COMPREHENSIVE MOBILITY PLAN FOR THIRUVANANTHAPURAM

FINAL REPORT - 2023

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

AUGUST 2023

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Location : Karamana - Kaliyikkavila Road

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ABBREVIATIONS

ATL	Average Trip Length
CMP	Comprehensive Mobility Plan
DPR	Detailed Project Report
ECS	Equivalent Car Space
GIS	Geographical Information System
GoI	Government of India
GoK	Government of Kerala
GHG	Green House Gases
IPT	Integrated Public Transport
IT/ITES	Information Technology and Information Technology Enabled Services
ITS	Intelligent Transport System
JnNURM	Jawaharlal Nehru Urban Renewal Mission
kmph	Kilometres per hour
TMC	Thiruvananthapuram Municipal Corporation
MoHUA	Ministry of Housing and Urban Affairs
MoRTH	Ministry of Road Transport and Highways of India
MRTS	Mass Rapid Transit System
KMRL	Kochi Metro Rail Corporation
KSRTC	Kerala State Road Transport Corporation
KURTC	Kerala Urban Road Transport Corporation
NATPAC	National Transport Planning and Research Center
NH	National Highway
NMT	Non-Motorized Transport
PCTR	Per Capita Trip Rate
PCU	Passenger Car Unit
PT	Public Transport
PHPDT	Peak Hour Peak Direction Traffic
RNI	Road Network Inventory
SH	State Highway
UMTC	Urban Mass Transit Company

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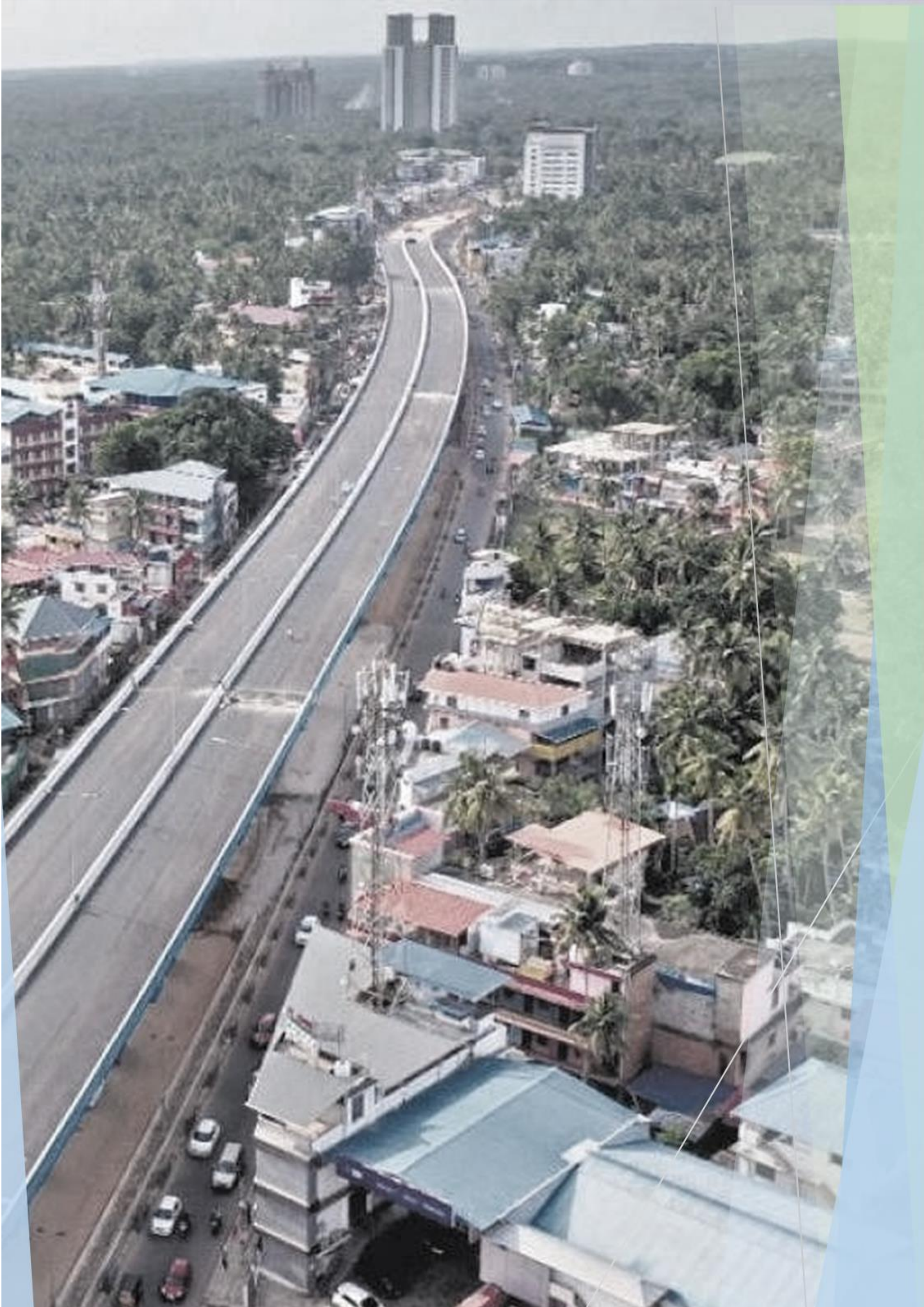
EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

The growth of Thiruvananthapuram city being strongly fostered by tourism, education, and trade and commerce thus, reducing the impact of urban development especially the transportation sector on environment is a conscious component of the city's urban planning. Sustainable Urban Transportation should be the core module of Thiruvananthapuram City as, a highly efficient transport system would ensure mobility for all through easy access to employment, education and other needs thereby supporting the envisaged economic growth activities in this capital city.

In this regard, Kochi Metro Rail Corporation Limited (KMRL) has appointed Urban Mass Transit Company (UMTC) to prepare a Comprehensive Mobility Plan (CMP) to provide comprehensive transportation strategies and policy measures for Thiruvananthapuram.

The Comprehensive Mobility Plan (CMP) recommended by Ministry of Housing and Urban Affairs (MoHUA) is a long-term vision for desirable mobility patterns in the city and provides comprehensive and integrated transportation strategies and policy measures. CMP document is a roadmap for the transport infrastructure development and its investments in line with the Sustainable Urban Transportation principles. Various previous studies emphasis predominantly on the following principles:

1. Integrating Urban growth with Transport Planning.
2. Connectivity to surrounding urban centres.
3. Improving and promotion of Public Transport, NMVs and pedestrians.
4. Developing efficient MRTS to cater to the future needs.

Thus, considering the overall traffic and transportation perspectives, both regional and national level guidelines and approaches promote sustainable urban transport framework for 20 to 30-year horizon period. Thus, CMP Thiruvananthapuram is a necessary strategic vision document highlighting the national and regional framework for Urban Transportation

STUDY AIM & OBJECTIVES

With a vision to strengthen transportation system of this capital city in a sustainable manner while catering to the horizon year mobility needs, the study aims to provide the users in Thiruvananthapuram an efficient, smart, convenient and inclusive sustainable travel mode choices while fostering as safe, comfortable and seamless travel experience in the study area. The proposed objectives for the project are as follows,

To provide a sustainable transportation system which is accessible within 500m from the activity generating areas like workplaces, educational institutes etc.

To ensure significant increase in public transportation share while supplying highly reliable and sophisticated PT system

To improve safety on roads for Non-Motorised Transport users by providing appropriate infrastructure for cyclists and pedestrians which ultimately help boost the public transport.

To reduce vehicular emissions by usage of alternative fuel options like E-Vehicles and streamlining their usage into the city's public transport as well as intermediate public transport system.

Thiruvananthapuram CMP Study Objectives

STUDY AREA PROFILE

The study area comprises of Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and eight adjoining panchayats spread over an area of 371.94 sqkm (91908 Acre).

Thiruvananthapuram Planning Area Details (Source: LSGD Secondary Data, Census-2011)

SN	ADMINISTRATION	AREA (SQ KM)
1	Thiruvananthapuram Municipal Corporation	212.84
2. Panchayats		
2a	Mangalapuram	21.66
2b	Andoorkonam	13.96
2c	Vilavoorkal	12.02
2d	Vilappil	19.42
2e	Balaramapuram	10.53
2f	Kalliyoor	17.23
2g	Pallichal	21.7
2h	Venganoor	13.8
3. Municipality		
3a	Neyyattinkara	28.78
TOTAL		**371.94**

- The urban sprawl in Thiruvananthapuram has taken place predominantly in east and south directions. Settlements have primarily emerged along the major transport corridors. Rapid urbanization can be observed that along the major mobility corridors such as NH-66, NH Bypass, MC Road, Perookooda road, etc. The current growth pattern is somewhat semi-radial with Techno-Park being the major growth magnet on north, Vizhinjam International seaport and Neyyyattinkara in the south, Mannanthala, Peroorkada, Nedumangad, Peyad in the east.

  The base 2023 population of the study area is considered as 13.56 lakhs in line with the Draft Master Plan Report for 2040 which has presumed that 1.45% growth rate would be sustained in the coming years and a constant growth was used to predict the future population, as it is expected that more people would be attracted to the city by the implementation of large projects such as Vizhinjam sea port, Techno Park expansion etc, which is anticipated to balance the declining growth rate. Thiruvananthapuram, being a prominent tourism and institutional centre, the study area experiences floating population of students, visitors, employees and migrant workers. Thus, a floating population of 2.71 lakhs for the base year 2023 has been considered. The population density of the study area is observed to be 3645 ppsqkm, accounting to be third dense urban area in the state followed by Kochi and Kozhikode.
- The share of transportation accounts to about 7% in the total area and about 10% of the total developed area within the corporation limits indicating decent share of transportation in land use mix.
- Work Participation Ratio (WPR) for Thiruvananthapuram Corporation is 36% percent as per census 2011, which increased from 29.7 percent as per 2001 census. Some salient features of key economic generators in the study area are as follows-
  - The government sector employees a significant share of the population in Thiruvananthapuram, accounting to over 20%[1] of the total working population.
  - Techno-Park area houses about 470 companies in the Techno-Park area employing nearly 70,000[2] people.
  - As per the records of Directorate of Industries and Commerce (DIC), Government of Kerala there are about 25 thousand industrial units in Thiruvananthapuram. Large and medium industries employ around 40,000 people[3].

[1] Draft Master Plan -2040, 2022

[2] Techno-park Data, Ref: ETPK/CR/KMRL/2023/126, 2023

[3] Industrial Profile of Thiruvananthapuram-MSME, Annual Survey of Industries 2018-19(Volume I)-2022

  - As per the Department of tourism records, nearly 30 lakh tourists visited Thiruvananthapuram annually before COVID and about 12 lakh tourist post-COVID, as son 2021[4].
  - Nearly 30% of the foreign tourist avail medical tourism.
  - Vizhinjam International Transhipment Deepwater Multipurpose Seaport towards the south of the study area envisions to provide about 1 lakh indirect employment in the region.
  - Trade is largely concentrated in the core city along Chalai and Palayam areas. Chalai bazar the central point for the supply of commodities in the region. The M.G. Road is the recent and the main thoroughfare in the town, along which various shops and shopping centres are positioned.
  - In addition, World Vegetable Market in Kochuveli is a prominent trading location in the study area. With a vast range of fresh produce, fruits, and organic vegetables, this market complex caters to the vegetable needs of the region.

SOCIO-ECONOMIC CHARACTERISTICS

- The average household size is observed to be 3.45 with average number of 1.4 earning members per household.
- The average number of students per household is about 1.3 with an average of 1.9 members making trips on regular basis.
- The average monthly income as per the Household survey is about INR 30,498.
- The classification based on the category of vehicles owned indicates that 24% of the households own no vehicle while, 32% of the households own on two-wheelers.

EXISTING TRAVEL CHARACTERTICES

Secondary and Primary Survey data analysis has been carried out understand the existing travel conditions in the city. An extensive on ground surveys were carried out, between the month of December, 2022 and February, 2023 excluding the public holidays. The surveys were initiated on 13th December, 2022 and were completed by 27th February, 2023. The key observations form the same are as follows-

- The vehicles registered in the study area as on 2022 is over 10lakhs. The Cumulative Annual Growth Rate of registered vehicles is observed to be around 6.4%. The growth rate of vehicles (CAGR) has reduced from 10.5%in 2018 to 6.4% in 2022 due to COVID-19

[4] Kerala Tourism Statistics-2019, 2021- Department of Tourism, GoK

impact. And the majority of about 60% vehicles registered are two-wheelers indicating the growing dependence on private modes.

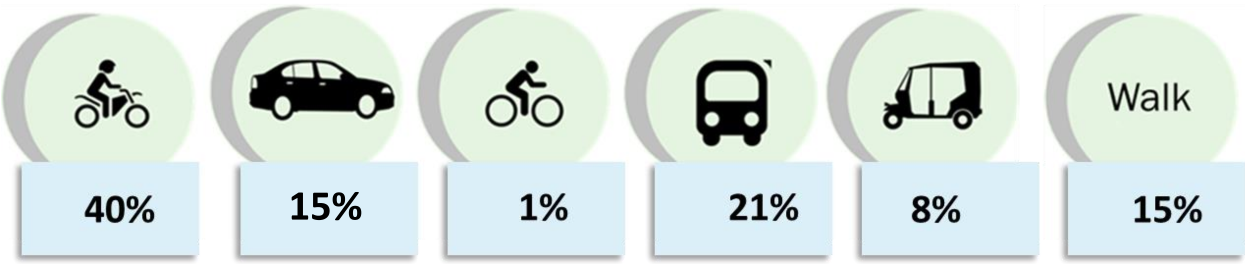
- The surveyed network indicates that on 28% of the corridors have Right of Way (ROW) availability over 18m. 58% of the surveyed network has 2-lane and above configuration. 4lanes constitute about 16% of the total network, which are largely along the NH-66, NH-Bypass, MC road, MG Road, etc.
- Owing to the high pedestrian movement is the core or city centre due to various activity nodes such as religious places, transit hubs, government institutions, commercial markets, etc. the city has taken up improvement measures in major areas such East Fort, MG Road, etc. The improvements include even development of plaza near the Padmanabha Swami Temple, Sky walk near East Fort, foot over bridge at Pattom, development of pedestrian sidewalks, Pedestrian Safety Enhancement Controller (PeSCo) near Cotton Hill School and etc, to ensure the safety of the pedestrians.
- However, 14.2% of the major network has footpath availability in the study area. And only 5% of the network has footpaths over 2m widths indicating the need to improve pedestrian infrastructure in the study area. Cycle corridors are not available in any of the major corridors in the city, except for 6km bicycle lane demarcation.
- Despite of various improvement and efforts made by the Municipal Corporation and Smart City Corporation, encroachments and haphazard parking is significantly observed in areas such Fort, Chalai, Kazhakoottam, Peroorkada, Attukal and Manacaud.
- These encroachments coupled with inaccessible footpaths, lack of safety and sufficient mid-block crossings often push the pedestrian movements towards the fast vehicle lanes raising safety concerns.
- The average running speed in the study area is 21.3kmph, while the journey speed during the peak hours is about 19.5kmph.
- The highest pedestrian footfall at Medical College followed by Thampanoor due the adjoining activity nodes such as colleges, transportation terminals, commercial areas, etc. The degree of conflict between the vehicles and pedestrian resulted that Palayam, Thampanoor and Medical College have highest degree of conflicts and which require immediate measures to ensure pedestrian safety.
- As per the 2022 AAI Thiruvananthapuram records, 80 daily domestic and international flights which has increased to 582 weekly operations in March, 2023 with a growth rate of 31.5%. The daily passenger flow is observed to about 11 thousand, with international passenger owing to nearly 42% of the total passengers.
- Thiruvananthapuram, Pettah, Kochuveli, Kazhakoottam and Veli Railway Stations are located towards the north and Nemom railway station to the south within the corporation limits are the prominent six stations. While Kaniyapuram, Murukkumpuzha, serve the

northern area and Balaramapuram and Neyyattinkara railway stations serve southern part of the study area.

