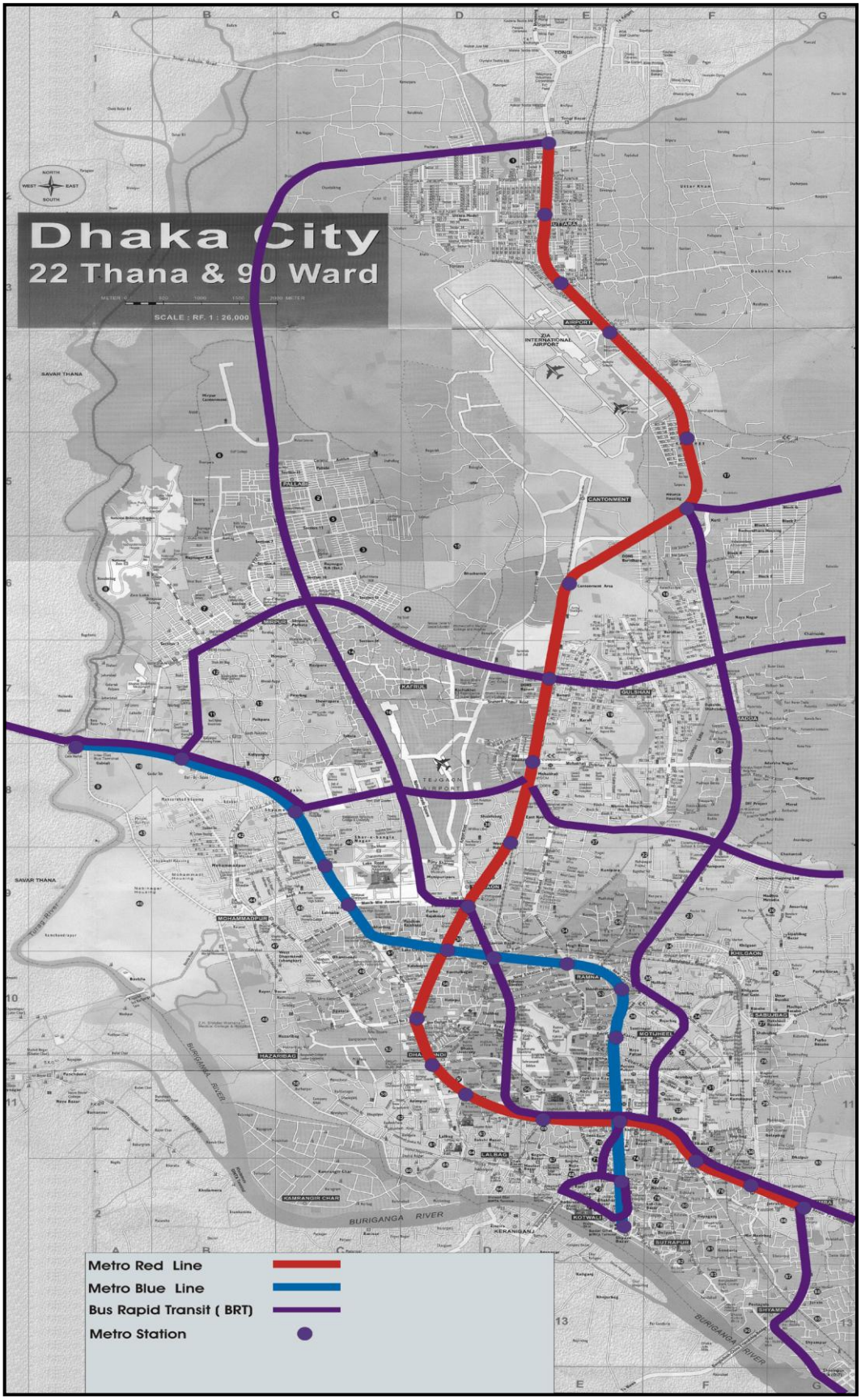


Exhibit 8-16 Blend of BRT and METRO – Outer Area

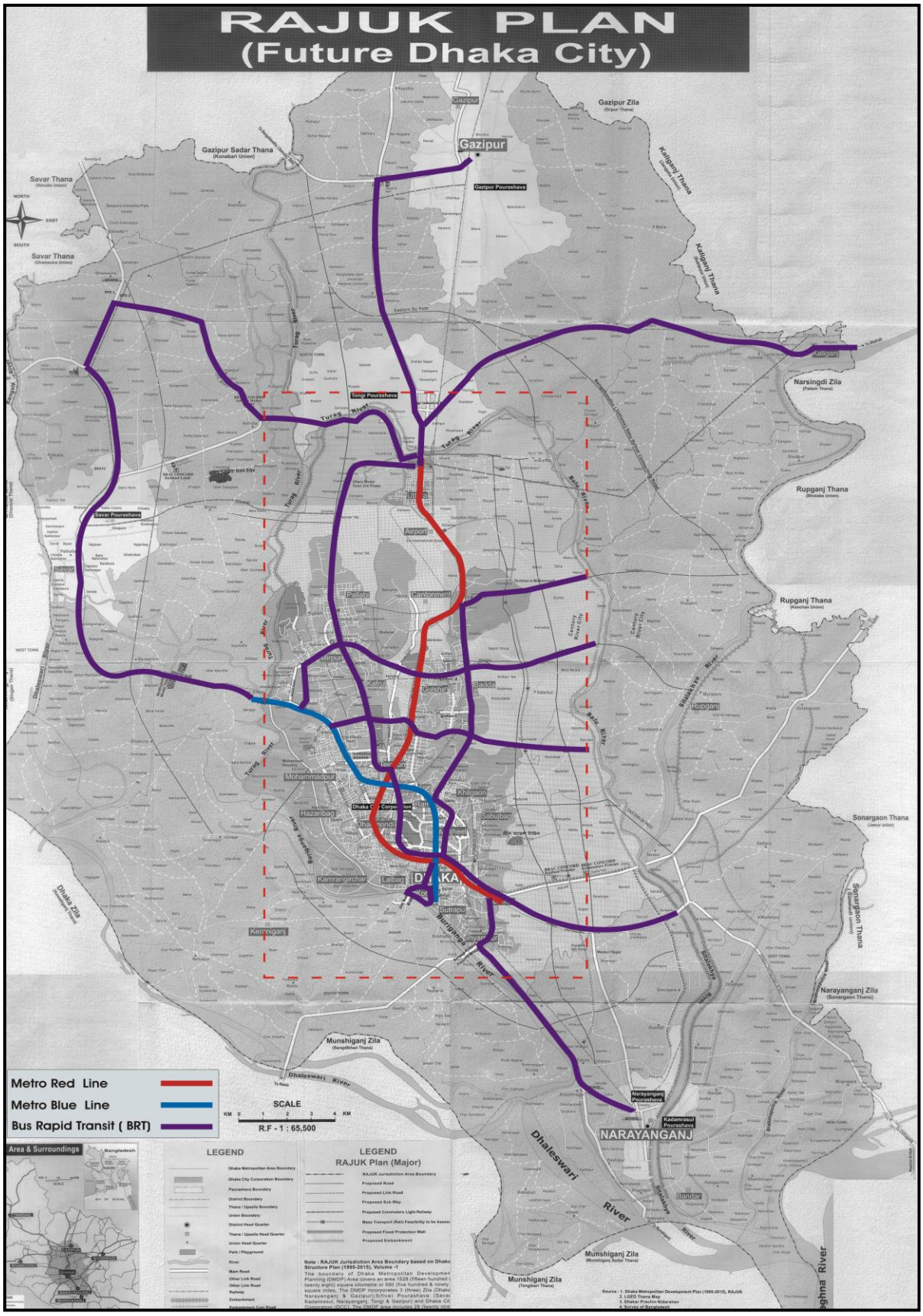


Exhibit 8-17 ALL METRO/ NO BRT – Inner Area

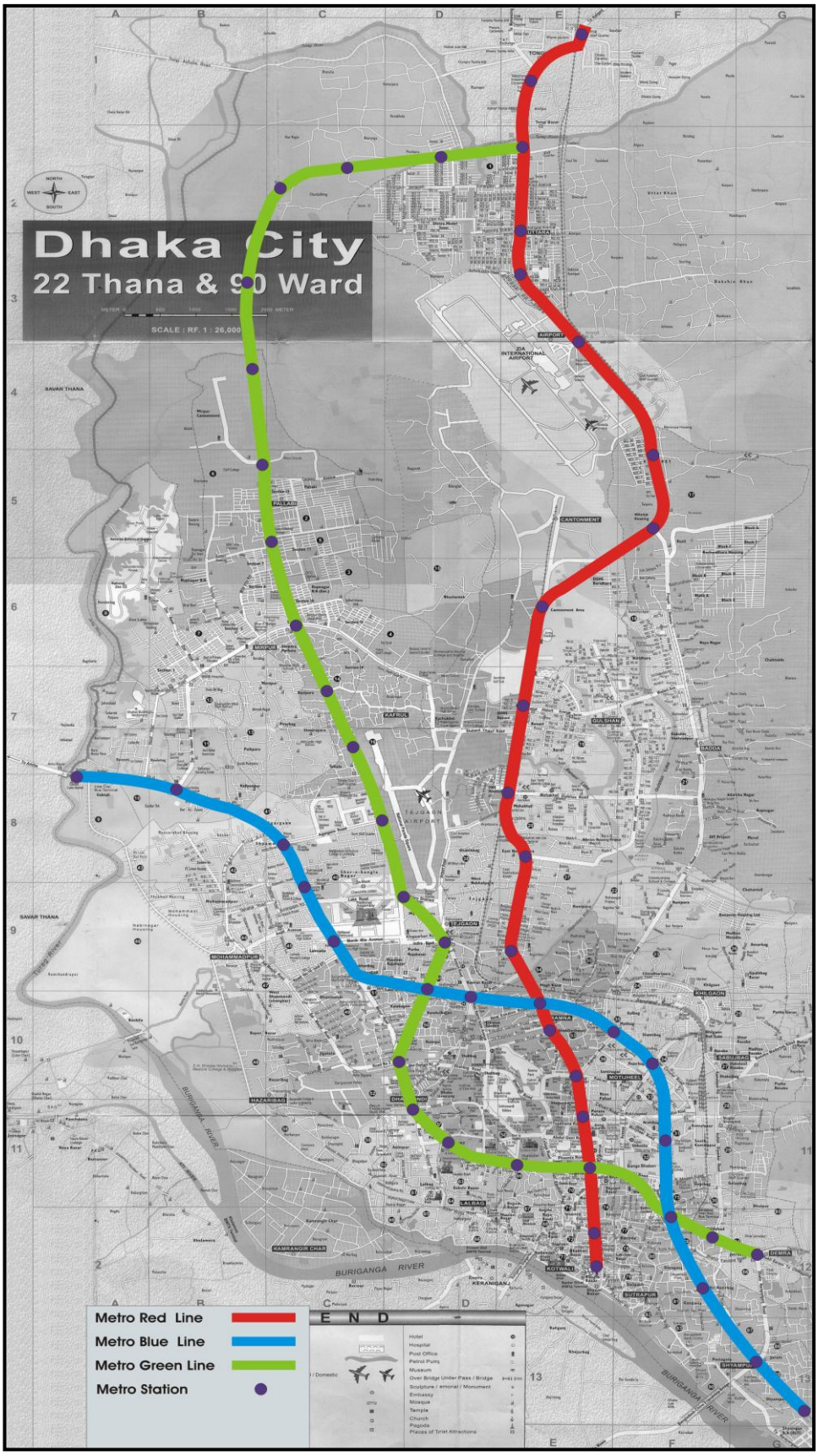


Exhibit 8-18 ALL METRO/ NO BRT – Outer Area

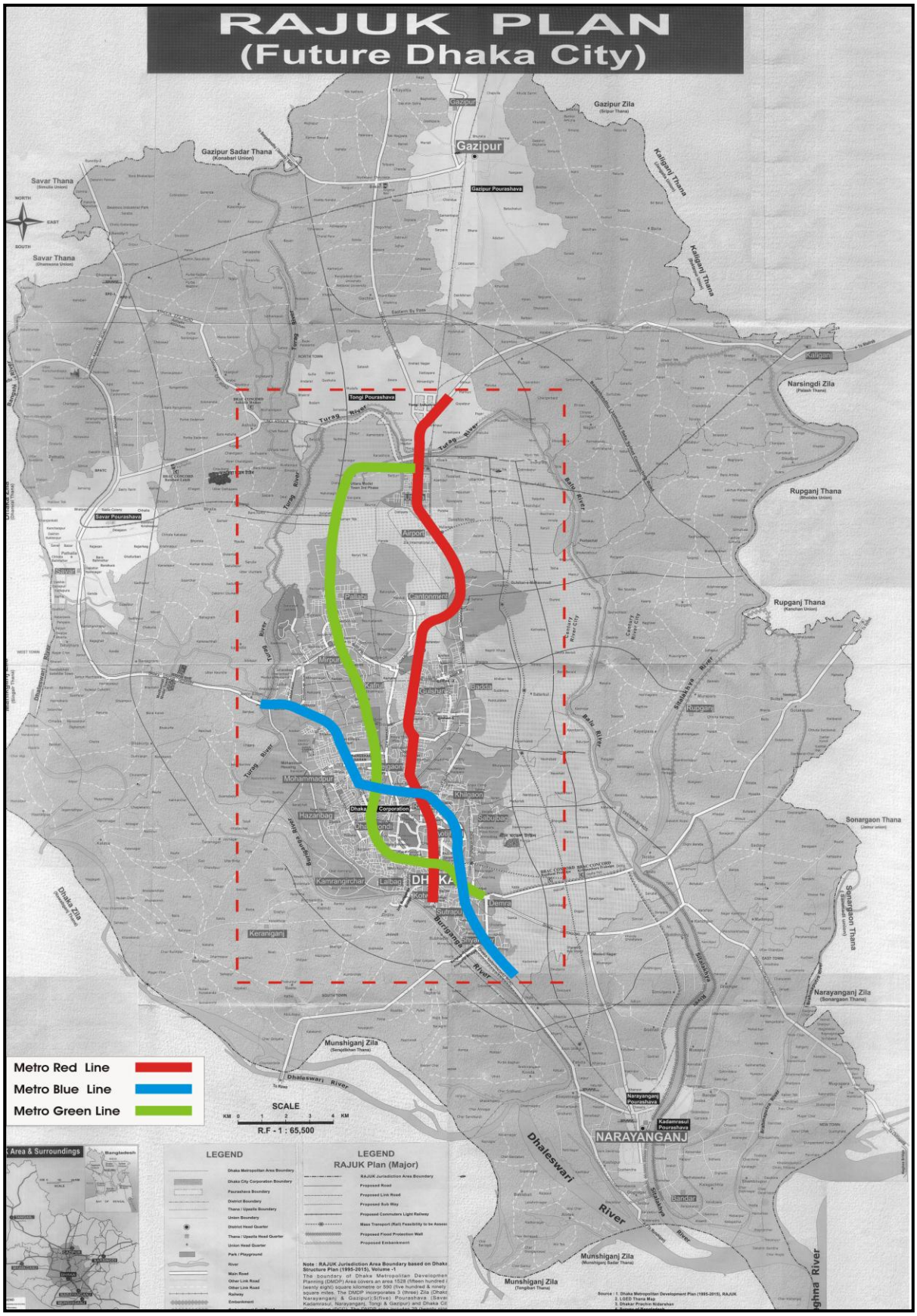


Exhibit 8.19 Objective Evaluation of Alternative Transport Strategies

Exhibit 8-20 Comparison of Strategies – Person Trips

Exhibit 8-21 Comparison of Strategies – Person Kilometres

Exhibit 8-22 Comparison of Strategies – Person Hours

Exhibit 8-23 Comparison of Strategies – Vehicle Trips

Exhibit 8-24 Comparison of Strategies – Vehicle Kilometres

Exhibit 8-25 Comparison of Strategies – Vehicle Hours

Exhibit 8-26 Comparison of Strategies – Travel Speed

Exhibit 8-27 Comparison of Strategies – Travel Speed 2

Exhibit 8.28 Subjective Evaluation of Alternative Transport Strategies

9. RECOMMENDATIONS

9.1 INTRODUCTION

Of necessity, the STP has investigated a wide ranging series of issues. Starting from a consideration of population and economic growth patterns, the study proposed a series of possible visions for the likely growth and settlement patterns for the 20 year planning horizon up to 2024. These land use scenarios were basically different ways of accommodating the huge population increase predicted from an existing population of 12 millions to a future population of 36 millions. Discussions about the options with various stakeholders resulted in a selection of just one option namely, a Growth Pole Scenario. In this scenario, the vision sees the creation of a series of satellite communities on the fringe of the Dhaka built-up area. The satellite communities would be developed with their own employment base so that they would not be "commuter cities" but rather would be self-contained communities with their own transportation systems and other facilities. The main findings from the STP study were the identification of properly designed connections between these cities and Dhaka.

