KARNATAKA URBAN INFRASTRUCTURE DEVELOPMENT AND FINANCE CORPORATION

COMPREHENSIVE TRAFFIC AND TRANSPORTATION PLAN FOR BENGALURU

FINAL REPORT

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THE INFRASTRUCTURE PEOPLE

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LIST OF ABBREVIATIONS

AMP	Automatic Mechanical Parking
ATC	Area Traffic Control
BBMP	Bruhat Bengaluru Mahanagara Palike
BDA	Bengaluru Development Authority
BIA	Bengaluru International Airport
BIAAPA	Bengaluru International Airport Area Planning Authority
BIEC	Bengaluru International Exhibition Centre
BMA	Bengaluru Metropolitan Area
BMICAPA	Bengaluru Mysore Infrastructure Corridor Area Planning Authority
BMLTA	Bengaluru Metropolitan Land Transport Authority
BMRCL	Bengaluru Metro Rail Corporation Limited
BMRDA	Bengaluru Metropolitan Region Development Authority
BMTC	Bengaluru Metropolitan Transport Corporation
BOT	Build-Operate-Transfer
BRTS	Bus Rapid Transit System
B-TRAC	Bengaluru Traffic Regulation and Control
CBD	Central Business District
CMP	Conventional Multi Level Parking
CRR	Core Ring Road
CRS	Commuter Rail System
DBP	Devanahalli Business Park
D.O.	District Office
DULT	Directorate of Urban land Transport
FSI	Floor Space Index
FMCG	Fast Moving Consumer Goods
GC	Generalised Costs
GPS	Geographical Positioning System
HBB	Home Based Business
HBE	Home Based Education
HBO	Home Based Other
HBW	Home Based Work
HCV	Heavy Commercial Vehicle
HIS	Household Interview Survey
HSRL	High Speed Rail Link
IFC	Integrated Freight Complex
IRR	Internal Rate of Return
IT	Information Technology
ITS	Intelligent Transport System
ITPL	International Technology Park Limited
ITPB	International Technology Park Bengaluru
IVRS	Interactive Voice Recording System

IVT	In Vehicle Time
KSPCB	Karnataka State Pollution Control Board
KSRTC	Karnataka State Road Transport Corporation
KUIDFC	Karnataka Urban Infrastructure Development and Finance Corporation
LCV	Light Commercial Vehicle
LRT	Light Rail Transit
MCV	Medium Commercial Vehicle
MMTC	Multi Modal Transit Centre
MRT	Mass Rapid Transit
NHAI	National Highways Authority of India
NICE	Nandi Infrastructure Corridor Enterprise
NMT	Non Motorised Traffic
OCC	Occupancy Factor
O-D	Origin - Destination
ORR	Outer Ring Road
PA	Production / Attraction
PCU	Passenger Car Unit
PHPDT	Peak Hour Peak Direction Traffic
PIS	Passenger Information System
PRR	Peripheral Ring Road
PWD	Public Works Department
ROB	Road Over Bridge
ROW	Right of Way
RUB	Road Under Bridge
T&CP	Town & Country Planning
TEC	Traffic Engineering Cell
TPU	Transport Planning Unit
TTMC	Traffic &Transit Management Centre
ULB	Urban Local Body
VA	Vehicle Availability
VMS	Variable Messaging Signs
VOT	Value of Time
VOC	Vehicle Operating Cost

EXECUTIVE SUMMARY
COMPREHENSIVE TRAFFIC AND TRANSPORTATION PLAN FOR BENGALURU

1. PROBLEMS AND ISSUES

1.1 Bengaluru population has been growing at a rate of 3.25% per year in the last decade. There has been a phenomenal growth in the population of vehicles as well especially the two and four wheelers in this period due to rising household incomes. The number of motor vehicles registered has already crossed 36 Lakhs. In the absence of adequate public transport system, people are using the personalized modes which is not only leading to congestion on limited road network but also increasing environmental pollution. An average citizen of Bengaluru spends more than 240 hours stuck in traffic every year. Such delays result in loss of productivity, reduced air quality, reduced quality of life, and increased costs for services and goods.

1.2 The analysis of collected data from primary and secondary sources has brought the following major issues regarding the transport system of Bengaluru.

1 Road network capacity is inadequate. Most of the major roads are with four lane or less with limited scope of their widening. This indicates the need for judicious use of available road space. The junctions are closely spaced on many roads. Many junctions in core area are with 5 legs. This makes traffic circulation difficult. There is need to optimise the available capacity by adopting transport system management measures and by making use of intelligent transportation systems.

2 Traffic composition on roads indicates very high share of two wheelers. The share of cars is also growing. This indicates inadequate public transport system. V/C ratios on most of the roads are more than 1. Overall average traffic speed is about 13.5 Kmph in peak hour. This not only indicates the need of augmenting road capacity but the also to plan high capacity mass transport systems on many corridors.

3 Outer cordon surveys indicate high through traffic to the city. This points to the need of road bypasses not only for Bengaluru Metropolitan Area (BMA) but also for Bengaluru Metropolitan Region (BMR). High goods traffic also indicates the need of freight terminals at the periphery of the city.

4 The household travel surveys indicate high share of work trips. This segment of travel demand needs to be mostly satisfied by public transport system. Considering the large employment centres being planned in the BMA, the public/mass transport system needs to be upgraded/extended substantially.

5 At present, modal split in favour of public transport is about 46% (exclusive of walk trips). The trends show a decline in this share over the last two decades. This is further expected to fall unless adequate and quality public transport system is

provided to the people of Bengaluru. Share of two wheelers and cars in travel demand is disturbingly high. This trend needs to be arrested.

6 There is high pedestrian traffic in core area and some other areas in Bengaluru. Footpath facilities are generally not adequate and their condition is deteriorating. Therefore up gradation of their facilities is very important. Share of cycle traffic has declined over the years. This mode of transport needs to be promoted by providing cycle tracks along the roads.

7 Parking is assuming critical dimensions in Bengaluru. Parking facilities need to be augmented substantially. In the long run, city-wide public transport system needs to provide not only to reduce congestion on roads but also to reduce parking demand.

8 Area of the BMA has been increased as per Revised Master Plan-2015. This plan has provided for densification of existing areas, Mutation corridors, hi-tech areas etc in various parts of the city. This likely to have a major impact on traffic demand. The transport network including mass transport system needs to be planned taking the proposed development in to consideration.

9 Major developments have been proposed in the suburban towns of Bengaluru by BMRDA in the BMR. This is likely to increase interaction between Bengaluru and these suburban towns. There will be need to provide commuter rail services to these towns from Bengaluru.

1.3 Thus while planning for the transport system of Bengaluru, the above problems and issues need to be kept in consideration. The issues relating to traffic and transportation in a large and growing city like Bengaluru need to be viewed in the larger perspective of urban planning and development. Issues relating to land use planning and development control, public-private transportation policy and industrial location would need to be integrated at the perspective planning level. With Metro Rail under implementation there is the need to coordinate inter modal transport issues.

2. PREFERRED STRATEGY FOR TRANSPORT DEVELOPMENT

In order to prepare the Comprehensive Transport Plan the following policy measures have been considered.

1 Extension of mass transport system to provide wide coverage and transport integration with other modes of transport.
2 Provide substantially large network of medium level mass transport system such as BRT to cover the areas beyond the Metro network and on over loaded corridors.
3 Landuse adjustments and densification of corridors along mass transport corridors where possible.
4 Extension of commuter rail system upto the BMRDA's New Townships & beyond upto Tumkur, Hosur etc. to act as sub-urban services.

5 Rationalisation of local bus system and its augmentation.
6 Improvement in traffic management through TSM measures.
7 Special facilities for pedestrians within the entire network specially in the core areas; pedestrianisation of selected shopping streets in side the core area going to be served by Metro. Provision of pedestrian sky walks/subways, footpaths and road furniture along the roads where necessary.
8 Diverting through traffic on Peripheral Ring Road. Providing transport hubs at the junctions of Peripheral Ring Road with important radials such as; the National Highways and other heavily loaded roads.
9 Improving primary, arterial and other important roads (particularly radial and ring roads) by providing grade separation, junction improvements, adding missing links, widening and other road side facilities wherever necessary.
10 Institutional strengthening of Urban Transport organisations.

3. TRANSPORT DEMAND ANALYSIS

3.1 Population of the BMA is expected to increase from 61 lakh in 2001 to 88 lakh in 2015 and 122 lakh in 2025. In addition, BIAAPA area which has also been included in the study area, will have a population of 9 Lakhs by 2025. Considering proposed land use, transport sector requirements upto 2025 have been assessed using travel demand modeling. The transport sector recommendations contained in the Master Plan for BMA, city development plan proposed by Bruhat Bengaluru Mahanagara Palike (BBMP) under the auspices of Jawaharlal Nehru National Urban Renewal Mission (JNNURM), region development plan prepared by Bengaluru Metropolitan Regional Development Authority (BMRDA), development plans of Bengaluru International Airport Area Planning Authority (BIAAPA) and Bengaluru-Mysore Infrastructure Corridor Area Planning Authority (BMICAPA) have been examined.

3.2 For the purpose of transport demand analysis, various scenarios have been considered as follows.

Scenario 1: This scenario considers a 'do minimum' situation wherein Improvement & augmentation in existing system for the bus network and roads already proposed. The purpose of the scenario is to capture the intensity of the problem if no measures are taken to overhaul the transport system in the city.

Scenario 2: in addition to what has been considered in scenario 1, scenario 2 considers the implementation of metro project as planned in Phase-1 (42.9 Km).

Scenario 3: This scenario is developed on scenario 2 with additional lines of Mass Transport system to address the anticipated demand with extensive public transport system as the focus for development. It is developed upon scenario 2 with additional lines of mass transport systems (about 630 Km of Metro, Light Metro, BRT, Sub-Urban Commuter Rail and HSRL).

3.3 120 lakh person trips by mechanical modes are estimated to be generated in 2025. Present modal split of 54% in favour of public transport is estimated to fall to 49% by 2025 for scenario 1. Thus most of the trips would be undertaken by personalised modes and bus system creating unbearable congested conditions. For scenario 2, which includes Phase 1 metro network, modal split in favour of public transport is expected to improve to 54% by 2025. However, this is also not enough for the city of size of Bengaluru and many roads would still be overloaded. For scenario 3, the modal split in favour of public transport is estimated as 61%. In the scenario 3 with high parking charges and VOC, the modal split in favour of public transport is estimated as 70%. This modal split is in conformity with the desirable modal split for the city of size of Bengaluru as recommended by a Study Group of Government of India. The study, thus, recommends scenario 3 that would fulfill the objectives of the transport sector development integrated with the proposed land use and giving predominance to the public transport system.

4. PROPOSED TRAFFIC AND TRANSPORTATION PLAN

4.1 On the basis of projected traffic, an integrated multi-modal mass transport system plan on various corridors has been suggested in order to cater to traffic up to the year 2025. The mass transport systems have been proposed on various corridors considering expected traffic demand by 2025, available road right-of-ways and system capacity. The balance traffic should be carried by road system in order to satisfy the needs of normal bus system and other modes such as two wheelers, cars, bicycles, trucks, pedestrians etc. The proposed Traffic and Transportation Plan for Bengaluru contains the following types of proposals, which will cater to requirements of the projected travel demand up to the year 2025.

- Mass Transport System
  - *Metro System*
  - *Light Metro System*
  - *Bus Rapid Transport (BRT) System*
  - *Sub-Urban Commuter Rail System*
  - *High Speed Rail Link (HSRL)*
- City Bus System
  - *Augmentation of Bus Fleet*
  - *Grid Routes*
  - *Bus Terminal cum Traffic & Transit Management Centres (TTMC)*
  - *Multimodal Transit Centre*
  - *Volvo Depot cum Traffic & Transit centre*
  - *New Bus Stations/bus shelters*
  - *Additional Bus Depots*
  - *IT Infrastructure*
  - *HRD Infrastructure*
  - *Environmental Protect Projects*
- Integrated Multimodal Transit Centres cum Intercity Bus Terminals

- Transport System Management Measures
- Pedestrian/NMT Facilities
  - *Footpaths*
  - *Skywalks/Subways*
  - *Pedestrian zones*
  - *Cycle Tracks*
- Road Development Plan
  - *New Roads/Missing Links*
  - *Road Widening*
  - *Grade Separators*
  - *Re-alignment of ORR*
- Parking Facilities
- Integrated Freight Complexes

4.2 Integrated multi modal transport system has been recommended in order to ensure seamless travel. For the balance travel demand, road improvement proposals have been formulated. While making road proposals, entire corridor has been proposed to be improved instead of isolated improvements.

4.3 The proposed mass transport corridors are shown in **Table 0.1** and **Figure 0.1**. Proposals pertaining to city bus system (other than BRT), parking, pedestrian and road improvement proposals are shown in **Figures 0.2 -0.6**. Summary of proposals is given in **Table 0.2**.

4.4 Summary of the cost estimates for various projects is also given in **Table 0.2.** Overall cost of the entire plan is estimated as Rs 53367 Crore of which Rs 23987 Crore is proposed for Phase I (2011-15). Cost of the projects proposed in Phase II (2016-20) is Rs 26080 Crore.

Table 0.1 Proposed Mass Transport Corridors

Sl. No.	Corridor	Length (Km)
A	***Metro Corridors-Phase-I (under construction)***	
1	Hesarghatta – Puttenahalli Cross	24.2
2	Baiyyappanahalli – Mysore Road Terminal	18.7
	Total Length	**42.9**
B	***Extension of Metro Corridors***	
1	Extension of Puttenahalli Cross- Hesarghatta line to BIEC	2.7
2	Extension of Hesarghatta – Puttenahalli Cross line to PRR	7.4
3	Extension of Baiyyappanahalli – Mysore Road terminal line to Kengeri	5.9
4	Extension of Mysore Road terminal – Baiyyappanahalli line to Whitefield	12.4
	Total Length	**28.4**

Sl. No.	Corridor	Length (Km)
C	***New Metro Corridors***	
1	Electronic City to Srinivasapur	31.8
2	Yeshwantpur to BIA	37.8
	Total Length	**69.6**
D	**HSRL**	**34.0**
E	**Light Metro Corridors**	
1	Hebbal–JP Nagar (along Western ORR)	31.3
2	Toll Gate to PRR along Magadi Road	9.7
3	National College to Kathriguppe Junction	5.0
4	Hosur Road–BG Road Junction to PRR	13.8
5	Indira Nagar to White Field	17.2
	Total Length	**77.0**
F	**Suburban Commuter Rail Service Corridors**	
1	Kengeri – Ramanagaram	32.0
2	Baiyyappanahalli – Hosur	41.0
3	Yeshwantpur – Tumkur	64.0
4	Yelahanka – Doddaballapur	24.0
	Total Length	**161.0**
G	**Bus Rapid Transit (BRT) Corridors**	
1	JP Nagar–Hebbal (along Eastern ORR)	31.7
2	ORR to Hosur Road (upto PRR)	13.0
3	Hosur Road to Tumkur Road (Western PRR)	42.9
4	Tumkur Road to Hosur Road (Eastern PRR)	78.5
5	Along CRR	31.2
6	PRR to Kengeri to JP Nagar	15.9
7	Domlur Extn to Koramangala	5.6
8	Mulur to Maruthinagar	7.1
9	BIEC to PRR	2.1
10	Cricket Stadium to BIA via Hebbal	34.0
11	Yelahanka to PRR	9.9
12	KR Puram Metro station to PRR (Along Old Madras Road)	7.7
	Total BRT Length	**279.6**
	Grand Total Length (Km) (A+B+C+D+E+F+G)	**692.5**

Table 0.2 Summary of Cost Estimates for the Entire T&T Plan (2010 prices) (Rs. Crore)

ITEM	Length Kms/Nos.	Total Cost (Rs. Cr.)	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
MASS TRANSPORT CORRIDORS					
Metro System	141.0	20882.0	0	20882.0	0
HSRL	33.0	3960.0	3960.0	0	0
Light Metro System	77.0	7700.0	4100.0	1380.0	2220.0
Sub Urban Commuter Rail System	161.0	2415.0	2415.0	0	0
BRT System	279.6	3914.4	2076.2	1838.2	0
IMPROVEMENT IN CITY BUS SYSTEM					
Improvement in City Bus System		5282.0	2372.0	1830.0	1080.0
Master Control facility for Public Transport Operational Integration		30.0	30.0	0	0
ROAD INFRASTRUCTURE					
New Roads	183.2	5403.9	5403.9	0	0
Outer Ring Road Realignment	16.6	346.1	346.1	0	0
Road Improvements (Inside ORR)	71.1	85.4	85.4	0	0
Road Improvements (Outside ORR)	469.1	422.2	422.2	0	0
GRADE SEPARATORS					
Grade Separators-Road (Nos.)	12	383.0	383.0	0.0	0.0
Rail Over Bridges / RUBs-Rail (Nos.)	32	864.0	864.0	0	0
PEDESTRIAN FACILITIES		369.0	369.0	0	0
PARKING FACILITIES (No. of car spaces)	8500	420.0	420.0	0	0
INTEGRATED FREIGHT COMPLEXES (IFC)	6	300.0	150.0	150.0	0
TRANSPORT SYSTEM MANAGEMENT		590.0	590.0	0	0
GRAND TOTAL		**53367.0**	**23986.8**	**26080.2**	**3300.0**

5. INSTITUTIONAL STRENGTHENING

5.1 The current structure of governance for the transport sector is not adequately equipped to deal with the problems of urban transport. Multiplicity of organizations, independent legislations and inherent conflict in the roles and responsibilities of stakeholders actually impede in the process of planning and implementation of major schemes aimed at development. Government of Karnataka has recently accorded sanction for the creation of State Directorate of Urban Land Transport (DULT) under the Urban Development Department with the intended objective of ensuring integration of transport planning and development of transport infrastructure in urban areas. This DULT needs to be strengthened by any adequate technical staff such as Transport Planners, Traffic Engineers, Travel Demand Modelers, Civil Engineers etc. The government has also sanctioned setting up of Bengaluru Metropolitan Land Transport Authority (BMLTA) for BMR. BMLTA will function as an umbrella organization to coordinate planning and implementation of urban transport programmes and projects.

All land transport systems (excluding Railways) in the BMR will be brought under the purview of BMLTA. Therefore it is important that BMLTA is established at the earliest with statutory backing and adequate technical staff provided for this organization. It is also important that BMLTA is also given with the power to assign various projects to various organizations. All the finances to the concerned organizations should also be routed through BMLTA in order to make BMLTA effective and to ensure timely completion of projects.

5.2 Transport Planning is an essential component of town planning. Presently there is no proper technical body for required transport planning inputs. It is necessary that technical expertise is created within BDA and BMRDA to undertake this task. For the purpose, Transport Planning Unit (TPU) is proposed to be established in BDA and BMRDA.

A large number of agencies deal with road system such as BBMP, BDA, Traffic Police, PWD, NHAI, BMRDA, Transport Department, BMTC etc. There are numerous issues of proper road geometrics, traffic circulation, junction design, traffic signals, road signs/markings, street furniture etc which are not properly attended to by these agencies due to lack of traffic engineering expertise. Traffic planning is a continuous affair. It is therefore important that Traffic Engineering Cells are established in these organizations with qualified and adequate staff such as traffic engineers and transport planners. This will ensure that the traffic schemes are properly implemented with better results and fine-tuned later, if necessary. This will go a long way to improve traffic flow in Bengaluru. As bus system will continue to be an important sub-system in future also, it is also important that BMTC is adequately strengthened through its HRD initiatives.

CHAPTER – 1
INTRODUCTION

1.1 GENERAL BACKGROUND

1.1.1 Bengaluru is the fifth largest metropolis (6.5 m in 2004) in India and is one of the fastest growing cities in Asia. It is also the capital of Karnataka. The name Bangalore, which was earlier used, was an anglicised version of the city's name and as of now, the city is called Bengaluru. It is globally recognized as IT capital of India and also as a well developed industrial city.

1.1.2 Bengaluru city was built in 1537 by Kempegowda. During the British Raj, Bengaluru developed as a centre for colonial rule in South India. The establishment of the Bengaluru Cantonment brought in large numbers of migrant workers from Tamil Nadu, Andhra Pradesh and North Indian states for developing and maintaining the infrastructure of the cantonment. The cantonment area covers nearly dozen revenue villages, which included Binnamangala, Domlur, Neelasandra and Ulsoor to name a few. The defence establishments and residential complexes are part of the core area. Bengaluru is a radial pattern city growing in all directions. The city which was 28.85 Sq. Km in 1901 increased to 174.7 Sq. Km in 1971 to 272 Sq. Km in 1986 and 437 Sq. Km upto 2007. However, subsequently the existing TMCs & CMCs along with the surrounding villages was amalgamated and brought under the overall jurisdiction of City Corporation which was renamed from BMP to Bruhat Bengaluru Mahanagara Palike (BBMP). Accordingly, the total area under BBMP increased from 437 Sq.Km to nearly 800 Sq.Km.

Figure 1.1 which shows the physical growth of Bengaluru during the last five centuries, indicates that the city has a long history and the transport system has grown organically with its inherent problems to meet the requirements of changing times. **Figure–1.2** shows the area under jurisdiction of BBMP.

1.1.3 The city which was originally developed as a Garden City has over the years, slowly transformed into an industrial and software hub of India. The establishment of the Silicon Park on the outskirts of the city has converted the city and its surroundings into Silicon Valley of the country. It has also caused an urban sprawl around, to some extent lop sided towards south and east. It has become a commercial, administrative and military centre for the region because of its salubrious climate and cosmopolitan nature of people. It was also known as pensioner's paradise with well developed residential areas, roads with well grown trees, good commercial establishments, shopping malls etc. Despite such growth it is trying to maintain its character of garden city.

Figure 1.1 Physical Growth of Bengaluru during the Last Five Centuries

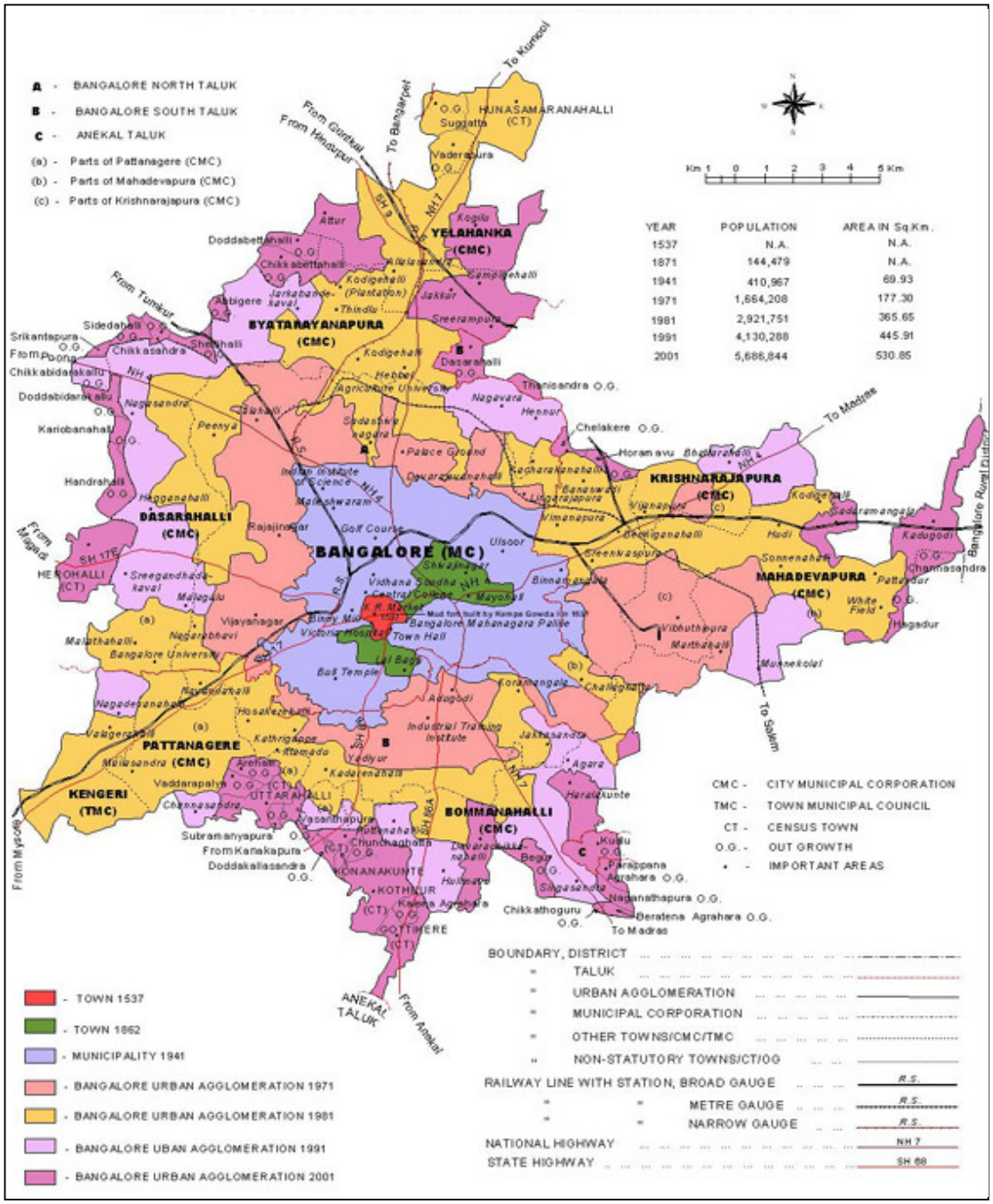
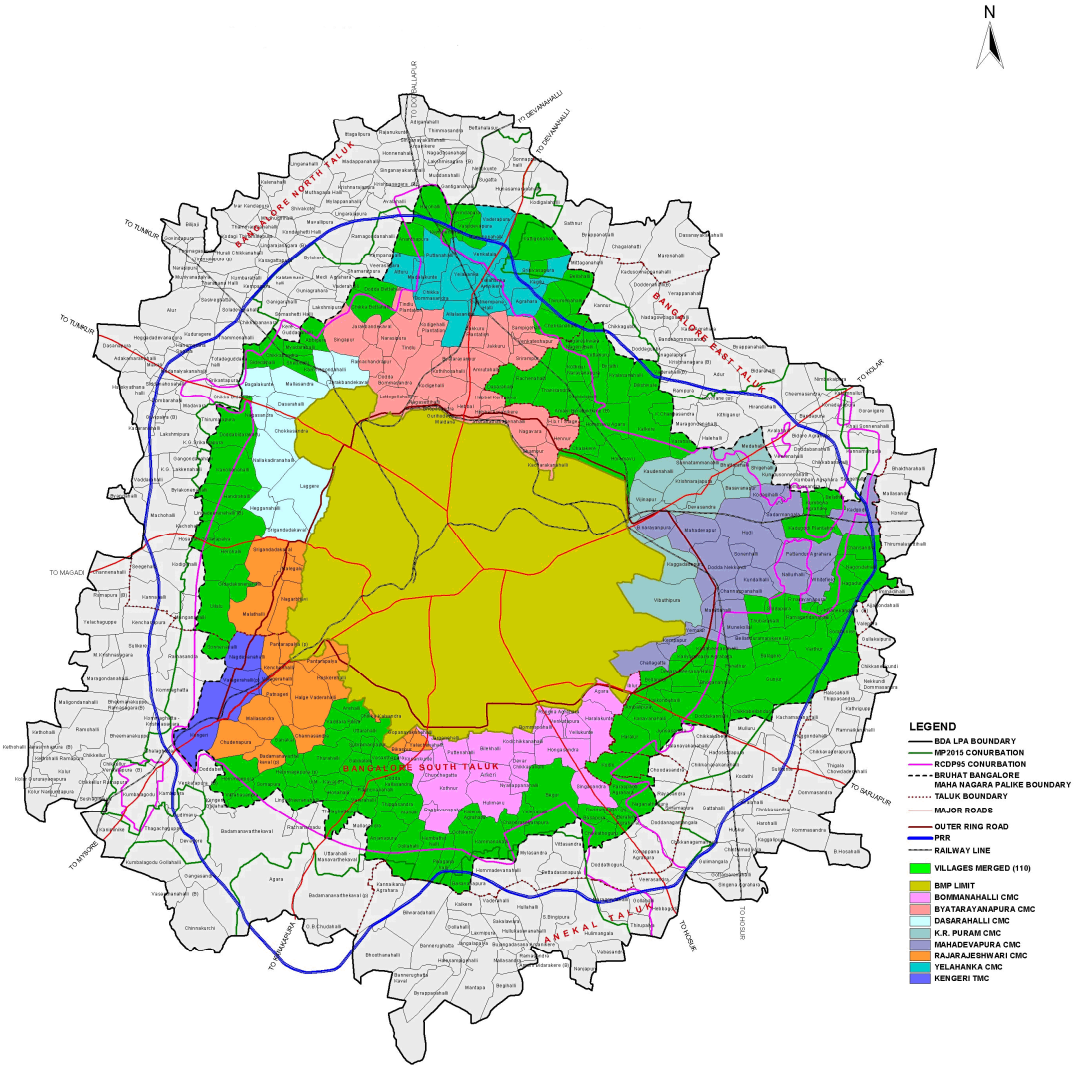


Figure 1.2 – Areas under jurisdiction of BBMP



1.2 PHYSICAL CHARACTERISTICS

1.2.1 Bengaluru is located in the South East of Karnataka. It is located in the heart of the Mysore Plateau at an average elevation of 920M (3,018 feet) above mean sea level. It is positioned at 12.97° N 77.56° E. Bengaluru District borders with Kolar District in the North-East, Tumkur District in the North-West, Mandya District in the South-West, Chamarajanagar District in the South and the neighbouring state of Tamil Nadu in the South-East.

1.2.2 The topography of Bengaluru can be classified as a plateau, with a central ridge running NNE-SSW and land sloping gently on either side and longitudinally. The highest point is Doddabettahalli, which is 962 m and lies on this ridge. The roads generally have gentle to medium gradients. Bengaluru has a number of fresh water lakes and water tanks, the largest of which are Madivala Tank, Hebbal Lake, Ulsoor Lake and Sankey Tank. The soil is predominantly of red soil interspersed with rock helping quicker drainage.

1.2.3 Due to its elevation, Bengaluru enjoys a pleasant and equable climate throughout the year. The highest temperature recorded is 41°C and the lowest is 7.8°C. Winter temperatures rarely drop below 12°C and summer temperatures rarely exceed 38°C. Monsoons commence sometime around mid April. The wettest months are August, September and October, in that order. The city receives rainfall of about 860mm from the North-East and South-West monsoons.

1.3 DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

1.3.1 Population of Bengaluru has been growing @ over 3% per annum since independence (**Table 1.1)**. The city, which had a population of 1.6 lakh in 1901, reached 61 lakh in 2001. With a decadal growth rate of 49%, Bengaluru was one of the fastest-growing Indian metropolises for the decade 1991-2001. It has an average density of about147.97 people/hectare. Currently the Bengaluru Metropolitan Area (BMA) is estimated to have population of about 70 lakh and is expected to be 80 lakh by 2011 and 88.40 lakh by 2015 as per Master Plan, 2015. By 2025, population of BMA is expected to reach 112.21 lakh as indicated in **Table 1.1**.

Table 1.1 Growth of Population in Bengaluru

Year	Population (lakh)	Decadal Growth (%)	Annual Growth
1901	1.63	-9.58	-1.00%
1911	1.89	16.18	1.51%
1921	2.40	26.69	2.39%
1931	3.10	29.05	2.58%
1941	4.11	32.66	2.87%
1951	7.86	91.34	6.70%
1961	12.07	53.49	4.38%
1971	16.64	37.88	3.26%
1981	29.22	75.56	5.79%
1991	41.30	41.36	3.52%
2001	61.70*	49.39	4.10%
2011	80.15*	29.90	2.65%
2015	88.40*		
2025	112.21**		3.07%

(* – Revised Master Plan, 2015 for BMA, ** – projected for BMA)

1.3.2 Bengaluru has the second highest literacy rate (83%) for an Indian metropolis, after Mumbai. The city's workforce structure is predominantly non-agrarian, with only 6% of Bengaluru's workforce being engaged in agriculture-related activities. Roughly 10% of Bengaluru's population live in slums – a relatively low proportion when compared to other cities in the developing world.

1.3.3 Bengaluru's ₹ 52,346 crore economy (2006-07 Net District Income) makes it one of the major economic centres in India. With an economic growth of 10.3% p.a, Bengaluru is the fastest growing major metropolis in India, and is also the country's fourth

largest FMCG market. With a per capita income of ₹ 74,709, the city is the third largest hub for high net worth individuals after Mumbai and Delhi.

1.3.4 One of the important factors spurring Bengaluru's growth was central government investment in Bengaluru's public sector industries, partially because it is geographically out-of-reach from India's rivals. This led to the concentration of technical and scientific navigators in Bengaluru, and is a factor in leading the "IT revolution" in Bengaluru. Thus, Bengaluru became headquarters to several public manufacturing heavy industries such as Hindustan Aeronautics Limited (HAL), National Aerospace Laboratories (NAL), Bharat Heavy Electricals Limited (BHEL), Bharat Electronics, Bharat Earth Movers Limited (BEML) and Hindustan Machine Tools (HMT). In 1972 the Indian Space Research Organisation (ISRO) was established under the Department of Space and headquartered in the city.

1.3.5 As of 2009, Bengaluru was inducted in the list of Global Cities and ranked as ***"Beta World City"*** alongside Geneva, Copenhagen, Boston, Cairo, Riyadh, Berlin to name a few. The turn of the millennium witnessed the growth of Internet based technologies which resulted in the dotcom boom. Bengaluru's IT industry grew during this period with the establishment of local and foreign IT companies. In 2001, Business Week published an article entitled "India's Silicon Valley" which traced the growth of the IT industry in India in general and Bengaluru in particular. The use of the term "Silicon Valley of India" to refer to Bengaluru grew in local media and as time progressed, in international media too. Thus, the term Silicon Valley has been in use and this has in turn contributed its position as the nation's leading IT exporter. A large number of Information Technology companies located in the city contribute 38% of India's IT and software export market. Globalisation has seen the city's potential to grow as an IT capital of the country. Bengaluru's IT industry is divided into three main clusters — Software Technology Parks of India, (STPI); International Technology Park Bengaluru (ITPB), formerly International Technology Park Ltd. (ITPL); and Electronics City. Infosys and Wipro, India's largest software companies, have big campuses in Electronics City. If the growth of Information Technology has presented the city with unique challenges, Biotechnology has now become another rapidly expanding field in the city. Bengaluru accounts for 47% or 127 of the approximately 265 biotechnology companies in India. The Bengaluru Stock Exchange is the largest in South India. **Figure 1.3** shows the major activity centres along with the transport network in Bengaluru.

1.3.6 With the growth of population and industries, the number of educational institutions has also grown up in the city and BMA. Numerous educational institutions up to High School and Colleges have come up in almost all the developing residential localities and extensions. Most of the institutions for professional courses like engineering and medicine are located within the jurisdiction of BBMP. There are a few institutions of higher learning and special requirements like Government Educational Institutions which are spread all over the city. Indian Institute of Science, popularly known as Tata Institute which was established in 1909 in Bengaluru, is the premier institute for scientific research and study in India. Nationally renowned professional institutes such as the National Institute of Design (NID), National Law School of India University (NLSIU), the Indian Institute of Management (IIM-B) and the Indian Statistical Institute

are located in Bengaluru. The city is also home to the premier mental health institution in India National Institute of Mental Health and Neuro Sciences (NIMHANS). Bengaluru also has some of the best medical colleges in the country, like St. John's Medical College (SJMC) and Bengaluru Medical College and Research Institute (BMCRI).

1.3.7 In the planned growth over the last 2 decades, the primary and secondary educational institutions have been provided in each of the residential localities and to this extent the educational requirements of the younger people is satisfied by and large locally. It is for the higher and selective learning, that people have to make longer trips requiring vehicular journeys.

1.4 TRANSPORT NETWORK

1.4.1 **Road Network Characteristics**: Bengaluru is endowed with a radial pattern of road network converging in the core area of the city. The total road network of the city is about 4000 km of which arterial/sub-arterial roads account for about 350 km. The road network is shown in **Figure 1.3**. The road network in the central parts of the city has developed organically over the last few centuries and has inadequate Right-of-Way. There is also a Ring Road (Outer Ring Road of about 62 Km) which cuts across the various radial roads. An Intermediate Ring Road has been constructed in fragments at south-east of the city between Koramangala and Old Airport Road.

Some of the National Highways which pass through Bengaluru include:

- NH – 4 connecting to Pune and Chennai
- NH – 7 connecting to Varanasi and Capecamorin
- NH – 209 connecting Dindigul / Pollachi

The following are the State Highways in Bengaluru:

- SH – 17 connecting Mysore & Gundlupet
- SH – 17E connecting T G Halli
- SH – 19 connecting Hindupur via Yelahanka and Doddaballapur
- SH – 86 connecting Mysore via Kanakapura

Figure 1.3 Major Activity Centres along with the Transport Network in Bengaluru

A-3 size

1.4.2 The road network is mostly underdeveloped in terms of size, structure, continuity and connectivity. Nearly 82% of the total existing road network of 1763 Km (taken for travel demand modelling purposes within the BBMP jurisdiction) is with 2-lane carriageway as shown in **Table 1.2**. Length of roads with carriageway of 4 lanes and above is only 290 km. The roads indicating carriageway widths are shown in **Figure 1.4**. Thus most of the roads have inadequate carriageway widths to cater to growing traffic at an acceptable level of service. Most of the roads in the city are also used for on-street parking facility which even reduces the effective carriageway width available for traffic. Most of the major roads in Bengaluru have V/C ratios > 1.0 indicating high congestion, low speeds and high delays. The intersections are also closely spaced which further increases the problem of traffic. Most of the intersections in the core area are multi legged with 4 legs or more. This compounds the traffic delays at junctions.

Table 1.2 Distribution of Roads with Carriageway Widths in Bengaluru

Type of Road	Length (Km)	%
Two Lane Undivided One Way	62.3	3.53
Two Lane Undivided Two Way	1379.2	78.21
Three Lane	31.6	1.79
Four Lane Undivided One Way	10.3	0.59
Four Lane Undivided Two Way	49.7	2.82
Four Lane Divided Two Way	198.5	11.25
Six Lane Divided	31.4	1.78
Six Lane Undivided One Way	0.5	0.03
Total	**1763.5**	**100.00**

1.4.3 The available Right-of-Way of major roads are generally inadequate to allow for their major widening as given in **Table 1.3**. This is a major issue in augmenting the capacity of transport system in Bengaluru. This indicates public transport system will have to play a very major role in satisfying the mobility requirements of people of Bengaluru as they are the most economic users of the road space.

Table 1.3 Distribution of Roads with available RoW in Bengaluru

Road RoW (m)	Length of Major Roads (%)
Less than 20	40.7
20-30	40.0
More than 30	19.3
Total	**100.0**

Figure 1.4 Carriageway Widths of Roads

A-4 size

1.4.4 **Rail Network:** Bengaluru is an important and a major junction on the South-Western railway network. There are three major railway stations in Bengaluru – City Railway Station, Cantonment Railway Station and Yeshwantpur Railway Station. Bengaluru is served by 5 radial rail corridors (shown in **Figure 1.2**):

- B.G. line from Chennai on east
- B.G. line from Mumbai-Pune on north-west
- B.G. line from Guntakal on the north
- B.G. line from Salem / Trivandrum from east
- B.G. line from Mysore from south-west

Though at present these rail corridors serve only intercity traffic, a small number of conventional short distance passenger trains are run in morning and evening hours to nearby (satellite) towns like Tumkur, Chikkaballapur, Bangarpet, Hosur and Mandya to serve the commuters. Its layout is conducive to convert them as "Commuter Rail System" (CRS), to provide viable commuter services to suburbs and also some nodes in the Bengaluru.

Till the beginning of 2010, no rail corridors were operated as regular intra-urban commuter corridors. However, on 6th April 2010, the Government of Karnataka in association with SWR has introduced train services from Yeshwantpur to Hosur and Yeshwantpur to Bengaluru International Airport (BIA) at Devanahalli on trial basis.

1.4.5 **Airport**: The earlier HAL Airport located about 11 Km from city centre towards the east of the city and adjacent to the Hindustan Aircrafts Ltd was opened to passenger traffic in 1947. The present Bengaluru International Airport (BIA) located near Devanahalli became operational in May 2008. The Bengaluru International Airport is located north of the City at a distance of 40 Km from the city centre.

The NH-7 (Bellary Road) is the only main road link connecting city to the BIA. Thus the only public transport connecting the airport from different parts of the city are the bus services operated by BMTC. Apart from this, the IPT mainly comprising of private taxis are the only other modes of transport available to BIA. Direct flights from Bengaluru fly to destinations in Asia, the Middle East and Europe. The liberalisation of India's economic policies has led to increase in the number of domestic carriers within India, with several carriers such as Indian, SpiceJet, Kingfisher Airlines, Jet Airways, Air Deccan, Paramount and Go Air servicing the city.

1.5 GROWTH OF MOTOR VEHICLES

1.5.1 **Vehicle Growth and Composition**: The vehicle population in all cities in India started growing rapidly since later part of 1980s. Bengaluru is no exception. It has always had a reputation of having more two wheeler users. The liberalization policy of the country made availability of not only vehicles but also loans for buying vehicles. With the rapid growth of IT sector in Bengaluru, the affordability of larger segment of employees increased for ownership of vehicles, more specially two wheelers. Coupled with inadequacy of comfortable and convenient public transport gave an impetus to more and more commuters shifting to cars and two wheelers for their commuting in

Bengaluru. Growth of motor vehicles is shown in **Table 1.4**. The number of registered motor vehicles has reached 36.8 Lakhs and the average growth of vehicles during the last 10 years has been found to be about 10%. The two wheelers, constituting about 70% of the total registered vehicles (in 2010), have grown at an average rate of about 10% per annum during the last few years. Lately, growth rate of cars have been found to be faster than two wheelers. The trend is likely to continue. This will result in higher use of personalised modes of transport particularly cars unless extensive and convenient public transport system is provided.

Table 1.4 Growth of Motor Vehicles in Bengaluru (in Lakh)

Year	2-Wh	Cars	Autos	Buses	Trucks	Maxi Cab	Tractors / Trailers	Others	Total Vehicles
1980	1.12	0.36	0.10	0.05	0.08	0.00	0.04	0.01	1.75
1985	2.16	0.60	0.10	0.05	0.12	0.00	0.01	0.02	3.07
1990	4.59	0.91	0.17	0.05	0.19	0.00	0.04	0.04	5.98
1995	6.49	1.26	0.37	0.11	0.29	0.02	0.06	0.10	8.71
2000	10.67	2.14	0.61	0.21	0.42	0.04	0.12	0.17	14.38
2001	11.62	2.36	0.64	0.23	0.48	0.05	0.13	0.16	15.66
2002	12.92	2.61	0.68	0.25	0.53	0.05	0.15	0.20	17.39
2003	14.19	2.87	0.72	0.28	0.59	0.07	0.16	0.24	19.12
2004	15.86	3.36	0.74	0.34	0.68	0.10	0.20	0.28	21.57
2005	18.11	3.87	0.80	0.37	0.85	0.13	0.23	0.31	24.67
2006	20.74	4.54	0.91	0.39	0.92	0.16	0.29	0.46	28.41
2007	22.32	5.27	0.95	0.48	1.10	0.18	0.31	0.45	31.07
2008	22.64	5.53	0.96	0.49	1.19	0.19	0.32	0.54	31.85
2009	26.08	6.46	1.06	0.42	1.29	0.21	0.32	0.69	36.53
2010	25.47	7.24	0.93	0.73	1.38	0.20	0.13	0.78	36.86

Source: Bengaluru Traffic Police Web Site and RTO, Bengaluru

1.5.2 Intermediate Public Transport: Autorickshaws (popularly known as autos) and taxis are the IPT facility available in Bengaluru. Autos are the popular form of transport and can be called common man's taxi in Indian cities and towns. It is a hybrid three wheel, three-seater (in addition to driver) low floor vehicle, which is easily manoeuvrable and at the same time provides a fast service. Priced much lower than a car, majority of autos are owned by the driver himself. Apart from the autos, regular small cars (Maruti Omni vans and Indica diesel cars) as taxis are provided by several operators commonly referred to as City Taxis or call Taxis. The number of autos and call taxis registered in Bengaluru is about 82000 and they are growing at the rate of 5-6 % p.a. The autos are also used for education and other trips and to a large extent by the visitors to the city. The drivers tend to take advantage of the vehicle's size and manoeuvrability and criss cross in traffic contributing a lot to accidents and traffic indiscipline and delays to overall traffic flow.

1.5.3 Public Transportation System: Buses are the predominant public transport system in all Indian cities. While four other metropolises Mumbai, Kolkata, Chennai, Delhi and

even Hyderabad have one or more forms of rail transport systems to cater to varying extents for commuters, Bengaluru has only bus as its public transport system. The city has one of the better run city bus transport systems in the country. It is operated in the Public Sector by Bengaluru Metropolitan Transport Corporation (BMTC), a wholly owned company of the State Government. As per the statistics of 2009, BMTC operates services on 5370 routes with fleet strength of 5593. BMTC has 24 depots in and around Bengaluru city. The corporation has about 28000 employees to man its operation. The daily ridership is approximately 40 Lakhs. BMTC operates 578 City and 1756 Sub-Urban routes per day. It has established state of the art commuter friendly modernized bus stations at Shivaji Nagar, Shanti Nagar and MCTC. The Kempegowda Bus Station at Subhash Nagar is also modernized with improved commuter amenities. The other major terminal of BMTC operating in the city is located at K R Market. In addition to this, sub nodal stations at different parts of the city have been constructed for the benefits of commuters. Its patronage has started having significant growth since 2002-03. In order to increase the frequency of services and to provide direction oriented services in place of destination oriented services, about 27 high density trunk corridors (Grid Routes) were started in 2007.

In order to increase the frequency of services and to provide direction-oriented services in place of the destination oriented services, 27 high density trunk corridors (Grid Routes) were identified and services offered along these routes. These Grid Routes are shown in **Figure-1.5.** However, due to poor patronage for these services, these were withdrawn and BIG10 services have been started along 12 major corridors in and around the City and its sub-urbs mainly along Hosur Road, Bannerghatta Road, Sarjpura Road, Kanakapura Road, Mysore Road etc. These buses are run on a direction based concept where the commuter takes the next (high frequency, every 15 minutes) bus in his/her direction of travel, and if need be, makes a change over to another bus to reach the destination. The service terminates on different points on the radius of the city core, to avoid congesting the city centre.
The progress of BMTC during the last few years is briefly given in the **Table 1.5** below.

Table 1.5 Operational statistics of Bengaluru Metropolitan Transport Corporation

Sl. No.	Factor	1999 -2000	2000 - 2001	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008
1.	Operations	2017	2190	2253	2302	2581	3199	3531	4116	4701
2.	Schedules	2121	2376	2535	2932	3291	3827	3957	4326	4773
3.	Fleet	2285	2473	2658	3036	3460	3925	4106	4606	4891
4.	Daily Average Scheduled Km (in lakh)	4.86	5.15	5.77	6.19	7.18	9.02	9.33	9.48	10.56
5.	Routes	1063	1147	1212	1345	1523	1690	1726	1927	2064
6.	City Services	789	798	817	988	1029	1131	1102	1148	1245
7.	Suburban Services	1065	1282	1412	1647	1985	2382	2542	2882	3229
8.	Pushpak Services	267	296	306	297	287	314	313	296	299
9.	Passengers carried per day (in Lakh)	25.50	25.75	26.25	26.75	30.35	32.07	34.78	37.75	38.59
10.	Accidents per Lakh Km	0.26	0.26	0.22	0.22	0.23	0.18	0.16	0.14	0.15

Source: BMTC

(The operational statistics for the years **2008-09 onwards** are not available in BMTC and hence the same has not been included in the Table above).

BMTC has now added a few more buses to its fleet under the JNNURM. The plans of adding new depots, new bus stations, commuter amenity centres, bus shelters, GPS system etc. are being implemented by BMTC in phases. A few Traffic & Transit Management Centres (TTMC) have been constructed at some locations of the City and a few are planned for future also. Details of the same have been dealt in detail in Chaper-7 of this report.

1.6 BENGALURU METROPOLITAN REGION

1.6.1 Bengaluru Metropolitan Region Development Authority (BMRDA) has been given the responsibility of planning the 8,000 Sq.Km of Bengaluru Metropolitan Region (BMR) consisting of 2191 Sq.Km in the Urban Districts and 5814 sq km in the Rural Districts. The planning areas falling in the BMR are indicated in the **Figure 1.6** and **Table 1.6.**

Table 1.6 Local Planning Areas in Bengaluru Metropolitan Region

Sl. No.	Area		Area Sq. Kms
1	B M A		1240.69
2	BMICAPA (within BMA)	65.31	
3	BMICAPA (outside BMA but within BMR)	338.74	404.05
4	Ramanagaram Taluk		200.25
5	Channapatna Taluk		110.60
6	Bengaluru South Taluk		27.89
7	Anekal LPA		406.00
8	Nelamangala LPA		750.00
9	Magadi LPA		501.00
10	Hosakote LPA		591.00
11	Kanakapura LPA		879.00
12	BIAAPA LPA		985.00
13	RCUDA LPA		62.50
14	APZ-1 (excl. RCUDA)		462.50
15	Industrial Zones in BMR		1723.26
	Total		**8005.00**

1.6.2 The regional plan while emphasizing on development of a regional transport network is also under taking the planning and development of 5 new township at Bidadi, Ramanagaram, Solur, Sathanur & Nandagudi covering a total area of 61,000 hectares on the outskirts of BMA. These townships are proposed to create the modern work and play environment in urban settlements within the areas as per **Table 1.7**.

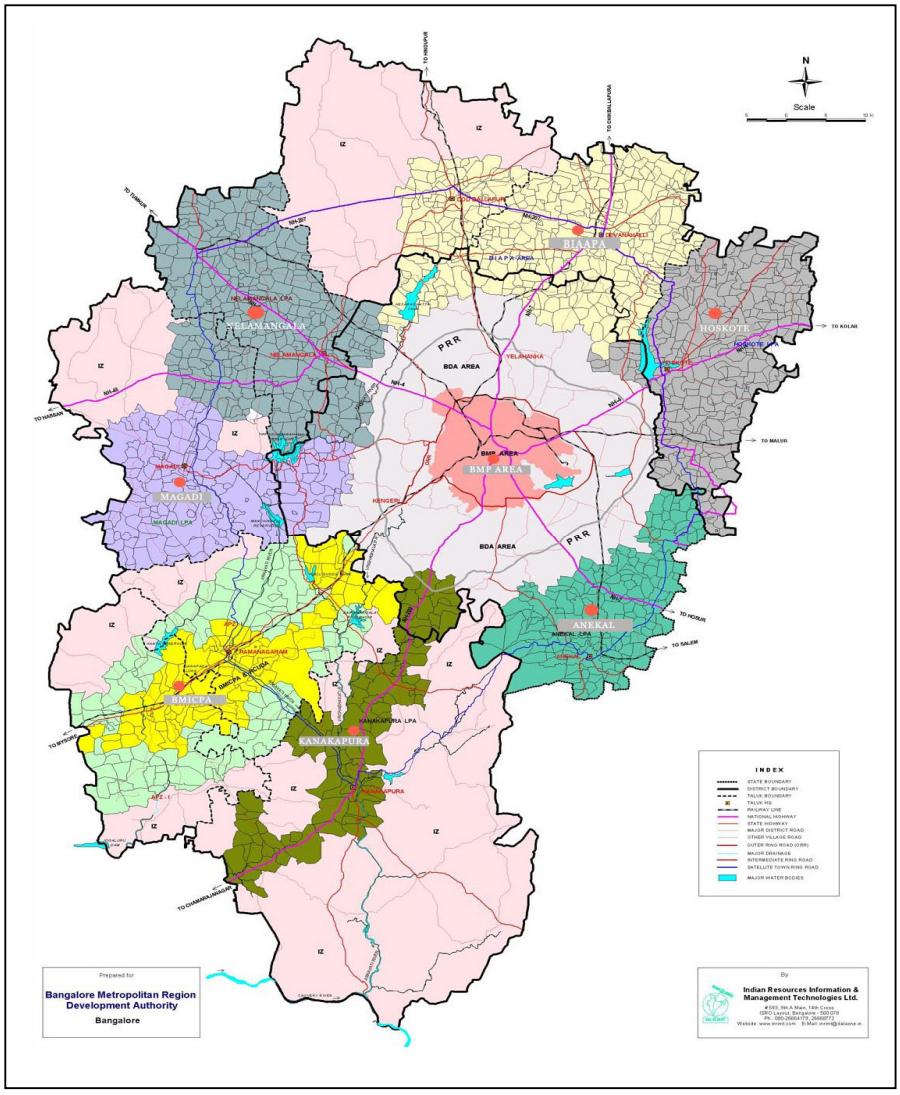
Figure-1.5 Grid Routes of BMTC

A-4

Table 1.7 BMRDA Townships Areas (Acres)

Township	Pvt. Land	Govt. Land	Total
Bidadi	6959	2725	9684
Ramanagaram	3621	392	4013
Sathanur	5891	10341	16232
Solur	9661	2864	12525
Nandagudi	13762	4745	18507
Total	**39894**	**21067**	**60961**

Figure 1.6 Bengaluru Metropolitan Region – Local Planning Areas



1.6.3 The following road network proposed by the BMRDA within the BMR consists of:

1)	Satellite Town Ring Road (STRR)	–	204 Km
2)	Intermediate Town Ring Road (ITRR)	–	130 Km
3)	Radial Roads	–	180 Km
4)	Town Ring roads	–	176 Km

1.7 URBAN LAND USE STRUCTURE FOR BMA

1.7.1 Existing Situation: Bengaluru city has spatially developed in a concentric manner. The economic activities have been growing at an unprecedented pace locating themselves in a sporadic manner with limited plan intervention covering an area of 1307 Sq. Kms. The existing landuse distribution of the BMA for 2003 & its comparison with the proposed Land use as per Revised Master Plan 2015 is given in the **Table 1.8**. The spatial distribution of existing land use is shown in **Figure 1.7**.

1.7.2 Revised Master Plan – 2015: Bengaluru Development Authority (BDA) is responsible for preparing Master Plan for the BMA and guiding its development. Salient features of the Revised Master Plan-2015 are as follows:

a. Local planning area (LPA) or Bengaluru Metropolitan Area (BMA) – 1307 Sq. Km (including BMICAPA area)
b. The city has to be planned for a population of 80 lakh by 2011 and 88 lakh by 2015.
c. Land Use Proposals: Keeping in view the rapid socio-economic development in Bengaluru and the development patterns in the BMR, the Master plan has evolved the following proposed land use for the Bengaluru Metropolitan Area as indicated in **Table 1.8** and **Figure 1.8**.
d. Economic activities & their spatial distribution: During the year 2003 approx. 6,30,000 Sqm of office space was sold which consisted 5,00,000 Sqm for suburban Hi-Tech firms and the balance 150,000 Sqm for other businesses. For the year 2015 the Plan envisages following requirement of office spaces:

	Area in Sqm.		
Office Type	**Suburb**	**CBA**	**Total**
High-Tech	6,71,006	8,13,293	14,84,299
Non- High-Tech	2,34,093	5,85,394	8,19,487
Total	9,05,009	13,98,687	23,03,786

Figure 1.7 Spatial Distribution of Existing Land Use

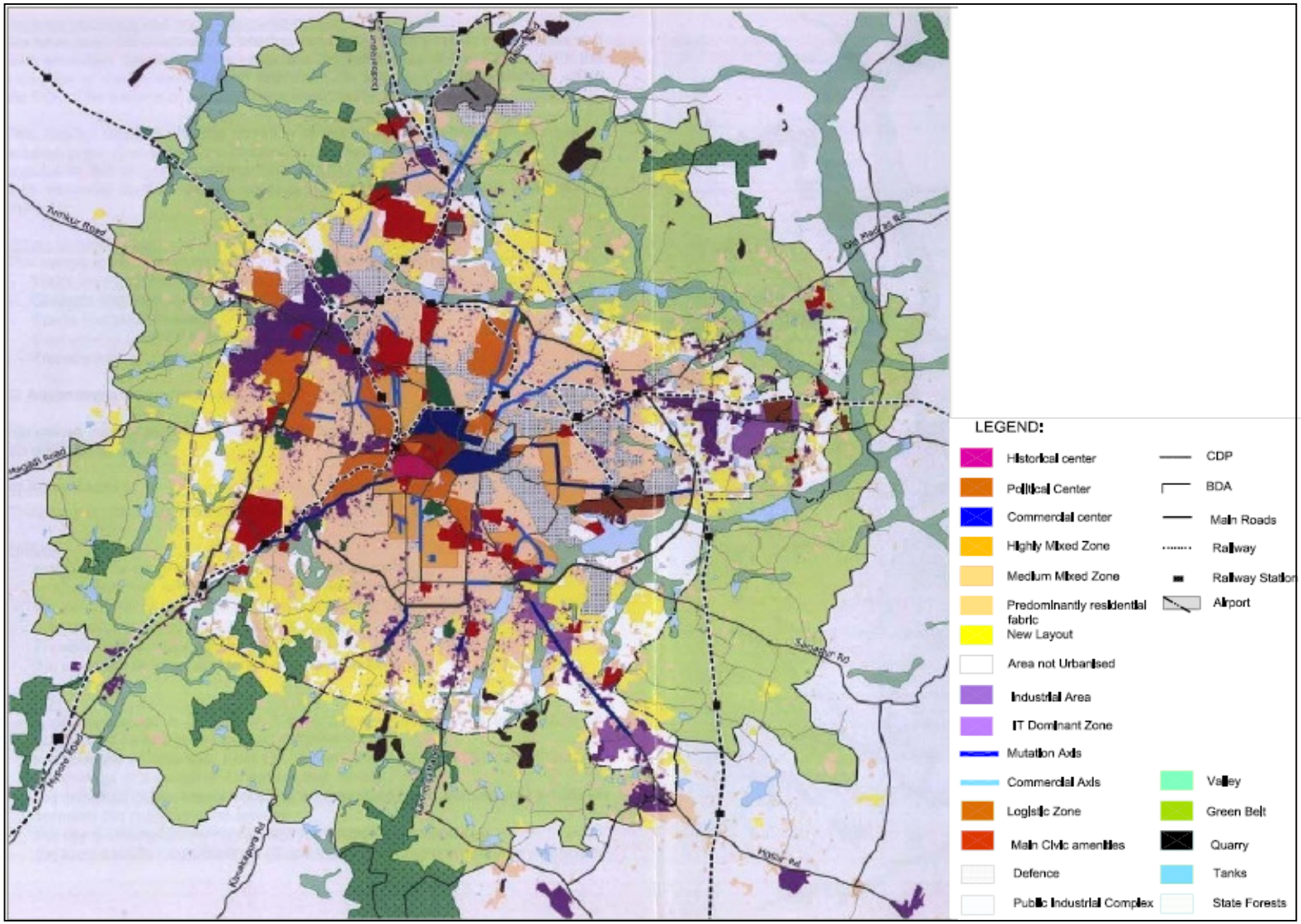


Figure 1.8 Proposed Land Use for Bengaluru Metropolitan Area

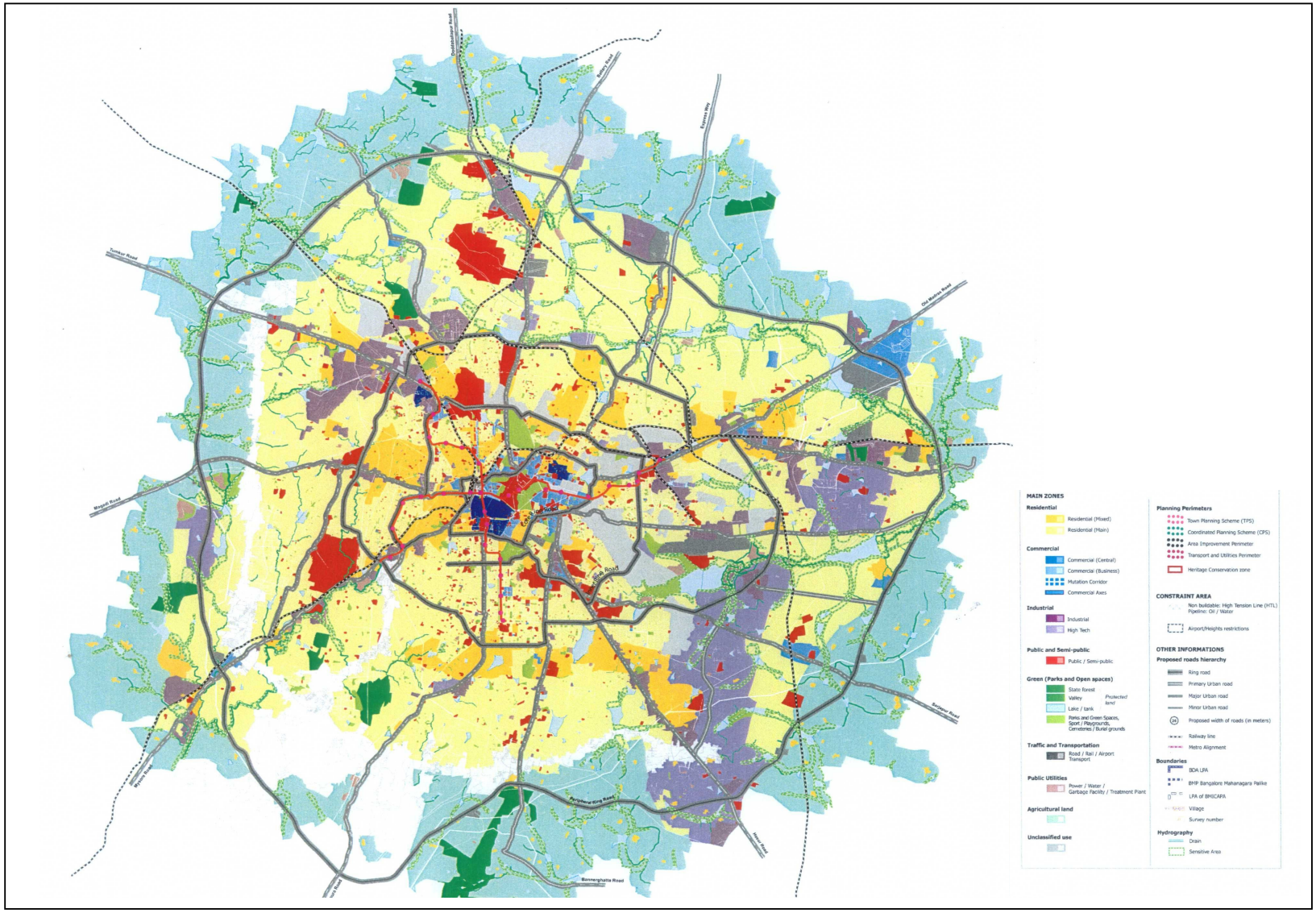


Table 1.8 Existing and Proposed Land Use for BMA

Land Use	2003		2011	
	Sq. Kms	% age distribution	Sq. Kms	% age Distribution
Residential	159.76	37.91	243.69	43.16
Commercial	12.83	3.04	16.43	2.91
Industrial	58.83	13.96	38.44	6.81
Open spaces	13.10	3.11	77.88	13.79
Public & Semi-public	46.56	11.05	49.08	8.69
Public Utilities	2.49	0.59	–	0.00
Offices and Services	4.27	1.01	–	0.00
Traffic & Transportation	88.31	20.96	116.97	20.72
Un-classified	35.26	8.37	22.14	3.92
Total	421.41	100	564.63	100
Agriculture land	649.24			
Lakes & Tanks	39.02			
Quarry	9.61			
Vacant	187.72			
Total	**1307.00**		**564.63**	

Source- Revised Master Plan-2015

Keeping the above in view, the Master Plan has proposed the following development strategy:

i. In order to reap the benefits of the potential expected to be created by Multi-Modal Transport System at the transport Hub in the centre, Highest FAR is proposed in identified Central Business Area. FAR 2.5; Ground Coverage 75% within the core area surrounded by the proposed Core Ring Road.
ii. Strengthening and extensions of employment areas along major roads and in clusters like Peenya, Bommasandra or Electronic City.
iii. Identifying new industrial areas – 3 locations in the north accessible directly from PRR and the Radial Roads.
iv. High tech zone with FAR ranging between 2 to 3.25 – vacant area between Whitefield (ITPL) and Electronic City proposed as Hi-tech zone.

e. Secondary Centres: 10 Secondary Sub Centres (administrative / education & health) to be located at places to be served by Public transport – near railway station and big rail road junction.
f. Compact City Development: Vacant areas in the City need to be occupied and spread of layouts needs to be minimised.
g. Protection of natural drainage and ground water sources.
h. Land values to be linked to market economy – built area density to be proportionate to land price and presence of transport infrastructure.
    i) Higher FAR for old bungalow and villa areas.
    ii) Review of the areas accompanied by Industries along the major Roads – Virtually extension of core area to the periphery – Mutation zones.

iii) Redevelopment of derelict industrial areas – promotion of market (actual and creation of mini zones of activities public amenities & infrastructure and social housing.

iv) Densification of low density area (< 200 ppha)

v) Encourage mixed land use in core areas – the live work mixed use reduces commuting time and mix of different activities increases economic efficiency. For these areas action imperatives defined are:

- Diversion of traffic in mixed land-use areas by introduction of "one way"
- Enforcement of new parking regulations
- Ban on entry of heavy goods vehicles in such areas
- Widening of Roads
- Removal of encroachments
- Appropriate transport system for the commuters to reduce owner vehicle usage
- Demarcation into transport and utility zones
- Maintenance of open spaces
- Improvement of Civic services

i. Development of a Structured Road Network: The emphasis being on:

- Core Ring Road
- Supplementing Outer Ring Road
- Organising transportation/Logistic facilities: Specific Areas strategically located to provide for storages facilities, garages, and heavy vehicles supported by personnel, technicians and offices as well as integrating various transport modes like road, railway and air.
- Developing Multimodal Public Transport System: consisting of rail & road based systems i.e. Metro-Rail, Mono-Rail, Circular Rail and other proven MRT systems.

j. Local Planning Area: The entire local planning area of Bengaluru has been categorised into three major areas for application of Zonal Regulations and consist of:

1. Main Areas: Comprising
   - ✓ Old Urban Areas including the Petta Zone & Traditional Area Zone
   - ✓ Urban Redevelopment Areas M.G. Road Area Zone, CBD Zone, CBD Areas, CD Precinct Zone, Transformation / Development Zone and Mutation Corridor Zone
   - ✓ Residential Areas including mixed residential area, mainly residential area, and Commercial Axis Zone
   - ✓ Industrial / Activities Areas including Industrial, High Tech and Logistics/ Transport Zone
   - ✓ Green Areas including Protected Land, Restricted Development, and Agriculture Land Zones
2. Specific Areas: Areas not covered by main areas and comprise large public and semi-public infrastructure; large transport structures, dedicated land uses, scheme areas & heritage conservation areas.

3. Constraint Areas: Areas having restrictions on type of development with its internal technical rules determining regulations within the site and around.

k. Based on the ward boundaries, existing physical features, and the analysis of the existing development trends within the City, 47 Planning Districts (PDs) have been delineated to implement the Master Plan. The planning districts are organized in three rings :

1st Ring: The Core area PDs 1.01 to 1.07
2nd Ring: The development urban areas surrounding the core are PDs 2.01to 2.18
3rd Ring: The urban extension areas in the City's outskirts PDs 3.01 to 3.22

These planning district boundaries are indicated in **Figure 1.9.**

1.8 BENGALURU MYSORE INFRASTRUCTURE CORRIDOR AREA PLANNING AUTHORITY (BMICAPA)

1.8.1 The BMICAPA Planning Area comprises of BMIC Project Area and its environs. The total area is 701.01 Sq. Kms. The BMICP comprises five self sustainable new townships viz., Corporate Township, Commercial Township, Industrial Township, Heritage Township & Eco-Tourism Township, 111 Kms of Expressway between Bengaluru & Mysore, 41 Kms of Peripheral Road connecting NH-4 and NH-7 on the southern segment of Bengaluru and about 9 Kms of Link Road connecting west of Chord Road/Mysore Road junction and "O'' point of the Expressway. It also includes interchanges at the junction of main, arterial and major roads.