- The railway system of Thiruvananthapuram provided services to 41 thousand passengers daily as per the data as received from Southern Railway-2022, indicating a strong intercity interaction of Thiruvananthapuram with its surrounding areas.
- The public transport network formed together by the Kerala State Road Transport Corporation (KSRTC) and the private buses, covers 80 percent of the major roads indicating a strong presence of public transport services. The presence of organized public transport system is easily seen, in the form of a huge fleet size of 90 city circular services and 361 sub-urban services plying in the study area. About 25 thousand passengers commute daily using city circular services as per 2022 data.
- Along with KRSTC the city bus services are provided by private operators. The city currently has 108 private city bus permits. The major transportation corridors are the National Highway 66, Medical College Road, and Shencottah Road.
- Auto-rickshaws and Taxi are the inter-mediated public transport modes in Thiruvananthapuram that provide door to door connectivity. These modes are largely used by the floating population for work and other purposes. However, the taxis are predominantly used for tourism purposes. Electric auto rickshaws have been rolled out in the city in the recent years, as a part of Smart City Projects. The base fare for private auto-rickshaw services is about INR 30.
- Kerala State Electricity Board (KSEB) has is setting up Electric Vehicle (EV) Charging Points on electric poles and auto-rickshaw stands across various locations in the study area to promote the usage of EVs. Over 45 charging points and stations have already been setup in the study area. The charging points area integrated with mobile applications (ElectreeFi) and drivers can make payment through these applications. KSEB changers INR 13 (excluding GST) for fast charging and INR 9 (excluding GST) for pole mounted charging.
- Currently, there are no restrictions levied at present, on the entry-exit of trucks in the city. The areas like Chalai and Palayam have limited right of way availability and with the movement and parking of trucks on–street in an unorganized manner creates chaos and disrupts the traffic movement.
- Vizhinjam is an important port and a fishing harbour in the study area and is currently being developed as an international Transhipment and Deep-Water Multipurpose Seaport. This internal seaport is expected to generate over 1 lakh indirect employment.
- Road safety is a crucial factor considering the increasing number of vehicles on Thiruvananthapuram roads. The fatality shares of accidents in 2012 was around 8.6% which increased to 9.6% in 2022 as per traffic police records. The number of fatalities per

lakh population is 12.48 in the study area indicating an alarming value and the need to improve the road safety in the study area

- The parking assessment was carried out at major locations in the study area, it indicated that highest on-street parking accumulation in Attakulangara, Sasthamangalam, Vanross Junction and East Fort areas while the highest off-street parking accumulation was observed near Gandhi Park. The average parking density at major location in the study area is about 180 with an average parking duration of 40mins. Further, it is observed that highest composition of vehicles parked are two-wheeler with a share over 65%. And it also observed that 53% of the vehicle parked more that 30mins are two-wheelers.
- The Per Capita Trip Rate (PCTR) was observed to be 1.24 including the walk trips and the PCTR for motorized trips is about 0.94.
- The major modes of travel are observed to be two wheelers and car with a total modal share of 55% while the share of bus based public transport accounts to only 21%, clearly indicating that private mode dominance mode over public buses. The mode share of the passenger trips is as presented in the figure below.



Mode Share (Primary Surveys-2022-23)

Note: The increase in the usage of private modes can also be observed as a post covid scenario. Thus, the travel characteristics shall be viewed in two ways, current travel pattern & optimistic travel pattern. Since the inclination towards public transport is slowing improving due to better facilities and comfort of travel, pre covid scenario also becomes a part of this comparison. The same shall be considered while assessing the alternative scenarios.

- The observed average trip length in is observed to be 7.8Km including the walk trips and 9.0 km for motorised.
- The major mode of access and dispersal modes is walk with a share of 85.4% of the total access and dispersal modes.
- Nearly 55% of the trips made are work-based trips and about 34% of the trips are made for educational purposes. This indicates that nearly 80% of the trips being made are regular and daily trips in the study area.

SERVICE LEVEL BENCHMARKING

The service level benchmarks (SLB)[5] issued by MoHUA specify parameters to measure the effectiveness of existing land use-transport planning in the study area and set benchmarks for achieving the same. In Service Level Benchmark, four levels of Service (LoS) have typically been specified. They are LOS1, LOS2, LOS3 and LOS4. The LOS1 represents the highest performance level whereas LOS4 represents the Lowest. The summary of the indices is as presented below:

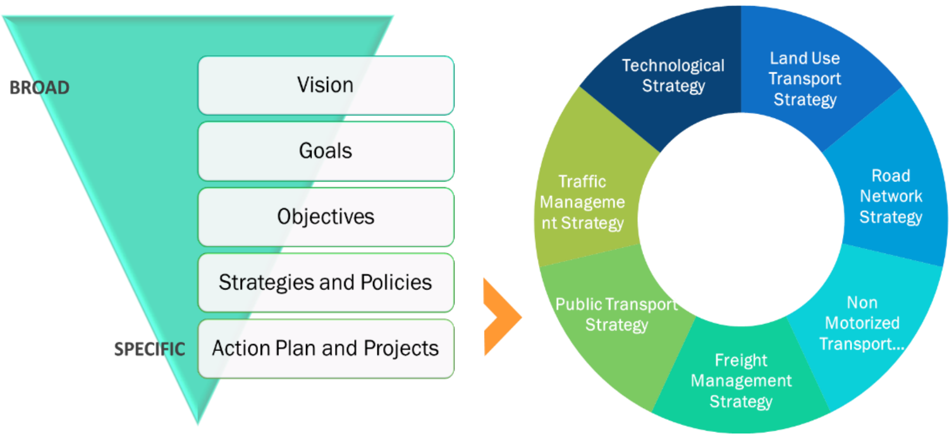
SN	BENCH MARK	OVERALL LOS	INFERENCE AS PER MOUD GUIDELINES
1	Public Transport Facilities	2	The study area indicates the availability of good public transportation services. However, integration of the services and developing a high-capacity PT system would further enhance and cater to the growing travel demand in the state capital city
2	Pedestrian infrastructure facilities	3	The city has minimal pedestrian facilities which need immediate improvements especially at intersections and unobstructed footpaths it.
3	Non-Motorized Transport Facilities	3	The city has minimal NMT facilities which needs considerable improvements as many parts of the study area are not served by it.
4	Level of usage of Intelligent Transport System (ITS) Facilities	3	The study area lacks adequate ITS facilities.
5	Travel speed (Motorized and Mass transit)	3	The study area has considerable travel speeds for the existing but with small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed in the horizon years.
6	Availability of Parking places	4	The authorities need to initiate immediate actions with respect of providing paid parking spaces and demand management for parking.
7	Road safety	4	Need considerable improvements in road design and available road infrastructure, traffic management and other such reasons which contribute significantly to road safety.
8	Pollution levels	2	Level of pollution in a study area is not alarming, however the quality can be improved by encouraging and introduction the usage of public modes rather than the private modes.
9	Integrated land use Transport system	4	Need to improve the coherence between study area structure and public transport system.

[5] SLBs for Urban Transport- MoUD, Government of India -2013 – The Socaring and raking is as per the benchmarks given by MoUD

SUSTAINABLE URBAN MOBILITY MEASURES

The vision of the study area is to foster - "People Centric Sustainable, Efficient and World Class Urban Transport System that provides the residents of Thiruvananthapuram, safe, comfortable reliable and convenient mobility options while catering to their affordability, and providing them with seamless integration"

In line with these principles, the mobility goals for Thiruvananthapuram 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 the study area.



Thiruvananthapuram CMP Urban Transport Strategies

LAND USE AND TRANSPORT PLAN

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.

MULTI NODALURBAN FORM DEVELOPMENT CONCEPT

The structure of the study area resembles a compact node in the core Palayam area with growth centres emerging around it such as Kazhakoottam, Nemom, Neyyattinkara, Mannanthala, Nedumangad, Attingal, Vizhinjam, Balaramapuram, Peyad, etc. Thus, a multi-nodal development concept is recommended for Thiruvananthapuram in in semi-ring radial structure. Multi-Nodal development structure recommended Thiruvananthapuram would decongest the core area and for efficient and equitable distribution of transport demand throughout the city, it is imperative to develop sub-city centre in different places of the city. These growth centres or sub-centres shall be connected through efficient city public transportation systems strengthen by high density growth corridors on either side.

Multiple sub-centres are recommended based on the proximity to the main city centre, i.e., within immediate, medium proximity and Low proximity for development as shown in the table below.

Proximity of Core and Sub-Centres

CENTRE AND SUB- CENTRES	AREA NAMES	DESCRIPTION
CORE AREA	Palayam, Thampanoor, Chalai, Killipalam, Thycaud, Vanchiyoor, East Fort, Vazhuthacaud	Constitute the core areas of the study area and major activity attraction nodes housing commercial, government offices, heritage zones, transit stations, etc. These areas constitute to high travel demand are required to be connected by high quality of public transport and NMT infrastructure, Parking and Traffic management strategies. The same has been proposed in the following sections.
IMMEDIATE PROXIMITY SUB-CENTERS	Pattom, Peroorkada, Poojapura, Pappanamcode, Nemom, Muttathara, Aakulam, Kochuveli	These are major development node within the study area with considerable travel demand owing to the educational and governmental institutional, Commercial centres, Transit stations, etc. These areas have the maximum potential for immediate development owing to the proximity. These areas require high quality of public transport and NMT infrastructure, Traffic management strategies for the ease of vehicles and passengers. The same has been proposed in the following sections.
MEDIUM PROXIMITY SUB-CENTERS	Kazhakkoottam, Mannanthala, Peyad, Balarampuram, Kovallam, Vizhinjam, Mangalapuram	These are the newly developing growth centre with potential economic activity to act as strong growth anchoring nodes in the study area. These areas house, IT Parks, Seaport, Tourism centres, industries and commercial zones. These high employment generations nodes require strong and seamless connectivity to the city centre, thus, provision of high-quality public transportation system and improved road connectivity for passenger vehicles and goods are considered.
LOW PROXIMITY SUB-CENTERS	Nedumangad, Neyyattinkara, Attingal	These are the important satellite towns of the city. However, owing the growth pattern towards the south, Neyyattinkara has significant trip interaction with the city centre. The linear growth between these towns and core area requires improved connectivity, thus, provision of high-quality public transportation system and improved road connectivity are considered.

It is vital to develop and strengthen these areas with activity generators such as colleges, industries, employments hubs and so on as part of the land use strategies in Master Plan.

GROWTH CORRIDORS AND TRANSIT ORIENTED DEVELOPMENT CONCEPT

To maximize the passenger throughput, these corridors should be developed on the concepts of high density, mixed land use must the developed along the major mobility corridors in the city. Under the Land Use Transport Plan, 2 TOD corridors with an influence area of 120.5sqkm along the 65km of identified corridors and 4 Growth corridors influence area of 7.5 sqkm along the 25km of identified corridors are recommended. The recommend corridors are as follows,

Recommended TOD and Growth Corridors

SN	NAME OF THE CORRIDOR	LENGTH (KM)	TYPOLOGY
1	NH-66 (Mangalapuram to Neyyattinkara)	38.1	TOD Corridor
2	NH-Bypass (Kazhakkoottam to Vizhinjam)	27.0	TOD Corridor
3	MC Road	4.2	Growth Corridor
4	Peroorkada Road	6.4	Growth Corridor
5	Peyad Road	7.4	Growth Corridor
6	Pothencode Road	7.3	Growth Corridor

The salient features of the proposed corridors are as follows,

- The TOD Corridors with 1km and Growth Corridors with 500m influence area are proposed and of mixed-use development band. The plots along these corridors will be encouraged with higher floor space index.
- These are recommended for higher densification with used and activity generators using Floor Space Index as a vital tool. FSI value of 3 to 4 is recommended for the residential area in the study area.
    - A FSI up to 3-4 for TOD corridors and Growth corridors with mixed residential and commercial zone is recommended.
- These zones are recommended to provide high quality highway access suitable for industry, logistic infrastructure, educational and skill development institutions, business facilities, residential and other support social infrastructure.

Recommended TOD and Growth Corridors with Growth Centers

ROAD NETWORK STRATEGY

The road network generally forms the most basic level of transport infrastructure with urban areas. It is the backbone of any form of mobility. In order to provide mobility solutions for the Study Area. it is vital that there is effective integration between land use and transport in the entire region.

NETWORK STRUCTURE

The road network spatially displays topologic and geometric variations in their structure. This strategy aims at defining a clear network pattern and hierarchy of roads. Considering the proposed land use, semi-ring and radial network structure has been proposed. Semi-Ring and Radial Roads area recommended for developing a clear network pattern in the study area is as follows,

Recommended Semi-Radial Network

SN	NAME OF THE CORRIDOR	LENGTH (KM)	ROW (M)	TYPOLOGY
1	Vizhinjam to Mangalapuram (Southern Ring)	34	60	Outer Ring Road
2	Mangalapuram to Navaikulam (Northen Ring)	30	60	Outer Ring Road
3	Vettu Road to Thiruvallam via Peroorkada	42.0	30	Inner Ring Road
4	Eanchakkal Junction to Kuzhivila via Kesavadasapuram	20.0	30	Inner Ring Road
5	NH-66	38.1	24	Major Radial
6	NH-Bypass	27.0	24	Major Radial
7	MC Road	4.2	24	Major Radial
8	Peroorkada Road	6.4	24	Major Radial
9	Peyad Road	7.4	21	Major Radial
10	Pothencode Road	7.3	21	Major Radial
11	Nettayam Road	5.2	21	Major Radial

About 221.6 km of the network is recommended for developing a clear network pattern in the study area. Since these corridors include all the major spines within the study area, thus should be designed based on the standards.

UPGRADATION OF EXISTING ROAD NETWORK CAPACITIES

The study recommends 170.6 km of network widening after considering the functional hierarchy and development need. The widening of roads is proposed for upgradation of existing lane capacities, provision or improvement of NMT facilities. The proposal is phased out into two considering the importance of the road and its connectivity. In Phase I, which is the priority one, a total of 93.4 km of road widening. Whereas in Phase II a total of 77.2 km road will be widened. The corridors suitable for upgradation of lane capacities or widening based on the horizon year demand in the study area are as follows,

Recommended Roads for capacity upgradation

S. N.	Name of the Corridor	Length (Km)	Proposed Widening of Existing Road (M)	Typology
PHASE - I				
1	NH-66	10.0	27	Arterial
2	Medical College - Kumarapuram	2.5	21	Arterial
3	Vizhinjam - Pallichal	7.5	21	Arterial
4	Vazhuthacaud	2.6	21	Arterial
5	Amman Kovil (Thycaud) - Thycaud Jn	2.5	21	Arterial
6	Kaimanam- Thiruvallam	5.4	21	Arterial
7	Paruthiapara - Ambalamukku	2.4	21	Arterial
8	Mannarakonam - Kundamanbhagam	3.2	14	Sub-Arterial
9	Thycaud - Mettukada	1.0	14	Sub-Arterial
10	Pappanamcode - Pamamcode Bridge	2.5	14	Sub-Arterial
11	Coastal Road	6.0	14	Sub-Arterial
12	Balaramapuram - Ooruttambalam	18.8	30	Arterial
13	Vellapally - Mukkampalamoodu	2.8	18	Sub-Arterial
14	Trivandrum – Nagarcoil Highway	20.8	45	Arterial
15	Poovar - Neyyattinkara	5.4	30	Arterial
PHASE - II				
16	Mannanthala - Vazhayila	6.4	21	Arterial
17	Peroorkada - Mukkolakkal	10.8	21	Arterial
18	Peroorkada - Sasthamangalam	4.2	21	Arterial
19	Peyad Road	7.4	30	Arterial
20	Nettayam Road	5.2	21	Arterial
21	Peroorkada - Nettayam	3.2	14	Sub-Arterial
22	Mannanthala - Karyavattom	10.1	14	Sub-Arterial
23	Peyad - Vilappilsala	4.9	24	Arterial
24	Thachottukavu – Anthiyoorkkonam	5.2	30	Arterial
25	Pallichal - Ooruttambalam	5.3	24	Arterial
26	Nemom - Punnamoodu	6.8	18	Sub-Arterial

S. N.	Name of the Corridor	Length (Km)	Proposed Widening of Existing Road (M)	Typology
PHASE - I				
27	Neyyattinkara - Kattakkada	7.7	18	Sub-Arterial

DEVELOPMENT OF MISSING LINKS/NEW LINKS

In order to decongest the existing roads and to foster the ease of commuting new roads or missing links have been identified and recommended in the study area. The details of the same are as presented below,

Recommended New Links

SN	Name of the Corridor	Proposed Road Widths (M)	Phase
1	Manchadi Jn - Poonthi Road	19	Phase II
2	Manchadi Jn - Pulayanarkotta via Kunnam Sivan Kovil	10	Phase II
3	Port Road	45	Phase II
4	Kottiyodu Road - Medical College	14	Phase II
5	Edavacode - Keraladithyapuram road	10	Phase III
6	Kalady south Jn - Kaimanam Thiruvallam Road	10	Phase III

DEVELOPMENT OF GRADE SEPARATORS

As the study area is physically segregated by the Railway track and canals, road bridges are proposed to enable smooth flow across the study area. The study recommends 21 crossing which includes 12 flyovers, 4 railway crossings and 5 canal crossings. The locations are presented below.