Following the acceptance of the single Growth Pole Scenario, the study looked into the levels of future transport activity, which will be likely to occur in the area. This investigation showed that the level of transportation activity would treble in the case of vehicle trips and would more than double in the case of transit trips. In short, it was estimated that the future transportation system would need to be designed to accommodate a daily peak hour demand of over 1.3 million public transport trips and almost 300,000 vehicle trips.

A number of transportation strategies were considered and presented to numerous stakeholders. These options presented various ways in which to satisfy the demands using different emphases for public and private transport links. It was clear from the discussions that to satisfy demand using road-based systems would not be sufficient and the team was requested to concentrate upon solutions which gave emphasis to public transport. This bold decision had significant implications on how the study arrived at the final recommendations for the integrated system. Although the study had amassed a large portfolio of highway projects for testing, the primary emphasis moved towards finding solutions first for public transit systems and using the most efficient means whereby the demands could be met. Once these solutions had been investigated and the need for a mass rapid transit system established, the highway needs were investigated. The most significant result of this approach was that, in order to make the public transit system the most efficient, a number of corridors, previously identified for major highway schemes were required for the major mass rapid transit lines. The demands changed as a result of emphasizing the mass rapid transit system and the needs for some major expressways required re-thinking.

It should be appreciated and stressed that the study, by definition is a "strategic" study and the list of projects considered and recommended is defined to serve strategic needs. There will be other projects required which will serve more localised needs. These have not been defined in this report and should be the subject of other more locally based investigations.

9.2 THE PREFERRED TRANSPORTATION STRATEGY

Chapter 8 has presented the analysis and evaluation of the ten alternative transportation strategies studied in the main phase of the project. It falls upon the shoulders of the Consultant team to recommend which of these ten strategies would be, in its view, the most preferred. As noted earlier, the selection is not a simple task of ranking by statistics or of subjective reasoning. The selection takes account of many facets and blends these facets to arrive at a final view.

In deciding this view, the senior members of the STP team met on a number of occasions in order to arrive at a consensus view. The recommendation, therefore is not the view of one person but is, rather, the agreed position of the team as a whole. The following logic was used in order to eliminate strategies and gradually arrive at the final selection. As a reminder **Exhibit 9-1** shows the ten strategies being considered. Reference should also be made to **Exhibits 8-19** and **8-28** in the previous Chapter.

Exhibit 9-1 Strategies Being Evaluated

STRATEGY NAME	LEVEL OF ROADS INVESTMENT	BRT COMPONENT	METRO COMPONENT
1a	Roads+	All BRT	No METRO
1b	Roads+	Part BRT	Part METRO
1c	Roads+	No BRT	All METRO
2a	Roads++	All BRT	No METRO
2b	Roads++	Part BRT	Part METRO
2c	Roads++	No BRT	All METRO
3a	Roads+++	All BRT	No METRO
3b	Roads+++	Part BRT	Part METRO
3c	Roads+++	No BRT	All METRO
3d	Roads+++	No BRT	No METRO

Stage One Elimination – The Need for a Multi-Modal Approach

The majority of the populace in the city relies either on non-motorized travel (walk, cycles, rickshaw, etc) or on public transport for its mobility. As a result strategies without an emphasis on public transport are not favoured. Although Strategy 3d has a low price tag on it [$2.2bn] and is within the anticipated budget, it shows more time used in operations [1,067,000 Person-Hours compared with 835,000 for 3a for example]. Also Strategy 3d has a lower average speed (13.4kph) than all other strategies. This low operating speed is occurring because of the absence of a high quality public transport provision. Both of these factors will mean that the strategy has fewer benefits than most others.

Conclusion 1 – Eliminate Strategy 3d.

Stage Two Elimination – The Need for a Realistic Financial Package

It is a fact of life that there are never, or hardly ever, unlimited resources. In Bangladesh, this lack of resources is particularly evident. The STP team made an estimate of the likely availability of financial resources for transportation infrastructure in Dhaka. Taking account of the government provision and making allowances for donor provisions, the team estimated a figure of approximately USD$100m per year. Hence over the 20 year life of the project, there would be a likely sum of USD$2billions available. Allowing however, for additional funding from the government and keen interest from the private sector, the figure can be increased say by 100% to a total of USD$4billions. Allowing for this increase, it is considered that any strategy which requires more than 25% above this figure [i.e. in excess of $5bn] will be difficult to mobilize.

Conclusion 2 – Eliminate Strategies 1c ($5.7bn), 2c ($5.9bn), 3b ($5.7bn) and 3c ($6.9bn).

Stage Three Elimination – The Need for a Good Basic Roads Package

Of the remaining five strategies [1a, 1b, 2a, 2b and 3a] two of these (1a and 1b) contain just Roads+ package which does not contain construction of the Eastern and Western Bypasses which are part of the Roads ++ package. Since it is considered that these are key links in developing the Growth pole Scenario it is believed that the additional US$300 millions is worth the investment.

> Conclusion 3 – Eliminate Strategies 1a and 1b in favour of 2a and 2b due to the need for additional roads infrastructure in the fringe areas particularly the Eastern and Western By-passes.

Stage Four Elimination – Three Levels of Road Systems

Two of the remaining three strategies have a common theme which is an extensive mass rapid transit system based on BRT technology. There is no Metro system in these strategies. The variant is the level of investment in roads. Although the overall planning emphasis has been rightly placed on public transport, it is also certain that there is a need for an improved road system in the city. The main difference in the two strategies is that in 2a the package includes 60 road projects totalling $1,100m. Strategy 3a then adds a large package of elevated expressways at an additional cost of $900m.

Reference to the Subjective Evaluation (**Exhibit 8-28**) shows the aggregate scores at 317 (2a) and 283 (3a). Strategy 2a scores top marks for Safety and Social Development. Strategy 3a scores top marks for Mobility and Accessibility and for Economic Development. Strategy 2b scores 274 overall and is equal to 2a in terms of Efficiency, Safety and Environment. It scores lower on achievability due to the lack of experience with Metro Systems.

Reference to the Objective Evaluation (**Exhibit 8-19**) shows that there is little or no variation in Person-Trips (High = 1,655,800; Low = 1,654,400), in Person-Kilometres (High = 14,487,000; Low = 14,424,000), and in Vehicle-Trips (High = 235,700; Low = 234,000). However, in terms of Person-Hours, Strategy 3a has the lowest of the three (835,000 compared with 887,000 for Strategy 2a and 908,000 for Strategy 2b). Strategy 3a also has the lowest number of Vehicle-Kilometres (2,279,000 compared with 2,312,000 for Strategy 2a and 2,311,000 for Strategy 2b). In terms of Vehicle-Hours, Strategy 3a is again preferred with 179,000 compared with Strategy 2a at 215,000 and Strategy 2b at 207,000. Finally operating speeds identify Strategy 3a as the preferred with an average of 17.3kph compared with 16.3kph for Strategy 2a and 16.2kph for Strategy 2b.

> Conclusion 3 – Eliminate Strategy 2a in preference to Strategy 3a since the assessments show that the addition of the larger roads package proves to be highly beneficial in operational terms and provides the city with a third level of super highways.

Stage Five – The Selection - The Need for Flexibility in Mass Rapid Transit

Of the remaining two – Strategy 2b and Strategy 3a – the argument is principally one of the need and demand for mass rapid transit. It is argued that to place all the reliance on one system only (namely the BRT system) could place the city at risk. It is better to have the flexibility provided by more than one system. Hence a blend of BRT and Metro is preferred to a single system based on BRT alone.

When one considers these issues the time period of the STP study of the year 2024 is significant. The STP is required to look forward 20 years and recommend a transportation strategy, which must reflect firstly what are needed as top priorities and secondly what is

realistically achievable. The first priority is to maximise the existing resources by a strong traffic management program. This should be complemented by an appropriate mass rapid transit system. The lead-in time to design, finance and construct a Metro system is considered to be at least 10 to 15 years in the future. It is also recognized that in the much longer term, BRT may not be the complete solution for a city which will exceed 36 millions.

However, just because the STP stops at the year 2024 at a target population level of 36 millions, the city's growth will not stop then. Almost certainly, as system capacities are exceeded, the ultimate system will need to include a Metro system. In order to plan for this eventuality, studies should commence in the first phase of the STP 20 year period so that when the time is right, design can be completed and resources identified for the introduction of the Metro system. As the reviews of the STP plans are made (a review every 5 years is recommended), so should the reviews of the mass rapid transit system. For this reason the planning of BRT, MRT and Expressway systems should be considered in an integrated manner from the outset so as not to prejudice any of the three subsystems.

> Recommendation – Strategy 2b is recommended as the preferred strategy because, in the Consultants' views it represents the best balance between public transport provision and individual transport to serve the future needs of Dhaka and also offers the optimum flexibility in mass rapid transit bearing in mind full knowledge of the context of reasonably expected financial resources.

In order to obtain the resources to enable Strategy 2b to be successful, the following actions should be considered by the government:

- An increase of the share of budget allocated to transport in the Dhaka area by a minimum of 50% over previous years.
- Pursuit of an increase in its applications for donor funding to target at least a 50% increase in previous funding in the transport sector.
- Aggressive pursuit of private sector funding sources especially for construction and operation of the elevated expressways and the mass rapid transit system.
- Introduction of a special levy in the form of a government surcharge to be allocated for transportation investment.
- Floatation of government bonds and the identification of restrictions (if any) which would be placed on the persons buying them.

9.3 MODIFICATIONS TO PREFERRED STRATEGY 2B FOLLOWING CONSULTATIONS

The evaluation methods and results from the consultant's evaluation process were presented to the study's Advisory Committee. The strategies as presented were debated and the committee were given time to evaluate the presentation and present their own views. Whilst the overall findings were not disputed the committee engaged in open dialogue and provided a view that the blend of BRT and Metro was essential for the efficient and flexible system for the city. At the same time it was felt that the cost aspects of including the full Roads+++ package would be too onerous to finance. It was suggested therefore that the final strategy to be pursued would be a modification and middle ground between those presented by the consultants. Accordingly, the Consultants developed a strategy which was based on 2b (namely a blend of BRT and Metro) together with a middle ground between the Roads++ and the Roads +++ packages. Thus the blend of mass rapid transit systems was complemented by an extensive roads program but a reduced program of elevated expressways. This selected strategy is shown in **Exhibits 9-2, 9-3** and **9-4**. The main features in developing and defining the strategy are described below.

9.3.1 Regional Highway Improvements

The study approach is concentrated in the STP Study Area. However, the study was asked to investigate the needs for the provision of transport links to the surrounding communities and potential locations for satellite communities. The recommendations for regional highway provision are shown in **Exhibit 9-2**. The recommendations are for improvements to existing highways rather than the creation of new alignments. The exception to this is the Dhaka By-pass currently under construction to the east of the city and east of the Balu River.

The projections for future traffic are all within the capacity provided by well engineered 2-lane highways. Although, there is no urgent need to consider highways in excess of this width, it is essential that all of the regional routes are investigated in detail and a rolling program of upgrading should be implemented. This program of upgrading should include the following main tasks:

- Highway Safety Audit. All roads should be subject to a Safety Audit by an independent reviewer, who should investigate, amongst other aspects – sight lines, horizontal and vertical curvatures, surface quality, frontage properties, pedestrian activities, school and market areas etc. The Safety Audit should be presented to the Ministry of Communications for the necessary action.

- Inventory. All roads should be subject to a detailed highway inventory or a review of the existing inventory where one has been performed. This should include as a minimum – width, surface quality and type, horizontal and vertical alignments, lighting, markings and signing, bridges and culvert conditions. In particular, the alignments should be reviewed for all-weather use taking account of the likely flood levels.

- All roads should be upgraded to the required standards for a two-lane national highway based on the inventory and to include the necessary improvements to sight lines, signing, pavement markings and surface treatment.

- All bridges and culverts should be reviewed for strength and foundations and improvement implemented where necessary.

Although the demand is seen to be within the capacity requirements of 2-lane roads, it is suggested that the government considers a regular program of obtaining the right-of-way so that the widening in the future to dual 2-lane roads can be achieved when the demand is shown. In fact, this process has already started with the road to Gazipur already Dual 2-lanes and the Chittagong Road similarly widened. This initiative should continue as funds become available.

9.3.2 Major Generators

One important aspect of planning the highway system and mass rapid transit lines is to serve and connect areas of major traffic generation. The following major generators and transport connectors were all considered and linked with highway improvements and one or more rapid transit lines (either BRT or Metro).

1)	International Airport	2)	Saidabad Bus Terminal
3)	Gabtali Bus Terminal	4)	Kamalpur Rail Station
5)	Gulshan Area	6)	Mohakhali Area
7)	Dhanmondi Area	8)	Mahodpur Area
9)	Tejgaon Area	10)	Rampura Area
11)	Ramna Area	12)	City Hall Area
13)	University Area	14)	Secretariat Area

15) Motijihel Area
16) Pallabi Area
17) Sher-e-Bangla Area
18) Old City Area
19) Mohakhali Bus Terminal

The highways and mass rapid transit lines have been organozed to serve these generators and to provide a system which would integrate the BRT and Metro lines as shown in **Exhibits 9-3** and 9-4.

9.3.3 The Selected System - Description of Mass Rapid Transit Lines

The Feasibility Studies scheduled for Phase A of the STP implementation Action Plan will define the alignments and station locations for all of the mass rapid transit lines. However, to begin focussed discussions, the project Consultant has been able to consider all the various options and study the computer outputs. This has enabled the STP team to devise a system which serves the major generators and provides good coverage of the travel demand. In the Selected System, there are 3 BRT lines and 3 Metro lines as described below. Due to the lead-in time for design, financing, appointment of a contractor and operating consortium and the construction period, it is essential that the BRT lines move ahead in the early years whilst the Metro system is being developed. Of course, the schedule shown in the Action Plan (see Chapter 10) can be changed if finance and other details can be arranged earlier.