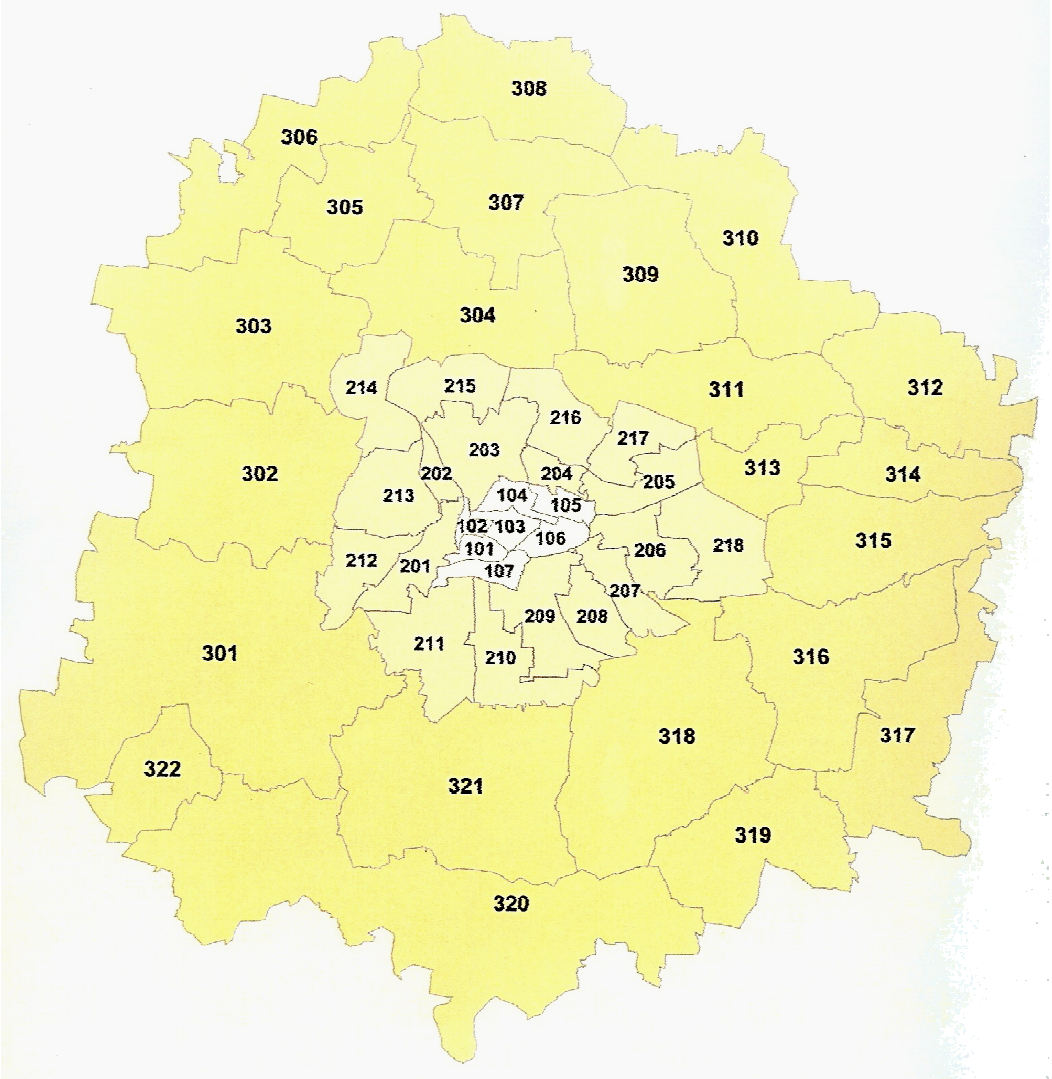
The BMICP Planning area (64 Sq. Km in BMA) within which the 41 Km of Peripheral Road connecting NH-4 and NH-7 on the southern segment of Bengaluru and the link road are located has been planned for various land uses as under:

Table 1.9 Proposed Land Use of BMICAPA in BMA

Land Use	Area (Ha.)	% age
Residential	4882	8
Commercial	2174	3
Industrial	708	1
Public & Semi-Public	415	1
Parks & Open Spaces	1052	2
Traffic & Trans.	3230	5
Sub Total	**12461**	**19**
Agriculture Land	51875	81
Total	**64336**	**100**

Assuming a normal residential density of 350 pph & overall density of 150 pph this corridor will be able to accommodate between 17 to 18 lakh of population.

Figure 1.9 Planning Districts in Bengaluru Metropolitan Area



Legend

101	Petta	210	Jayanagar	308	Bettaalasuru
102	Majestic	211	Banashankari	309	Tanisandra
103	Gandhi Nagar	212	Vijaya Nagar	310	Bagaluru
104	Vasantnagar	213	Rajaji Nagar	311	Horamavu
105	Shivaji Nagar	214	Peenya	312	Avalahalli
106	Richmond Town	215	Mathikere	313	K R Puram
107	Chamarajapet	216	Kaval Byrasandra	314	Sadara Mangala
		217	Kammanahalli	315	Whitefield
201	Kempapura Agrahara	218	C.V. Raman Nagar	316	Varthur
202	Srirampuram			317	Dommasandra
203	Malleswaram	301	Kengeri	318	Begur
204	Jayanagar	302	Herohalli	319	Electronic City
205	Baiyyappanahalli	303	Makali	320	Bannerghatta
206	Indiranagar	304	Byatarayanapura	321	Anjanapura
207	Unclassified	305	Bavalakere	322	Kumbalagodu
208	Koramangala	306	Hesarghatta		
209	Shanti Nagar	307	Yelahanka		

1.9 BENGALURU INTERNATIONAL AIRPORT AREA PLANNING AUTHROITY (BIAAPA)

1.9.1 The BIAAPA's jurisdiction comprises of towns in and around Devanahalli which includes Devanahalli, Doddaballapur and Vijayapura. BIAAPA has also been entrusted the task of developing the areas around BIA. With this in view, the towns of Devanahalli, Doddaballapur, Vijayapura and Airport Township are being developed **(Figure-1.11).** Major residential, industrial, public/semi public and commercial areas are planned in these towns. With the commissioning of BIA, the area around BIA has opened up opportunities for development of various economic activities. Different agencies of Government of Karnataka have proposed numerous developmental projects around the BIA. All these proposed developments are expected to generate as well as attract huge traffic to and from Bengaluru City.

The proposed developments around BIA is shown in **Figure – 1.10.**

Figure – 1.10 Proposed Developments around BIA

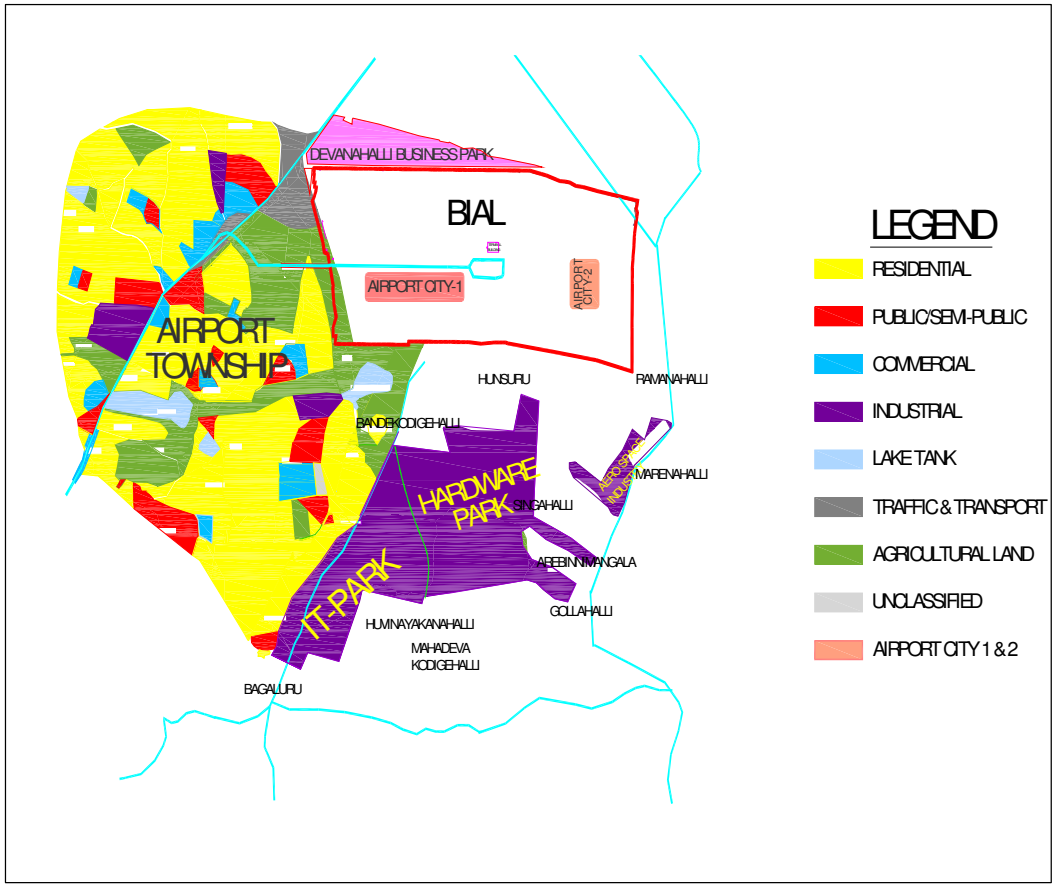
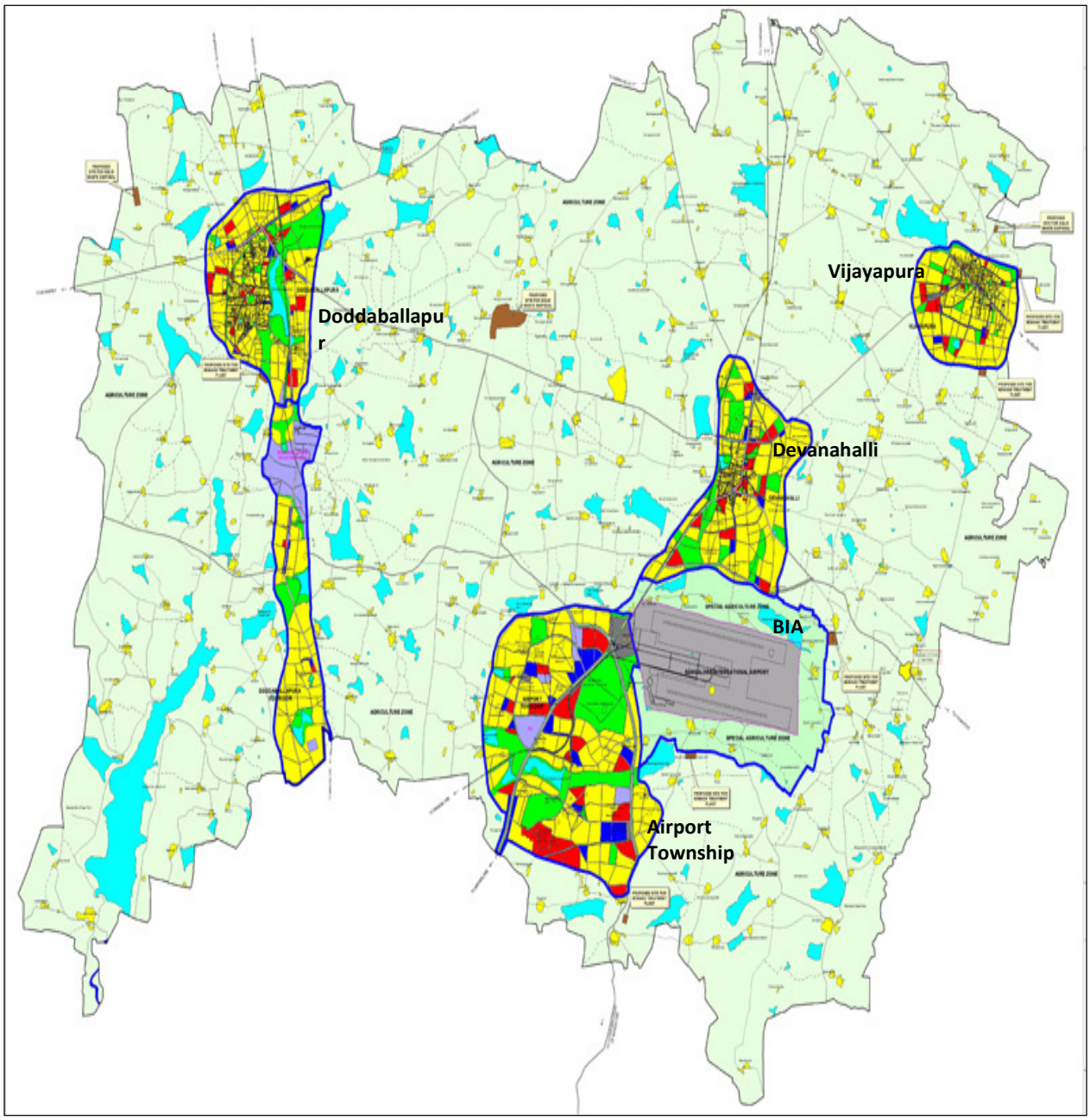


Figure 1.11 Bengaluru International Airport Area Planning Authority – Outline Development Plan 2021



1.9.2 The projected population of towns in and around Devanahalli is given in **Table -1.10** below:

Table – 1.10 Projected Population of BIAAPA Towns

Sl. No.	Town	Population (lakh)	
		2011	2021
1.	Devanahalli	1.57	3.50
2.	Doddaballapur	2.38	5.40
3.	Vijayapura	0.48	1.25
4.	Airport Township	2.05	4.90

Source: Master Plan 2021, BIAAPA

1.9.3 It is proposed to develop ***Devanahalli Business Park (DBP)*** on BOT basis. The DBP is proposed to be developed in an area of about 414 Acres. The DBP will consist of IT and ITeS park / SEZs, Central Business District, multi speciality hospitals, office complexes, commercial complexes, retail and entertainment, aviation academy and other utilities. Once the DBP is developed, about 2.5 Lakh people are expected to work or visit DBP. In addition to the above, about 83 Acres of land has been ear marked for Central Government and State Government organisations which includes Bus Depot for BMTC, Cargo handling Facility for MSIL, Mega Convention Centre for Tourism Department of Karnataka, Warehouse for Karnataka Beverages Corporation Ltd, Modern Meteorological Centre and Office Complex for Meteorological Department, Government of India, Customs House and Air Cargo Complex for Customs Department, Government of India, Trade Promotion Centre for New Mangalore Port Trust, and for Director General of Civil Aviation (DGCA), Government of India and Karnataka State Industrial Investment Development Corporation (KSIIDC).

1.9.4 It is also proposed to construct a ***Hi-tech IT park*** by Karnataka Industrial Area Development Board (KIADB) near BIA with area of about 2600 acres. This Hi-Tech park is divided into three different zones, viz., Hardware Park, IT Park and Aero Space. Location of the Hi-tech Park is shown in **Figure – 1.11** above.

1.9.5 As a part of the overall Master Plan, Bengaluru International Airport Limited (BIAL) has earmarked about 310 acres of land within the project site for the first phase of commercial real estate development. BIAL's vision is to develop this prime property called ***'Airport City'*** as a destination in itself and create a premier business, retail and entertainment hub. This area will be a well balanced mix of office parks, retail and entertainment and hospitality. These proposed developments enlisted above are expected to generate and attract large traffic to and from Bengaluru.

To meet the traffic demand generated from the proposed *Airport City*, efficient Public transport system is essential. At present, Volvo AC buses (popularly known as '***Vayu Vajra***') are plying from different localities of the City upto BIA with limited stops enroute. To meet the traffic demand likely to be generated/attracted from the proposed *Airport City*, BRT may be introduced as a short term/immediate measure. However, as a long term measure, either Metro or LRT or Monorail will have to be provided. Although GoK has plans to introduce HSRL from Cricket Stadium connecting BIA, this will serve only the passengers traveling to the BIA with only 3 stops in between. Hence, the most appropriate mass transport system would be Metro/ LRT /Monorail. The specific proposals for implementation have been dealt in Chapters-6 & 7 of this report.

1.10 EARLIER STUDIES

1.10.1 The first committee to work on a planned development of Bengaluru was Bengaluru Development Committee (BDC) constituted in 1952. Subsequently in 1961, the Bengaluru Metropolitan Planning Board was constituted for bringing out a Master Plan for Bengaluru. The BMPB prepared an outline development plan for BMPA.

1.10.2 The Town and Country Planning Act came into force from 1965 and a City Planning Authority was constituted in August 1967. A Comprehensive Development Plan (CDP) was prepared by the City Planning Authority for the year 2001 with an estimated population of 38 lakh.

1.10.3 In order to implement CDP, the Bengaluru Development Authority (BDA) came into existence in 1976 with the authority to control the land-use in the metropolitan area. The result of 1981census, however, threw over board the assumptions of CDP. As the population anticipated for 1991 was reached in 1981 itself, the CDP had to be revised drastically and the population projections were revised in view of the recent trends. A plan was prepared and approved in 1984, then revised 10 years later and approved in 1995 for a population of 45 Lakhs in 1991 and 70 Lakhs for the year 2001. This plan is merely a zoning document with rough location of the road network. This has now been updated by BDA and French Consultants using satellites imagery and digital area maps and Revised Master Plan – 2015 published.

1.10.4 However, rapid growth in population and economic activities after independence brought to the fore increasing traffic and transportation problems due to the gap between demand and supply of transport system. In order to look for solutions to the traffic problems, several studies have been conducted in the past. Some of these major traffic studies are described briefly below.

1.10.5 The first Comprehensive Traffic and Transportation Plan was prepared in 1963 – 64 by CRRI, New Delhi. The plan was based on the population, land use and area projections made in the Outline Development Plan for Bengaluru Metropolitan Region prepared by the Town Planning Department.

1.10.6 An effort to refresh the data and update the proposals was made by the Town Planning Department in 1977. One of its recommendations was to look into a Mass Rapid Transit Project i.e. a metro for Bengaluru in 1981. Based on Lynne Committee's recommendations, Southern Railway team recommended a 2- corridor metro of 24 Km, 3 commuter rail lines, and a 58 Km ring railway at a cost of Rs.6500 million in 1983 terms and to be completed over a period of 25 years.

1.10.7 In 1988 under World Bank funding, RITES Ltd was commissioned to carryout another transport study with broad coverage of roads, traffic and mass transit. The study was completed proposing various roads and traffic improvements, as also commuter rail lines but again without much follow up.

1.10.8 In 1993, Government of Karnataka established a committee to look into MRTS, which recommended the same metro project put forward by Southern Railway in 1983 and the same circular railway.

1.10.9 In 1994, the Government of Karnataka created BMRTL to seek public/private partnership of MRTS project. BMRTL commissioned a feasibility study, which pointed out to develop LRT based 96 km long MRTS network.

1.10.10 A study was carried out in 1999 proposing a large and varied road improvement program, including 45 multi-grade intersections, 25 pedestrian underpasses and various corridor improvements. In the process, grade separators were reduced to 19 with 9 to be done in the first phase.

1.10.11 In 2001, the State Government along with railways commissioned RITES Ltd. to study introduction of commuter rail facility. The report is still under active consideration of the State Government.

1.10.12 In 2003, Government of Karnataka, commissioned Delhi Metro Rail Corporation Ltd. (DMRCL), to carry out a Detailed Project Report for introduction of Metro Rail in Bengaluru. The study initially recommended 2 line metro, 18 Km and 15 Km in length, cross shaped. The lines intersect at the Bengaluru City Railway Station and KSRTC Bus Station.

1.11 NEED FOR THE COMPREHENSIVE TRAFIC AND TRANSPORTATION PLAN

1.11.1 Thus several studies have been carried out for the city to improve transportation system in Bengaluru. As short-term measures, road widening, flyovers, junction improvements were suggested and some of them have been implemented also. As long term solution, versatile and comfortable Mass Rail Transit System and commuter rail services have been recommended. However, the traffic and transportation scenario continues to be worsening. The BDA has recently got prepared a comprehensive development plan (Revised Master Plan-2015). This plan has considered the first phase of Bengaluru Metro Rail Project as well as network augmentation of Bengaluru Metropolitan Transport Corporation. It, however, does not cover the urban transportation needs of the city fully. Therefore, it was felt by the Government of Karnataka to take a stock of the prevailing situation and prepare a comprehensive traffic and transportation plan which will not only cover short term requirements but also medium and long transport system requirements upto 2025. It should also provide for proper inter-modal transport integration.

1.11.2 It is in this context that Karnataka Urban Infrastructure Development Finance Corporation (KUIDFC) has initiated this study for preparing a Comprehensive Traffic and Transportation Plan for Bengaluru and engaged RITES Ltd, a Government of India Enterprise, to carry out this study.

CHAPTER – 2
STUDY OBJECTIVES AND METHODOLOGY

2.1 STUDY GOALS

2.1.1 The present study goals include:

i) Development of transportation network to achieve convenient and cost effective accessibility to places of employment and education for the next 20 years;

ii) Optimal utilization of funds and human resources.

2.2 OBJECTIVES OF THE STUDY

i) Identify travel pattern of residents of the local planning area of Bengaluru which is co-terminus with the territorial jurisdiction of Bengaluru Development Authority (BDA);

ii) Select, develop and operationalise an Urban Transport Planning model using state of the art modeling techniques and software package, appropriate to the conditions and planning needs of the study area;

iii) Assess the relevance of the existing strategy, identify the consequences of pursuing alternative transportation strategies and recommend / update a long – term comprehensive transportation strategy for the study area up to 2025 (2015 and 2025);

iv) Identify for all modes, a phased program of appropriate and affordable investments and policy proposals; and also integration of various modes of mass transits.

v) Help strengthen transport planning skills, and transfer all data, planning model/tools and knowledge obtained through the study to KUIDFC and other agencies such as BDA, BMTC, KSRTC, South Western Railway, BMRTL, Traffic Police, etc.

vi) Strategize transport policy as an integrate part of urban planning

vii) Recommend institutional mechanism for inter agency co-ordination

viii) Assess existing infrastructure and forecast requirement – short term and long term.

2.3 SCOPE OF THE STUDY

2.3.1 In line with the specific objectives of the study described above, the scope of work is divided roughly into the following areas of activities as follows.

i) Collecting household, land use, and travel demand data

ii) Development and operation of an urban transport model

iii) Formulation of transport strategy and institutional mechanism;

iv) Identification of a phased program of transport investments and management proposals; and

v) Training and knowledge transfer to the concerned agencies

2.4 STUDY METHODOLOGY

2.4.1 The adopted study methodology to achieve the set objectives and scope is given in **Figure 2.1**. The study methodology adopted can be broadly divided in to five stages.

Stage 1:

- Finalisation of study methods
- Secondary data collection and analysis.
- Finalization of zone plans and hierarchy of zones
- Detailed sampling basis and questionnaires for Household Interviews, Business Interviews and Roadside Interviews.
- Base road and public transport network survey.
- Draw up Proposal for traffic surveys like speed-flow, parking, traffic counts, network inventory, and their analysis.
- Required computer program suites etc.

Stage 2:

The second stage was the collection of information, and review of existing transport scenario. In order to collect various travel information following surveys were conducted.

- Household Interviews
- Roadside Interview Surveys
- Public Transport Surveys
- Traffic surveys
- Road Network Inventory
- Speed and Delay Studies

The data so collected was analyzed and validated to the existing traffic scenario which forms an input to the transport models.

Stage 3:

Development of detailed operational model forms the fourth stage of the study, this included

- Development of observed trip matrices
- Calibrate and validate trip end models
- Formulation of projects necessary to fulfill the requirement of master plan using forecast models
- Calibration and validation of trip distribution – modal split model
- Validation of Assignment models and running them for different schemes / combination of facilities
- Formulation of management policies

Stage 4:

The fourth stage involved development of Transport Strategy for Bengaluru

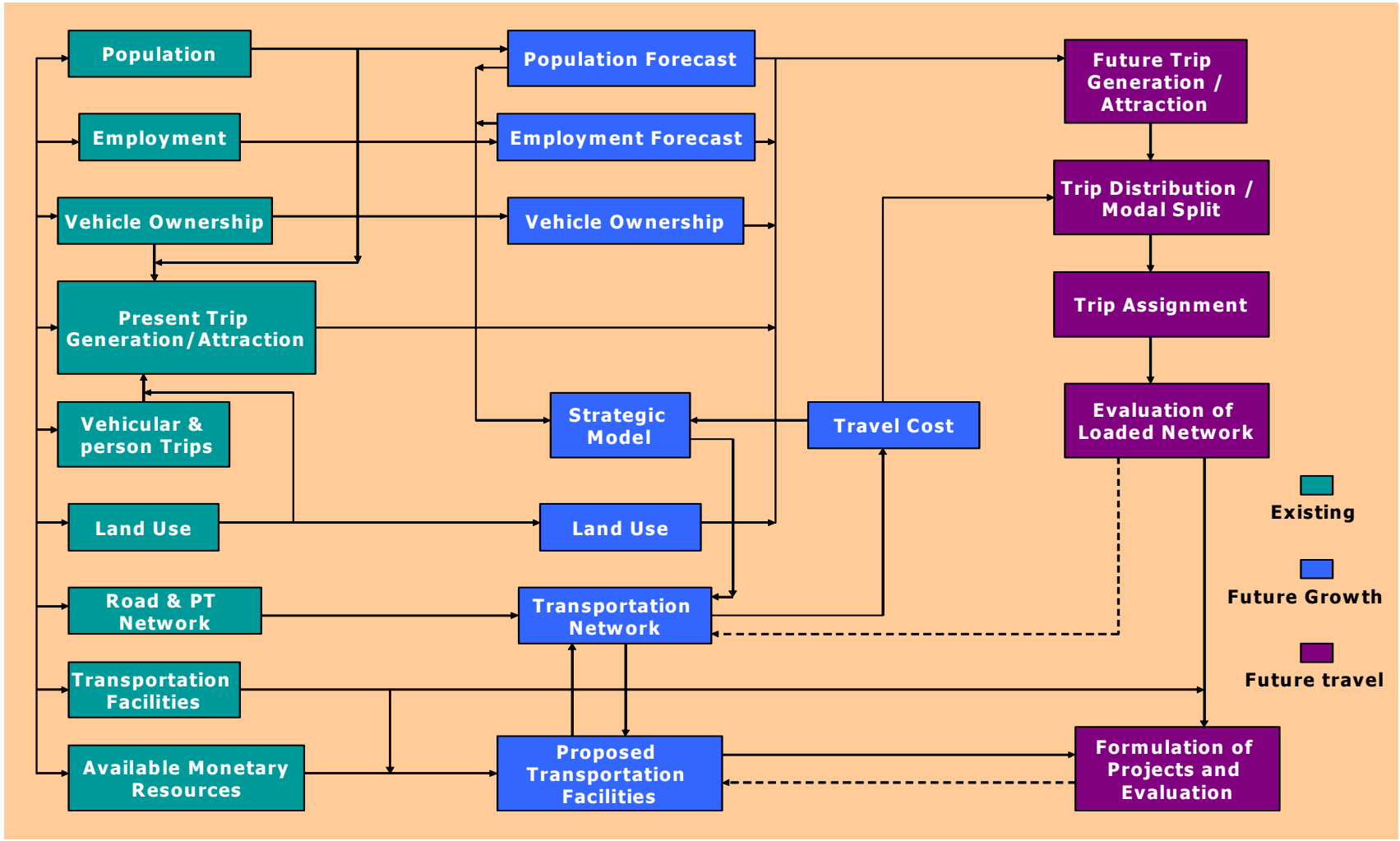
- Taking stock of current situation of Bengaluru – Urban Transport Policy, Economic growth, current initiative, land use plans both existing and proposed etc.,
- Analyzing the traffic situation in terms of present situation and constraints and future growth.
- Proposed land use based on the newly prepared Master Plan.
- Analyzing the transportation demand vis-à-vis the supply and the constraints.
- Analyzing the present institutional arrangement and future requirement.

Stage 5:

The fifth and the final stage of the study involve the following:

- Development of various strategies to address the transport requirements
- Evaluation of strategies based on selected criteria (mobility, congestion, safety, environmental and economic) and recommendation of suitable strategy
- Drawing up a Transport Plan for BMA and investment requirements
- Preparation of investment program for various schemes in operational plan,
- Carrying out a financial analysis of the proposals identified for Implementation in regard to implementing agencies with funding options
- Carrying out economic analysis for the recommended strategy to establish viability
- Recommending Organizational set up and institutional arrangement for implementation of plan.

Figure: 2.1 Methodology for Preparing Comprehensive Traffic and Transportation Plan for Bengaluru



CHAPTER – 4
DEVELOPMENT OF OPERATIONAL TRAVEL DEMAND MODEL

4.1 INTRODUCTION

4.1.1 The travel demand modeling process consists of development of formulae (or models), enabling forecast of travel demand and development of alternative strategies for handling this demand. It is not just one model, but a series of inter-linked and inter-related models of varying levels of complexity, dealing with different facets of travel demand. Through these models, the transportation study process as a whole is checked and calibrated before it is used for future travel predictions. India is one of the developing countries having heterogeneous type of vehicles on roads varying from slow moving vehicles such as cycles to fast moving two-wheelers, cars, buses, trucks etc. It is necessary to select appropriate travel demand software which can model multi modal transport system.

4.1.2 The Bengaluru travel demand model has been built using CUBE family of software. This suite is developed, marketed and supported by Citilabs, a company formed by the merger of the software division of MVA and the Urban Analysis Group (UAG). Citilabs is headquartered near Florida and its software is currently used by more than 2,000 clients in 70 countries worldwide including India. CUBE software is one of the leading transportation software packages, featuring state-of-the-art graphic capabilities with integrated GIS functionality developed in partnership with ESRI and a flow-chart style interface for developing models. CUBE has the capability to handle vehicle and passenger forecasting, micro-simulation modeling and freight modeling, all viewed through a common interface. The software can address the impact of new landuse developments as envisaged by master plan control policies. Cube is fully capable of modeling typical mixed traffic flow conditions such as private transport (car and 2wheeler) and public transport (auto rickshaw, bus and rail based mass transit systems). Cube can forecast virtually any future year scenario network including conventional metro, light rail, monorail and bus rapid transit as well as different transport management scenarios including parking fee and road pricing.

4.1.3 An integrated landuse transportation model is required to enable estimation of future travel demand which will help in identifying transport requirements. A number of sub-models are developed as follows:

a. Trip end model
b. Trip distribution model
c. Modal split model
d. Assignment model

4.1.4 The normal and easily available landuse variables at zonal levels such as population, employment and student enrolment have been made use of in transport demand analysis. The model uses the analysed data from household interview and other primary traffic surveys conducted as a part of this study and secondary data like landuse

parameter. The following input requirement of the CUBE software are being worked out keeping in view the Revised Master Plan for Bengaluru 2015:

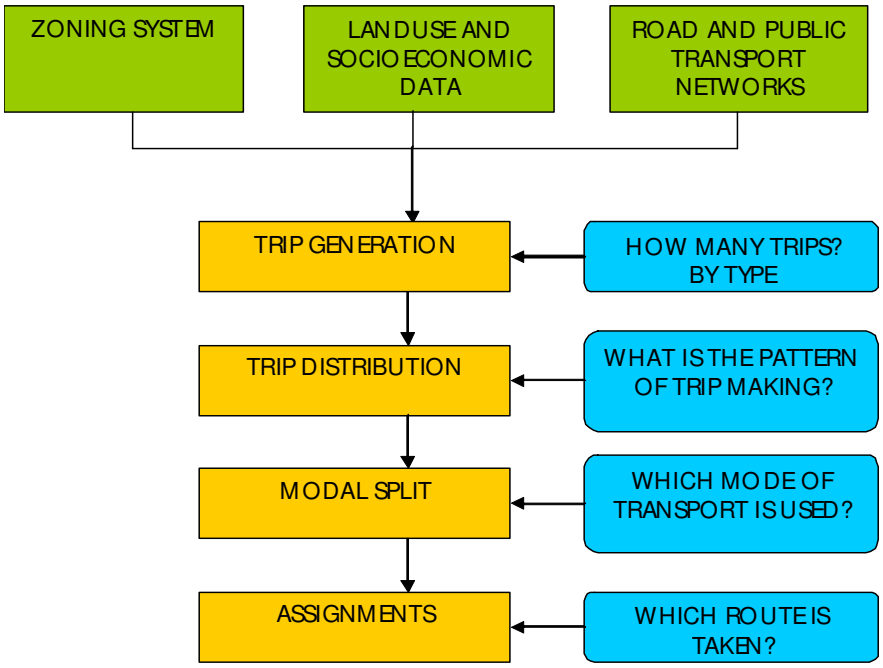
Key Model Inputs:

a. Location of developments as envisaged by master plan policies such as dense residential developments, SEZ etc.
b. Landuse Parameters by traffic zones such as Population, Employment, School Enrolment
c. Road and Public transport network
d. Travel patterns in form of origin and destination matrices by mode of travel and purpose of the trip

4.2 METHODOLOGY FOR MODEL DEVELOPMENT

4.2.1 The model developed is a traditional four-stage integrated landuse transport transportation model, as illustrated in **Figure 4.1** below.

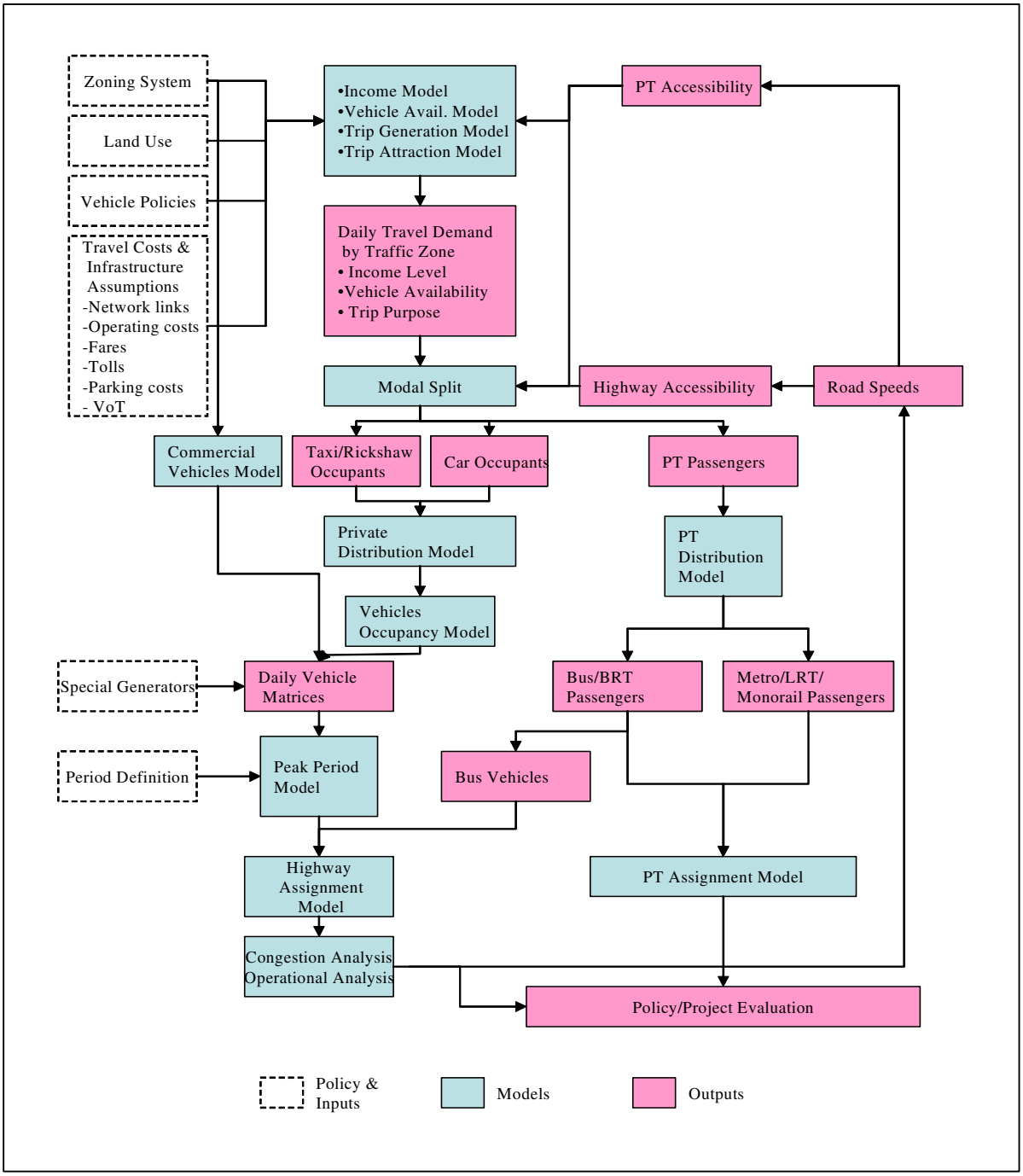
Figure 4.1: Four-Stage Integrated Landuse Transport Model Structure



4.2.2 **Figure 4.2** provides a summary of the interactions of the different part of the proposed integrated landuse transport model. The main inputs to the modelling are shown to the left of the figure in the uncoloured boxes and include the zoning system (representing the spatial disaggregation of the study area), land use data, mater plan policies and travel costs by competing modes.

4.2.3 The blue coloured boxes in the figure represent the different sub-models. The pink colored boxes are model outputs and ultimately provide information for the project evaluation that will be carried out once the model is completed. The model features a "feedback loop" in which the changes in public transport accessibility (i.e. through provision of enhanced public transport) can affect the number of trips generated in the first stage of the 4-stage process.

Figure 4.2 Methodology for Integrated Landuse Transport Model Development



4.3 MODEL INPUTS – POPULATION, EMPLOYMENT AND STUDENT ENROLLMENT

4.3.1 This model requires the base and horizon year population, employment, student enrollment and total trip distribution in study area on the basis of existing situation in 2005, proposed landuses of 2015 and 2025 for entire Bengaluru Metropolitan Area, BIAAPA area and traffic zones.

4.3.2 The concept of land use transport model is to distribute population and employment so as to minimise the total travel demand. The model is run for various combinations of horizon year, land use and transport network scenarios. The horizon year land use and trip distribution generated by the most combination is then adopted for further stages of transport planning process.

4.3.3 The basic employment is defined as the employment whose location is not dependent on residential population of an area. This employment is mainly generated by State Government employment, industries, universities; other major educational centers, corporate offices, nationalised banks, other regional and higher level institutions and wholesale trade.

4.4 MODEL STRUCTURE

4.4.1 The model developed has the following characteristics:

Motorised daily model is based on productions / attractions and internal trips of Bengaluru residents for base year 2005. These modes of travel (ie. Car+Taxi, two wheelers, auto-rickshaw, and bus) comprise 63.3 Lakh daily trips having different purposes (i.e. work, business, education and other – social/recreational).

- *The different sub-models i.e. vehicle availability, generation, attraction, distribution, modal choice and assignment models have the following characteristics:*
- *Vehicle availability model estimates the distribution of households by vehicle availability group, which has an impact on the number of trips and the chosen mode and destination;*
- *Generation and attraction models calculate trips generated and attracted by each zone, by purpose and vehicle availability group;*
- *Distribution models distribute trips generated into the possible destinations and provide all modes matrices;*
- *Modal choice models split total travel demand matrices by mode;*
- *Assignment models represent the last stage of the model, build paths, assign origin / destination (OD) matrices, and finally provide loaded networks for average hour and global AM peak hour. A standard average hour factor of 7% is applied to the daily OD matrices for hourly highway and public transport (PT) assignment.*
- *The model considers four modes i.e. Car+Taxi, Two Wheelers (2W), Auto-rickshaw (Auto) and Public Transport (PT).*
- *The model considers four purposes i.e. Home Base Work (HBW), Home Based Education (HBE), Home Based Business (HBB) and Home Based Other (HBO).*
- *Three vehicle availability groups i.e. No Vehicle available (NV), car available (Car) and 2W available (2W) have been considered.*
- *The model area covers the Bengaluru Metropolitan Area (BMA) (traffic zones 1-174) and adjoining Bengaluru International Airport Area Planning Authority (BIAAPA) area*

including the BIA at Devanahalli (traffic zones 175 – 191). The bordering areas are being treated as external zones. The model zoning system contains 201 zones, 191 internal zones (BMA & adjoining BIAAPA areas) and 10 external zones. The model development is largely based on the Households Interview after expansion from sample to total population. Travel characteristics of BIAAPA area have been assumed to be same as that of the adjoining BMA areas.

4.5 BASE YEAR HIGHWAY MATRICES DEVELOPMENT

- The next step was to build the base year highway matrices necessary to obtain costs for the model development (distribution and modal choice)

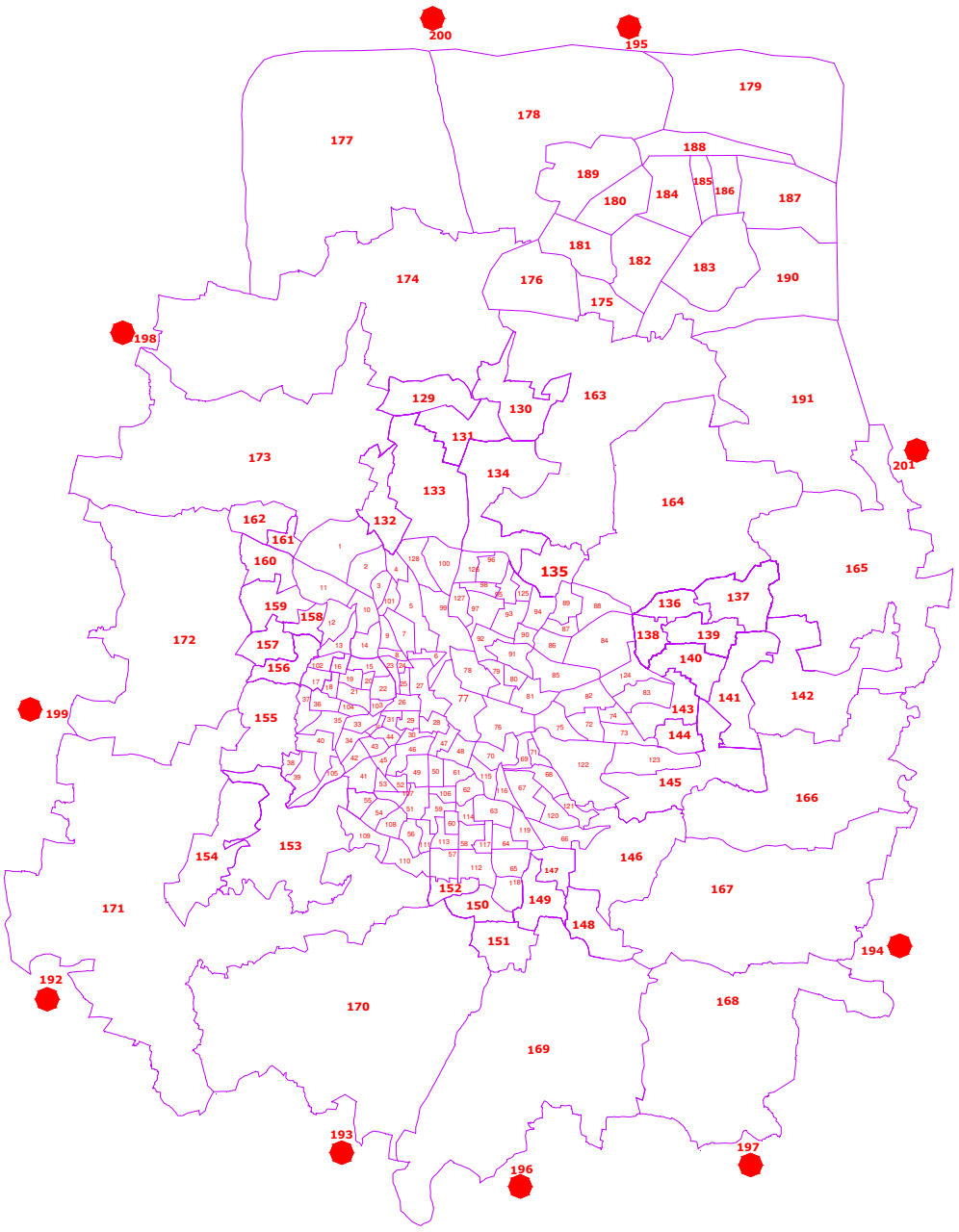
- HIS (Household Interview Survey) matrices are converted to vehicles using occupancy and PCU factors and added to external matrices to get total traffic to get the final highway matrices (car, auto, 2W).

4.6 VEHICLE AVAILABILITY, GENERATION AND ATTRACTION MODELS

4.6.1 The development and calibration of vehicle availability, generation, and attraction models, as estimated based on 2005 HIS database are as follows:

- Vehicle availability model estimates the distribution of households by vehicle availability group (No Vehicle, car available, and two wheelers available) based on the households monthly average income by zone
- Generation model calculates daily person trips generated by purpose (Home Base Work, Home Based Education, Home Based Business, and Home Based Other), and households group (segmentation by size and vehicle availability);
- Attraction model produces daily person trip attracted by purpose and vehicle availability group.

Figure 4.3 Model Zoning System



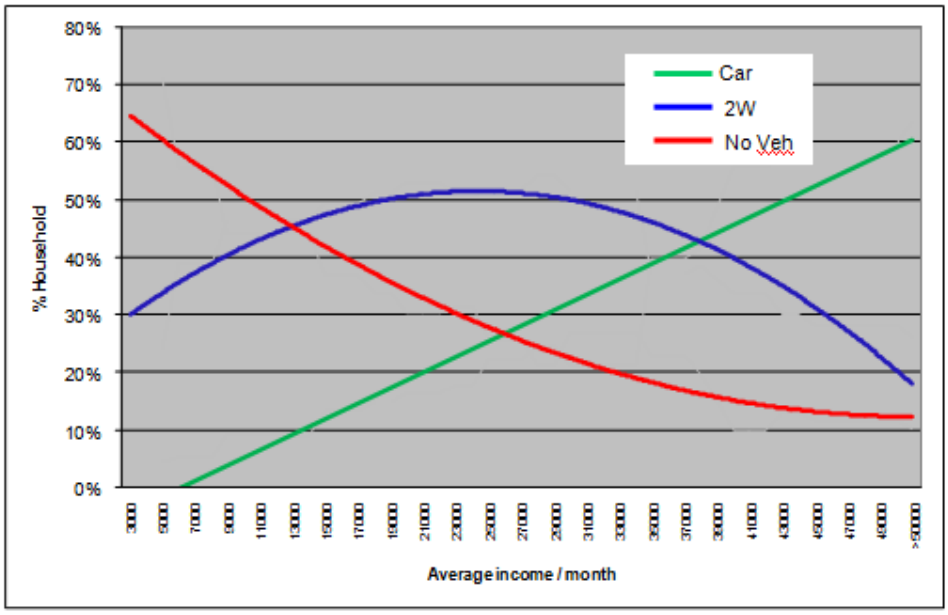
4.6.2 **Vehicle Availability Model**: **Figure 4.4** shows the estimated distribution of households by income and vehicle availability group. The trends match the existing situation. The proportion of households with no vehicle logically decreases with income increase, and conversely the part of households with car available increases when income rises. The percentage of households with two wheelers available increases up to an income of Rs.25,000 per month, then decreases, indicating that from this income point, households have more opportunity to buy a car. In terms of the model application, it should be noted that the households distributions are applied to the monthly average income, defined for each zone (total 191) from the HIS database. **Table 4.1** presents the

vehicle availability model calibration; the model household's distribution by vehicle availability is identical to the HIS data: no vehicle 41%, car available 9%, and two wheelers available 44%.

Table 4.1: Vehicle Availability Model Calibration Results

Particular	Vehicle Availability Group			Total
	No Vehicle	Car	2W	
HIS (No. of households)	7,36,647	1,83,529	7,56,229	**16,76,405**
Model (No. of households)	7,27,468	1,67,709	7,81,228	**16,76,405**
HIS (%age)	44%	11%	45%	**100%**
Model (%age)	43%	10%	47%	**100%**
Difference (%age)	-1%	-1%	2%	**0%**

Figure 4.4 Distribution of Households by Income and Vehicle Availability Group



4.6.3 **Generation Model:** Vehicle availability model results are an input to the generation model, which also requires household size distribution. Therefore, a model estimating the distribution of households (HH) by household's size (1, 2, 3, 4, 5, and 6+ members) was also developed, as shown in **Figure 4.5**. In the model application, the distribution is calculated for each individual traffic zone based on each zone average households size, this explains why for instance a percentage of households with 6+ persons (average) have some households with only three members (2% in that case).

4.6.3.1 The relationship between average household size and percentage of households with number of members is given in **Figure 4.5**. The proportion of households with one, two, or three persons decreases when the average household size increases, and on the opposite side, the percentage of households with 5 or 6+ members increase.

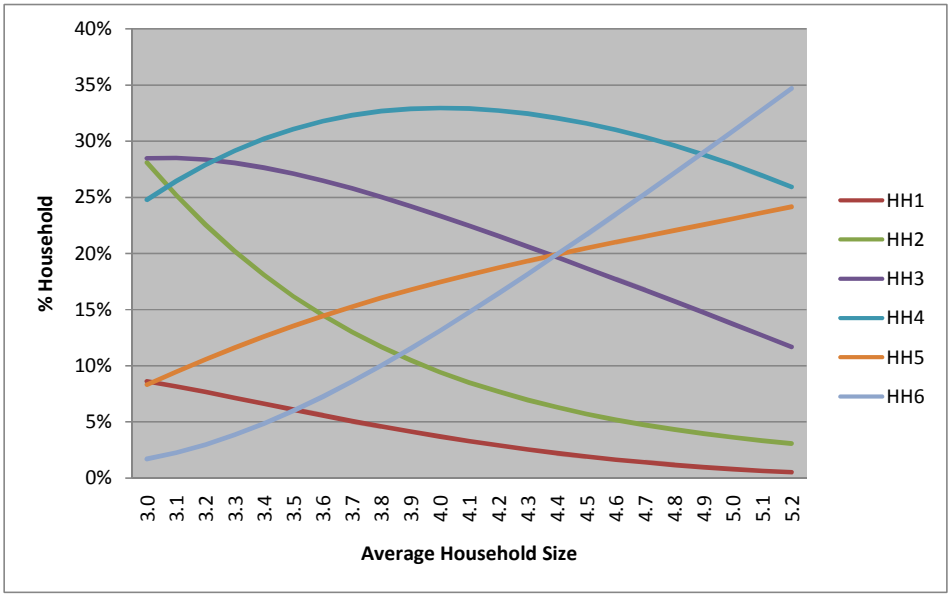
4.6.3.2 As illustrated in **Table 4.2**, model distribution is very close to the HIS one: household proportion with only 1 member 4%, 2 members 10%, 3 members 22%, 4 members 32%, 5 members 17%, and 6+ members 15%.

Table 4.2 Generation Model Calibration Results (Household Size Distribution)

(No. of Households)

HH Size	HH1	HH2	HH3	HH4	HH5	HH6+	Total
HIS	59,513	1,74,230	3,91,821	5,46,587	2,91,217	2,13,037	**16,76,405**
Model	62,882	1,67,864	3,74,601	5,29,762	2,93,211	2,48,085	**16,76,405**
HIS (%age)	4%	10%	23%	33%	17%	13%	**100%**
Model (%age)	4%	10%	22%	32%	17%	15%	**100%**
Difference (%age)	0%	0%	-1%	-1%	0%	2%	**0%**

Figure 4.5: Distribution of Households by Household Size



4.6.3.3 Vehicle availability and households size models predict the number of households per size and vehicle availability. Based on this segmentation (6 HH sizes x 3 vehicle availability group = 18 groups), daily person trip rates were extracted by purpose and are presented in **Table 4.3** (18 groups x 4 trip purposes = 72 trip rates). Figures show a trip rate increase with household size increase, and the clear impact of the motorisation: people make more trips if they are motorised (even more if they have a car rather than a two-wheelers) and also make longer trips. The generation is home based and therefore based on Productions / Attractions (PA), not Origins / Destinations. At the end of the generation models application, the segmentation by household size disappears since trips are aggregated by purpose and VA (4 x 3 = 12 groups).

Table 4.3 HIS Database Daily Person Trip Rates by Purpose, Household Size and Vehicle Availability

Purpose	HBW			HBE			HBO			HBB		
HH size / VA	NV	Car	2W	NV	Car	2W	NV	Car	2W	NV	Car	2W
1	0.85	1.39	1.25	0.09	0.02	0.12	0.16	0.75	0.10	0.01	0.14	0.02
2	1.26	2.08	1.29	0.06	0.10	0.04	0.80	1.16	0.87	0.06	0.09	0.12
3	1.62	2.44	1.51	0.28	0.70	0.39	0.83	1.32	0.81	0.11	0.21	0.18
4	1.68	2.67	1.70	0.59	1.15	0.62	0.95	1.54	0.90	0.10	0.21	0.14
5	2.02	3.03	2.09	0.63	1.30	0.72	1.01	1.73	1.01	0.13	0.29	0.17
6+	2.62	4.40	2.77	0.65	1.36	0.71	1.24	2.42	1.32	0.20	0.46	0.26

Note: external, walk, cycle, cycle rickshaw, and train trips not included.

4.6.3.4 **Table 4.4** shows the numbers of daily person trips by purpose and vehicle availability group in the HIS database.

Table 4.4 HIS database Daily Person Trips By Purpose And Vehicle Availability Group

Purpose / VA	NV	Car	2W	Total
HBW	1346840	504738	1504694	**33,56,272**
HBE	341344	169420	437280	**9,48,043**
HBO	702999	282609	768792	**17,54,401**
HBB	86205	44314	136401	**2,66,920**
Total	**24,77,388**	**10,01,081**	**28,47,167**	**63,25,635**

4.6.4 **Attraction Model:** The Generation Model produces daily person trips generated by traffic zone, whilst the attraction model estimates daily person trips attracted by traffic zone (by purpose and vehicle availability). For each of the 12 groups (4 purposes x 3 VA), a linear regression was estimated, explaining the number of trips attracted by the socio-economic data, total employment for HBW, HBB, and HBO, and school enrolment for HBE. **Figure 4.6** presents for instance the linear regression of HBW – no vehicle available group: with R-square value equal to 0.84, it shows a good match between the data from HIS and the estimated values from the linear regression (more R^2 is near to 1, more the linear regression is reliable). To be consistent with the generation model, the attraction model is based on PA.

The Attraction model calibration is summarised in **Table 4.5**, by purpose and vehicle availability. HIS and Model figures are very similar, showing a very close correspondence between modelled and observed.

Figure 4.6 Attraction Model (HBW-NV Linear Regression)

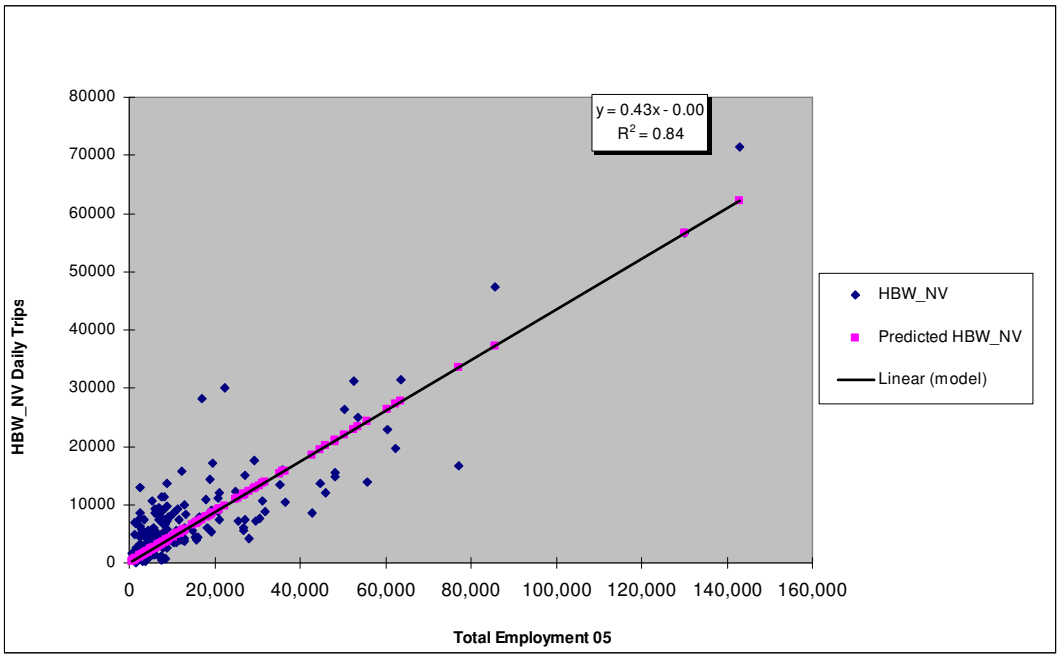


Table 4.5: Attraction Model Calibration Results (No. of person trips/day)

Group	HIS	Model	Difference
HBW_NV	1346840	1357039	0.8%
HBW_Car	504738	509028	0.8%
HBW_2W	1504694	1515630	0.7%
HBE_NV	341344	345896	1.3%
HBE_Car	169420	171648	1.3%
HBE_2W	437280	441841	1.0%
HBB_NV	86205	87204	1.1%
HBB_Car	44314	44888	1.3%
HBB_2W	136401	137402	0.7%
HBO_NV	702999	707422	0.6%
HBO_Car	282609	285002	0.8%
HBO_2W	768792	773419	0.6%
TOTAL	**6325635**	**6376420**	**0.8%**

4.7 DISTRIBUTION MODELS

4.7.1 The models were developed based on the HIS database and the Generalised Costs (GC) produced from the Highway and Public Transport cost models implemented in Cube Voyager. The main features of the models are as follows:

- **12 segments**: 4 purposes (Home Based Work, Home Based Education, Home Based Business, and Home Based Other) x 3 vehicle availability groups (No Vehicle, car available, and two wheelers available);
- **Unit** : Person (Productions / Attractions – PA);

- **Period**: Daily;
- **Model formulation**: Gravity Model, based on composite GC is presented in **Figure 4.7.**

Figure 4.7: Gravity Model Formulation

$$T_{ij} = a_i b_j P_i A_j F(C_{ij})$$

Where

T_{ij} = trips estimated from zone i to zone j

P_i = productions from zone i

A_j = attractions to zone j

a_i, b_j = row/column balancing factors

$F(C_{ij})$ = cost deterrence from zone i to zone j

$$F(C_{ij}) = C_{ij}^{X_1} \exp(X_2 C_{ij})$$

Where

$F(C_{ij})$ = cost deterrence for zone i to zone j

C_{ij} = generalised cost for zone i to zone

X_1, X_2 = coefficients to be calibrated.

- The **composite GC** is the average of the GC for individual modes weighted by modal split proportions (produced by modal split models) by Origin / Destination movements;

- For individual modes, the GC represents perceived costs, where the unit is minute equivalent, implying the use of Values of Time (VOT, 2005 prices, Rupees / hour) by mode to convert monetary costs (Fare, Vehicle Operating Cost – VOC, and Toll Charges) into minutes. Toll charges were not considered in the study area in the year 2005, but this is incorporated as a parameter in the model so as to replicate the future imposition of these charges in the study area if any. For the purpose of the study, toll has been taken as zero. Occupancy factors (OCC) are also used for Car+Taxi, 2W and Auto to obtain person based GC. Hereafter are described the GC by mode, IVT means In Vehicle Time;

  - **Car+Taxi GC** = Time + [((VOC + Toll) / OCC) / VOT] x 60;
  - **2W GC** = Time + [((VOC + Toll) / OCC) / VOT] x 60;
  - **Auto GC** = Time + 1.5 x Wait Time + [(Fare / OCC) / VOT] x 60;
  - **PT GC** = IVT + 1.5 x Walk Time + 2 x Wait Time + (Fare / VOT) x 60 + Transfer Time;

The generalised cost for all the modes consider the cost in terms of travel time, VOCs and associated comfort level of various modes e.g. waiting and transfer time for auto and PT modes. **Table 4.6** summarises the model values of VOT, VOC and OCC for use in the base year model calibration;

Table 4.6 Base Year Values of Time, Vehicle Operating Costs and Vehicle Occupancy Rates

Mode	VOT (Rs/hour)	VOC (Rs/Km)	Occupancy
Car+Taxi	89	4.40	2.59
2W	54	1.20	1.53
Auto	43	3.00	2.49
PT	26	-	-

- **Parking costs** are not used for the distribution model (Car+Taxi and 2W GC) in order to avoid counter-intuitive model behaviour in the future model application if the parking costs increase considerably (actually this increase would have more impact on the modal choice than on the distribution and therefore is considered in the modal choice module.

4.7.2 **Calibration Results**: This section provides the distribution models calibration results by market segment: X_1 and X_2 parameters, intrazonal trips, average GC (in minutes), and trip GC distribution. As illustrated by **Table 4.7** and figures in **Annexure 4A**, the overall models results are similar to the HIS database.

Table 4.7 Distribution Models Calibration Results

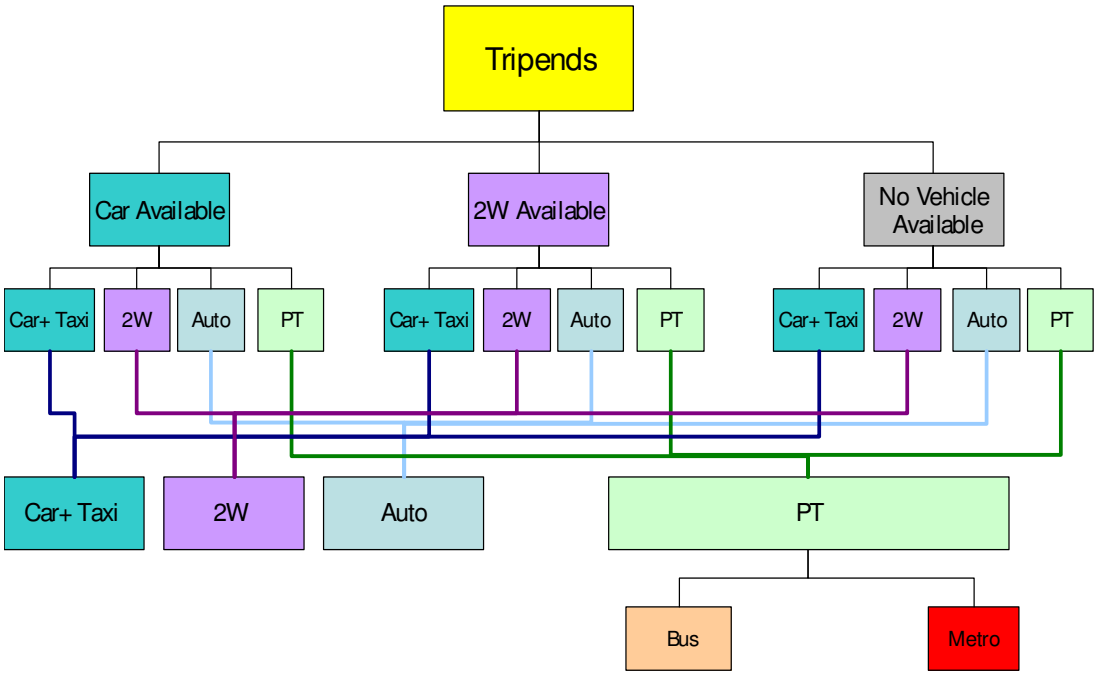
	HIS		Model				Difference	
Segments	Daily Trips	Avg GC	X1	X2	Daily Trips	Avg GC	Trips	Avg GC
HBW NV	1346850	94.1	-0.84316	-0.02398	1346850	100.5	0%	6.4%
HBW Car	504746	24.9	-1.00283	-0.02232	504746	28.6	0%	12.9%
HBW 2W	1504642	27.7	-1.23621	-0.03486	1504641	28.9	0%	4.2%
HBB NV	86195	94.2	-1.11578	-0.01350	86195	111.0	0%	15.1%
HBB Car	44308	21.5	-2.47170	0.02378	44307	25.8	0%	16.7%
HBB 2W	136385	23.3	-1.87393	-0.01319	136385	26.6	0%	12.4%
HBE NV	341326	86.4	-0.69755	-0.02773	341325	101.2	0%	14.6%
HBE Car	169407	19.3	-0.04748	-0.12299	169407	20.4	0%	5.4%
HBE 2W	437231	20.8	-1.13519	-0.07329	437231	22.4	0%	7.1%
HBO NV	702993	83.9	-0.30219	-0.03490	702993	91.5	0%	8.3%
HBO Car	282636	21.0	-1.89740	-0.03161	282635	22.2	0%	5.4%
HBO 2W	768759	21.6	-0.60915	-0.09566	768758	23.0	0%	6.1%

4.8 MODAL SPLIT MODELS

4.8.1 The models were developed based on the HIS database and the Generalised Costs (GC) produced from the highway and Public Transport cost models implemented in Cube Voyager.

4.8.2 **Figure 4.8** illustrates the modal split models structure: trips are split into the four modes (Car+Taxi, 2W, Auto, and PT) by vehicle availability group (Car, 2W, and NV), then added by mode, PT trips being separated between bus and metro services during the assignment stage. It should be noted that the PT matrix produced by the modal split models contains trips using school, chartered, and public buses, but only the last two categories are retained for the PT assignment, the other two groups (school and chartered buses) not using the public network. However, these are taken into account in the highway assignment.

Figure 4.8: Modal Split Model Structure



4.8.3 The main features of the modal split models are as follows:

- **12 segments:** 4 purposes (Home Base Work, Home Based Education, Home Based Business, and Home Based Other) x 3 vehicle availability groups (No Vehicle, car available, and two wheelers available);
- **4 modes**: Car+Taxi, Two wheelers, autorickshaw, and PT;
- **Unit:** person (Productions / Attractions – PA);
- **Period:** Daily;
- **Model formulation**: combined split, multi-logit formulas (equations provided in **Figure 4.9**, where P means Probability and C is the Generalised Cost);

Figure 4.9: Multi-Logit Formulae (Combined Split)

$$P_{Car+taxi} = \frac{e^{(-\lambda C_{Car+taxi})}}{e^{(-\lambda C_{Car+taxi})} + e^{(-\lambda C_{2W})} + e^{(-\lambda C_{Auto})} + e^{(-\lambda C_{PT})}}$$

$$P_{2W} = \frac{e^{(-\lambda C_{2W})}}{e^{(-\lambda C_{Car+taxi})} + e^{(-\lambda C_{2W})} + e^{(-\lambda C_{Auto})} + e^{(-\lambda C_{PT})}}$$

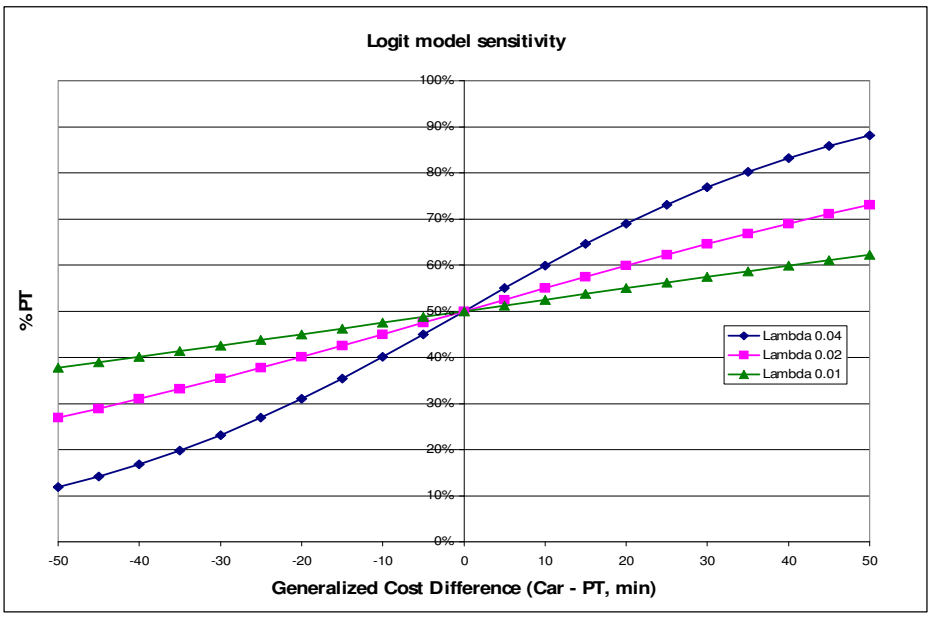
$$P_{Auto} = \frac{e^{(-\lambda C_{Auto})}}{e^{(-\lambda C_{Car+taxi})} + e^{(-\lambda C_{2W})} + e^{(-\lambda C_{Auto})} + e^{(-\lambda C_{PT})}}$$

$$P_{PT} = \frac{e^{(-\lambda C_{PT})}}{e^{(-\lambda C_{Car+taxi})} + e^{(-\lambda C_{2W})} + e^{(-\lambda C_{Auto})} + e^{(-\lambda C_{PT})}}$$

- **Logit parameters estimation:** the mode choice sensitivity revealed by the model is mainly determined by the parameterλ. This model parameter was developed based

on statistical regression analysis, which also provided some initial estimates on the mode biases. As shown by **Figure 4.10** for illustrative purpose only (example with two modes, car and PT), when λ increases, the model becomes more responsive to the difference in cost.

