FINAL REPORT
MAY 2019

COMPREHENSIVE MOBILITY PLAN FOR CHENNAI METROPOLITAN AREA

Chennai Metro Rail Limited

Urban Mass Transit Company Limited

cMDA

DISCLAIMER:

Revision	Revision 1
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Description	Final Report of Comprehensive Mobility Plan for Chennai Metropolitan Area

ABBREVIATIONS

ATCC	:	Area Traffic Control Centers
BAU	:	Business As Usual
BRT	:	Bus Rapid Transit Systems
CBD	:	Central Business District
CCTS	:	Chennai Comprehensive Transportation Study
CCTV	:	Closed Circuit Tele Vision
CDP	:	City Development Plan
CMA	:	Chennai Metropolitan Area
CMDA	:	Chennai Metropolitan Development Authority
CMRL	:	Chennai Metro Rail Limited
GCC	:	Greater Chennai Corporation
GoI	:	Government of India
GoTN	:	Government of Tamil Nadu
HHI	:	Household Interview
HO HO	:	Hop On, Hop Off
IPT	:	Intermediate Public Transport
IRC	:	Indian Road Congress
IRR	:	Inner Ring Road
ITES	:	Information Technology Enabled Services
LCV	:	Light Commercial Vehicle
LRT	:	Light Rail Transit
MRTS	:	Mass Rapid Transit System
MTC	:	Metropolitian Transport Corporation
NH	:	National Highways
NHAI	:	National Highway Authority of India
NMT	:	Non Motorized Transport
NUTP	:	National Urban Transport Policy
ORR	:	Outer Ring Road
PHPDT	:	Peak Hour Peak Direction Traffic
PPHPD	:	Passenger Per Hour Per direction
RoB	:	Rail road Over Bridge
SEZ	:	Special Economic Zone
SUT	:	Sustainable Urban Transport
GST	:	Grand Southern Trunk Road
GNT	:	Grand Northern Trunk Road
IRR	:	Inner Ring Road
ORR	:	Outer Ring Road
TAZ	:	Traffic Analysis Zone
TDM	:	Travel Demand Management
ULB	:	Urban Local Body
UMTA	:	Unified Metropolitan Transport Authority
UMTC	:	Urban Mass Transit Company

Executive Summary

A. Background

Chennai, the capital city of Tamil Nadu is a rapidly developing Metropolitan region. The Chennai Metropolitan Area (CMA) comprises of the city of Chennai, 16 Municipalities, 20 Town Panchayats and 214 Village Panchayats in 10 Panchayat Unions. Based on the Second Master Plan, the current Metropolitan area is expected to have a population of 126 lakhs by 2026. With increasing migration to urban areas, population is rising witnessing rapid motorization, along with increased congestion and pollution. To alleviate all the existing and possible future transport problems and to facilitate safe and efficient movement of people, it is essential to prepare the Comprehensive Mobility Plan that provides a long-term vision and mobility solutions for the citizens of Chennai. The study develops a perspective plan for sustainable urban transport over a 30-year horizon period.

A.1. OBJECTIVES OF CMP

Comprehensive Mobility Plan for CMA has been carried out in accordance with the National Urban Transport Policy Guidelines suggested by the Ministry of Housing and Urban Affairs (MoHUA) with focus on mobility of people rather than that of vehicles. The ultimate goal of a CMP is to provide a long-term strategy for the desirable mobility pattern of a city's populace. To achieve this goal, following are the main objectives:

OBJECTIVES

- To provide a long-term vision for desirable urban development in Chennai Metropolitan Area (CMA)
- To illustrate a basic plan for urban development and include a list of proposed urban land use and transport measures to be implemented within a time span of 30 years
- To ensure that the most appropriate, sustainable and cost-effective implementation program is undertaken in the urban transport sector
- To identify feasible short term, medium term and long-term traffic management measures and transport infrastructure needs to facilitate safe and efficient movement of people for the present and future.

The stakeholders include City authorities from Chennai Metropolitan Development Authority (CMDA), Greater Chennai Corporation (GCC), Traffic Police Department, Southern Railways, Metropolitan Transport Corporation (MTC), National Highways of India (NHAI), State Highways Department of Tamil Nadu ,Tamil Nadu Urban Infrastructure and Financial Services ,Tamil Nadu Pollution control Board ,Road Transport Authority (RTO) , Tamil Nadu Public Works Department , Smart City Limited and also include academic experts from various eminent colleges involved in the study of mobility solutions for the city.

B. City Profile

CMA is delineated as the Study Area and it covers 1189 sqkm with Chennai city -176 Sq.km (which has been expanded to 426 sqkm in 2011), Thiruvallur district -637 Sq.km & Kancheepuram district -376 Sq.km.

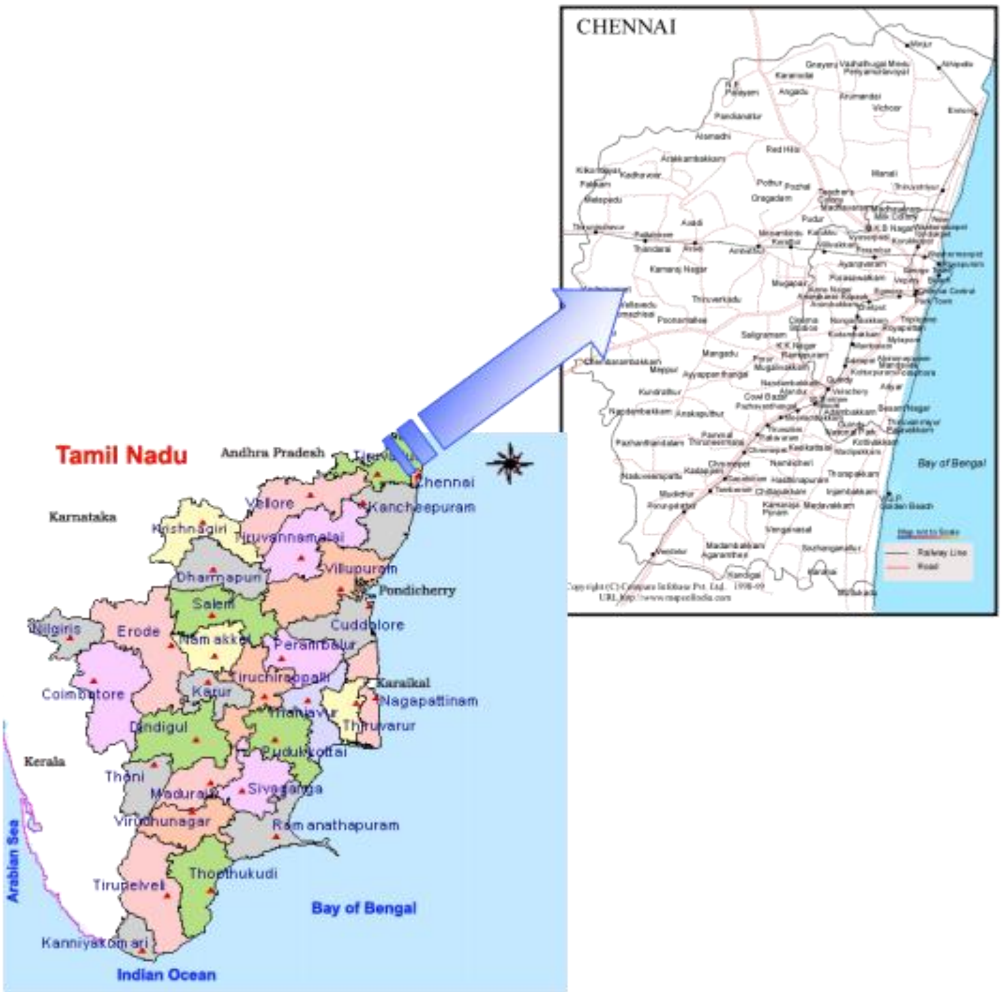


Figure 1: Chennai Location

The population of CMA as per Census 2011 was 86.54 lakh. Though the decadal population growth in the CMA is 27%, the growth in the Chennai core city is only 8%. Municipalities grew at 41%, Town Panchayats at 67% and Village Panchayats at 91%. Many areas within the

Chennai City have shown a negative growth rate in the last decades, while higher growth is observed in the Rest of Chennai Metropolitan Area.

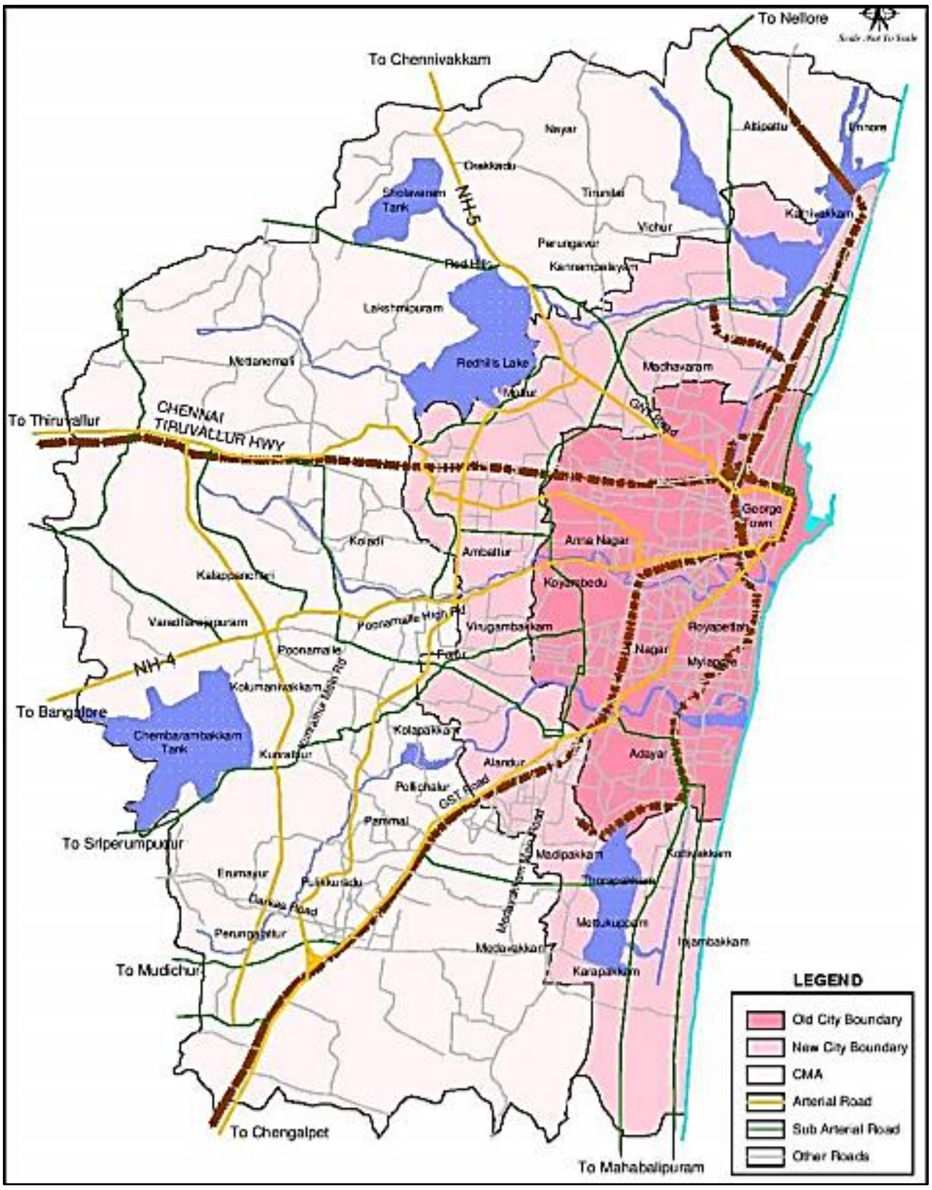


Figure 2: Chennai Metropolitan Area

Table 1: Population and Decadal Growth Rate (Source: Census, 2011)

Description	Population in Lakhs					Decadal Growth Rate			
	1971	1981	1991	2001	2011	1971-1981	1981-1991	1991-2001	2001-2011*
Chennai City	26.42	32.85	38.43	43.43	46.46*	2.20%	1.58%	1.23%	0.68%
Rest of CMA (Municipalities, Town Panchayats, Village Panchayats)	8.62	13.16	19.75	26.98	40.08	4.32%	4.14%	3.17%	4.04%
CMA	35.04	46.01	58.18	70.41	86.54	2.76%	2.37%	1.93%	2.08%

**After the expansion process In October 2011 the City area has been revised to 426 Sq.km from 176 Sq.km with a population of approx. 66 Lakhs in 2011 and 71 Lakhs in 2019(Source: GCC website)*[1]

The land use for the study area is considered based on the Second Master Plan. As envisioned in the Second Master Plan the growth strategy is to guide the future growth outside the Chennai Corporation along the radial corridors in the south, north, south west direction. Consequently, the IT Corridor, NH32, NH 716, NH48, NH16 and Thiruvottiyur ponneri poncheti are likely to be the future growth corridors. Several SEZs, IT/ITES activities, and industrial/commercial projects are likely to be located in the next 15 years in places at outskirts of CMA, Marai Malai Nagar, Irungattukottai, Sriperumbudhur, Thiruvallur, Gummudipoondi owing to the manufacturing of automobiles. Having two Ports, Chennai Port and Ennore Port besides International Airport at Meenambakkam in the study area has made Chennai as a prime location for industries and commerce. Some of the large industrial estates such as Ambattur, Manali, etc, are located in CMA and house multi-product industries. Small industrial estates at Guindy, Thirumazhisai and Thirumudivakkam accommodate medium and small scale industries. Chennai has a large base of leather industry and accounts for 50% of the total exports of the country. An export processing zone (MEPZ) is located at Tambaram for apparel and other exports. Development of a number of Special Economic Zones (SEZs) is in the planning stage.

Table 2: Proposed Land use 2026 as per Master Plan

Category	Land Use % (2006)		Land Use % (2026)	
	City	CMA	City	CMA
Residential	54.25	21.87	51.41	45.88
Commercial	7.09	0.37	4.05	0.86
Industrial	5.17	6.28	4.67	10.56
Institutional	18.48	3.01	3.93	7.18
Open Space	2.09	0.19	5.68	0.38
Agricultural	0.57	11.92	-	7.2
Non-Urban	0.47	2.33	-	2.3
Others (Agriculture, Water Bodies, Redhill Catchment Area, Roads and forests etc.)	11.88	54.03	21.31	39.34
Total	100	100	100	100

[1] http://www.chennaicorporation.gov.in/about-chennai-corporation/aboutCOC.htm

The major land use is residential in Chennai city, accounting up to 54%, followed by Institutional land use, while in the rest of CMA, residential land use is 22% and Institutional land use is only 3%. In Chennai city and rest of CMA in 2006, about 12% land is lying vacant and undevelopable in the urban core, about 54% lie in similar conditions in the CMA.

As per the State Transport Authority, Chennai has reported 55.7 lakh (as on 2018) registered vehicles that account for over 22% of all vehicles registered in the State. As per records, annual growth rate is 6.5% and the CAGR over the last 10 years is 6.3%.

Chennai Metropolitan Area has an extensive dense Public Transport network which comprises of MTC buses, Suburban railways and MRTS connecting various areas within the Metropolitan area. Apart from the Public Transport network, CMA has a strong IPT network with auto rickshaws and shared auto rickshaws.

B.1. KEY OBSERVATIONS

From the review of Chennai city profile, certain key observations have been made pertaining to the study context, as listed below:

- The city road network has a radial pattern depicting finger like plan, with five major roads (NH-32, NH716, NH-16, NH-48 and TPP road) which connects various cities across India. Ribbon development of urban areas along all the five major radial roads has been observed
- The Municipalities and Town Panchayats have experienced higher annual growth rate 4.04% in 2011 compared to 3.17% in 2001. While the Chennai city has experienced a lower annual growth rate of 0.68% in 2011 compared to 1.23% in 2001
- The CMA has high decadal growth rate owing to the growth of population along the outer regions.
- Total vehicle population has increased by an average of 6.5% per annum with a major share of increase in personalised modes.
- Two wheelers and pedestrians account to 85% of the accident victims calling for the need for improvement in road conditions and raising safety concerns.

In order to further quantify the above observations and analyse the transportation system in the city several primary surveys have been undertaken.

C. Existing Travel And Transport Characteristics

The existing travel and transport characteristics of the study area were assessed through primary surveys to understand the trip patterns, travel demand, transport infrastructure needs, mobility issues and to develop Travel Demand Model. In order to understand traffic and travel characteristics including the Origin, Destination, Mode Choice, Socio-Economic Characteristics, Cost, Distance and User preference various primary surveys were conducted.

Based on the primary survey analysis the below mentioned observations were identified;

Total number of trips (Daily)	**157 lakhs**
Per Capita Trip Rate	**1.62**
Motorized Trip Rate	**1.17**
Average Trip Length	**9.9 km**
Motorized Public Transport mode share (Bus+Rail)	**28.20%**
Average vehicle speed	**25.8 Kmph (CMA)** **17 Kmph (Chennai City)**

Analysis of household survey data has revealed significant increase in household income, per capita trip rate, share of trips performed by motorized two wheelers & cars, trip lengths by various modes while there has been a sizeable reduction in the percentage share of trips by Public Transport modes.

- Household size of 3.77 is observed in the current study, when compared with 2008 CTTS (4.07).
- Average household income has increased from Rs.8700 in 2008 to Rs.21875 in 2018 at a CAGR of 9.7% where the average household income has increased from Rs.1370 in 1992 to Rs.8700 in 2008 at a CAGR of 12.4%.
- Analysis of household survey data has revealed significant increase in household income, per capita trip rate, share of trips performed by motorized two wheelers & cars, trip lengths by various modes while there has been a sizeable reduction in the percentage share of trips by Public Transport mode.
- When comparing the household income level and trip rate, it is found that higher income households are making more trips than lower income group.
- Number of trips made by various age groups were compared and found that trip makers between 41-65 years in 2008 is 18% whereas in 2018, the share of these trip makers has increased to 25%.

- A slightly higher per capita trip rate with 1.62 is observed in 2018 compared to 1.60 in 2008.The motorized per capita trip rate has increased to 1.17 in 2018 from 1.06 in 2008.
- The mode share observed in the present study is presented in the table given below.

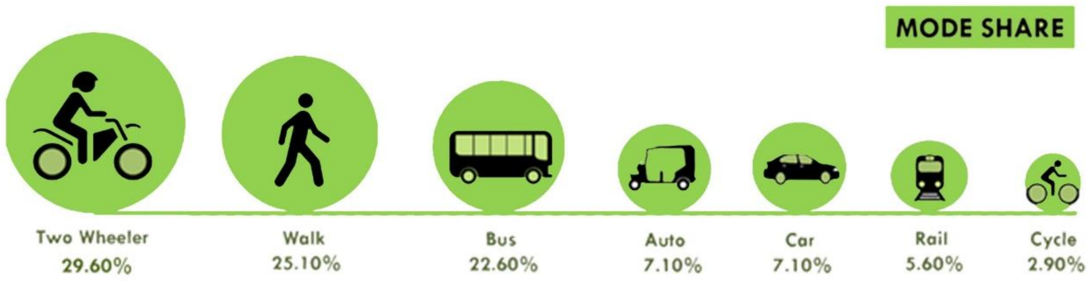


Figure 3: Modal Share

Table 3: Modal Share of 2008 and 2018

S.No	Travel Mode	2008	2018
1	**Walk**	28.0%	25.1%
2	**Bicycle**	6.0%	2.9%
3	**Auto-rickshaw**	4.0%	7.1%
4	**Car/van**	6.0%	7.1%
5	**Two-wheeler**	25.0%	29.6%
6	**Bus**	26.0%	22.6%
7	**Train**	5.0%	5.6%
	Total	100%	100%

- Trips by Non-motorized transport decreased from 41% in 1970 study, 40% in 1984 study, 46.6% in (1992-95) and 34% in (2008) to 28% (2018).
- Cyclist opinion survey revealed that amongst users, 73% travel for work while 10% travel for educational purpose with about 84% travelling daily. Among the problems cited in using bicycle, interference due to parking/pedestrians/bus stops ranked first.
- Significant increase in the percentage of trips by two-wheeler is observed (29.6% in 2018) when compared with previous studies (2% in 1970, 3% in 1984, 7% in 1992-95 and 25% in 2008).
- Significant decrease in the percentage of trips by bus is observed from HHI survey- 22.6% in 2018 when compared 26% in 2008 (CTTS-2008). While there is significant increase in the percentage of trips by train from 5 % in 2008 to 5.60% in 2018.

- There is a significant increase in trips with trip lengths ranging between 2 and 8 km. The average trip length for train and bus has increased to 13.2 km in 2018 from 12 .4 km in 2008 and 12.9 km in 2018 from 10.0 km in 2008 respectively. However, the average trip length in the study area has reduced to 9.9 km from a previously observed ATL of 11.5 km in 2008.

- Heavy pedestrian crossings are observed in CBD/ commercial areas such Egmore Railway station, South Usman Road in front of T. Nagar Bus Stand, Arcot Road at Porur Junction, Arcot Road near Meenakshi College, Koyambedu Junction, College road junction, Cathedral Road with minimal available crossing facilities and accounts for a high number of pedestrian accidents.

C.1. CHALLENGES:

A detailed analysis of the surveys has helped in identifying the following challenges within the study area.

- **Lack of land use transport integration**: Despite the fact that the First and second Master plan aided in the existing land use and transport integration, the transport infrastructure projects were not at par with the land use development along these corridors considering the sprawling especially where the employment generation was high.

- **Lack of NMT facilities**: The primary survey analysis indicates that about 95% of surveyed roads lack of requisite footpath infrastructure. The lack of NMT infrastructure has increased safety concerns and dependency on motorized modes, resulting in decreased share of Non-motorized transport trips from 34% in (2008) to 28% (2018). Thus, there is need for developing NMT facilities in and around any Public Transport facility stations.

- **Need for parking policy**: Demand for organised parking in the central business district (CBD) are high. Acute shortage of parking supply is witnessed in commercial areas of Anna Salai, Periyar EVR Salai, T.Nagar, Purasawalkam, George Town, Nungambakkam, Adyar and Mylapore. The primary surveys indicate that the average parking duration at on-street parking locations is observed to be less than one hour and is observed to be higher at commercial areas. Providing adequate supply and increasing the turnover through demand management measures and through enforcement the unauthorised parking needs to be regulated. Thus, there is need for a parking policy which can help identify parking principles and smarter parking management systems which can benefit people and in economy in time and money, while also leading to more liveable and safe cities.

- **Lack of demand management measures**: There is increased supply in the public transport sector in case of Chennai. Optimizing the use of available resources is the need of the hour. Demand management systems such as flexi work hours, active Traffic management, Time, distance and Place (TDP) pricing needs to tapped to make use of the existing resources efficiently.

- **Lack of intermodal integration**: Chennai city has extensive Public Transport network with different modes such as bus system, Sub-Urban trains, Metro and Intermediate Public transport systems (Auto-Rickshaws, Share Autos, Taxi services). There is a Lack of Integration among different modes of public transport in terms of Route Integration, Operation and service integration, and Institutional Integration and Technological integration.

D. Service Level Benchmarking

The SLBs describe the levels of transport performance like safety and access, pollution, accidents, congestion etc. in Chennai currently. They indirectly reflect the state of governance in the city. Above all, these benchmark indicators allow stakeholders to quantify the past, present and changes in transport and its sustainability. Figure 4 shows the summary of existing service level benchmarking for Urban Transport in Chennai.

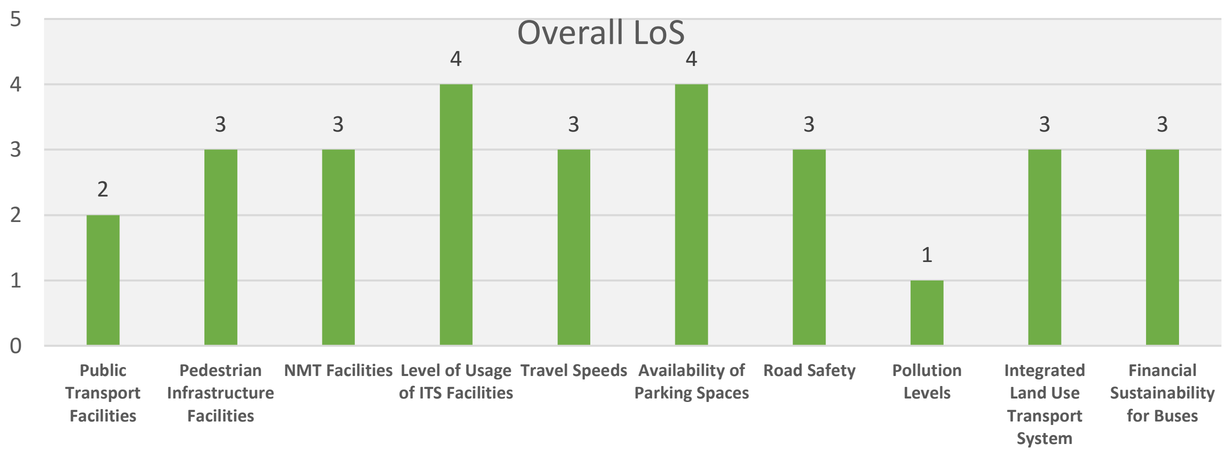


Figure 4: Overall LoS for various parameters

Table 4: Computation of Service Level Benchmarks

Parameters	Overall LoS	Indicators	LoS
Public Transport Facilities	2	Presence of Organized Public Transport in urban area	1
		Extent of Supply/Availability of Public Transport System	1
		Service Coverage of Public Transport	1
		Average Waiting Time for Public Transport Users	3
		Level of Comfort in Public Transport	3
		Percentage of Fleet as per Urban Bus Specification	3
Pedestrian Infrastructure Facilities	3	Signalized Intersection Delay	3
		Street lighting (Lux)	3
		Percentage of Study Area Covered	3
NMT Facilities	3	Percentage of Network Covered	4
		Encroachment on NMT Roads by Vehicle Parking	4
		NMT Parking Facilities at Interchange	2
Level of Usage of ITS Facilities	4	Availability of Traffic Surveillance	4
		Passenger information System (PIS)	4
		Global Positioning System (GPS/GPRS)	4
		Signal Synchronization	4
		Integrated Ticketing System	4
Travel Speeds	3	Average Travel Speed of Personal Vehicles	3
		Average Travel Speed of Public Transport	2
Availability of Parking Spaces	4	Availability of On-Street Paid Public Parking Spaces	4
		Ratio of Maximum and Minimum Parking Fee	4
Road Safety	3	Fatality Rate per Lakh Population	4
		Fatality Rate of Pedestrian and NMT	3
Pollution Levels	1	Concentration of Sulphur Dioxide (SO2)	1
		Concentration of Oxides of Nitrogen (NOx)	1
		Concentration of Suspended Particulate Matter (SPM)	1
		Concentration of Respirable Suspended Particulate Matter (RSPM)	1
Integrated Land Use Transport System	3	Population Density – Gross	3
		Mixed Land Use on Major Transit Corridors	1
		Intensity of Development – City Wide (FSI)	1
		Intensity of Development along Transit Corridors	4
		Road Network Pattern and Completeness	2
		Percentage of Area under Roads	3
		Percentage Network with Exclusive RoW for Transit (For > 1 Million Population)	4
Financial Sustainability for Buses	3	Extent of Non Fare Revenue	4
		Staff per Bus Ratio	2
		Operating Ratio	2

E. Vision, Goals and Development of Scenarios

E.1. VISION

In order to provide a transportation system for the citizens of Chennai, the vision of Comprehensive Mobility Plan (CMP) for Chennai is defined as:

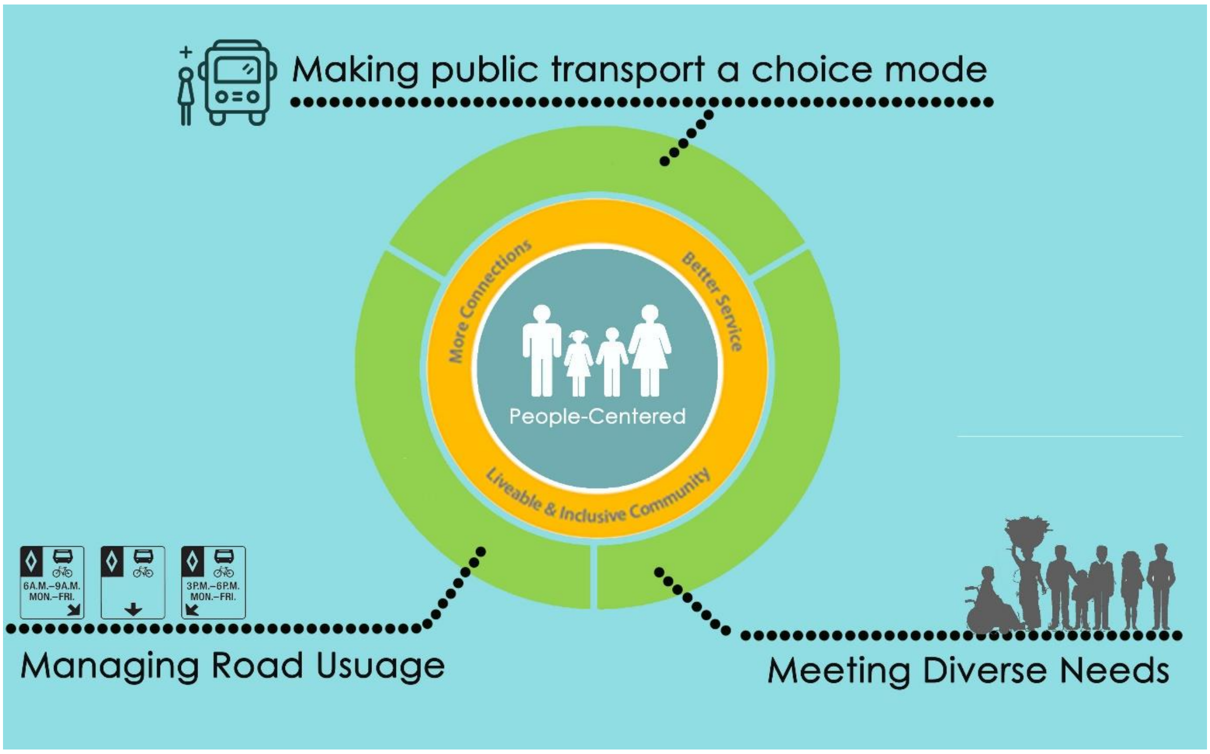


Figure 5: Schematic Vision Representation

> ***To attain a People Centric Urban Transport System that aims at achieving livable and inclusive community through an efficient and sustainable system by providing integrated, safe and convenient mobility to people of all abilities and goods.***

To ensure that mobility solutions for Chennai are people centric and are in conformity with sustainable mobility, the following goals have been targeted for the horizon year.

Goal 1

Develop Public Transit system in conformity with the land use that is accessible, efficient and effective.

Goal 2

Ensure safety and mobility of pedestrians and cyclist by designing streets and areas that make a more desirable, liveable city for residents and visitors and support the Public Transport system.

Goal 3

Develop traffic and transportation solutions that are environmentally sustainable, economically and financially viable for efficient and effective

Goal 3

Develop a Parking System that reduces the demand for parking and need for private mode of transport and also facilitate organized parking for various types of vehicles.

The main focus of the study is to develop a long-term transportation strategy for Chennai Metropolitan Area (CMA) with the help of an urban transport planning model. The base year travel scenario has been modelled as the initial step to assess the current demand on the system. The study area has been delineated into 275 smaller physical units, termed as Traffic Analysis Zones (TAZs) to facilitate analysis of travel demand and trip patterns. In addition to 275 internal zones 23 external zones were delineated to analyse the external trip interactions of CMA. Planning variables (i.e. Population, Workers, Students and Employment, etc.) were attributed to CMA transport network (Links, Nodes, TAZs, etc.).

In order to assess the transport scenario, business as usual scenario was developed. On assessing the impacts on transport and travel characteristics, sustainable urban scenarios were developed in line with the CMP vision and objectives. The development of the scenarios included socio – economic (land use transitions, population and employment) projections and travel characteristics which were attributed into the four stage travel demand model for the horizon years.

Table 5: Planning variable projections for horizon years

Years	Population			Employment		
	Chennai City*	Rest of CMA	Total CMA	Chennai City*	Rest of CMA	Total CMA
2018	50.76	46.97	97.72	23.05	22.65	45.71
2023	54.27	52.72	106.99	27.28	26.82	54.1
2028	57.92	59.15	117.06	31.87	31.32	63.19
2038	66.47	75.07	141.55	40.82	40.13	80.96
2048	79.25	101.23	180.49	53.07	52.18	105.25

* *for city limit of 176 Sq.km*

E.2. LAND USE TRANSITIONS:

The land use pattern and economic activities for Business As Usual scenario have been considered in line with the proposed Second Master Plan 2026 and base year trends. For a Sustainable Urban Transport scenario, densification along the major mobility and transit corridors has been considered along with increased share in mixed land use.

E.3. BUSINESS AS USUAL (BAU) SCENARIO

This scenario assesses the transport system with base year trends and assumes no radical policy interventions for sustainable development and emission mitigations to identify the effects on travel infrastructure, mode share and PT systems in the city.

The BAU scenario evaluated using two sub-scenarios, namely-

1. Business as Usual – Do Nothing Scenario (without any committed projects)
2. Business as Usual – Do Minimum Scenario (with committed projects)

In Do Nothing Business as Usual (BAU-DN) scenario the existing road network with no expected development in existing road network is considered along with the planning variable and travel characteristics.

In Do Minimum Business as Usual (BAU-DM) scenario the existing road network with committed development projects are considered. The committed projects include various projects proposed for road and PT network. The network characteristics for horizon years is as shown:

E.4. SUSTAINABLE URBAN TRANSPORT SCENARIO

In Sustainable Urban Transport (SUT) scenario the urban mobility strategies along with the planning variable and travel demand forecasts as assigned, calibrated and validated in the transport model.

A comparison of traffic and travel characteristics in the two scenarios with goals set for Sustainable Scenario is presented in Table 6.

Table 6: Comparison of Traffic and Travel Characteristics for various Scenarios

Name of the Impact	BAU Scenario Do Nothing (2048)	BAU Scenario Do Minimum (2048)	Target (2048)	SUT Scenario - (2048) - Achieved
Share of Private Transport (PVT) Trips*	55.0%	56.6%	<50.0%	38.9%
Share of Public Transport Trips*	37.7%	36.3%	>50.0%	57.2%
Share of Intermediate Public Transport (IPT) Trips*	7.3%	7.1%	7.0%	3.9%
Avg. Network Speed (kmph)	10.23	12.1	>=24	24.0
Walkability (Arterial & Sub-Arterial)	38.0%	39.2%	>90.0%	100%
Cyclability (Arterial & Sub-Arterial)	0.0%	1.3%	>80.0%	80%
PVT Vehicle Kilometer Travelled (in '000)	27065	29084	Reduce by 10%	21737

* *Share excluding walk trips (Motorised Share)*

It is observed that the share of Public Transport (Bus and MRT) in Sustainable scenario has increased nearly 1.5 times in Sustainable Urban Transport scenario compared to Business As Usual Scenario (Do Nothing Scenario). Also, average V/C ratio has reduced from 1.17 (BAU Do-Nothing) to 0.69 (BAU-Do Something), which is about 40% decrease in congestion level and average network speed has increased by 2.3 times in Sustainable scenario when compared to BAU Do-Nothing Scenario . Considering the improved situation under Sustainable scenario, it has been selected for proposing various transport improvement proposals.

F. Urban Mobility Plan

The mobility goals for Chennai have been addressed through a multipronged approach. The following strategies have been adopted to meet the various goals set for Chennai.

1. Land Use and Transport Strategy
2. Public Transit Improvement Strategy
3. Road Network Development Strategy
4. Non-Motorized Transport Strategy
5. Freight Management Strategy
6. Traffic Engineering and Traffic Management Strategy
7. Travel Demand Management Strategy
8. Technological Strategy

F.1. LAND USE AND TRANSPORT STRATEGY

The land-use transport strategy developed focuses on accessibility, connectivity, and mixed land use developments to minimize private vehicle trips, encourage transit-oriented development. Integrated land use and transport development promotes balanced regional growth in line with regional development strategies, with the objective of:

- Promoting balanced spatial growth
- Minimizing land requirements for private transport
- Promoting transit-oriented growth
- Reducing the need to travel
- Encouraging walkable/ cycle-able neighbourhoods

F.1.1. Hybrid Growth Development:

Chennai has Hybrid growth pattern with compact development with the city limits and mutli-nodal development around the core city. The transport infrastructure in the potential growth nodes should substantiate the land use development and should complement the development.

Thus, the ideal network pattern for Chennai is Semi Radial Transit Network binding the Hybrid growth pattern. The core area is envisaged as the main city centre. The sub centres are divided based on the proximity to the main city centre, i.e. within immediate proximity (along

Inner Ring Road), medium proximity (between IRR and ORR) and Low proximity (along Outer Ring Road).

Table 7: Proximity of Core and Sub-Centres

Immediate Proximity (Along Inner ring road)	Medium Proximity (b/w IRR and ORR)	Low Proximity (Along Outer Ring Road)
• Madhavaram • Red Hills • Kolathur • Valasaravakkam • Ramapuram • Velachery • Adyar	• Manali New Town • Vichoor Village • Padiyanallur • Madhuravoyal • Thirumullaivoyal • Thiruverakadu • Katupakkam • Kunrathur • Trisulam • Keelkatalai • Palaikaranai • Karapakkam • Medavakkam	• Minjur • Karonodai • Pattabiram • Avadi • Thirumazhisai • Attipattu • Thiruniravur • Korattur • Vandalur

The development structure proposed for Chennai considers other important nodes (Satellite Cities) around CMA while envisioning the growth pattern. The important nodes around the CMA are,

- Navallur
- Siruseri
- Sriperambudur
- Thiruvallur
- Gummidipoondi
- Pooneri
- Chengalpattu
- Urapakkam
- Maraimalainagar
- Tamaraipakkam
- Perumalpattu
- Kaelambakkam
- Thiruporur

F.1.2. Transit Oriented Development:

The semi ring-radial network is designated as the structure for mobility corridors. To maximize the passenger throughput, these corridors should be developed on the concepts of transit-oriented development.

Chennai being one of the major metropolitan cities in the country has the great potential to adopt TOD principles. Following corridors are considered for transit-oriented development (i.e. increase in population density by increasing Floor Space Index)

1. Old Mahabalipuram Road (OMR)
2. GST Road –NH32 (Kathipara Junction to Urapakkam)
3. Arcot Road –SH113(Arcot road to Dharkast Road)
4. CTH Road-NH716 (Padi to Thiruniravur)
5. GNT Road-NH16 (Vyasarpadi to Padiyanallur)
6. Outer Ring Road (Vandalur to Minjur Road)
7. Chennai Central to St. Thomas Road (Metro Corridor-1)
8. Chennai Airport (Meenambakkam)-Wimco Nagar Road (Metro Corridor-2)
9. Madhavaram to SIPCOT Road (Metro Corridor-3)
10. CMBT-Light House Road (Metro Corridor-4)
11. Madhavaram to Sholinganallur Road (Metro Corridor-5)

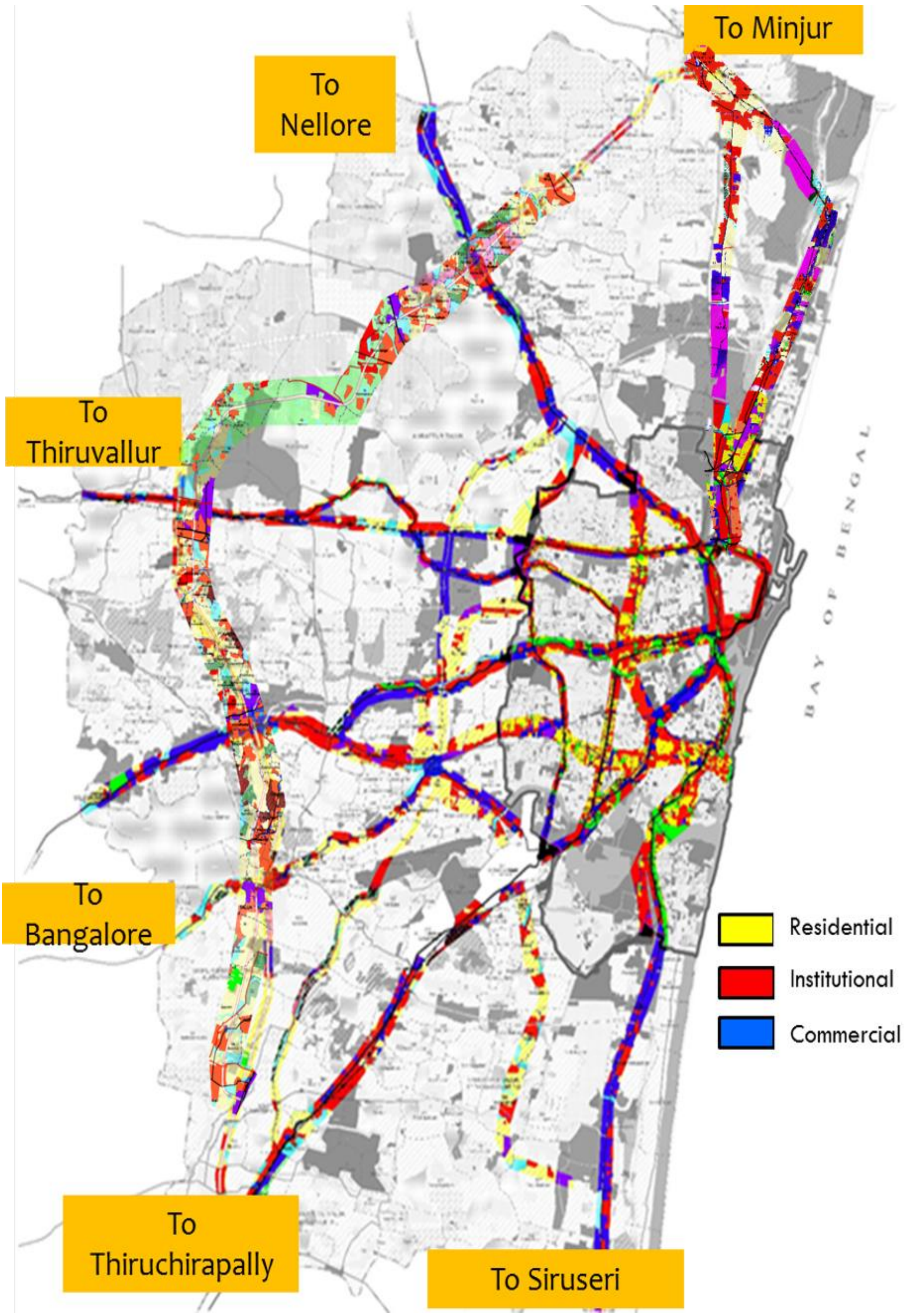


Figure 6: Major Corridor for Transit Oriented Development

The CMP proposes a Floor Space Index (FSI)[2] of 2.5 along all the identified radials and proposed metro corridors while an FSI of 4 along the Outer Ring Road to boost the development of the growth centres outside the municipal limits. Promoting higher FSI along these major mobility centres shall enhance the existing and proposed PT systems. As per the densification study carried out by CMDA, the proposed FSI for the study area is 2 and 0.5 increase along the major mobility corridors with the city is envisioned. Further, CMP suggest to cap the FSI along the periphery ring road to constrain the haphazard growth. Further, a detailed Transit Oriented Development (TOD) study need to be carried out for understanding the consumed FSI and potential for Densification along the mobility corridors.

F.2. ROAD NETWORK PLAN

A well connected and planned road network is essential for better commuting of the various users in the city. The proposals for improving road network include:

- Road Widening/Upgradation
- Development of Missing links/New Links/Ring Roads
- Road Infrastructure Development (River/Canal Bridges and ROBs)

F.2.1. Development of Mobility Corridors

In Chennai the rings emanate circumferentially from the business core area moving from Old Fort Area (George Town and vicinity) towards Anna Salai and T Nagar. In addition there is a possibility to develop rings which bind these radial roads together providing a ring radial pattern for the network.

F.2.2. Road Widening/upgradation

- All the roads identified for road widening shall be provided with median in between to reduce accidents and safety. The major highways shall be provided with service lane to reduce multiple entry/exit points. Mobility corridors are proposed to have 2-lanes exclusively for public transport (i.e. buses) on kerb side or median. The road widening has been discussed into two sections.
- Development of Other Roads - Based on V/C ratios and PT PPHPD, few other roads have been prioritized for widening to increase the PT share. Approximately, 25 km have been proposed for widening

[2] *The Floor Space Index are proposed on the basis of Densification Study (along Metro Rail) -2013 Outcomes.*

Table 8: Proposed Road Widening for Chennai

S.No	Name of Road	Proposed Lane Config	Additional Number of Lanes	Length (Km)
1	Kovilpadagai Main Road	4	2	6.9
2	Athipattu Main Road/NCTPS Road	4	2	4.95
3	Chennai-Thiruvallur High Road/Chennai Ananthapur Highway nearby Vepampattu	4	2	1.41
4	Avadi main Road Near JB Estate	4	2	1.2
5	Kuntrathur Main Road	4	2	0.7
6	Nehru Bazar Road nearby avadi railway station	4	2	0.55
7	Thiruneermalai Road	4	2	3.1
8	SH575 at Koduvalli	4	2	2.9
10	Mangadu Main Road at Pattur	4	2	2
12	Velachery Road at Venkatapuram	4	2	0.6
13	Mangadu Main Road at Paraniputhur	4	2	0.6
14	Peripheral Ring Road (Poonjeri-chengalpattu-sriperambudur-Thiruvallur – Kattupalli	6	4	190

F.2.3. Development of missing links or new links or ring roads

In order to complete the existing ring - radial network, certain missing links have been identified and road network has been proposed to improve the degree of connectivity and direct access within the study area. 44.5 km of network has been proposed in addition to the completion of Outer Ring Road and the proposal of Peripheral Road.

Table 9: Proposed New/Missing Links

Road No	Start	End	Length (km)
Road No 1	SA Polytechnic College	Lakshmi Nagar to vanagaram Ambattur road	3
Road No 2	Poonamalle Pattabiram Road	Avadi Main Road	2.6
Road No 3	Paruthipattu	Thirumazhasai	3.5
Road No 4	Vaelanpanchadi - Perumalagaram Salai	Paruthipattu	1.4
Road No 5	Meppur Village	Melma Nagar Main Road	2.5
Road No 6	Iyapanthangal (Near ORR)	Kundrathur Main Road	1.1

Road No	Start	End	Length (km)
Road No 7	KCG College Road	ECR-New Link with Bridge crossing Buckingham Canal	0.6
Road No 8	Gandhi Theru (Okkiym Thoraipakkam)	ECR via Bhaktha Vedanta Swami Road	0.7
Road No 9	OMR	ECR (Uthandi toll) - New Link	0.7
Road No 10	Sathyavani Muthu St (Parameswaran Nagar)	ECR- Bridge crossing Buckingham Canal	0.6
Road No 11	Sendrambakkam vichoor Rd	Andarkuppam Redhills road	1.2
Road No 12	Minjur	Nandiabakkam-Attipattu Main Road	3.1
Road No 13	Minjur	100feet Road-Mulaivoyal	6
Road No 14	Bund road along Adyar river bunds from T.V.Ka. Bridge	to Maraimalai Adigalar Bridge at Saidapet	5.4
Road No 15	Formation of Tambaram Eastern Bye pass road branching from Marmalong bridge - Irumbuliyur road to	Rajakilpakkam (via) Agaramthen road towards Perungalathur	10.5
Road No 16	Formation of new link road connecting Greenways Road (DGS Dinakaran Salai)	Durgabhai Deshmukh Road through Tamil Nadu Music College	1.5
Proposed High Level Bridge			
Road No 17	Bridge across Coovam river at Padikuppam in lieu of existing bed level causeway connecting PadiKuppam road to Poonamallee High Road		
Road No 18	Bridge Across Coovam River Connecting Mount Poonamallee Avadi Road and Paruthipatu Thiruverkadu Municipal Road		
Road No 19	Bridge across "B" canal at Thiruvottiyur - Ponneri - Panchetty Road.		
Road No 20	Bridge across Coovam River at Nolambur road Junction in NH-4		

F.2.4. Road Infrastructure Development

Considering the scale of the city and the movement of people from every part of the city, the city has dense suburban railway network which needs well supported road infrastructure to surpass the rail networks. The study, recognizes that there is a need for 23 ROB/RUB for improved connectivity as shown in Table 10.

Table 10: Proposed ROB/RUB

S.No.	Proposed ROB/RUB
1	Manicka Jalaganda St near Vandalur zoo bus stop to Vandalur NH32
2	Kamaraj High Road near Perungalathur railway station
3	Radha Nagar Main Road near Chrompet-NH 45
4	DGQA Rd in Meenambakkam
5	Jayaram St towards Meenambakkam Metro
6	Velachery Road in Alandur (Near officer's Colony)
7	Vysarpadi Jeeva Railway Station near Alluri Polleri Amman Temple
8	Korattur Railway Station Road
9	Bazzar St Near Ambattur Railway Station
10	Nehru Bazzar Road Near Avad Railway Station
11	Sekkadu Main Road near Hindu College
12	Thandalam - Nemilichery Rd near Nemilicheri Railway Station
13	Thiruvottiyur High Road near pencil factory bus stop
14	Theyagappa Chetty Street in Korukkupet Railway Station
15	Station Road Near Wimco Nagar Rly Station
16	St No 1 in Tirumoorthy Nagar near Manali High Road
17	Railway Station Road near Nandiyambakkam Rly Station
18	Railway Station Road near Minjur Rly Station
19	Thirunindravur –Thiruvallur near Veppampattu Railway Station
20	Thiruvottriyur and Ennore Railway Stations
21	Widening the Railway Over Bridge at of Mount - Poonamallee-Avadi Road
22	Widening the existing Road Over Bridge at in the Inner Ring Road (Dual five lane)
23	Construction of Road Over Bridge at Chennai – Thiruttani- Renigunta Road (SHU148) in lieu of existing two lane ROB

F.3. PUBLIC TRANSPORT STRATEGY

Public Transport improvement plans include service improvements for buses, and para-transit, appropriate Mass Rapid Transit (MRT) options and infrastructure development plans and intermodal integration plans. The proposals under Public Transport improvement plans are:

a) Rationalization of existing city bus services for efficient Public Transport systems

b) Development of mass rapid transit systems.

c) Ensuring multi-modal integration in Public Transport

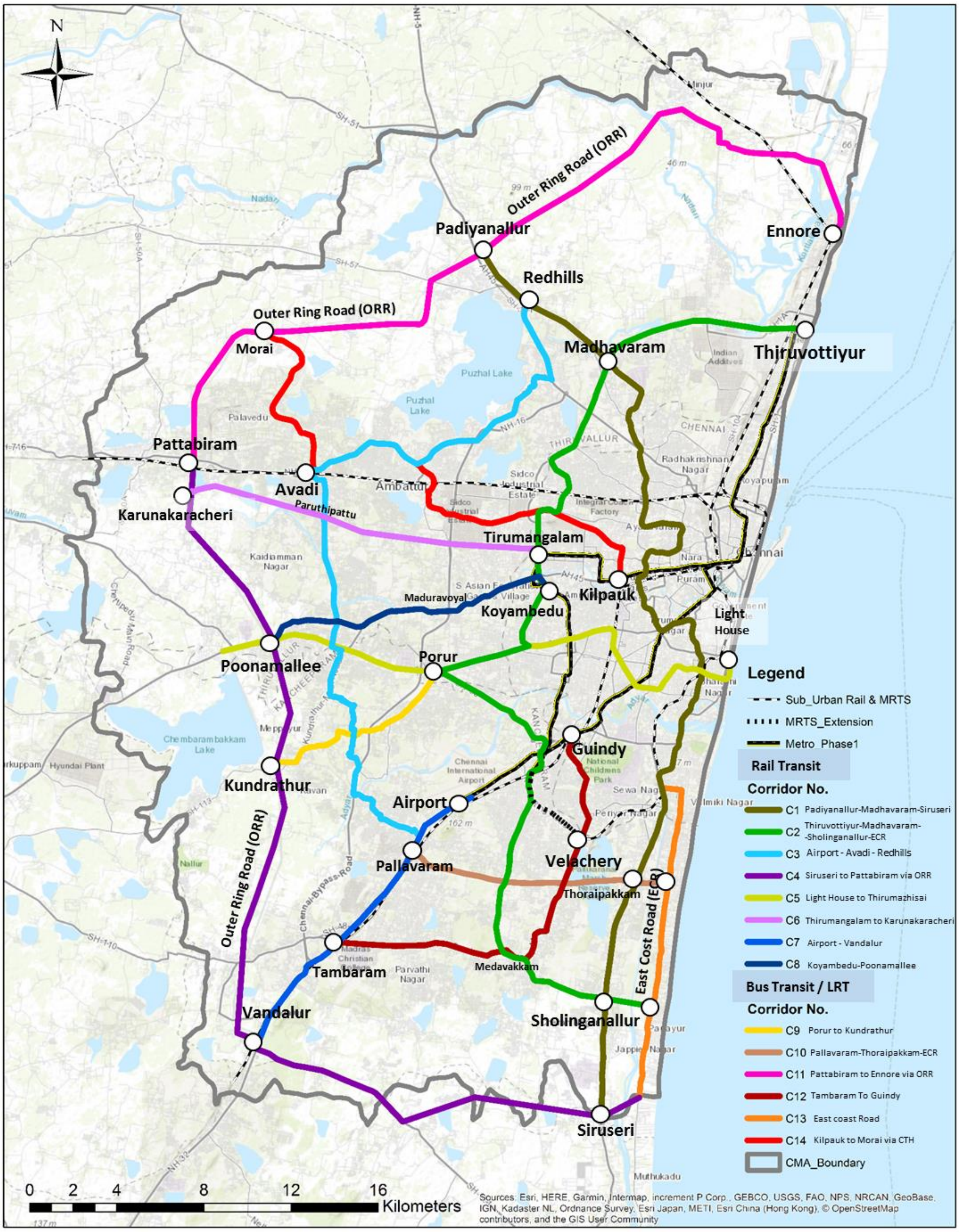
d) Providing adequate infrastructure facilities for Public Transport in terms of intermodal mobility hubs and bus stops

e) Implementation of ITS to improve the reliability of Public Transport systems

f) Promoting public participation and campaigning mass awareness programs.

F.3.1. Higher Order Mass Transit Systems

The selection of higher order system is based on the Passengers per Hour per Direction (PPHPD) and feasibility of implementation, along with other parameters. The urban transport model developed for CMA has evaluated the PPHPD values on all major corridors of Chennai (i.e. mobility corridors) for 2048. The PPHPD values as well as the proposed routes along the mobility corridors are shown in Figure 7 and Table 11.



Title	Proposed Mass Transit Corridors	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 7: Proposed Mass Transit Network

Table 11: PPHPD for Proposed Mass Transit Network

Sl No	Links	Route Length	PPHPD	Proposed MRT Option
C1	Padiyanallur-Madhavaram-Siruseri	54.13	37735	RAIL
C2	Thiruvottiyur-Madhavaram-Sholinganalur-ECR	53.45	27461	RAIL
C3	Airport - Avadi - Redhills	37.03	27141	RAIL
C4	Siruseri to Pattabiram via ORR	49.18	19530	RAIL
C5	Light House to Thirumazhisai via Poonamallee	29.87	27866	RAIL
C6	Thirumangalam to Karunakaracheri via Paruthipet	11.69	16793	RAIL
C7	Airport - Vandalur	17.44	16394	RAIL
C8	Koyambedu-Poonamallee via Madhuravoyal	13.7	10348	RAIL
C9	Porur to Kunrathur	15.02	7259	BUS/LRT
C10	Pallavaram-Thoraipakkam-ECR	13.68	7911	BUS/LRT
C11	Pattabiram to Ennore via ORR	38.66	7011	BUS/LRT
C12	Tambaram To Guindy via Medavakkam	20.4	9876	BUS/LRT
C13	East coast Road	15.28	5161	BUS/LRT
C14	Kilpauk to Morai via CTH	28	5652	BUS/LRT

F.3.2. Route Rationalisation

The route rationalization plan for Chennai has been done based on the trunk feeder network concept. All trunk corridors connecting growth centres are identified and are proposed as Trunk line which will be corridors with high PHPDT. These lines will have comparatively higher frequency and will have high capacity buses or mass rapid transit systems running. Since, the mass rapid transit proposal is a long term strategy, the route rationalization plan has to be implemented in short term with the trunk line as buses.

Table 12: Route Rationalisation Proposal

Total No. of Routes	699
Total No. of Routes for Modified (Improved Headway)	79
Total No. of Routes for Retaining	605

However, a detailed Route Rationalisation feasibility exercise needs to be carried out in order to access the demand on each routes from which routes can be modified retained or curtailed.

F.3.3. Bus Augmentation:

Based on the route rationalization plan prepared and estimated, the number of buses required in Chennai for the horizon years are computed. Fleet requirement over the years is estimated based on assessing the Central Institute of Road Transport (CIRT) and MoHUA norms and demand is computed as 8123 buses (including scrapped buses) for the year 2048. For Horizon years (including rail fleet) with 50% of fleet is proposed as electric buses in next 30 years. However, a detailed feasibility study is to be undertaken. The details of the Bus Fleet Augmentation for the horizon years are as shown in Table 13.

Table 13: Proposed Bus Fleet Augmentation

Parameter	2018	2023	2028	2038	2048
Total Existing Bus Fleet (Only buses)	3740	-	-	-	-
Proposed Bus Fleet as per MoHUA Norms	3961	4403	4885	6087	8123
Electric Buses to be procured	1046	1156	1286	3043	4062
Standard Buses to be procured	1046	1156	1286	3043	4062

F.3.4. Bus Terminals

The existing Inter State bus Terminus (ISBT) are located at Koyembedu and Madhavaram. CMP proposes four additional terminus with the South bound buses from Coimbatore, Madurai, Salem etc. to be terminated at Kilambakkam Bus stand (near Vandalur/Urapakkam along GST Road), West bound buses from Bangalore, Hosur to be terminated at Thiruniravur and north bound buses to be terminated at Madhavaram, Nallur Terminals in order to decongest the Koyembedu Bus Stand. In addition, the existing terminal at Koyembedu is proposed to be operated as the main Intra city bus terminal.

Table 14: Proposed Bus Terminals

S.No	Proposed Bus Terminus
1	Kilambakkam
2	Poonamallee
3	Thiruninravur
4	Nallur

All the existing terminals in the city are proposed to be taken up for Infrastructure upgradation. However, a detailed feasibility study needs to carried out considering the availability of land.

F.3.5. Intermediate Public Transport / Feeder Services

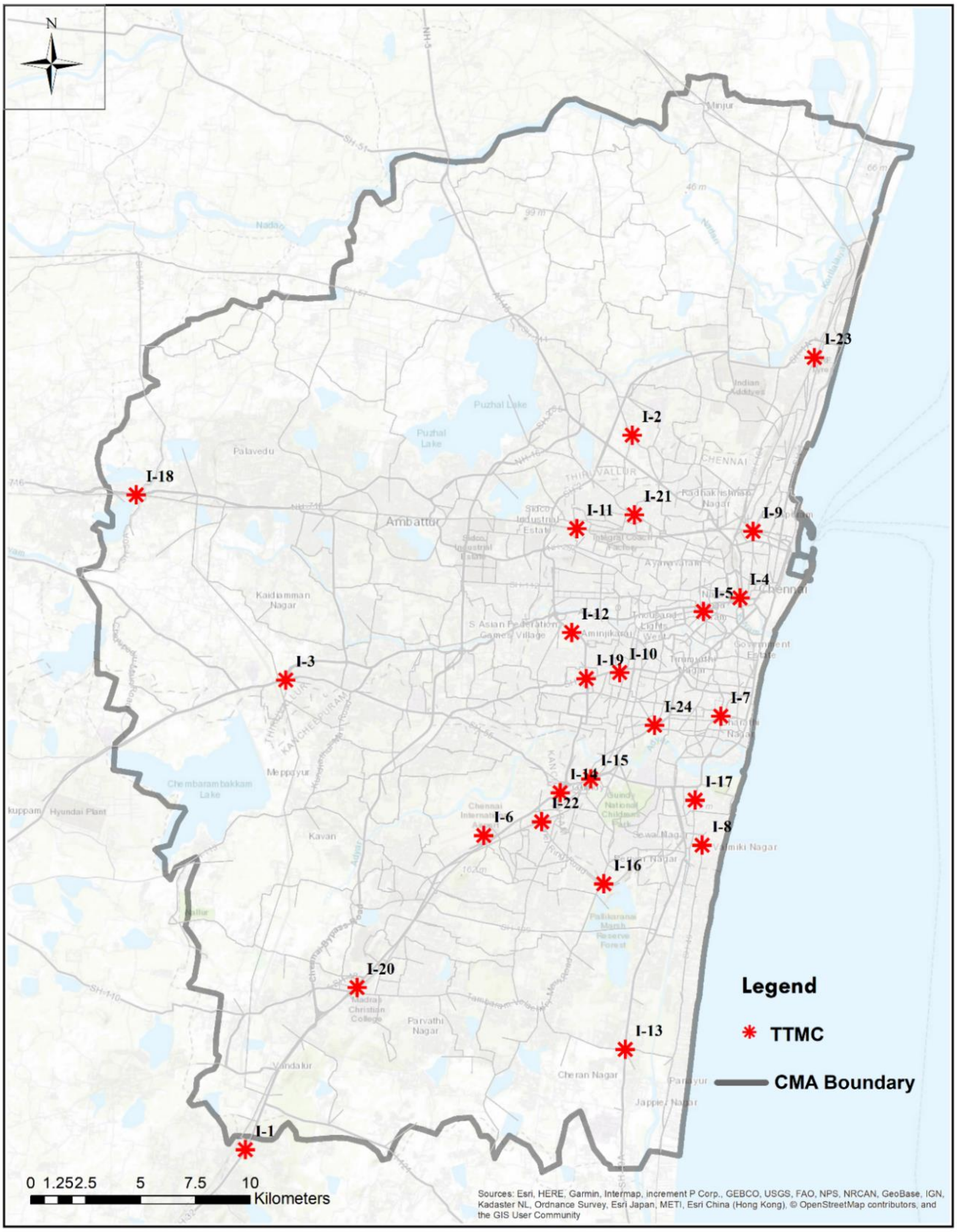
The need for an integrated system will help in improving accessibility of users through establishing first mile and last mile connectivity. In Chennai, the IPT routes operated overlap with the major trunk PT corridors .Although improving public transport in Chennai would be a key strategy, it is also important to ensure that auto-rickshaw/Share Auto services fulfil their intended role as feeder services instead of competing with public transport for long-distance trips.

F.3.6. Multimodal Integration :

At the intersection of each mobility corridor/ transit corridor with the inner Ring Road/ outer Ring Road of the city, a transfer terminal should be facilitated. The main objective of these Multimodal station is to provide Urban Transport Infrastructure with several amenities under one roof. This will help the city to minimize congestion and also reduce the pollution hazards. This system can be integrated with other modes of transportation systems like metro, Sub-urban, MRTS and BRT corridors. The Multimodal nodes are proposed based on the degree of interchanges between various modes. The proposed Multimodal Station locations are given below and are shown in Table 15.

Table 15: Proposed Multimodal Locations

S.No	Interchange Locations
State - City - Bus /NMT	
I-1	Kilambakkam Bus Stand
I-2	Madhavaram
I-3	Poonamallee
Rail /City-Bus/NMT	
I-4	Central
I-5	Egmore
I-6	Airport
I-7	Thirumayilai (LUZ)
I-8	Thiruvanmiyur
I-9	Washermanpet
I-10	Kodambakkam
I-11	Villivakkam
I-12	CMBT
I-13	Sholinganallur
I-14	Alandur
I-15	Guindy
I-16	Velachery
I-17	Adyar
I-18	Thiruniravur
I-19	Vadapalani
I-20	Tambaram
I-21	Perambur
I-22	St.Thomas Mount
I-23	Wimco Nagar
I-24	Nandanam



Title	**Proposed Traffic and Transport Management Centre**	Prepared by Urban Mass Transit Company Limited
Project	**Comprehensive Mobility Plan for Chennai Metropolitan Area**	

Figure 8: Proposed TTMC Locations

F.4. NON-MOTORISED PLAN

The CMP envisions Chennai as a city where people are given more importance than vehicles, where access to opportunities and mobility for all residents in Chennai are ensured. The design of the streets in the city are proposed to consider pedestrian-oriented, multi-modal street designs. They will also incorporate appropriate environmental planning and water management techniques. The proposals under Non-Motorized Transport (NMT) Plan for Chennai are:

- Development of Footpath facilities.
- Development of Cyclist-Friendly streets
- Area-Wise NMT Recommendations

F.4.1. Development of Footpath facilities

CMP has identified all the major spines of Chennai for immediate need of footpaths as per the design standards. All the junctions in Chennai should be designed with due consideration for pedestrians. The CMP proposed an ideal width of 1.8m for footpaths with a maximum height of 150mm from the finished road surface. Accordingly, CMP has identified 861 km of roads within CMA where the footpaths have to be built immediately or the existing footpath should be reconstructed according to the design standards. In addition, local authorities should develop the footpaths in all other streets following the development of footpaths in the priority streets.

F.4.2. Pedestrian Crossing Infrastructure:

From the PV^2 Analysis, the degree of interventions at crossings have been identified. Consequently, CMP suggests 26 grade separators for pedestrian crossing. In addition, Ponnamallee has also been identified for grade separator facilities as the part of area development plan one in front of bus stand and other on Ponnamallee bus stand. The details of the locations are as follows:

Table 16: Proposed Grade Separators for Pedestrians

S.no	Location
1	Anna Nagar 2nd avenue
2	Arcot Road at Porur Junction
3	Arcot Road near Vadapalani Bus Stand
5	Duraisawmy road Pothys junction
6	GST Road near Chrompet Bus Stand
7	GST Road near Pallavaram Bus Stand

S.no	Location
8	GST Road near Tambaram Bus Stand
9	Koyambedu Junction
10	Mofussil Bus Terminus
11	Mt Poonamallee Rd nr Iyappanthangal Bus Stand
12	Poonamallee Trunk Road
13	South Usman Road in front of T. Nagar Bus Stand
14	South Usman Road
15	Vadapalani Signal Arcot Road
16	Vadapalani Signal Jawaharlal Nehru Road
17	Arcot Road near Meenakshi College
18	Broadway ,NSC bose Road
19	College road junction near Women Christine College
20	Duraisawmy Road ,T-Nagar
21	In Front of Raja Annamalai Mandram
22	Sterling road junction
23	Kathipara Junction
24	Taramani Velachery Road Vs Velachery Bypass Rd
25	Taramani Velachery Road Vs Velachery Main Road
26	Thiruvottiryur Bus Stand Junction

F.4.3. Pedestrian Mall Facilities:

Pedestrian malls are the most common form of pedestrian zone/ pedestrian streets in large cities. Theses streets are typically along the commercial frontages with high pedestrian footfalls and are closed to most automobile traffic throughout the day of for limited hours. These are observed as the virtues of pedestrian streets and one of the core elements of urban renewal. The pedestrianized streets in India have shown improved footfalls and commercial sales, sense of identity, social interactions and safety along the streets making them active public spaces in the city.

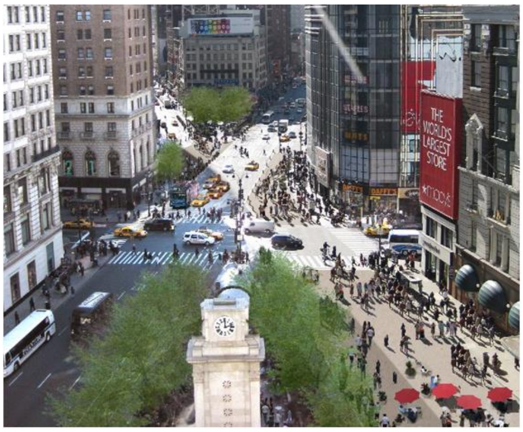


Figure 9: Broadway Pedestrian Mall

In case of Chennai 18 locations have been identified to be developed as Pedestrian Malls to improve the quality of streets and public spaces. These locations have been identified on accessing the nature of activity nodes (commercial, recreational and institutional establishments), pedestrian footfalls and the potential for renewal of unused spaces. The following are the proposed locations for Pedestrian Malls,

Table 17: Pedestrian Mall Locations

S.No	Pedestrian Mall Locations
1	Chennai Central
2	NSC bose road
3	Chinna Bazaar Road
4	Kasi Chetty street
5	Broadway Eravalu Street
6	Puraswalkam
7	T-Nagar -Usmaan Road
8	Mylapore Tank Road
9	Pondi Bazaar
10	Parry's Corner
11	Anna Nagar (Roundana)
12	Muthulingam Street-West Tambaram
13	Vadapalani -North Mada Street
14	Madhya Kailash
15	Olympia Tech Park
16	Kathipara Flyover
17	Koyembedu
18	Moolakadai

F.4.4. Development of cyclist-friendly streets

Total for 183 km of dedicated NMV lanes along with 268 km of shared routes are proposed in the plan connecting important activity centres and trip attractors. The bicycle tracks have been proposed in the city as segregated or dedicated based on the traffic and ROW constraints observed.

The implementation of the Cycling Infrastructure in the study area would complete 9 recreational cycling loops/trails of approximately 237.5 km in the area covering various scenic and historically important landmarks. These trails are already popular among cycling enthusiasts in the city and the implementation of the proposal would help garnering interest from the public.

Prioritization for Implementation:

It is recommended that the system's stations be implemented in the order of priority mentioned below:

1. Transit Stations, Terminals
2. Catchment area of the above
3. Colleges, Schools

F.5. FREIGHT MANAGEMENT STRATEGY

Freight policy principles adopted for Chennai mainly include restricting the heavy vehicles entering the city during day time, developing truck terminals at or near cordon points and distribute the goods in the city through LCV/sustainable transport choices, developing a Freight Operator Recognition scheme etc.

Under the freight management strategy, freight corridors and truck terminals are proposed.

At present, the Poonamallee High Road connecting Maduravoyal to Chennai Port is an elevated freight corridor carrying freight from Chennai Port to outside and vice versa. Also, there are three existing truck terminals (i.e. Madavaram, Maduravoyal and Manjanbakkam) with partial terminal facilities like shops, offices, dormitories and parking. In order to enhance connectivity, certain freight corridors have been proposed. These terminals are proposed for upgradation. In addition to these, seven new truck terminals are proposed based on goods traffic demand. Seven truck terminals are proposed at Irungattukottai, Madhuravoyal, Koyembedu, Karunakarancheri, Manali New Town, Nallur (Chekkadu), Oragadam and one near Kattupalli Port Road

Northern Port Access Road has been proposed under Vision Tamil Nadu 2023 to enhance connectivity from Ennore Port to NH 16. However, since Peripheral road has been proposed from Ennore Port to Mahabalipuram extending up to 125km, Northern Port Access road has not been considered in the current study.

Table 18: Proposed Freight Corridor

S.No.	Road Name	From	To	Length (KM)
1	Peripheral Road	Kattupalli Port	Mahabalipuram	133
2	Outer Ring Road	Ennore Port	Vandallur	62
3	Chennai Bypass Road	Kathairaved, Retteri Lake	Singaperimal Koil	33
4	Manali Oil Refinery (High) Road	Bharatiyar Nagar Beach Road	Madhavaram Roundabout	14
5	Mumbai Highway	Chennai Port	Sriperumbudur	43
6	Chennai Srikakulam Highway	Near Chennai Central Railway Station	Pudukoyal	34
7	Ennore High Road	Chennai Port	Ennore Port	25
8	Minjur Road	Sadayankuppam	Ponneri	24

However, a Feasibility study together with DPR need to be carried for ground viability, accessibility options and infrastructure facilities in developing truck terminals.

F.6. TRAFFIC ENGINEERING AND MANAGEMENT MEASURES

Traffic engineering aims at achieving safe and efficient movement of people and goods on roadways. It includes various strategies adopted to efficiently manage the movement of vehicles like one-way systems, no parking zones etc. Some of the strategies adopted in Chennai for management measures include:

- Junction Improvement
- Traffic Management Plans
- Pavement Markings and Signage’s

F.6.1. Junction Improvement

Junction improvement essentially involves the combination of the following elements:

- Closure of medians at certain intersections
- Provision of adequate sight distance
- Providing adequate corner radii
- Providing sufficient turning radii
- Providing pedestrian and cyclist crossing facilities
- Bus stops near junctions to be re-located
- Providing signs/lane-markings/lighting etc.

It is observed that 33 junctions in the study area are critical as the traffic level at the junctions are very high and need improvement.

F.6.2. Vehicular Grade Separation at Intersections:

Grade separated facilities are proposed at the following locations:

S.No	Location
1	Sterling Road Vs College Road
2	NSK Salai Vs Thirumalaipillai Road Vs Valluvar Kottam High Road
3	Pantheon Road Vs Marshalls Road Vs Dr. Nair Road
4	Walaja Road Vs Qaid-e-Milleth Road
5	Medavakkam Tank Road Vs Purasavakkam High Road
6	Venkatanarayana Road Vs Burkit Road
7	Kathivakkam High Road Vs Tondiarpet Road
8	Thiruvottiyur High Road Vs Kathivakkam High Road
9	Manali High Road vs Ennore High Road
10	Sardar Patel Road Vs Velachery Road
11	Avadi Poonamallee Road Vs Poonamallee Trunk Road
12	CTH Road Vs Redhills Road
13	Kaliyamman Kovil Street and MGR Salai (Arcot Road)
14	Ennore Expressway and Manali Oil Refinery Road
15	Jawaharlal Nehru Road and TPP Road
16	Redhills-Thiruvallur Road and NH-5
17	Pammal Main Road Vs GST Road
18	Anna Salai Vs Sardar Patel Road
19	Junction of Rajiv Gandhi Salai with Sardar Patel road at Madhya Kailash.
20	Inner Ring Road and P.T.Rajan Salai Junction.
21	Marmalong Bridge – Irumbuliyur road near Kaiveli, Madipakkam
22	Chennai – Thiruthani – Renigunta Road and Korattur Road.
23	Chennai - Thiruthani - Renigunta Road at the intersection of Mount Poonamallee Avadi Road and at the intersection of Heavy Vehicles Factory Road at Avadi
24	Chennai-Thiruthani-Renigunta Road at the junction of of Vanagaram – Ambattur Road
25	Marmalong Bridge- Irumbuliyur Road covering Madampakkam road Junction, Tambaram Eastern Bypass and Camp Road Junction near Selaiyur
26	Intersection of Kodambakkam - Sriperumbudur road and Poonamallee - Kundrathur - Pallavaram Road, including providing connectivity to ORR via Erikkarai Road at Kundrathur
27	Construction of Multi level Grade Separator on Mount-Poonamallee-Avadi road from MIOT Hospital to Mugalivakkam via Ramapuram, L&T and DLF
28	Intersection of Mount - Poonamallee - Avadi road, Chennai – Chittoor - Bangalore road & Poonamallee - Kundrathur- pallavaram road at Kattupakkam in Poonamallee.
29	EVR Salai at the intersection from Raja Muthiah Salai to Pulla Avenue in Chennai city
30	Junction of East Coast Road and Lattice Bridge Road at Thiruvanmiyur
31	Chennai-Thiruvallur High Road at the junction of Ambattur Estate bus depot.
32	Grade Separator at Harrington road junction

F.7. TRAFFIC MANAGEMENT PLANS:

F.7.1. Area Traffic Management Plans

Area wise Traffic Management plans with focus on NMT improvement are suggested for Chennai especially around the core area. The recommendations would include:

- Redevelopment of streets in the area considering pedestrians and cyclists
- Provision of public bike sharing facilities
- Creation of pedestrian areas
- Removal of on street parking etc.
- Traffic Management/Re-routing

The following two locations have been identified for Area-wise Traffic Management plans,

1. West Tambaram

2. Poonamallee

F.7.2. Pavement Markings and Signages

Even though road signs and markings are provided on major road stretches of Chennai, some of the sign boards are not visible and some are not maintained properly. It is recommended that proper signs be installed at all appropriate locations. Traffic control devices such as Centre line, Traffic lane lines, Stop lines, Pedestrian crossings, Parking space Kerb marking for visibility, Obstruction marking etc must be provided keeping in view all users of the road and especially night time driving. All the traffic signs should be facilitated as per the guidelines provided in IRC: 67-2001. The total length of road for immediate intervention in terms of pavement marking and signage is 1400 km worth mobility corridors.

F.8. TRAVEL DEMAND MANAGEMENT MEASURES

A broad range of demand management strategies are available and can be brought to use depending on the situation and suitability. Some of the "tools" used for TDM are listed below:

- Subsidizing transit costs for employees, Students – Providing Subsidized Transit cost for Employees would promote the usage of public transport and lets the user to public transport instead of Private mode.
- Car parking controls and pricing: Parking in the areas where congestion is high example T-nagar, Purasiwalkam can be priced with differential fares with help of Intelligent Parking management tools.

- Flex-time work schedules with employers to reduce congestion at peak times: Most of the trips happen during peak hours of the day. Having a staggered work times would help reduce congestion during peak hours and also helps in efficient utilisation of the available Public Transport systems
- Road space rationing by restricting travel at certain times and places – The traffic access is restricted in certain urban cordon area ,city centre like George town, Mylapore based upon the last digits of the license number on pre-established days and during certain periods, usually, the peak hours.
- Workplace travel plans: The Travel plans for the employers are set with regulations such as use public transport as travel alternative rather than private. The aim is to reduce use of car dependency.
- Road space reallocation, aiming to re-balance provision between private cars and other sustainable modes
- Private Motorised trip reduction programs
- Public education and awareness programs
- Parking Strategies

F.8.1. Parking Policy and Management

Existing Parking Situation in CMA was analysed in terms of parking demand, turnover, occupancy and future growth requirements. This report has identified 36 roads for on street parking accounting for 3125 ECS as shown below in Table 19 and 22 off-street parking locations. It is important to designate parking spaces and price them in order to effectively manage parking in the city.

Table 19: Proposed On-Street Parking

S.No	Location	Total Length (m)
1	LB Road Near Kamraj Avenue 2nd Street	477
2	Saidapet -Near Saidapet Police Station	458
3	Cp Ramswamy Road,Alwarpet	406
4	Kaliamman Koil Street -Near Koyembedu Bus Terminus	272
5	Nsc Bose Road - Sowcarpet	1871
6	Gandhi Road (Nungabakkam)	269
7	Parrys -Near Broadway Mtc Bus Terminus	218
8	Sri Thyagaraya Road Towards T-Nagar	773
9	Sri Thyagaraya Road Towards Anna Salai	615

S.No	Location	Total Length (m)
10	Porur -Near Porur Lake Jaya Nagar	720
11	Puraswalkam High Road Near Doveton Flyover	230
12	Puraswalkam High Road Near Kelly's Bus Stop	345
13	Royapettai -Near Luz Chruch Road	514
14	Triplicane High Road -Near Tripilicane Post Office	838
15	Velachery-Near Bypass Road Bus Stop	421
16	Vyasarpadi Near Ethiraj Swamy Salai Road	569
17	Vyasarpadi Near Vyasarpadi Flyover	452
18	Waltex Road (Beside Central Station)	816
19	Anna Nagar 2nd Avenue	1610
20	Pallavan Salai	560
21	Kamarajar Salai Near Light House	2330
22	Anna Nagar Shanthi Colony	1610
23	Gopathinarayan Swami Chetty Road	650
24	Avvai Shanmugam Salai	365
25	Luz Church Road Mylapore	280
26	Besant Nagar Near 7th Avenue	1560
27	100' Road Near Madhavaram-Red Hills Road	1200
28	Csir Road Near World Bank Stop	2200
29	GNT Road Near Moolakadai Bus Stop	510
30	Inner Ring Road Near Perambur Red Hillls Road Jn	1020
31	Red Hills Near Oragadam Bus Stop	476
32	Mount Ponnamalle High Road Near Dlf Bus Stop	860
33	Rajiv Gandhi Salai Near Karapakkam	1070
34	200' Road Near Rajiv Gandhi Road	625
35	200' Road Near Velachery Main Road	625
36	Walajah Road	500

Table 20: Proposed MLCP Locations

Code	Location	ECS
P-1	Uthamar Gandhi Salai near T-Nagar	320
P-2	Thanikachalam Road near T-Nagar	390
P-3	Siva Nayanam Street near T-Nagar	275
P-4	Broad Way Bus Terminus	760
P-5	Velachery near Vijayanagar Bus Stand	350
P-6	Anna Nagar Rountana	330

Code	Location	ECS
P-7	Puraswalkam nera Kelly's	400
P-8	Chennai Central Railway Station	270
P-9	Mylapore /LUZ	320
P-10	Tripilicane (Bharathi Salai)	330
P-11	Royapettah near Peters Rd Flyover	330
P-12	Ayanavaram near Palani Andavar Temple	300
P-13	Kilpauk near Ega Theater	300
P-14	Nungabakkam near Sterling Road	400
P-15	Kodambakkam near Meenakshi College for Women	300
P-16	Chetpet (Daspuram)	325
P-17	Chrompet (Sub-Urban Railway Station)	330
P-18	Koyembedu near CMBT	400
P-19	Saidapet near Saidapet Metro Station	320
P-20	Tambaram Sub-Urban Railway Station	340
P-21	Meenabakkam Sub-Urban Railway Station	260
P-22	Mandaveli Sub-Urban Railway Station	201
P-23	EH Road (Opp to Nathaji Nagar)	2287
P-24	Wall Tax Road	2287
P-25	Kannapan Thidal	2287
P-26	Avadhanam Papya Road, Choolai	1841
P-27	Pulianthoppu	1143
P-28	Kolathur Road	1143
P-29	Zonal Office	579
P-30	Old Lorry at Permbur High Road Jamaliya	2034
P-31	Elango nagar playground	1715
P-32	Gajalakshmi Colony	2287
P-33	NSK Salai, near Zone 10 office, Kodambakkam	1115
P-34	VAO Office	678
P-35	Old Court	571
P-36	Richard Park	2287
P-37	RK Mutt Road	2861
P-38	Near Anna Enclave Junction of ECR	2397
P-39	Manthoppu Land (Opposite to Infosys Gate)	2287
P-40	Dandeeswarar Temple Land	858
P-41	Kapaleeswarar Temple, P.S School	1415
P-42	Kapaleeswarar Temple Marriage Hall	1039
P-43	Kapaleeswarar Temple Greenways road	882
P-44	Arulmigu Arunachaleswarar Temple land	800
P-45	Ekambaranathar Temple land	770
P-46	CMDA Truck Terminal Parking next to Andhra Bus Terminus	2573

Code	Location	ECS
P-47	Basin Bridge Near Mint Bridge	1715
P-48	Pallavan Salai Thiru-vi-ka Nagar Play Ground	565
P-49	Vacant Land at DRB school opp Ground	2034
P-50	KM Garden Play Ground	1526
P-51	Millennium park	1576
P-52	Ambedkar nagar play ground	1009
P-53	AD Block Park	1042
P-54	A- Block 4th Street (Near Amma Arangam Shenoy Nagar)	1201
P-55	Gajapathy street	252
P-56	Poonamalle High Road (Kushaldoss)	303
P-57	Rutland Gate 2nd Street	349
P-58	Greams Road	715
P-59	Wallace Garden 2nd Street	678
P-60	Whites Lane	349
P-61	Luz Church Road	848
P-62	T.Nagar Sivagnanam Street	663
P-63	Rajaji Street	2584
P-64	K.K.Salai	1303
P-65	Nerkundram Pathai	296
P-66	Ponnammal Street	1644
P-67	Amma Koil Street	568
P-68	32nd Cross Street, Besant Nagar	1208
P-69	Thiruvanmiyur Market	353
P-70	Lake View Road	1966
P-71	SAS HotelL OSR Land (Adjacent to Symrise)	503
P-72	Kapaleeswarar Temple Greenways Station	992
P-73	Apollo Hospitals Taramani Velachery main road	99
P-74	RBI Subway	75
P-75	Kodambakkam Flyover	75
P-76	Vadapalani Temple Land	70
P-77	Burkit road	138
P-78	Burkit road	111
P-79	Thulukanatham an koil street (Opp to unit 43 office)	197
P-80	Duraisamy Subway	100

Note: Additional 62 off-street parking locations within GCC are identified and listed in Annexure J

Some of other Parking management strategies discussed include

- Parking pricing and time limits are important parking management mechanisms in order to enhance turnover of parking bays and ensure access to limited on-street parking in high parking demand areas

- Proof of Parking should be mandated, that residents should procure a No Objection Certificate from the Development Authority. They will be required to show that they have the required parking space within their premises to get the NOC, failing which they cannot register their vehicle with the RTO.
- Parking Enforcement
- Reduced parking standards near transit – in a buffer zone of 300 m around the transit line. All Metro corridors, the high mobility corridor and proposed metro corridors need not provide the same amount of parking that is required elsewhere
- Shared Parking - Optimize parking capacity by allowing complementary land uses to share spaces, rather than providing separate spaces. The areas where shared space arrangements can be implemented: Mylapore, Alwarpet, Porur, George Town, Luz Church, Triplicane
- Restricted parking zones can be created to help ease parking congestion in residential areas around major demand generators. Parking Permits are provided for residents, business and visitors with Resident Parking Zone (RPZ) where On-Street parking is controlled. This mitigated the un-intended effects of non-resident parking in the zone. Areas where RPZ can be created are:
    - Mylapore
    - George Town
    - Purasaiwalkam
    - Tripilicane
    - Royapettah
    - Egmore

Intermediate Public Transport parking around transit station, the pickup, drop-off points and freight parking regulation are recommended and a study for the same is proposed to be undertaken.