9.3.4 Line 1 – The Red Route [BRT]

This line is planned to serve the eastern corridor and is based on Pragat Sarani and DIT Road. It begins at Uttara and serves the International Airport. Because the northern sections of Airport Road currently have very little congestion Line 1 could run as an Express, Limited Stop service as far as Pragat Sarani Intersection. From here, the BRT service will be moved into two protected median lanes as far as Malibag. At this point the line will move onto the Outer Ring Road as far as Kamalpur Station and then south and east to terminate at Saidabad Bus Terminal. It is suggested that this would be the first line to be made operational and could be introduced in stages with final opening within 3 years (2008). As demand is shown to increase, the line could be extended to Tongi and Gazipur in the north and to Demra and Narayanganj in the south.

9.3.5 Line 2 – The Blue Route [BRT]

This line is planned to serve the western corridor and is based on Mirpur Road and Zahir Rahan Sharani Road. It begins at the Gabtali Bus Station/River Landing Stage and would run in two protected median lanes as far as Dhanmondi. At this point the line will cross over onto Zahir Rahan Sharani Road as far as Saidabad Bus Terminal where it will terminate. When the Gulshan-Jatrabari flyover is in operation, it would be possible to leap-frog some services and run as express links missing out the at-grade sections near Kaptan Bazaar and Bhanga Bhaban. It is suggested that this would be the second line to be made operational and could be introduced in stages with final opening within 4 years (2009). As demand is shown to increase, the line could be extended to Savar in the west and to Demra and Narayanganj in the south.

9.3.6 Line 3 – The Yellow Route [BRT]

This line is planned to serve the central corridor and is based on Airport Road and the Ramna Area. It begins at the International Airport and can run as an Express, Limited Stop service as far as the Cantonment Area at the north of Airport Road. The BRT will then be moved into two protected median lanes as far as Mohakhali. At this point the line will divert from Airport Road and pass Mohakhali Bus Terminal following Shaheed Tazzudin Road as far as Ramna. The idea then is to run the BRT in one direction in an anti-clockwise loop based on College Road, Phoenix Road and Nazrul Islam Sharani. It is suggested that this would be the third line to be

made operational and again could be introduced in stages. The loop may first of all be based on Phoenix Road until true access can be made into the old city area. Later the loop could be extended south to include Kazi Alauddin Road, Nawab Yusef Road, Islampur Road. Johnson Road, English Road and North South Road. This will also provide a good interface between the transit system and the waterways system at Sadar Ghat. Final opening for the smaller loop based on Phoenix Road could be within 5 or 6 years (2010). As demand is shown to increase, the line could be extended to Uttara, Tongi and Gazipur in the north. It will be necessary to engage in further dialogue with the designers of the Mogh Bazar elevated highway since this construction will impact upon the BRT route at that intersection. One possible solution is to have stops north and south of the flyover and run the BRT in normal traffic over the flyover itself. Further planning will be undertaken for this location.

9.3.7 Line 4 – The Green Route [Metro]

This line is planned to serve the central corridor and is based on use of the existing railway corridor. It begins at Uttara, serving the International Airport and could run at-grade possibly as far as the Cantonment Area at the north of Airport Road. The Metro will then go underground serving Mohakhali, Tejgaon, Mogh Bazar, Khilgaon and Kamalapur Station terminating at Saidabad Bus Station. It is suggested that this could be planned and the alignment agreed in Phase 1, the contractual arrangements, financing and design accepted in Phase 2 and construction could begin in Phase 3A. Final opening might be towards the end of Phase 3A or the beginning of Phase 3B 15-20 years.

Due to the levels of passenger traffic demand on this corridor, once the Metro Line 4 is opened, there will not be a need for the BRT Line 3 on the upper sections of Airport Road. Line 3 can be restricted to the southern loop sections. This will permit the Airport Road corridor to be released for highway usage where the traffic demand is shown to be high. This central corridor is a prime target for an elevated expressway connecting to the Gulistan-Jatrabari flyover. It is likely, although further study will be needed, that the viaduct will be constructed on the alignment of Airport Road. It is anticipated that with the removal of the BRT Line 3 and the construction of the Metro Line 4 on the railway alignment, there will be freedom to construct the viaduct on the line of Airport Road.

9.3.8 Line 5 – The Brown Route [Metro]

This line is planned to provide two good east-west connections within the high density residential areas of Gulshan, Dhanmondi and Mirpur and the developing areas to the west of the Cantonment Area. The alignment is also based on connecting other elements of the transit system and is shown as a continuous loop. Commencing in Gulshan at Pragat Sarani, the route follows Kamal Attaturk across Airport Road. The line serves Kafrul, Mirpur, Mohammadpur, Dhanmondi, moves east to serve Tejgaon (Farmgate) then Rampura before turning north to Badda and Gulshan. It is believed that this could be constructed above ground and could accelerate the implementation process compared with underground Metro construction. It is suggested that this could be planned and the alignment agreed in the middle of Phase 1 (2009), the contractual arrangements, financing and design accepted early in Phase 2 (2012) and construction could begin at the end of Phase 2 with final opening around 10-12 years (2015-2017). One interesting design feature will be to ensure that if constructed above ground and if the planned elevated expressway is constructed on Airport Road, the Metro Line will need to pass over the Viaduct. Whilst an engineering challenge, it is not impossible and similar construction can be seen in Bangkok as the Skytrain passes over Ramna IV viaduct.

9.3.9 Line 6 – The Purple Route [Metro]

This line is planned to provide a connection within the developing areas to the west of the Cantonment Area and the central area. The alignment is based on Begum Rokeya Sarani,

Sonargaon Road and Zahir Raihan Sharani. Commencing in Pallabi, the route follows Begum Rokeya Sarani as far as Tejgaon where it follows the alignment of Airport Road as far as the Sonargaon Hotel. At this point the line follows Sonargaon Road to Zahir Raihan Sharani terminating at Saidabad Bus Terminal. It is possible that some of the northern section as far as Sher–e-Bangla could be above ground thereby accelerating the process of implementation. It is suggested that this could be planned and the alignment agreed in the middle of Phase 1 (2009), the contractual arrangements and design accepted in Phase 2 (2012) and construction could begin towards the end of Phase 3A with final opening around 15-17 years (2019). An option has been considered to move the alignment to pass through part of the Old City area. Although a detail of alignment planning and feasibility, it is show on **Exhibit 9-3** for illustration purposes.

As more detailed planning begins in Phase 1 of the Action Plan, and operational issues are considered, it is recommended that the planners consider linking Metro Line 4 with Metro Line 6 at Saidabad. This would then in effect create a downtown loop with interfaces at Tejgaon between the two lines and also with the overhead Metro Line 5. One way to proceed with construction would be to favour investment in Line 6 as far as Saidabad and then link this directly to the lower part of Line 4 up to Tejgaon, in effect providing a loop in the downtown area before the full Line 4 Metro is constructed. These and other operational concepts will be an important part of the Feasibility Studies planned for Phase 1.

9.3.10 Major Interchange Development Potential

Although the mass rapid transit system is planned to serve all the major traffic generators, in fact it will itself create enormous potential for new developments. This potential will be created as a result of the very high accessibility provided by the transportation system. The following nodes are particularly interesting as viable sites for major new commercial and residential developments.

- Airport Road/Kamal Attaturk. The intersection of Lines 3, 4 and 5.
- Tejgaon. The intersection of Lines 4, 5 and 6.
- Saidabad Bus Terminal. Served by Lines 1, 2, 4 and 6.

9.3.11 Elevated Expressway Elements

Strategy 2b contains the package referred to as Roads ++ with 60 highway projects. The selected strategy, which is a modification of 2b includes three significant elevated expressways. In effect it moves the selected strategy to a point between 2b and 3b. The three viaducts included in the selected strategy are as follows: -

- Gulistan-Jatrabari. This is a project from DCC and was referred to in the original list of projects as number #52. Recent announcements have revealed that this will be financed as a PPP project and will be put in operation as a Tolled Highway.

- The Elevated Expressway. This is a project from RHD and was referred to in the original list as project #44. It is conceived in two phases; one from Gulistan to Mohakhaliy Flyover and the second from Mohakhaly Flyover to the north.

- Mogh Bazar. This is a project from RHD and was referred to in the original list as project #72. It will construct flyovers over Eskaton Road. It appears from reviews of the designs that there is no connection to the Elevated Expressway project noted above. It is suggested that this connection be investigated before plans are finalized for this project.

9.4 PRIMARY RECOMMENDATIONS

Throughout the course of the STP Study, a large number of issues have been raised, covering a broad spectrum of multi-modal transport systems. Having selected Strategy 3a as the preferred, it became apparent that there are some recommendations that are more significant, more substantial and more important in influencing and shaping the character and quality of the Dhaka area. As a result, a set of seven recommendations have been labelled as 'Primary Recommendations', each of which is summarized below. The intent is not to diminish the importance and relevance of other recommendations, but rather to emphasize and stress the strategic importance of these seven recommendations.

Recommendation #1: Traffic Management

Establish a program to reclaim the full potential capacity of the existing roadway space.

At the present time, the driver competence and behaviour patterns in the city are very poor. In addition, the highways have been taken over by traders and others who use the running surfaces for uses other than transportation. This causes traffic congestion and delays and reduces the carrying capacity of the highways. One of the major untapped transport related assets of Dhaka is the substantial unused traffic capacity in the existing highway system that is now being wasted through inappropriate use and poor driver behaviour.

It is recommended that a program be instituted to move forward in a positive and definitive manner to reclaim the full capacity of the existing public right-of-way and highway space. This reclamation can be achieved by: -

(a) Relocating and/or removing uses which are not appropriate. Prominent among these inappropriate uses are – street traders who set up stalls on the pedestrian ways and also on the highways themselves, building materials again blocking the footpaths and highways and haphazard uncontrolled parking of rickshaws and other vehicles.

(b) Providing better organization and improvement in the operational practices of drivers. This poor behaviour is a direct result of not controlling the licensing scheme rigorously. It is known that licenses can be obtained without having taken any formal instruction or testing procedure. As a result, drivers are not competent to handle their vehicles properly and are unaware of the rules of the road. The result is inefficient operations, congestion and danger.

Although driver education and licensing is a wider issue, this first recommendation concentrates on what can be achieved by undertaking correct traffic management of the main arterial links. By re-planning the main links and intersections, the city would gain an essential and cost-effective resource for very little outlay. Substantial economic benefits can be anticipated from this action.

Recommendation #2: Bus Consolidation

Restructure the bus operations from a large number of small operators into a smaller number of large operators.

The consolidation of bus operations is a recognized, long-standing need that has remained unchanged during the past decade. While there are a few private bus operators with fleets of 30 or more buses, the vast majority of buses, particularly minibuses and microbuses are held by individuals rather than in collective ownership. Recent surveys have shown that some 800 individuals own approximately 1,450 buses and mini-buses.

Such fragmentation affects investment decisions, on-street operational behaviour, vehicle safety, size of the bus fleet and other aspects. All of these aspects have a negative impact on the quality of the service provided to the users as well as other transport modes using the highways. In order to make significant improvements in the operations of the system it will be necessary to merge owners into cooperatives. This can be done effectively by introducing route franchising arrangements. However, before this can be done effectively, there needs to be a re-organization of the roles of various actors (BRTC for example) and the legislative background which exists.

As a first step however in making the existing fleet more efficient, the study recommends the immediate introduction of a series of bus priority measures and bus only lanes. This can be put into effect immediately whilst other parts of the transit system are being planned and designed.

Recommendation #3: Integrated Multi-Modal Mass Rapid Transit System

Proceed with the planning, design, development and implementation of an integrated mass rapid transit system.

A metropolitan area, the size of Dhaka, needs some form of mass rapid transit to provide good quality transport, at an affordable cost, for a large number of users. As the area continues to grow, the need for such a system becomes even more acute. A number of candidate systems were considered during the study and their applicability was identified using a number of criteria. Principal among the criteria were – capital cost, capacity provided and ability to construct. The three main candidate systems considered were Metro (heavy rail based, completely segregated and a blend of over ground and underground), LRT (Light Rail Transit either street running or elevated/underground and BRT (Bus Rapid Transit either street running or elevated/underground).

In terms of capital cost Metro is the most expensive and BRT the least expensive. Capacity is highest with Metro (up to 60,000 passengers per hour) is least with LRT (about 10,000 to 20,000 passengers per hour) with BRT in the middle ground (between 15,000 to 25,000 passengers per hour[1]). In terms of ability to construct, the BRT system is a clear winner with simple traffic management methods only required to implement the basic system. Metro, due to the need to have complete segregation is the most difficult to construct and will be either underground in tunnel[2] or on elevated track. LRT is more difficult to implement than BRT and offers very little difference in capacity.

The study also investigated the future role of the railways and the waterways networks. Both of these systems have the potential to provide much needed capacity. However, in the case of railways, there is a need for a considerable investment to bring this up to the necessary quality (see Recommendation #7). The waterway already has an extensive network of ferries and smaller boats providing service between the outlying areas and the city area. However, as with the railways, there is a need for large investments and organisational improvements to make this system an integrated part of the whole system. The work on traffic assessments has shown that the attraction of waterway transport is low in comparison with other forms due to the speed differential. For this to be a practical contender in the multi-modal system there will be a need to identify and implement a fast boat system.

[1] *In fact, some of the very modern BRT systems are seen to exceed this figure and, with two lanes operational can approach capacities of 35,000 passengers per hour.*

[2] *At the outset of the study, there was grave concern that any underground system could be at all viable. On further study and with advice from specialists in sub-soil conditions, opinions have changed to the extent that it is considered quite a viable proposition to construct a Metro underground in Dhaka.*

As described in section 9.2, the recommended strategy calls for short-term investment in a BRT-based rapid transit system coupled with a longer term view leading toward Metro-based service. The essential part of achieving the integration of all available systems is to begin with a co-ordinated approach from all authorities providing transportation services with a view to realising the best attributes of all systems.

Recommendation #4: Selected Highway Projects

Provide selected highway projects that serve basic access requirements to major areas of development.

During the development and study of the highway system in the study area, the study team obtained information on a large number of possible highway projects. This information was assembled from the relevant agencies [for example MOC, DTCB, RAJUK, LGED, RHD and DCC] responsible for highway implementation either by study of published documents or by visits and discussions with senior officials at each agency. The list of projects was constantly updated and a finally agreed list of 77 projects formed the basis of the study investigations. This list of projects is contained in Annex A to this report.

The study undertook a series of tests on these schemes firstly by incorporating all of the schemes in the future networks and investigating which were justifiable on the grounds of traffic service. At the end of the analysis, it became clear that some schemes were not performing as strategic highways since the traffic flows were very low. Others showed low figures but were considered strategic in nature and were retained. Still more were considered as being not appropriate due to their impact on other aspects of the overall system including the proposed Mass Rapid Transit system.

The Roads ++ package which forms a part of the Modified Strategy 2b consists of some 62 highway projects of varying widths including an elevated expressway system of approximately 16 kms in length. Chapter 10 which follows describes the priorities established for this highway program and there are companion volumes to this report containing Terms of Reference for those projects considered to be essential for study and/or construction in the first 5 year period.

Recommendation #5: Safety Improvements

Improve methods of driver training and testing, vehicle roadworthiness inspections and design layouts of highways.

The incidence of road collisions, injuries and deaths together with the associated economic loss in terms of property damage, medical costs and lost productivity has reached alarming levels in Bangladesh. While efforts to reduce the number and severity of accidents involve many elements, good drivers who are driving well-maintained vehicles is an essential part of the solutions that should receive priority consideration.