Figure 4.10: Logit Model Sensitivity



- The GC represents perceived costs, where the unit is minute equivalent, implying the use of Values of Time (VOT, Rupees / hour) by mode to convert monetary costs (fare, Vehicle Operating Cost – VOC, parking cost at destination, and toll) into minutes. Occupancy factors (OCC) are also used for Car+Taxi, 2W, and Auto to obtain person based GC. Below are described the GC by mode, IVT means In Vehicle Time:

  - **Car+Taxi GC** = Time + [((VOC + Toll + Parking Cost) / OCC) / VOT] x 60;
  - **2W GC** = Time + [((VOC + Toll + Parking Cost) / OCC) / VOT] x 60;
  - **Auto GC** = Time + 1.5 x Wait Time (4) + [(Fare / OCC) / VOT] x 60;
  - **PT GC** = IVT + 1.5 x Walk Time + 2 x Wait Time + (Fare / VOT) x 60 + Transfer Time.

4.8.4 Calibration Results: Tables 4.8, 4.9 and **4.10** demonstrate that there is close correspondence between the synthesised and observed values from the HIS. Some specific comments can be made:

- In theory, for any multi-logit model with four possible choices, there are a maximum of three bias factors available;
- The Lambda parameters trends are sensible, lower for car and higher for NV, meaning less sensitivity to cost for car.

Table 4.8 Calibrated Modal Choice Models Parameters

Segments	Lambda	Bias mode 1	Bias mode 2	Bias mode 3
HBW-NV	-0.008741	0.1630	0.1693	-0.5809
HBW-Car	-0.001107	0.8475	-1.0222	-0.6722
HBW-2W	-0.001001	-1.4256	-1.4354	-1.0109
HBE-NV	-0.019270	0.6813	0.6175	-0.0095
HBE-Car	-0.004949	0.9209	0.7873	0.7366
HBE-2W	-0.001891	0.8673	0.8412	0.5527
HBB-NV	-0.048537	-0.4106	-0.3348	-0.0662
HBB-Car	-0.022885	0.9182	-0.9870	-0.6417
HBB-2W	-0.003314	-1.8066	-1.1945	-1.0382
HBO-NV	-0.006025	2.1653	0.2985	0.1798
HBO-Car	-0.003072	0.7893	0.6357	0.9862
HBO-2W	-0.003737	0.2715	0.6260	0.6132

Table 4.9 Modal Split Models Calibration Results

HIS												
VA	NV				CAR				2W			
Purpose/ Mode	Car+ Taxi	2W	Auto	PT	Car+ Taxi	2W	Auto	PT	Car+ Taxi	2W	Auto	PT
HBW	21543	87982	77424	1159892	158553	228244	10312	107629	23818	1002112	28416	450348
HBE	17880	9933	24010	289521	27544	53896	15332	72647	38146	107371	45251	246513
HBB	1110	6372	9336	69387	17228	17832	2367	6887	2062	94524	8328	31488
HBO	4451	10624	122876	565048	88749	35280	67111	91470	7789	138661	211121	411222
MODEL												
HBW	25700	64554	71790	1194994	162983	227987	10645	107414	24813	1013955	27776	449086
HBE	18316	10155	30084	287342	29833	58653	16892	66270	39562	115187	46900	240192
HBB	1721	8796	8750	67936	18440	18595	2392	5462	2185	97461	8533	29223
HBO	5028	12097	147253	543043	91978	36366	68816	87842	8576	143719	222098	399026

Table 4.10 Modal Split Models Calibration Results – Overall

Modes	Daily Person Trips	
	HIS	Model
Car+Taxi	408872	429135
2W	1792828	1807525
Auto	621883	661929
PT	3502052	3477830
Total	**6325635**	**6376419**

4.9 MODEL VALIDATION

4.9.1 Introduction

4.9.1.1 This section describes the model validation results, which is the last step in the model development. Distribution and Modal split model validation is done for daily model whereas assignment model validation is done for AM Peak Hour. All the models built are linked together through the output files and therefore the model validation only uses

synthetic data, all produced by the model itself.

4.9.1.2 The model validation has no impact on the vehicle availability, generation, and attraction models results, therefore they are the same as the ones presented earlier.

4.9.1.3 The model validation actually consists of a slight adjustment of the model calibration data to match the observed figures. For distribution and modal choice, some biases were added to the costs. For the PT assignment, transfer time was adjusted to 7.5 minutes (apart for transfer from / to metro, 1.5 minutes), in order to replicate observed data.

4.9.1.4 These calibration adjustments will remain as part of the model for future years and scenario application. It should also be noted that the model validation results come from an iterative run of the model in order to ensure the convergence of the results and the consistency with the model runs for future years.

4.9.2 Distribution Models: **Table 4.11** and the figures in **Annexure 4B** illustrate the distribution models validation results by segment: X_1 and X_2 parameters, and trip distribution. Models results are generally close to the HIS database.

Table 4.11 Distribution Models Validation Results

	HIS	Model			Difference
Segments	Daily Trips	X1	X2	Trips	Trips
HBW NV	1346850	-0.8432	-0.0240	1357039	0.8%
HBW Car	504746	-1.0028	-0.0223	509028	0.8%
HBW 2W	1504642	-1.2362	-0.0349	1515630	0.7%
HBB NV	86195	-1.1158	-0.0135	87203	1.2%
HBB Car	44308	-2.4717	0.0238	44888	1.3%
HBB 2W	136385	-1.8739	-0.0132	137402	0.7%
HBE NV	341326	-0.6975	-0.0277	345896	1.3%
HBE Car	169407	-0.0475	-0.1230	171648	1.3%
HBE 2W	437231	-1.1352	-0.0733	441841	1.0%
HBO NV	702993	-0.3022	-0.0349	707422	0.6%
HBO Car	282636	-1.8974	-0.0316	285002	0.8%
HBO 2W	768759	-0.6091	-0.0957	773419	0.6%

4.9.3 Modal Split Models: This section provides the modal split models validation results, based on a slight update of the costs compared to the model calibration. Similar to the distribution models, modal split percentages from the models are very close to the HIS database as shown in **Table 4.12 and Table 4.13.**

Table 4.12 Modal Split Models Validation Results

HIS												
VA	**NV**				**CAR**				**2W**			
Purpose / Mode	**Car+ Taxi**	**2W**	**Auto**	**PT**	**Car+ Taxi**	**2W**	**Auto**	**PT**	**Car+ Taxi**	**2W**	**Auto**	**PT**
HBW	2%	7%	6%	86%	31%	45%	2%	21%	2%	67%	2%	30%
HBE	5%	3%	7%	85%	16%	32%	9%	43%	9%	25%	10%	56%
HBB	1%	7%	11%	80%	39%	40%	5%	16%	2%	69%	6%	23%
HBO	1%	2%	17%	80%	31%	12%	24%	32%	1%	18%	27%	53%
MODEL												
HBW	2%	5%	5%	88%	32%	45%	2%	21%	2%	67%	2%	30%
HBE	5%	3%	9%	83%	17%	34%	10%	39%	9%	26%	11%	54%
HBB	2%	10%	10%	78%	41%	41%	5%	12%	2%	71%	6%	21%
HBO	1%	2%	21%	77%	32%	13%	24%	31%	1%	19%	29%	52%
DIFFERENCE												
HBW	0%	-2%	0%	2%	1%	0%	0%	0%	0%	0%	0%	0%
HBE	0%	0%	2%	-2%	1%	2%	1%	-4%	0%	2%	0%	-2%
HBB	1%	3%	-1%	-3%	2%	1%	0%	-3%	0%	2%	0%	-2%
HBO	0%	0%	3%	-4%	1%	0%	0%	-2%	0%	1%	1%	-2%

Table 4.13 Modal Split Models Validation Results – Overall

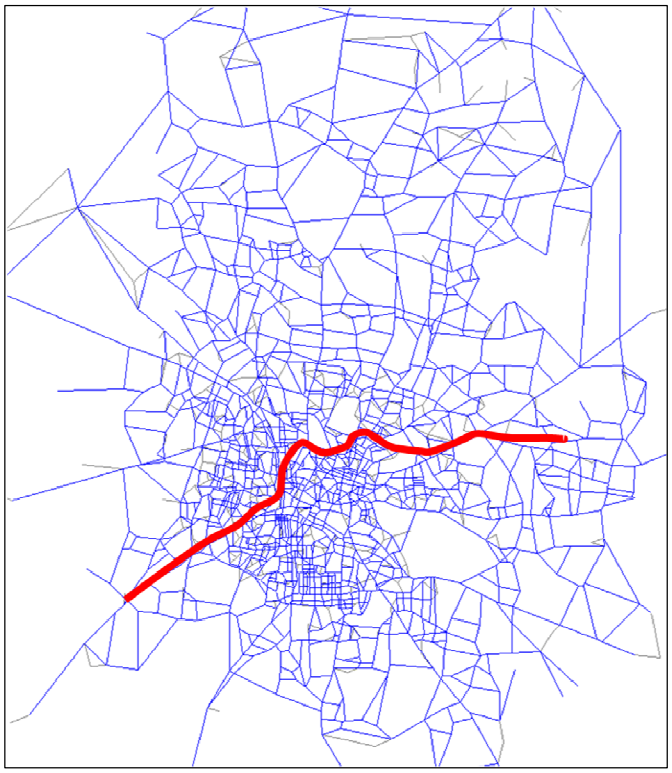
Modes	HIS	Model	Difference
Car+Taxi	6.5%	6.7%	0.3%
2W	28.3%	28.3%	0.0%
Auto	9.8%	10.4%	0.5%
PT	55.4%	54.5%	-0.8%
Total	100.0%	100.0%	0.0%

4.9.4 **Assignment Models**: This section deals with the morning peak assignment model validation process. The highway assignment is a multiple user classes assignment using equilibrium algorithm and capacity constraint. The output of the assignment is a loaded highway network with volumes by link and vehicle type. Validation was assessed on the basis of comparison of observed passenger trips at the screenline against corresponding model forecasts. East-West Railway line within the study area is considered as the screen line as shown in the **Figure 4.11**. The total modelled figures across the screenline are within 17% of the observed counts for the peak hour as shown below in the **Table 4.14**.

Table 4.14 Comparison of Observed and Assigned Peak Passenger Trips

Sno.	Direction	Observed	Assigned	% Difference
1	North to South	82216	67163	18.3%
2	South to North	67547	57616	14.7%
	Total	**149764**	**124779**	**16.7%**

Figure 4.11 Screenline Location in Study Area



4.10 ECONOMIC EVALUATION PARAMETERS

4.10.1 General

The mass transit systems have structural impact on the urban environment and quality of life. This necessitates that investments in these systems are appraised taking into account the structural impacts. Therefore, economic evaluation needs to be undertaken. The implementation of mass transit systems will result in reduction of number of vehicles on roads and increase in the journey speed of road-based vehicles. This is expected to generate substantial benefits to the economy as a whole in terms of reduction in fuel consumption, vehicle operating costs, and passenger time. In addition, there will be reduction in accidents and atmospheric pollution. Other benefits include reduction in noise, increase in mobility levels, improvement in quality of life and general economic growth.

4.10.2 Approach and Methodology

Economic analysis for Mass Transit systems has been carried out within the framework of "with" and "without" the project. The "without the project" situation assesses the cost to the economy in case the projected volume of traffic continues to move with the prevailing modes of transport. The "with the project" situation estimates the total costs that the economy would have to bear for introducing the mass Transit systems. The cost under the above two situations has been evaluated in terms of market prices and then in economic terms, deriving the latter from the former by converting market prices into appropriate shadow prices. This has been done to iron out distortions due to externalities and anomalies arising in real world pricing systems.

4.10.3 Cost and Benefit Analysis

The impact of the proposed projects on the economy has been worked out keeping the following constituents of cost and benefit streams:

4.10.3.1 Cost streams

a. Capital cost of infrastructure and rolling stock
b. Operating cost of the mass transit system and
c. Capital and operating cost of residual vehicles that would continue to move on road even after the introduction of mass transit system.

4.10.3.2 Benefit streams

The introduction of mass transit systems will yield tangible and non-tangible savings due to equivalent reduction in road traffic and certain socio-economic benefits. These include savings in road construction and maintenance, vehicle operating costs, travel time and other socio-economic benefits of travel time, better accessibility, better comfort and quality of life, increase in mobility etc.

Quantification of some of the social benefits has not been attempted because universally acceptable norms do not exist to facilitate such an exercise. However, it has been considered appropriate to highlight the same, as given below:

- Reduced road stress
- Better accessibility to facilities in the influence area
- Economic stimulation in the micro region of the infrastructure
- Increased business opportunities
- Overall increased mobility
- Facilitating better planning and up-gradation of influence area
- Improving the image of the city
- Benefits due to structuring effects as discussed above
- Real estate price increase, thereby increasing overall wealth held by the public.

4.10.3.3 Benefits taken into account

The benefits finally taken into account for this analysis include:

a. Capital and operating cost (on present congestion norms) of carrying the total volume of passenger traffic by existing bus system and private vehicles in case mass transit system project is not taken up.
b. Savings due to decongestion in vehicle operating cost of all buses and other vehicles including those that would continue to use the existing transport network even after the mass transit system is introduced.
c. Savings in time of commuters using the Mass Transit System over the existing transport modes because of faster speeds of mass transit system and because of reduced congestion on roads.
d. Savings in time of those passengers continuing on existing modes, because of reduced congestion on roads.
e. Savings on account of prevention of accidents and pollution, with introduction of mass transit system and

f. Savings in fuel consumption on account of less number of vehicles on road and decongestion effect with introduction of mass transit system are included in those of vehicle operating cost.

4.10.3.4 **Economic Evaluation**

The cost and benefit streams for 30-year period in the economic prices have been worked out for the Mass Transit System. The total cost worked out on the above basis is then subtracted from the total benefits to estimate the net benefit of the project. This flow is then subjected to the process of discounting to work out the Internal Rate of Return (IRR) on the projects to examine the viability of the project in economic terms.

4.11 CONCLUSION

4.11.1 The model validation results presented, show that the model accurately replicates the existing travel situation in the study area (base year 2005) since the model figures are close to the observed data from HIS database. Therefore, the next step following the model development, calibration, and validation, is to provide multi-modal travel demand forecasts for the future years.

4.11.2 The forecast year assignment model will produce traffic and passenger flows on the future network. Key outputs such as changing in overall trip making, modal share and growth across strategic points compared to the existing situation will be closely monitored to ensure consistency and reliability.

CHAPTER – 5
STRATEGY FOR LONG TERM TRANSPORT DEVELOPMENT

5.1 NATIONAL URBAN TRANSPORT POLICY

5.1.1 The Government of India has evolved a policy to overcome the problem of poor mobility which dampens the economic growth and deterioration in the quality of life. The approach is to deal with this rapidly growing problem as also it can offer a clear direction and a framework for future action. The vision of this policy is:

- To recognize that people occupy center-stage in our cities and all plans would be for their common benefit and well being
- To make our cities the most livable in the world and enable them to become the "engines of economic growth" that power India's development in the 21st century
- To allow our cities to evolve into an urban form that is best suited for the unique geography of their locations and is best placed to support the main social and economic activities that take place in the city.

5.1.2 The objective of this policy is to ensure safe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and such other needs within our cities. This is sought to be achieved by:

- Incorporating urban transportation as an important parameter at the urban planning stage rather than being a consequential requirement
- Encouraging integrated land use and transport planning in all cities so that travel distances are minimized and access to livelihoods, education, and other social needs, especially for the marginal segments of the urban population is improved
- Improving access of business to markets and the various factors of production
- Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus
- Encourage greater use of public transport and non- motorized modes by offering Central financial assistance for this purpose
- Enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes
- Establishing effective regulatory and enforcement mechanisms that allow a level playing field for all operators of transport services and enhanced safety for the transport system users
- Establishing institutional mechanisms for enhanced coordination in the planning and management of transport systems
- Introducing Intelligent Transport Systems for traffic management
- Addressing concerns of road safety and trauma response
- Reducing pollution levels through changes in traveling practices, better enforcement, stricter norms, technological improvements, etc.
- Building capacity (institutional and manpower) to plan for sustainable urban transport and establishing knowledge management system that would service the needs of all urban transport professionals, such as planners, researchers, teachers, students, etc

- Promoting the use of cleaner technologies
- Raising finances, through innovative mechanisms that tap land as a resource, for investments in urban transport infrastructure
- Associating the private sector in activities where their strengths can be beneficially tapped
- Taking up pilot projects that demonstrate the potential of possible best practices in sustainable urban transport

5.2 GROUND REALITIES VS URBAN TRANSPORT POLICY

i) The urban planners do consider the transportation as an important parameter, but the growth of the city has been so fast that the inadequacy sets in too fast to enable any possible review and taking remedial measure.

ii) It is very much essential to carry out integrated land use transportation planning. It is proposed to test impact of densifying measures around MRTS stations. But such measures will require major policy change and practicability and implications of same will need to be studied.

iii) Transport planning in the last two decades in BMA has been oriented towards developing a mix of public transport but funds have been a constraint. Despite same, 43 km of metro lines have been taken up and the bus transport has been providing more and more services, which is indicated by the fleet growth and increased passenger trips.

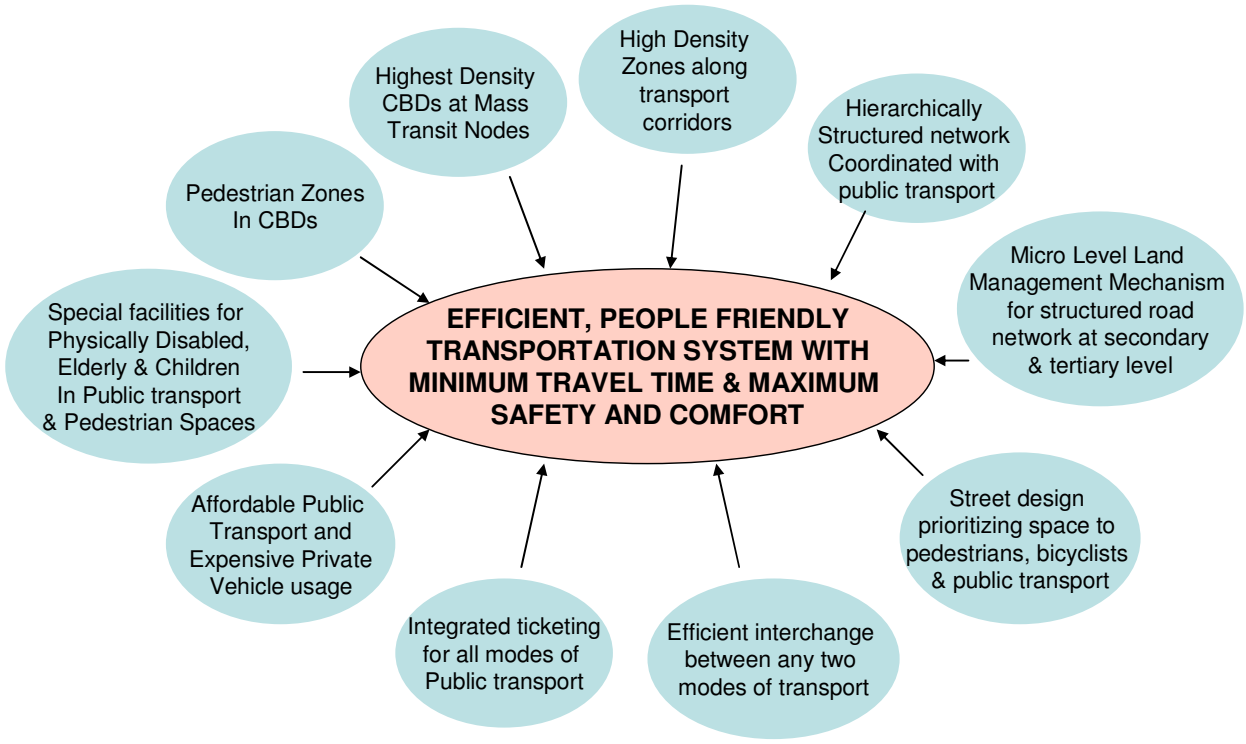
iv) Share of walk and cycle trips in Bengaluru have been comparatively low in Bengaluru even earlier. Non motorized trips share has been going down. Apart from non availability of cycle tracks on roads, increased trip lengths for almost all purposes may have caused this fall.

v) The current policy has been more road oriented. The fast growing economy and higher per capita income has resulted in high vehicle ownership and usage. The roads in the core area getting congested and land cost mechanism has encouraged more of peripheral growth, increasing urban sprawl. This has resulted in longer trip lengths for all purposes.

5.3 VISION

5.3.1 With this background, it is desirable to have a vision be developed before considering different alternative strategies. A vision by definition is 'a vivid image produced by imagination'. A Transport Planner's vision for the city and metropolitan area is to see 'a well contained city with efficient people-friendly transport system with minimum travel time & maximum safety and comfort'. At the same time the facility provided should be optimally used. The different actions which have to contribute to this vision are diagrammatically represented in **Figure 5.1**.

Figure 5.1 Vision for Transportation and Associated Actions



The diagram above paraphrases what we would like to see when we look at Bengaluru ten years from now. In order to achieve this, an integrated land use- transport strategy is called for. Preparation of such a step is diagrammatically indicated in **Figure 5.2** below.

Figure 5.2 Integrated Landuse Transport Strategy for Bengaluru

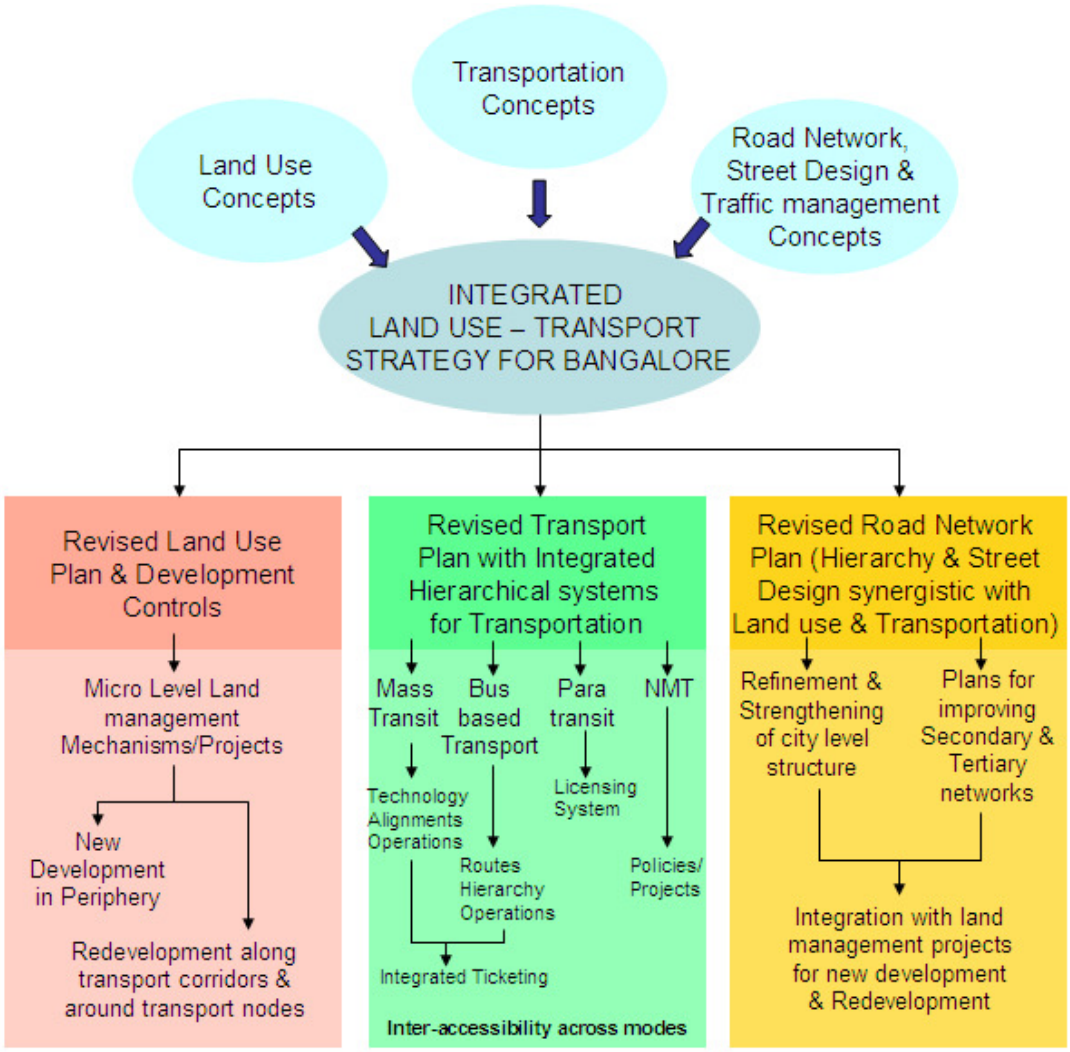


Diagram source: Balachandran and Sowmya Haran

5.3.2 **Road Map (Strategies):** Considering the status of progress in various fronts that have already been initiated in Bengaluru, the road to an integrated urban transportation strategy is fraught with difficulties. The process is bound to be messy and will appear costly in terms of time, money and effort to be invested in such an exercise. However, the COST OF NOT DOING THE INTEGRATION is far higher than that of doing it and the resultant situation, if the integration is not done, will be far more messy than the process of doing it. Therefore the following initiatives are recommended.

5.3.2.1 **Integrated land use – transport strategy:** A team consisting of both urban planners and transportation planners and preferably led by an urban planner with a holistic understanding of urban transport issues should put together an integrated land use – transport strategy for Bengaluru. This strategy should incorporate modern concepts in land use planning, urban transportation planning road network planning and street design in a mutually complementary manner. Such an approach necessarily means that

the team should review the city's Master Plan as well as plans relating to mass transport and road network improvements.

5.3.2.2 **Institutional Strengthening of Urban Transport:** At present, there are many agencies involved in various components of urban transport. However, there is little co-ordination amongst them. Thus there is need for creation of a unified metropolitan transport authority. Although Directorate of Urban Land Transport (DULT)/ Bengaluru Metropolitan Land Transport Authority (BMLTA) have been created to look after the subject of Urban Transport, these organizations need to be strengthened with adequate technical manpower. Data collected by various agencies should be made available to a unified agency so that a coordinated and integrated transport system can be developed. Existing Institutions also need to be strengthened with adequate technical staff who can deal with urban transport matters. Integrated land use transport strategy as explained above will have no statutory backing as such. Therefore if this strategy is to be taken seriously then it should be mandated by an overarching body which has sway over all the stakeholder organizations. No such body exists as of today. Such a body should also carry out the task of land use planning for preparation and operationalization of this strategy.

5.3.2.3 **Revised Land Use Plan and Development Controls**: The land use and density component of the above strategy can be operationalized only through revisions in the Master Plan. High traffic generating activities and high density (high FSI) zones should be realigned around citywide mass transport nodes and along major transportation corridors.

Such a reorganization of land use and density cannot be realized only through the modifications in the Master plan. In already developed areas, this needs to be translated into projects for planned redevelopment, ensuring that the high density and high intensity of activities are supported by appropriating land for improvements in the road network, street design and supporting infrastructure. The energy for redevelopment already exists in the real estate market in Bengaluru, and will receive further impetus from the implementation of mass transport projects.

In new growth areas, a mechanism for micro-level planning (such as Town Planning Schemes in Gujarat) will need to be introduced to ensure that all new development is adequately served by primary, tertiary and secondary road network with provision for public transport facilities. These would also essentially have to be translated into land management projects.

5.3.2.4 Road network and street design: Having articulated the approach to road network planning and street design in the Strategy document, the primary road network proposals in the Master Plan should be modified appropriately. In many places, particularly in the already developed areas, these modifications can be realized only through carefully structured redevelopment projects as the missing links in the primary road network will have to go through existing development.

In the case of the secondary and tertiary level roads, as explained in the previous section, the improvements in developed areas, in many cases, will have to be achieved through planned redevelopment. In the new growth areas these have to be part of proactive land management initiatives.

Street design has to be standardized according to the hierarchical level and function of a street and customized according to local conditions. On all BRTS roads, the street design of extremely high importance. In the areas surrounding a mass transport node also, street design has to enable easy access of pedestrians, bicyclists and para transit passengers to the mass transport facility.

5.4 OBSERVATIONS

5.4.1 The important observations are as following, which will now guide the strategy for development.

1. The City though claimed to be compact in the basic premise, is actually quite wide spread – The development area of more then 800 sq km, to accommodate around 1 Crore persons by 2015/20 as per Master Plan 2015. Thus, a multi-modal system with a fairly large coverage will be required.

2. Pockets of economic activities like Hi-Tech & Electronic city having very large employment potential are planned. Of course a large part of the human resources to be engaged in these activities is expected to come from with in BMA but quite a large no. is also to the expected from the Bengaluru Metropolitan Region & even from towns like Hosur, Tumkur, etc. This will require special High capacity mass transport system connecting these work centres with the living areas within Bengaluru as well as meeting the needs of the long distance / suburban commuters, especially along the corridors leading to these centers.

3. The present radial network is bringing the entire load of traffic to the ORR & core areas causing congestion. The trend needs to be stopped through :

    - Dispersal of traffic at the periphery by completing the PRR, & the other Ring Roads planned at the Regional level like the Intermediate Ring Road & Satellite Town Ring Road.
    - Creating Transport Hubs for goods traffic and the junctions of PRR & selected Radials
    - Banning the entry of Heavy vehicles at the Transport hubs & allowing only LCV to transport the goods from the Transport Hubs to the inner city areas and that too during the non-peak hours (i.e. No Entry between 9 A.M. to 9 P.M.)

4. The Master Plan 2015 proposal of having Mutation Zones along practically all the radial corridors would require some sort of mass transport system along them.

5. The core areas inside the core ring road are proposed to be fully traversed by the Metro. Therefore the vehicular movement inside this area should be minimized & if possible completely avoided during working hours for 9am to 9pm through:

   - Complete pedestrianisation of narrow commercial streets.
   - Providing adequate parking along the CRR and running dedicated BRT on the lower level of the CRR and restricting all private vehicles on the elevated portion thereof.
   - Smooth & free flow of emergency vehicles like Ambulance, Fire Engines etc in side the core area.
   - The goods feeder services like LCV be allowed to come in only doing 9PM to 9AM to unload materials etc.
   - Attempts may be made to decentralize certain trades requiring bulk carriage like heavy machinery, hardware, building material etc in organized markets beyond the ORR and preferably near the PRR.
   - On a few of the wide roads inside the core area the feasibility of running BRT etc. may be examined.

5.5 PREFERRED STRATEGY FOR TRANSPORT DEVELOPMENT

5.5.1 Based on the above observations it is clear that the already planned network will be insufficient to cope up with the future requirements especially after the target year of 2015. As such in order to prepare the Comprehensive Transport Plan, the following policy measures are required to be taken based on which the CTTP will be finalized.

1. Extension of mass transport system to provide wide coverage and interchange facilities with other modes of transport.
2. Provide substantially large network of medium level mass transport system such as BRT to cover the areas beyond the Metro network and on over loaded corridors.
3. Landuse adjustments and densification of corridors along mass transport corridors where possible.
4. Extension of commuter rail system upto the BMRDA's New Townships & beyond upto Tumkur, Hosur etc. to act as sub-urban services.
5. Introducing BRT and wherever possible dedicated bus lanes
6. Rationalisation of Local Bus system and its augmentation.
7. Improvement in traffic management through TSM measures.
8. Special facilities for pedestrians within the entire network specially in the core areas; pedestrianisation of selected shopping streets in side the core area going to be served by Underground sections of Metro. Provision of pedestrian sky walks, under passes, footpaths and other road furniture along the roads where necessary.
9. Diverting through traffic on Peripheral Ring Road. Providing transport hubs for Interstate passenger and freight traffic near the junctions of Peripheral Ring Road with important radials such as; the National Highways and other heavily loaded roads.
10. Improving Primary, Arterial and other important roads by providing grade separation, junction improvements, adding missing links, widening and other road side facilities wherever necessary. The arterial roads outside the PRR need to be

improved upto the New BMRDA townships in order to take the increased load of commuters.

11. Transport integration of various modes.
12. Strengthening of existing institutions dealing with various aspects of urban transport and formation of a unified transport authority for inter-agency co-ordination

CHAPTER – 6

FUTURE TRANSPORT DEMAND ANALYSIS AND SYSTEM SELECTION

6.1 FUTURE GROWTH SCENARIO

6.1.1 Revised Master Plan-2015 for the BMA has been published. This document gives the likely growth to take place in various areas of the BMA. The plan also gives locations of various land uses such as residential, commercial, industrial, IT uses etc. The study area of BMA and adjoining BIAAPA is estimated to have population of about 71 lakh in 2005 and 123 lakh by 2025. The employment in this area, which was 26.7 lakh in 2005 is expected to grow to 50.5 lakh in 2025. Similarly, student enrolment is expected to grow from 16.5 lakh to 26.6 lakh in 2025. Traffic zone wise distribution of population, employment and student enrolment in 2005, 2015 and 2025 are given in **Annexures 6A, 6B** and **6C** respectively.

6.1.2 The proposed growth of population and economy is expected to generate high travel demand. An integrated landuse transportation model has been built to enable estimation of future travel demand. The development of travel demand model has been discussed in detail in Chapter 4. As per travel demand modeling exercise, daily travel demand is expected to grow from 68 lakh person trips in year 2005 to 120 lakh in year 2025. The present chapter examines some transport scenarios to meet the travel demand and recommends the best scenario.

6.2 ASSUMPTIONS FOR TRANSPORT DEMAND FORECASTING

6.2.1 The following assumptions have been made for forecasting transport demand for 2025:

(i) Calibrated and validated travel demand models as explained in Chapter 4 have been used.

(ii) Land use distribution (population, employment and student enrolment) in 2025 in various traffic zones as detailed above.

(iii) Additional roads as planned or under construction in Bengaluru are taken as available.

(iv) Fare levels of various public transport systems such as metro and buses and vehicle operating costs of different vehicles have been taken as same as in the year 2005.

(v) The growth of intercity passenger traffic depends on the development of adjoining areas. Inter-city passengerof adjoining areas to/from Bengaluru are expected to grow at a higher rate of 3.5 % upto the year 2015. On later stages, the development will be saturated and it is assumed that the growth rate will slow down to 2.5% per annum upto the year 2025.

(vi) Inter-city goods traffic will grow at 6% per annum up to 2025.

(vii) Intra-city goods traffic will grow at 3% per annum up to 2025.

6.3 BUSINESS AS USUAL SCENARIO

6.3.1 In this scenario, entire traffic will move on the road network system by buses and other vehicles, as it is moving now. Total number of daily person trips are expected to be 120 lakh in 2025 including inter-city trips. Daily intra-cty person trips are expected to be about 111 lakh in 2025. The modal split in favour of public transport in this scenario is

expected to fall from present 54.5% to 49.7% in 2025 as given in **Table 6.1.** Desireline diagrams for bus person trips and other vehicles for this scenario are given in **Figures 6.1 and 6.2** respectively. The traffic assignment in 2025 on road network in this scenario for bus person trips and other vehicles are given in **Figures 6.3 and 6.4 respectively.** These figures show that many roads will be overloaded beyond their capacity. Thus high capacity public transport system on many corridors will need to be provided in Bengaluru.

Table 6.1 Expected Modal Split for Intra-city Person Trips –Business as Usual

Sl. No.	Mode	Scenario			
		Base Scenario – 2005		BAU – 2025	
		Daily Trips	Modal Share (%age)	Daily Trips	Modal Share (%age)
1	Car	429137	6.7	778159	7.0
2	Two Wheeler	1807526	28.4	3363559	30.3
3	Auto	661930	10.4	1449958	13.0
4	Bus	3477830	54.5	5515380	49.7
	Total	**6376422**	**100.0**	**11107056**	**100.0**

6.4 SCENARIO WITH PHASE I OF BENGALURU METRO UNDER CONSTRUCTION

6.4.1 Road network of 2025 along with 42.9 Km of metro network of Phase I (two corridors of Hessaghatta to Puttenahalli Cross and Mysore Road Terminal to Baiyyappanahalli under consideration now) will be available. Daily metro ridership in this scenario is expected to be about 12.4 lakh by 2025. The modal split (%age of trips by public transport to total motorized trips) in favour of public transport in 2025 is expected to be 54% which will be even less than 2005 level of 54.5% as given in **Table 6.2**. It indicates that public transport system will cater to less number of daily trips in this scenario and in order to increase the share of public transport, more public transport network will be required.

Table 6.2
Expected Modal Split for Intra-city Person Trips –
With Phase-I of Metro under Construction

Sl. No.	Mode	Base Scenario – 2005		2025	
		Daily Trips	Modal Share (%age)	Daily Trips	Modal Share (%age)
1	Car	429137	6.7	708381	6.4
2	Two Wheeler	1807526	28.4	3206533	28.9
3	Auto	661930	10.4	1200846	10.8
4	Bus/Metro	3477830	54.5	5991296	53.9
	Total	**6376422**	**100.0**	**11107056**	**100.0**

Figure – 6.1

Desire line Diagram for PT Passengers on Road Network in 2025 in BAU Scenario

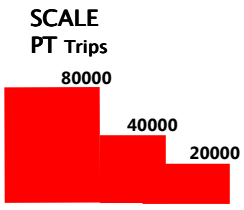


Figure 6.2

Desire line Diagram for other than PT Modes on Road Network in 2025 in BAU Scenario

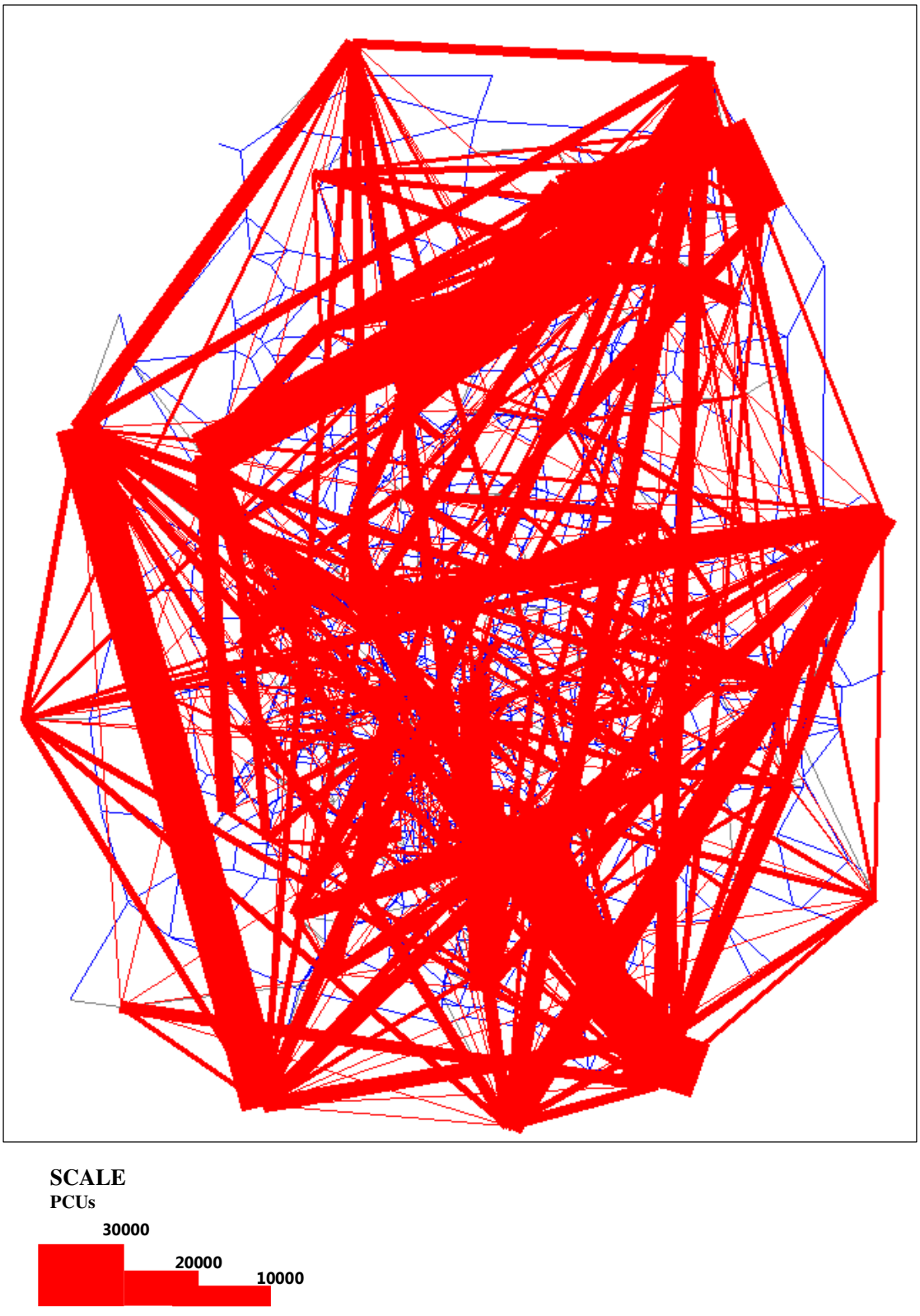


Figure 6.3

Expected Peak Hour PT Passengers on Road Network in BAU 2025 Scenario

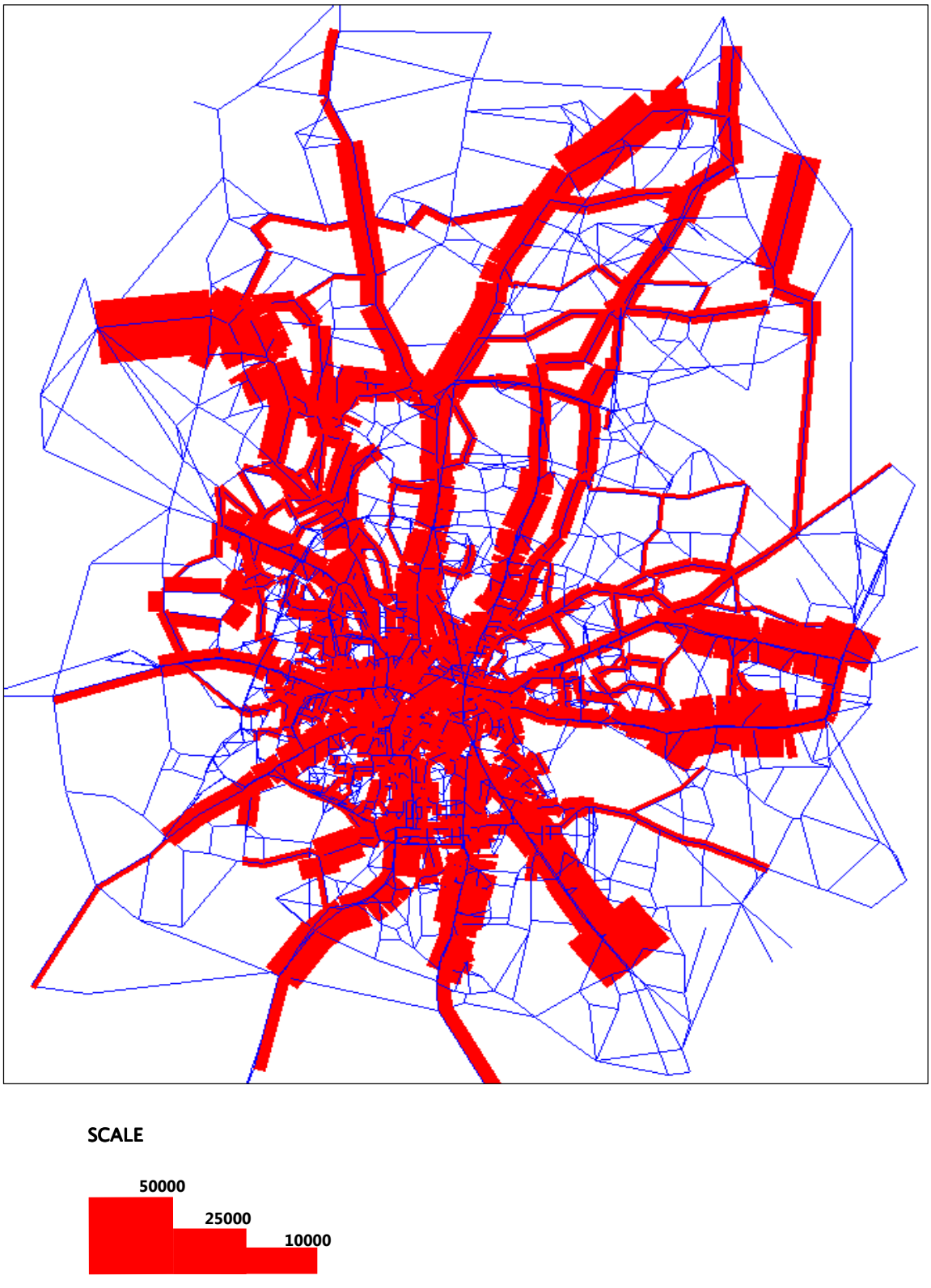


Figure 6.4

Expected Peak Hour Traffic Volumes (other than PT) in PCUs on Road Network in BAU 2025 Scenario

However, in this scenario some sections in the metro corridor of Hesaraghatta to Puttenahalli Cross will be overloaded by 2025. This scenario also shows that many roads as given below will also still be overloaded.

1. Outer Ring Road
2. Core Ring Road
3. Hosur Road
4. Bannerghatta Road
5. Magadi Road
6. NH7 – Bellary Road
7. Old Airport Road
8. Sarjapur Road
9. Kanakapura Road
10. Mysore Road

Thus additional high capacity public transport corridors in many areas will be required.

6.5 DEVELOPMENT OF ALTERNATIVE PUBLIC TRANSPORT NETWORKS

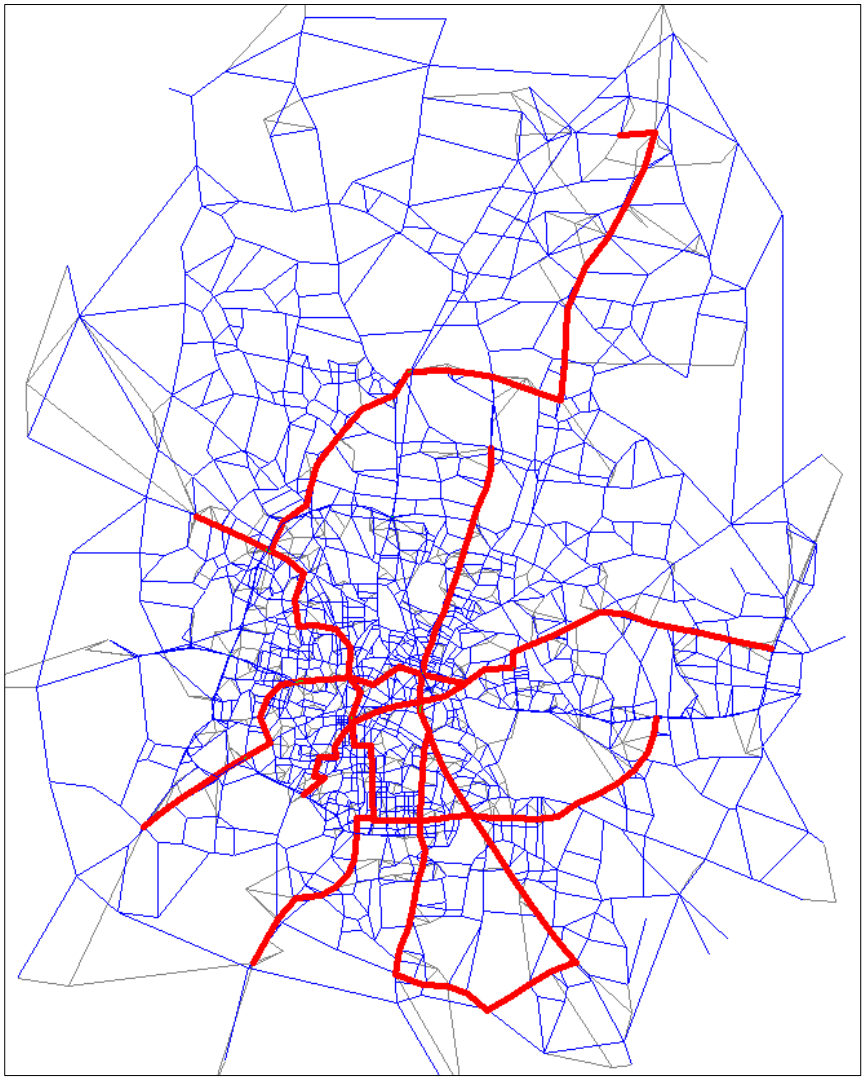
6.5.1 Considering the expected traffic to be generated in 2025, a number of alternative public transport networks were attempted to meet the future transport demand requirement. Four different alternatives have been examined for the public transport corridors in the study area which are described below:

6.5.1.1 **Alternative 1** – A total of 7 corridors with a total length of 192-km are considered in the first alternative (refer **Figure 6.5**). The proposed road network of the year 2025 has been considered. The public transport corridors as considered are given as under:

1. PRR – Puttenahalli Cross – Hesarghatta Junction – BIEC
2. Whitefield – Baiyyappanahalli – Mysore Road Terminal – Kengeri
3. Electronic City to Jigani to Koramangala (Hosur Road – BG Road Junction) – Nagavara
4. Hosur Road (PRR) to Koramangala (Hosur Road – BG Road Junction)
5. Trinity Circle (MG Road) to National College to Kathriguppe Junction
6. RV Road Terminal to Marathahalli
7. Yeshwantpur to BIA

Figure 6.5

Development of Alternative Public Transport Network Alternative-1

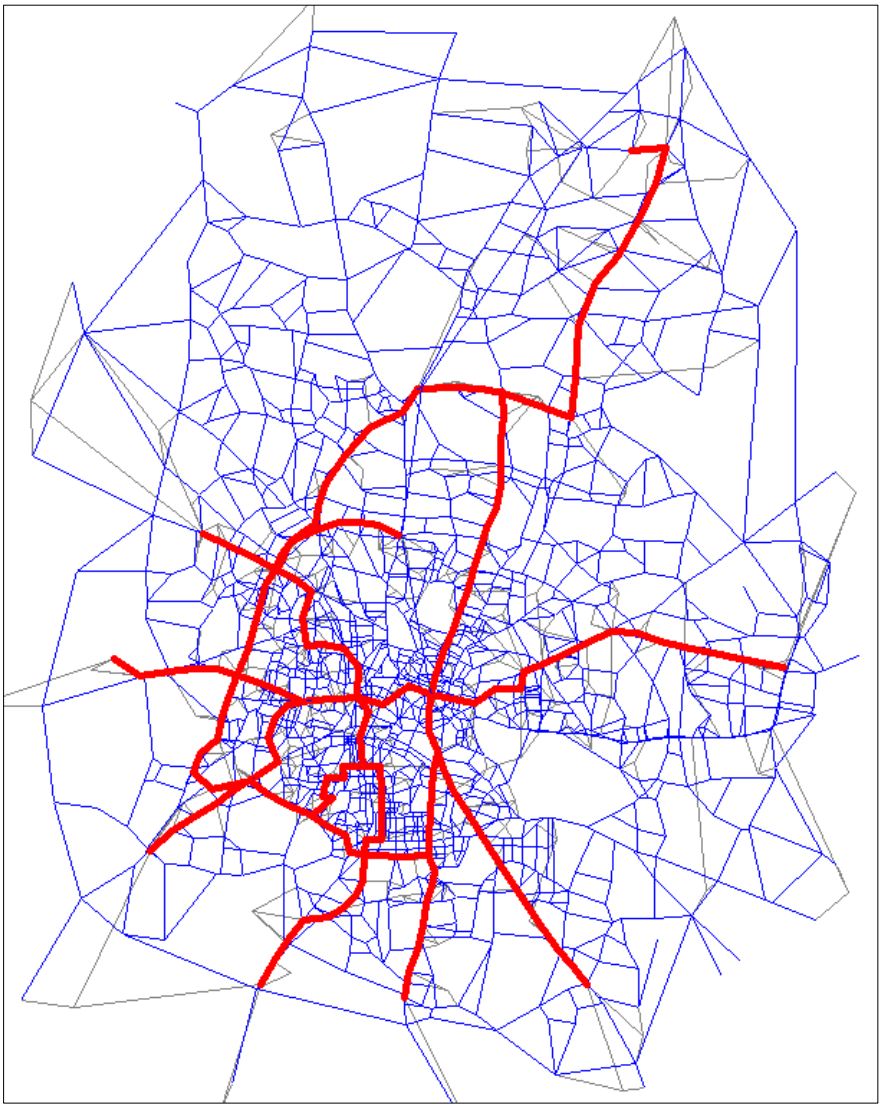


6.5.1.2 **Alternative 2 –** A total of 8 corridors are considered to be taken in the second alternative (refer **Figure 6.6**). Second alternative has a total length of 201-km. The corridors considered are as listed below:

1. PRR – Puttenahalli Cross- Hesarghatta line – BIEC
2. Whitefield – Baiyyappanahalli – Mysore Road terminal – Kengeri
3. Electronic City to Nagavara to Srinivasapur
4. Yeshwantpur to BIA
5. Hebbal-Yeswantpur-JP Nagar (along Western ORR)
6. Toll Gate to PRR along Magadi Road
7. National College to Katriguppe Junction
8. Hosur Road-BG Road Junction to PRR

Figure 6.6

Development of Alternative Public Transport Network Alternative-2

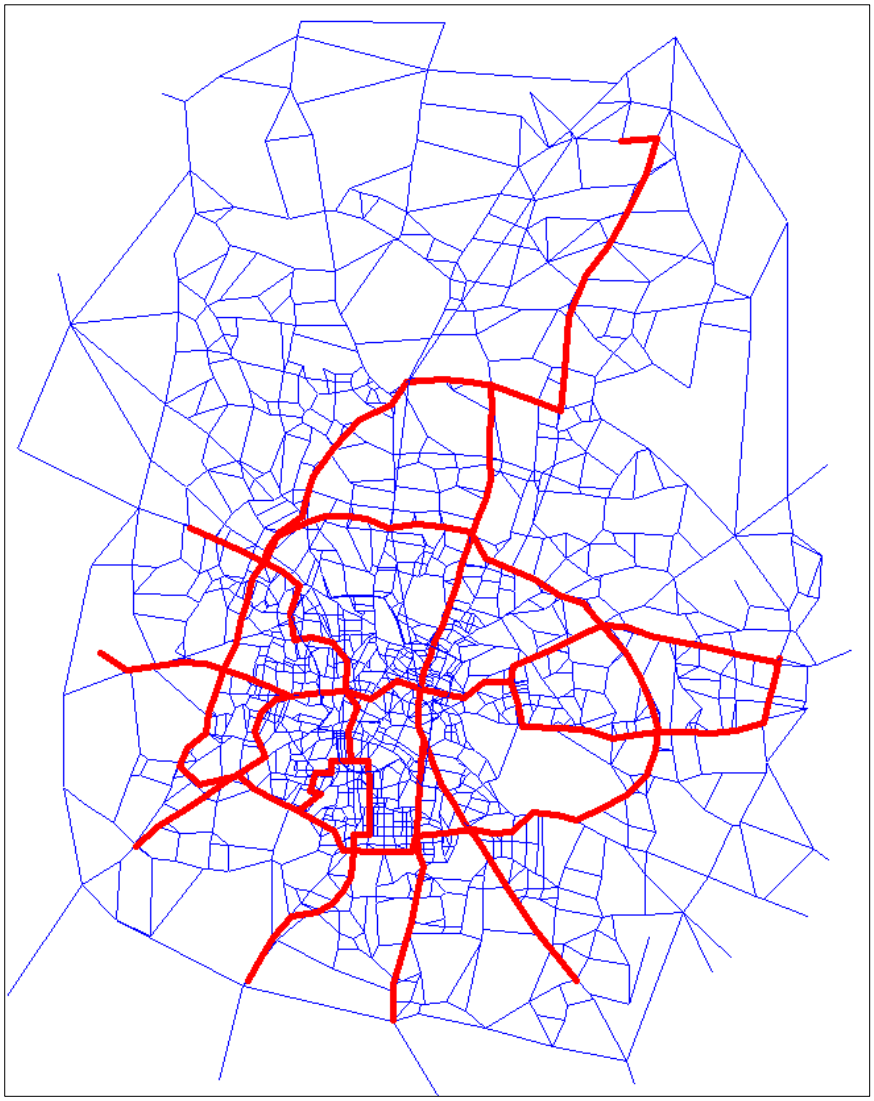


6.5.1.3 **Alternative 3** – In this alternative 9 corridors are considered to be taken (refer **Figure 6.7**). Third alternative has a total length of about 250 km. The public transport corridors as considered are given as under:

1. PRR – Puttenahalli Cross– Hesarghatta – BIEC
2. Whitefield – Baiyyappanahalli – Mysore Road terminal – Kengeri
3. Electronic City to Nagavara to Srinivasapur
4. Yeshwantpur to BIA
5. Hebbal–Yeswantpur–JP Nagar–Hebbal (along ORR)
6. Toll Gate to PRR along Magadi Road
7. National College to Kathriguppe Junction
8. Hosur Road–BG Road Junction to PRR along Banner Ghatta Road
9. Indira Nagar to White Field

Figure 6.7

Development of Alternative Public Transport Network Alternative-3

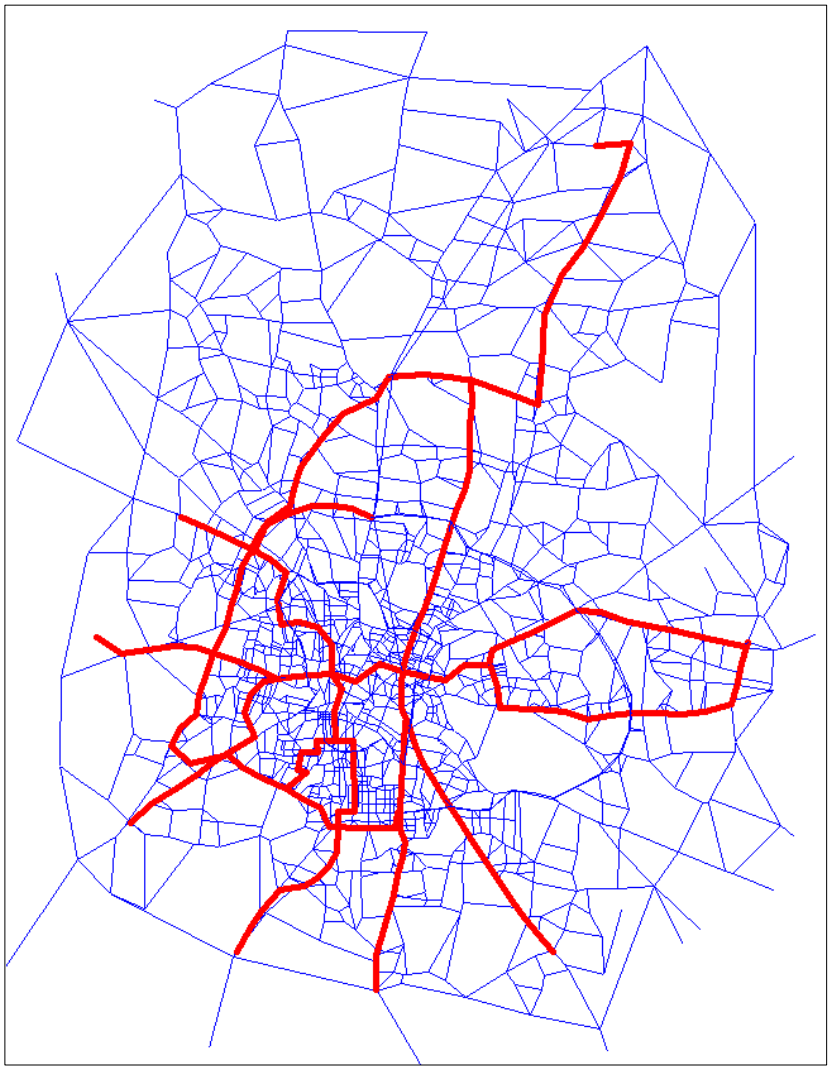


6.5.1.4 **Alternative 4** – In this alternative 9 corridors are considered to be taken (refer **Figure 6.8**). This alternative has a total length of 213-km. The public transport corridors as considered are given as under:

1. PRR – Puttenahalli Cross- Hesarghatta – BIEC
2. Whitefield – Baiyyappanahalli – Mysore Road terminal – Kengeri
3. Electronic City to Nagavara to Srinivasapur
4. Yeshwantpur to BIA
5. Hebbal-Yeswantpur-JP Nagar (along Western ORR)
6. Toll Gate to PRR along Magadi Road
7. National College to Kathriguppe Junction
8. Hosur Road-BG Road Junction to PRR along Bannerghatta Road
9. Indira Nagar to White Field

Figure 6.8

Development of Alternative Public Transport Network Alternative-4



6.6 EVALUATION OF ALTERNATIVE PUBLIC TRANSPORT NETWORKS

6.6.1 The prime objective of any type of urban transportation planning is the development of an optimum comprehensive strategy. This is achieved because of assessment of largely subjectively developed alternative public transport networks. The assessment is carried out in an objective manner, which is of course many times subject to political or collective decision, reflecting the public's view of desirability and/or acceptability. However, the task of the consultant is to compare sensible alternatives on a common yardstick and advise the decision-makers of the quantifiable facts.

6.6.2 In the present study, evaluation of alternative public transport networks has been attempted from the point of view of passenger transport demand for the horizon year 2025 and ability of the various networks to cater to this demand. In view of above, following criterion for comparative evaluation was considered:

a) PHPDT in each alternative network,
b) Passengers served by each alternative network per day ,
c) Passenger kms performed per day,

d) Passenger km carried per km on each alternative network per day, and
e) Cost of Public transport system per passenger km per day

6.6.3 Comparative evaluation of the four alternative options as described above for the horizon year 2025 are given below in **Table 6.3 & Table 6.4**.

Table 6.3 Evaluation of PHPDT of Alternative Public Transport Networks 2025

Sl. No.	Corridor Name	PHPDT 2025			
		Alternative 1	Alternative 2	Alternative 3	Alternative 4
1	PRR – Puttenahalli Cross – Hesarghatta Junction – BIEC	39600	41600	35100	36100
2	Whitefield – Baiyyappanahalli – Mysore Road Terminal – Kengeri	29300	37300	35000	39000
3	Electronic City to Jigani to Koramangala (Hosur Road – BG Road Junction) – Nagavara	27600	–	–	–
4	Electronic City to Nagavara to Srinivasapur	–	28200	26500	27800
5	Hosur Road (PRR) to Koramangala (Hosur Road – BG Road Junction)	18600	–	–	–
6	Trinity Circle (MG Road) to National College to Kathriguppe Junction	12800	–	–	–
7	RV Road Terminal to Marathahalli	15900	–	–	–
8	Yeshwantpur to BIA	22800	24500	26200	25800
9	Hebbal–Yeswantpur–JP Nagar–Hebbal (along full ORR)	–	–	17500	–
10	Hebbal–Yeswantpur–JP Nagar (along Western part of ORR)	–	18600	–	17200
11	National College to Kathriguppe Junction	–	7600	7900	8300
12	Toll Gate to PRR along Magadi Road	–	13500	10200	11000
13	Hosur Road–BG Road Junction to PRR	–	20200	13100	13500
14	Indira Nagar to White Field	–	–	12600	10500

Table 6.4 Evaluation of Alternative Public Transport Networks 2025

Sl. No.	Alternative Network	No. of Corridors	Total Length (KM)	Daily PKM (in Lakh)	Daily PKM/KM (in Lakh)	Daily Passengers (in Lakh)	Cost / PKM (in Rs.)
1	Alternative 1	7	192	303.81	1.58	30.13	11055
2	Alternative 2	8	200.7	321.03	1.60	39.14	9942
3	Alternative 3	9	249.6	354.17	1.62	38.58	10391
4	Alternative 4	9	213	351.34	1.65	37.63	9574

6.6.4 The network in Alternative 4 will cater to about 1.65 Lakh passenger kilometers per kilometre of public transport network per day by the year 2025, which is maximum amongst all alternatives. The cost of alternative 4 network is also lowest at Rs. 9574 per passenger km served in 2025. This network is expected to cater 37.63 Lakh commuters by the horizon year 2025.

6.7 RECOMMENDED PUBLIC TRANSPORT NETWORK

6.7.1 Considering the evaluation of Public Transport networks, **Alternative 4** network has been recommended as it is the most efficient in catering the future passenger transport

demand in the horizon year 2025. The **Alternative 4** network is also most cost efficient public transport network. Some corridors where the phpdt was less than 10,000 were removed from the high speed mass transport corridors and were taken as bus corridors. The various public transport corridors identified in this scenario are given in **Table 6.8**.

6.7.2 With this scenario, the modal split for intracity trips for Bengaluru in 2025 is shown in **Table 6.5**. The table indicates that with the introduction of recommended public transport network, the public transport share will increase from about 54% in BAU scenario with Phase I metro to 61% in 2025.

Table 6.5
Modal Split for Intracity Trips for Bengaluru, 2025 –
With Phase I Metro and Additional Corridors of Public Transport System

Sl. No.	Mode	Daily Trips – 2025	Modal Share (%)	Daily Trips BAU-2025	Modal Share (%)
1	Car	603081	5.4	708381	6.4
2	2w	2916718	26.3	3206533	28.9
3	Auto	798040	7.2	1200846	10.8
4	PT	6789218	61.1	5991296	53.9
	Total	**11107056**	**100.0**	**11107056**	**100.0**

6.7.3 Scenario with Higher Parking Charges and Higher Fuel Cost for Private Vehicles

6.7.3.1 The vehicle ownership is expected to go up significantly in future years. This will induce car owners to use their cars more often. The result of this is already reflected in earlier analysis. Many roads would still be overloaded. Therfore it will be necessary to increase the cost of car use in order to make the car users to shift to Public transport system. Increasing the parking charges in work centers can be one way to encourage this shift to public transport. A scenario of high parking charges and increase in fuel cost/vehicle operating cost has also been considered. Car parking charges of Rs 300/- in major work/commercial centers and Rs. 150/- in other commercial centers have been considered.

6.7.3.2 Transport demand forecasting process has been carried out for the above scenario. **Table 6.6** shows the result of this scenario. Higher parking charges/VOC are expected to increase modal split in favour of public transport for intra-city trips to 70% for this scenario. However in terms of passenger kilometer (pkm) served, the recommended Public transport is epected to serve about 80% of total pkm by all mortised modes.

Table 6.6
Modal Split for Intra-city Person Trips for Parking/Higher VOC Scenario, 2025

Sl.No.	Mode	Daily Trips	Modal Share (%)
1	Car	383739	3.5
2	Two Wheeler	2071705	18.7
3	Auto	897545	8.1
4	Bus/Metro	7754068	69.8
	Total	**11107056**	**100.0**

6.7.3.3 Desireline diagrams for bus person trips and other vehicles for this scenario in 2025 are given in **Figures 6.9 and 6.10** respectively. The traffic assignment in 2025 on road network in this scenario for bus person trips and other vehicles are given in **Figures 6.11 and 6.12** respectively. These figures show that traffic levels on roads will be much lower and manageable. Therefore this scenario of achieving 70% modal split in favour of Public transport is considered desirable.

6.7.3.4 In order to increase the modal split in favour of public transport further, some additional measures such as restriction on car ownership, congestion pricing etc may need to be thought at a time when all the areas in Bengaluru are provided with an adequate and convenient intergrated public transport and thus alternative to car use is available.