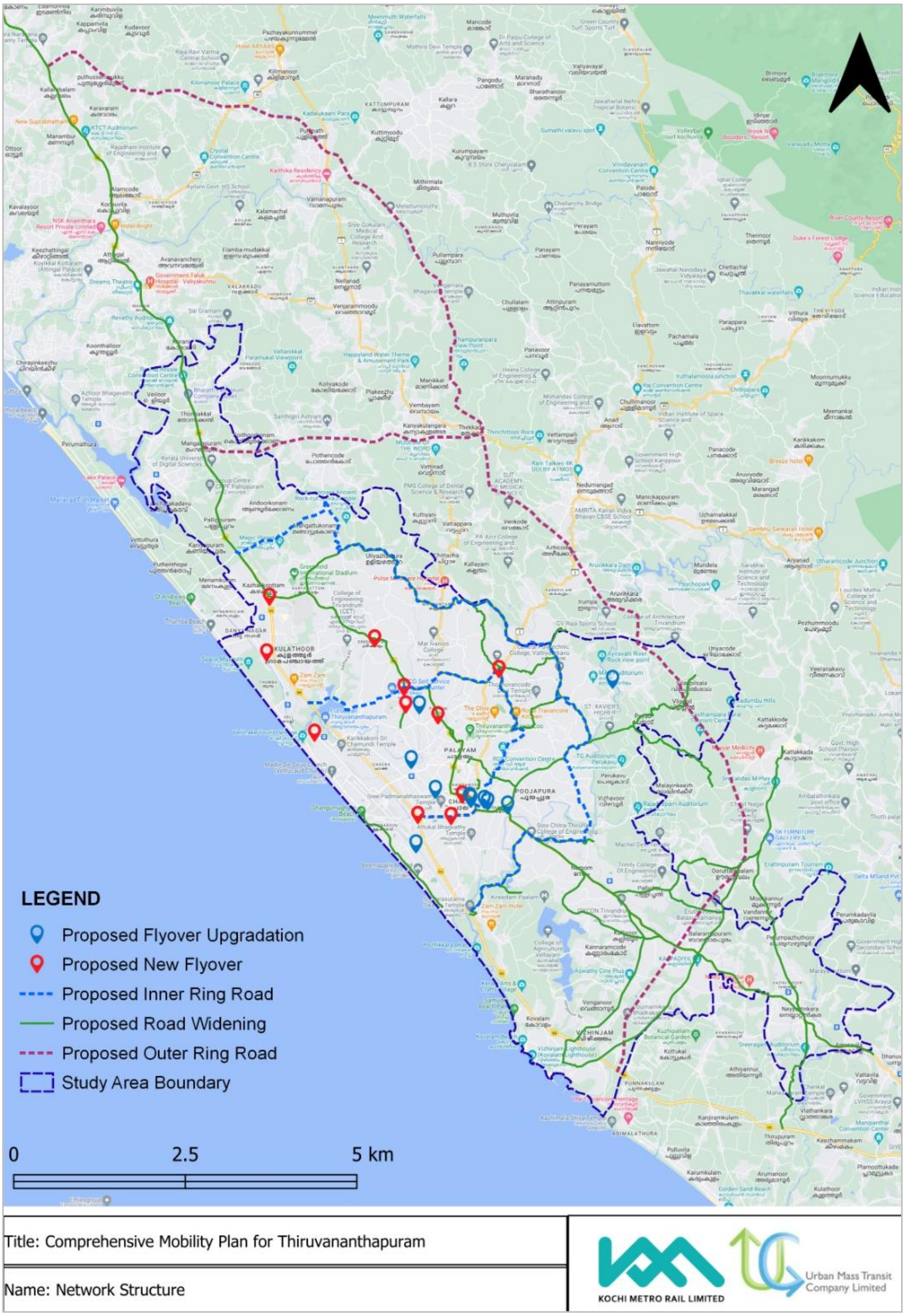
Recommended Upgradation of Grade Separators

S. No.	Name of the Corridor	Typology	Phase
1	Thampanoor Flyover	Flyover	Phase I
2	Thampanoor	ROB	Phase I
3	Uppidamoodu Bridge	ROB	Phase II
4	Kannammoola Bridge	ROB	Phase II
5	Valiyashala Bridge	ROB	Phase II
6	Chalakuzhy Bridge	River Crossing	Phase II
7	Valiyashala Bridge	River Crossing	Phase II
8	Kunjalummoodu Bridge	River Crossing	Phase II
9	Ponnara Bridge	River Crossing	Phase II
10	Vellaikadavu Bridge	River Crossing	Phase II

Recommended New Grade Separators

S. No.	Name of the Corridor	Typology	Phase
1	Medical College	Grade Separator	Phase II
2	Thampanoor	Grade Separator	Phase II
3	Pattom	Grade Separator	Phase II
4	Ulloor	Grade Separator	Phase II
5	Station Kadavu	Grade Separator	Phase II
6	Eanchakkal	Grade Separator	Phase II

S. No.	Name of the Corridor	Typology	Phase
7	Sreekaryam	Grade Separator	Phase II
8	Peroorkada	Grade Separator	Phase II
9	Kochuveli	Grade Separator	Phase II
10	Attakulangara	Grade Separator	Phase II



Proposed Road Network Transitions

PUBLIC TRANSPORT STRATEGY

Public transport is one of the most environmentally sustainable forms of transport. The public transport improvement strategy includes service improvements for buses, trams and para-transit, appropriate Mass Rapid Transit (MRT) Options and infrastructure development plans and intermodal integration plans.

HIGH DEMAND MOBILITY CORRIDOR

Development of higher capacity mass transit system is recommended to move large numbers of people at one time which will lead to lower travel time, and decreased congestion. About 71.6 km of High Demand Mobility Corridors have been identified with a Max PPHPD of 5000 to nearly over 20000 in the horizon years. Considering the demand on the major mobility corridors the most suitable high-capacity mass transit modes can be explored. The suitable corridor has been identified based PPHPD however, a detailed study has to be carried out assess the feasibility of these corridors based on other screening criteria.

Recommended High Demand Mobility Corridor in the Study Area

SN	NAME OF THE CORRIDOR	LENGTH (KM)
PHASE I		
1	Techno City to Pallichal via Karmana, Nemom	27.4
2	Kazhakkoottam to Killipalam VIA Einchakkal	14.7
PHASE II Extension Corridors		
1	Pallichal to Neyyattinkara	11.1
2	Techno city to Mangalapuram	3.7
3	Eanchakkal to Vizhinjham	14.7

CITY BUS RATIONALIZATION

A route-to-route overlap analysis has been carried out for bus services in Thiruvananthapuram is observed that about 34% of the routes have above 60% average route overlap with the proposed trunk routes or MRTS corridors. It is recommended to retain the cap on the private bus permits. Further, it is recommended to rationalise 20 routes which are observed to be overlapping with the Proposed Mass Transit Corridors from Kesavadapuram to Pallichal by re-outing from alternative corridors.

Route Rationalization Proposals

RATIONALIZATION OF ROUTES	2027
Total No. of Routes	70
Total No. of Routes for Curtailed/Modified	20

Recommended Private Bus routes for Rationalization

SN	NAME OF THE CORRIDOR	NATURE OF OVERLAP	RECOMMENDATION	PHASE
1	Pappanamcode-Kundappanakunnu	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
2	Medical College-Chiramukku	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
3	Medical Clg-Valiyavila	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
4	Pravanchalbalam-Poonthura	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
5	Kochiravila-Medical College	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
6	Pongumoodu-Thrikannapuram	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
7	Pallimukku-Pongumoodu	Overlap with Proposed High Demnad Corridor	Re-routing the overlap section	Phase II
8	Thiruvallam-Nettayam	Overlap with City Circular Services	Re-routing the overlap section	Phase I
9	Konchiravila-Vayalikkada	Overlap with City Circular Services	Re-routing the overlap section	Phase I
10	Sreekariyam-Veli	Overlap with City Circular Services	Re-routing the overlap section	Phase I
11	Sreekariyam-Kochuveli	Overlap with City Circular Services	Re-routing the overlap section	Phase I
12	Kalady-Pulayanarkotta	Overlap with City Circular Services	Re-routing the overlap section	Phase I
13	Pappanamcode-Karikkakom Temple	Overlap with City Circular Services	Re-routing the overlap section	Phase I
14	Pulayanarkotta-Poonthura	Overlap with City Circular Services	Re-routing the overlap section	Phase I
15	Kundamanbhagom-Akg Nagar	Overlap with City Circular Services	Re-routing the overlap section	Phase I
16	Thrikannapuram-Madhavapuram	Overlap with City Circular Services	Re-routing the overlap section	Phase I
17	Medical College-Thrikannapuram	Overlap with City Circular Services	Re-routing the overlap section	Phase I
18	Akg Nagar-Pappanamcode	Overlap with City Circular Services	Re-routing the overlap section	Phase I
19	Kodunganoor-Kalady	Overlap with City Circular Services	Re-routing the overlap section	Phase I
20	Pongumoodu-Thiruvallam	Overlap with City Circular Services	Re-routing the overlap section	Phase I

PUBLIC TRANSPORT FLEET AUGMENTATION

Based on the route rationalization plan, Mass Transit Corridors and estimated demand, the number of buses required the study area for the horizon years are computed. Fleet requirement is over the years is estimated based on various norms and demand and is presented in the Table below

Fleet Requirement Over the Years [6]

FLEET REQUIREMENT	2023	2031	2041	2051
Fleet Requirement (MouHA norm)				
Existing Bus Fleet	479	-	-	-
Proposed Bus Fleet	-	1066	1231	1422
Addl. Fleet Required	-	587	165	191
Fleet Requirement (CIRT norm)				
Existing Bus Fleet	479	-	-	-
Proposed Bus Fleet	-	711	821	948
Addl. Fleet Required	-	232	110	127
Fleet Requirement (SUT Scenario)				
Existing Bus Fleet	479	-	-	-
Proposed Bus Fleet	-	650	787	946
Addl. Fleet Required	-	171	137	159
Suggested Fleet Requirement				
Proposed Standing Bus Fleet	479	650	787	946
Buses to be Scrapped	-	-	65	79
Addl. Fleet Required (Including Scrapped Buses)	**0**	**171**	**202**	**238**

On comparison with CIRT and MoHUA norms and Demand assessment for SUT scenario, CMP suggests a standing bus fleet of 650 by 2031 and 946 buses with 80% fleet being Electric by 2051.

NEW CITY BUS ROUTES

On assessment have been 11 corridors have identified as high demand city bus corridors as secondary corridors to the primary proposed MRTS corridors. The bus systems are recommended to operate at high frequency of 5mins in the horizon years (2027). The details of the same are as presented below,

High Demand City Bus Routes in the Study Area

SN	NAME OF THE CORRIDOR	LENGTH (KM)
1	MC Road	4.2
2	Peroorkada Road	6.4

[6] The proposed fleet size includes the fleet required on the proposed new routes.

SN	NAME OF THE CORRIDOR	LENGTH (KM)
3	Peyad Road	7.4
4	Pothencode Road	7.3
5	Nettayam Road	5.2
6	Attakulangara-Eanchakkal Road	2.7
7	Palayam- Airport Road	3.5
8	Bakery Junction Road to Thampanoor	2.0
9	Pottakuzhy Road – Medical College Road	3.1
10	Pattom-Kowdiar Road	2.3
11	CV Raman Road	3.2

The study proposed 2 additional city circular routes to existing rationalized city circular routes. The proposed are integrated with the proposed mass transit system network. A total fleet size of 17 is proposed on 2 routes for 2027 and 27 buses by 2052. The headway of these routes varies from 5mins to 15mins during the peak hours and 15mins to 45mins during the off-peak hours. The list of proposed routes is as follows,

Proposed New Routes

S.NO.	ROUTE NAME	DISTANCE IN KMS	PHASE	BUSES			
				2027	2031	2041	2051
1	Bypass –Kochuveli Loop	18	Phase I	7	8	10	12
2	Kazhakkoottam Loop	22	Phase I	9	11	13	15
TOTAL		40		17	20	23	27

INLAND WATER TRANSPORT

Inland Waterways are recommended on 5 routes of 51km in the study area and the details of the same are as presented below,

Inland Water Transport Fleet

SN	ROUTES	LENGTH (KM)	PHASE	FLEET REQURIED (2031)
1	Kovalam to Thiruvallam bridge	4.7	Phase I	4
2	Thiruvallam to Karamana bridge	11.0	Phase I	9
3	Murukkumpuzha to Kochuveli via Veli	19.1	Phase II	15
4	Kochuveli to Thiruvallam via Airport	10.4	Phase II	11
5	Jagathy to Thiruvallam	5.2	Phase II	9

Electric boats of capacity 25-35 capacity with an operating speed of 14kmph at 15-20 mins headway is recommended. Smaller boats are recommended as majority of the corridors are operate parallel to the mass transit corridors. However, these can be operated under tourism circuit along with daily commuting. A holistic infrastructure is recommended to be developed, with Stations and Terminals.

11 Inland Waterways Station and terminals are recommended the details of the same are as presented below,

Inland Water Transport Stations

SN	ROUTES	Typology	PHASE
1	Kochuvelli	Station	Phase I
2	Airport	Station	Phase I
3	Eanchakkal	Station	Phase I
4	Thiruvallam	Station	Phase I
6	Kovallam	Terminal	Phase I
6	Iranimuttam	Station	Phase I
7	Prakash Nagar	Terminal	Phase I
8	Killipalam	Station	Phase II
9	Jagathy	Terminal	Phase II
10	Kadinamkulam	Station	Phase II
11	Murukkumpuzha	Terminal	Phase II

PUBLIC TRANSPORT TERMINALS

The public transport terminals, which includes the airport, railway station, bus terminals and inland water terminals in the city plays a vital role in connecting people from one place to the other. The development of all these terminals enhance better connectivity and enhanced transitions. The identified existing airport and railway stations; and the proposed inland waterway terminal are shown in table below.

Public Transport Terminals – Airport, Railway & Waterway

SN	TERMINAL	TYPE	TYPOLOGY
1	Thiruvananthapuram International Airport	Airport	Domestic and International Services
2	Thampanoor Railway Station	Railway	Regional Services
3	Kochuveli Railway Station	Railway	Regional Services
4	Nemom Railway Station	Railway	Regional Services
6	Kovalam	Waterway	Sub-urban Services
6	Prakash Nagar	Waterway	Sub-urban Services

SN	TERMINAL	TYPE	TYPOLOGY
7	Jagathy	Waterway	Sub-urban Services
8	Murukkumpuzha	Waterway	Sub-urban Services

It is also recommended for the de-centralization of KSRTC sub-urban services for the city center from East Fort Terminal and limited services form Thampanoor Bus terminals. The KSRTC services operate in Hub and spoke model between major hubs and minor hubs for city and sub-urban services.

KSRTC Terminals Usage

SN	TERMINAL	AREA (Acres)	TYPOLOGY
1	Thampanoor	2.72	City Services / limited sub-urban
2	East fort	1.9	City Services
3	Vikas bhavan	2.85	City Services
4	Medical College	1.1	City Services
6	Peroorkada	2.44	Sub-urban Services (north-east)
6	Pappanamcode	2.05	Sub-urban Services (South-east)
7	Eanchakkal	5.8	Sub-urban Services (South)
8	Anayara	3.5	Sub-urban Services (north)
9	Vizhinjam	2.3	Sub-urban Services (South

MULTI – MODAL INTERCHANGES

Multi – Modal Interchange (MMI) facilitates the commuters to get all their daily requirements at a single place. This will help the city to minimize congestion and also reduce the pollution hazards. Multi-Modal Interchanges are also recommended for easing out the transfers across various transit modes. The details are as presented below,

Multi-Modal Interchanges

SN	HUB / INTERCHANGE	TYPOLOGY	MODES	CATEGORY	REMARKS	PHASE
MULTI-MODAL MOBILITY HUBS						
1	Thampanoor Railway and Bus Terminus	City and Sub-urban and regional interchanges	MRT, Bus, Rail	Major	Integrated Hub infrastructure with passenger and transportation facilities	Phase I
2	Kochuveli	City and Sub-urban and regional interchanges	MRT, Bus, Rail, Ferry	Major		Phase I
3	Thiruvananthapuram Airport	City and Sub-urban and regional interchanges	MRT, Bus, Rail, Ferry	Major		Phase I
4	Nemom	City and Sub-urban and regional interchanges	MRT, Bus, Rail	Major		Phase II
5	Techno Park	City interchanges	MRT and Bus	Major		Phase I
MULTI-MODAL INTERGHANGE FACLILITES						

<table>
<tr><td>1</td><td>Ulloor</td><td>City interchanges</td><td>MRT and Bus</td><td>Minor</td><td rowspan="8">Transfer facilities such as bus bays, pick up and drop of bays, park and ride facilities, skywalks, footpaths, etc.</td><td>Phase II</td></tr>
<tr><td>2</td><td>Thiruvallam</td><td>City interchanges</td><td>Bus and Ferry</td><td>Minor</td><td>Phase II</td></tr>
<tr><td>3</td><td>Killipalam</td><td>City interchanges</td><td>MRT, Bus, Ferry</td><td>Minor</td><td>Phase II</td></tr>
<tr><td>4</td><td>University</td><td>City interchanges</td><td>MRT and Bus</td><td>Minor</td><td>Phase III</td></tr>
<tr><td>5</td><td>Anayara</td><td>City and Sub-urban and regional interchanges</td><td>Bus and Ferry</td><td>Minor</td><td>Phase III</td></tr>
<tr><td>6</td><td>Kazhakkoottam</td><td>City interchanges</td><td>MRT and Bus</td><td>Minor</td><td>Phase II</td></tr>
<tr><td>7</td><td>Vizhinjam</td><td>City interchanges</td><td>MRT and Bus</td><td>Minor</td><td>Phase III</td></tr>
<tr><td>8</td><td>Neyyattinkara</td><td>City and Sub-urban and regional interchanges</td><td>MRT and Bus</td><td>Minor</td><td>Phase III</td></tr>
</table>

Proposed Public Transport Network Transitions

INTERMEDIATE PUBLIC TRANSPORT STRATEGY

The study recommends provision of infrastructure facilities for the operation of IPT. The allocation of IPT will be governed by Corporation or ULB or Smart City in ordination with RTA and Traffic Police Departments. The infrastructure facilities shall include,

Halt and go stops are recommended at all the major activity nodes with considerable distance from the bus-stands to avoid chaos. These stops are recommended to be locate at a minimum distance of 250m from the junctions. The capacity of these stop will be demand based assessed by the traffic police with a minimum holding capacity of 3.