In parallel with this report on the Strategic Transport Plan, the study has produced a companion volume which covers the issues of Urban Transport Policy. In this companion volume, the study recommends a complete overhaul of the driver and vehicle licensing and testing system. It is proposed that BRTA take on this role following a re-structuring and strengthening of their operations and abilities. The activity will require the establishment of a comprehensive database which is to be kept up to date and which will include information on all vehicles (including Buses and Rickshaws) and all drivers of

any type of vehicle. It is recommended that this data base[3] includes accident data and should be made available on-line to relevant agencies such as Police and highway designers as well as safety specialists.

In terms of the safe design of roads, it is recommended that the authorities undertake a complete safety audit of the highways under their jurisdictions taking into account the latest safety design measures and best practices in terms of sight lines, road markings, surface treatments and intersection channelization.

Recommendation #6: Pedestrian Facilities

Develop and implement a major program of pedestrian facility provision and improvement to serve pedestrians better and encourage people to walk from choice rather than from necessity.

Walking is currently a commonly used mode of transport in Dhaka. While walking is a matter of choice and convenience for some people, the reality is that for many people, walking is a matter of economic necessity. Despite a high proportion of walking trips, suitable pedestrian facilities have traditionally been neglected. A major commitment to improve all types of pedestrian facilities is recommended. Not only is this aimed at serving those who have no choice but to walk, it is also to encourage others who have a choice to walk more often.

There are policy implications here as well as planning implications. At present, although the rules of the road require that preference be given to pedestrians, there is no evidence of this on the street. The project has recommended in its parallel Urban Transport Policy report that a "Pedestrian First" policy be implemented. In this, the regulations would be reviewed and adjusted to ensure that the pedestrian has right of way in the appropriate circumstances (pedestrian crossings for example). This will also mean that motorists must be trained to understand this and the regulations must be enforced rigorously. A publicity campaign should be launched to begin this process of understanding.

Recommendation #7: Railway Resolution

Commission a feasibility study to evaluate and resolve the options of improving railway transport within Dhaka.

Three primary issues related to the existing railway in Dhaka are:-

- the significantly under-use of rail as a transport mode for passengers and freight
- the serious and disproportionately adverse impact of the railway on other land based transport modes, due to the number of existing at-grade crossings, and
- the important value that such a linear right-of-way represents within a dense urban environment.

Many and varied suggestions have been made in the past for the use of this right of way and the future of the railway, including:-

- relocating the railway to the eastern side of Dhaka and using the existing alignment for other transport related uses,
- elevating the railway along the existing alignment while also substantially upgrading the services, and

[3] *DTCB is already in the process of designing a Database which will incorporate numerous planning and design aspects including accidents, traffic flows and socio-economic data.*

- terminating the rail line at an appropriate northern point, establishing suitable station facilities (passenger and freight) and relying upon intra-urban modes to distribute and collect passengers and goods throughout the Dhaka urban area.

The multiplicity of options and the large service-related and financial consequences of such potential changes are very substantial and need a full evaluation before a definitive decision is made. However, the STP recommends strongly that the inter-city operation on this corridor be stopped and the right of way be made available for the construction of a mass rapid transit line. In order to substantiate the necessary works, the study investigated a number of options for this work as follows:-

- **Option A**: Upgrade the existing railway line. While the right-of-way exists, it must be separated and protected either by elevating the railway or by installing road underpasses or overpasses at numerous locations. Also, the quality of the road bed, the rails, the switching equipment, intermediate stations and the rolling stock are such that the cost to replace would be similar to the cost for a new alignment. The cost estimate for this was USD$1.9 billion.

- **Option B**: Relocate the railway to a new alignment in the Eastern Corridor area. If done, this would probably involve building it on an embankment that is high enough to stay above flood levels, and would probably incorporate openings (via bridges/box culverts) at several locations to provide space for east-west roadways, as well as all new track bed, rails, switching equipment, intermediate stations and rolling stock. The cost estimate for this approach was USD$2.8 billion.

- **Option C**: Terminate the existing line at points north and south entry points and create new stations. Onward connections into Dhaka would be provided via a mass rapid transit system and regular bus services and automobile type transport. The existing railway line between the north and south entry stations as well as the existing central station (Kamalapur) and the container port would become available and reused for other purposes. This option would involve the construction of two new rail stations and related yard facilities as well as improvement to the rail line from the north station north to Gazipur and the south station south to Narayanganj. The costs for this option were estimated as USD$900 million.

- **Option D**: Terminate the existing line at a point north and build a new north station and abandon the portion south to Narayanganj. Onward connections from the North station into Dhaka would be provided via a mass rapid transit system, regular bus services and automobile type transport. The existing railway line between the north and south entry stations as well as the existing central station (Kamalapur) and the container port and the rail right-of-way south to Narayanganj would be available and reused for other purposes. This option would involve the construction of only one new rail station and related yard facilities as well as improvement to the rail line from the north station north to Gazipur. The estimate cost for this option is USD$600 million.

Given the range of options and the range of costs and the uncertainty of the cost estimates, a value of USD 1.0 billion was used as a set aside amount for the railway within the Dhaka metropolitan area for strategic transport planning purposes.

9.5 TRAFFIC MANAGEMENT RECOMMENDATIONS

9.5.1 Introduction

Recommendation #1 above has stressed the need to reclaim the lost capacities in the existing highway system by the use of traffic management measures. The concept requires that good practice in organization and priorities is implemented within the existing right of way. No land acquisition is required and no displacement of persons results. Having said that, any non-conforming uses such as illegal structures forming pinch points and persons who carry on their businesses on the road itself will be affected.

9.5.2 Specifics

In implementing these traffic management schemes the following principles should be adopted:-

- The right-of–way should be clearly defined and all obstructions removed within these confines. This will entail a gradual clearance of illegal trading areas, surplus building materials left over from construction and items such as refuse containers deposited on the road itself.

- The road design standards should be reviewed to ensure that they are appropriate for urban design conditions in Dhaka. Once accepted the highway functional classification should be implemented to the extent possible consistent with the need to avoid land acquisition and person displacement. The primary effect of enforcing the functional classification will be to design the correct number of running lanes and the methods to protect these running lanes from other non-conforming uses. A specific impact which is prevalent in Dhaka is the use of the nearside lane for haphazard parking and waiting areas. In a three lane highway, this practise effectively reduces capacity by some 30%. In an arterial classification in which a dual-3 lane highway is planned, all three running lanes must be clear of obstruction and available for moving traffic.

- The intersection geometry will also be controlled by the urban design standards and this will include sight lines, specification of lanes for turning traffic and properly placed stop lines. Correct movement through the intersection should be organized by the use of channelization islands. These islands will not only channel traffic movements correctly, they will also provide pedestrian refuges for safer pedestrian crossing movements.

- On the running lanes, it is essential to provide clear surface markings in order to channel traffic into the correct lanes. This should be included well in advance of the intersections so that vehicles adopt the correct lane for their movements through the intersection. At the intersection, clear lane markings will designate lanes for left and right turns and for straight ahead movements. The right and left turns will need to be segregated in some instances in order to prevent bad turning practices (for example making right turns from other than the right lane or other designated lane).

- In some instances on faster moving arterials (Airport Road for example) overhead gantry signs should be installed. These will provide better advanced warning of lane designations and the advanced knowledge of direction signing will avoid or minimise last minute decisions about lane changes. At present in Dhaka there is a lack of consistency in direction signing and this should be resolved by a program of review or all arterials and their signing. This is a major contributor to the reduction of collisions.

- Parking should be prohibited on arterials highways unless it is possible to designate spaces such that they do not interfere with the free flow of traffic. In most cases this

should not pose a difficulty since adequate parking areas can usually be located on nearby side roads. At bus stops, there will be a need to provide properly design spaces for the use of feeder services provided by either rickshaws or CNGs.

- The services provided for pedestrian movements are divided into to Linear (along the footpath) and Transverse (across the highway). The present condition of footpaths in Dhaka is appalling and dangerous. Pedestrians are forced into the road itself due to poor footpath design and misuse of the footpath space. As part of the traffic management improvements, the footpaths should be cleared of obstructions and properly paved. Regarding pedestrian crossings, the policy needs to be reviewed and revised and a fully overt program put into effect to protect the pedestrian. When on a crossing the pedestrian must have right-of-way and drivers must first of all be aware of this and secondly must know that if they violate the rules they will be caught and punished.

- Where bus public transport uses the arterials, two major factors are needed within traffic management planning. Firstly, if the bus service operates under normal conditions within the traffic stream, the minimum requirements will be that stops are organised such that buses will pull off the running lanes into bus lay-bys. In more advanced circumstances there will be Bus Only lanes and these should be clearly designated and protected from other traffic in relevant sections by low kerbs or other separators. The BRT systems, of course, will have its own exclusive right-of-way protected by kerbs and other barriers.

- The policy and planning role for rickshaws has been published in the parallel volume on Urban Transport Policy. Some highways will be designated as being “Rickshaw Free”. On these highways, signing must be posted to advise rickshaw drivers that they must not enter and suitable waiting areas should be provided on side roads such that they can make efficient connections for feeder services. Where rickshaw bans occur, there should be parallel routes created and maintained in the neighbourhoods so that rickshaw operation is made more efficient.

9.6 BUS SECTOR RECOMMENDATIONS

9.6.1 Introduction

The dependence upon bus transit for a large majority of people in the city requires that this mode should have a prime place in the immediate and longer term future of the area’s transport strategy. The considerations concentrate upon Immediate Term, Short Term and Long Term approaches. At present, the operation of buses within the city is in turmoil and the service to the public is very poor. Buses fight for road space with other vehicles and usually come off second best. In the Immediate term (identified as from now until the end of the year 2006), it is recommended that a series of bus priority and bus only lane schemes be provided on the main arterials in the city. What this means is that some lanes will be dedicated to buses and banned to other vehicles and some intersections will have lanes given over to bus transit with priority green times at signals.

In the Short Term (identified as from 2007 to 2012), there will be a progressive program of introducing BRT operations with limited stop services on a number of routes within Dhaka and extending on demand to the surrounding cities. In total these routes constitute some 210 kms, covering most of the city and providing a high quality rapid service on long haul routes. In parallel with the introduction of the BRT system, the regular bus routes will be re-organised to provide more localised, frequent stop services within the neighbourhood super blocks and across blocks for longer services.

In the Long Term (identified as beyond 2019) and subject to a feasibility study, some of the BRT lines will be superseded by Metro lines and new Metro lines will be constructed. The whole system will be integrated with common ticketing and easy efficient interchange stations.

9.6.2 Bus Operator Consolidation

One of the Primary Recommendations of the STP is a restructuring of the bus industry to transfer ownership from a large number of small operators into a small number of large operators. This is a recognized, long standing need that has remained unchanged during the past decade. Unchanged in the dual sense that (i) little has occurred in terms of consolidation and (ii) little has changed regarding the importance of consolidation. In 1994, the Dhaka Integrated Transport Study (DITS), stressed the importance of restructuring and consolidation in order to achieve improved quality of service, increased productivity, and effective regulation.

While precise figures are not readily available, it is estimated that there are around 10 private bus operators with fleets of 30 or more buses, predominantly in the large-bus sector but including some large minibus operators. Aside from these larger operators, buses are under individual rather than collective ownership, although some individuals own several buses. Microbuses are generally held under individual rather than collective ownership. The overall level of fragmentation of the industry remains high.

Regulators acknowledge that it is very difficult to control bus operators on an individual basis. Following recent efforts and coinciding with the entry of several new large bus operators, the government, through the efforts of the Road Transport Committee, has achieved some success in encouraging consolidation of the industry into larger operating units operating under a company rather than an individual basis. The policy has been applied using a range of approaches including:

- Discouraging route permit applications by individuals and encouraging applications from companies
- Reducing the duration of permits from 3 years to 1 year for the more fragmented diesel minibuses and human haulers
- Informal encouragement such as verbally at meetings of the Road Transport Committee
- Shifting human haulers and diesel minibuses off the main arteries and on to the side roads

The Road Transport Committee is instructing small operators to form cooperatives. Individual applications for route permits are discouraged, with company applications given preference. The DTCB's recently implemented demonstration project on bus route franchising, also sought to encourage industry consolidation by only accepting bids from cooperatives or companies and by specifying a minimum fleet size requirement for participation in the tender. In terms of route permits, new bus operators are given a 3 year permit following an initial trial period. Minibuses and human haulers (except for the small number of CNG buses) are being issued only 1 year permits. Gradually these are being replaced with newer vehicles.

It is recommended that the government continue with these policies and actions that encourage industry consolidation and fleet renewal. Further measures that the government should consider implementing, either immediately or as part of the integrated mass rapid transit system, include:

- Encouraging bus operator consolidation in conjunction with the implementation of the BRT system. Operators would be required to raise capital for new buses and, in order to participate in bidding for contracts to operate trunk or feeder services in the new system,

they would be required to form operating companies or cooperatives or comply with the regulations set down by the overall BRT franchise operator.

- Announcing in advance the policy that BRT will be implemented in Dhaka as part of the mass rapid transit system and that route permits on affected routes will not be renewed. This step will encourage industry consolidation, because the buses being displaced are largely under individual ownership, whereas newer buses are being introduced as part of a fleet of an operating company.
- Combining the purchase of new buses – ideally as part of the new BRT system elements – with a requirement to scrap a specified number of dilapidated human haulers or minibuses.
- Providing taxi licenses to operators displaced by the introduction of larger operating companies and new services using larger buses.

9.6.3 Bus Operator Competition and Investment

Healthy competition is an important pre-requisite in order to provide good quality service and to attract financial investment in the bus sector. Several aspects that are needed to promote healthy competition and continued investment in the bus sector in Dhaka include:-

- more general issues of fares policy,
- encouraging competition for the market, rather than in the market,
- the role of bus route franchising and contracting,
- pressing immediate concerns relating to 'unfair' competition from dilapidated buses, and
- the use of intercity buses to provide urban bus services.

a) Issues Related to Fares Policy

From observations and discussions with the industry, there does not appear to be any urgent requirement for changes in the bus fare policy at the present time. Since 2001, the intense competition on the major travel corridors has led to a drop in bus fares and, as a result, operators are charging less than the officially prescribed bus fare. This is especially true for trips longer than around 10 kilometres. However, such low fares are only sustainable due to the poor quality and condition of the vehicles and the service being provided. The low fares also have the adverse affect of precluding and/or discouraging investments in better vehicles.

The issue of fares will require more detailed attention when a BRT system is introduced or even an improved regular bus system is planned. The financial viability of a new or improved bus system and the affordability of fares to users should be considerations of paramount importance throughout the planning process. Along with the design parameters of the system and associated rolling stock options, the fare charged to users will be a major determinant of financial viability, profitability, and remuneration of operators and other system agents. It will also be a primary determinant in the success of attracting private sector investors.

It is recommended that in elaborating a fare policy the following guiding principles be adopted. A fares policy should:

- Maximise income while maintaining a low fare for users,
- Allow the system to cover its own costs without external funding,
- Facilitate understanding of the system by the citizens of the city,
- Ensuring that the special needs of some sectors of society (e.g. Women, Children and the Infirm) will receive special attention and will be subject to differential fare structures.