Figure 6.9

Desireline Diagram for PT Passengers in 2025 with Recommended Scenario

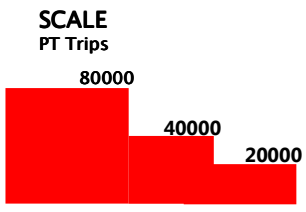


Figure-6.10

Desireline Diagram for other than PT (in pcus) in 2025 with Recommended Scenario

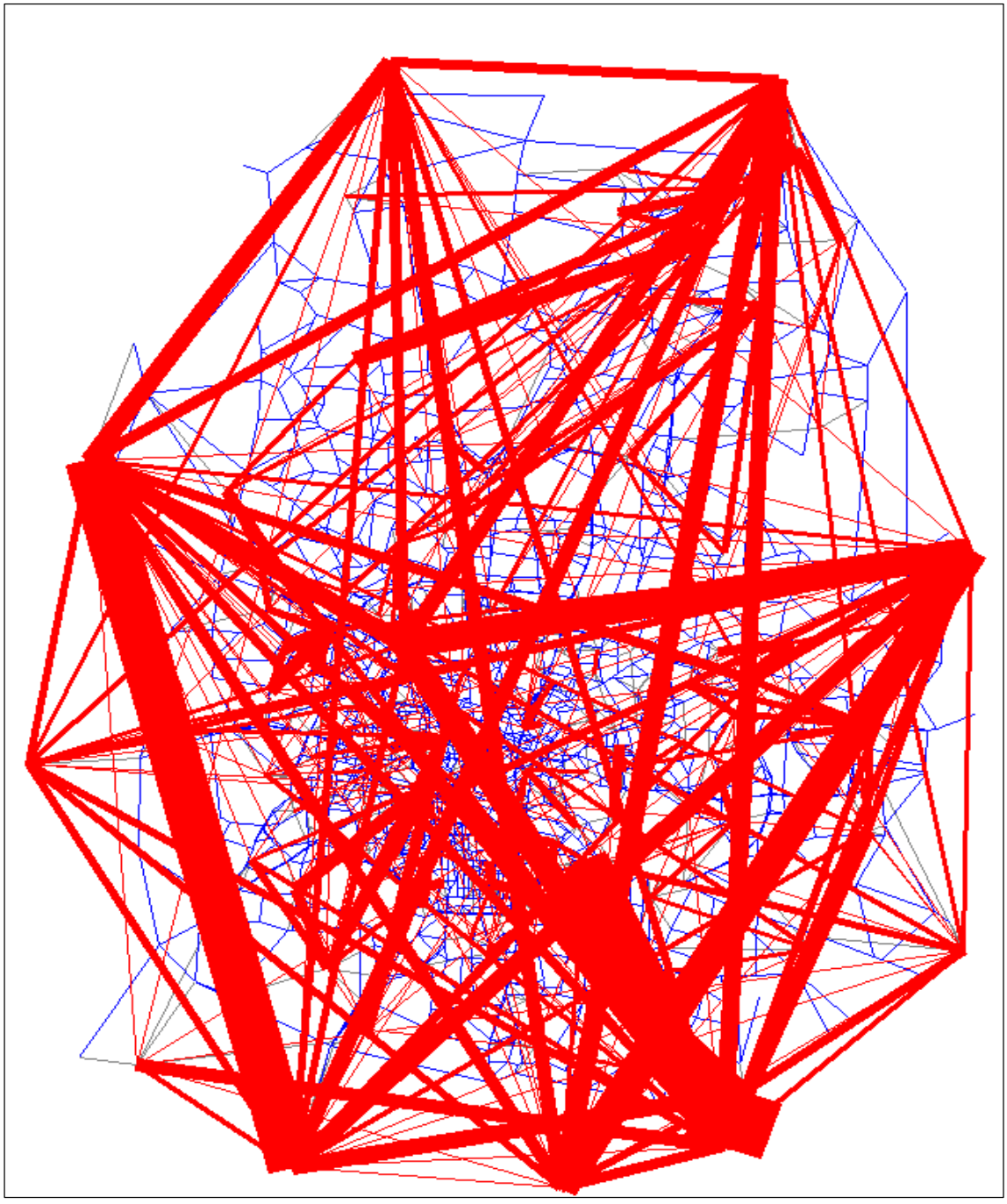
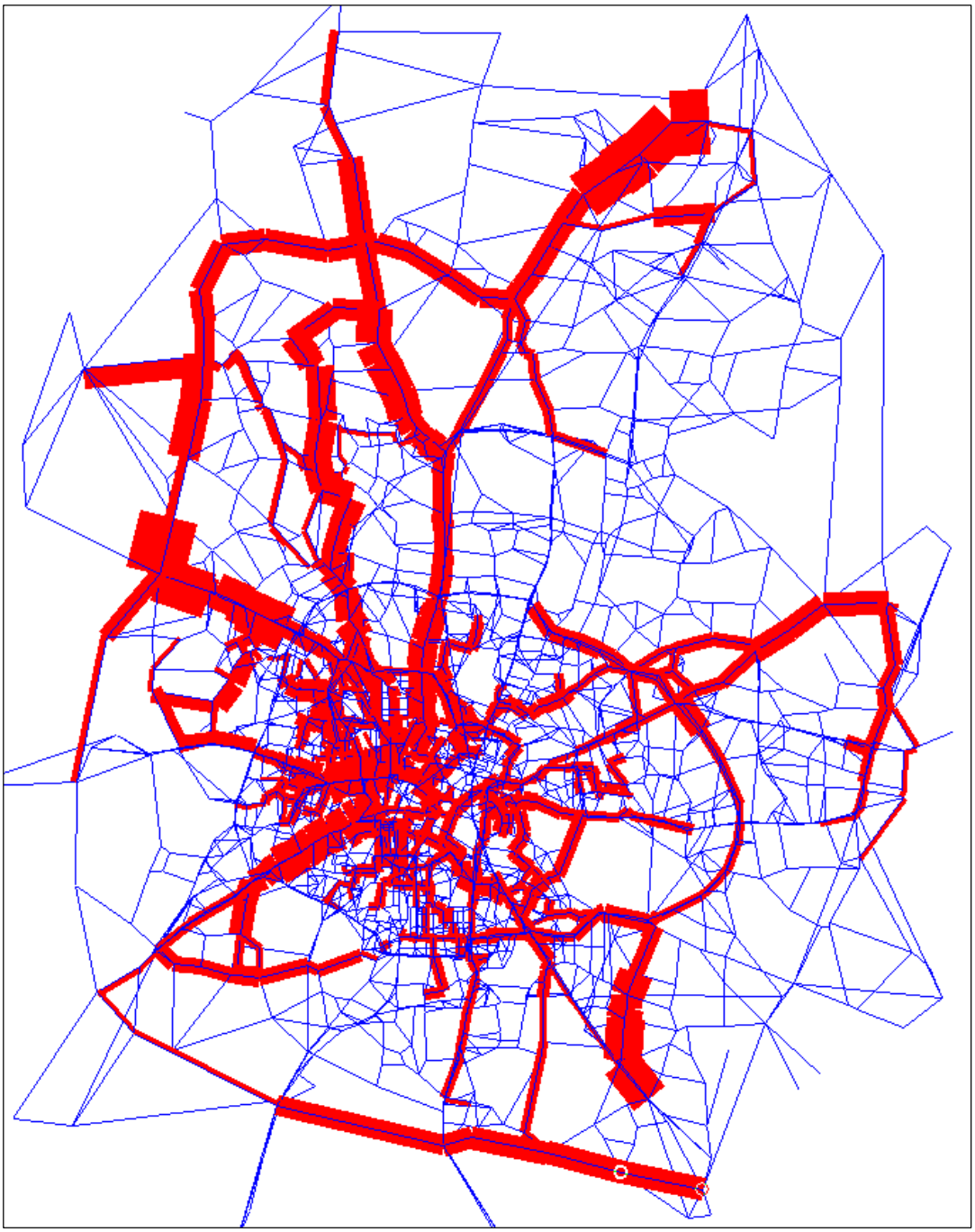


Figure – 6.11

Expected Peak Hour PT Passengers on Road Network with Recommended Scenario



SCALE

Peak Hour PT Passengers

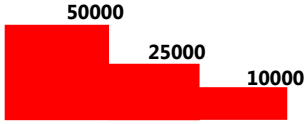


Figure 6.12 Expected Peak Hour Traffic Volumes (other than PT) in PCUs on Road Network with Recommended Scenario

6.8 SYSTEM SELECTION

6.8.1 **Criteria for Choice of Mode**: Choice of mode will depend mainly on demand level on a corridor, available road right-of-way (ROW) and the capacity of the mode. Other considerations are likelihood of increase in traffic in next 20-25 years, land-use along the corridor, the location of building lines, and the potential for increasing the ROW. Cost of the same mode of transport can vary at different locations depending on engineering constraints. It is therefore important that the final choice of mode is based on techno-economic considerations.

6.8.2 In choosing a mode for a corridor, first priority should be given to at-grade services. It offers convenience to commuters particularly the short distance users. Commuters do not have to walk up and down to use the services. The construction cost is low. It offers the best financial sustainability. If road ROW is inadequate and it cannot be widened, and/or the route is congested, an elevated mode needs to be proposed.

6.8.3 **Capacity of Various Modes**: Based on studies by World Bank and others, the following capacity norms for various modes are adopted for Bengaluru.

Table 6.7 Capacity of Various Modes

Modes	Capacity (PHPDT)
Metro Rail	> 25000
Elevated Light Metro (LRT, Monorail etc.)	upto 25000
BRT (for one lane each side)	upto 8000
BRT (for one lane each side with grade separation at junctions)	upto 12000
BRT (for two lane each side with grade separation at junctions	upto 20000

6.8.4 **Right of Way Requirement**: All medium capacity modes normally lie within the road right of way and hence require a share in the road space. At-grade modes however require more space than elevated modes. For at-grade BRT (with one lane each side), the desirable right of way requirement is 35-45 m to meet the requirements of the IRC code, but with an absolute minimum of 28 m. The latter allows for two- lane sub-standard carriageways each way. It is highly unlikely that the desired ROW will be available for full length of the corridor. Elevating the corridor at tight locations could be one option. For BRT system with island bustop, bus doors need to be open on both sides.

If minimum ROW is not available, elevated modes become necessary. For elevated Monorail or LRT, minimum of 20 m road is required because at ground level space is required only for a column and its protective measures. Typical cross-sections for roads with different ROW with different type of BRT system and Light Metro (LRT/Monorail) are shown in **Figures 6.13 (a to d) and 6.14** respectively.

Figure 6.13 (a) Typical Cross-Section of BRT with 35 M (ROW)

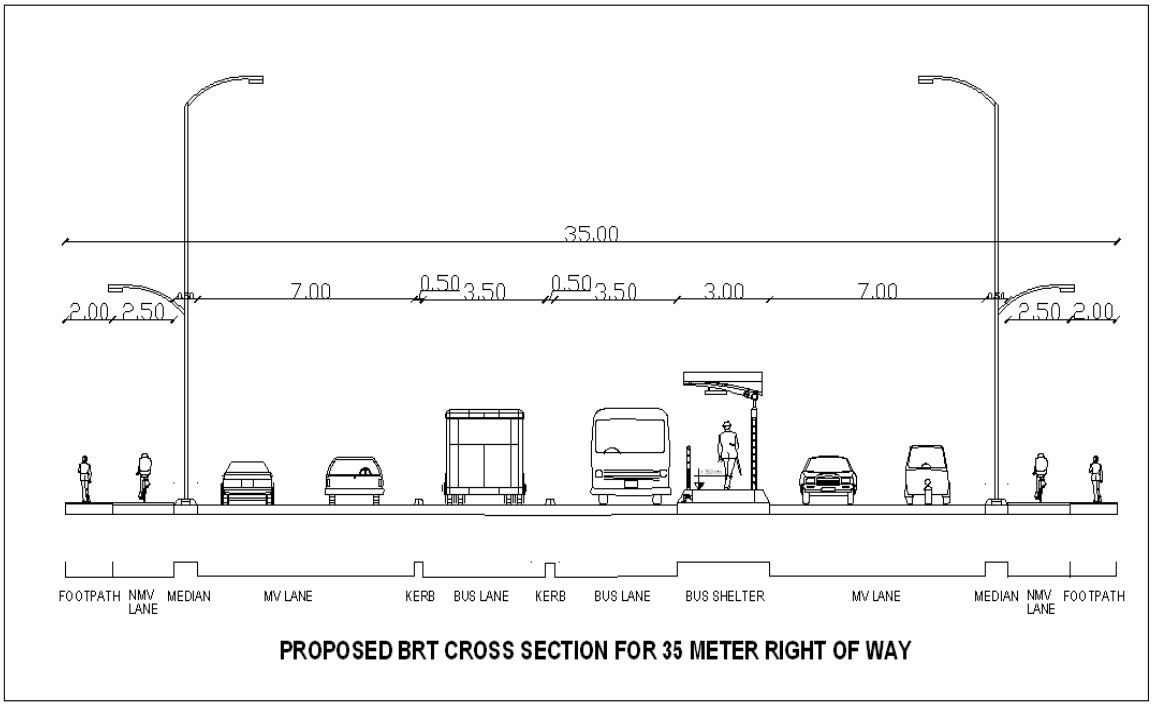


Figure 6.13 (b) Typical Cross-Section of BRT with 45 M (ROW)

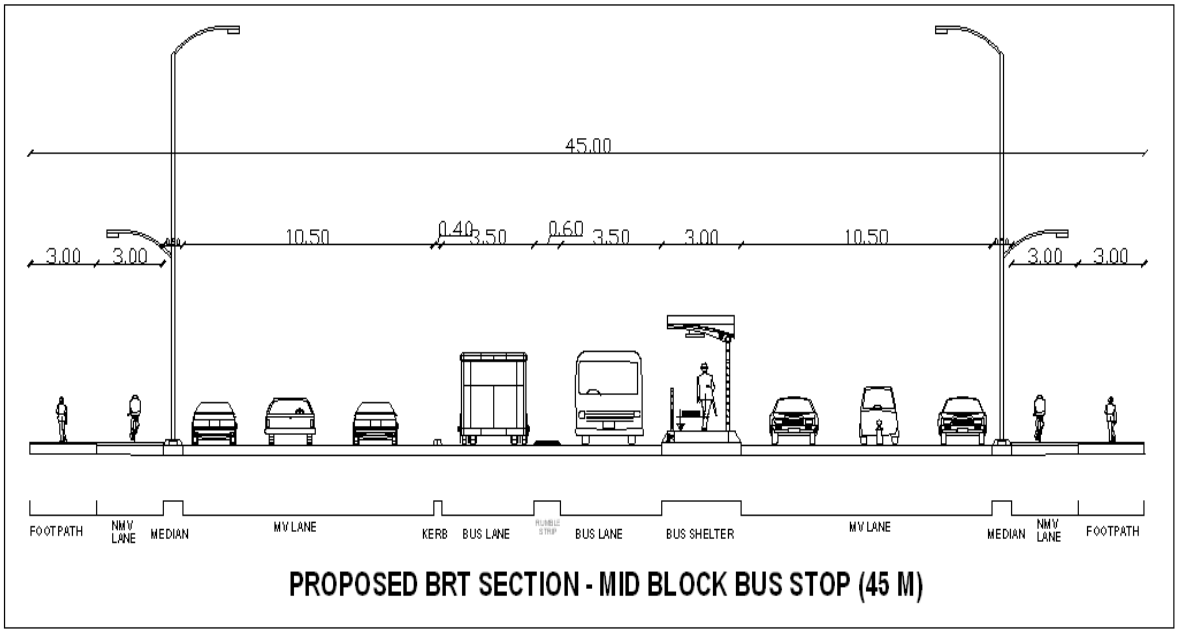


Figure 6.13 (c) Typical Cross-Section of BRT with 60 M (ROW)

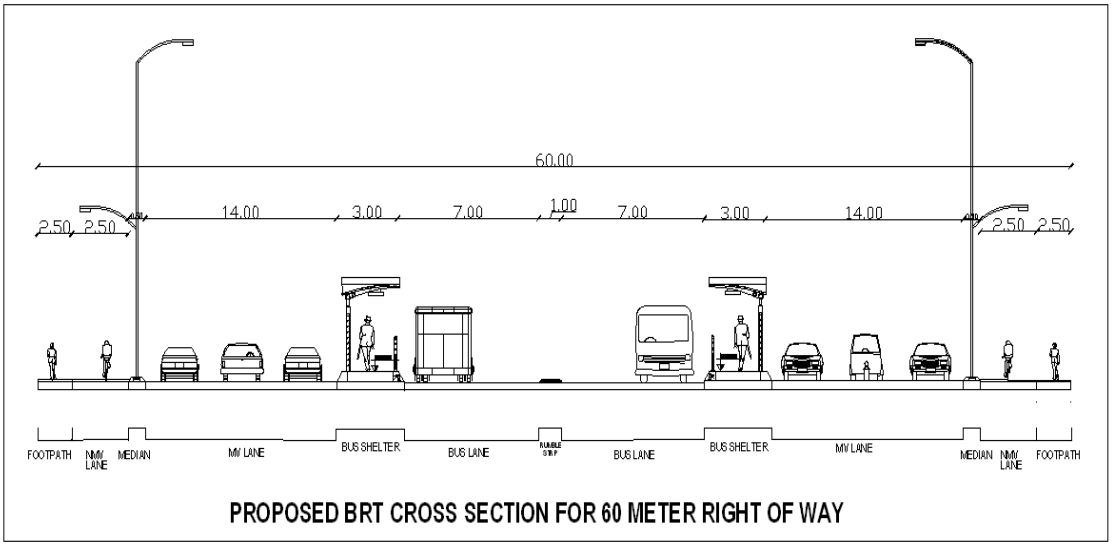


Figure 6.13 (d) Typical Cross-Section of BRT with island bustop with 60 M (ROW)

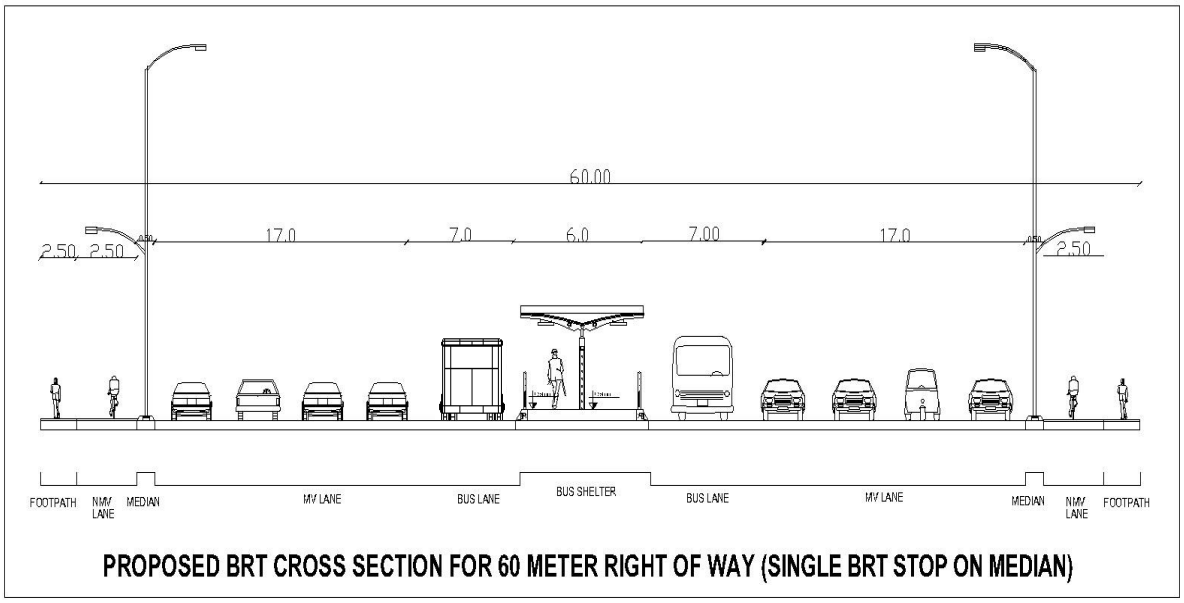
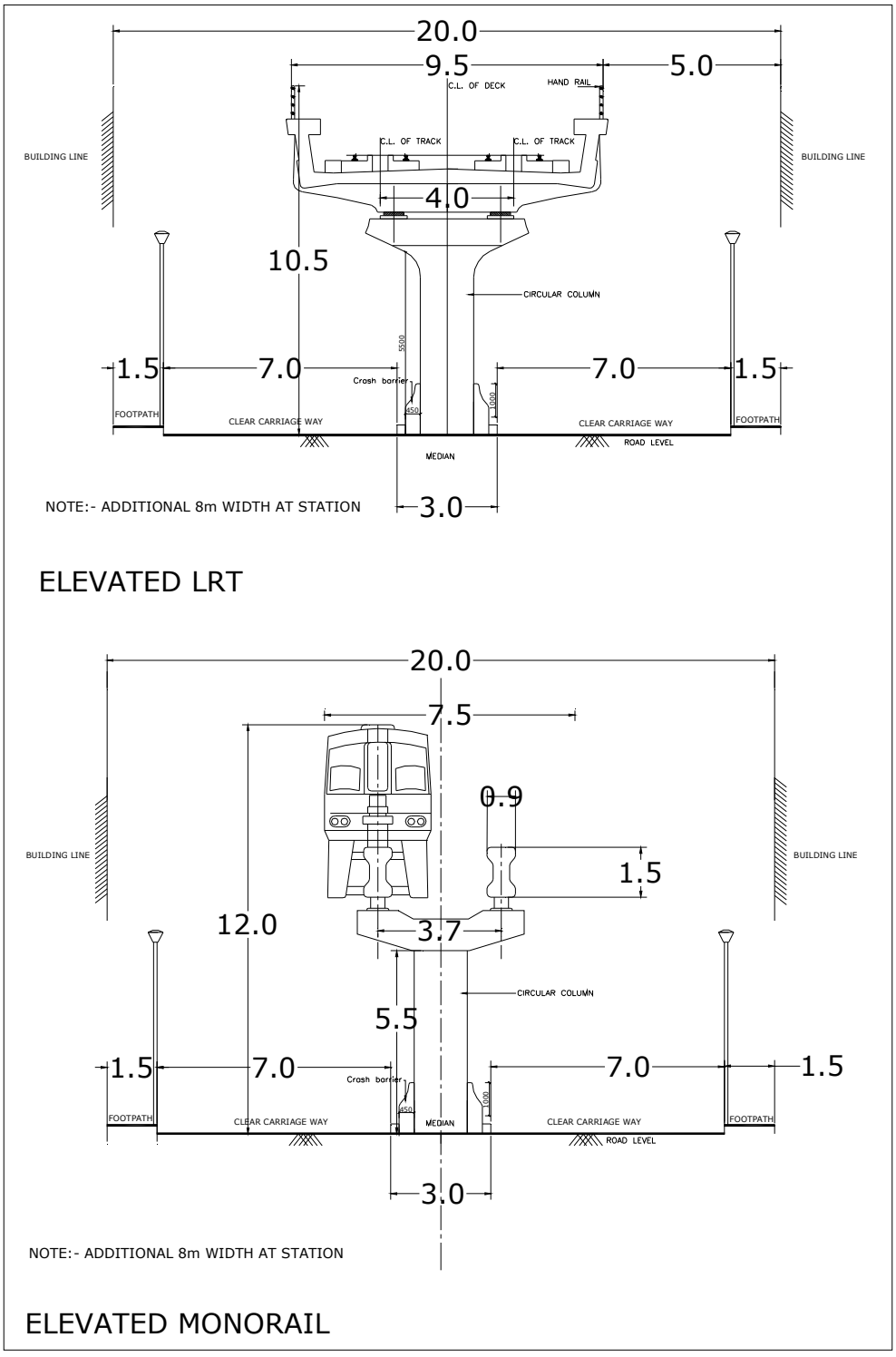


Figure 6.14 Typical Cross Sections of Light Metro (LRT/Monorail) System



6.9 RECOMMENDED PUBLIC TRANSPORT NETWORK AND SYSTEM

6.9.1 Considering the evaluation of public transport networks, the public transport network and system has been selected on the basis of above criteria to meet future transport demand. Metro, Light Metro (which can be LRT, Monorail or any other medium capacity rail based system) and BRT systems have been recommended for various corridors.

The recommended network and recommended system for various corridors are given in **Table 6.8**. Total additional proposed Metro length in Bengaluru is 98 Km, Light Metro 77 Km and BRT 279.6 Km. Thus total metro length within Bengaluru by 2025 will be 140.9 Km, Light Metro 77.0 km and BRT 279.6 Km. With HSRL, the total metro length will be 174.9 km. Overall public transport system length will be 531.5 Km by 2025. In addition suburban commuter rail system of 161 Km is also proposed to cater to commuters from nearby towns.

Table 6.8 Recommended Integrated Public Transport Network and System

Sl.No.	System Type	Corridor	Max. PHPDT (2025)	Length (Km)
1	**Metro**			
a	***Metro Corridors-Phase-I***			
	Hesarghatta – Puttenahalli Cross		29173	24.2
	Baiyyappanahalli – Mysore Road Terminal		30385	18.7
			Total (a)	**42.9**
b	***Extension of Metro Corridors***			
	I.	Extension of Puttenahalli Cross-Hesarghatta line to BIEC	13978	2.7
	II.	Extension of Hesarghatta – Puttenahalli Cross line to PRR	19105	7.4
	III.	Extension of Baiyyappanahalli – Mysore Road terminal line to Kengeri	5050	5.9
	IV.	Extension of Mysore Road terminal – Baiyyappanahalli line to Whitefield	20230	12.4
			Total (b)	**28.4**
c	***New Metro Corridors***			
	V.	Electronic City to Srinivasapur	23452	31.8
	VI.	Yeshwantpur to BIA	23577	37.8
		Total (c)		**69.6**
		Total Metro Length (a+b+c)		**140.9**
2	**Light Metro**			
	I	Hebbal-JP Nagar (along Western ORR)	14945	31.3
	II	Toll Gate to PRR along Magadi Road	10371	9.7
	III	National College to Kathriguppe Junction	6147	5.0
	IV	Hosur Road-BG Road Junction to PRR	11794	13.8
	V	Indira Nagar to White Field	11617	17.2
		Total Light Metro Length		**77.0**
3	**BRT**			
b	***New BRT Corridors***			
	I	JP Nagar-Hebbal (along Eastern ORR)	7397	31.7
	II	ORR to Hosur Road	12364	13.0
	III	Hosur Road to Tumkur Road (Western PRR)	11688	42.9
	IV	Tumkur Road to Hosur Road (Eastern PRR)	12219	78.5
	V	Along CRR	8582	31.2

Sl.No.	System Type	Corridor	Max. PHPDT (2025)	Length (Km)
	VI	Kengeri to JP Nagar	5200	15.9
	VII	Domlur Extn to Koramangala	4865	5.6
	VIII	Mulur to Maruthinagar	7637	7.1
	IX	BIEC to PRR	11519	2.1
	X	Cricket Stadium to BIA via Bellary Road	9429	34.0
	XI	Yelahanka to PRR along Dodaballapur Road	13185	9.9
	XII	KR Puram Metro station to PRR along Old Madras Road	5966	7.7
		Total BRT Length		**279.6**
4		**High Speed Rail Link to BIA**		34.0
		Total Length (Km) (Metro + Light Metro + BRT+HSRL)		**531.5**

6.10 SUMMARY OF TRANSPORT DEMAND FORECAST FOR THE RECOMMENDED PUBLIC TRANSPORT NETWORK

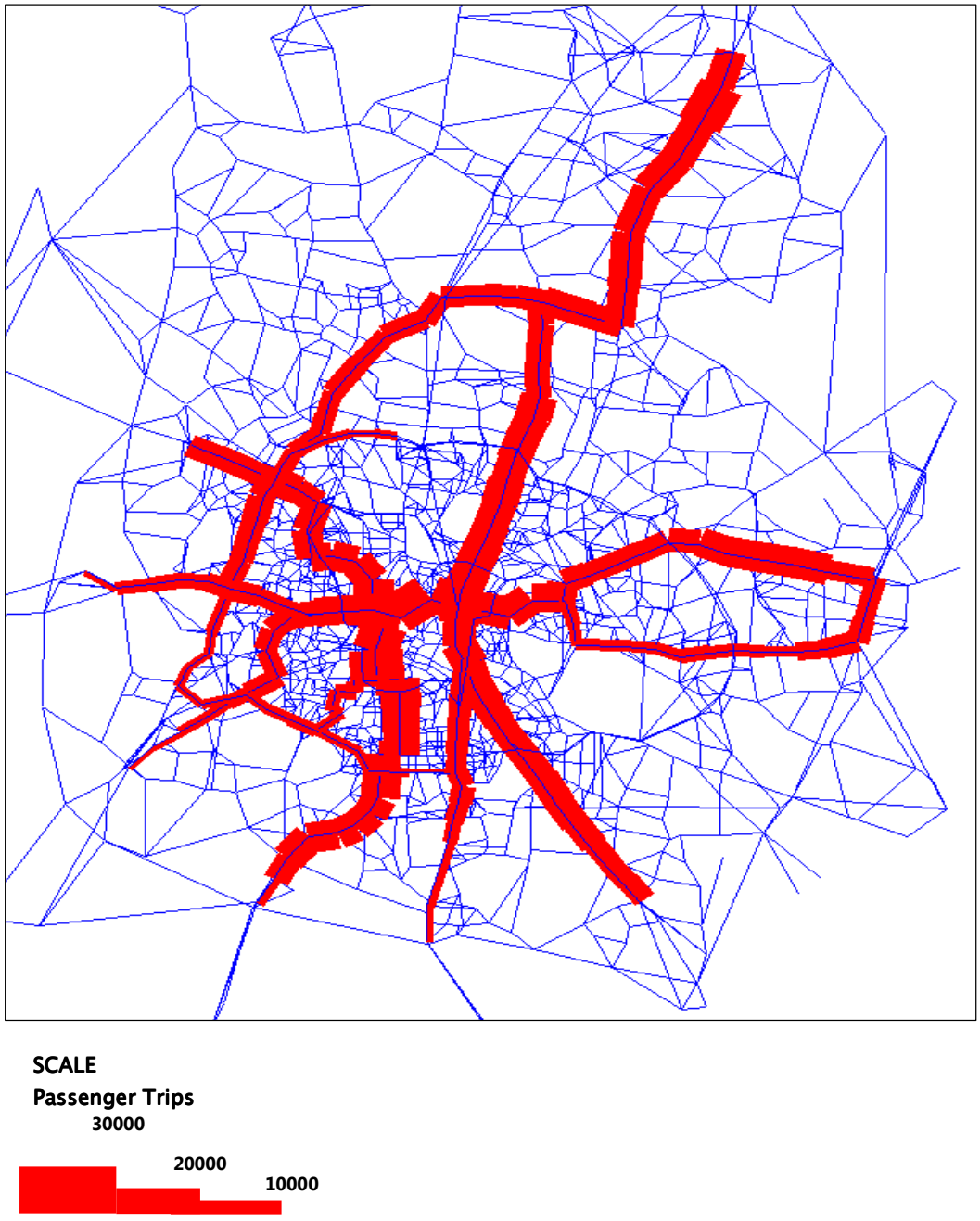
6.10.1 Ridership on Metro/Light Metro System, 2025: Daily ridership on the entire Metro/Light Metro system upto 2025 is expected to be 31.7 Lakh passengers with about 42 lakh boardings. Thus there will be 1.32 interchange transfers per passenger trip on Metro/Light Metro system. Line wise boardings for 2025 are shown in **Table 6.9.** Peak hour section loads on various metro/Light Metro corridors are given in **Figure 6.15.**

Table 6.9 Ridership on Metro/Light Metro System, 2025

Sl.No.	Name	Daily Boardings (2025)
1	PRR to Puttenahalli to Hesarghatta to BIEC	8,12,299
2	Kengeri to Mysore Road to Baiyyappanahalli to Whitefield	7,28,851
3	Electronic City to Srinivaspura	7,48,350
4	Yeshwantpur to BIA	9,38,748
5	Hebbal to JP Nagar	2,88,933
6	Toll Gate to PRR	1,95,401
7	National College to Kathriguppe Junction	56,695
8	Hosur Road – BG Road Junction to PRR	2,34,875
9	Indiranagar to Whitefield	1,63,800
	Grand Total MRT Boardings	**41,67,952**
	Total Daily Metro Trips	**31,69,944**
	Interchange Transfers	**1.32**

Figure – 6.15

PHPDT on Metro/Light Metro Corridors in 2025 with Recommended Scenario



6.11 DESCRIPTION OF PUBLIC TRANSPORT CORRIDORS AND AREAS SERVED

6.11.1 Metro Light Metro and BRT Corridors: The description of the entire existing and proposed Metro, Light Metro and BRT corridors and areas served by each corridor are given in **Tables 6.10, 6.11** and **6.12** for Metro, Light Metro and BRT respectively.

Table 6.10 Existing and Proposed Metro Corridors in Bengaluru and Areas Served

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
1	**PRR to Puttenahalli to Hesarghatta to BIEC**	PRR – Kanakpura Road – RV Road – KR Road – BVK Iyengar Road – Chikpete – KSRTC Bus Terminal at Majestic – Platform Road –Malleswaram – MKK Road – Navarang – Chord Road – Rajajinagar I Block – ISKCON – Soap Factory – Yeshwanthpur Rly Stn – NH – 4 (Tumkur Road) – ORR Jn with Tumkur Road – Jalahalli Circle – Hesarghatta– BIEC	Corridor benefits areas of Talaghattapura, Navaratan Gardens, Munireddy Layout, Siddanna Layout, Kailash Nagar, Jayachamarajendra, Kashinagar, Jarganahalli, Yelachanahalli, Puttenahalli, JP Nagar, Sarbandapalya, Banashankari, Jayanagar, Southend Circle, LalBagh, Shankarapuram, Chikkanna Gardens, City Market, old Tharagupet, Sultanpet, Chikpete, Gandhinagar, Swastik, Malleshwaram, Devaiah Park, Sriramapuram, Mariyappanapalya, Rajaji Nagar, Mahalakshmipuram, Soap Factory, Yeshwantpur, ORR, Peenya, Jalahalli, Dasarahalli, Hesarghatta cross and terminates at BIEC on NH–4.	34.3
2	**Kengeri to Mysore Road to Benniganahalli to Whitefield**	Kengeri – Uttarahalli Road Junction – RVCE – Mysore Road – Chord Road – Vijayanagar–Toll gate–Magadi Road – Leprosarium – City Railway Station – KSRTC Bus Terminal at Majestic – KG Road – Post Office Road – Civil Court – Central College – KR Circle – Dr.Ambedkar Veedhi –Gopala Gowda Circle – High Court – Vidhana Soudha – GPO – Raj Bhavan Road – Minsk Square – Cubbon Road – Chinnaswamy Stadium –Parade Grounds – MG Road – Anil Kumble Cirlce – Webbs Junction – Trinity Circle – Swamy Vivekananda Road (Old Madras Road) – CMH Road – Indira Nagar 100 Feet Road – Old Madras Road (NH–4) – Baiyyappanahalli – Benniganahalli – K R Puram –	Corridor caters to areas of Kengeri, Harsha Layout, BHEL layout, Davasapalya, Mutharayana Nagar, ITI layout, Nayandahalli, Pantarapalya, Deepanjali Nagar, Kavika layout, Nethaji layout, Vijayanagar, M C Layout, CPWD Quarters, Police quarters, Cholurpalya, Vidyaranya Nagara, Manjunatha Nagar, Kempapura Agrahara, Gopalapura, Subhash Nagar, Gandhi Nagar, Upparpete, Balepete, Anchepet, Central College, City Civil Court, UVCE, Vidhana Soudha, Chinnaswamy Stadium, MG Road, Trinity Circle, Ulsoor, Hoysalanagar, Indiranagar, HAL, Benniganahalli, Tin Factory, Jyothipuram, K R Puram, Singayyanapalya, Kaverinagar, Hudi, Kadugodi Industrial area, Kadugodi Colony and ends at Whitefield Rly stn.	37

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
		Hudi – Whitefield.		
3	**Electronic city to Srinivaspura**	Electronic City – Hosur Road (NH-7) – Silk Board Junction – BG Hosur Road Junction – Hosur Road – Vellara Junction – Museum Road – Lady Curzon Road – Old Poor House Road – AM Road – Station Road – Netaji Road – Tanners Road – Arabic College Main Road – Nagawara Main Road – Jn. of Nagawara Road with ORR – Thanisandra Main Road – Srinivasapura.	Corridor covers areas of Singasandra, HAL Layout, MICO Layout, Muneshwara Nagar, Bommanahalli, Roopena Agrahara, Dollar Scheme Colony, Koramangala, Suddaguntepalya, Dairy Colony, Adugodi, Ayyappa Garden, Langford Town, Richmond Town, Tasker Town, Shivaji Nagar, Sulthangunta, Cantonment, Cleveland Town, Fraser Town, Pottery Town, Rashthrothana Vidya Kendra, Diana Public School, KNS Institute of Technology, Kannur Road Junction, Reva Institue of Technology, Thanisandra Main Road and terminates at Srinivasapura.	31.8
4	**Yeshwantpur to BIA**	Yeshwantpur Rly Stn.- Mathikere Bus Terminal – MS Ramaiah Road – BEL Circle – Bhadrappa Layout – Jn. of D Rajagopal Road, Kodigehalli Main Road – Kodigehalli Level Crossing – along Railway line – Sahakaranagar – Judicial Layout – Yelahanka Level Crossing–Bellary Road – Yelahanka Bazar Rd – Kogilu Cross – Kogilu Road – Kannuru – Hosuru – Marenahalli – Bagaluru – Sahibpalya – Basavannaguda – Banda Kodigenahalli – Mailanahalli – Bengaluru International Airport.	Corridor covers areas of Yeshwanthpur, Mohan Kumar Nagar, Mathikere Extension, Nethaji Nagar, Poornappa Garden, Sundara Nagar, Railway Men's colony, Dodda Bommasandra, Lottegollahalli, Badrappa Layout, Devinagar, Tatanagar, Kodigehalli, Maruthi Layout, Sahakaranagar, Rajiv Gandhi Nagar, Judicial Layout, Allalasandra, Gandhi Nagar, Yelahanka, Kogilu, Srinivaspur, Ballahalli, Kannuru, Hosuru, Marenahalli, Chagaletty, Bagaluru, Sahibpalaya, Basavannaguda, Bande Kodigenahalli, Mailanahalli, Bengaluru International Airport (BIA).	37.8
			Total Metro corridors Length	**140.9**

Table 6.11 Proposed Light Metro Corridors in Bengaluru and Areas Served

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
1	**Hebbal to JP Nagar**	NH – 7 – ORR Jn. Near Hebbal – Along ORR – Kuvempu Circle – BEL Circle – Jn. Of ORR with NH –4 (Tumkur Road) – along NH – 4 (West) – ORR(South side) – NH–4 ORR Jn.– ORR Sumanahalli Flyover Jn.– along Magadi Road – ORR Jn.– along ORR – ORR Malathahalli Road Jn. – Ullal Road Jn.– Bengaluru University Road – BU Road – Mysore Road Jn.– along Mysore Road – Mysore Road – ORR Jn.– Hosakererhalli Cross on ORR – ORR Puttalingaiah Road Jn.– Kanakapura Road ORR jn.– ORR Bannerghatta Road Jn.– Bannerghatta Road – Marenahalli Road Jn.–Silk Board Jn.– Along ORR –Agara Jn.– Sarjapur ORR Jn. –Iballur Jn.– Bellandur Jn.– Marathahalli Bridge – along ORR – ORR OMR (NH–4) Jn.– along ORR – ORR Thanisandra Main Road Jn.– Hebbal	Corridor passes through Hebbal – Basweshwara Layout – Patellappa Layout – Lottegollahalli– Railway Men's Colony – Sundara Nagar – Gokul Extension – Muthyalanagar, Goraguntapalya, Yeshwanthpur Industrial Area, Narasimha Layout, Kanthirava Layout, Jai Bhuvaneshwari Nagar, Sreenivasa Nagar, Narasimhaswamy Nagar, Swathantra Yodharanagar, Kempegowda Layout, Chowdeshwari Nagar, NGO's Colony, Prem Nagar, Marlingappa Extension, Kengunta, Mallathahalli, Mariyappanapally, Gnana Bharathi, Mutharayanagar, Nayandahalli, Pantarapalya, Veerabhadranagar, Hosakerehalli, BSK, Kathriguppe, Kadaranahalli, Kumaraswamy Layout, JP Nagar, Someshwara Colony, Teacher's Colony, Ibbalur, Bellandur, Devarabeesanahalli, Kadubeesanahalli, Marathahalli, Aswath Nagar, Doddanekkundi, Mahadevpura, B Narayanapura, K R Puram, Sathya Layout, ITI, Banaswadi, Kalyan Nagar, Vijinapura, Channasandra, Babusabpalya, HBR Layout – Nagawara, Yogesh Nagar, Guddadahalli – Hebbal.	31.0
2	**Toll Gate to PRR**	Toll Gate Bus Station – Along Magadi Main Road– Sumanahalli Flyover – along Magadi Road – PRR.	Corridor passes through Agrahara Dasarahalli, Govindaraj Nagar, Prashanth Nagar, Kamakshipalya, Rajaji Industrial Town, KHB Colony, Asthagrama Layout, Narasimharaj Colony, Muthurayaswamy Extension, Sunkadakatte, Madeshwaranagar, Anjana Nagar, Bedarahalli, Balaji Layout	10.0

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
3	**National College to Kathriguppe Junction**	National College – Vanivilas Road – Bull Temple Road – Jn. of Bull Temple Road with Bugle Rock Road – Kumaraswamy Temple Road – Jn. of Kumaraswamy with 10th Main Road – 10th Main Road – Shankarnag Circle – Vidya Peetha Circle – Kathriguppe Main Road – Kathriguppe ORR Junction.	Gandhi Bazaar, Gavipuram, Hanumantha Nagar, SBM Colony, Ashok Nagar, Srinivasapura, Vivekananda Nagar, Kathriguppe	5.0
4	**Hosur Road – BG Road Junction to PRR**	Hosur Road – BG Road Junction – along Bannerghatta Road – Diary Circle – Bannerghatta Road – ORR Jn.– Along Bannerghatta Main Road – Bannerghatta – NICE Road.	Pothulappa Garden, MICO, Pukhraj layout, Gupta Layout, Lakkasandra, Chandrappa Nagar, Ranga Dasappa layout, Govardhan Nagar, Bengaluru Dairy, NIMHANS Staff Quarters, Sadduguntepalya, Bismillah Nagar, Gurappanapalya, Tilak Nagar, KEB Colony, MICO Layout, Vysya Bank Layout, BTM Layout (II Stage), J P Nagar IV Phase, Sarakki Dollars Layout, Doresanipalya, IIM, Sahyadri Layout, Panduranga Nagar, Omkara Nagar, Samrat Layout, Arakere, Syndicate Bank Colony, Arakere MICO Layout, Srinivasulu Layout, Nobo Nagar, Kalena Agrahara, Himagiri Meadows	14.0
5	**Indira Nagar to Whitefield**	Jn. of NH-4 and 100 Feet Road- Along 100 Feet Road, Indira nagar – CMH Road Jn.- Along 100 Feet road- Kodihalli Jn.- Along Old Airport Road- 80' Road Jn- Along Old Airport Road- CV Raman Nagar Main Road Jn.- Varthur Main Rd.- Marathahalli Jn.-along Varthur Main Rd.- ITPL Main Road-Varthur Road- Whitefield Road-Whitefiled Railway Station.	The corridor starts from Indira Nagar and traverses along Old Airport Road serving the areas of HAL II Stage, Kodihalli, Konen Agahara, Jeevan Bimanagar, Ramesh Nagar, Old Airport, Jawahar nagar, Marathahalli, Channapanahalli , BEML Layout, Ramgondanahalli, Whitefiled, Vijay nagar, Ambedhkar Nagar, VS reddy colony, Kadugodi Industrial Area and ends at Whitefield Railway Station.	17.0
			Total Length	**77.0**

Table 6.12 Existing and Proposed BRT Corridors in Bengaluru and Areas Served

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
1	**JP Nagar To Hebbal**	Bannerghatta Road Jn.- Bannerghatta Road - Marenahalli Road Jn.-Silk Board Jn.- Along ORR -Agara Jn.- Sarjapur ORR Jn. -Iballur Jn.- Bellandur Jn.- Marathahalli Bridge - along ORR - ORR OMR (NH-4) Jn.- along ORR - ORR Thanisandra Main Road Jn.- Hebbal	Corridor passes through JP Nagar, Someshwara Colony, Teacher's Colony, Ibbalur, Bellandur, Devarabeesanahalli, Kadubeesanahalli, Marathahalli, Aswath Nagar, Doddanekkundi, Mahadevpura, B Narayanapura, K R Puram, Sathya Layout, ITI, Banaswadi, Kalyan Nagar, Vijinapura, Channasandra, Babusabpalya, HBR Layout - Nagawara, Yogesh Nagar, Guddadahalli - Hebbal.	31.7
2	**ORR to Hosur Road**	Jn. of NICE Corridor with Hosur Road-Hi-Tech Corridor (Hosa Road) - Jn. of ORR with Sarjapur Road	Corridor serves the areas of Naganathapura, Kudlu, Haraluru, Bovi Colony, Kasavanahalli, Kaikondanahalli, Maruthi nagar and Bellandur	13.0
3	**Hosur Road to Tumkur Road (Western *PRR)***	Jn. Of Hosur Road (NH-7) with PRR (South) - along PRR (West) - Jn. Of PRR with Tumkur Road (NH-4)	Corridors passes through Hommedevanahalli, Chikka Kammanahalli	42.9
4	**Tumkur Road to Hosur Road (Eastern PRR)**	Jn. Of Tumkur Road with PRR (North) - along PRR (East)	Corridor serves the areas of Srinivasapura, Kogilu Layout, Tirumanahalli, Nagareswara , Nagenahalli, Bhairatibande (Vijayanagar), Aduru, Old Madras Road, Whitefield, Sigehalli	78.5
5	**Along CRR**	Mekhri Circle - C V Raman Road - CNR Rao Circle (IISc Circle) - Yeshwanthpur Circle- Dr.Raj Kumar Road - Navarang Circle- Rajajinagar Entrance - along Mysore Deviation Road - Tank Bund Road - Sirsi Circle - Albert Victor Road - Bull Temple Road - Gandhi Bazaar - Tagore Circle - Kanakanapalya Road - Siddapura Road - Hosur Road (NIMHANS) - Dairy Circle - Adugodi - Vellara Jn - Richmond	Corridor serves the areas of parts of Sadashivanagar, Raj Mahal Vilas Extension, Yeshwanthpur, Subramanyanagar, Gayatri Nagar, Rajajinagar, Prakash Nagar, Okalipuram, Railway Colony, Gopalapura, Nagamma Nagar, , Cheluvadipalya, Anandapuram, Chamarajpet, Raghavendra Colony, Vinayaka Extension, Kempegowda Nagar, Gandhi Bazaar, Kanakanpalya, Siddapura, Hombegowda Nagar, Wilson Garden, Adugodi, Lakkasandra, Goverdhan Nagar, Pukhraj Layout, Pothulappa Garden, Richmond Town,	31.2

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
		Road – Trinity Circle –Murphy Town – Kensington Road – St. John's Church Road – Millers Road – Jayamahal Road via Cantonment Railway Station – Mekhri Circle	Ashok Nagar, Murphy Town, Jayaraj Nagar, Kalhalli,Cleveland Town, Benson Town, Cantonment, Nandidurga Extension, J C Nagar, Jayamahal	
6	**Kengeri to JP Nagar**	Kengeri Satellite Town – Komaghatta Road –Jn. of Komaghatta Road with ORR – along ORR (South) – ORR Mysore Road Jn. (Kengeri Flyover) – along Mysore Road (North) – Mysore Road Uttarahalli Road Jn.–Uttarahalli Jawaharlal Nehru Road Jn.–Uttarahalli ORR Jn.– along ORR – JP Nagar	Kengeri, Mailasandra, Sukalpalya, Srinivasapura, Channasandra Layout, Kodipur, Uttarahalli, Padmanabha Nagar, Kadarenahalli, Kumaraswamy Layout, JP Nagar	15.9
7	**Domlur Extension to Koramangala**	Domlur – along Old Airport Road – Jn. of 100 Feet Road with Old Airport Road – along Inner Ring Road – 80 Feet Peripheral Road Junction (Koramangala) –100 Feet Road –17 th Main Road –7 th Cross Road Junction – St.John's Medical College	Domlur, Agaram, Army area, Challaghatta, Ejijpura and Koramangala	5.6
8	**Mulur to Maruthinagar**	Jn. of SH–35 with Sarjapur Road – along Sarjapur Road –Jn. of Sarjapur Road with Hosa Road	This corridor serves the areas of Mullur, Sulakunte, Kodathi and Valliyamma Layout.	7.1
9	**BIEC to PRR**	Jn. of Ring Road with Tumkur Road near BIEC – along NH–4 – Jn. of NH–4 with PRR	This corridor serves the areas of Chokkasandra, Nagasandra, Vinayaka Layout, Prashanth Nagar, Vidya nagar, Madanayakahalli & Maheshwari Nagar.	2.1
10.	**Cricket Stadium to BIA along Bellary Road**	Cricket Stadium– Chowdaiah Road– Mekhri Circle–Bellary Road (NH–7)–Jn. of ORR and Bellary Road at Hebbal– Jn. of Kodigehalli and Bellary Rd.– Yelahanka Bypass rd.–Kogilu cross on Bellary road–Jn. of Bellary and Bagalur Main	The corridor starts from Cricket Stadium and serves areas around Palace Guttalahalli, Kumara Park area, Sadashivanagar, Palace Grounds, Gangenahalli, Anandanagar colony, Sanjaynagar, Hebbal Kempapura, Byatarayanapura, Sahakaranagar, Kodigehalli,Jakkur layout,	34.0

Sl.No.	Name of Corridor	Corridor Description	Areas Covered	Total (Km)
		Road-Bellary Road- Loop to reach BIA	Nehru nagar, Yelahanka, Marutinagar, Chikkajala, Sonnapanahalli, Sadahalli and finally terminates at BIA.	
11.	**Yelahanka to Doddaballapur**	Yelahanka Road – Along Doddaballapur Road- Jn. Of PRR and Doddaballapur Road	The corridor serves areas of Old Yelahanka Town, Yelahanka Satellite Town and traverses along Doddabalapur Road till the junction of proposed PRR and also serves areas of Puttanahalli, Kenchehalli, Sri Balaji Layout, CPRF campus, Horahalli.	9.9
12.	**KR Puram Metro Station to PRR along Old Madras Road**	KR Puram Metro Station- Jn. of OMR & ORR- Jn. of Devasandra Main Road & OMR- along OMR- Jn. of OMR & PRR	The corridor starts from KR Puram Metro Station and serves areas of Krishanrajapuram, A.Narayanapura Extension, Duravani nagar, Devasandra, ITI Colony, Hosabasavanapura and Bhattarahalli.	7.7
			Total BRT Length	**279.6**

CHAPTER – 7
TRAFFIC AND TRANSPORTATION PLAN

7.1 COMPONENTS OF TRAFFIC AND TRANSPORTATION PLAN

7.1.1 On the basis of projected traffic and long term transport strategy, an integrated multi-modal mass transport system plan indicating different mass transport systems on various corridors has been suggested in order to cater to traffic up to the year 2025. The balance traffic should be carried by road system in order to satisfy the needs of normal bus system and other modes such as two wheelers, cars, bicycles, trucks, pedestrians etc. The proposed Traffic and Transportation plan for Bengaluru contains the following types of proposals, which will cater to requirements of the projected travel demand up to the year 2025.

- Mass Transport System
  - Metro System
  - Light Metro System
  - Bus Rapid Transport (BRT) System
  - Sub-Urban Commuter Rail System
  - High Speed Rail Link (HSRL)
- City Bus System
  - Augmentation of Bus Fleet
  - Grid Routes
  - Bus Terminal cum Traffic & Transit Management Centres (TTMC)
  - Multimodal Transit Centre
  - Volvo Depot cum Traffic & Transit centre
  - New Bus Stations/bus shelters
  - Additional Bus Depots
  - IT Infrastructure
  - HRD Infrastructure
  - Environmental Protect Projects
- Integrated Multimodal Transit Centres cum Intercity Bus Terminals
- Transport System Management Measures
- Pedestrian/NMT Facilities
  - Footpaths
  - Skywalks/Subways
  - Pedestrian zones
  - Cycle Tracks
- Road Development Plan
  - New Roads/Missing Links
  - Road Widening
  - Grade Separators
  - Re-alignment of ORR
- Parking Facilities
- Integrated Freight Complexes

7.1.2 While framing the proposals priority has been given to public transport and non-motorized transport such as pedestrian facilities. For the balance travel demand, road improvement proposals have been formulated. The details of these proposals are given in the following paragraphs.

7.2 MASS TRANSPORT SYSTEM

7.2.1 Public/Mass Transport System will be the backbone of the city's transport system. The basic premise of the Transport Plan in terms of the National Urban Transport Policy is to create an efficient, cost effective and extensive network of public transport which could provide comfortable, convenient and affordable means of transport to the maximum number of commuters. In this direction a number of schemes are already under implementation and quite a few on the drawing board. Infact keeping in view the observations of the scenarios in Chapter-6 there exist a large requirement for additional facilities in respect of public/mass transport system for the large area proposed to be developed in the forthcoming two decades as per the Master Plan – 2015 proposals.

7.2.2 Broadly Public/Mass Transport System systems can be categorized in two types:

i. Rail Rapid Transit System
ii. Bus Rapid Transit (BRT) System

7.2.2.1 **Rail Rapid Transit Systems**

Rail rapid transit system or metro rail system with electric traction is highly energy efficient and environmentally friendly. Being a guided system, such system is quite safe and suited for automatic operation. For rapid transit services in urban areas, grade separation (elevated/underground) or fully protected right of way construction is an essential requirement. With modern train control and signalling systems, capacities of 25000 PHPDT or higher are possible with metro rail system. Based on transport demand projections, metro rail system can be designed for following two capacity levels:

i. Light Metro System: Light and Medium capacity system, designed capacity up to 25,000 PHPDT – this includes elevated LRT and monorail system.
ii. Heavy Metro System: designed capacity = more than 25000 PHPDT

7.2.2.2 **Bus Rapid Transit (BRT) system:** Bus Rapid Transit is used to classify a variety of high-capacity, high-speed and/or high-quality service types provided by road based public transport modes. Bus Rapid Transit services tend to provide a higher quality bus service through a range of methods providing improved right of way and priority (e.g. busway and signal priority) to improve journey times and improve reliability of services. These may be combined with vehicle modifications to improve carrying capacity (bi-articulated and tri-articulated buses), comfort (luxury commuter buses) or to provide a different image (stylised buses with the appearance of light rail). The advantage of these bus-based systems is their inherent flexibility allowing for staged development and a mix of operational environments.

BRT system requires exclusive lanes and high capacity buses. With such system a capacity of around 8,000 PHPDT can be achieved with single lane each way. This

capacity can be increased upto 20000 PHPDT through measures like provision of additional lanes, overtaking lane and grade separation at junctions. A variety of power systems are becoming available, including hybrid diesel electric units. CNG buses can also be used in the BRT system. As carrying capacity of buses is much less compared to rail coaches, for a given volume of traffic O&M cost of BRT system is much higher.

7.3 THE METRO NETWORK SYSTEM

7.3.1 Metro Corridors under Implementation: Work on implementation of 42.9 Km of metro, partly underground and partly elevated, has already been initiated by Bengaluru Metro Rail Corporation Ltd. (BMRCL) along East-West & North-South corridors crossing at Majestic. Metro corridor near City Railway Station, Vidhana Soudha, Majestic and City Market will be underground and most of the remaining corridor will be elevated. These corridors will basically cover the most congested core areas of Bengaluru like Peenya, Gandhinagar, M.G. Road, Vijayanagar, Indiranagar, Majestic, K.R. Market, Jayanagar etc. **Table 7.1** gives these Phase I Metro corridors.

Table 7.1 Phase-1 Metro Corridors

Sl. No.	Corridor	Length Km
1	Baiyyappanahalli to Mysore Road	18.7
2	Hesarghatta – Puttenahalli Cross	24.2
	Total length	**42.9**

Implementation of the elevated parts of Phase-1 has been divided into four "reaches" as described below:

East West Corridor :-

- Reach-1: This reach comprises of elevated eastern part of East – West corridor between Baiyyappanahalli and M.G. Road. This reach is expected to be operational by August 2011.
- Reach-2: The elevated western part of East-West corridor between Mysore Road Station and Magadi Road Station is expected to be completed by 2012.

Construction of underground sections has been started and is expected to be completed by 2013.

North South Corridor :-

- Reach-3: The elevated northern part of North South corridor between Swastik and Peenya is expected to be completed by 2012
- Reach-4: The southern part of North South corridor between K.R. Road and Puttenahalli Cross is expected to be completed by 2012.

Construction of underground sections has been started and is expected to be completed by 2013.

7.3.2 **North-South Corridor of Phase-1: Hesarghatta to Puttenahalli Cross:** The initial alignment of North – South corridor was from Yeshwantpur upto R V Road. In view of the developments along Tumkur Road and in the southern part of the City, it was decided to

extend this corridor from Yeshwantpur upto Hesarghatta in the North and from R V Road upto Puttenahalli Cross in the South. The N-S corridor starts from Hesarghatta and passes through Tumkur Road touching Peenya, ORR, Yeshwantpur and passes through the Chord Road in front of ISKCON Temple. From here, it takes a left turn near the Chord Road – M K K Road Junction and proceeds along M K K Road to reach the Railway Over Bridge. Here, it takes a right turn and runs parallel till Binny Mill. It then passes along Platform Road to reach Majestic which is the Interchange point for the N-S and E-W Corridors. From Majestic, the corridor passes through Chickpet area, A.S. Char Road to reach City Market near Vani Vilas Hospital. From here, the corridor passes along K R Road crossing Shiva Shankar Circle to reach National College Circle. From here, it traverses along Vani Vilas Road to reach Lal Bagh West Gate and then reaches South End Circle passing through R V Road. From here, it traverses along R V Road to finally reach Puttenahalli Cross. The total length of this corridor is 24.2 Km. Of this, the stretch between Swastik and K R Road is underground and the remaining portion is elevated.

7.3.3 **East-West Corridor of Phase-1: Baiyyappanahalli to Mysore Road:** The alignment of East – West corridor is from Baiyyappanahalli upto Mysore Road. The total length of this corridor is 18.7 Km. The E-W corridor starts from Baiyyappanahalli and passes through Old Madras Road, 80 Feet Road, Indiranagar, CMH Road, to reach Ulsoor. From here, it passes through Swami Vivekananda Road to reach Trinity Circle and then traverses through M G Road to reach Anil Kumble Circle. From here, it deviates through the parade grounds to reach Chinna Swamy Stadium on Cubbon Road. From here, the corridor passes through Minsk Square, GPO Junction, Vidhana Soudha, Gopala Gowda Circle to reach K R Circle via Dr. Ambedkar Road near M S Buildings. From K R Circle, the alignment passes through Post Office Road to reach Mysore Bank Circle. From here, it traverses through K G Road to reach Majestic, which is the Interchange point. From Majestic, it crosses the railway quarters to reach Magadi Road and then passes via Magadi Road to reach Toll Gate Junction. Here, it takes a left turn to pass through Vijayanagar, Attiguppe, Deepanjali Nagar to reach the junction of Mysore Road and Chord Road near BHEL. At this point, the alignment takes a right turn and passes along Mysore Road and finally terminates just before the junction of ORR with Mysore Road. Only the stretch between Chinna Swamy Stadium and Magadi Road entrance near Leprosarium is underground. The portion from Baiyyappanahalli to Chinna Swamy Stadium and from Magadi Road Leprosarium upto Mysore Road is elevated.

7.3.4 **Extension of Metro Corridors:** The above corridors may be able to give relief to the immediate traffic problems within the core areas and its immediate neighborhood but by the time the Master Plan proposals get implemented and development of areas beyond the Outer Ring Road takes place in right earnest, the above system will fall short and a more extensive system will become necessary. This is especially true because the Master Plan 2015 and its detailed Zonal plans propose the development of large areas for various urban uses. This brings very large spread of area on which various urban activities will take place. They would now be located right upto the Peripheral Ring Road in practically all directions and at a few places even beyond it. These activities include some huge employment potential areas like the Electronic City in the east and southern portions of the BMA. It is therefore necessary that the Metro gets ultimately extended to

the most of the high density centers. Therefore the following additional corridors, considering the projected travel demand are proposed to be taken up as extension of the Metro.

7.3.4.1 **Extension of Hesarghatta – Puttenahalli Cross Corridor upto BIEC on Northern side and upto Peripheral Ring Road on southern side**: Hesarghatta – Puttenahalli Cross Corridor is proposed to be extended upto Bengaluru International Exhibition Center (BIEC) along Tumkur Road on northern side of the corridor. The area to the south of Jayanagar consisting of J.P. Nagar, Banashankari and Kumaraswamy layout are fully developed and quite densely populated. Substantial commutation takes place between these areas and core areas of Bengaluru. BMICAPA has plans to develop residential and commercial activities along the Bengaluru Mysore Expressway corridor, the North-South commuter traffic is expected to increase substantially. It is therefore being proposed that the already approved North-South corridor between Hesarghatta & Puttenahalli cross may be extended upto the PRR along Kanakapura Road and upto BIEC along Tumkur Road. Total length of these extensions is 10.1km.

7.3.4.2 **Extension of Mysore Road Terminal upto Kengeri on Western side and Baiyyappanahalli Corridor upto Whitefield on Eastern side**: The first phase of the East West line has been taken up from Baiyyappanahalli to Mysore Road. However as would be seen from the plan and the subsequent proposals, Outer Ring Road (ORR) is one of the most important spines of Bengaluru on which large city traffic converges and keeping this in view mass transport in the form of BRT/ Light Metro is proposed on it in addition to its improvement and smoothening. Whitefield is the Rail station for the proposed Sub-Urban Train Rail Systems on Bengaluru City Station – Whitefield rail corridors. Since it is a very important transport node where a number of transport modes i.e. Light Metro, CRS etc., meet, it can act as an excellent inter-modal interchange. Therefore it is proposed the East-West corridor is extended from Baiyyappanahalli to Whitefield on the eastern side and from Mysore road terminal to Kengeri on western side of the phase I corridor covering a distance of 18.3 Km.

7.3.5 **New Metro Corridors**

7.3.5.1 **Electronic City to Srinivasapur**: The singular North-South corridor planned so far will mostly be able to cater to the city between BIEC and upto PRR along Kanakapura Road. However the development coming up on the eastern side between Hosur Road and White Field – the I.T. and the Electronic cities and in the Northern side near Srinivasapur need another north-south corridor. In order to meet the traffic demand of this area another 31.8 Km long corridor from Srinivasapur to Electronic City via Nagavara, has been proposed. This corridor serves the areas of Singasandra, Dakshin Honda, Kudlu, Garvebhavipalya, HCL, Bommanahalli, Roopena Agrahara, Madiwala, Sarjapur Road Junction, Koramangala 7th Block, Adugodi, Hosur-BG Road Junction, Langford Town, Richmond Road, MG Road, Commercial Street, Coles Park, Benson Town, Fraser Town, P&T Colony, Gandhi Nagar, Nagawara, Rashthrothana Vidya Kendra, Diana Public School, KNS Institute of Technology, Kannur Road Junction, Reva Institue of Technology, Thanisandra Main Road and terminates at Srinivasapura. This corridor will also have interchange with the BIA Metro to provide direct access from south Bengaluru to the BIA.

7.3.5.2 **Yeshwantpur to BIA:** A new International airport has come up at Devanahalli about 35 Kms North of Bengaluru. In order to provide an unhindered approach to the BIA, a metro link between Yeshwantpur and BIA 37.8 Km long has been proposed. The corridor starts from Yeshwantpur Industrial Area and covers the area of Mathikere, BEL circle, Bhadrappa Layout, Kodigehalli, Sahakaranagar, Judicial Layout, Yelahanka Bazar, Kogilu, Srinivaspur, Ballahalli, Kannuru, Hosuru, Marenahalli, Bagaluru, Sahibpalya, Basavanagudda, Bande Kodigenahalli, Mailanahalli and finally terminates at Bengaluru International Airport (BIA).

The above proposals of metro extensions and new metro corridors have been consolidated and listed in **Table 7.2** along with the phase-1 metro corridors with total length of 140.9 Km.

Table 7.2 Recommended Metro System 2025

Sl. No.	System Type	Corridor	Max. PHPDT (2025)	Length (Km)
	Metro			
a	**Metro Corridors-Phase-I (under construction)**			
i)	Hesarghatta – Puttenahalli Cross (North-South Corridor)		29173	24.2
ii)	Baiyyappanahalli – Mysore Road Terminal (East-West Corridor)		30385	18.7
			Total (a)	**42.9**
b	**Extension of Metro Corridors**			
i)	Extension from Hesarghatta line to BIEC along Tumkur Road (Nortl part)		13978	2.7
ii)	Extension of Puttenahalli Cross line to PRR along Kanakapura R (Southern part)		19105	7.4
iii)	Extension of Mysore Road terminal line upto Kengeri (Western part)		5050	5.9
iv)	Extension of Baiyyappanahalli line upto Whitefield (Eastern part)		20230	12.4
			Total (b)	**28.4**
c	**New Metro Corridors**			
i)	Electronic City to Srinivasapur		23452	31.8
ii)	Yeshwantpur to BIA		23577	37.8
			Total (c)	**69.6**
	Total Metro Length (a + b + c)			**140.9**

Thus ultimately it is suggested that 141 Km of network of Metro will be required to effectively serve the major traffic corridors and high density use areas to meet the travel demand up to 2025.

7.4 LIGHT METRO SYSTEM

7.4.1 Light Metro system are characterized by exclusive rights of way, advanced train control systems, short headway capability, and floor level boarding. These systems approach the passenger capacity of full metro systems, but can be easily constructed by using the

ability of light metro system vehicles to turn tighter curves and climb steeper grades than standard metro system vehicles.

7.4.2 In addition to the metro, the corridors in Bengaluru where the traffic volumes are upto 25,000 PHPDT and the requirement is to cover a wide area with a large network and also to act as feeder to Metro, a medium capacity system is required. In fact upto about 12000 PHPDT, BRTS can also work reasonably well. However the limitation with it is that in order to make it really effective, dedicated 10 meter wide bus lanes (bus ways) are necessary at grade. However on roads where the right of way does not permit carving out the at-grade busway, an elevated light Metro (LRT, Monorail etc.) is the preferred option, since it does not impinge upon the capacity of the at grade carriageways which continue handling the vehicular traffic. The Master Plan 2015, while pointing out the inadequacies of the present public transport system and emphasizing the need for a multi-modal public transport system, has referred to light metro as one of the alternative modes. It is proposed to have a light metro along the western part of the ORR from JP Nagar to Hebbal. In addition to this, the other corridor proposed is from Hosur Road – Bannerghatta Road Junction to PRR, Kathriguppe Road / Ring Road Junction to National College, PRR to Toll Gate along Magadi Road and Indiranagar to Whitefield. Accordingly the following corridors with a total length of 77 Km have been identified for Light Metro system.

Table 7.3 Light Metro Corridors

Sl. No.	Corridor	Length Km
1	Hebbal to JP Nagar	31.3
2	Toll Gate to PRR	9.7
3	National College to Kathriguppe Junction	5.0
4	Hosur Road – BG Road Junction to PRR	13.8
5	Indiranagar to Whitefield	17.2
	Total	**77.0**

7.5 BRT SYSTEM

7.5.1 BRT is one of the most cost effective public transport modes where the following two conditions can be met:

- Sufficient Right of way (30m or more) is available along the corridor to provide for exclusive carriage ways for BRT
- The peak hour commuter load is up to 12,000 PHPDT

7.5.2 The BRT also has the advantage of large coverage and ease of accessibility as well as simpler operational systems. Accordingly taking into consideration the Master Plan 2015 development proposals and travel demand, BRT system is proposed on the following corridors as given in **Table 7.4** along with approximate right of way of the roads and tentative status of available land.

Table 7.4 Bus Rapid Transit (BRT) Corridors

Sl. No.	Corridor	Length (Km)	Proposed Master Plan Carriage Way (m)
1	JP Nagar–Hebbal (along Eastern ORR)	31.7	45
2	ORR to Hosur Road (upto PRR)	13.0	60
3	Hosur Road to Tumkur Road (Western PRR)	42.9	100
4	Tumkur Road to Hosur Road (Eastern PRR)	78.5	100
5	Along CRR	31.2	28 to 45
6	PRR to Kengeri to JP Nagar	15.9	24
7	Domlur Extn to Koramangala	5.6	45
8	Mulur to Maruthinagar	7.1	45
9	BIEC to PRR	2.1	60
10	Cricket Stadium to BIA via Hebbal	34.0	25 to 60
11	Yelahanka to PRR	9.9	35
12	KR Puram Metro station to PRR (Along Old Madras Road)	7.7	60
	Total	**279.6**	

Thus it is proposed to have at least **532 Km** of mass transport system consisting of Metro, Light Metro, HSRL and BRT. All these proposals are shown in **Figure 7.1**. In addition to this network, the city bus system will cover a much larger area and will compliment the above systems.