F.8.2. Technological Measures

Technological improvements are important for the city to be smart. Technological improvements can encompass changes in vehicle design, fuel use, energy use and reduction in CO_2 emissions related to the electrically driven vehicles. Various actions framed for the same are:

a) Smart signalling at intersections

b) Real time information systems for public transport

c) Introduce integrated ticketing system

d) Use of smart parking technologies

F.9. TRAFFIC MANAGEMENT CENTRE

A traffic management centre (TMC) is a hub of transportation administration, where data is collected and analysed and combined with other transport characteristics.

Traffic Management Centres should be provided at different locations within CMA for better control of movement of vehicles in the city. Introduction of ITS in the form of dynamic Variable Message Signs (VMS); Passenger Information Systems; development of ITS enabled Traffic Control Centre etc. are the components under Information Communication applications. On a priority basis, Traffic Control Centres should be developed in:

- North Chennai : Flower Bazaar, Washermanpet and Madhavaram
- West Chennai : Anna Nagar, Ambattur and Pulianthope
- South Chennai : T.Nagar, Adyar and Mount
- East Chennai : Vepery, Mylapore and Triplicane

F.9.1. Smart signalization

It is proposed to provide smart signalization at all major junctions in the city. All the existing signals should also be converted as smart signals. Total of 383 Junctions are identified to be smart signals in Chennai.

F.9.2. Vehicle Technology

As a green initiative to move towards Sustainable urban transport, technological transformations in terms of public transport vehicles are suggested. With efforts to reduce carbon emissions the LCMP suggests the used of CNG or electric vehicles.

F.10. ENVIRONMENTAL IMPACT

The impact of the proposed projects from the environmental effects is analysed at a broader perspective. Some of the broad indicators for environmental impact changes are quantified. The local emissions for the base year is 75.6 and for Business as usual –do nothing , Business as usual do minimum and sustainable Urban transport scenarios are 69.1,67.9 and 26.6 respectively . While the CO2 /GHG emissions for the base years is calculated to be 2589.6 and for Business as usual –Do nothing , Business as usual -Do minimum and Sustainable Urban Transport Scenarios are 3501.8 , 3740.1 and 1512.3 respectively . The CMP suggests that the Sustainable Urban Transport based approach is to be taken up in order to reduce emissions.

G. Implementation Plan

This section briefs on the costs associated with each of the proposed improvements, along with the phasing of the projects. The implementation plan also provides various financial options to be looked at towards implementing the proposed projects. A proper Institutional Frame Work is of utmost importance for the successful implementation and monitoring of all the schemes.

G.1. PRIORITIZATION OF PROJECTS

The proposals under consideration are broadly grouped under three categories:

- Short term proposals: These are short term proposals that need to be reviewed and revised within 5 years as per the requirement.

Table 21: Short Term Projects

Sl.No	Projects	Unit	Quantity	Rates (in Crores)	Total Cost (in Crores)	Phasing		
						2018-2028 PhaseI	2028-2038 PhaseII	2038-2048 PhaseIII
Short Term Projects								
1	Footpath	km	861	1.5	1291.5	1291.5	0	0
1a	Grade Separator -FOB/Box Culvert/Subway	Nos	26	2	52	26	26	
2	Cycle Tracks	km	461	1.5	691.5	691.5	0	0
3	Junction Improvements	Nos	167	0.6	100.2	28.2	36	36
4	Road Markings/Signages	km	1358	0.05	67.9	47.85	7.3	12.75
5	Bus Augmentation							
A	Bus	Nos	21186					
B	Electric Standard Buses (12mm)	Nos	10593	2	21186	6780	6144	8263
C	Standard Buses	Nos	10593	0.6	6355.8	2034	1843	2479
6	Bicycles	Nos	17000	0.0012	20.4	20.4	0	0
7	Pedestrian Malls	km	18	5	90	45	45	0
8	Area Traffic Control Center	Nos	12	30	360	360	0	0
9	Smart Signals	Nos	296	0.3	88.8	88.8	0	0
10	Grade Separator at Junctions	Nos	32	35	1120	1120	0	0
Total (Crores) (Rs.) - Short Term Projects					***31424.1***	***12533.3***	***8101.3***	***10790.8***

- Medium Term Improvements: the usefulness of these improvements will last for about 5-10 years.

Table 22: Medium Term Projects

Sl.No	Projects	Unit	Quantity	Rates (in Crores)	Total Cost (in Crores)	Phasing		
						2018-2028	2028-2038	2038-2048
						Phase I	Phase II	Phase III
11	ROBs	Nos	23	40	920	920	0	0
12	Multi modal Transit Hubs	Nos	24	10	240	100	70	70
13	Bus Terminal	Nos	29	20	580	200	200	180
14	Off street Parking	Nos	80					
A	Off street Parking Up to 100 ECS	Nos	4	10	40	40	0	0
B	Off street Parking 100-200 ECS	Nos	4	16	64	64	0	0
C	Off street Parking >200 ECS	Nos	72	146	10512	10512	0	0
Total (Crores) (Rs.) - Medium Term Projects					**12356**	**11836**	**270**	**250**

- Long Term Improvements: the usefulness of these improvements will last for more than 10-15 years

Table 23: Long term projects

Sl.No	Projects	Unit	Quantity	Rates (in Crores)	Total Cost (in Crores)	Phasing		
						2018-2028	2028-2038	2038-2048
						PhaseI	PhaseII	PhaseIII
Long term Projects								
15	Satellite Town Ring Road	Nos	190	15	2850			2850
16	Truck Terminal	Nos	7	20	140	40	40	60
17	Missing Links/New Links							
17a	New Link (6 Lane)	Km	44.5	7	312	0	155.75	155.75
17b	Road Widening	Km	25	5	125	87.5	12.5	25
17c	Bridge	Nos	4	10	40	40		
18	Rail Based Transit System		266.5					
18a	Rail Based -Elevated	Km	160	350	55962.9	23997	31966	
18b	Rail Based -Underground	Km	107	500	53298	22854	30444	
19	Bus Based Transit System	Km	131	35	4586	1559	0	3027
Total (Crores) (Rs.) - Long-term Projects					***117314***	***48578***	***62618***	***6118***
Total (Crores) (Rs.) - All Projects					***161094.1***	***72947.3***	***70989.3***	***17158.8***

The total project cost is computed as Rs. 1, 58,256.9 crores, where the projects are phased according to urgency and duration of implementation. Only block cost estimates have been done and the detailed cost estimates need to be worked out.

G.2. FINANCING OPTIONS

The key funding sources besides Gross Budgetary Support and fare box can be dedicated levies, land monetization, recovery from non-user beneficiaries, debt and private investments. Various financing options considered for Chennai are shown below:

- **Equity Sharing Model** - Under this model, a Special Purpose Vehicle (SPV) is set up as a joint venture between Central Government and State Government for the implementation of the project and for its subsequent Operation & Maintenance. Here, the Government of India and State Government make equal equity contribution and run SPV as a commercial enterprise. The remaining amount can be arranged as soft loan from funding agencies.

- **Public Private Partnership** - Public-Private Partnerships is cooperation between a public authority and private companies, created to carry out a specific project. In a PPP for a new transport infrastructure development project, the public authority creates a secure environment for the private sector to carry out the project, and the private partner offers its industry know-how, provides funding and shares in the project's risk. . The decision to undertake a public-private partnership and the kind of PPP to be developed depends on the following factors:

    - Cost of the project
    - A well-structured institutional framework and the local authority's experience in developing transport projects
    - The tasks entrusted to the private sector (design, construction, development, operation, maintenance)
    - If the project is not self-financing
    - How the sharing of responsibilities and risks are undertaken etc.

- **Government Sources of funding** - One of the particularities of the urban transport sector is that it depends on funding from several sources and involves various partners, public and private, individual and collective.

    - Amrut Funding
    - Viability Gap Funding
    - Dedicated Urban Transport Fund at city level etc.

H. Institutional Framework

In Chennai, the UMTA has notified on 2019 through G.O. (Ms.) No. 11, dated 16th January 2019. The roles and responsibilities of UMTA are already defined in this Act and the same have been recommended here as well. Chennai Unified Metropolitan Transport Authority (CUMTA) would be a single body to monitor the implementation of various traffic and transportation measures, including promoting the cause of public mass passenger transport systems and regulating their operations, besides implementation of traffic and transportation infrastructure in the Chennai Metropolitan Area. It is recommended that an UMTA formed for Chennai Urban Mobility Area should consist following authorities:

- Government of Tamil Nadu
- Chennai Metropolitan Development Authority
- District Collectors
- Greater Chennai Corporation
- Municipalities
- Panchayats
- State Urban Development Department
- Transport Department
- Finance Department
- Public Work Department
- Chennai Traffic Police
- Metropolitan Transport Corporation
- Chennai Metro Rail Limited
- Chennai Smart City Limited
- National Highway Authority of India
- Indian Railways
- Indian Waterways Authority
- Experts in finance, law, corporates
- Public Representatives

H.1. FUNCTIONS AND POWERS OF AUTHORITY

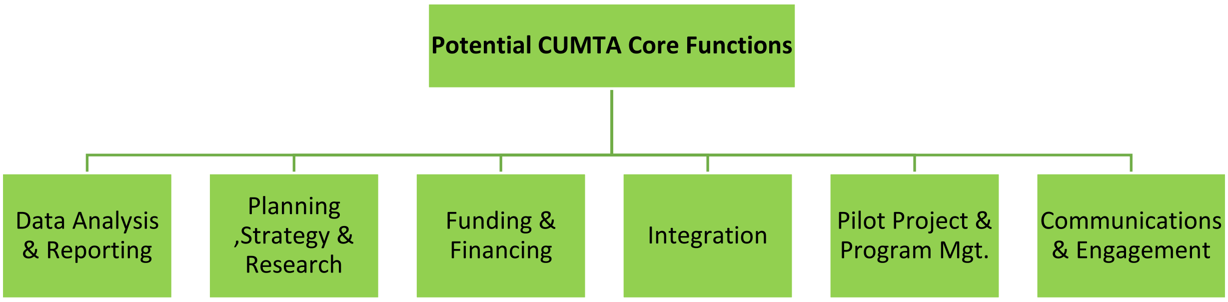


Figure 10: CUMTA Workshop Summary

The major functions and powers of authority include preparation of Comprehensive Mobility Plans and Transport Master Plans along with public transportation, and non-motorised transportation within the Urban Mobility Area. The other functions of the Authority include facilitate financing of all transport related investment seeking funds managed by the Authority, approve all major Transport Projects proposed for or in the Urban Mobility Area, monitor use of funding for urban transport activities etc.

H.2. IMPLEMENTING AGENCIES

Based on roles and responsibilities of various institutions, the agencies responsible for implementing the proposed projects are presented in Table 24.

Table 24: Details of Implementing Agencies

Proposals	Proposed Schemes	Probable Funding Sources
SPV – Metro Rail/ Indian Railways/ Transport Department		
Public Transport system	Rail based Transit System	Central/ State Govt. funds/ AMRUT/ Soft Loans through SPV
SPV –MTC, State Transport Department		
Public Transport system	High Capacity Improved Bus System with Priority Lanes	State Govt. funds/ AMRUT/ Soft Loans
	Articulated Bus/ CNG Bus / Hybrid Buses	State Govt. funds, AMRUT
Municipal Corporation, PWD, PWD-NH		
Pedestrian Facility	Footpath	Municipal funds, AMRUT, DUTF

Proposals	Proposed Schemes	Probable Funding Sources
Improvement	Pelican Signals	Municipal funds, AMRUT, DUTF
	FOB	Municipal funds, AMRUT, DUTF
	Skywalks	Municipal funds, AMRUT, DUTF
NMT Facility	Semi Segregated Cycle Track	Municipal funds, AMRUT, DUTF
Improvement	Segregated Cycle Track	Municipal funds, AMRUT, DUTF
	Cycle Parking Stands	Municipal funds, AMRUT, DUTF
Municipal Corporation, Traffic Police ,PPP		
Parking Management	On Street Parking	Municipal funds, PPP, AMRUT
Plan	Off Street Parking	Municipal funds, PPP, AMRUT
	MLCP	Municipal funds, PPP, AMRUT
Smart City, Transport Department, MTC, Traffic Police		
Intelligent Transport systems	Semi Actuated Signals	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Pelican Signals	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Automated Vehicle Location System	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Variable Message Signs	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	ITS Control Centre	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Public Information System	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Common Mobility Card	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Mobile Phone Application	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Surveillance Cameras	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	GPS	Municipal funds, DUTF, AMRUT, Smart City (SPV)

Proposals	Proposed Schemes	Probable Funding Sources
SPV – MTC, Transport Department		
Bus Transport	Inter-Modal facilities	PPP, Central/ State Govt. funds, AMRUT
	Bus Stops	PPP, Central/ State Govt. funds, AMRUT
Terminals	Proposed New Bus stand	PPP, Central/ State Govt. funds, AMRUT
NHAI, PWD-NH		
Road Network Improvement	Flyovers	Soft Loans, Central/State Govt. funds
	ROBs	Soft Loans, Central/State Govt. funds
PWD-NH		
Road Network Improvement	New Links	Soft Loans, Central/State Govt. funds
NHAI, PWD-NH		
Road Network Improvement	Road Widening	Soft Loans, Central/State Govt. funds
Transport Department, Traffic police, PWD/PWD-NH, LAD, Department of Health		
Road Safety policy and action plan	Accident recording, Black Spot identification	Road Safety Fund, Soft Loans
	Roads according to road safety standards and safety features on roads	Road Safety Fund, Soft Loans
	Upgradation of emergency care system	Road Safety Fund, Soft Loans
	Safer vehicles and strict enforcement of road safety rules	Road Safety Fund, Soft Loans
	Implementation of ITS and monitoring systems	Road Safety Fund, Soft Loans

I. Conclusion

To conclude, the CMP has drawn up the transport roadmap for Chennai for **2048** including transport investment program containing short, medium and long term projects. The plan has focused on the mobility of the people, and encouraging systems that maximize the throughput of people. The CMP for Chennai, a total transport investment of about **1,61,094 Crores** for a period of 30 years.

Table 25: Phasing of projects

Project Priority	Cost (Crores)(INR)	Phase I	Phase II	Phase III
Short Term Projects	31424.1	12533.25	8101.3	10790.75
Medium Term Projects	12356	11836	270	250
Long Term Projects	117314	48578	62618	6118
Total Cost	161094.1	72947.3	70989.3	17158.8

The mobility goals for Chennai need to be addressed through a multipronged approach. It is important to note that each of the above strategies is equally important and the order of listing does not imply priority. The strategies when implemented through specific projects shall fulfil the goals and objectives of the CMP. The impact of proposals as evaluated in the CMP shows an increase in Public transport mode share and reduction in pollutions when compared to BAU scenario in 2048.

Mobility being one of the pre-requisite for the economic development, it is necessary to create better mobility solutions to a city like Chennai which aspires to be global city. All the plans and the strategies reviewed in this study will have a significant impact in alleviating the traffic woes of the CMA in the future years.

FINAL REPORT
MAY 2019

COMPREHENSIVE MOBILITY PLAN FOR CHENNAI METROPOLITAN AREA

Chennai Metro Rail Limited

Urban Mass Transit Company Limited

DISCLAIMER:

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Revision	Revision 1
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Report Approved By	Mr.N.Seshadri Iyengar , Mr. S. Ramakrishna
Description	Final Report of Comprehensive Mobility Plan for Chennai Metropolitan Area

Contents

5-1

Development of Scenarios ,Vision and Goals

BASE YEAR TRAVEL DEMAND MODELLING
BUSINESS AS USUAL SCENARIO
VISION
GOALS
SUSTAINABLE URBAN TRANSPORT SCENARIO
COMPARISON OF SCENARIOS WITH TARGET

Urban Mobility Plan

6-1

ILANDUSE AND TRANSPORT PLAN
ROAD NETWORK PLAN
PUBLIC TRANSPORT PLAN
NON-MOTORISED TRANSPORT PLAN
FREIGHT MANAGEMENT PLAN
TRAFFIC ENGINEERING AND MANAGEMENT MEASURES
TRAVEL DEMAND MANAGEMENT MEASURES
TECHNOLOGICAL MEASURES
IMPACT OF THE PROPOSED PROJECT
IMPLEMENTATION PLAN
INSTITUTIONAL FRAMEWORK

7-1

Impact of the Proposed Projects

ANTICIPATED IMPACT OF PROPOSED PROJECTS
SOCIAL IMPACT
ENVIRONMENTAL IMPACT

Implementation Plan

8-1

PRIORITISATION OF PROJECTS
PROJECT COSTS ,PHASING AND PPP POTENTIAL
FINANCING OPTIONS

9-1

Institutional Framework

FUNCTIONS AND POWERS OF AUTHORITY
IMPLEMENTING AGENCIES

List of tables

List of figures

ABBREVIATIONS

ATCC	:	Area Traffic Control Centers
BAU	:	Business As Usual
BRT	:	Bus Rapid Transit Systems
CBD	:	Central Business District
CCTS	:	Chennai Comprehensive Transportation Study
CCTV	:	Closed Circuit Tele Vision
CDP	:	City Development Plan
CMA	:	Chennai Metropolitan Area
CMDA	:	Chennai Metropolitan Development Authority
CMRL	:	Chennai Metro Rail Limited
GCC	:	Greater Chennai Corporation
GoI	:	Government of India
GoTN	:	Government of Tamil Nadu
HHI	:	Household Interview
HO HO	:	Hop On, Hop Off
IPT	:	Intermediate Public Transport
IRC	:	Indian Road Congress
IRR	:	Inner Ring Road
ITES	:	Information Technology Enabled Services
LCV	:	Light Commercial Vehicle
LRT	:	Light Rail Transit
MRTS	:	Mass Rapid Transit System
MTC	:	Metropolitan Transport Corporation
NH	:	National Highways
NHAI	:	National Highway Authority of India
NMT	:	Non Motorized Transport
NUTP	:	National Urban Transport Policy
ORR	:	Outer Ring Road
PHPDT	:	Peak Hour Peak Direction Traffic
PPHPD	:	Passenger Per Hour Per direction
RoB	:	Rail road Over Bridge
SEZ	:	Special Economic Zone
SUT	:	Sustainable Urban Transport
GST	:	Grand Southern Trunk Road
GNT	:	Grand Northern Trunk Road
IRR	:	Inner Ring Road
ORR	:	Outer Ring Road
TAZ	:	Traffic Analysis Zone
TDM	:	Travel Demand Management
ULB	:	Urban Local Body
UMTA	:	Unified Metropolitan Transport Authority

Introduction

1. Introduction

Chennai, the capital city of Tamil Nadu is a rapidly developing Metropolitan region. As per the Second Master Plan, the Metropolitan area is expected to have a population of 126 lakhs by 2026. With increasing migration to urban areas, the rising population is witnessing rapid motorization, along with increased congestion and pollution. To alleviate all the existing transport problems and to facilitate safe and efficient movement of people in the future, it is essential to revise the Comprehensive Mobility Plan with a long-term vision and mobility solutions for the citizens of Chennai.

In this context, Chennai Metro Rail Corporation Limited has awarded the study of preparing the Comprehensive Mobility Plan (CMP) to Urban Mass Transit Company Limited (UMTC) to come out with a plan for the safe and sustainable mobility needs of the people of Chennai. The Study develops a perspective plan for sustainable urban transport over a 30-year horizon period.

1.1 SUSTAINABLE MOBILITY PRINCIPLES

Sustainable Mobility Principles provide a roadmap for comprehensive mobility development which helps in providing desired level of mobility and accessibility to all citizens, while focusing on minimising the impact on environment.

> ***Sustainable transport refers to any means of transport with low impact on the environment. It includes walking and cycling, using Public Transport, as well as technology to move people, goods, and information in ways that reduce its impact on the environment, the economy and the society.***

Sustainable mobility relies on “avoid, shift and improve” framework, i.e., minimise motorized trips where possible or give options for using shared/Public Transport, encourage shift to sustainable (low carbon) modes and improve the efficiency of motorized vehicles.

The Sustainable Mobility Principles thus, provide technological as well as planning strategies to meet the mobility and accessibility demands of all the people by focusing on moving people through the least carbon emitting modes of transport. These principles help us in identifying and adopting a long-term strategy, which ensures desirable mobility, safety and accessibility to people across genders and socio-economic profiles, while reducing carbon emissions.

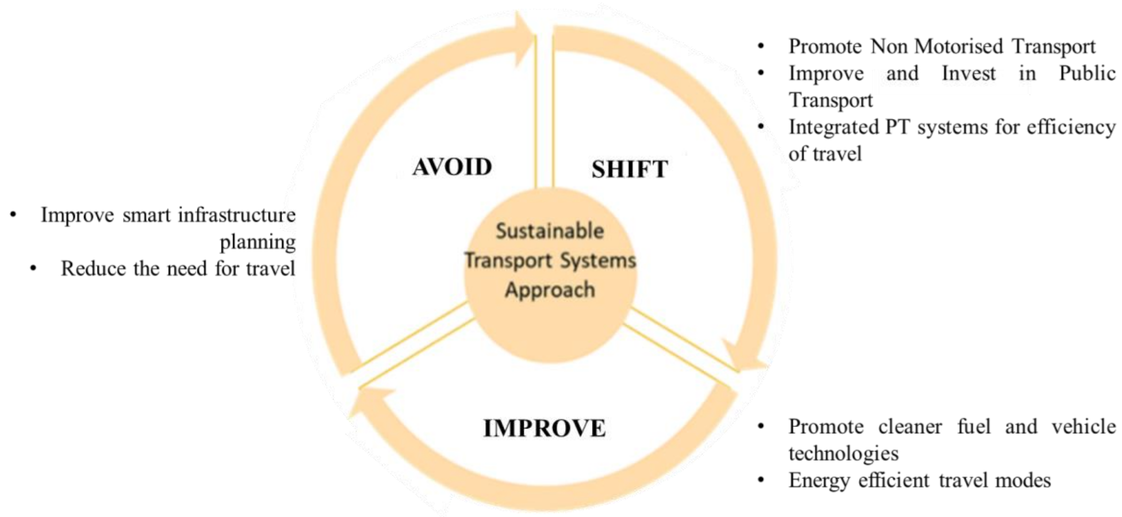


Figure 1-1: Sustainable Mobility Principle Approach

1.2 IMPACT OF REGIONAL/NATIONAL FRAMEWORK:

The Comprehensive Mobility Plans (CMP) need to be in cognizance with the national and regional frameworks and guidelines to enhance mobility, promote pedestrians and traffic safety. The existing national policy framework has been considered for framing the strategies for Chennai.

1.2.1. NATIONAL FRAMEWORK

Comprehensive Mobility Plan for Chennai Metropolitan Area has been carried out in accordance with the National Urban Transport Policy Guidelines suggested by the Ministry of Housing and Urban Affairs (MoHUA). Accordingly, the focus is on the following:

1. Focus on the mobility of people rather than that of vehicles

2. Focus on improvement and promotion of Public Transport, NMVs and pedestrians as important city transport modes

3. Focus on integrating Land use and Transport Planning

4. Recommend an urban transport strategy that is in line with the National Urban Transport Policy (NUTP)

Thus, considering the overall traffic and transportation related perspectives, both regional and national level guidelines and approaches have been gaining momentum for promotion of sustainable urban transport framework for 30-year horizon period.

1.2.2. REGIONAL FRAMEWORK

The following past studies and reports were reviewed and inferences were drawn to understand the growth envisaged for the city. The detailed analysis of the reviewed reports and studies have been attached in the Annexure A.

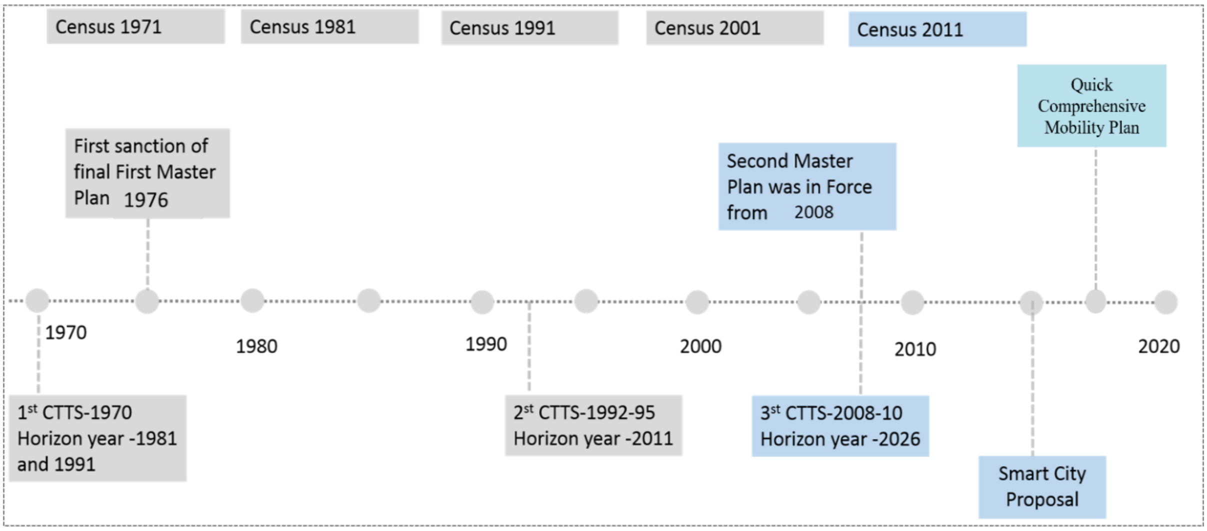


Figure 1-2: Studies Undertaken from 1970's to Present

1.2.2.1 First Master Plan for Chennai

The First Master Plan (FMP) was sanctioned in 1976 and had estimated that by 2001, the Chennai Metropolitan Area (CMA) will have a total population of 7.1 million with 4 million in Chennai city alone.

Various strategies have been proposed in the First Master Plan for dispersal of the projected population and overall development of CMA. Relieving congestion in the city through development of radial corridors linked to three satellite towns and six urban nodes and decentralizing the economic and industrial activities into urban nodes and satellite towns are some of the strategies aimed at development of CMA. Also, the FMP identified the following projects for immediate implementation:

Roads:

- Construction of the missing links of the Inner Ring Road (IRR) and construction of Intermediate ring road (except between NH-4 and NH-5) and Outer Ring Roads (ORR).
- Construction of three terminals for long distance buses and truck terminals on the radial corridors at their junction with the ORR.
- Construction of new Western Express way connecting Anna Nagar with Avadi.

Railways:

- Construction of the MRTS along the North-South Eastern corridor.
- Introduction of electrified sub-urban train system on Madras-Thiruvallur and Madras-Minjur lines.
- Construction of a combined railway terminal.
- Construction of a circular railway.

Review of Traffic and Transportation project of First Master Plan

As regards traffic and transportation projects, MRTS has been completed from Chennai beach up to Velachery. The MRTS ridership has increased over the years but the problem of congestion remains the same as the growth of vehicles has seen a tenfold increase from 5 lakh vehicle in 1992 57 lakhs in 2018. The per capita trip rate has increased to 1.62 in 2018 from 1.28 in 1992 which has further led to congestion on all major arterial roads. The Journey speeds on all major roads have decreased drastically. For example; the journey speeds in Anna Salai was 43 km/hr in 1992 while the speeds have decreased to less than 15 km/hr in 2018. Average journey distance in the CMA is currently about 9.9 km increasing from 7.8 km over the last 26 years indicating urban sprawl. However, the First Master Plan has envisioned, the Inner Ring Road, Outer Ring Road and MRTS projects and shifting of Truck terminals to Madhavaram, development of new bus terminus in Koyembedu has helped in easing congestion with the growing vehicle population. [1]

1.2.2.2 Second Master Plan for Chennai

The Second Master Plan of Chennai, prepared for horizon year 2026 for CMA aims at the creation of an inclusive, world-class city which will be economically vibrant, socially sound and ecologically sustainable with a projected population of 126 lakhs (2026). Strategies planned under the Second Master Plan included dispersal of the population over the metropolitan area, diversification to optimum level by allowing flatted development along wider roads and allowing multi-storeyed buildings in the rest of CMDA. It was also proposed to allow higher floor space index (FSI) of 2 along the MRTS-influence areas (Luz to Velachery) for residential developments with smaller dwelling sizes of 75 sq.m , to encourage social housing provisions by private developers of special building, group development, and multi-storeyed development over large lands through development regulations. The traffic and transportation proposals included 45 km long metro rail, elevated expressways along city water ways, network of freight corridors and bus priority corridors, flyovers and series of pedestrian facilities.[1]

1.2.2.3 Chennai Comprehensive Transportation Studies for CMA

The Chennai Comprehensive Transportation Studies prepared for CMA seeks to create an integrated land use and transport plan that aims to guide investments in transport in an efficient manner to achieve an overall mobility.

One of the goals identified as part of the vision is to increase the Public Transport trips to 70% from the existing 41% of the total motorized modal share. Three major strategies have been identified for Public Transport improvement:

- Bus Augmentation
- Higher Order Mass Transit System
- Intermodal integration facilities

A Non-Motorized Transport plan has been proposed focussing the footpaths, providing bike lanes and bicycle boulevards, using street furniture and pedestrian friendly design features, encourage bike sharing etc. Freight management strategies have also been adopted to increase the efficiency of freight and commercial transport. [2]

1.3 OBJECTIVES AND VISION OF MOBILITY PLAN

The ultimate goal of a CMP is to provide a long-term strategy for the desirable mobility pattern of a city's populace. To achieve this goal, the following are the main objectives:

- To provide a long-term vision for desirable urban development in Chennai Metropolitan Area (CMA)
- To illustrate a basic plan for urban development and include a list of proposed urban land use and transport measures to be implemented within a time span of 30 years.
- To ensure that the most appropriate, sustainable and cost-effective implementation program is undertaken in the urban transport sector.

[1] Second master Plan for CMA, Chapter 1, Review of First Master Plan
[2] Chennai Comprehensive Transportation Study, August 2010

- To identify feasible short term, medium term and long-term traffic management measures and transport infrastructure needs to facilitate safe and efficient movement of people for the present and future.

The CMP has to be in accordance with the Revised CMP Toolkit, published by the MoHUA, and should also focus on the following:

- A study of Service Level Benchmarks as per MoHUA's Handbook on Service Level Benchmarks for Urban Transport.
- Study on Sustainable Habitat Mission for the city to make habitat sustainable through modal shift to Public Transport, as per National Mission on Sustainable Habitat.
- The study should also look in to the possibility of enhancing the NMT programs to make the sustainable habitat an integral part of the planning process.

The broad scope of the Comprehensive Mobility Plan is listed below:

- To review the demographic profile of the city which includes location, land area etc.
- To delineate the traffic analysis zones and review the existing urban transport and environment.
- To describe the existing traffic and transportation system in the study area
- To identify in detail, the problematic situations related to the existing transportation infrastructure and traffic operation
- To present the various traffic analyses results based on the surveys conducted Comprehensive Mobility Plan for Chennai Metropolitan Area
- To review the existing travel behaviour of individuals and review the energy and environment of the study area
- To understand the Level of Service provided to the citizens with the help of service level benchmarking
- To develop a Business as Usual (BAU) scenario based on land use transitions and socio-economic projection and comparing the travel characteristics of BAU scenario with the base year as well as SLB
- To outline the short-term traffic improvements needed for study area

- To provide details on the development and validation of the travel demand model for the study area
- To present the projected travel demand in the study area for different horizon years.
- To develop and evaluate various transport strategies
- To recommend various medium-term and long-term traffic improvement measures based on the scenarios and to develop an Urban Mobility Plan
- To recommend Demand Management Measures
- To develop an Implementation Plan
- To suggest an Institutional Arrangement

1.4 STAKEHOLDER IDENTIFICATION

Identifying the stakeholders and understanding their role in the process is important to achieve the overall goals of Comprehensive Mobility Planning. The Stakeholders involvement helps in understanding other various activities or projects carried out in the city and also helps in improving the planning process in terms of geographical coverage, policy integration, resource availability and overall legitimacy.

The stakeholders include City authorities from Chennai Metropolitan Development Authority (CMDA), Greater Chennai Corporation (GCC), Traffic Police Department, Southern Railways, Metropolitan Transport Corporation (MTC), National Highways Authority of India (NHAI), State Highways Department of Tamil Nadu and also include academic experts from various eminent colleges involved in the study of mobility solutions for the city. The consultations are conducted to involve the stakeholders throughout the process and the recommendations /suggestions put forward are considered in CMP plan preparation. The Stakeholders are consulted at each stage of the project to make the outcome of the Study more beneficial to the citizens of Chennai.

1.5 APPROACH AND METHODOLOGY

This section defines the approach and methodology of the study, as per Ministry of Housing and Urban Affairs (MoHUA), Government of India (GoI) to achieve sustainability mobility principles. The proposed Mobility Plan aims at achieving a radical shift from personalised modes to Public Transport supply and Non-Motorized Transport modes.

The current study follows a holistic approach with an integrated planning mechanism involving all stakeholders so as to engage them in the planning process while understanding the city's needs from their perspective. The detailed methodology for the present study encompassing all the activities defined in the Scope of Work is presented in Figure 1-3.

Stage I: Defining the scope of the CMP

Task I: Define Objectives & Vision of the mobility plan

The objective would aim at addressing the following aspects:

- A long-term strategy for the desirable city mobility pattern.
- Improve and promote public transport, NMVs and facilities for pedestrians.
- Development of an Urban Transport strategy that is in line with National Urban Transport Policy (NUTP).
- Ensure that most appropriate sustainable and cost effective investments are made in the transport sector.

Task 1-1: Mobilization
Task 1-2: Reconnaissance of State
Task 1-3: Delineation of Planning Area
Task 1-4: Defining short, medium and long term planning horizons

Task III: Finalization of Work Plan

A detailed work plan chart to be prepared
- Identifying specific project tasks as they interrelate to one another.
- The work plan would serve as a valuable management tool in continually monitoring levels of completion.

Stage II: Data Collection and Analysis of the Existing Urban Transport

Task 2-1: Review of Regional Connectivity.
Task 2-2: Delineation of Traffic Analysis Zones and Review of land use pattern & population density.

Task 2-4: Study of Existing travel Behaviour
- Primary Surveys such as Screen Line classified volume count surveys, Household Interview Surveys , Road side Interview Survey and Public Transport Passenger Counts
- Analysis and Estimation of Travel Characteristics.

Task 2-5:Analysis and Indicators

Task 2-3: Review of the Existing Transport systems
- Review of the Road Infrastructure.
- Assessment of Transit Infrastructure.
- Review of IPT Infrastructure
- Primary surveys such as Road network inventory, classified turning volume count survey, Parking Survey Bus/ Ferry Boarding and Alighting Survey and Vehicle Operators Survey

Stage III: Development of Business as Usual (BAU)

Task 3-1: Framework for Scenarios
Task 3-2: Socio-Economic Projections
Task 3-3: Land Use Transitions
Task 3-4: Transport Demand Analysis
Task 3-5: Technology Transitions
Task 3-6: Model Framework
Task 3-7: Analysis and Indicators

Stage IV: Development of Sustainable Urban Transport Scenarios (SUTS)

Task 4-1: Framework for Scenarios
Task 4-2: Strategies for SUTS
Task 4-3: Transport Demand Analysis of Alternative Strategies for SUTS
Task 4-4: Technology Transitions under a Low Carbon Scenario
Task 4-5: CO2 Emissions and Air Quality
Task 4-6: Analysis and Indicators

Stage V: Development of Urban Mobility Plan

Task 5-1: Integrated Land Use= and Urban Mobility Plan
Task 5-2: Formulation of the Public Transport Improvement Plan
Task 5-3: Preparation of Road Network Development plan & NMT Facility Improvement Plan
•Road Network Development Plan
•NMT Facilities
•Task 5-4: Preparation of Mobility Management Measures

Task 5-6: Development of Fiscal Measures
• Fare policy for public transportation, and parking;
•Subsidy policy for public transport operations;
•Taxation on private vehicles and public transport vehicles; and
•Potential for road congestion charging.
Task 5-7: Mobility Improvement Measures and NUTP Objectives

Task 5-5: Preparation of Mobility Management Measures Regulatory measures in relation to:
•Bus service improvement (concession, privatization and lease contract)
•Traffic safety improvement (traffic regulation, mandatory road user education, enforcement systems);
•Introduction of Transport Demand Management (TDM) measures.
•Vehicle emissions (Focus on non-fuel based vehicles and compressed natural gas/ CNG vehicles)
•And Public-Private Partnership (PPPs)
Institutional measures in relation to:
•Coordination mechanism to integrate public transport operation and to integrate fares;
•Establishment of Unified Metropolitan Transport Authorities (UMTA)
•Establishment of SPVs for the implementation of proposed projects ; and other change necessary to promote PPPs;

Stage VI: Implementation Plan

Task 6-1: Preparation of Implementation Programs
•Short term (next 0-5 years)
•Medium term (5-10 years)
•Long term (more than 10 years)

Task 6-2: Identification and Prioritization of Projects
•Short-term measures
•Medium-term measures
•Long-term measures

Task 6-3: Funding of Projects

Task 6-4: Monitoring of CMP Implementation and Stakeholders Consultation

Figure 1-3: Study Methodology

The Scope of Work for preparation of Comprehensive Mobility Plans for this city is given below:

1.5.1. TASK 1: DEFINING SCOPE AND TIMEFRAME OF CMP

The study area includes the city and the Metropolitan Area of 1,189 sq.km and the planning horizon has been envisaged for 30 years. The short and medium-term target years have been defined as 5 and 10 years from the base year (2018) respectively. The task also considers identification of data requirements and finalization of traffic survey locations, and delineation of study area.

1.5.2. TASK 2: COLLECTING DATA AND ANALYSIS OF URBAN TRANSPORT ENVIRONMENT

This task primarily consists of secondary data collection and review pertaining to the city profile such as demographics, socio economic and travel characteristics. A detailed review of past studies have been carried out with consideration to the study area. Detailed primary surveys were also conducted and analysed. The outcomes included review of existing road network characteristics, assessment of PT, IPT & NMT facilities, existing road infrastructure, parking needs and assessing freight infrastructure within the study area in order to identify the gaps. The data collected has been compared with the Service Level Benchmarks to assess the level of services delivered to citizen.

1.5.3. TASK 3: PREPARE AND EVALUATE URBAN TRANSPORT DEVELOPMENT STRATEGY

Based on the existing transport situation, vision and goals for future, alternative scenarios were developed. Business As Usual and Sustainable Urban Transport scenarios were developed that included population and employment projections, preferred land use and transport improvements. These scenarios have been compared to identify the scenario that fits the best in cognizance with the goals identified under CMP.

1.5.4. TASK 4: DEVELOP URBAN MOBILITY PLANS

The transport development strategies considered under the preferred scenario have been detailed out for meeting the demand in the horizon years. The proposed strategies comprise of integrated land use transport strategies, road network strategies, Public Transport, Intermediate Public Transport and Non-Motorised Transport strategies and Freight Management Plan that have been segregated into short term, medium term and long-term urban mobility plans. Travel Demand Management measures and fiscal measures are also being addressed to in this task.

However, feasibility studies need to be conducted to understand the viability of the proposals identified in the mobility plans.

1.5.5. TASK 5: PREPARATION OF THE IMPLEMENTATION PROGRAM

The various mobility measures prepared are phased into the following categories: Short term (0-5 years), Medium term (5-10 years) and Long term (10-30 years) to ensure that the timing of the interventions for each of the strategies is set appropriately for the success of the transport network development. The block cost estimates have been prepared phase wise and a resource assessment of all recommended projects have be done and suggestions to be made to the city authority, city-specific and project specific indicative source of financing for the project.

1.5.6. TASK 6: STAKEHOLDER CONSULTATION

A consultation is necessary at this stage to inform all the main stakeholders about the main transport proposals to be made in these cities. The recommendations put forward in the stakeholder consultation will be considered before preparation of final CMP report

City Profile

2. City Profile

2.1 INTRODUCTION:

The City of Chennai, capital of Tamil Nadu, is one of the biggest cultural, economic and educational centers in South India. According to the 2011 Indian census, it is the sixth-largest city and fourth-most populous urban agglomeration in India.

The City has grown from trading port along Bay of bengal and currently has a good mix of manufacturing and service sector Industries. A major chunk of India's automobile manufacturing industry is based in and around the City. It is a major hub of IT and automobile industry in India. In recent years rapid growth in population and in-migration is being driven by IT/ITES services.

2.2 STUDY AREA DELINEATION

The study intends to meet the development of the City to meet the mobility needs of the citizens of Chennai. To achieve this aim, the Chennai Metropolitan Area (CMA) is delineated as the Study Area. The study area covers about 1189 sqkm which encompasses parts of Chennai district (176 Sq.km), (which grew to 426 sqkm after the expansion in 2011), Thiruvallur district (637 Sq.km) & Kancheepuram district (376 Sq.km). The CMA comprises of the city of Chennai (Chennai Municipal Corporation area),16 Municipalities, 20 Town Panchayats and 214 Village Panchayats in 10 Panchayat Unions. CMDA has notified to expand the area of CMA to 8,878 sq.km as per G.O.(Ms) No.13 ON 22.1.2018.However ,the area of expansion is still under discussed Hence ,the area for the current study is limited to 1189 sq.km .

Table 2-1: Number of Villages

Local Body	No. of Local Bodies
Municipality	16
Town Panchayats	20
Village Panchayat	214

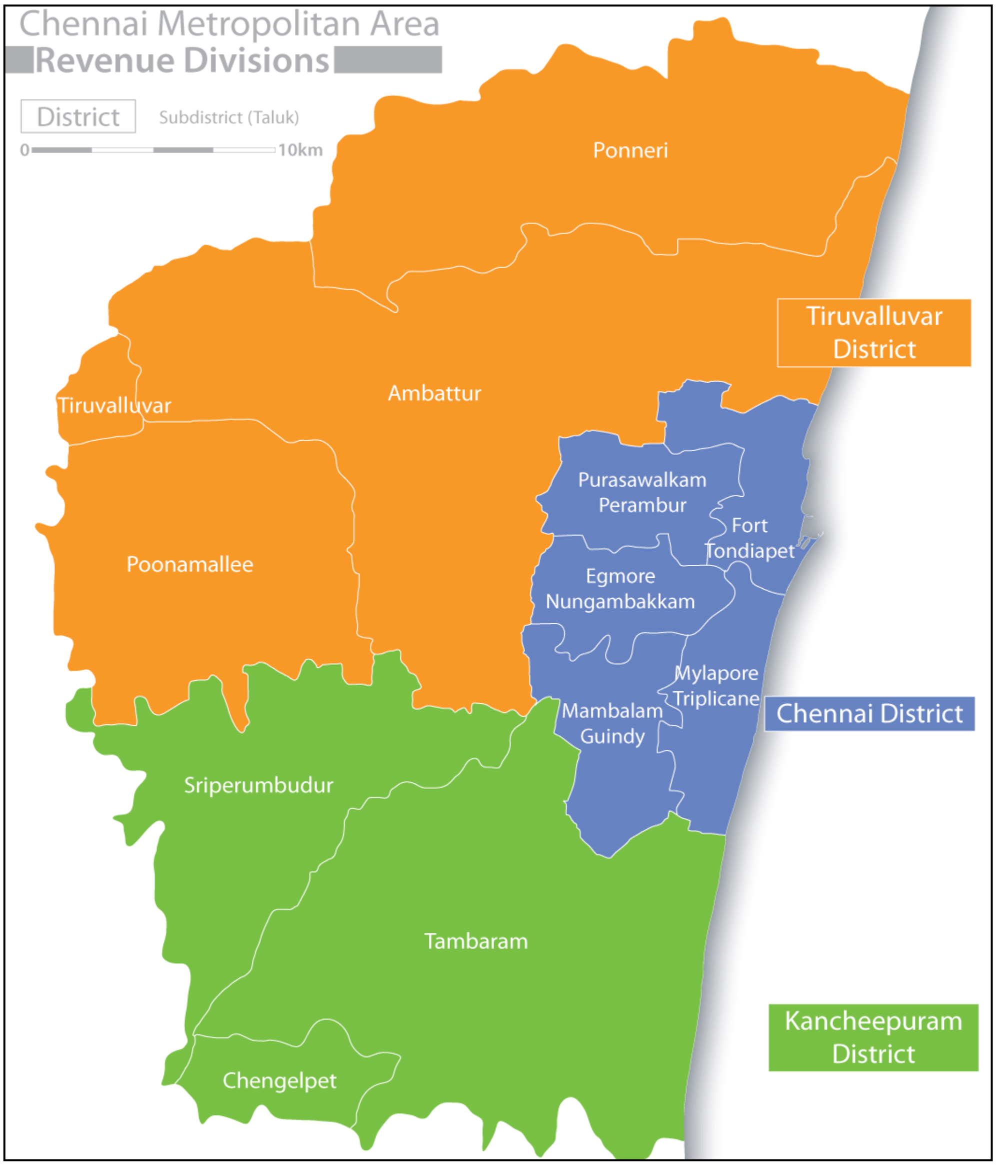


Figure 2-1 Revenue Divisions of Chennai Metropolitan Area

2.3 LOCATION AND REGIONAL LINKAGES

The city is located at 13.0827° N, 80.2707° E and is well connected to major cities through National Highway 16 to Kolkata, NH 48 to Bengaluru, NH 716 to Thiruvallur and NH 32 to Tiruchirappalli. Chennai is located 345km East of Bangalore and 627km South East of Hyderabad and is connected via NH4 and NH 16 respectively. Figure 2-2 shows the connectivity of Chennai with major cities.

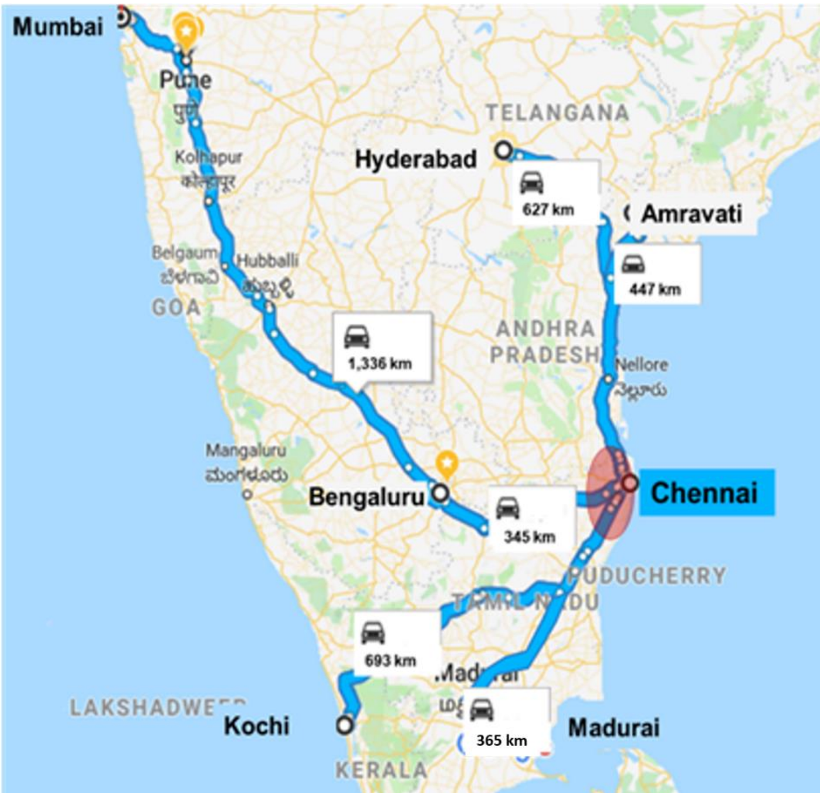


Figure 2-2 Location and regional connectivity of Chennai

2.4 SPATIAL SETTING AND GROWTH PATTERN

The settlement structure of Chennai is common to many large South-Asian conurbations, reflecting various economic and political decisions. The oldest areas are the closest to the port – Georgetown, the traditional commercial center, and the Fort area, once housing the British administrative and military headquarters.

The modern business and commercial developments are farther south-west, e.g., T.Nagar and Nungambakkam, along major roads such as Anna Salai, and in the south (Adyar, Velachery).

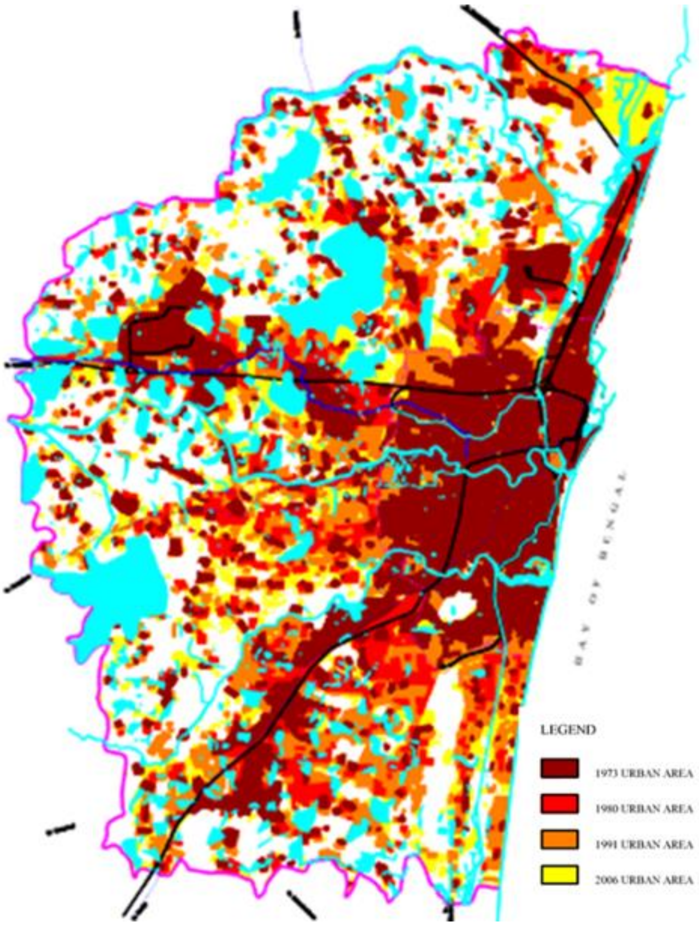


Figure 2-3 Growth pattern of Chennai Urban Area

The industrial activity in the city developed in the Northern and Western parts supported by the bustling Ennore port and the growth in these regions are mix with residential developments. The new growth regions are emerging in Northern and Eastern regions to support the manufacturing sector (in Northern Chennai) and Service sector (in Central city). The advent of the Software and Services industry resulted in growth along Southern and South western corridors. The residential growth was higher along with the major corridors connecting to the central city area driven by ease of access and economics of transportation. Figure 2-3 shows the development of urban area within Chennai over the years. The major development corridors developed include:

- North-West Corridor – Along GNT Road
- Western Corridor – Along Poonamallee Road
- South-West Corridor – Along GST Road and Railway line
- South IT Corridor – Along Old Mahabalipuram Road

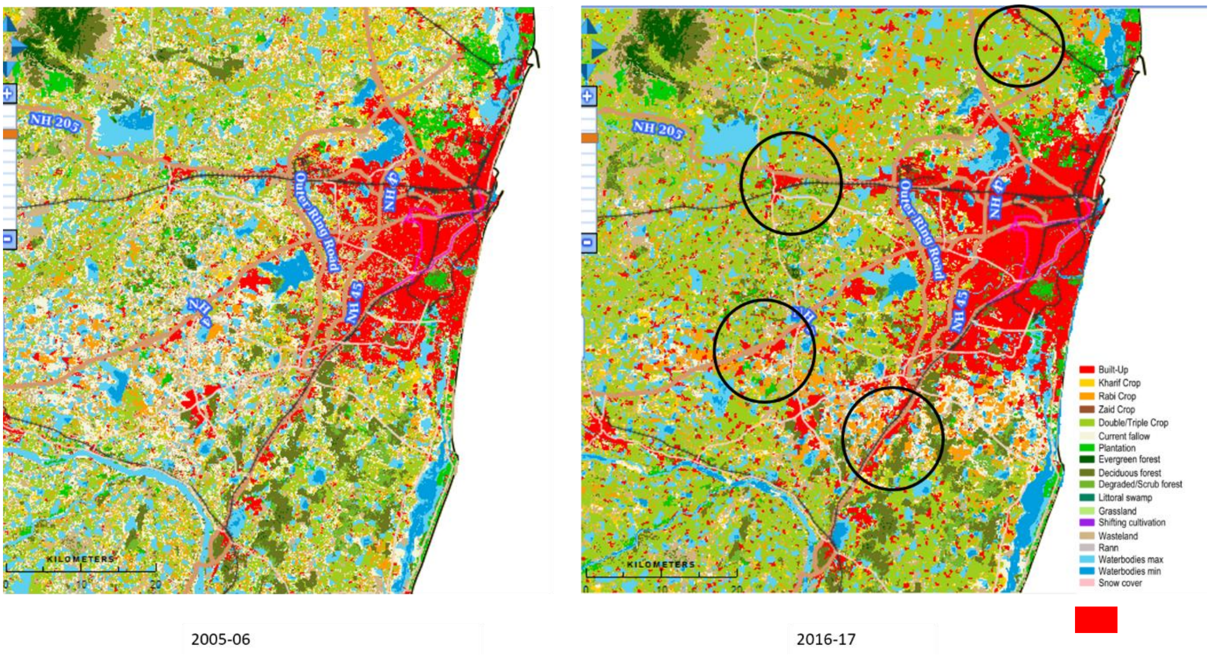


Figure 2-4 Growth trend within study area

Figure 2-4 shows the growth trend within the study area over last two decades (2001 -2011). From the graphs, it is evident that over the years, urban sprawl has increased owing to increased economic activities.

2.5 POPULATION

The population of Chennai Metropolitan Area and Chennai city were 86.54 lakh[3] and 71[4] lakh [4]respectively. The decadal population growth in CMA is 27%, while the city growth is 8%. Municipalities has grown at 41%, Town Panchayats at 67% and Village Panchayats at 91%. Some areas within the core city have also shown a negative growth rate in the last decade, while higher growth is observed in the peripheral areas of city. The decadal growth rate of CMA is 26.64% as per Census 2011.

The growth rate of CMA is attributed to the growth in suburban areas of Chennai because of the inflow of population in CMA for employment opportunities, institutional facilities, relatively less congested and more affordable housing opportunities within reasonable commuting distance of the City. Moreover, the industrial hub comprising of the automotive industries and the IT hub have contributed to the expansion of the city towards these agglomerations.

[3] As per Census 2011
[4] Source: Official website of GCC (Population mentioned for an area of 426 sq.km)

Table 2-2 Population and Decadal Growth Rate (Source: Census, 2011)

Area	Population in Lakhs					Decadal Growth Rate			
	1971	1981	1991	2001	2011	1971-1981	1981-1991	1991-2001	2001-2011*
Chennai City	26.42	32.85	38.43	43.43	46.46*	2.20%	1.58%	1.23%	0.68%
Rest of CMA (Municipalities, Town Panchayats, Village Panchayats)	8.62	13.16	19.75	26.98	40.08	4.32%	4.14%	3.17%	4.04%
CMA	35.04	46.01	58.18	70.41	86.54	2.76%	2.37%	1.93%	2.08%

**After the expansion process In October 2011 the City area has been revised to 426 Sq.km from 176 Sq.km with a population of approx. 66 Lakhs in 2011 and 71 Lakhs in 2019* (Source: GCC website)[5]

2.5.1. POPULATION DENSITY

Chennai is one of the major metropolitans which has high population density figures. The City has a gross density of 264 persons/ha, while CMA has 75 persons/ha.

Table 2-3 Gross Density in the Study Area

Description	Area (Sq. km)	Density (persons per hectare)					
		1971	1981	1991	2001	2011	2026 (Master Plan)
Chennai City	176	150	187	218	247	264	333
Municipalities	240	20	34	49	66	93	149
Town Panchayats	156	7	11	17	25	41	78
Village Panchayats	617	4	5	8	12	23	32
CMA	1189	29	39	49	59	75	105

The gross density in most of the municipal areas and Town Panchayats is low, indicating that these areas offer high potential for growth and would be receiving residential areas in future as proposed in Second Master Plan.

[5] http://www.chennaicorporation.gov.in/about-chennai-corporation/aboutCOC.htm

Figure 2-5 represents the spatial distribution of population and population density of CMA in 2018. The population density is observed to be relatively higher in places such as George Town, Nungambakkam, T. Nagar, Koyambedu and Anna Nagar.

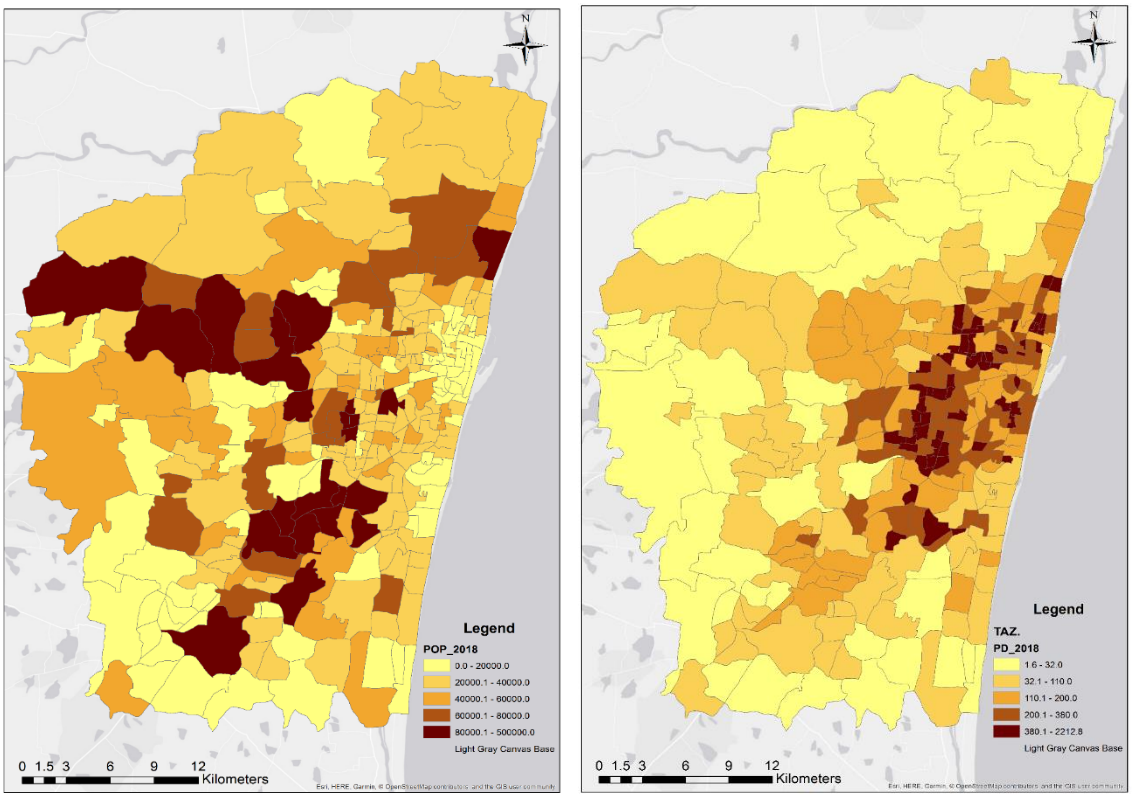


Figure 2-5: Spatial Representation of (Left) Population of CMA and (Right) Population Density of CMA in 2018

2.6 ECONOMIC PROFILE

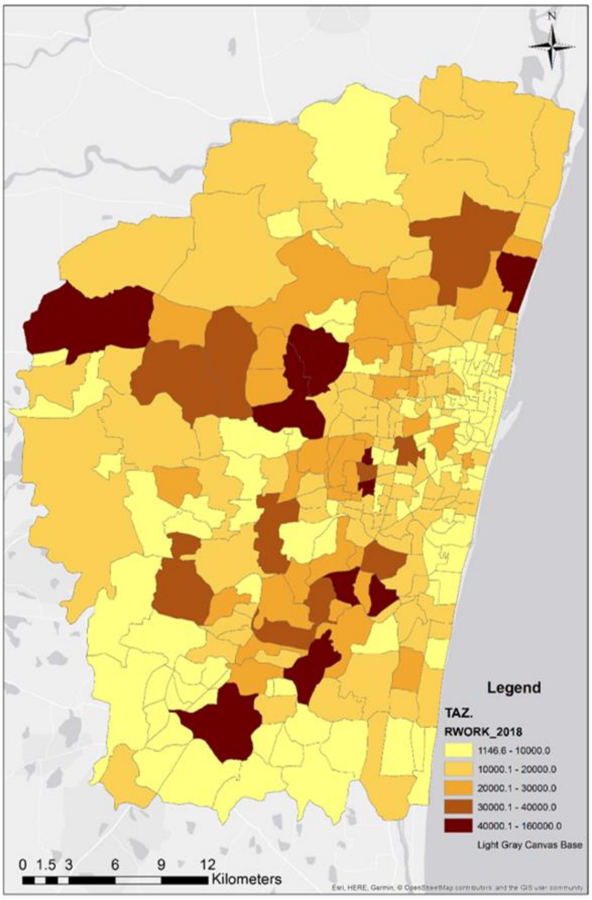
Chennai is one of the top cities in India as per Gross Domestic Product figures. The GDP of Chennai and adjoining two districts had increased 2.7 times during FY 05-11 with a CAGR of 18% with a GDP of about $80 billion. The economy of Chennai and its extended region continues to grow faster than rest of Tamil Nadu. Chennai has witnessed significant increase in per capita income levels over the years. With the economy and population on the rise, an efficient Public Transport system & network is required to address the needs of travelling faster and comfortable.

Work participation rate in Chennai was 34.26% which rose to 39.1% in 2011. The CMA workforce participation increased from 34.15% to 38.96% during the period 2001-11. The percentage of non- workers was 60.89 percent in City and 61% percent in CMA during 2011 which was 65.73% and 65.84% respectively in 2001.

Table 2-4: Workforce Participation for Chennai (Census, 2011)

Census	Population (Lakh)	Workforce (in lakhs)		
		Total	Male	Female
2001	43	15	12	3
2011	46	18	14	4
% Increase	1%	2%	2%	3%

89% of the total workers are Main workers and 11% are Marginal workers. 75% of the total workers are Male and 25% Female.



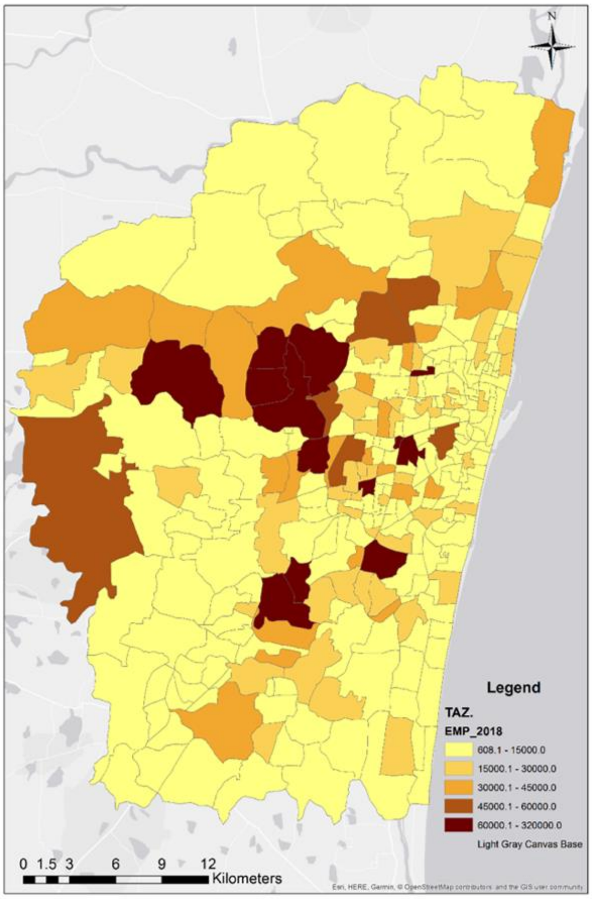


Figure 2-6: Spatial representation of (Left) Employment and Employment Density in CMA in 2018

2.7 LAND USE CHARACTERISTICS

The major land use category is residential use in Chennai city, accounting up to 54%, followed by Institutional land use, while in the rest of CMA, residential land use is 22% and Institutional land use is only 3%. In Chennai city and rest of CMA in 2006, about 12% land is lying vacant and undevelopable in the urban core, about 54% lie in similar conditions in the CMA.

Table 2-5 Existing Land use in CMA(As per Second Masterplan 2026)

Land-use	Chennai (in %)	Rest of CMA (in %)
Residential	54.25	21.87
Commercial	7.09	0.37
Industrial	5.17	6.28
Institutional	18.48	3.01
Open Space & Recreation	2.09	0.19
Agricultural	0.57	11.92
Non-Urban	0.47	2.33
Others	11.88	54.03
Total	100	100

The existing and proposed Master Plan landuse for CMA- 2006 and 2026 as per Second Master Plan is as shown in Figure 2-8.

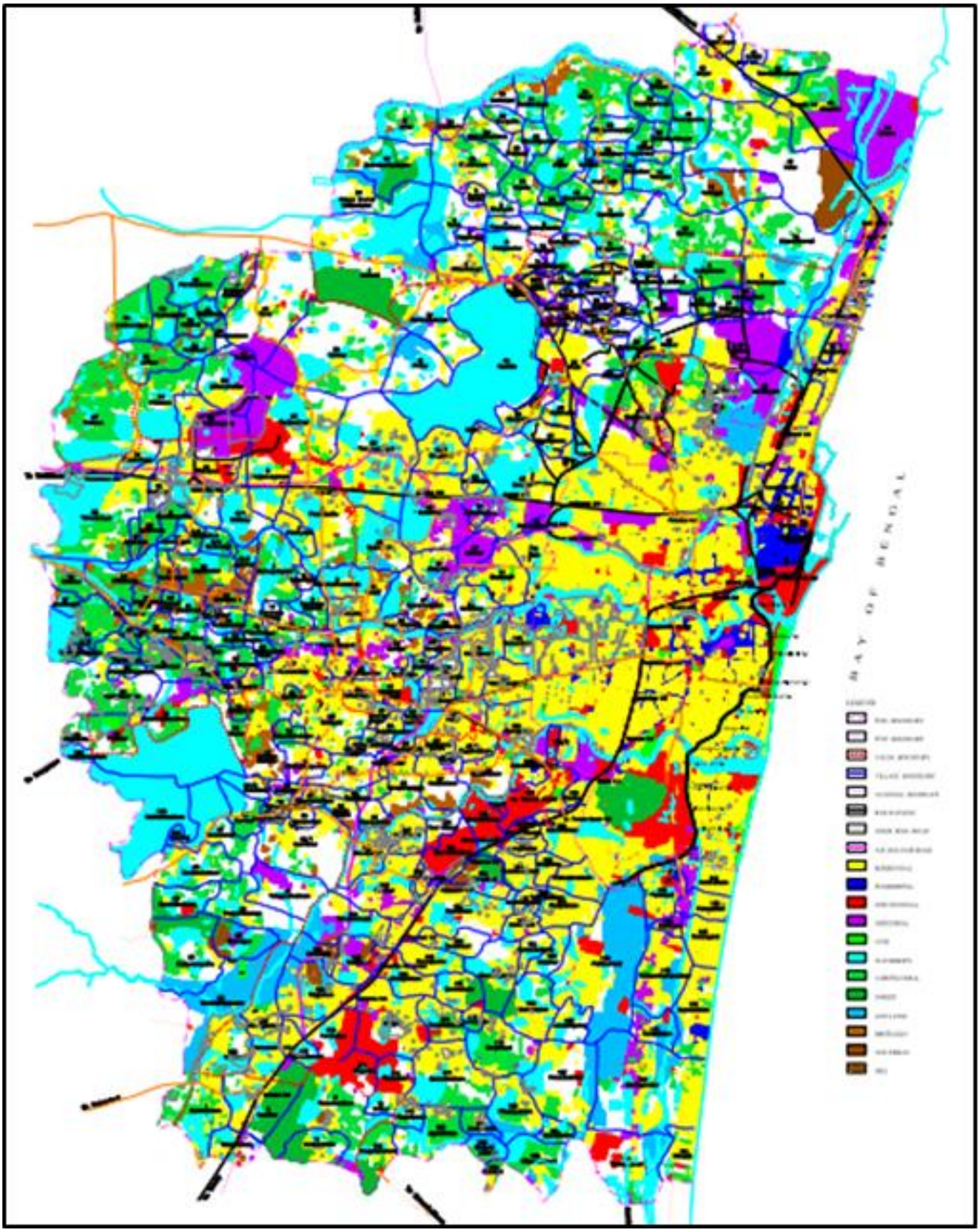


Figure 2-7 Existing Landuse Map -2006 *(Source:Second Master Plan for CMA -2026)*

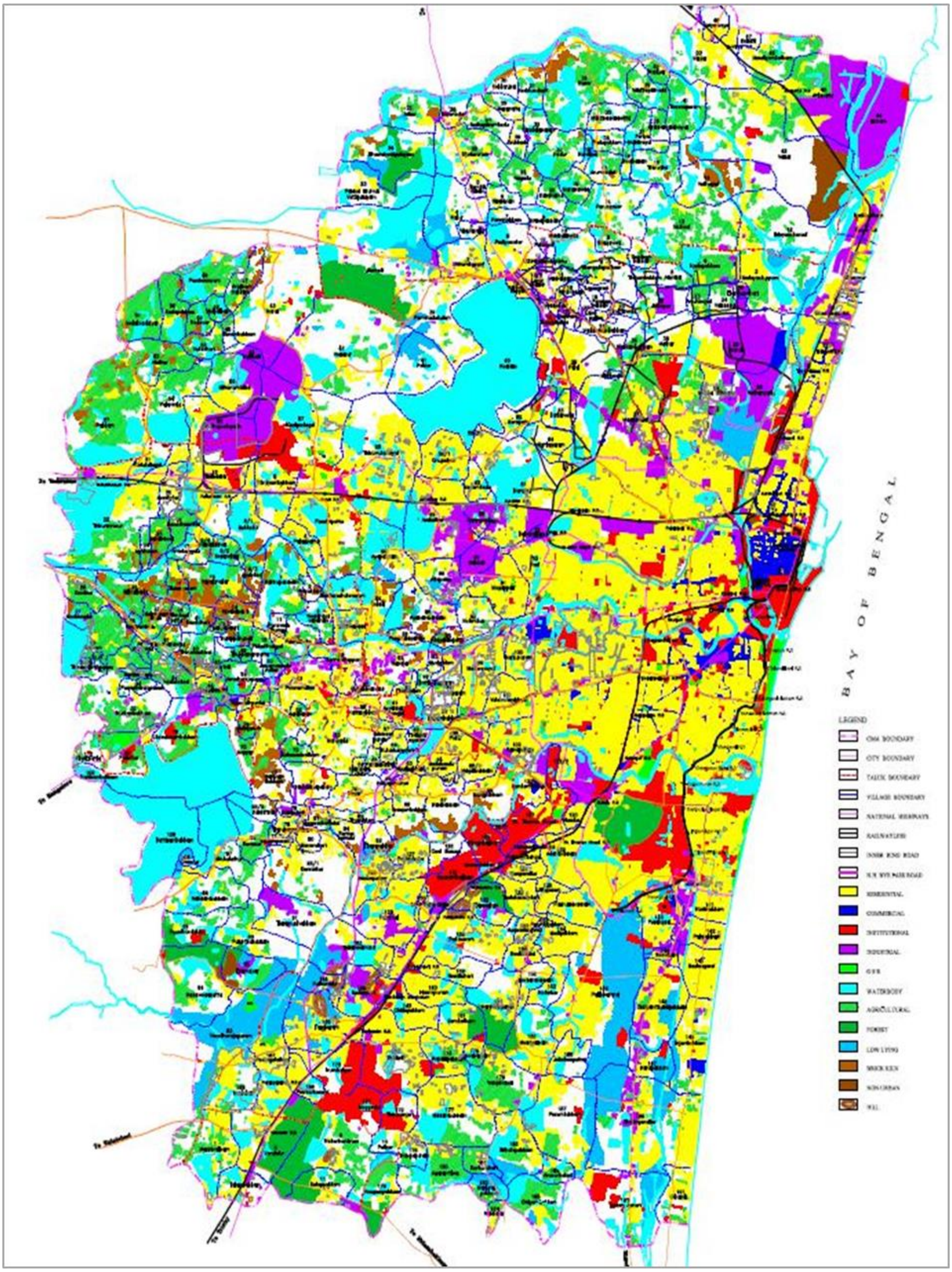


Figure 2-8: Proposed Land use Map for CMA

Source: (Second Master Plan-2026 for CMA)

2.7.1. COMPARISON OF PROPOSED LAND USE WITH URDPFI GUIDELINES

The land use of Chennai proposed in the Development Plan has been compared with Urban and Regional Development Plan Formulation and Implementation (URDPFI) guidelines to assess the adequacy of existing areas under various land uses. As indicated in the table below, the city lacks adequate land use share under industrial, public and semi-public and recreational categories. The commercial and industrial uses are not in proportion with the residential use.

Table 2-6 Comparison of Proposed Land use with URDPFI Guidelines

Category	URDPFI Guidelines	Proposed (2026)	
		City	CMA
Residential	35-40	51.41	45.88
Commercial	04-05		
Industrial	12-14	4.67	10.56
Institutional		3.93	7.18
Public & Semi Public	14-16	-	-
Recreational	20-25	5.68	0.38
Transportation	15-18	-	-
Others (Agriculture, Water Bodies, Redhill Catchment Area, Roads and forests etc.)	Balance	21.31	39.34
Total	100	100	100
***Others is not applicable for URDPFI Comparison as the field includes Roads (as per CMDA – Second Master Plan)**			

2.8 TRAVEL AND TRANSPORT CHARACTERISTICS

2.8.1. ROAD NETWORK CHARACTERISTICS

The corporation has approximately 6,010 km length of roads[6] spread over an area of 1,189 Sq.km. The road network of Chennai has a radial pattern radiating from George Town, which is the main CBD (Central Business District) of CMA (Chennai Metropolitan Authority). The prime road network consists of four National Highways connecting to other major cities. Other major arterial roads within the city include Arcot Road, Kamarajar Salai, Thiruvottiyur High Road, Old Mahabalipuram Road and East Coast Road. The Orbital road network implemented as per the First Master Plan comprises of Jawaharlal Nehru Road (IRR) and Chennai By-pass Road. The

[6] http://www.chennaicorporation.gov.in/departments/roads/index.htm

orbital road network has improved the accessibility and reduced the congestion on the radial network particularly in Anna Salai and Periyar EVR Salai.

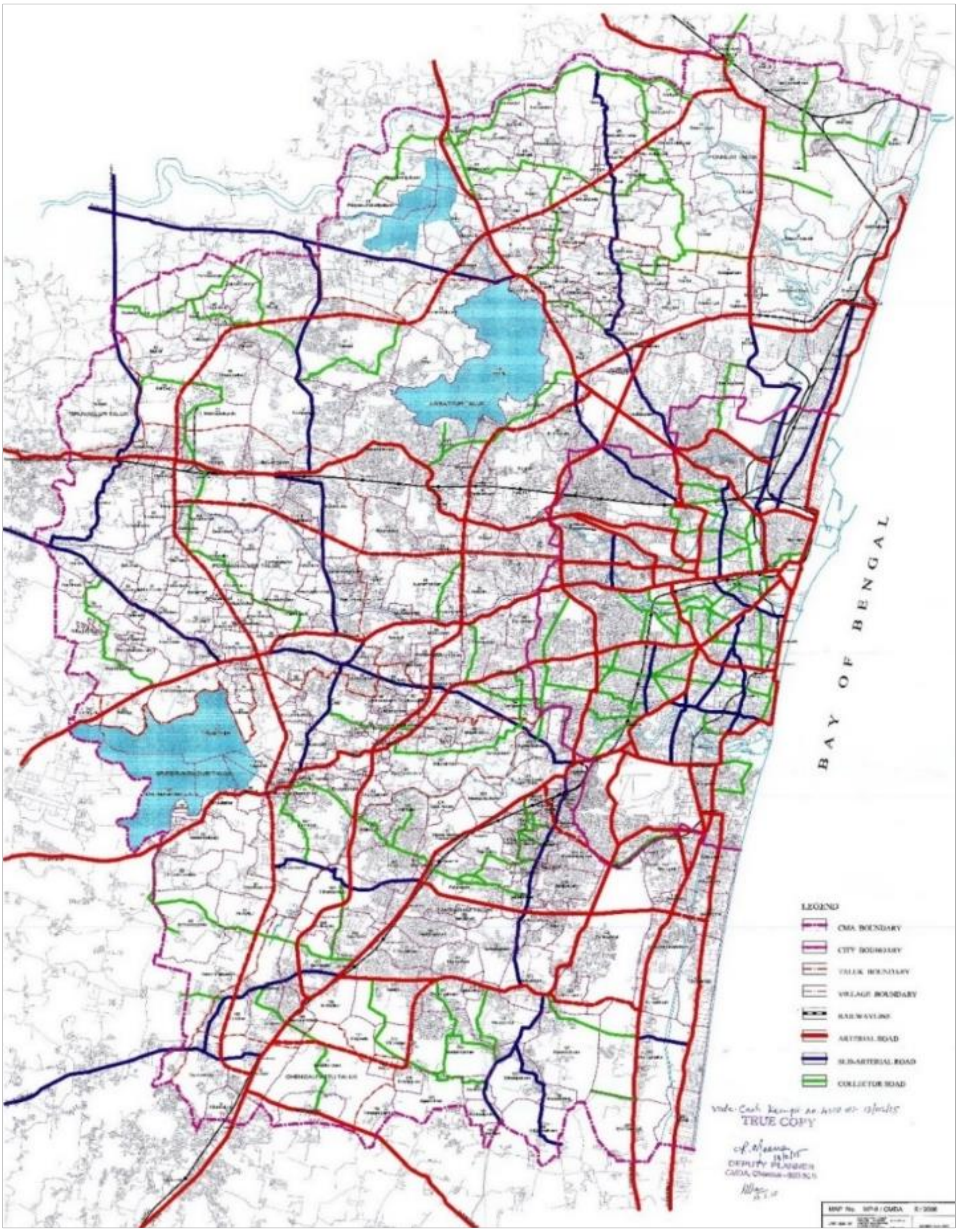
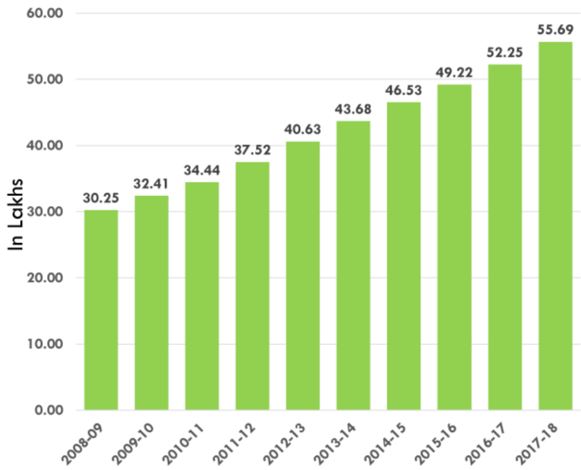


Figure 2-9 Proposed Road Network Hierarchy in CMA. Source: Second Master Plan

2.8.2. REGISTERED VEHICLES AND GROWTH IN VEHICLES

As per the State Transport Authority, Chennai district has reported 55.7 lakh (as on 2018) registered vehicles which accounts for over 22% of all vehicles registered in the State. As per records, the CAGR over the last 10 years is 6.3%. The Vehicles registered in Kanchipuram and Tiruvallur districts stand at 6.8 lakhs and 13.8 lakhs respectively.

Figure 2-10: Traffic congestion in Chennai



S.No	Area	Total Registered Vehicles
1	Chennai	5568911
2	Kanchipuram	681755
3	Tiruvallur	1387223

Figure 2-11: Growth of vehicles in Chennai District

Table 2-7 District Wise Vehicle Registered (as on 1.10.2018)

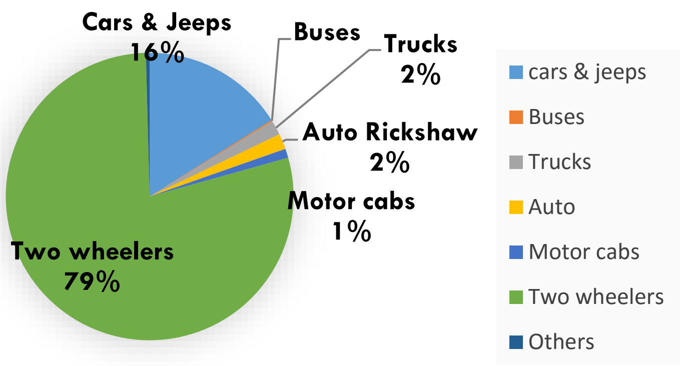


Figure 2-12: Registered vehicle Composition in Chennai

2.8.3. CITY BUS SYSTEM

The bus service in Chennai Metropolitan Area is operated by Metropolitan Transport Corporation (Chennai) with 27 bus terminals in Chennai was nationalized in 1947 by introducing 30 buses and again in 1972 with a total fleet of 1029.

At present MTC has a total fleet of 3740 buses which operate in 684 different routes (*MTC, Chennai*). There are 27 bus depots in the metropolitan area. MTC bus services carry around 48 lakhs passengers daily. The Metropolitan Transport Corporation has 32 depots, each with an average parking capacity of 100 buses. Tambaram and Anna Nagar depots, with 222 and 214 buses each respectively are the largest, and Basin Bridge depot, with only 45 buses, is the smallest. 387.35 km of roads within CMA are demarcated as bus route roads

Figure 2-13 City buses in Chennai

MTC buses follows distance-based stage fare system, where each stage is approximately 2km. The minimum fare is Rs.5/- for the first two kilometres while the maximum fare is Rs.46/- for the last two stages. The summary of MTC services is as shown in Table 2-8.

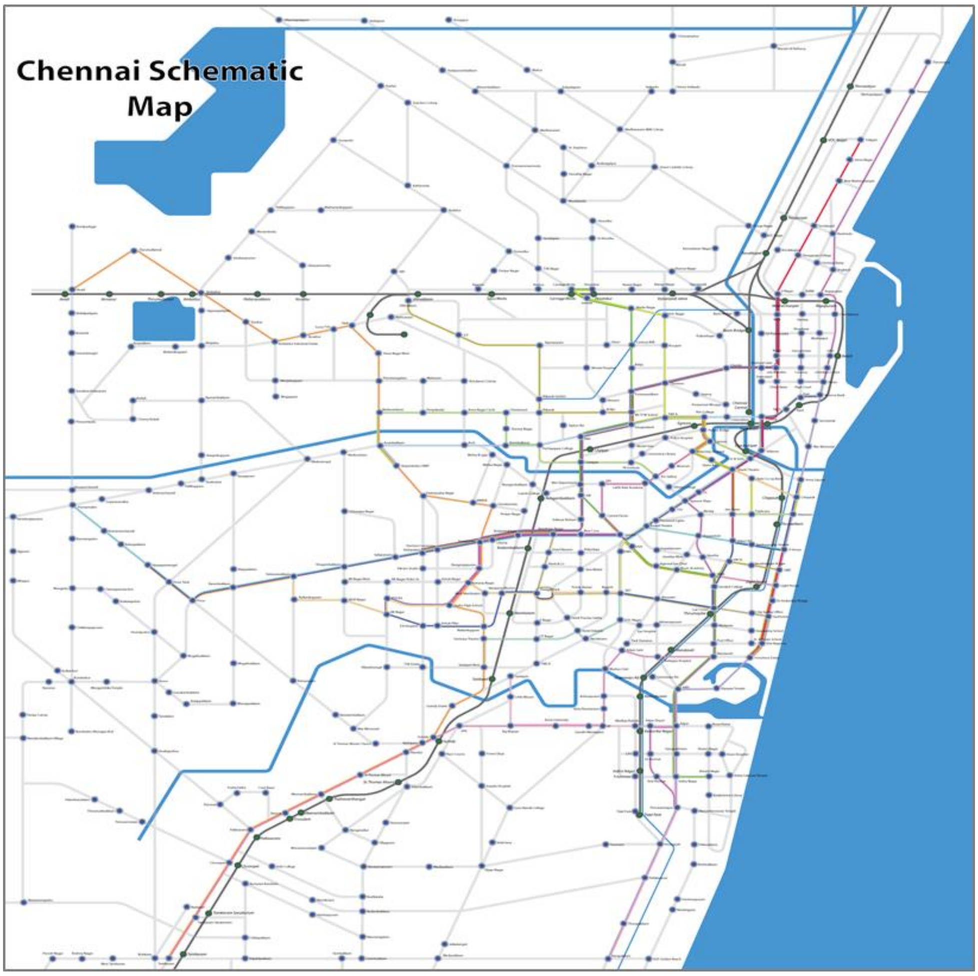


Figure 2-14: Schematic Bus Route Map of MTC

Table 2-8 MTC Summary Table

Year	Buses	Routes	Scheduled Services
Mar-14	3750	802	3531
Mar-15	3794	805	3531
Mar-16	3984	845	3685
Mar-17	3980	833	3688
Mar-18	3740	684	3439

It can be observed from the above table that MTC has considered reducing the routes of operation attributed to a decline in the fleet as well as scheduled services.