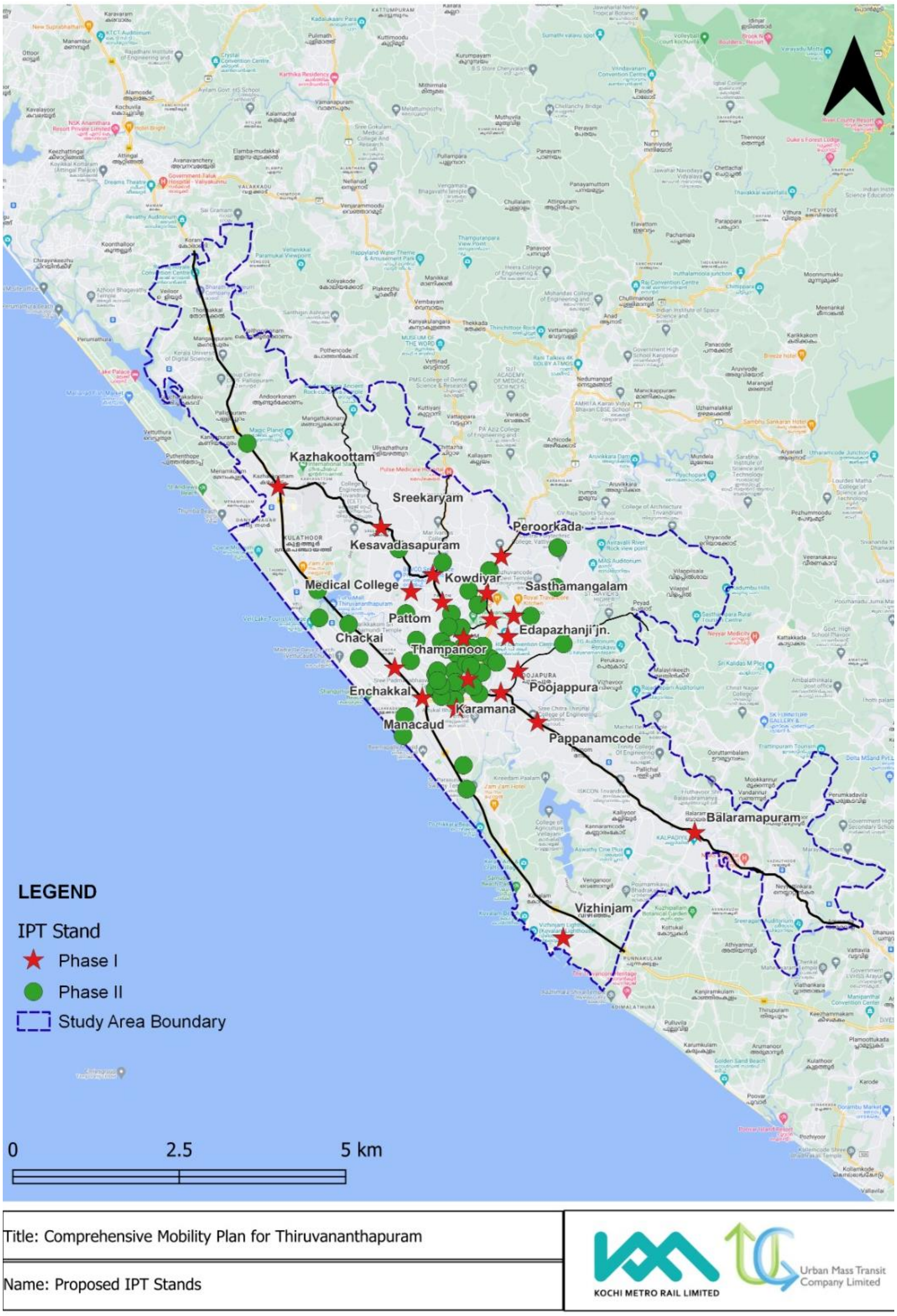
Proposed Halt and Go Stops with Electric Vehicle charging facilities

S. No.	Location Name	Capacity	Phase
1	Balaramapuram	8 TSR	Phase I
2	Chackai	5 TSR	Phase I
3	Edapazhanji jn.	5 TSR	Phase I
4	Eanchakkal	8 TSR	Phase I
5	Karamana	5 TSR	Phase I
6	Kazhakoottam	8 TSR	Phase I
7	Kesavadasapuram	8 TSR	Phase I
8	Kowdiyar	5 TSR	Phase I
9	Manacaud	5 TSR	Phase I
10	Medical College	8 TSR	Phase I
11	Palayam	8 TSR	Phase I
12	Pappanamcode	5 TSR	Phase I
13	Pattom	8 TSR	Phase I
14	Peroorkada	5 TSR	Phase I
15	Poojappura	5 TSR	Phase I
16	Sasthamangalam	5 TSR	Phase I
17	Sreekaryam	5 TSR	Phase I
18	Thampanoor	8 TSR	Phase I
19	Vellayambalam jn.	5 TSR	Phase I
20	Vizhinjam	5 TSR	Phase I
21	Airport jn	3 TSR	Phase II
22	All Saints jn.	5 TSR	Phase II
23	Ambalamukku	3 TSR	Phase II
24	Ambalathara	3 TSR	Phase II
25	Anayara	3 TSR	Phase II
26	Attakulangara	5 TSR	Phase II
27	Ayurveda College	8 TSR	Phase II
28	Bakery Jn.	5 TSR	Phase II
29	Choorakattupalayam	5 TSR	Phase II
30	Devaswom Board jn.	3 TSR	Phase II

S. No.	Location Name	Capacity	Phase
31	DPI jn.	5 TSR	Phase II
32	East Fort	8 TSR	Phase II
33	General hospital Jn (GH jn)	8 TSR	Phase II
34	Housing board Jn.	3 TSR	Phase II
35	Jacob's Jn.	3 TSR	Phase II
36	Jagathy	3 TSR	Phase II
37	Kaithamukku	3 TSR	Phase II
38	Kannamoola	3 TSR	Phase II
39	Killippalam	8 TSR	Phase II
40	Kochuveli	5 TSR	Phase II
41	Kumarapuram	5 TSR	Phase II
42	Kuravankonam	5 TSR	Phase II
43	Kuzhivila	3 TSR	Phase II
44	Law college jn	3 TSR	Phase II
45	Maruthankuzhy	3 TSR	Phase II
46	Melepazhavangadi	3 TSR	Phase II
47	Mettukada	3 TSR	Phase II
48	Model School Jn.	3 TSR	Phase II
49	Nettayam	3 TSR	Phase II
50	Old Collectorate jn.	5 TSR	Phase II
51	Paruthippara	3 TSR	Phase II
52	Pettah	5 TSR	Phase II
53	Plamoodu	5 TSR	Phase II
54	PMG	5 TSR	Phase II
55	Pongumoodu	3 TSR	Phase II
56	Punnapuram jn	3 TSR	Phase II
57	SP fort jn	5 TSR	Phase II
58	Statue	5 TSR	Phase II
59	Thampuranmukku	3 TSR	Phase II
60	Thirumala	3 TSR	Phase II
61	Thiruvallam	5 TSR	Phase II
62	Valiyathura	3 TSR	Phase II
63	Vattiyoorkavu	3 TSR	Phase II
64	Vazhapally jn	3 TSR	Phase II
65	Vazhuthacaud	3 TSR	Phase II
66	Vettu road	5 TSR	Phase II
67	West Fort	5 TSR	Phase II
68	Women's College jn.	3 TSR	Phase II

* TSR - Three-Seater Auto Rickshaw

E-stations are advised to be provided at major mobility network intersections. The following locations are recommended, though a detail assessment could be carryout while implementation. The charging points will be similar to the KESB electric pole points for two-wheelers and e-autorickshaw.



Proposed Halt and Go Stops with Electric Vehicle charging facilities

NON-MOTORISED TRANSPORTATION STRATEGY

Non-Motorized Transport (NMT) strategy is a key element in successfully encouraging clean urban transport. It can be a very attractive mode of transport for relatively short distances, it makes up the largest share of trips.

PEDESTRIAN NETWORK

The study identifies 262 Km of network to be developed with dedicated pedestrian infrastructure (footpath). The proposed network covers about 100% of the major road network in the study area.

It is also recommended to develop about 3.5 Km out of 262 Km of pedestrian priority streets where pedestrian and NMT movement are only allowed during the whole day except at night to allow fright movement. The streets identified are the major corridors in the core city with high commercial and religious activity and having a higher pedestrian footfall. The proposed pedestrian priority streets are recommended to be take-up as a part of the improvement of Thiruvananthapuram core city by the development agency. The details of the network recommended for improvement is as presented below.

Corridors with Proposed Footpath

S. No.	Name	Length (Km)	Min. Footpath Width (M)
1	Vizhinjam-Poovaar Road	8.23	3
2	Vettamukku Road	5.16	2
3	Veli-Venpalavattom Road	1.61	2
4	Veli-Perumathura Road	2.45	3
5	Vazhuthacaud-Poojappura Road	2.10	2
6	Vattiyoorkkav-Puliyarakkonam Road	5.35	2
7	Valiyathura-Muttathara Road	4.92	3
8	Ulloor-Akkulam Road	4.84	3
9	Trivandrum-Vizhinjam Road	0.40	3
10	Trivandrum-Nagarcoil Highway	20.83	2
11	Trivandrum-Bakery-Palayam Road	2.12	2.5
12	Thiruvananthapuram-Neyyar Road	3.52	2
13	Thirumala-Peyad-Malayinkeezhu Road	6.24	2
14	Thampanoor Road	2.66	2.5
15	Sreekaryam-Pothencode Road	7.63	2
16	Sreekaryam-Kullathoor Road	4.57	3
17	Sasthamangalam Road	1.05	3
18	Sachivothama Road	1.52	3
19	Pravachambalam-Ooruttambalam Road	5.32	2
20	Pottakuzhy Road	1.10	3
21	Pothencode-Murukkumpuzha Road	5.21	2
22	Poojappura Road	3.88	2
23	Peyad-Vellanad Road	2.02	2
24	Peyad-Puliyarakonam Road	2.35	2
25	Pettah-Venpalavattom Road	3.58	3
26	Pazhaya Road	0.93	3

S. No.	Name	Length (Km)	Min. Footpath Width (M)
27	Pattom-Kowdiar Road	2.29	3
28	Pappanamcode-Malayinkeezhu Road	7.51	2
29	Pallimukku-Kannammoola Road	0.96	3
30	Pallichal-Vizhinjam Road	5.76	2
31	Palayam-Airport Road	9.36	3
32	Palayam PMG Road	0.40	2.5
33	Pachalloor-Poonkulam Road	11.23	2
34	NH66 Bypass	12.00	3
35	NH66	39.83	2
36	Neyyattinkara-Kattakkada Road	4.60	2
37	Nemom-Punnamoodu Road	5.13	2
38	Muttada Road	2.29	3
39	MG Road	2.37	2.5
40	Medical College-Ulloor Road	0.81	3
41	Medical College-Kumarapuram Road	0.95	3
42	MC Road	5.07	3
43	Maruthunkuzhi-Kachani Road	2.33	2
44	Maruthankuzhi-Kachani Road	3.23	2
45	LMS Vellayambalam Road	1.23	2.5
46	LMS Attakulangara Road	1.01	2.5
47	Kumarapuram-Kannanmoola Road	2.25	3
48	Kowdiar Ave	4.64	3
49	Kovalam Road	2.60	3
50	Kazhakoottam Road	2.98	3
51	Kannammoola-Thekkummoodu Road	2.24	3
52	Kaimanam-Thiruvallam Road	5.65	2
53	C V Raman Pillai Road	3.14	2.5
54	Balaramapuram-Ooruttambalam Road	2.72	2.5
55	Attakkulangara-Eanchakkal Road	1.51	3
56	Attakkulangara-Killippalam Bypass Road	1.17	3
57	Airport Road	1.95	2.5

Proposed Pedestrian Priority Streets

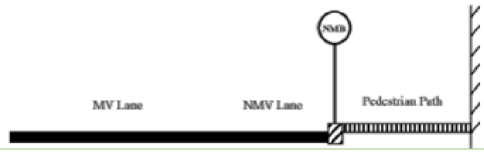
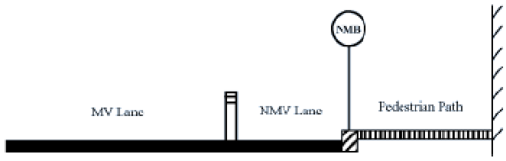
S. No.	Name	Length (Km)
1	West Nada	0.11
2	Vadakkenada	0.16
3	Sabapathi Coil St.	0.30
4	Pazhavangadi St.	0.47
5	Padmatheertham N St.	0.33
6	Padmanabhaswamy Temple Road	0.37
7	Kothuval St.	0.35
8	Chotthupurai Street	0.16
9	Chalai Market Road	1.26

BICYCLE NETWORK

Cycling is increasingly recognized as a clean, sustainable mode of transport and an essential part of an inter-modal plan for sustainable urban travel. The study proposes 90 Km of dedicated bicycle network. The proposed network covers only 40% of the major road network in the city due to the hilly terrain of the city. It is recommended to maintain a minimum of 2m wide dedicated bicycle track for bi-directional sections and a minimum of 3m for uni-directional tracks.

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 for Thiruvananthapuram. Non-Motorized Vehicles (NMV) lanes can generally be classified into four main categories and are listed below. In case of Thiruvananthapuram, Non-Motorized Vehicles (NMV) lane typology 2, 3 and 4 are suggested.

Types of NMV Lanes

S. No.	Type of NMV Lane	Cross Section
1	NMV lanes shared with MVs and designated by signs	
2	NMV lanes designated by lane markings (e.g., striping) and within the highway right-of-way	
3	NMV-exclusive lanes physically separated from MVs by barriers (e.g., concrete blocks, steel railing, raised curb) and within the highway right-of-way	
4	NMV-exclusive lanes within an independent right-of-way (often referred to as NMV paths)	

Proposed Corridors for Bicycle Infrastructure

S. No.	Name	Length	Typology
1	Attakkulangara-Killippalam Bypass Road	1.24	3
2	Attakulangara-Enchakkal Road	1.51	3
3	Beach Road	2.09	2
4	C V Raman Pillai Road	3.50	3
5	Chilakkoor-Vallakkadavu Road	9.57	2
6	Kazhakoottam Road	2.98	3
7	Kovalam Road	9.25	2

S. No.	Name	Length	Typology
8	Kowdiar Ave	1.22	3
9	LMS Vellayambalam Road	1.23	3
10	NH66 Bypass	23.26	3
11	Poonthi Road	7.15	3
12	Thampanoor Road	1.88	3
13	Veli-Airport-Palayam Road	9.74	3
14	Veli-Perumathura Road	3.48	2
15	VSSC Road	0.74	2
16	Ulloor – Akkulam Road	4.84	3
17	NH66 (Ulloor to Overbridge Jn)	7.12	3
18	West Nada	0.11	4
19	Vadakkenada	0.16	4
20	Sabapathi Coil St.	0.30	4
21	Pazhavangadi St.	0.47	4
22	Padmatheertham N St.	0.33	4
23	Padmanabhaswamy Temple Road	0.37	4
24	Kothuval St.	0.35	4
25	Chotthupurai Street	0.16	4
26	Chalai Market Road	1.26	4

DEVELOPMENT OF BICYCLE CORRIDOR ALONG BEACH

Western side of Thiruvananthapuram city is covered by Arabian sea hence creating numerous numbers of beaches. A proper bicycle corridor connecting those beaches will enhance the tourism activity as well as health-oriented activity. The proposed corridor connecting various identified beaches in Thiruvananthapuram is provided below. This will also encourage local people to use bicycle more often than other motorised vehicles. As of now some localities are using bicycle along the same corridor, due to lack of proper bicycle infrastructure facilities, which includes dedicated cycle tract and cycle holding facilities, people are unable to utilize the corridor to the maximum.

Identified Beaches for Proposed Bicycle Corridor

S. No.	Name
1	Gloria Beach
2	Puthukurichy Beach
3	Deshamulam Beach
4	Vettuthura Beach
5	Puthenthope North Beach
6	Puthenthope Beach
7	St. Andrews Beach
8	Thumba Arattuvazhi Beach
9	Thumba Beach
10	Kochuthura Beach
11	Pallithura Beach
12	Veli Beach
13	Kochuveli Beach
14	Mosconagar Beach

S. No.	Name
15	Sealand Beach
16	Vettukadu Beach
17	Kannanthura Beach
18	Thaikkuttam Beach
19	Shangumughan Beach
20	Valiathura Beach
21	Poonthura Beach
22	Pozhikkara Beach
23	Samudra Beach
24	Kovalam Beach
25	Hawah Beach
26	Vizhinjam Beach
27	Chowara Beach
28	Somatheeram Beach

DEVELOPMENT OF BICYCLE CORRIDOR CONNECTING TOURIST ATTRACTIONS

Tourism is one of the major revenue generators in Kerala and in Thiruvananthapuram. In the year 2019 (before the impact of Covid'19), a total of 310451 foreign and 3038167 domestic tourists visited Thiruvananthapuram, which is around 18% of total tourists visiting Kerala.