Issues, which will require detailed attention, many of which are interrelated, include:-

- Whether fares will be distance based, zonal, or flat (regardless of distance),
- Fare collection technology,
- Method of fare verification,
- How fare payment media will be sold,
- Avoiding excessive queuing at fare payment or verification points,
- How collected cash will enter a bank account, and the role of a fare collection company,
- How information will be distributed to the public (users),
- How the resulting data about system usage will be collected and managed,
- How fare integration with feeder services will be established.

b) Issues Related to Competition

Competition 'within' the market

Competition in general is a positive force that leads to better services and lower costs through efficiency and productivity improvements. However, the 'wrong' form of competition can lead to bus operators 'fighting' for passengers on the street and can have destructive consequences for the bus sector.

Bus operators and drivers in Dhaka are currently paid according to the number of passengers they pick up. While this competition 'within the market' creates incentives in the form of lower bus fares, thereby improving affordability by passengers, it has many negative consequences. For example, it encourages poor driver conduct such as speeding to overtake buses in front, stopping in the traffic stream to block buses behind from passing, lingering in terminals or at major stops along the route until buses are full and to increase the gap with the bus in front, overcrowding of buses, failure to come to complete stops to allow passengers to board and alight in safety and allowing boarding and alighting at random locations along the route instead of at prescribed properly designed stops.

Bus drivers, crews and operators act in this manner not because they are inherently ill-disciplined, incompetent or uncaring, but rather because this is the way the current bus sector organisation and structure of incentives encourages them to act. This problem can be addressed by changing the structure of incentives so that competition acts as a positive rather than destructive force. Efforts to attempt to force bus drivers to disregard the structure of incentives and instead act in a more responsible manner would require high levels of enforcement and is unlikely to succeed. A more productive approach, as evidenced by international experience, shows that changing the structure of incentives so that it is in the interests of drivers and crews to act more responsibly is the only viable solution to this problem.

Competition 'for' the market

Forming a structure of incentives to encourage better bus driver and bus operator behaviour while maintaining competition to ensure acceptable service quality at reasonable costs is therefore a key challenge of bus sector reforms in Dhaka. Various approaches are possible, most of which involve encouraging competition for the right to operate bus services under conditions of on-street exclusivity or limited competition. This involves creating a franchise or set of defined operator rights and obligations which is then subjected to an open bidding procedure typically according to a two stage process. The first stage is based on qualitative criteria (e.g. local operating experience, financial stability, emission standards of buses, etc.) and either qualifies or disqualifies a consortium of operators from participating in a bid. The second stage of bid evaluation is based on objectively quantifiable and previously announced criteria (e.g. fare, frequency of service, bus size, and bus age, etc.). The winning operators

subsequently enjoy some form of exclusivity of the right to provide bus services, either along the route or in a particular geographical zone

Successful recent bus sector reform initiatives have all involved eliminating the on-street 'fight for passengers' in favour of a new bus sector business model involving competition for the right to operate bus services under conditions of reduced on-street competition. In all cases, the regulator must periodically monitor the delivery of services to ensure that operators comply with service standards specified in the bidding process.

This issue of how to ensure competition which is not destructive but which at the same time ensures that fares remain affordable and buses well maintained with good service standards is a major component of the planning process for bus sector reforms in Dhaka and is a key element in planning and achieving bus sector improvements.

c) Unfair Competition

Unfair competition has a significant effect in working against modern bus operation in Dhaka. Three forms of competition in Dhaka currently work against the establishment of modern bus operating companies in Dhaka namely:-

- Competition between modern bus operators complying with environmental, employment and safety requirements and dilapidated minibuses and human haulers which do not meet these standards. It is recommended that the government take action to enforce minimum environmental, safety and employment conditions for all owners, operators and drivers, especially upon the owners and drivers of dilapidated minibuses and human haulers.
- Competition between urban bus operators, which have permits to operate services, and inter-city buses operating within the urban area but without permits. As with the prevalence of buses operating in violation of safety, employment and environmental standards, this can result in short term benefits for passengers in the form of reduced fares, but in the medium to long term the impact on passengers will be negative, as the modern bus sector declines or disappears. Bus sector regulation is required to address this competition from buses without permits. In the short term it is probably undesirable simply to ban these buses, as they are meeting a market need and their withdrawal may result in substantial hardship for passengers. However, in the medium term the government should aim to reduce the number of these buses by stricter enforcement mechanisms, and replace them with modern buses operating with permits and meeting relevant service and other standards.
- Competition between unsubsidised operators which need to cover all costs from fare revenues, and the BRTC, which is heavily subsidised. Although state-owned operators are not necessarily less efficient than private operators and need not necessarily operate at losses, the immunity of the BRTC from regulation under the Motor Vehicles Ordinance of 1983 and the failure of the government to impose and enforce realistic revenue targets probably has a negative effect on the modernisation of the bus sector in Dhaka. It is recommended that the government move toward treatment of BRTC on commercial grounds and set and enforce revenue targets and efficiency goals. Subsidies for the BRTC should be explicit and targeted. The immunity from regulation of the BRTC should be withdrawn. BRTC should be allowed to participate in tenders for new route franchises only if bids can be proven to be based on commercial grounds. Otherwise, BRTC should be excluded from participation in bids for new bus services. In the medium term serious consideration should be given to the incorporation or privatisation of BRTC so as to enable it to compete in the bus sector alongside the newly emerging private operators.

9.6.4 Replacement of Small Buses with Larger Buses

Bus frequency survey data indicates that there is a strong potential for replacing many smaller buses with larger buses. Minibuses and human haulers have an important role to play in Dhaka in providing a local services in areas difficult to access with larger buses providing a feeder service to the main trunk bus lines operating on arterial roads, and serving areas where demand may be too low to justify higher capacity buses. The current arrangement however, whereby minibuses and human haulers provide a very high frequency service on routes along major corridors of the city, is highly inefficient.

The survey data and commonsense observations show great potential for rationalising urban bus services on major roads by shifting from smaller to larger vehicles and thereby:

- Reducing the cost of provision of services on a per passenger basis,
- Reducing congestion,
- Promoting bus industry consolidation from individual to collective ownership,
- Improving the level of service to passengers.

9.6.5 Acknowledgment of the Special Issues Regarding Gender

It is a fact of life in Bangladesh that not all sectors of the family require the same consideration when it comes to travel. The role of women is one of particular concern and there should be measures implemented to ensure that this sector is as safe as any other group. Solutions to the issue are not only transportation-based; they also involve social issues and societal restrictions. In making plans for the future transit system, it is difficult to provide segregation on rail and bus rolling stock other than simply by marking areas for segregated use. On regular services, a more specific segregation can be achieved by creating “Women Only” services. This has been tried already but with limited success.

At the same time as trying to promote such segregation in services, it is essential to involve women’s groups since the whole issue of “segregation” is one of widely varying views. This issue will be identified carefully in the project to be included in the Phase 1 public transport survey for which Terms of Reference will be written.

9.7 LAND USE DEVELOPMENT

Land use and transportation are inextricably interrelated. Whereas, land use and the related activity it generates, has a direct and immediate impact on the available transport systems, it is equally true that the level at which transport is provided to a given area is a strong determinant in the type and density of adjacent land uses. The shape and form of major urban cities, as well as sectors within such cities, reflect the significant influence of the supply and form of transportation that existed during the time that development occurs.

While land use and transportation are closely related, it is important to recognize that transportation is intended to serve land use, and not visa versa. Land use and its related activities are the basis for all economic and social activities that determine the quality of all aspects of people’s professional and personal lives. Transportation is an important and essential means to support, facilitate, and enhance such land use activities – transportation is not an end unto itself.

As part of the initial stage of the STP Study, three land use scenarios were developed. During the course of the STP Study, discussions with stakeholders, agency representatives and steering committee members, it became evident that the preferred land use scenario was the Regional Growth Center/Satellite Community Scenario and furthermore, that remaining study

resources should focus on more in- depth evaluation of transport strategies for this single land use scenario, rather than simultaneous consideration of all three land use scenarios. Therefore, the development and evaluation of alternative transport strategies was done within the context of the single land use scenario referred to as Regional Growth Center/Satellite Cities Scenario.

Recommendation #8 *Adopt a Regional Growth Center/Satellite Cities land use scenario as an overall framework for future land use and development.*

The concept of Regional Growth Centre/Satellite Cities is one of self-sustainable rather than dormitory communities. Dormitory communities, which are primarily residential with jobs located in other areas to which people than commute, are not growth pole communities. Communities built on the growth pole concept are relatively self-contained communities in which the number of jobs is approximately equal to the size of the labour force.

A decision to adopt a Regional Growth Centre/Satellite Cities Scenario carries with it an implied commitment that greater emphasis will be placed on the development of communities surrounding Dhaka and lessening the increasing densification of Dhaka proper. This implied commitment translates into planning, development and investment decisions that create the necessary mechanisms for growth pole communities to evolve over a period of years.

The Regional Growth Centre/Satellite Cities concept requires physical planning and coordination of infrastructure investments to encourage and support not only the industries, but also those working in these industries, as well as the urban development and services they generate. Transportation is certainly one of the requirements, however, other services such as water, sewerage, electricity and other basic services must be established and provided in a coordinated and integrated manner. Establishment of schools, markets, parks and open space, sport facilities, academic centres, medical facilities and governmental service centres are all necessary and important ways to establish and foster the development of regional growth centres.

Recommendation #9: Prepare Area Plans for the designated Regional Growth Center/Satellite Cities to serve as the framework for guiding the coordination and implementation of urban development, services, and infrastructure investments.

9.8 THE UNITARY AUTHORITY

At present, the land use planning functions are separated from the transportation planning functions. Whereas RAJUK has developed the Structure Plan and is responsible for its implementation, the transportation functions are spread among BRTA, DTCB, DCC and the Police. The planning control function which should be part of the overall planning process is the responsibility of RAJUK but there is little evidence that this function is being exercised. The lack of coordination between land use planning and transportation planning is evidenced by the manner in which development occurs that is not in accordance with the Structure Plan and leads to situations where suitable transportation is not available to serve the needs of the development.

In order to achieve integration between transportation and land used development, it is recommended that the government establish a Unified Authority that is responsible for the planning of both land use and transportation. The policies related to the establishment and responsibility of a Unified Authority are discussed in some detail in the STP Urban Transport Policy and the organizational structure and functions of a Unitary Authority are presented and discussed at length in the STP Institutional Strengthening and Capacity Building Report.

Recommendation #10: Establish a single governmental entity (Unitary Authority) with responsibility for land use, transportation, and the integration of the two, at the level of strategic/structure planning.

9.9 ESSENTIAL PREPARATORY PROJECTS

9.9.1 Eastern Embankment

The construction of the eastern embankment as a flood control measure is important for a number of reasons:

- To provide relief and protection from the devastating impact, in terms of human suffering and economic loss, experienced with periodic flooding.
- To provide the protection needed to properly develop the area west of the Balu River, consistent with the well founded DMDP Urban Area Plan and Structure Plan and also consistent with any future land use scenario that is likely to occur.
- To provide the protection needed to properly develop a suitable transport network (land based and waterways) for the area west of the Balu River.
- To provide the protection needed to properly develop a suitable land base transport network (e.g. Eastern Bypass, Buses, Mass Rapid Transit) for the area west of the Balu River.
- To provide the protection needed to properly implement the eastern portion of the Circular Waterways System, including river ports and related land transport linkages.

9.9.2 Creation of Water Retention Ponds

Both the Structure Plan (DSP) and the Urban Area Plan (UAP) for Dhaka indicate retention ponds diagrammatically in the DCC Eastern and Western Fringe areas. However, little has been done to further define, establish, and protect these critical features. The existing watercourses need to be retained for development as retention ponds, probably in the form of elongated lakes in the manner of Banani and Gulshan Lakes (part of the same water system) and additional retention ponds need to be created. Doing so is essential for a viable drainage and runoff control system. Unless appropriate actions are taken to ensure that the area's most fundamental physical constraint is adequately taken into account (low lying land in a flood-prone deltaic area), any investment in the transport infrastructure, or any other sector, will be rendered needlessly vulnerable.

9.9.3 Reservation of Critical Roadway Rights-of-Way

Adequate right-of-way is an essential requirement for the provision of efficient and sufficient transport facilities and services. One of DMDP's major and largely unrealized strategies was the early development of infrastructure to enable early population absorption capacity. "*Considerably more cost-effective development would result if new, formally urbanized land reached higher densities more rapidly*". The DMDP recommended emplacement of infrastructure services early to support high densities - as opposed to allowing land to develop initially at low densities followed by increased density at a later time. It is recognized that, as efficient as such an approach may be in theory, full implementation of the strategy is not easy or inexpensive, and may not always be achievable in the Bangladeshi circumstances.

At the same time, however, provision of a basic level of transport access to newly developing areas and the reservation of right-of-way for future upgrading are not insurmountable obstacles. The reservation of the right-of-way for all major roads in the Eastern Fringe and Western Fringe areas is strongly recommended.

Recommendation #11: Proceed with implementation of three important land use related items: (1) construction of the Eastern Embankment; (2) creation of water retention ponds; and (3) reservation of critical roadway rights-of-way;

9.10 LAND USE AND DEVELOPMENT AT MAJOR TRANSPORT NODES

BRT and Metro stations, by their very nature are a focal point for development, because of the immediate direct access they provide to a high quality transportation system that is able to move large volumes of people, in a dependable and predictable manner, and at a reasonable cost. As such, the areas surrounding the stations are prime locations for development in general and high density development in particular.

Mass transit-related land development policies should work towards creating communities that are compact, mixed-use activity areas centred on a station that by design encourages residents, workers, and shoppers to use the metro system. The station is the centrepiece that connects the residents and workers to its outer regions as well as the civic and public spaces that surround it. The land development policies must emphasize pedestrian-oriented environments, and encourage use of the public transportation system.

9.10.1 Scale of Potential Development at Transit Stations

In analyzing the general scale of the potential development that could occur around a station, it is found, for example, for a 400 meter area surrounding one station, buildings constructed at a height of 24 floors will result in a total building floor area of nearly 4 million square meters, assuming 25% of the total land area that the building will actually occupy when completed (building footprint) and 75% used of the total land area for other purposes (e.g. streets, walkways, open space, landscaped areas, etc.). Building constructed to 36 and 12 floor heights would result in total building floor areas of 6 and 2 million square meters, respectively.

Through the use of Station Area Plans and programmatic Environmental Impact Statements, the geographic limits, development policies, land use regulations, design standards, capital improvement program, and financing measures can be integrated into a coordinated process that correlates land uses with supporting infrastructure, and developers and local governments can thus avoid inefficient over- and under-sizing of streets, sewers, water lines, etc.

Transit station areas are excellent locations to encourage a mix of different land uses and development. The mix and density of land use at station areas has a direct impact on the function and character of a community and, in turn, influences ridership. The more people that live and work in, or are otherwise attracted to, a station developed area, the greater opportunity for encouraging transit use.

Mixed use includes shopping/retail areas, local neighbourhood scaled entertainment venues, community, recreational and other local facilities. Complimentary businesses such as shopping facilities are provided in commercial zones as well as in the commercial/residential developments in the district centres and town centres. A wide range of community facilities in the mixed-use group includes education, health, social welfare and recreation.

Recommendation #12 Plan and implement high density development in the areas surrounding urban METRO rail stations.

9.10.2 Capturing Increased Land values at Transit Stations

Transit stations, by their very nature are a focal point for development, because of the immediate direct access they provide to a high quality transportation system that is able to move large volumes of people, in a dependable and predictable manner, and at a reasonable cost. As such, the areas surrounding the stations are prime locations for development in general and high density development in particular, all of which equates to higher values for land and air-rights around the stations.