2.8.4. SUB-URBAN RAILWAY AND MRTS

Chennai Metropolitan Area has an extensive rail network traversing across the city. The city has three suburban railway lines, namely North line, West line, South line and the fourth being MRTS line.

Table 2-9: Areas covered within Sub urban MRTS Line

Line	Area covered	Distance (km)
Sub-Urban Railway	Chennai Beach – Vandalur	34.4
	Chennai Central – Thiruninravur	29.0
	Chennai Central – Minjur	26.0
MRTS	Chennai Beach – Velachery *	19.34
Total		108.74

** Velachery to St Thomas Mount MRTS line is under implementation stage*

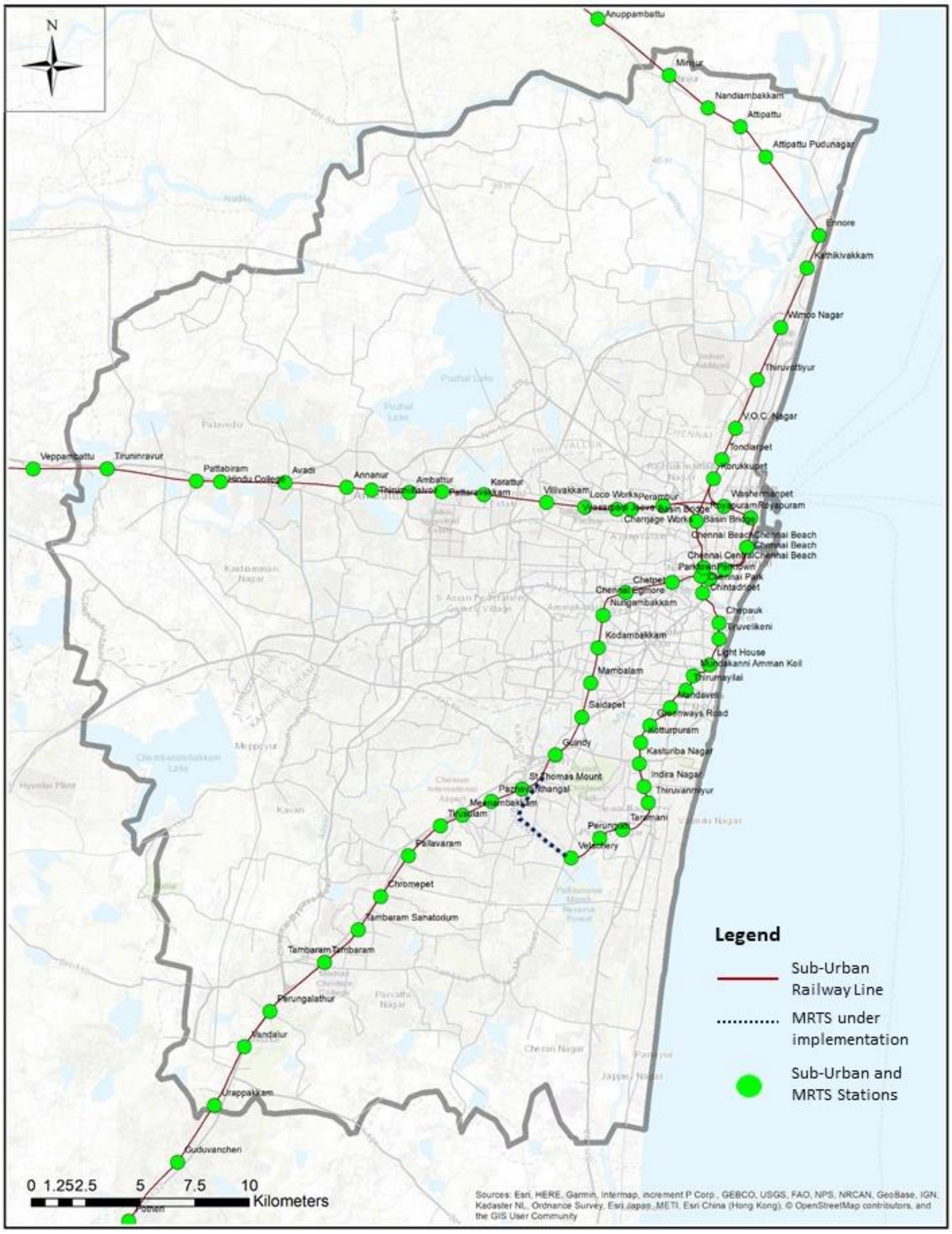


Figure 2-15: Sub-Urban Rail Network

As per studies, low fare in comparison to other modes of transport has been cited as one of the main reasons for relatively higher ridership in suburban trains. The same fare slab is also applicable on the exclusive MRTS line as well. The revised fare slab for Chennai suburban rail is presented below:

Table 2-10: Suburban Fare Chart

Distance Upto (km)	Fare (In Rs.)
<20	5
21 - 45	10
46 - 70	15
71 - 100	20

As per the secondary data obtained from Southern Railways, the suburban sector operates 700 services daily, that includes 244 in the Beach–Tambaram section, 230 services in the Chennai Central–Tiruvallur section, and 86 in the Chennai Central–Gummidipoondi section. The busiest suburban rail line is the Beach-Tambaram line, which runs 9-12 coach rakes at peak hour headways of 8-10 min. This line has a peak demand of around 24,000 passengers per hour per direction. The MRTS operated from Chennai Beach to Velachery with 140 services.

2.8.5. CHENNAI METRO RAIL

Recognizing the increasing travel demand in the city, the state government has constructed a metro rail system which has been operational in the city from 2015. Currently, the system has two lines in operation the details are shown in Table 2-11. The minimum fare is Rs.10/- for the first two kilometres while the maximum fare is Rs.60/- for the last two stages. The summary of Metro fare is as shown in Annexure F.

Line-1

Thiruvottiyur -Washermenpet–Broadway (Prakasam Road)–Chennai Central Station–Government Estate–Tarapore Towers–Spencers–Gemini–Anna Salai–Saidapet–Guindy–Chennai Airport

Line-2

Chennai Central–along EVR Periyar Salai–Vepery–Kilpauk Medical College–Aminjikarai–Shenoy Nagar–Annanagar East-Anna Nagar 2nd avenue–Tirumangalam–Koyambedu-CMBT–along Inner Ring Road–Vadapalani–Ashok Nagar–SIDCO–Alandur–St. Thomas Mt.

The portions of Corridor-1 with from Washermanpet to Saidapet, and Corridor-2 from Chennai Central to Anna Nagar 2nd Avenue will be underground and the remaining elevated.

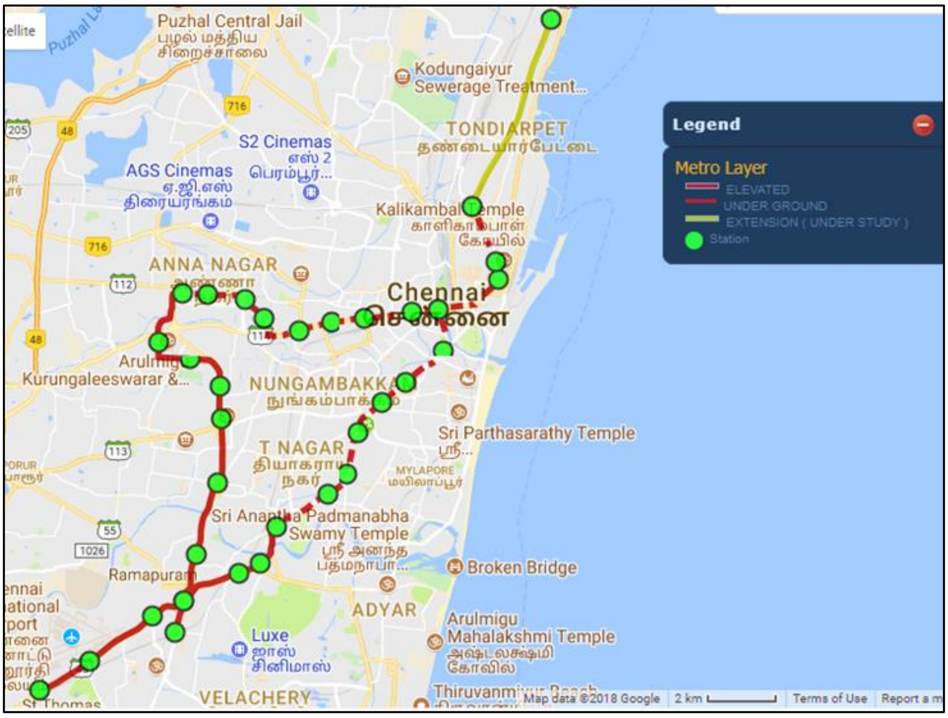


Figure 2-16: Chennai Metro -Phase 1 Alignment

Table 2-11: Chennai Metro Phase I - Key Figures

Phase 1	Total Network Distance	Currently Operational
Corridor 1 + Extn.	32.10 km (23+9)	23.10 km
Corridor 2	22 km	22 km

2.8.6. INTERMEDIATE PUBLIC TRANSPORT

Auto Rickshaw

Auto rickshaws are one of the most popular modes of para-transit in Chennai city. They provide first and last mile connectivity to a major share of city population. In spite of the existence of buses and trains, last mile connectivity remains an unresolved issue in Chennai, due to the underdeveloped feeder system. The IPTs cater to about 1.5 million commuters in Chennai on a daily basis. Currently, there are 74,026[7] auto rickshaws plying in Chennai city, of which about 33% run on LPG and the remaining on petrol. The current fare stands at a minimum of Rs. 25 for an initial distance of 1.8 km and Rs. 12/- for every subsequent kilometre as per government

[7] http://www.tn.gov.in/sta/g4.pdf

fixed rates. The registered auto Rickshaws for Chennai, Kanchipuram and Thiruvallur district are 88,994, 7100 and 8415 respectively.

Figure 2-17 Auto Rickshaws in Chennai

Shared Auto Rickshaw

Share Autos are a preferred mode of transportation for short distances in Chennai. People dependent on the informal sector find this para transit system highly convenient, as they can get board or get off wherever they seek to. Moreover, this system is well connected and passengers are not forced to wait long times as this mode has much higher frequency of operation compared to MTC buses. The autos charge Rs. 10/- to Rs. 50/, a fare though higher than buses, but much lower than the auto rickshaws.

As per the study conducted by City Connect on the Para-transit Sector in Chennai, each Share Auto caters to around 154 passengers per day, and are estimated to cater to approximately 18,48,000 passenger-trips per day. In additional to private and shared auto rickshaws, demand responsive system in the form of Motor cab and Maxi cabs stand at a combined figure of 57,000 vehicles as of year 2018.

2.8.7. GOODS TRANSPORT

The movement of the goods vehicles particularly the heavy vehicles and trucks are restricted on the city roads. As part of the Second Master Plan, several market activity centres have been relocated and truck terminals are proposed on the outer limits of Chennai.

Some important places of arrival and dispatch of goods are observed to be at George Town, Salt Cotaurs, Chennai Harbour, Industrial Estates at Guindy and Ambattur and the timber yards near Chrompet and Tambaram on NH-45 and the petroleum installations at Korukkupet and Manali.

At present, the movement of goods vehicles is considered as haphazard to other users and several restrictions are placed on their movements. The CMDA has taken steps to shift some of the wholesale markets and create truck terminals on the periphery of the City. Of these, Sathangadu steel market, Koyembedu perishables market and Madhavaram truck terminal have been made operational.

Figure 2-18 Vehicles catering to goods transport

2.9 ACCIDENT DATA

Based on the Accident statistics as received from Chennai City Traffic Police for 2013-2017, it is observed that there has been a slight reduction in the overall non-fatal and fatal accidents over the years while a marginal increase has been observed for fatal accidents over 2016-17.

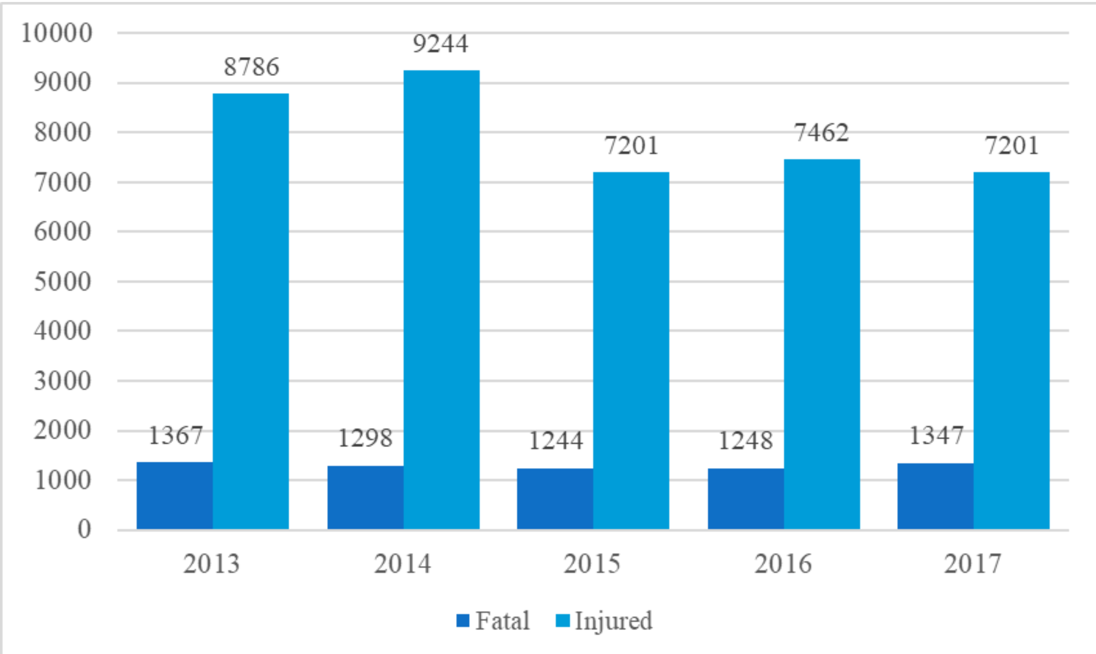


Figure 2-19 Accident Data 2013-17

Road Safety is increasingly becoming an important aspect in transportation sector as the Nation has been losing valuable lives every year. As per Ministry of Road Transport & Highways Statistics, over a lakh people die from road accidents every year and alarmingly the fatalities forming a chunk in the age group 18-35 with reasons attributed to over speeding and non-adherence of road traffic rules.

For instance, in the year 2017, Chennai tops the chart with maximum number of accidents over 7000. Chennai stands second with regard to fatal accidents only behind the national capital Delhi. Due cognizance have to be taken and capacity building for road safety related aspects have to be initiated by state government for reduction in accidents.

2.10 ENVIRONMENTAL QUALITY

With increasing population and improving economy the population levels in urban areas has increased drastically. The purchasing power of individuals have also paved way for increased vehicle ownership. The average households with at least one vehicles stand at 54 %. This affluence in the population has resulted in increasing pollution load in the big cities. The pollution levels as monitored by the macroscopic parameters PM10 and NOx emissions (as on Dec. 2018) are as following.

Annual Mean Concentration of SO2 – 9.0

Annual Mean Concentration Range of Oxides of Nitrogen (NOX)- 17.0

Annual Mean Concentration of SPM – 62.0

Annual Mean Concentration of RSPM - 32.0

2.11 KEY OBSERVATIONS

From the review of Chennai city profile, certain key observations have been made pertaining to the study context, as listed below:

- The city has well established road network connecting various other important cities in India.
- The road network has a radial pattern, with five major roads depicting a five-finger plan
- Ribbon development of urban areas along major radial roads over the years has been observed

- The Municipalities and Town Panchayats have experienced higher growth rate than that of the City.
- The CMA has high decadal growth rate owing to the growth of population along the outer regions.
- Total vehicle population has increased by an average of 6.61% per annum with a major share of increase in personalised modes.
- Two wheelers and pedestrians account to 85% of the accident victims calling for the need for improvement in road conditions and raising safety concerns.

In order to further quantify the above observations and analyse the transportation system in the city several primary surveys have been undertaken. The details of the surveys and survey results are discussed in the following Chapter 3, Volume II and Annexure B.

Existing Travel and Transport Characteristics

3. Existing Travel and Transport Characteristics

The existing travel and transport characteristics of the study area were assessed through primary surveys to understand the trip patterns, travel demand, transport infrastructure needs, mobility issues and to develop Travel Demand Model.

3.1 PRIMARY TRAFFIC AND TRAVEL SURVEYS

The salient features of the traffic and travel characteristics in the city based on the primary surveys executed in 2018 are explained are shown in the following sub sections. Detailed analysis of the surveys conducted is presented in Annexure B.

Table 3-1: List of Primary Surveys

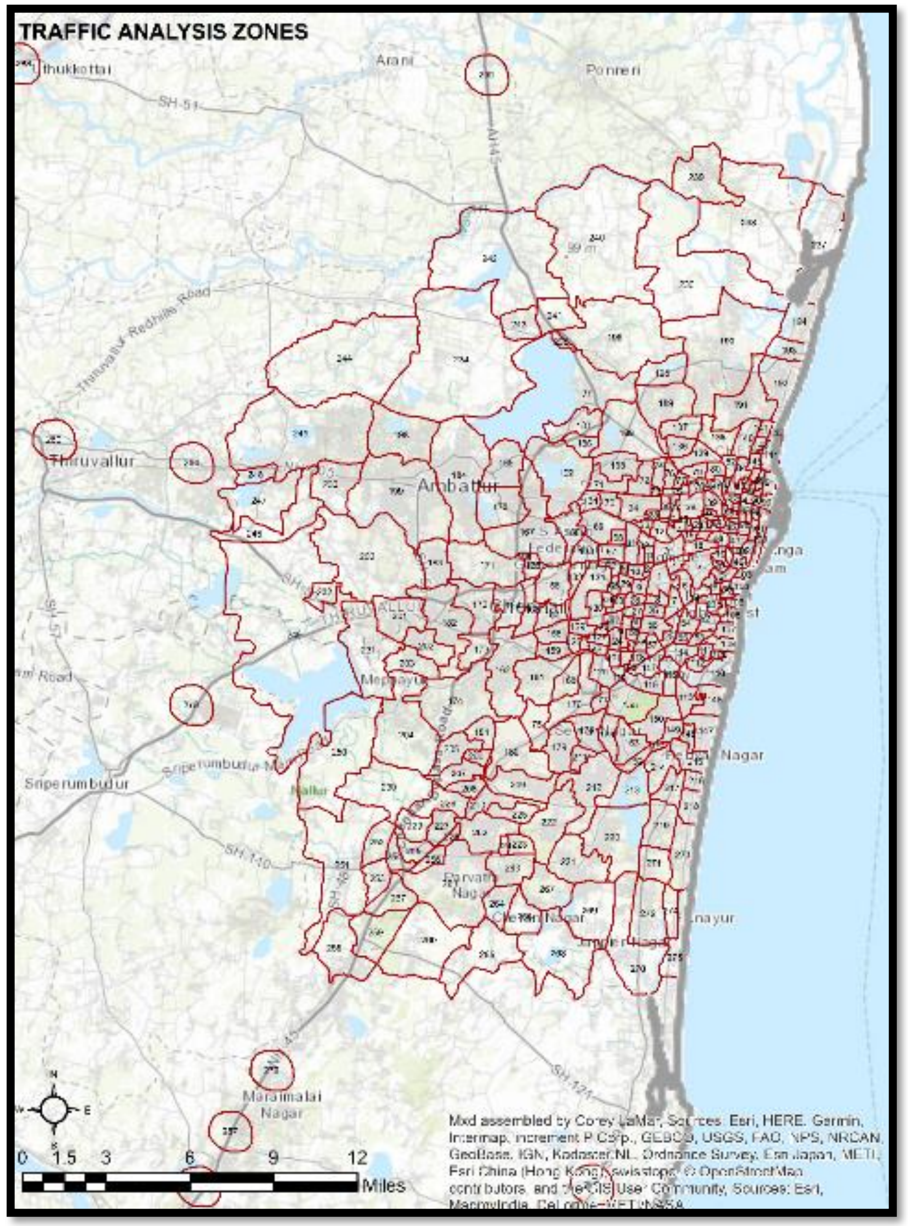
Sl. No	Type of Survey	Location/Sample Size	Duration	Day of the Week
1	**Classified Traffic Volume Count at Outer Cordon Locations**	15 Outer Cordon Locations	Classified, Mode wise, Direction wise Counts 16 Hours Counts for every 15 mins interval	Weekday One non incident, non-event working day
2	**Classified Traffic Volume Count at Inner Cordon Locations**	26 Inner Cordon Locations	Classified, Mode wise, Direction wise Counts 16 Hours Counts for every 15 mins interval	Weekday One non incident, non-event working day
3	**Classified Traffic Volume Count at Screen Line Locations**	49 Screen Line Locations	Classified, Mode wise, Direction Wise Counts, 16 hours Counts (06:00 am to 10:00 pm) for every 15 mins interval	Weekday One non incident, non-event working day

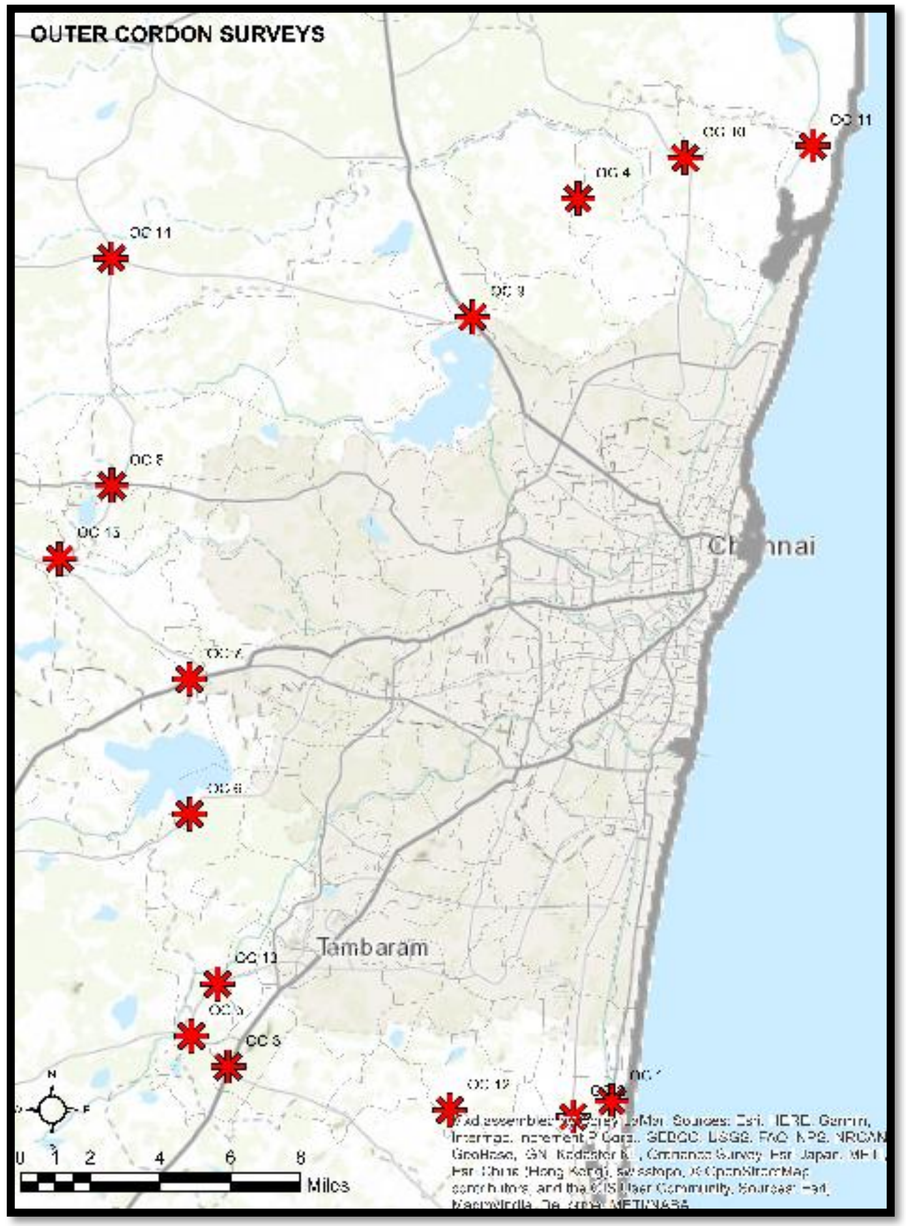
Sl. No	Type of Survey	Location/Sample Size	Duration	Day of the Week
4	**Classified Traffic Volume Count at Intersections**	36 Locations	Classified, Mode wise, Direction Wise Counts, 16 hours Counts (06:00 am to 10:00 pm) for every 15 mins interval	Weekday One non incident, non-event working day
5	**Classified Traffic Volume Count at Mid-Block Locations**	26 Mid-block Locations	Classified, Mode wise, Direction Wise Counts, 16 hours Counts (06:00 am to 10:00 pm) for every 15 mins interval	Weekday One non incident, non-event working day
6	**Classified Turning Movement Counts**	58 Locations	Classified, Mode wise, Direction Wise Counts 16 hours Counts (06:00 am to 10:00 pm) for every 15 mins interval	Weekday One non incident, non-event working day
7	**Road Side Origin – Destination Surveys at the Outer Cordon Locations**	15 Outer Cordon Locations	Mode-wise, Direction Wise Counts at the Outer Cordon Locations - 16 hrs (06:00 to 22:00)	Weekday One non incident, non-event working day To be conducted on the same day as that of the Classified Traffic Volume Counts at the Outer Cordon Locations
8	**Pedestrian Count**	58 Locations	Direction Wise,	Weekday

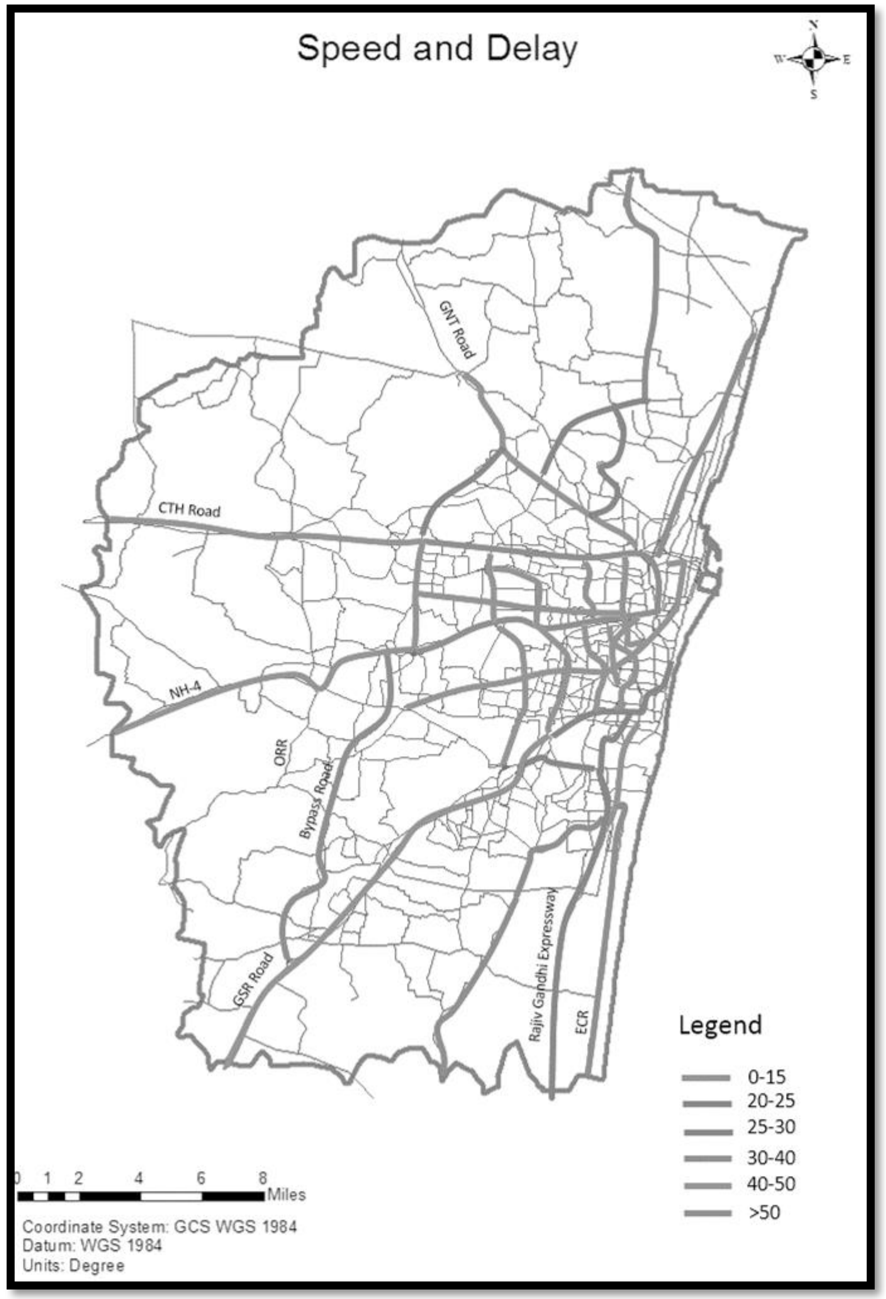
Sl. No	Type of Survey	Location/Sample Size	Duration	Day of the Week
			16 hours Counts (06:00 am to 10:00 pm) for every 15 mins interval	One non incident, non-event working day
9	**Terminal Survey**	7 Locations	24 hours	Weekday One non incident, non-event working day
10	**Speed and delay corridors**	85 Corridors	-	Weekday One non incident, non-event working day
11	**On Board Survey**	60 Routes	24 hours	Weekday One non incident, non-event working day
12	**Boarding and alighting**	50 Stops	16 hours	Weekday One non incident, non-event working day
13	**Household survey**	22,188 samples (1% sample size)	-	Weekdays non incident, non- event working days
14	**Parking Survey**	25 Locations	12 Hours	Weekday One non incident, non-event working day
15	**Road Inventory**	1358 km	-	-
16	**Cyclists opinion survey**	1000 Samples	8 Hours	Weekday One non incident, non-event working day

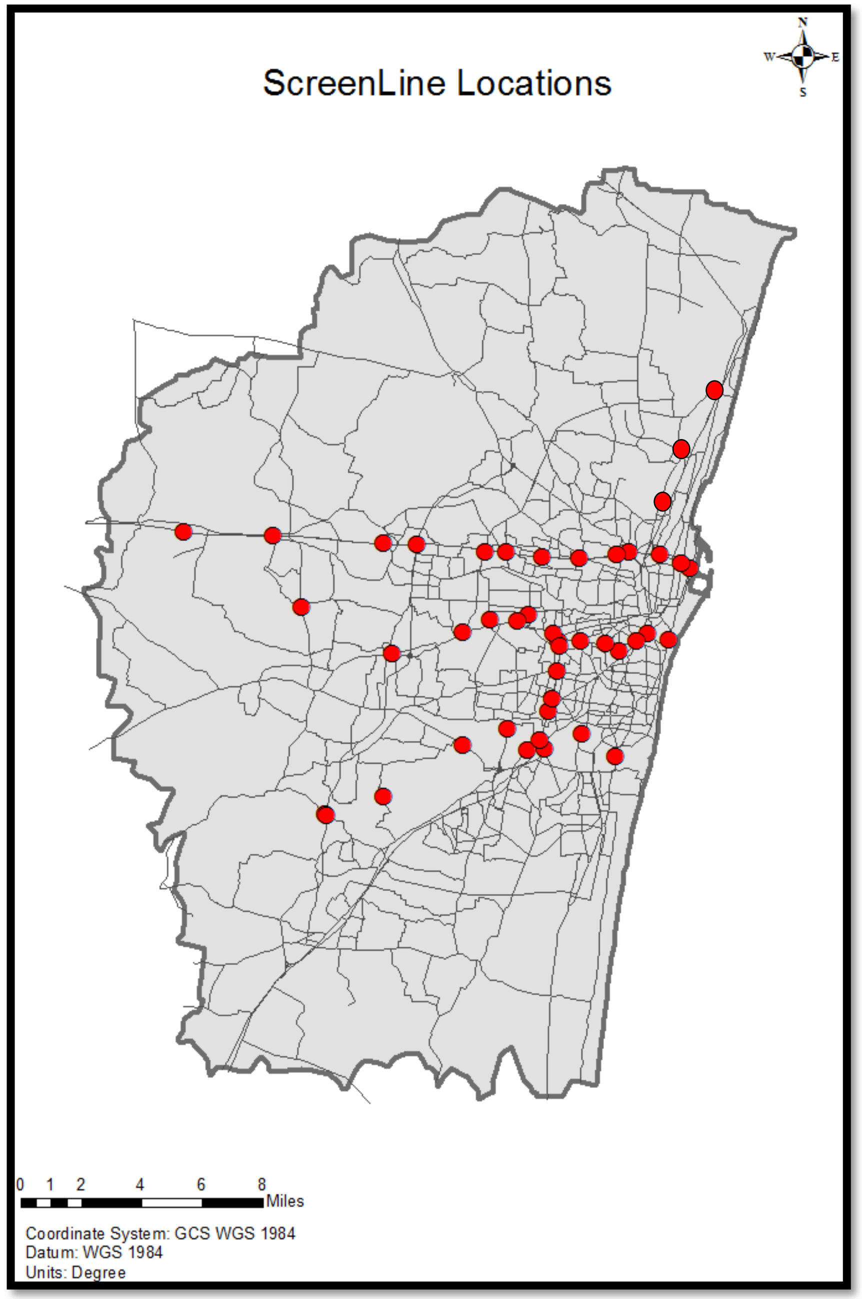
Sl. No	Type of Survey	Location/Sample Size	Duration	Day of the Week
17	**IPT Survey**	2000 Samples	8 Hours	Weekday One non incident, non-event working day

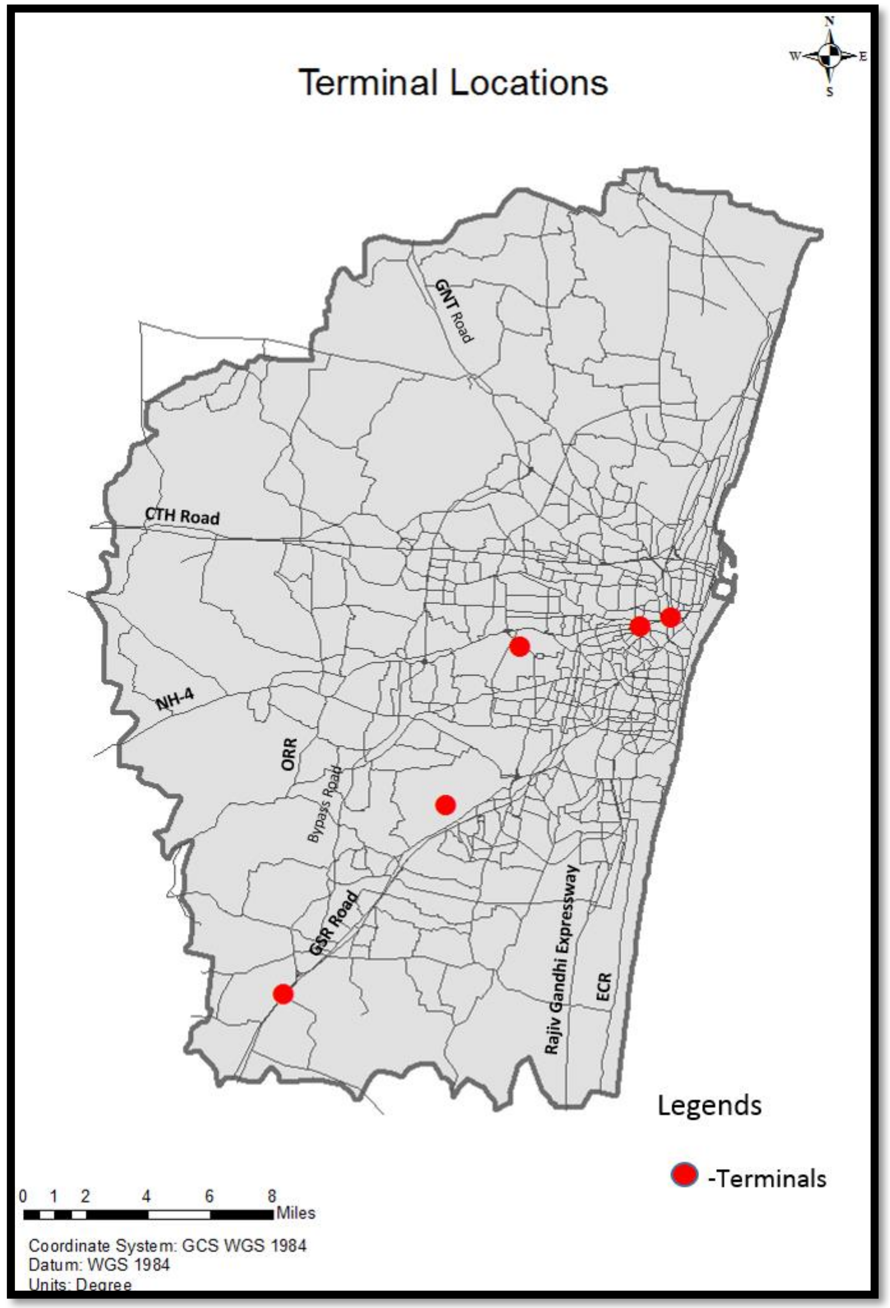

ROAD NETWORK INVENTORY
Chennai
Tambaram
To Thiruvallur
To Kanchipuram
To Bangalore
To Sriperambudur
NH 4
Chennai Thiruvallur High Road
Miles
0 1 2 4 6 8

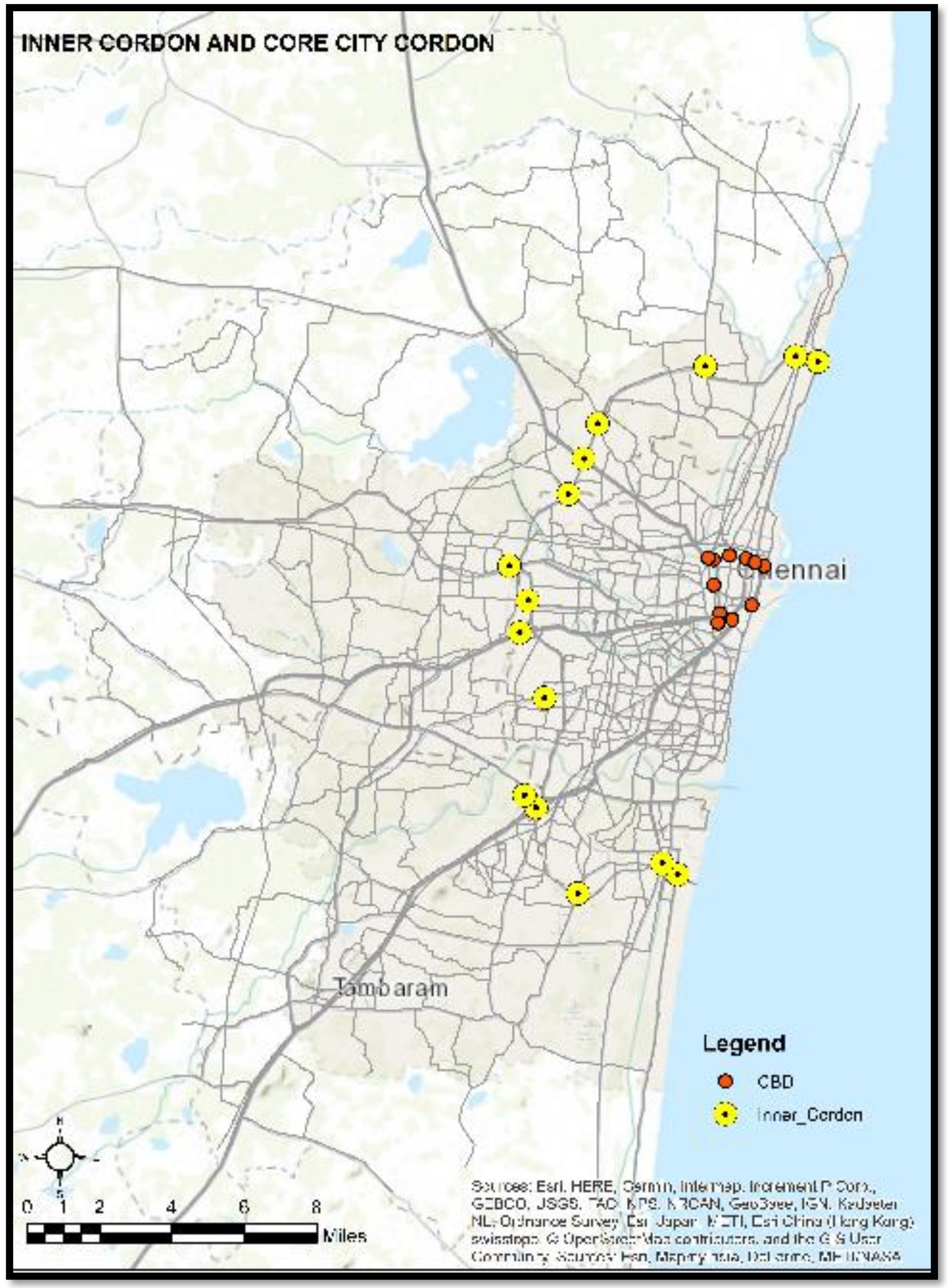

TRAFFIC ANALYSIS ZONES
Ponneri
Thiruvallur
Ambattur
Sriperumbudur
Maraimalai Nagar
Miles
0 1.5 3 6 9 12

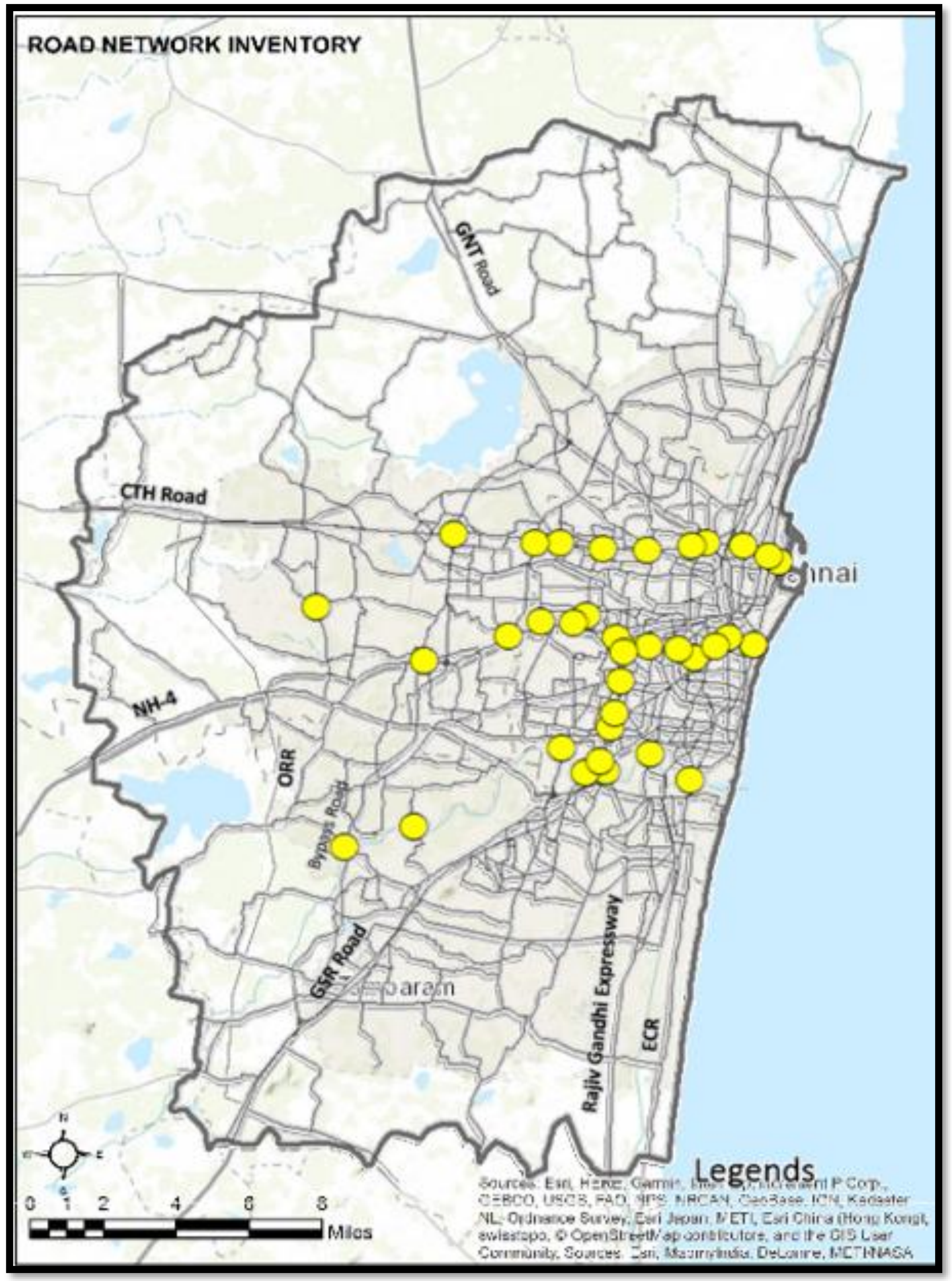

OUTER CORDON SURVEYS
OC 11
OC 10
OC 4
OC 9
OC 8
OC 6
OC 13
OC 12
OC 1
Chennai
Tambaram
Miles
0 1 2 4 6 8


Speed and Delay
GNT Road
CTH Road
NH-4
ORR
Bypass Road
GSR Road
Rajiv Gandhi Expressway
ECR
Legend
0-15
20-25
25-30
30-40
40-50
>50
0 1 2 4 6 8
Miles
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree


ScreenLine Locations
0 1 2 4 6 8
Miles
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree


Terminal Locations
GNT Road
CTH Road
NH-4
ORR
Bypass Road
GSR Road
Rajiv Gandhi Expressway
ECR
Legends
-Terminals
0 1 2 4 6 8
Miles
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree


INNER CORDON AND CORE CITY CORDON
Chennai
Tambaram
Legend
CBD
Inner_Cordon
0 1 2 4 6 8
Miles


ROAD NETWORK INVENTORY
GNT Road
CTH Road
NH-4
ORR
Bypass Road
GSR Road
Rajiv Gandhi Expressway
ECR
Legends
0 1 2 4 6 8
Miles

3.2 OBSERVATIONS OF EXISTING TRAVEL AND TRANSPORT CHARACTERISTICS

After conducting the detailed survey analysis, several parameters defining the traffic and travel pattern of the CMA for the base year were established. The outcomes of the surveys and analysis have been submitted in detail in Annexure – B and Volume II (separate volume is not required). A summary of the traffic survey inferences is presented in this chapter.

Based on the primary survey analysis the below mentioned observations were identified;

Table 3-2 Base Year Travel Characteristics

Total number of trips (Daily)	157 lakhs
Per Capita Trip Rate	1.62
Motorized Trip Rate	1.17
Average Trip Length	9.9 km
Motorized Public Transport mode share (Bus + Rail)	28.20%
Average vehicle speed (CMA)	25.4 kmph (CMA) 17.8 kmph (Excl. bypass and ORR)

Table 3-3 Screen Line Traffic Characteristics

Location Number	Location Name	Direction 1		Direction 2		Total	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
1	Durgabhai Deshmukh Road	26071	26723	25304	23723	51375	50446
2	Gandhi Mandapam Road Near Adyar Villa	31908	73362	30105	76401	62013	149763
3	Anna Salai At Saidapet Maraimalai Adigal Bridge	85081	79551	68494	66941	153575	146493
4	Alandur Bridge Near Guindy Industrial Estate	15022	15231	15162	14696	30184	29927

Location Number	Location Name	Direction 1		Direction 2		Total	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
5	Jawaharlal Nehru Road Crossing Adyar River	43436	40186	45097	40811	88533	80997
6	Mount Poonamellee Road Near Miot Hospital	62948	55374	41290	36841	104238	92216
7	Cowl Bazzar Road	4747	4130	4523	4005	9270	8135
8	Pammal Kundrathur	11838	11242	11411	10961	23249	22202
9	Chennai Bypass Road Near Adyar Rivere Crossing	11838	11242	11412	10962	23250	22203
10	Mount Ponnamale Near River View - Nandabakkam	39789	41872	42797	44639	82586	86511
11	Kamaraj Salai At Napier Bridge	42253	48023	39206	45447	81459	93471
12	Anna Salai Near Chindadripet Railway Station	38988	36267	38194	36303	77182	72570
13	Arunachala Street At St Andrew S Bridge	30930	34139	34516	35624	65446	69763
14	Adithanar Road At Harris Bridge	13020	14491	10743	10275	23763	24766
15	Binny Road Near Quaid -E- Millath College	21846	23558	43176	48742	65022	72301
16	Pantheon Road Near Co – Optex	44345	39790	23010	20858	67355	60648
17	Mc Nichols Road Crossing Cooum River	59331	56853	55173	52006	114504	108859

Location Number	Location Name	Direction 1		Direction 2		Total	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
18	Harrington Road Crossing Coourriver	17617	17614	14622	13999	32239	31613
19	Periyar Evr Salai Near Aminjikarai Market	52404	54798	42907	45354	95311	100152
20	Anna Nagar 3rd Avenue Near K3 Police Station	44207	39792	43440	38963	87647	78755
21	Bridge Crossing Cooum River	23397	25595	20150	22404	43547	48000
22	Jawaharlal Nehru Road	46386	51179	40426	43936	86812	95115
23	Golden George Rathnam Bridge	4728	3949	5528	4621	10256	8570
24	Causeway Near Mgr Engineering College	24062	20908	23721	20621	47783	41528
25	Bridge At Vanagaram - Ambattur Road	28074	25386	29001	24474	57075	49860
26	Thiuverkadu Causeway	25321	24353	22296	20226	47617	44579
27	Bridge At Avadi - Poonamallee Road	26139	28398	24036	25640	50175	54038
28	Rajaji Salai Near Royapuram Railway Station	29049	34263	34832	42662	63881	76924
29	Mannarswamy Koil Street Near Chetty Thottam	38251	38418	22403	20496	60654	58914
30	Monegar Choultry Road Behind Stanley Medical College	20913	23149	20833	23002	41746	46152

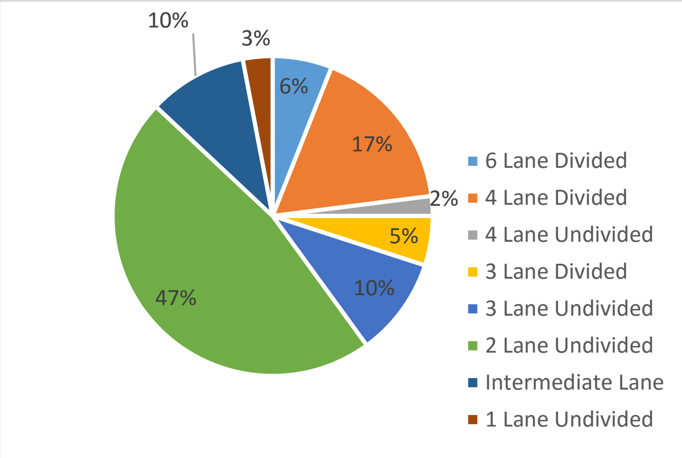
Location Number	Location Name	Direction 1		Direction 2		Total	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
31	Thiruvottriyur High Road Near Washermanpet Railway Station	23301	28436	22950	28473	46251	56908
32	Kathivakkam High Road	20103	21593	20339	19043	40442	40637
33	Erukkanchery High Road Near Venkateshapuram	13016	13564	13437	15095	26453	28659
34	Perambur Barracks Road Near Vyasarpadi Jeeva Railway Station	24690	21643	24072	21141	48762	42784
35	Perambur High Road Near Perambur Railway Station	25504	29098	25578	28413	51082	57511
36	Perambur Loco Works 1 Near Jawahar Nagar	36848	31530	22458	18900	59306	50430
37	Perumbur Loco Works	11128	9695	15653	14307	26781	24002
38	Tvs Juncyion Jawaharla Nehur Road	62248	63131	75439	77181	137687	140312
39	Cth Road ,Agathiyar Nagar	58064	51156	53034	46874	111098	98030
40	New Military Road Near Avadi Railway Station	31341	31572	30241	30192	61582	61764
41	Avadi Railway Station	31799	28919	30941	32319	62740	61239
42	Ambathur - Thiruthani Hwy	56654	53942	51424	48965	108078	102907
43	Chennai Outer Ring Road	51392	53388	48408	51771	99800	105159
44	Nelson Manickam Road	26071	24385	25304	23372	51375	47757

Location Number	Location Name	Direction 1		Direction 2		Total	
		Vehicles	PCUs	Vehicles	PCUs	Vehicles	PCUs
45	Nsk Salai Near Kodambakkam Railway Station	31895	31063	30105	30064	62000	61127
46	Dhuraswamy Road Subway	62948	55374	41290	36841	104238	92216
47	Madley Road Subway	24166	21410	21294	19144	45460	40554
48	Aranganathan Subway	33469	33063	33584	31793	67053	64855
49	Saidapet Market	15932	15956	19477	18787	35409	34744

The peak hour traffic at screen line locations varies from 8% to 10% with a high share of motorized two wheelers. Details are given in Table 3-3.

- Highest Traffic Volumes
    - ✓ Adyar River - Anna Salai -Maraimalai Adigal Bridge (Saidapet) with 1,46,493 PCUs/day.
    - ✓ Cooum River - Nungambakkam Bridge with 1,08,859 PCUs/day.
    - ✓ E-W Railway Screen Line - TVS Junction on Jawaharlal Nehru Road with 1,28,825 PCUs/day
    - ✓ N-S Railway Screen Line is highest at Duraisamy Subway with 92,216 PCUs.

The data obtained from road inventory survey for each link was appended to the corresponding link in the private vehicle network file and used as the basis for selecting an appropriate speed flow curve for the network development. The road inventory data has highlighted the deficiencies on the road network in terms of road width, as only 31% of roads have widths of four lanes and above. The type of roads are presented in the Figure 3-1.



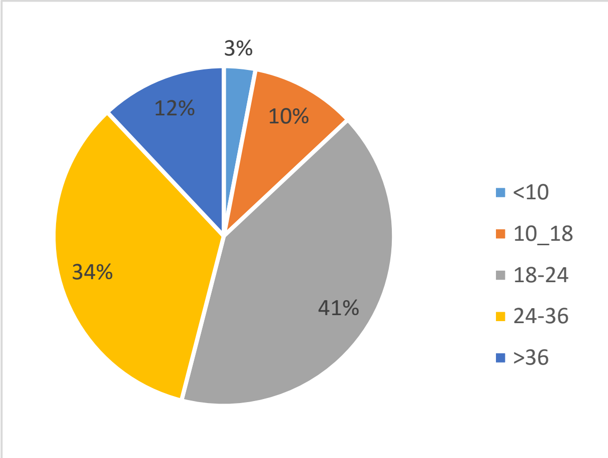


Figure 3-1 Lane Configuration and ROW Classification

The abstract on analysis of speed and delay data as seen in Table 3-4 reveals that delays are mostly at intersections and that speeds on all roads have reduced over the years due to the increase in vehicular traffic. Significant drop in speeds have been witnessed from the 2008 observation on Sardar Patel Road, Dr. Muthu Lakshmi Road (LB Road) and Arcot Road.

Table 3-4 Journey Speed Characteristics along Mobility Corridors

Sl. No	Location	Peak Hour Journey Speed (km/hr)	
		2008	2018
1	Pallavaram- Thoraipakkam Road (200ft Radial Road)	42	31
2	Chennai Tiruvallur High Road (Padi Crossing to Nemilicheri)	27	26
3	East Coast Road (Thiruvanmiyur Signal to Kovalam Toll)	31	48
4	Great Northern Trunk (GNT) Road upto Padiyanallur	33	33
5	Poonamallee High Road	21	22
6	Great Southern Trunk (GST) Road (NH45) upto Vandalur	32	21
7	Chennai Byepass from Perungalathur near Tambaram on NH45 to Madhavaram on NH 5 via Maduravoyal	60	65
8	Avadi Poonamallee High Road	26	22
9	Chennai Bangalore highway (NH4) upto Thirumazhaisai	23	15
10	Dr Muthulakshmi road	20	12

Sl. No	Location	Peak Hour Journey Speed (km/hr)	
		2008	2018
11	Periyar EVR Salai	25	14
12	Jawaharlal Nehru road	27	21
13	Sardar Patel Road	24	12
14	Santhome High Road	28	19
15	Kamaraj Salai	34	22
16	Anna Salai	28	17
17	Gandhi Mandapam Road	30	19
18	GN Chetty Road	21	12
19	MGR Salai	15	13
20	Arcot Road	20	11
21	Basin Bridge	10	15
22	Mc Nichols Road	18	12

Heavy pedestrian crossings are observed in CBD/ commercial areas compared to other locations. Pedestrian crossings at junctions/roads in the city ranged from 3988 to 57968 for twelve hours duration. Among all the locations within the study area, heavy pedestrian crossing was observed at Egmore Railway station, South Usman Road in front of T. Nagar Bus Stand, Arcot Road at Porur Junction, Arcot Road near Meenakshi College, Koyambedu Junction, College road junction, Cathedral Road. The peak hour in pedestrian crossing is observed at more number of locations in CMA between 7.00 PM and 8.00 PM. A summary of the counts at identified locations are presented in Table 3-5.

Table 3-5 Pedestrian Movement Count at Various Locations

SN	Location	Pedestrian Count (12 Hrs)	Peak Hour	Peak Hour Count		
				Total	Across	Along
1	Ambattur Railway Station	20112	17.00 - 18.00	2376	1059	1317
2	Aminjikarai Market Junction	16420	11.00 - 12.00	2740	1651	1089
3	Anna Nagar 2nd avenuve	12488	11.00 - 12.00	2514	1500	1014
4	Anna salai near SIET college	23017	19.00 - 20.00	2847	1383	1464
5	Arcot Road at Porur Junction	35842	11.00 - 12.00	4652	2264	2388
6	Arcot Road near Meenakshi College	30525	17.00 - 18.00	4747	2147	2600
7	Arcot Road near Vadapalani Bus Stand	18977	11.00 - 12.00	2136	666	1470
8	Avadi Road Junction	16275	19.00 - 20.00	2415	1313	1102
9	Broadway	24118	19.00 - 20.00	3636	900	2736
10	CTH Road in front of Ambattur Bus Stand	17001	09.00 - 10.00	1658	643	1015
11	CTH Road in front of Ambattur Estate Bus Stand	4506	19.00 - 20.00	760	221	539
12	CTH Road near Avadi bus stand	24614	17.00 - 18.00	3247	2104	1143
13	Cathedral Road	27995	17.00 - 18.00	3937	2057	1880
14	College road junction	28865	18.00 - 19.00	4856	2724	2132
15	Doveton	7053	10.00 - 11.00	1198	427	771
16	Durai sawmy road Pothis junction	10400	19.00 - 20.00	1724	495	1229
17	Egmore Railway station	57968	19.00 - 20.00	7161	3454	3707

SN	Location	Pedestrian Count (12 Hrs)	Peak Hour	Peak Hour Count		
				Total	Across	Along
18	GST Road near Chrompet Bus Stand	19887	11.00 - 12.00	3661	2727	934
19	GST Road near Pallavaram Bus Stand	14061	10.00 - 11.00	2356	1548	808
20	GST Road near Tambaram Bus Stand	18289	10.00 - 11.00	2567	1737	830
21	In Front of Perambur Bus Stand	11977	10.00 - 11.00	1697	1150	547
23	Jawaharlal Nehru Road In Front of Central	16192	19.00 - 20.00	1892	1000	892
24	Kamarajar Salai near Queen Mary's College	7332	19.00 - 20.00	1337	504	833
25	Kathipara Junction	6629	11.00 - 12.00	1468	1215	253
26	Kathivakkam High Road near Ennore Railway Station	14910	11.00 - 12.00	1895	775	1120
27	Koyambedu Junction	29200	19.00 - 20.00	3633	1706	1927
28	Lattice Bridge Road near Thiruvanmiyur Bus Stand Junction	15541	16.00 - 17.00	1853	620	1233
29	Light house	10242	18.00 - 19.00	1868	1140	728
30	Luz Intersection-Kutchery Road	9233	17.00 - 18.00	1381	621	760
31	Luz Intersection	16345	19.00 - 20.00	1969	617	1352
32	Mount Poonamallee Road in front of Iyappanthangal Bus Stand	5154	11.00 - 12.00	780	432	348
33	Pachaiappas college junction	7824	19.00 - 20.00	1051	512	539

SN	Location	Pedestrian Count (12 Hrs)	Peak Hour	Peak Hour Count		
				Total	Across	Along
34	Periyar EVR Salai Vs E.V.K Sampath Street	13260	11.00 - 12.00	1758	1103	655
35	Periyar EVR Salai Vs Mint Street	14563	11.00 - 12.00	1846	720	1126
36	Periyar EVR Salai Vs New Avadi Road	13367	11.00 - 12.00	1758	1103	655
37	Periyar EVR Salai Vs Taylors Road	24484	19.00 - 20.00	5660	3894	1766
39	Radhakrishnan salai	3988	19.00 - 20.00	500	194	306
40	Rattan Bazar- Evening Bazaar Road Intersection	16781	19.00 - 20.00	2067	1048	1019
41	Royapettah high road	6237	19.00 - 20.00	803	312	491
42	Sardar Patel Vs Velachery Main Road	14239	11.00 - 12.00	1717	666	1051
43	South Usman Road in front of T. Nagar Bus Stand	36123	19.00 - 20.00	4773	2213	2560
44	South Usman Road	10400	19.00 - 20.00	4747	495	1229
45	Sterling road junction	6267	11.00 - 12.00	789	157	632
46	TTK Road Junction	18540	16.00 - 17.00	2263	1065	1198
47	Taramani Velachery Road Vs Velachery Byepass Road	16345	19.00 - 20.00	1969	617	1352
48	Taramani Velachery Road Vs Velachery Main Road	13509	16.00 - 17.00	1868	1140	728
49	Thiruvottiryur Bus Stand Junction	9180	09.00 - 10.00	1438	1060	378

SN	Location	Pedestrian Count (12 Hrs)	Peak Hour	Peak Hour Count		
				Total	Across	Along
50	Thiruvottriyur High Road near Wimco Nagar Railway Station	15697	19.00 - 20.00	2020	952	1068
51	Tollgate Near Thiruvottriyur	7332	19.00 - 20.00	1337	504	833
52	Vadapalani Signal Arcot Road	18014	19.00 - 20.00	2063	969	1094
53	Vadapalani Signal Jawaharlal Nehru Road	16472	19.00 - 20.00	1955	898	1057

Table 3-6 Peak Hour Traffic Volume Comparison with CTTS-2008

S.No	Location names	2008		2018		% Annual Growth rate
		Peak Hour PCU	Peak Hour Vehicles	Peak Hour PCU	Peak Hour Vehicles	
1	Velachery Road near Velachery Railway Station	4451	5069	10501	11875	9%
2	GST Road near Kathipara Junction	13454	13742	20448	23519	4%
3	Mount Poonamallee Road (St. Thomas Mount)	6708	7474	17607	19437	10%
4	Periyar EVR Salai near Rohini Complex	7079	8473	8409	9164	2%
5	GNT Road near Eveready Warehouse	3078	5249	11343	9587	14%
6	Ennore High Road near Container Terminal	853	2100	5314	5526	20%
7	East Coast Road near Thiruvanmiyur RTO	6257	7402	8965	9350	4%
8	Lattice Bridge Road near NIFT	7850	8316	14031	15081	6%

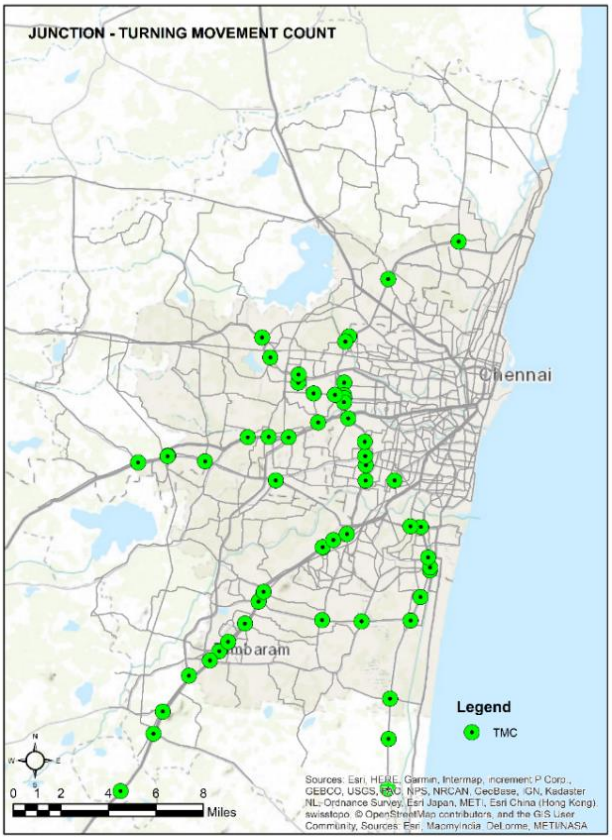


Figure 3-2 Turning Movement Locations

Daily Traffic is lowest at the intersection of 2nd Main Road & Ambit Park Road (Ambattur Industrial Estate) (48918 PCUs) and highest at Ashok Pillar Circle (251826 PCUs). It has been observed that 33 locations exceed 10,000 PCUs during peak hour.

Traffic Characteristics at outer Cordons:

- Sizeable increase in traffic ranging from 4% to 20% is observed at Inner Cordon locations in comparison to the previous study (2008 CTTS study) with negative growth in the category of slow-moving vehicles at several locations. Proportion of slow-moving vehicles in the traffic stream is more at CBD Cordon as compared to Inner Cordon locations.

- Passenger traffic at Outer Cordon locations has increased over the period and perhaps the commercial vehicle prohibitions within and the urban sprawl beyond contribute to this trend.

- Corresponding with the traffic composition, the number of two wheelers parked on-street is the highest followed by cars with average duration of parking being just over an hour. Cycles are observed to be parked in larger numbers at railway stations and in the vicinity of bus terminals, their numbers being constrained for want of space and commercial vehicles were observed to be parked on TPP Road and Manali Oil Refinery Road. Off-street multi- level parking lots are yet to get implemented despite earlier studies recommending the same.

- Earlier the urban centers were located within the Chennai districts whereas the current trend shows that the growth centers are distributed along Siruseri, Tambaram, Oragadam, Ambattur, Redhill's ,Ennore located outside of Chennai District following the concept of multi Nuclei Theory . The Population of Chennai city has increased from 43.4 lakh to 46.5 lakhs whereas population of rest of CMA has increased from 22.2 lakhs to 40.1 lakhs. Due to this shift in population and people's tendency to choose their residence near to their office locations which are dispersed all around the CMA has led to reduction in average trip length. In addition, it is prevalent from the primary survey that people started using cars for trip lengths less than 10km due to the increased vehicle ownership and affordability of shared taxis (i.e. Ola and Uber).

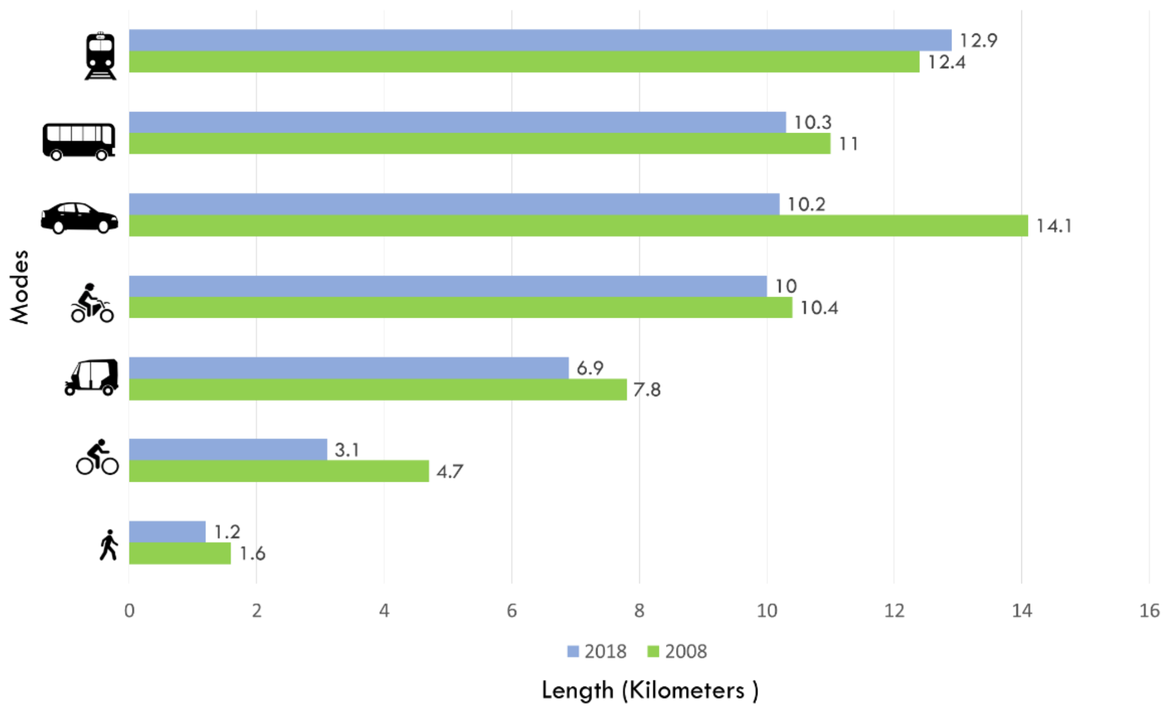


Figure 3-3: Average Trip Length of Various Modes

3.2.1. TRAVEL CHARACTERISTICS:

Analysis of household survey data has revealed significant increase in household income, per capita trip rate, share of trips performed by motorized two wheelers & cars, trip lengths by various modes while there has been a sizeable reduction in the percentage share of trips by Public Transport mode. The summary of the surveys are specified below:

- A household size (3.77) is observed in the current study, when compared with 2008 CTTS (4.07).
- Average household income has increased from Rs.8700 in 2008 to Rs.21875 in 2018 at a CAGR of 9.7% where the average household income has increased from Rs.1370 in 1992 to Rs.8700 in 2008 at a CAGR of 12.4%.
- Analysis of household survey data has revealed significant increase in household income, per capita trip rate, share of trips performed by motorized two wheelers & cars, trip lengths by various modes while there has been a sizeable reduction in the percentage share of trips by Public Transport mode.
- When comparing the household income level and trip rate, it is found that higher income households are making more trips than lower income group.

- Number of trips made by various age groups were compared and found that trip makers between 41-65 years in 2008 is 18% whereas in 2018, the share of these trip makers has increased to 25%.
- A slightly higher per capita trip rate with 1.62 is observed in 2018 compared to 1.60 in 2008.The motorized per capita trip rate has increased to 1.17 in 2018 from 1.06 in 2008.
- The mode share observed in the present study is presented in the figure and in the table given below.

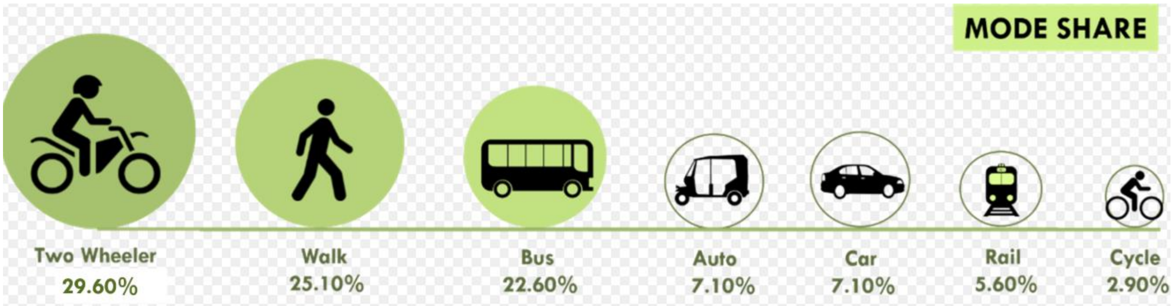


Figure 3-4: Modal Share in CMA

- Trips by Non-motorized transport decreased from 41% in 1970 study, 40% in 1984 study, 46.6% in (1992-95) and 34% in (2008) to 28% (2018).
- Cyclist opinion survey revealed that amongst users, 73% travel for work while 10% travel for educational purpose with about 84% travelling daily. Among the problems cited in using bicycle, Interference due to parking/pedestrians/bus stops ranked the first.
- Significant increase in the percentage of trips by two wheeler is observed (29.6% in 2018) when compared with previous studies (2% in 1970, 3% in 1984, 7% in 1992-95 and 25% in 2008) as presented in the Table.
- Significant decrease in the percentage of trips by Public Transport (bus+train) is observed in HHI (28.2% in 2018) when compared with previous studies (54% in 1970, 55% in 1984, 42.7% in 1992-95 and 31% in 2008).
- There is a significant increase in trips with trip lengths ranging between 2 and 8 km. However, the average trip length in the study area has reduced to 9.9 km from a previously observed Average Trip Length of 11.5 km in 2008.
- The number of goods vehicles in Chennai has increased from 6,671 in 1980 to 66209 in 2008 and 90076 (excluding autorickshaw, taxis based on RTO) in 2018. Based on the OD survey,the total good vehicle trips is 1.57 lakhs.

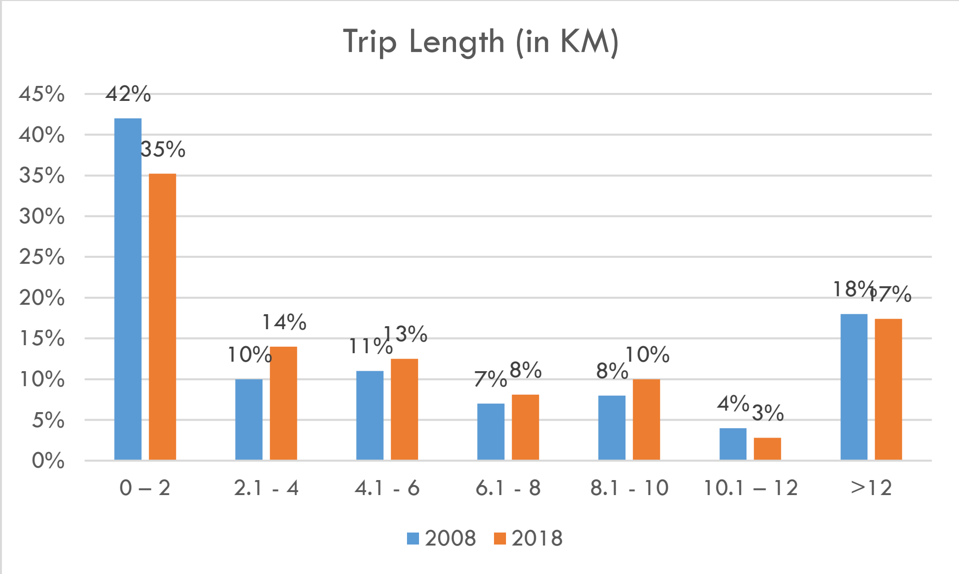


Figure 3-5: Comparison of Trip Length Distribution

It has been observed that there is considerable decrease in trip lengths of personalized modes while predominance of shared autos in several sectors has reduced the trip length of IPT, as shown in Table 3-7.

Table 3-7 Average Trip Length Over the Years

	Average Trip Length in Km		
Travel Mode	**1992-95**	**2008**	**2018**
Walk	1.1	1.6	1.2
Bicycle	2.8	4.7	2.9
IPT	12.2	7.8	6.4
Two Wheeler	6.3	10.4	10.3
Car/Van /Jeep	8.0	14.1	10.5
Private Bus	18.5	12.0	7.0
Public Bus	14.4	10.0	12.9
Train	11.1	12.4	13.2

3.3 CHALLENGES ON EXISTING TRAFFIC AND TRANSPORT SYSTEMS

A detailed analysis of the surveys conducted have helped in identification of the following challenges within the study area:

3.3.1. LACK OF LAND-USE TRANSPORT INTEGRATION:

As part of the First Master Plan of 1970 and consecutive Comprehensive Traffic and Transport Studies, the main focus of these studies was to decongest the Chennai city within CMA. The land use along the South, West, North and Southwest were developed with IT parks, SEZ and Industries. Considering the rapid sprawling, the transport infrastructure projects were not at par with the land use development along these corridors where the employment generation was high.

3.3.2. LACK OF NMT FACILITIES:

The city clearly exhibits providing minimum NMT facilities while planning for any transport infrastructure projects. The primary survey analysis indicates that about 95% of surveyed roads lack of requisite footpath infrastructure. The lack of NMT infrastructure has increased safety concerns and dependency on motorized modes, resulting in decreased share of Non-motorized transport trips from 34% in (2008) to 28% (2018). Thus, there is need for developing NMT facilities in and around any Public Transport facility stations.

3.3.3. NEED FOR PARKING POLICY:

Demand for organised parking in the central business district (CBD) are high. Acute shortage of parking supply is witnessed in commercial areas of Anna Salai, Periyar EVR Salai, T.Nagar, Purasawalkam, George Town, Nungambakkam, Adyar and Mylapore. The primary surveys indicate that the average parking duration at on-street parking locations is observed to be less than one hour and is observed to be higher at commercial areas. Providing adequate supply and increasing the turnover through demand management measures and through enforcement the unauthorised parking needs to be regulated. Thus, there is need for a parking policy which can help identify parking principles and smarter parking management systems which can benefit people and in economy in time and money, while also leading to more liveable and safe cities.

Figure 3-6: On street haphazard parking observed in study area

3.3.4. LACK OF DEMAND MANAGEMENT MEASURES

There is increased supply in the Public Transport sector in case of Chennai. Optimizing the use of available resources is the need of the hour. A broad range of demand management strategies are available and can be brought to use depending on the situation and suitability. Demand management systems such as flexi work hours, active Traffic management, time, distance and Place (TDP)pricing needs to tapped to make use of the existing resources efficiently. Some of the "tools" used for TDM are listed below:

- **Subsidizing transit costs for employees, Students** – Providing Subsidized Transit cost for Employees would promote the usage of public transport and let the user to Public Transport instead of Private mode.
- **Car parking controls and pricing:** Parking in the areas where congestion is high example T-nagar, Purasiwalkam can be priced with differential fares with help of Intelligent Parking management tools.
- **Flex-time work schedules with employers to reduce congestion at peak times:** Most of the trips happen during peak hours of the day. Having staggered work times would help reduce congestion during peak hours and also help in efficient utilisation of the available Public Transport systems
- **Road space rationing by restricting travel at certain times and places** – The traffic access is restricted in certain urban cordon area, city centre like George Town, Mylapore based upon the last digits of the license number on pre-established days and during certain periods, usually, the peak hours.

- **Workplace travel plans**: The Travel plans for the employers are set with regulations such as use public transport as travel alternative rather than private. The aim is to reduce use of car dependency.
- **Road space reallocation**, aiming to re-balance provision between private cars and other sustainable modes
- **Private Motorised trip reduction programs**
- **Public education and awareness programs**
- **Parking Strategies**

3.3.5. LACK OF INTEGRATION

Chennai city has extensive Public Transport network with different modes such as bus system, Sub-Urban trains, Metro and Intermediate Public Transport systems (Auto-Rickshaws, Share Autos, Taxi services). There is a Lack of Integration among different modes of Public Transport in terms of Route Integration, Operation and service integration, and Institutional Integration and Technological integration.

3.3.6. ROUTE INTEGRATION, OPERATION AND SERVICE INTEGRATION

MTC buses, Sub-Urban trains, Metro and IPT run parallel causing congestion and additional cost to the operator on competing which in turn reduces the service levels and reliability. Such a scenario divides the ridership between the modes as either cost or the comfort may dictate the commuter's choice. Transfer requires a good coordinated scheduling of the main and feeder services, combined or suitable ticketing system and minimal waiting time.

3.3.7. TECHNOLOGICAL INTEGRATION

The city lacks adequate ITS facilities. The single ticketing system (AFC) across different modes, Passenger Information Systems (PIS) etc., can improve the Public Transport share and user convenience.

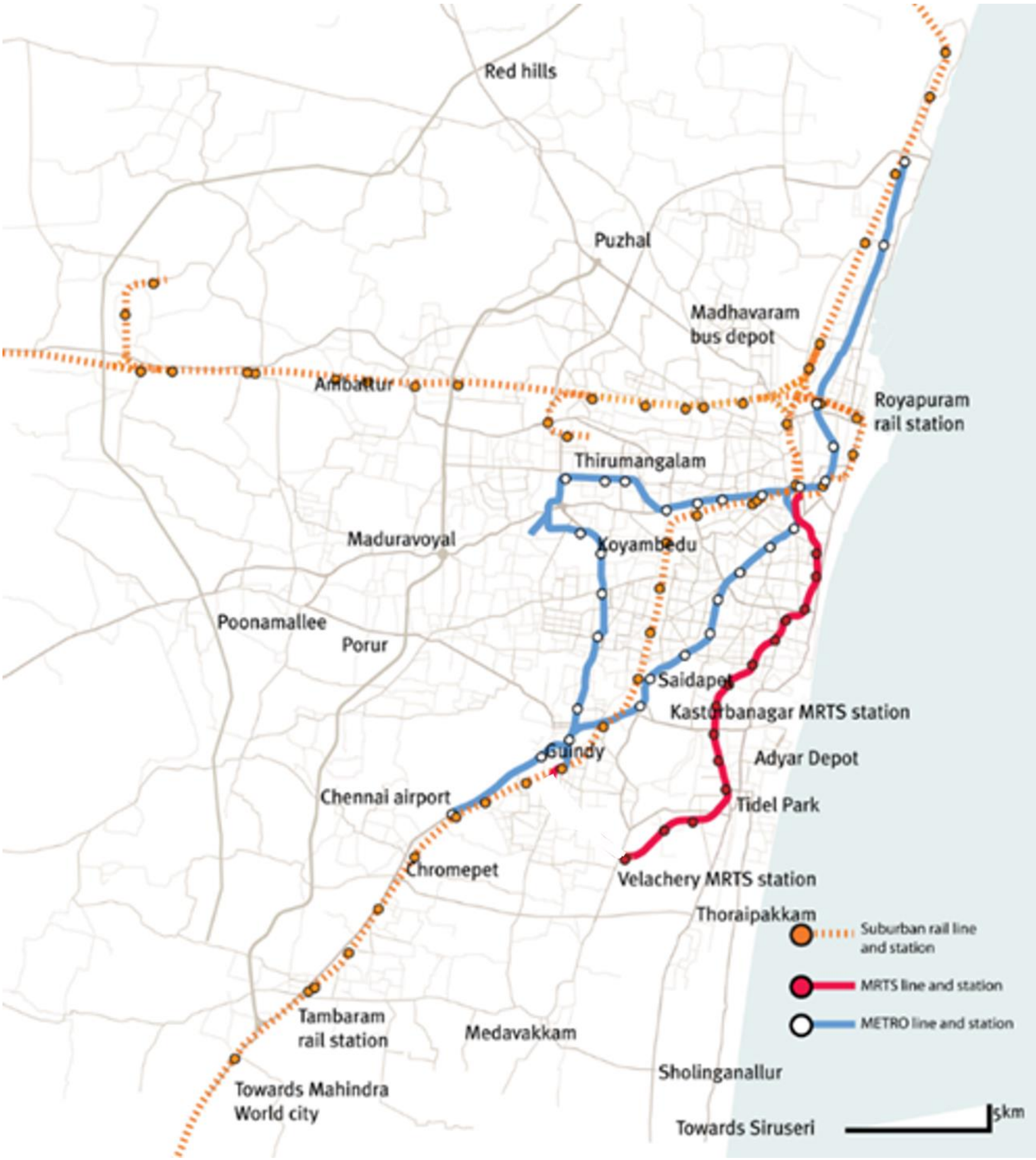


Figure 3-7 Public Transit System

3.3.8. INSTITUTIONAL INTEGRATION

There are various Departments /Agency looking after various functions to plan, operate and regulate the different modes of transport. In order to avoid difficulties in the functioning of these organisations which has single vision of catering to the user needs on considering the system as a whole, Unified Metropolitan Transport Authority (UMTA) has been recommend under than purview of State Government. In 1980 National Transportation Policy committee recommended such a setup while National Urban transport Policy approved UMTA by the Government of India (GOI) in 2006. The UMTA has to be prioritized and setup within a timeframe. It can be observed that the city's poor integrated transport system is another factor leading to an increase in vehicular traffic. Despite Chennai having a four-direction train system, there is no connectivity either with the sub-urban train, the MRTS or the metro.