7.6 SUB-URBAN COMMUTER RAIL SYSTEM

7.6.1 Within the BMA, approximately 120 Km of rail system of the Indian Railways exists basically for long distance passengers and goods/ freight. This system currently is not being optimally utilized for sub-urban movement with in the BMA. However RITES in its study has identified some of the Railway corridors along which it is possible to run Sub-Urban Commuter Rail services with some additions and improvements. A similar proposal of utilizing approximately 62 Km track and incurring an expenditure of Rs. 650 Crore on making the commuter service possible in two phases (2007 to 2012 & 2013 to 2018 each estimated to cost Rs. 325 Cr.) has been recommended in Master Plan 2015. The plan has also indicated a land requirement of 62 Ha for this project. However it is found that the network proposed above will not be sufficient to meet sub-urban requirements of Bengaluru Metropolitan Region and beyond.

7.6.2 With the coming up of BMRDA's planned new Town Ships at Bidadi, Ramanagaram, Solur, Sathanur & Nandagudi, high level of commutation is expected between them and the Metropolis. Also, with the development of the huge Multiple Economic Activity Areas like Electronic City, I.T. Parks, Industrial & Commercial Areas with consequent job opportunities on the one hand and availability of comparatively cheaper accommodation in surrounding towns like Hosur, Ramanagaram and Tumkur etc. where a large number of working population is likely to live, substantial commuter movement between these towns and the Metropolis will take place. In order to cater

to this suburban commuter traffic, the Sub-Urban Train Service is proposed as given in **Table 7.5** below.

Table 7.5 Sub-Urban Commuter Rail Service Corridors

Sl. No.	Corridor	Length Km
1.	Kengeri – Ramanagaram	32.0
2.	Baiyyappanahalli – Hosur	41.0
3.	Yeshwantpur – Tumkur	64.0
4.	Yelahanka – Doddaballapur	24.0
	Total	**161.0**

7.7 HIGH SPEED RAIL LINK (HSRL):

7.7.1 Government of Karnataka has decided to implement the HSRL to connect City centre to BIA at Devanahalli. The alignment of this corridor starts at Police Grounds situated between M G Road and Cubbon Road. The alignment passes through Cubbon Road, Raj Bhavan Road and Sankey Road to reach BDA Head Office. It then passes straight along Bellary Road (NH-7) to reach BIA passing through the areas of Ganga Nagar, Hebbal and Yelahanka to finally reach BIA. The total length of this corridor is about 34 Km out of which 33 Km is elevated and about 1 Km at-grade. The entire corridor has only 4 stations at Cubbon Road, Hebbal, Yelahanka and BIA. Cubbon Road and Hebbal stations are the check-in stations while Yelahanka is only a pick up station.

These proposals are indicated in **Figure 7.1.**

Figure 7.1 PROPOSED INTEGRATED PUBLIC TRANSPORT NETWORK- 2025

A-3 size

7.8 AUGMENTATION AND IMPROVEMENT IN CITY BUS SYSTEM

7.8.1 While the high capacity BRT will be operational on selected routes where substantial right of way is available, the major areas, specially the inner areas and the areas approached by the internal roads will in any case continue to be served by local bus system which will act as the most important feeder system to the Metro, Mono Rail/LRT and the CRS. For this purpose the BMTC has identified East-West, North-South & diagonal grid routes along 27 corridors as already indicated in **Figure 1.4**. In addition to improving the fleet capacity, rationalization of routes, improvement in traffic management at the junctions including priority signaling, provision of proper road side bus stops and feeder bus services for Metro, Mono Rail and CRS along with the integration points will provide effective use of the bus system. BMTC shall continue to play a vital and leading role in public transport in any scenario of the City's development. In order to meet the future challenge, BMTC has planned a number of initiatives as included in the following proposals:

Table 7.6 Proposed Improvements in the City Bus System

Sl. No.	Proposals	Description
1.	**Augmentation of Schedule and Fleet**	At present the BMTC has deployed a fleet of 6122 buses at more than 1700 routes carrying more than 42 Lakh passengers. By the year 2025, despite the fact that we are going to add Metro, Mono-rail /LRT or BRT, still the feeder services and regular bus services on the other less dense corridors will definitely be run by the city bus system only. This city bus system will supplement the other mass rapid transit system modes in an integral manner. It is expected that by 2025, 55 Lakh trips will be performed by buses only. For this volume of traffic at least 9000 buses will be required. However, this number may have to be increased substantially in case any of the MRT components lag behind in implementation. It is further pointed out that mere increase in fleet is not enough, its quality will also have to be of much higher standard if we want to achieve the NUTP policy of changing the passenger preference from personalized vehicles to Public Transport. Accordingly it is suggested that all the new buses to be added to fleet, either as addition or replacement should be low floor good quality buses fully considering the commuter comfort. A judicious mix of express buses serving point to point destinations, limited stop buses along with regular buses will have to be provided.
2.	**Grid Routes and Dedicated Bus Lanes**	The BMTC has identified 27 grid routes in the North, South, East and West and diagonal directions, which was expected to meet the requirement till about 2010. Most of these grid routes are confined upto the ORR, and only a few transcend beyond it. However, by 2025 when the complete Development Area of more than 814 Sq. Kms proposed in BDA Master Plan gets fully occupied, these grid routes will have to be extended upto the PRR and new direction oriented routes added to serve this area. These routes will complement the Metro and BRT already proposed between the ORR and PRR.
3	**Bus Terminal cum Traffic & Transit Management Centres**	TTMC's are planned to have multi-level parking lot, public utilities like mini-shopping centres and food courts. These centers, in addition to providing park & ride facilities are also proposed to act as hubs for Mini – Buses planned by BMTC

Sl. No.	Proposals	Description
	(TTMC)	to transport the commuters from every major residential area to the nearest TTMC, so that commuters can board a bus of their choice. BMTC has planned such TTMC's at the about 50 locations. Of these, TTMCs at Jayanagar Bus Station, Shanthinagar, Domlur, Kengeri, Bannerghatta, Koramangala, ITPL at Whitefield, Vijayanagar are completed. The TTMC at Jayanagar Bus Station has become operational while that at Shanthinagar has been completed and inaugurated in September 2010. In fact few these centers will act as Intermodal transfer nodes and will provide logistic support to MRT modes like – Metro, Monorail/LRT, BRT & Sub-Urban Train System etc. through Park & Ride as well as other facilities. In fact as the MRT network grows, some additional TTMC's may be required and in some cases, a slight relocation of some of the proposed TTMC's may be required.
	TRAFFIC & TRANSIT MANAGEMENT CENTERS (TTMC)	
	Completed: Jayanagar Bus Station, Shanthinagar, Bannerghatta, Kengeri, Domlur, Yeshwantpur, Koramangala, Vijayanagar, ITPL and Banashankari	
	To be taken up in the near future: Kathriguppe, HSR layout, Nagarabhavi, Yelahanka, Anjanapura	
	Others listed for future years: Indiranagar, Hebbal, Hennur, Kalyan Nagar, Srigandada Kaval, Poorna Prajna, Jayanagar Depot-4, Peenya, Rajarajeshwari Nagar, Hosakote, Bidadi, Vaddarahalli, BIA, Venkatala, Bairathi, Avalahalli, Channasandra, Kodathi, Dodda Togur, Gollahalli, Kaggalipura, Challaghatta, Sulikere, Machohalli, Madapura, Harohalli, Soladevanahalli, Kambipura, Baiyyappanahalli, KR Puram, Vishweswaraiah Layout, Basaweshwaranagar, Chikkanagamangala, M S Palya, B T M Layout	
4	**Multi-Modal Transit Center**	The MMTC at Subhash Nagar has been planned at a cost of Rs. 400 Crore
5	**Volvo Depot cum Traffic & Transit Centre**	Banashankari
6	**New Bus Stations / Bus Shelters**	In addition to the 6 major Bus stations viz., Kempe Gowda Bus Station at Subhash nagar, Shivajinagar, K R Market, Shanthinagar, MCTC on Mysore Road & Banashankari and 27 sub-nodal bus-stations commissioned at various locations, BMTC has plans for another 23 bus stations and about 300 bus shelters.
7	**Modern Bus Depots**	Nagarabhavi, Sreegandadakaval, Vaddarahalli, Kothnurdinne, Poornaprajna Layout
8	**New Depots**	In addition to the existing 24 bus depots, BMTC intends adding another 27 depots at a cost of Rs. 161 Crore to make the total number to 51. However in order to cater to the 2025 proposed fleet size of 9000 buses, BMTC may need another 20 depots for the additional fleet.
9	**Improvement of IT Infrastructure**	BMTC is the first public transport undertaking in the country to use the sophisticated GPS technology for monitoring and tracking of vehicles. In order to provide commuter friendly information, the corporation proposes to transfer GPS generated positional details of the buses to commuters in the form of Passenger Information System (PIS) through display at bus stops/ bus stations also through Interactive Voice Response System (IVRS). In addition, introduction of Electronic Destination Boards on buses, introduction of Electronic Ticketing System, Expansion of Computerisation activity and establishment of surveillance system are being implemented in stages.

Sl. No.	Proposals	Description
10	**Development of HRD Infrastructure**	Training of employees of a large staff organization such as bus system is very important. Therefore 2 hitech multi disciplinary centers, establishment of employee training modules and establishment of employee development centers have been proposed.
11	**Environment Protection Projects**	Various environment protection measures at bus depots are being proposed such as Rain water harvesting, Installation of solar lighting system and other environmental initiatives.

7.8.2 The BMTC is rendering excellent service as a public transport provider and the services have improved over the last few years. BMTC also has introduced AC Volvo buses for long distance travel to areas like Electronic City, ITPL in addition to the Vayu Vajra services to BIA from different areas of Bengaluru. It is therefore imperative to ensure that the mass transport system is patronised. As of now, Metro Phase-1 is under construction and a full fledged MTS would be available in Bengaluru by 2015 when the Metro becomes fully operational. Towards this end, BMTC needs to provide feeder services to meet the requirements of the public preferring to travel by Metro as against private vehicles.

7.8.3 Rationalization of bus services is an on-going exercise to achieve the objectives of enhancing bus operation efficiency while meeting passenger demand, reducing traffic congestion and roadside emission, having regard to the changes in passenger demand and the opening of new transport infrastructure. BMTC has already embarked on the concept of 'Route Rationalization'. However, the trend of BMTC needs to be changed for providing 'Direction Oriented Services' as opposed to destination oriented services presently being operated by BMTC. The direction-oriented route plan is based on the 'hub and spoke' principle: lots of spokes leading to one hub. Thus, high-frequency buses can ply on very busy routes and low frequency buses on easier routes. The bus routes may also be classified into 4 or 5 categories depending on the type of roads on which the services are being operated. The routes may be classified as under:

- **Arterial / Radial Roads** – As these roads are generally straight long roads, vestibule services may be run with more frequency. Example: Mysore Road, Hosur Road, Bannerghatta Road etc.

- **Thoroughfares**: These roads may not be generally wide but definitely carry large volume of bus traffic. Hence, the present range of buses can be operated along these routes as these roads act as thoroughfares to other areas in the vicinity. Example: Sampige Road / Margosa Road In Malleswaram

- **Local Thoroughfares**: These are roads are of minimum width but the areas are destinations themselves. Hence, it would be viable to run minibuses along these routes / areas with increased frequency e.g. on Sanjayanagar Main Road where destinations include Sanjayanagar, Nagashettihalli, Bhoopasandra) and Hanumanthanagar 50 Feet Road (destinations include Srinagar, Girinagar etc).

- **Collector Roads:** These roads are very narrow but demand for public transport is more. Hence, feeder buses may be provided along these routes / roads/ areas to connect them to the nearest terminal / bus stop with more frequency of services being operated throughout the day. It is however suggested that before embarking on these proposals, a detailed study of some of the routes may be conducted and feasibility of introducing these facilities need to be adjudged.

7.8.4 BMTC has been providing PHS (Peak Hour Service) for office goers by operating buses to Vidhana Soudha, BBMP and other Government Departments during the morning and evening hours on week days from almost all areas of Bengaluru. These services are restricted only for one or 2 hours per day in the morning and evening. It would however be more prudent if 'Express Services' are provided throughout the day with a judicious mix of point to point and limited stop service on a regular basis. This in turn will have an effect on the road network in the City.

7.8.5 BMTC is also operating Hospital Special Services to cater to the needs of the patients visiting some of the hospitals within the CBD of the City. Although the services rendered by BMTC have improved over the years, there is still need to augment the services. Towards this effect, it is proposed and recommended that separate bus lanes may be provided in high density and frequency corridors wherever feasible. For this, some pilot routes may be first identified and implemented on a trial basis and based on the results of this, decision may be taken for provision of separate bus lanes.

7.8.6 Thus, BMTC needs to concentrate on the following aspects:

- **Service Reduction:** For bus routes with low utilisation and subject to their actual performance, measures like adjusting the bus routing, service frequency and timetable, reducing the number of bus stops, truncation or amalgamation of routes, route cancellation, etc. as appropriate may be adopted.
- **Service Improvement:** On the other hand, the service frequency of bus routes may be increased according to the patronage of and passenger demand for existing bus services, or introduce new bus services where circumstances so warrant.

7.9 INTEGRATED MULTI MODAL TRANSIT CENTRES (IMTC)-CUM-INTERCITY BUS TERMINALS

7.9.1 At present all the buses whether Inter-city, Inter-state or Intra-city originate and terminate at the Central station in Majestic area. This not only creates congestion and heavy traffic density on all radial routes coming into the core of Bengaluru but also results in substantial delay to the passengers who have to take the buses to far flung areas. Though another intercity bus terminal cum integrated multi modal transit center is being contemplated at Peenya, it will not be sufficient to meet the requirements of traffic from the other direction – especially North, East & South. It is, therefore proposed that there should be at least 4 more Intercity terminals. Accordingly it is suggested that ultimately 5 intercity terminals be located at the following places:

1. Peenya (North-West of Bengaluru)
2. Hosur Road (South-East of Bengaluru)
3. Baiyyappanahalli (East of Bengaluru)

4. Bellary Road near Hebbal (North of Bengaluru)
5. Majestic (at the present KSRTC Terminal) (Central Bengaluru)

7.9.2 The details of each of the above mentioned proposed IMTCs are briefly described herewith:

- The area for Peenya IMTC has been acquired by M/s BMRCL and handed over to KSRTC. The work is in progress and is likely to be completed by November 2012.
- The location for IMTC on Hosur Road is yet to be identified by M/s KSRTC.
- The IMTC at Baiyyappanahalli is already under partial operation since March 2010. The work for construction of full fledged IMTC is to be taken up on priority as also the connectivity of the IMTC (by way of grade separator) with Old Madras Road for easy and efficient movement of buses and private vehicles.
- The location near Hebbal is identified and the work is yet to commence.
- For the proposed IMTC at Majestic, tenders have been finalised and the work is likely to commence by the end of 2011 and the facility may become operational in the next 4 to 5 years.

7.9.3 The above terminals are proposed to be located at the Metro and BRT terminals and will act as inter modal interchanges between regional and local traffic. Also these would be the center for Chartered and tourist buses, with adequate parking facilities and tourist bureaus / offices etc as well as other tourist infrastructure for operation of private tour operators who are presently located mostly around the Majestic Area. These proposals have been indicated in **Figure 7.2**.

7.10 INTER-MODAL INTERCHANGES

7.10.1 **Proper integration of modes:** Integration between amongst bus, metro, light metro and suburban railway is a vital need for the future. The city is planning two such major inter-modal interchanges.

- The first such interchange is already under bid – the Kempegowda Bus Station at Subhash nagar is proposed to be converted into an interchange that accommodates the BMTC, KSRTC, Metro, and a "city center" complex.
- The second interchange is proposed at Baiyyappanahalli, which will have the BMTC, KSRTC, Railways and Metro.

In addition to the above major 46 interchanges as indicated in **Figure 7.1** are proposed at required intersections of mass transport corridors. These inter-modal interchanges and their facilities have been discussed in detail in Chapter 8 of this report.

7.11 ROAD INFRASTRUCTURE

7.11.1 The present road network consists of the Ring Roads and major radial corridors. A number of proposals have already been very broadly included in the Master Plan 2015. In addition quite a few proposals are being implemented by Govt. agencies like NHAI, State PWD, BBMP, BDA, BMRDA and BMICAPA along with the private sector through PPP model. It is necessary to integrate / superimpose all these proposals in the light of

projected travel demand for road traffic and confirm that they are in conformity with each other and there is neither conflict nor duplication. As the radial road corridors are expected to have high traffic volume, these corridors have been proposed to be strengthened instead of isolated improvements. The road improvement proposals include road widening, new roads (bypasses and other roads), ORR realignment, grade separators (road flyovers, ROBs, RUBs), Integrated Freight Complexes etc. These proposals are explained below.

7.11.2 **Functional Hierarchy:** In the existing road network, except for defining National Highways no other road has been specifically defined according to its functions. The Master Plan 2015 has broadly defined them as under:

- Ring Roads – Core Ring Road (CRR), Outer Ring Road (ORR), Peripheral Ring Road (PRR), Intermediate Ring Road (IRR), Satellite Township Ring Road (STRR)
- Expressways – Airport Link Road
- Highways – National Highways, State Highways
- Arterial Roads
- Sub-arterial roads
- Other link roads

Figure 7.2

Integrated Multi Modal Transit Centres cum Intercity Bus Terminals

A-3 size

It is however suggested that for new roads, we may clearly define them as shown in **Table 7.7** below and provide them with adequate protective green belt beyond their Right of Way in order to control direct access and avoid ribbon development:

Table 7.7 Functional Hierarchy of Roads

Road Nomenclature	Functional Characteristics	Minimum Suggested Right of Way (ROW)	Restricted green belt beyond the ROW
R-1	Access controlled Expressway with proper service roads like Peripheral Ring Road, Expressway linking the Town with New airport, Other Regional Roads like the Intermediate Ring Road and the Satellite Towns Ring Road etc.	100 Mts	30 Mts.
R-2	Arterial Roads	80 Mts	15 Mts
R-3	Secondary Roads/ Sub-Arterial Roads providing main internal access in functional areas- Industrial, residential, institutional and commercial areas.	45 Mts	
R-4	Access Roads providing access to individual properties. No kerb parking is to be provided	20 Mts.	

The suggested cross-sections for the above categories of roads are shown in **Figure 7.3**. It is suggested that in order to control the development along R-1 & R-2 roads, legislation similar to the 'the Punjab Scheduled Roads and Controlled Areas Restriction of Unregulated Development Act, 1963' may be enacted.

Figure 7.3

Proposed Road Cross Sections

A-3 Size

7.11.3 Major Road Proposals

7.11.3.1 **Ring Roads**: The City would be looking at significantly altering the radial, "through the core" traffic pattern by improving / developing key "rings," in the BBMP, BDA, and BMRDA jurisdictions:

- **Core Ring Road (CRR)**: Of about 30 km length, around the core area, this would form the primary "bypass" to the inner core BBMP area. This road may be constructed as an elevated corridor, to minimize land acquisition. The ground level carriageways may be reserved for public transport i.e. BRT, while the private vehicles and para transit vehicles should use the elevated deck. However this proposal will also entail improvement to the radials meeting it and their junctions with the CRR.

- **Outer Ring Road (ORR)**: Is at a radius of 7 to 10 Km from the city center. The outer ring road covers a total length of 62 Km and connects all major roads and highways in and around Bengaluru. However, by efflux of time, the ORR has almost become a city road, with local traffic and many signaled intersections, and development all around. At present this road has a number of bottlenecks and kinks. Infact near Pantarapalya on Mysore for about 6.5 Kms the ORR follows the Mysore Road radial corridor only. The proposals consist of realigning the ORR at a couple of points and providing 2 fly-overs where the ORR has some common portions with Sarjapur Road and Bannerghatta Road. These proposals are to be carried in small lengths totaling up to about 16.6 Kms and are indicated in the **Table 7.8** below. On the eastern crescent of this road, BRT corridor with exclusive segregated lanes and allied facilities for operating high capacity buses has been proposed, while on its western crescent Monorail / LRT has been proposed.

Table 7.8 Outer Ring Road Re-alignment

Sl. No.	Stretch	Length Km
1	Elevated road along Bengaluru University Road	2.5
2	Realigning ORR between Magadi Road and Pipe Line Road	1.9
3	Realigning ORR at Tumkur Road through CMTI	1.2
4	Realigning ORR from Kasturi Nagar to Mahadevapura along Salem railway line	5.0
5	Elevating ORR along common portion with Sarjapur Road	2.0
6	Elevating ORR along common portion with Bannerghatta Road	1.0
7	PESIT to Jnanabharati Entrance Bengaluru University	3.0
	Total	**16.6**

- **Peripheral Ring Road (PRR)**: The Master Plan 2015 has proposed a Peripheral Ring Road of around 116 Km around Bengaluru at a radial distance of 2.80 to 11.50 Km from the existing outer ring road. On the western side of the city just about 1

to 5 Km inside the PRR an access-controlled expressway is already being constructed under the auspices of the Bengaluru Mysore Infrastructure Corridor Area Planning Authority (BMICAPA) through Private Sector. This Expressway connects NH-7 (Hosur Road) and NH-4 (Tumkur Road) covering approx. 41 Kms. The Eastern Portion of the PRR between NH-4 & NH-7 via Old Madras Road, Airport Road should be taken up immediately to be followed by implementation of the western portion. The entire PRR should have exclusive segregated lanes and allied facilities for operating high capacity buses as BRT system. Along this Ring Road at its Junctions with Hosur Road (NH-7), White Field Road, Old Madras Road (NH-4), Bellary Road, Tumkur Road and Mysore Road, six Integrated Freight Complexes (IFC) have been proposed for handling entire freight traffic. These IFCs are indicated in **Figure 7.4**. Since it is proposed not to allow the HCV's to enter the town inside the PRR, the junctions will have to be grade separated at these points. This road should be treated as R-1 and have the 30 meters restricted belt on either side beyond the ROW.

7.11.3.2**Other New Roads / Missing Links**: In addition to the above roads, a few small links are required to cater to the important activity areas from the major existing Network and under implementation. Accordingly the new roads (including elevated CRR, PRR, A.P. Link Expressway and other new links proposed to be taken up are as listed in **Table 7.9** below.

Table 7.9 New Roads / Missing Links

Sl. No.	Corridor	Length Km
1	Core Ring Road (CRR- Elevated)	30
2	Arterial Roads crossing CRR	30
3	Peenya Industrial Area to Bengaluru Mysore Expressway	2.2
4	Peripheral Ring Road (PRR)	114
5	Link from Tigalarapalaya Main Road to Nelagadaranahalli	1.23
6	Link from Hesarghatta Main Road to Shettihalli and Madarahalli to M. S. Palya	4.02 (1.38 + 2.64)
7	Link from Sampigehalli to CRPF parade	1.72
	Total	**183.17**

7.11.3.3**Road Improvements**: The entire traffic from the BMA, the Region and even beyond converges on to the Center of Bengaluru and the work areas along the radial corridors and gets dispersed through the ring roads. Most of the radials roads suffer from congestion because of their over utilization of their limited capacity. In addition the limited carriageway, inefficiency of the junctions and their incapability to handle the volumes of traffic further reduces the capacity of the road systems. Accordingly it was found necessary that quite a few important roads will require improvements through widening in order to cater to projected road traffic up to the year 2025. Accordingly the roads, both inside the ORR and out side the ORR, connector roads, parallel ring roads etc identified for their improvements in terms of widening of carriageway, provision of drainage, surface improvement, foot-path etc. are listed in **Annexure – 7A.** Widening on

these roads will be subject to land acquisition and other local issues. In addition, at some of the critical junctions where normal signaling cannot effectively manage the traffic volumes, grade separators like underpasses & flyovers will be necessary. Also at road crossings with railway lines, at some places Road Over Bridges or Road Under Bridges will be necessary.

Thus, the total length of roads which need improvements is indicated in **Table – 7.10** below:

Table 7.10 Road Improvements

Sl. No.	Type of Road / Location	Total length (Km)
1.	Inside ORR	71.1
2.	Radial Roads outside ORR	202.2
3.	Connector Roads	117.4
4.	Parallel Ring Road	149.5
	Total	**540.2**

The junctions/road stretches requiring Grade Separators, ROBs and RUBs are indicated in **Table 7.11**. (Some of these have been completed and open for traffic while some are under construction).

Table 7.11 List of proposed Grade Separators

Sl. No.	Location / Road
Grade Separators – Roads (Flyovers & Underpasses)	
1	Hudson Circle– N.R. Road Under pass
2	Minerva circle–J.C. Road Fly over
3	Nagavara Junction Along ORR Flyover – **In Progress**
4	Hennur Banaswadi along ORR underpass – **In Progress**
5	Flyover along Hosur Road near Check post
6	Hosur Road–Inner Ring Road along Hosur Road fly over
7	Additional slip road at CSB intersection
8	Along 16 main BTM Layout underpass
9	Kanakapura Road & ORR Jn. Along ORR flyover
10	Flyover on RV road near RV Teacher College
11	Tagore Circle underpass on Gandhi Bazaar Main Road – **In Progress**
12	Tumkur Road & ORR Junction along ORR Grade separator
13	Underpass along pipeline road near Ayyappa Temple
14	Grade separator along Guttahalli Main Road near Guttahalli Circle
15	Underpass at Prof. CN Rao Circle – **In Progress**
16	Grade separator at ORR & Magadi Road Junction – **In Progress**
17	Grade Separator at the junction of Mysore Road & ORR near Nayandahalli – **In Progress**
18	Grade separator along ORR at Junction of 14th Main of HSR Layout **– In Progress**
19	Grade separator along ORR at intersection of Belandur – **In Progress**
20	Grade separator along ORR at intersection of Devarabeesanahalli – **In Progress**
21	Grade separator along ORR at intersection of Kadubeesanahalli – **In Progress**

Sl. No.	Location / Road
22	Grade separator along ORR at intersection of Mahadevapura – **In Progress**
23	Grade separator along ORR at intersection of Kalyan nagar – **In Progress**
24	Grade separator along ORR at intersection of Hennur – **In Progress**
25	Grade separator along ORR at intersection of Veerannapalya – **In Progress**
26	Underpass near Kanteerava Studio along ORR
Road Over Bridges / Road Under Bridges – Rail	
27	ROB along MES Road near Jalahalli
28	Underpass along Link Road Connecting D Rajagopal Road & Kodigehalli Road
29	Ashoka Theatre – Pottery Road
30	Nagavara–Arabic College Road
31	Kasturinagar–Chikka–Banaswadi Road
32	Baiyyappanahalli Road
33	Kadugondanahalli Railway line along Nagavara Main Road
34	Hudi Main Road near Whitefield Railway Station
35	Construction of ORR connecting Mysore Road to Magadi Road including underpass across Bengaluru Mysore Rly Line – Work includes construction of ORR, RUB along B'lore–Mysore Rly line & approaches to RUB. RUB to be taken up by SW Rlys. Original cost Rs. 53.53 Cr. Revised to Rs. 73.24 Crore RUB & approaches Rs. 92 Cr.
36	Along Settihalli Main Road
37	Along S M Road near Gurudwara
38	Along Kodigehalli Main Road near Kodigehalli Railway Station
39	Along Hesarghatta Main Road
40	Near Tanisandra Railway Station
41	Along Kundalahalli Road at Kundalahalli Gate
42	Along Varthur Road near Lakshmi Layout
43	Along Panathur Main Road near Bellandur Railway Station
44	Along Sarjapur Road
45	RUB/ROB near Nayandahalli Railway Station
46	RUB at Nayandahalli
47	RUB at J J Nagar Shamanna Garden LC–4
48	Additional Box at Okalipuram
49	Additional Box at Okalipuram Junction
50	RUB at 11th Cross Malleswaram
51	RUB at 18th Cross Malleswaram near Nirmala Rani School
52	RUB at Mysore Lamps, Malleswaram
53	RUB near Yeshwantpura Railway Station
54	ROB at Mohan Kumar Nagar, Mathikere
55	RUB at Kaggadasapura
56	RUB at Lottigehalli cross
57	ROB at Sampigehalli Road, Jakkur
58	ROB/RUB at Yelahanka old township opp. MES Circle, Yelahanka Railway Station

The above proposals are shown in **Figure 7.4.** Some of the infrastructure projects listed above which include construction of ROBs and RUBs, are needed to be constructed at the railway lines in the City. As this would be a joint venture between the SWR and the local civic bodies like BBMP and BDA, these projects need to be taken up based on the priority as envisaged by the BBMP and BDA.

Figure 7.4

ROAD PROPOSALS & IFCs

A-3 SIZE

7.11.3.4 **Connectivity to BIA:** Road is the only means of connectivity to BIA as on date, located about 40 Km from the city centre at Devanahalli. All out efforts are being made by the Government of Karnataka to ensure a smooth and safe travel to and from BIA. It is also observed that the delay occurs at different junctions within the city limits only. However, from Yelahanka and beyond upto BIA, the travel is more or less smooth and unhindered. However, to ensure a signal free travel for the passengers to and from BIA, it is therefore essential that grade separators like short flyovers or underpasses may be constructed especially at the junctions along this stretch of Bellary Road. This will ensure signal free travel to and from BIA as also smooth maneuver for the cross traffic at junctions.

7.12 NON- MOTORISED TRANSPORT FACILITIES

7.12.1 **Cycle Facilities:** Bicycle use in Bengaluru is not significant but still this needs to be encouraged on environmental considerations. Provision for safer and better section of road or cycle track is the best way to keep them on roads. This necessitates more on roads in the periphery of city and in many areas in BMA. In CBD, some side roads and lanes can be exclusively reserved for cyclists and pedestrians in peak periods. In the new cross sections for major roads in **Figure 7.3**, reservation for cycle tracks has been incorporated.

7.12.2 **Priority to non-motorized transport:** With increasing urban sprawl and rising income levels, non-motorized transport has lost its earlier importance. Statistics show that the share of bicycles out of the total vehicle volume in Bengaluru is only about 1%. The longer trip lengths have made cycling more difficult. Further, non-motorized modes are also exposed to greater risk of accidents as they share a common right of way with motorized vehicles. However, non-motorized modes are environmentally friendly and have to be given their due share in the transport system of a city. First of all, the safety concerns of cyclists and pedestrians have to be addressed by encouraging the construction of segregated rights of way for bicycles and pedestrians. Apart from improving safety, the segregation of vehicles moving at different speeds would help improve traffic flow, increase the average speed of traffic and reduce emissions resulting from sub-optimal speeds. Such segregated paths would be useful not only along arterials, to enable full trips using NMT but also as a means of improving access to major public transport stations. Such access paths, coupled with safe bicycle parking places, would contribute towards increasing the use of public transport. Creative facilities like shade giving landscaping, provision of drinking water and resting stations along bicycle corridors would also be encouraged as they can mitigate, to a large extent, adverse weather conditions. The use of the central verge along many roads, along with innovatively designed road crossings, seems to offer promise for being developed as cycle tracks.

7.12.3 **Pedestrian Facilities:** Pedestrians form a major proportion of commuters. Not only trips are conducted by walk in its entirety but every public transport trip will also have component of walk at its both ends. Though they are short distance travelers, they are spread all over the city. As facilities furnished for them are encroached upon by vendors or for road space, they have to spill on roads.

These contribute to accidents also. One alternative for their facility and controlling their spill on roads is to provide good footpath with railings covering about one to one half meters width on either side of the road with openings at desired crossing points. Another alternative is to develop some narrow roads especially adjacent to major arterials as "pedestrians only" roads. Bus bays and foot paths at bus stops can also help in restraining their spill on to carriageways and reducing accidents. Pedestrian subways at important locations on all 6 lane roads and at busy inter sections/junctions on 4 lane roads are to be planned on a programmed basis.

7.12.3.1 **Pedestrian Cross-Over Walk-ways facilities**: The proposed skywalks/pedestrian subways are given in **Table 7.12**.

Table 7.12 Sky Walks / Pedestrian Sub-Ways

Sl. No.	Locations of Sky Walks / Pedestrian Sub-Ways
1.	Cauvery Bhavan to Education Department Building and to Law College to Mysore Bank crossing KG Road at Mysore Bank Junction
2.	Opposite NTI connecting Guttahalli Road and Palace (opposite Bus Stop) on Sankey Road
3.	Lalbagh Main Gate (Javaraiah Circle)
4.	Bannerghatta Road near Jayadeva Hospital
5.	At Kengeri Bus Stand, Mysore Road
6.	At Byatarayanapura on Bellary Road (near Junction of BBMP office complex)
7.	Shanthala Silk House to KSRTC Main Bus Station and to Good-Shed Road
8.	RNS Motors, Tumkur Road
9.	Jalahalli Circle, Tumkur Road
10.	Near Webb junction
11.	Near Kamakhya, Kathriguppe Ring Road
12.	Gandhi Bazaar Main Road
13.	On Vittal Mallya Road near Mallya Hospital
14.	On JC Road near Ravindra Kala Kshetra
15.	On Hosur Main Road near Madivala Check post
16.	On Raja Ram Mohan Roy Road, near Pallavi theatre
17.	On Richmond Road near D'Souza Circle
18.	On Commissariat Street near Garuda Mall
19.	On Residency Road near Mayo Hall
20.	On Kamaraj Road near Commercial Street
21.	Near Indira Nagar 100 feet Road & Water Tank junction on Airport Road
22.	On Hosur Road(Near Forum)
23.	On Tumkur Road, near SMS Railway Junction
24.	On Air Port Road, Marath Halli at Village Road.
25.	On Air Port Road, Marath Halli at Junction of Under Pass ORR
26.	K.R. Puram Bus Stand
27.	Bharatiya Vidya Bhavan, Devaraj Urs Road
28.	On Hosur Road "T" Junction with Tavarekere Main Road (Opposite Sai Sadan & Prestige Acropolis) (High Rise Apartments Condominium)
29.	Mission Road at the foot of Fly over
30.	Vidhana Veedhi near M S Building
31.	Tumkur Road near Yeshwantpur Circle
32.	At South End Circle

Sl. No.	Locations of Sky Walks / Pedestrian Sub-Ways
33.	Double Road opposite Shanthi Nagar bus station
34.	City Market additional arm to be added to existing underpass
35.	30 no. Sky –walks / Sub-Ways along the eastern crescent of the ORR

The choice between lift/escalator operated skywalks and underpasses will depend upon the specific site conditions and the quantum of pedestrian traffic while undertaking the detailed feasibility studies. Location of these facilities is indicated in **Figure 7.5**.

7.12.3.2 **Foot paths**: It has been observed that most of the footpaths along the major arterial and sub arterial roads need extensive repairs and up gradations. The major problems observed are:

- Insufficient widths (< 1.5 mts.)
- Uneven surface because of settlement of base course, improper covering of service lines, manholes etc.
- Obstruction due to encroachments, unwanted garbage, unused building materials, fallen/ half cut trunks of trees and full grown trees, cable stays of electric poles etc.
- Level difference and steep risers with junctions of roads.

For this purpose tentatively it has been estimated that footpaths along 350 Km of roads are required to be taken up. The basic principles for construction of new footpaths and improvement of existing ones are as under:

- Footpaths along existing roads should be widened and the minimum width be kept at least 2.0 mts.
- Proper leveling of footpath surface – with a stable base course fully compacted and safe guarded against any settlement before laying the top surface. In addition the cover for the underground services and man holes, if any, located below the footpaths or crossing should be properly designed to maintain a proper level with the surface of the footpath and no subsidence occurs.
- Continuity of footpaths
- Adequate ramp facilities for physically challenged people at junctions and cross overs.
- Proper merger of footpaths with skywalks/ underpasses/zebra crossings and junctions be provided with pedestrian priority signaling.

7.12.3.3 **Pedestrian Zones**: Substantial areas inside the Core Ring Road has quite a few streets which are either fully commercial or majority of whose frontage is being used as shopping. The commercial activities on these roads can broadly be divided into the following two categories:

i. Retail and general shopping like general merchandise, clothing and allied products, household white goods, consumer electronics, groceries & kitchen ware, Food & sweet shops etc., which are more or less regularly visited by shoppers.

ii. Wholesale and specialised shops dealing in machinery, building materials, Hardware etc. which are occasionally visited by customers with specific

requirements and need bulk handling through Trucks and MCV's. As far as these commercial activities are concerned attempt should be made to shift them out side the ORR along wide corridors where adequate loading / unloading facilities can be provided along with required parking facilities for visitors / shoppers. For shifting of these wholesale activities both strong measures against their functioning in their present locations in the core areas and incentives for shifting to the new locations will have to be provided.

The majority of the customers visit the core area to meet their retail needs through first type of establishments. As per the plan, this central area is going to be very well served by:

- Metro Links namely
  i. Baiyyappanahalli to Mysore Road (East-West Corridor)
  ii. Hesarghatta to Puttenahalli (North-South Corridor)
- An elevated Core Ring Road surrounding this area with provision for BRT
- Adequate park & ride facilities out side the core area at Bus Terminal cum Traffic & Transit Management Centres, Metro Termini & important metro Stations, BRT stations, along side Core Ring Road and Monorail Termini & Stations.

7.12.3.4**Proposed Pedestrian Zones:** To start with following two areas are being suggested for pedestrianisation:

1. Gandhi Nagar & Chickpet Areas- The area surrounded by Sheshadri Road, Kalidas Marg, K.G. Road, District Offices Road, N.R. Road, Mysore Road and Bhashyam Road, Tank Bund Road & Dhanvantri Road can be converted into two pedestrian zones I & II on either side of K.G. Road. The two Zones can be inter connected through a semi depressed under pass near Alankar Plaza and Janatha Bazar. All the private vehicles will be required to move on Sheshadri Road, Kasturba Road, NR Road and Bhashyam Road, while K.G. Road and District Offices Road be used by Public Transport. In the surrounding areas 5 mechanical parking spaces with a capacity of 500 vehicles each may be provided at;

- P13- Behind Sagar
- P14- Kanteerava Stadium
- P15-Near City Market
- P16-Near Bakshi Gardens
- P17 – KSRTC Bus Depot

2. Commercial Street – To be designated as 'CLOSED FOR VEHICLES FROM 10 A.M TO 9 P.M.' and supported by parking P-2 near Kamaraj Road
3. Brigade Road – To be designated as 'CLOSED FOR VEHICLES FROM 10 A.M TO 9 P.M.' and supported by parking P-1 near M.G. Road

These proposals are indicated in **Figure 7.6.**

Figure 7.5

PEDESTRIAN FACILITY PROPOSALS

A-3 SIZE

Figure 7.6

PEDESTRIAN ZONES

A-3 SIZE

7.13 PARKING

7.13.1 The parking demand is increasing with growth of vehicles in the city. The multistoried buildings in busy/commercial areas are major attractors. Though the building regulations specify a minimum provision of parking area, there can be many defaulters and some who later convert the spaces for other purposes. This results in the vehicle parking spilling to streets (main road or side streets). A practical solution is to provide off street multistoried parking lots in these areas. As funds will be a constraint, consultants suggest a policy in this regard. The Owner who fails to provide required parking spaces as per the regulations should be charged an annual levy equivalent to market rental value for the short fall in parking area provided. Subsequently the market value will rise every year. Amount so collected plus parking charges collected will be enough to meet the repayment installments of loans which were taken to construct multistoried parking lots. Once such facility is provided it is possible to prevent the on street parking of vehicles or otherwise road space can be utilized for traffic. The development control regulations and TCP act may be suitably amended to provide for such levies.

7.13.2 Parking demand can also be controlled by implementing transport management measures like staggering office and school working hours and banning on-Street parking of private vehicles in CBD and on major arterials. However it must be realized that mere regulatory measures are not enough and positive steps are required to meet the parking demand and provide safe parking outside the congested areas. It is suggested that for proper parking management and control, to start with we may divide the city into three zones.

7.13.2.1 Zone A – Central areas inside the Core Ring Road where only short term parking on hourly basis should be provided between 9 AM and 9 PM with high telescopic charges increasing with every hour of parking. These areas will invariably be provided with automatic mechanical parking (AMPs). Beyond 9 PM and upto 9 AM they can offer lower tariff rates for long term night parking.

7.13.2.2 Zone B – between CRR and ORR – in these areas a combination of AMPs and CMPs can be provided at selected interchanges, especially at the TTMCs and other identified locations closer to public transport corridors. Parking in these areas will also be short term time based but at a slightly lower tariff as compared to Zone A.

7.13.2.3 Zone C – outside the ORR – large CMPs may be provided at the TTMC s and other locations adjoining the public transport stations of Metro, Monorail/LRT, BRT etc. These will be long term parking lots of 8 to 12 hours duration at a nominal tariff to encourage the vehicle owners to park at these facilities and use the public transport system to their destination and back.

7.13.3 It is observed that in the CBD areas of the City, on-street parking is prevalent on most of the major roads engulfing the effective carriageway width available for the vehicle users. In view of this, it is prudent that parking facilities as explained above are

provided to ensure smooth maneuver of vehicles. To begin with, parking for about 8500 vehicles has been suggested at the following sites listed in **Table 7.13**.

Table 7.13 Proposed Parking Sites

Sl. No.	Location	Phase	Type
1	M G Road	P-1	AMP
2	Near Kamaraj Road	P-1	AMP
3	Gandhi Nagar	P-1	AMP
4	Koramangala near Raheja Tower	P-1	CMP
5	Rajajinagar BDA Complex	P-1	CMP
6	Banashankari BDA Complex	P-1	CMP
7	Gandhi Bazaar	P-1	CMP
8	Malleswaram	P-1	AMP
9	Fire Station, Residency Road	P-1	AMP
10	Dhobi Ghat, Cunningham Road	P-1	AMP
11	SP Office, Miller Road, Cunningham Road crossing	P-1	AMP
12	Kanteerava Stadium	P-1	AMP
13	K.R. Market	P-1	AMP
14	Bakshi Gardens	P-1	AMP
15	KSRTC Bus Depot	P-1	AMP

Of these sites, where the availability of land is limited and the land values very high, automatic mechanical parking (AMP) which can provide 500 parking lots in approx. 1000 Sqm of space have been suggested. In the outer areas, conventional multistory parking (CMP) has been proposed.

7.13.4 In addition, since most of the TTMC's are proposed to be adequately served by Public Transport like Metro, Mono Rail/LRT, BRT etc, substantial Park and ride facilities should be provided from where the commuters can switch over from private to public transport. These proposals are indicated in **Figure 7.2**.

Similarly at all the termini of Metro, Mono Rail/LRT, BRT, suburban CRS and their major stations out side the Core Ring Road should be provided with adequate park and ride facilities. Within the core area where the land is scarce and very expensive, mechanical automatic & semi automatic parking may be provided with heavy time based parking charges.

7.13.5 In the long run, when the mass transport system is city-wide and adequate, parking demand will stabilize. Therefore it is important that adequate and convenient mass transport system as recommended above is provided. However, before taking up the proposals for implementation, it is highly recommended that the concerned agencies carry out detailed studies and then proceed with the facilities to be provided.

7.14 FREIGHT MOVEMENT

7.14.1 The freight movement through the city particularly on some of the arterials is already restricted in CBD area. Many orbital corridors cannot be easily restrained till such time

the wholesale activities are concentrated in the CBD. The strategy already followed is to decongest the CBD by shifting the wholesale market to outer areas or proposed IFCs along the PRR. In order to facilitate the shifting of the wholesale activity from the core areas, both harsh measures in terms of restriction on the activities at their present location and incentives for relocation in the new areas will have to be followed. The restrictions in the central areas could be in the form of banning the entry of HCVs completely and permitting only LCVs between 10 PM and 9 AM; treating these properties as engaged in misuse activities and charge a very hefty misuse charge on a daily basis and a substantial increase in the property tax. All private vehicles should be banned from entering these areas between 9 AM to 10PM. simultaneously well developed wholesale markets may be created along side the IFCs with modern transport, loading and unloading, parking and ancillary facilities. These sites can be allotted to the persons relocating their business on no profit no loss basis on priority.

7.14.2 The provision of PRR is itself going to help diversion of through freight traffic. Nearly 80% of the ORR has lost the sole identity of ring road, the PRR being thought of in this connection will be a boon to the city. Development of another orbital ring road as proposed by BMRDA would also help in diversion of the freight traffic. So far there is no though regarding the shifting of the goods shed. If a ring railway is formed over the outer ring road, shifting of the goods shed to the periphery of the city can also be thought of. But this will take longer time. However, future planning of the rail facilities in and around Bengaluru will need to be kept this in mind. Such shifts will have some adverse effect i.e. HCV/LCV movement from the goods sheds on the periphery and any wholesale complexes, into the city will develop. By suitable management measures like restricting these movements during particular timings of the day, problem can be suitably managed.

7.14.3 **Integrated Freight Complexes (IFC)**: Near the junctions of the PRR with the following radial corridors, six IFC's are proposed as indicated in **Figure 7.4**:

1. Hosur Road
2. White Field Road
3. Old Madras Road
4. Bellary Road
5. Tumkur Road
6. Mysore Road

In addition to acting as nodes for handling the HCVs traffic and diverting it on the PRR they will also act as center for wholesale trade. Quite a few wholesale markets to be shifted outside the central area can be located as part of the IFC for efficient handling for bulk goods.

7.15 DEMAND CONTROL

7.15.1 Reducing Private Vehicle Use: There are two ways to restraint the growth of private vehicles on road either by pricing policy or by providing better level of service on public transport. Road pricing is difficult to achieve in a city like Bengaluru particularly since its enforcement would be very difficult. It should be possible to put constraints in

some areas by restricting private vehicles entering into the congested roads particularly during the peak hours. Providing good public transport with feeder IPT modes like Mini buses for facilitating the commuters to reach their destinations from Train/Bus stations would also induce many private vehicle users to shift from private vehicles. In fact with the coming up of the Core Ring Road, proposed improvements in the alignment of the ORR, Coming up of the various Mass Rapid Transit (MRT) Modes like Metro, Mono-Rail /LRT & BRT we can substantially achieve the objectives through the following measures:

- Enough parking lots be provided outside the ORR & CRR easily accessible from the radials reaching the ORR & CRR
- Proper park & ride facilities for long term parking at the stations / termini of the MRT modes out side the ORR.
- Providing comfortable, environmental friendly transport (Electrically operated / CNG mini buses) between MRT stations and the core areas.
- The parking facilities provided / planned in side the CRR should only be for short term parking with high hourly charges.
- Congestion Charges be imposed on slab-scale from private vehicles entering first the ORR and then the CRR.
- Private vehicles be completely banned from entering the pedestrian zones during the shopping hours i.e. 10 AM to 9 PM.

The above measures can help in reducing private vehicles in busy areas.

7.15.2 **Land use for demand optimization**: The land use and density component of the above strategy can be operationalized only through revisions in the Master Plan. High traffic generating activities and high density (high FSI) zones should be realigned around mass transport nodes and along major transportation corridors.

Such a reorganization of land use and density cannot be realized only through the modifications in the Master plan. In already developed areas, this needs to be translated into projects for planned redevelopment, ensuring that the high density and high intensity of activities are supported by appropriating land for improvements in the road network, street design and supporting infrastructure. The energy for redevelopment already exists in the real estate market in Bengaluru, and will receive further impetus from the implementation of mass transport projects.
In new growth areas, a mechanism for micro-level planning (such as Town Planning Schemes in Gujarat) will need to be introduced to ensure that all new development is adequately served by primary, tertiary and secondary road network with provision for public transport facilities. These would also essentially have to be translated into land management projects.

7.15.3 **Development of Integrated Facilities**: As already pointed out, Bengaluru has a good network of rail system, which can be converted by adding a few facilities like parallel lines, electrification, additional stations etc to serve as a Sub-Urban Train Rail System also. Detailed studies have been completed already. CRS along with the Metro System

under construction and the Bus Transport can be integrated with good interchange and parking facilities at stations to form an Integrated Transport System.

7.16 TRANSPORT SYSTEM MANAGEMENT

7.16.1 Background: Bengaluru City has witnessed a phenomenal growth in vehicle population. As a result, many of the arterial roads and intersections are operating over the capacity (i.e., V/C is more than 1) and average journey speeds on some of the key roads in the Central Areas are lower than 10 Kmph in the peak hour. Therefore, it has become necessary to establish plans for efficient traffic management in Bengaluru. In this regard, Bengaluru City Traffic Police had envisaged the *"Bengaluru Traffic Improvement Project – B-TRAC"* which has been implemented in stages in the City.

7.16.2 Goals and Objectives: The city of Bengaluru needs a traffic management that addresses not just supply aspects, but also the demand aspect. The objectives of transport system management are two-fold:

1. **Operational Objectives**: (a) Reduce traffic congestion in the Central Area of Bengaluru City; (b) Auto stands/ waiting areas need to be earmarked throughout the city in such a way that they do not hinder the movement of other traffic in Bengaluru. (c) Reduce accidents in the city of Bengaluru; (d) Achieve significant reduction in pollution; (e) Achieve substantial compliance of Traffic Laws and Rules; and (f) Set up an effective Trauma Care System.
2. **Institutional Objectives**: (a) Coordinated traffic management by developing mechanisms for the same, like institutionalizing Traffic Task Force, Road Safety Committee, Traffic Action Committee etc; (b) Robust Revenue Model (traffic funds to pay for traffic management infrastructure and maintenance); (c) Legal and Institutional reforms; (d) Capacity Building (Modernization and up gradation of Traffic Training Institute etc.); and (e) Strengthening of Traffic Police by augmenting officers and staff; construction of buildings and provision of modern communication and mobility.

7.16.3 Strategy: Transport system management framework is as follows: (a) Land use development controls; (b) Primacy to Public Transport; (c) Parking controls and management; (d) Automated Control and Enforcement (ITS/ATC); (e) Entry Restriction to the Central Area; and (F) Road safety plan for accident reduction. Specific components of the strategy are: (a) Central Area – Area Traffic Control System; One way systems; dedicated bye-lanes and signal priority for buses; Parking controls; creation of no-auto zones; restricted entry of traffic in to the core area (b) Core Ring Road development for unhindered movement of traffic thereby avoiding the central area (c) Corridor Traffic Control System (as in ATC) for the several radial roads (d) up gradation of Intermediate and Outer Ring Roads and development of the Peripheral Ring Road (e) Traffic Police modernization with improved communication, computerization, mobility, capacity building and automated enforcement systems.

7.16.4 Components: The various components of transport system management are as under:

- Junction Improvements
- Street Furniture and Road Marking

- Intelligent Transport System including. ATC, VMS etc for 250 intersections
- Surveillance / monitoring and enforcement cameras etc
- Education and Training / Others
-

7.16.5 **Benefits**: The benefits likely to be achieved by phased implementation of transport system management are as follows:

(a) Reduction in Traffic congestion by 30% in the Central Area of Bengaluru City
(b) Reduction in accidents by 30% in the city of Bengaluru
(c) Significant reduction in pollution
(d) Substantial compliance of Traffic Laws and Rules
(e) Effective Trauma Care System
(f) Coordinated Traffic Management
(g) Enhanced level of Traffic and Road Safety Awareness and
(h) State of the art Traffic Policing and regulation leading to substantial compliance.

7.16.6 **Summary**: Transport system management is the first of its kind project in the country to address the issues of traffic congestion, safety etc by utilizing the latest traffic management technology and techniques, which are appropriate to our context. This has given the much-needed impetus for larger infrastructure projects to be planned and implemented for improving the transportation system in Bengaluru city.

CHAPTER – 8
TRANSPORT INTEGRATION

8. 1 NEED

8.1.1 A multi-modal public transport network for the BMA has been proposed to be developed to meet expected commuter's travel needs. Integration of various modes of transport is vital to evolution of a least-cost and viable transport system. Objective of an integrated transport system is to offer maximum advantage from economic, traffic and planning considerations. Various transport modes are to be integrated in such a way that each mode supplements the other. For effective integration, total transport system has to be planned, implemented and operated under common policies. Depending upon the forecast transport demand and other parameters along various corridors, an appropriate transport system giving least-cost option has been proposed.

8.2 INTEGRATION OF MODES

8.2.1 It is not possible to provide direct origin to destination service and vice a versa for all commuters. The need to interchange modes and or corridors is an essential feature of any public transport system. The planning objective as stated earlier is to minimize the need to change and when change is essential to make it as convenient as possible and with minimum time loss.

8.2.2 Integration of various modes of transport is vital to evolution of a least-cost and viable transport system. Intermodal interchange points in Bengaluru have been conceived to provide seam less connectivity to the passengers across various modes of transport between the inter-state buses, sub urban railways, local buses, metro, light metro and IPT modes. Required interchanges have been planned between following pairs of systems:

- Metro to Metro
- Metro to Light Metro
- Metro to suburban CRS
- Metro to BRT
- Light Metro to Light Metro
- Light Metro to suburban CRS
- Light Metro to BRT
- Suburban CRS to Suburban CRS
- Suburban CRS to BRT
- BRT to BRT

8.2.3 The proposed network includes corridors that are collector routes to serve areas at some distance from the mass transport routes. Other corridors are radial that normally would be direct origin to destination routes and hence will meet the objective of minimum interchanges. There are circular routes that will interchange with the radial routes. On these routes, one interchange should meet the needs of most commuters. The overall network of radials and circular corridors has formed a grid and hence most commuters should not need more than one or two interchanges.

8.3 FEEDER SERVICES

8.3.1 Feeder services to the proposed network will also be important in order to provide convenient and quick transfer of passengers from one mode of transport to other. As all commuters will not be living within walking distance of the proposed network, proper planning for feeder services will be necessary to ensure the forecast passenger demand on the system. For catchment area of about 0.5-1 Km from the proposed network, commuter can easily access it by walk. People residing in next 1-Km can reach station by cycles, scooters, auto-rickshaws and mini-buses. Areas outside the 2-Km catchment area will require regular feeder bus services to important terminals/stations. Feeder services can also be provided by Para-transit modes. However, choice of a particular mode will depend upon passenger demand, road cross-section, road gradient, etc.

8.4 INTER-MODAL INTERCHANGE FACILITIES

8.4.1 The major interchanges have been planned between Metro/Light Metro/ suburban Rail and Bus/IPT modes. The city is planning two such major inter-modal interchanges at the Kempegowda Bus Station, Subhash Nagar and at Baiyyappanahalli. In addition to the above, following 46 major interchange locations as indicated in **Table 8.1** below and shown in **Figure 7.1** of **Chapter 7** are proposed at required intersections of mass transport corridors.

Table 8.1 Intermodal Interchanges in Bengaluru and Their Type

Sl. No.	Name	Type of Inter Change
1	PRR (Tumkur Road)	BRT to BRT
2	BIEC	Metro to BRT
3	Hesarghatta	Metro to Light Metro
4	Magadi Road (PRR)	Light Metro to BRT
5	Kamakshipalya	Light Metro to Light Metro
6	Kengeri	Metro to BRT to Suburban CRS
7	PRR (Kanakapura Road)	Metro to BRT
8	PRR (Bannerghatta Road)	Light Metro to BRT
9	Jayanagar	Metro to BRT
10	JP Nagar	Metro to Light Metro to BRT
11	Kathriguppe	Light Metro to Light Metro
12	Mysore Road	Metro to Light Metro
13	Toll Gate	Metro to Light Metro
14	Gopalapura	Metro to BRT
15	National College	Metro to Light Metro
16	BTM Layout	Light Metro to BRT
17	Central Silk Board Junction	Metro to BRT
18	Koramangala	Metro to BRT
19	Hosur Road BG Road Junction	Metro to Light Metro to BRT
20	Maruti Nagar	BRT to BRT
21	Electronic City	Metro to BRT
22	Mullur	BRT to BRT
23	Sanjay Nagar (Varthur road)	Light Metro to BRT to Suburban CRS

Sl. No.	Name	Type of Inter Change
24	Whitefield	Metro to Light Metro
25	Benniganahalli	Metro to BRT to Suburban CRS
26	Baiyyappanahalli	Metro to Metro to Suburban CRS
27	Indira Nagar	Metro to Light Metro
28	Domlur	Light Metro to BRT
29	Trinity Circle	Metro to BRT
30	Cantonment Railway Station	Metro to BRT
31	MKK road	Metro to BRT
32	Mekhri Circle	BRT to BRT to Metro
33	Yeshwanthapura	Metro to Metro to BRT to Suburban CRS
34	Hebbal	Metro to Light Metro to BRT
35	Nagawara	Metro to BRT
36	Srinivaspura	BRT to BRT to Metro
37	Cricket Stadium	Metro to Metro to BRT
38	Yelahanka	Metro to Metro to BRT to Suburban CRS
39	Kogilu	Metro to Metro to BRT
40	Gokul Extension	Metro to Light Metro
41	Nayandahalli	Metro to Light Metro
42	JP Nagar IV Phase	Light Metro to Light Metro
43	Bull Temple Road	Light Metro to BRT
44	Muktadahalli	Metro to BRT
45	JP Nagar IV Phase	BRT to BRT to Suburban CRS
46	Majestic	Metro to Metro to BRT

8.4.2 One of the most important elements of transport integration is the provision of inter-change facilities. Required inter-changes will be between the proposed mass transit systems such Metro, LRT/Monorail, BRTS, suburban CRS and with other feeder services. Inter-change facilities at stations would depend upon expected station load to ensure proper system utilization.

8.4.3 Within the interchange points, well planned pedestrian facilities like network of foot over bridges allows easy movement of passengers between the bus terminal, metro/light metro station and railway station. The access roads to proposed interchange points have been proposed to be strengthened. The other inter – change facilities will include circulation facilities and adequate parking areas for various modes that are likely to come to important stations including feeder, bus/mini-bus. Retail commercial and office spaces are also proposed to be provided at these interchange locations to make this more attractive and convenient. This will also add to the demand of the public transport system. The inter-change facility provision for passengers will have to be made for peak demand at each station. At either stations, proper road based integration is to be ensured.

8.4.4 The proposed interchange points will have the following facilities for the passengers:

- Stairs, Escalators and Lifts for Normal and Emergency Operations
- Lifts to provide access for elderly and disabled

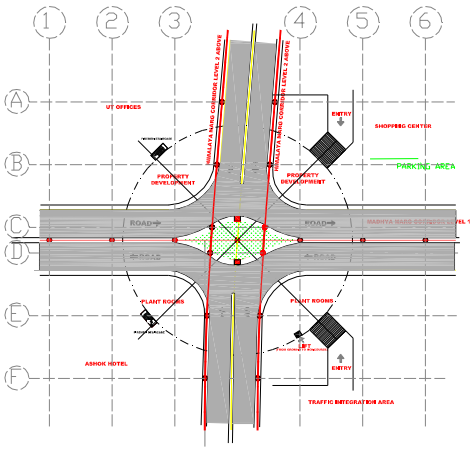
- Ticketing Gates
- Ticket Counters and Ticket Issuing Machines (TIMs)
- Passenger Information Display System (PIDS)
- Public Address system
- Clocks
- Signage
- Safety and Security System like Close Circuit cameras and CCTV, Electronic Access Control System etc
- Fire Fighting System

8.4.5 The main issue is to make these interchanges convenient with minimum time penalty. Facilities for interchange between modes/corridors should be planned for convenience and minimum loss of time. Side by side or vertical interchange that involves minimum walking is the best and hence has to be the norm in planning. Some typical designs of interchange station are shown in **Figures 8.1**, **8.2 & 8.3.** It is proposed that planning and design of convenient interchanges and safe access from the area up to stations and stops forms the subject of a special study devoted to achieve the objective.

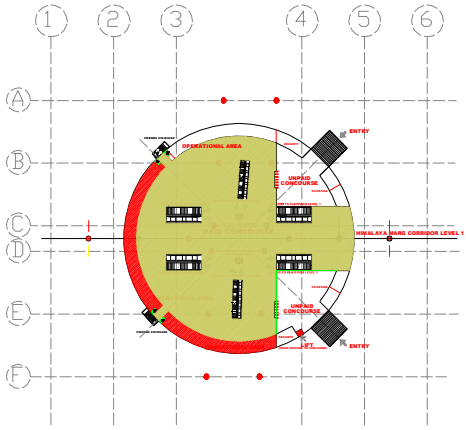
8.5 OPERATIONAL INTEGRATION

8.5.1 Integration at operational level will be required to synchronize the timings of mass transit and feeder services. For efficient inter-change, walking/waiting time at these stations will need to be minimized. Introduction of common ticketing and their availability at convenient places will be necessary to ensure forecast patronage of the system. An integrated passenger information system covering all modes through publication of common route guides, time-table, and information boards at terminals for providing up-to-date information for the system users will also be important. For the purpose, a Master Control Facility may be set up in order to achieve the optimal utilization of the integrated transport system.

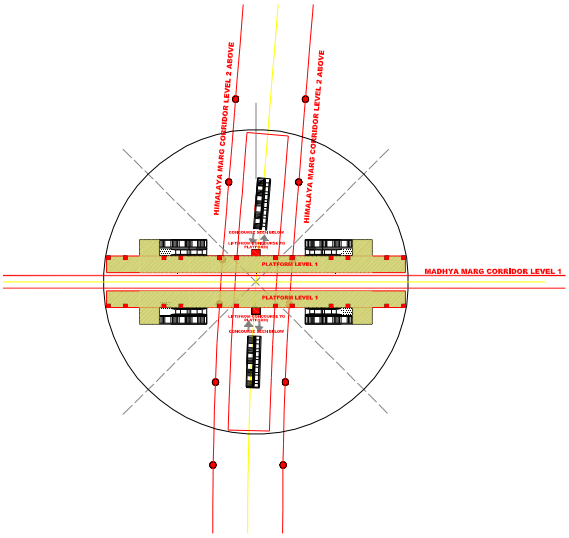
Figure 8.1: Typical Mass Rapid Transit Interchange Station



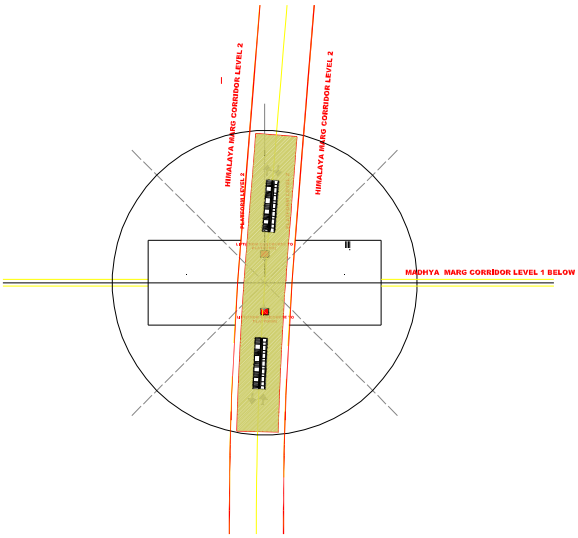
ROAD LEVEL PLAN



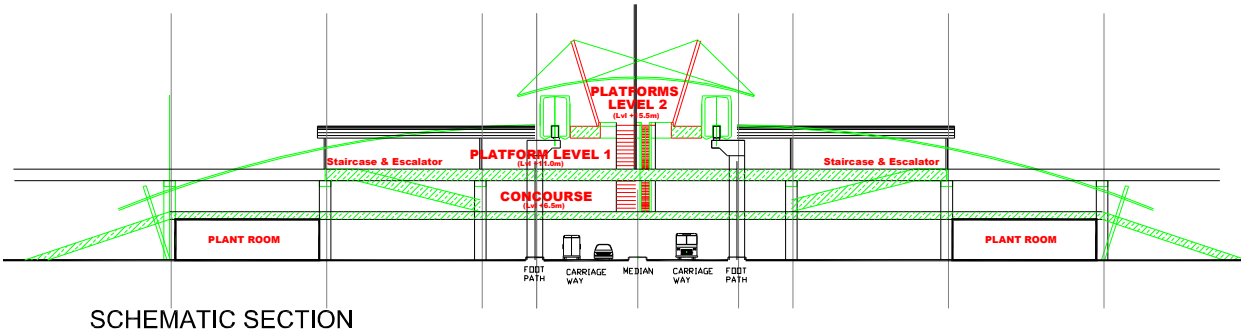
CONCOURSE LEVEL PLAN



PLATFORM LEVEL 1 PLAN



PLATFORM LEVEL 2 PLAN



SCHEMATIC SECTION

Figure 8.2

A-4

Figure 8.3

A-4

CHAPTER – 9
COST ESTIMATES, PHASING AND FINANCING PLAN

9.1 UNIT RATES

9.1.1 The Traffic and Transportation Plan comprising proposals for public/mass transport system, inter-city bus terminals, pedestrian facilities, parking facilities, road infrastructure, integrated freight complexes, transport system management measures etc has been prepared for the BMA to cater to travel demand up to the year 2025 at an acceptable level of service as explained in Chapter 7. In order to know the financial implications of these proposals, block cost estimates have been worked out in this chapter. Unit rates adopted for items at 2010 prices are given in **Table 9.1**.

Table 9.1 Unit Rates

Sl. No.	Item	Unit	Rate (Rs Cr.)
1	Metro Elevated Section	per Km	150
2	Metro Underground Section	per Km	350
3	Mono Rail/ Light Rail Transport System	per Km	100
4	Sub –Urban Commuter Rail System	per Km	15
5	BRT	per Km	14
6	Low floor urban commuter buses	Each	0.5
7	Bus Terminal cum Traffic & Transit Management Centres (TTMC)	Each	50
8	Bus Station	Each	13
9	Bus Depot	Each	8
10	Bus Shelter	Each	0.04
11	Inter-city Bus Terminal	Each	50
12	New dual carriage way road	per lane / Km	1.75
13	Widening of roads	per lane/Km	0.6
14	Grade Separators 6 lane dual CW 700 mts long	each	35
15	Improvements of Foot paths	per Km	0.3
16	Sky walks	Each	2.5
17	Automatic Mechanical Parking	per parking space	0.06
18	Conventional Multi Storey Parking	per parking space	0.03
19	Integrated Freight Complex	Each	50

9.2 ECONOMIC EVALUATION

9.2.1 Economic evaluation for metro/light metro projects has been carried out within the framework of "with" and "without" the project. The "without the project" situation assesses the cost to the economy in case the projected volume of traffic continues to move with the prevailing modes of transport. The "with the project" situation estimates the total costs that the economy would have to bear for introducing the various corridors of metro/light metro projects. The cost under the above two situations has been evaluated in terms of market prices and then in economic terms, deriving the latter from the former by converting market prices into appropriate shadow prices. This has been done to iron out distortions due to externalities and anomalies arising in real world pricing systems.

9.2.2 **Benefits taken into account**: The following benefits have been taken into account for this analysis:

a. Capital and operating cost (on present congestion norms) of carrying the total volume of passenger traffic by existing bus system and private vehicles in case metro/light metro project is not taken up.

b. Savings, due to decongestion in vehicle operating cost of all buses and other vehicles including those that would continue to use the existing transport network even after the metro/light metro corridor is introduced.

c. Savings in time of commuters using the metro/light metro over the existing transport modes because of faster speeds of metro/light metro and because of reduced congestion on roads.

d. Savings in time of those passengers continuing on existing modes, because of reduced congestion on roads.

e. Savings on account of prevention of accidents and pollution, with introduction of metro/light metro

9.2.3 **Economic Internal Rate of Return**: The capital cost stream of infrastructure works and rolling stock for metro/light metro corridors has been given in **Table 9.3.**The O&M cost has been considered as 3% of the capital cost for each year.

The cost and benefit streams for 30-year period in the economic prices have been worked out for metro/light metro corridors. The total cost worked out on the above basis is then subtracted from the total benefits to estimate the net benefit of the project. This flow is then subjected to the process of discounting to work out the internal rate of return on the project, to examine the viability of the project in economic terms. Thereafter, the project EIRR in economic terms is arrived at by using shadow prices and are given in **Table 9.2** for various metro/light metro corridors.

Table 9.2 EIRR of Various Metro/Light Metro Corridors

Sl. No.	Description of MRTS corridors	Length (Km.)	EIRR (%)
I	Hesarghatta- Puttenahalli - North - South Metro Corridor and Baiyyappanahalli- Mysore Road East-West Metro Corridor	42.9	24.04
II	(i)The extension of North –South Metro corridor of Hesarghatta to BIEC and Puttenahalli to PRR (ii) The extension of East- West Metro corridor of Baiyyappanahalli- Whitefield and Mysore Road to Kengeri	29.4	17.85
III	Hosur Road (PRR) – Srinivaspura of Metro Corridor	31.8	15.15
IV	Yeshwantpur - BIA of Metro Corridor	37.88	14.38
V	Hebbal to J P Nagar of Light Metro Corridor	31.3	15.23
VI	Toll Gate - PRR of Light Metro Corridor	9.7	22.14
VII	National College - Kathriguppe junction of Light Metro Corridor	5.0	12.89
VIII	Hosur Road – BG Road junction - PRR of Light Metro Corridor	13.8	16.26
IX	Indira Nagar - Whitefield of Light Metro Corridor	17.2	13.90

9.3 COST ESTIMATES OF PROPOSALS AND PHASING OF IMPLEMENTATION

9.3.1 Considering the various proposed schemes and unit rates, cost estimates of these schemes have been worked out at 2010 prices and are given for proposed mass transport corridors, city bus system, road infrastructure, grade separators, pedestrian facilities, parking facilities, integrated freight complexes and transport system management measures in **Tables 9.3 to 9.10** respectively. The entire transport development plan is not required to be implemented in one go. Considering the existing problems, expected traffic demand levels, economic internal rate of return of the projects and schemes already under implementation/ active consideration of the Government, phasing of implementation of various projects has been suggested in three phases (2011-15, 2016-20 and 2021-25) and is also given in these tables. Cost estimates for each project to be implemented in the three phases have also been given in the tables.