The fact that there will be added value is indisputable. The amount of the added value is best determined by unimpeded open market forces. The use of the added value could be for any number of public benefit uses including, appropriately, a funding source for transit system development and expansion.

Recommendation #13: Capture a portion of the value added to the land surrounding the METRO stations.

9.11 RICKSHAW IMPROVEMENTS

9.11.1 The Licensing Systems

Creation of a proper licensing system, coupled with an effective mechanism for enforcement of the regulations, will automatically reduce the number of rickshaws in operation, due to the fact that many vehicles are sub-standard in quality and would not pass a roadworthiness test.

The rickshaw license itself should be re-designed so as to make it non-forgeable and easily detected. A “smart chip” system could easily be introduced and embedded into the license. There should then be a concentrated program of inspecting and licensing of all rickshaws. The private sector could be usefully employed in this context to undertake the inspections under license from BRTA. In fairness to the owners of the vehicles, they should be given a grace period (e,g, 6 months), in which to comply with the new rules. After this period, the identification of non-conforming rickshaws operating on the city streets would result in a fine to the owner and removal of the rickshaw from operation until repairs are made to bring the vehicle into a roadworthy condition.

At the same time as licenses are issued for vehicles, there must be a parallel program of licensing of the pullers themselves. As a vehicle plying the public highway, the ‘drivers’ need to be properly trained in the rules of the road and they should be required to prove their eligibility to operate the vehicle to a recognized body. Again BRTA would be the most appropriate organization to administer this licensing. All pullers should be required to take the test of competence before being issued with a license and they should be required to keep this license on their person at all times of operation. Pullers found to be operating without a genuine license would be fined and their license revoked.

Recommendation #14: Establish a program for the re-licensing of rickshaw owners and operators and a means to improve the skills of the drivers and the quality of the vehicles.

9.11.2 The Numerical Control

An argument has been put forward which says that *"If there is congestion from rickshaws let us limit the number of rickshaws"*. There is a certain logic to this argument. Indeed, a precedence exists in many other cities which, for example, have limited the number of taxis. Other cities (London, for example) do not limit the number of taxi licenses issued but rather rely on market forces to control the numbers. Importantly however, at the same time as market forces exert such control, stringent rules are in force, which operators and owners must abide by, in order to gain a license and operate a taxi.

At the present time in Dhaka, there are reportedly 89,000 licenses issued for rickshaws. This implies that over 80% of the rickshaw fleet is operating illegally. There is virtually no enforcement of the violations by the Police who claim that they are powerless to intervene since the rickshaw is not a considered a "motor vehicle" under the Motor Vehicle Act. This illegal operation could be removed or reduced by the issuing of new licenses, however the question remains as to how many licenses should be issues and/or how many rickshaws should be allowed to operate -- 100,000, 200,000, or more. What is the logic for this number?

A more rational approach is one that relies upon market forces. Since a large number of rickshaws continue to operate, one can assume that there is sufficient revenue being generated to maintain the fleet and the operators, albeit at a very low economic level and quality standard. As more rickshaws enter the market and the revenue received is split amongst more people, the numbers of rickshaws operating will change. If left alone, one can assume that the numbers plying will adjust a) to meet the demand and b) to equate with the revenue received.

In addition to this, it should be noted that, as new, modern public transport systems are introduced in the future, the public could well be attracted to these other forms of transport and the market for both rickshaws and baby taxis could shrink. In order to provide a constant level of service to the public, any planned decrease or control in rickshaw operations should be accompanied by an associated increase in the alternate form of public transport, which replaces the rickshaw service.

Recommendation #15: Rely upon travel demand and market forces to determine the number of rickshaws in operation, rather than through the issuance of licenses.

9.11.3 Operating Network

It is certain that much of the congestion on the highways in Dhaka is a direct result of poor driver behaviour. Having said this, the comment applies to all road users and not only to rickshaws. It is not considered acceptable that the full blame for congestion should be leveled at this one sector of the transportation system. There needs to be a complete overhaul of road behaviour involving both pedestrians and drivers. This will entail the review and re-writing of the Highway Code together with a city-wide and continuous public awareness campaign.

At the same time, it is clear that much of the congestion is caused by the mix of vehicles performing different functions. The arterial road system is a clear illustration of this. On many arterials there are larger and faster moving vehicles mixed with slowly moving rickshaws. In addition to the congestion effects, the disparity in operating speeds is a major cause of collisions, injuries and deaths. In order to reduce both accidents and congestion, therefore, some arterial highways will be re-planned so that rickshaws will be excluded from using them.

In parallel with these exclusions on the major highways, there will be parallel efforts to create a series of designated routes within neighbourhoods to facilitate the operations of the rickshaws. This policy (Policy #27) is specifically identified so that the role of the rickshaw will be changed

to providing local area circulation within the neighbourhoods as well as feeder services from the neighbourhood areas to the major trunk haul mass rapid transit system.

The current policy regarding the provision of space for rickshaws to wait/park is one of self enforcement. In most cases the pullers themselves organize the rank on a first-come/first-served basis. At the busier intersections, the police directing the traffic also assist in organizing the queue of vehicles. However, there are no formal areas for waiting and this causes confusion and nuisance to other road users. A system of providing spaces on a more formalized manner is required. These spaces would be provided off the main arterials on side roads adjacent to the proposed mass rapid transit system stops. In this way the rickshaws would be seen as an integral part of the overall system by carrying passengers to/from the mass rapid transit system as well as providing functioning as a circulation system within the neighbourhoods.

Recommendation #16: Continue with the planning and implementation of a gradual program that redefines the role for rickshaws as one of a neighborhood circulation system and a feeder service to mass rapid transit stations, including suitable facilities to provide such services.

9.11.4 Design Improvements

Some local companies have been active in considering the re-design of the rickshaw to make them more comfortable for the passenger and less of a burden for the puller/driver. These moves should be encouraged since the actual effort required to move the vehicles is quite considerable.

In parallel with the move towards improving the vehicle quality, there should be an effort to create better maintenance facilities. At present this is highly informal and significant improvements can be made to the quality of the vehicles if better equipped workshops could be provided. One way to achieve this is to provide a series of fully equipped communal workshops in which individual operators could pay for the use of proper tools and advice. This would replace the informal roadside repairs currently in use. Micro financing grants/loans may be a mechanism for encouraging and assisting with the development of better design and maintenance practices.

Recommendation #17: Encourage and support efforts to improve the design of rickshaws as well as the associated maintenance facilities and procedures.

Exhibit 9-2 Study Area Regional Highway

Exhibit 9-3 The Selected Strategy Mass Rapid Transit System

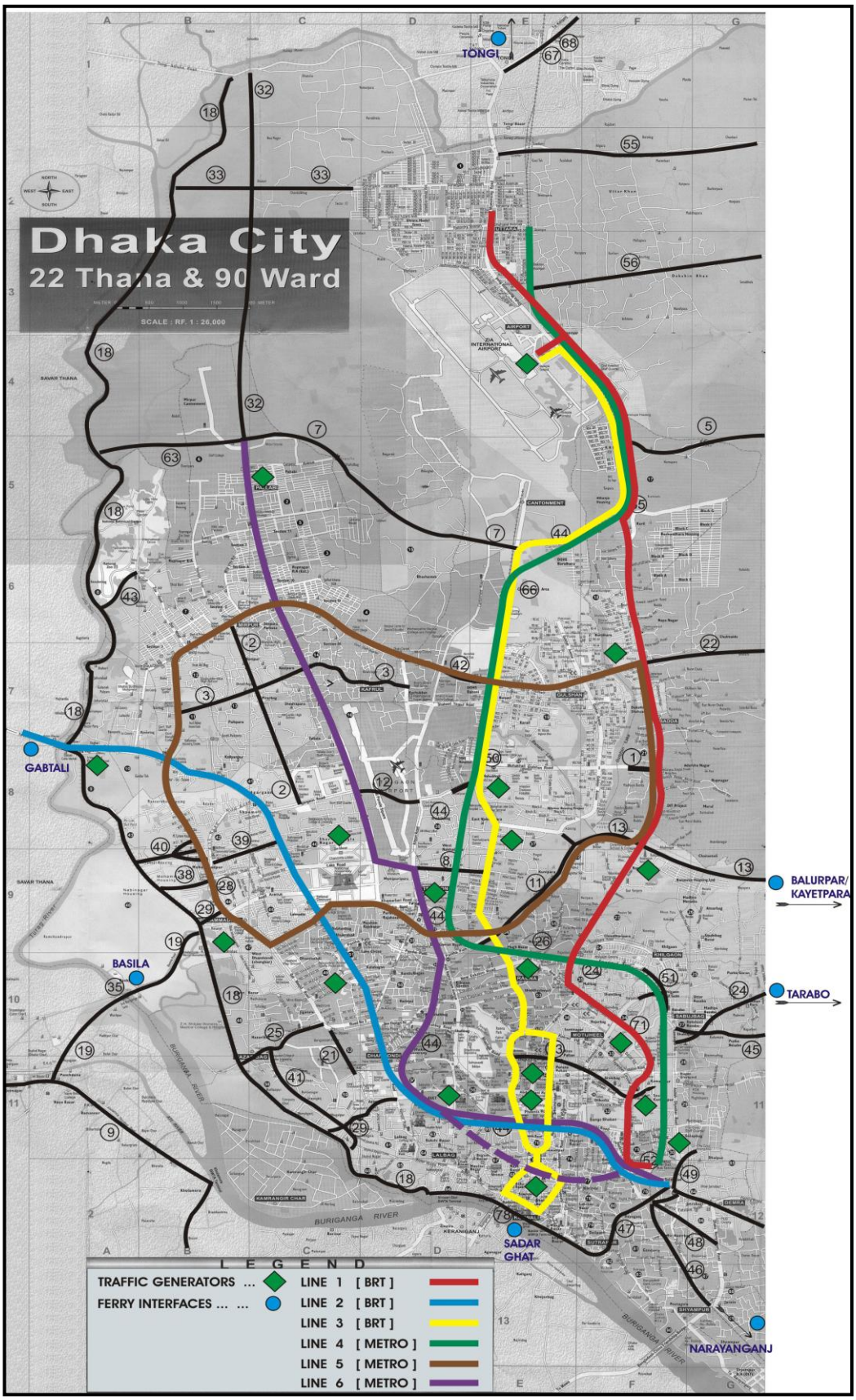
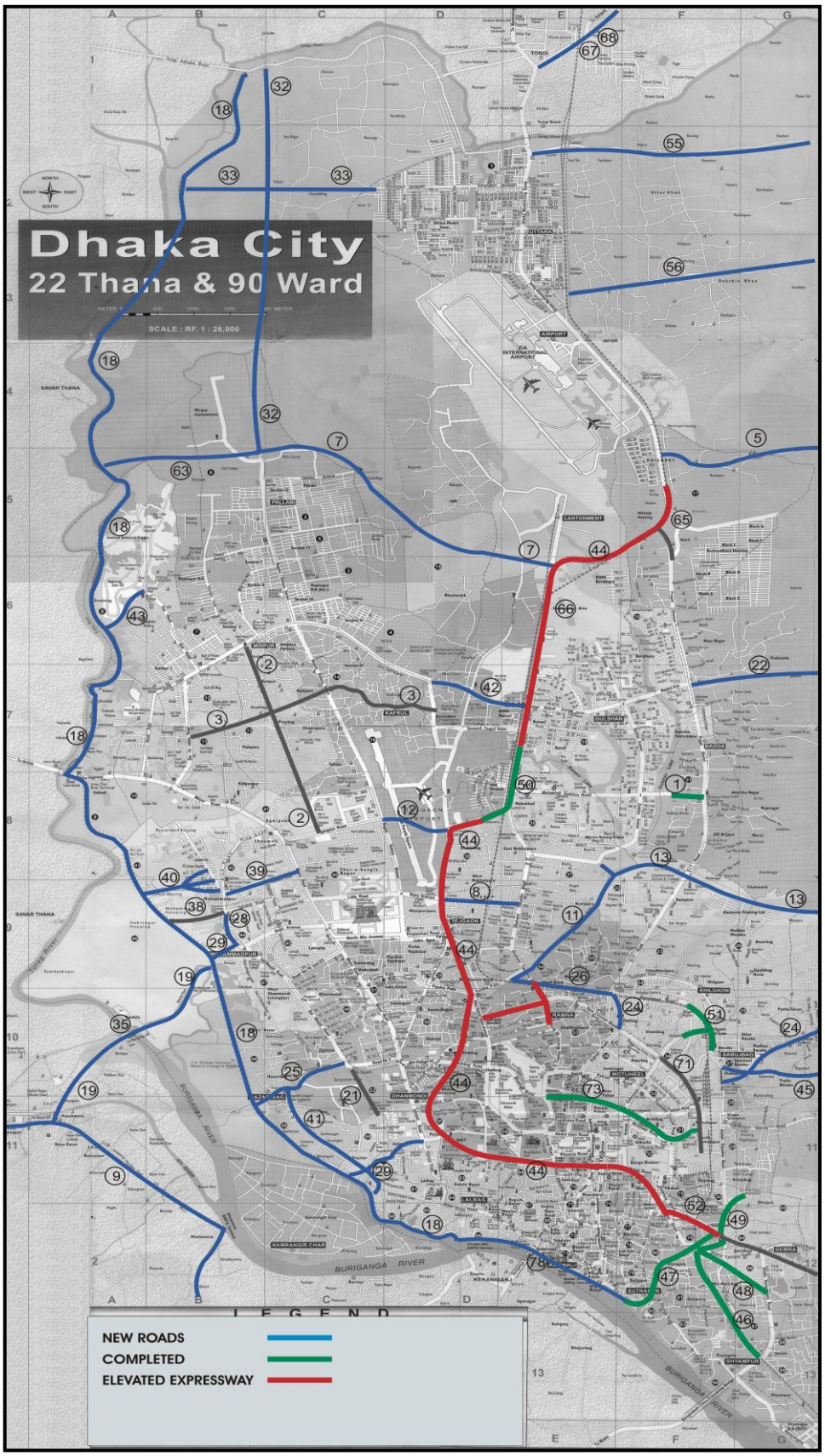


Exhibit 9-4 The Selected Strategy Roads Package



10. PHASING OF THE STRATEGIC TRANSPORT PLAN

10.1 INTRODUCTION

The Terms of Reference request that the study provides recommendations for implementing the final plan divided into three separate phases. In fact, it is believed to be more useful to divide the implementation plan into four phases of five years each. This has been done on the basis of the following criteria:

a) Readiness - of the project in terms of right-of way availability and the stage reached in the completion of the design;
b) Urgency - on the basis of demonstrated traffic flows; and
c) Need - to fill noticeable gaps in the overall network.

In terms of transit the six lines forming the system are shown in Exhibit 9-3 in the previous Chapter. The 60 highways and the Expressways projects forming the final network are shown on Exhibits 9-4 in the previous Chapter and are listed in the table noted as Exhibit 10-1 and described in Exhibits 10-2, 10-4, 10-6 and 10-8. Mass Transit Phasing is listed in Exhibits 10-3, 10-5 10-7 and 10-9. The total costs for both the Highways and Mass Transit projects are listed in the accompanying text box at approximately $3½ billions. Phase 1 has been kept to a minimum in terms of highway investment since the main thrust of this first five year period is to increase the efficiency of the existing network and move forward with some elements of the Mass Rapid Transit System.