SAFE ROUTES TO SCHOOL

Safe Routes to School (SRTS) is an approach that promotes walking and bicycling to school through infrastructure improvements, enforcement, tools, safety education, and incentives to encourage walking and bicycling to school.

The pilot areas identified are as presented below.

Pilot Areas Identified for SRTS Thiruvananthapuram

S. No.	Code	Name
1	PP1	Kaniyapuram and Pallippuram Areas
2	PP2	Indiraji Nagar, Karyavattom and Kurrissadi Areas
3	PP3	Tilak Nagar and Mayuram Areas
4	PP4	Pavithra Nagar Area

It is recommended to take up pilot projects for SRTS in these areas in light with the consideration and elements suggested above.

NON-MOTORISED TRANSPORT PRIORITY CORRIDORS

NMT priority streets prioritize people and are typically most appropriate in corridors with commercial activity on both edges of the street such as Padmanabhaswamy Temple Street, Chalai Market Road, etc. For Thiruvananthapuram it is recommended to develop about 13km as NMT priority streets where pedestrian and bicyclist movement are only allowed except at night for fright loading and unloading. The streets identified are the major corridors in the East Fort connecting Shree Padmanabhaswamy Temple and Chalai Market.

Recommended NMT Priority Streets

S. No.	Name	Length (Km)
1	West Nada	0.11
2	Vadakkenada	0.16
3	Sabapathi Coil St.	0.30
4	Pazhavangadi St.	0.47
5	Padmatheertham N St.	0.33
6	Padmanabhaswamy Temple Road	0.37
7	Kothuval St.	0.35
8	Chotthupurai Street	0.16
9	Chalai Market Road	1.26

PUBLIC BIKE SHARING SYSTEM

Public bike sharing systems have gained significant popularity in recent years as an eco-friendly and convenient transportation option in urban areas. Public bike sharing systems play a vital role in promoting sustainable transportation and improving urban mobility. By The public bike sharing systems will be provided near all the major tourist attraction points and other attraction centres.

Proposed PBS Locations

S. NO.	LOCATION	PBS TYPE	CYCLES PER STATION
1	Kazhakoottam	Low Capacity	10
2	Kulathoor	Low Capacity	10
3	Chacka	Low Capacity	10
4	Venpalavattom	Low Capacity	10
5	Enchakkal	Low Capacity	10
6	GK Junction	Low Capacity	10
7	Poonthura	Low Capacity	10
8	Thiruvallam	Low Capacity	10
9	Kovalam	Low Capacity	10
10	East Fort	Low Capacity	10
11	Thampanoor	Low Capacity	10
12	Killippalam	Low Capacity	10
13	Panavila	Low Capacity	10
14	Kowdiar	Low Capacity	10
15	Pattom	Low Capacity	10
16	Kumarapuram	Low Capacity	10
17	Veli	Medium Capacity	15
18	LuLu Mall	Medium Capacity	15
19	Kovalam Beach	Medium Capacity	15
20	Vizhinjam	Medium Capacity	15
21	Museum	Medium Capacity	15
22	Pallithura	High Capacity	25
23	Mukkolakkal	High Capacity	25
24	Kochuveli	High Capacity	25
25	All Saints College Junction	High Capacity	25

Proposed NMT Network Improvements

NON-MOTORISED TRANSPORT OUT-REACH PROGRAMS

It is essential to promote public awareness and revive the bicycling culture and reducing the dependency on private modes. Thus, an outreach and education strategy for promoting the system is recommended. The outreach and education goals need to be defined at the planning stage of the system itself to focus the efforts of the implementation. Following strategies can be adopted for an effective public outreach

- Create a network of allies and provide platforms for them to actively participate as disseminators of benefits
- Use proactive and creative communication media to promote key messages. Communication media can be print, broadcasts, short films, event marketing etc.
- Programmes can be conducted in schools and colleges advocating the need for Non-Motorized Transport. Events like Car Free Day, Happy Streets, Cycle Day can also be promoted.
- Encourage various university and school students to use bicycles under Safe Routes School or Pedal to School programs.
- Conduct Heritage Bicycle rides, etc.
- Encourage Bicycling as a recreational activity by creating Bicycle tracks along the lakes and further connecting them. Call for weekly bicycle competitions etc.

TRAFFIC MANAGEMENT MEASURES

Traffic demand measures 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, traffic flow, area improvements etc.

JUNCTION IMPROVEMENTS

Intersection improvements are recommended to facilitate the movement of public transport, safe movement and crossing of pedestrians at junctions. List of junctions proposed for improvement in their geometry are given below.

Identified Junctions for Improvement

S N	Name	Phase
1	Balaramapuram	Phase I
2	Chackai	Phase I
3	Edapazhanji jn.	Phase I
4	Enchakkal	Phase I
5	Karamana	Phase I
6	Kazhakoottam	Phase I
7	Kesavadasapuram	Phase I
8	Kowdiyar	Phase I
9	Manacaud	Phase I
10	Medical College	Phase I
11	Palayam	Phase I
12	Pappanamcode	Phase I
13	Pattom	Phase I
14	Peroorkada	Phase I
15	Poojappura	Phase I
16	Sasthamangalam	Phase I
17	Sreekaryam	Phase I
18	Thampanoor	Phase I
19	Thirumala	Phase I
20	Vellayambalam jn.	Phase I
21	Vizhinjam	Phase I
22	Airport jn	Phase II
23	All Saints jn.	Phase II
24	Ambalamukku	Phase II
25	Ambalathara	Phase II
26	Anayara	Phase II
27	Attakulangara	Phase II
28	Ayurveda College	Phase II

S N	Name	Phase
29	Bakery Jn.	Phase II
30	Choorakattupalayam	Phase II
31	Devaswom Board jn.	Phase II
32	DPI jn.	Phase II
33	East Fort	Phase II
34	General hospital Jn (GH jn)	Phase II
35	Housing board Jn.	Phase II
36	Jacob's Jn.	Phase II
37	Jagathy	Phase II
38	Kaithamukku	Phase II
39	Kannamoola	Phase II
40	Killippalam	Phase II
41	Kochuveli	Phase II
42	Kumarapuram	Phase II
43	Kuravankonam	Phase II
44	Kuzhivila	Phase II
45	Law college jn	Phase II
46	Marappalam	Phase II
47	Maruthankuzhy	Phase II
48	Melepazhavangadi	Phase II
49	Mettukada	Phase II
50	Model School Jn.	Phase II
51	Nettayam	Phase II
52	Old Collectorate jn.	Phase II
53	Overbridge	Phase II

S N	Name	Phase
54	Paruthippara	Phase II
55	Pazhavangadi	Phase II
56	Pettah	Phase II
57	Plamoodu	Phase II
58	PMG	Phase II
59	Pongumoodu	Phase II
60	Punnapuram jn	Phase II
61	RBI	Phase II
62	RMS	Phase II
63	SP fort jn	Phase II
64	Statue	Phase II
65	Thampuranmukku	Phase II
66	Thirumala	Phase II

S N	Name	Phase
67	Thiruvallam	Phase II
68	Uppidamoodu	Phase II
69	Valiyathura	Phase II
70	Vallakkadavu	Phase II
71	Vattiyoorkavu	Phase II
72	Vazhapally jn	Phase II
73	Vazhuthacaud	Phase II
74	Vettimurichakotta	Phase II
75	Vettu road	Phase II
76	West Fort	Phase II
77	West Nada	Phase II
78	Women's College jn.	Phase II

Geometric improvements and signalization serve only for short term duration. The traffic level at few junctions reaches the 10000 PCU mark during peak hours as shown below. The crucial junction being Pattom, VJT Hall Palayam, Thampanoor, Karamana junctions. The situation will deteriorate considerably with growing population of private modes in the city.

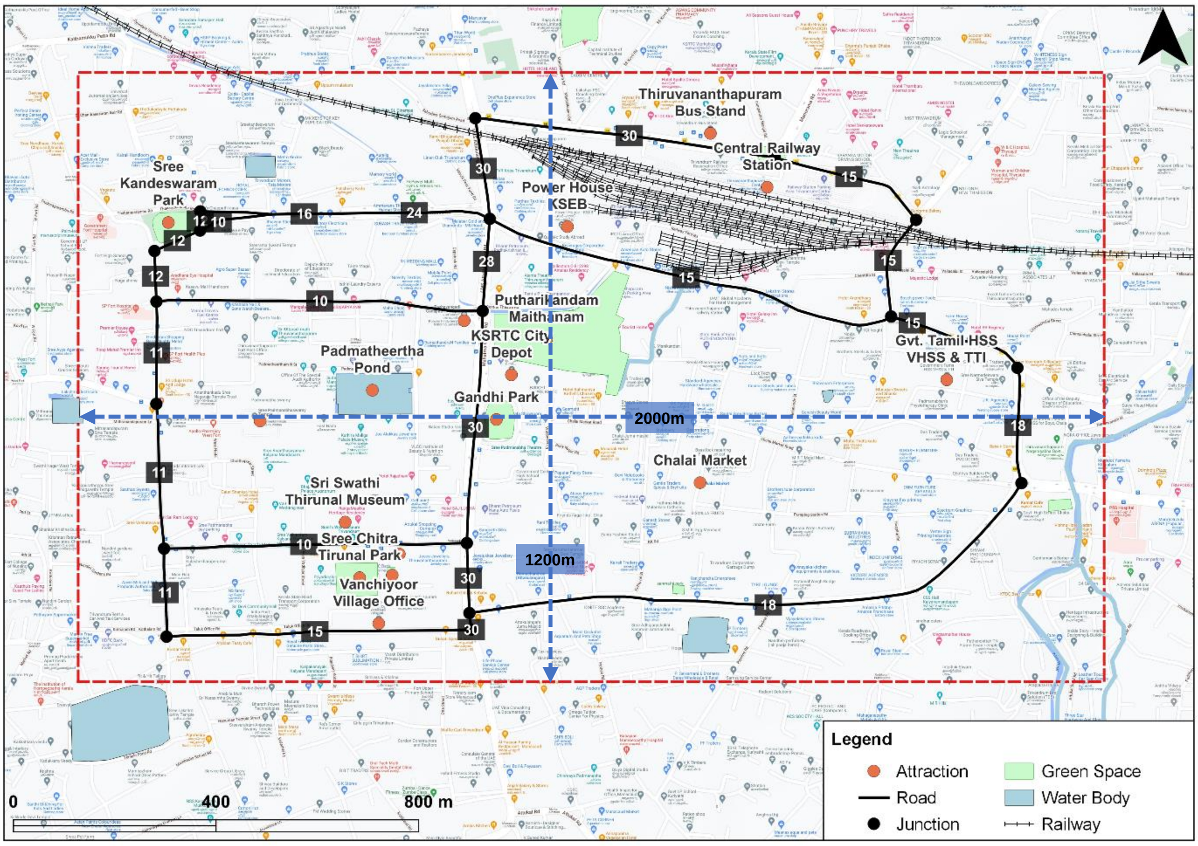
Improvements Proposed at Identified Junctions Phase I

S. NO.	JUNCTION	TYPOLOGY
1	Kazhakoottam	Signalized
2	Sreekaryam	Grade Separator
3	Kesavadasapuram	Grade Separator
4	Pattom	Grade Separator
5	VJT Hall Palayam	Grade Separator
6	Thampanoor	Grade Separator
7	Karamana	Grade Separator
8	Pappanamacode	Grade Separator
9	Balaramapuram	Grade Separator
10	Vellayambalam	Grade Separator

S. NO.	JUNCTION	TYPOLOGY
11	Kowdiyar	Grade Separator
12	Peroorkada	Grade Separator
13	Sasthamangalam	Grade Separator
14	Manacaud Junction	Grade Separator
15	Vizhinjam	Signalized
16	Chakka	Grade Separator
17	Eanchakkal	Grade Separator
18	Medical College	Grade Separator
19	Poojappura	Grade Separator
20	Edapazhji Junction	Grade Separator

EAST FORT & THAMPANOOR: COMMERCIAL & RELIGIOUS AREA

East Fort is the main commercial and religious area of the city with Chalai Market and Sree Padmanabhaswamy Temple. The Chalai Market houses for all sorts of people need in day-to-day life, which includes groceries, mobile phones, etc. Tampanoor area hosts for major bus station and railway station of the city with huge passenger footfall daily. The surrounding areas of both these areas are having lot of public and private services, educational institutions, multiplex, etc. Both these areas attract high volumes of traffic and higher pedestrian footfall. Existing major road networks with their right of way and major attraction points are identified and shown below.



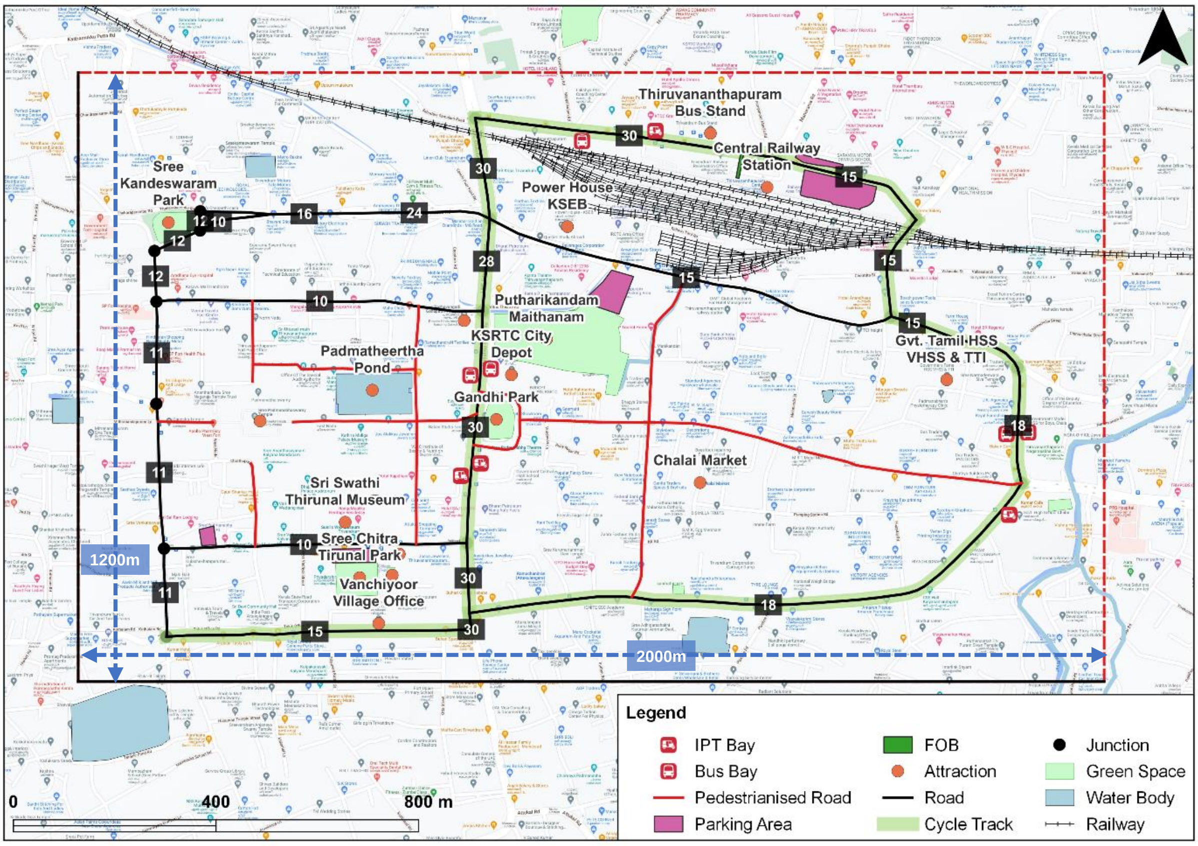
Contextual Map of East Fort & Thampanoor Area

PROPOSED INTERVENTIONS AND IMPROVEMENTS

- Based on the higher footfall, and to improve the mobility at Chalai Market area and Sree Padmanabhaswamy Temple area, complete pedestrianisation of the roads are proposed at both these areas. Even though complete pedestrianisation is proposed, fright movement to these locations are permitted at night time.
- Wide footpath has been proposed on all the major roads identified in the area.

- Cycle track is proposed on the major road identified for enhancing the sustainable and safe mobility.
- Since lot of buses are stopping in front of the Thiruvananthapuram Bus stand and East Fort bus stand, bus bays with proper waiting area for the passengers are proposed at both the locations.
- IPT bays are proposed at East Fort and Thiruvananthapuram Bus stand to improve the first and last mile connectivity.
- To access the Chalai Market from the east side, bus bays and IPT bays are proposed.
- Foot over bridge have been proposed directly from the central railway station foot over bridge to Thiruvananthapuram Bus Stand to have a proper integration of both the central railway station and Thiruvananthapuram Bus Stand.
- Parking locations identified (4 locations – Central Railway Station, Sree Padmanabhaswamy Temple, Sree Chitra Tirunal Park and Putharikandam Maithanam) in the area are proposed with multilevel parking facility. The identified locations are within a walkable distance from the major attraction points.