The key to increasing ridership in Public Transport is a comprehensive approach to improving Public Transport from the user's perspective, and this should cover Affordability, Availability, Accessibility and Acceptability - The four A's. Among these four, Accessibility is a crucial factor.

In Chennai, the ease of passengers accessing the metro is considerably low. To serve areas beyond the walkshed, a feeder system needs to be provided. Transfer requires a good coordinated scheduling of the main and feeder services, combined or suitable ticketing system and minimal waiting time.

It can be observed that the city's poor integrated transport system is another factor leading to an increase in vehicular traffic. Despite Chennai having a four-direction train system, there is no connectivity either with the sub-urban train, the MRTS or the metro.

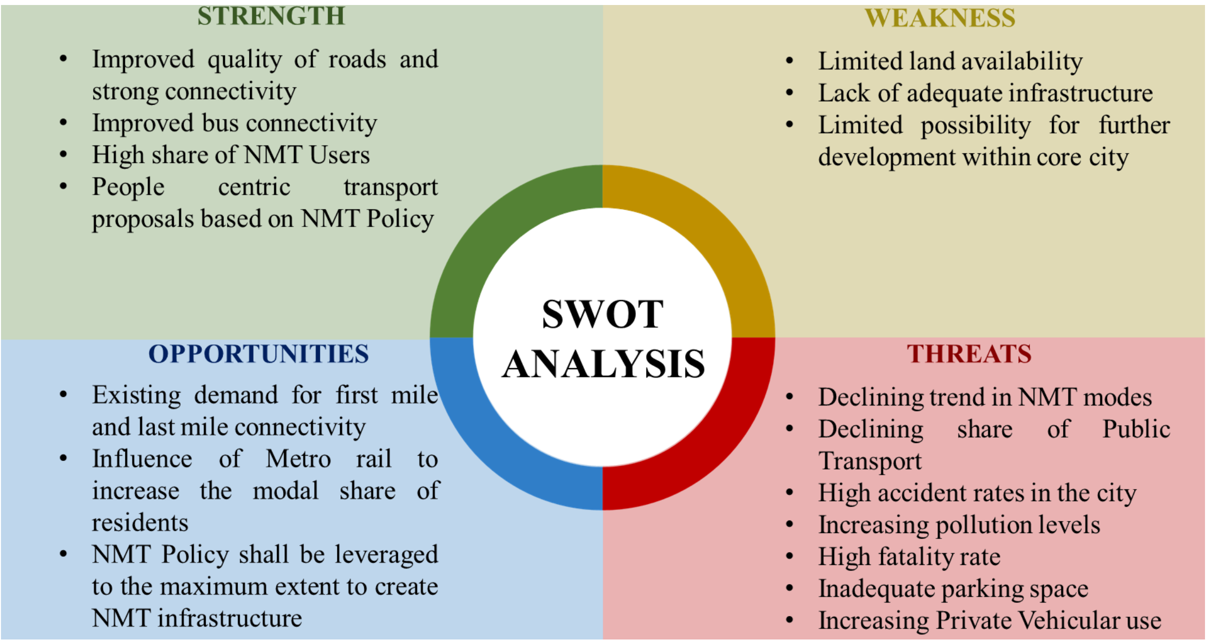


Figure 3-8: SWOT Analysis for CMA

Service Level Benchmarking

4. Service Level Benchmarking

Benchmarking is a tool used by public agencies to make more informed decisions regarding the performance, make comparisons internally and with other organizations and continuously improve performance using the lessons learned through this comparison process. Benchmarking allows public agencies to direct limited resources to the program. Benchmarking helps to establish baseline measures of performance, and helps monitor the agency's individual performance over time, and also how it compares with the other organizations, and also improving performance by sharing of lessons learnt from different entities.

4.1 NEED FOR BENCHMARKING

The National Urban Transport Policy highlights the crucial link between transport demand and land use planning and the need to develop an integrated mobility plan for each city. Accordingly, each city should develop Comprehensive Mobility Plan with focus on accessibility, mobility and traffic flow (in that order). Rather than the present approach of "predict and provide" it has to be "Planning for the desirables". However, there need to be some yardstick to measure and compare the effectiveness of policies and urban projects across cities. Urban agencies in India currently do not have any system for measuring performance of urban transport activities, assessing impacts of projects and taking further action on them. The service level benchmarks (SLB) issued by MoHUA, currently MoHUA specify parameters to measure the effectiveness of land use-transport planning in Chennai.

The SLBs describe the levels of transport performance like safety and access, pollution, accidents, congestion etc. in Chennai currently. They indirectly reflect the state of governance in the city. Above all, these benchmark indicators allow stakeholders to quantify the past, present and changes in transport and its sustainability. Table 4-1 shows the summary of existing service level benchmarking for Urban Transport in Chennai.

Table 4-1: Existing Service Level Benchmarking-summary

S. No	Bench mark	Score	LOS	Inference as per MOUHA Guidelines
1	Public Transport Facilities	12	2	The city has Public Transport system which may need considerable improvements in terms of supply of buses/coaches and coverage as many parts of the city are not served by it. The frequency of the services may need improvements

S. No	Bench mark	Score	LOS	Inference as per MOUHA Guidelines
	<12 Good · 12-16 · 17-20 · 21-24 Need Improvements			
2	Pedestrian infrastructure facilities	9	3	The city has pedestrian facilities which may need some improvements at intersections, footpaths and street lighting as some parts of the city are not served by it. The system provided is otherwise comfortable and sustainable. .
	3-5 Good · 6-8 · 9-10 · 11-12 Need Improvements			
3	Non-Motorized Transport Facilities	10	3	The city lacks adequate NMT facilities.
	3-5 Good · 6-8 · 9-10 · 11-12 Need Improvements			
4	Level of usage of Intelligent Transport System(ITS) Facilities	20	4	The city lacks adequate ITS facilities.
	5-7 Good · 8-10 · 11-15 · 16-20 Need Improvements			
5	Travel speed (Motorized and Mass transit)	5	3	Small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed
	2 Good · 3-4 · 5-6 · 7-8 Need Improvements			
6	Availability of Parking places	8	4	Paid parking spaces provided in the city need to be improved upon and to cater to the demand some differential parking rates for the CBD have been adopted. The city authorities need to initiate considerable improvement measures

S. No	Bench mark	Score	LOS	Inference as per MOUHA Guidelines
		2 / 3-4 / 5-6 / 7-8 Good … Need Improvements		
7	Road safety	6	3	Need Considerable improvements in road design and available road infrastructure. Traffic management and in other such reasons which significantly contribute to road safety
		2 / 3-4 / 5-6 / 7-8 Good … Need Improvements		
8	Pollution levels	4	1	Need some improvement in emission standards, checking pollution etc.
		<=5 / 6-9 / 10-13 / 14-16 Good … Need Improvements		
9	Integrated land-use Transport system	18	3	Indicative of coherence between city-structure and Public Transport system.
		Good … Need Improvements <=9 / 10-14 / 15-20 / 21-24		
10	Financial sustainability of Public Transport by bus	8	3	The Public Transport of a city is financial sustainable but needs considerable improvements
		Good … Need Improvements <=4 / 5-7 / 8-9 / 10-12		

4.2 COMPUTATION OF LOS

The consolidated benchmarking of the existing scenario of the study area is as shown in Table 3-5. The Level of Service (LOS) is given on a scale of 4 wherein 1 indicates "Good-To be maintained" and 4 indicates "Needs immediate improvement".

Table 4-2: Computation of Service Level Benchmarks

Parameters	Overall LoS	Indicators	LoS
Public Transport Facilities	2	Presence of Organized Public Transport in urban area	1
		Extent of Supply/Availability of Public Transport System	1
		Service Coverage of Public Transport	1
		Average Waiting Time for Public Transport Users	3
		Level of Comfort in Public Transport	3
		Percentage of Fleet as per Urban Bus Specification	3
Pedestrian Infrastructure Facilities	3	Signalized Intersection Delay	3
		Street lighting (Lux)	3
		Percentage of Study Area Covered	3
NMT Facilities	3	Percentage of Network Covered	4
		Encroachment on NMT Roads by Vehicle Parking	4
		NMT Parking Facilities at Interchange	2
Level of Usage of ITS Facilities	4	Availability of Traffic Surveillance	4
		Passenger information System (PIS)	4
		Global Positioning System (GPS/GPRS)	4
		Signal Synchronization	4
		Integrated Ticketing System	4
Travel Speeds	3	Average Travel Speed of Personal Vehicles	3
		Average Travel Speed of Public Transport	2
Availability of Parking Spaces	4	Availability of On-Street Paid Public Parking Spaces	4
		Ratio of Maximum and Minimum Parking Fee	4
Road Safety	3	Fatality Rate per Lakh Population	4
		Fatality Rate of Pedestrian and NMT	2
Pollution Levels	1	Concentration of Sulphur Dioxide (SO2)	1
		Concentration of Oxides of Nitrogen (NOx)	1
		Concentration of Suspended Particulate Matter (SPM)	1
		Concentration of Respirable Suspended Particulate Matter (RSPM)	1
Integrated Land Use Transport System	3	Population Density – Gross	3
		Mixed Land Use on Major Transit Corridors	1
		Intensity of Development – City Wide (FSI)	1
		Intensity of Development along Transit Corridors	4
		Road Network Pattern and Completeness	2
		Percentage of Area under Roads	3

Parameters	Overall LoS	Indicators	LoS
		Percentage Network with Exclusive RoW for Transit (For > 1 Million Population)	4
Financial Sustainability for Buses	3	Extent of Non Fare Revenue	4
		Staff per Bus Ratio	2
		Operating Ratio	2

The detailed SLB for each parameter has been provided in the Annexure C.

Development Of Scenarios, Vision And Goals

5. Development of Scenarios, Vision and Goals

The main focus of the study is to develop a long-term transportation strategy for Chennai Metropolitan Area (CMA) with the help of an urban transport planning model. Transport Demand Modelling has been carried out to replicate the Chennai's "real" transportation system and forecasting the state of the system for the targeted horizon year (2048) under various scenarios. This chapter discusses the development of alternative scenarios and their evaluation with outputs of travel demand modelling.

5.1 BASE YEAR TRAVEL DEMAND MODELING

The base year travel scenario has been modelled as the initial step to assess the current demand on the system. The 1,189 sqkm. of study area has been delineated into 275 smaller physical units, termed as Traffic Analysis Zones (TAZs) to facilitate analysis of travel demand and trip patterns. In addition to 275 internal zones 23 external zones were delineated to analyse the external trip interactions of CMA.

Planning variables (i.e. Population, Workers, Students and Employment, etc.,) which are required for estimating the travel demand generated at zonal level were attributed to CMA transport network (Links, Nodes, TAZs, etc.). To assess the travel demand and future characteristics, the growth rates considered were according to the Second Master Plan until the horizon period of 2026 beyond which the growth rates considered were according to the developments envisaged. The travel demand, characteristics and Origin-Destination (O-D) person trip matrices obtained from the primary traffic and travel surveys were assigned onto the travel network and validated. The details of the same are furnished in Annexure-D.

A four-stage land use-based transport model was developed Chennai Travel Demand Model. The four-stage transportation model consists of trip generation, trip distribution, mode choice and trip assignment. The details of the process have been discussed in Annexure D. The travel demand model has been assigned, calibrated and validated for the base year and the outcomes are as represented in the Table 5-2 and Table 5-1, the average V/C ratio is observed to be 0.51 and the average speed is 25.40 km/hr (CMA) and 15.13 km/hr (along Mobility Corridors). The base year desire line and passenger flow is as shown in Figure 5-1 and Figure 5-2.

Table 5-1: V/C and Corridor PPHPD on Major Roads for Base Year 2018

S. No	Name of Road	Base 2018	
		V/C	Corridor PPHPD
1	Jawaharlal Nehru Road	0.84	29128
2	Anna Salai	0.71	27394
3	Great Southern Trunk Road	0.84	24539
4	Rajaji Salai	0.71	12599
5	Poonamalle High Road	0.80	18919
6	Old Siruseri Road	0.41	12802
7	East Coast Road	0.79	9810
8	NH-16	0.46	12661
9	Chennai-Thiruvallur High Road	0.26	17938
10	NSK Salai	0.63	15550
11	Erukkancheri High Road	0.98	10961
12	Nungambakkam High Road	0.95	11525
13	Arcot Road	0.65	9830
14	Chennai Bypass Road	0.75	18181
15	Kuntrathur Road	0.85	5920
16	New Avadi Road	0.40	7374
17	ORR	0.70	3963
18	Tiruvottiyur Ponneri Panchetti Road	0.58	7374
19	200 Feet Road	0.47	3963
20	Mount Poonamalle Road	0.83	7351

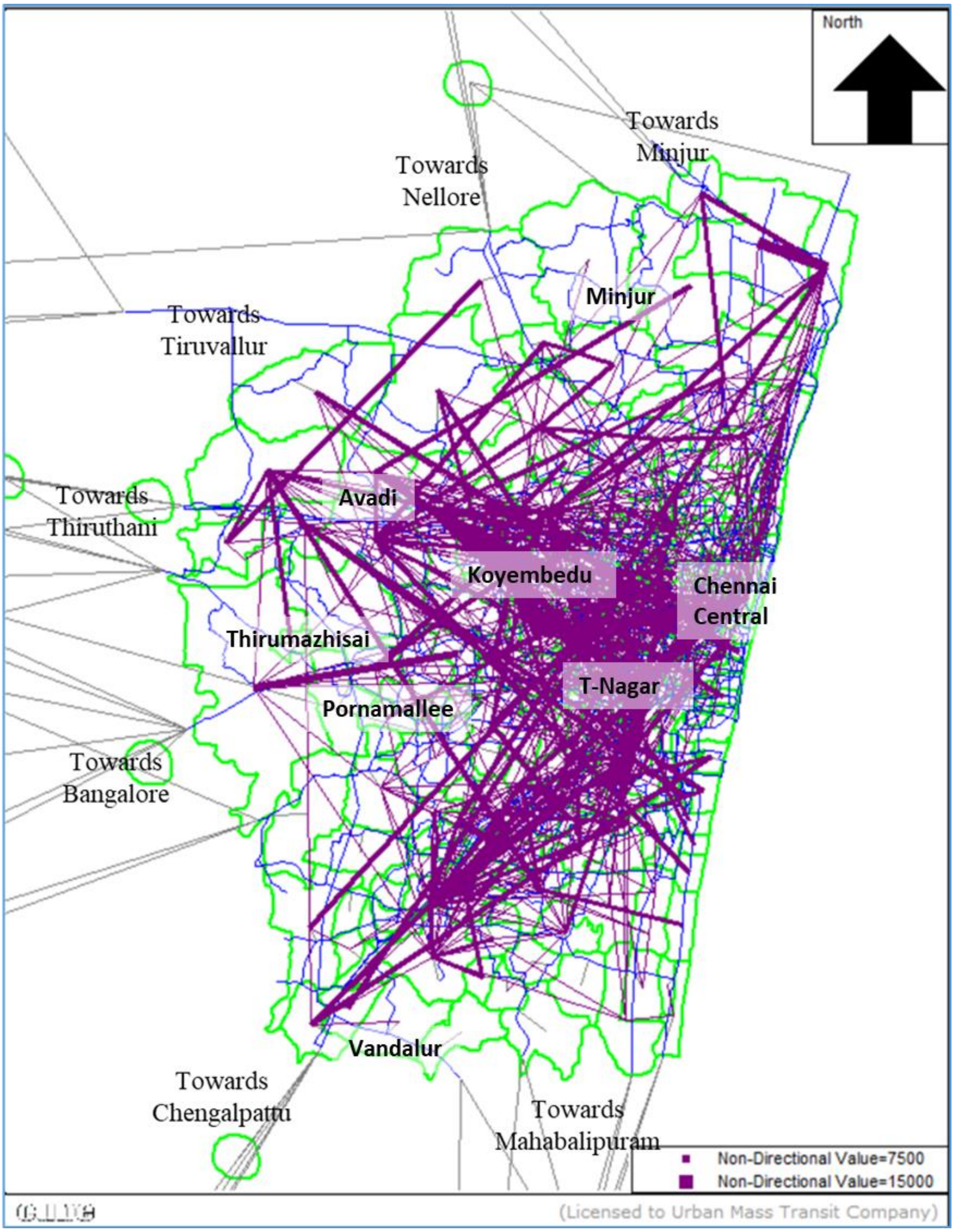


Figure 5-1 Base Year-2018 Desire line Diagram

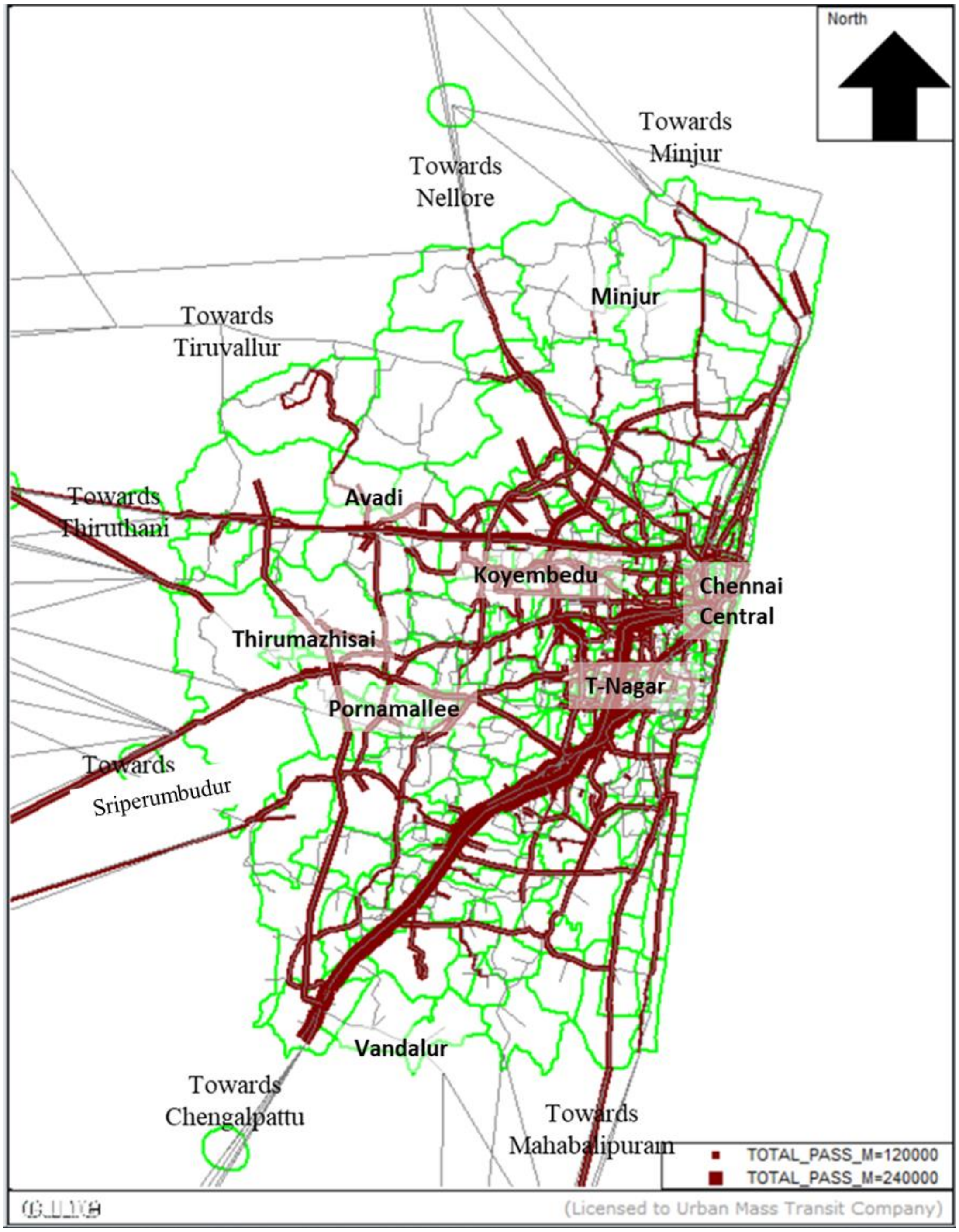


Figure 5-2 Base Year-2018 Passenger Flows

Table 5-2: Network Characteristics for Base Year 2018

Outcomes	2018
Avg. Network Speed (kmph)	25.40
Avg. V/C Ratio	0.51
PVT Vehicle Distance Travelled (Veh-Km)	13584
Share of Public Transport Trips (Excluding Intrazonal Trips)	41%

5.2 BUSINESS AS USUAL SCENARIO

CMP considers Business as Usual Scenario (BAU) wherein the present base year trends are assumed to continue for the horizon years with minimum changes to occur in the future. This scenario assesses the transport system with base year trends and assumes no radical policy interventions for sustainable development and emission mitigations to identify the effects on travel infrastructure, mode share and PT systems in the city.

The BAU scenario evaluated using two sub-scenarios, namely-

1. Business as Usual – Do Nothing Scenario (without any committed projects)
2. Business as Usual – Do Minimum Scenario (with committed projects)

5.2.1.1 SOCIO-ECONOMIC TRANSITIONS

The socio-economic transitions are considered to attribute the travel characteristics for the horizon year.

5.2.1.2 POPULATION PROJECTIONS

The population of CMA region as per Census 2011 is 86.54 lakhs with a decadal growth rate of 31.91% and CAGR of 2.81%. The population projections for the base and horizon year are considered on comparing the 2nd Master Plan's projected 2011 population and the actual population observed by the census. In consultation with CMDA, it was understood that the low growth scenario of UUGD (Urban-Urban Growth Difference) for the city and medium growth scenario of UURGD (Urban –Urban Rural Growth Difference) for CMA is more apt. Similarly, for CMP projections in the Second Master Plan have been updated based on 2011 Census Population.

The Existing Population (as per 2011 Census) was projected for the horizon year of 2018, 2023, 2028. 2038 and 2048. The upcoming past growth trend was considered to arrive at a method for projection of population in all the areas. The land along the proposed mass rapid transit corridor has potential to be developed as Transit Oriented Development and is also considered for population projections. The rest of CMA is expected to grow very fast compared to Chennai city, due to new developments, upcoming investments and migrating population at nearby/surrounding areas. The UUGD method was found suitable for the City and UURGD method was found more appropriate for the CMA as a whole, with the assumption of growth rate based on history and judgment and also the future urbanisation and population policies. Population for the horizon year is calculated and the same is presented in Table 5-3. The distribution of population and population density under Business As Usual scenario for horizon years 2018 and 2048 are as shown in Figure 5-3.

Table 5-3: Population Projections for Chennai

S.No	Name of the Area	Population (in Lakhs)					
		2011	2018	2023	2028	2038	2048
1	Chennai City	46.47	50.76	54.27	57.92	66.47	79.25
2	Rest of CMA	40.07	46.97	52.72	59.15	75.07	101.23
3	Total CMA	86.54	97.72	106.99	117.06	141.55	180.49

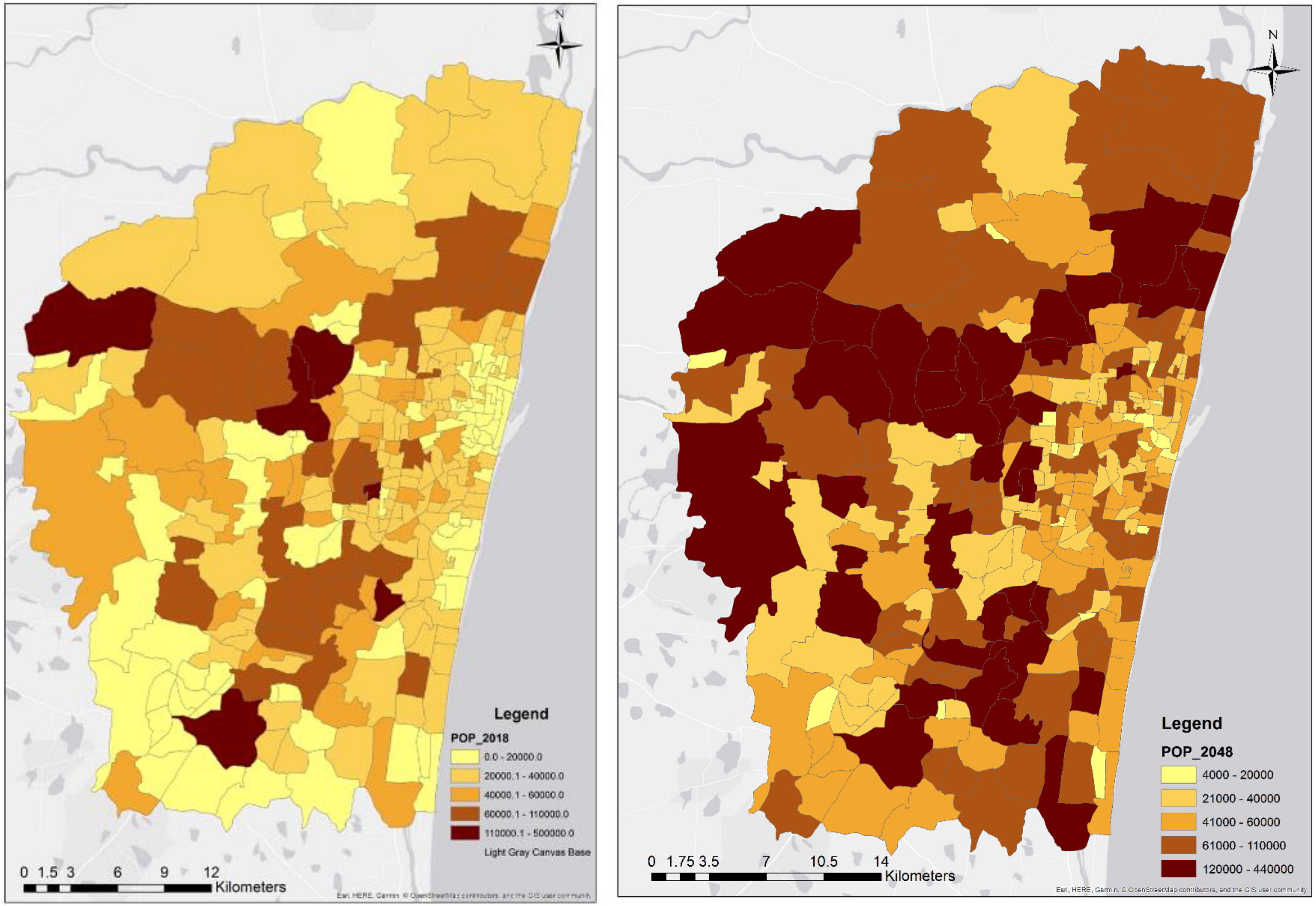


Figure 5-3 Population Distribution- for BAU (2018 and 2048)

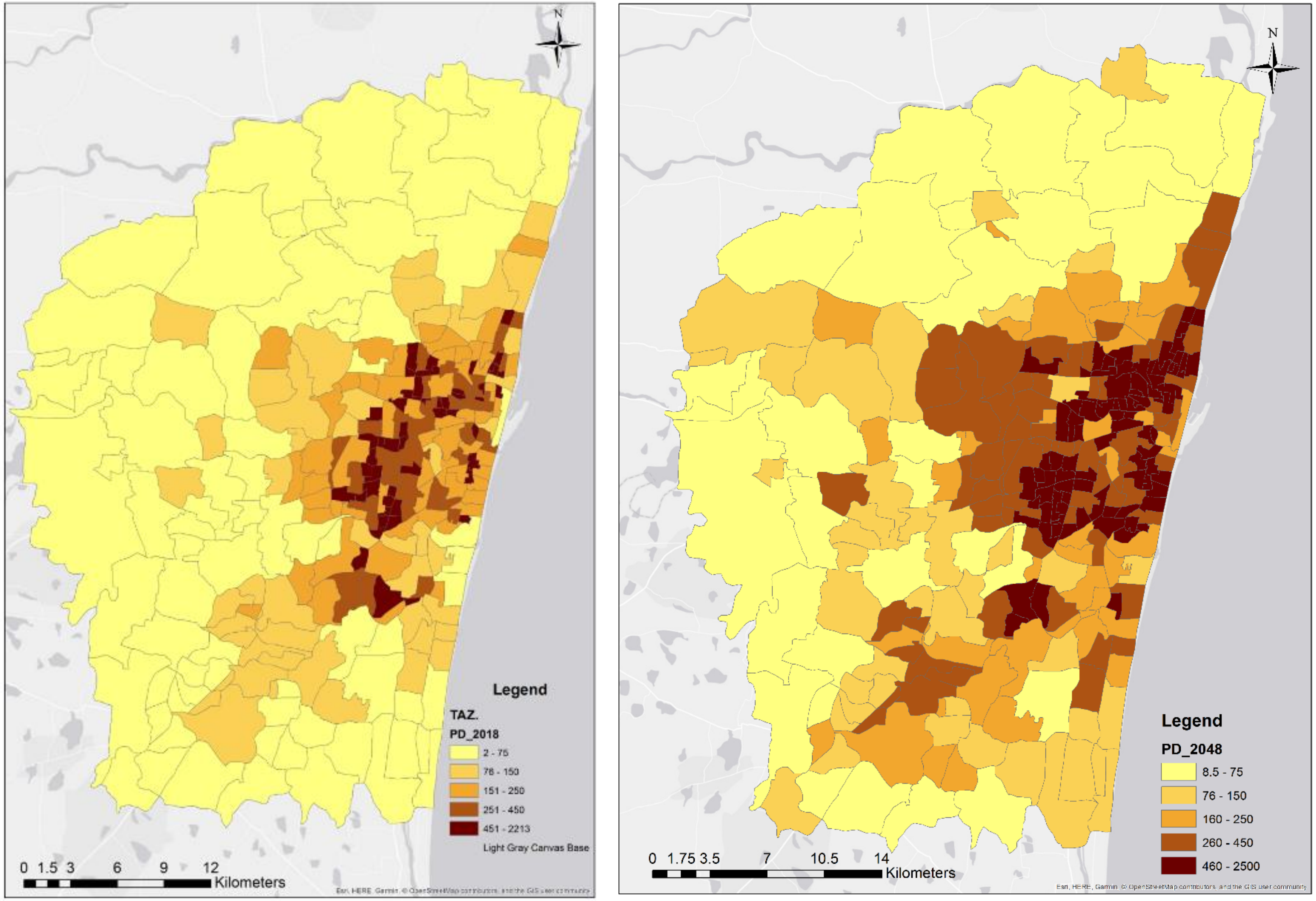


Figure 5-4: Population Density Distribution-2018 & 2048 for BAU

5.2.1.3 EMPLOYMENT PROJECTIONS

Similar to the population projections the employment projections have been carried out for the base and horizon years based (as shown in Table 5-4) with the assumption of growth rate based on history and judgment and also the future urbanisation and Employment policies.

Table 5-4 Employment for Horizon Years (2018-2048)

S.No	Name of the Area	Employment (In Lakh)				
		2018	2023	2028	2038	2048
1	Chennai City	23.05	27.28	31.87	40.82	53.07
2	Rest of CMA	22.65	26.82	31.32	40.13	52.18
3	Total CMA	45.71	54.10	63.19	80.96	105.25

The distribution of employment and employment projections for the base and horizon years 2018 & 2048 are shown in Figure 5-5 and Figure 5-6

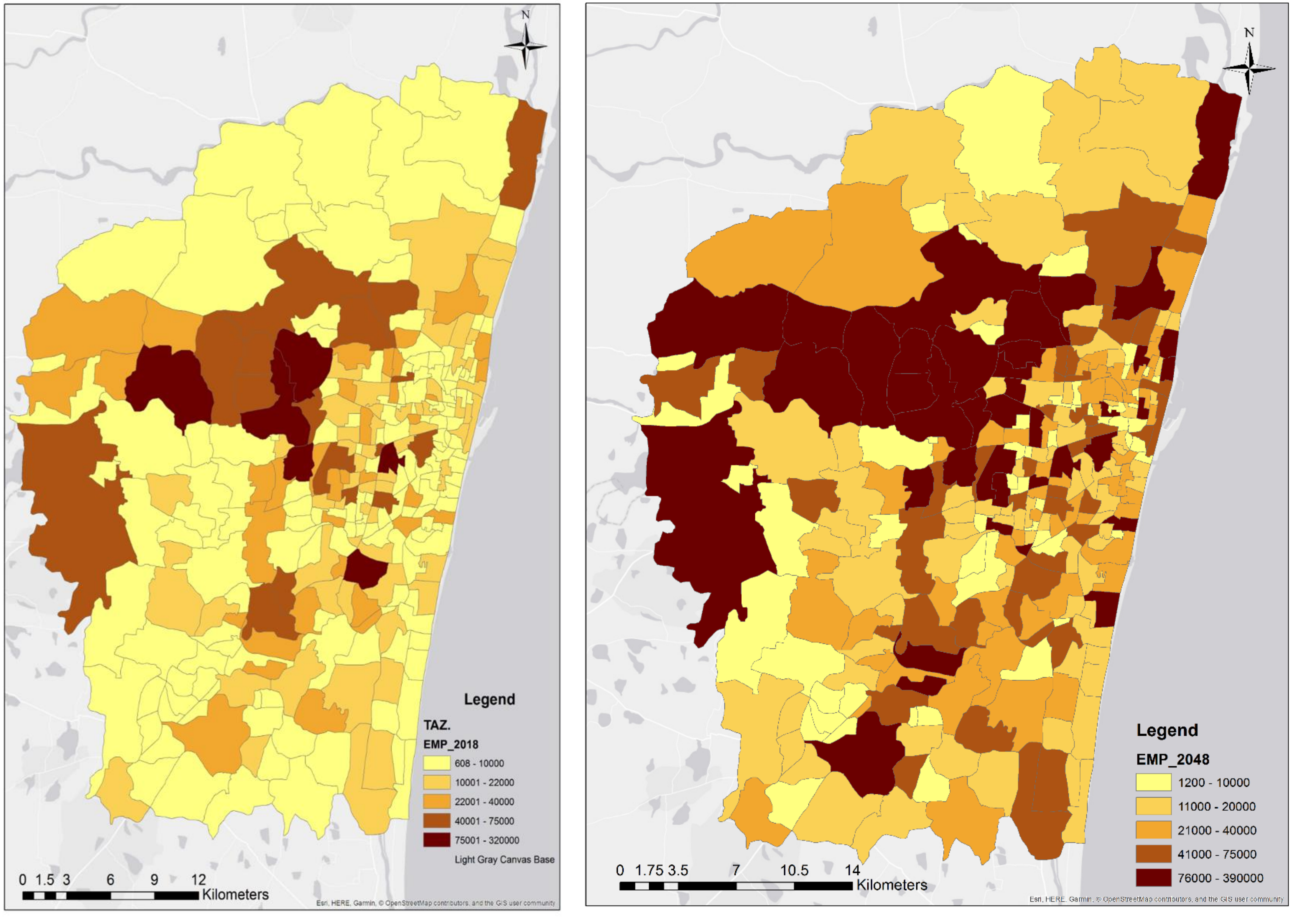


Figure 5-5 Employment Distribution- for BAU (2018 and 2048)

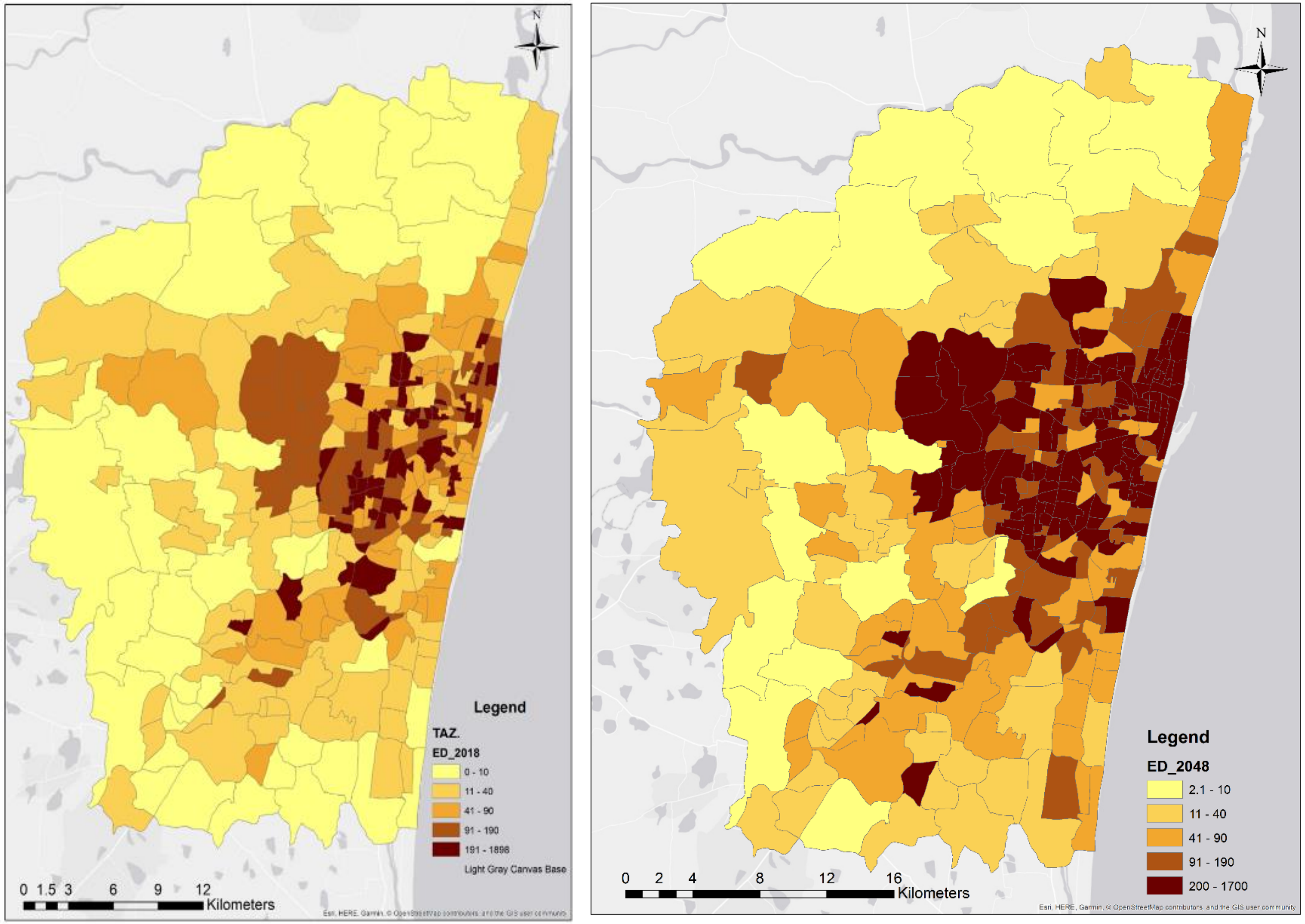


Figure 5-6 Employment Density Distribution- for BAU (2018 and 2048)

5.2.1.4 LANDUSE TRANSITIONS

The proposed land-use distribution as per the Chennai Metropolitan Development Authority (CMDA) is shown in the Figure 5-7 Horizon Year Land use (2026). It is observed that major portion (45%) is occupied by primary and mixed residential land use followed by land under transport and Communication (13.3%) and Public & Semi-public (6.1%). The envisaged land use pattern has been considered in the BAU scenario.

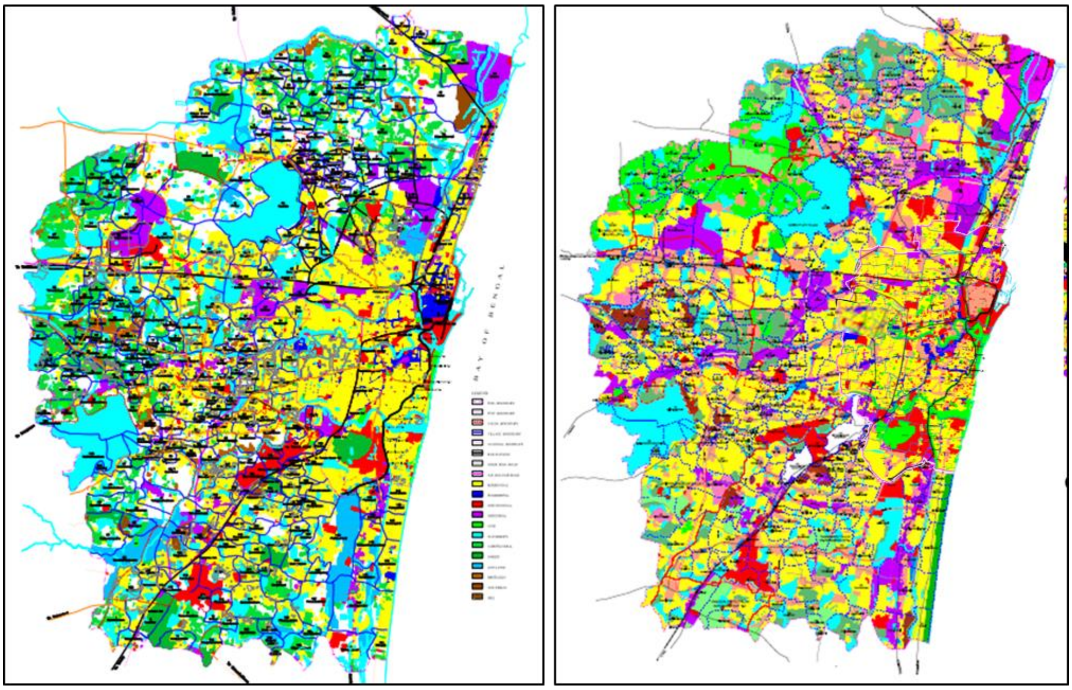


Figure 5-7 Land use Plan (2006) and Proposed Land use Plan (2026)

Table 5-5 Proposed Land Use 2026

Land Use	Chennai City		Rest of CMA	
	Extent in Hectares	%	Extent in Hectares	%
Primary Residential use zone	5917	33.5%	32091	31.6%
Mixed Residential use zone	2427	13.7%	13503	13.3%
Commercial use zone	714	4.05%	880	0.8%
Institutional use zone	2869	16.2%	3889	3.8%
Industrial use zone	692	3.9%	7274	7.1%
Special and Hazardous Industrial use zone	131	0.7%	3416	3.3%
Open Space & Recreational use zone	1001	5.6%	393	0.3%
Agriculture use zone			7296	7.2%
Non-Urban	113	0.6%	2333	2.3%
Urbanisable			2076	2.0%

Land Use	Chennai City		Rest of CMA	
	Extent in Hectares	%	Extent in Hectares	%
Others (Roads, water bodies, hills, Redhills catchments area, forests etc.,)	3755	21.3%	28148	27.8%

5.2.2. BUSINESS AS USUAL SCENARIO - DO NOTHING

In Do Nothing Business as Usual (BAU-DN) scenario the existing road network with no expected development in existing road network is considered along with the planning variable and travel characteristics. The details of internal and external trips and travel demand forecast are as shown Annexure D. The average V/C ratio increases from 0.51 to 1.20 and the average network speed decreases from 25.4 km/hr to 10.14km/hr from base year 2018 to horizon year 2048. The peak period considered in the base year model for computing the V/C values is from 8:00am to 12 noon. V/C ratios along with corridor PPHPD on major roads for horizon years have been compiled and presented in Table 5-6. The outcomes of the network characteristics are as shown in Table 5-7. The passenger flow diagrams for the Horizon years is presented in Figure 5-8 and the passenger flow diagrams for the Horizon years is presented in Figure 5-9.

Table 5-6: V/C and Corridor PPHPD on Major Roads for Horizon Years - BAU Do Nothing

S. N	Name of Road	V/C Ratio				Corridor PPHPD			
		2023	2028	2038	2048	2023	2028	2038	2048
1	Jawaharlal Nehru Road	0.93	1.06	1.28	1.51	32582	35757	35430	38980
2	Anna Salai	0.81	0.88	1.03	1.20	26701	24807	25140	26887
3	Great Southern Trunk Road	0.87	0.94	1.06	1.25	24877	24051	26472	25653
4	Rajaji Salai	0.68	0.80	1.01	1.25	13321	13167	12359	14404
5	Poonamalle High Road	0.89	1.00	1.21	1.46	20164	20726	27806	32814
6	Old Mahabalipuram Road	0.56	0.62	0.74	0.86	16112	16096	18816	28807
7	East Coast Road	0.35	0.44	0.58	0.79	10762	15238	12728	23808
8	Grand Northern Trunk Road –NH16	0.77	0.88	1.11	1.30	13987	13061	15376	16764

S. N	Name of Road	V/C Ratio				Corridor PPHPD			
		2023	2028	2038	2048	2023	2028	2038	2048
9	Chennai-Thiruvallur High Road	1.22	1.43	1.78	2.19	14810	17385	21090	25169
10	NSK Salai	0.95	1.06	1.27	1.54	15734	17623	18161	19616
11	Erukkancheri High Road	0.88	1.02	1.28	1.57	15464	15701	16140	20460
12	Nungambakkam High Road	0.81	0.92	1.15	1.40	12256	12788	12509	15378
13	Arcot Road	0.98	1.14	1.37	1.63	10622	11709	10952	12082
14	Chennai Bypass Road	0.52	0.62	0.77	0.94	15221	17631	21003	24387
15	Kundrathur Road	0.79	0.89	1.05	1.31	8024	6320	6219	8259
16	New Avadi Road	0.83	0.95	1.18	1.39	9115	9207	10346	13011
17	Outer Ring Road	0.36	0.43	0.58	0.84	4282	4380	5760	6634
18	Thiruvottiyur Ponneri Panchetti Road	0.66	0.77	0.93	1.24	7201	9109	9387	13197
19	200 ft Radial Road (East Tambaram to Velachery)	0.55	0.67	0.84	0.98	5752	6834	8117	10189
20	Mount Poonamalle Road	0.98	1.14	1.36	1.59	15983	15774	20198	20417

Table 5-7: Network Characteristics for Base Year and Horizon Years - BAU Do Nothing

OUTCOMES	2018	2048
Avg. Network Speed (kmph)	25.40	10.20
Avg. V/C Ratio	0.51	1.20
PVT Vehicle Distance Travelled (Veh-Km) ('000)	13584	27826
Share of Public Transport Trips (Excluding Intrazonal Trips)	41%	38.0%

Figure 5-8 shows that the line thickness of passenger flow along the sub urban rail increases drastically from 2018 to 2048, and metro rail network is showing an increased line thickness in the year 2048.

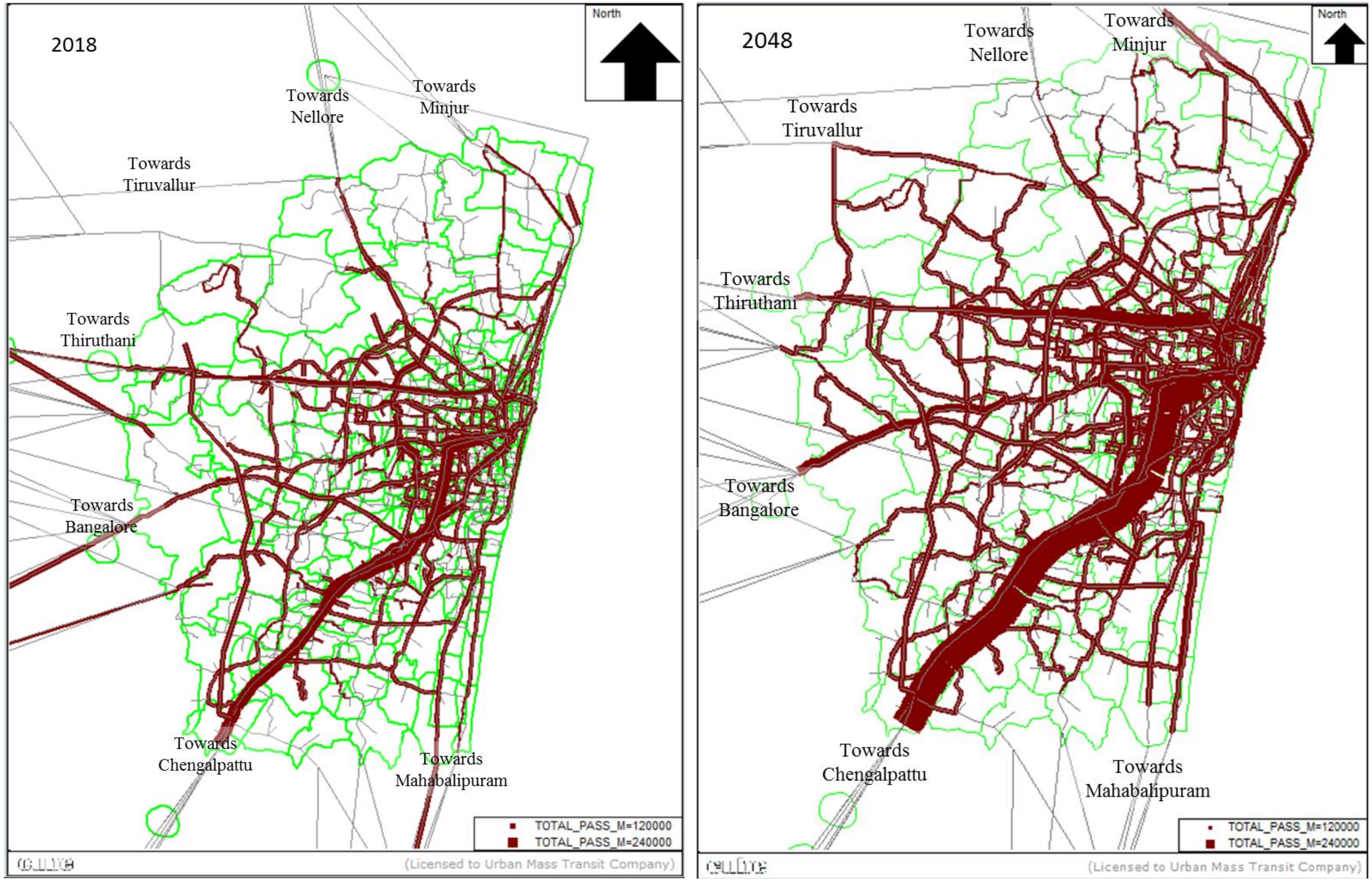


Figure 5-8 *Passenger Flows for Base Year (2018) and Horizon Year (2048) – BAU Do Nothing Scenario*

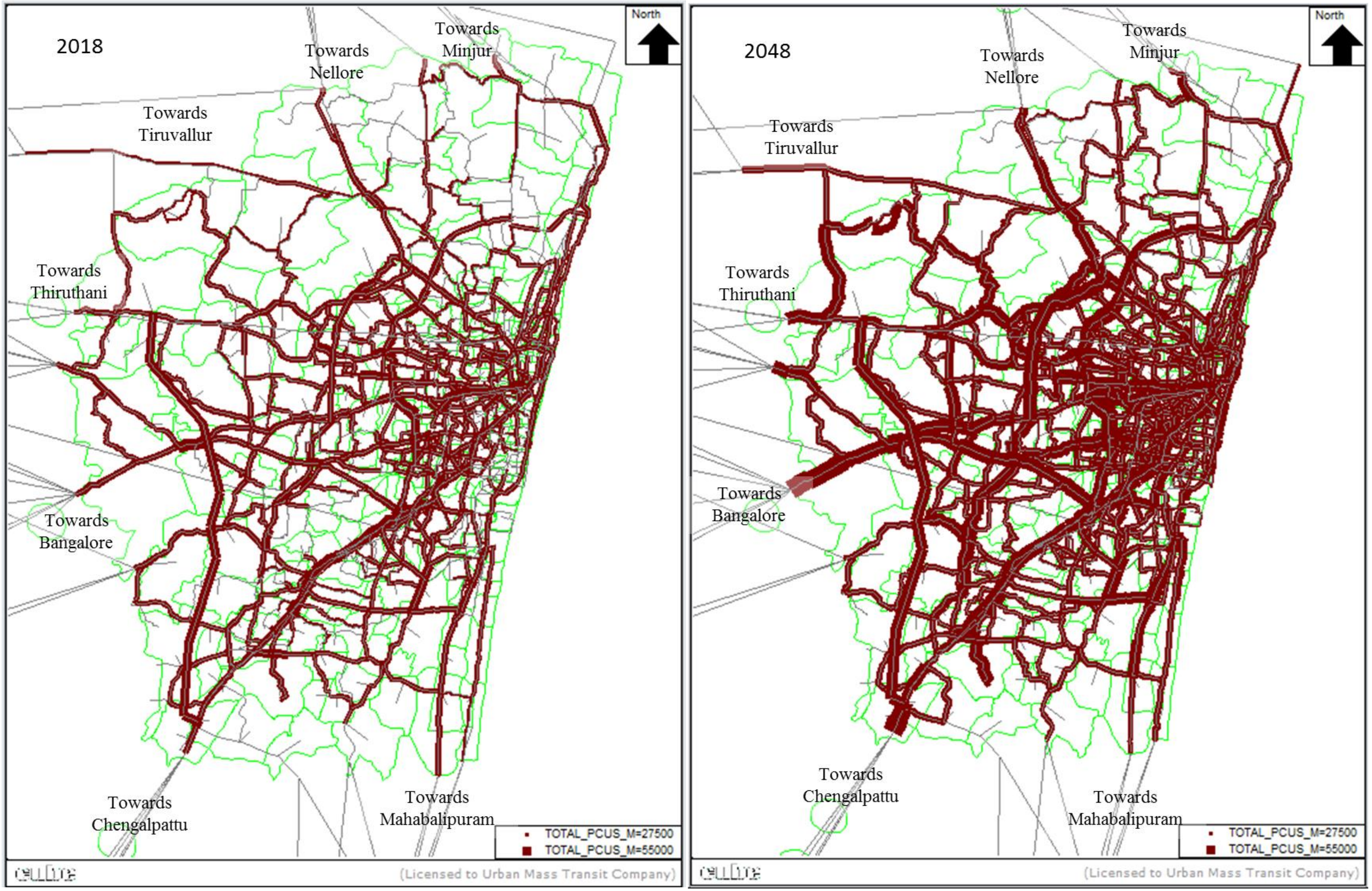


Figure 5-9: PCU Flows for Base and Horizon Year – BAU Do Nothing Scenario

5.2.3. BUSINESS AS USUAL SCENARIO - DO MINIMUM

In Do Minimum Business as Usual (BAU-DM) scenario the existing road network with committed development projects are considered. The list if committed projects proposed by various departments like NHAI, GCC, CMRL Southern Railways, etc., are given in Table 5-8. For Public Transport projects the existing frequency of operations were considered.

Table 5-8: List of Committed Road Development Projects

S.No	Highway/ PT	Name of the Proposal/Project	Implementing Agency	Implementation Timeline
1	Highway	Anna Salai with Mahalingapuram through Usman Road suitably integrating Existing flyovers.	GCC	5 years
2	Highway	Phase 2 of ORR (6 Lane from Nemilichery to Minjur)	TNRDC	5 Years
3	Highway	6 Lane elevated Road from Madhuravoyal to Sriperambudur	NHAI	5 Years
4	Highway	6 Lane Elevated corridor from Tambaram To Chengalpattu and 8 lane from Chengalpattu to Thindivanam	NHAI	5 Years
5	Highway	Construction of Rail Over Bridge (ROB) at Ennore High road and Manali Salai in lieu of Railway level crossing nos. 2A & 2B at an estimate cost of Rs. 117.47 crore	GCC	5 Years
6	Highway	Construction of bridge at Stephenson road across Otteri Nullah	GCC	5 Years
7	Highway	Construction of Vehicular Subway at Bojarajanagar in lieu of existing railway level crossing 11A under Railway deposit work.	GCC	5 Years
8	Highway	ROB at Villivakkam LC 1	GCC	5 Years
9	Highway	Widening of Bridge across Otteri Nullah at Asprin Garden 1st street.	GCC	5 Years
10	Highway	Construction of Bridges connecting Nesapakkam and Nandampakkam across Adyar River at two locations.	GCC	5 Years
11	Highway	Construction of Bridges across B'Canal at 6 locations connecting ECR and OMR.	GCC	5 Years
12	Highway	Construction of integrated ROB in lieu of existing LC No2A at Ennore High Road and LC	GCC	5 Years

S.No	Highway/ PT	Name of the Proposal/Project	Implementing Agency	Implementation Timeline
		No2B at Manali Road in Dn 38 and 41 ZoneIV DEPC method		
13	Highway	Construction of bridge across Puzhal surplus water Canal at Vadaperumbakkam in Dn-17, Zone –II by Design, Engineering, Procurement and Construction (DEPC) method.	GCC	5 Years
14	Highway	Construction of bridge across Puzhal surplus water Canal at Amullavoyal in Dn-18, Zone –II by Design, Engineering, Procurement and Construction (DEPC) method.	GCC	5 Years
15	Highway	Construction of bridge across Puzhal surplus water Canal at Burma Nagar Main Road in Dn-16, Zone –II by Design, Engineering, Procurement and Construction (DEPC) method.	GCC	5 Years
16	Highway	Construction of ROB in lieu of existing Level Crossing at Kolathur - Villivakkam LC1 in Dn-65, Zone – VI and in Dn- 95 &96, Zone –VIII	GCC	5 Years
17	Highway	Construction of Grade Separator at Teynampet junction connecting Theyagaraya Road and Eldams Road in Dn- 117 & 123, Zone – IX by Design, Engineering, Procurement and Construction (DEPC) method.	GCC	5 Years
18	Sub-Urban	4th line from Beach to Egmore	Southern Railways	5 to 10 years
19	Sub-Urban	4th line from Beach to Korukkupet	Southern Railways	5 years
20	Sub-Urban	3rd and 4th Line from Beach to Attipattu	Southern Railways	10 years
21	Sub-Urban	3rd Line from Tambaram to Chengalpattu MRTS	Southern Railways	5 years
22	Sub-Urban	4th Lne from Tambaram to Chengalpattu MRTS	Southern Railways	5 to 10 years

The average V/C ratio increases from 0.51 (2018) to 1.10 (BAU-Do minimum -2048) and the average network speed decreases from 25.40 km/hr to 12.10 km/hr from base year 2018 to horizon year 2048(BAU-Do minimum). V/C ratios along with corridor PPHPD on major roads for horizon years have been compiled and presented in Table 5-9. The outcomes of the network characteristics are as shown in Table 5-10. The passenger flow diagrams and PCU flow diagram for the Horizon years are presented in Figure 5-10 and Figure 5-11.

Table 5-9: V/C and Corridor PPHPD on Major Roads for Horizon Years - BAU Do Minimum

S.N	Name of Road	V/C				Corridor-PPHPD			
		2023	2028	2038	2048	2023	2028	2038	2048
1	Jawaharlal Nehru Road	0.87	0.97	1.21	1.47	30284	31595	34202	39777
2	Anna Salai	0.75	0.82	0.95	1.13	28468	29679	31024	46840
3	Great Southern Trunk Road	0.79	0.86	1.01	1.21	25314	27052	26338	25920
4	Rajaji Salai	0.64	0.76	1.00	1.26	13371	11498	11622	14185
5	Poonamalle High Road	0.81	0.90	1.07	1.25	20267	21215	28457	30925
6	Old Mahabalipuram Road	0.52	0.58	0.68	0.83	15529	16504	18954	28766
7	East Coast Road	0.35	0.42	0.61	0.81	10091	11322	17681	22205
8	Grand Northern Trunk Road -NH16	0.64	0.70	0.88	1.14	8037	7372	7910	10555
9	Chennai-Thiruvallur High Road	1.08	1.24	1.52	1.93	15761	17018	21639	26568
10	NSK Salai	0.87	0.97	1.18	1.46	16068	17630	18979	19522
11	Erukkancheri High Road	0.89	1.04	1.30	1.63	15815	14017	16399	20222
12	Nungambakkam High Road	0.82	0.92	1.10	1.33	12320	12393	12024	14556
13	Arcot Road	0.84	0.97	1.20	1.51	11189	11288	11874	11528

S.N	Name of Road	V/C				Corridor-PPHPD			
		2023	2028	2038	2048	2023	2028	2038	2048
14	Chennai Bypass Road	0.50	0.60	0.81	1.03	15193	16193	19993	25096
15	Kuntrathur Road	0.76	0.88	1.07	1.37	10306	11254	6831	9026
16	New Avadi Road	0.79	0.90	1.09	1.31	9353	8966	9999	12284
17	Outer Ring Road	0.45	0.57	0.76	0.93	7673	9182	11038	13755
18	Ponneri Road	0.51	0.58	0.79	1.00	7044	7396	9682	13141
19	200 ft Radial Road (East Tambaram and Velachery)	0.49	0.60	0.79	1.00	5200	6093	7826	10283
20	Mount Poonamalle Road	0.82	0.95	1.18	1.43	15532	15466	17295	20380

Table 5-10: Network Characteristics for Horizon Years- BAU Do Minimum

Comparison	2018	2048
Avg. Network Speed (kmph)	25.40	12.10
Avg. V/C Ratio	0.51	1.10
PVT Vehicle Distance Travelled (Veh-Km) ('000)	13584	29694
Share of Public Transport Trips*	41%	37.0%

*Excluding Intra Zonal Trips

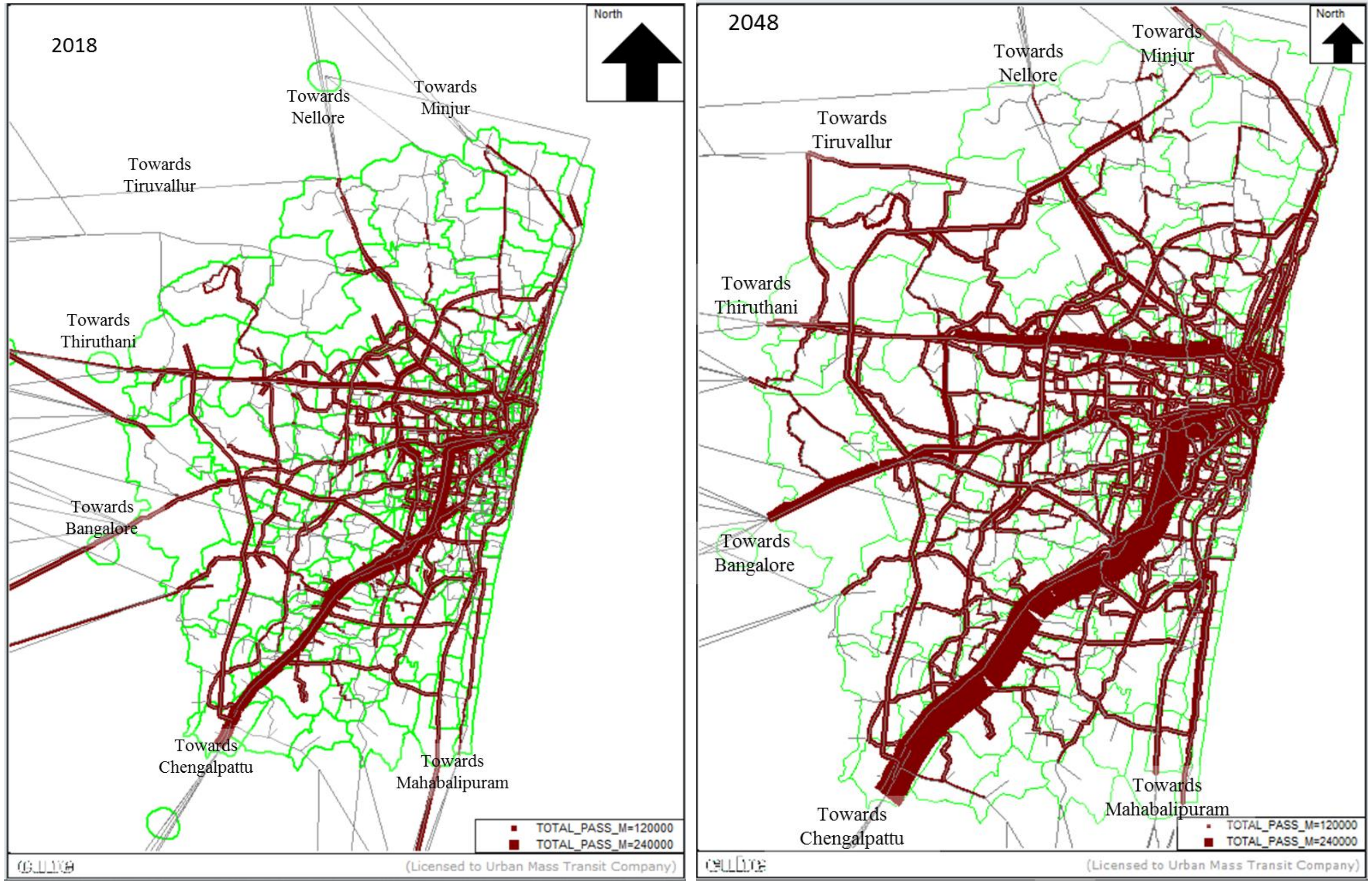


Figure 5-10 Passenger Flows for Base Year (2018) and Horizon Year (2048)– BAU Do Minimum Scenario

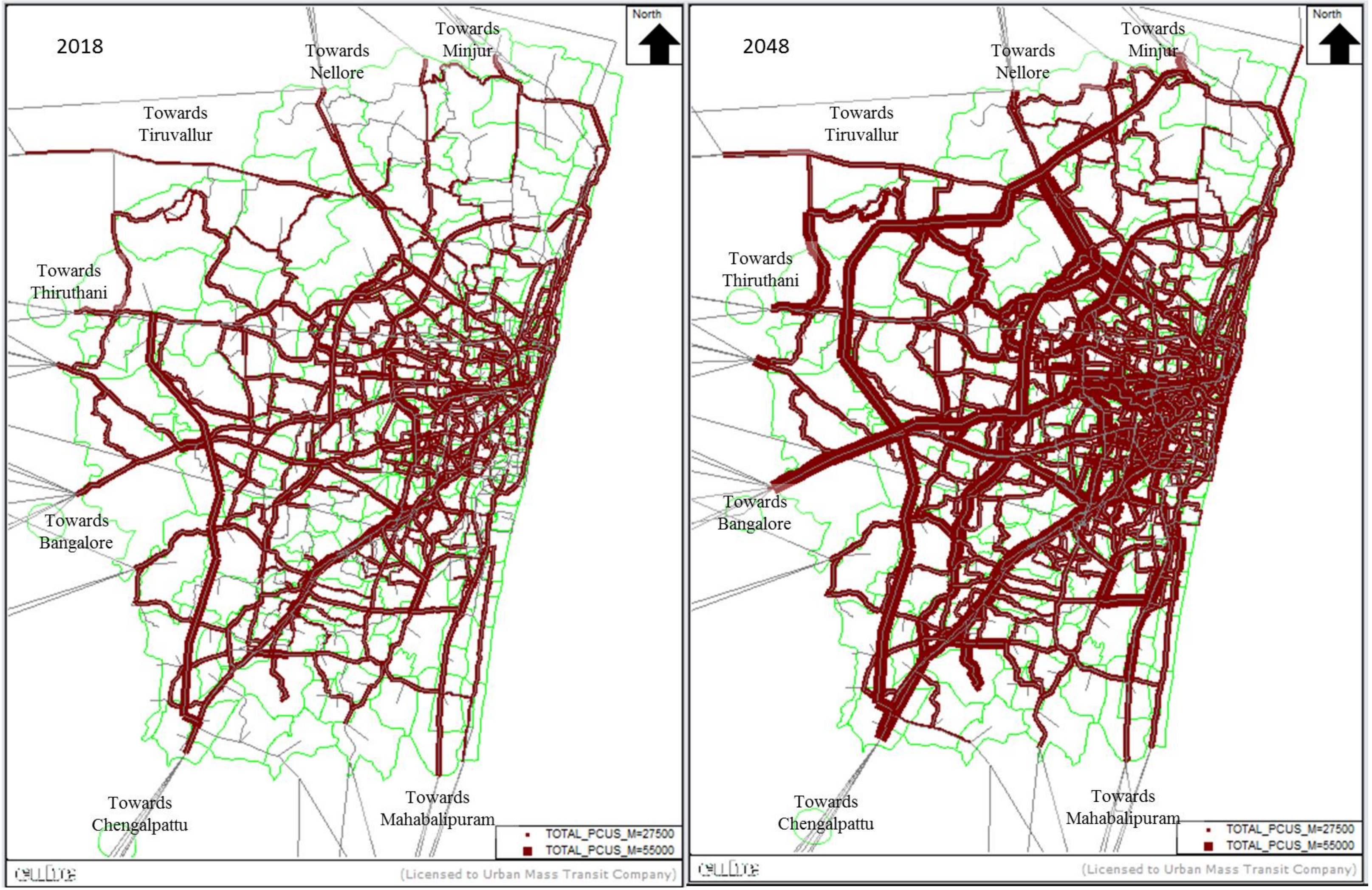


Figure 5-11: PCU Flows for Base Year (2018) and Horizon Year (2048) – BAU Do Minimum Scenario

On comparing the outputs of Base scenario with BAU -Do minimum scenario, it is observed that VC ratio has increased 1.5 times from 0.51 in 2018 to 1.10 in 2048 and the average speed has decreased from 25.40 kmph to 12.1 kmph. This indicates the increased travel time and exhausted capacity of the exiting road infrastructure. Thus, it is necessary to identify strategies with a long-term vision for convenient and sustainable movement of people in Chennai.

Table 5-11: Network Characteristics for Horizon Years

Outcomes	Base-2018	BAU-DN 2048	BAU-DM 2048
Avg. Network Speed (kmph)	25.40	10.20	12.10
Avg. V/C Ratio	0.51	1.20	1.10
PVT Vehicle Distance Travelled (Veh-Km)	13584	27826	29694
Share of Public Transport	41%	38.0%	37.0%

The study seeks to develop a most optimal transport road map keeping in view the National Urban Transport Policy which strongly suggests that if transport has to be sustainable, a radical shift must be made towards Public Transport supply and non-motorized transport modes. Thereby, goals and objectives have been designed to cater for the transportation needs of Chennai.

5.3 VISION

As stated earlier, the CMP is a long-term vision for desirable accessibility and mobility pattern for people and goods in Chennai to provide safe, secure, efficient, reliable and seamless connectivity that supports and enhance economic, social and environmental sustainability. The four major elements that outline the city's vision are:

- **Sustainability**: The transportation system of the City shall be conducive to lower consumption of fossil fuels. It shall be based on managing the travel demand itself, rather than trying to provide for whatever demand exists and allowing demand to grow in an unplanned way.
- **Equity**: Transportation in the City shall be accessible to all demographic sections of society. The City shall provide "Mobility for all", meaning any person above a certain age should be able to travel independently. Special attention shall be paid to school students, senior citizens, people from financially weaker sections, women - especially pregnant women, physically challenged persons.
- **Convenience**: Not only residents of the City, but also visitors should also be able to figure their way around the city very easily.

- **Safety**: Rates of fatal and serious traffic accidents should be at par with the best in the world.

In order to provide a transportation system for the citizens of Chennai that has all the above characters, the vision of Comprehensive Mobility Plan (CMP) for Chennai is defined as:

> ***To attain a People Centric Urban Transport System that aims at achieving livable and inclusive community through an efficient and sustainable system by providing integrated, safe and convenient mobility to people of all abilities and goods.***

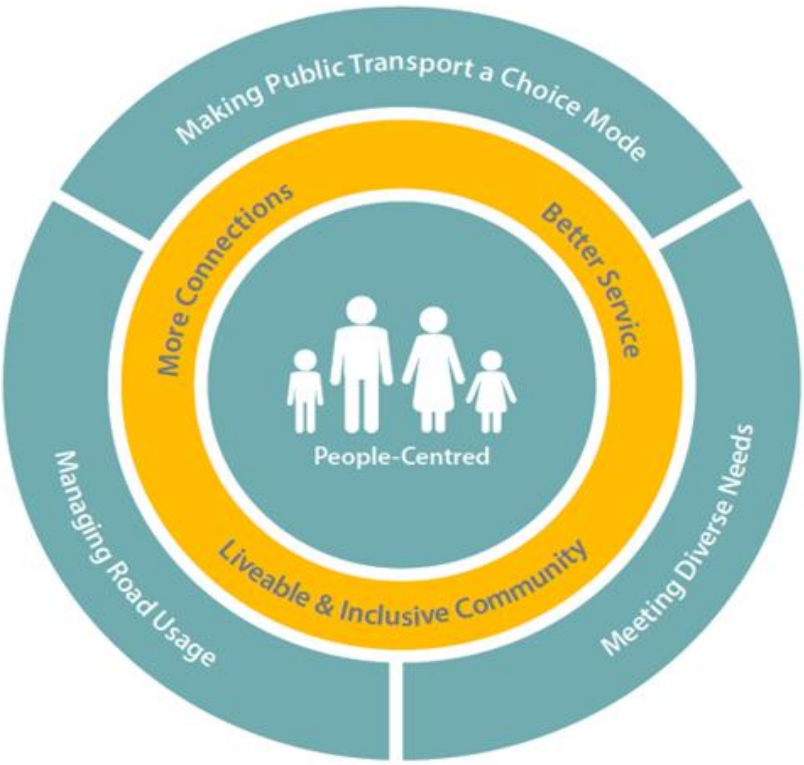


Figure 5-12 Schematic Vision representation

5.4 GOALS

To ensure that mobility solutions for Chennai are people centric and are in conformity with sustainable mobility, various goals have been targeted for the horizon year. Table 5-12 shows the goals set to be achieved in the horizon year by implementing all the proposals recommended in this study.

Goal 1: Develop Public Transit system in conformity with the land use that is accessible, efficient and effective.

Goal 2: Ensure safety and mobility of pedestrians and cyclist by designing streets and areas that make a more desirable, liveable city for residents and visitors and support the Public Transport system.

Goal 3: Develop traffic and transportation solutions that are environmentally sustainable, economically and financially viable for efficient and effective movement of people and goods.

Goal 4: Develop a Parking System that reduces the demand for parking and need for private mode of transport and also facilitate organized parking for various types of vehicles.

Table 5-12: Target goals for sustainable solutions

Name of the Impact	Base Year (2018)	BAU Scenario Do Nothing (2048)	BAU Scenario Do Minimum (2048)	SUT Scenario (2048) – Target
Share of Private Transport (PVT) Trips	49.1%	54.8%	55.9%	<50.0%
Share of Public Transport Trips	41.0%	38.0%	37.0%	>50.0%
Share of Intermediate Public Transport (IPT) Trips	9.9%	7.3%	7.1%	7.0%
Avg. Network Speed (kmph)	25.40	10.2	12.1	>24
Walkability (Arterial & Sub-Arterial)	38.0%	38.0%	39.2%	>90.0%
Cyclability (Arterial & Sub-Arterial)	0.0%	0.0%	1.3%	>80.0%
PVT Vehicle Kilometer Travelled (in '000)	13584	27826	29694	Reduce by 10%

Each goal can be achieved by meeting the following objectives:

- Improve the Public Transport (PT) accessibility by densification along major Public Transport corridors and integration with feeder services. This reduces the need of travel for daily needs and increases the usage of sustainable modes.
- Improve the Public Transport system by provision of dedicated lanes/ROW and good quality of service.
- Ensure safety and mobility of Pedestrians and cyclists by designing streets and areas that make a more desirable, liveable city for residents and visitors and support the Public Transport system.
- Encourage low carbon emission modes by providing Public Bicycle Sharing schemes and disincentive and taxation for highly polluted private vehicles.
- Develop a Parking Policy that reduces the demand for parking and need for private mode of transport and also facilitate organized parking for various types of vehicles to reduce the usage of private modes.

5.5 SUSTAINABLE URBAN TRANSPORT SCENARIO

As shown in Table 5-12, BAU scenario results in increased private trips and decreased Public Transport trips. As per Ministry of Housing and Urban Affairs guidelines and RFP, a sustainable scenario has to be considered to reduce congestion and pollution, while conserving resources like urban space and capital expenditure. Hence, a Sustainable Urban Transport (SUT) Scenario has been developed that achieves the goals stated in the earlier section in line with CMP vision.

The following proposals have been prioritized and considered based on the outputs of BAU and secondary reports (i.e. Second Master Plan-2008, CTS-2008, Master Plan Metro Rail-2015, etc.). These proposals have been evaluated in the calibrated travel demand model.

- Land use-Transit network integration, Transit Oriented Development along mobility corridors,
- Development of mass transit corridors,
- Development of Public Transport Corridors (Trunk and Feeder) and Augmentation of buses,
- Development of Multi modal interchanges,

- Development of mobility corridors and other roads as per road hierarchy (i.e. missing links, Hierarchy road system, part of public transit corridor),
- Improved infrastructure facilities for Non-Motorised Transport,
- Improvements in vehicle technologies.

5.5.1. SOCIO-ECONOMIC TRANSITIONS

The following socio-economic transitions are considered to attribute the travel characteristics for the horizon year.

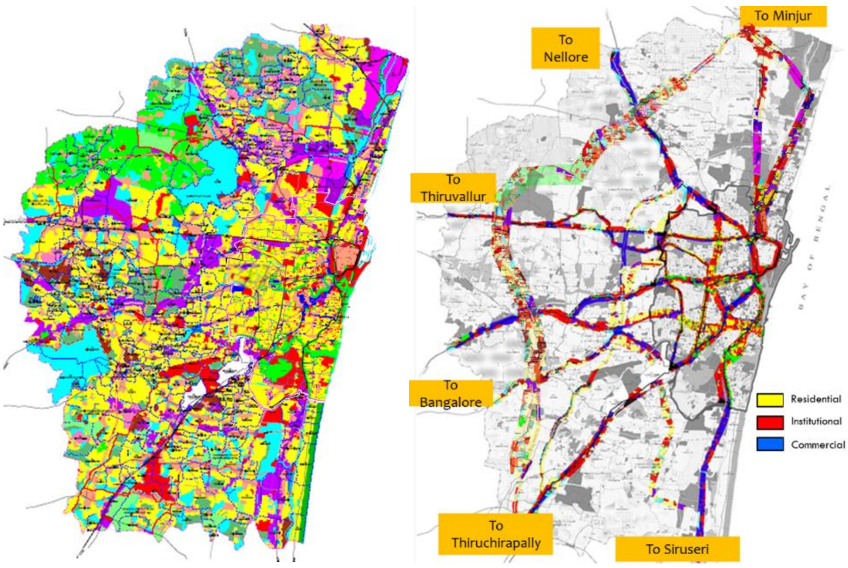


Figure 5-13 Proposed Land use Plan-2026(Left) and Proposed Corridors for densification in SUT (Right)

5.5.1.1 LANDUSE TRANSITIONS

The land use/transport-based approach is based on the underlying principle that the spatial re-distribution of population in the study area will depend on transport network options (accessibility) and land use (including concentration of population and employment at growth centres). The parameters identified for the re-distribution of population and employment to the clusters are: availability of land for development, economic activity prospects, revised Floor Space Index, lengths of bus route network, metro and other transit network, national highway, state highway, and all other existing and proposed major (4 lane and above) roads that pass through the cluster, number of potential growth centres areas in each cluster, and accessibility by various modes of transit systems and mobility corridors. Such considerations are taken to employ and achieve population and employment distribution for future years based on the concept of Transit Oriented Development (TOD) along major mobility and transit corridors as shown in Figure 5-13.

5.5.1.2 POPULATION PROJECTIONS

Based on the land use/transport-based approach the spatial re-distribution of population in the study area was carried out by assigning weightages to each of the selected criteria as discussed in Section 5.5.1.1. Under Sustainable Urban Transport Scenario. The re-distributed population and achieved population density is as represented in Figure 5-14 and Figure 5-15.

5.5.1.3 EMPLOYMENT PROJECTIONS

Based on the land use/transport-based approach the spatial re-distribution of employment in the study area was carried out by assigning weightages to each of the selected criteria as discussed in Section 5.5.1.1. Similar to the population distribution under Sustainable Urban Transport Scenario. The re-distributed employment and achieved employment density is as represented in Figure 5-16 and Figure 5-17.