Phase	From	To	Cost (US$m)
1	2005	2009	386
2	2010	2014	936
3A	2015	2019	1,329
3B	2020	2024	870
Totals			3,521

There is a need to provide some physical infrastructure in the early years but the main investment is scheduled for the second phase after comprehensive project preparation has taken place. The listing of recommended projects is divided into:

- Highways – this category of projects includes the construction and implementation of road schemes, flyovers and underpasses.
- Transit – this category includes projects within the public transport sector.

10.2 PHASE 1 PROJECTS

The first phase of the development is scheduled for the five years covering the period 2005 to 2009. This is a critical time since the momentum gained by undertaking the STP study should not be lost. It is essential to move forwards immediately if the long term plan is to be achieved in a meaningful way. For this reason, efforts should be concentrated upon those projects which are in an advanced state of readiness and which will bring immediate benefits from their implementation. As a result, the emphasis has been placed on the maximisation of existing resources and improved management of current transport service. The principle guiding this first phase is to ensure, by taking immediate and positive steps towards better management that the future investments in infrastructure will not be wasted and will be based on a system which is working efficiently. In short, the first phase will impose some order on the existing situation before major investment is made.

A) HIGHWAY PROJECTS

There are a number of projects which are currently under way and it has been assumed that these will all be completed by the end of the first phase. These, together with new projects are listed in Exhibit 10-2.

Exhibit 10-2 Highway Schemes for Phase 1 (2005 to 2009)

I/D	Name	Comment	Cost ($m)
1	Gulshan to Badda	This project under RAJUK connects the Gulshan area with the important DIT route to the eastern edge of development.	open
7	Zia Colony - Mirpur	This is a 6.3kms dual 2-lane road which is planned so as to open up the area south and west of the International Airport. It will create a much needed east-west link in the northern part of the city allowing traffic from the western parts of the area to access the Airport without having to make large detours. The project by DCC and Cantonment Board links to Scheme 63 (see below) which together will connect through to the Eastern embankment road (Scheme 18) also included in this phase.	14.0
12	Tejgaon Airport Tunnel	Originally a new project identified by STP it is intended to provide much needed east-west connection for the city. It will lead directly west from the end of the recently constructed Mohakhlai Flyover. The alignment is not yet fixed but is anticipated to connect on the west side of the airport into Agargaon Road. Anticipated as a dual 3-lane highway. It is essential to move ahead in year 1 with the pre-feasibility study and enter into discussions with the Cantonment Board. Cost estimate includes all design and tendering. One complication that will require careful study is how the tunnel will join in to the Mohakhali Flyover and the anticipated Elevated Expressway from Gulistan (see below).	50.0
13	Merul Badda - Golakandial	The Dhaka By-pass (see Scheme 20) will be opened within the first phase and the up-grading of this route has been included in order to provide a new connection to the By-pass. It is shown as an upgrading scheme under the control of RHD. This route also is brought forward in the program in order to provide a land-based link to the Ferry terminal proposed for upgrading at Baurpur/Kayetpara.	9.0
15	Tongi - Ghorashal	The Dhaka By-pass (see Scheme 20) will be opened within the first phase and the up-grading of this route has been included in order to provide a new connection to the By-pass. It is shown as an upgrading scheme under the control of RHD. For the first phase, it is recommended for construction from Tongi to the By-pass only. The second part is scheduled for Phase 2.	8.0
20	Dhaka By-Pass	This 48kms route is currently under construction. It will connect between The Chittagong Road in the south and the Tongi-Gazipur Road north of Tongi. It is understood that it will be open to traffic in 2006.	36.0
24	Malibagh - Janapath	This scheme is in the early days of preparation and needs to be accelerated in the planning process. It is proposed by RAJUK as a dual 2-lane highway of 670m. It has been included in the early phase due to the need to accommodate one leg of the BRT Line C.	13.0

I/D	Name	Comment	Cost ($m)
44	Elevated Expressway	This scheme has been added in to the modified Strategy 2b. Some planning has been undertaken by RHD and the government has been in discussions with a consortium from Thailand. It is understood that work on the final designs has started. Although it is in an advanced stage of construction, it is considered that the main construction would be undertaken in Phase 2. Costs have been included but could be removed since it is anticipated that this would be a PPP arrangement of some sort. The current estimates are USD$330m and 15% has been included for preliminary works.	50.0
50	Mohakhali Flyover	This scheme has been opened to traffic in late 2004 following development by RHD.	open
51	Khilgaon Flyover	This 1,780m viaduct was opened to traffic following development by LGED.	open
52	Gulistan – Jatrabari Flyover	This scheme has been added-in to the modified Strategy 2b. The agreement has been signed by the government with a private consortium and work on the final designs has started. Although it is in an advanced stage of construction, it is considered that the main construction would be undertaken in Phase 2. This phase has included costs for continued scheme development including concession agreement negotiation, final designs, tolling strategies and financing. The current estimate is US$120m and 15% has been added for design and preliminary works.	40.0
53	Postogola - Narayanganj	This is an ongoing project supervised by RHD and will provide a dual 2-lane connection between Shyampur and Narayanganj. It is an important corridor and the 10.5kms project should be open to traffic in 2005.	open
64	Mogh Bazaar Flyover	This scheme is under feasibility study and preliminary design. Further work is required on Detailed Design and financing. Although private finance is anticipated the costs have been included. Current estimate is US$26m and 15% has been allowed for further development works.	4.0
73	Ramna Star Gate – Notre Dame College	This is an ongoing project under the control of RAJUK. It is being constructed as a dual 2-lane highway of 2.14 kms in length. This was included in the base network of schemes.	open
	Traffic Management	This is an urgent development and can be established as one project or a series of projects dependent upon the size of the package and the availability of designers and contractors. Conceptually it will firstly, be structured to provide a Design Guide for Traffic Management on arterial highways. When the Design Guide has been agreed, it will then select those roads which should have traffic management and will finally plan, design and implement the principles in the Design Guide for these highways. For the Selected Strategy, a high level of work will be undertaken on 150 kms of highway. Costs have been estimated to include all design and civil works at a rate of $200,000 per kilometre. Preference for sections to receive treatment will concentrate on the links having BRT lines. See also the Transit table below.	30.0

I/D	Name	Comment	Cost ($m)
	Preliminary Engineering	A number of projects should be made ready in this first phase so that the final design works can be undertaken in Phase 2. Preliminary works should concentrate on the definition of the alignments and the acquisition of rights of way. Schemes to be included within this category of preparation are - 7, 8, 11, 18, 27, 28, 29, 33, 42, 44, 54, 58 and 63. The cost estimate for this work has been made on the basis of allocating the sum of $250,000 for each scheme.	3.0
46-49		In addition to the projects listed above, schemes 46 to 49 have all been completed and were included in the first phase listing for network testing.	open
		TOTAL COST FOR THE ABOVE	**257**

Note: *The costs quoted for roads in this and other tables are obtained from the agency which is currently developing the schemes. The Consultants have had frequent meetings with each agency and have obtained the best information available. Where the Consultants have changed the costs the reasons have been noted in the text. It should be noted that there are no land and property acquisition costs included in any of the scheme estimates. In defining strategic decisions and in most economic analyses land costs are normally excluded. They become a cost at the final design stage and are normally associated with governmental responsibilities.*

B). TRANSIT PROJECTS

A mixture of studies, re-organisations and new projects will be required in this first phase as described in Exhibit 10-3.

Exhibit 10-3 Transit Schemes for Phase 1 (2005 to 2009)

I/D	Name	Comment	Cost ($m)
	Bus Route Survey	The immediately pressing need in public transport is to maximise the use of the existing bus fleet. There is data available but it is fragmented and held in different locations by different organizations. A comprehensive inventory survey of facilities, routes, fares, personnel, equipment, operating companies etc should be undertaken so as to provide a sound basis for planning. The result should be a complete and detailed inventory of all aspects surrounding public bus operations. This survey should be commissioned as a matter of urgency enlisting the cooperation of BRTA, BRTC and the operators.	0.25
	Bus Route and Priority Measures Study	Building upon the results of the survey shown above, the route organisations should be rationalized and coordinated by DTCB and BRTA. The decisions regarding the introduction of the Mass Rapid Transit System (see below) should also be considered so as to ensure that the rapid transit systems and the local and feeder systems complement each other. The study should investigate the needs to make special provision in the existing and future services for special sectors of society including children, the infirm and women. Once rationalized, there should be a gradual program of up-grading the provision for bus priority on the main highways served by the regular bus transit.	10.0

I/D	Name	Comment	Cost ($m)
		These upgrading schemes should include Bus Only Lanes, Re-organization of Stops, Streamlining of Ticketing, etc. It is estimated that some 75 to 100 kms of route would need to be studied. NB this study should be undertaken in parallel with the Traffic Management study recommended in Highways above. Costs for the study have been estimated as $0.25m and the implementation costs can be shared with those for the Traffic Management improvements.	
	Mass Rapid Transit Guidelines	In order to activate the Mass Rapid Transit system in accordance with a reasonable schedule, the first year of the first phase should concentrate on providing guidelines for the systems to be adopted. This will include both BRT and Metro components. The main operating and performance specifications should be established and a realistic cost should be identified. It may be necessary either to visit other candidate system already in operation or invite other specialists to consult regarding the preferred system to be adopted in Dhaka. Once written and agreed, work may proceed gradually from this Design Guideline. For this component, costs have been estimated only for the basic study and the production of the guidelines.	2.5
	BRT Study and Construction	In the first 5 year phase, the first two lines of the Mass Rapid Transit System are planned to be opened. These are recommended as Line 1 and Line 2. Opening of these two BRT lines will provide fast public transport connections between the Airport and Saidabad along the eastern corridor and between Mirpur, the central area and Saidabad via the Mirpur Road Corridor. The total distance is 21.0kms. The traffic management study will be a major contributor to this work. The Design Guidelines produce above will provide the control on design and performance specifications. It is envisaged that the transit system will be run by PPP organisation. The study will need to address the issue of how the operating company will be formed and how the project will be financed. Concession Agreements need to be produced and consortia invited for bidding and negotiations. It is anticipated that the first two lines should be operational by the 4th or 5th year of this first phase. The construction costs have been estimated at $5m per kilometre and a further 10% has been added for initial studies, financing and Concession Agreement negotiations.	115.0
	Bus System in Old City	In order to provide a good shuttle service in Old Dhaka a twin loop system should be implemented in this phase to complement the BRT Line 3 scheduled for this and the next phase. This will entail some traffic management signing and bus stop provision. A length of 5kms of street has been chosen at a cost estimated at $200,000 per kilometre. The system will also provide a land-based connection to the Ferry Terminal at Sadar Ghat.	1.0
		TOTAL COST FOR THE ABOVE	**129.0**

In summary, the total costs for Phase 1 are estimated as $386 millions.

10.3 PHASE 2 PROJECTS

A). HIGHWAY PROJECTS

Exhibit 10-4 Highway Schemes for Phase 2 (2010 to 2014)

I/D	Name	Comment	Cost ($m)
8	Bijoy Saroni – Shaheed Tazuddin Rd	This scheme has been in mind for some years but has become very difficult due to the presence of the Rang's building on the east side of the intersection. It is an essential link in the strategic network. Planned as an 800m long dual 2-lane highway it is the responsibility of RAJUK.	15.0
11	Panthapath - Rampura	This key link in the network is planned by DCC as a dual 2-lane highway of 3.6 kms in length. It passes though poor soil conditions and the area is liable to flooding. As a result it is designed to be on a viaduct. Traffic figures justify a dual 2-lane highway but it is considered that since it will be on viaduct there will be no possibility of widening in the future and hence the recommendation is to design for dual 3-lanes thereby ensuring additional capacity beyond the 20 year horizon. Costs have been increased by 40% to allow for the additional lane on the viaduct.	67.0
15	Tongi - Ghorashal	Phase 1 showed that this highway was included as far as the Dhaka By-pass (see Scheme 20). In Phase 2 the route has been extended from the By-pass as far as Kaliganj.	11.0
18	Circular Ring Road	In order to organise the western areas of the city and to begin the process of moving development to the west, it is recommended that the road to be located on the embankment be developed in this phase. Proposed by RHD as a 25 kms long dual 2-lane highway the upgrading scheme provides a key link in the strategic network. Traffic projections to 2024 show that Dual-2 is adequate for this route. The construction of this route together with the implementation of BRT Line 2 will provide good land-based connection to the Ferry Terminal at Gabtali.	8.0
27	Muhammadpur Bus Stand – Embankment	This scheme together with Scheme 28 provides a good connection between Muhammadpur and the embankment. It is a DCC scheme which will upgrade the 700m section to a full dual 2-lane highway.	0.5
28	Muhammadpur Shia Mosque - Embankment	This scheme together with Scheme 27 provides a good connection between Muhammadpur and the embankment. It is a DCC scheme which will upgrade the 600m section to a full dual 2-lane highway.	1.0
29	Azimpur - Embankment	This 1.5kms section is proposed by DCC for upgrading to a dual 2-lane highway. Since it provides a key link between the BUET area and the embankment road (also being recommended for improvement in the phase) traffic figures show that a dual 2-lane highway will suffice to 2024. Even so the right of way to expand is suggested and a feasibility study is required here before proceeding to dual 3-lanes. The cost estimate has been increased to allow for a Dual-3 land highway.	3.0

I/D	Name	Comment	Cost ($m)
33	Uttara 10 - Embankment	With the upgrading of the embankment road proposed in this phase, it is recommended that the Uttara New Town should be connected to this highway by Scheme 33. This is a dual 2-lane road proposed by RAJUK over a distance of 3 kms.	2.0
42	Sagorika - Banani	DCC have proposed this link which connects to the Airport Road from the Kafrul area. The STP study has shown the need to complete a Dual-2 lane east-west link from Kamel Ataturk. This connection could be by way of an underpass although the potential conflict with a future Metro Line 4 and the Elevated Expressway should be noted when planning this scheme. The underpass would cross both the Airport Road and the Railway Line and provide a much needed east west link in this part of the city. A section of the Golf Course could also be preserved by use of the underpass. This key link will also be in the alignment of Metro Line 5 planned possibly as an elevated train. A cost of $5m has been added for the underpass.	5.0
44	Elevated Expressway	This scheme has been added in to the modified Strategy 2b. Some planning has been undertaken by RHD and the government has been in discussions with a consortium from Thailand. It is understood that work on the final designs has started. Although it is in an advanced stage of construction, it is considered that the main construction would be undertaken in Phase 2. Costs have been included but could be removed since it is anticipated that this would be a PPP arrangement of some sort. The current estimates are USD$330m.	330.0
52	Gulistan – Jatrabari Flyover	This scheme has been added in to the modified Strategy 2b. The agreement has been signed by the government with a private consortium and work on the final designs has started. Although it is in an advanced stage of construction, it is considered that the main construction would be undertaken in Phase 2. Costs have been included but could be removed since it is anticipated that this would be a PPP arrangement of some sort. The current estimates are USD$120m.	120.0
54	Eastern Embankment	The real justification for the embankment will be made by others on the basis of flood protection. However, the STP study has shown the justification of some form of highway on this alignment. Traffic figures do not warrant the planned dual 2-lane highway partly due to the limited amount of development in the area but also because of the presence of the Eastern By-pass (as distinct from the Dhaka Bypass further to the east). It is recommended that this scheme be reduced to a 2-lane road. The costs have been reduced from the estimated US$413m but much more work is required on this scheme to identify an accurate cost and a viable scheme. However, it has been included since without the embankment (with or without the highway) it will not be possible to develop the areas to the east of the city and the west of the Balu River.	300.0