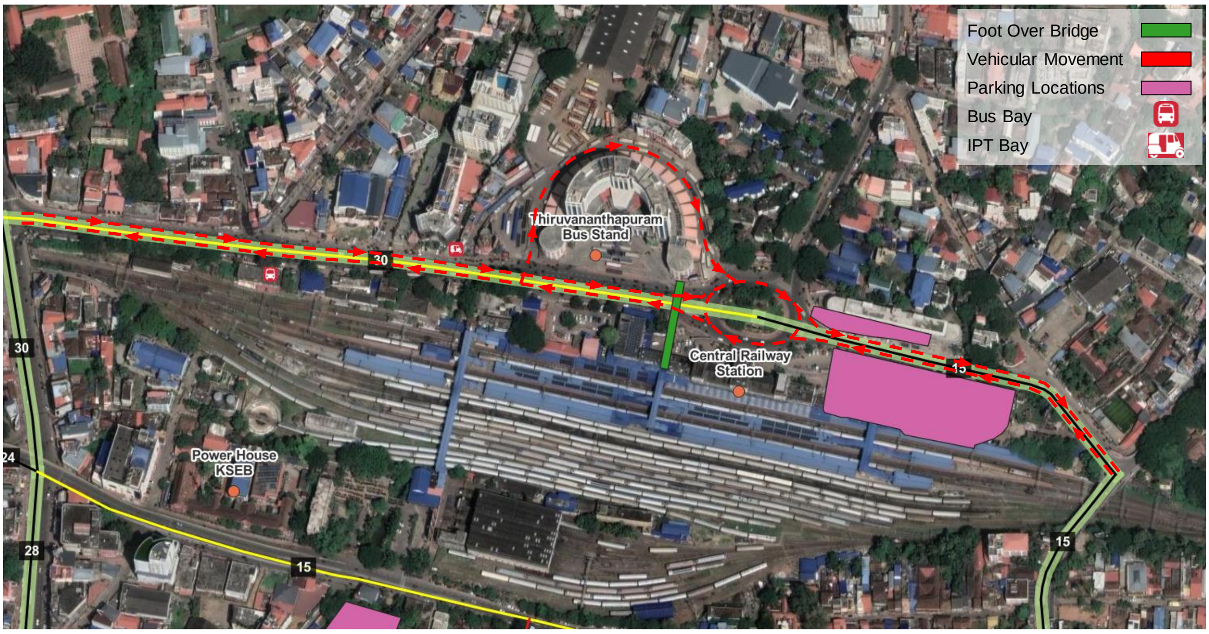
The conceptual map of the area is provided below.



Conceptual Map of Area Management Plan for East Fort & Thampanoor Area

THAMPANOOR

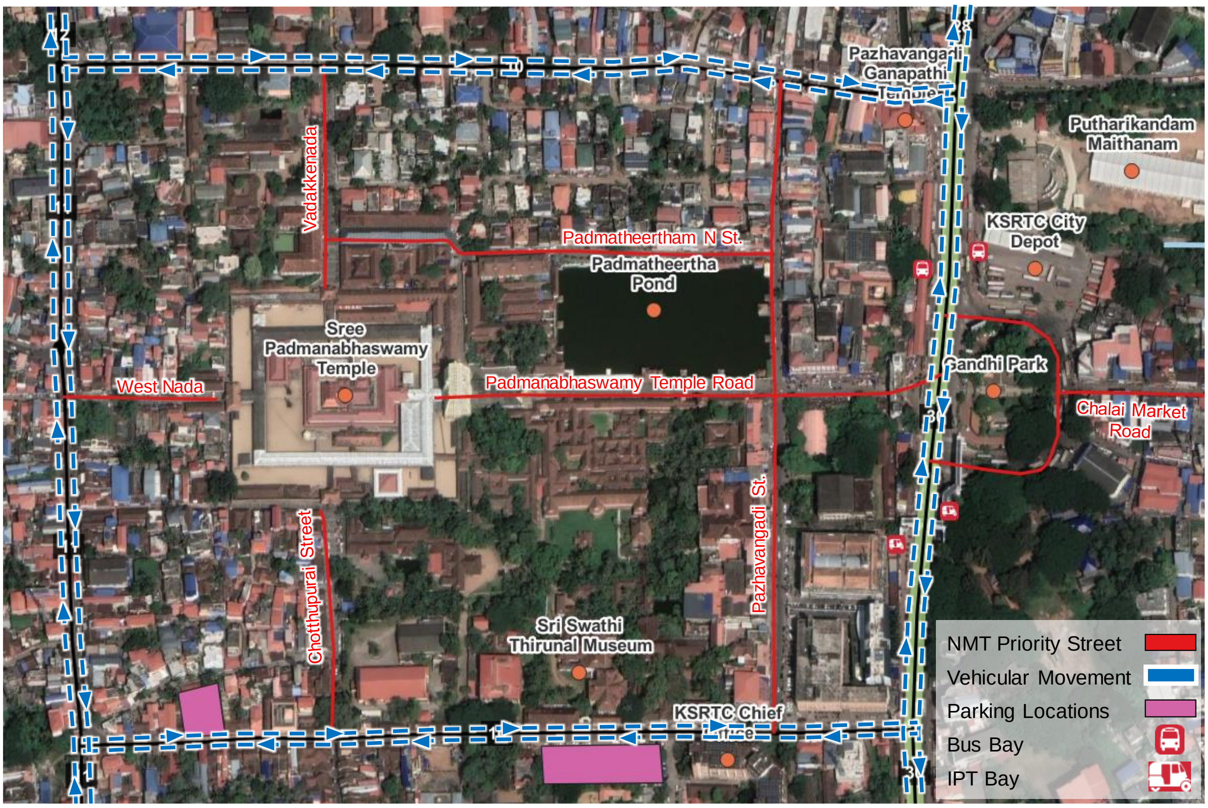
Thampanoor is the core area of the Thiruvananthapuram city with KSRTC bus terminal and Thiruvananthapuram central railway station. The railway station, is the busiest railway station of the state in terms of daily passengers. The pedestrian vehicular interaction in the area is on the higher side due to passenger movement between the railway station and bus terminal. As to improve the safety of the passengers and to enhance the integration, a foot over bridge (FOB) has been proposed from the railway station foot over bridge to KSRTC bus terminal. Designated IPT and bus bays are proposed in the area for improving the first and last mile connectivity. The parking facilities near Thampanoor area is also identified. The vehicular movement and various improvements proposed at the area is as shown below.



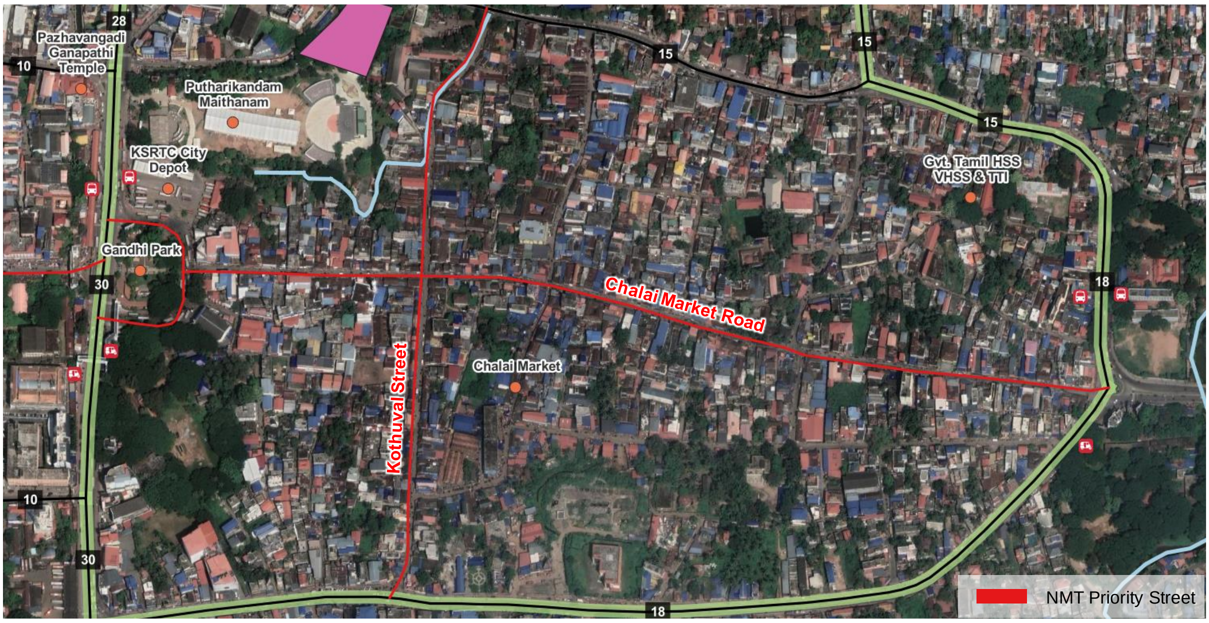
Proposals at Thampanoor

EAST FORT

East fort area hosts one of the important religious centres in the state with Shree Padmanabhaswamy Temple. The private buses in the city are utilizing this area as a bus terminal, which make the place chaotic in terms of pedestrian and vehicular interactions. PT and IPT bays are proposed to channelize the bus movement and utilize the area to the minimum for buses. The proposed bus bay near the Gandhi Park area is to be developed by utilizing some of the land owned by the KSRTC for KSRTC city depot. Also, to enhance the safety and mobility of the devotees towards the temple and adjacent area, some of the roads are made as NMT priority corridors. The available parking locations near the East Fort area are identified. The vehicular movement and various proposals at the area is as shown below. The cross-section of the proposed NMT priority corridor is provided below.



Proposals at East Fort Area



Proposed NMT Priority Corridors at Chalai Market Area

CHALAI MARKET

This is one of the busiest markets in the city. The areas have limited right of way availability and with the movement and parking of trucks on–street in an unorganized manner creates chaos and disrupts the traffic and pedestrian movement even after imposing one-way regulations. To overcome the current situation and to enhance safe movement of pedestrians, the two main corridors below. Inside the market area, Kothuval Street and Chalai Market Road are proposed as NMT priority corridor. Kothuval Street is connecting Power House Road in the north of Chalai Market and Bypass Road in the south.

PARKING MANAGEMENT STRATEGY

Parking Management Strategy includes a variety of strategies that encourage more efficient use of existing parking facilities, improve the quality of service provided to parking facility users and improve parking facility design.

DESIGNATED ON-STREET PARKING SPACES

Designated On-Street Parking is recommended on the following locations with optimum lengths for to be effective use of the available parking bays. It is suggested to restrict free On-Street Parking on the other stretches around these corridors. In addition to the motorized parking, some minimum number bicycle parking spaces have also been provided at each location to encourage the use on Non-Motorized Transport in the study area.

Proposed On-street Parking Spaces Capacities

Location	Effective Length (m)	Parking Bays								
		LHS			RHS			Total		
		2W	4W	Cycle	2W	4W	Cycle	2W	4W	Cycle
MG Road Between Attakulangara and LMS	812	382	64	30	372	69	25	754	133	55
NH 66-Plamoodu to Kesavadasapuram	758	-	-	-	326	70	30	326	70	30
Mettukada - Vellayambalam	577	137	81	30	86	94	25	223	175	55
Sreekaryam - Chekkamukku	757	454	35	30	352	57	25	806	92	55
Vellayambalam - Sasthamangalam	717	188	96	30	259	78	25	447	174	55
East Fort	820	402	53	30	560	18	25	962	71	55
Sreekumar Theatre - Vanross Junction	906	545	44	30	466	64	25	1011	108	55
Medical College - Ulloor Road	715	361	45	30	361	41	25	722	86	55

DESIGNATED OFF-STREET PARKING SPACES

Designated Off-Street Parking is recommended on the following locations with optimum area for effective use of the available parking bays. It is suggested to restrict free On-Street Parking on the other stretches around these areas. In addition to the motorized parking, some minimum number of bicycle parking bays have also been provided at each location to encourage the use on Non-Motorized Transport in the study area.

Proposed Off-street Parking Spaces Capacities

Location	Area (m^2)	ECS (Proposed)	Composition			Bays			Type
			2W	4W	Cycle	2W	4W	Cycle	
Palayam Market	600	52	36%	46%	18%	30	39	35	Surface
Power House Road	1300	116	57%	26%	18%	160	72	116	Surface
Gandhi Park	600	50	44%	36%	20%	43	35	39	Surface
Chandrasekharan Nair Stadium	300	25	42%	31%	28%	15	11	13	Surface
Attukal Shopping Complex	700	61	27%	48%	25%	22	39	31	Surface
Karimpanal Arcade	500	42	48%	31%	21%	23	15	19	Surface
KSRTC Stand East Fort	800	64	68%	18%	14%	49	13	31	Surface
Thiruvananthapuram Municipal Corporation	800	66	19%	62%	19%	10	32	21	Surface
Chalai KSRTC Depot	630	1054	63%	12%	24%	62	12	20	MLCP
Medical College	360	552	77%	10%	13%	120	15	20	MLCP
Transport Bhavan Near Fort	405	1065	63%	22%	16%	80	28	20	MLCP
Palayam Market	630	1054	63%	12%	24%	62	12	20	MLCP
Railway Station	450	765	75%	5%	20%	185	13	20	MLCP
Pattom	525	790	69%	13%	18%	78	15	20	MLCP
Ayurveda College	216	533	62%	8%	31%	116	15	20	MLCP

*MLCP – Multi-level parking

CONCEPT - PARKING POLICY

PARKING PRICING

Parking pricing and time limits are important parking management mechanisms in order to promote short-term parking enhance turnover of parking bays at proposed designated locations and ensure access to limited on-street parking in high parking demand areas. For the study area, the following pricing methods are suggested to be implemented.

DISTANCE FROM OFF-STREET PARKING FACILITY

The parking on streets adjacent to off-street parking facilities should be priced 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. Thus, parking around all the designated parking should be priced higher based on the land use values of those locations.

TIME-OF-THE DAY / OCCUPANCY BASED PRICING

Dynamic pricing is suggested to be incorporated to achieve higher parking turn-over rates. For Thiruvananthapuram Time and Occupancy based pricing methods are recommended.

The occupancy-based pricing is based on either a target average occupancy on street at the locations known to saturate easily. The following locations can be considered for occupancy-based parking pricing:

- Thampanoor
- East Fort
- Palayam
- MG Road
- LMS Vellayambalam Road
- Ulloor Road
- Kesavadasapuram

The 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. The following locations can be considered for Time-based parking pricing:

- Kazhakkoottam
- Sreekaryam
- Enchakkal

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. The On-Street Parking locations around the following locations are suggested to have higher parking price,

- Central Railway Station
- Kochuveli Railway Station
- Thampanoor KSRTC Bus Stand
- East Fort Bus Stand

The tentative parking prices based on the demand and willing to pay is as shown below.

Peak Hour Parking Fees

Vehicle Type	Morning/ Evening Peak Hours (3-4 Hrs Each)			
	Up to 1 hr	2 hr	3 hr	4 hr
Two-Wheeler	5	10	15	20
Private Car	20	40	60	80
Large Car/ SUV	30	50	70	90

Short Term Parking Fees

Vehicle Type	Day (8AM to 8PM)												Night (8PM to 8AM)	Full Day
	Up to 1 hr	Up to 2 hrs	Up to 3 hrs	Up to 4 hrs	Up to 5 hrs	Up to 6 hrs	Up to 7 hrs	Up to 8 hrs	Up to 9 hrs	Up to 10 hrs	Up to 11 hrs	Up to 12 hrs		
Two-Wheeler	5	5	5	10	10	10	15	15	15	20	20	20	5	25
Private Car	15	30	45	60	75	90	105	120	120	120	120	120	10	130
Large Car/ SUV	25	40	55	70	85	100	115	130	130	130	130	130	20	150

Long Term Parking Fees

Vehicle Type	Daily Charges			Subsidised Charges	
	Day 12 hrs (8AM to 8PM)	Night 12 hrs (8PM to 8AM)	24 hrs Day + Night	Quarterly	Annually
Two-Wheeler	200	50	250	250	1000
Private Car	1200	100	1300	1000	4000
Large Car/ SUV	1300	200	1500	1250	5000

A detailed Parking Policy Study should be carried out capturing the land values and dynamic parking conditions to identify feasibility of the locations and the parking fees at proposed locations.

TECHNOLOGICAL TRANSITIONS

PASSENGER INFORMATION SYSTEMS (PIS)

In the case of public transit, PIS refers to an information system, which provides real-time, dynamic information for passengers. This may include both predictions about arrival and departure times, and information about the nature and causes of disruptions. The system utilizes vehicle location data from AVL systems to disseminate information on the current location of the bus to passengers and predict arrival times at bus stops (Green City Streets n.d.). This is particularly useful on low-frequency routes and when buses deviate from scheduled times due to unforeseen circumstances[7]. In case of Thiruvananthapuram, the initiative has been made by KSRTC to implement PIS system inside all the buses, all terminals and bus stops.

VECHICLE 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 CMP suggests the used of electric vehicles.

In case of Thiruvananthapuram, newly formed circular service buses are provided with Electrical buses, which needs to be further expanded.

Whereas, E-rickshaws are highly recommended in the city. 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.

SMART CITY BUS SHELTER

Smart city bus shelters are modernized and technologically advanced bus shelters that aim to enhance the overall experience for commuters and improve the efficiency of public transportation systems. The identified locations for implementing the smart bus shelters in Thiruvananthapuram by Smart City is provided below.