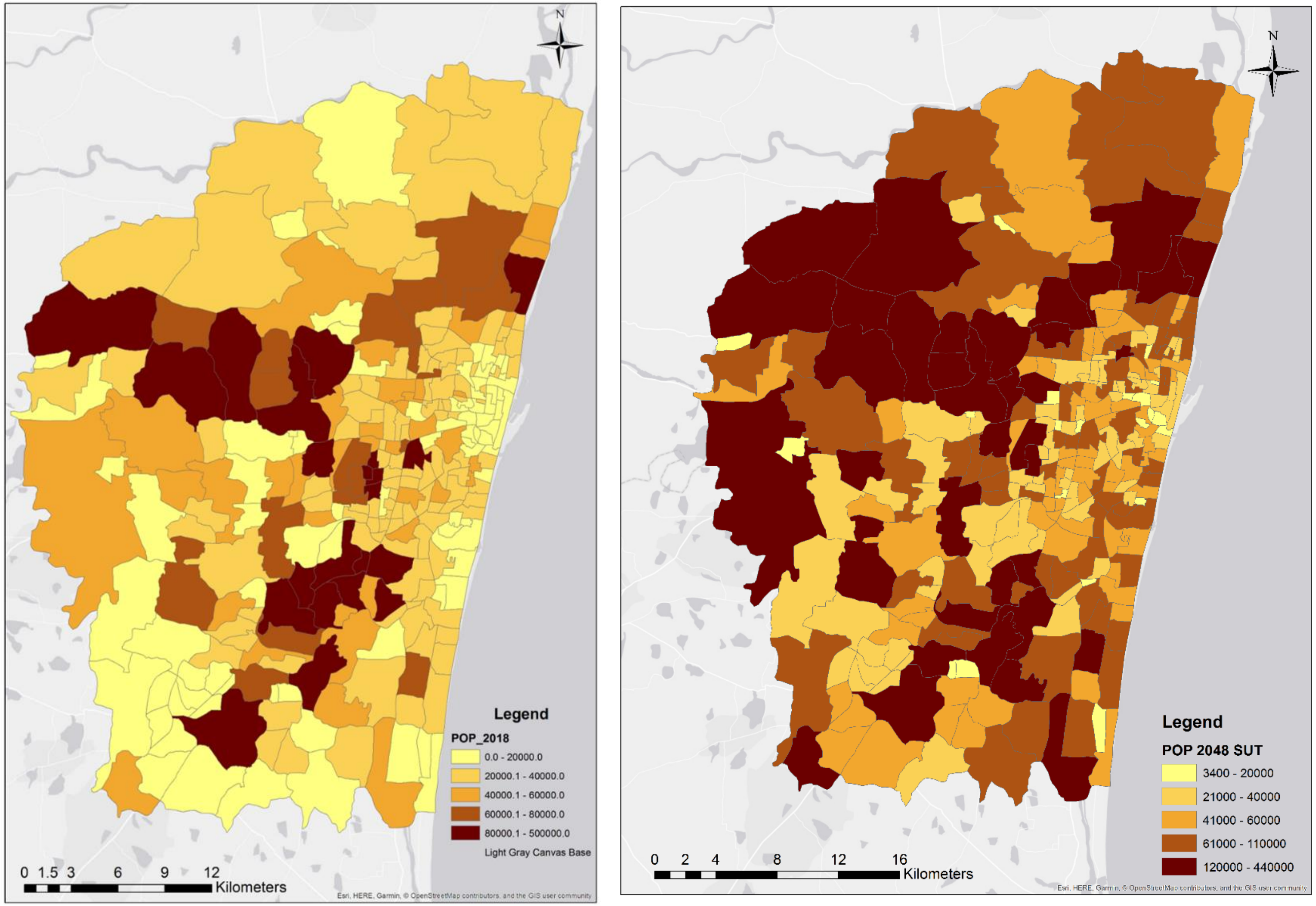


Figure 5-14 Population Distribution- for SUT (2018 and 2048)

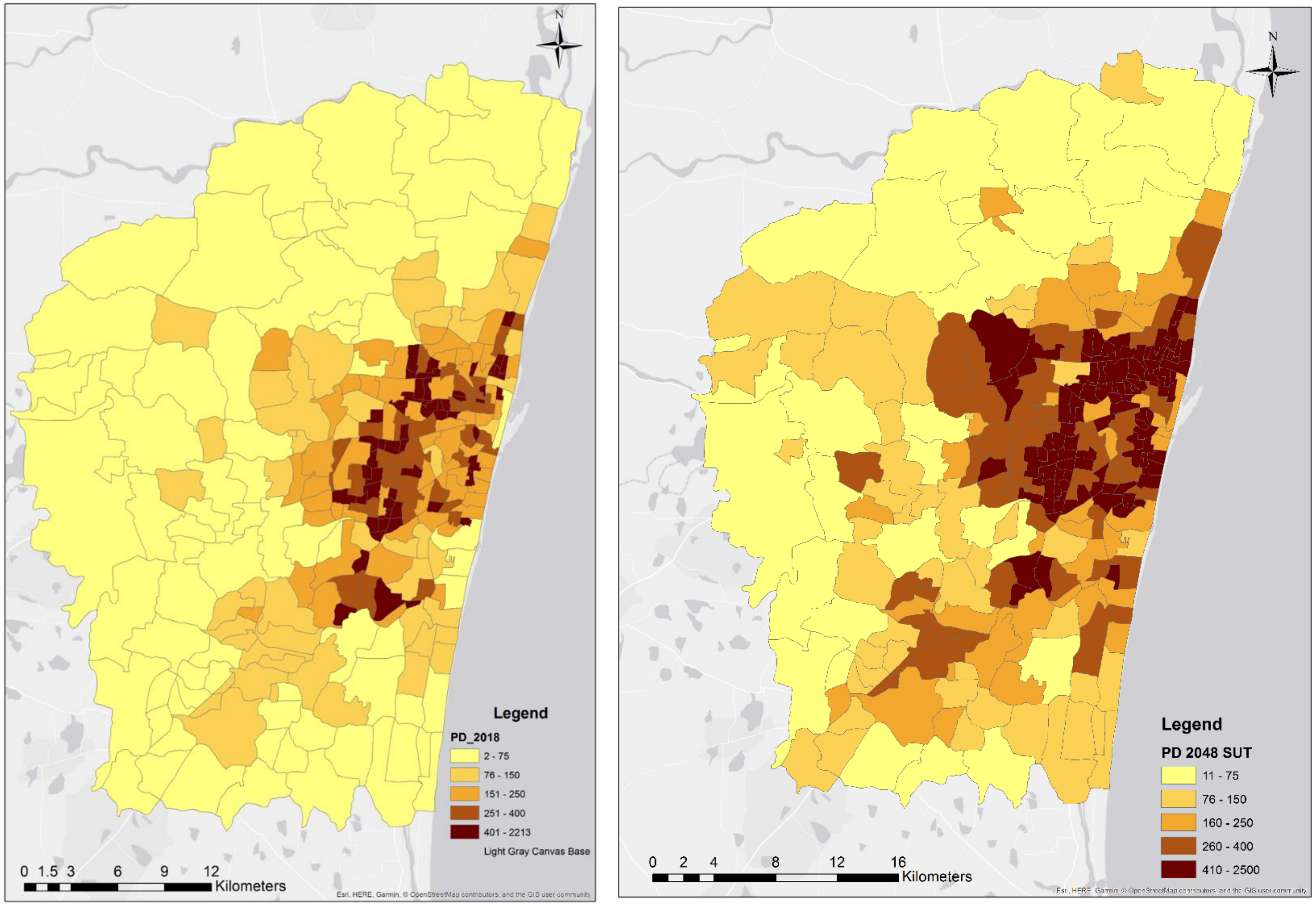


Figure 5-15 Population Density Distribution- SUT (2018 and 2048)

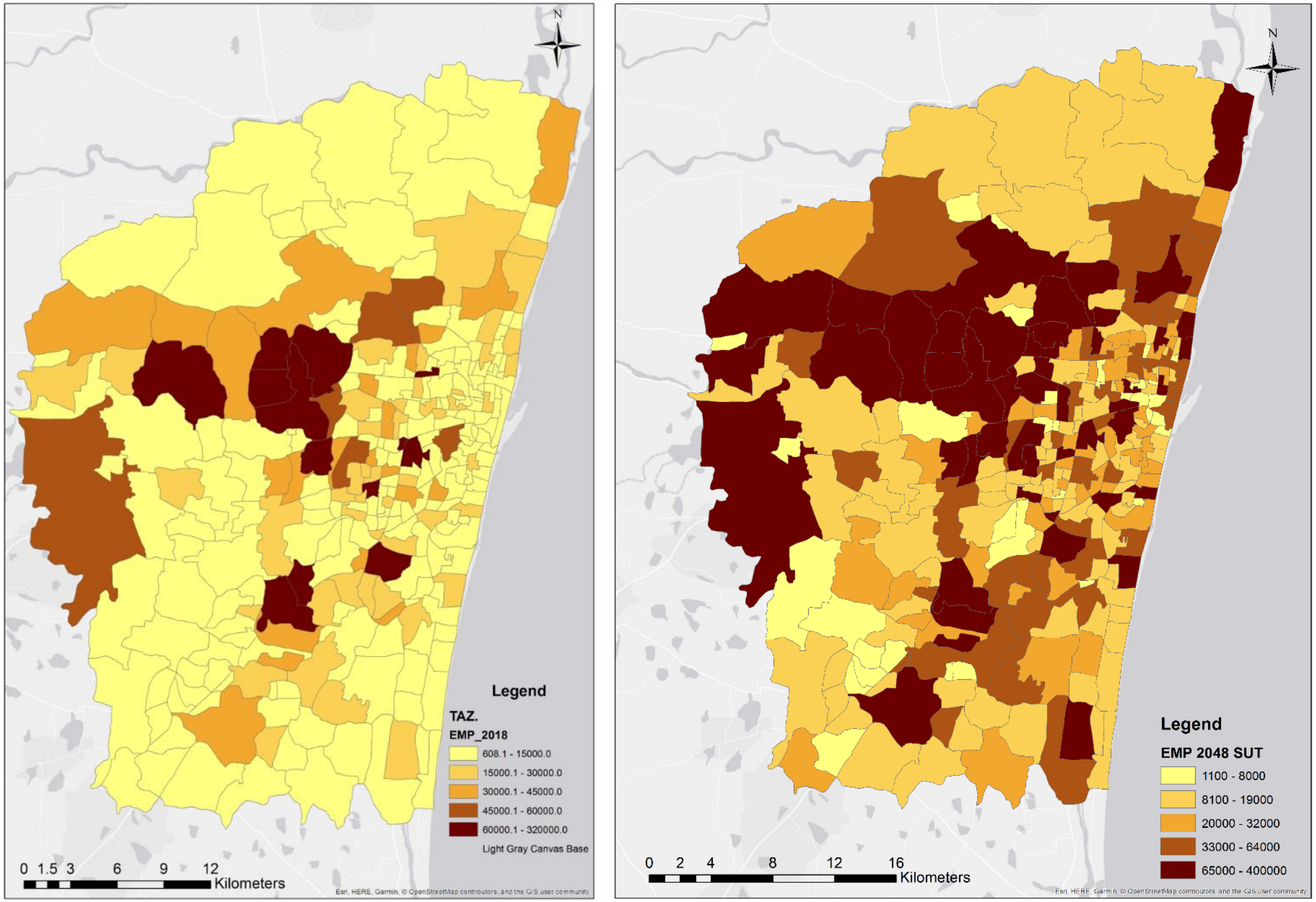


Figure 5-16 Employment Distribution- for SUT (2018 and 2048)

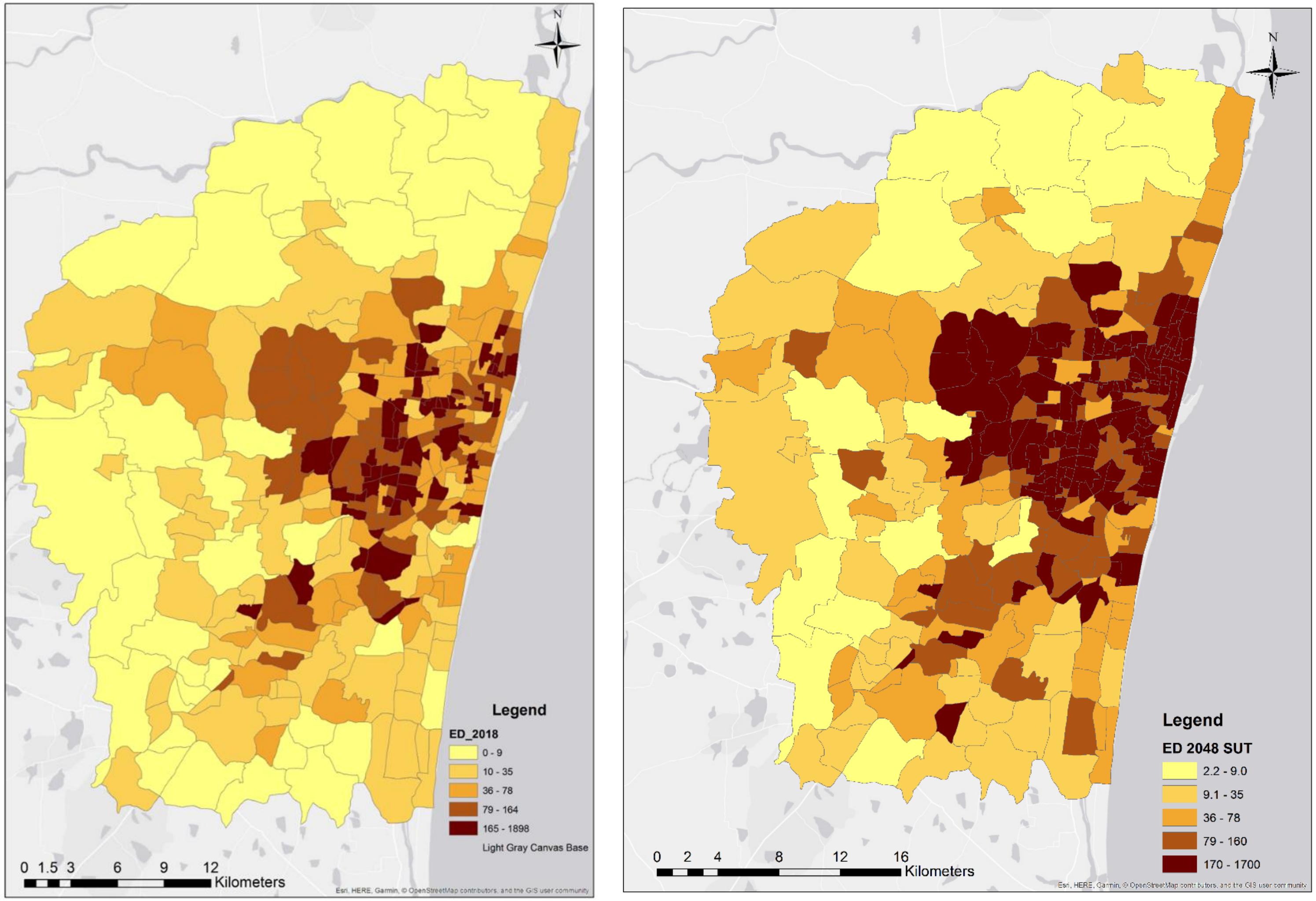


Figure 5-17 Employment Density Distribution- for SUT (2018 and 2048)

In Sustainable Urban Transport (SUT) scenario the urban mobility strategies (Refer Chapter 5) along with the planning variable and travel demand forecasts as assigned, calibrated and validated in the transport model. The details of internal and external trips and travel demand forecast are as shown Annexure D. The average V/C ratio decreases from 1.20 (BAU-Do Nothing) to 0.74 (SUT Scenario) in 2048 and the average network speed increase from 10.2km/hr to 24 km/hr from BAU to SUT in the 2048. V/C ratios along with corridor PPHPD on major roads for horizon years have been compiled and presented in Table 5-13. The outcomes of the network characteristics are as shown in Table 5-14 The passenger flow diagrams for the Horizon years is presented in Figure 5-19 and PCU flow diagram for horizon year is presented in Figure 5-20.

Table 5-13: V/C and Corridor PPHPD on Major Roads for Horizon Years 2048- SUT

S.No	Name of Road	V/C				Corridor-PPHPD			
		2023	2028	2038	2048	2023	2028	2038	2048
1	JN Road	0.67	0.73	0.85	1.02	31127	42791	42276	56764
2	Anna Salai	0.60	0.65	0.73	0.81	25149	26857	29378	30115
3	Great Southern Trunk Road	0.72	0.74	0.83	0.95	30794	32192	32562	50507
4	Rajaji Salai	0.43	0.52	0.67	0.83	14001	13732	10876	10477
5	Poonamalle High Road	0.64	0.69	0.79	0.92	27273	35434	38189	59428
6	Old Mahabalipuram Road	0.38	0.42	0.50	0.62	12969	11354	14581	16047
7	East Coast Road	0.25	0.34	0.48	0.69	7651	11486	12646	18809
8	Grand Northern Trunk Road –NH16	0.51	0.55	0.64	0.80	11200	14991	18192	18083
9	Chennai-Thiruvallur High Road	0.76	0.85	1.05	1.35	21581	19765	24412	31387
10	NSK Salai	0.72	0.77	0.87	0.99	17544	20395	27995	35780
11	Erukkancheri High Road	0.71	0.78	0.98	1.20	15803	17837	22329	27462
12	Nungambakkam High Road	0.67	0.74	0.84	0.97	17944	21607	33381	43114
13	Arcot Road	0.63	0.71	0.84	0.98	15590	13163	30703	31476
14	Chennai Bypass Road	0.41	0.48	0.60	0.80	21575	18745	17315	36704
15	Kundrathur Road	0.49	0.59	0.75	0.98	10411	12955	10743	13933

S.No	Name of Road	V/C				Corridor-PPHPD			
		2023	2028	2038	2048	2023	2028	2038	2048
16	New Avadi Road	0.64	0.69	0.81	0.96	9093	8372	9089	12166
17	Outer Ring Road	0.57	0.63	0.74	0.88	11674	12573	15644	22974
18	Thiruvottiyur Ponneri Panchetti Road	0.38	0.43	0.52	0.71	5945	6400	7916	10204
19	200 ft Radial Road (East Tambaram to Velachery)	0.39	0.46	0.58	0.71	6468	7642	11157	13355
20	Mount Poonamalle Road	0.55	0.61	0.74	0.87	10252	9223	8932	8942

Table 5-14: Network Characteristics for Horizon Years-SUT

Network Characteristics	2048 (BAU-DM)	2048 (SUT)
Avg. Network Speed (kmph)	12.10	24.0
Avg. V/C Ratio	1.10	0.74
PVT Vehicle Distance Travelled (Veh-Km) ('000)	29694	21737
Share of Public Transport Trips*	37.0%	57.2 %

* Excluding Intra Zonal Trips

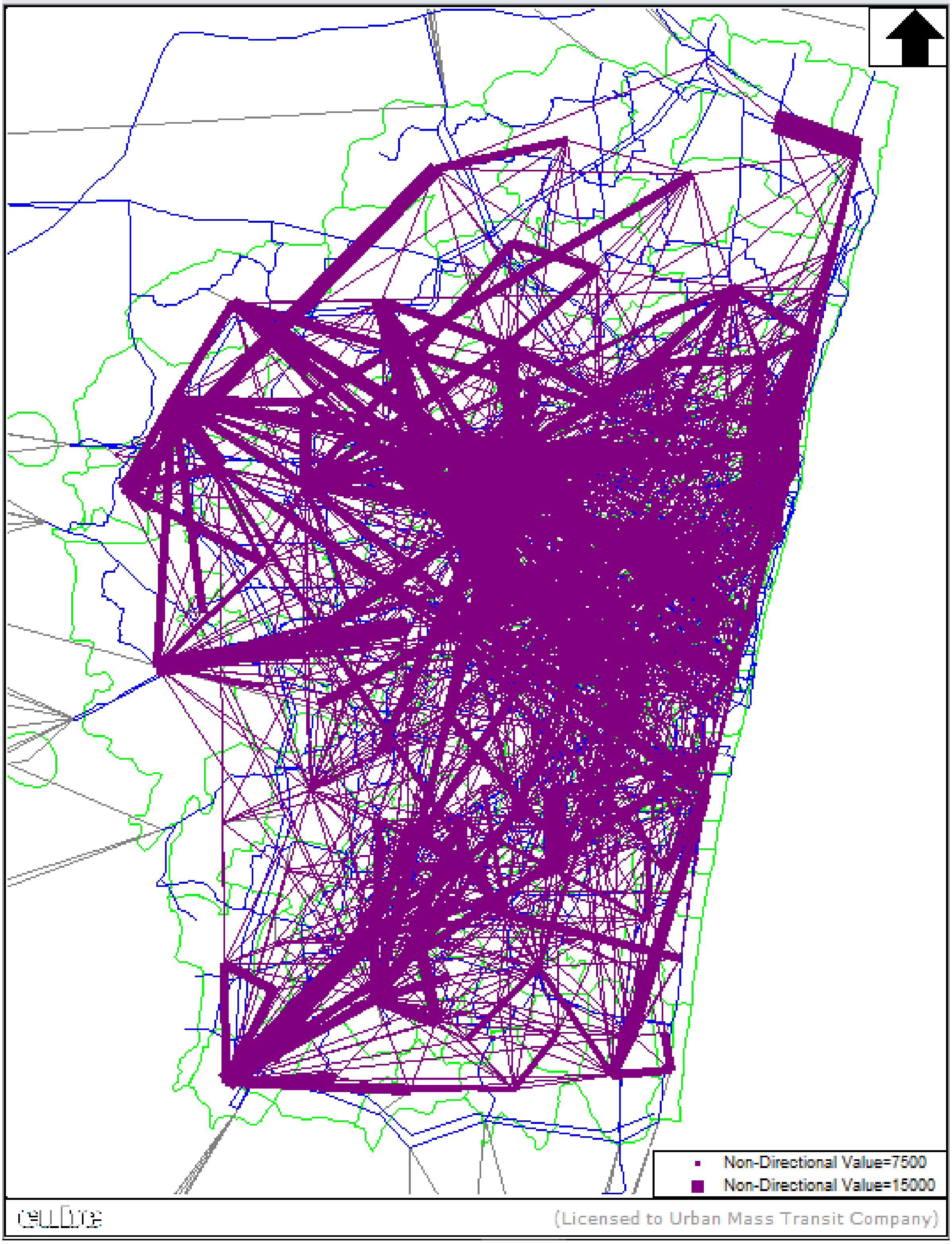


Figure 5-18: Desire Line diagram for SUT - 2048

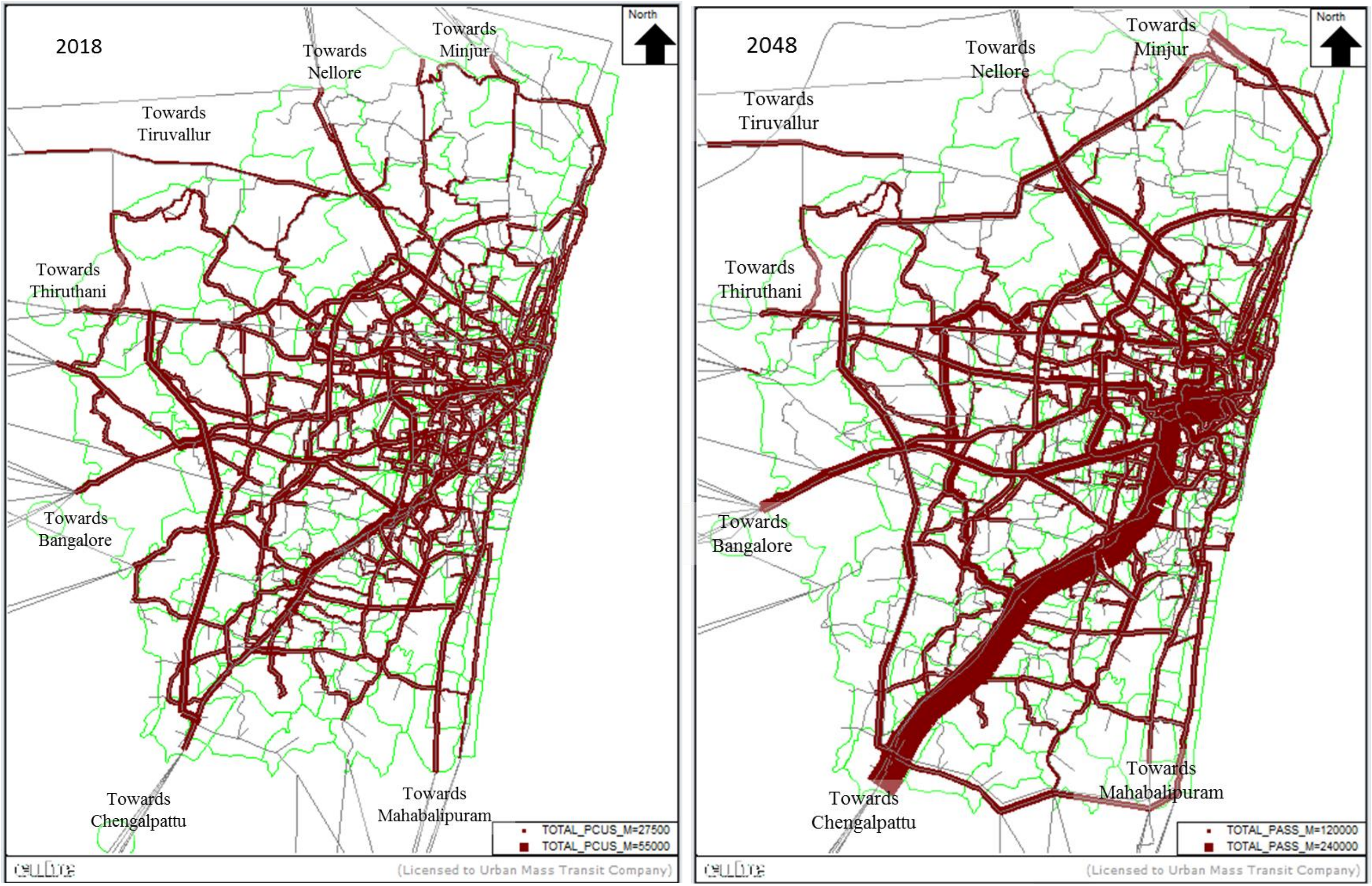


Figure 5-19 Passenger Flows for Base year (2018) and Horizon year (2048) - SUT Scenario

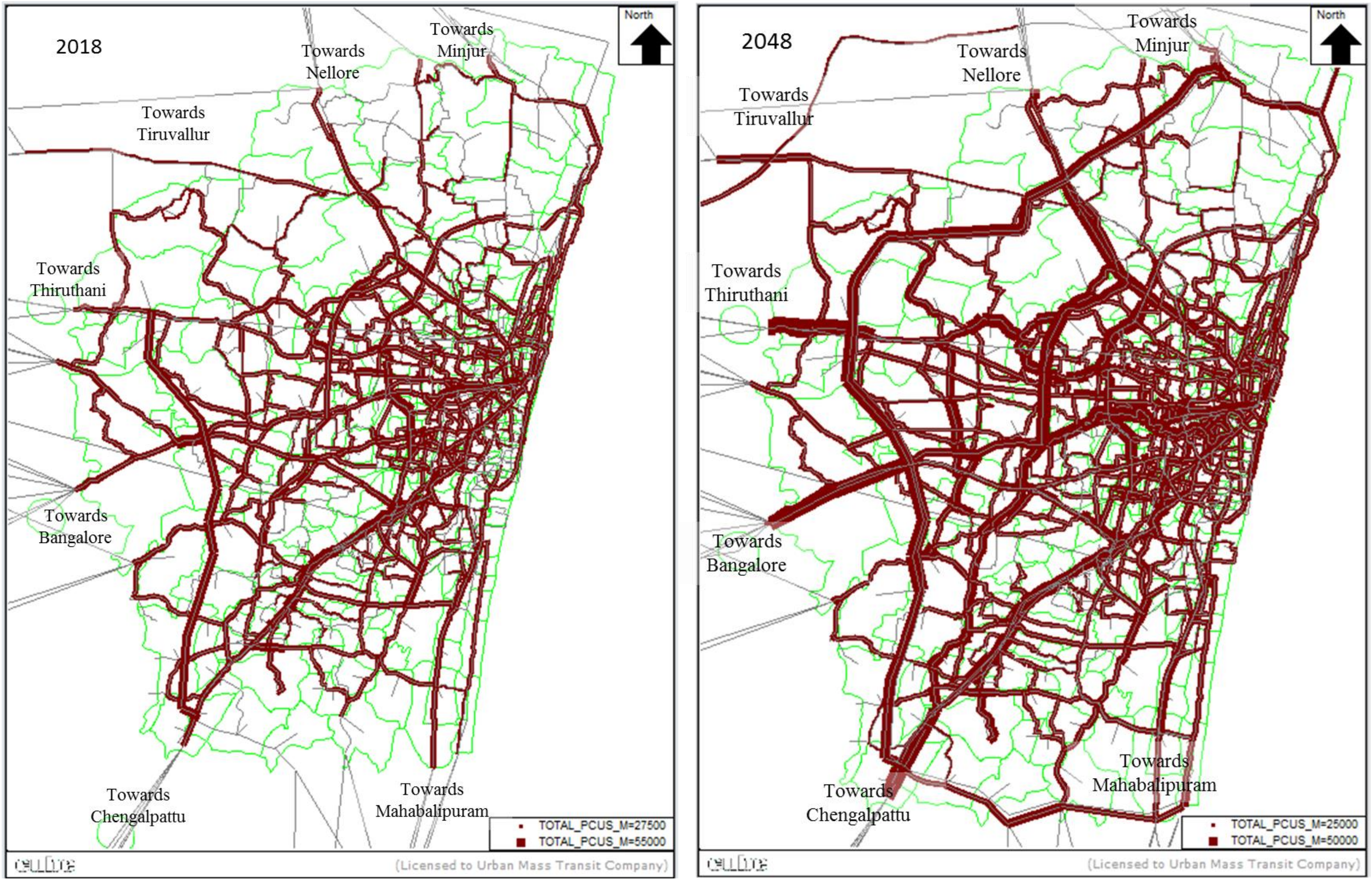


Figure 5-20 PCU Flows for Base Year (2018) & Horizon Year (2048)- SUT Scenario

5.6 COMPARISION OF SCENARIOS WITH TARGET

A comparison of traffic and travel characteristics in this scenario with goals set for Sustainable Scenario is presented in Table 5-15.

Table 5-15: Comparison of Traffic and Travel Characteristics for various Scenarios

Name of the Impact	BAU Scenario Do Nothing (2048)	BAU Scenario Do Minimum (2048)	Target (2048)	SUT Scenario - (2048) - Achieved
Share of Private Transport (PVT) Trips*	54.8%	55.9%	<50.0%	38.9%
Share of Public Transport Trips*	38.0%	37.0%	>50.0%	57.2%
Share of Intermediate Public Transport (IPT) Trips*	7.3%	7.1%	7.0%	3.9%
Avg. Network Speed (kmph)	10.2	12.1	>=24	24.0
Walkability (Arterial & Sub-Arterial)	38.0%	39.2%	>90.0%	100%
Cyclability (Arterial & Sub-Arterial)	0.0%	1.3%	>80.0%	80%
PVT Vehicle Kilometer Travelled (in '000)	27826	29694	Reduce by 10%	21737

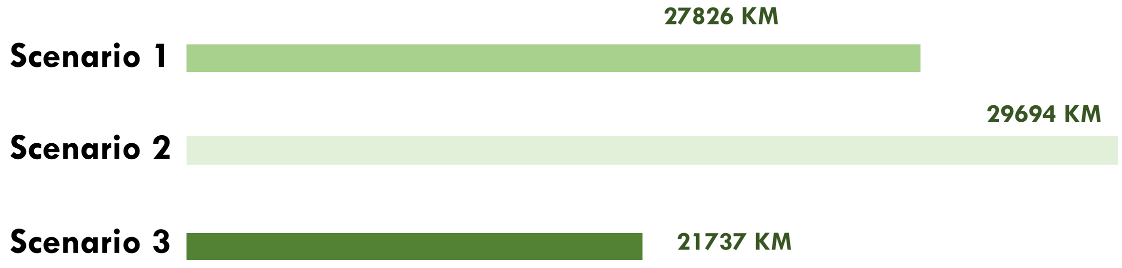
* Excluding Intra Zonal Trips

It is observed that the share of Public Transport (Bus and MRT) in Sustainable scenario has increased nearly 1.5 times compared to Business as Usual Do-Nothing Scenario. Also, average V/C ratio has reduced from 1.20 (BAU Do-Nothing) to 0.74 (BAU-Do Something), which is about 38% decrease in congestion level and average network speed has increased by 2 times in Sustainable scenario when compared to BAU Do-Nothing Scenario. Considering the improved situation under Sustainable scenario, it has been selected for proposing various transport improvement proposals.

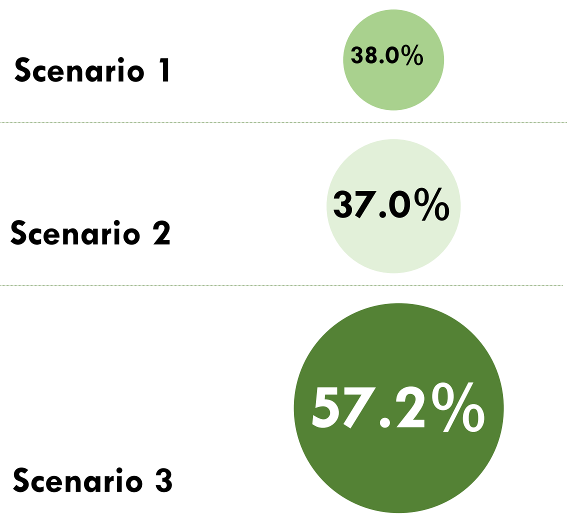
COMPARISON OF SCENARIOS WITH TARGET

Business As Usual (Do Nothing) (2048)	Business As Usual (Do Minimum) (2048)	Sustainable Urban Transport Scenario (2048)
No Expected Development in considered	Committed Development projects are considered	To achieve the goals in line with CMP Vision
Scenario 1	**Scenario 2**	**Scenario 3**

PRIVATE VEHICLE KMS TRAVELLED



PUBLIC TRANSPORT MODAL SHARE



Share of **Public Transport** increased nearly **1.5 times** compared to Business As Usual Scenario in **Sustainable Urban Transport** Scenario

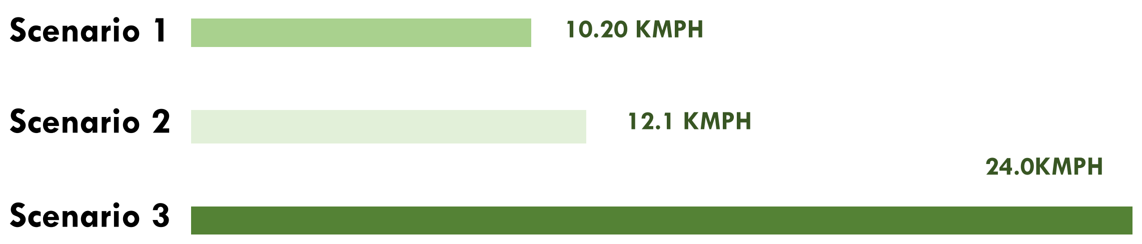
COMPARISON OF SCENARIOS WITH TARGET

Scenario 1	Scenario 2	Scenario 3
Business As Usual (Do Nothing) (2048)	**Business As Usual (Do Minimum) (2048)**	**Sustainable Urban Transport Scenario (2048)**
No Expected Development in considered	Committed Development projects are considered	To achieve the goals in line with CMP Vision

AVERAGE VOLUME BY CAPACITY RATIO

Scenario 1	Scenario 2	Scenario 3
1.20	1.10	0.74

AVERAGE NETWORK SPEED



EMISSIONS (TONNES/DAY)

	Scenario 1	Scenario 2	Scenario 3
Local Emissions	75	60	23
Co2/GHG Emissions	3800.8	4138.6	1502.2

Urban Mobility Plan

6. Urban Mobility Plan

The mobility goals for Chennai have been addressed through a multipronged approach. Solutions for complex transport improvements cannot be achieved by a single strategy. The following strategies have been adopted in tandem to meet the various goals set for Chennai.

1. Land Use and Transport Strategy
2. Public Transit Improvement Strategy
3. Road Network Development Strategy
4. Non-Motorized Transport Strategy
5. Freight Management Strategy
6. Traffic Engineering and Traffic Management Strategy
7. Travel Demand Management Strategy
8. Technological Strategy

It is important to note that each of the above strategies are equally important and the order of listing does not imply priority. Each of the broad strategies includes sub strategies of immense importance. The strategies when implemented through specific projects shall fulfil the goals and objectives of the Low Carbon Mobility Plan. The sections below discuss these strategies.

6.1 LAND USE AND TRANSPORT PLAN

The transport network of city is dependent on its land use. Land use and the transport network strategy development must go hand in hand. Connectivity helps in the realization of the land use planned. The land-use transport strategy developed focuses on accessibility, connectivity, and mixed land use developments to minimize private vehicle trips, encourage transit-oriented development. In the long term, the transport strategy should be based on the urban growth envisaged for the city. Transport network strategy, therefore, enables the city to take an urban form that best suits the geographical constraints of its location and also one that best supports the key social and economic activities of its residents. Integrated land use and transport development promotes balanced regional growth in line with regional development strategies, with the objective of:

- Promoting balanced spatial growth
- Minimizing land requirements for private transport

- Promoting transit-oriented growth
- Reducing the need to travel
- Encouraging walkable/ NMT friendly neighbourhoods

The land use transport strategies adopted for Chennai are as follows,

1) Hybrid Growth Development
2) Transit Oriented Development

6.1.1. HYBRID GROWTH DEVELOPMENT

Various development concepts are developed and implemented across the world which are namely, Compact City Concept, Multi-Nodal Transit Concept and Hybrid Concept. Multi nodal Transit concept considers dispersion of major economic activity nodes and transit corridors around the main city centre. While the compact city concept is observed in cities like Barcelona, Curitiba where the development of the city region is restricted up to certain limits and a hybrid concept is a combination of dispersed (Mutli nodal) and compact development. Figure 6-1 represents the conceptual mobility corridor patterns.

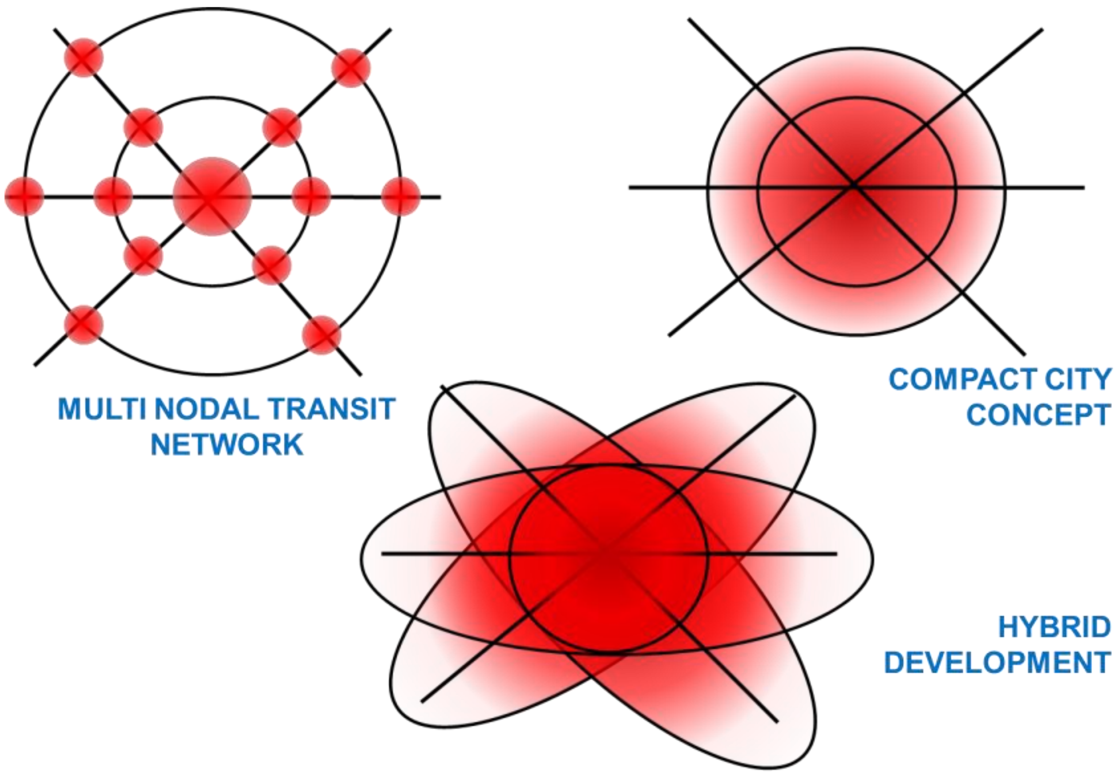


Figure 6-1 Mobility Corridor Patterns Concept

The urban growth form and its spatial structure are articulated by two structural elements, Nodes and Linkages.

6.1.1.1 NODES

Nodes are reflected in the centrality of urban activities - can be related to the spatial accumulation of economic activities or to the accessibility to the transport system. Terminals, such as bus stations, railyards, and airports, are important nodes around which activities agglomerate at the local or regional level. Nodes have a hierarchy related to their importance and contribution to urban functions, such as production, management, retailing and distribution.

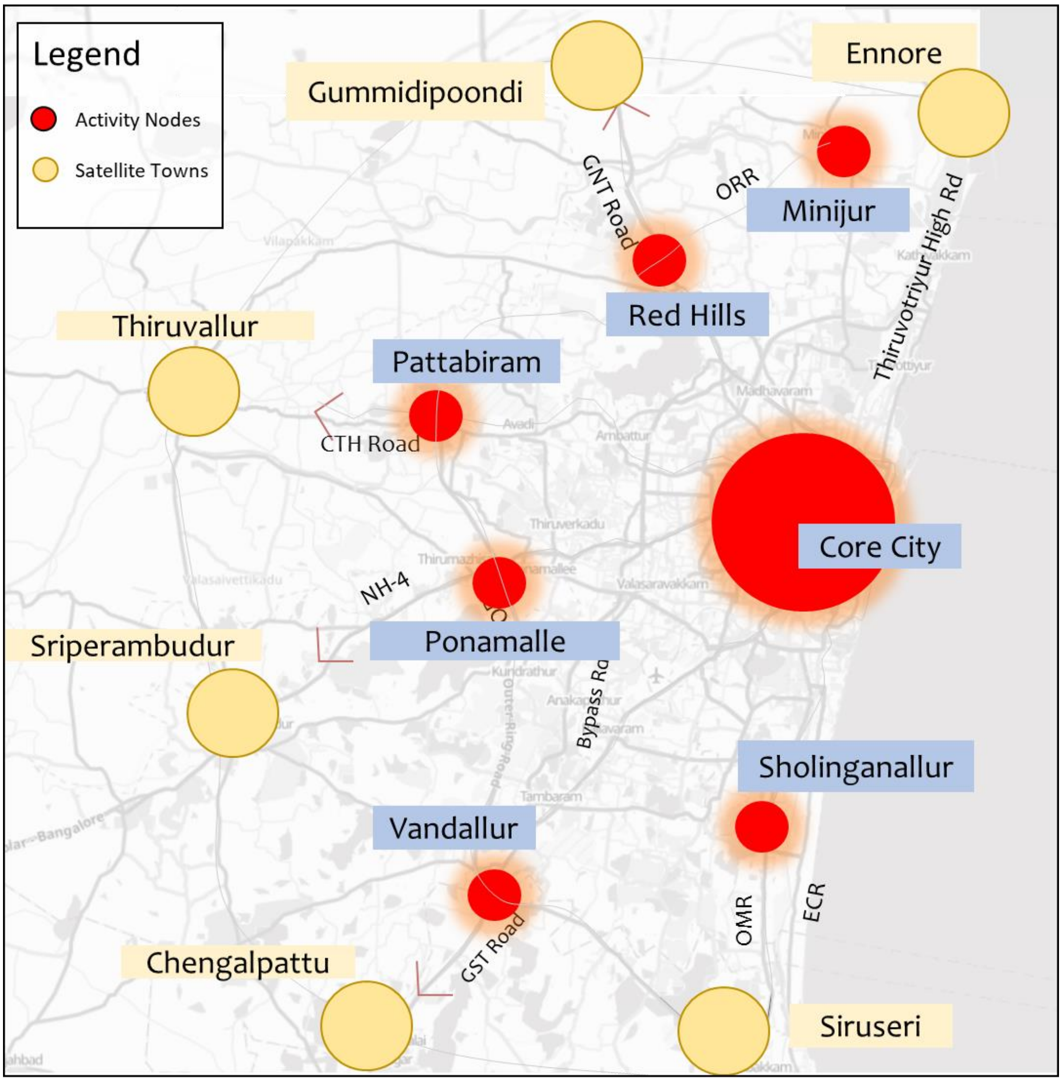


Figure 6-2 Potential Growth Centres

The spread of activities in Chennai represents a hybrid development, wherein, the compact development is observed with municipal limits and multi-nodal development around the municipal limits within CMA. Major Growth Nodes in Chennai are, Sholinganallur (IT Hub), Minjur (Industrial and Freight hub), Red Hills (Real Estate), Pattabiram, Poonammallee and Vandalur (Transit and IT growth). The Figure 6-2 represents the potential growth nodes in and around the CMA region.

6.1.1.2 LINKAGES

Linkages are the infrastructures supporting flows from, to and between nodes. The lowest level of linkages includes streets, which are the defining elements of the urban spatial structure. In Chennai, ring radial road network ensures linkage of major and potential growth nodes with minor ones. The National highways and State Highways[1] currently provide certain degree of connectivity within the core city. The development of the potential growth nodes can be supported by improved connectivity and network structure. Thus, growth strategy aims to provide linkages to strength the growth of these nodes.

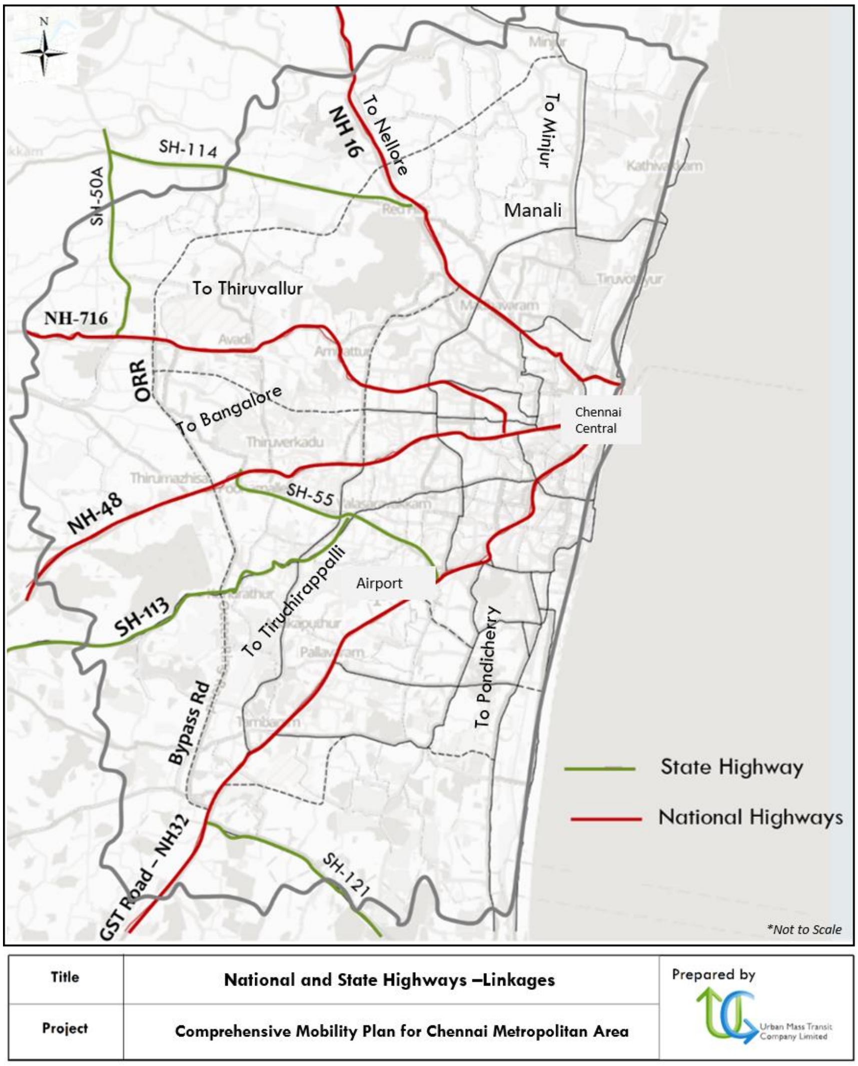


Figure 6-3 Linkages (National and State Highways)

6.1.1.3 HYBRID GROWTH DEVELOPMENT

As discussed in Section 5.1.1 Chennai has Hybrid growth pattern with compact development with the city limits and mutli-nodal development around the core city. The transport

[1] *National Highways – (NH-716,NH-48,NH-32,NH-16) and State Highways (SH-50A,SH-114,SH-113,SH-55,SH-121)*

infrastructure in the potential growth nodes should substantiate the land use development and should complement the development.

Thus, the ideal network pattern for Chennai is Semi Radial Transit Network binding the Hybrid growth pattern. The core area is envisaged as the main city centre. The sub centres are divided based on the proximity to the main city centre, i.e. within immediate proximity (along Inner Ring Road), medium proximity (between IRR and ORR) and Low proximity (along Outer Ring Road).

Table 6-1 Proximity of Core and Sub-Centres

Immediate Proximity (Along Inner ring road)	Medium Proximity (b/w IRR and ORR)	Low Proximity (Along Outer Ring Road)
• Madhavaram • Red Hills • Kolathur • Valasaravakkam • Ramapuram • Velachery • Adyar	• Manali New Town • Vichoor Village • Padiyanallur • Madhuravoyal • Thirumullaivoyal • Thiruverakadu • Katupakkam • Kunrathur • Trisulam • Keelkatalai • Palaikaranai • Karapakkam • Medavakkam	• Minjur • Karonodai • Pattabiram • Avadi • Thirumazhisai • Attipattu • Thiruniravur • Korattur • Vandalur

The development structure proposed for Chennai considers other important nodes (Satellite Cities) around CMA while envisioning the growth pattern. The important nodes around the CMA are

- Navallur
- Siruseri
- Sriperambudur
- Thiruvallur
- Gummidipoondi
- Pooneri
- Chengalpattu
- Urapakkam
- Maraimalainagar
- Tamaraipakkam
- Perumalpattu
- Kaelambakkam
- Thiruporur

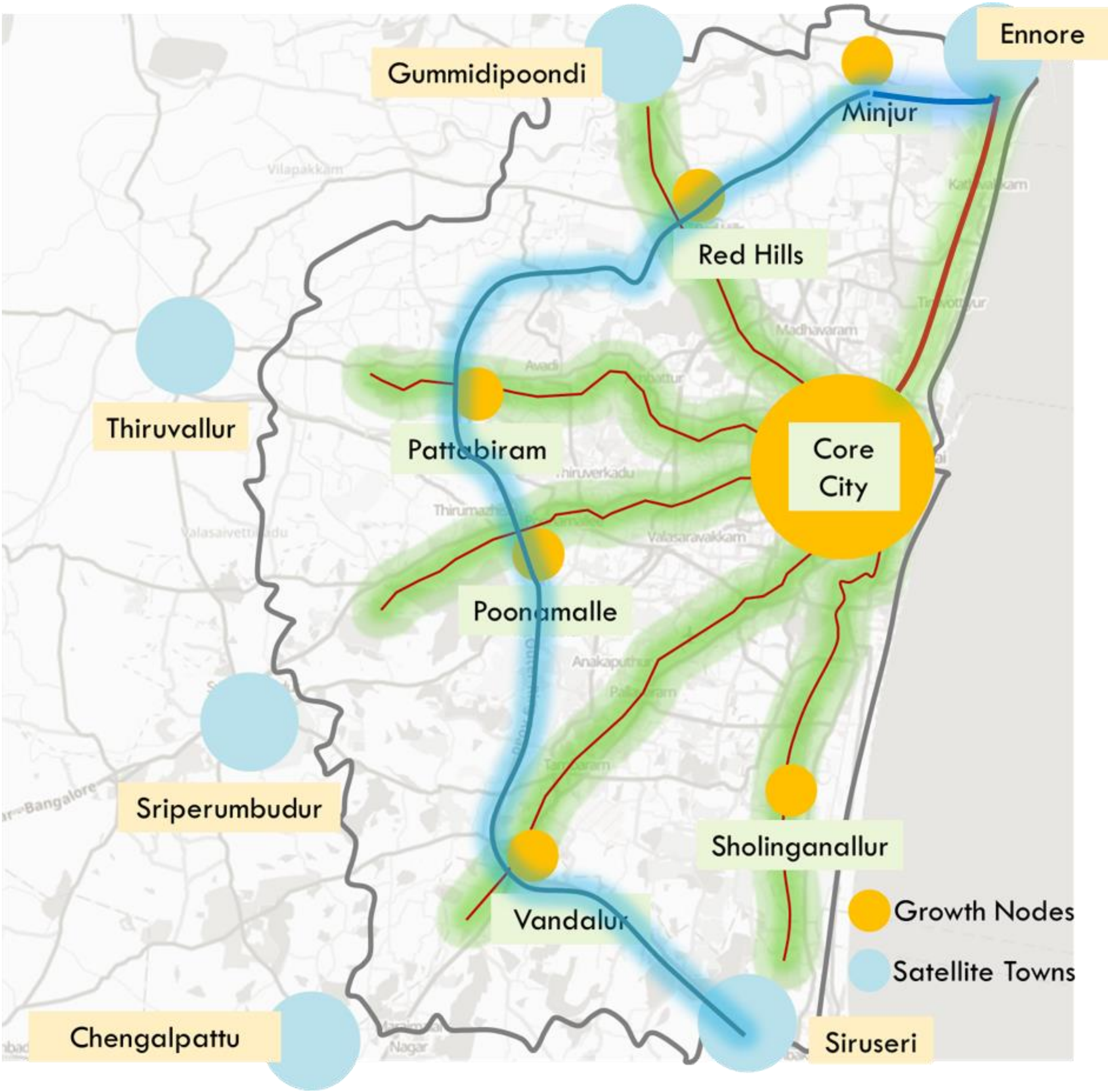


Figure 6-4 Road Network Development Vs Economic Nodes in The City

All major nodes should consider a transport development strategy in accordance with the overall vision of the city. For example, the major nodes like Siruseri, Poonamalle can develop a High-rise dense settlement with improved Non-Motorised Transport plan to enhance the NMT user movement support Public Transport plan .So that the node is well connected for inter node travel as well as intra node travel.

6.1.2. TRANSIT ORIENTED DEVELOPMENT

The semi ring-radial network is designated as the structure for mobility corridors. To maximize the passenger throughput, these corridors should be developed on the concepts of transit-oriented development. Mixed use development that is cognizant of the low-income users of the transit system is important. It is necessary to create environments where walking and transit are viable transportation options by making it easier to go from one transportation mode to another, the connection between community and development is enhanced ensuring that a community is accessible to all. Resilient neighbourhoods will provide the needs of daily living, within walking distance (1/2 to 1 km radius) as shown in Figure 6-5.

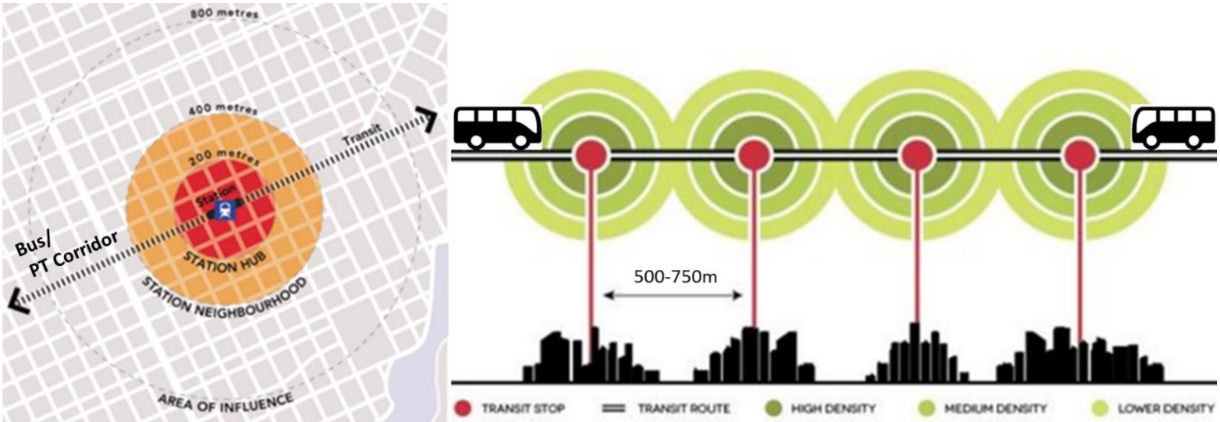


Figure 6-5 Concept of Transit Oriented Development[2]

The TOD planning process includes:

1) **Travel Connections**: Convenient and direct pedestrian connections, pedestrian scale blocks, interconnected street network including bicycle circulation and parking.

2) **Building Scale and Orientation**: Building placement is a powerful tool in reinforcing streets as public amenities. The quality of "out of vehicle" experiences is influenced by the placement of buildings in relation to the street and other buildings, as well as their height and scale (Figure 6-6).

3) **Public Spaces**: This would include pedestrian-friendly streets including adoption of traffic calming measures, parks and Plazas as community gathering spaces to enable social interaction, quality facilities for transit users

4) **Parking**: Parking structures/shared parking lots are two ways to reduce the amount of space occupied by parking facilities.

[2] *www. Wordpress.org accessed on 27th September 2016*

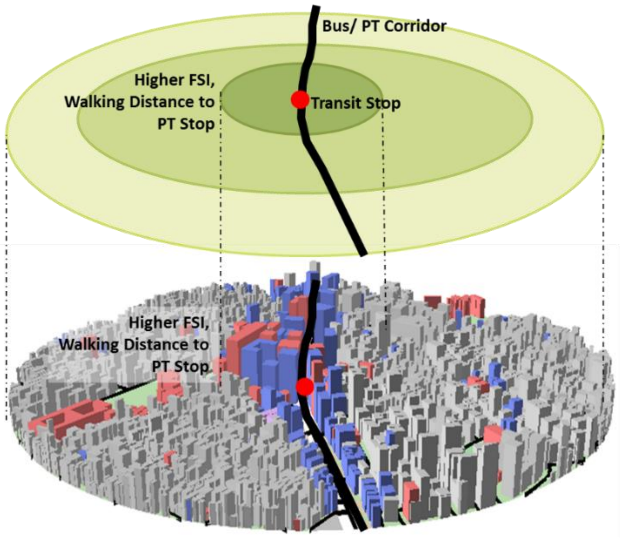


Figure 6-6 Building Height and Scale in TOD

Chennai being one of the major metropolitan cities in the country has the great potential to adopt TOD principles. Following corridors are considered for transit-oriented development (i.e. increase in population density by increasing Floor Space Index) and are shown in Figure 6-7.

1. Old Mahabalipuram Road (OMR)
2. GST Road –NH32 (Kathipara Junction to Urapakkam)
3. Arcot Road –SH113(Arcot road to Dharkast Road)
4. CTH Road-NH716 (Padi to Thiruniravur)
5. GNT Road-NH16 (Vyasarpadi to Padiyanallur)
6. Ennore –Manali Expressway
7. Outer Ring Road (Vandallur to Minijur Road)
8. Chennai Central to St. Thomas Road (Metro Corridor-1)
9. Chennai Airport (Meenambakkam)-Wimco Nagar Road (Metro Corridor-2)
10. Madhavaram to SIPCOT Road (Metro Corridor-3)
11. CMBT-Light House Road (Metro Corridor-4)
12. Madhavaram to Sholinganallur Road (Metro Corridor-5)

The CMP proposes a Floor Space Index (FSI)[3] of 2.5 along all the identified radials and proposed metro corridors. While an FSI of 4 along the Outer Ring Road to boost the development of the growth centres outside the municipal limits. Promoting higher FSI along theses major mobility centres shall enhance the existing and proposed PT systems. As per the densification study the proposed FSI for the study area is 2 and 0.5 increase along the major mobility corridors with the city is envisioned. Further, CMP suggest to cap the FSI along the periphery ring road to constrain the haphazard growth. Further, a detailed Transit Oriented Development (TOD) study need to be carried out for understanding the consumed FSI and potential for Densification along the mobility corridors.

[3] *The Floor Space Index are proposed on the basis of Densification Study (along Metro Rail) -2013 Outcomes.*

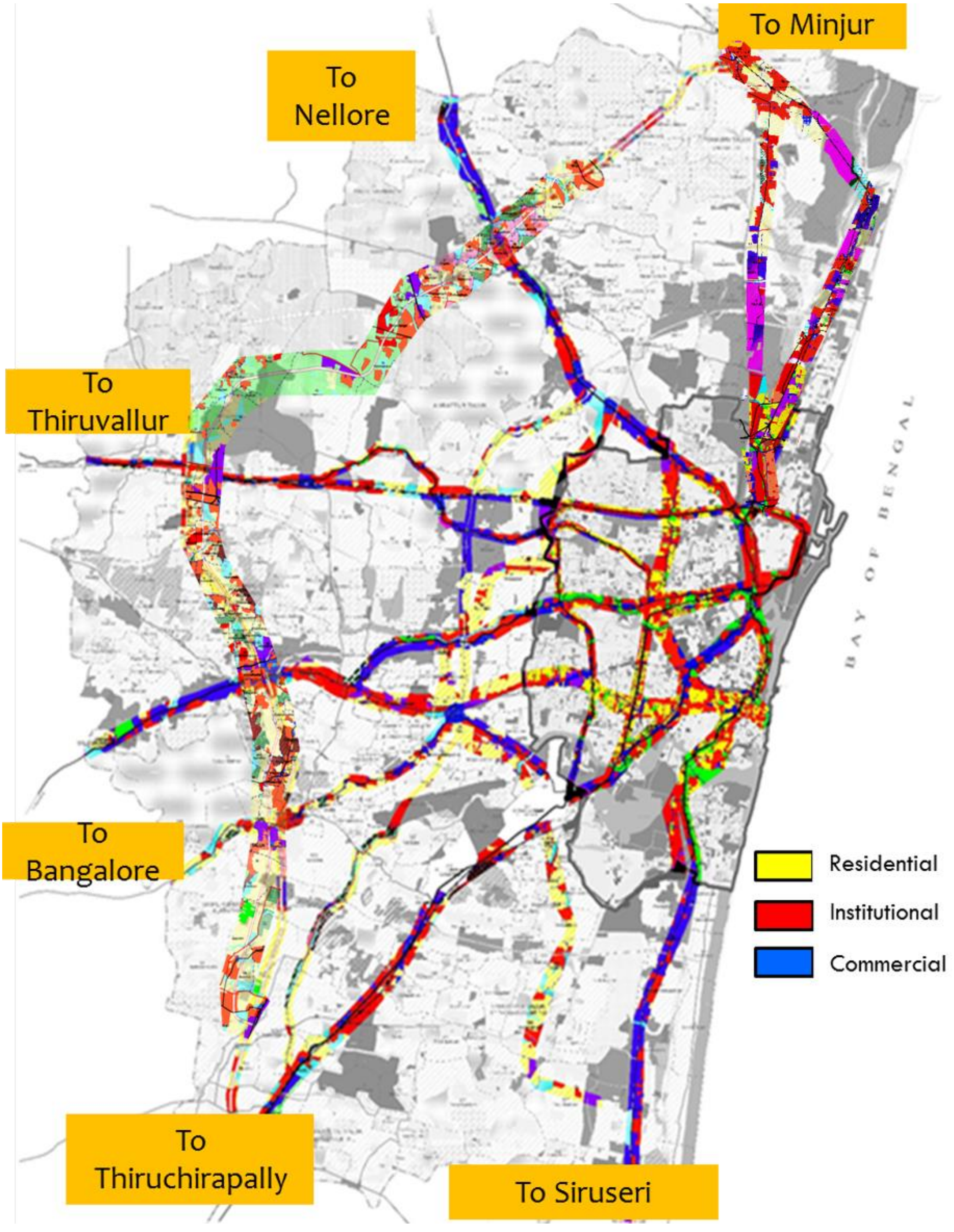


Figure 6-7 Major Corridors for Transit Oriented Development

6.2 ROAD NETWORK PLAN

A well connected and planned road network is essential for better commuting of the various users in the city. Road network development also includes improving the intersections to give equal emphasis to all road users. The road network development should add to the overall development strategy for the city. The network should have sufficient capacity to carry the vehicles. Road Network proposals are considered only if it is absolutely necessary. Provision of more flyovers and more widening will support more and more use private vehicles; hence those proposals are considered such that it will help in decongesting the junctions and can be helpful in improving the PT speeds and safer NMT movements. The proposals of improving road network include:

- Road Widening/Upgradation
- Development of Missing links/New Links/Ring Roads
- Road Infrastructure Development (River/Canal Bridges and ROBs)

6.2.1. ROAD WIDENING/ UPGRADATION

Widening of roads is a must when the volume carried increases considerably compared to its capacity. All the roads identified for road widening shall be provided with median in between to reduce accidents and safety. The major highways shall be provided with service lane to reduce multiple entry/exit points. The road widening has been discussed into two sections.

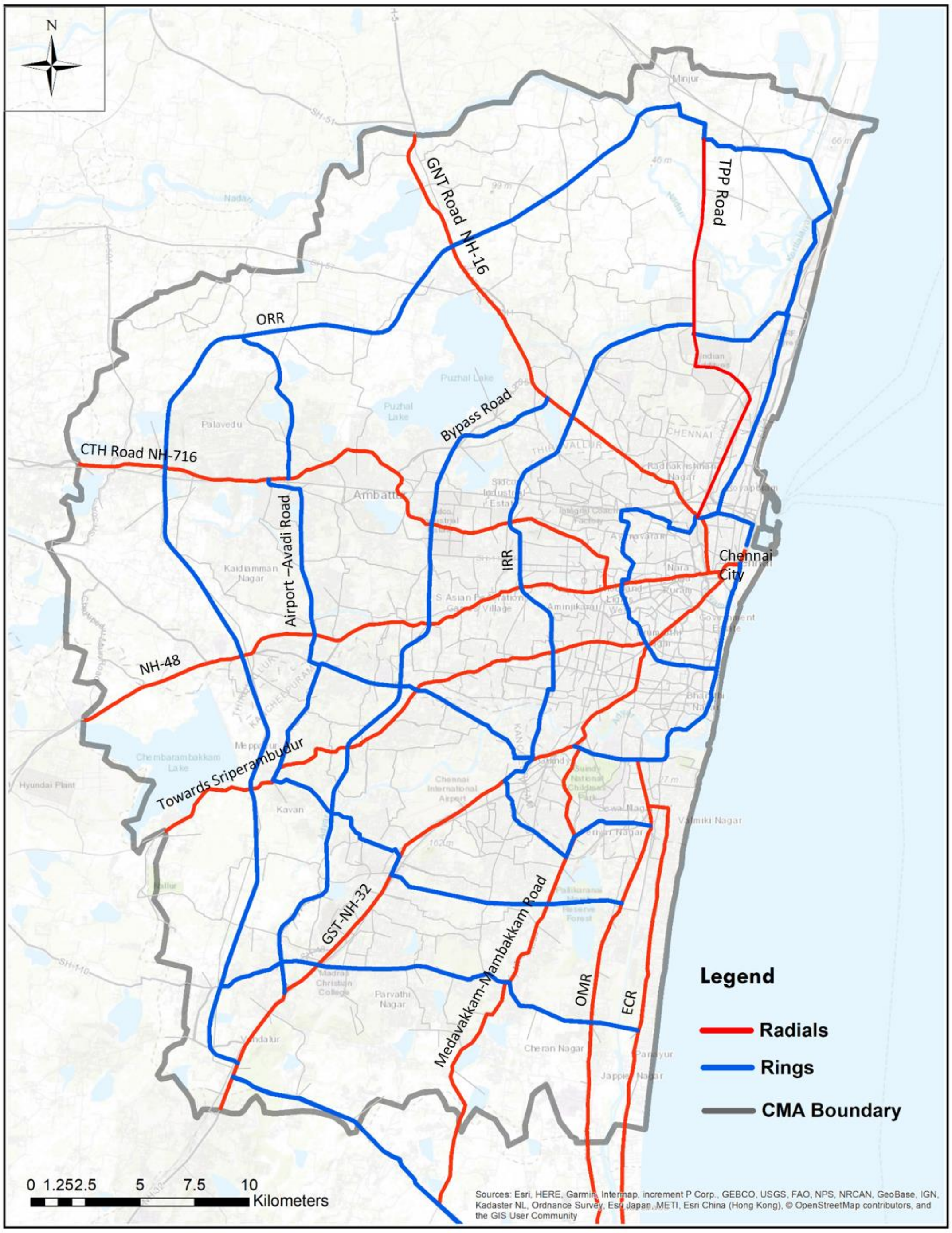
- Development of Mobility Corridors
- Development of Other Roads

6.2.1.1 DEVELOPMENT OF MOBILITY CORRIDORS (RING AND RADIAL ROADS)

Chennai city clearly has a characteristic semi-ring-radial network development. In Chennai the rings emanate circumferentially from the business core area moving from Old Fort Area (George Town and vicinity) towards Anna Salai and T Nagar. In addition, there is a possibility to develop rings which bind these radial roads together providing a ring radial pattern for the network.

In essence, mobility corridors maximize throughput of people, focusing on mass transport and non-motorized traffic, rather than vehicle traffic. These mobility corridors offer a strong network providing connectivity to major attraction centres in the city along with regional connectivity. These corridors should be considered for an augmented Public Transport system.

The radial corridors are Thiruvattiyur Ponneri Panchetti Road (TPP), Grand Southern Trunk Road (GST), Grand Western Trunk Road (GWT), Chennai Thiruvalluvar High Road (CTH), Arcot Road, and Grand Northern Trunk Road (GNT). The Rings binding these radials are Inner Ring Road, Chennai NH Bypass and Outer Ring Road.



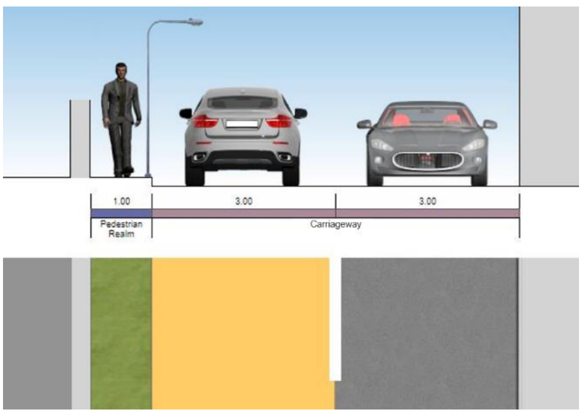
Title	**Rings and Radial Road Networks in CMA**	Prepared by Urban Mass Transit Company Limited
Project	**Comprehensive Mobility Plan for Chennai Metropolitan Area**	

Figure 6-8 Proposed Ring and Radial road Network in Chennai

Since, these corridors include all the major spines within Chennai city, they should be designed based on the standards. Few streets (Eg. T-Nagar,) are being upgraded with the street design standards as part of the Smart City Proposal. The other streets can also be taken up for upgradation based on city site context as per standards. A mobility corridor should have right of way of at least 25 m for mixed traffic conditions. In Chennai, the radial network is present but the network needs to be upgraded to mobility corridor standards. Some portions of these networks need to be widened to function as a mobility corridor. These corridors would be expected to have the following cross-sectional elements:

1. Continuous kerb, footpath and bi-cycle lanes
2. Service roads where feasible
3. Restriction or preferably prohibition of parking on the carriageway/shoulders
4. At-grade/grade-separated Public Transport systems as per the Public Transport/mass transport master plan

The CMP has identified certain road sections for improving the mobility corridor by including the cross sectional elements which are as shown in the following figures for references.



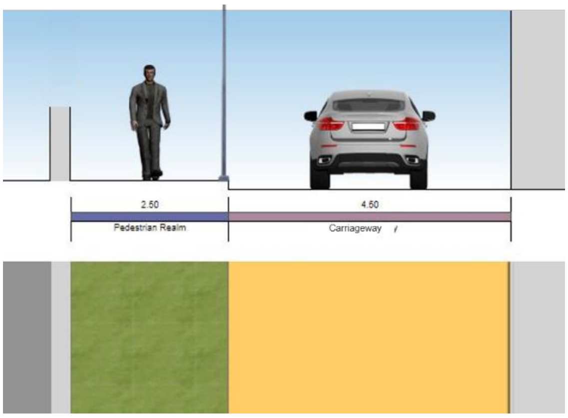


Figure 6-9: Cross section of road with 7m ROW (Option A-left, Option B-Right)

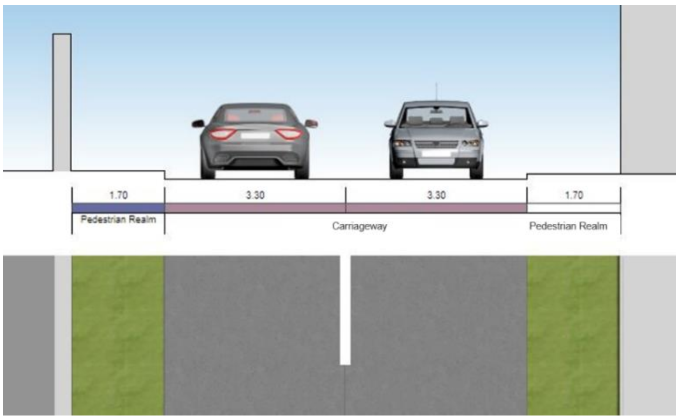


Figure 6-10: Cross section of road with 10m ROW

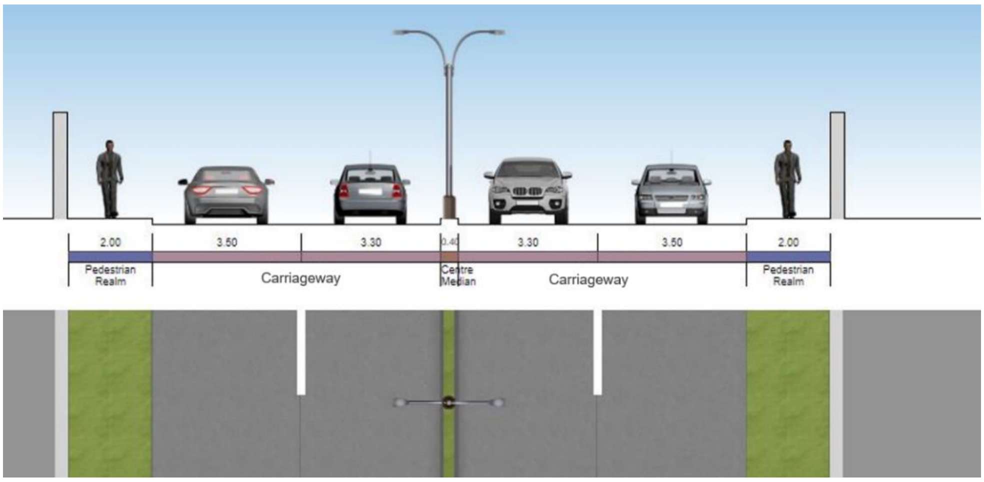


Figure 6-11: Cross section of road with 18m ROW

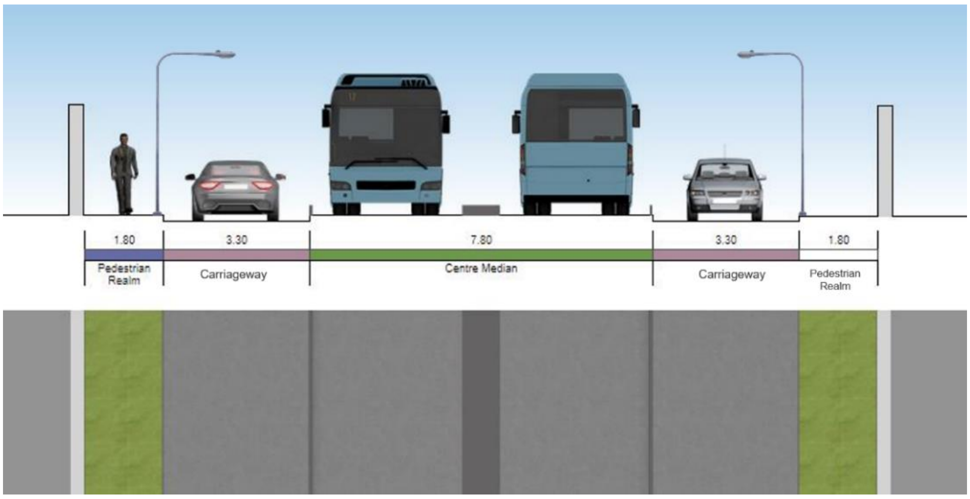


Figure 6-12: Cross section of road with 18m ROW with BRT

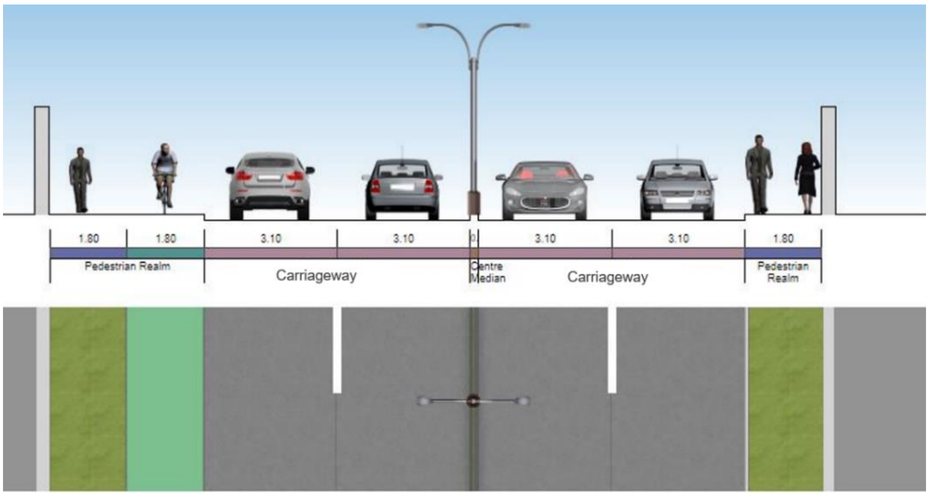


Figure 6-13: Cross section of road with 18m ROW with Cycle Track

Table 6-2 Proposed Lane configuration

S.No	Name of Road	Proposed Lane Config	Additional Number of Lanes	Length (Km)
1	Kovilpadagai Main Road	4	2	6.9
2	Athipattu Main Road/NCTPS Road	4	2	4.95
3	Chennai-Thiruvallur High Road/Chennai Ananthapur Highway nearby Vepampattu	4	2	1.41
4	Avadi main Road Near JB Estate	4	2	1.2
5	Kuntrathur Main Road	4	2	0.7
6	Nehru Bazar Road nearby avadi railway station	4	2	0.55
7	Thiruneermalai Road	4	2	3.1
8	SH575 at Koduvalli	4	2	2.9
10	Mangadu Main Road at Pattur	4	2	2
12	Velachery Road at Venkatapuram	4	2	0.6
13	Mangadu Main Road at Paraniputhur	4	2	0.6
14	Poonjeri –Sriperambudur-Chengalpattu-Thiruvallur-Kattupali	6	4	190

6.2.2. DEVELOPMENT OF MISSING LINKS OR NEW LINKS OR RING ROADS

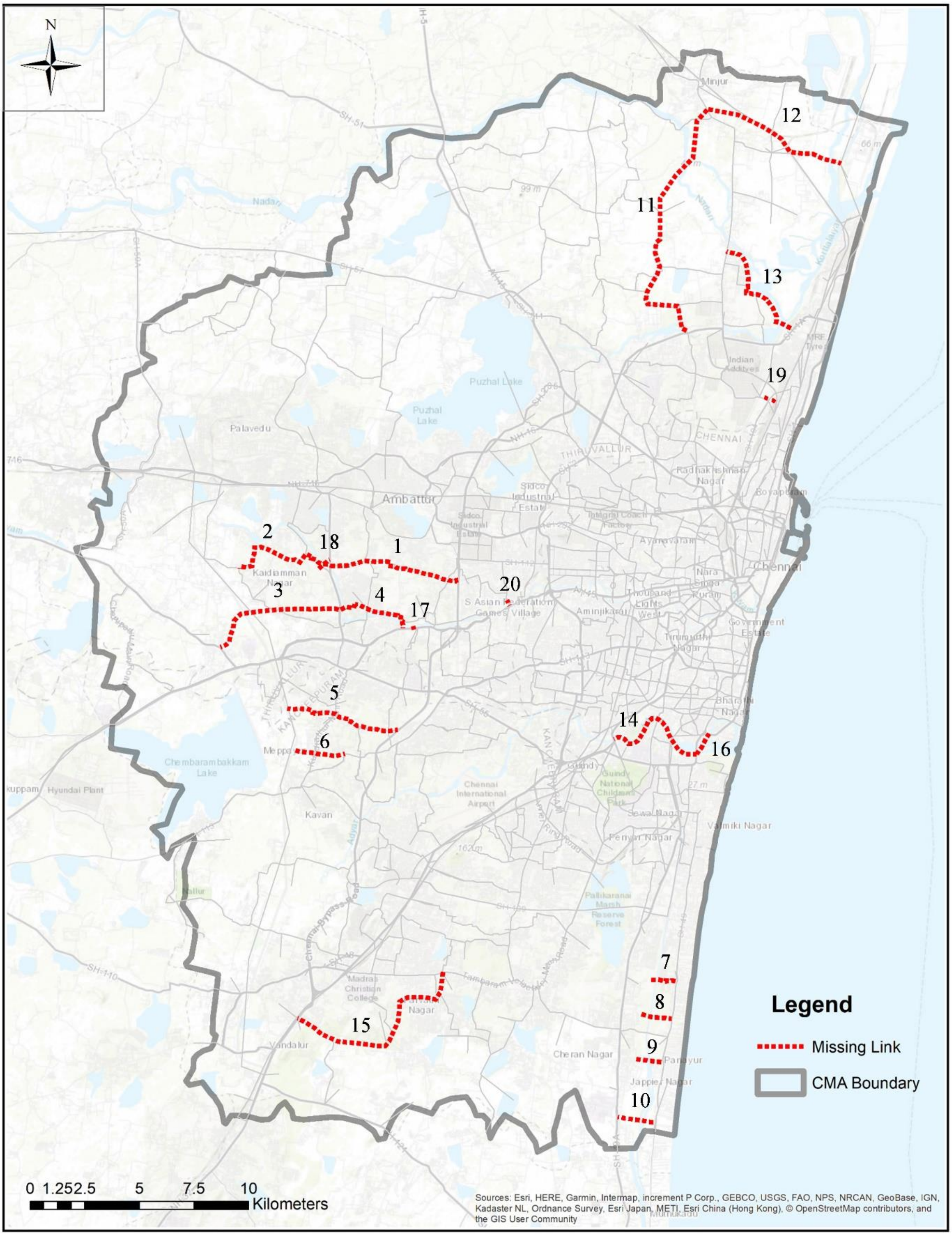
In order to complete the existing ring - radial network, certain missing links have been identified and road network has been proposed. This will improve the degree of connectivity and direct access within the study area.

Table 6-3 Proposed New Links

Road No	Start	End	Length (km)
Road No 1	SA Polytechnic College	Lakshmi Nagar to vanagaram Ambattur road	3.0
Road No 2	Poonamalle Pattabiram Road	Avadi Main Road	2.6
Road No 3	Paruthipattu	Thirumazhasai	3.5
Road No 4	Vaelanpanchadi - Perumalagaram Salai	Paruthipattu	1.4
Road No 5	Meppur Village	Melma Nagar Main Road	2.5
Road No 6	Iyapanthangal (Near ORR)	Kundrathur Main Road	1.1
Road No 7	KCG College Road	ECR-New Link with Bridge crossing Buckingham Canal	0.6

Road No	Start	End	Length (km)
Road No 8	Gandhi Theru (Okkiym Thoraipakkam)	ECR via Bhaktha Vedanta Swami Road	0.7
Road No 9	OMR	ECR (Uthandi toll) - New Link	0.7
Road No 10	Sathyavani Muthu St (Parameswaran Nagar)	ECR- Bridge crossing Buckingham Canal	0.6
Road No 11	Sendrambakkam vichoor Rd	Andarkuppam Redhills road	1.2
Road No 12	Minjur	Nandiabakkam-Attipattu Main Road	3.1
Road No 13	Minjur	100feet Road-Mulaivoyal	6.0
Road No 14	Bund road along Adyar river bunds from T.V.Ka. Bridge	to Maraimalai Adigalar Bridge at Saidapet	5.4
Road No 15	Formation of Tambaram Eastern Bye pass road branching from Marmalong bridge - Irumbuliyur road to	Rajakilpakkam (via) Agaramthen road towards Perungalathur	10.5
Road No 16	Formation of new link road connecting Greenways Road (DGS Dinakaran Salai)	Durgabhai Deshmukh Road through Tamil Nadu Music College	1.5
Proposed High Level Bridge			
Road No 17	Bridge across Coovam river at Padikuppam in lieu of existing bed level causeway connecting PadiKuppam road to Poonamallee High Road		
Road No 18	Bridge Across Coovam River Connecting Mount Poonamallee Avadi Road and Paruthipatu Thiruverkadu Municipal Road		
Road No 19	Bridge across "B" canal at Thiruvottiyur - Ponneri - Panchetty Road.		
Road No 20	Bridge across Coovam River at Nolambur road Junction in NH-4		

An outer ring road (ORR) has been developed considering the future developments and land use as per Second Master Plan (2026), a new Peripheral Ring Road (PRR) has been proposed connecting the major low proximity towns around Chennai with an approximate length of 162 km. It also connects all the major radials emerging out of the city and hence will also give an easy way of connectivity from one radial to another without reaching the city centre. This will help in the decongestion of city centre. CMDA is working on proposing Grid of roads in 29 villages along ORR. The Missing links in the newly developed areas are mentioned below Table 6-3.