Table 9.3 Cost Estimates of Proposed Mass Transport Corridors (Rs. Crore)

Sl. No.	Corridor	Length Km	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
Metro System							
1	Hesarghatta – Puttenahalli Cross	24.2		Under Implementation			
2	Baiyyappanahalli – Mysore Road Terminal	18.7					
3	Extension from Hesarghatta line to BIEC along Tumkur Road (Northern part)	2.7	150	405		405	
4	Extension of Puttenahalli Cross line to PRR along Kanakapura Road (Southern part)	7.4	150	1110		1110	
5	Extension of Mysore Road terminal line upto Kengeri (Western part)	5.9	150	885		885	
6	Extension of Baiyyappanahalli line upto Whitefield (Eastern part)	12.4	150	1860		1860	
7	Electronic City to Srinivasapur	31.8		7750		7750	
8	Yeshwantpur to BIA	37.8		8872		8872	
	Total	**140.9**		**20882**		**20882**	
High Speed Rail Link to BIA							
1	Proposed Devanahalli Airport to M.G. Road via Bellary Road (HSRL)	**34**		**3960**	**3960**		
Light Metro System							
1	Hebbal to JP Nagar (Bannerghatta Road) along the western crescent of Outer Ring Road	31.3	100	3130	3130		

Sl. No.	Corridor	Length Km	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
2	Toll Gate to PRR along Magadi Road	9.7	100	970	970		
3	National College to Kathriguppe Road Junction	5	100	500			500
4	Hosur Road - Bannerghatta Road Junction to PRR along Bannerghatta Road	13.8	100	1380		1380	
5	Indiranagar to Whitefield	17.2	100	1720			1720
	Total	**77**		**7700**	**4100**	**1380**	**2220**
Sub-Urban Commuter Rail System							
1	Kengeri - Ramanagaram	32	15	480	480		
2	Baiyyappanahalli - Hosur	41	15	615	615		
3	Yeshwantpur - Tumkur	64	15	960	960		
4	Yelahanka - Doddaballapur	24	15	360	360		
	Total	**161**		**2415**	**2415**		
BRT System							
1	JP Nagar-Hebbal (along Eastern ORR)	31.7	14	443.8	443.8		
2	ORR to Hosur Road (upto PRR)	13.0	14	182.0	182.0		
3	Hosur Road to Tumkur Road (Western PRR)	42.9	14	600.6		600.6	
4	Tumkur Road to Hosur Road (Eastern PRR)	78.5	14	1099.0		1099.0	
5	Along CRR	31.2	14	436.8	436.8		
6	PRR to Kengeri to JP Nagar	15.9	14	222.6	222.6		
7	Domlur Extn to Koramangala	5.6	14	78.4	78.4		
8	Mulur to Maruthinagar	7.1	14	99.4	99.4		
9	BIEC to PRR	2.1	14	29.4	29.4		
10	Cricket Stadium to BIA via Hebbal	34	14	476	476.0		
11	Yelahanka to PRR (Along Doddaballapur Road)	9.9	14	138.6		138.6	
12	KR Puram Metro station to PRR (Along Old Madras Road)	7.7	14	107.8	107.8		
	Total	**279.6**		**3914.4**	**2076.2**	**1838.2**	

Table 9.4 Cost Estimates for Proposed Improvement in City Bus System and Intercity Bus Terminals/ IMTCs (Rs. Crore)

Sl. No.	Proposals	Phase	Qty/Nos.	Unit Cost	Total Cost	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
City Bus System								
1	New Buses to be added by 2014	P-1	1000	0.5	500	500		
	Addl. Buses to be added by 2018	P-2	1000	0.5	500		500	
	Addl. Buses to be added by 2025	P-3	1000	0.5	500			500
2	Bus Terminal cum Traffic & Transit Management Centres (TTMC)		40	50	2000	250	1250	500
3	New Bus Stations	P-1	23	13	299	299		
4	New Bus Shelters	P-1	300	0.04	12	12		
5	New Depots							
	Upto 2010	P-1	27	8	216	216		
	Addl. Depots required by 2018	P-2	10	8	80		80	
	Addl. Depots required by 2024	P-3	10	8	80			80
6	Improvement of IT Infrastructure	P-1			200	200		
7	Multimodal Transit Centre at Subhash Nagar	P-1	1	400	400	400		
8	Development of HRD Infrastructure	P-1			175	175		
9	Environment Protection Projects	P-1			50	50		
Intercity Bus Terminals / IMTCs								
10	Intermodal Transit Centres cum Intercity Bus Terminal-Peenya	P-1	1	70	70	70		
11	Intermodal Transit Centres cum intercity Bus terminals- Hosur Rd, Bellary Rd, Baiyyappanahalli at Old Madras Road	P-1	4	50	200	200		
Master Control facility for Public Transport Operational Integration								
12	Master Control Facility Centre	P-1	1	30	30	30		
	Total				**5312**	**2402**	**1830**	**1080**

Table 9.5 Cost Estimates for Proposed Road Infrastructure Development Plan (Rs. Crore)

Sl. No.	Corridor	Length Km	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
New Roads							
1	Core Ring Road (CRR) (elevated)	30	45	1350	1350		
2	Arterial Roads crossing CRR	30	1.25	37.5	37.5		
3	Peenya Industrial Area To Bengaluru Mysore Expressway	2.2	12	26.4	26.4		
4	Peripheral Ring Road (PRR)	114	35	3990	3990		
5	Link from Tigalarapalya main road to Nelagadaranahalli (Cost included in the cost of parallel ring road)	1.23					
6	Link from Hesarghatta main road to Settihalli and Madarahalli to Mohammed Sabi Palya (Cost included in the cost of parallel ring road)	4.02					
7	Link from Sampigehalli to CRPF parade ground (Cost included in the cost of parallel ring road)	1.72					
	Total	**183.17**		**5403.9**	**5403.9**		
Outer Ring Road Re Alignment							
1	Elevated road along Bang. University Road (excluding cost of Construction of ORR connecting Mysore Road to Magadi Road including underpass across Bengaluru Mysore Rly Line accounted for at item no. 9 of RUB/ROB List)	2.5	22	55	55		
2	Realigning ORR between Magadi Rd. and Pipe Line Rd	1.9	11	20.9	20.9		
3	Realigning ORR at Tumkur Rd through CMTI	1.2	11	13.2	13.2		
4	Realigning ORR from Kasturi Nagar to Mahadevapura along Salem railway line	5	11	55	55		
5	Elevating ORR along common portion with Sarjapur Rd (excluding cost of grade separators at Agara & Ibbalur at item no. 6 & 7 of list of Grade separators)	2	11	22	22		
6	Elevating ORR along common portion with Bannerghatta Road	1	45	45	45		

Sl. No.	Corridor	Length Km	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
7	PESIT to Jnanabharati Entrance Bengaluru University	3	45	135	135		
	Total	**16.6**		**346.1**	**346.1**		
Road Improvements (Inside ORR)							
	Road Improvements (Inside ORR)	**71.1**		**85.37**	**85.37**		
Road Improvements (Outside ORR)							
1	Radial Roads	202.2	0.9	181.98	181.98		
2	Connector Roads	117.4	0.9	105.66	105.66		
3	Parallel Ring Road	149.5	0.9	134.55	134.55		
	Total	**469.2**		**422.19**	**422.19**		

Table 9.6 Cost Estimates for Proposed Grade Separators (Rs. Crore)

Sl. No.	Location / Road	Nos.	Unit Cost per G.S	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
Grade Separators-Roads							
1	Hudson Circle- N.R. Road Under pass	1	35	35	35		
2	Minerva circle-J.C. Road Fly over	1	28	28	28		
3	Flyover along Hosur Road near Check post	1	28	28	28		
4	Hosur Road-Inner Ring Road along Hosur Road fly over	1	28	28	28		
5	Additional slip road at CSB intersection	1	28	28	28		
6	Along 16 main BTM Layout underpass	1	28	28	28		
7	Kanakapura Road & ORR Jn. Along ORR flyover	1	35	35	35		
8	Flyover on RV road near RV Teacher College	1	16	16	16		
9	Tumkur Road & ORR Junction along ORR Grade separator	1	45	45	45		
10	Underpass along pipeline road near Ayyappa Temple	1	28	28	28		
11	Grade separator along Guttahalli Main Road near Guttahalli Circle	1	28	28	28		
12	Underpass near Kanteerava Studio along ORR	1	56	56	56		
	Total	**12**		**383**	**383**		

Sl. No.	Location / Road	Nos.	Unit Cost per G.S	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
Road Over Bridges / RUBs-Rail							
13	ROB along MES Road near Jalahalli	1	22	22	22		
14	Underpass along Link Road Connecting D Rajagopal Road & Kodigehalli Road	1	22	22	22		
15	Ashoka Theatre - Pottery Road	1	22	22	22		
16	Nagavara-Arabic College Road	1	22	22	22		
17	Kasturinagar-Chikka-Banaswadi Road	1	22	22	22		
18	Baiyyappanahalli Road	1	22	22	22		
19	Kadugondanahalli Railway line along Nagavara Main Road	1	22	22	22		
20	Hudi Main Road near Whitefield Railway Station	1	22	22	22		
21	Construction of ORR connecting Mysore Road to Magadi Road including underpass across Bengaluru Mysore Rly Line	1	92	92	92		
22	along Settihalli main rd	1	22	22	22		
23	along S M Road near Gurudwara	1	22	22	22		
24	Along Kodigehalli Main Rd near Kodigehalli Rly Stn	1	22	22	22		
25	Along Hesarghatta Main Rd	1	22	22	22		
26	Near Tanisandra Rly Stn	1	22	22	22		
27	Along Kundalahalli Road at Kundalahalli gate.	1	22	22	22		
28	Along Varthur Road near Lakshmi Layout	1	22	22	22		
29	Along Panathur Main Rd near Bellandur Rly Stn	1	22	22	22		
30	Along Sarjapur Rd	1	28	28	28		
31	RUB/ROB near Nayandahalli Railway Station	1	28	28	28		
32	RUB at Nayandahalli	1	28	28	28		
33	RUB at J J Nagar Shamanna Garden LC-4	1	28	28	28		
34	Additional Box at Okalipuram	1	28	28	28		
35	Additional Box at Okalipuram Junction	1	28	28	28		

Sl. No.	Location / Road	Nos.	Unit Cost per G.S	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
36	RUB at 11th Cross Malleswaram	1	28	28	28		
37	RUB at 18th Cross Malleswaram near Nirmala Rani School	1	28	28	28		
38	RUB at Mysore Lamps, Malleswaram	1	28	28	28		
39	RUB near Yeshwantpura Railway Station	1	28	28	28		
40	ROB at Mohan Kumar Nagar, Mathikere	1	28	28	28		
41	RUB at Kaggadasapura	1	28	28	28		
42	RUB at Lottigehalli cross	1	28	28	28		
43	ROB at Sampigehalli Road, Jakkur	1	28	28	28		
44	ROB/RUB at Yelahanka old township opp. MES Circle, Yelahanka Railway Station	1	28	28	28		
	Total	**32**		**864**	**864**		

Table 9.7 Cost Estimates for Proposed Pedestrian Facilities (Rs.Crore)

Sl. No.	Name of Road	Length (Km)/ No.	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
1	Improvement & Augmentation of Foot Paths	350	0.3	105	105		
Skywalks/Subways							
2	Cauvery Bhavan to KG Circle crossing across KG Road and D.O. Road	1	12	12	12		
3	Opposite NTI connecting Guttahalli Road and Palace (opposite Bus Stop) on Sankey Road	1	4	4	4		
4	Lalbagh Main Gate (Javaraiah Circle)	1	4	4	4		
5	Bannerghatta Road near Jayadeva Hospital	1	4	4	4		
6	At Kengeri Bus Stand, Mysore Road	1	4	4	4		
7	At Byatarayanapura on Bellary Road (near Junction of BBMP office complex).	1	4	4	4		

Sl. No.	Name of Road	Length (Km)/ No.	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
8	Shanthala Silk House to KSRTC Main Bus Station and to Good-Shed Road	1	4	4	4		
9	RNS Motors, Tumkur Road	1	4	4	4		
10	Jalahalli Circle, Tumkur Road	1	4	4	4		
11	Near Webb Junction	1	4	4	4		
12	Near Kamakhya, Kathriguppe Ring Road	1	4	4	4		
13	Gandhi Bazaar Main Road	1	4	4	4		
14	On Vittal Mallya Road near Mallya Hospital	1	4	4	4		
15	On JC Road near Ravindra Kala Kshetra	1	4	4	4		
16	On Hosur Main Road near Madivala check post	1	4	4	4		
17	On Raja Ram Mohan Roy Road, near Pallavi theatre	1	4	4	4		
18	On Richmond Road near D'Souza Circle	1	4	4	4		
19	On Commissariat Street near Garuda Mall	1	4	4	4		
20	On Residency Road near Mayo Hall	1	4	4	4		
21	On Kamaraj Road near Commercial Street	1	4	4	4		
22	Near Indira Nagar 100 Feet Road & Water Tank junction on Airport Road	1	4	4	4		
23	On Hosur Road (Near Forum)	1	4	4	4		
24	On Tumkur Road, near SMS Railway Junction	1	4	4	4		
25	On Air Port Road, Marath Halli at Village Road	1	4	4	4		
26	On Airport Road, Marath Halli at Junction of Under Pass ORR	1	4	4	4		
27	K.R. Pura Bus Stand	1	4	4	4		
28	Bharatiya Vidya Bhavan, Devaraj Urs Road	1	4	4	4		

Sl. No.	Name of Road	Length (Km)/ No.	Unit Cost per Km	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
29	On Hosur Road "T" Junction with Tavarekere Main Road (Opposite Sai Sadan & Prestige Acropolis) (High Rise Aptt. Condominium)	1	4	4	4		
30	Mission Road at the foot of Fly over	1	4	4	4		
31	Vidhana Veedhi near M S Building	1	4	4	4		
32	Tumkur Road near Yeshwantpur Circle	1	4	4	4		
33	At South End Circle	1	4	4	4		
34	Double Road opposite Shanti Nagar Bus Station	1	6	6	6		
35	City Market additional arm for existing underpass	1	2	2	2		
36	30 no. Sky –walks / Sub-Ways along the eastern crescent of the ORR	30	4	120	120		
	Sub-Total	66		264	264		
	Total			**369**	**369**		

Table 9.8 Cost Estimates for Proposed Parking Facilities (Rs. Crore)

Sl. No.	Location	Type	Capacity	Cost per Parking Space	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
1	M G Road	AMP	500	0.06	30	30		
2	Near Kamaraj Road	AMP	500	0.06	30	30		
3	Gandhi Nagar	AMP	500	0.06	30	30		
4	Koramangala near Raheja Tower	CMP	1000	0.03	30	30		
5	Rajajinagar BDA Complex	CMP	500	0.03	15	15		
6	Banashankari BDA Complex	CMP	1000	0.03	30	30		
7	Gandhi Bazaar	CMP	500	0.03	15	15		
8	Malleswaram	AMP	500	0.06	30	30		
9	Fire Station, Residency Road	AMP	500	0.06	30	30		
10	Dhobi Ghat, Cunningham Road	AMP	500	0.06	30	30		
11	SP Office, Miller	AMP	500	0.06	30	30		

Sl. No.	Location	Type	Capacity	Cost per Parking Space	Total Cost	Phase-I 2011-15	Phase-II 2016-20	Phase-III 2021- 25
	Road, Cunningham Road crossing							
12	Kanteerava Stadium	AMP	500	0.06	30	30		
13	K.R. Market	AMP	500	0.06	30	30		
14	Bakshi Gardens	AMP	500	0.06	30	30		
15	KSRTC Bus Depot, Majestic	AMP	500	0.06	30	30		
	Total		**8500**		**420**	**420**		

Table 9.9 Cost Estimates for Proposed Integrated Freight Complexes (Rs. Crore)

Sl. No.	Location	No.	Cost per Unit	Total Cost (Rs. Cr.)	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
1	Hosur Road	1	50	50	50		
2	White Field Road	1	50	50		50	
3	Old Madras Road	1	50	50		50	
4	Bellary Road	1	50	50		50	
5	Tumkur Road	1	50	50	50		
6	Mysore Road	1	50	50	50		
	Total	**6**		**300**	**150**	**150**	

Table 9.10 Cost Estimates for Transport System Management Measures (Rs. Crore)

Sl. No.	Component	Nos.	Unit Cost	Total Cost	Phase-I 2011-15
1	Junction Improvements	250	0.8	200	200
2	Street Furniture and Road Marking			125	125
3	Intelligent Transport System including. ATC, VMS etc for 250 intersections			175	175
4	Surveillance / Monitoring and enforcement cameras etc			60	60
5	Education and Training / Others			30	30
	Total			**590**	**590**

9.3.2 Summary of the cost estimates for various projects is given in **Table 9.11.** Overall cost of the entire plan is estimated as Rs 53367 crore of which Rs 23987 crore is proposed for Phase I (2011-15). Cost of the projects proposed in Phase II is Rs 26080 crore.

Table 9.11 Summary of Cost Estimates for the Entire T&T Plan (2010 prices) (Rs. Crore)

ITEM	Length Kms/Nos.	Total Cost (Rs. Cr.)	Phase-I 2011-15	Phase-II 2016- 20	Phase-III 2021- 25
MASS TRANSPORT CORRIDORS					
Metro System	141.0	20882.0	0	20882.0	0
HSRL	33.0	3960.0	3960.0	0	0
Light Metro System	77.0	7700.0	4100.0	1380.0	2220.0
Sub Urban Commuter Rail System	161.0	2415.0	2415.0	0	0
BRT System	279.6	3914.4	2076.2	1838.2	0
IMPROVEMENT IN CITY BUS SYSTEM					
Improvement in City Bus System		5282.0	2372.0	1830.0	1080.0
Master Control facility for Public Transport Operational Integration		30.0	30.0	0	0
ROAD INFRASTRUCTURE					
New Roads	183.2	5403.9	5403.9	0	0
Outer Ring Road Realignment	16.6	346.1	346.1	0	0
Road Improvements (Inside ORR)	71.1	85.4	85.4	0	0
Road Improvements (Outside ORR)	469.1	422.2	422.2	0	0
GRADE SEPARATORS					
Grade Separators-Road (Nos.)	12	383.0	383.0	0.0	0.0
Rail Over Bridges / RUBs-Rail (Nos.)	32	864.0	864.0	0	0
PEDESTRIAN FACILITIES		369.0	369.0	0	0
PARKING FACILITIES (No. of car spaces)	8500	420.0	420.0	0	0
INTEGRATED FREIGHT COMPLEXES (IFC)	6	300.0	150.0	150.0	0
TRANSPORT SYSTEM MANAGEMENT		590.0	590.0	0	0
GRAND TOTAL		**53367.0**	**23986.8**	**26080.2**	**3300.0**

9.4 BROAD FINANCING OF TRANSPORTATION PROJECTS

9.4.1 The estimated investment for the entire T &T Plan based on public transport oriented system for the period till 2025 is estimated to be Rs 53367 crore at 2010 prices as given in **Table 9.11**. About half of this investment is proposed during the period 2011-15 which coincides with the JNNURM mission period. The proposed Implementing Agency (given in **Table 9.12**) and broad financing for each of the major investments proposed is dealt with briefly below:

Table 9.12 Implementing Agencies for Various Projects

Sl. No.	ITEM	Implementing Agency
1.	Metro	BMRCL
2.	Mono Rail / LRT	BMRCL/New Company
3.	Sub Urban Commuter Rail System	Railways/Govt of Karnataka
4.	BRT	BMTC / BBMP/BDA
5.	City Bus System (including Inter City Bus Terminals)	BMTC/KSRTC
6.	New Roads	BBMP/BDA

7.	Road Improvements (Inside ORR)	BBMP
8.	Road Improvements (ORR & Outside ORR)	BBMP,BDA/NHAI
9.	Grade Separators	BBMP/NHAI/ BDA
10.	Rail Over Bridges / RUBs	Railways / BBMP
11.	Improvement & augmentation of foot paths	BBMP
12.	Pedestrian Sky Walks / Sub-Ways	BBMP
13	Parking Facilities	BBMP
14	Integrated Freight Complexes (IFC)	BDA
15	B-TRAC	BBMP/Traffic Police

9.4.2 Metro: Financing for Rs 8035 crore corresponding to the present phase I corridors under implementation now (about 43km) has already been arranged and the project is implemented by BMRCL, a company incorporated for the purpose. Balance investment of Rs 20882 crore for the 141 km of Metro should also be mobilized by the company through a combination of contributions from Government of India, Government of Karnataka and debt financing as being done for Phase I. For Metro Airport Rail Link project, a significant amount of finances can be raised through property development.

The Airport Metro Project may be implemented on BOT basis with viability gap funding from the Government.

9.4.3 Light Metro: The implementing agency for Light Metro system could either be BMRCL or a new special purpose company to be incorporated. It is recommended that funding for this project be on similar lines as Metro. The viability of the scheme should be established at the time of preparation of the detailed project report.

9.4.4 Sub Urban Commuter Rail System: This project involves the active participation of two principal stake holder's viz. Railways and State. The funding pattern is recommended to be:

- Railways – Railway related infrastructure including rolling stock and O&M approx one third of the project cost
- Government of Karnataka – One third of the project cost to cover the cost of expansion of stations, and additional tracks
- BMRDA- Access roads, parking facilities and passenger facilities to cover one third of the project cost

9.4.5 BRT System: Implementing agency for BRT system may be BMTC/BDA or a new special purpose company to be incorporated with representative from BBMP, BDA and BMRDA. The project may be implemented on PPP model.

9.4.6 All Road Improvements and New Roads: Investments to the extent of Rs 7,505 crore proposed till 2014 for road related infrastructure would be implemented by Bruhat Bengaluru Mahanagara Palike (BBMP), BDA etc. It is recommended that the funding for these projects be arranged under the JNNURM scheme seeking 35% grant from GOI, 15% from GOK and balance to be arranged by BBMP/BDA through debt financing and internal resources. Since this represents the core infrastructure for decongesting the city traffic system the funding should be routed through the JNNURM.

9.4.7 City Bus System/Inter-city Bus System: Out of estimated investment of Rs 5,312 crore, the cost of rolling stock requirement by the city bus transport corporation is Rs 1500 crore. This amount is proposed to be funded through internal resources and project financing structure of the corporation. The balance amount of Rs 3812 crore represent the infrastructure support required by the transport corporations. An amount of Rs 1872 crore is proposed to be incurred during the period 2011-15 and it is recommended that the same be funded under the JNNURM funding pattern viz:

- GOI: 35% – Rs 655 Crore
- GOK: 15% – Rs 281 Crore
- BMTC/KSRTC: 50% – Rs 936 Crore (IMTCs / Inter-city Bus Terminals could also undertaken by KSRTC on PPP model)

For the phases II and III the funding will have to be arranged by the company based on the strength of its balance sheet.

9.4.8 Footpaths/Pedestrian Sky Walks/subways and Parking facilities: An amount of Rs 789 crore is estimated towards improving and strengthening the pedestrian facilities and establishing parking facilities at identified locations across the city. The funding for the same shall be arranged though a PPP model where revenue sharing models could be explored. Viability gaps if any could be funded by BBMP the implementing agency.

9.4.9 Integrated Freight terminals: An amount of Rs 300 crore for establishing freight complexes at six locations is recommended to be funded through a PPP model involving oil companies, freight operators, industries' associations and BDA as the implementing agency.

9.4.10 Transport System Management: This component represents the intelligent road system including traffic management systems to be introduced in the city to reduce the number of accidents and regulate the traffic using technological interventions. It is proposed that the amount of Rs 590 crore estimated under this head is posed under JNNURM with 50% contribution of the ULB allocated by BBMP (balance 50% from GOI and GOK as per JNNURM norms).

9.5 FUNDING OF INFRASTRUCTURE THROUGH DEVELOPMENT, CONVERSION & INFRASTRUCTURE DEVELOPMENT CHARGES: Alternatively Government can also partly finance the CTTP by imposing External Development Charges (EDC), Licence Fee, Conversion Charges of land-use and Infrastructure Development Charges (IDC) on the lines of Haryana Government (refer Notifications on External Development Charges in Haryana – **Annexures 9A** to **9D)** for the new developing areas (about 320 sq km) in Bengaluru.) The estimated revenue that can be generated through these sources is given in **Table 9.13** below:

Table 9.13 Expected Recoverable Charges through Development of External Areas as per Master / Zonal Plans 2015

Landuse	Net Extension Area Sq. Km	Rates prevalent per Sqm in Haryana	Suggested Avg. Rates of EDC, IDC, Conv. Charges, License Fee per Sq. Km.	Expected Returns Rs. Cr
Residential	255			
Plotted Dev. (60%)	153	1227	125	19125
Gr. Housing (40%)	102	3328	350	35700
Commercial	38	11297	1150	43700
Industrial	6.5	1250	125	812.5
I.T	20	2271	250	5000
Total	**319.5**			**104337.5**
Assuming 70 % of the above Returns to be used for Town Level Public Health Services (Water Supply, Sewerage, Storm Water Drainage), Power, Community Facilities etc.				Rs. 73036 Cr.
Balance amount that should be used for financing CTTP				Rs. 31301 Cr.

Thus about Rs 100,000 crore can be generated through the above charges for the planned new areas for development as per the Master Plan 2015. Out of this about Rs 30000 crore may be used for financing transportation projects.

CHAPTER – 10
INSTITUTIONAL STRENGTHENING

10.1 REGIONAL PLANNING

10.1.1 Though the study covers the transportation problems in the BMA, the impact of the traffic from the neighboring towns has also to be taken into consideration. The description of the BMR has already been given in Chapter 1. These towns lie in outer belt and the traffic which emanates from or bound for these come into or exit the city mostly though the major radials like Mysore Road, Magadi Road, NH-7, NH-4 and NH-209. The traffic to and from these areas have been accounted for through the outer cordon survey. Planning for these townships is being carried out independently by Bengaluru Metropolitan Regional Development Authority (BMRDA). The data available individually for these towns as at present is meager. Hence, for the purpose of this study, the traffic which is passing through the outer cordon as determined by traffic counts at cordon points has been considered as the basis. The BMRDA is also involved in the development of the satellite towns and BIAPPA area.

10.1.2 As such it is presumed that any future planning in these areas will be directly controlled by the BMRDA or the BMRDA will be more actively involved in their development plans. According to the present structure, the overall planning in the BMRDA in respect of land use and transportation facilities is looked after and controlled by the BMRDA which forms the nodal agency. However the planning in respect of industries, education, commerce etc., for areas outside the city, are done by the respective Departments of the State Government at District level. They are coordinated by the District Commissioners. Within the city, it is partly coordinated by BDA and the City Corporation. The implementation of the various plans / proposals in the region is thus under different agencies as discussed below.

10.2 AGENCIES INVOLVED IN CIVIC WORKS

10.2.1 Presently day-to-day land use control and maintenance of services like drainage, roads etc., are done by Bruhat Bengaluru Mahanagara Palike and BDA, while BDA also prepares the Master Plan and development control regulations. The road infrastructure connecting the different municipalities, towns and also the National Highways and the State Highways passing through the city are maintained, improved and expanded by the Public Works Department/NHAI. The water supply within the city is looked after by the Bengaluru Water Supply & Sewerage Board (BWSSB).

10.2.2 Progress of works and flow of funds in respect of any aided projects, is watched and monitored by a Project Management Department/ Division of KUIDFC.

10.3 ROLE OF VARIOUS TRANSPORTATION AGENCIES

10.3.1 **Transport Department**: The Commissioner for Transport is in-charge of the licensing of the motor vehicles, issue of route permits/area of operation and monitoring condition of the vehicles by having them periodically examined and also maintaining

the various statistics with regard to the transportation in the whole city. There are nine Regional Transport Officers who control the licensing and monitoring of the vehicle operations in and around BMA. While the commercial vehicles and larger passenger vehicle operations are licensed for statewide operation, the licensing for IPT modes like auto-rickshaws are confined to respective districts. There are certain constraints on their operations outside their respective areas, particularly from the district into the city, which sometimes cause problems. Even collection of the data on the vehicles operating in the metropolitan region becomes difficult in view of this.

10.3.2 Traffic Engineering & Transport Management: The traffic engineering works, design and implementation within the city is looked after by a separate division under the Engineering Department in BBMP and BDA. In parallel, the Commissioner of Police under whom there is a Traffic Division also initiates and implements certain traffic engineering proposals as part of traffic management.

10.3.2.1 The Traffic Management is considered an enforcement function and the Traffic Division under the Commissioner of Police does all the planning and implementation within the city as mentioned earlier. There is a coordinating body which is of a recommendatory nature functioning under the Home Secretary.

10.3.3 Public Transport consisting of Road and Rail within BMA: The road transport is looked after by Bengaluru Metropolitan Transport Corporations (BMTC) working under the direct control of the Secretary / Transport of the State Government. In addition, there is Karnataka State Road Transport Corporation serving peripheral areas and regional towns around BMA.

10.3.3.1 Bengaluru Metro Rail Corporation Limited (BMRCL) has been entrusted with the implementation of Bengaluru Metro.

10.3.3.2 The Railway transport is under the South Western Railway, which works under the Ministry of Railways of the Central Government. There is very little coordination between these agencies. The fare policies are dictated by the State Government for bus and by the Central Government under the authority of the Parliament for the Railways. The expansion of facilities and utilisation of the available facilities are done by the respective agencies depending upon the availability of funds. Their routing and services are also run, keeping in view need for maximizing their use of assets and revenues. This naturally results in development of very little inter-modal services for the benefit of the commuters.

10.3.3.3 Existing institutional arrangement for transportation in Bengaluru is given in **Table 10.1**.

Table 10.1- Existing Institutional Arrangement for Transport in Bengaluru

Sl. No.	Functions	Institution
1.	Policies and framework affecting transport sector	Departments of Urban Development and Transport
2.	Road building, road maintenance, street lighting, Construction of select Ring Roads and Grade Separators, construction of bus shelters construction of traffic islands, Issue of permission for road cutting	Bruhat Bengaluru Mahanagara Palike (BBMP) the urban local body of Bengaluru City
3.	Enforcement of traffic laws and regulations, management of traffic junctions and corridors, regulation of right of ways, parking and right of ways	Bengaluru City Traffic Police
4.	Public transport system – bus based – construction and maintenance of bus depots, stations and passenger centres	Bengaluru Metropolitan Transport Corporation (BMTC)
5.	Public transport system – Metro Rail	Bengaluru Metro Rail Corporation Limited (BMRCL)
6.	Preparation of Comprehensive Development Plan (CDP) (primarily land use and zoning), formulating of regulations, construction of select ring roads and grade separators	Bengaluru Development Authority (BDA)
7.	Planning of transport System in BMR	BMRDA
8.	Registration of motor vehicles, issue of licenses and enforcement of regulations of motor vehicle act	Regional Transport Office and Department of Transport, Government of Karnataka
9.	Monitoring of air quality and noise levels	Karnataka State Pollution Control Board (KSPCB)
10.	Infrastructure and finance	Karnataka Urban Infrastructure and Finance Corporation Limited (KUIDFC)
11.	Construction and Operation of rail system	Indian Railways
12.	Construction and maintenance of NH	NHAI

10.4. NEED FOR UNIFIED METROPOLITAN TRANSPORT AUTHORITY

10.4.1 The above discussion suggests that there are many agencies involved in the urban transport in Bengaluru. As such, there is nothing wrong in multiplicity of authorities. However currently there is no mechanism to ensure coordination among various institutions which is one of the key road block affecting formulation and implementation of major schemes and initiatives to improve the traffic situation and mobility plans in the city. Close co-ordination is needed on number of factors as indicated in **Figure 10.1**.

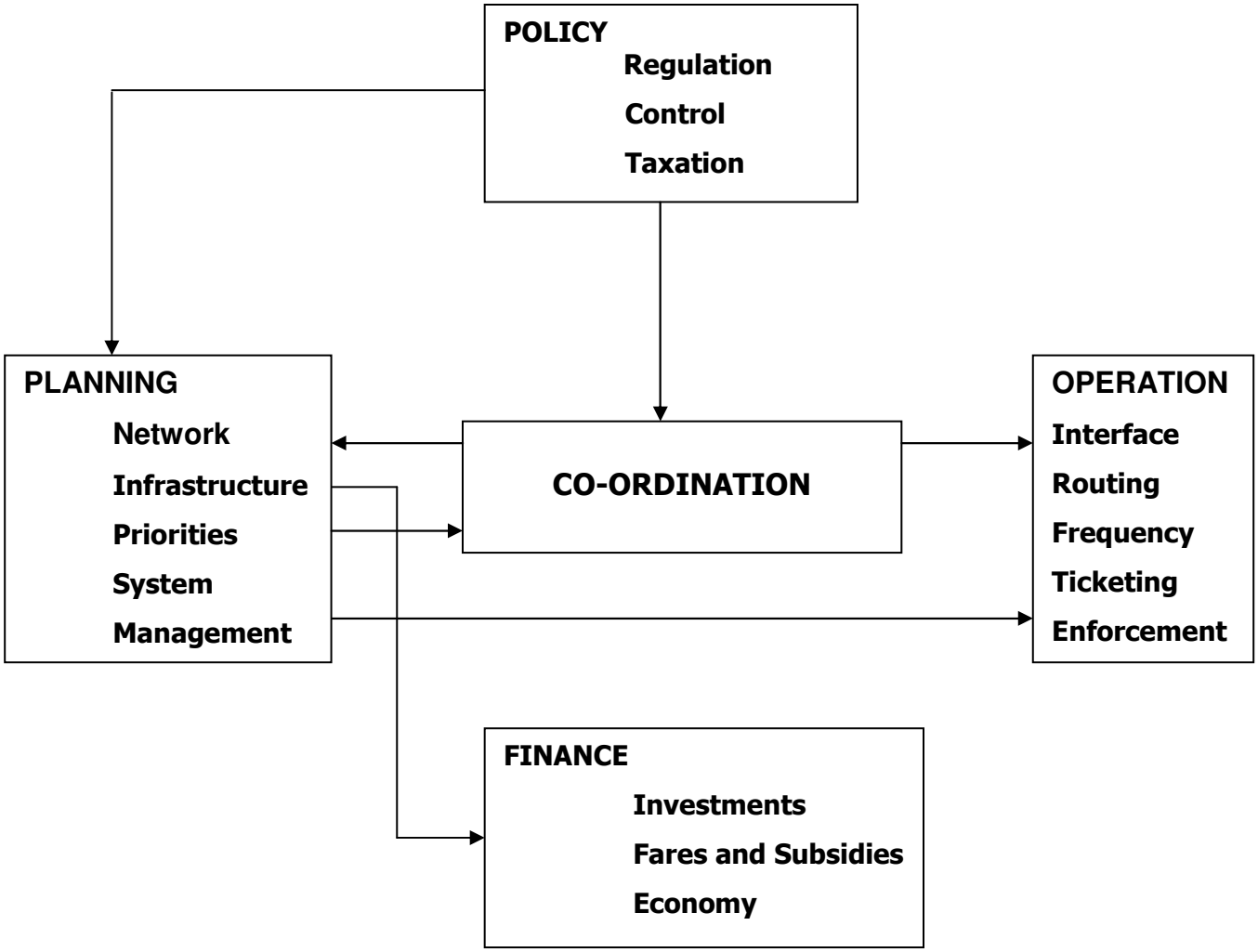
10.4.2 Since early 1990s planners in India have been suggesting need for a Unified Metropolitan Transport Authority (UMTA) in order to ensure co-ordination, co-operation and continuity. In view of the fact that both central and state government

agencies are involved in providing urban transport, such an authority will need to be created by an act in Parliament, even though the city and state governments are primarily responsible for urban planning including transport. Alternatively, it can be one of the existing authorities with full powers of planning, implementation and control. Such an authority could be an urban development authority at the third level. All departments of the authority should be manned by skilled personnel in technical jobs. The authority should ensure planning, development, co-ordination and implementation.

10.4.3 The National Urban Transport Policy has recommended setting up of Unified Urban Transport Authorities (UMTA's) in million plus cities. In the policy document it is observed as follows:

'*The current structure of governance for the transport sector is not equipped to deal with the problems of urban transport. These structures were put in place well before the problems of urban transport began to surface in India and hence do not provide for the right coordination mechanisms to deal with urban transport. The central government will, therefore, recommend the setting up of Unified Metropolitan Transport Authorities (UMTA's) in all million cities to facilitate more co-ordinated planning and implementation of urban transport programmes & projects and integrated management of urban transport systems. Such Metropolitan Transport Authorities would need statutory backing in order to be meaningful*'.

Figure 10.1 FACTORS AFFECTING COORDINATION OF URBAN TRANSPORT



10.5 DIRECTORATE OF URBAN LAND TRANSPORT (DULT)

10.5.1 Bearing in mind the National Urban Transport Policy, the Government of Karnataka felt that there is a strong case for reorganization of the administration structure dealing with urban land transport in the State by creation of a State Directorate of Urban Land Transport (DULT) under the administrative control of the Urban Development Department. Considering this, DULT has now been sanctioned by the State Government. The functions of the DULT are as follows:

1. Periodic assessment of travel demand in a given area through CTTS and other studies
2. Determination of level of public transport required on different corridors and the type of transport system required.
3. Assessment and recommendation of the new investments needed for creation of transport infrastructure
4. Apart from State owned service providers devising a system of procurement of public transport services from private operators and ensuring compliance

5. Setting policy guidelines for development of total network
6. Actively liaising with the municipal bodies/UDAs in designing and developing integrated policies and plans

10.5.2 The Directorate of Urban Land Transport (DULT) initially covered jurisdiction of seven Municipal Corporations in the State viz, Bengaluru, Mysore, Mangalore, Hubli-Dharwar, Belgaum Gulbarga and Bellary. The integrated transport plans for these cities may extend to the local planning areas (LPAs) also. It is being gradually extended in stages to all towns / cities and urban settlements with a population of over one lakh.

10.5.3 The newly created Directorate of Urban Land Transport (DULT) shall take up Comprehensive Traffic and Transportation Studies (CTTS) for towns. These studies would help assess the urban transport needs over a medium term perspective (say 25 years), identify technological and cost options, intensity of local urban economic activity and paying capacity of the average population and in short help arrive at an optimal urban transport solution. On completion of the CTTS, the existing master plan for the LPAs of these cities will be updated / revised to incorporate the necessary land use changes so that the transport and land use plan are totally integrated. A city level investment plan for creation of transport infrastructure together with sources of financing will also have to be created so as to enable posing of the projects for financing under different schemes including multilateral / bilateral assistance as also on PPP basis.

10.5.4 Provision of clearance/ no objection certification from DULT may be made compulsory for any major traffic generating centers such as shopping complex/malls, commercial/ office centers etc. DULT may also examine the implication of such a proposal by way of getting done the traffic impact analysis of such projects.

10.5.5 Other functions of the State Directorate of Urban Land Transport would include (i) road network planning in the urban areas, (ii) setting of technical standards for construction of the maintenance of urban roads, (iii) planning execution of infrastructure for pedestrians/cyclists, (iv) comprehensive drainage network to ensure road quality, (v) parking infrastructure etc. All of them will be part of the Integrated Transport Plan at the city level and would be developed in close coordination with the local bodies that will eventually need to adopt the plan.

10.5.6 An important aspect with respect to the adopted functions of the State Directorate for Urban Land Transport is capacity building. It is necessary to develop a manpower base for good and sustainable urban transport planning and execution by creating a pool of skilled manpower. There is a need to:

1) Strengthen academic programme in the State in urban transport
2) Create systems for accreditation of specialists in urban transport
3) Ensure mechanism for continuous training at all levels.

A multi disciplinary team of experts will be constituted as an advisory board for the State Directorate of Urban Land Transport to provided inputs for:

1) Capacity building
2) Academic and educational programmes
3) Preparation of standards/manuals/codes
4) Development for Intelligent Transport System (ITS)
5) Other technical issues related to urban transport

10.5.7 The Organisation for DULT is supposed to have Commissioner (Urban Land Transport), Special Officer (Urban Planning), Traffic & Transportation Planners, Traffic Engineer etc. It is necessary that DULT is staffed with adequate numbers of transportation personnel as it will cover urban transport for all cities of Karnataka. The following technical staff is proposed for DULT:

1) Chief Traffic & Transportation Planner	1 No.
2) Deputy Chief Traffic & Transportation Planner	1 No.
3) Transport Planner	10 Nos.
4) Traffic Engineers	5 Nos.
5) Travel Demand Modelers	2 Nos.
6) Town Planners	2 Nos.
7) Civil Engineers	5 Nos.

10.6 BENGALURU METROPOLITAN LAND TRANSPORT AUTHORITY

10.6.1 Bearing in mind the National Urban Transport Policy, the State Government considered it also necessary to create a Unified Metropolitan Transport Authority for the Bengaluru Metropolitan Region (BMR) which will function as an umbrella organization to coordinate planning and implementation of urban transport programmes and projects and provide an integrated management structure. All land transport systems (excluding Railways) in the BMR may be brought under all purview of the Bengaluru Metropolitan Land Transport Authority (BMLTA). The BMLTA is being created initially under an executive order and later with statutory backing.

10.6.2 Under the circumstances explained above, Government has already sanctioned creation of Bengaluru Metropolitan Land Transport Authority (BMLTA) for Bengaluru metropolitan Region (BMR) as per Government Order No. UDD 134BMR 2006 (2),Bengaluru dated 09.03.2007. This shall be taken up as a part of the Greater Bengaluru reorganization exercise so as to make it operational by 2007-08. Initially as an interim arrangement, the Government has set up this as a Committee of the BMRDA with the Chief Secretary as Chairman with the following composition.

1.	Chief Secretary to Government	Chairman
2.	Principal Secretary, Finance Department	Member
3.	Principal Secretary, UDD	Member
4.	Principal Secretary, Transport Department	Member
5.	Principal Secretary, Forest Ecology & Environment Department	Member
6.	Principal Secretary, Public Works Department	Member
7.	Commissioner, Directorate of Urban Land Transport (DULT)	Member
8.	Commissioner, BBMP	Member
9.	Commissioner, BDA	Member
10.	Managing Director, BMTC	Member
11	VC & Managing Director, KSRTC	Member
12	Managing Director, BMRCL	Member
13.	Commissioner of Police	Member
14.	Managing Director, KUIDFC	Member
15.	Representatives from Railways, AAI etc	Member
16.	Any other experts connected with the Urban Transport found necessary	Member
17.	Commissioner, BMRDA	Member Secretary

10.6.3 The Functions of BMLTA / committee shall be as follows:

(1) To coordinate all land transport matters in the BMR

(2) To prepare detailed Master Plan for Transport Infrastructure based on the Comprehensive Traffic and Transport Study for Bengaluru.

(3) To oversee implementation of all transportation projects

(4) To appraise and recommend transportation and infrastructure projects for bilateral / bilateral Central assistance.

(5) To function as empowered Committee for all Urban Transportation Projects

(6) To initiate action for a regulatory frame work for all land transport systems in BMR.

(7) To initiate steps, where feasible for common ticketing system.

(8) Take any other decision for the integrated urban transport and land use planning and implementation of the projects.

(9) Any other functions entrusted from time to time.

10.6.4 BMLTA / committee will function as an umbrella organization to coordinate planning and implementation of urban transport programmes and projects and provide an integrated management structure. All land transport systems (excluding Railways) in the Bengaluru Metropolitan Region shall be brought under the purview of BMLTA / Committee.

10.6.5 It is seen from the above that the GOK has already taken the lead and has initiated steps to strengthen the institutions for urban transport. Therefore it is important that BMLTA is established at the earliest with statutory backing and adequate technical staff provided for this organization. It is also important that BMLTA is also given with the

power to assign various projects to various organizations. All the finances for transportation projects to the concerned organizations should also be routed through BMLTA in order to make BMLTA effective and to ensure timely completion of projects.

10.6.6 Shifting of utilities, a key function encountered in most of the road improvement works as well construction of new roads requires very effective coordination among institutions to ensure timely completion of projects. This key function is reported to be the major contributor for project delays and cost over runs. Revamping of institutional arrangements with assignment of authority to single entity to accord approvals and sanction would enhance the efficiency of implementation of major projects proposed under the CTTS. The study recommends that this be vested with BMLTA.

10.7 TRANSPORT PLANNING UNIT (TPU)

10.7.1 The role of BDA with regard to town planning is defined within the BDA act as follows:

i) To prepare a structure plan for the development of BMA
ii) To formulate schemes for implementation the structure plan
iii) To secure and coordinate the execution of the town planning schemes for development of transport infrastructure and management of transport system in accordance with the plan.
iv) To entrust to any local authority the work of execution of the development plan and schemes
v) To coordinate the activities of the various bodies which are concerned with developmental activities.

10.7.2 Transport planning is essential ingredient of the town planning. Presently there is no proper technical body for the required transport planning inputs. It is necessary that technical expertise is created not only within BDA to undertake this task but also in BMRDA to carry out similar jobs at Bengaluru Metropolitan Region Level.

10.7.3 The proposed Transport Planning Unit (TPU) will perform the following specific functions:

i) To prepare a strategic plan for long term development and utilisation of transport facilities
ii) To formulate schemes for implementing the strategic transport plan
iii) To secure and coordinate the execution of schemes for development of transport infrastructure and management of transport system in accordance with the plan.
iv) To entrust to appropriate local authorities the work of execution of transport schemes
v) To coordinate activities of the various bodies concerned with transport with BDA
vi) To define a strategic transport network for BDA / BMRDA
vii) To define a metropolitan transport policy based on strategic network demand and plan.

10.7.4 The other important responsibilities of Transport Planning Unit will include the establishment of criteria for capital investment and methods for fixing the priorities for road and transport schemes and feasibility studies. The TPU will also be responsible to prepare definite policies related to public transport, road safety, environmental protection and goods movement pattern with related agencies dealing with road planning, railways, traffic engineering, enforcement and regulation will be imperative.

10.7.5 The TPU will be headed by a Senior Transport Planner, who will be of rank of Superintending Engineer. The head will be overall in charge and will give the necessary direction to the unit apart from the high level coordination with the concerned departments. He will be assisted by two transport planners, one for policy planning and other for the co-ordination and monitoring. An economist at a senior level is also proposed to be associated with the unit on a part time basis depending upon the requirements.

10.8 TRAFFIC ENGINEERING CELLS (TEC)

10.8.1 A large number of agencies deal with roads such as BBMP, BDA, Traffic Police, PWD, NHAI, BMRDA, Transport Department, BMTC etc. There are numerous issues of proper road geometrics, traffic circulation, junction design, traffic signals, road signs/markings, street furniture etc which are properly attended to by these agencies due to lack of traffic engineering expertise. Traffic planning is a continuous affair. It is therefore important that Traffic Engineering Cells are established in these organizations with qualified and adequate staff such as traffic engineers. This will ensure that the traffic schemes are properly implemented with better results and fine tuned later, if necessary. This will go a long way to improve traffic flow in Bengaluru.

ANNEXURE-3A- LIST OF TRAFFIC ZONES

Traffic zones	NAME OF TRAFFIC ZONE
1	HMT
2	Jalahalli
3	Yeshwantpura
4	Mathikere-North
5	Kodandarampura
6	Dattatreya Temple
7	Malleswaram
8	Gayathrinagar
9	Subramanyanagar
10	Mahalakshmipuram
11	Peenya Industrial Area
12	Nandini Layout
13	Geleyara Balaga Layout
14	Nagapura
15	Rajajinagar
16	Kamalanagar
17	Vrushabhavathinagar
18	Kamakshipalya
19	Basaweshwaranagar
20	Shivanagar
21	Industrial Town-West
22	Sri Ramamandir
23	Prakashnagar
24	Bhashyam Nagar
25	Ramachandrapura
26	Sevashrama
27	Gandhinagar
28	Chickpet
29	Cottonpet
30	S.K.R. Market
31	Binnypet
32	Kempapura Agrahara
33	Vijayanagar
34	RPC Layout (Hampi Nagar)
35	Marenahalli
36	Thimmanahalli
37	Amarjyothinagar

Traffic zones	NAME OF TRAFFIC ZONE
38	Moodalapalya
39	Chandra Layout
40	Attiguppe
41	Gali Anjaneyaswamy Temple
42	Bapuji Nagara
43	Padarayanapura
44	Jagajivanramnagar
45	Azadnagar
46	Chamarajapet
47	Dharmarayaswamy Temple
48	Sudhamanagar
49	Kempegowda nagar
50	Vishweshwarapuram
51	Basavanagudi
52	Hanumanthanagar
53	Srinagar
54	Srinivasanagara
55	Girinagar III Stage
56	Banashankari II stage
57	JP Nagar I, VI Phase
58	Jayanagar IV, V
59	Yediyur
60	Jayanagar Complex, III Block
61	Mavalli
62	Siddapura
63	Lakkasandra
64	Gurappanapalya-East
65	BTM Layout-North
66	Madivala-East
67	Koramangala-West
68	Ejipura
69	Neelasandra
70	Shanthinagar
71	Austin Town
72	Domlur-North
73	Jivanbima Nagar
74	Jeevanbimanagar

Traffic zones	NAME OF TRAFFIC ZONE
75	Jogupalya
76	Richmond Town
77	Sampangiramnagar
78	Vasantha nagar
79	Shivajinagar
80	Bharathinagar
81	Ulsoor
82	Hoysalanagar
83	Sir C.V. Raman Nagar-South
84	Benniganahalli
85	Sarvagna Nagar
86	Maruthisevanagar
87	Lingarajapuram
88	Banaswadi
89	Kacharakanahalli
90	Sagayapura
91	Pulakeshinagar
92	Jayamahal
93	Devarajeevanahalli
94	Kadugondanahalli
95	Kaval Byrasandra-West
96	Hebbal-East
97	Jayachamarajendranagar
98	Ganganagar-HMT Layout
99	Aramane nagar
100	Sanjayanagar-East
101	Mathikere-South
102	Basaweshwaranagar
103	Industrial Town-East
104	MRCR Layout
105	Deepanjali Nagar
106	Mohamadan Block/Jayanagar II
107	Banashankari I Stage

Traffic zones	NAME OF TRAFFIC ZONE
108	Kathriguppe
109	Bhuvaneshwarinagar
110	Padmanabhanagar
111	Kari Sandra
112	JP Nagar II, III, IV, V phase
113	Jayanagar VII, VIII
114	Byrasandra, Tilak Nagar
115	Hombegowdanagar
116	Adugodi
117	Gurappanapalya-West
118	BTM Layout-South
119	Madivala-West
120	Koramangala-East
121	Jakkasandra Layout
122	Domlur-South
123	Old Airport
124	Sir C.V. Raman Nagar-North
125	Kaval Byrasandra-East
126	Hebbal-West
127	Ganganagar-Gangenahalli
128	Sanjayanagar-West
129	Yelahanka (earlier CMC) - Ward No. 1-14, 20, 21, 22, 29
130	Yelahanka (earlier CMC) - Ward No. 16-19
131	Yelahanka (earlier CMC) - Ward No.15, 23-31
132	Byatarayanapura (earlier CMC) - Ward No. 3 - 11
133	Byatarayanapura (earlier CMC) - Ward No.12 - 16, 19
134	Byatarayanapura (earlier CMC) - Ward No. 17, 18, 20-22, 27
135	Byatarayanapura (earlier CMC) - Ward No. 23-26, 28-31
136	K R Puram (earlier CMC) - Ward No.1, 5-10
137	K R Puram (earlier CMC) - Ward No. 2, 4, 12, 13, 14, 19
138	K R Puram (earlier CMC) - Ward No.11, 29-33
139	Mahadevapura (earlier CMC) - Ward No. 1-11
140	K R Puram (earlier CMC) - Ward No.3, 15-18, 34, 35

Traffic zones	NAME OF TRAFFIC ZONE
141	Mahadevapura (earlier CMC) – Ward No. 12, 13, 21, 22, 24
142	Mahadevapura (earlier CMC) – Ward No. 14–20
143	K R Puram (earlier CMC) – Ward No. 21, 22, 24, 26
144	K R Puram (earlier CMC) – Ward No. 20, 23, 25, 27, 28
145	Mahadevapura (earlier CMC) – Ward No. 23, 25–31
146	Bommanahalli (earlier CMC) – Ward No. 1–5
147	Bommanahalli (earlier CMC) – Ward No . 12–16
148	Bommanahalli (earlier CMC) – Ward No. 6–9
149	Bommanahalli (earlier CMC) – Ward No. 10, 11, 17, 18
150	Bommanahalli (earlier CMC) – Ward No. 23–27
151	Bommanahalli (earlier CMC) – Ward No. 19–22
152	Bommanahalli (earlier CMC) – Ward No. 28–31
153	Pattanagere (earlier CMC) – Ward No. 13–29
154	Kengeri (earlier TMC) – Ward No. 1–23
155	Pattanagere (earlier CMC) – Ward No. 1–12
156	Dasarahalli (earlier CMC) – Ward No. 31–33
157	Dasarahalli (earlier CMC) – Ward No. 24, 34, 35
158	Dasarahalli (earlier CMC) – Ward No. 26, 29, 30
159	Dasarahalli (earlier CMC) – Ward No. 23, 25, 27, 28
160	Dasarahalli (earlier CMC) – Ward No. 17–22
161	Dasarahalli (earlier CMC) – Ward No. 4, 9–16
162	Dasarahalli (earlier CMC) – Ward No. 5–8
163	Hunasemaranahalli

Traffic zones	NAME OF TRAFFIC ZONE
164	Chikkagubbi
165	Seegehalli
166	Devarabeesanahalli
167	Kodathi
168	Huskuru
169	Begur
170	Thalaghattapura
171	Gollahalli
172	Machohalli
173	Makali
174	Ivar Kandapura
175	Bagaluru
176	Kodigahalli
177	Nellukunte
178	Hosuru
179	Devanahalli
180	Minakunte
181	Chikkajala
182	Basavana Gudda
183	Singahalli
184	Mailanahalli
185	Bavuru
186	Arasinakunte

Traffic zones	NAME OF TRAFFIC ZONE
187	Bettakote
188	Bavanahalli
189	Sadahalli
190	Kodenahalli
191	Budigere
External Traffic Zones	
192	Mysore Road
193	Kanakapura Road
194	Sarjapur Road
195	Bellary Road
196	Bannerghatta Road
197	Hosur Road
198	Tumkur Road
199	Magadi Road
200	Doddaballapur Road
201	Old Madras Road

Distribution of Daily Vehicles by Modes at Mid Block Locations

SN	Road Name	Car	Mini Bus	Bus	LCV	Truck	2-Wh	Auto	SMV	Total Vehicles	Total PCUs
1	Chord Road near Toll gate	12305	1041	1546	2649	3270	35358	10248	598	**67015**	**76556**
	Composition	18.4	1.6	2.3	4.0	4.9	52.8	15.3	0.9	100.0	
2	Magadi Road near Prasanna Theatre	1694	664	804	670	21	8794	1413	536	**14596**	**14724**
	Composition	11.6	4.6	5.5	4.6	0.1	60.2	9.7	3.7	100.0	
3	R.V. Road near Vijaya College (South End Circle)	14157	425	1784	898	7	29671	8936	892	**56770**	**60236**
	Composition	24.9	0.7	3.1	1.6	0.0	52.3	15.7	1.6	100.0	
4	Hosur Road (NH – 7) near Wipro – CSB Junction	16648	2426	4120	2417	84	29744	5840	1234	**62513**	**66116**
	Composition	26.6	3.9	6.6	3.9	0.1	47.6	9.3	2.0	100.0	
5	Airport Road near Kemp Fort	9966	1180	960	297	13	14467	2659	604	**30146**	**29589**
	Composition	33.1	3.9	3.2	1.0	0.0	48.0	8.8	2.0	100.0	
6	Rajajinagar Link Road near Sujatha Theatre	18036	714	4822	1779	48	72378	29566	398	**127741**	**146209**
	Composition	14.1	0.6	3.8	1.4	0.0	56.7	23.1	0.3	100.0	
7	Sampige Road near Sampige Theatre	8758	655	3156	750	10	30229	13727	262	**57547**	**68045**
	Composition	15.2	1.1	5.5	1.3	0.0	52.5	23.9	0.5	100.0	
8	M.G. Road near Trinity Circle (Big Kids Kemp)	24752	811	3111	12	3	51436	18794	485	**99404**	**109114**
	Composition	24.9	0.8	3.1	0.0	0.0	51.7	18.9	0.5	100.0	
9	Richmond Road / Gen. Thimmaiah Road near Masjid (Richmond Circle)	12944	256	1827	718	20	28811	14597	692	**59865**	**69452**
	Composition	21.6	0.4	3.1	1.2	0.0	48.1	24.4	1.2	100.0	
10	Residency Road / F.M. Cariappa Road near Richmond Circle	8936	659	1058	98	0	17790	9606	363	**38510**	**45024**
	Composition	23.2	1.7	2.7	0.3	0.0	46.2	24.9	0.9	100.0	
11	K.G. Road near Cauvery Bhavan	12665	672	7473	791	14	27401	20480	400	**69896**	**100455**
	Composition	18.1	1.0	10.7	1.1	0.0	39.2	29.3	0.6	100.0	
12	Mahakavi Kuvempu Road near Varalakshmi Nursing Home	4986	675	808	514	53	18092	10580	976	**36684**	**43720**
	Composition	13.6	1.8	2.2	1.4	0.1	49.3	28.8	2.7	100.0	
13	Outer Ring Road near Kamakya	11108	860	1928	1781	1248	18292	1928	321	**37466**	**38026**
	Composition	29.6	2.3	5.1	4.8	3.3	48.8	5.1	0.9	100.0	
14	Outer Ring Road near BTM Layout Bus Stop	15911	923	1026	3764	1834	43595	12454	351	**79859**	**86609**
	Composition	19.9	1.2	1.3	4.7	2.3	54.6	15.6	0.4	100.0	

SN	Road Name	Car	Mini Bus	Bus	LCV	Truck	2-Wh	Auto	SMV	Total Vehicles	Total PCUs
15	Bannerghatta Road near Mantri Apartments	11492	834	980	2548	289	30241	8581	563	**55528**	**59087**
	Composition	20.7	1.5	1.8	4.6	0.5	54.5	15.5	1.0	100.0	
16	Mysore Road near KIMCO	7085	1151	2227	1923	2212	14870	2545	1084	**33097**	**36667**
	Composition	21.4	3.5	6.7	5.8	6.7	44.9	7.7	3.3	100.0	
17	J.C. Road near BMP Parking Lot (Bharat Theatre Jn.)	15685	634	2816	1862	78	61092	17263	391	**99821**	**106048**
	Composition	15.7	0.6	2.8	1.9	0.1	61.2	17.3	0.4	100.0	
18	Lal Bagh Road near Urvashi Theatre	10107	339	883	912	94	29011	11138	460	**52944**	**58226**
	Composition	19.1	0.6	1.7	1.7	0.2	54.8	21.0	0.9	100.0	
19	K. R. Road near National High School -check	8782	484	1974	435	35	26309	10529	986	**49534**	**56291**
	Composition	17.7	1.0	4.0	0.9	0.1	53.1	21.3	2.0	100.0	
20	Old Madras Road / Swami Vivekananda Road near NGEF	14941	439	2090	4326	1531	36849	6972	1633	**68781**	**70039**
	Composition	21.7	0.6	3.0	6.3	2.2	53.6	10.1	2.4	100.0	
21	Sankey Road (T. Chowdaiah Road) near NTI	51377	1234	2026	4191	13	100045	23918	391	**183194**	**185057**
	Composition	28.0	0.7	1.1	2.3	0.0	54.6	13.1	0.2	100.0	
22	Sankey Road / T. Chowdaiah Road after Cauvery Theatre	51870	1200	1983	4193	10	95284	24135	391	**179067**	**182047**
	Composition	29.0	0.7	1.1	2.3	0.0	53.2	13.5	0.2	100.0	
23	Bellary Road / Ramana Maharshi Road near Mekhri Circle	26658	951	1839	2770	13	48385	14381	427	**95425**	**100973**
	Composition	27.9	1.0	1.9	2.9	0.0	50.7	15.1	0.4	100.0	
24	Dr. Raj Kumar Road near Navarang Theatre	14858	469	4340	1407	87	39860	19774	321	**81115**	**97489**
	Composition	18.3	0.6	5.4	1.7	0.1	49.1	24.4	0.4	100.0	

Distribution of Peak Hour Vehicles by Modes at Mid Block Locations

Road Name	Peak Hour	Car	M.bus	Bus	LCV	Truck	3 Axle	Ag Tractor	2-Wh	Auto	SMV	Total
Chord Road near Toll gate	**M**	1623	81	136	211	223	0	0	4522	1061	58	**7915**
	%	20.5	1.0	1.7	2.7	2.8	0.0	0.0	57.1	13.4	0.7	**100.0**
	E	1070	125	143	240	255	0	0	2960	1093	46	**5932**
	%	18.0	2.1	2.4	4.0	4.3	0.0	0.0	49.9	18.4	0.8	**100.0**
Magadi Road near Prasanna Theatre	**M**	182	54	81	60	1	0	0	946	177	51	**1552**
	%	11.7	3.5	5.2	3.9	0.1	0.0	0.0	61.0	11.4	3.3	**100.0**
	E	116	67	76	52	45	0	0	824	149	51	**1380**
	%	8.4	4.9	5.5	3.8	3.3	0.0	0.0	59.7	10.8	3.7	**100.0**
R.V. Road near Vijaya College (South End Circle)	**M**	1297	28	156	68	0	0	0	2975	786	94	**5404**
	%	24.0	0.5	2.9	1.3	0.0	0.0	0.0	55.0	14.5	1.7	**100.0**
	E	1589	22	183	73	0	0	0	3056	804	85	**5812**
	%	27.3	0.4	3.1	1.3	0.0	0.0	0.0	52.6	13.8	1.5	**100.0**
Hosur Road (NH – 7) near Wipro – CSB Junction	**M**	1460	262	310	80	12	0	0	2647	498	164	**5433**
	%	26.9	4.8	5.7	1.5	0.2	0.0	0.0	48.7	9.2	3.0	**100.0**
	E	1891	254	292	269	3	0	0	3105	585	64	**6463**
	%	29.3	3.9	4.5	4.2	0.1	0.0	0.0	48.0	9.1	1.0	**100.0**
Airport Road near Kemp Fort	**M**	1149	112	82	25	0	0	0	1690	237	81	**3376**
	%	34.0	3.3	2.4	0.7	0.0	0.0	0.0	50.1	7.0	2.4	**100.0**
	E	1072	170	122	17	0	0	0	1384	319	58	**3142**
	%	34.1	5.4	3.9	0.5	0.0	0.0	0.0	44.0	10.2	1.8	**100.0**
Rajajinagar Link Road near Sujatha Theatre	**M**	1886	50	489	193	9	0	0	8199	2758	33	**13617**
	%	13.9	0.4	3.6	1.4	0.1	0.0	0.0	60.2	20.3	0.2	**100.0**

Road Name	Peak Hour	Car	M.bus	Bus	LCV	Truck	3 Axle	Ag Tractor	2-Wh	Auto	SMV	Total
	E	1852	94	474	158	0	0	0	6424	3531	41	**12574**
	%	14.7	0.7	3.8	1.3	0.0	0.0	0.0	51.1	28.1	0.3	**100.0**
Sampige Road near Sampige Theatre	**M**	779	67	295	80	0	0	0	2301	1291	22	**4835**
	%	16.1	1.4	6.1	1.7	0.0	0.0	0.0	47.6	26.7	0.5	**100.0**
	E	1323	76	319	60	0	0	0	3762	1367	23	**6930**
	%	19.1	1.1	4.6	0.9	0.0	0.0	0.0	54.3	19.7	0.3	**100.0**
M.G. Road near Trinity Circle (Big Kids Kemp)	**M**	2372	67	287	0	0	0	0	5676	1700	51	**10153**
	%	23.4	0.7	2.8	0.0	0.0	0.0	0.0	55.9	16.7	0.5	**100.0**
	E	2499	103	237	3	0	0	0	5055	1863	37	**9797**
	%	25.5	1.1	2.4	0.0	0.0	0.0	0.0	51.6	19.0	0.4	**100.0**
Richmond Road / Gen. Thimmaiah Road near Masjid (Richmond Circle)	**M**	1269	24	203	71	0	0	0	2509	1566	53	**5695**
	%	22.3	0.4	3.6	1.2	0.0	0.0	0.0	44.1	27.5	0.9	**100.0**
	E	1400	50	175	65	3	0	0	2935	1047	65	**5740**
	%	24.4	0.9	3.0	1.1	0.1	0.0	0.0	51.1	18.2	1.1	**100.0**
Residency Road / F.M. Cariappa Road near St. Joseph's College (Richmond Circle)	**M**	1148	53	70	3	0	0	0	2038	930	33	**4275**
	%	26.9	1.2	1.6	0.1	0.0	0.0	0.0	47.7	21.8	0.8	**100.0**
	E	676	56	87	9	0	0	0	2253	943	41	**4065**
	%	16.6	1.4	2.1	0.2	0.0	0.0	0.0	55.4	23.2	1.0	**100.0**
K.G. Road near Cauvery Bhavan	**M**	1170	44	769	71	3	0	0	2041	1962	40	**6100**
	%	19.2	0.7	12.6	1.2	0.0	0.0	0.0	33.5	32.2	0.7	**100.0**
	E	1106	84	767	92	0	0	0	2738	2447	28	**7262**
	%	15.2	1.2	10.6	1.3	0.0	0.0	0.0	37.7	33.7	0.4	**100.0**

Road Name	Peak Hour	Car	M.bus	Bus	LCV	Truck	3 Axle	Ag Tractor	2-Wh	Auto	SMV	Total
Mahakavi Kuvempu Road near Varalakshmi Nursing Home	**M**	428	63	75	49	4	0	0	1900	873	83	**3475**
	%	12.3	1.8	2.2	1.4	0.1	0.0	0.0	54.7	25.1	2.4	**100.0**
	E	614	53	73	43	4	0	0	2206	1348	85	**4426**
	%	13.9	1.2	1.6	1.0	0.1	0.0	0.0	49.8	30.5	1.9	**100.0**
Outer Ring Road near Kamakhya	**M**	1009	74	168	156	112	0	4	2212	173	24	**3932**
	%	25.7	1.9	4.3	4.0	2.8	0.0	0.1	56.3	4.4	0.6	**100.0**
	E	946	94	166	150	96	0	3	1633	156	21	**3265**
	%	29.0	2.9	5.1	4.6	2.9	0.0	0.1	50.0	4.8	0.6	**100.0**
Outer Ring Road near BTM Layout Bus Stop	**M**	1490	84	101	279	157	14	3	4754	991	31	**7904**
	%	18.9	1.1	1.3	3.5	2.0	0.2	0.0	60.1	12.5	0.4	**100.0**
	E	1529	87	76	312	138	22	2	4506	1222	32	**7926**
	%	19.3	1.1	1.0	3.9	1.7	0.3	0.0	56.8	15.4	0.4	**100.0**
Bannerghatta Road near Mantri Apartments	**M**	1125	74	106	167	26	0	0	3582	969	39	**6087**
	%	18.5	1.2	1.7	2.7	0.4	0.0	0.0	58.8	15.9	0.6	**100.0**
	E	1384	96	58	200	29	0	0	2834	847	47	**5494**
	%	25.2	1.7	1.1	3.6	0.5	0.0	0.0	51.6	15.4	0.9	**100.0**
Mysore Road near KIMCO	**M**	659	135	222	154	180	0	0	1650	255	93	**3348**
	%	19.7	4.0	6.6	4.6	5.4	0.0	0.0	49.3	7.6	2.8	**100.0**
	E	788	98	216	171	227	0	0	1400	154	122	**3176**
	%	24.8	3.1	6.8	5.4	7.1	0.0	0.0	44.1	4.8	3.8	**100.0**
J.C. Road near BMP Parking Lot (Bharat Theatre Jn.)	**M**	2020	60	249	200	16	0	0	8515	2143	47	**13250**
	%	15.2	0.5	1.9	1.5	0.1	0.0	0.0	64.3	16.2	0.4	**100.0**
	E	1446	62	303	201	12	0	0	4706	1925	44	**8699**
	%	16.6	0.7	3.5	2.3	0.1	0.0	0.0	54.1	22.1	0.5	**100.0**