Smart City Bus Shelters

S. No.	Smart Bus Shelters
PHASE I	
1	Women's College Bus Stop
2	Panavila Bus Stop
3	Killipalam Bus Stop Along Model Boys School
4	Killipalam Bus Stop Opp. Model Boys School
5	Railway Station Bus Stop

[7] Source: Bus Karo 2.0

S. No.	Smart Bus Shelters
6	Ayurveda College Bus Stop
PHASE II	
1	Vazhuthacaud Bus Stop Near Police HQ
2	Vazhuthacaud Bus Stop Near Juma Masjid
3	Kalabhavan Bus Stop
4	Vazhuthacaud Bus Stop Near Annie Mascrene Square - Thycaud
5	Mettukada Junction Bus Stop - Thycaud
6	Thycaud Bus Stop Near W&C Hospital
7	Kanakakunnu Palace - 1
8	Kanakakunnu Palace - 2
9	Public Office Building
10	Museum
11	LMS
12	Bakery Junction
13	Palayam
14	Saphalyam
15	Statue North
16	Statue South
17	Overbridge Junction
18	Model School
19	East Fort
20	Government Hospital Junction
21	Kerala University
22	Bakery Junction
23	VJT Hall

ADAPTIVE TRAFFIC CONTROL SYSYTEM (ATCS)

The Adaptive Traffic Control System (ATCS) is an advanced traffic management technology that uses real-time data and intelligent algorithms to optimize traffic flow and improve the efficiency of signalized intersections. The proposed intersections at which the ATCS is planning to be implemented are listed in the following Table.

Proposed Intersection for ATCS

S. No	Junction
1	Medical College Junction
2	GG Hospital
3	Pottakkuzhi
4	Pattom
5	Plamoodu
6	PMG
7	Mascot Hotel
8	War Memorial
9	Palayam
10	VJT Hall
11	Statue South
12	Statue Middle
13	Statue North
14	Pulimoodu
15	Ayurveda College
16	Overbridge
17	Pazhavangadi
18	East Fort
19	Vettumurichakotta
20	Attakulangara
21	Peroorkkada
22	Amabalamukku
23	Kowdiar
24	Vellayambalam
25	Keltron House
26	Museum
27	Corporation
28	LMS Junction
29	Althara Junction
30	SMC Junction
31	Vazhuthacaud
32	Xanadu (Women's College)
33	Panavila
34	Model School

S. No	Junction
35	Thampanoor
36	RMS Junction, Thampanoor
37	Asan Square
38	AKG Center Junction
39	General Hospital
40	Pattoor
41	Nalumukku

FREIGHT STRATEGY

Freight movement in indicates the level of economic activities in the city. The location of economic nodes decides the movement of goods traffic and managing the goods traffic movement is vital to maintain the acceptable level of congestion during peak hours within the city.

Restricting the heavy goods vehicle movement in major mobility corridors during peak hours is the long-term strategy that need to be considered to avoid excess congestion caused by goods traffic during peak hours.

Proposed Freight Terminals with Capacity

S. No.	Location	Trucks	Area Required (Sq. M.)
1	Chempakamangalam	500	140000
2	Mannanthala	250	70000
3	Karakulam	300	86000
4	Amaravila	250	70000
5	Punnakulam	500	140000

PROJECT IMPACT ASSESSMENT

Projects evolved in CMP will help to achieve sustainable development goals by means of reducing private mode share and travel time. This chapter presents the impact of the proposed strategies under Sustainable Urban Transport scenario in comparison to the Business-as-Usual scenario. The impact assessment is based on the following parameters as suggested in the CMP – Toolkit 2014.

The impact on the above are as presented in the table below.

Impact Assessment for Travel Characteristics.

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Impact on Network Characteristics					
1	**Modal Share (%)-Motorized Modes**				
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	65%	69%	56%
	Public Modes	% of trips made by public transport modes	21%	18%	30%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	14%	13%	15%
2	**Trip Length (Km)**				
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car and Auto users in the study area	9	11.2	11.4
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.5	9.2	9.3
3	**Travel Time (Minutes)**				
	Travel Time (PvT Modes)	Average Travel Time of the Two-wheeler, Car and Auto users in the study area	24	34	31
	Travel Time (PT Modes)	Average Travel Time of the Public Transport users in the study area	32	40	34
4	**Accessibility to Public Transport (Population in lakh)**				
	Access to PT	Population having access to PT	7.0	7.2	8.3

Impact Assessment for Network Characteristics

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR (2023)	BAU (2051)	SUT (2051)
1 Infrastructure and Land use					
1	**Infrastructure Quality**				
	Average Speed (Kmph) (PvT)	Average speed of private modes	21.8	19.4	22.6
	Average Speed (Kmph) (PT)	Average speed of public transport modes	16.2	15.6	20.4
2	**Safety**				
	Quality of footpath infrastructure	% of city covered with Footpaths (Arterial and Sub-Arterial)	32%	50%	100.0%

Environmental Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Local Emissions (Tonnes/day)	10.7	31.3	12.5
GHG Emissions (Tonnes/day)	72.1	120.1	81.2
Exposure to Transport Noise	>75	>75	<75

Vehicle Fuel Transition Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Percent of public transport fleet in compliance with Indian emissions standards	45%	65%	85%

Passenger Information System

PARAMETER	DESCRIPTION	BAU (2051)	SUT (2051)	BAU (2051)
Passenger Information System (PIS) for Public Transport	Share of Terminals, Stations having PIS	10%	50%	100%

Global Positioning System

PARAMETER	DESCRIPTION	BAU (2051)	SUT (2051)	BAU (2051)
Global Positioning System / GPRS	Share of Public Transport Vehicles and IPT with onboard GPS/GPRS which are connected to common control center	50%	50%	**100%**

IMPLEMENTATION PLAN

The projects identified in the earlier section are divided into three categories based on the phasing of projects for implementation. The long-term, medium-term and short-term projects have come as the output of transportation assessment carried out specifically to understand the future demand and system requirement. The projects proposed are to be implemented in three phases.

- Phase I - To be implemented between 2023 and 2027
- Phase II – To be implemented between 2027 and 2041
- Phase III - To be implemented between 2041 and 2051

Accordingly, long term, medium term and short-term proposals for the study area are shown below.

List of Short-Term Proposals

SN	SHORT TERM PROPOSALS	MEDIUM-TERM PROPOSALS	LONG TERM PROPOSALS
1	Junction, Corridor Improvements	Upgradation of Existing Roads / Development of New Links	Development of New Links
2	Pedestrian Network Improvements	Flyover / ROBS / RUBS/ Canal Crossings	Upgradation of Existing Roads
3	Bicycles Corridors Improvements	Dedicated Cycle Tracks	Flyover / ROBS / RUBS/ Canal Crossings
4	Area Improvement Plans	Pedestrian Network Improvements	Improved Bus System
5	Parking Management Plan	New PT Terminals/ MMI Hubs	Truck Terminals
6	Improved Public Transportation System (Bus, Waterways & MRTS), Route Rationalization	Improved PT System, New Routes	
7	Electric Vehicle Charging Stations	Off-Street Multi-Level Parking	
8	Network Structure Improvements	ITS Systems	
9	Smart Bus Stops		

PROJECT COSTING

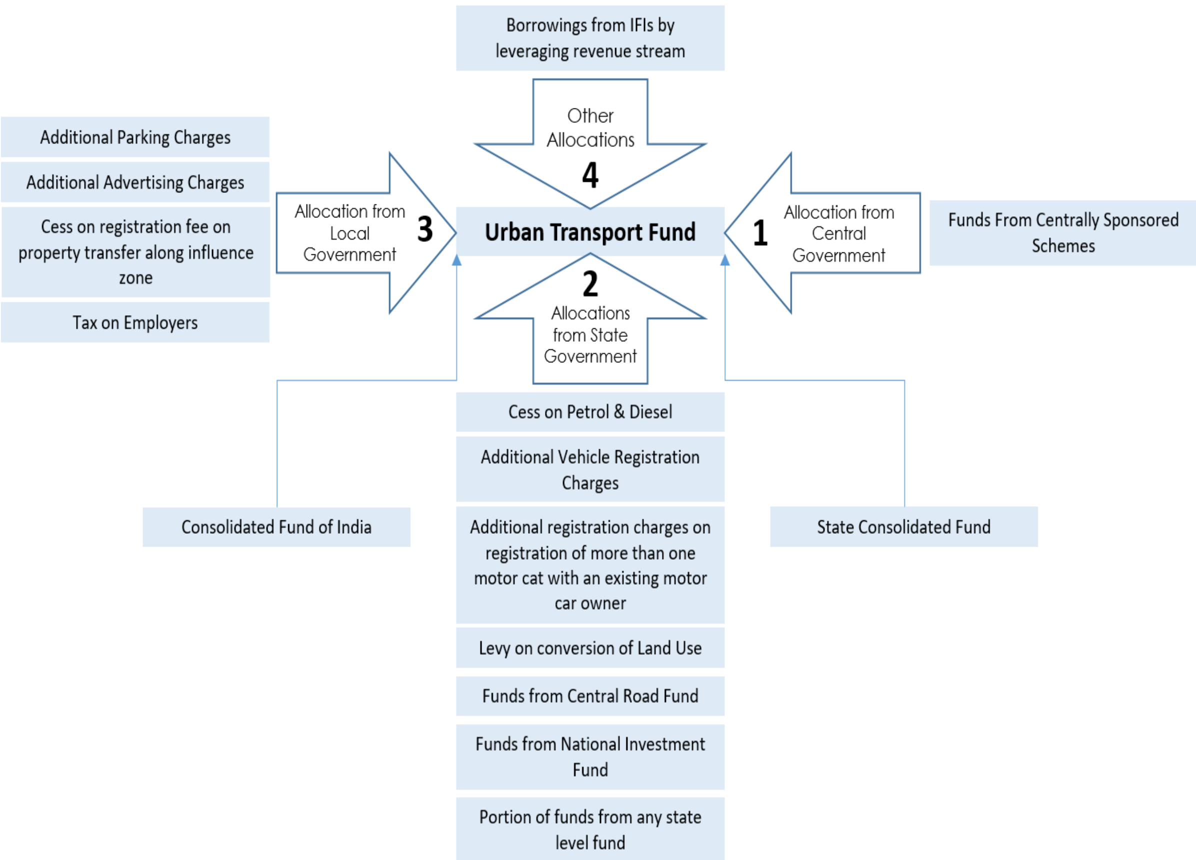
The tentative block cost estimation is done in reference with the district scheduled rates for year 2023. The overall short-term project cost is estimated to be 7212.91 crores. All junction improvement schemes, footpath implementation, cycle track network development, removal of encroachment will fall into this category. While the approximate cost of medium-term projects is 3149.00 crores and 4045.83 crores for long term measures.

Estimated Project Costs

SL.NO	PROJECTS	TOTAL COST (IN CRORES)	PHASING RS (IN CRORES)		
			2023-2027	2027-2041	2041-2051
1	Improvement of Road Network	2308.37	382.96	1825.24	100.18
2	Improvement of Non-Motorised Transport Facilities	459.97	173.05	286.92	0.00
3	Improvement of Public Transport System	10802.50	6630.08	803.78	3368.64
4	Improvement of Freight Transportation System	758.26	0.00	197.28	560.98
5	Intelligent Transportation System Facilities	67.25	19.96	31.26	16.03
6	Improvement of Parking Facilities	11.39	6.87	4.52	0.00
	Overall CMP Proposals	**14407.74**	**7212.91**	**3149.00**	**4045.83**

FINANCING OPTIONS

The financing of the projects can be taken up under PPP or under government funding, exploring viability gap funding or dedicated urban transport fund.



IMPLEMENTING AGENCIES

Based on roles and responsibilities of various institutions, the agencies responsible for implementing the proposed projects in the CMP are as follows-

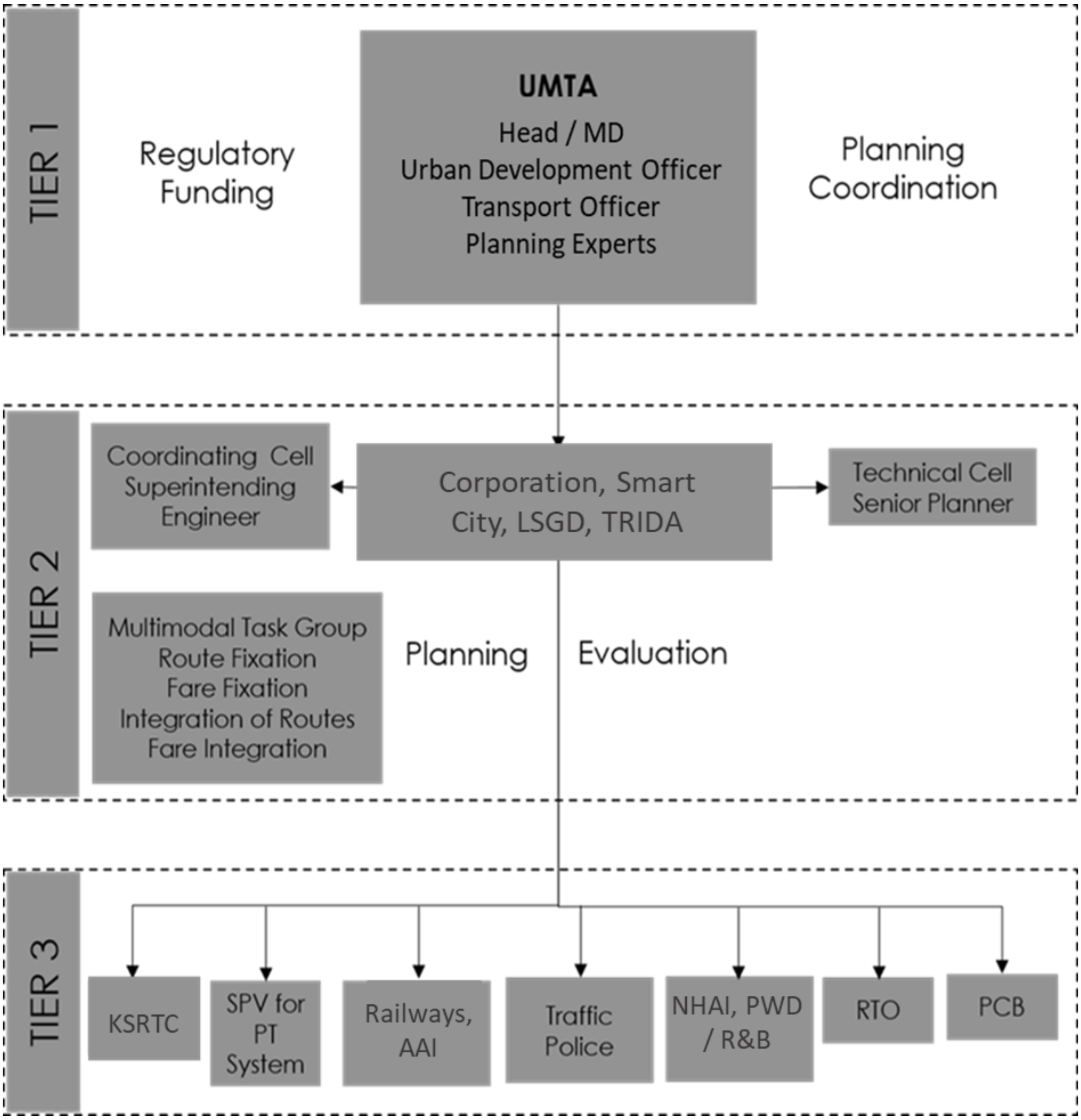
Details of Implementation Agency

SN	Projects	Agencies Responsible	Implementation Operation	
			Construction	Operation/Maintain
Improvement of Road Network				
1	Upgradation of Existing Roads	PWD/NHAI/TMC	PWD/ NHAI / Private	PWD / NHAI / Private
2	New Links	PWD/NHAI/TMC	PWD/ NHAI / Private	PWD / NHAI / Private
3	Flyover upgradation (2-Lane)	PWD/NHAI	PWD/ NHAI / Private	PWD / NHAI / Private
4	ROB/ Canal Crossing Upgradation (2-Lane)	PWD/NHAI/TMC	PWD/ NHAI / Private	PWD / NHAI / Private
5	Flyover (4-Lanes)	PWD / TMC / State Govt. / NHAI	State Govt. / TMC	PWD / NHAI / Private
6	Junction Improvements	PWD / TMC / State Govt. / NHAI	State Govt. / TMC	PWD / NHAIs
Improvement of Non-Motorised Transport Facilities				
1	Footpath	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
2	NMT Only Lanes	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
3	Shared Cycle Tracks	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
4	Dedicated Cycle Tracks	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
5	Public Bike Sharing Stations	TMC / Smart City / Private	TMC / Smart City / Private	TMC / Smart City / Private
6	Public Bike Sharing Cycles	TMC / Smart City / Private	TMC / Smart City / Private	TMC / Smart City / Private
7	Public Education and Awareness program	TMC / Smart City / Private / NGOs /State Govt.	TMC / Smart City / NGOs	TMC / Smart City / Private /NGOs
Improvement of Public Transport System				
1	Bus Fleet Augmentation	KSRTC	State Govt.	KSRTC
2	Improvement of Bus Terminals / Multi Modal Mobility Hubs	KSRTC/TMC / Smart City	KSRTC/TMC / Smart City / Private	KSRTC/TMC / Smart City / Private
3	New Public Transportation Station	KSRTC/ SPV /TMC / Smart City	KSRTC/SPV/ TMC / Smart City / Private	KSRTC/TMC / Smart City / Private /SPV
4	In Land Water Ways System	KSRTC/ SPV /TMC / Smart City	KSRTC/SPV/ TMC / Smart City / Private	KSRTC/TMC / Smart City / Private /SPV