Title	Missing Links	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-14: Missing Links

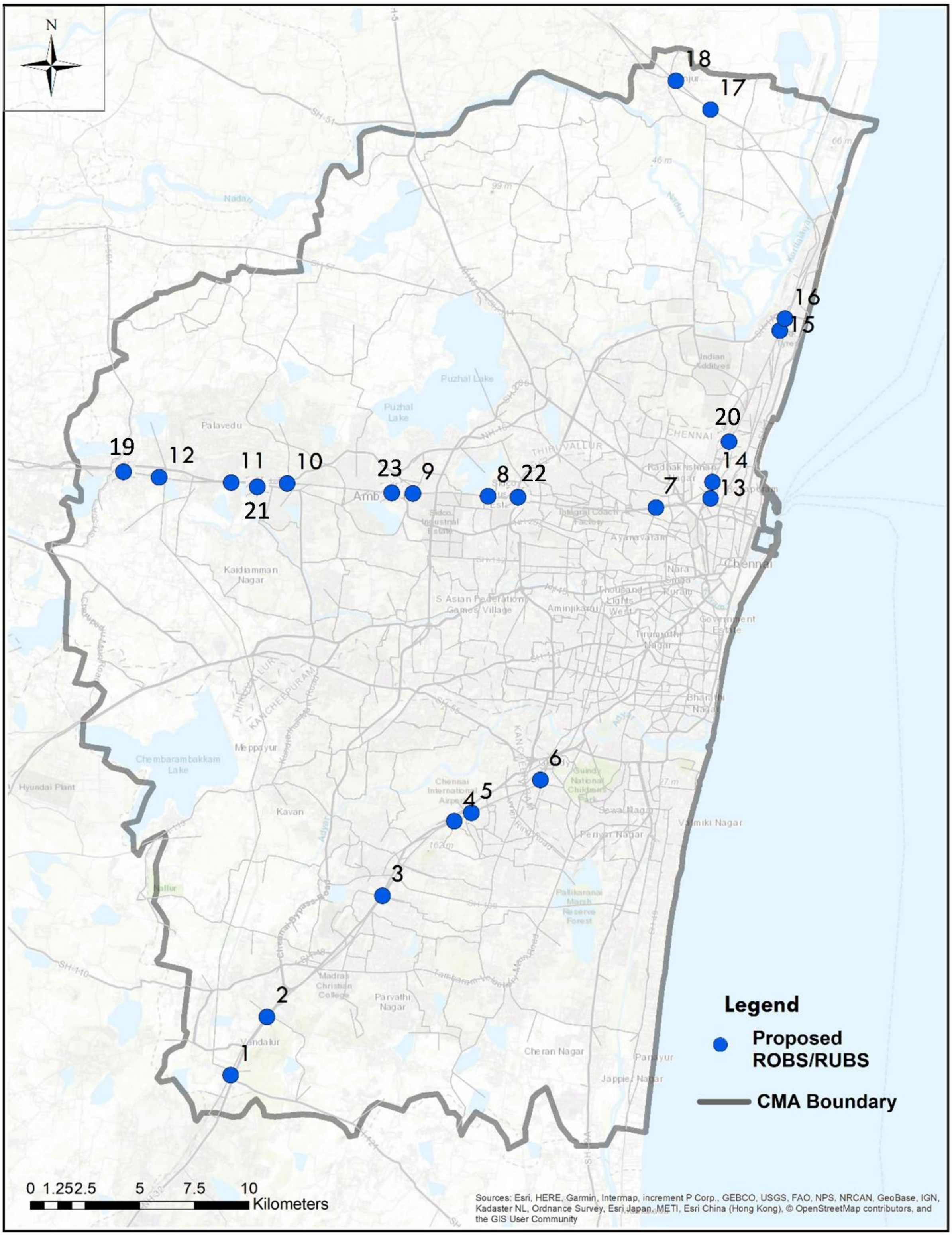
6.2.3. ROAD INFRASTRUCTURE DEVELOPMENT (RIVER/ CANAL BRIDGES AND R.O.B AND R.U.B)

Adequate and properly maintained road infrastructure is always necessary to support smooth flow of passengers. More efficient infrastructure will enable better mobility for people and goods as well as provide better connection between regions. Considering the scale of the city and the movement of people from every part of the city, the city has dense suburban railway network which needs well supported road infrastructure to surpass the rail networks.

The study, recognizes the need for 18 ROB/RUB where the Train Vehicle Units (TVUs) have cross the optimum limit of 1 lakh, to improve connectivity as shown in Figure 6-15 and Table 6-4

Table 6-4: Proposed ROB/RUB locations

S.No.	Proposed ROB/RUB
1	Manicka Jalaganda St near Vandalur zoo bus stop to Vandalur NH32
2	Kamaraj High Road near Perungalathur Railway station
3	Radha Nagar Main Road near Chrompet-NH 45
4	DGQA Rd in Meenambakkam
5	Jayaram St towards Meenambakkam Metro
6	Velachery Road in Alandur (Near officer's Colony)
7	Vysarpadi Jeeva Railway Station near Alluri Polleri Amman Temple
8	Korattur Railway Station Road
9	bazaar St Near Ambattur Railway Station
10	Nehru Bazzar Road Near Avad Railway Station
11	Sekkadu Main Road near Hindu College
12	Thandalam - Nemilichery Rd near Nemilicheri Railway Station
13	Thiruvottiyur High Road near pencil factory bus stop
14	Theyagappa Chetty Street in Korukkupet Railway Station
15	Station Road Near Wimco Nagar Rly Station
16	St No 1 in Tirumoorthy Nagar near Manali High Road
17	Railway Station Road near Nandiyambakkam Rly Station
18	Railway Station Road near Minjur Rly Station
19	Thirunindravur –Thiruvallur near Veppampattu Railway Station
20	Thiruvottriyur and Ennore Railway Stations
21	Widening the Railway Over Bridge at of Mount - Poonamallee-Avadi Road
22	Widening the existing Road Over Bridge at in the Inner Ring Road (Dual five lane)
23	Construction of Road Over Bridge at Chennai – Thiruttani- Renigunta Road (SHU148) in lieu of existing two lane ROB



Title	Proposed ROBS/RUB	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-15 Proposed ROB/RUB locations

6.3 PUBLIC TRANSPORT PLAN

Public Transport is one of the most environmentally sustainable forms of transport. CMP divides Public Transport improvement plans into a number of sections, including service improvements for buses, and para-transit, appropriate Mass Rapid Transit (MRT) Options and infrastructure development plans and intermodal integration plans.

Provision of Public Transport is complex and in order to evolve an effective and efficient service, it is necessary to understand this complexity. The complexity exists both within the organization of a service provider and the environment in which the service provider operates. As the external environment impacts the transport system to a large extent, it is necessary for the external environment to be examined properly. Similarly, the internal sub-systems need to be fully appreciated. Adopting a correct and well-informed approach is a pre-requisite for improving Public Transport.

At present, City bus, Sub-Urban rail and Metro (Phase –I -45 km) are the Public Transport systems in operation in Chennai. MTC, Metropolitan Transport Corporation (Chennai) Ltd. provides the bus based Public Transport services. At present, there are 3740 buses which ply on 684 routes within CMA.

The Public Transport system for Chennai should be convenient, efficient, affordable, reliable and integrated. Improving the existing Public Transport involves infrastructure improvements like reserving lanes and tracks and operational improvements like optimizing routes and schedules. The improvement in Public Transport is likely to not only maintaining the existing modal share of Public Transport, but also to create a shift from other modes to Public Transport.

Public Transport system planning will not only consider where terminal, routes and stops are placed but also whether they are accessible to all potential users. The plans for the system should take into account the accessibility issues for pedestrians and cyclists, the differently abled and elderly people as well as private vehicle users after they have parked their vehicles.

The proposals under Public Transport improvement plan are:

a) Rationalization of existing city bus services for efficient Public Transport systems

b) Development of mass rapid transit systems.

c) Ensuring multi-modal integration in Public Transport

d) Providing adequate infrastructure facilities for Public Transport in terms of intermodal mobility hubs and bus stops

e) Implementation of ITS to improve the reliability of Public Transport systems

f) Promoting public participation and campaigning mass awareness programs.

g) Providing first and last mile connectivity

6.3.1. ROUTE RATIONALISATION:

Chennai has a good Public Transport Coverage through bus. In Chennai City 304 Roads to a total length of 222 km are Bus Route Roads. The existing bus routes need modification as there are multiple overlapping bus routes running across the city. But the existing bus route network is able to cater to almost all the major production and attractions in the area. The present structure of bus routes in Chennai has led to higher frequencies on all radials and rings leading to bunching of buses, over speeding and lower patronization for Public Transport. Comprehensive Mobility Plan has identified the need to update the route and schedules which in technical terms is called as route rationalization plan.

At present MTC has a fleet size of 3740 buses which operate in 684 different routes. There are 27 bus depots in the metropolitan area. MTC bus services carry around 48 lakhs passengers daily. The Metropolitan Transport Corporation has 32 depots, each with an average parking capacity of 100 buses. These depots vary in size. The Tambaram and Anna Nagar depots, with 222 and 214 buses each respectively are the largest, and Basin Bridge, with only 45 buses, is the smallest. MTC operates 684 routes in the city. Thus 32% of the routes operated are running parallel to the metro (32% - 5 stations or more 62%- 2 stations or more).

Distribution of bus routes over frequency of bus trips per route has been analyzed and is presented in Table 6-5 . It is observed that 57.31 % of bus routes undertake only trips with less than 3 buses per route. The route rationalization plan for Chennai has been done based on the trunk feeder network concept. All trunk corridors connecting growth centres are identified and are shown Trunk line will be provided in the corridors with high PHPDT. These lines will have comparatively higher frequency and will have high capacity buses or mass rapid transit systems running. Since, the mass rapid transit proposal is a long term strategy, the route rationalization plan has to be implemented in short term with the trunk line as buses.

Table 6-5 Distribution of Bus Routes over Frequency

Buses per Route	No. of Routes	% No. of Routes
3	392	57.31%
6	101	14.77%
9	52	7.60%
12	37	5.41%
15	24	3.51%
18	25	3.65%

Buses per Route	No. of Routes	% No. of Routes
21	20	2.92%
24	13	1.90%
27	5	0.73%
30	15	2.19%
Total	**684**	**100.0%**

The route rationalization plan has identified the routes that need modification; that are to be terminated and retained. The details are given in Table 6-6

Table 6-6 Route Rationalisation Proposal

Total No. of Routes	684
Total No. of Routes for Modified (Improved Headways)	79
Total No. of Routes for Retaining	605

Figure 6-16 Major PT Trunk Corridors

6.3.2. BUS AUGMENTATION:

Based on the route rationalization plan prepared and estimated, the number of buses required in Chennai for the horizon years are computed. Fleet requirement over the years is estimated based On assessing the CIRT and MoHUA norms and demand is computed as 8123 buses (including scrapped buses) for the year 2048. For Horizon years (including rail fleet) with 50% of fleet is proposed as electric buses in next 20 years. However, a detailed feasibility study is to be undertaken. The details of the Bus Fleet Argumentation for the horizon years are as shown in Table 6-7.

Table 6-7 Bus Fleet Argumentation

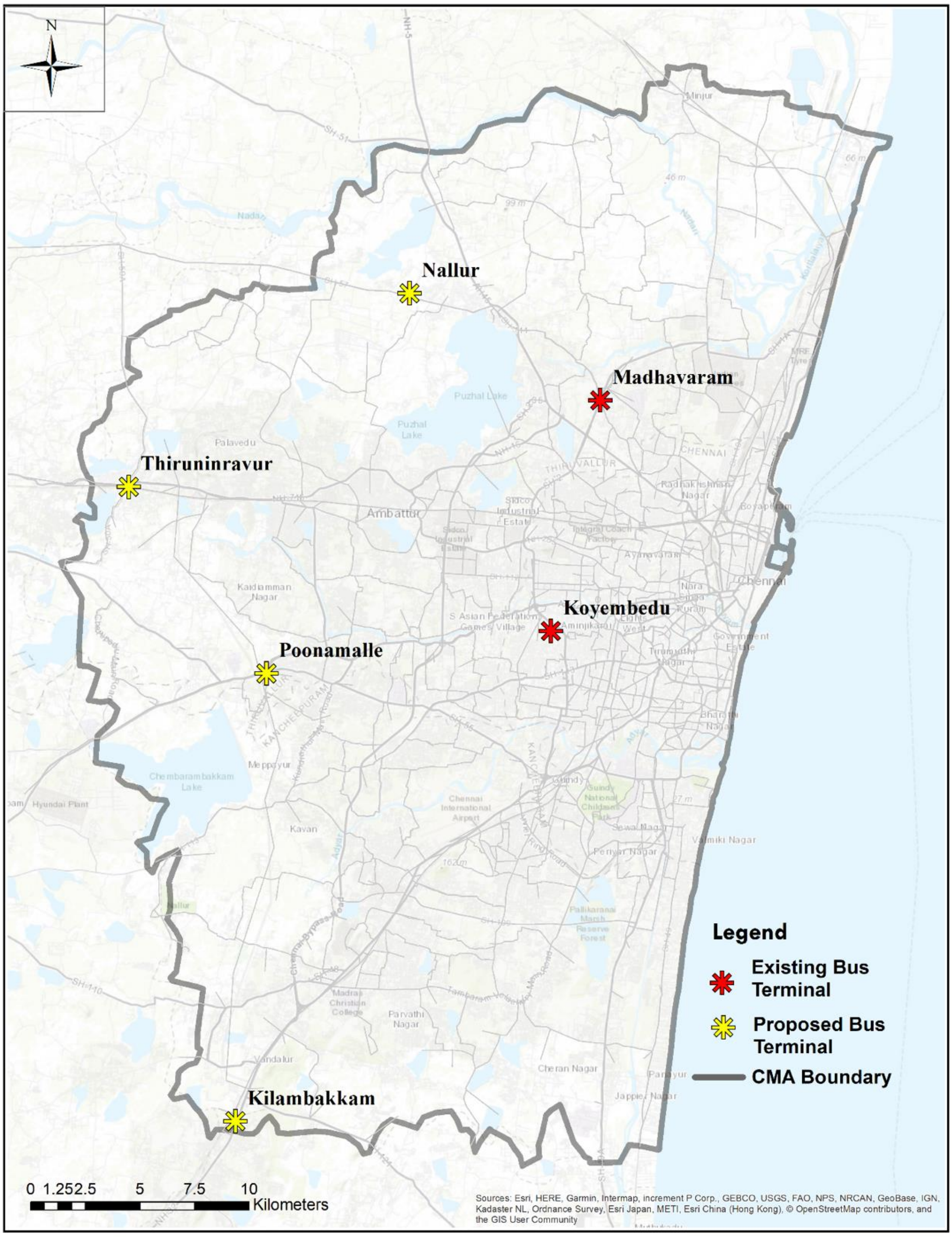
Bus Fleet Augmentation	2018	2023	2028	2038	2048
Total Existing Bus Fleet (Only buses)	3740	-	-	-	-
Proposed Bus Fleet as per MoHUA Norms	3814	4262	4756	6006	8123
Scrapping of Buses	1870	1870	1944	4756	6006
Electric Buses to be procured	972	1159	1219	3003	4062

6.3.3. BUS TERMINALS:

The existing Inter State bus Terminus (ISBT) is located at Koyembedu and Madhavaram. CMP suggests that the South bound buses from Coimbatore, Madurai, Salem etc. should be terminated at Kilambakkam Bus stand , West bound buses from Bangalore, Hosur to be terminated at Thiruniravur , and the north bound buses to be terminated at Madhavaram and Nallur in order to decongest the Koyembedu Bus Stand. The Proposed bus terminal is shown in Figure 6-17.The location and area requirements for the identified depots were worked out based the demand calculated based on Intercity Bus Traffic and proposed terminal locations are presented in the Table 6-8. In addition, the existing terminal at Koyembedu is proposed to be fully operational for city bus services and is proposed for upgradation. A detailed feasibility study needs to be carried out considering the availability of land.

Table 6-8 Proposed Bus Terminal cum Depot

Location Name
Ponamallee
Kilambakkam
Nallur
Thrirunindravur



Title	Proposed Intercity Bus Terminals	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-17 Existing Bus Depot/Terminal for Inter-City

The terminal locations are located where routes connect or terminate, as determined by passenger demand patterns. The bus passenger demand was projected for the horizon year based on the Inter-city passenger trips from outer cordon and from terminal surveys results.

The peak hour bus flow is shown in table below.

Location Name	2018	2038	2048	Area Required (in acres)
	Total Bus Required _Peak Hour	Total Bus Required _Peak Hour	Total Bus Required _Peak Hour	
Ponamallee	102	312	590	24
Kilambakkam	200	612	1160	46
Nallur	192	587	1110	44

The peak bus flow per hour is greater than 300 and hence the terminal capacity is planned to accommodate the same. It is estimated that a bus depot of 5 acres can house 120 buses [4](including workshop). Therefore, the total bus depot land required is 114 acres in the city.

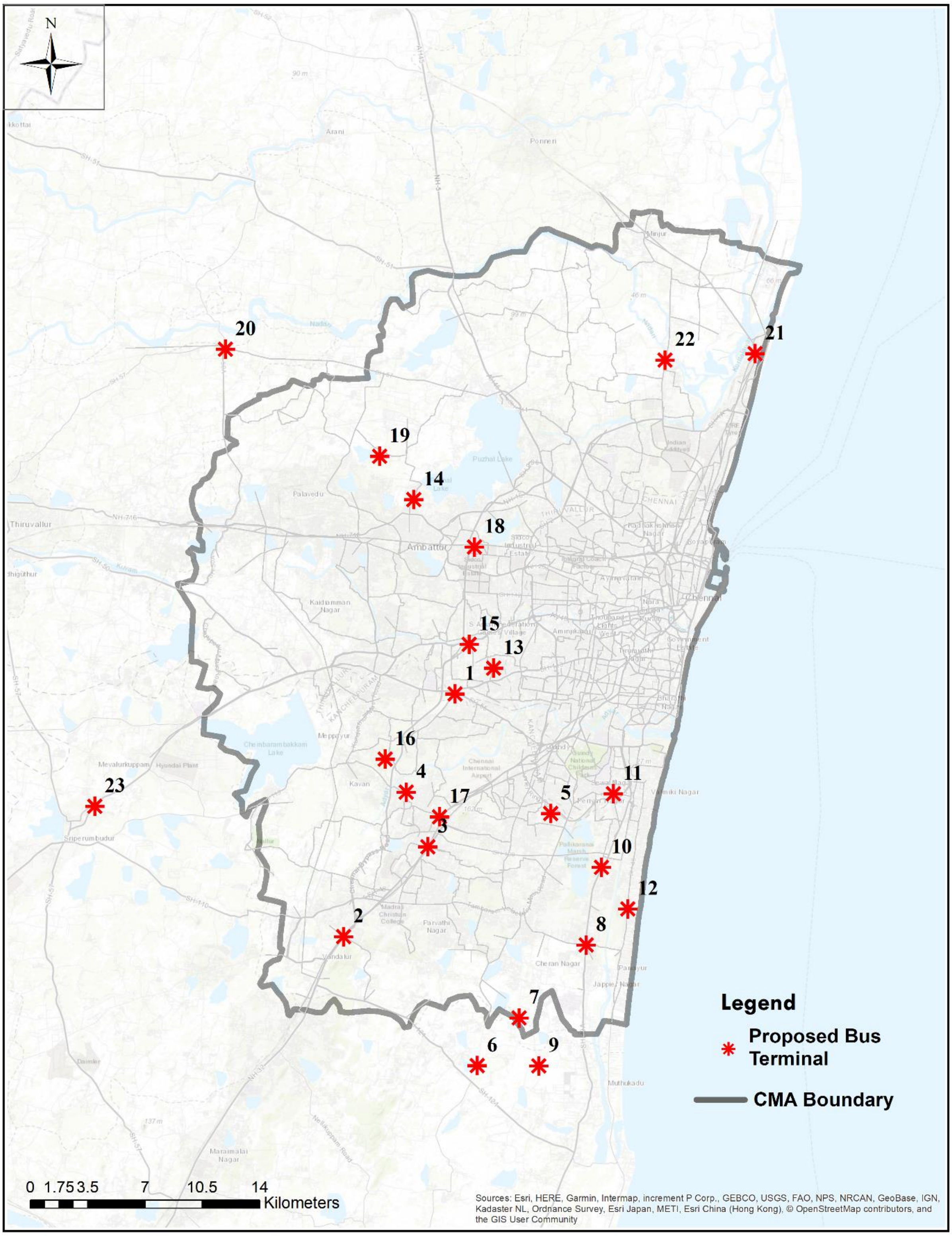
There are total of 71 terminals out of which 31 are owned by MTC which cater to the 3740 buses which operate within CMA. Additional of 23 bus terminals are proposed based on the Production attraction factors. Figure 6-17 and Figure 6-18 shows the existing and proposed bus terminals.

Table 6-9 : List of Existing Bus Terminal

TERMINUS DETAILS			
OWNED BY MTC BUS TERMINALS: 31		OWNED BY OTHER BUS TERMINALS: 40	
Sl.no.	Bus Terminus	Sl.no.	Bus Terminus
1	Adyar	1	Ambathur O.T.
2	Adambakkam	2	Anna square
3	Ambathut estate	3	Broadway
4	Anna nagar west	4	C.M.B.T
5	Avadi	5	Central
6	Ayanavaram	6	Chenglepet
7	Besant nagar	7	Egmore
8	Ennore	8	Guduvanchery
9	Foreshore estate	9	Guindy
10	Iyyappanthangal	10	Hasthinapuram

[4] *Based on case studies ,Shakti bus Terminal planning and design guidelines and EPCA reports - Delhi,2016*

TERMINUS DETAILS			
OWNED BY MTC BUS TERMINALS: 31		OWNED BY OTHER BUS TERMINALS: 40	
11	High court	11	I.C.F.
12	J.J.Nagar East	12	I.O.C
13	J.J.Nagar West	13	Karnodai
14	K.k.nagar	14	Kelambakkam
15	K.Kannadasan Nagar	15	Kilkattalai
16	Kannagi Nagar	16	Korattur
17	M.k.b nagar	17	Korukkupet
18	M.m.d.a	18	Kovalam
19	Mandaveli	19	Kundrathur
20	Perambur	20	Manali
21	Periyar nagar	21	Madhavaram village
22	Semmenchery	22	Mamallapuram
23	T.Nagar	23	Medavakkam
24	T.V.K Nagar	24	Minjur
25	Thiruvanmiyur	25	Pallavaram
26	Thiruverkadu	26	Pattabiram
27	Thiruvotriyur	27	Periyapalayam
28	Tollgate	28	Poonamallee
29	Vadapalani	29	Pozhichalur
30	Villivakkam	30	Pudur
31	Padiyanallur	31	Redhills
-	-	32	Saidapet
-	-	33	Sanatorium
-	-	34	Sriperumbudur
-	-	35	Tambaram
-	-	36	Thiruporur
-	-	37	Thiruvallur
-	-	38	Vandaloor zoo
-	-	39	Velachery
-	-	40	Vivekananda house



Title	Proposed Bus Terminal	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-18 Proposed Bus Terminal for CMA

Table 6-10 : List of Proposed Bus Terminals

S.No	Proposed Bus Terminus
1	Porur
2	Perungalathur
3	Chrompet
4	Anagaputhur
5	Puluthivakkam
6	Mambakkam
7	Ottiyambakkam
8	Sholinganallur
9	Siruseri
10	Thoraipakkam
11	Taramani
12	Injampakkam
13	Valasaravakkam
14	Thirumullaivoyal
15	Madhuravoyal
16	Thandalam
17	Pammal
18	Pattarvakkam
19	New Vellanur
20	Tamaraipakkam
21	Kathivakkam
22	Vichoor Village
23	Irungattukottai

6.3.4. INTERMEDIATE PUBLIC TRANSIT / FEEDER SERVICES:

Unreliable last mile connectivity impacts the overall quality and usage of mass transit and results in a mode share shift of Public Transport. While efforts are being made to enhance mass Public Transport, last mile connectivity has to be improved and linked into existing services.

An integrated system will aid ease of access for users. Auto-rickshaws and share Auto not only act as good feeder services to these mass transit options but can also be a mode of choice for occasional or short trips. They play a key role in improving sustainability for urban transport. There is a need to introduce new models of regulation and reforms that can be adopted for a more efficient and safer system that enable the rickshaw to have an optimal role in the transport mix.

The IPT services can provide first and last mile connectivity attracting more riders. The services are convenient as the pickup and drop off is provided at any point along the route. The Shared autos ply on narrow roads with less Right of way owing to their easy manoeuvrability enabling them to access the inaccessible locations.

Due to the restrictive policies, IPT providers largely operate informally

- Drivers lack job security and benefits
- They also do not have documentation of income, which limits access to credit to purchase their rickshaws
- Drivers are often subjected to harassment and confiscation of vehicles
- Negative environmental implications due to lack of regulation on emissions

Passenger service is unsafe and poor with

- No regulation of fares
- Little integration between modes due to lack of co-operation inconveniences passengers
- Lack of safety regulations puts passengers at risk
- Concern for safety due to mixed traffic flow driven by growth in private vehicles

Attempts need to be made to organize IPT

1. Provide better service to passengers
2. Transparency of fares and complaints hotline
3. Driver behaviour and road safety training
4. Dispatch services or "dial-a-rickshaw"
5. Include added features such as seatbelts, newspapers, etc.
6. Organize drivers and provide basic insurance, credit and allowances
7. Tea vendors can co-ordinate bookings and dispatch in return for rent-free space and a captive market of drivers
8. Medical and accident insurance and discounted medical facilities
9. Children's education allowance
10. Integrate with mass Public Transport

11. Feeder services for first and last mile connectivity – Shared Auto from railway station to homes
12. Promote sustainability: Electric Autos, solar-powered rickshaw or rickshaws on CNG.

6.3.5. KEY CHALLENGES

Competition of Auto-Rickshaw Services with Public Transport

Current trends in urban transport highlight the usage of IPT modes (i.e. auto-rickshaws and taxis) in cities for daily commute trips, because of the poor quality of Public Transport. Thus, improving Public Transport in cities would be a key strategy in ensuring that auto-rickshaw services fulfill their intended role as feeder services instead of competing with Public Transport for long-distance trips.

In Chennai, the IPT routes operated overlap with the major trunk PT corridors as shown in

. Although improving Public Transport in Chennai would be a key strategy, it is also important to ensure that auto-rickshaw/Share Auto services fulfil their intended role as feeder services instead of competing with Public Transport for long-distance trips. The same is achieved by rationalizing their major routes to feed into the PT corridors, designating the routes, stops. A common mobility card can also be introduced which can be used across the modes by the user.

The Potential IPT corridors which will feed to the major trunk PT corridors are identified. These routes are given in

. However, detailed feasibility study is to undertaken to identify the Routes, Operation plan and service required in accordance with the development of Transit corridors.

Figure 6-19 Key IPT routes Proposed

6.3.6. MULTI-MODAL INTEGRATION PROPOSALS

At the intersection of each mobility corridor/ transit corridor with the inner ring road/ outer ring road of the city, a transfer terminal shall be facilitated. The transfer terminal is technically called as Transport and Traffic Management Centres (TTMC). The main objective of these TTMCs is to provide Urban Transport Infrastructure with several amenities under one roof. Commuters can come from their places in personal vehicles to the Public Transport mode and make use of all the public amenities provided and return to their destinations. They get all their daily requirements at a single place. This will help in reducing the number of trips which also reduce the pollution hazards. This system can be integrated with existing and proposed modes of transportation network like Metro, Sub-urban, MRTS and BRT corridors. The Multimodal nodes are proposed based on the degree of interchanges between various modes. The proposed TTMC locations are given below and are shown in Figure 6-20.

Fig .Rotterdam Central Station (Left) Façade view and Right (Sectional 3D View).The multimodal station connects High Speed Rail with Light Rail system

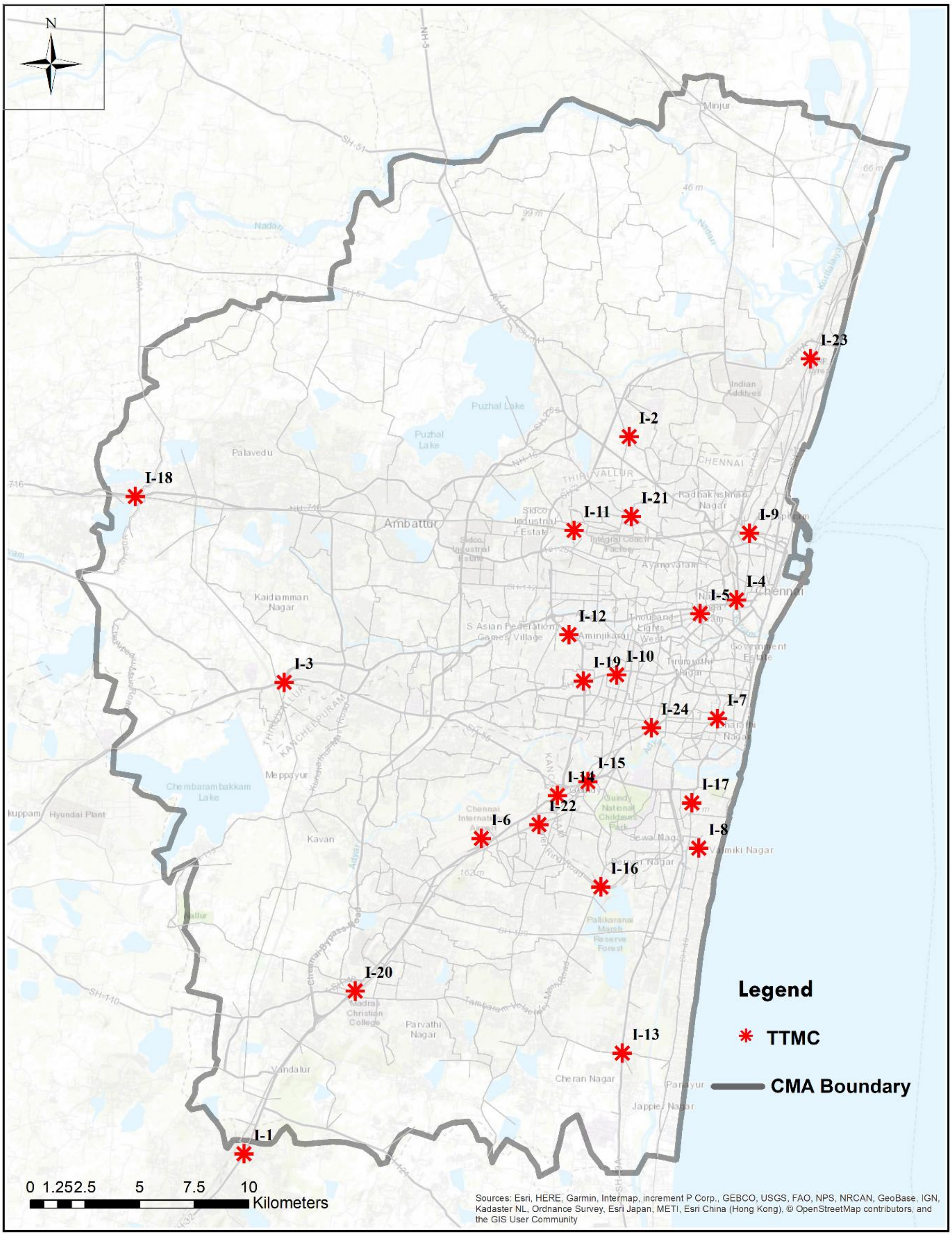
Table 6-11 Proposed TTMC Locations

S.No	Interchange Locations
State - City - Bus /NMT	
I-1	Kilambakkam Bus Stand
I-2	Madhavaram
I-3	Poonamallee
Rail /City-Bus/NMT	
I-4	**Central**
I-5	**Egmore**
I-6	**Airport**
I-7	**Thirumayilai (LUZ)**
I-8	**Thiruvanmiyur**
I-9	**Washermanpet**
I-10	**Kodambakkam**
I-11	**Villivakkam**

S.No	Interchange Locations
I-12	**CMBT**
I-13	**Sholinganallur**
I-14	**Alandur**
I-15	**Guindy**
I-16	**Velachery**
I-17	**Adyar**
I-18	**Thiruniravur**
I-19	**Vadapalani**
I-20	**Tambaram**
I-21	**Perambur**
I-22	**St.Thomas Mount**
I-23	**Wimco Nagar**
I-24	**Nandanam**

Table 6-12 Proposal TTMC Locations

The proposed TTMCs will act as a transfer points between different modes of transport and will also act as a terminating point for the higher order PT systems. The Interchanges is to be integrated seamlessly which will ensure safe, comfortable and accessible transfers. Improvement of Pedestrian friendly facilities such as footpaths, grade separated facility, organised hawkers zone and improvement of on-street/off-street parking facilities including the provision for first and last mile connectivity should be provided. The TTMC should integrate schedules, services, time-tables, extra for smooth functioning of the Public transport system in the city. Operational Integration shall improve the passenger transfers, comfort and travel time. Single fare for single trip across various mode to enhance seamless travel experience for the passengers. Fare integration shall reduce the out vehicle time for the passengers. Central Command and Control Centre is recommended to ensure operational planning and integration for the agencies and assess the passenger with travel information, trip planners, PIS, extra.



Title	**Proposed Traffic and Transport Management Centre**	Prepared by Urban Mass Transit Company Limited
Project	**Comprehensive Mobility Plan for Chennai Metropolitan Area**	

Figure 6-20 Proposed Multi-Modal Station

6.3.7. HIGHER ORDER MASS TRANSIT SYSTEMS:

A Mass Transit System is designed to move a large number of people at one time. Mass Rapid Transit system usually runs in special guideways which will lead to reduced travel times, minimised congestion, reduction in accidents and better quality of life.

Figure 6-21 Space required to transport the same number of passengers: Car, Bicycle and Bus.

A number of modes are available for Public Transport and as some of the technologies, especially metro rail, are highly capital intensive, which necessitates certain guidelines for choice of different transit modes. However, buses will continue to be the major mode of Public Transport, which will act as a feeder mode to Metro rail along conceived corridors and will also continue to serve other catchments. The selection of higher order system is based on the Passengers per Hour per Direction (PPHPD) and feasibility of implementation, along with other related parameters as mentioned below:

Need For A Mass Transit System	Selection Criteria
From energy efficiency point of view, the use of mass transit is vastly superior when compared to using personalized modes of travel. Available literature shows that, to meet each km of passenger travel demand:	**A. Effectiveness of mode in meeting demand** **B. Cost** **C. Right of way availability** **D. Environmental Impact** **E. Journey Time** **F. Safety**

A. A car consumes nearly five times more energy than a 52 seater bus with 82% average load factor **B. A car occupies over 38 times more road space per passenger in comparison to a bus** **C. The fuel cost of two wheelers is 6.8 times, three wheelers 7 times and cars 11.8 times when compared to a bus.**	**G. Comfort** **H. Flexibility** **I. Reliability** **J. Fare** **K. Technical Sophistication** **L. Implementation Complexities** **M. Image**

(Source: UNDP Reference Guide, Vol 2: Public Transport – 2013, MoHUA, GoI)

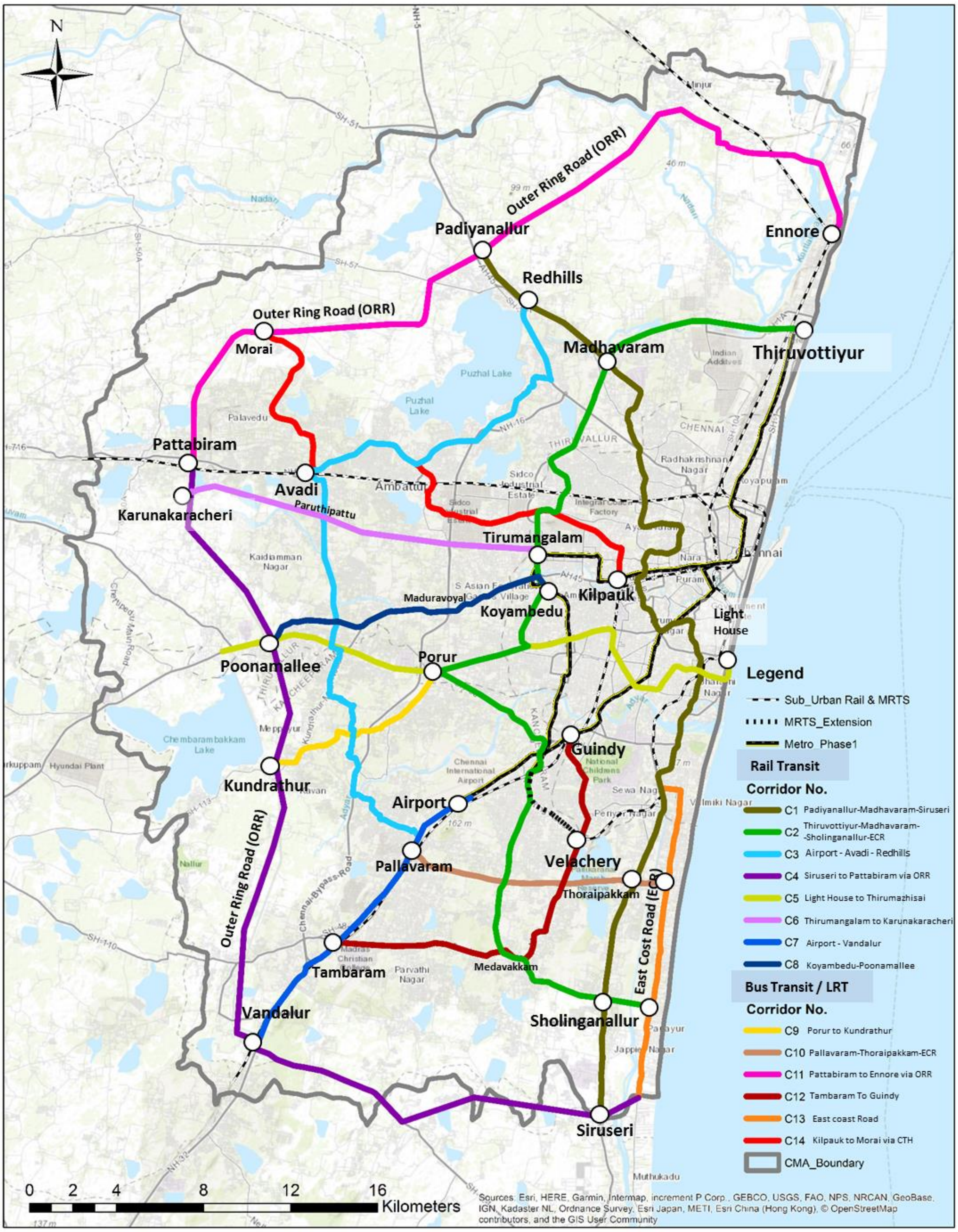
The guidelines for selection of mass rapid transit choice for the city is given as specified by working group Table 6-13 on Urban Transport for 12th Five Year Plan of India and is based on guiding documents, past studies and experiences.

Table 6-13 Selection of Mass Rapid Transit System Choice

Mode Choice	Desirable PPHPD	Population (Million)	Average Trip Length
Metro	>15000 for at least 5 km continuous length	>=2	>7-8
LRT at Grade	<=10000	>1	>7-8
Monorail	<=10000	>1	About 5-6
BRT	>=4000 and upto 20000	>1	>5
Organized City Bus Service as per UBS-II		>1 Lakh, 50000 in case of hilly towns	>2-3
Source: Mode Selection as mentioned in 12th Five Year Plan (Recommendations of working group)			

Mode Choice	Desirable PPHPD
Bus Based System	<10,000
Rail Based System	>=10,000
*** Based on Guiding Documents, Past Studies on Various DFR's***	

The urban transport model developed for CMA has evaluated the PPHPD values on all major corridors of Chennai (i.e. mobility corridors) for 2048. The PPHPD values along the mobility corridors are shown in Table 6-14



Title	Proposed Mass Transit Corridors	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-22 Proposed Mass Troposed Mass Corridors

Table 6-14 PPHPD Values along Mobility Corridors in 2048

Sl No	Links	CODE	Route Length	PPHPD	Proposed MRT Option
1	Padiyanallur-Madhavaram-Siruseri	C1	54.13	37735	RAIL
2	Thiruvottiyur-Madhavaram-Sholinganalur-ECR	C2	53.45	27461	RAIL
3	Airport - Avadi - Redhills	C3	37.03	27141	RAIL
4	Siruseri to Pattabiram via ORR	C4	49.18	19530	RAIL
5	Light House to Thirumazhisai via Poonamallee	C5	29.87	27866	RAIL
6	Thirumangalam to Karunakaracheri via Paruthipet	C6	11.69	16793	RAIL
7	Airport - Vandalur	C7	17.44	16394	RAIL
8	Koyambedu-Poonamallee via Madhuravoyal	C8	13.7	10348	RAIL
9	Porur to Kunrathur	C9	15.02	7259	BUS/LRT
10	Pallavaram-Thoraipakkam-ECR	C10	13.68	7911	BUS/LRT
11	Pattabiram to Ennore via ORR	C11	38.66	7011	BUS/LRT
12	Tambaram To Guindy via Medavakkam	C12	20.4	9876	BUS/LRT
13	East coast Road	C13	15.28	5161	BUS/LRT
14	Kilpauk to Morai via CTH	C14	28	5652	BUS/LRT

Based on the PHPDT values, the implementation of an appropriate Mass Transit System is recommended on rings and radial routes. However, feasibility studies and DPRs need to be carried in order to identify appropriate mass transit systems on the mobility corridors. However, this study will indicate the possible systems to be implemented on the mobility corridors based on the forecasted PHPDT numbers and the right-of-way considerations. Route-wise PHPHDT values have been presented in Table 6-14.The map for the proposed mass transit system is shown in Figure 6-22

6.3.8. PROMOTING PUBLIC TRANSPORT-OUTREACH PROGRAMMES:

For successful implementation of the transit system, it is necessary to promote public awareness and create a sense of public ownership of the project. For this to happen effectively, it is necessary to evolve an outreach and education strategy for promoting the system.

The outreach and education goals need to be defined at the planning stage of the system itself to focus the efforts of the project implementation. The outreach and education goals as listed under UNDP Reference Guide for Public Transport are as follows:

a. Introduce the concept of the transit system, its purpose and the benefits to the various stakeholders

b. Create profile of the system as a big impact, with incremental steps for achieving the long term vision for mobility in the city

c. Enhance the understanding that mass transit projects positively impact economic health and environmental stability of the city

d. Introduce the concept of specific systems as an important strategy in making the best use of transportation resources

e. Establish communication channels for the public to receive information and interact with the implementing agencies

Following strategies can be adopted for an effective public outreach

1. Create a network of allies and provide platforms for them to actively participate as disseminators of project benefits

2. Use proactive and creative communication media to promote key messages. Communication media can be print, broadcasts, short films, event marketing etc.

3. Programmes can be conducted in schools and colleges advocating the need for Public Transport.

Further, an Integrated Public Transport study need to be carried out for detailed estimation of infrastructure and service requirement. This study will include both physical and service integration.

6.4 NON-MOTORISED TRANSPORT PLAN

The CMP envisions Chennai as a city with a general sense of well-being through the development of quality and dignified environment where people are encouraged to walk and cycle; equitable allocation of public space and infrastructure; and access to opportunities and mobility for all residents in Chennai.

Currently, 61% of the exiting footpaths do not abide by the standards in terms of minimum clear walking space, continuity, crossing treatments, etc.,

Figure 6-23 Major Corridors for Transit Oriented Development

Thus, Chennai Metropolitan Development Authority (CMDA) should aim to increase the use of cycling and walking by creating a safe and pleasant NMT network of footpaths, cycle tracks, greenways, and other facilities to serve all citizens. The design of the streets in the city are proposed to consider pedestrian-oriented, multi-modal street designs. They will also incorporate appropriate environmental planning and water management techniques. Together, these measures will achieve the following:

1. Improved access and mobility for all residents.
2. Social and economic empowerment through the provision of improved low-cost mobility.
3. Gender equity through the provision of NMT facilities that are safe for women to use.
4. Social inclusion in creating NMT facilities that follow principles of universal design and are usable to the greatest extent possible by everyone, regardless of his or her age, ability, or status in life.
5. Reduced local and global environmental impacts of Chennai transport system through expanded use of zero pollution modes.
6. A changed culture that accepts the use of cycling and walking as acceptable and aspirational means to move around in the city.
7. Participation of local residents, businesses, and other stakeholders in the preparation of designs and standards in order to foster the community's active use and sense of ownership of these spaces.

The proposals under Non-Motorized Transport (NMT) Plan for Chennai are:

- Development of Footpath facilities.
- Development of Cyclist-Friendly streets

- Area-Wise NMT Recommendations

6.4.1. DEVELOPMENT OF FOOTPATH FACILITIES

Pedestrian trips are generally short trips and can be observed everywhere in a city. And hence, ideally pedestrian walkways should be provided on all major roads and streets in the city. However, special consideration for pedestrians should be given near junctions (dangerous intersections), major activity nodes (like schools, colleges, etc.).

Safe Route to Schools programs should be conducted and should be encouraged to follow in all the schools in Chennai. The streets accessing the schools should be designed for pedestrians.

The smaller local streets/residential streets may not have sufficient width to provide a segregated pedestrian walkway. But these residential streets should also provide safe route to pedestrians. This can be achieved by

a) Installation of speed limits

b) Installing speed breakers at frequent intervals

c) Providing table top crossings etc.

CMP has identified all the major spines of Chennai for immediate need of footpaths as per the design standards. All the junctions in Chennai should be designed with due consideration for pedestrians.

The footpath design should be uniform across the city. Depending on the volume of pedestrians, the area requires footpaths with minimum width of 1.8m and maximum height of 150mm from the finished road surface. In certain cases, where the available road ROW makes it difficult to provide 1.8 m barrier free space for footpaths, the widths should not be less than 1.2 m. However, the maximum height of 150 mm cannot be compromised in any circumstance. Increasing the footpath height to more than 150 mm makes them unusable by pedestrians, thereby defeating the purpose of providing the footpaths. A sample design of footpath is shown in Figure 6-24.

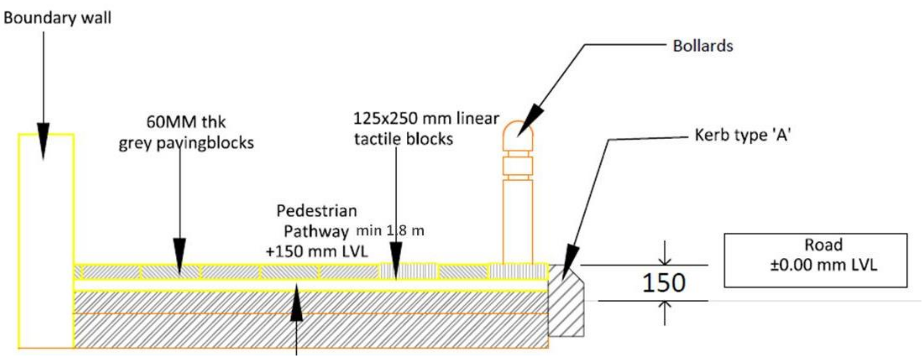


Figure 6-24 Sample Design of Footpath

CMP has identified 752 km of roads within CMA where the footpaths have to be built immediately or the existing footpath should be reconstructed according to design standards. The list of footpaths is given in Table 6-15 and shown in Figure 6-25. The local authorities should develop the footpaths in all other streets following the development of footpaths in the priority streets.

Table 6-15 Footpath Network

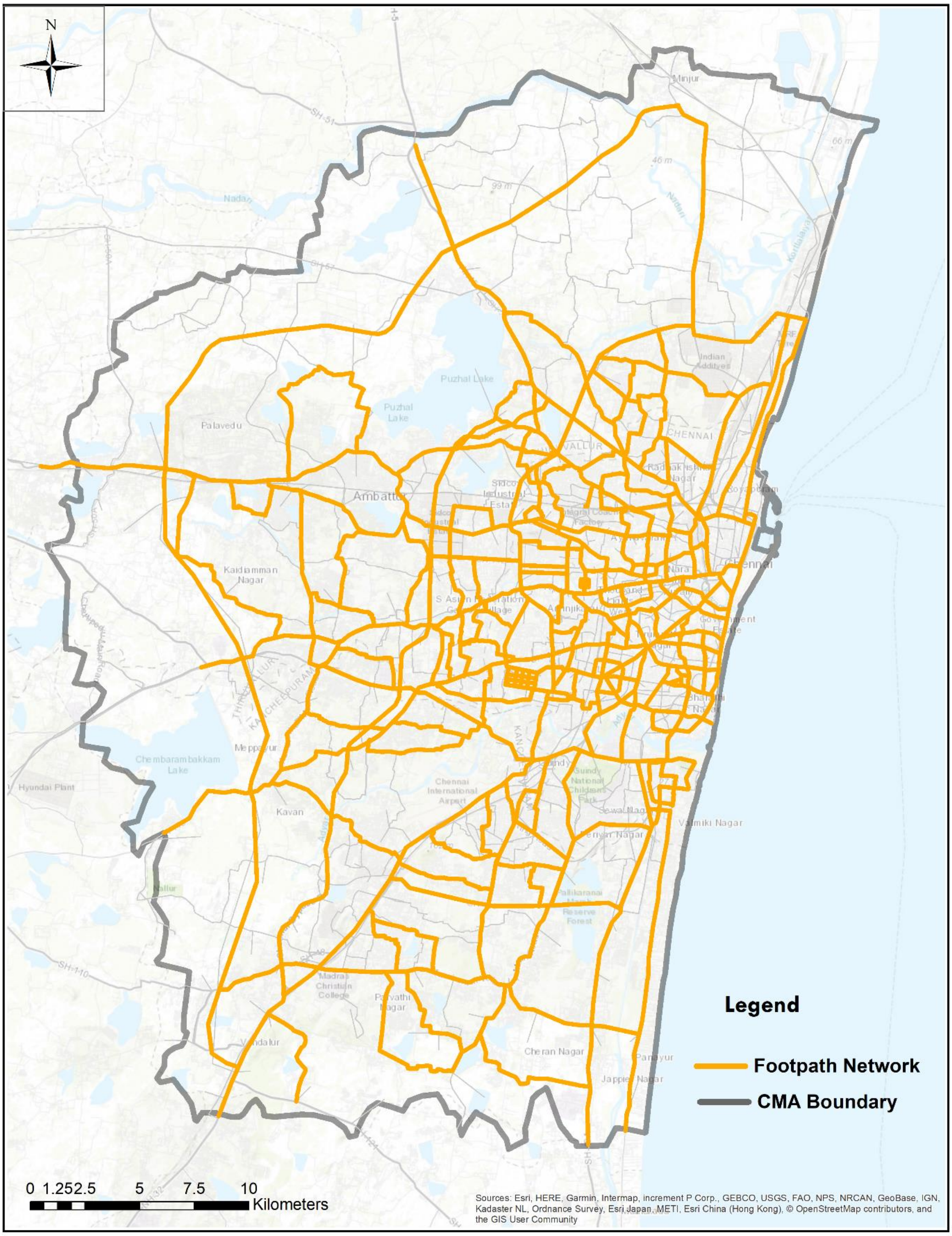
S.No	Name	Length (km)
1	Flag Staff Road-Rajaji Salai	4.1
2	Anna Salai	7.6
3	Dr.Radhakrishnan Salai	7.4
4	Swami Sivananda Salai	1.9
5	Adithanar Road -Walajah Road	3.1
6	Greams Road	0.9
7	Bharathi Salai	2.3
8	Thiru vi ka high road	7.3
9	LUZ Church road	1.9
10	Dr.Natesan Road	2.2
11	St. Peters road	2.5
12	Thyagaraya Road	1.2
13	Pasumpon Muthuramalinga thevar road	3.7
14	Greenways	4.9
15	Anna Salai	5.2
16	Velachery Road -kamaraj Garden Street	6.3
17	Southern Arm inner ring road	2.5
18	Medavakkam Main Road	4.9
19	Thiruvallur Main Road	1.9

S.No	Name	Length (km)
20	Thillai Ganga Nagar Main Road -Inner Ring Road	2.5
21	Thiruvallur Main Road	3.1
22	Taramani Road	3.1
23	18th main road	2.5
24	Anna nagar 2nd avenue	1.7
25	Shanthi Colony	1.7
26	Kaliamman Kovil Street	5.3
27	Ambattur Estate bus depot road	6.4
28	Alapakkam Main Road	2.4
29	Gerugambakkam Main Road	4.3
30	Mettukuppam Main Road	4.2
31	Kamarajar salai	2.2
32	Dr.Ambedkar road	4.5
33	Kilpauk Garden Road	2.2
34	Kilpauk Garden Road	1.7
35	Paper mills road	9.4
36	Thiruvottiyur High Road	8.2
37	Basin road	5.0
38	Kamarajar Salai	7.7
39	Padasalai St	5.9
40	Milk Colony	2.7
41	TH Road	2.4
42	Sidco Main Road	1.5
43	Manali high Road	3.8
44	Madhavaram High road -renukagah Amman 1st	2.9
45	Raja Muthaiyah Road -basin bridge road	2.3
46	Dr.Ambedkhar College Road	3.6
47	Ayanavaram Road	5.6
48	Paper mills road	9.4
49	Diary Road	6.4
50	3rd Avenure anna nagar	1.9
51	Red Hills Road	2.1
52	Kadappa Road	4.3
53	Rajaji Road	27.6
54	Poonamalle High Road	26.4
55	GST	56.5

S.No	Name	Length (km)
56	GNT	19.8
57	Madhavaram Red Hills road	8.1
58	SH114	29.1
59	Vanagaram Ambattur Road	6.6
60	Vanagaram Main road	2.3
61	Avadi Main Road	7.2
62	OMR	20.1
63	ECR	13.7
64	Perumbakkam Main Road	9.5
65	Kundrathur Main road	18.5
66	Trunk road -Poonamalle High road	11.3
67	Bharathipuram Main Road	1.13
68	1st main road and W-park road ,shenoy nagar	1.74
69	80 ft road ,Perambur (Huzur garden)	2.1
70	Gandhi Mandapam Road	3.29
71	kasturbhai Nagar ,Adyar	7.39
72	Perumbakkam Main Road	15.4
73	Pammal Main road	7.46
74	Medavakkam Main Road	3.31
75	Velachery Main Road	4.2
76	Muthukumaran Street,Vilijiyabakkam Lake	4.15
77	Kannadapalayam Road	12.7
78	Muvarasanpatti Main Road	7.37
79	Dharga road, Pallavaram	4.54
80	Mogappair Estate Road	4.27
81	Mangadu Main Road	6.59
82	Gerumgabakkam Main Road	6.47
83	Sembakkam-Hastinapuram Link Road	5.1
84	Agaram Main Road	12.4
85	Hillside Road -Sithalapakkam Road	6.6
86	Sivan Koil Street	3.83
87	Tonakela Camp Road -Ambattur Road	5.75
88	Thiruverkadu Road	4.52
89	Surapet Main Road	8
90	Minjur- manali New town	10.5
91	ORR	62

S.No	Name	Length (km)
92	SH-206	11.1
93	70 ft road	1.1
94	Elaiyamman Kovil Street	4.35
95	Puraswalkam	2.18
96	KK nagar	6.81
97	Mugalivakkam Road	3.46
98	Mangadu Main road	3.79
99	Sathya Street ,Valasarawalkam	2.71
100	T-Nagar-Burkit Road	4.1
101	T-Nagar-Venkatanarayana Road	1.26
102	Madipakkam Main road - 200ft road	2.54
103	Madambakkam Main Road	5.41
104	Gandhi Road	5.1
105	Sitalapakkam Main Road	3.39
106	Vandalur-Dargas Road	6
107	Tambaram-Mudichur-Sriperambudur road	4.72
108	Thirumulaivayal Road	3.38
109	Chettiyar Agaram Road	3.96
110	Thangal St	4.75
Footpath network identified within GCC* (		109.4
Total Length (in Kms)		861

Footpath network identified by Smart City within GCC – detailed location is provided in Annexure J



Title	Proposed Pedestrian Network	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-25 Footpath Network

Pedestrian Crossing Infrastructure

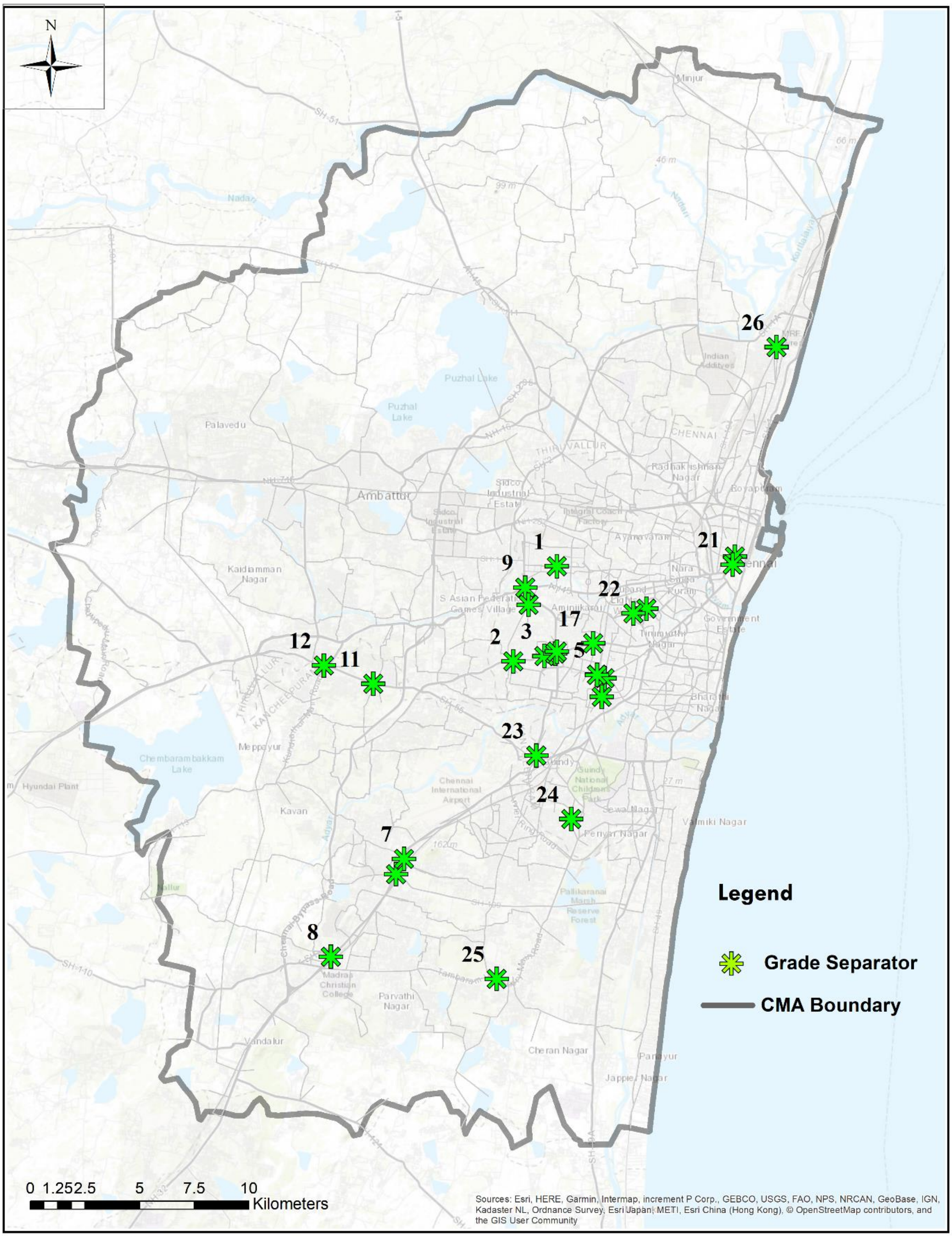
The degree of conflicts between the pedestrians and vehicles have been assessed with the help of PV Square analysis across the major junctions in the city and the degree of interventions at crossings have been identified. The CMP suggests 26 Pedestrian grade separators for pedestrian crossing. Among which Poonamallee has also been identified for grade separator facilities as the part of area development plan. The details of the locations for which the PV2 are calculated are shown in the Figure 6-26 and Table 6-16. Apart from the identified locations, any location warranting for the pedestrian demand based on the PV^2 value $PV^2>10^8$ for undivided carriageways and $PV^2>2x10^8$ for divided carriageways shall be taken up by the respective stake holders based on the site condition and requirements.

Foot Over Bridge - ITO, Delhi.

Table 6-16 Interventions for Pedestrian Crossing

S.No	Location	PV^2	Pedestrian Facility Type
1	Anna Nagar 2nd avenue	1.08×10^{10}	Grade Separated
2	Arcot Road at Porur Junction	2.3×10^{9}	Grade Separated
3	Arcot Road near Vadapalani Bus Stand	1.04×10^{10}	Grade Separated
5	Durai sawmy road Pothys junction	2.6×10^{9}	Grade Separated
6	GST Road near Chrompet Bus Stand	3.52×10^{10}	Grade Separated

7	GST Road near Pallavaram Bus Stand	1.5×10^{10}	Grade Separated
8	GST Road near Tambaram Bus Stand	1.39×10^{10}	Grade Separated
9	Koyambedu Junction	3.99×10^{10}	Grade Separated
10	Mofussil Bus Terminus	2.16×10^{10}	Grade Separated
11	Mt Poonamallee Rd -Iyappanthangal Bus Stand	1.6×10^{9}	Grade Separated
12	Poonamallee Trunk Road	5.6×10^{9}	Grade Separated
13	South Usman Road in front of T. Nagar Bus Stand	7.1×10^{9}	Grade Separated
14	South Usman Road	2.6×10^{9}	Grade Separated
15	Vadapalani Signal Arcot Road	1.01×10^{10}	Grade Separated
16	Vadapalani Signal Jawaharlal Nehru Road	9.5×10^{9}	Grade Separated
17	Arcot Road near Meenakshi College	3.2×10^{10}	Grade Separated
18	Broadway	1.6×10^{9}	Grade Separated
19	College road junction	1.71×10^{10}	Grade Separated
20	Duraisawmy Road	0.7×10^{9}	Grade Separated
21	In Front of Raja Annamalai Mandram	6.3×10^{9}	Grade Separated
22	Sterling road junction	8.7×10^{9}	Grade Separated
23	Kathipara Junction	1.67×10^{10}	Grade Separated
24	Taramani Velachery Road Vs Velachery Bypass Rd	6.8×10^{9}	Grade Separated
25	Taramani Velachery Road Vs Velachery Main Road	6.5×10^{9}	Grade Separated
26	Thiruvottriyur Bus Stand Junction	1.08×10^{10}	Grade Separated



Title	**Grade Separators - Pedestrian Crossing**	Prepared by Urban Mass Transit Company Limited
Project	**Comprehensive Mobility Plan for Chennai Metropolitan Area**	

Figure 6-26 Junctions eligible for Pedestrian Crossing Grade Separators

Pedestrian Mall Facilities

The pedestrian malls are open spaces that serve as a gathering and activity space for social, recreational and civic purposes. These spaces can be created underside of metro stations, flyovers etc. where large pedestrian volumes are witnessed throughout the day. These spaces serve as one of the core elements of urban renewal. These have shown improved pedestrian footfalls, sense of identity and belonging, social interactions, better safety along these areas making them active and vibrant spaces of the city. The Figure 6-27 illustrated the examples of Pedestrian Malls around the world.

Figure 6-27 Examples of Pedestrian Malls Amritsar (Top Left), Canal Road- Hong Kong (Top Right), Bridge of Garden (Bottom Left) and Snake and Ladder Area, Bangalore

In case of Chennai, 18 locations have been identified to be developed as Pedestrian Malls to improve the quality of streets and public spaces. These locations have been identified on accessing the nature of activity nodes (commercial, recreational and institutional establishments), pedestrian footfalls and the potential for renewal of unused spaces. The following are the proposed locations for Pedestrian Malls,

S.No	Pedestrian Mall Locations
1	Chennai Central
2	NSC bose road
3	Chinna Bazaar Road

S.No	Pedestrian Mall Locations
4	Kasi Chetty street
5	Broadway Eravalu Street
6	Puraswalkam
7	T-Nagar -Usmaan Road
8	Mylapore Tank Road
9	Pondi Bazaar
10	Parry's Corner
11	Anna Nagar (Roundana)
12	Muthulingam Street-West Tambaram
13	Vadapalani -North Mada Street
14	Madhya Kailash
15	Olympia Tech Park
16	Kathipara Flyover
17	Koyembedu
18	Moolakadai

6.4.2. DEVELOPMENT OF CYCLIST-FRIENDLY STREETS

Cycling is increasingly recognized as a clean, sustainable mode of transport and an essential part of an inter-modal plan for sustainable urban travel. More cycling in urban areas in place of car use could contribute to less energy consumption from travel activity and reduced congestion. Increasing cycling could be a promising way to contribute to the reduction of greenhouse and other emissions. More than capturing the captive users to use the cycles for movement, the development of cycle tracks should attract more uninterested citizens to use cycles.

(left -A cycle lane, created from the carriageway) and (Right -Cycle tracks at carriageway level that break to become lanes across accesses and side roads)

Bicycle friendly streets are designed considering following principles:

- **Safety**: Segregated cycle tracks for increased sense of security and safe route to schools and bus stops.

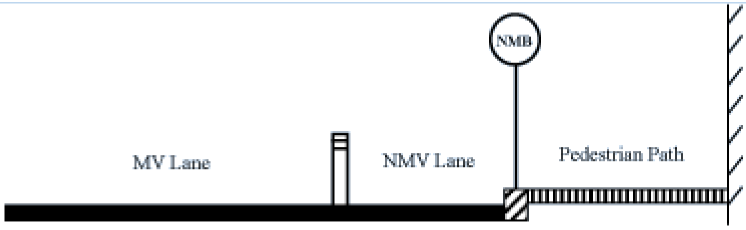
- **Connectivity**: The NMT network should connect major attractions and a complete consistent network with fewer missing links.
- **Comfort**: A more comfortable pedestrian and cycle path with facilities to support and encourage the use of NMT.
- **Ambience**: To make cycling a pleasant and great experience to its users.

Design Appropriate Measures

Once appropriate measures conforming to a city's cycle policy have been selected, they should be designed appropriately. Most cities worldwide tend to adopt and develop their own detailed design guidelines; however the following section provides guidance on the basic design of common measures and can be used as advisory design notes.

Non-Motorized Vehicles (NMV) lanes can generally be classified into four main categories and are listed in Table 6-17.

Table 6-17 Types of NMV Lane and Cross sections

Type of NMV Lane	Cross Section
Type I NMV Lane **NMV lanes shared with MVs and designated by signs**	
Type II NMV Lane **NMV lanes designated by lane markings (e.g. striping) and within the highway right-of-way**	
Type III NMV Lane **NMV-exclusive lanes physically separated from MVs by barriers (e.g. concrete blocks, steel railing, raised curb) and within the highway right-of-way**	

Type IV NMV Lane **NMV-exclusive lanes within an independent right-of-way (often referred to as NMV paths)**	

Minimum recommended widths for bicycle lanes vary from country to country, however they typically fall within the range of 1.2–2.0 meters, which allows for the physical width of a bicycle's handlebar plus a margin of safety. As per MoHUA guidelines, recommended lane widths for various NMV lane types are provided in Table 6-18.

Table 6-18 Recommended NMV Lane Width

NMV Type	Type II Lane		Type III & IV Lanes		Increment Increase	
	Minimum	**Standard**	**Minimum**	**Standard**	**Minimum**	**Standard**
Bicycle	1.2	1.4	1.5	1.5	1.0	1.0

Note: These NMV lanes are considered to operate as one-way facilities

In cities with high use of one or more NMV types, these lanes should be widened to provide sufficient capacity. The recommended maximum gradient of NMV lanes should be no greater than 5%. This is the maximum slope that would still allow safe downhill speeds and reasonable climbing effort for NMV operators.

Non-Motorized Vehicles (NMV) lanes for Chennai (CMA)

Total for 183 km of dedicated NMV lanes along with 268 km of shared routes are proposed in the plan connecting important activity centres and trip attractors. The bicycle tracks proposed in the city are Type I, II and III based on the traffic and RoW constraints observed. The network is proposed in the plan connecting important activity centres and trip attractors and are shown in Table 6-19 and Figure 6-29.

Work Underway – 17km of Cycle Lanes - Thermoplastic Lane Marking and Signboards

The Special Project Department (GCC) has proposed to provide bicycle lane within Greater Chennai Corporation for a length of 17 km in two stretches. The cycle lanes are marked with a green thermoplastic paint patch and there are signboards at every 200 metres. A yellow lane marker is used to demarcate the lane.

Reach 1 - 13 km	Reach 2 - 4 km
1. Sardar Patel Road	1. Swamy Sivanantha Salai
2. Taluk Office road	2. Flag Staff Road
3. Velachery Main road	3. Napier Bridge
4. Indira Nagar 1st Avenue	4. Anna Salai
5. Indira Nagar 2nd Avenue	-
6. Indira Nagar 3rd Avenue	-
7. Kasturba Nagar 3rd Cross St	-
8. DGS Dinakaran Salai	-
9. Durgabai Deshmukh Road	-
10. Broadies castle road	-

Figure 6-28 Work Underway for Bicycle Infrastructure Improvement

Table 6-19 Corridors for Bicycle Infrastructure Improvement

S.No	Road Name	From	To	Length (km)
Dedicated Track - Segregated				
1	Rajaji Road	Royapuram Goodshed	Chennai Central near Rajiv Gandhi General Hospital	4
2	Poonamallee high Road	Royapuram Railway Station via Old Jail Road, Ramanan Road	Nazarethpet via Nombal, Senneerkuppam	27
3	GST to Ennore Via JNU Road	Vandalur near Cresent Engineering College via Guindy, Koyembedu, Sidco Industrial Estate	JNU Road via Manali Petro Chemicals, Beach Road	57
4	GNT-Erukkancheri Highroad	Chennai Central	Guntur Chennai Highway GNT near Madhavaram Roundabout	20
5	Vanagaram Main Road	TNHB, KK Nagar	Ambattur Industrial Estate	3
6	Trunk road - Poonamallee High Road	Alandur Bus Stop	Bypass Bus Stop –	12

S.No	Road Name	From	To	Length (km)
			Seneerkuppam	
7	Flag Staff Road-Rajaji Salai	Fort St.George	Kamarajar Promenade	4
8	Anna Salai	Fort St.George	T-Nagar	8
9	Dr.Radhakrishnan Salai	Nungambakkam	Kamarajar Promenade	8
10	Greams Road	Moore's Road	Anna Salai	1
11	Thiru vi ka High Road	Anna Salai	Sardar Patel Road	8
12	Greenways	PS Kumaraswamy Road	Santhome Basicilica Bus Stop	5
13	Anna Salai/Mount road-Turnbulls via GK Moopanar Flyover	Semmozhi Bus Stop	Anna University Bus Station	5
14	Velachery Road - Kamaraj Garden Street	Velachery	Medavakkam	7
15	18th main road	Anna nagar west depot	K4 Police station bus stop	3
16	Shanthi Colony	100 feet road	Anna Arch road	2
17	3rd Avenure anna nagar	Gandhi Nagar Hospital Bus stop	Anna arch bus stop	2
19	Chembarambakkam Lake	Thirumazhisai	Malayambakkam	7
Total Length (in kms)				**183**

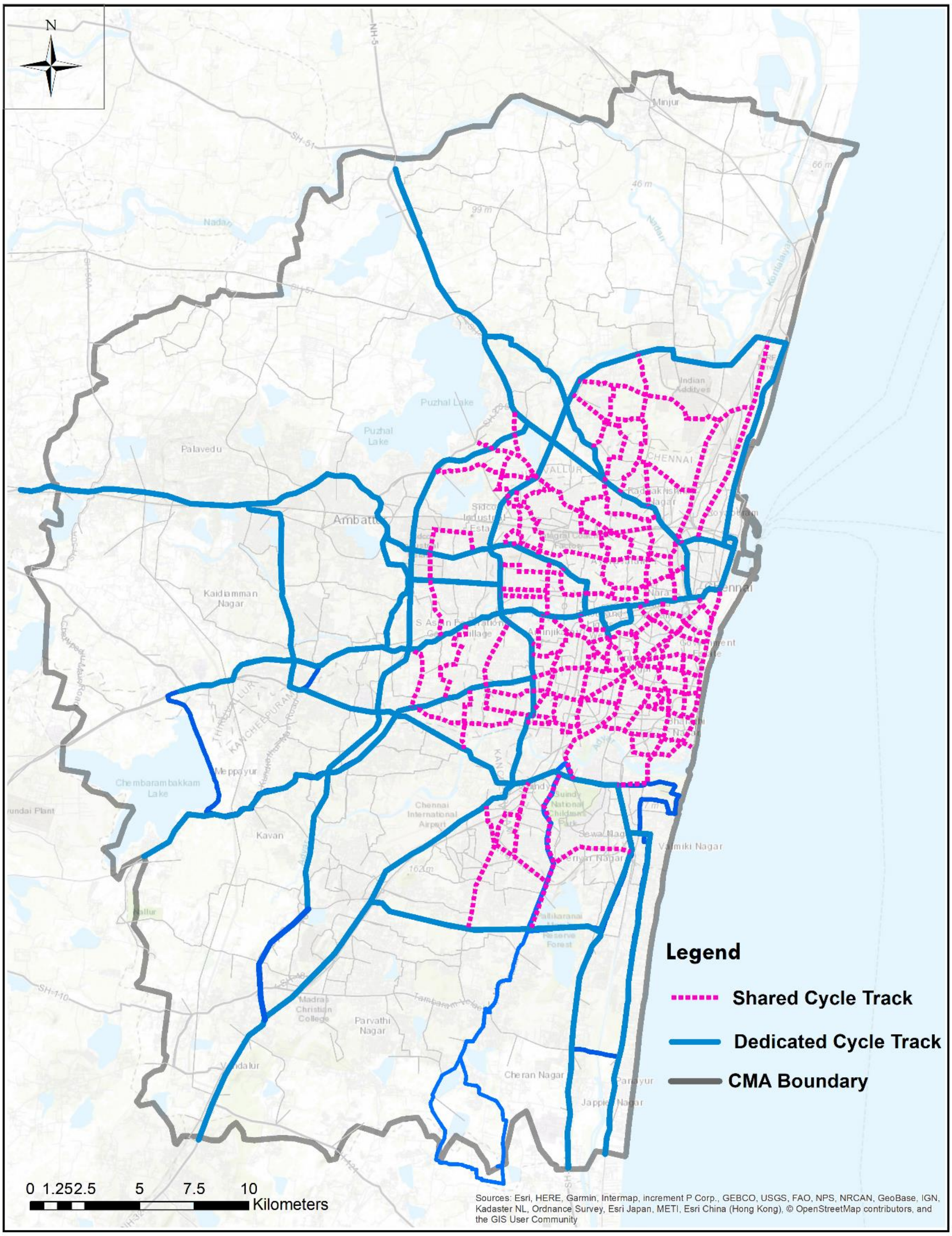
S.No	Road Name	From	To	Length (km)
Dedicated Track with only lane markings				
20	SH114	Sterling Road	Avadi By-pass road	29
21	Vanagaram Ambattur Road	Vanagaram Bus stop	Collector Nagar Bus Stop	7
22	Avadi Main Road	NH 716	Trunk Road	7
23	Sardar Patel Road - OMR	Highways Research Station ,guindy	AGS bus stop near Thalambur Main Road	13
24	ECR	Thiruvanmiyur	Kovalam	14
25	Perumbakkam Main Road	Tambaram bus stand	Sholinganallur bus stand	10
26	Kundrathur Main road	Sivan temple bus stop	Kundrathur Bus stop	19
27	Swami Sivananda Salai	Temple Tank	Kamarajar Promenade	2
28	Adithanar Road - Walajah Road	Dr.Nair road	Kamarajar Promenade	3
29	Bharathi Salai	Thousand Lights Bus stop	Kannagi Statue Bus stop	3
30	LUZ church road	Alwarpet Anjaneyar Bus Stop	Santhome Basicilica Bus Stop	2
31	Dr.Natesan Road	Dr.Besant Road	Kutchery Road	2
32	St.peters road	St.peters road	Dr.Besant Road	3
33	Thyagaraya Road	T-Nagar	Teynampet bus stop	1
34	Pasumpon Muthuramalinga thevar road	Gandhi Mandapam Turnbulls Road	Foreshore Estate Bus Terminus	4

S.No	Road Name	From	To	Length (km)
35	Southern Arm inner ring road	Thillai Ganga Nagar Main Road	Kamaraja Garden Street	3
36	Thiruvallur Main Road	Jayalakshmi Theatre Bus stop	Adambakkam MRTS	2
37	Thillai Ganga Nagar Main Road -Inner Ring Road	Inner Ring Road	Near Bhuvaneshwari Nagar	3
38	Thiruvallur Main Road	Alandur	Velachery Main Road	3
39	Taramani Road	Vijayanagar Bus stop	SRP Tools	3
40	Anna nagar 2nd avenue	Thirumangalam Metro Station	Kandaswamy college bus stop	2
41	Ambattur Estate bus Depot Road	Korattur Bus stop	Wavin Bus stop	7
42	Kamarajar salai	Water testing lab bus stop	NH45	2
43	Dr.Ambedkar road	Ashoka Nagar	Mehta nagar bus stop	4
44	Kilpauk Garden Road	Kauvery Colony bus stop	Kilpauk bus stop	2
45	Kilpauk Garden Road	Kilpauk bus stop	Kellys bus stop	2
46	Paper mills road	Perambur red hills road	Perambur Railway Station	10
47	Thiruvottiyur High Road	Washermenpet Railway Station	Wimco Nagar	8
48	Basin Road	Washermenpet	Thiruvottiyur	5
49	Kamarajar Salai	100 ft road	Basin road	8
50	Milk Colony	Assisi nagar	Madhavaram milk colony	3

S.No	Road Name	From	To	Length (km)
51	TH ROAD	Basin road	Kannadasan bus terminus	3
52	Sidco Main Road	Kannadasan Bus terminus	Vyasarbadi	2
53	Manali high Road	Moolachatram	Kodunagaiyur	4
54	Raja Muthaiyah Road - Basin bridge road	Basin Bridge Jn	Sydenhams Road	3
55	Dr.Ambedkhar College Road	Vysarpadi Industrial Estate	Poonamalle High road near Vepery	4
56	Ayanavaram Road	Pattalam Bus Stop	Nadhamuni Bus stop	6
57	Paper mills road	Perambur High road	Red Hills	10
58	Diary Road	Ponnamallee high road	UCO bank bus stop	7
59	Red Hills Road	Ambedkar Nagar Bus stop	Kallu Kadai bus stop	2
Total Length (in kms)				**227**

S.No	Road Name	From	To	Length (km)
Type 3: Shared Track with only signage				
60	Madhavaram Red Hills road	Moolakadai	Red Hills	8
61	Medavakkam Main Road	Adambakkam MRTS	200 feet radial road	5
62	Kaliamman Kovil Street	Koyembedu	Dr.Ambedkhar Road	6
63	Alapakkam Main Road	Madhuravoyal	karambakkam Bus stop	3

S.No	Road Name	From	To	Length (km)
64	Gerugambakkam Main Road	Gerugambakkam bus stop	Manapakkam	5
65	Mettukuppam Main Road	Jai Garden Bus stop	kaesavarthini Bus stop	5
66	Padasalai St	Chinnasekkadu	Saelaivalyal	6
67	Madhavaram High road -renukagah Amman 1st	Moolakadai Bus Stop	Vyasarpadi bus station	3
Total Length (in kms)				**41**



Title	**Proposed Cycle Network**	Prepared by Urban Mass Transit Company Limited
Project	**Comprehensive Mobility Plan for Chennai Metropolitan Area**	

Figure 6-29 Network for Bicycle Infrastructure Improvement

Recreational Trails

Figure 6-30 Recreational Cycling Routes in Chennai

The implementation of the Cycling Infrastructure in the study area would complete 9 recreational cycling loops/trails of approximately **237.5 km** in the area covering various scenic and historically important landmarks. These trails are already popular among cycling enthusiasts in the city and the implementation of the proposal would help garnering interest from the public.

Table 6-20 Route details of recreational trails

S.No	Recreational Loops	Length (km)
1	Koyambedu – Anna tower park – Koyambedu	10
2	Madhya Kailash – Besant nagar beach – Madhya Kailash	10.1
3	Madhya Kailash – Pallikarnai – Madhya Kailash	21
4	Anna university – Marina beach – Anna University	22.4
5	OMR to ECR loop	29
6	Velachery MRTS – Ottiambakkam quarry – Velachery MRTS	30
7	Porur junction – Chembarambakkam lake – Porur junction	32
8	Padi – Puzhal lake – Padi flyover	35
9	Padi – Sholavaram lake – Padi	48
Total Length of Tracks		**237.5**

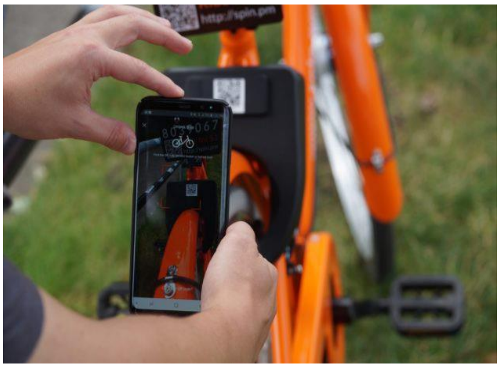
Figure 6-31 Recreational Loop

Bicycle sharing scheme

Public Bicycle Sharing is one of the emerging mode of transport system. In this system bicycle parking stations are provided across the city at important locations. User can rent a bike for short duration from one parking station and return it same or any parking station in the city. Based on the duration of use bicycle users is charged nominal fees. Such system can act as feeder system to other Public Transport system and help in improving the first and last mile connectivity.

Work Underway:

Greater Chennai Corporation has planned to implement the A dock-less Cycle Sharing System (CSS) through a prospective bidder who would "Design, Built, Finance and Operate (DBFO)" the developed facility over a period of 7 years. Corporation has assigned 378 Parking Slots (identified in the DPR) which would house the dock-less cycles (4976 bicycles estimated by DPR). These dock-less bicycles would have a definite parking slot and empty slots would be refilled with cycles through bicycle mini trucks as part of the routine operations by the chosen service provider. It is proposed to implement the project on a cashless transaction and the Cycle Sharing's Information Technology (IT) system is expected to bring in an App, websites and other IT facilities for a user friendly cycle share experience for the citizens of Chennai.



Recommendations:

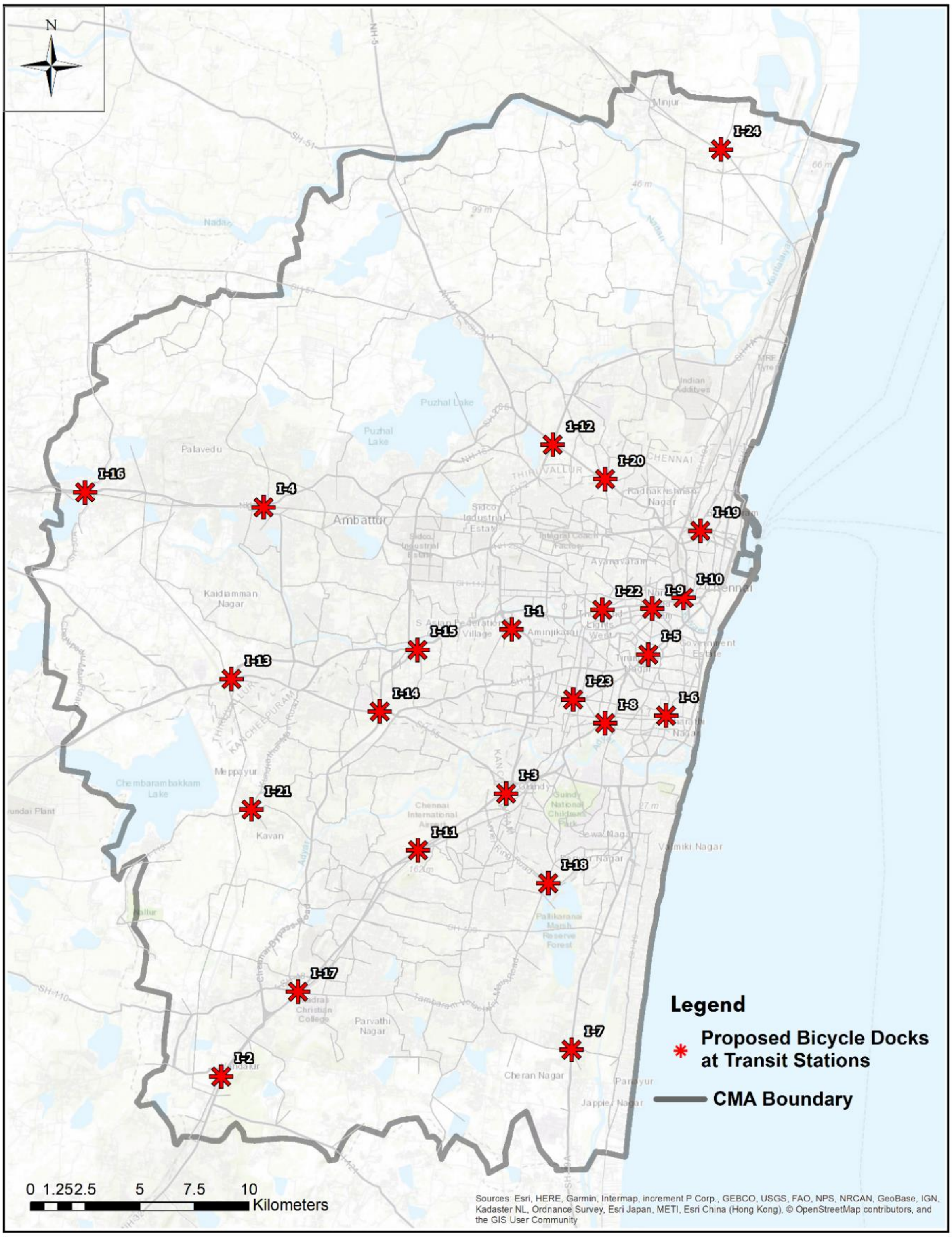
The CMP identifies the need for 17,000 bicycles at 205 docking stations (15 major interchanges and 190 public transit stations). A detailed feasibility study has to be carried out for the supply in order to cater to the demand observed at various locations.