Road Name	Peak Hour	Car	M.bus	Bus	LCV	Truck	3 Axle	Ag Tractor	2-Wh	Auto	SMV	Total
Lal Bagh Road near Urvashi Theatre	**M**	918	24	78	104	16	0	0	2688	1025	35	**4888**
	%	18.8	0.5	1.6	2.1	0.3	0.0	0.0	55.0	21.0	0.7	**100.0**
	E	1105	41	85	100	6	0	0	3719	1142	51	**6249**
	%	17.7	0.7	1.4	1.6	0.1	0.0	0.0	59.5	18.3	0.8	**100.0**
K. R. Road near National High School	**M**	868	51	218	41	3	0	0	3228	897	74	**5380**
	%	16.1	0.9	4.1	0.8	0.1	0.0	0.0	60.0	16.7	1.4	**100.0**
	E	753	29	174	50	4	0	0	2362	912	73	**4358**
	%	17.3	0.7	4.0	1.2	0.1	0.0	0.0	54.2	20.9	1.7	**100.0**
Old Madras Road / Swami Vivekananda Road near NGEF	**M**	1333	33	168	265	114	7	0	3859	602	107	**6488**
	%	20.5	0.5	2.6	4.1	1.8	0.1	0.0	59.5	9.3	1.6	**100.0**
	E	1602	54	199	398	117	4	0	3817	625	253	**7069**
	%	22.7	0.8	2.8	5.6	1.7	0.1	0.0	54.0	8.8	3.6	**100.0**
Sankey Road (T. Chowdaiah Road) near NTI	**M**	5115	80	156	231	2	0	0	12254	2198	43	**20078**
	%	25.5	0.4	0.8	1.2	0.0	0.0	0.0	61.0	10.9	0.2	**100.0**
	E	5281	91	228	453	2	0	0	9719	2267	42	**18083**
	%	29.2	0.5	1.3	2.5	0.0	0.0	0.0	53.7	12.5	0.2	**100.0**
Sankey Road / T. Chowdaiah Road) after Cauvery Theatre	**M**	5133	80	156	231	3	0	0	12254	2280	43	**20179**
	%	25.4	0.4	0.8	1.1	0.0	0.0	0.0	60.7	11.3	0.2	**100.0**
	E	4976	87	233	464	1	0	0	9621	2309	46	**17737**
	%	28.1	0.5	1.3	2.6	0.0	0.0	0.0	54.2	13.0	0.3	**100.0**
Bellary Road / Ramana Maharshi Road near Mekhri Circle Underpass	**M**	2350	93	141	172	0	0	0	5036	1264	30	**9086**
	%	25.9	1.0	1.6	1.9	0.0	0.0	0.0	55.4	13.9	0.3	**100.0**

Road Name	Peak Hour	Car	M.bus	Bus	LCV	Truck	3 Axle	Ag Tractor	2-Wh	Auto	SMV	Total
	E	2057	73	216	233	1	0	0	4873	1349	52	**8854**
	%	23.2	0.8	2.4	2.6	0.0	0.0	0.0	55.0	15.2	0.6	**100.0**
Dr. Raj Kumar Road near Navarang Theatre	**M**	1652	29	445	146	11	0	0	3241	1584	38	**7146**
	%	23.1	0.4	6.2	2.0	0.2	0.0	0.0	45.4	22.2	0.5	**100.0**
	E	1433	64	401	155	7	0	0	4866	1867	20	**8813**
	%	16.3	0.7	4.5	1.8	0.1	0.0	0.0	55.2	21.2	0.2	**100.0**

Distribution of Daily Vehicles by Modes at Screen Line Locations

SN	Road Name		Car	Mini Bus	Bus	LCV	Truck	2-Wh	Auto	SMV	Total Vehicles	Total PCUs
1	RUB near Cantonment Railway Station		13939	478	5002	1430	493	72639	34341	206	**128528**	**151910**
		%	10.8	0.4	3.9	1.1	0.4	56.5	26.7	0.2	100.0	
2	Level Crossing near ITC		12158	405	549	276	82	27311	12662	407	**53849**	**60469**
		%	22.6	0.8	1.0	0.5	0.2	50.7	23.5	0.8	100.0	
3	ROB on Chord Road near Mysore Road Intersection		12278	801	3134	2213	3081	33924	6661	423	**62515**	**70264**
		%	19.6	1.3	5.0	3.5	4.9	54.3	10.7	0.7	100.0	
4	ROB near Malleswaram		22233	1650	10350	2335	54	78830	12201	484	**128136**	**133638**
		%	17.4	1.3	8.1	1.8	0.0	61.5	9.5	0.4	100.0	
5	ROB near Yeshwantpur		12306	1987	2563	2864	300	30678	10103	417	**61217**	**68620**
		%	20.1	3.2	4.2	4.7	0.5	50.1	16.5	0.7	100.0	
6	RUB on NH – 4		18059	564	2499	5403	1901	42447	8092	1911	**80876**	**83078**
		%	22.3	0.7	3.1	6.7	2.4	52.5	10.0	2.4	100.0	
7	RUB near Binny Mill		20971	1178	982	842	1506	68651	38258	407	**132794**	**157592**
		%	15.8	0.9	0.7	0.6	1.1	51.7	28.8	0.3	100.0	
8	RUB on Dhanavantari Road		18947	1508	6879	0	9	63084	28306	507	**119240**	**141294**
		%	15.9	1.3	5.8	0.0	0.0	52.9	23.7	0.4	100.0	
9	RUB near Khodays		20797	356	6179	743	610	47639	31397	1197	**108918**	**142815**
		%	19.1	0.3	5.7	0.7	0.6	43.7	28.8	1.1	100.0	
10	RUB near Okalipuram		22552	356	6179	597	580	50021	32126	1197	**113608**	**147112**
		%	19.9	0.3	5.4	0.5	0.5	44.0	28.3	1.1	100.0	
11	RUB near Marathahalli		13156	401	1896	157	282	37177	18202	407	**71677**	**83183**
		%	18.4	0.6	2.6	0.2	0.4	51.9	25.4	0.6	100.0	
12	RUB on S C Road (near Kino Theatre)		4889	243	1860	404	0	19123	9908	507	**36934**	**45743**
		%	13.2	0.7	5.0	1.1	0.0	51.8	26.8	1.4	100.0	
13	RUB on Sankey Road near Windsor Manor		53759	1249	2044	4215	39	100166	26444	478	**188394**	**192547**
		%	28.5	0.7	1.1	2.2	0.0	53.2	14.0	0.3	100.0	
14	RUB on Hare Krishna Road near Shivananda		15960	978	2330	472	25	44016	15312	311	**79404**	**86615**
		%	20.1	1.2	2.9	0.6	0.0	55.4	19.3	0.4	100.0	
15	RUB on Millers Road		13327	603	4951	1493	3121	67873	31270	417	**123055**	**148966**

SN	Road Name		Car	Mini Bus	Bus	LCV	Truck	2-Wh	Auto	SMV	Total Vehicles	Total PCUs
		%	10.8	0.5	4.0	1.2	2.5	55.2	25.4	0.3	100.0	
16	RUB near Fraser Town Police Station		5226	357	557	377	62	12844	5392	384	**25199**	**28186**
		%	20.7	1.4	2.2	1.5	0.2	51.0	21.4	1.5	100.0	

Distribution of Peak Hour Vehicles by Modes at Screen Line Locations

SN	Location	Peak Hour	Car, Jeep, Taxi	Bus		LCV	Truck	3 Axle	Tractor	2-Wh	Auto	Total Vehicles
				M.bus	Bus							
1	RUB near Cantonment Railway Station	M	1150	55	336	71	24	0	0	6862	3295	**11793**
		%	9.8	0.5	2.8	0.6	0.2	0.0	0.0	58.2	27.9	100.0
		E	1217	46	432	117	46	0	0	7053	3058	**11969**
		%	10.2	0.4	3.6	1.0	0.4	0.0	0.0	58.9	25.5	100.0
2	Level Crossing near ITC	M	760	34	42	20	6	0	0	1836	966	**3665**
		%	20.7	0.9	1.1	0.6	0.2	0.0	0.0	50.1	26.4	100.0
		E	1077	30	41	20	5	0	0	2542	1063	**4778**
		%	22.5	0.6	0.9	0.4	0.1	0.0	0.0	53.2	22.2	100.0
3	ROB on Chord Road near Mysore Road Intersection	M	947	30	221	179	185	15	1	2677	444	**4699**
		%	20.2	0.6	4.7	3.8	3.9	0.3	0.0	57.0	9.4	100.0
		E	1277	103	356	183	116	21	10	3068	703	**5838**
		%	21.9	1.8	6.1	3.1	2.0	0.4	0.2	52.6	12.0	100.0
4	ROB near Malleswaram	M	2197	154	932	168	5	0	0	7624	788	**11867**
		%	18.5	1.3	7.9	1.4	0.0	0.0	0.0	64.2	6.6	100.0
		E	1917	115	869	210	4	0	0	6560	859	**10534**
		%	18.2	1.1	8.2	2.0	0.0	0.0	0.0	62.3	8.2	100.0
5	ROB near Yeshwantpur	M	1085	135	195	178	8	0	0	3005	913	**5518**
		%	19.7	2.5	3.5	3.2	0.1	0.0	0.0	54.5	16.5	100.0
		E	1022	196	194	250	1	0	0	2706	783	**5152**
		%	19.8	3.8	3.8	4.8	0.0	0.0	0.0	52.5	15.2	100.0
6	RUB on NH – 4	M	1333	33	168	265	114	7	0	3859	602	**6381**
		%	20.9	0.5	2.6	4.2	1.8	0.1	0.0	60.5	9.4	100.0
		E	1602	54	199	398	117	4	0	3817	625	**6816**
		%	23.5	0.8	2.9	5.8	1.7	0.1	0.0	56.0	9.2	100.0
7	RUB near Binny Mill	M	1725	108	114	72	147	4	10	6978	3581	**12739**

SN	Location	Peak Hour	Car, Jeep, Taxi	Bus		LCV	Truck	3 Axle	Tractor	2-Wh	Auto	Total Vehicles
				M.bus	Bus							
		%	13.5	0.8	0.9	0.6	1.2	0.0	0.1	54.8	28.1	100.0
		E	1935	168	86	59	163	2	11	6603	3623	**12650**
		%	15.3	1.3	0.7	0.5	1.3	0.0	0.1	52.2	28.6	100.0
8	RUB on Dhanavantari Road	M	1558	134	590	0	0	0	0	4602	2582	**9466**
		%	16.5	1.4	6.2	0.0	0.0	0.0	0.0	48.6	27.3	100.0
		E	2646	152	638	0	0	0	0	7524	2734	**13694**
		%	19.3	1.1	4.7	0.0	0.0	0.0	0.0	54.9	20.0	100.0
9	RUB near Khodays	M	1273	32	274	75	2	0	0	5016	1947	**8619**
		%	14.8	0.4	3.2	0.9	0.0	0.0	0.0	58.2	22.6	100.0
		E	2016	17	555	25	55	0	0	3863	3168	**9699**
		%	20.8	0.2	5.7	0.3	0.6	0.0	0.0	39.8	32.7	100.0
10	RUB near Okalipuram	M	1350	32	274	56	2	0	0	5146	1985	**8845**
		%	15.3	0.4	3.1	0.6	0.0	0.0	0.0	58.2	22.4	100.0
		E	2041	17	555	25	55	0	0	3963	3168	**9824**
		%	20.8	0.2	5.6	0.3	0.6	0.0	0.0	40.3	32.2	100.0
11	RUB near Marathahalli	M	1229	26	123	4	34	0	0	3369	1790	**6575**
		%	18.7	0.4	1.9	0.1	0.5	0.0	0.0	51.2	27.2	100.0
		E	1195	40	206	21	19	0	0	3481	1772	**6734**
		%	17.7	0.6	3.1	0.3	0.3	0.0	0.0	51.7	26.3	100.0
12	RUB on S C Road (near Kino Theatre)	M	470	9	116	34	0	0	0	2136	962	**3727**
		%	12.6	0.2	3.1	0.9	0.0	0.0	0.0	57.3	25.8	100.0
		E	495	12	130	35	0	0	0	1480	811	**2963**
		%	16.7	0.4	4.4	1.2	0.0	0.0	0.0	49.9	27.4	100.0
13	RUB on Sankey Road near Windsor Manor	M	5115	80	156	231	2	0	0	12254	2198	**20035**
		%	25.5	0.4	0.8	1.2	0.0	0.0	0.0	61.2	11.0	100.0
		E	5281	91	228	453	2	0	0	9719	2267	**18041**
		%	29.3	0.5	1.3	2.5	0.0	0.0	0.0	53.9	12.6	100.0

SN	Location	Peak Hour	Car, Jeep, Taxi	Bus		LCV	Truck	3 Axle	Tractor	2-Wh	Auto	Total Vehicles
				M.bus	Bus							
14	RUB on Hare Krishna Road near Shivananda	M	1673	90	242	31	2	0	0	4607	1507	**8152**
		%	20.5	1.1	3.0	0.4	0.0	0.0	0.0	56.5	18.5	100.0
		E	1702	90	247	30	0	0	0	4570	1746	**8385**
		%	20.3	1.1	2.9	0.4	0.0	0.0	0.0	54.5	20.8	100.0
15	RUB on Millers Road	M	1071	53	346	92	176	20	0	6558	3041	**11357**
		%	9.4	0.5	3.0	0.8	1.5	0.2	0.0	57.7	26.8	100.0
		E	1217	46	432	117	185	46	4	7053	3058	**12158**
		%	10.0	0.4	3.6	1.0	1.5	0.4	0.0	58.0	25.2	100.0
16	RUB near Fraser Town Police Station	M	421	27	41	22	3	0	0	1270	433	**2217**
		%	19.0	1.2	1.8	1.0	0.1	0.0	0.0	57.3	19.5	100.0
		E	506	26	45	26	0	0	0	1260	459	**2322**
		%	21.8	1.1	1.9	1.1	0.0	0.0	0.0	54.3	19.8	100.0

Distribution of Daily Vehicles by Modes at Outer Cordon Locations

SN	Road Name		MOTORISED VEHICLES (MV)									Total Motor vehicle	Total Motor PCU	Non Motorised Vehicles					Total N.M.V	Total N.M.V PCU	Total vehicles	Total PCU
			Car	Bus		Trucks				Scooter	Auto Rickshaw			Animal	Hand	Cycle	Pedal					
			Jeep				Regular		Ag	M.Cycle												
			Taxi	Mbus	Bus	LCV	Truck	3 Axle	Tractor	Moped				Drawn	Cart	Rick	Cycle	Other				
1	Sarjapur Road		1436	368	645	337	865	163	194	4145	205	**8358**	**11822**	0	0	0	266	1	**267**	**0**	**8625**	**11933**
		%	16.6	4.3	7.5	3.9	10.0	1.9	2.2	48.1	2.4			0.0	0.0	0.0	3.1	0.0			100.0	
2	Old Madras Road		5710	420	2056	2527	3342	1726	121	6386	896	**23186**	**39932**	0	0	1	159	1	**161**	**0**	**23347**	**39999**
		%	24.5	1.8	8.8	10.8	14.3	7.4	0.5	27.4	3.8			0.0	0.0	0.0	0.7	0.0			100.0	
3	Bellary Road		4150	396	1280	1411	2539	1066	171	4484	305	**15802**	**27426**	0	0	0	99	1	**100**	**0**	**15902**	**27468**
		%	26.1	2.5	8.0	8.9	16.0	6.7	1.1	28.2	1.9			0.0	0.0	0.0	0.6	0.0			100.0	
4	Doddaballapur Road		2962	427	1290	949	2137	97	153	4118	498	**12630**	**21350**	2	1	0	210	0	**213**	**90**	**12843**	**21440**
		%	23.1	3.3	10.0	7.4	16.6	0.8	1.2	32.1	3.9			0.0	0.0	0.0	1.6	0.0			100.0	
5	Tumkur Road		7494	1093	3074	3396	7308	699	105	10993	1685	**35847**	**61980**	0	0	0	226	0	**226**	**90**	**36073**	**62071**
		%	20.8	3.0	8.5	9.4	20.3	1.9	0.3	30.5	4.7			0.0	0.0	0.0	0.6	0.0			100.0	
6	Magadi Road		1776	311	848	586	1079	37	96	5068	809	**10610**	**14032**	38	0	0	154	0	**192**	**119**	**10802**	**14151**
		%	16.4	2.9	7.9	5.4	10.0	0.3	0.9	46.9	7.5			0.4	0.0	0.0	1.4	0.0			100.0	
7	Mysore Road		1122	145	296	239	190	21	27	2683	78	**4801**	**5236**	18	0	0	216	0	**234**	**125**	**5035**	**5361**
		%	22.3	2.9	5.9	4.7	3.8	0.4	0.5	53.3	1.5			0.4	0.0	0.0	4.3	0.0			100.0	
8	Kanakapura Road		3870	563	1631	951	2866	133	185	5281	747	**16228**	**27684**	1	0	0	238	0	**239**	**97**	**16467**	**27781**
		%	23.5	3.4	9.9	5.8	17.4	0.8	1.1	32.1	4.5			0.0	0.0	0.0	1.4	0.0			100.0	
9	Bannerghatta Road		3409	899	1620	723	778	49	67	5018	987	**13550**	**19138**	35	0	0	343	0	**378**	**201**	**13928**	**19339**
		%	24.5	6.5	11.6	5.2	5.6	0.4	0.5	36.0	7.1			0.3	0.0	0.0	2.5	0.0			100.0	
10	Hosur Road		6529	1219	2627	2905	9019	4787	64	10455	1024	**38629**	**77953**	4	7	0	85	0	**96**	**54**	**38725**	**78007**
		%	16.9	3.1	6.8	7.5	23.3	12.4	0.2	27.0	2.6			0.0	0.0	0.0	0.2	0.0			100.0	

Existing One way Streets

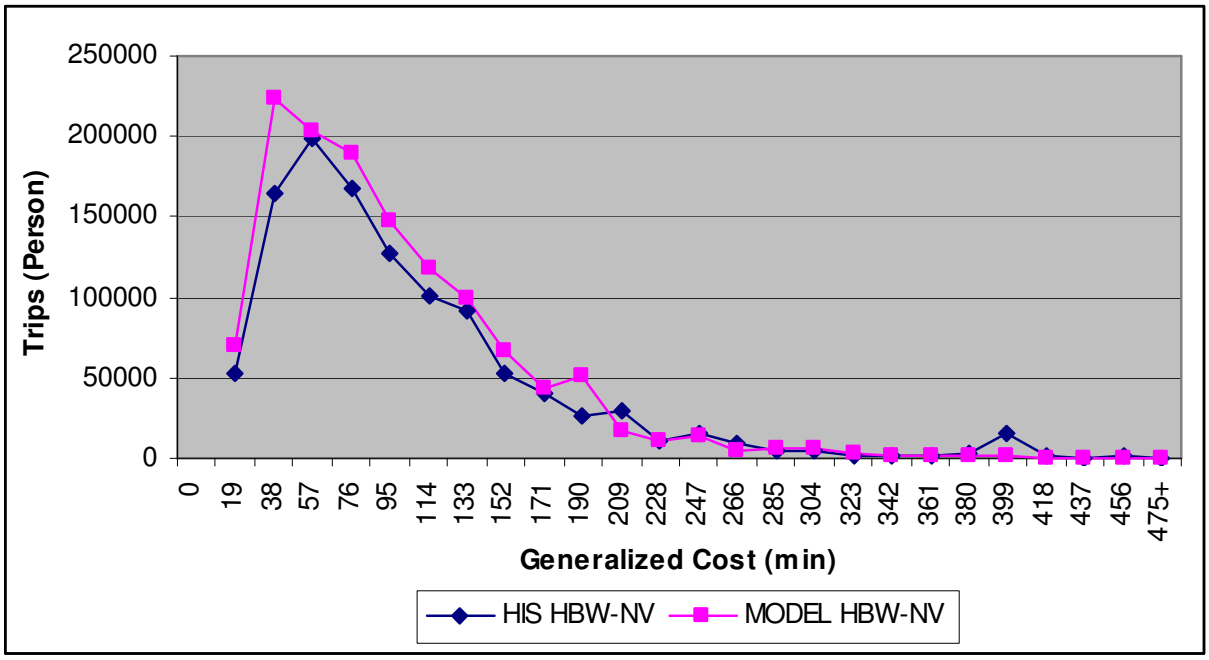
SN.	Road Name	Direction of One-Way
1	Church Road	Brigade Road Jn. to Museum Road Cross
2	St. Marks Road	Cash Pharmacy Jn. to S.B.I Circle
3	O.M Bank Road	S.B.I Circle to Ashivardam Circle
4	Lavelle Road	Queen's Circle to Richmond Circle
5	King Road	Queen's Circle to CTO Circle
6	Sheshadri Iyengar Road	Siddalingaiah Circle to High Court Jn.
7	Fountain Road	High Court Junction to Siddalingaiah Circle
8	Raj Bhavan Road	CTO Circle to Basaweshwara Circle
9	T.Chowdaiah Road	Raj Bhavan LRDE to Infantry Road
10	Infantry Road	Ali Asker Road Jn. to CTO Circle
11	Queen's Road	Balekundri Circle to CTO Circle
12	Queen's Road	From Balekundri Circle to Veterinary Hospital Road Jn.
13	S.C Road	Swastik Circle to Rajiv Gandhi Circle
14	1st Main Road S.S Puram	Link Road to Swastik Circle
15	South Park Road	Nehru Circle to P.F Road
16	Link Road	Malleswaram 5th Cross Jn. to 1st Main road
17	Sampige Road	Rajiv Gandhi circle to Sampige Talkies
18	V.S. Raju Road	Serpentine Road Jn. to Palace Cross Road Jn.
19	Palace Road	Basaweshwara circle to Avinash Petrol Bunk
20	Cunningham Road	Balekundri Circle to Chandrika Hotel
21	T.Chowdaiah Road	High Ground's Jn. to L.R.D.E Jn.
22	Basava Bhavan Road	From Basaweshwara Circle to LRDE Jn.
23	Seshadri Road	East to West
24	Miller Tank Bund Road	North to South
25	3rd Main S.S Nagar	13th Cross S.S Nagar to 8th Main S.S Nagar Jn.
26	13th Main HAL 2nd Stage Indiranagar	East to West
27	New Thippasandra Main Road	West to East
28	Nethaji Road	M.M Road Nethaji Road Jn. to Promenade Road Nethaji Road Jn.
29	Lazar Road	Kenchappa Road Jn. to Pottery Road Jn.
30	Hutchins Road	North Side new Road Jn. to South Direction Davis Road Jn.
31	C.C. Road	West to East
32	Ramakrishna Road	East to West
33	Swamy Vivekananda Road	Kamadhenu Jn. to O.M Road Jn.
34	Ulsoor Bazar Road	Kensington Road to O.M Road
35	Kensington Road	Kensington Oval to Kamadhenu Jn.
36	Sai Mandir Road	West to East
37	Dispensary Road	Alis Road Jn. to Dickenson Road

SN.	Road Name	Direction of One-Way
38	Commercial Street	Kamaraja Road Jn. to OPH Road Jn.
39	Ibrahim Saheb Street	OPH Road Jn. to Kamaraja Road Jn.
40	OPH Road	MK Street Road Jn. to Taj Circle
41	Hospital Road	Main Guard Cross Road Jn. to Infantry Road Jn.
42	Infantry Road	Flying Street Jn. to Main Guard Cross Road Jn.
43	Lady Curzon Road	Cubbon Road Jn. to Infantry road Jn.
44	M.K Street	Richardson Jn. to OPH Road Jn.
45	Kamaraja Road	Dickenson Road Jn. to Nala Road Jn.
46	Labbe Masjid Road	Ibrahim Saheb Street Jn. to C. Street
47	Jewellary Street	D.K Street Road Jn. to C. Street Jn.
48	D.K. Road	Taj Circle Jn. to Russel Market
49	Chandini Chowk Road	Russel Market Jn. Shivaji Circle
50	M.K Street	Richards Jn. to OPH Road Jn.
51	Nethaji Road	Bamboo Bazar Circle to M.M Road
52	Nagarthpet Main Road	Sunkallpet Jn. to Avenue Road Jn.
53	S.J.P Road	City Market to Town hall Circle
54	J.C. Road	Shivaji Jn. to Town Hall Jn.
55	N.R. Road	N.R. Circle to Police Corner
56	Nrupatunga Road	K.R. Circle to Police corner
57	Old Post Office Road	Mysore Bank Circle to K.R. Circle
58	Kasturba Road	Hudson Circle to Siddalingaiah Circle
59	Mallya Hospital Road	Siddalingaiah Circle to RRMR Circle
60	RRMR Road	RRMR Circle to Hudson Circle
61	Devanga Hostel Road	Hudson Circle to Mission Road Jn.
62	Mission Road	N.R. Circle to Subbaiah Circle
63	K.G. Road	Corporation Circle towards Majestic
64	H. Siddaiah Road	K.H Jn. to Urvashi Jn.
65	W. Garden 10th cross	Wilson Garden Main Road to Hosur Main Road
66	W. Garden 12th cross	Hosur Main road to Wilson Garden Main road
67	Koramangala 60 Ft. road	North to South
68	B.T.S Road (Wilson Garden)	West to East
69	Brigade Road	Arts & Crafts to Old P.S.-North to South
70	Hayes Road	Cash Pharmacy Circle to Richmond road - North to south
71	Residency Cross Road	Residency Rd. to M.G. Road - South to North
72	Kingston Street	South to North
73	Campbell Road	Mother Theresa to Hosur road - North to South
74	Langford Cross Road	Lalbagh Road to Langford Road Garden
75	Commissariat Road	Residency Road Jn. to BMTC Bus Stop
76	Primrose Road	MG Rd. Jn. to Magarath Road Jn.
77	Magarath Road	BMTC Bus Stop to Hosmat Hospital

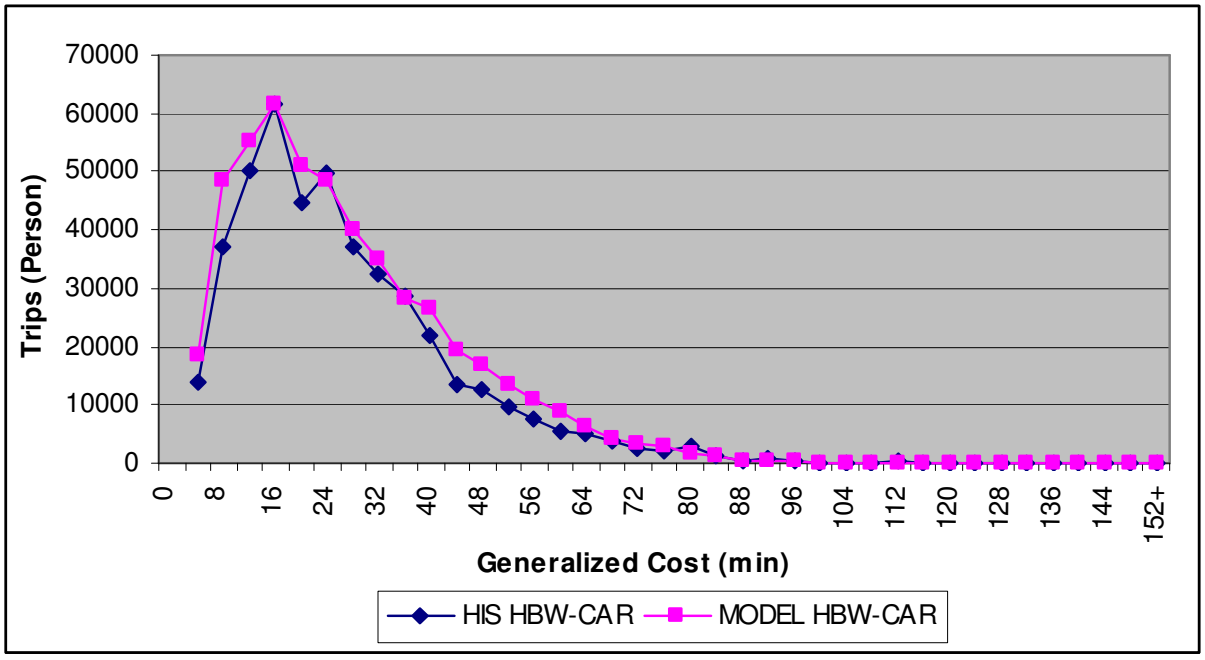
SN.	Road Name	Direction of One-Way
78	Richmond Road	Hosmat Jn. to D'Souza Circle
79	Viveknagar 4th Main Road	North to South
80	5th Main Road BTM	B.B. Road to 6th Main Road BTM 2nd Stage
81	6th Main Road BTM	6th Main Road towards B.B Road
82	Hegganahalli Main Road	Sunkadakatte Jn. to Peenya 2nd Stage Bus Stop- South to North
83	J.C. Nagar Main Road	Jayamahal Road Shivanna Circle to PRTC Circle - North to south
84	A.M Lane	B.V.K. Iyengar Road Jn. to D.K.Lane Jn. -East to West
85	OTC Road	Good shed Rd to Cottonpet Main Road to Cottonpet Main Rd.
86	Sulthanpet Main Road	Akkipet Main Road to A.S.R. Street Jn.
87	Avenue Road	Mysore Bank Circle to City Market
88	B.V.K. Iyengar Road	Kempegowda Road to Chickpet Circle
89	Balepet Main Road	Junction of R.T Street & Balepet main road on north towards south upto Balepet circle
90	Cottonpet Main Road	Briand Square to Shanthala Circle
91	T.C.M Rayon road	Shanthala Circle to Mysore Road Veterinary Hospital Jn.
92	Tank Bund Road	J.J Nagar Main Road K.P.T.C.L Office to Binny Mill
93	Palace Road	Maharani College Circle to Mysore Bank
94	Seshadri Road	Maharani College Circle to Khoday's Circle
95	K.G Road	Tank Bund Elite Jn. to Mysore Bank Circle & Upparpet P.S Jn. To K.G. Circle
96	Avenue Road	Mysore Bank Circle to Hospital Road Jn.
97	S.C Road	Kempegowda Circle to Ananda Rao Circle
98	Albert Victor Road	Medical College to Kalasipalya Main Road
99	M.T.B. Road	A.M. Road Jn. to L.B.F. Road
100	Narashimaraja Road	Jamia Mosque Jn. to Town Hall Circle
101	Kalasipalyam Main Road	A.V Road Jn. to Market Square
102	JC Road	Town hall to Minerva
103	H. Siddaiah Road	Lalbagh Road Jn. to J.C. Road Bharath Jn.
104	LBF Road	Minerva Circle to Lalbagh Main Gate
105	Krumbigal Road	Lalbagh West Gate to Lalbagh Main Gate
106	SJP Road	Town Jn. to Market Circle
107	Old Taragupet Road	AS Char Street Jn. to Avenue Road Jn.
108	Avenue Road	Mysore Circle to Market Circle
109	9 th Cross	5th Main Jn. to Sirsi Circle
110	7 th cross	1 st Main Chamarajapet to Mysore Road Jn.
111	2nd Cross Chamarajapet	Royan Circle to 5 th Main, J Chamarajapet Jn.
112	K.R. Road	Market Square Jn. to Medical College Circle Jn.
113	A.N. K Road/Diagonal Road	Sajjan Rao Circle to National college Circle
114	K.R. Road	Medical College Circle Jn. to Market Square Jn.
115	Sultan Road	Briand Square Jn. to Royan Circle Jn.

SN.	Road Name	Direction of One-Way
116	Bugle Rock Road	Bull Temple Road Jn. to R.Road Jn.
117	30th Cross Road Jayanagar	9th Main Road to 11 th Main Road
118	27th Cross Road Jayanagar	10th Main Road to 9 th Main Road
119	9th Main Road	32nd Cross to 30th Cross
120	11th Main Road Jayanagar	30th cross to 27th cross
121	J.C. Nagar Main Road	Jayamahal Road Shivanna Circle to PRTC Circle
122	Sampige Road	Malleswaram 18th Cross Jn. to Malleswaram Circle
123	Margosa Road	Malleswaram 5th Cross Jn. to 18th Cross Jn.
124	7th Cross, Malleswaram	Margosa Road Jn. to Coconut Avenue Road Jn.
125	8th Cross Malleswaram	Coconut Avenue Road Jn. to Margosa Road Jn.
126	Malleswaram 17th cross	Malleswaram 12th Main Road Jn. to 4th Main Road Jn
127	Sampige Road	Mill Corner Jn. to T.Chowdaiah Road Jn.
128	8th Main Road M.C layout	Vijayanagar Signal Light Circle to 18th Cross Jn.

Mode and Purpose wise Distribution Model Calibration



1. HBW-NV Distribution Model Calibration



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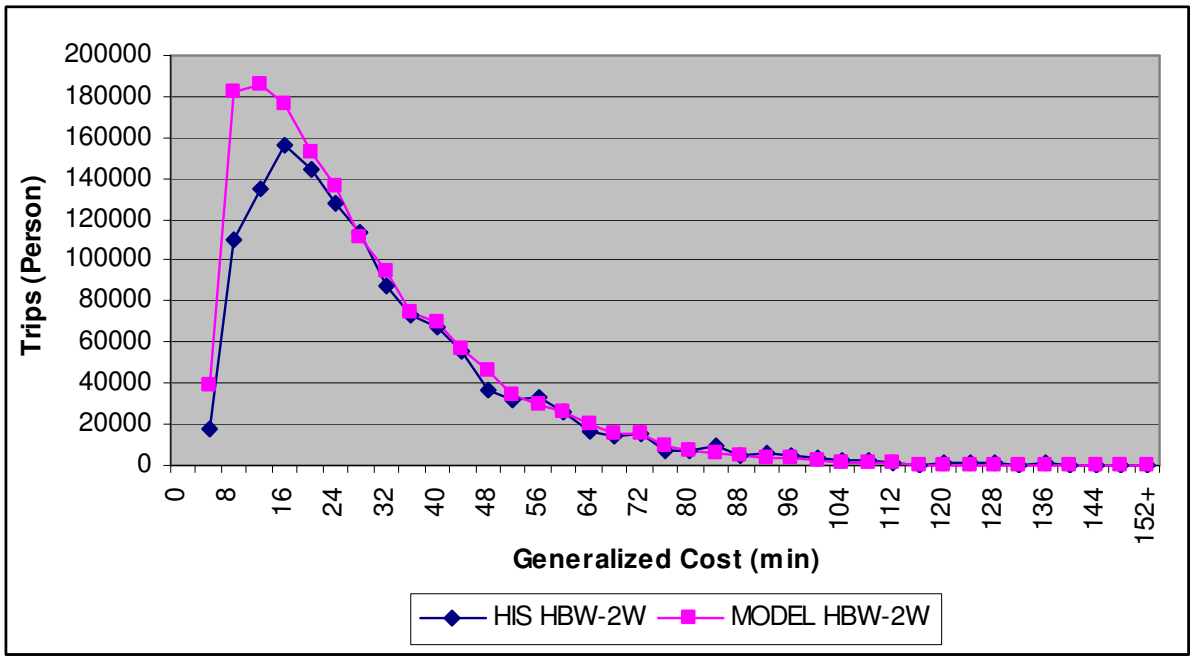

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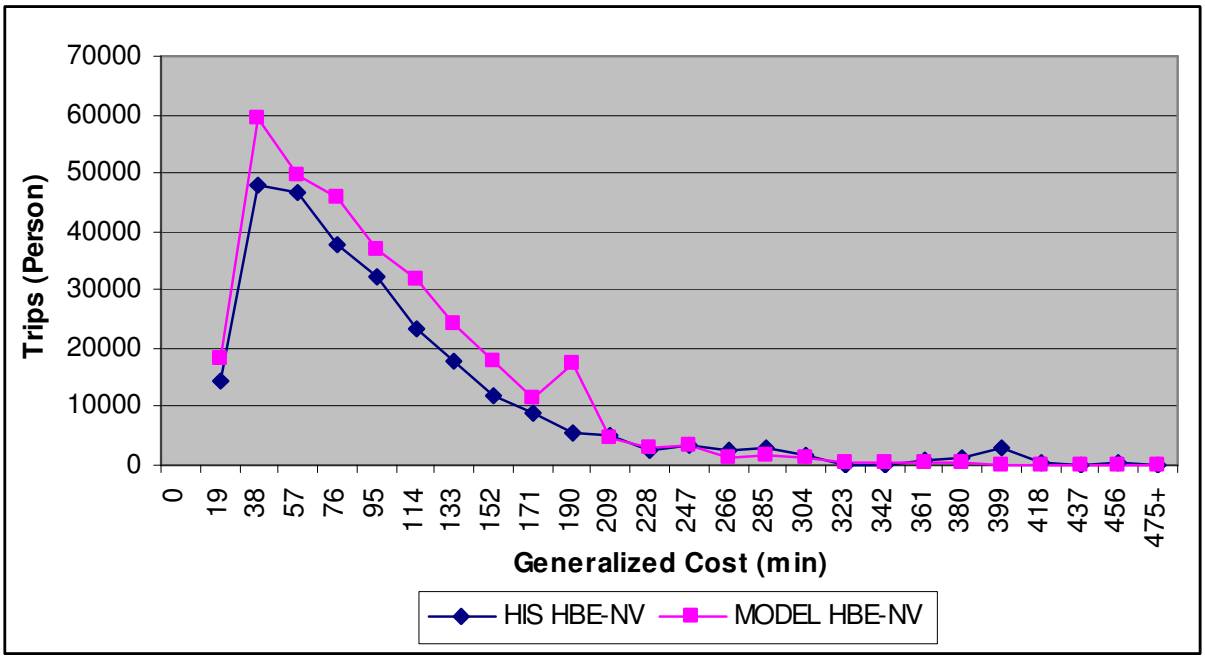
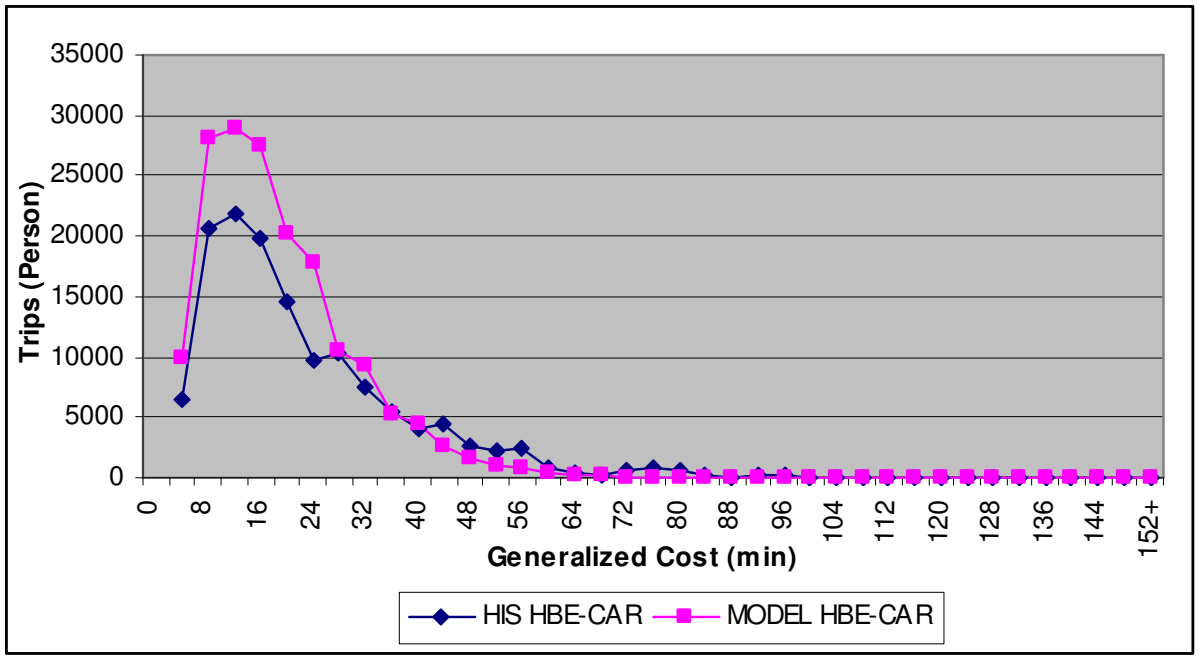


4. HBE-NV Distribution Model Calibration



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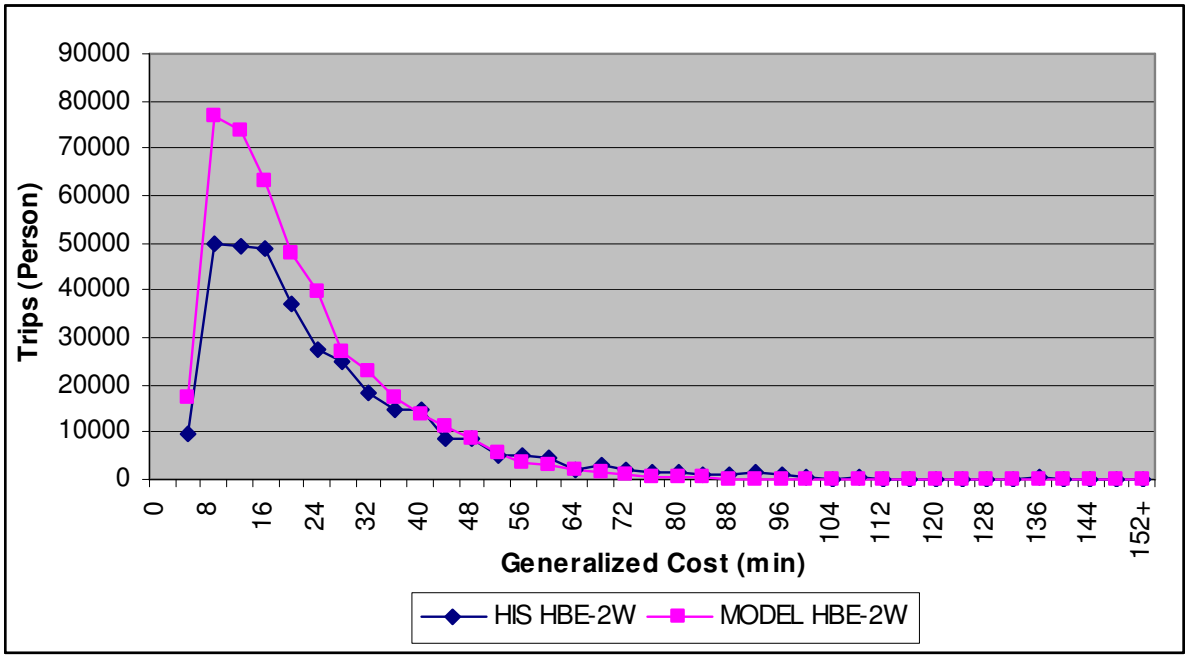

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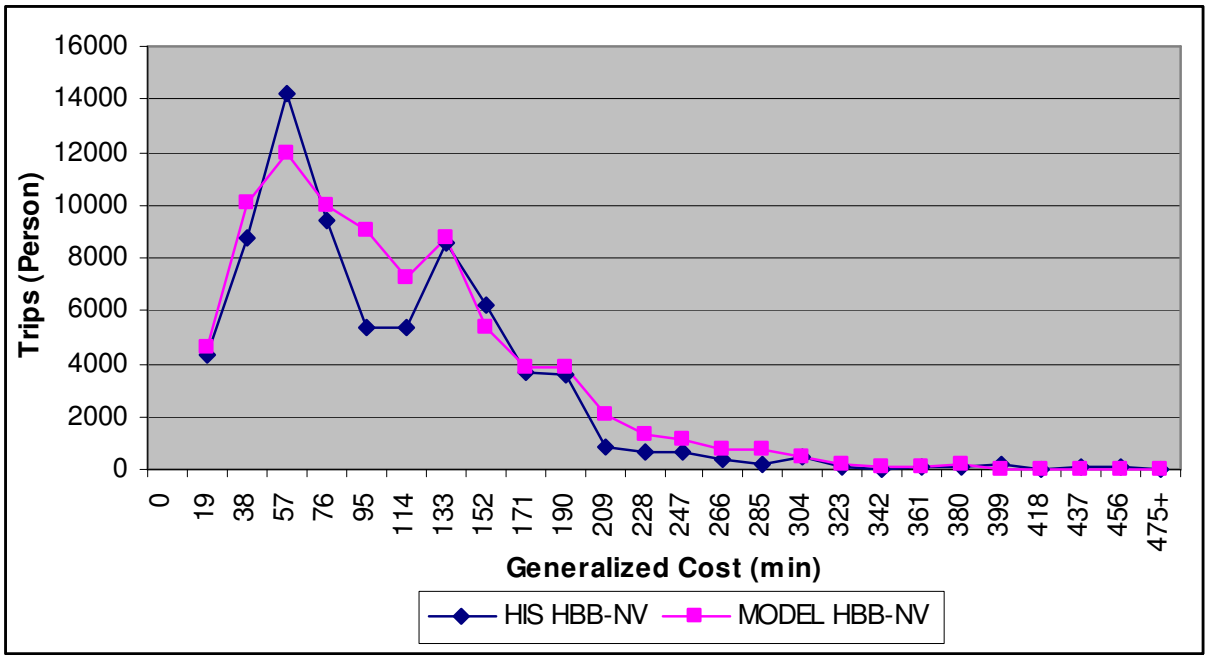
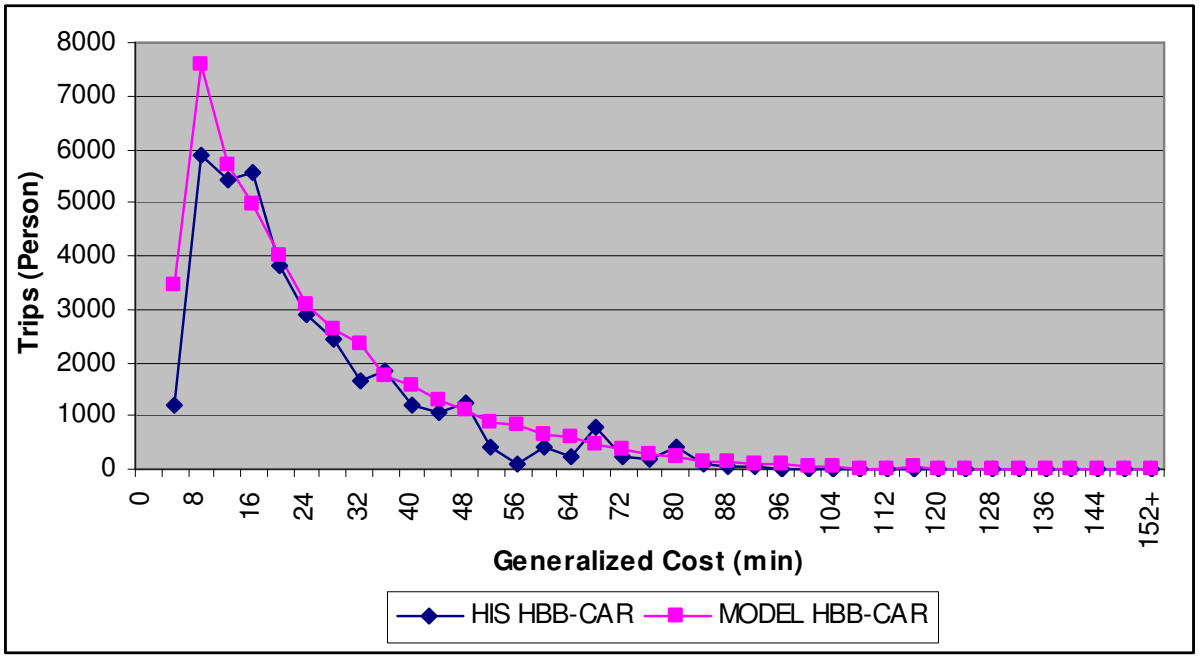
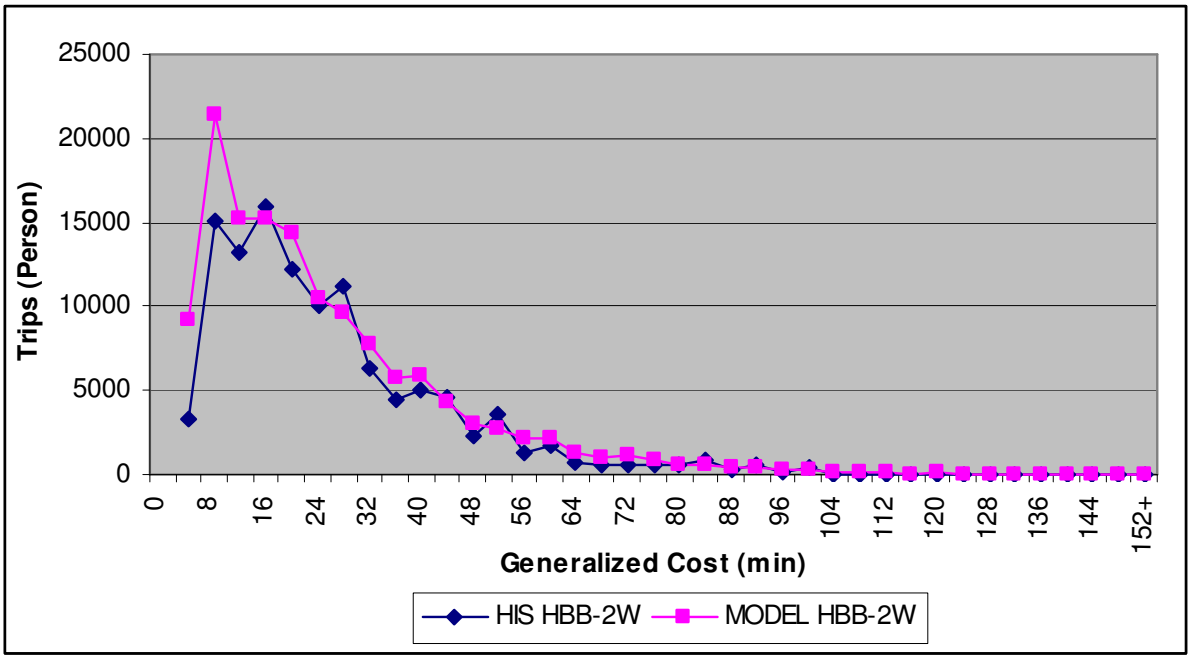


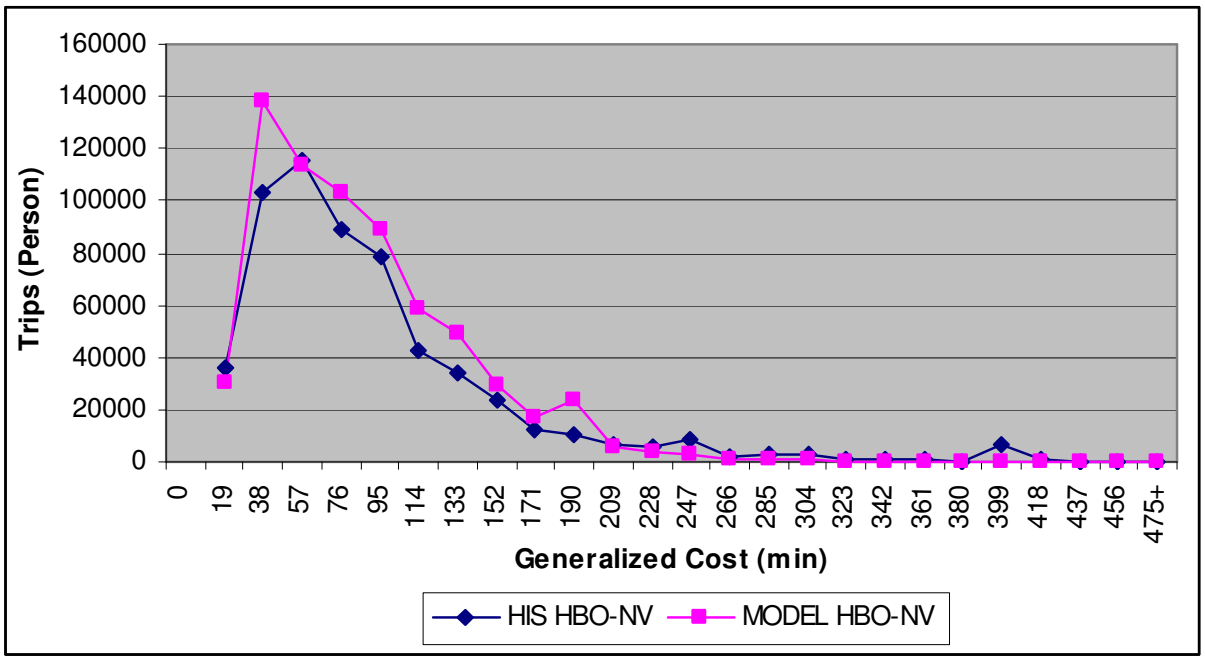
7. HBB-NV Distribution Model Calibration



8. HBB-Car Distribution Model Calibration



9. HBB-2W Distribution Model Calibration



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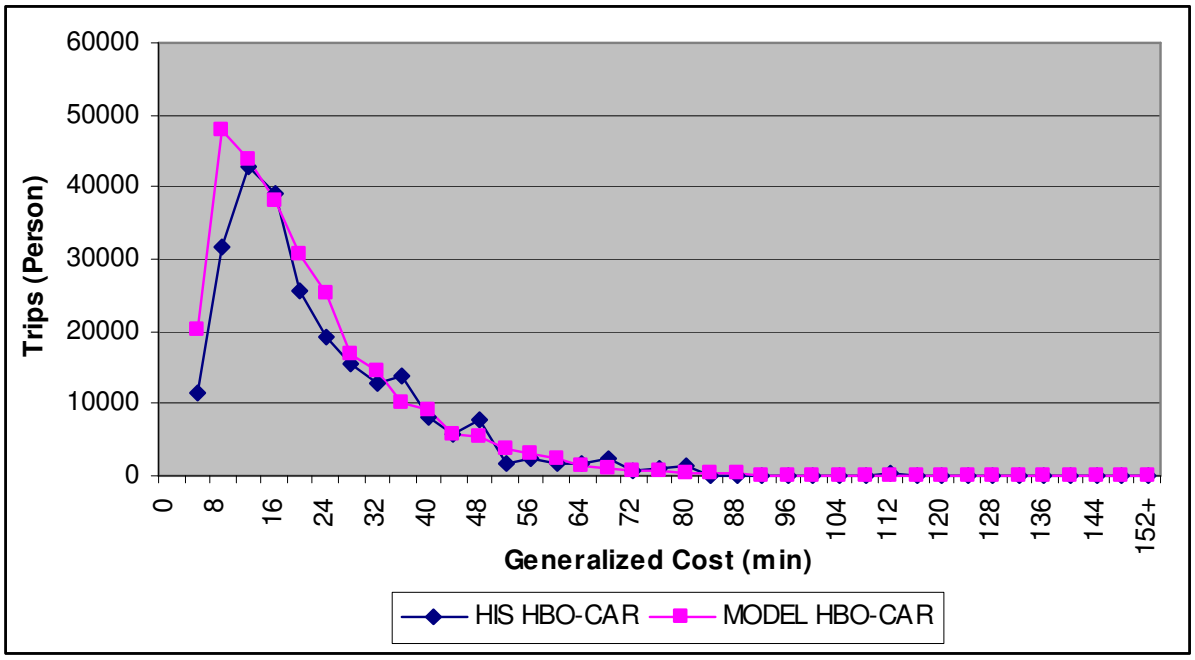
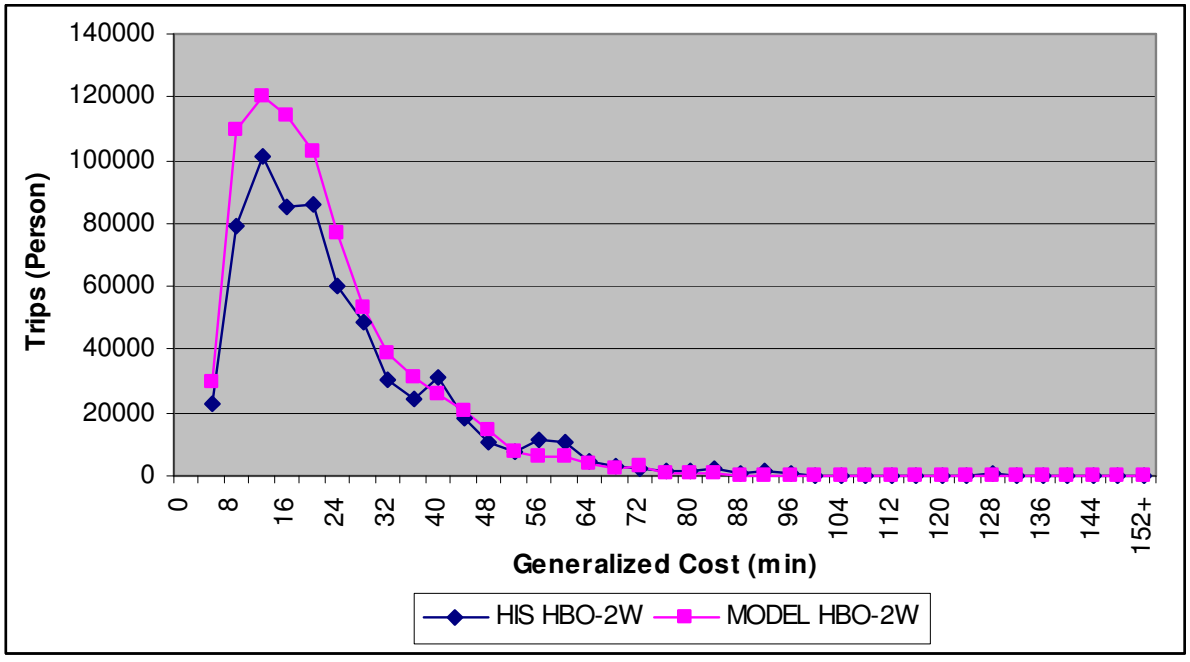
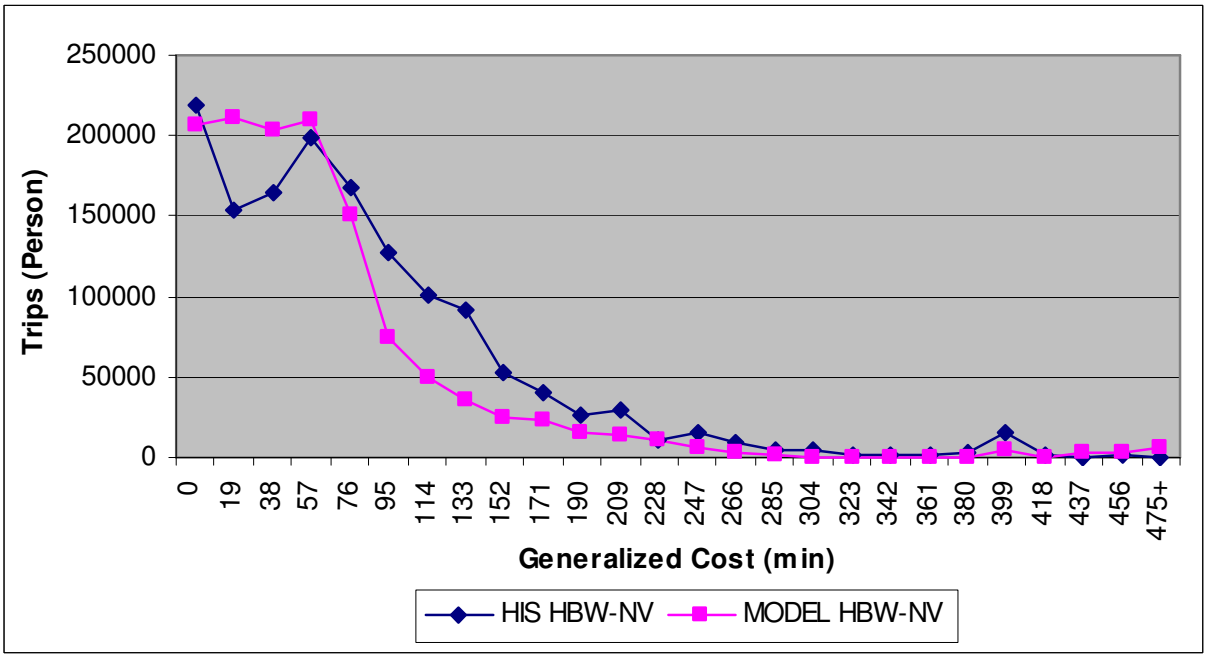


11. HBO-Car Distribution Model Calibration

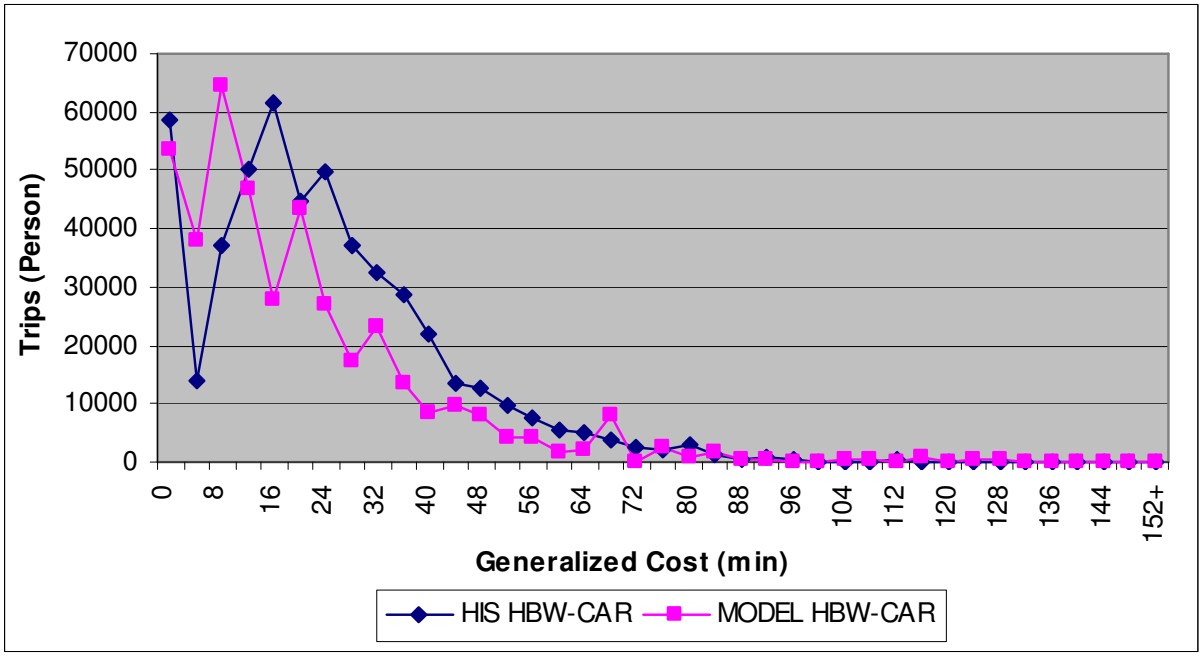


12. HBO-2W Distribution Model Calibration

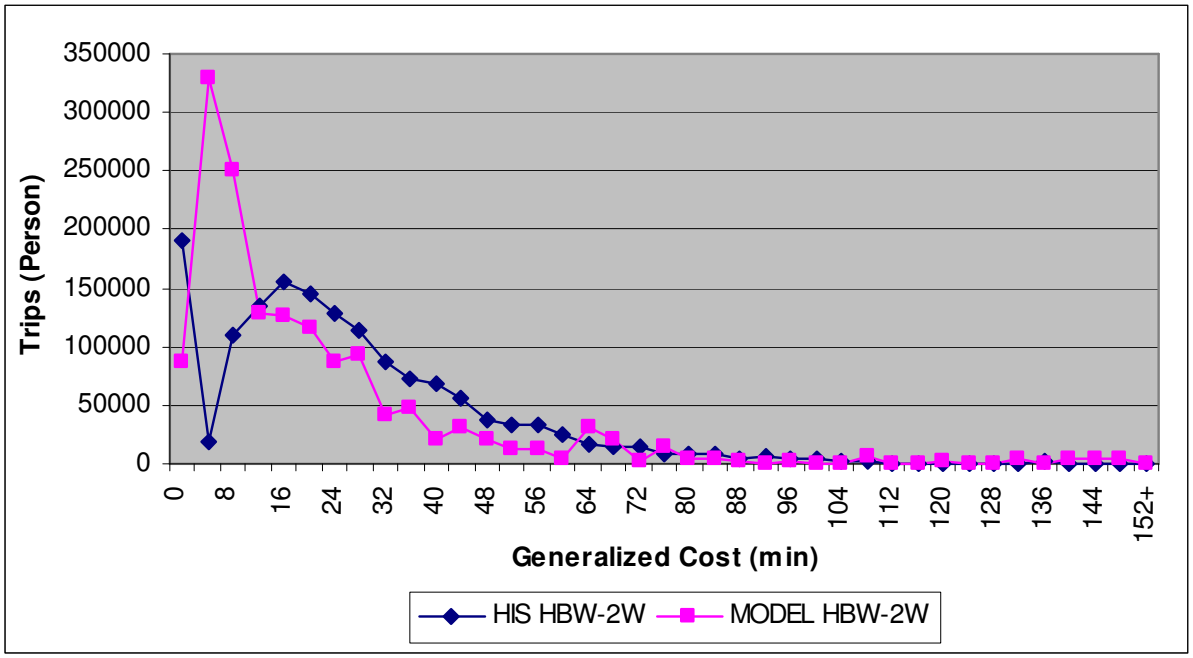
Mode and Purpose wise Distribution Model Validation



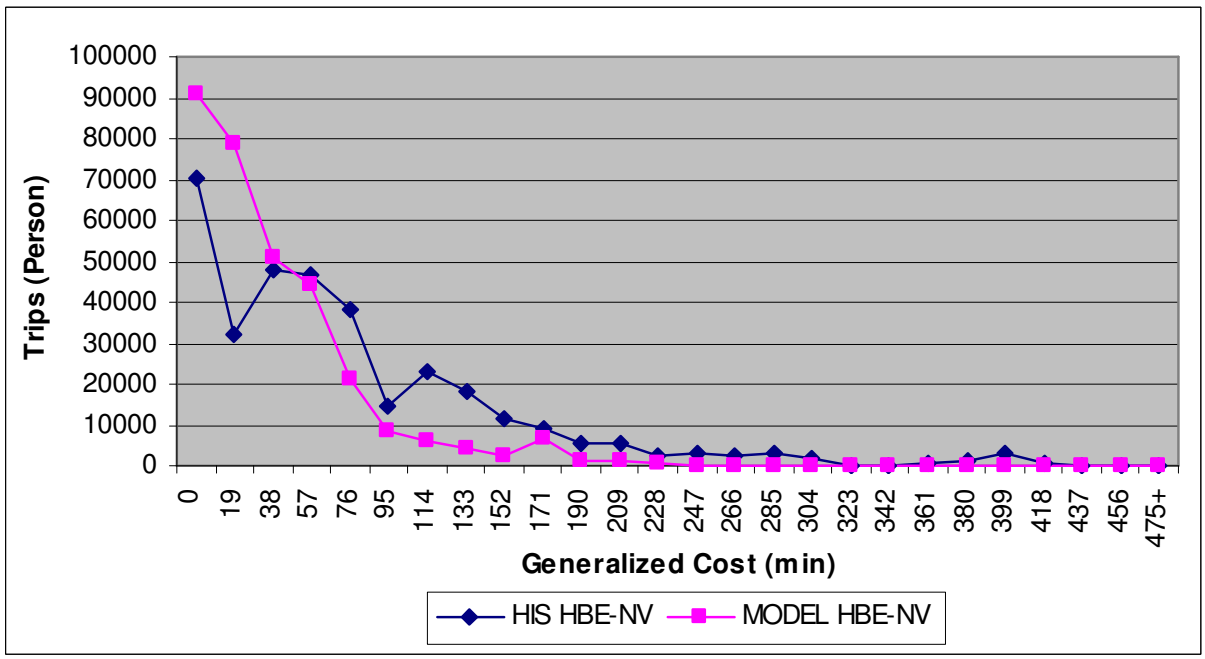
1. HBW-NV Distribution Model Validation



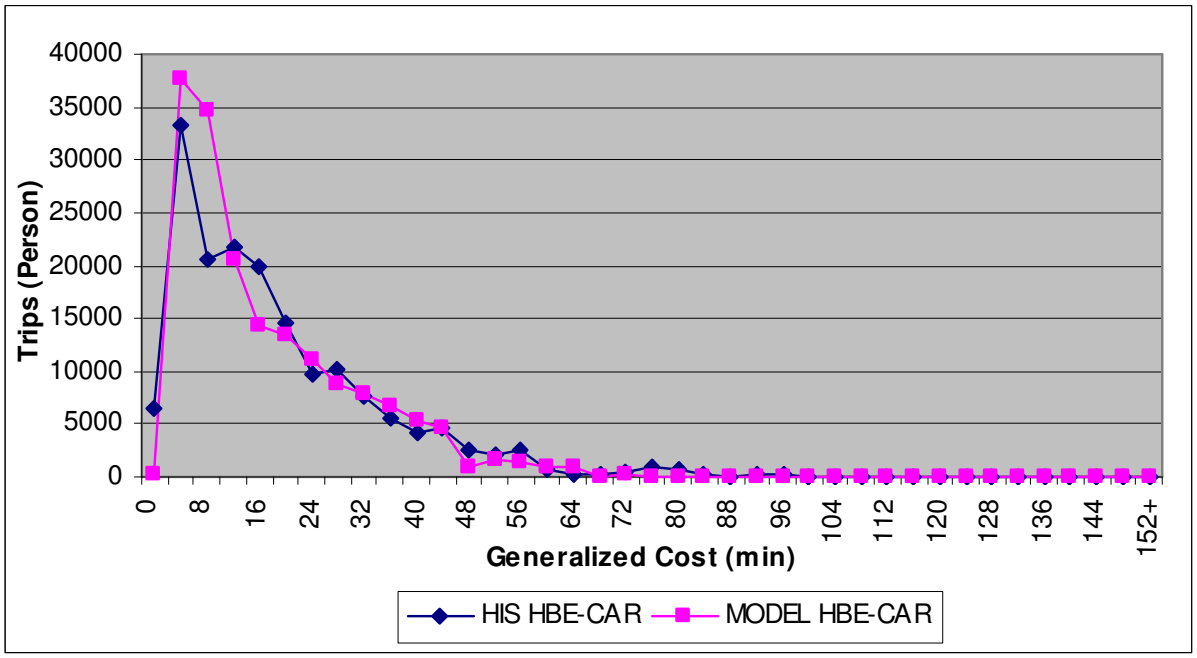
2. HBW-Car Distribution Model Validation