I/D	Name	Comment	Cost ($m)
58	Jatrabari Bridge – Polder Rd	With the addition of the eastern embankment road (Scheme 54) it is logical to connect this to the city. Scheme 13 was recommended for inclusion in Phase 1, providing a good link in the central part of the area. Scheme 58 proposed by RHD as a dual 4-lane highway will provide a good connection to the southern areas. Following traffic projections, it is recommended that this be built first as a dual 2-lane highway with widening later but the right-of-way should be obtained in Phase 2. Costs are divided between this phase and Phase 3.	10.0
63	Pallabi – Western Embankment	This scheme connects with Scheme 7 to form a continuous east-west link between the Airport and the western parts of the city. The Western Embankment Road has been recommended for this phase and also the Zia Colony Road (Scheme 7). It is logical to construct this link 63 to the same standards as the connecting links and hence STP recommends that this scheme be designed as a dual 2-lane highway. Costs have been increased accordingly.	3.0
64	Mogh Bazaar Flyover	This scheme is under feasibility study and preliminary design. Further work is required on Detailed Design and financing. Although private finance is anticipated the costs have been included. Current estimate is US$26m.	26.0
	Preliminary Engineering	A number of projects should be made ready in this first phase so that the final design works can be undertaken in Phase 3. Preliminary works should concentrate on the definition of the alignments and the acquisition of rights of way. Schemes to be included within this category of preparation are - 4, 5, 6, 9, 14, 19, 23, 25, 26, 30, 34, 35, 37, 59, 62 and 69. The cost estimate for this work has been made on the basis of allocating the sum of $250,000 for each scheme.	4.0
		TOTAL COST FOR THE ABOVE	**906**

B) TRANSIT PROJECTS

Exhibit 10-5 Transit Schemes for Phase 2 (2010 to 2014)

I/D	Name	Comment	Cost ($m)
	Bus Re-organisation and Priority Measures	The decisions regarding the further introduction of more lines of the Mass Rapid Transit System (see below) should be further considered and the provision for bus priority measures on other main highways should be introduced. It is estimated that another 25 kms of route would need to be studied. The rationalization of the bus routes need to be made so that the Mass Transit Lines are served with Feeder Routes. Costs for the study have been estimated as $0.25m and the implementation costs can be shared with those for the continuous program of Traffic Management improvements.	5.0
	BRT	In the second phase, Line 3 of the Mass Rapid Transit	

I/D	Name	Comment	Cost ($m)
	Extension	System is planned to be opened. This is recommended as an extension of Line 3 penetrating into the Old Town and increasing the Line 3 by a distance of 5kms.	15.0
	Metro Design	The second phase should include the Preliminary Design for the Metro Lines and the Final Designs for the first line. The work should include the completion of studies on station location, interchanges, supply and operations. Accurate costing should now be possible and the tenders finalized. The bidding consortium should be selected and negotiations completed with regard to Concession Agreements, Operating Company and Construction Schedule. The relationship with the company already in existence operating the BRT lines should be agreed. All should be made ready for a beginning on site by the early stages of Phase 3A. An estimate of US$2m per year has been allowed for these studies and negotiations.	10.0
		TOTAL COST FOR THE ABOVE	**30.0**

In summary, the total costs for Phase 2 are estimated as $936 millions.

10.4 PHASE 3A PROJECTS

A. HIGHWAY PROJECTS

Exhibit 10-6 Highway Schemes for Phase 3a (2015 to 2019)

I/D	Name	Comment	Cost ($m)
4	Ashulia – Aricha Rd	The previous phase developed the Western Embankment Road and this phase now proceeds to develop roads to the west of the River Turag. The opening of Scheme 4 will be coordinated with Scheme 30 (see below) also developed in this phase. The scheme connects the Western Embankment Road with the Western Bypass and is a 2-lane road of 7 kms proposed by LGED.	1.0
5	Khilkhet – Eastern By-pass	As well as developing the western areas, this phase provides additional impetus to developments to the east of the city. Scheme 5 is proposed by RHD as an upgrading to dual 2-lane highway status over a length of 6.5 kms. It intersects first with the Eastern By-pass, then the Eastern Embankment Road and finally joins the Dhaka By-Pass as Scheme 6 (see below).	4.0
6	Eastern By-pass – Dhaka By-pass	In accordance with Scheme 5 (see above) this scheme completes the east-west highway between Khilkhet and the Dhaka By-pass acting as an encouragement to develop the eastern areas. It is proposed by RHD and is 6 kms in length.	15.0
9	Konakhola - Hazratpur	This project is planned to encourage development in the south-western areas and is proposed by RHD as a 2-lane road. Traffic flows are low and the upgrading as proposed will be sufficient to increase the safety aspects of this road.	13.0

I/D	Name	Comment	Cost ($m)
14	Bashaboo Mosque – Balu River	This scheme is planned to encourage the development of the lands to the east of the city. It is a dual 2-lane highway stretching 6.3 kms from the city to the Eastern By-pass at Keodata. It is proposed by RAJUK and needs to be coordinated with construction of the bridge over the Balu River (Scheme 37) also included in this phase.	30.0
19	Muhamadpur - Keraniganj	In conjunction with Scheme 35 (See below) this highway is proposed by RHD as a dual 2-lane highway in two sections amounting to 4.0 kms. Traffic flows suggest that this should be a dual 3-lane facility. In addition the scheme forms approach roads to the bridge over the Buriganga at Basilia which is scheduled as dual 3-lanes. The STP recommends that this is constructed as dual 3-lanes. Costs have been increased accordingly. There should also be a good land-based connection made to the Ferry terminal recommended for improvement at Basilia.	6.0
23	Eastern By-pass	This is a key highway in the plan to open up development in the areas to the east. Proposed by RHD as a dual 3-lane highway it stretches for 30 kms from the Chittagong Road in the south to just north of Tongi in the north. It links with Scheme 62 (see below and also scheduled for this phase) to create a continuous link to Narayanganj. The scheduling has been delayed for two reasons – firstly the assumption that the Eastern Embankment will have a higher priority due to flood control and secondly due to the timing for the development of the areas to the east. There is also some concern that traffic figures do not appear to justify the dual 3-lanes although it is recommended that right-of-way be secured so that this can be achieved when required.	100.0
25	Jikatala – Hazaribag	A key link in the local network providing access from the Western Embankment to the Dhanmondi area. It is proposed by RAJUK and should be developed eventually as a dual 2-lane highway and increased right-of-way should be secured accordingly. Costs are for a single 2-lane highway.	1.0
26	Moghbazar - Malibagh	This is a new link connecting Shahhed Tazuddin with DIT Road. It is well used and the proposal for a dual 2-lane highway by RAJUK is a sound one justified on traffic grounds. There is a need to review the other projects in the area notably Scheme 64 which is the Mogh Bazar Flyover project.	2.0
30	Western By-pass	The Western By-pass is planned to open up the western areas for development and to provide a key corridor to control this development. It connects the EPZ at Savar running due south to intersect with Scheme 9 above. It is proposed by RHD as a 37 kms long dual 2-lane highway. Traffic figures suggest that this is properly conceived. However, it is recommended that right-of–way be acquired for a dual 3-lane facility since the highway is a key project and needs to be safeguarded for future expansion if required.	62.0
34	Muktarpur Bridge	Although this project does not reveal a large demand in traffic terms, it provides a key link in the strategic network and deserves to be considered. It is proposed by RHD as a dual 2-lane road of 1.5kms.	31.0

I/D	Name	Comment	Cost ($m)
35	Buriganga Bridge at Basilia	In conjunction with Scheme 19 (See above) this bridge is proposed by RHD as a dual 3-lane cross-sections amounting of 700 ms. Traffic flows reinforce the suggestion that this should be a dual 3-lane facility. In addition Scheme 19 forms the approach roads to the bridge which are also scheduled for improvement in this phase.	13.0
37	Keodata Bridge over Balu River	This bridge links with Scheme 14 (see above and included within this phase). It is a dual 2-lane bridge of 40m length proposed by RHD.	1.0
59	Berulia - Ashulia	The previous phase developed the Western Embankment Road and this phase now proceeds to develop roads to the west of the River Turag. The opening of Scheme 59 will be coordinated with Schemes 4 and 30 (see above) also developed in this phase. The scheme connects the Western Embankment Road with the Western Bypass and is a dual 2-lane road of 15 kms proposed by RHD planned to serve the Savar EPZ.	24.0
62	Dhaka Link Road	As noted in Scheme 23 above, this road links with the Eastern By-pass to create a strong north-south link in the eastern development areas. It is a dual 2-lane highway of 10.5 kms proposed by RHD.	11.0
69	Jatrabari – Demra Ghat	This scheme is also planned to encourage the development of the lands to the east of the city. It is a proposed by RHD as a dual 3-lane highway stretching 7.5 kms from the city to the Eastern By-pass at Tarabo. It needs to be coordinated with construction of the bridge over the Balu River (Scheme 36) included in Phase 3b.	5.0
	Preliminary Engineering	A number of projects should be made ready in this first phase so that the final design works can be undertaken in Phase 3b. Preliminary works should concentrate on the definition of the alignments and the acquisition of rights of way. Schemes to be included within this category of preparation are - 10, 16, 17, 21, 22, 31, 32, 36, 39, 40, 43, 45, 55, 56, 57, 70 and 74. The cost estimate for this work has been made on the basis of allocating the sum of $250,000 for each scheme.	5.0
		TOTAL COST FOR THE ABOVE	**319**

B. TRANSIT PROJECTS

Exhibit 10-7 Transit Schemes for Phase 3a (2015 to 2019)

I/D	Name	Comment	Cost ($m)
	Metro Design	The Phase should include the Final Design for the complete Metro system and the tenders should be ready for bidding by the third year of the phase. Full and accurate Bills of Quantities should be available and a complete cost and financial analysis finished.	10.0
	Metro Construction	The successful Tenderer should complete the working drawings and commence construction of the first line	1,000

		suggested as Line 5. It is anticipated that the first section would be open by the year 2020. The cost estimate is very tentative at this stage and is based on a per kilometre rate of $50m for the elevated sections with an opening of the first line of 20 kms on elevated track.	
		TOTAL COST FOR THE ABOVE	**1,010**

In summary, the total costs for Phase 3a are estimated as $1,329 millions.

10.5 PHASE 3B PROJECTS

A. HIGHWAY PROJECTS

Exhibit 10-8 Highway Schemes for Phase 3b (2020 to 2024)

I/D	Name	Comment	Cost ($m)
10	Hazratpur - Hemeyetpur	A 2-lane road proposed by RHD	12.0
16	Fatullah – Munshigank	A 2-lane road proposed by RHD	10.0
17	Hemayetpur - Manikganj	A 2-lane road proposed by RHD	11.0
21	NMT Road - Bangladesh Rifles	A single lane road included so as to allow traffic management on Mirpur Road	0.5
22	Progati Sarani – Balu River	A 2-lane road proposed by RAJUK and serving the ever expanding eastern areas.	8.0
31	Mitijhee – Kamalapur	A 2-lane road widening to serve traffic destined to main railway station.	0.5
32	Pallabi – Uttara 3	This dual 2-lane highway proposed by RAJUK is to the west of Uttara and will complete the basic infrastructure in this area and open up the land for expansion.	6.0
36	Demra Bridge	This scheme connects with Scheme 69 and will allow further access from the southern part of the city to the eastern development areas. Proposed by RHD it is 1.08 kms in length and will be built as dual 3-lanes wide.	14.0
39	Mohamadpur – Mirpur Rd	This 2-lane road will combine with Scheme 40 to create a good connection to the Western Embankment. It is a proposal by DCC and will be a useful service to the Sohrawardy Hospital.	0.5
40	Krishi Market – Western Embankment	This 2-lane road will combine with Scheme 39 to create a good connection to the Western Embankment. It is a proposal by DCC and will be a useful service to the Sohrawardy Hospital.	1.0
43	Mirpur Zoo - Embankment	Although not significant in strategic terms this provides a useful link to a major generator. It is proposed as a 2-lane road by DCC.	1.0
45	Bashaboo Rd - Manikdi	A dual 2-lane highway upgrading proposed by RAJUK and completing the connections from the southern part of the city to the eastern areas.	24.0

I/D	Name	Comment	Cost ($m)
55	Uttara 8 – Balu River	Together with Scheme 56, this provides the basic road infrastructure in the northern part of the eastern development areas. It is proposed by RAJUK as a 2-lane highway but it is recommended that the right-of –way be acquired to permit eventual widening to dual 2-lanes.	1.0
56	Uttara 4 – Balu River	Together with Scheme 55, this provides the basic road infrastructure in the northern part of the eastern development areas. It is proposed by RAJUK as a 2-lane highway but it is recommended that the right-of –way be acquired to permit eventual widening to dual 2-lanes.	1.0
57	Savar EPZ - Western By-pass	A scheme proposed by RHD and completing the connection to the Western By-pass. It is a dual 2-lane highway of 20 kms in length and key to the development of the western areas.	27.0
70	Connector to Buriganga Bridges 1 & 2	This is a dual 2-lane highway proposed by RHD on the southern side of the river and connecting the two main arterials crossing the river. A key link in the infrastructure there.	1.0
74	ICD – Buriganga Bridge Rd	A proposed road by BIWTA connecting the new ICD terminal. It is proposed as a dual 2-lane highway of 4.3 kms. BIWTA have suggested this as Toll Road a concept which requires further analysis.	2.0
		TOTAL COST FOR THE ABOVE	**120**

B. TRANSIT PROJECTS

Exhibit 10-9 Transit Schemes for Phase 3b (2020 to 2024)

I/D	Name	Comment	Cost ($m)
	Metro Construction	It is anticipated that sections of Metro Lines 4 and 6 will be completed in this phase. Full operations will probably be beyond the study period of 20 years. It is suggested that work be concentrated upon Line 6, the Pallabi line due to relative ease of construction. The section of Line from Pallabi to Tajgaon (Kawran Bazar area) is suggested as the first section a distance of 6 kilometres. In addition, work could proceed on parts of Line 4 provided that the railway line is released for development. The feasibility study by Bangladesh Railways published during Phase 1 will allow less peculation about this Line. If the existing line is not to be released, then Line 4 might be considered for overhead construction and work could proceed in the sections between Tejgaon (Kawran Bazaar) and Saidabad over the existing railway line, a distance of 6 kms. In effect this would create a link from Pallabi to Saidabad with a change at Tejgaon. The Line 6 costs are estimated at US$75m per kilometre and the elevated sections of Line 4 at US$50 per kilometre.	750
		TOTAL COST FOR THE ABOVE	**750**

In summary, the total costs for Phase 3b are estimated as $870 millions.

10.6 THE REMAINING MASS TRANSIT SYSTEM

It will be noted that the above does not complete the Mass Rapid Transit system. This is based on some concerns expressed about the ability to mobilise finance, design and construct all of the system within the short space of 20 years. The missing sections are 6 kilometres of Line 6 and 8 kilometres of Line 4. The total costs of these sections amount to US$450m for Line 6 and either US$400m if Line 4 is built on structure or US$600m if it is underground. This additional US$1 billion if identified and provided the construction industry can mobilize sufficiently well, could allow the system to be completed earlier. The first review of the STP will be in 2009 and by then the progress will be well documented to enable any re-scheduling to be achieved and accelerate the program of construction.

Exhibit 10-1