Prioritization for Implementation:

It is recommended that the system's stations be implemented in the order of priority mentioned below:

In priority, the cycle stations would be launched in:

1. Transit Stations, Terminals
2. Catchment area of the above
3. Colleges, Schools.



Title	**Proposed Bicycle Dock Locations**	Prepared by Urban Mass Transit Company Limited
Project	**Comprehensive Mobility Plan for Chennai Metropolitan Area**	

Figure 6-32: Proposed Public Bike Sharing docks

6.5 FREIGHT MANAGEMENT PLAN

A safe, reliable and efficient movement of freight and servicing trips to, from, within and through Chennai in balance with the needs of other transport users to support the overall economy is necessary.

The overall aim of freight management plan is to

- Ensure that the Chennai road network allows efficient and reliable handling and distribution of goods vehicles
- Minimize the impact of congestion
- Minimize the impact of pollution
- Shift gradually to more sustainable freight movement.

Chennai with its growing economy also has many industrial bases scattered across the area. The Petroleum and chemical industries and port allied activities on the northern side and Automobile industries on the south west attract a significant freight movement with the city also. Under the freight management strategy, freight policy and truck terminals are proposed.

Currently, there are two ports in Chennai, located at Ennore and Chennai. While, Chennai port has reached the saturation levels of capacity, Ennore port has been sanctioned for expanding its capacity to handle 320 million tonnes from 24 million tonnes. This expansion will require an additional area of 2339.3 Ha. Thus, to cater to this increased demand of cargo, a new rail, road and utility corridor is also proposed within the existing port boundary. [5]

6.5.1. FREIGHT POLICY

For an efficient management of freight traffic within the city, periodic stakeholder consultations should be held. The freight policy will be aimed at efficient and reliable handling and distribution of goods and services. Freight policy principles adopted for Chennai are:

a) Manage the heavy demands placed on the regional infrastructure, by balancing the needs of freight and passenger traffic

b) Improve the array of transportation options available to regional freight users

c) Restrict the heavy vehicles entering the city during day time.

[5] Adani Ports to pump ₹53,000 cr to expand capacity of Kattupalli port

d) Develop truck terminals near cordon points and distribute the goods in the city through LCV/sustainable transport choices

e) By pass the external freight traffic passing through the city.

f) It is advisable to develop a Freight Operator Recognition Scheme. A tiered set of membership levels can be given to frequent operators coming to the city.

g) Develop a freight information portal i.e. a single interface is available for information on the freight movement.

6.5.2. FREIGHT TERMINALS

A freight terminal is a processing node for freight. Freight terminals are required for the efficient movement of freight vehicles within the city so that congestion is very limited. Freight Terminals need to be provided near various sensitive areas in the city which attract heavy vehicles and also possibly in the outskirts.

Chennai is known for its port and its allied industrial activities. Ambattur Industial Estate, Manali, Oragadam contributed to increase in freight traffic in CMA. Highways like Chennai NH Bypass carry most of the freight traffic which pass through CMA. Currently, freight movement within the city is restricted during the day to reduce the conflict and decrease the congestion during peak hours. The freight traffic should not be allowed in the city between 8am to 9pm, the freight must be stopped outside city boundaries. At present, the Poonamallee High Road connecting Maduravoyal to Chennai Port is an elevated freight corridor carrying freight from Chennai Port to outside and vice versa. Also, there are three existing truck terminals (i.e. Madavaram, Maduravoyal and Manjambakkam) with partial terminal facilities like shops, offices, dormitories and parking. In order to enhance connectivity, certain freight corridors have been proposed. The existing terminals are proposed for upgradation. In addition to these, 7 new truck terminals are proposed based on goods traffic demand and are shown in Figure 6-33 and Table 6-21.

Northern Port Access Road has been proposed under Vision Tamil Nadu 2023 to enhance connectivity from Ennore Port to NH 5. However, since Peripheral Road has been proposed from Ennore Port to Mahabalipuram extending up to 125km, Northern Port Access road has not been considered in the current study.

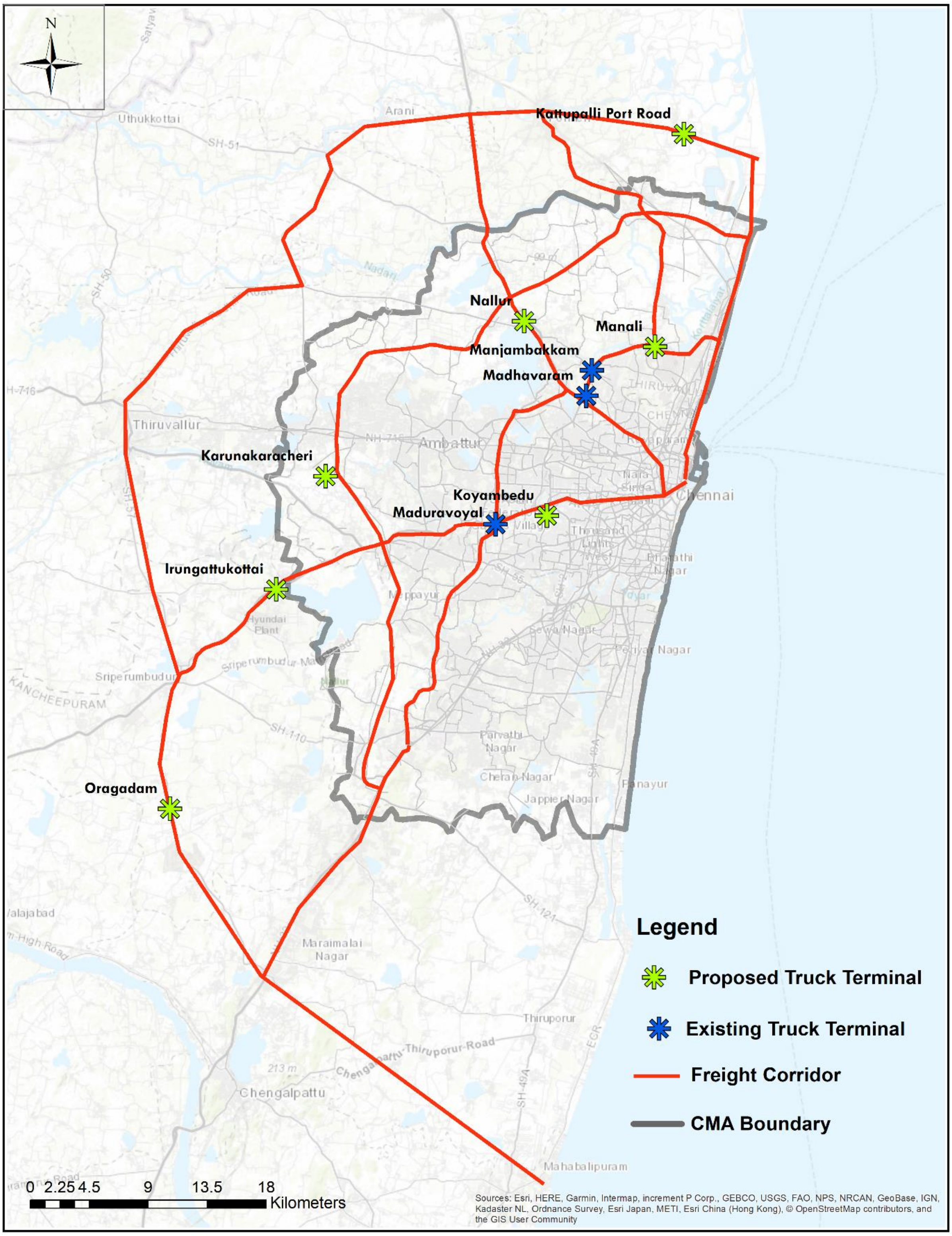
Table 6-21 Truck Terminal Locations

S.No.	Location	Type
1	Oragadam	Proposed New Terminal
2	Maduravoyal	Upgradation of Terminal

S.No.	Location	Type
3	Karunakaracheri	Proposed New Terminal
4	Nallur	Proposed New Terminal
5	Madhavaram	Upgradation of Terminal
6	Manali New Town	Proposed New Terminal
7	Manjambakkam	Upgradation of Terminal
8	Koyambebu	Proposed New Terminal
9	Irungattukottai	Proposed New Terminal
10	Kattupalli Port Road	Proposed New Terminal

Table 6-22 Proposed Freight Corridor

S.No.	Road Name	From	To	Length (km)
1	Peripheral Road	Kattupalli Port	Mahabalipuram	133
2	Outer Ring Road	Ennore Port	Vandalur	62
3	Chennai Bypass Road	Kathairaved, Retteri Lake	Singaperumal Koil	33
4	Manali Oil Refinery (High) Road	Bharatiyar Nagar Beach Road	Madhavaram Roundabout	14
5	Mumbai Highway	Chennai Port	Sriperumbudur	43
6	Chennai Srikakulam Highway	Near Chennai Central Railway Station	Pudukoyal	34
7	Ennore High Road	Chennai Port	Ennore Port	25
8	Minjur Road	Sadayankuppam	Ponneri	24



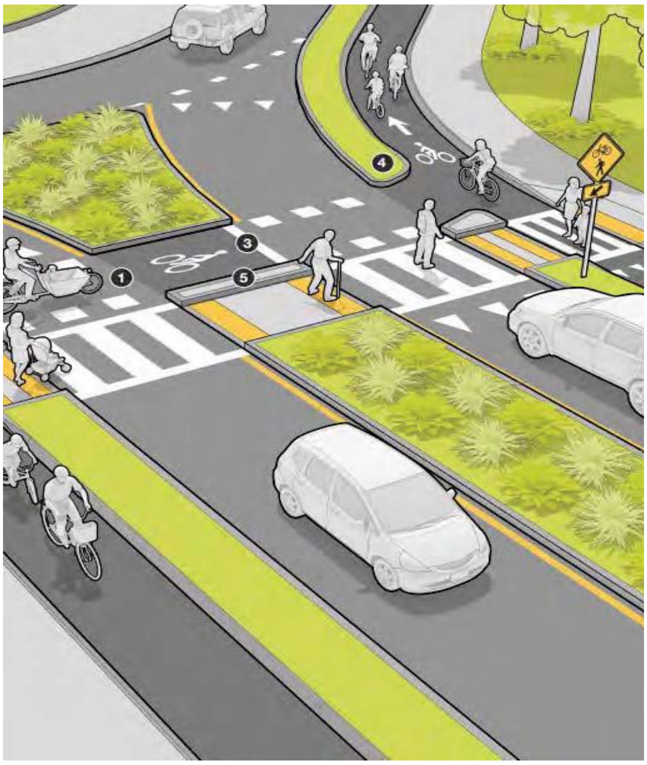
Title	Proposed Truck Terminals and Freight Corridor	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-33 Proposed truck terminals in Chennai

However, a Feasibility study and DPR studies have to be carried for ground viability, accessibility options and infrastructure facilities in developing truck terminals.

6.6 TRAFFIC ENGINEERING AND MANAGEMENT MEASURES

Traffic engineering aims at achieving safe and efficient movement of people and goods on roadways. It focusses on road geometry, sidewalks, crosswalks, cycling infrastructure, traffic signs, road surface markings, traffic signals etc. Traffic management includes various strategies adopted to efficiently manage the movement of vehicles like one-way systems, no parking zones etc.



These measures generally qualify as short-term measures for bringing in immediate relief from traffic problems. A combination of several measures can prove to be effective mean of problem solving. These measures are not very capital intensive and give instant results.

6.6.1. JUNCTION IMPROVEMENTS

It is noticed that traffic accident rates are usually higher at intersections. Many factors affect accident occurrence at intersections, including traffic volume, traffic control, and frequency of access points, the number of arms, the speed limit, the median type and width, the number of traffic lanes, the existing turn lanes and the lighting level. Junction improvement essentially involves the combination of the following elements:

- Closure of medians at certain intersections
- Prohibition of free right turns

- Provision of adequate sight distance
- Providing adequate corner radii
- Providing sufficient turning radii
- Flaring approaches towards intersections
- Providing channelizers/division islands
- Providing pedestrian and cyclist crossing facilities
- Bus stops near junctions to be re-located
- Providing signs/lane-markings/lighting

Junctions coming along the dedicated cycle tracks should be designed accordingly with priority to the cyclists. Pedestrians should be given priority at all the junctions. If it is difficult to channelize the pedestrian movement, it is advised to install pelican signals.

Intersection improvements are recommended to facilitate the movement of Public Transport and safe movement and crossing of pedestrians at junctions.

It is observed that 47 junctions **(Table 6-23**) in the study area are critical as the traffic level at these junctions has already reached the close to the 10,000 PCU mark during peak hours. The situation in these junctions will deteriorate considerably in a year. Hence, 14 of the junctions as mentioned in Figure 6-34 . Table 6-24 needs to be considered as a priority in the short-term improvement plan.

Table 6-23 Critical Junctions in CMA

SNo	Intersection Name
1	NH-5 & Alapakkam Road
2	NH-5 & Mogapair Estate Road
3	NH-5 & Karuneekar Street
4	Chennai Bypass Road & Thiruvallur High Road
5	NH-5 & Kaliamman Koil Street
6	Grand Northern Trunk Road & 4th Avenue, Anna Nagar
7	Jawaharlal Nehru Road & 2nd Avenue
8	Jawaharlal Nehru Road & Ambattur Estate Road
9	Jawaharlal Nehru Road & 18th Main Road,Anna Nagar
10	GNT & Vivekananda Nagar Main Road
11	Sardar Patel Rd. and NH-45 /GST Road
12	Sardar Patel Rd. & Gandhimandapam Rd. Int.
13	Sardar Patel & Rajiv Gandhi Salai Int.
14	Rajiv Gandhi Salai (OMR) & East Coast Road
15	OMR & Kalki Krishnamurthy Rd./ Lattice Bridge Road
16	Anna Statue -Anna Salai

SNo	Intersection Name
17	Vanagaram
18	Thiruvanmiyur
19	Tidel Park
20	SRP Tools
21	Sholinganallur
22	Sterling Junction
23	Madhya Kailash
24	Vadapalani -Arcot Road
25	J.N.Road @lakshman shruthi
26	CMBT Terminus
27	Thirumangalam Bridge-near Mogappair
28	OMR & Tharamani Road
29	OMR & MGR Main Rd. Int.
30	OMR & Thuraipakkam Rd./ Pallavaram-Thoraipakkam Link Rd
31	GST Rd. & Inner Ring Rd. Int.
32	GST Road & Pazavanthangal Stn. Road
33	GST Road & Dargah Rd. Int.
34	GST & 200ft. Ring Rd. Int.
35	GST Road & Chitlapakkam Main Rd. (MIT Flyover)
36	GST Road & Tambaram Stn. Road
37	NH-45 & Irumbuliyur-Mudichur-Oragadam
38	NH-45 & Velachery Tambaram Main Road
39	NH-45 & Vandalur Kelambakkam Road
40	Medavakkam Main Road & 200 Feet Road
41	Tambaram Velachery Main Road & 200 Feet Road
42	Arcot Road & Jawaharlal Nehru Road
43	PT Rajan Road/ 2nd Avenue & Jawaharlal Nehru Road
44	10th Avenue & Jawaharlal Nehru Road (Ashok Pillar Circle)
45	NH-45 & 1ST Main Road Intersection Near Pazhavanthangal
46	Madhavaram roundabout
47	Moolakadai

Following is the list of junctions proposed for improvement in their Geometry:

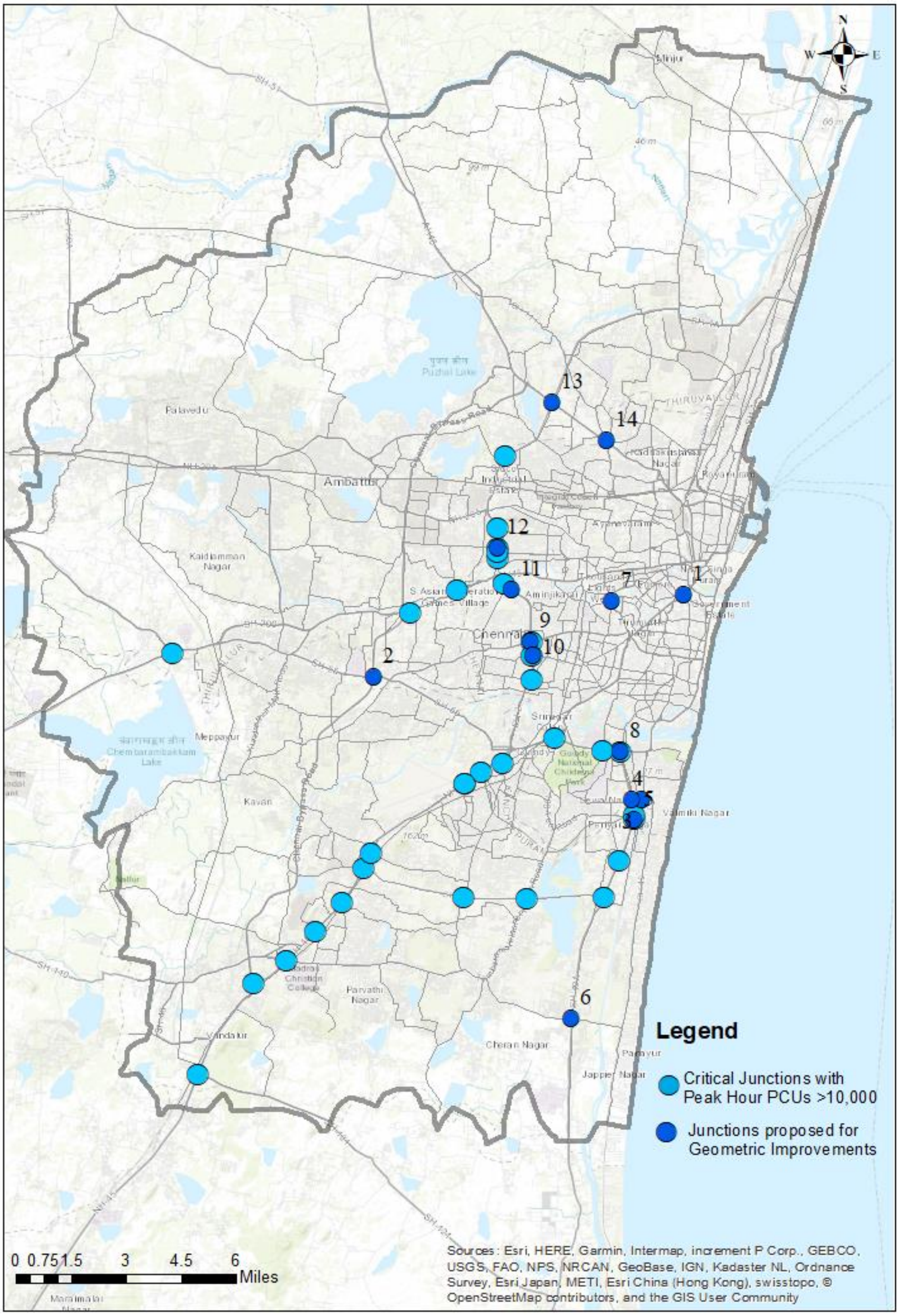


Figure 6-34 Critical Junctions and Junctions for Geometric Improvements

Table 6-24 14 critical junctions for Immediate Improvement

S.No	Location	Existing Junction Type
1	Anna Statue -Anna Salai	Staggered Junction
2	Vanagaram	4 arm Junctions
3	Thiruvanmiyur	4-Arm Junction
4	Tidel Park	T-junction
5	SRP Tools	T-junction
6	Sholinganallur	4-Arm Junction
7	Sterling Junction	4-Arm Junction
8	Madhya Kailash	T-junction
9	Vadapalani -Arcot Road	4-Arm Junction
10	J.N.Road @lakshman shruthi	4-Arm Junction
11	CMBT Terminus	4-Arm Junction
12	Thirumangalam Bridge-near Mogappair	4-Arm Junction
13	Madhavaram roundabout	Roundabout -4 Arm
14	Moolakadai	Roundabout -4 Arm

Sterling Road Junction

Thirumangalam Junction

Thiruvanmiyur Junction

Tidel Park Junction

Arcot Rd. & JN Road Junction,

Mt Poonamallee – Bypass Rd Jn (near Porur

Anna Statue Junction, Anna Salai

Junction near CMBT

Madhya Kailash Junction

Moolakadai Junction

Lakshman Shruthi Junction, JN Road

Madhavaram Roundabout

Sholinganallur

SRP Tools Junction

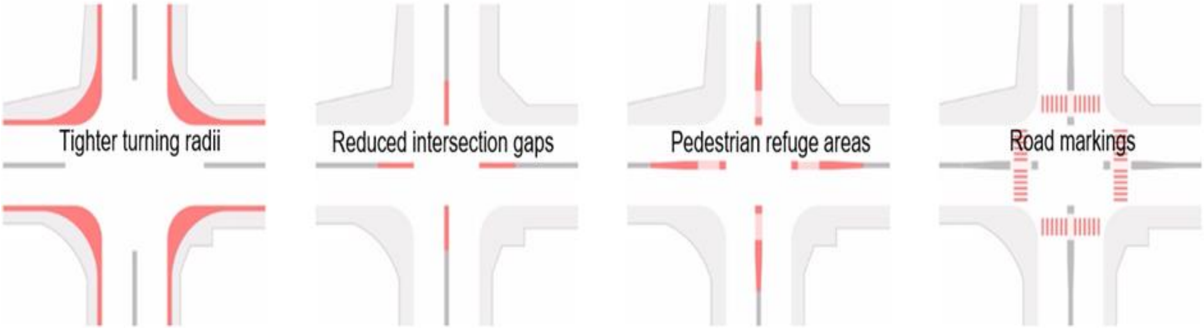


Figure 6-35 Typical Improvement Measures

Typical Geometric corrections include tightening turning radii, reducing intersection gaps, providing refuge islands for pedestrians.

Junction design has been done for Anna Statue Junction (Anna Salai), Vanagaram Road, SRP Tools Junction, Sholinganallur Junction, Streling Road, Madhavaram Roundabout and Moolakadai Junction as shown in the Figure 6-36,Figure 6-37,Figure 6-38,Figure 6-39,Figure 6-40and Figure 6-41.

The proposed junction improvements include,

- Maintaining uniform carriage way- to regulate entry and exit at junctions
- Reduction of Conflict points through channelizing the flow
- Correction of Turning Radii
- Provision of Channelizers, Median placement and its radii correction
- Provision of pedestrian refugee islands and crossings
- Provision of footpaths with minimum clear walking space
- Provision of locations for Signages, Signals and Way finder, etc.

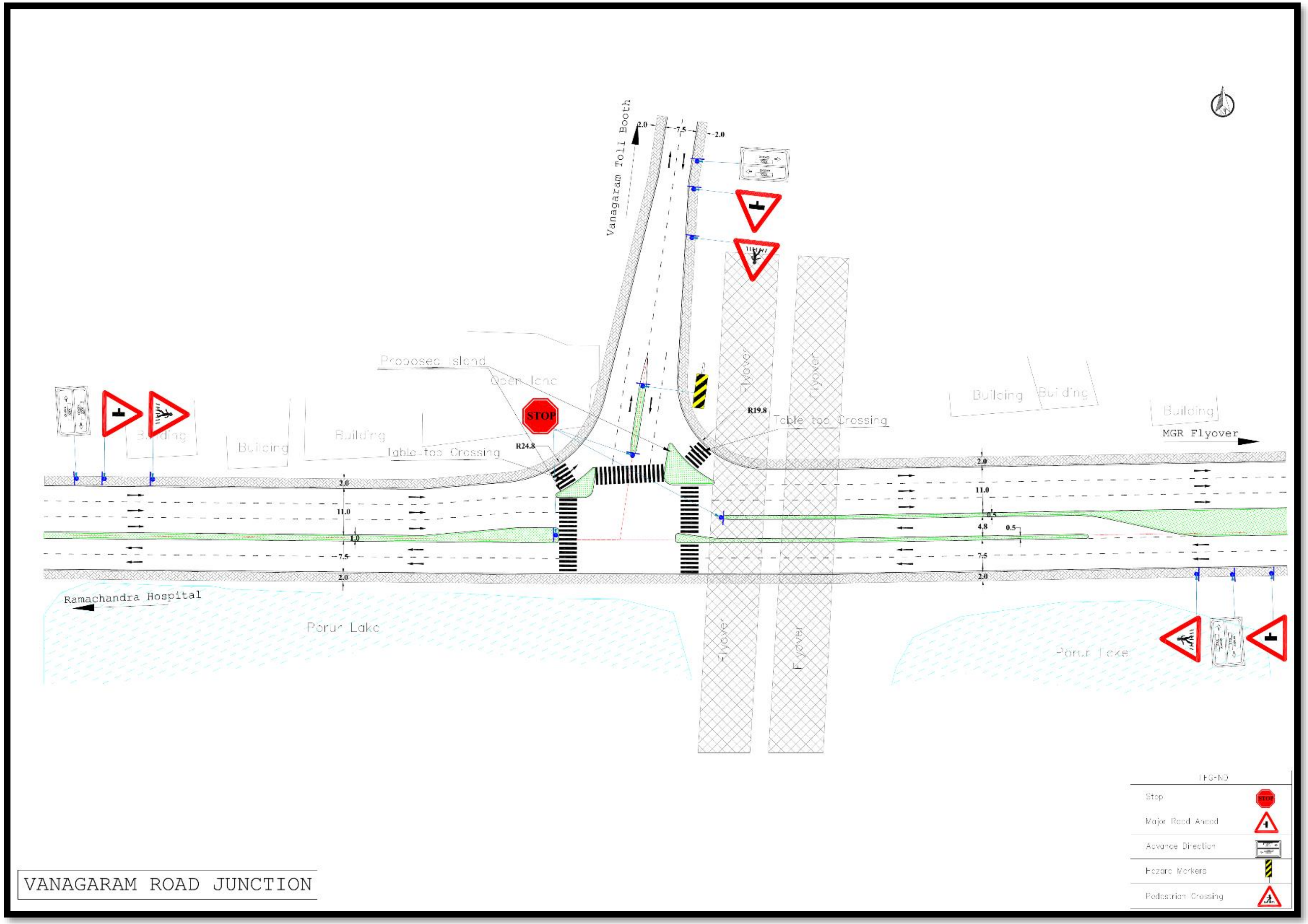


Figure 6-36 Junction improvement for Vanagaram Junction

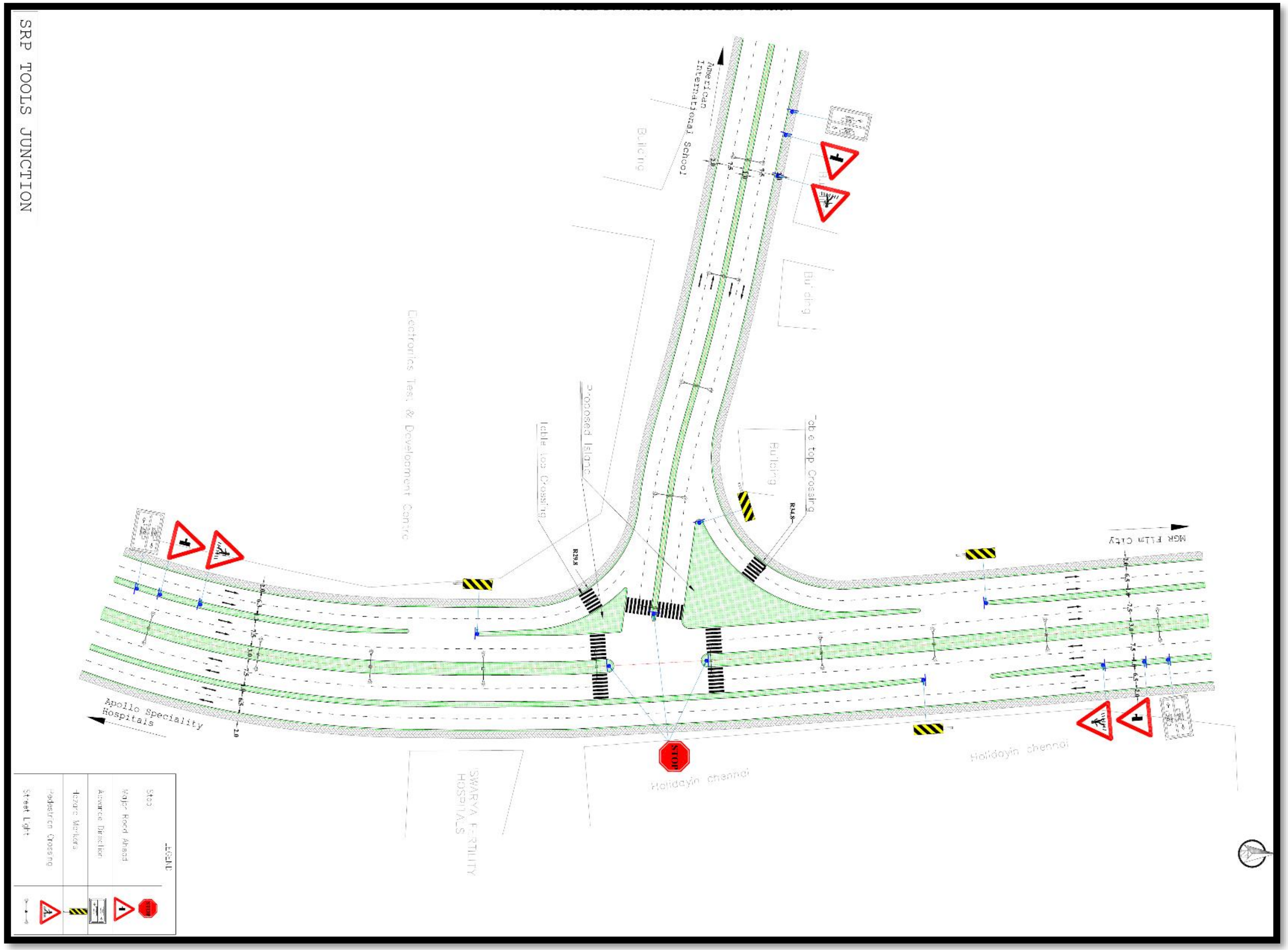


Figure 6-37 Junction improvement for SRP Tools Junction

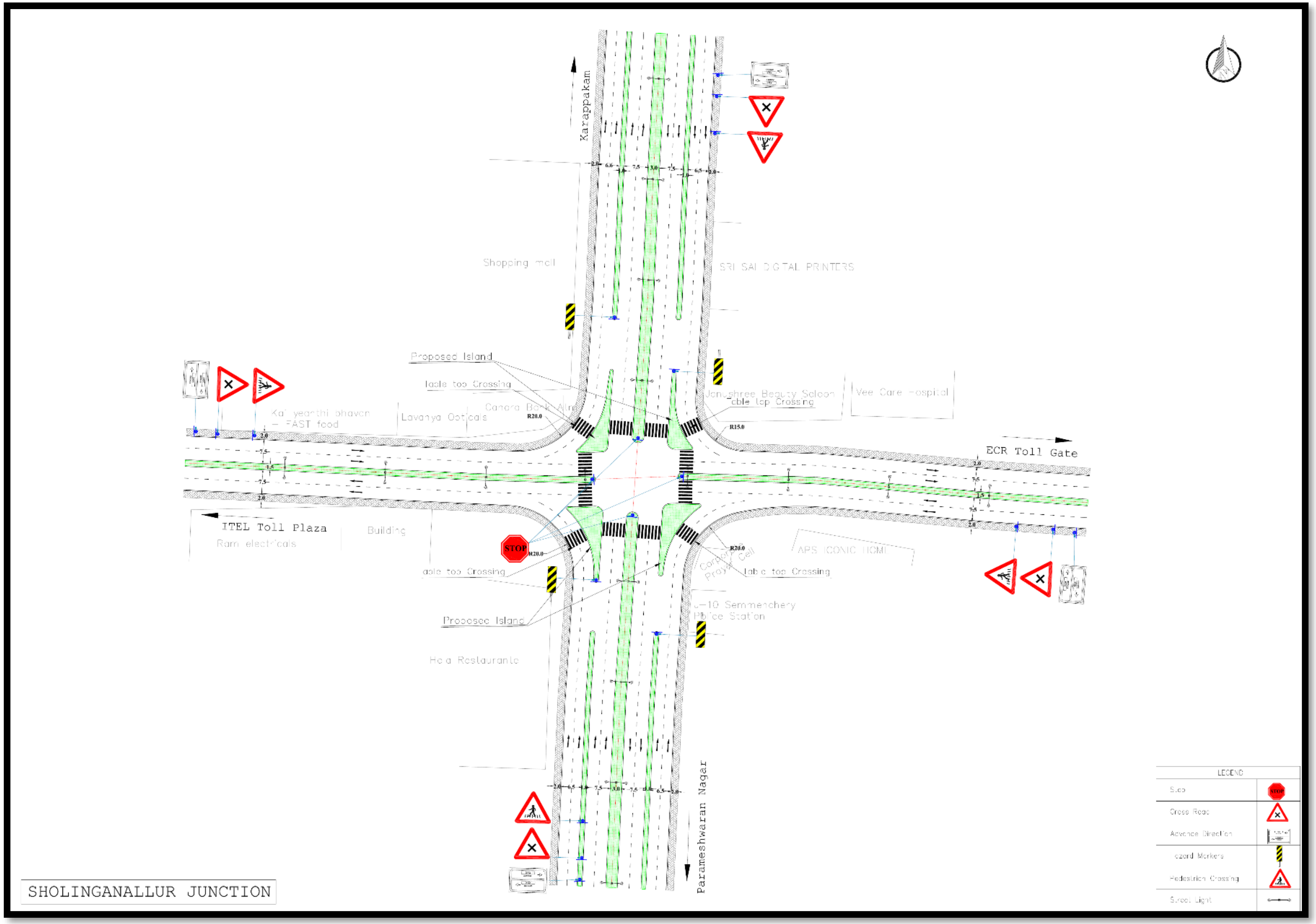
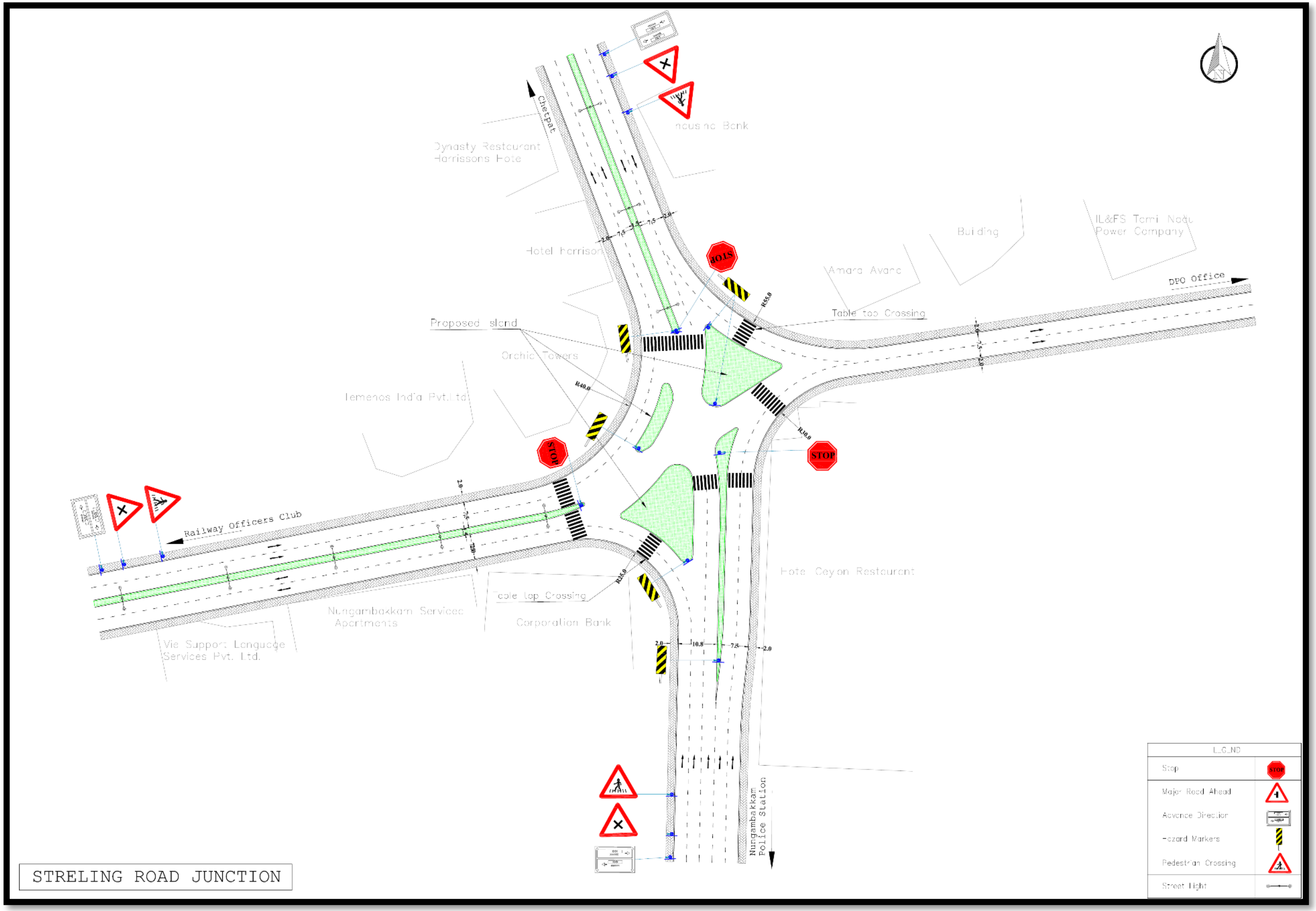


Figure 6-38 Junction improvement for Sholinganallur Junction



STRELING ROAD JUNCTION

Figure 6-39 Junction improvement for Sterling Road Junction

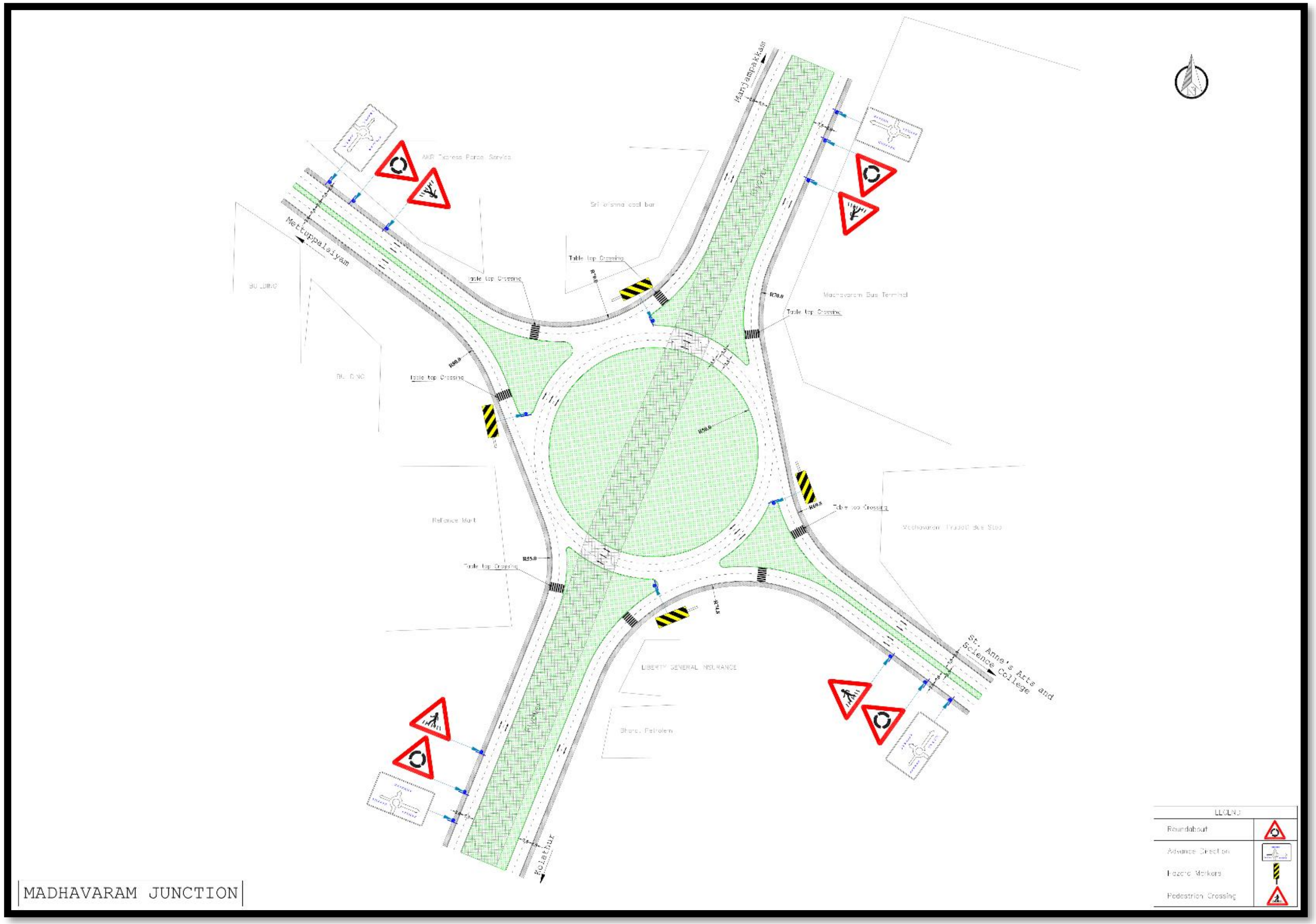


Figure 6-40 Junction improvement for Madhavaram RoundAbout

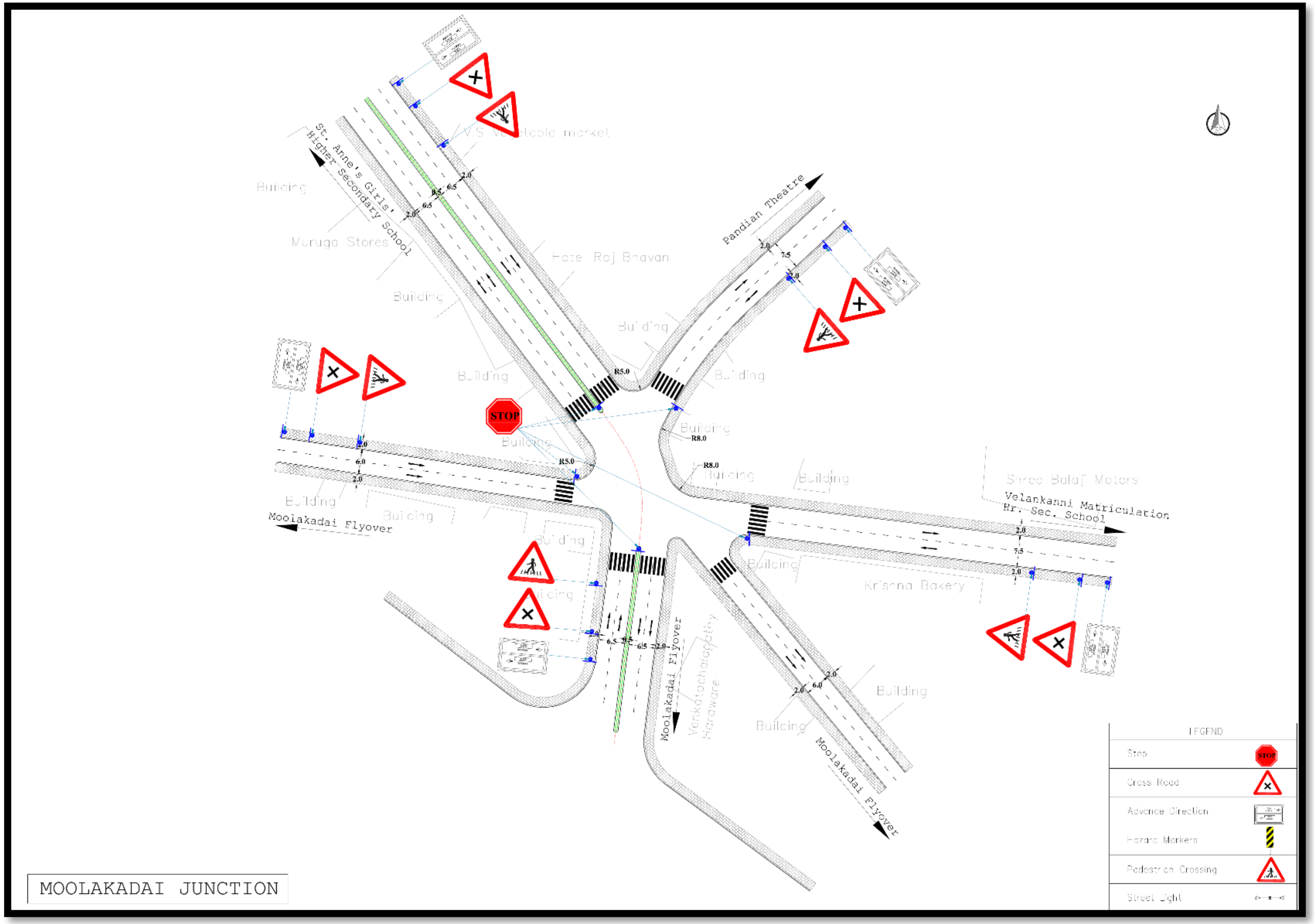


Figure 6-41 Junction improvement for Molakadai Junction

In addition to above identified 33 junctions for critical improvements under immediate action plan, 120 junctions are suggested for improvements under medium term interventions. The list of additional junctions is as shown in Table 6-25.

Table 6-25 Additional Junctions for Geometry Improvement- Medium Term

S.No	Intersection Name
1	Spencers Junction
2	Whites Road x Anna Salai
3	Peters Road x Anna Salai
4	Greams Road x Anna Salai
5	Lloyds Road x Anna Salai
6	Clock Tower Junction
7	Egmore Udupi Point
8	Egmore Co-optex Point
9	Egmore Pantheon Roundabout
10	N H Road x KH Road
11	Haddows Road x NH Road
12	Sterling Point
13	Loyola In gate
14	TTK Salai x Chamiers Road Junction
15	TTK Salai x Alwarpet Junction
16	V.R. Road x North Boag Road Jn
17	G.N. Road x North Boag Road Jn
18	Madley Junction
19	Usman Road x Ranganathan Street
20	Duraisamy Road x Pothys Junction
21	Jeenis Road & Bazaar Road Junction
22	Alandur Road & Five Light Junction
23	L.B.Road & S.V.Patel Road Jn.
24	KB.N. 3rd Cross Street & S.V.Patel Road Junction (K.B.N. Signal)
25	D.O. Road & G.N. 4th Main Road Jn
26	Indira Nagar 1st & 2nd Avenue Jn
27	J.N. 100 Feet Road & Ambal Nagar In
28	J.N. 100 Feet Road & CIPET Junction
29	Anna Salai & S.V.Patel Road Junction
30	Taluk Office Road In front of Saidapet Bus Depot
31	S.V.Patel Road & Velachery Main Road Junction
32	Anna Salai - Estate Road Junction

S.No	Intersection Name
33	Velachery Main Road & Velachery Bye pass Road
34	Five Furling Road & Velachery Main Road Junction
35	L.B.Road & Sastri Nagar 1st Avenue Junction
36	L.B.Road & M.G.Road Junction
37	M.G.Road & 7th Avenue Junction
38	4th Main Road - Elliot's Beach(Kosi Coroner without Signal)
39	MMC Point
40	Gandhi Irwin Point
41	EVR Salai x EVK Sampath Junction
42	C.I.T. Nagar 3rd Main Road
43	Anna Salai & Thandhandan Nagar In.
44	Anna Salai & Little Mount
45	Anna Salai - Estate Road Junction
46	GST Road Nehru Statue junction
47	G.S.T. Road x Palvanthangal Jn
48	G.S.T. Road x Meenambakkam Bazaar
49	G.S.T. Road x Thirisoolam junction
50	Airport Top of Bridge
51	GST Road X IG Road [n
52	Kannagi Statue Junction
53	Labour Statue Junction
54	KB.N. 'Signal & S.V.Patel Road Junction(KB.N.Signal)
55	Gandhi Mandapam Point
56	Anna University Point (Sardar Patel Road)
57	Rajaji Salai - Indian Bank
58	Rajaji Salai - Broadway Point
59	Parry's Corner
60	Moolakothalam Junction
	S.N. Chetty X 0 gate
61	S.N. Chetty X Check Post
62	T.H. Road X Toll gate
	T.H. Road X MRF checkpost
63	T.H. Road X E1laiamman Koil
64	GNT Road - Padiyanallur Junction
65	GNT Road - PayavoyalJunction
66	GNT Road - Vadakarai Junction

S.No	Intersection Name
67	GNT Road - Paddy & Rice Mill Kalyanamandapam
68	GNT Road - Puzhal Union Office
69	Manali Market
70	Luz Junction
71	North Mada Junction
72	South Mada Junction
73	San thome High road x South Canal bank road junction.
74	Dr Natesan Road x Dr RK Salai .
75	Dr Besant Road x Dr Natesan Road x TH Road (Ice house
76	Lloyds Road x Kamarajar Salai
77	Peters Road (Mrisahibpet Market)
78	Royapettah High Road x Dr RK Salai
79	Dr RK Salai x VM Street
80	Music Academy Junction
81	Dr RK Salai x Gopalapuram 4th Road (Chola Point)
82	Dr RK Salai x Binny Road
83	Bells Road x Wallajah Road
84	Wallajah Road x Canal Road
85	Bharathi Salai x Canal Road
86	Wallajah Road x TH Road
87	Bharathi Salai x Rathna Cafe Junction
88	Clock Tower Junction
89	Bharathi Salai x TH Road
90	Co-optex Point
91	Anna Salai x Aziz Nagar Junctions
	Market Junction
92	Duraisamy Road x Pothys Junction
93	V.N. Road x JYM Junction
94	V.N. Road x Burkit Road Junction
95	South Boag Road x New Boag Road Junction
96	Arcot Road x Gokulam Point
97	G.N. Road x Vani Mahal Junction
98	North Boag Road x Bazullah Road Junction
99	Kodambakkarn Road x North Usman Point
100	Theyagaraya Road x Dr. Nair Road Junction
101	Arcot Road x 80 feet Road Junction

S.No	Intersection Name
102	Arcot Road x Arunachalam Road Junction
103	Arcot Road x Vembuliamman Koil Junction
104	Anna Main Road x PT Rajan Salai Junction
105	Jeenis Road & Bazaar Road Junction
106	Alandur Road & Five Light Junction
107	Taluk Office Road In front of Saidapet
108	S.V.Patel Road & Velachery Main Road
109	Velachery Main Road & VelacheryBye
110	Five Furling Road & Velachery_
111	4th Main Road - Elliot's Beach Signal)
112	Thiruvalluvar Salai & KKSaiai
113	Velachery Main road M.C.C. College junction
114	Velacherry Main Road X Mahalakshmi Nagar junction
115	Velacherry Main Road Rajakilpaukkam junction
116	Velacherry Main Road Camp Road Junction
117	Perumbakkam Junction
118	Marnbakkam Junction
119	Quidde Millath College Junction
120	Madhya Kailash Point

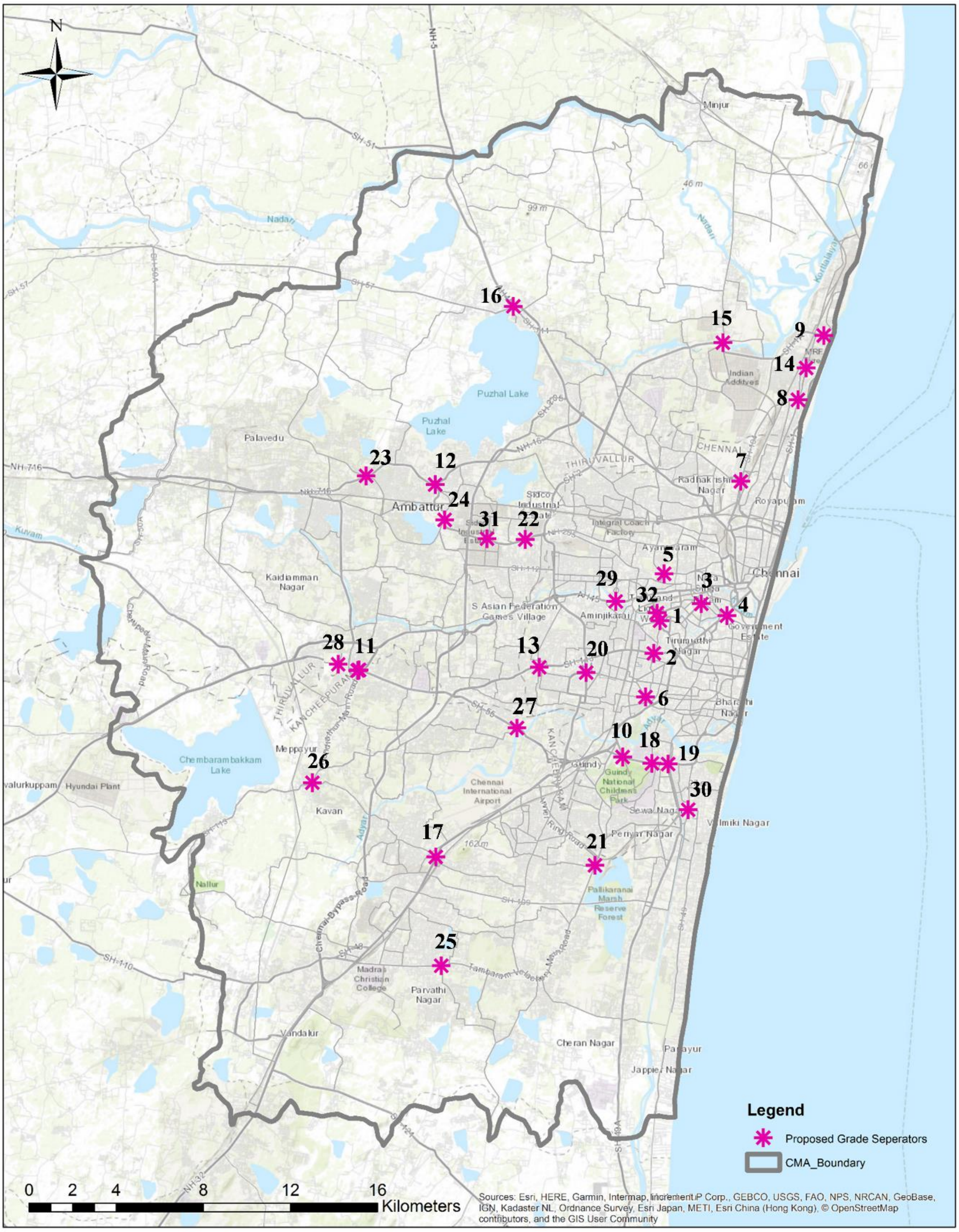
6.6.1.1 VEHICULAR GRADE SEPARATION AT INTERSECTIONS

Intersections require higher order treatments like subways or flyovers for better management of traffic in addition to geometric enhancements. Most of the arterial roads such as Anna Salai, Jawaharlal Nehru Road and Periyar EVR Salai are already congested and require devising of decongestion plans. Grade separators act as relief measures for congestion at the junctions as an intermediate measure while holistic planning of public transport will be essential for future considerations. The study proposes 32 grade separators at Intersections, as an Intermediate measure. The intersections are identified based on volume of traffic handled at these junctions where the Peak hour approach volume is more than 10,000 PCU's as shown in table below.

Grade separated facilities are proposed at the following locations:

S.No	Junction Locations	Junction PCU	Year of Consideration
1	Sterling Road Vs College Road	13352	2023
2	NSK Salai Vs Thirumalaipillai Road Vs Valluvar Kottam High Road	11036	2023
3	Pantheon Road Vs Marshalls Road Vs Dr Nair Road	11432	2028

S.No	Junction Locations	Junction PCU	Year of Consideration
4	Walaja Road Vs Qaid-e-Milleth Road	15017	2023
5	Medavakkam Tank Road Vs Purasavakkam High Road	13005	2023
6	Venkatanarayana Road Vs Burkit Road	10253	2023
7	Kathivakkam High Road Vs Tondiarpet Road	10670	2028
8	Thiruvottiyur High Road Vs Kathivakkam High Road	10170	2028
9	Manali High Road vs Ennore High Road	10980	2028
10	Sardar Patel Road Vs Velachery Road	11598	2028
11	Avadi Poonamallee Road Vs Poonamallee Trunk Road	19138	2023
12	CTH Road Vs Redhills Road	14841	2023
13	Kaliyamman Kovil Street and MGR Salai (Arcot Road)	11298	2023
14	Ennore Expressway and Manali Oil Refinery Road	10575	2028
15	Jawaharlal Nehru Road and TPP Road	10617	2028
16	Redhills-Thiruvallur Road and NH-5	13644	2023
17	Pammal Main Road Vs GST Road	15441	2023
18	Anna Salai Vs Sardar Patel Road	15210	2023
19	Junction of Rajiv Gandhi Salai with Sardar Patel road at Madhya Kailash.	10286	2028
20	Inner Ring Road and P.T.Rajan Salai Junction.	15256	2023
21	Marmalong Bridge – Irumbuliyur road near Kaiveli, Madipakkam	10511	2028
22	Chennai – Thiruthani – Renigunta Road and Korattur Road.	12222	2023
23	Chennai - Thiruthani - Renigunta Road at the intersection of Mount Poonamallee Avadi Road and at the intersection of Heavy Vehicles Factory Road at Avadi	10551	2023
24	Chennai-Thiruthani-Renigunta Road at the junction of Vanagaram – Ambattur Road	16222	2023
25	Marmalong Bridge- Irumbuliyur Road covering Madampakkam road Junction, Tambaram Eastern Bypass and Camp Road Junction near Selaiyur	10304	2028
26	Intersection of Kodambakkam - Sriperumbudur road and Poonamallee - Kundrathur - Pallavaram Road, including providing connectivity to ORR via Erikkarai Road at Kundrathur	10341	2028
27	Construction of Multi level Grade Separator on Mount-Poonamallee-Avadi road from MIOT Hospital to Mugalivakkam via Ramapuram, L&T and DLF	11719	2023
28	Intersection of Mount - Poonamallee - Avadi road, Chennai – Chittoor - Bangalore road & Poonamallee - Kundrathur- pallavaram road at Kattupakkam in Poonamallee.	13608	2023
29	EVR Salai at the intersection from Raja Muthiah Salai to Pulla Avenue in Chennai city	11340	2023
30	Junction of East Coast Road and Lattice Bridge Road at Thiruvanmiyur	15027	2023
31	Chennai-Thiruvallur High Road at the junction of Ambattur Estate bus depot.	11594	2023
32	Grade Separator at Harrington road junction	13440	2023



Title	Proposed Grade Seperator Locations	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-42 Proposed Grade Separator Locations

6.6.2. TRAFFIC MANAGEMENT PLANS

Following are the general Traffic management measures.

- Proper sign boards should be provided at important junctions, arterial/sub arterial roads, entry/exit points of market areas, cordon points, accident prone locations, school/college zones and other commercial areas.
- Zebra crossings, Lane Markings and Stop lines should be marked on all arterials and sub arterial roads.
- Pedestrian crossings should be provided at mid-blocks near school/college zones and major commercial areas. Pelican signals should be installed at such places. An exclusive pedestrian phase should be provided for safe pedestrian crossing with a cycle time no less than 15sec and designed as per IRC.
- Pedestrian refuge islands should be provided at wider junctions.
- Parking should be restricted at least 50-100m near to the junction on all the approach roads.
- Hawkers and Vendors should be restricted at least 50-100m near to the junction on all the approach roads and from using footpaths.
- Bus stop and Auto/Taxi stand has to be shifted 50-100m away from junctions
- Commercial vehicles (except Goods Auto) should not be allowed during peak periods inside the city which should be stopped at all Outer Cordons.
- Before implementation of Traffic Management Schemes, traffic awareness programmes shall be organized.

Area wise Traffic Management plans with focus on NMT improvement are suggested for Chennai especially around the core area. The recommendations would include:

- Redevelopment of streets in the area considering pedestrians and cyclists
- Provision of public bike sharing facilities
- Creation of pedestrian areas
- Removal of on street parking etc.
- Traffic Management/Re-routing

The following two locations have been considered as a case study for Area-wise Traffic Management plan based on the land use, increasing traffic conditions, considering large volume of pedestrian footfall and accident blackspots.

1. West Tambaram

2. Poonamallee

Poonamallee:

The developments in Poonamallee is concentrated around the Poonamallee Bus. The dense commercial developments are observed on the Avadi-Poonamallee Highway right at the entrance of the existing bus terminus with spread on both the east and west directions along this highway. Poonamallee connects to Porur and Thirumazhisai on the east and west via Poonamallee High Road and to Avadi and Mangadu on the North and South. The Outer Ring Road intersects Poonamallee High Road at 1.2 km from the bus terminus. The north bound freight traffic is expected to come down on Poonamallee Bypass after completion of dedicated ORR till Minjur.

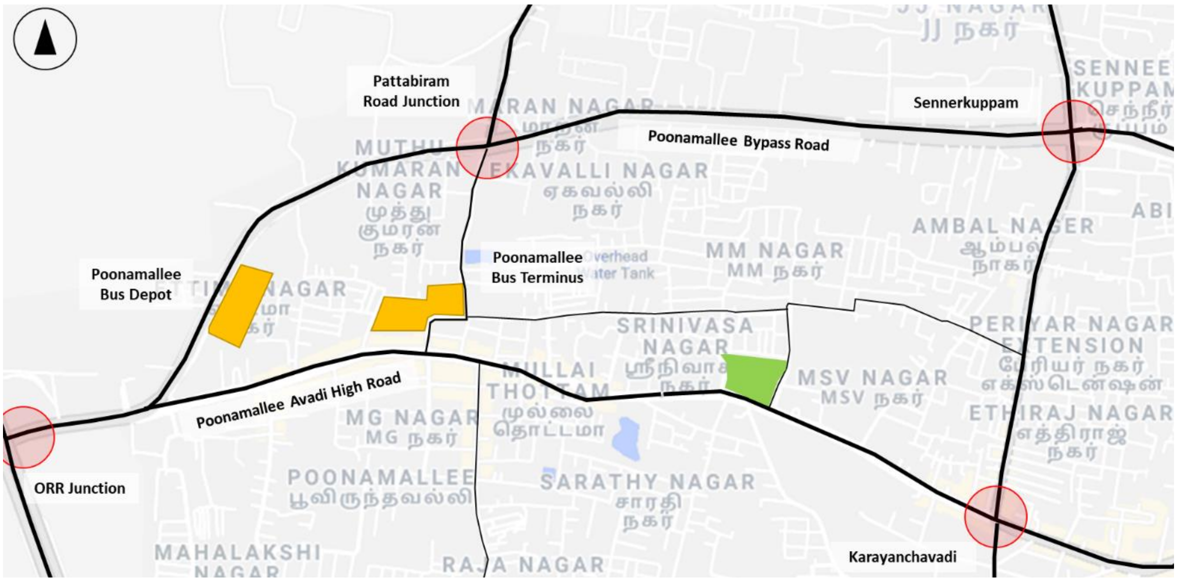


Figure 6-43 Area Map of Poonamallee

Figure 6-44 Photographs of Poonamallee- Poovirundhavalli Thayar Temple (Middle), Vaitheeswaran Temple (Right)

This area houses a thriving residential and commercial zone with a huge generation and attraction to the Chennai City on a daily basis with residential pockets of Thirumal Nagar, MM Nagar, Srinivasa Nagar, MG Nagar and Rukmani Nagar among many. It also has the famous Poovirundhavalli Thayar Temple located few meters away from the bus terminus and Vaitheeswaran Temple.

The major destination from Chennai along this route include Sriperumbudur, Kanchipuram, Arakkonam, Vellore, Chitoor, Gudiyatham and Bangaluru. Since, this Poonamalle High Road and Bypass connects to Oragadam via Sriperumbudur, a lot of freight traffic is observed on the bypass road destined to ports and towards north of Chennai. Similarly, Poonamalle High Road attracts a lot of commuter traffic toward Chennai City.

Challenges

- Encroachment of pedestrian facilities on Poonamallee on both sides by commercial activities
- Absence of footpath in internal roads both on the north and south side of Poonamalle High Road which house the residential population
- Huge demand of pedestrian crossing facilities right in front of Poonamallee Bus Terminus
- On-street parking of MTC during festive seasons as terminus is used for operating long distance buses
- Extensive on-street parking in the commercial streets

Neglected Footpath Facility

Unsafe Pedestrian Crossing (Absence of dedicated grade separated crossing facilities)

Insufficient Footpath & Lack of Maintenance

Absence or Encroachment of Footpath

On-street Parking in Commercial Areas

Smaller Roads with 2-Way Movements

Recommendations:

The following recommendations are made for the area:

Poonamalle has a severe shortage of space and, so, parking in the area needs to be at a punitive premium. Travelling by foot needs to be encouraged and mass-parking facilities need to be organised on the periphery of Poonamallee.

- **One-Way Streets:** Two roads have been proposed as one-way streets. The Theradi Street at the exit side of bus terminus is very small to handle two way traffic and gets choked adding to the existing chaotic driving conditions caused by on-street parking. It is proposed to have unidirectional traffic from terminus exit to Poonamallee High Road and have other direction on Temple Road from Poonamalle High Road towards Nambi Street. Strict enforcement of one-way traffic is required for smooth traffic movement. Violations have to be penalised for traffic disobedience. The one way street movement pattern is shown in Figure 6-46 .
- **Parking**: It has been observed that on-street parking has been a menace for the pedestrians as vehicles encroach the pedestrians' usage area forcing them to walk on the carriageway. An organised parking lot has to be planned at by City Corporation for alleviation of on-street parking problems. It has been observed that, few parking lots are operational at Poonamalle Bus terminus, no parking lots are observed in or near the commercial areas.
- **Augmentation of Pedestrian Facilities**:
  - ✓ It is observed that the existing facilities of footpath on Poonamalle High Road and Poonamalle Bypass are either too small not adhering to standards or totally encroached by on-street vendors. For the kind of pedestrian movement on Poonamallee High Road, minimum of 3-4m footpath on either side with exclusive pedestrian guardrails have to be implemented for pedestrian safety.
  - ✓ There is little or no pedestrian footpath observed in and around the commercial area – a minimum of 1.8m in the residential area and 3-4 m in commercial areas to be planned.
  - ✓ FOB facility is required right in front of the Bus terminus on Poonamallee High Road for catering to the huge pedestrian demand.
  - ✓ The junction at Pattabiram Road Intersection with Poonamallee Bypass Road poses great threat to the thousands of pedestrians with absence of zebra crossings. It has been observed that there is excessive queuing of vehicles at

this junction (upto 700m towards Seeneerkuppam) due to freight movement in addition to passenger trips casing danger to pedestrians. Proper signalisation with dedicated FOB have to be planned for smooth and convenient pedestrian movement.

Absence of FOB/Subway promotes jay-walking in fromt of Bus Terminus

Pattabiram Road Junction with Bypass Road - Provision of dedicated pedestrian facilities in the form of FOB/ Zebra Crossing

Figure 6-45 Ground Situation in Poonamalle

Rerouting of MTC Buses for Smooth Traffic Flow: It has been observed that the Poonamallee High Road has been choking with the kind of vehicular traffic. The stretch between Karayanchavadi to Poonamalle bus terminus is extremely congested with heterogenous traffic movement, commercial activities and pedestrians walking on carriageways. MTC buses are proposed to be looped in and around the terminus through Tank Street, Pattabiram Road Junction, Bypass Road, Sennerkuppam Junction, Avadi Main Road/Karayanchavadi Road, Karayanchavadi Junction for better management of traffic.

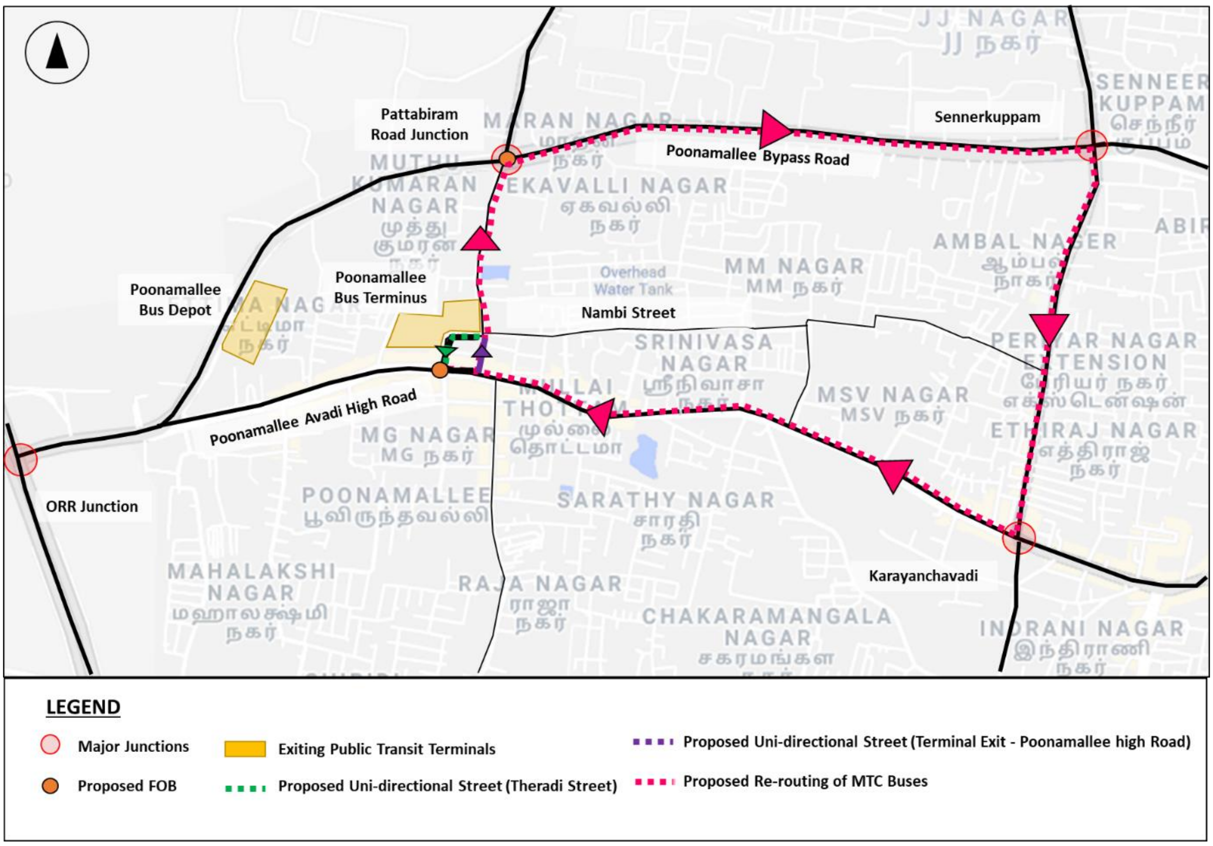


Figure 6-46 Poonamallee - Area Based Development

West Tambaram:

The developments in West Tambaram is concentrated in and around the Tambaram Railway Station which is essentially a gateway to Chennai for traffic bound to Chennai from south. While the development and traffic movements are relatively more organised in East Tambaram with wider roads, Tambaram West has been suffering with congested traffic conditions, commercial establishments, market area and excessive pedestrian movement. This area is important for Tambaram Railway Station, West Tambaram MTC parking/terminus and service facilities of Passport Seva Kendra, EPF, Churches, and some Hotels.

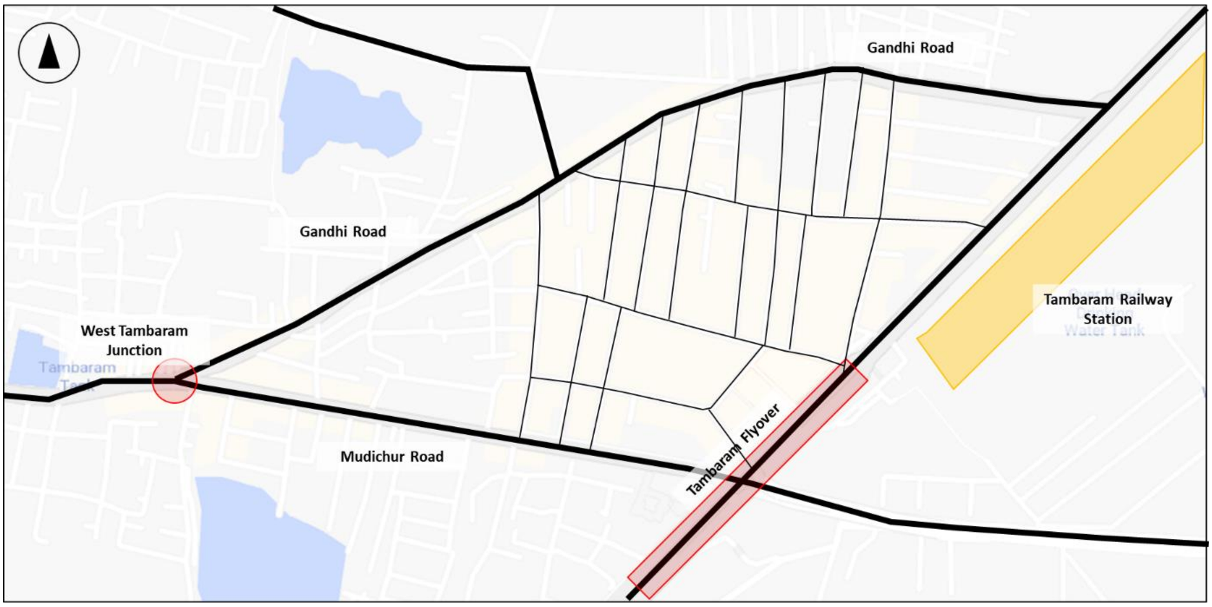


Figure 6-47 West Tambaram

Some of the important destinations at West Tambaram include Passport Seva Kendra, Employee Provident Fund Office and Head Post Office Tambaram. This area houses a thriving flower and vegetable markets in addition to a busy commercial zone.

Challenges

- Encroachment of pedestrian facilities on GST Road on both sides by road side shops
- Absence of footpath in internal roads in the highlighted portion
- Huge demand of pedestrian crossing facilities
- Existing Subway not efficiently utilised by pedestrians to cross GST road to reach railway station. At grade crossing is mostly used by stopping the traffic which results in chaos
- Excessive encroachment of subway by street vendors
- Absence of proper signages for existing facilities
- On-street parking of MTC as well as long distance buses in the vicinity of Railway Station
- No parking facilities in west side of GST Road while Railway station area has got multiple parking facilities
- Extensive on-street parking in the commercial streets

1. Neglected Footpath Facility

2. Extensive At Grade Pedestrian Movement

3. Encroachment of Subway

4. Absence of Signage leading to Subway

5. Insufficient Footpath & Lack of Maintenance

6. Absence of Footpath and Guardrails

7. On-street Parking in Commercial Areas

8. Flower & Vegetable Market

Challenges with Enforcement: Series of one ways covering Ayyaswamy Street and Ramaswamy Street have been proposed by Traffic Police. The local traffic given the commercial use have not been adhering to the one ways.

Challenges with Pedestrian – Vehicular Interference:

- It has been observed from traffic surveys that a total of over **1.5 lakh daily PCUs** are registered on GST Road. The road has mix of heterogeneous traffic with two wheelers, cars/vans/buses and also the vulnerable cyclists with a peak hour traffic of about **13,000 PCUs**.
- The pedestrian count carried near Tambaram Bus Terminal observes daily **18,289** pedestrians with **2567** in the peak hour.
- Such high interference of thousands of pedestrians with vehicular traffic requires dedicated pedestrian facilities at signalised intersections as well as mid-blocks. The PV^2 at GST road with that pedestrian movement and vehicle interference is $2.93*10^{11}$ while IRC mandates provision of dedicated pedestrian facilities if the value is more than $2*10^8$

Recommendations:

The following recommendations are made for the area:

West Tambaram has a severe shortage of space and, so, parking in the area needs to be at a punitive premium. Travelling by foot needs to be encouraged and mass-parking facilities need to be organised on the periphery of George Town.

- **One-Way Streets:** It has been observed that the two way movement of traffic at the service road underneath the Flyover (Shanmugam Road Intersection till Hindu Mission Hospital) gets choked with two way movement of traffic adding to the existing chaotic driving conditions caused by on-street parking. It is proposed to have unidirectional traffic from Shanmugan Road Intersection till Hindu Mission Hospital for congestion alleviation Strict enforcement of one-way traffic on existing streets is required for smooth traffic movement. Violations have to be penalised for traffic disobedience. The one way street movement pattern is shown in Figure 6-48.

- **Pedestrian only Lanes:** Muthulingam Street is proposed to be pedestrian only street during the morning and evening peak periods of 8:00 AM to 12:00 PM and 5:00 PM to 9:00 PM. Heavy vehicle traffic, which is a must for loading and unloading goods traded in the area, needs to be restricted to late night hours.

- **Parking:** It has been observed that on-street parking has been a menace for the pedestrians as vehicles encroach the pedestrians' usage area forcing them to walk on the carriageway. An organised parking lot has to be planned at West Tambaram by City Corporation for alleviation of on-street parking problems. It has been observed that, while few parking lots are operational at flat Rs 25 for 24 hours servicing the Railway Station, no parking lots are observed in or near the Market Area.

- **Augmentation of Pedestrian Facilities**:

  - It is observed that the existing facilities of footpath on GST road are either too small not adhering to standards or totally encroached by on-street vendors. For the kind of pedestrian movement on GST road, minimum of 3-4m footpath on either side with exclusive pedestrian guardrails have to be implemented for pedestrian safety.

  - There is little or no pedestrian footpath observed in and around the market area – a minimum of 1.8m in the residential area and 3-4 m in commercial areas to be planned.

  - The existing subway is not being utilised to the fullest of its capacity because on encroachment by vendors as shown in picture above. Removal of encroachment of subway has to be carried out for better utilisation of this infrastructure.

  - FOB facility is under construction across the GST at few meters away from the existing Subway for catering to the huge pedestrian demand.

  - The junction at Gandhi Road Intersection with GST Road (near Tambaram Sanatorium Bus terminus) poses great threat to the thousands of pedestrians with absence of zebra crossings. Proper signalisation with dedicated zebra crossing marking and exclusive pedestrian phase have to be planned for smooth and convenient pedestrian movement.

On-going Construction of FOB near the existing Subway

Gandhi Road Junction with GST Road - Provision of dedicated pedestrian facilities in the form of Zebra Crossing

Shifting of Existing MTC Bus Stand: It is proposed to ban the parking of MTC and long distance buses along GST road. It has been observed that the MTC buses are parked/terminated all along the GST Road from Market Area till the Tambaram Sanatorium Bus Stand. It is proposed to shift the terminal to the existing Bus Stand to avoid chaos in the already congested area. The existing on-street terminal shall be used only as pick-up drop off bays.

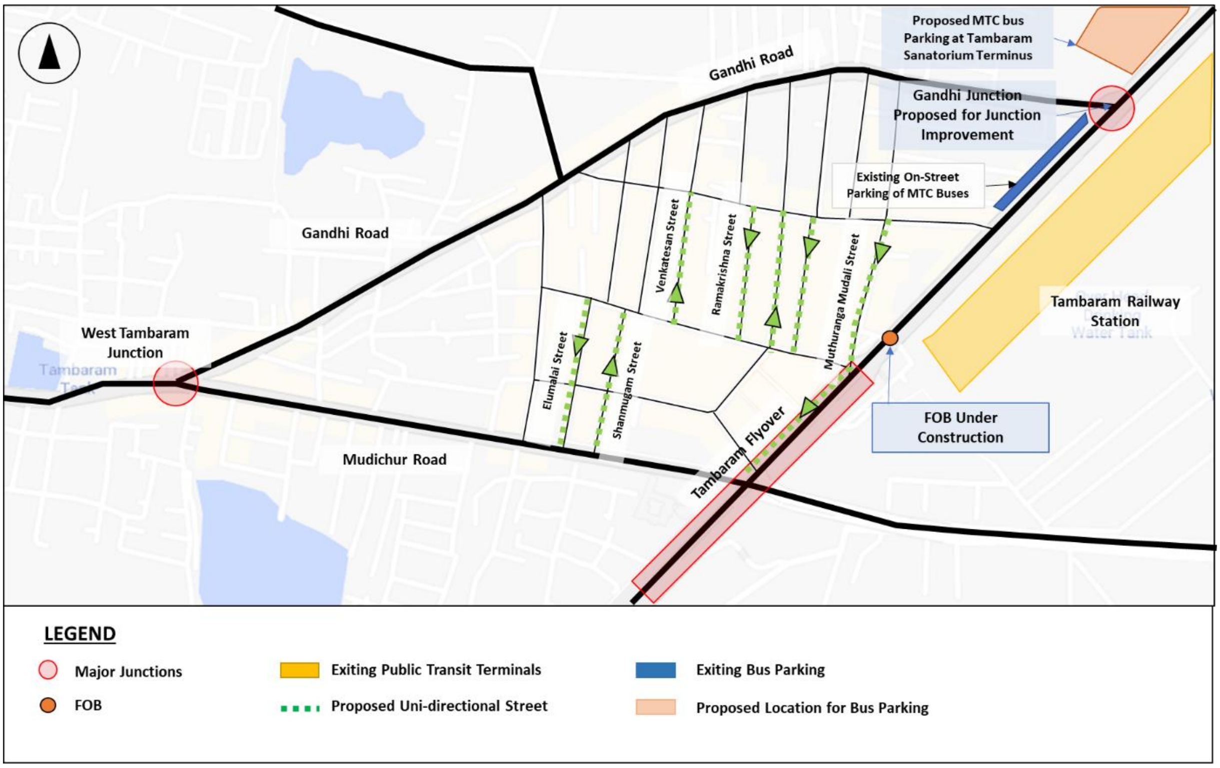


Figure 6-48 West Tambaram - Area Based Development

6.6.3. PAVEMENT MARKINGS AND SIGNAGES

Even though road signs and markings are provided on major road stretches of Chennai, some of the sign boards are not visible and some are not maintained properly. It is recommended that proper signs be installed at all appropriate locations. Road signs are classified in three categories:

a) Mandatory/Regulatory Signs: To inform users about certain rules and regulations to improve safety and free flow of traffic. These include all signs such as STOP, GIVE WAY, Speed Limits, No entry etc. The violation of rules and regulations conveyed by these signs is a legal offence.

b) Cautionary/Warning Signs: To caution the road users of certain hazardous condition either on or adjacent to the roadway. Some examples are Hairpin bend, Narrow Bridge etc. ( ).

c) Informatory Signs: These signs are used to provide information and to guide road users along routes. The information could include name of places, sites, direction to the destinations etc. (Figure 6-51).

Traffic control devices such as Centre line, Traffic lane lines, Stop lines, Pedestrian crossings, Parking space Kerb marking for visibility, Obstruction marking etc must be provided keeping in view all users of the road and especially for night time driving. All the traffic signs should be facilitated as per the guidelines provided in IRC: 67-2001.

Figure 6-49 Mandatory Signs

Figure 6-50 Cautionary or Warning Signs

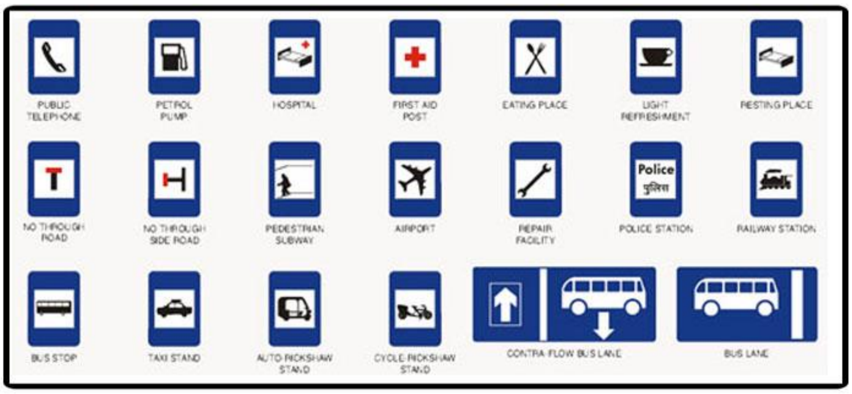


Figure 6-51 Information Signs

The total length of road for immediate intervention in terms of pavement marking and signage is 1400 km worth mobility corridors.