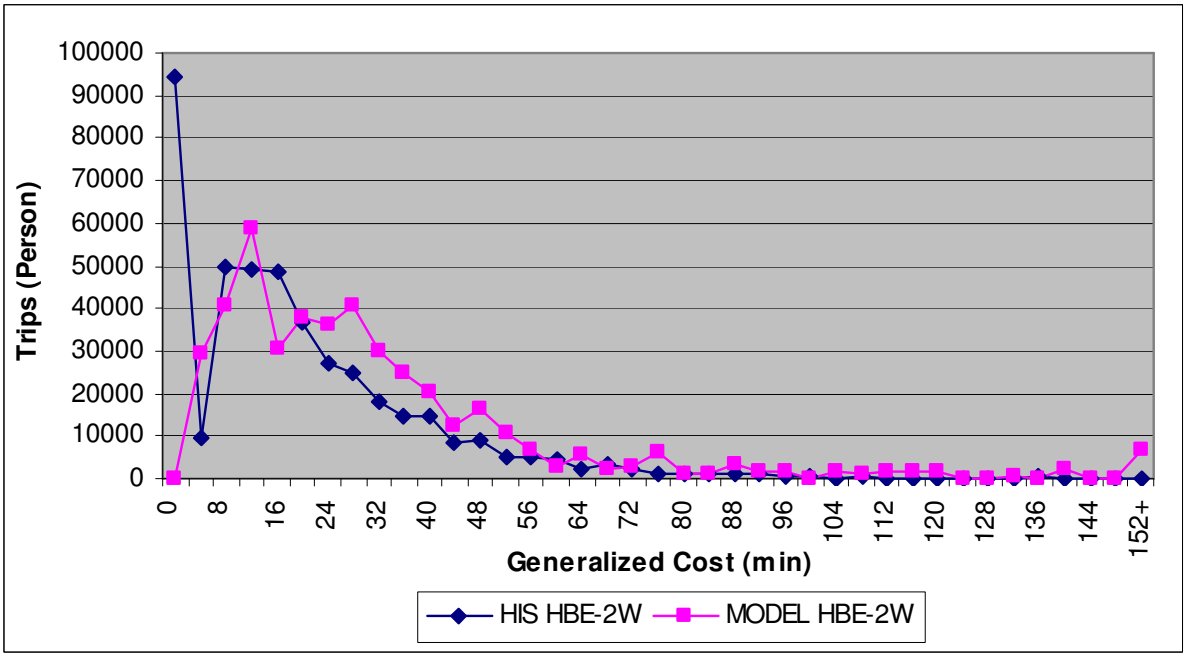
3. HBW-2W Distribution Model Validation



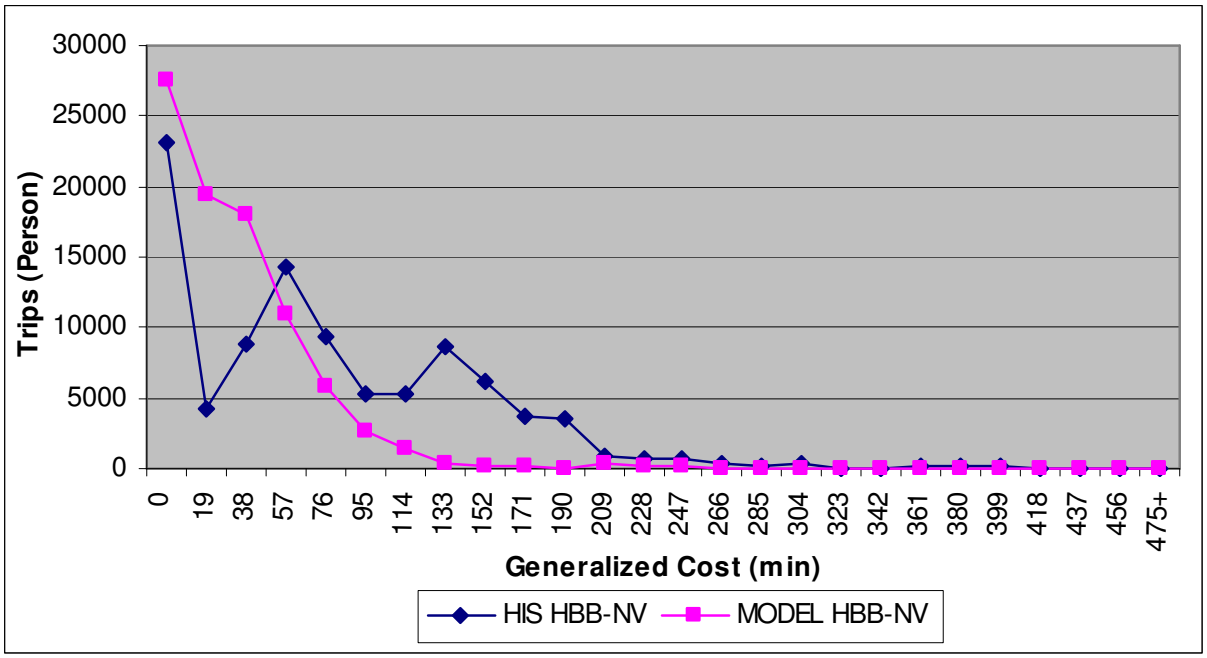
4. HBE-NV Distribution Model Validation



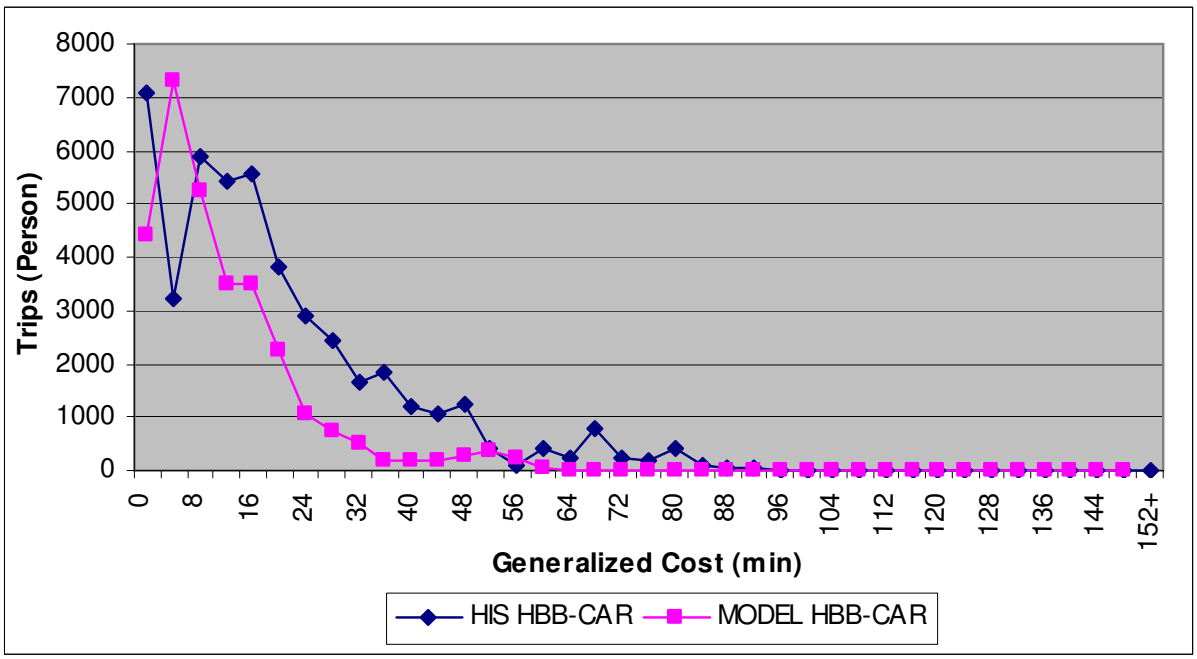
5. HBE-Car Distribution Model Validation



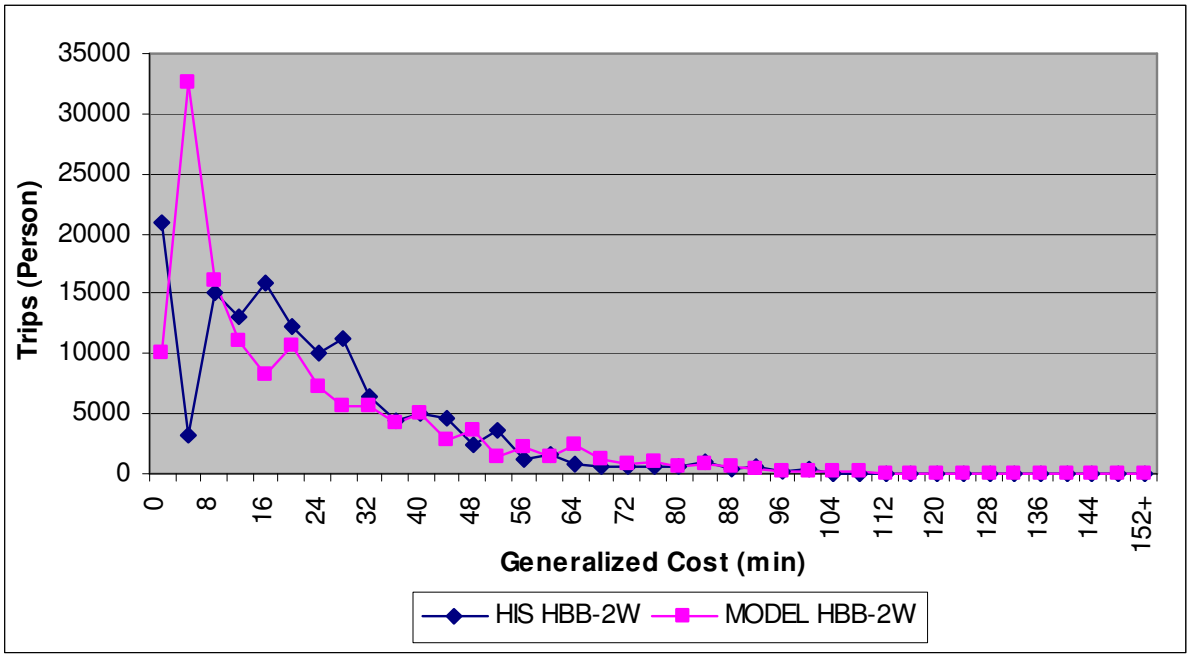
6. HBE-2W Distribution Model Validation



7. HBB-NV Distribution Model Validation



8. HBB-Car Distribution Model Validation



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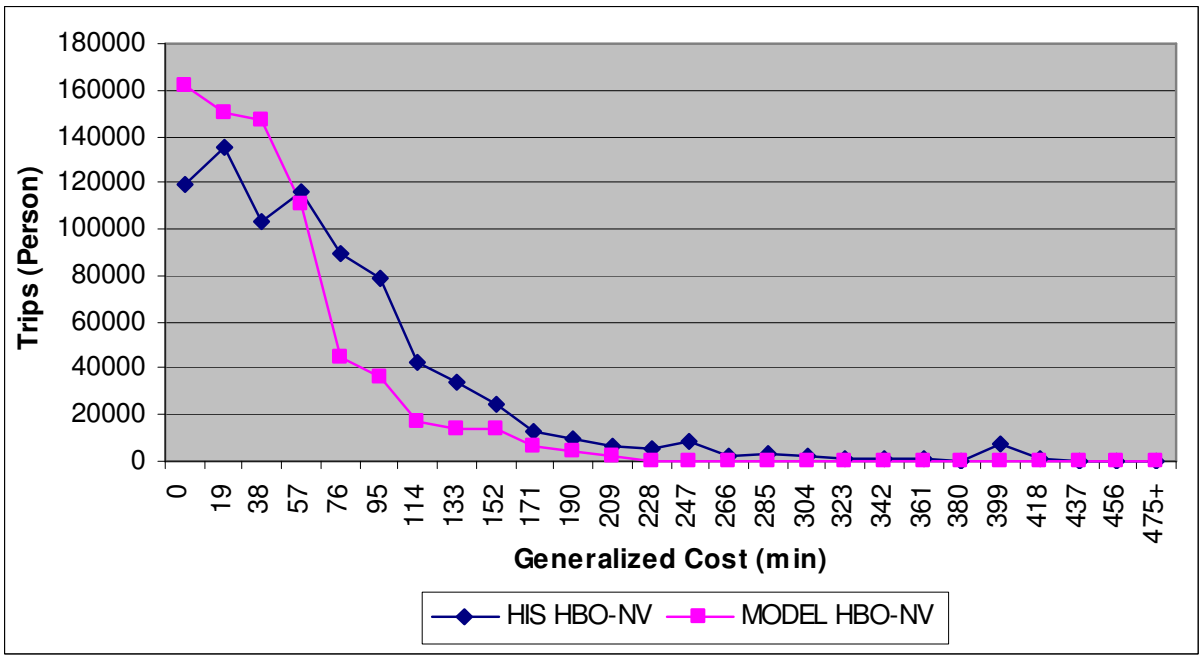
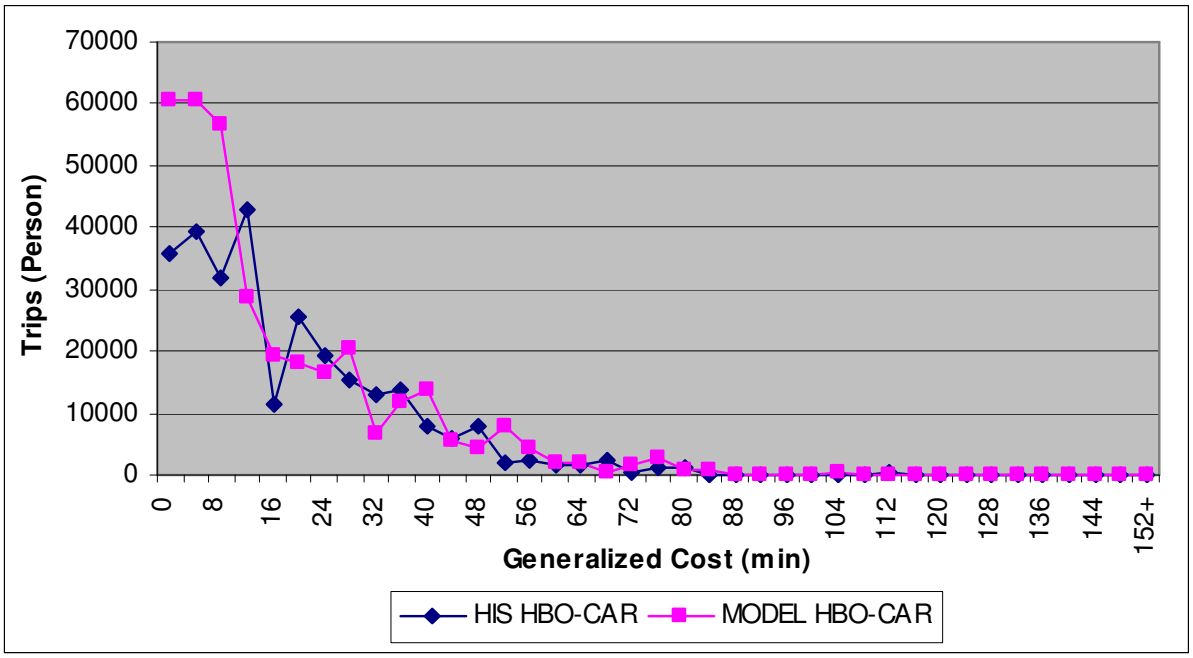
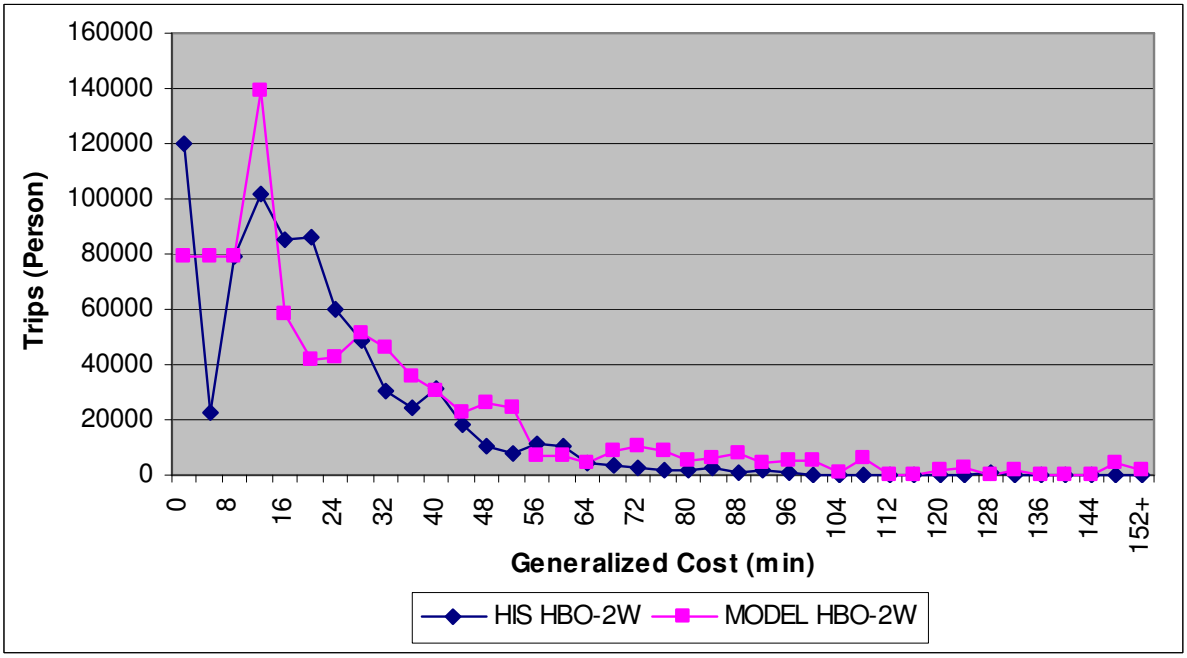


10. HBO-NV Distribution Model Validation



11. HBO-Car Distribution Model Validation



12. HBO-2W Distribution Model Validation

Zone-wise Distribution of Population 2005, 2015, 2025

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
1	HMT	33409	47837	59467
2	Jalahalli	41848	55139	65584
3	Yeshwantpura	51794	63125	71475
4	Mathikere-North	29569	34553	39317
5	Kodandarampura	28727	34553	39317
6	Dattatreya Temple	40817	44499	48189
7	Malleswaram	38961	46900	50790
8	Gayathrinagar	40328	42192	44349
9	Subramanyanagar	42458	45837	48181
10	Mahalakshmipuram	39531	43812	46053
11	Peenya Industrial Area	38161	43549	46927
12	Nandini Layout	40726	44367	48047
13	Geleyara Balaga Layout	47864	56757	62695
14	Nagapura	39313	48576	52345
15	Rajajinagar	39683	44949	48436
16	Kamalanagar	42532	45597	49379
17	Vrushabhavathinagar	31727	36724	39770
18	Kamakshipalya	32504	36724	39770
19	Basaweshwaranagar	31155	36887	39947
20	Shivanagar	30431	33897	37444
21	Industrial Town-West	25589	29478	32563

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
22	Sriramamandir	33356	35662	39393
23	Prakashnagar	37995	40535	44775
24	Bhashyam nagar	17167	19965	22054
25	Ramachandrapura	43821	47701	51147
26	Sevashrama	37363	43657	47278
27	Gandhinagar	38081	42706	46248
28	Chickpet	38159	43457	47061
29	Cottonpet	37861	38884	39669
30	S.K.R. Market	32899	33748	34429
31	Binnypet	32503	32906	33570
32	Kempapura Agrahara	41210	41811	42654
33	Vijayanagar	39870	40826	41650
34	RPC Layout (Hampi Nagar)	29087	32427	34085
35	Marenahalli	42649	47892	51608
36	Thimmanahalli	46559	49811	52358
37	Amarjyothinagar	48599	55034	59010
38	Moodalapalya	46882	49005	53070
39	Chandra Layout	40577	42843	47325
40	Attiguppe	25266	28562	31550
41	Gali Anjaneyaswamy Temple	23306	27656	30549
42	Bapuji Nagara	17997	19783	21853
43	Padarayanapura	46967	52239	57704

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
44	Jagajivanramnagar	29770	34382	38738
45	Azadnagar	33178	37816	39750
46	Chamarajapet	23744	25211	26500
47	Dharmarayaswamy Temple	43223	50555	53140
48	Sudhamanagar	59933	63577	65510
49	Kempegowda nagar	44029	46686	48106
50	Vishweshwarapuram	40821	47457	49884
51	Basavanagudi	42577	49667	52207
52	Hanumanthanagar	36154	39333	42385
53	Srinagar	42419	50626	53746
54	Srinivasanagara	44071	50491	54408
55	Girinagar III Stage	20477	24278	26818
56	Banashankari II stage	13732	16185	17879
57	JP Nagar I, VI Phase	44418	49502	53608
58	Jayanagar IV, V	39287	43320	45535
59	Yediyur	35282	37987	39930
60	Jayanagar Complex, III Block	35210	37987	39930
61	Mavalli	41485	50639	54839
62	Siddapura	46035	50639	54839
63	Lakkasandra	41100	47060	50963
64	Gurappanapalya-East	40674	47060	50963
65	BTM Layout-North	41123	47060	50963

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
66	Madivala-East	56129	65959	71430
67	Koramangala-West	34923	43973	47620
68	Ejipura	36859	40016	43335
69	Neelasandra	35621	40016	43335
70	Shanthinagar	21165	24030	26023
71	Austin Town	22211	24030	26023
72	Domlur-North	38571	43346	46941
73	Jivanbima Nagar	21172	24610	26520
74	Jeevanbimanagar	22104	24610	26520
75	Jogupalya	41646	45596	47928
76	Richmond Town	30172	33757	36557
77	Sampangiramnagar	32679	33757	36557
78	Vasanthnagar	26194	30586	33786
79	Shivajinagar	27085	30586	33786
80	Bharathinagar	47752	55869	61714
81	Ulsoor	22152	23944	26449
82	Hoysalanagar	30027	33181	35933
83	Sir C.V. Raman Nagar-South	27312	33181	35933
84	Benniganahalli	43838	51800	58651
85	Sarvagna Nagar	30131	34533	39101
86	Maruthisevanagar	29551	36567	40393
87	Lingarajapuram	23267	24378	26929

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
88	Banaswadi	30822	35472	39966
89	Kacharakanahalli	20315	23648	26644
90	Sagayapura	56609	62781	65991
91	Pulakeshinagar	38117	41456	43576
92	Jayamahal	42664	47086	49494
93	Devarajeevanahalli	28357	32249	33898
94	Kadugondanahalli	19089	21499	22599
95	Kavalbyrasandra-West	30175	35607	38561
96	Hebbal-East	13083	15260	16526
97	Jayachamarajendranagar	41906	47435	50862
98	Ganganagar-HMT Layout	40425	44405	48088
99	Aramane nagar	39214	45009	48743
100	Sanjayanagar-East	32946	33205	33539
101	Mathikere-South	40569	43462	46142
102	Basaweshwaranagar	36532	41368	43483
103	Industrial Town-East	37036	42616	46151
104	MRCR Layout	44372	47020	49424
105	Deepanjali Nagar	38204	41886	45360
106	Mohamadan Block/Jayanagar II block	28811	32960	36408
107	Banashankari I Stage	30457	32960	36408
108	Kathriguppe	34071	44531	49189
109	Bhuvaneshwarinagar	40477	41418	43537

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
110	Padmanabhanagar	40477	48892	52947
111	Kari Sandra	58821	63097	66324
112	JP Nagar II, III, IV, V phase	34418	45176	57491
113	Jayanagar VII, VIII	36287	40578	43944
114	Byrasandra, Tilak Nagar	48210	53131	56407
115	Hombegowdanagar	49035	51841	56141
116	Adugodi	43100	48441	50919
117	Gurappanapalya-West	56432	63606	68882
118	BTM Layout-South	68123	74789	80992
119	Madivala-West	48752	53056	57456
120	Koramangala-East	46201	53056	57456
121	Jakkasandra Layout	41573	47250	51987
122	Domlur-South	42047	47250	51987
123	Old Airport	43360	50572	55863
124	Sir C.V. Raman Nagar-North	27312	33116	36580
125	Kaval Byrasandra-East	28175	33116	36580
126	Hebbal-West	38083	41267	45404
127	Ganganagar	28425	33101	36419
128	Sanjayanagar-West	28246	33101	36419
129	Yelahanka (earlier CMC) - Ward No.1-14, 20, 21, 22, 29	58044	92682	143433
130	Yelahanka (earlier CMC) - Ward No. 16-19	20404	32580	50421
131	Yelahanka (earlier CMC) - Ward No.15, 23-31	28832	46037	71247

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
132	Byatarayanapura(earlier CMC) – Ward No. 3 – 11	54074	89363	138297
133	Byatarayanapura(earlier CMC) – Ward No.12 – 16, 19	51570	85225	131893
134	Byatarayanapura (earlier CMC) – Ward No. 17, 18, 20–22, 27	40272	66554	102998
135	Byatarayanapura(earlier CMC) – Ward No.23–26,28–31	51732	85492	132308
136	K.R. Puram (earlier CMC) – Ward No.1, 5–10	41977	69371	107359
137	K.R. Puram (earlier CMC) – Ward No. 2, 4, 12, 13, 14, 19	29823	49286	76274
138	K.R. Puram (earlier CMC) – Ward No.11, 29–33	46868	77454	119868
139	Mahadevapura (earlier CMC) – Ward No.1–11	51740	85506	132328
140	K.R. Puram (earlier CMC) – Ward No. 3,15–18, 34, 35	40726	67304	104159
141	Mahadevapura (earlier CMC) – Ward No. 12,13, 21, 22, 24	32140	53115	82200
142	Mahadevapura (earlier CMC) – Ward No.14–20	33138	54764	84752
143	K.R. Puram (earlier CMC) – Ward No. 21, 22, 24, 26	36440	60221	93197
144	K.R. Puram (earlier CMC) – Ward 20, 23, 25, 27, 28	24108	39841	61658
145	Mahadevapura (earlier CMC) – Ward No. 23, 25–31	43374	71680	110932
146	Bommanahalli (earlier CMC) – Ward No.1–5	40022	66140	102024
147	Bommanahalli (earlier CMC) – Ward No 12–16	36096	59652	92016
148	Bommanahalli (earlier CMC) – Ward No. 6–9	32021	52918	81628
149	Bommanahalli (earlier CMC) – Ward No. 10, 11, 17, 18	31535	52115	80389
150	Bommanahalli (earlier CMC) – Ward No. 23–27	32772	54159	83543
151	Bommanahalli (earlier CMC) – Ward No. 19–22	29176	48216	74376
152	Bommanahalli (earlier CMC) – Ward No. 28–31	36559	60418	93196
153	Pattanagere (earlier CMC) – Ward No.13–29	45551	72733	112194

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
154	Kengeri (earlier TMC) – Ward No.1–23	50146	82871	127881
155	Pattanagere (earlier CMC) – Ward No.1–12	41482	66236	102172
156	Dasarahalli (earlier CMC) – Ward No. 31–33	33607	53600	82680
157	Dasarahalli (earlier CMC) – Ward No. 24,34,35	51016	81366	125510
158	Dasarahalli (earlier CMC) – Ward No. 26, 29, 30	42071	67100	103504
159	Dasarahalli (earlier CMC) – Ward No. 23, 25, 27, 28	34627	55227	85190
160	Dasarahalli (earlier CMC) – Ward No.17–22	38209	60940	94002
161	Dasarahalli (earlier CMC) – Ward No. 4, 9–16	51632	82348	127026
162	Dasarahalli (earlier CMC) – Ward No. 5–8	43343	69128	106633
163	Hunasemaranahalli	77326	123564	191227
164	Chikkagubbi	61411	98133	151870
165	Seegehalli	39677	63402	97894
166	Devarabeesanahalli	55522	88722	136909
167	Kodathi	30034	47993	74060
168	Huskuru	88538	141372	218155
169	Begur	57641	92038	142026
170	Thalaghattapura	115786	191348	295273
171	Gollahalli	112078	178960	276157
172	Machohalli	42795	68333	105447
173	Makali	100429	160482	247644
174	Ivar Kandapura	53502	85495	131929
175	Bagaluru	750	1875	4688

Traffic Zone	Name of Traffic Zone	Population		
		2005	2015	2025
176	Kodigahalli	3750	9375	23438
177	Nellukunte	30312	75781	180777
178	Hosuru	800	2000	25000
179	Devanahalli	62823	157057	350000
180	Minakunte	14359	35896	85631
181	Chikkajala	11168	27919	66602
182	Basavana Gudda	26324	65810	156990
183	Singahalli	400	1000	3000
184	Mailanahalli	200	500	2000
185	Bavuru	200	500	2000
186	Arasinakunte	200	500	2000
187	Bettakote	400	1000	2000
188	Bavanahalli	17151	30615	62109
189	Sadahalli	5046	9006	18271
190	Kodenahalli	17392	31045	62981
191	Budigere	18893	33724	68417
	Total	**7095973**	**9331762**	**12337760**

Zone-wise Distribution of Employment 2005, 2015, 2025

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
1	HMT	8857	20133	45765
2	Jalahalli	21084	26394	33043
3	Yeshwantpura	50329	63236	79454
4	Mathikere-North	8805	10154	11708
5	Kodandarampura	6063	7093	8298
6	Dattatreya Temple	13361	14517	15774
7	Malleswaram	60604	69195	79004
8	Gayathrinagar	2537	3846	5830
9	Subramanyanagar	2428	6220	15930
10	Mahalakshmipuram	7987	8621	9305
11	Peenya Industrial Area	85780	124426	180484
12	Nandini Layout	12489	13565	14735
13	Geleyara Balaga Layout	7857	8992	10291
14	Nagapura	4843	10192	21449
15	Rajajinagar	53555	59167	65368
16	Kamalanagar	11839	12756	13744
17	Vrushabhavathinagar	5746	6433	7202
18	Kamakshipalya	26919	29776	32937
19	Basaweshwaranagar	14705	16651	18854
20	Shivanagar	7780	8630	9573
21	Industrial Town-West	12922	14577	16444

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
22	Sriramamandir	7651	8314	9035
23	Prakashnagar	5262	5713	6201
24	Bhashyam nagar	2653	3007	3408
25	Ramachandrapura	11029	11915	12873
26	Sevashrama	2755	3099	3486
27	Gandhinagar	130013	174010	232896
28	Chickpet	26765	29724	33010
29	Cottonpet	5848	8066	11127
30	S.K.R. Market	142862	146148	149510
31	Binnypet	15643	15897	16156
32	Kempapura Agrahara	7730	7864	8001
33	Vijayanagar	48094	49156	50240
34	RPC Layout (Hampi nagar)	8415	9109	9861
35	Marenahalli	4575	6943	10536
36	Thimmanahalli	10942	12941	15305
37	Amarjyothinagar	4841	8767	15878
38	Moodalapalya	3186	4587	6606
39	Chandra Layout	9222	12797	17756
40	Attiguppe	5777	6455	7213
41	Gali Anjaneyaswamy Temple	6527	11005	18555
42	Bapuji Nagara	10388	12322	14614
43	Padarayanapura	7101	9505	12724

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
44	Jagajivanramnagar	4914	5606	6394
45	Azadnagar	5801	6349	6950
46	Chamarajapet	48132	50849	53719
47	Dharmarayaswamy Temple	35945	39856	44193
48	Sudhamanagar	5170	8995	15651
49	Kempegowda nagar	8652	9043	9453
50	Vishweshwarapuram	3016	4490	6686
51	Basavanagudi	31312	34672	38393
52	Hanumanthanagar	7663	8297	8984
53	Srinagar	12642	14230	16017
54	Srinivasanagara	3771	4190	4655
55	Girinagar III Stage	7749	8868	10149
56	Banashankari II stage	35312	40292	45975
57	JP Nagar I, VI Phase	18126	19913	21876
58	Jayanagar IV, V	55807	60081	64682
59	Yediyur	3301	4716	6736
60	Jayanagar Complex, III Block	1425	2422	4116
61	Mavalli	10254	11790	13555
62	Siddapura	6698	7310	7979
63	Lakkasandra	6089	8742	12551
64	Gurappanapalya-East	4057	6396	10084
65	BTM Layout-North	25445	28326	31533

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
66	Madivala-East	24794	27970	31553
67	Koramangala-West	62484	72964	85201
68	Ejipura	8617	9344	10131
69	Neelasandra	8821	9730	10732
70	Shanthinagar	16369	18151	20127
71	Austin Town	7403	8013	8674
72	Domlur-North	15902	17542	19352
73	Jivanbima Nagar	3312	4865	7148
74	Jeevanbimanagar	29636	32461	35556
75	Jogupalya	5062	5430	5825
76	Richmond Town	77021	84781	93322
77	Sampangiramnagar	44789	47372	50104
78	Vasanthnagar	27143	30827	35011
79	Shivajinagar	63638	71076	79383
80	Bharathinagar	3847	5178	6971
81	Ulsoor	31757	34701	37917
82	Hoysalanagar	42692	46703	51090
83	Sir C.V. Raman Nagar-South	7230	8293	9513
84	Benniganahalli	12967	18831	27348
85	Sarvagna Nagar	7973	9082	10346
86	Maruthisevanagar	5261	6151	7192
87	Lingarajapuram	19358	20825	22405

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
88	Banaswadi	12768	14539	16556
89	Kacharakanahalli	2381	4398	8123
90	Sagayapura	1586	3046	5849
91	Pulakeshinagar	12697	13575	14515
92	Jayamahal	2394	4028	6777
93	Devarajeevanahalli	2654	4363	7173
94	Kadugondanahalli	5899	6419	6984
95	Kaval Byrasandra-West	4574	5171	5845
96	Hebbal-East	19309	21702	24390
97	Jayachamarajendranagar	20659	22760	25074
98	Ganganagar-HMT Layout	4327	6626	10147
99	Aramane nagar	11816	13173	14687
100	Sanjayanagar-East	3561	4476	5625
101	Mathikere-South	1411	3276	7605
102	Basaweshwaranagar	4967	5419	5912
103	Industrial Town-east	7733	8632	9636
104	MRCR Layout	686	2154	6764
105	Deepanjali Nagar	8170	8902	9700
106	Mohamadan Block/Jayanagar II block	824	1583	3041
107	Banashankari I Stage	4458	4874	5329
108	Kathriguppe	7551	9073	10902
109	Bhuvaneshwarinagar	5632	5841	6058

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
110	Padmanabhanagar	7574	8662	9907
111	Kari Sandra	1223	1299	1379
112	JP Nagar II, III, IV, V phase	1533	3404	7560
113	Jayanagar VII, VIII	3226	4720	6906
114	Byrasandra, Tilak Nagar	1578	2766	4847
115	Hombegowdanagar	12689	13577	14527
116	Adugodi	21258	23106	25114
117	Gurappanapalya-West	4009	4429	4894
118	BTM Layout-South	15300	16683	18190
119	Madivala-West	5204	6894	9133
120	Koramangala-East	2954	4761	7674
121	Jakkasandra Layout	3749	4193	4688
122	Domlur-South	1479	2936	5828
123	Old Airport	28100	31895	36203
124	Sir C.V. Raman Nagar-North	5877	6802	7872
125	Kaval Byrasandra-East	5164	5884	6704
126	Hebbal-West	4274	4667	5095
127	Ganganagar-Gangenahalli	8663	9806	11100
128	Sanjayanagar-West	1481	3199	6910
129	Yelahanka (earlier CMC) - Ward No.1-14, 20, 21, 22, 29	29165	35029	42071
130	Yelahanka (earlier CMC) - Ward No.16-19	1197	5242	22958
131	Yelahanka (earlier CMC) - Ward No.15, 23-31	2501	8091	26179

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
132	Byatarayanapura(earlier CMC) – Ward No. 3 – 11	7317	11702	18715
133	Byatarayanapura(earlier CMC) – Ward No.12 – 16, 19	4473	9793	21440
134	Byatarayanapura (earlier CMC) – Ward No. 17, 18, 20–22, 27	4869	10457	22454
135	Byatarayanapura (earlier CMC) – Ward No. 23–26, 28–31	12947	20706	33114
136	K.R. Puram (earlier CMC) – Ward No. 1, 5–10	10938	17493	27975
137	K.R. Puram (earlier CMC) – Ward No. 2, 4, 12, 13, 14, 19	36397	47918	63087
138	K.R. Puram (earlier CMC) – Ward No.11, 29–33	8679	13880	22198
139	Mahadevapura (earlier CMC) – Ward No.1–11	5126	10884	23110
140	K.R. Puram (earlier CMC) – Ward No. 3, 15–18, 34, 35	15980	25555	40869
141	Mahadevapura (earlier CMC) – Ward No.12,13,21,22,24	6623	13358	26939
142	Mahadevapura (earlier CMC) – Ward No.14–20	46127	73767	117971
143	K.R. Puram (earlier CMC) – Ward No. 21, 22, 24, 26	4058	9095	20380
144	K.R. Puram (earlier CMC) – Ward No. 20, 23, 25, 27, 28	4359	6970	11147
145	Mahadevapura (earlier CMC) – Ward No. 23,25–31	30534	54728	98093
146	Bommanahalli (earlier CMC) – Ward No. 1–5	17898	28577	45626
147	Bommanahalli (earlier CMC) – Ward No. 12–16	27056	43199	68972
148	Bommanahalli (earlier CMC) – Ward No. 6–9	52486	70165	93799
149	Bommanahalli (earlier CMC) – Ward No. 10, 11, 17, 18	4505	7193	11485
150	Bommanahalli (earlier CMC) – Ward No. 23–27	11456	14832	19204
151	Bommanahalli (earlier CMC) – Ward No. 19–22	7587	12113	19340
152	Bommanahalli (earlier CMC) – Ward No 28–31	6849	10935	17459
153	Pattanagere (earlier CMC) – Ward No. 13–29	7732	12135	19044

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
154	Kengeri (earlier TMC) – Ward No. 1–23	20792	33203	53022
155	Pattanagere (earlier CMC) – Ward No.1–12	6625	10398	16319
156	Dasarahalli (earlier CMC) – Ward No. 31–33	11660	18289	28686
157	Dasarahalli (earlier CMC) – Ward No. 24, 34, 35	3518	5518	8655
158	Dasarahalli (earlier CMC) – Ward No. 26, 29, 30	1233	1933	3032
159	Dasarahalli (earlier CMC) – Ward No. 23, 25, 27, 28	5782	9070	14226
160	Dasarahalli (earlier CMC) – Ward No. 17–22	7669	12029	18867
161	Dasarahalli (earlier CMC) – Ward No.4, 9–16	18829	26153	36325
162	Dasarahalli (earlier CMC) – Ward No.5–8	5883	9228	14474
163	Hunasemaranahalli	7023	17250	42368
164	Chikkagubbi	2467	8760	31102
165	Seegehalli	9348	20064	43065
166	Devarabeesanahalli	8094	12710	19959
167	Kodathi	8033	12615	19809
168	Huskuru	22421	35194	55244
169	Begur	12439	19525	30649
170	Thalaghattapura	19670	31412	50163
171	Gollahalli	8924	14009	21990
172	Machohalli	5293	8309	13043
173	Makali	17162	26949	42318
174	Ivar Kandapura	3738	5869	9217
175	Bagaluru	90	225	703

Traffic Zone	Name of Traffic Zone	Employment		
		2005	2015	2025
176	Kodigahalli	450	1125	3516
177	Nellukunte	7012	17531	48679
178	Hosuru	296	740	128750
179	Devanahalli	7539	18847	52500
180	Minakunte	2411	6026	17251
181	Chikkajala	2653	6632	18397
182	Basavana Gudda	5096	12741	35924
183	Singahalli	8173	20433	122325
184	Mailanahalli	274	685	101863
185	Bavuru	1624	4060	10300
186	Arasinakunte	424	1060	3300
187	Bettakote	448	1120	80300
188	Bavanahalli	2744	5511	12422
189	Sadahalli	807	1621	3654
190	Kodenahalli	2783	5588	12596
191	Budigere	3023	6070	13683
	Total	**2671831**	**3423676**	**5048959**

Zone-wise Distribution of Student Enrolment 2005, 2015, 2025

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
1	HMT	1712	2452	3048
2	Jalahalli	13444	17714	21069
3	Yeshwantpura	21298	25958	29391
4	Mathikere-North	11212	13102	14908
5	Kodandarampura	2783	3347	3808
6	Dattatreya Temple	19267	21005	22747
7	Malleswaram	45562	54846	59395
8	Gayathrinagar	1176	1230	1293
9	Subramanyanagar	1617	1746	1835
10	Mahalakshmipuram	7711	8546	8983
11	Peenya Industrial Area	12647	14433	15552
12	Nandini Layout	1948	2122	2298
13	Geleyara Balaga Layout	9138	10836	11969
14	Nagapura	3064	3786	4079
15	Rajajinagar	59931	67883	73150
16	Kamalanagar	4228	4532	4908
17	Vrushabhavathinagar	2022	2341	2535
18	Kamakshipalya	5747	6494	7032
19	Basaweshwaranagar	17690	20945	22682
20	Shivanagar	6495	7235	7991
21	Industrial Town-West	4932	5682	6276

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
22	Sriramamandir	9445	10098	11155
23	Prakashnagar	2548	2719	3003
24	Bhashyam nagar	2738	3185	3518
25	Ramachandrapura	8948	9740	10444
26	Sevashrama	2457	2871	3109
27	Gandhinagar	31017	34784	37669
28	Chickpet	2969	3381	3661
29	Cottonpet	1973	2026	2067
30	S.K.R. Market	31863	32686	33346
31	Binnypet	4577	4634	4727
32	Kempapura Agrahara	6223	6313	6441
33	Vijayanagar	31803	32565	33222
34	RPC Layout (Hampi Nagar)	7911	8820	9271
35	Marenahalli	3690	4144	4465
36	Thimmanahalli	9009	9638	10131
37	Amarjyothinagar	1797	2035	2182
38	Moodalapalya	1621	1695	1835
39	Chandra Layout	7258	7663	8465
40	Attiguppe	6634	7499	8284
41	Gali Anjaneyaswamy Temple	7232	8581	9479
42	Bapuji Nagara	12816	14089	15563
43	Padarayanapura	11900	13235	14620

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
44	Jagajivanramnagar	5273	6090	6862
45	Azadnagar	8796	10025	10538
46	Chamarajapet	30168	32032	33670
47	Dharmarayaswamy Temple	7730	9042	9504
48	Sudhamanagar	2655	2816	2902
49	Kempegowda nagar	6656	7058	7273
50	Vishweshwarapuram	6368	7404	7782
51	Basavanagudi	45879	53518	56255
52	Hanumanthanagar	7068	7689	8286
53	Srinagar	10772	12856	13649
54	Srinivasanagara	3764	4313	4647
55	Girinagar III Stage	8357	9908	10945
56	Banashankari II stage	24983	29446	32527
57	JP Nagar I, VI Phase	11694	13032	14113
58	Jayanagar IV, V	58931	64980	68303
59	Yediyur	4139	4457	4685
60	Jayanagar Complex, III Block	5012	5407	5684
61	Mavalli	11091	13538	14661
62	Siddapura	7656	8422	9120
63	Lakkasandra	6105	6991	7571
64	Gurappanapalya-East	7732	8946	9688
65	BTM Layout-North	12508	14313	15501

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
66	Madivala-East	14729	17309	18744
67	Koramangala-West	23680	29816	32289
68	Ejipura	5254	5704	6177
69	Neelasandra	9562	10742	11633
70	Shanthinagar	7673	8712	9435
71	Austin Town	7160	7746	8389
72	Domlur-North	3701	4159	4503
73	Jivanbima Nagar	3520	4091	4408
74	Jeevanbimanagar	11092	12350	13308
75	Jogupalya	7837	8581	9019
76	Richmond Town	28418	31795	34432
77	Sampangiramnagar	23379	24150	26154
78	Vasanthnagar	13734	16037	17715
79	Shivajinagar	25867	29211	32267
80	Bharathinagar	7486	8758	9674
81	Ulsoor	17260	18656	20608
82	Hoysalanagar	17845	19720	21355
83	Sir C.V. Raman Nagar-South	3517	4273	4627
84	Benniganahalli	232	274	310
85	Sarvagna Nagar	17799	20400	23098
86	Maruthisevanagar	6401	7921	8750
87	Lingarajapuram	13422	14063	15535

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
88	Banaswadi	11669	13430	15131
89	Kacharakanahalli	2305	2683	3023
90	Sagayapura	1565	1736	1825
91	Pulakeshinagar	14328	15583	16380
92	Jayamahal	2888	3187	3350
93	Devarajeevanahalli	1868	2125	2234
94	Kadugondanahalli	6312	7110	7473
95	Kaval Byrasandra-West	1578	1862	2017
96	Hebbal-East	12544	14631	15845
97	Jayachamarajendranagar	21017	23790	25509
98	Ganganagar-HMT Layout	1790	1967	2130
99	Aramane nagar	6570	7541	8167
100	Sanjayanagar-East	3745	3774	3812
101	Mathikere-South	1875	2009	2133
102	Basaweshwaranagar	4902	5551	5835
103	Industrial Town-East	5474	6299	6821
104	MRCR Layout	1171	1240	1304
105	Deepanjali Nagar	7243	7942	8600
106	Mohamadan Block/Jayanagar II block	934	1068	1180
107	Banashankari I Stage	3044	3294	3639
108	Kathriguppe	8777	11472	12672
109	Bhuvaneshwarinagar	8992	9201	9672

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
110	Padmanabhanagar	9952	12021	13018
111	Kari Sandra	2732	2930	3080
112	JP Nagar II, III, IV, V phase	1016	1333	1696
113	Jayanagar VII, VIII	6714	7507	8130
114	Byrasandra, Tilak Nagar	1560	1719	1825
115	Hombegowdanagar	11589	12252	13268
116	Adugodi	10033	11276	11852
117	Gurappanapalya-West	2083	2348	2543
118	BTM Layout-South	6094	6690	7245
119	Madivala-West	6275	6829	7395
120	Koramangala-East	3892	4469	4840
121	Jakkasandra Layout	3040	3456	3802
122	Domlur-South	2187	2458	2705
123	Old Airport	5355	6246	6900
124	Sir C.V. Raman Nagar-North	3651	4427	4890
125	Kaval Byrasandra-East	1910	2245	2480
126	Hebbal-West	2422	2624	2887
127	Ganganagar-Gangenahalli	3121	3634	3999
128	Sanjayanagar-West	3828	4486	4936
129	Yelahanka (earlier CMC) - Ward No. 1-14, 20, 21, 22, 29	21215	33875	52424
130	Yelahanka (earlier CMC) - Ward No. 16-19	2447	3907	6046
131	Yelahanka (earlier CMC) - Ward No. 15, 23-31	4228	6751	10448

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
132	Byatarayanapura(earlier CMC) – Ward No. 3 – 11	8324	13757	21290
133	Byatarayanapura(earlier CMC) – Ward No.12 – 16, 19	6691	11058	17114
134	Byatarayanapura(earlier CMC) – Ward No. 17, 18, 20–22, 27	5866	9694	15002
135	Byatarayanapura(earlier CMC) – Ward No. 23–26, 28–31	9763	16134	24969
136	K.R. Puram (earlier CMC) – Ward No. 1, 5–10	7340	12130	18772
137	K.R. Puram (earlier CMC) – Ward No. 2, 4, 12, 13, 14, 19	18801	31070	48084
138	K.R. Puram (earlier CMC) – Ward No. 11,29–33	8154	13475	20853
139	Mahadevapura (earlier CMC) – Ward No.1–11	8283	13688	21183
140	K.R. Puram (earlier CMC) – Ward No. 3, 15–18, 34, 35	11884	19640	30394
141	Mahadevapura (earlier CMC) – Ward No. 12, 13, 21, 22, 24	6223	10284	15915
142	Mahadevapura (earlier CMC) – Ward No. 14–20	8836	14602	22598
143	K.R. Puram (earlier CMC) – Ward No. 21, 22, 24, 26	3831	6331	9797
144	K.R. Puram (earlier CMC) – Ward No. 20, 23, 25, 27, 28	4148	6856	10610
145	Mahadevapura (earlier CMC) – Ward No. 23, 25–31	9988	16507	25546
146	Bommanahalli (earlier CMC) – Ward No. 1–5	7602	12562	19378
147	Bommanahalli (earlier CMC) – Ward No. 12–16	7812	12911	19916
148	Bommanahalli (earlier CMC) – Ward No. 6–9	12316	20354	31397
149	Bommanahalli (earlier CMC) – Ward No. 10, 11, 17, 18	2842	4697	7246
150	Bommanahalli (earlier CMC) – Ward No. 23–27	5764	9526	14694
151	Bommanahalli (earlier CMC) – Ward No. 19–22	3669	6064	9354
152	Bommanahalli (earlier CMC) – Ward No. 28–31	3733	6169	9516
153	Pattanagere (earlier CMC) – Ward No. 13–29	9333	14903	22988

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
154	Kengeri (earlier TMC) – Ward No. 1–23	18883	31206	48154
155	Pattanagere (earlier CMC) – Ward No. 1–12	6201	9901	15272
156	Dasarahalli (earlier CMC) – Ward No. 31–33	10583	16879	26037
157	Dasarahalli (earlier CMC) – Ward No. 24, 34, 35	3081	4913	7579
158	Dasarahalli (earlier CMC) – Ward No. 26, 29, 30	3478	5547	8556
159	Dasarahalli (earlier CMC) – Ward No. 23, 25, 27, 28	6418	10236	15790
160	Dasarahalli (earlier CMC) – Ward No. 17–22	7839	12502	19284
161	Dasarahalli (earlier CMC) – Ward No. 4, 9–16	15594	24871	38364
162	Dasarahalli (earlier CMC) – Ward No. 5–8	4576	7298	11257
163	Hunasemaranahalli	4512	7210	11157
164	Chikkagubbi	14289	22833	35337
165	Seegehalli	4324	6910	10669
166	Devarabeesanahalli	9207	14712	22703
167	Kodathi	5342	8537	13174
168	Huskuru	14290	22818	35211
169	Begur	7141	11402	17594
170	Thalaghattapura	8357	13810	21311
171	Gollahalli	4788	7645	11797
172	Machohalli	6876	10980	16943
173	Makali	9650	15420	23795
174	Ivar Kandapura	2525	4034	6226
175	Bagaluru	150	375	938

Traffic Zone	Name of Traffic Zone	School Enrolment		
		2005	2015	2025
176	Kodigahalli	750	1875	4688
177	Nellukunte	6062	15156	36155
178	Hosuru	160	400	5000
179	Devanahalli	12565	31411	70000
180	Minakunte	2872	7179	17126
181	Chikkajala	2234	5584	13320
182	Basavana Gudda	5265	13162	31398
183	Singahalli	80	200	600
184	Mailanahalli	40	100	400
185	Bavuru	40	100	400
186	Arasinakunte	40	100	400
187	Bettakote	80	200	400
188	Bavanahalli	3430	6123	12422
189	Sadahalli	1009	1801	3654
190	Kodenahalli	3478	6209	12596
191	Budigere	3779	6745	13683
	Total	**1652091**	**2097174**	**2661398**

Sl. No.	Name of Road	Length Km
Road Improvements (Inside ORR)		
1	Hosur Road	5.9
2	Hosur Laskar Road	4.3
3	Lower Agaram Road	2.4
4	Sarjapur Road	3.4
5	Bannerghatta Road	4.1
6	80' Koramangala	4.0
7	Dickenson Road	0.3
8	Kensington Road	0.3
9	Murphy Road	1.7
10	Richmond Road	5.2
11	Commissariat Road	0.7
12	A M Road	0.8
13	Mt joy Road & Kathriguppe Main Road via Vidyapeeta Circle	3.0
14	Dinnur Main Road and Kavalbyrasandra Road (via Ganganagar Sultan Palya)	4.5
15	Hosakerehalli Main Road (via Girinagar)	2.1
16	Vasanth Nagar Main Road	0.6
17	K R Road	1.2
18	Sultan Road	0.4
19	1st Main Chamarajapet	0.2
20	3rd Cross Chamarajapet & Bull Temple Road	1.0
21	Bull Temple Road via N R Colony, Chennamma Tank bed & 30th Main BSK 3rd Stage	1.1
22	Old Poor House Road-Haine's Road	1.0
23	Millers Tank Bund Road	0.5
24	Queen's Road	1.0
25	Dr. Ambedkar Road (Tannery Road)	4.4
26	Hennur Road	3.6
27	Banaswadi Road & Wheelers Road (via Banaswadi)	6.4
28	HMT main Road	2.1
29	Baiyyappanahalli Main Road	3.4
30	Kumaraswamy Layout Main Road	1.8
	Total	**71.1**
Road Improvements (Outside ORR)		
Radial Roads		
1	From Peenya II Stage to Andrahalli (via Peenya II Stage, Industrial area, Andrahalli)	4.0
2	Tumkur Road-NH4	8.8
3	Jalahalli Main Road to Attur via Yelahanka	28.0
4	Yeshwantpur to Yelahanka	20.0
5	Doddaballapur Road	6.0

Sl. No.	Name of Road	Length Km
6	NH-7 Kogilu Junction to Nagavara Main Road	8.0
7	Dasarahalli Main Road	16.0
8	HBR Ring Road to Nagavara Main Road leading to Jakkur	20.0
9	HBR Ring Road to Hennur Main Road	16.0
10	ITPL Road from Ring Road to Hope farm	8.5
11	Varthur Road from Marathalli to Varthur Kodi	5.0
12	Varthur to Outer Ring Road via Belegere and Panathur	6.5
13	Kaigondanahalli to Sarjapur	10.0
14	Bannerghatta Road - ORR to National Park	8.6
15	Bannerghatta Road - National Park to PRR	2.4
16	Begur Road from Hosur Road to Begur	7.0
17	Kanakapura Road.	10.4
18	Ring Road to Kanakapura Road (via Ittamadu)	7.0
19	Rajarajeshwari Nagar Arch to PRR	10.0
	Total	**202.2**
Connector Roads		
20	From Magadi Road to NH 4 (Via Sunkadakatte, Hegganahalli Main Road, Peenya II Stage, NTTF Circle, KIADB Main Road)	6.0
21	Peenya II Stage to Ring Road (via Peenya II Stage Bus stop, Rajagopal Nagar Main Road, Peenya Industrial Area)	3.0
22	NH-7 to Nagavara Main Road through Jakkur	16.0
23	NH-7 to Nagavara Main Road	12.0
24	Hennur Main Road to Hosakote Ring Road	10.0
25	Horamavu-Agara to HBR Ring Road	4.0
26	Horamavu Road from Outer Ring Road to Kalkere	4.2
27	T C Palya main Road from ORR to Anandapura	5.5
28	Devasandra Main Road from NH 4 to Basavanapura Road	1.7
29	Kundalahalli Road from Devasandra main Road to Kundalahalli gate via Hoodi	7.0
30	ITPL Road to Varthur Road via Pattanadur Agrahara & Nellurahalli	4.0
31	Sarjapur Road to Ring Road(near Devarabeesanahalli)	7.0
32	Nagarthapura to Matha Amruthamayee College	5.0
33	Hosur Road to Nagarthapura (Hosur Road)	4.0
34	Begur to Hosur Road (via Begur tank Bund, Chikkabegur and Manipal County)	7.0
35	Bannerghatta Road to Begur (via DoddaKammanahalli, Yelenahalli)	8.0
36	Kottur Dinne to Bannerghatta Road	5.0
37	Harinagar to Kottanur Dinne	4.0
38	Corporation Bank to Ring Road via Javaraiana doddi	4.0
	Total	**117.4**
Parallel Ring Road		
39	From Magadi Road to NH-4 (Via Herohalli, Karivobanahalli, Andrahalli, Tigalarapalya, Nelagadaranahalli, Nagasandra)	8.0

Sl. No.	Name of Road	Length Km
40	Hesarghatta Main Road to SM Road (via Mallasandra, Shetty halli, Abbigere, Kammagondanahalli Main Road, Gangammanagudi Circle)	6.0
41	Vidyaranyapura Main Road to Hennur Main Road	35.0
42	Nagavara Main Road to Kalkere Junction	8.0
43	Sarjapura Road to Kalkere via Chikkaballapur,Gujurpalya, Varthur, Hope farm, Kadugodi, Sadaramangala, Kodigehalli, Basavanapura, T.C.Palya	31.0
44	Matha Amruthamayee to Sarjapura Road (Kaigondanahalli)	5.0
45	Kanakapura Road-Amruthnagar to Harinagar	4.5
46	Kengeri to Konanakunte via Uttarahalli(end of Kanakapura Road)	13.5
47	Kengeri 80' Ring Road to Ullalu Main Road via Matha Mata	10.5
48	Begur Road to Hosur Road and Kudlu	6.0
49	B G Road to Begur Road (via BTM Layout, Kodichikkanahalli)	5.0
50	Chunchaghatta Road to B G Road	6.0
51	Jnanabharati Circle to Magadi Road	11.0
	Total	**149.5**
	Grand Total	**540.2**

Annexure 9A

External Development Charges in Haryana Cities

i) External development charges

Sr.No.	Name of city	Nature of colony					
		Plotted	G.H in plotted	G.H /Com.150	I.T	Com	Yea
1.	Gurgaon	24.18	104.44	104.44	83.69	121.85	200
2.	Faridabad	22.02	104.44	104.44		121.85	-d0
3.	Sonepat	24.18	104.44	104.44		--	-do
4.	Panipat	20.42	104.44	104.44		--	-do
5.	Karnal	20.42	104.44	104.44		---	-do
6.	Rohtak	22.02	104.44	104.44		--	-do
7.	Rewari	22.02	104.44	104.44		--	-dc
8.	Kaithal	20.42	104.44	104.44		--	-do
9.	Y.Nager	20.42	104.44	104.44		--	-do
10.	Kurukhetra	20.42	104.44	104.44		--	-do-
11.	Dharuhera	20.42	104.44	104.44		--	-do-
12	"			Industrial	41.845		

ii) The applicant is also required to deposit application scrutiny fee of Rs. 10/- per sq. mete plotted colony and for the on of each floor Group Housing, commercial, I.T. etc.

iii) The schedule of infrastructure development charges is also enclosed.

Rates of Infrastructure Charges in Haryana (in Rs. per Square Meter)

3. उक्त नियमों में, नियम 11 में, उप नियम (1) में, खण्ड (छ) में, "अनुसूची" शब्दे के स्थान पर, "अनुसूची-क" शब्द तथा अंक प्रतिस्थापित किए जायेंगे, अर्थात्, :—

"अनुसूची-क

[देखिए नियम 11 (1) (छ)]

अवसंरचना विकास प्रभारों की दरें (प्रति वर्ग मीटर में)

1	2	3	4	5	6
क्रम संख्या	प्रवर्ग	अति उच्च क्षमता जोन	उच्च क्षमता जोन	मध्यम क्षमता जोन	निम्न क्षमता जोन
	रिहायशी	500—00	375—00	250—00	70—00
	संस्थागत	500—00	375—00	250—00	70—00
	औद्योगिक	250—00	190—00	125—00	35—00
	वाणिज्यिक	1000—00	750—00	500—00	190—00
	समूह ग्रुप हाउसिंग	625—00	460—00	320—00	90—00

टिप्पण :- (i) प्लाटिड विकास प्रभार प्लाटिड क्षेत्र पर लागू हैं।

(ii) ग्रुप हाउसिंग/वाणिज्यिक/सूचना प्रौद्योगिकी पार्क/सूचना प्रौद्योगिकी सिटी के लिए प्रभार कालोनी के सकल क्षेत्र के लिए उद्ग्रहणीय है "।

डी० एस० ढेसी,
आयुक्त एवम् सचिव, हरियाणा सरकार,
नगर तथा ग्राम आयोजना विभाग।

HARYANA GOVERNMENT
TOWN AND COUNTRY PLANNING DEPARTMENT
Notification

The 23rd July, 2007

No. DS-07/13889.—The following draft of the rules further to amend the Haryana Development and Regulation of Urban Areas Rules, 1976, which the Governor of Haryana proposes to make in exercise of the powers conferred by Sub-section (1) read with Sub-section (2) of Section 24 of the Haryana Development and Regulation of Urban Areas Act, 1975 (8 of 1975), is hereby published as required by the said Sub-section (1) for the information of persons likely to be affected thereby.

Notice is hereby given that the draft of the rules will be taken into consideration by the Governmen on or after the expiry of a period of fifteen days from the date of publication of this notification in the Officia Gazette together with objections or suggestions, if any, which may be received in writing by the Commissione and Secretary to Government, Haryana, Town and Country Planning Department, Chandigarh, from any perso in respect of the draft of the rules before the expiry of the period so specified.

Draft Rules

1. (1) These rules may be called the Haryana Development and Regulation of Urban Area (Amendment) Rules, 2007.

(2) They shall come into force with immediate effect.

2. In the Haryana Development and Regulation of Urban Areas Rules, 1976 (hereinafter called the said rules), in rule 4, for the words "forty five", the word "fifty", shall be substituted.

3. In the said rules, in rule 11, in sub-rule (1), in clause (g), for the word "Schedule", the word and letter "Schedule A", shall be substituted, namely:—

"Schedule-A

[See rule 11 (1) (G)]

Rates of Infrastructure Development Charges

(Rs. in per square, metres)

Category	Hyper Potential Zone	High Potential Zone	Medium Potential Zone	Lower Potential Zone
Residential	500—00	375—00	250—00	70—00
Institutional	500—00	375—00	250—00	70—00
Industrial	250—00	190—00	125—00	35—00
Commercial	1000—00	750—00	500—00	190—00
Group Housing	625—00	460—00	320—00	90—00

Note.— (i) For plotted development the charges are applicable on plotted area.

(ii) For Group Housing/Commercial/Information Technology Parks/Information Technology City, the charges are leviable for gross area of the colony".

D. S. DHESI,

Commissioner and Secretary to Government Haryana,

Town and Country Planning Department.

42975—C.S.—H.G.P. Chd.

Annexure 9C

Rates of License Fee per Gross Acre in Haryana (Rs. in Lakh per Gross Acre)

1	2	3	4	5	6
			Haryana Development and Regulation of Urban Areas Act, 1975, to cover the controlled area declared under section 4(1)(b) in Gurgaon District (excluding the areas forming part of development plan of the Gurgaon-Manesar Urban Complex - 2021) and Sohna.	Dharuhera, Bawal in Rewari District, Oil Refinery, Panipat (Beholi) in Panipat District and to cover the controlled areas declared under section 4(1)(b) of the Punjab Scheduled Roads and Controlled Areas Restriction of Unregulated Development Act, 1963 (41 of 1963) in Faridabad District.	
Category of Uses					
Residential(Plotted)	5.25	—	4.20	3.00	0.50
Residential (Group Housing)	6.56	—	5.25	4.00	0.60
Commercial	On Gurgaon-Mehrauli Road (i) 420 for 175 Floor Area Ratio (ii) 315 for 150 Floor Area Ratio On Other Roads (i) 262.5 for 175 Floor Area Ratio (ii) 210 for 150 Floor Area Ratio	(i) 210 for 175 Floor Area Ratio (ii) 178.5 for 150 Floor Area Ratio	105 for 150 Floor Area Ratio	50.00 for 100 Floor Area Ratio	10.00 for 100 Floor Area Ratio
Industrial	0.53	0.53	0.53	0.20	0.05.".

SHAKUNTLA JAKHU,
Financial Commissioner and Principal Secretary to
Government Haryana, Town and Country Planning Department.

Rates of Conversion Charges in the controlled areas in Haryana (Rs. per Square Meter)

[Extract from Haryana Government Gazette (Extra.), dated the 21st December, 2006]

HARYANA GOVERNMENT

TOWN AND COUNTRY PLANNING DEPARTMENT

Notification

The 21st December, 2006

No. 8 DP-2006/31040.—In exercise of the powers conferred by Sub-section (1) read with Sub-section (2) of Section 25 of the Punjab Scheduled Roads and Controlled Areas Restriction of Unregulated Development Act, 1963 (Punjab Act 41 of 1963) and with reference to Haryana Government Town and Country Planning Department, Notification No. 8DP-2006/28573, dated the 10th November, 2006 read with Haryana Government, Town and Country Planning Department, Notification No. 8DP-2006/3439, dated the 27th February, 2006, the Governor of Haryana hereby makes the following rules further to amend the Punjab Scheduled Roads and Controlled Areas Restriction of Unregulated Development Rules, 1965, in their application to the State of Haryana namely :—

1. (1) These rules may be called the Punjab Scheduled Roads and Controlled Areas Restriction of Unregulated Development (Haryana Amendment) Rules, 2006.

(2) They shall be deemed to have come into force with effect from the 10th November, 2006.

2. In the Punjab Scheduled Roads and Controlled Areas Restriction of Unregulated Development Rules 1965, for Schedule IV, the following Schedule shall be substituted, namely :—

"SCHEDULE IV

[*See rule 26-D(g)*]

Rates of Conversion Charges in the Controlled Areas in the State

(Rates Rupees per square meter)

Potential Zone	Hyper Potential	High Potential	Medium Potential	Low Potential
1	2	3	4	5
Name of Controlled Areas	Controlled areas forming part of the Development Plan Gurgaon-Manesar Urban Complex-2021	Controlled areas declared under Section 4(1) (b) in Gurgaon District (excluding the controlled areas forming part of the Development Plan Gurgaon-Manesar Urban Complex-2021), including controlled areas around Sohna Town, controlled areas of Faridabad -Ballabgarh Complex controlled areas of Sonipat Kundli multi-functional Urban Complex, Panipat and periphery controlled area of Panchkula	Controlled areas around towns *i. e.* Karnal, Kurukshetra, Ambala City, Ambala Cantt., Yamuna-Nagar, Jagadhri, Bahadurgarh, Hisar, Rohtak, Rewari, Bawal-Dharuhera Complex, Gannaur, Palwal, Hodel, controlled areas declared under section 4(1)(b) in Faridabad District, Oil refinery Panipat (Bgholi)	All the other controlled areas declared in the State

2

Use	Abutting on			Abutting on			Abutting on			Abutting on		
	NH	SR/ Sector Road	Other Road	NH	SR/ Sector Road	Other Road	NH	SR/ Sector Road	Other Road	NH	SR/ Sector Road	Other Road
Residential	210	158	105	158	125	105	100	80	60	30	20	15
Commercial	1470	1260	1050	1260	1050	840	700	600	350	200	150	100
Industrial	21	21	21	13	13	13	6	6	6	3	3	3
Institutional	158	126	105	105	84	63	60	40	30	20	15	10
Recreational	21	21	21	13	13	13	6	6	6	3	3	3

Notes : 1. Abbreviation used indicate NH : National Highway; SR : Scheduled Road.

2. Sector Road is the Sector diyiding road as indicated on the Development Plan.

3. Where a piece of land falls in more than one category, the Higher/Highest rate shall apply.

4. 50 percent conversion charages shall be charged for food processing unit located in industrially backward area declared by the Industries Department, Haryana.".

SHAKUNTLA JAKHU,
Financial Commissioner and Principal Secretary to Government Haryana,
Town and Country Planning Department.

42028—C.S.—H.G.P., Chd.