6.7 TRAVEL DEMAND MANAGEMENT MEASURES

Travel demand management is an intervention (excluding provision of major infrastructure), to modify travel decisions so that more desirable transport, social, economic and/or environmental objectives can be achieved, and the adverse impact of travel can be reduced. A combination of TDM strategies and policies help reduce travel demand or redistribute this demand in space or in time. A demand management approach to transport has the potential to deliver better environmental outcomes, improved public health and stronger communities, and more prosperous and liveable cities.

TOOLS FOR TDM

A broad range of demand management strategies are available and can be brought to use depending on the situation and suitability. Some of the "tools" used for TDM are listed below:

- Subsidizing transit costs for employees or residents.
- Car parking controls and pricing
- Flex-time work schedules with employers to reduce congestion at peak times
- Road space rationing by restricting travel at certain times and places.
- Workplace travel plans
- Road space reallocation, aiming to re-balance provision between private cars and other sustainable modes

- Introducing active trip reduction programs
- Public education and awareness programs
- Parking Strategies

The city can choose and implement any of these strategies, as they have relatively less significant financial implications and most of them are policy decisions. One of the TDM tools, parking strategy, has been discussed in detail in the next sub-section:

6.7.1.1 PARKING POLICY AND MANAGEMENT

Effective parking strategies are essential to manage the unauthorized parking activities in the city. The parking strategies should address the issues which will in turn reduce the automobile dependency. The various measures adopted for parking are:

1. Designated Parking Spaces (On and Off-Street)
2. Parking Pricing
3. Enforcement
4. Proof of Parking
5. Parking Standards Near Transit Stations
6. Shared Parking
7. Parking Permits
8. IPT Parking
9. Freight Parking

6.7.1.2 DESIGNATED PARKING SPACES

Existing Parking Situation in CMA was analysed in terms of parking demand, turnover, occupancy and future growth requirements. The study has identified 36 roads for on street parking accounting for 3125 ECS and 22 off-street parking locations. It is important to designate parking spaces and price them in order to effectively manage parking in the city.

Table 6-26 Proposed On-street Parking Stretches

S.No	Location	Total Length (m)	ECS
1	LB Road Near Kamraj Avenue 2nd Street	445	52
2	Saidapet -Near Saidapet Police Station	458	51
3	Cp Ramswamy Road,Alwarpet	406	45
4	Kaliamman Koil Street -Near Koyembedu Bus Terminus	272	30
5	Nsc Bose Road - Sowcarpet	1871	206
6	Gandhi Road (Nungabakkam)	269	30
7	Parrys - Near Broadway MTC Bus Terminus	218	24
8	Sri Thyagaraya Road Towards T-Nagar	773	85
9	Sri Thyagaraya Road Towards Anna Salai	615	68
10	Porur -Near Porur Lake Jaya Nagar	720	80
11	Puraswalkam High Road Near Doveton Flyover	230	25
12	Puraswalkam High Road Near Kelly's Bus Stop	345	38
13	Royapettai - Near Luz Chruch Road	514	57
14	Triplicane High Road -Near Tripilicane Post Office	838	92
15	Velachery-Near Bypass Road Bus Stop	421	46
16	Vyasarpadi Near Ethiraj Swamy Salai Road	569	63
17	Vyasarpadi Near Vyasarpadi Flyover	452	50
18	Waltex Road (Beside Central Station)	816	90
19	Anna Nagar 2nd Avenue	1610	178
20	Pallavan Salai	560	62
21	Kamarajar Salai Near Light House	2330	257
22	Anna Nagar Shanthi Colony	1610	178

S.No	Location	Total Length (m)	ECS
23	Gopathinarayan Swami Chetty Road	650	72
24	Avvai Shanmugam Salai	365	40
25	Luz Church Road Mylapore	280	31
26	Besant Nagar Near 7th Avenue	1560	172
27	100' Road Near Madhavaram-Red Hills Road	1200	132
28	Csir Road Near World Bank Stop	2200	243
29	GNT Road Near Moolakadai Bus Stop	510	56
30	Inner Ring Road Near Perambur Red Hillls Road Jn	1020	113
31	Red Hills Near Oragadam Bus Stop	476	53
32	Mount Ponnamalle High Road Near Dlf Bus Stop	860	95
33	Rajiv Gandhi Salai Near Karapakkam	1070	118
34	200' Road Near Rajiv Gandhi Road	625	69
35	200' Road Near Near Velachery Main Road	625	69
36	Walajah Road	500	55

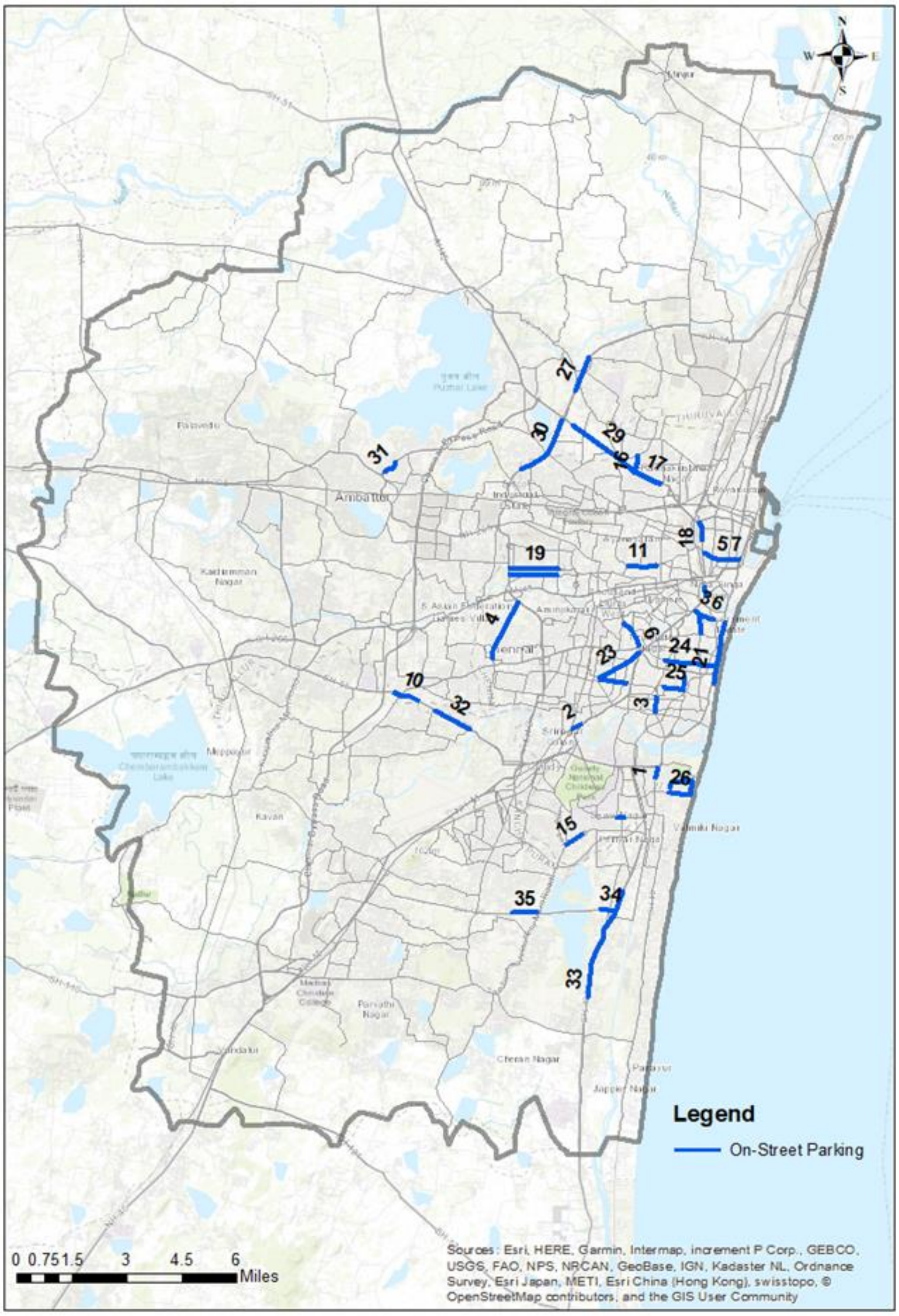


Figure 6-52 On-Street Parking Stretches

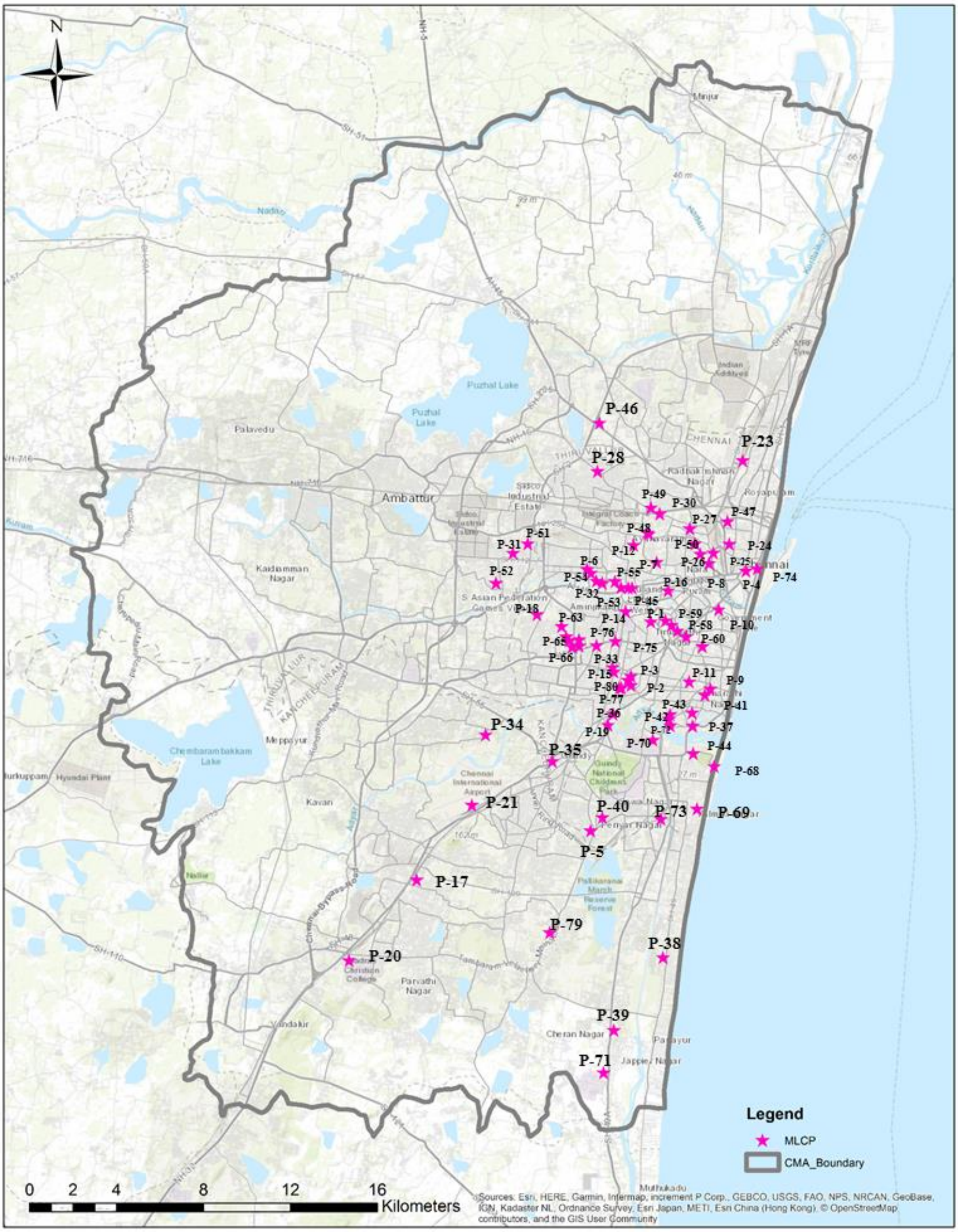
Provision of mass parking facilities should not always be the norm. However, mass parking facilities are needed in order to pedestrianize commercial areas. Hence, based on the land use activity, parking demand and pedestrian footfall, 22 Multi Level Car Parking (MLCP) locations are proposed to utilise the maximum of possible vertical space and to decongest the traffic. It has to be noted that these proposals are linked to the pedestrianisation in T Nagar (Smart –City Proposal).Additionally, 60 off street parking location proposed as part of the study are been considered by GCC which as presented in Annexure J.

Table 6-27 Proposed MLCP

Code	Location	ECS
P-1	Uthamar Gandhi Salai near T-Nagar	320
P-2	Thanikachalam Road near T-Nagar	390
P-3	Siva Nayanam Street near T-Nagar	275
P-4	Broad Way Bus Terminus	760
P-5	Velachery near Vijayanagar Bus Stand	350
P-6	Anna Nagar Rountana	330
P-7	Puraswalkam nera Kelly's	400
P-8	Chennai Central Railway Station	270
P-9	Mylapore /LUZ	320
P-10	Tripilicane (Bharathi Salai)	330
P-11	Royapettah near Peters Rd Flyover	330
P-12	Ayanavaram near Palani Andavar Temple	300
P-13	Kilpauk near Ega Theater	300
P-14	Nungabakkam near Sterling Road	400
P-15	Kodambakkam near Meenakshi College for Women	300
P-16	Chetpet (Daspuram)	325
P-17	Chrompet (Sub-Urban Railway Station)	330
P-18	Koyembedu near CMBT	400
P-19	Saidapet near Saidapet Metro Station	320
P-20	Tambaram Sub-Urban Railway Station	340
P-21	Meenabakkam Sub-Urban Railway Station	260
P-22	Mandaveli Sub-Urban Railway Station	201
P-23	EH Road (Opp to Nathaji Nagar)	2287
P-24	Wall Tax Road	2287
P-25	Kannapan Thidal	2287
P-26	Avadhanam Papya Road, Choolai	1841
P-27	Pulianthoppu	1143
P-28	Kolathur Road	1143
P-29	Zonal Office	579
P-30	Old Lorry at Permbur High Road Jamaliya	2034
P-31	Elango nagar playground	1715
P-32	Gajalakshmi Colony	2287
P-33	NSK Salai, near Zone 10 office, Kodambakkam	1115
P-34	VAO Office	678
P-35	Old Court	571

Code	Location	ECS
P-36	Richard Park	2287
P-37	RK Mutt Road	2861
P-38	Near Anna Enclave Junction of ECR	2397
P-39	Manthoppu Land (Opposite to Infosys Gate)	2287
P-40	Dandeeswarar Temple Land	858
P-41	Kapaleeswarar Temple, P.S School	1415
P-42	Kapaleeswarar Temple Marriage Hall	1039
P-43	Kapaleeswarar Temple Greenways road	882
P-44	Arulmigu Arunachaleswarar Temple land	800
P-45	Ekambaranathar Temple land	770
P-46	CMDA Truck Terminal Parking next to Andhra Bus Terminus	2573
P-47	Basin Bridge Near Mint Bridge	1715
P-48	Pallavan Salai Thiru-vi-ka Nagar Play Ground	565
P-49	Vacant Land at DRB school opp Ground	2034
P-50	KM Garden Play Ground	1526
P-51	Millennium park	1576
P-52	Ambedkar nagar play ground	1009
P-53	AD Block Park	1042
P-54	A- Block 4th Street (Near Amma Arangam Shenoy Nagar)	1201
P-55	Gajapathy street	252
P-56	Poonamalle High Road (Kushaldoss)	303
P-57	Rutland Gate 2nd Street	349
P-58	Greams Road	715
P-59	Wallace Garden 2nd Street	678
P-60	Whites Lane	349
P-61	Luz Church Road	848
P-62	T.Nagar Sivagnanam Street	663
P-63	Rajaji Street	2584
P-64	K.K.Salai	1303
P-65	Nerkundram Pathai	296
P-66	Ponnammal Street	1644
P-67	Amma Koil Street	568
P-68	32nd Cross Street, Besant Nagar	1208
P-69	Thiruvanmiyur Market	353
P-70	Lake View Road	1966
P-71	SAS HotelL OSR Land (Adjacent to Symrise)	503

Code	Location	ECS
P-72	Kapaleeswarar Temple Greenways Station	992
P-73	Apollo Hospitals Taramani Velachery main road	99
P-74	RBI Subway	75
P-75	Kodambakkam Flyover	75
P-76	Vadapalani Temple Land	70
P-77	Burkit road	138
P-78	Burkit road	111
P-79	Thulukanatham an koil street (Opp to unit 43 office)	197
P-80	Duraisamy Subway	100



Title	Proposed MLCP Locations	Prepared by Urban Mass Transit Company Limited
Project	Comprehensive Mobility Plan for Chennai Metropolitan Area	

Figure 6-53 Proposed MLCP Locations

6.7.1.3 PARKING PRICING

Parking pricing and time limits are important parking management mechanisms in order to enhance turnover of parking bays and ensure access to limited on-street parking in high parking demand areas. Following criteria could be be used to determine the parking fees.

1. **Land Values**

It is usually observed that parking demand is high in areas with high land value. A market approach on parking pricing would be to deal with parking as a commodity – priced on the basis of the value of land it occupies. The NUTP also suggests a land-value based approach for determining parking fee.

2. **Distance from Transit**

High parking charges should be levied on parking in places that are well-connected with transit facilities. This should be done in order to discourage private vehicle use.

3. **Distance from Off-street parking Facility**

The price of parking on streets adjacent to off-street parking facilities should be higher since they are more convenient to access. This would consider off-street prices as benchmark and ensure an optimum usage of the facilities provided.

4. **Vehicle Type and Duration of Parking**

There should be a variation in pricing for different vehicle types and duration of parking. Short-term parking should be encouraged by dis-incentivizing long duration parking. This will ensure a quicker turnover which is very important in parking facilities near commercial areas.

Parking rates should be based upon prorated numbers determined by the size of a vehicle, ranging from a two-wheeler (0.25 ECS) to a bus (4.0 ECS).

5. **Time-of-the day / Occupancy based pricing**

This price setting could be based on either a target average occupancy on street or price higher, the locations known to saturate easily. Time-of the day pricing can be adopted on stretches where the demand rises and then reduces over peak and off-peak hours of the day respectively.

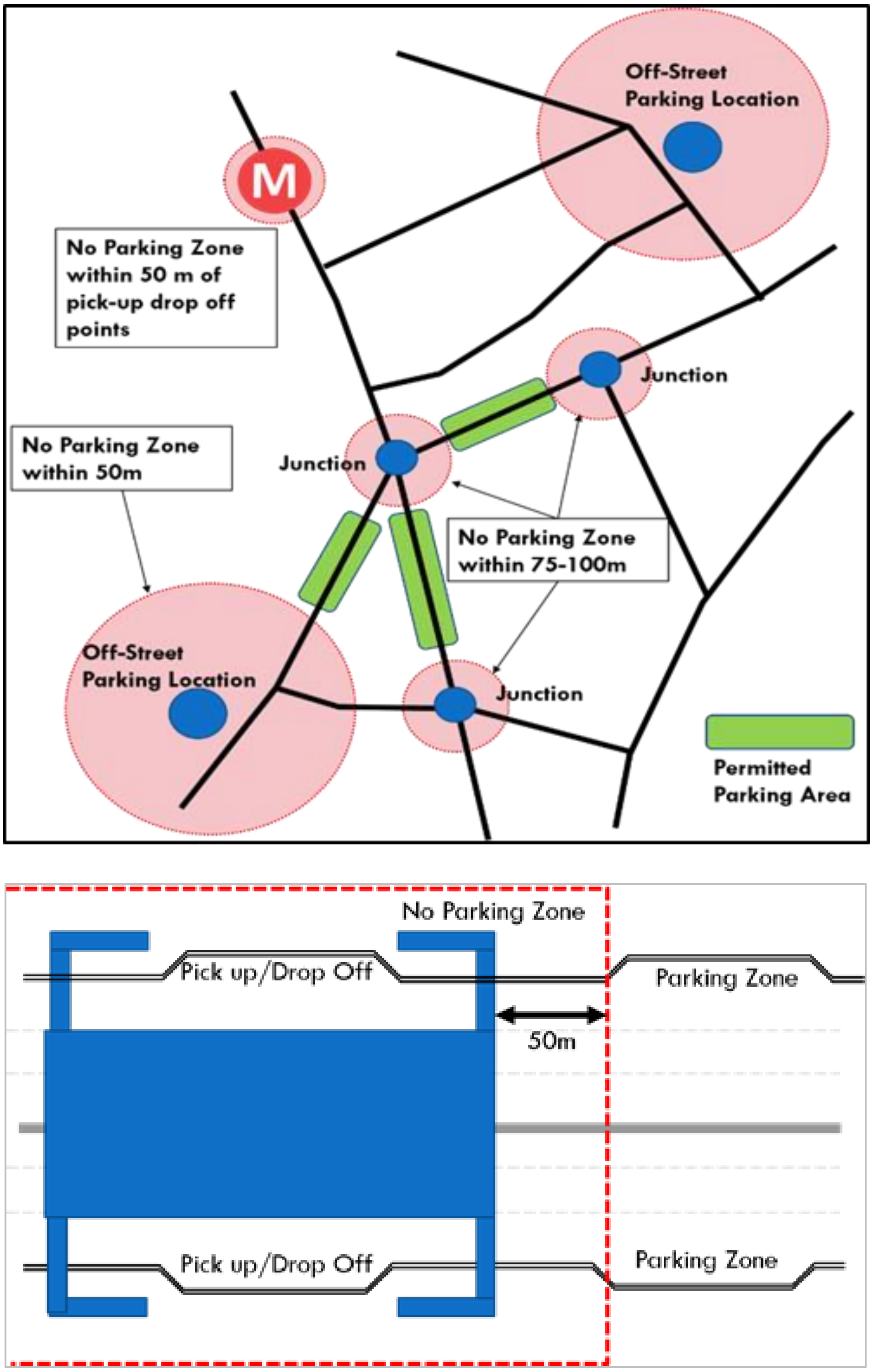


Figure 6-54 Conceptual Representation of Parking Management around the major nodes

6.7.1.4 ENFORCEMENT

Chennai shall enforce parking through the following mechanisms:

To improve the parking situation in Chennai, the Greater Corporation of Chennai (GCC), with support from Chennai Traffic Police, has initiated the process of transforming the city's parking management system (PMS) into a professionally operated service that sets a high standard in customer care and financial transparency. Chennai Smart City Limited (CSCL), a company of the Greater Chennai Corporation, will select a private partner to implement the PMS on a pan-city level.

Ensuring that all on-street parking areas, parking lots under bridges and flyovers, parking lots off-street are clearly marked and easily identified. Specifically, the following standards shall be followed:

1. On street parking spaces shall be designed as per IRC: SP: 12:2015
2. Boundaries of all on-street parking spaces will be marked by white line as indicated in IRC:35-1997
3. Signage clearly marking parking and no parking areas shall be marked as per IRC:67-2001

Follow certain guidelines while defining the no parking areas. These will include:

1. Prohibition of parking for at least 75 m from all junctions
2. Prohibition of parking at least 10 m from all zebra crossings
3. There should be no private vehicle parking beneath the elevated metro stations/ multi-modal transit stations.
4. On street Parking if necessary, should only be provided at distance of 50 meters from the metro station

For enforcing parking near schools, hospitals, educational institutes and other facilities, authorities can facilitate and encourage them to involve volunteers, traffic wardens or others to manage parking.

6.7.1.5 PROOF OF PARKING

This strategy serves two purposes - controlling the vehicle population and resolve parking issues. It should be mandated that residents should procure a No Objection Certificate from the Development Authority. They will be required to show that they have the required parking space within their premises to get the NOC, failing which they cannot register their vehicle with the RTO.

6.7.1.6 PARKING STANDARDS NEAR TRANSIT STATIONS

Reduced parking standards near transit – in a buffer zone of 300 m around the transit line. All Metro corridors, the high mobility corridor and proposed metro corridors need not provide the same amount of parking that is required elsewhere. Parking standards could be reduced by 50% around transit facilities.

6.7.1.7 SHARED PARKING

Optimize parking capacity by allowing complementary land uses to share spaces, rather than providing separate spaces.

“Office parking” that is generally empty in the evenings and on weekends ⟷ **“Residential parking” that is generally full in the evenings**

The areas where shared space arrangements can be implemented:

- Mylapore
- Alwarpet
- Porur
- George Town
- Luz Church
- Triplicane

6.7.1.8 PARKING PERMITS

Restricted parking zones can be created to help ease parking congestion in residential areas around major demand generators. Parking Permits are provided for residents, business and visitors with Resident Parking Zone (RPZ) where On-Street parking is controlled. This mitigated the un-intended effects of non-resident parking in the zone.

Table 6-28 Types of Permits

Permit Type	Description
Residents	Allows residents to park their vehicles in an available resident's bay in the zone where the permit is valid
Business	Allows owners/partners of the business to park their vehicles in a resident's bay, in the zone where the business is situated.
Visitors	Allows you to activate the permit for a visitor's vehicle when they arrive at residents home

Areas where RPZ can be created are:

- Mylapore
- George Town
- Purasaiwalkam
- Tripilicane
- Royapettah
- Egmore

6.7.1.9 IPT PARKING

Road in the study area must have designated on-street spots for parking taxis and three wheelers. These spaces must be specifically marked by the Authority. Transit stations should incorporate IPTS parking in their station design. No charges shall be recovered from IPTS for using these spaces. However, IPTS shall not be allowed to park in spaces designated for other vehicles, failing which heavy fines must be imposed.

6.7.1.10 FREIGHT PARKING

In order to manage freight parking, it is essential to prepare a city-wide freight vehicle management plan. Apart from decongesting parts of the city's road network, such a step also gives way to regulate on-street loading and unloading areas, parking of cargo vehicles etc. This section aims to address the unregulated parking of heavy trucks and other cargo vehicles on-street.

1. On-street parking spaces for loading and unloading purposes in select locations must be identified. Such spaces may be either time-bound or exclusive.
2. No vehicle apart from such cargo vehicles should be allowed to remain stationary in such parking bays for more than 5 minutes.
3. Such cargo vehicles must bear a commercial registration plate, also displaying the owner's name registered address on the windshield.
4. All cargo vehicles must be parked parallel to the kerb
5. Under any circumstances, freight vehicle should not be permitted to park in any area, especially in residential area for more than two hours continuously.
6. Failure to comply with the above, should be considered an offense and a heavy fine should be imposed.

6.8 TECHNOLOGICAL MEASURES

Technological improvements are important for the city to be smart. Technological improvements can encompass changes in vehicle design, fuel use, energy use and reduction in CO_2 emissions related to the electrically driven vehicles. Various actions framed for the same are:

a) Smart signalling at intersections

b) Real time information systems for Public Transport

c) Introduce integrated ticketing system

d) Use of smart parking technologies

Technological improvements include advanced applications which, without embodying intelligence as such, aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks.

A very critical project under smart city, for which DPR for entire city is being prepared, is the Intelligent Traffic Management System in Chennai. First phase will involve 159 junctions with automated vehicle and queue length detection and Area Traffic Control to streamline traffic. ITMS will include Passenger Information System and junction redesign to ensure efficiency and safety. This project is being funded by JICA and Government of Tamil Nadu.

6.8.1. INTELLIGENT TRANSPORT SYSTEMS

ITS encompasses all modes of transportation- air, sea, road and rail and intersects various components of each mode- vehicles, infrastructure, communication and operational systems.

(Reference: Center of Excellence in Urban Transport, IIT-M, Intelligent Transport Systems)

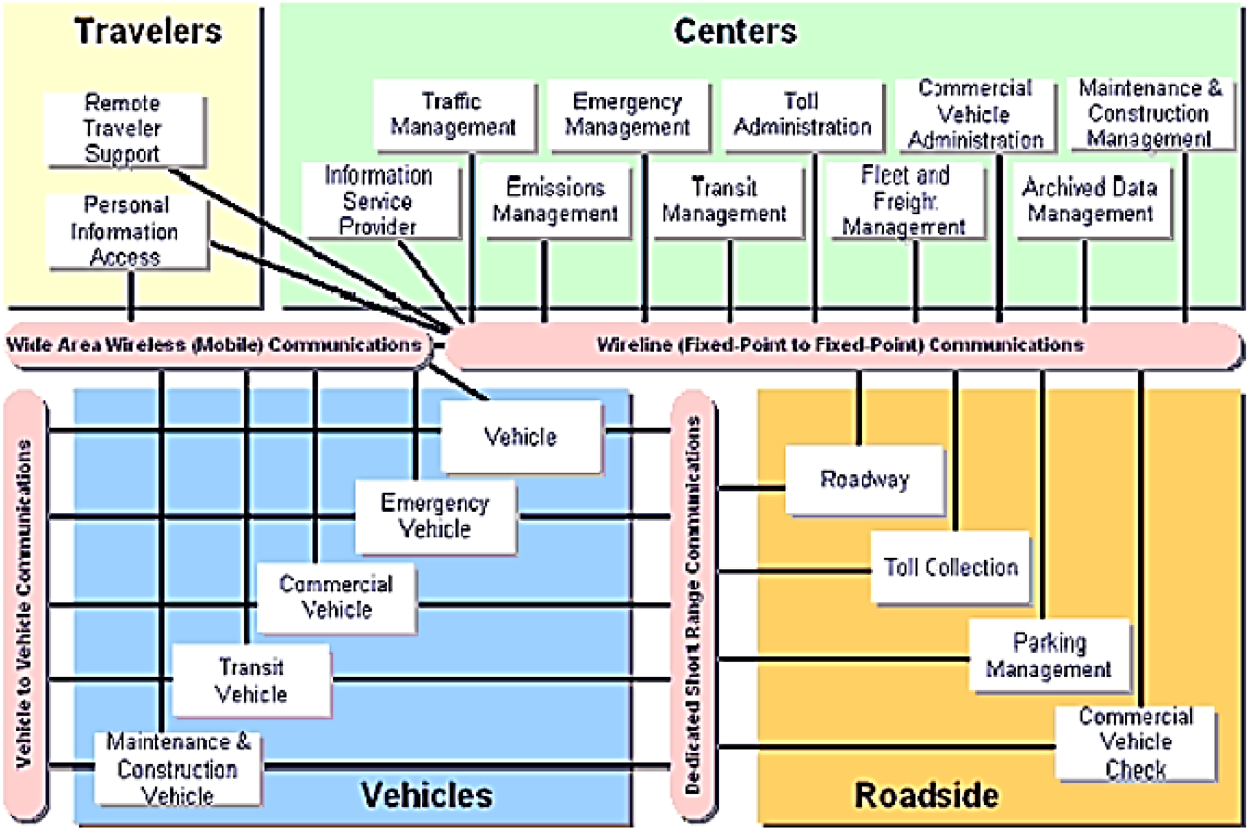


Figure 6-55 Broad Overview Of ITS

(Reference: Centre of Excellence in Urban Transport, IIT-M, Intelligent Transport Systems)

Intelligent Transport Systems will include:

a) **Advanced Traffic Management Systems (ATMS)** integrates various sub-systems (such as CCTV, vehicle detection, communications, variable message signs etc) into a coherent single interface that provides real information on traffic status.

b) **Advanced Traveller Information Systems (ATIS)** provides users of transportation systems both public and private mode users travel related information regarding routes, estimated travel times etc.

Figure 6-56 Examples of Advanced Traffic Management Systems

c) **Advanced Vehicle Control Systems (AVCS)** are tools and concepts that enhance the driver's control of the vehicle to make safe and more efficient.

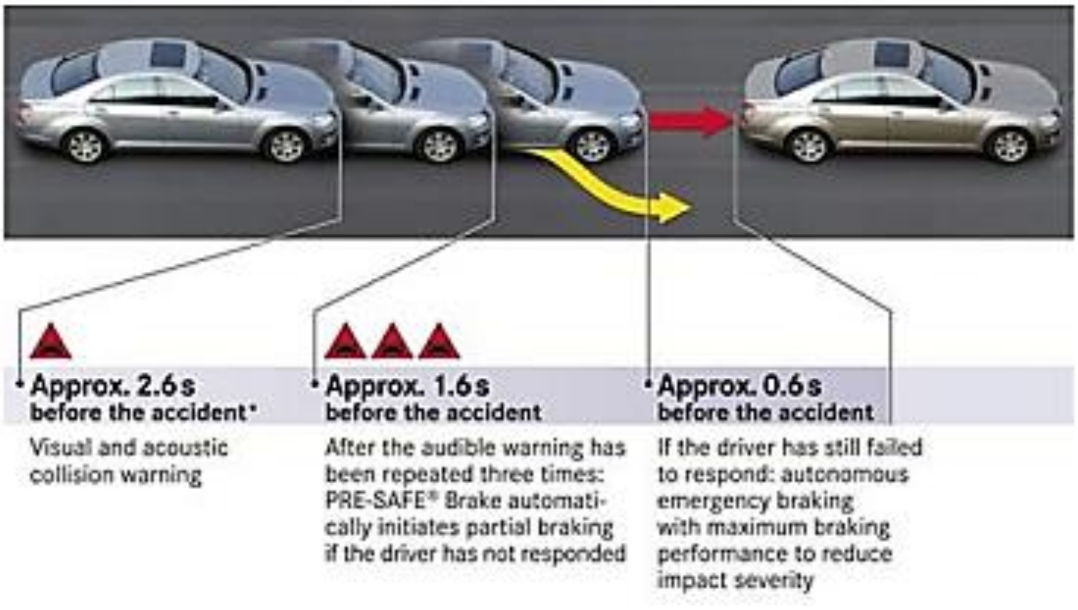


Figure 6-57 Examples of Advanced Vehicle Control Systems

d) **Commercial Vehicle Operations** for constant monitoring of heavy vehicles. It can be in the form of smart cards, weigh bridges etc.

e) **Advanced Public Transportation Systems**_to enhance efficiency of public transit systems through information systems, signal priorities, GPRS etc

6.8.2. TRAFFIC MANAGEMENT CENTER

A traffic management centre (TMC) is a hub of transportation administration, where data is collected and analysed and combined with other transport characteristics.

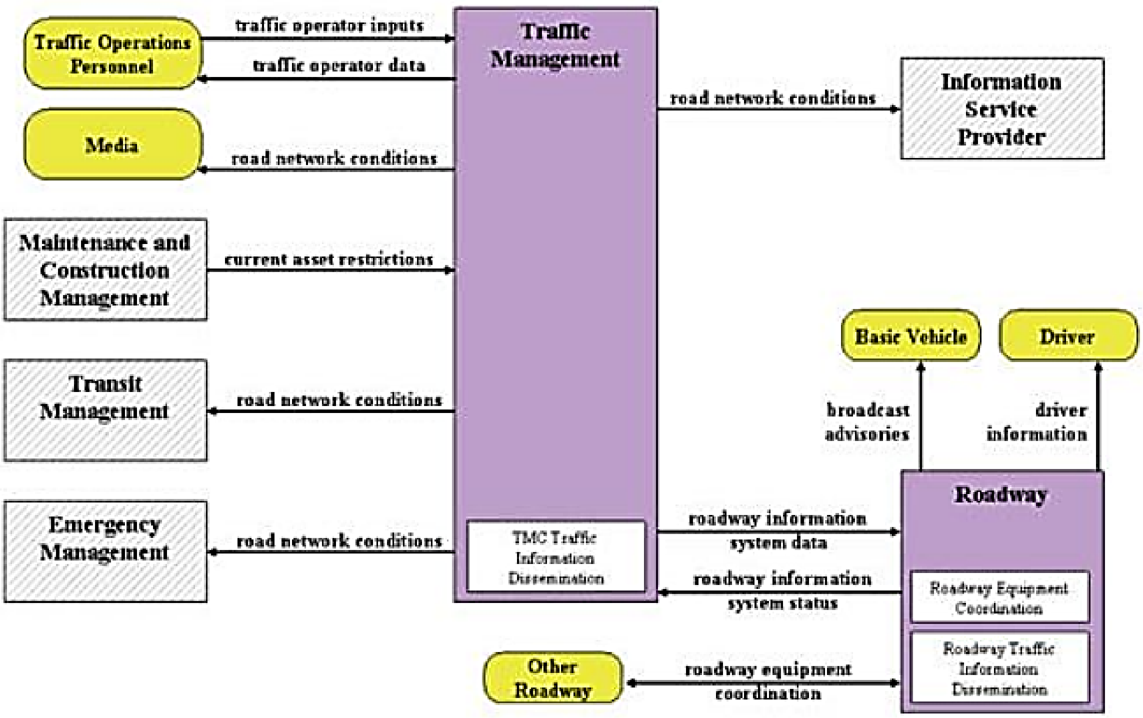


Figure 6-58 Schematic Representation of TMC

Traffic Management Centres should be provided at different locations within CMA for better control of movement of vehicles in the city. Introduction of ITS in the form of dynamic Variable Message Signs (VMS); Passenger Information Systems; Development of ITS enabled Traffic Control Centre etc. are the components under Information Communication applications. On a priority basis, Traffic Control Centres should be developed in:

1) North Chennai

- Flower Bazaar, Washermanpet and Madhavaram

2) West Chennai

- Anna Nagar, Ambattur and Pulianthope

3) South Chennai

- T.Nagar, Adyar and Mount

4) East Chennai

- Vepery, Mylapore and Triplicane

The functional areas of Control centre are:

- Real-time traffic monitoring

- Dynamic message sign monitoring and control
- Incident monitoring
- Traffic camera monitoring and control
- Active Traffic Management (ATM)
- Chain control
- Ramp meter monitoring and control
- Arterial management
- Traffic signal monitoring and control
- Automated warning systems
- Road Weather Information System (RWIS) monitoring
- Highway advisory radio
- Urban Traffic Management and Control
- Public Transport Information
- Real time route Information

6.8.3. SMART SIGNALIZATION

It is proposed to provide smart signalization at all major junctions in the city. All the existing signals should also be converted as smart signals. Total of 383 Junctions are identified to be smart signals in Chennai.

Benefits of smart signalization are:

1. Reduces delay and queuing
2. Efficient movement of pedestrians and cyclists
3. Maximize the volume movement
4. Reduces severity of crashes
5. Accessibility to pedestrians and side street traffic

6.8.4. VEHICLE TECHNOLOGY

As a green initiative to move towards Sustainable urban transport, technological transformations in terms of Public Transport vehicles are suggested. With efforts to reduce carbon emissions the LCMP suggests the used of CNG or electric vehicles.

6.8.4.1 Compressed Natural GAS (CNG) Buses and Auto Rickshaws:

Natural gas vehicles are increasingly used in Delhi, and other large cities like Ahmedabad, Mumbai, Pune, Kolkata as well as cities such as Lucknow, Kanpur, etc. In response to high fuel prices and environmental concerns, CNG is starting to be used also in pickup trucks, transit and school buses. The CNG vehicles have the following advantages,

- Natural gas vehicle have lower maintenance costs than other hydrocarbon-fuel-powered vehicles.
- Being a gaseous fuel, CNG mixes easily and evenly in air.
- CNG is less likely to ignite on hot surfaces, since it has a high auto-ignition temperature (540 °C), and a narrow range (5–15 percent) of flammability.
- CNG-powered vehicles are considered to be safer than gasoline-powered vehicles.
- Less pollution and more efficiency

Figure 6-59 CNG Vehicles in India

6.8.4.2 Electric Buses and Auto Rickshaws:

India is in the process of tackling its ambitious objective of having a 100 per cent zero-emissions, electric vehicle fleet by 2030, as envisaged by NITI Aayog. Consequently, experiments on the operational feasibility of all vehicle types, including buses, cars, two-wheelers, rickshaws, taxis and goods vehicles, are beginning. The Indian government understood the environmental need to switch to electric vehicles and to ensure it is a success, a number of initiatives are being implemented.

Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles (FAME Scheme) is one of said initiatives. FAME provides subsidies as a financial incentive to buyers of electric vehicles. The scheme allocated approximately INR155 crore for demand incentives in 2015-2016 and around INR340 crores between 2016-2017. As a result, each mode of transport has experienced some acceleration towards electrification.

Figure 6-60 Electric Vehicles

In comparison to conventional CNG or diesel buses, electric buses are costly. The cost of an electric bus available in the Indian market is typically three to four times the price of a CNG or diesel bus. Though it is suggested to shift to electric vehicles by 2048, CNG or Diesel (BS-IV) Buses are opted for the new fleet Public Transportation system. Thus, 70% Buses are proposed to be Diesel (BS-IV) Buses and 30% Buses are proposed to be Electrical Bus.

Whereas, E-rickshaws are highly recommended in the city along with CNG Vehicles. As a part of the old city rejuvenation, only E-Rickshaws shall be allowed to ply in the core are to provide connectivity during the restricted vehicle hours to provide connectivity. As E-Rickshaws come in various adoptive sizes they act as a viable and sustainable intermediate public transit option in the core areas.

Impact Of Proposed Projects

7. Impact Of Proposed Projects

7.1 ANTICIPATED IMPACT OF PROPOSED PROJECTS

Projects evolved in CTTP will help to achieve sustainable development goals by means of reducing private mode share, emission levels and travel time. Anticipated impacts of the proposed projects are segregated into the following categories and summarized in

- Social Impact
- Environmental Impact

Table 7-1: Impact of proposed projects

Name of the Impact	BAU Scenario Do Nothing (2048)	BAU Scenario Do Minimum (2048)	Target (2048)	SUT Scenario - (2048) - Achieved
Share of Private Transport (PVT) Trips*	55.0%	56.6%	<50.0%	38.9%
Share of Public Transport Trips*	37.7%	36.3%	>50.0%	57.2%
Share of Intermediate Public Transport (IPT) Trips*	7.3%	7.1%	7.0%	3.9%
Avg. Network Speed (kmph)	10.23	12.1	>=24	24.0
Walkability (Arterial & Sub-Arterial)	38.0%	39.2%	>90.0%	100%
Cyclability (Arterial & Sub-Arterial)	0.0%	1.3%	>80.0%	80%
PVT Vehicle Kilometer Travelled (in '000)	27065	29084	Reduce by 10%	21737

* *Share excluding walk trips (Motorised Share)*

7.2 SOCIAL IMPACT

The impact of the proposed projects from the social angle is analysed at a broader perspective. It is found that most of the projects have significantly less impact with respect to

Rehabilitation and Resettlement. Land acquisition for some of the projects is inevitable. The proposed projects significantly improve mobility with reduced travel time. The broad impacts have been compiled in Table 7-2.

Table 7-2: Social Impacts on Proposed Projects

Project	Right of way / Land Acquisition	Requirement of Rehabilitation and Resettlement	Reduction in Travel Time	Accessibility Improvement	Mobility Improvement
Higher Order Transit System	Yes	Yes	Yes	Yes	Yes
Bus Fleet Augmentation	No	No	Yes	Yes	Yes
Bus Terminals/ Intermodal Stations	Yes	Yes	Yes	Yes	Yes
TTMC / Transport Hub	Yes	Yes	NA	No	Yes
Freight Terminals	No	Yes	NA	No	Yes
ROBs / New Roads/ Road Widening/ Grade Separators	Yes	Yes	Yes	Yes	Yes
Ring Roads	Yes	Yes	Yes	Yes	Yes
Foot Paths	No	No	NA	Yes	Yes
FOBs/Pedestrian Subways	No	No	NA	Yes	Yes
Cycle Tracks/ Public Bicycle Sharing	No	No	NA	Yes	Yes
Parking Facilities	No	No	No	Yes	Yes
Junction Improvements	No	No	Yes	Yes	Yes
Intelligent Transportation System	No	No	Yes	Yes	Yes
Area Traffic Control Centers/ Signals	No	No	Yes	Yes	Yes

7.3 ENVIRONMENTAL IMPACT

The impact of the proposed projects from the environmental effects is analyzed at a broader perspective. Very few projects have significantly less impact with respect to air and noise pollution.

Some of the broad indicators for environmental impact changes are quantified and are presented in Table 7-5.

The impact of the proposed projects from the environmental effects is analysed at a broader perspective. Very few projects have significantly less impact with respect to air and noise pollution. Some of the broad indicators for environmental impact changes are quantified and are presented in Table 7-3 and Table 7-4.

Table 7-3: Local emissions in tonnes per day

Local Emissions				
Vehicle Type	**Base-2018**	**BAU1-2048**	**BAU2-2048**	**SUT-2048**
All Modes	73.6	75.0	60.0	23.0

Table 7-4: CO2/ GHG Emissions in tonnes per day

CO2/ GHG Emissions				
Vehicle Type	**Base-2018**	**BAU1-2048**	**BAU2-2048**	**SUT-2048**
All Modes	2594.3	3800.8	4138.6	1502.2

Table 7-5: Environmental factors

Name of the Impact	Base Year (2018)	BAU Scenario Do Nothing (2048)	BAU Scenario Do Something (2048)	SUT Scenario (2048)
Local Emissions (Tonnes/day)	73.6	75.0	60.0	23.0
GHG Emissions (Tonnes/day)	2594.3	3800.8	4138.6	1502.2
Exposure to Transport Noise	>75	>75	>75	<75
Percent of public transport fleet in compliance with Indian emissions standards	0		0	80%

Summary of Social and Environmental impacts have been presented in Table 7-6.

Table 7-6 Summary of Social and Environmental Impacts

Broad Project category	Activities / Sub Components	Impacts
Transit Nodal development based on TOD principles	• Development of serviced land for high density development • Public transport interchange hubs	• Land acquisition • Construction activity around the highway
Pedestrian / NMT Infrastructure Improvement	• Land acquisition for road widening and creation of service lane wherever necessary	• Removal of squatters and encroachers from the footpaths • Causing livelihood losses even though they are illegal • Loss of shelter for temporary shops / residences for squatters and encroachers
	• Construction of new footpaths	• Improvement in safety of pedestrians due to measures proposed
	• Segregated Cycle Tracks	• Improvement in pedestrian safety • Slowing of traffic at the time of constructing and erecting structures across major intersections • Encourage use of NMT and hence reduction in pollution
	• High Capacity Improved Public Transit System	• Land acquisition for dedicated lanes , Flyovers ,stations will cause Rehabilitation and Resettlement issues

Broad Project category	Activities / Sub Components	Impacts
Public Transport Planning		• Use of existing pavement width for dedicated bus lanes will cause removal of squatters and encroachments from roadsides causing loss of livelihood and loss of shelter • Construction / reconstruction / improvement of bus lanes/MRT systems will be causing construction issues as: ▪ Generation of noxious gases during construction, increasing air pollution ▪ Temporary increase in noise pollution during construction ▪ Contamination of road runoff with construction material stacked on road side ▪ Traffic safety during construction ▪ Traffic diversions causing lengthening of routes increasing air emissions and exposing previously unexposed neighbourhoods to noise • Reduction of additional lane width for other traffic if existing road width is used for demarcating the dedicated bus lanes

Broad Project category	Activities / Sub Components	Impacts
		• Reduction in private vehicles causing reduction in air / noise pollution
	Terminals/Depots/TTMC/ Transport Hubs/ Commuter Amenity Centers	• Acquisition of land for the facilities causes. Rehabilitation and Resettlement issues as loss of livelihood, loss of shelter, severance of community & social ties • Increase of noise and air pollution in the areas of terminals and depots • Improvement in approaches to the terminals and depots causing impacts on adjacent land-uses and land acquisition • Additional land acquisition, if any for the approach road improvement will lead to Rehabilitation and Resettlement issues along the roads and cause impacts on livelihood and shelter • Construction stage impacts include the increase in air and noise pollution • Contamination of road runoff with stacked construction materials

Broad Project category	Activities / Sub Components	Impacts
		Improvement of traffic conditions during operation stage causing reduction in air and noise pollution
	• FOBs/Sub-ways	• Temporary interruption to traffic and increase of emissions from vehicles due to higher idling times • Temporary increase of noise levels due to idling and traffic snarls • Alternate traffic diversion routes increasing route length and consequently emissions • Alternate traffic diversion routes exposing previously low traffic routes to higher urban traffic and increasing air / noise pollution • Removal of squatters and encroachers from the footpaths causing livelihood losses at approaches to the sub-ways / FOBs • Loss of shelter for temporary shops / residences for squatters and encroachers at approaches to the sub-ways / FOBs • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth

Broad Project category	Activities / Sub Components	Impacts
Traffic Engineering and Management Measures	• Junction Improvements	• May cause removal / displacement of squatters and encroachers. • Air and noise pollution from construction impacts • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
	• Area Based Management Systems	• Improvement in safety of pedestrians due to measures proposed • Improvement in pedestrian safety • Slowing of traffic at the time of constructing and erecting structures across major intersections • Encourage use of NMT and hence reduction in dependency on personalised modes. • Alternate traffic diversion routes increasing route length and consequently emissions.
Travel Demand Management Measures – Parking Management	• Priced, designated on-street parking space	• Reduction in urban congestion due to increase in effective carriage way width

Broad Project category	Activities / Sub Components	Impacts
	• Off- street parking development	• Discouraging parking and Pricing of designated parking spaces may over the long run, result in: ▪ Discouraging private vehicle use and promote the use of Public Transport ▪ Improved speeds due to reduction in congestion.
Technological Measures	• Automated Vehicle Location System • Variable Message Signs • ITS control Centre, PIS, Common Mobility Card, GPS, Mobile phone Applications and Surveillance Cameras	• Reduction in congestion due to reduced delays at junctions • Improved speeds on major corridors. • Improved reliability of Public Transport and comfort to the passengers • Improved safety as well as security.
Freight Management	• Banning and restrictions	• Reduction in urban congestion due to banned movement of freight in the day hours • Banning of use of animals for movement of goods in the city may result in: ▪ Animal welfare and safety ▪ Improved speeds in CBD area due to reduction in congestion

Broad Project category	Activities / Sub Components	Impacts
	• Relocation of Activity and Improvement inside existing freight terminal	• Resistance by operators for relocation • Improved operations due to better organized facilities
	• Creation of new freight terminal	• Acquisition of land in the peripheries • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth

Implementation Plan

8. Implementation Plan

This chapter details out the costs associated with each of the proposed improvements (short, medium & long term) along with the phasing of the projects. The implementation plan also provides various financial options to be looked at towards implementing the proposed projects. A suitable Institutional Frame Work is of utmost importance for successful implementation and management of all the schemes.

8.1 PRIORITISATION OF PROJECTS

All the proposals discussed so far can be broadly grouped under three categories:

- Long Term Improvements: the usefulness of these improvements will last for more than 10-15 years
- Medium Term Improvements: the usefulness of these improvements will last for about 5-10 years
- Short Term Improvements: these are short term proposals that need to be reviewed and revised within 5 years as per the requirement.

Accordingly, long term, medium term and short-term proposals for Chennai are shown in Table 8-1 to Table 8-4.

Table 8-1: Short Term Projects

Sl No	Short Term Projects	Unit	Quantity	Unit Cost (Crore)	Total Cost (Crore)
1	Footpath	km	861	1.5	1291.5
1a	Grade Separator -FOB/Box Culvert/Subway	Nos	26	2	52
2	Cycle Tracks	km	461	1.5	691.5
3	Junction Improvements	Nos	167	0.6	100.2
4	Road Markings/Signages	km	1358	0.05	67.9
5	Bus Augmentation				
5a	Bus	Nos	21186		
5b	Electric Standard Buses (12mm)	Nos	10593	2	21186
5c	Standard Buses	Nos	10593	0.6	6355.8
6	Bicycles	Nos	17000	0.0012	20.4
7	Pedestrian Malls	km	18	5	90
8	Area Traffic Control Center	Nos	12	30	360
9	Smart Signals	Nos	296	0.3	88.8
10	Grade Separator at Junctions	Nos	32	35	1120
				Total Cost (Crores) (Rs)	***31424.1***

Table 8-2: Medium Term Projects

Sl No	Medium Term Projects	Unit	Quantity	Unit Cost (Crore)	Total Cost (Crore)
1	ROBs	Nos	23	40	920
2	Multi modal Transit Hubs	Nos	24	10	240
3	Bus Terminal	Nos	29	20	580
4	Off street Parking	Nos	80		
4a	Off street Parking Upto 100 ECS	Nos	4	10	40
4b	Off street Parking 100-200 ECS	Nos	4	16	64
4c	Off street Parking >200 ECS	Nos	72	146	10512
				Total Cost (Crores) (Rs)	***12356***

Table 8-3: Long Term Projects

Sl No	Long Term Projects	Unit	Quantity	Unit Cost (Crore)	Total Cost (Crore)
1	Satellite Town Ring Road	Km	190	15	2850
2	Truck Terminal	Nos	7	20	140
3	Road Improvement				
3a	New Link (6 Lane)	Km	44.5	7	312
3b	New Link (6 Lane)	Km	25	5	125
3c	Bridge	Nos	4	10	40
4	Rail -Elevated	Km	160	350	55963
5	Rail -Underground	Km	107	500	53298
6	Bus Based Transit System	Km	131.04	35	4586
				Total Cost (Crores)	***117314***

Table 8-4: Total Project Cost

Project Priority	Cost (Crores)(INR)
Short Term Projects	31424.1
Medium Term Projects	12356
Long Term Projects	117314
Total Cost	**161094.1**

Table 8-5: Detailed Total Project Cost

Sl.No	Projects	Unit	Quantity	Rates (in Crores)	Total Cost (in Crores)	Phasing 2018-2028 PhaseI	2028-2038 PhaseII	2038-2048 PhaseIII
Short Term Projects								
1	Footpath	km	861	1.5	1291.5	1291.5	0	0
1a	Grade Separator -FOB/Box Culvert/Subway	Nos	26	2	52	26	26	0
2	Cycle Tracks	km	461	1.5	691.5	691.5	0	0
3	Junction Improvements	Nos	167	0.6	100.2	28.2	36	36
4	Road Markings/Signages	km	1358	0.05	67.9	47.85	7.3	12.75
5	Bus Augmentation							
A	Bus	Nos	21186					
B	Electric Standard Buses (12mm)	Nos	10593	2	21186	6780	6144	8263
C	Standard Buses	Nos	10593	0.6	6355.8	2034	1843	2479
6	Bicycles	Nos	17000	0.0012	20.4	20.4	0	0
7	Pedestrian Malls	km	18	5	90	45	45	0
8	Area Traffic Control Center	Nos	12	30	360	360	0	0
9	Smart Signals	Nos	296	0.3	88.8	88.8	0	0
10	Grade Separator at Junctions	Nos	32	35	1120	1120	0	0
Total (Crores) (Rs.) - Short Term Projects					***31424.1***	***12533.3***	***8101.3***	***10790.8***
11	ROBs	Nos	23	40	920	920	0	0
12	Multi modal Transit Hubs	Nos	24	10	240	100	70	70
13	Bus Terminal	Nos	29	20	580	200	200	180
14	Off street Parking	Nos	80					
A	Off street Parking Up to 100 ECS	Nos	4	10	40	40	0	0
B	Off street Parking 100-200 ECS	Nos	4	16	64	64	0	0
C	Off street Parking >200 ECS	Nos	72	146	10512	10512	0	0
Total (Crores) (Rs.) - Medium Term Projects					**12356**	**11836**	**270**	**250**

Long term Projects								
15	Satellite Town Ring Road	Nos	190	15	2850	0	0	2850
16	Truck Terminal	Nos	7	20	140	40	40	60
17	Missing Links/New Links							
17a	New Link (6 Lane)	Km	44.5	7	312	0	155.75	155.75
17b	Road Widening	Km	25	5	125	87.5	12.5	25
17c	Bridge	Nos	4	10	40	40	0	0
18	Rail Based Transit System*	Km	266.5					
18a	Rail Based -Elevated	Km	160	350	55962.9	23997	31966	
18b	Rail Based -Underground	Km	107	500	53298	22854	30444	
19	Bus Based Transit System	Km	131	35	4586	1559	0	3027
Total (Crores) (Rs.) - Long-term Projects					***117314***	***48578***	***62618***	***6118***
Total (Crores) (Rs.) - All Projects					***161094***	***72947***	***70989***	***17159***

8.2 PROJECT COSTS, PHASING AND PPP POTENTIAL

The projects identified in the earlier section are divided into three categories based on the urgency and duration of the implementation. Some of the long-term projects have potential to enter into Public Private Partnership (PPP); however, case to case project reports are required for validating the feasibility of each project. The cost of all the recommended projects is around 42369.6 Crores. It is important to highlight that the CMP serves only to identify schemes and the costs presented are only Block Cost estimates for decision makers. Detailed cost estimates need to be worked out at further stages.

8.3 FINANCING OPTIONS

As per the Recommendations of Working Group on Urban Transport for 12th Five Year Plan, the financing of urban transport projects in the country has largely been confined to gross budgetary support from the government and the user charges. Due to heavy investment needs of urban transport and conflicting demands on the general exchequer, the investment in urban transport in past has not kept pace with the rapidly increasing requirement of the sector. The current level of user charges of limited urban transport facilities, do not make the system self-sustainable. At the same time, providing safe, comfortable, speedy and affordable public urban transport to all has to be a necessary goal of the governance. The key funding sources besides GBS and fare box can be dedicated levies, land monetization, recovery from non-user beneficiaries, debt and private investments. The paradigm of financing has to clearly move towards non-users pay principle and the polluters pay principle. There is a need for long-term sustainable dedicated financing mechanism to address fast worsening scenario in the field of urban transport. All the various components in which the investment would be required in the 12th Five Year Plan would need to be funded through a combination of funding from Govt. of India, State Govt./urban local body, development agencies, property development, loan from domestic and financial institutions as well as PPP. Thus, it is imperative to identify projects that are amenable to Government funding or PPP.

8.3.1. EQUITY SHARING MODEL

Under this model, a Special Purpose Vehicle (SPV) is set up as a joint venture between Central Government and State Government for the implementation of the project and for its subsequent Operation & Maintenance. Under this arrangement Government of India and State Government make equal equity contribution and run SPV as a commercial enterprise. As per the prevalent practice, Central Government contribute 20% of the project cost as their equity contribution. An equal amount can be contributed by State Government aggregating the total equity to 40%. Remaining 60% is arranged as soft loan from funding agencies. Delhi Metro Rail Corporation, Bangalore Metro Rail Corporation, Chennai Metro Rail Corporation & Kolkata Metro Rail Corporation are some of the examples of success of such a SPV.

8.3.2. PUBLIC PRIVATE PARTNERSHIP (PPP)

Public-Private Partnerships is cooperation between a public authority and private companies, created to carry out a specific project. They can take on a number of forms, and can be a useful method of capturing property value gains generated by transport infrastructure. In a PPP for a new transport infrastructure development project, the public authority creates a secure environment for the private sector to carry out the project, and the private partner offers its industry know-how, provides funding and shares in the project's risk. The objectives of the public and private sector partners appear to be quite different. The public sector aims to best serve the interests of taxpayers. The aim is not to use public money to obtain a return on capital investments. The private sector, on the other hand, aims to ensure a return on investment for its shareholders and to be as profitable as possible and yet these two contrasting goals can function perfectly well together in the framework of a PPP. The decision to undertake a public-private partnership and the choice of the most suitable form of partnership greatly depends on the context and the types of project to be developed are given below:

- The project context may influence the type of PPP to be implemented. The public partner must evaluate the total cost of the project, its importance in terms of public need, the time frame, the number of actors involved and the geographic area in question. Does providing this public service require a major infrastructure? Will it require high levels of human and financial resources to provide this service? Before a decision can be made, it is necessary to fully understand the context of the proposed project.

- The cost of the project is of course a critical factor, which will weigh on the choice. Many PPP concern projects for underground systems, LRT and BRT requiring significant levels of financing which the local authorities would have difficulty assuming alone.

- A well-structured institutional framework and the local authority's experience in developing transport projects are also decisive factors. Urban transport is an industrial and commercial activity, which involves financial risk. Bringing in experienced partners is one way of compensating for a lack of certain skills in this field, though a good PPP should call upon other forms of expertise on the part of the public authority. This can sometimes facilitate obtaining a loan, in particular from international funding agencies.

- The tasks entrusted to the private sector (design, construction, development, operation, maintenance) will influence the type of contract.
- The sharing of responsibilities and risks will determine the degree of involvement of each partner and the type and clauses of the contract. There are many types of contracts but it is primarily the sharing of financial risk, which will determine the key characteristics. There are two categories of risk: commercial risk, related to trends in revenue, and industrial risk, related to the cost of construction and trends in operating and maintenance expenses. If both types of risk are covered by the public partner, then it would be a management contract in which the private partner is merely performing the work. The private partner must meet the specifications but will not be motivated to improve the service nor propose innovative techniques or management;
- If the project is not self-financing, i.e. if, at the end of the contract, the total revenues and gains do not balance out the total costs, the transit authority may be required to provide compensation, depending on the clauses of the contract.

8.3.3. GOVERNMENT SOURCES OF FUNDING

One of the particularities of the urban transport sector is that it depends on funding from several sources and involves various partners, public and private, individual and collective.

8.3.3.1 AMRUT FUNDING

Since cities and towns in India constitute the second largest urban system in the world and contribute over 50% of the country's GDP, they are central to economic growth. For the cities to realize their full potential and become effective engines of growth, it is necessary that focused attention be given to the improvement of infrastructure in an organized manner. According to AMRUT guidelines:

One-third of the project cost as grant from GoI for cities with a population of above 10 lakh.

Balance funding by State Governments / ULBs or through private investment.

The tender will include O & M for five years based on user charges. For the purpose of calculation of the project cost, the O&M cost will be excluded; however, the States/ULBs will fund the O&M through an appropriate cost recovery mechanism in order to make them self-reliant and cost-effective.

8.3.3.2 VIABILITY GAP FUNDING

In a recent initiative, the Government of India has established a special financing facility cal led "Viability Gap Funding" under the Department of Economic Affairs, Ministry of Finance, to provide support to PPP infrastructure projects that have at least 40% private equity committed to each such project. The Government of India has set certain criteria to avail this facility under formal legal guidelines, issued in August 2004, to support infrastructure under PPP framework. Viability Gap Funding can take various forms such as capital grants, subordinated loans, O&M support grants and interest subsidies. It will be provided in instalments, preferably in the form of annuities. However, the Ministry of Finance guidelines require that the total government support to such a project, including Viability Gap Funding and the financial support of other Ministries and agencies of the Government of India, must not exceed 20% of the total project cost as estimated in the preliminary project appraisal, or the actual project cost, whichever is lower. Projects in the following sectors implemented by the Private Sector are eligible for funding:

- Roads and bridges, railways, seaports, airports, inland waterways
- Power
- Urban transport, water supply, sewerage, solid waste management and other physical infrastructure in urban areas
- Infrastructure projects in Special Economic Zones
- International convention centres and other tourism infrastructure projects

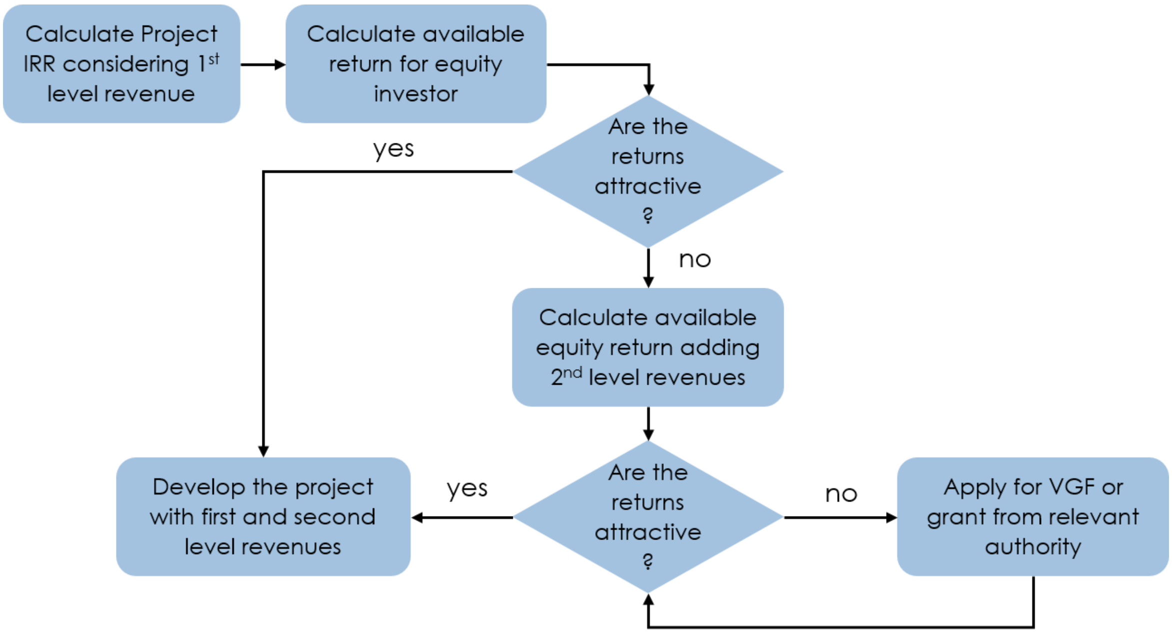


Figure 8-1 Process of Viability Gap Funding

8.3.3.3 Dedicated Urban Transport Fund at City Level

For the projects, which are not admissible under viability gap funding, the alternative sources of funding that a city could avail by setting up a dedicated urban transport fund at city level are given below:

A dedicated urban transport fund would need to be created at the city level through other sources, especially land monetization, betterment levy, land value tax, enhanced property tax or grant of development rights, advertisement, employment tax, congestion, a cess on the sales tax, parking charges reflecting a true value of the land, traffic challans etc.

The direct beneficiaries of an improved transportation infrastructure, include citizens/ passengers of a Public Transport system; vehicles using roads & flyover and businesses based on the infrastructure- i.e. advertisers on the system, vendors. The traditional revenue streams from them include fare box revenues; sale of monthly passes; advertising revenues and vendor licensing.

However, these projects have a number of indirect beneficiaries including property owners near the developed transport corridors gaining from higher potential value of property; business around the transport system- gaining from better connectivity; local Government gaining higher property taxes in the region due to escalation in property prices. These indirect beneficiaries are either usually ignored as source of value capture or it is limited.

There is a need to have a dedicated pool where all earmarked funds intended for use in development of urban transport at the city level are deposited. The rationale for having such a fund is to provide transparency for all monies allocated for purposes pertaining to urban transport. A dedicated fund, established by law, to receive revenues exclusively marked for urban transport will help ensure that these revenues are used for the intended purpose. The objectives of DUTF is to:

- Provide urban transport funding by tapping innovative sources
- Provide dedicated and sustainable funding for urban transport
- Efficient management of available funds
- Ensure transparency and accountability in fund management
- Leverage UTF revenue for raising funds from the market

Few Municipal Corporations in Maharashtra have already set up a dedicated urban transport fund through land monetization and advertisement rights. Similarly, Karnataka has set up a dedicated urban transport fund through MRTS cess on petrol and diesel sold in Bangalore, which is being used to fund the metro rail projects. The various sources of funding that can be used to set up the urban transport fund are explained in following sub sections:

Anticipated Purchase of Land

This method involves public authorities buying land before announcing that an infrastructure will be built or where the route will run. In this way, the purchase can be made at market price without the infrastructure. The strategy then consists in:

- Directly selling the land to private developers including the estimated added value in the sale price, such as was done in Aguas Claras on the periphery of Brasilia, or in Copenhagen;
- Developing the area as part of an urban renewal project and then selling it at market price, as was done in Copenhagen or in Japan, where rail companies were the first to use this method to finance their operations

A city can also levy additional stamp duty (5%) on registration of property.

Betterment Tax

A betterment tax is not the same as a property tax, because the increase in value of property is not due to the action of the owner (such as would be the case with renovations and improvements) but from a community action, thus justifying the public authorities to impose such a tax. However, it is not easy to implement, which no doubt explains why this financing mechanism is still underused.

This tax must be levied on all areas that benefit from the new transport infrastructure. The land is valued each year based on an optimal use of each site, without taking into account the existing facilities. A tax based on the value of the land is then levied in order to generate funds for the public sector. Thus, if the value of the land increases, the tax collected also increases. This means that a vacant plot of land in the city center which has been earmarked for building a residential and commercial complex will pay the same tax as an identical site which has already been developed in a similar manner. Unlike construction taxes, no tax reduction is available to landowners who leave the site empty. Likewise, taxes are not increased if the site is built upon. Landowners will therefore to seek to capitalize on the use of their land.

Land Value Tax

Once an area is well connected by Public Transport and is accessible to the commercial area and also the liveability of the area increases it is possible that the price of the land will increase. Such increase in price can be source revenue for the municipality. Similar to parking, the obtained revenue needs to be utilized for improvement of the area and other areas in the vicinity. A substantial amount of revenue could be generated through cess on turnover, particularly in cities, based on industry, trade and commerce activities. Such cess has already been levied for Bangalore MRTS project. Bangalore has also levied luxury tax and professional tax towards the metro fund.

Advertising

This is another important source of revenue for the city. When properly utilized this source can be of immense value in supporting sustainable urban transport measures in a city. The revenues from advertising in the city can be used to improve the existing transport system and/or create new schemes in sustainable transport.

Paris, France has used the advertising money in developing a public bike scheme, which is now a well renowned model. Similarly, Transport for London (TfL) has made a deal with the advertising specialist, Clear Channel, for the regular maintenance and design of the street furniture in return for the advertising space on bus shelters.

One important aspect that needs to be considered is that the advertising money needs to be utilized for improving the transport system rather than spending it on building more roads. In the similar way, the advertising should not be overdone to avoid visual pollution. Further, ideally advertising revenue should not be a reason for building of pedestrian overpasses as the _ good for the society from these overpasses is minimal.

Sources of Funds for DUTF

User charges/taxes suggested to be collected at the State shall be collected by the respective government departments and the proceeds shall be paid into the State consolidated fund and a portion shall then be transferred to UTF. Allocation of funds through the Central government schemes may directly go to UTF or be channelized through urban local bodies or the State Government. For example, under the AMRUT scheme of the GoI, funds are proposed to be allocated from the states to ULBs. Borrowings made by the SPV can directly be deposited into the UTF account. The receipts from the suggested sources of funds for UTF shall be regularly transferred to the UTF account on a monthly basis or more frequently. Figure 8-2 describes broadly the sources for UTF, segregated as Central-level, State-level, local-level and other allocations.

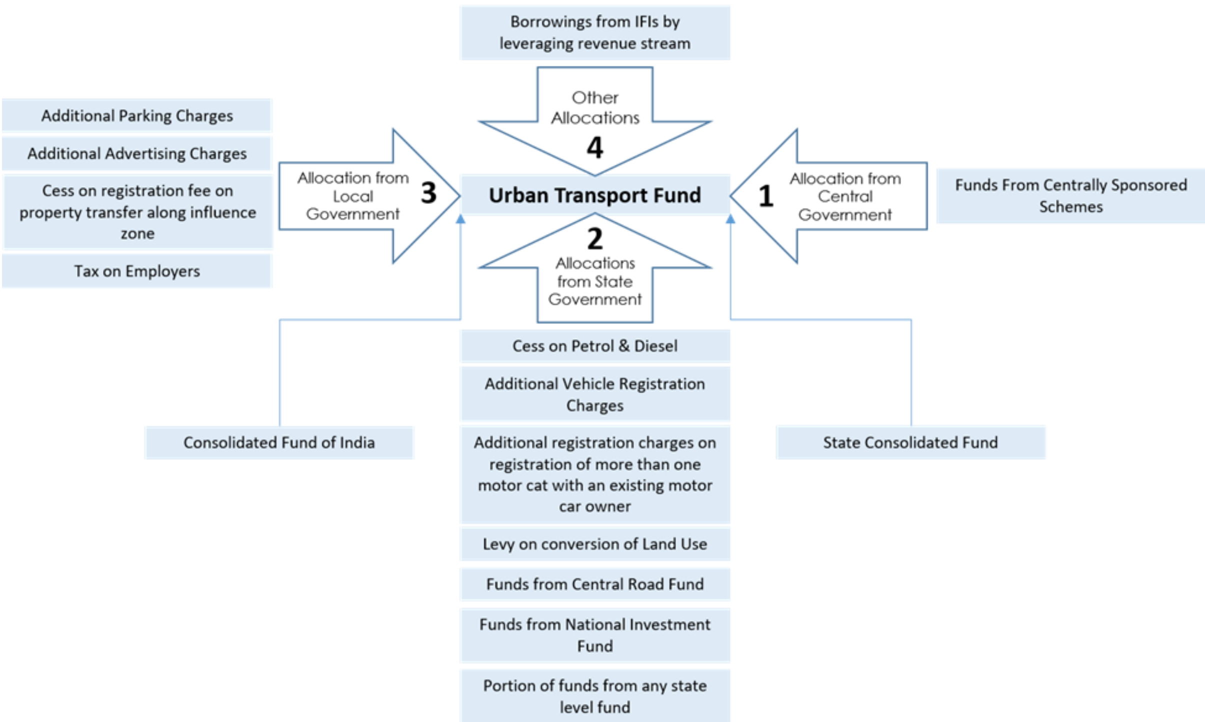


Figure 8-2: Sources of Fund for UTF

Institutional Framework

9. Institutional Framework

Transport system in a city has several stake-holding agencies that look after various aspects of the transport system and network and have overlapping functions and areas of work. These agencies are governed by various ministries and departments. Therefore, to delineate areas and to remove ambiguity of functions, an institutional framework has been proposed.

In Chennai, the UMTA is already under process of implementation and the following is summary of process of CUMTA formation with rules and amendments from time to time:

1. G.O. (Ms.) No.1, Transport (E) Department, dated 04th January 2011, a committee has been constituted under the Chairmanship of Chief Planner, Chennai Unified Metropolitan Transport Authority (CUMTA) to frame draft rules under CUMTA Act 2010.
2. The Chief Planner had sent a proposal for making rules under sub-section (1) of section 25 of the CUMTA Act 2010 (Tamil Nadu Act 44 of 2010).
3. Government has accepted the proposal from Chief Planner and accordingly CUMTA rules 2019 has been notified through G.O. (Ms.) No. 11, dated 16th January 2019.

Chennai Unified Metropolitan Transport Authority (CUMTA) would be a single body to monitor the implementation of various traffic and transportation measures, including promoting the cause of public mass passenger transport systems and regulating their operations, besides implementation of traffic and transportation infrastructure in the Chennai Metropolitan Area.

The CUMTA Act, which was aimed at framing an urban transport policy for the Chennai Metropolitan Area on the lines of the National Urban Transport Policy, received the assent of the Governor in year 2010 and was published in the Tamil Nadu Gazette Extraordinary in December, 2010. Eight years after assent, the CUMTA Act and relevant rules have been notified in January 2019 paving way for integrated functioning of Multimodal Transport System.

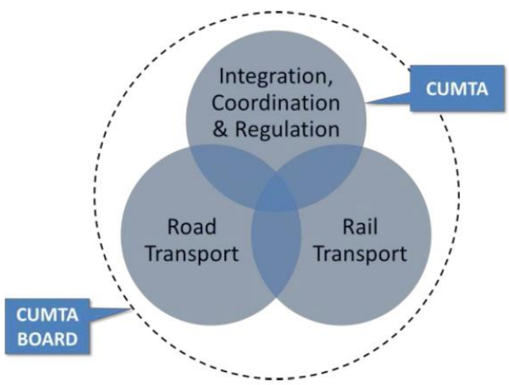


Figure 9-1 CUMTA Workshop Summary

It is recommended that CUMTA should consist following authorities:

(a) **Minister in-charge of Transport**, who shall be the Chairman, ex-officio;

(b) **Chief Secretary to the Government**, who shall be the Vice-Chairman, ex-officio;

(c) **Vice-Chairman of the Chennai Metropolitan Development Authority**, who shall be the Vice-Chairman, ex-officio;

(d) Secretary to Government, **Transport Department**, ex-officio;

(e) Secretary to Government, **Finance Department**, ex-officio;

(f) Secretary to Government, **Housing and Urban Development Department**, ex-officio;

(g) Secretary to Government, **Highways Department**, ex-officio;

(h) Secretary to Government, **Home Department**, ex-officio;

(i) Secretary to Government, **Municipal Administration and Water Supply Department**, ex-officio;

(j) **Commissioner of Police**, Greater Chennai, ex-officio;

(k) **Commissioner**, Chennai City Municipal Corporation, ex-officio;

(l) **Transport Commissioner**, ex-officio;

(m) **Member-Secretary of the Chennai Metropolitan Development Authority**, ex-officio;

(n) General Manager, **Southern Railway**, Chennai, ex-officio;

(o) **Divisional Railway Manager**, Chennai Division, Southern Railway, Chennai, ex-officio;

(p) Managing Director, **Metropolitan Transport Corporation (Chennai) Limited**, Chennai, ex-officio;

(q) Managing Director, **Chennai Metro Rail Limited**, Chennai, ex-officio;

(r) **One eminent traffic and transportation expert nominated by the Government** – the nominated member shall have special knowledge of and experience in the field of Transport Planning, Management, Operations, Engineering, Economics or such other discipline related to Urban Transport.

(s) **Three Co-opted Members** – one member each from among the Chief Executive Officers of new modes of transport, experts in the area of Urban Transportation who have special knowledge of and experience in the field of Transport Planning, Management, Operations, Engineering, Economics or such other discipline related to Urban Transport and the Executive Presidents/Secretaries of the registered associations representing public transportations, passengers, cyclists, pedestrians and similar groups. The co-opted members with have an initial period of 3 years followed by an only extension possible with another 3 year term.

9.1 FUNCTIONS AND POWERS OF AUTHORITY

The Chief Urban Planner (Transport), CMDA shall be the Member-Secretary of CUMTA and shall be the Chief Executive Officer (CEO) who will be responsible for:

- Proper administration of the affairs and events of the Authority and shall keep the Secretary to the Government, Housing and Urban Affairs apprised of action taken or proposed to be taken on important to be taken
- Prescribing the duties of all employees
- Exercising supervision and disciplinary control over the work and conduct of all employees
- Co-ordination and exercising general supervision over all the activities
- Executing all contract deeds and other instruments on behalf of Authority.

The functions of the Authority are enlisted below:

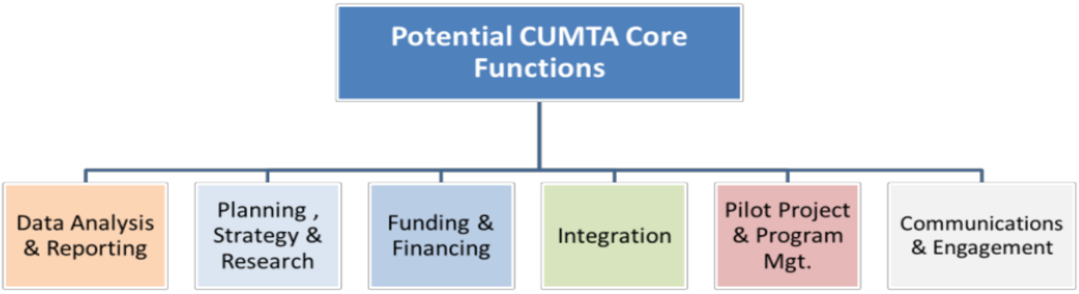
1. The Authority shall oversee, coordinate, promote and monitor the implementation of various traffic and transportation measures including promoting the cause of public mass passenger transport systems and regulating their operations, besides implementation of certain traffic and transportation infrastructure of special nature in the Chennai Metropolitan Planning Area.
2. The Authority shall act as a coordinating authority in the areas of transport.
3. The Authority shall take decisions on matters that would impinge on transport in the Chennai Metropolitan Planning Area and oversee that no steps are initiated by any agencies or local bodies that detract from the overall efficiency of the Comprehensive Transportation Plan.
4. Subject to the provisions of sub-section (1), the Authority shall—
    - Prepare a Comprehensive Transportation Plan addressing the planning and development of all the public mass passenger transport modes and related infrastructure within the Master Plan in consultation with the Chennai Metropolitan

Development Authority and recommend for implementation of the same through the respective transport agencies.

- Update the Comprehensive Transportation Plan periodically in tune with the changes in the traffic and transportation situation in the Chennai Metropolitan Planning Area;
- Monitor, co-ordinate and evaluate the implementation of the Comprehensive Transportation Plan;
- Plan and implement traffic and transportation infrastructure of special nature;
- Regulate measures for integration of all public mass passenger transport modes by means of various measures including routing and scheduling, operating feeder services and combined or common ticketing to facilitate seamless commuting options to the public;
- Regulate measures aimed at enhancing the equity and efficiency of each of the mass passenger transport modes and para-transit modes to serve the commuting needs of the Chennai Metropolitan Planning Area;
- Regulate route plan for the mass passenger transport modes and para-transit modes based on periodical review of routes;
- Determine fares for mass passenger transport modes and para-transit modes with the approval of the Government;
- Facilitate, debate and discuss on the innovative methods and practices and recommend measures for implementation of such methods and practices;
- Commission studies and research needed to improve the performance or efficiency of the mass passenger transport modes and para-transit modes and maintain a data base;
- Make recommendations to the Central Government in regard to the Railways and National Highways, wherever necessary, for improving transport system;
- Regulate the measures that would help to reduce the incidence of accidents and other matters relating to safety, including the standards for construction, maintenance and subsequent road safety audit by various civic agencies;
- Manage a road safety cell;
- Secure compliance of inter-agency requests and resolve differences that come up between such agencies;

- Regulate measures to integrate and consolidate any other action plan of the line agencies which fall outside the Comprehensive Transportation Plan but relating to mass passenger transport modes and related infrastructure in the Chennai Metropolitan Planning Area and facilitate implementation of the same

However, the various authorities under UMTA should perform their individual function under the purview of UMTA.



Source: CUMTA Workshop Summary

9.2 IMPLEMENTING AGENCIES

Based on roles and responsibilities of various institutions, the agencies responsible for implementing the proposed projects are presented in Table 9-1.

Table 9-1: Details of Implementing Agencies

Proposals	Proposed Schemes	Probable Funding Sources
SPV – Metro Rail/ Indian Railways/ Transport Department		
Public Transport system	Rail based Transit System	Central/ State Govt. funds/ AMRUT/ Soft Loans through SPV
SPV –MTC, State Transport Department		
Public Transport system	High Capacity Improved Bus System with Priority Lanes	State Govt. funds/ AMRUT/ Soft Loans
	Articulated Bus/ CNG Bus / Hybrid Buses	State Govt. funds, AMRUT
Municipal Corporation, PWD, PWD-NH		
Pedestrian Facility Improvement	Footpath	Municipal funds, AMRUT, DUTF
	Pelican Signals	Municipal funds, AMRUT, DUTF
	FOB	Municipal funds, AMRUT, DUTF
	Skywalks	Municipal funds, AMRUT, DUTF
NMT Facility Improvement	Semi Segregated Cycle Track	Municipal funds, AMRUT, DUTF
	Segregated Cycle Track	Municipal funds, AMRUT, DUTF

Proposals	Proposed Schemes	Probable Funding Sources
	Cycle Parking Stands	Municipal funds, AMRUT, DUTF
Municipal Corporation, PPP		
Parking Management Plan	On Street Parking	Municipal funds, PPP, AMRUT
	Off Street Parking	Municipal funds, PPP, AMRUT
	MLCP	Municipal funds, PPP, AMRUT
Smart City, Transport Department, MTC, Traffic Police		
Intelligent Transport systems	Semi Actuated Signals	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Pelican Signals	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Automated Vehicle Location System	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Variable Message Signs	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	ITS Control Centre	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Public Information System	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Common Mobility Card	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Mobile Phone Application	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	Surveillance Cameras	Municipal funds, DUTF, AMRUT, Smart City (SPV)
	GPS	Municipal funds, DUTF, AMRUT, Smart City (SPV)
SPV – MTC, Transport Department		
Bus Transport	Inter-Modal facilities	PPP, Central/ State Govt. funds, AMRUT
	Bus Stops	PPP, Central/ State Govt. funds, AMRUT
Terminals	Proposed New Bus stand	PPP, Central/ State Govt. funds, AMRUT
NHAI, PWD-NH		
Road Network Improvement	Flyovers	Soft Loans, Central/State Govt. funds
	ROBs	Soft Loans, Central/State Govt. funds
PWD-NH		
Road Network Improvement	New Links	Soft Loans, Central/State Govt. funds
NHAI, PWD-NH		
Road Network Improvement	Road Widening	Soft Loans, Central/State Govt. funds
Transport Department, Traffic police, PWD/PWD-NH, LAD, Department of Health		

Proposals	Proposed Schemes	Probable Funding Sources
Road Safety policy and action plan	Accident recording, Black Spot identification	Road Safety Fund, Soft Loans
	Roads according to road safety standards and safety features on roads	Road Safety Fund, Soft Loans
	Upgradation of emergency care system	Road Safety Fund, Soft Loans
	Safer vehicles and strict enforcement of road safety rules	Road Safety Fund, Soft Loans
	Implementation of ITS and monitoring systems	Road Safety Fund, Soft Loans