SN	Projects	Agencies Responsible	Implementation Operation	
			Construction	Operation/Maintain
5	MRT System (BRT/LRT)	KSRTC/ SPV /TMC / Smart City	KSRTC/SPV/ TMC / Smart City / Private	KSRTC/TMC / Smart City / Private /SPV
Improvement of Freight Transportation System				
1	Proposed New Truck Terminals	State Govt. / TMC / Traffic Police	State Govt. / Private	Private
Technological and Intelligent Transportation System Facilities				
1	New Signal Installations	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police
2	Adaptive Traffic Control System	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police
3	Smart City Bus Shelters	KSRTC/ TMC/ Smart City / Traffic Police	KSRTC/ TMC/ Smart City / Traffic Police / Private	KSRTC/ TMC/ Smart City / Traffic Police / Private
4	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police
5	Electric Charging Stations - 2w and 3w	TMC / Smart City / KSEB / Private	TMC / Smart City / KSEB / Private	TMC / Smart City / KSEB / Private
Improvement of Parking Facilities				
1	On street Parking	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police / Private	TMC/ Smart City / Traffic Police / Private
2	Off street Parking (MLCP)	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police / Private	TMC/ Smart City / Traffic Police / Private
3	Off street Parking (Surface))	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police / Private	TMC/ Smart City / Traffic Police / Private

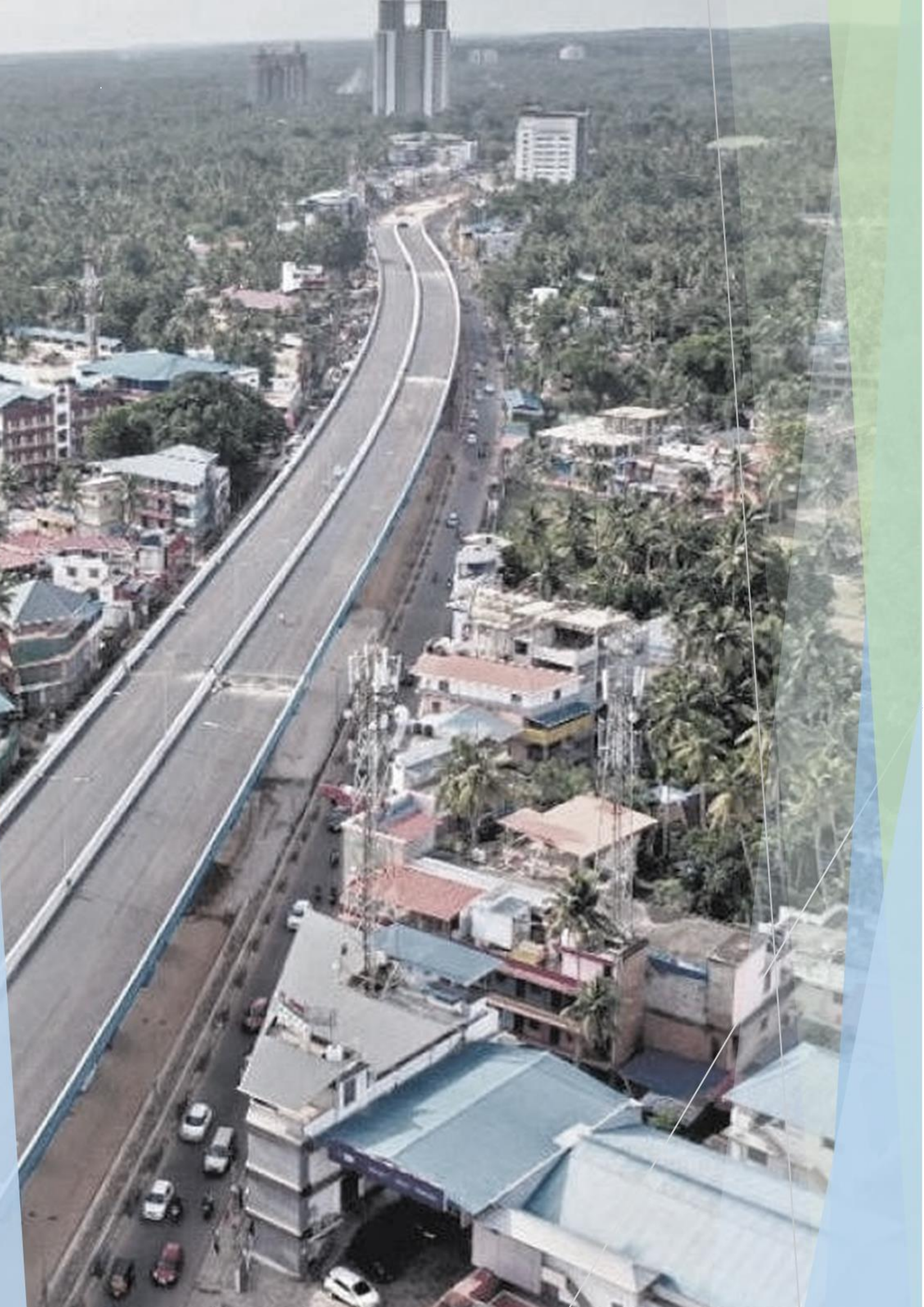
INSTITUTIONAL FRAMEWORK

City transport system generally involves several organizations that look after various forms and aspects of the transport system and network and have overlapping functions and areas of work. Therefore, to delineate areas and to remove ambiguity of functions the institutional framework has been proposed. It is recommended that the city level UMTA to be set up on an executive order for the ease of formation however, it must be given a legal backing so that it’s functioning falls under an act and commands greater authority.


TIER 1
Regulatory Funding
UMTA
Head / MD
Urban Development Officer
Transport Officer
Planning Experts
Planning Coordination
TIER 2
Coordinating Cell
Superintending Engineer
Corporation, Smart City, LSGD, TRIDA
Technical Cell
Senior Planner
Multimodal Task Group
Route Fixation
Fare Fixation
Integration of Routes
Fare Integration
Planning
Evaluation
TIER 3
KSRTC
SPV for PT System
Railways, AAI
Traffic Police
NHAI, PWD / R&B
RTO
PCB

01

INTRODUCTION



1 INTRODUCTION

The growth of Thiruvananthapuram city being strongly fostered by tourism, education, and trade and commerce thus, reducing the impact of urban development especially the transportation sector on environment is a conscious component of the city's urban planning. Sustainable Urban Transportation should be the core module of Thiruvananthapuram City as, a highly efficient transport system would ensure mobility for all through easy access to employment, education and other needs thereby supporting the envisaged economic growth activities in this capital city.

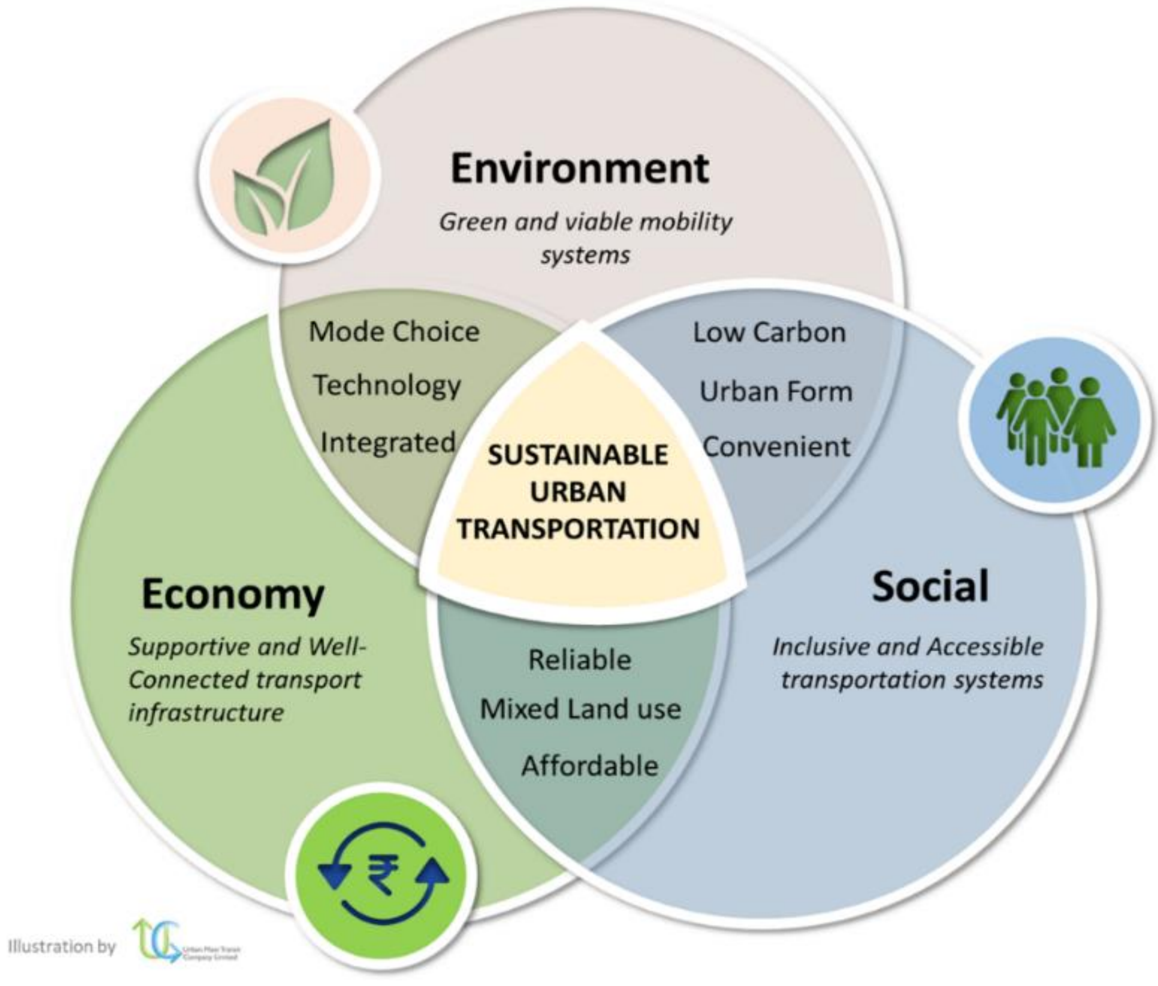


Figure 1 Concept of Sustainable Urban Transportation

A sustainable transportation is an integrated system which facilitates mobility in a way that preserves the social, environmental and economic interests of the city. Sustainable Urban Transportation planning has proven to gauge numerous comprehensive socio-economic and in environmental benefits.

These benefits include improved access to opportunities, supporting the urban growth, improved health, affordability, energy and environmental conservation, road safety, reduced parking costs, travel times, congestion and so on.

In this regard, Kochi Metro Rail Corporation Limited (KMRL) has appointed Urban Mass Transit Company (UMTC) to prepare a Comprehensive Mobility Plan (CMP) to provide comprehensive transportation strategies and policy measures for Thiruvananthapuram.

1.1 COMPREHENSIVE MOBILITY PLAN

The Comprehensive Mobility Plan (CMP) recommended by Ministry of Housing and Urban Affairs (MoHUA) is a long-term vision for desirable mobility patterns in the city and provides comprehensive and integrated transportation strategies and policy measures.

Figure 2 Graphics representing Comprehensive Urban Transportation Modes

CMP document is a roadmap for the transport infrastructure development and its investments in line with the Sustainable Urban Transportation principles.

1.2 IMPACT OF NATIONAL / REGIONAL FRAMEWORK

The Comprehensive Mobility Plans (CMP) is planned in cognizance with the national and regional frameworks and guidelines to enhance mobility, promote user safety.

1.2.1 NATIONAL FRAMEWORK

The National Urban Transport Policy (NUTP) Guidelines suggested by the Ministry of Housing and Urban Affairs (MoHUA) focus is on the following Sustainable Transportation principles:

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

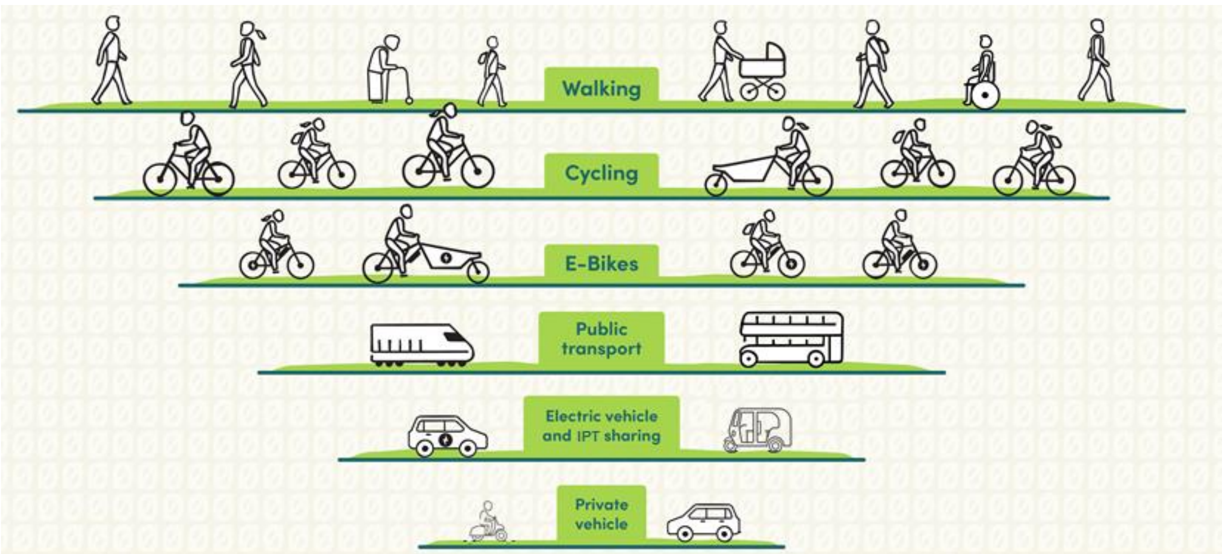


Figure 3 Hierarchy of Urban Transportation System

The thrust of NUTP is, “Moving people not vehicles” thus, outlaying a hierarchy of urban transportation system priority (Refer Figure 3). The transportation strategies and policies are recommended to prioritize infrastructure and action plans development to promote safe and convenient movement of Non-Motorised Transportation Users, followed by public transportation systems. The CMP Thiruvananthapuram is prepared on similar lines focusing on equitable road space usage for users as the core of the CMP vision (Refer Chapter 4).

1.2.2 REGIONAL FRAMEWORK

The vision of the Local Self Government Department (LSGD), Government of Kerala is to promote, "Vibrant and clean cities through inclusive, sustainable and integrated urban development, good governance and efficient service delivery" and sustainable urban transportation is one of the critical pillars of urban development to ensure ease of moving around and support the economic growth of city.

In line with the State and LSGD and Urban Local Bodies (ULBs) vision, various past studies (Refer Chapter 3 and Annexure) conducted for Thiruvananthapuram. The detailed analysis of the reviewed reports and studies have been attached in the Annexure A.

2011	DISTRICT URBANIZATION REPORT	Defines the future spatial structure of a district, which is formulated by integrating hierarchy and activity pattern of urban and rural settlements and the connectivity between them.
2012	MASTER PLAN 2031	Recommends strengthening the urban development through development of MRTS, Mobility hubs, cycle network, argumentation of bus system, sea ports in a integrated manner.
	THIRUVANANTHAPURAM MONORAIL PROJECT	Explores the feasibility of MRTS for enhanced transportation option on major mobility corridor of the city.
2015	COMPREHENSIVE MOBILITY PLAN	Recommends integrated strategies to develop a robust transportation system.
2020	DETAILED PROJECT REPORT – THIRUVANANTHAPURAM LIGHT METRO RAIL PROJECT	Details out the design of MRTS for enhanced transportation option on major mobility corridor of the city.
	THIRUVANANTHAPURAM – KASARAGOD HIGH SPEED RAIL	Emphasis on regional connectivity through semi high-speed rail line connecting
2022	MASTER PLAN, 2040	Recommends strengthening the urban development through development of MRTS, Mobility hubs, cycle network, argumentation of bus system, sea ports in a integrated manner.

This previous studies emphasis predominantly on the following principles:

5. Integrating Urban growth with Transport Planning.
6. Connectivity to surrounding urban centres.
7. Improving and promotion of Public Transport, NMVs and pedestrians.
8. Developing efficient MRTS to cater to the future needs.

Thus, considering the overall traffic and transportation perspectives, both regional and national level guidelines and approaches promote sustainable urban transport framework for 20 to 30-year horizon period. Thus, CMP Thiruvananthapuram is a necessary strategic vision document highlighting the national and regional framework for Urban Transportation.

1.3 STUDY AIM

With a vision to strengthen transportation system of this capital city in a sustainable manner while catering to the horizon year mobility needs, the study aims to provide the users in Thiruvananthapuram an efficient, smart, convenient and inclusive sustainable travel mode choices while fostering as safe, comfortable and seamless travel experience in the study area.

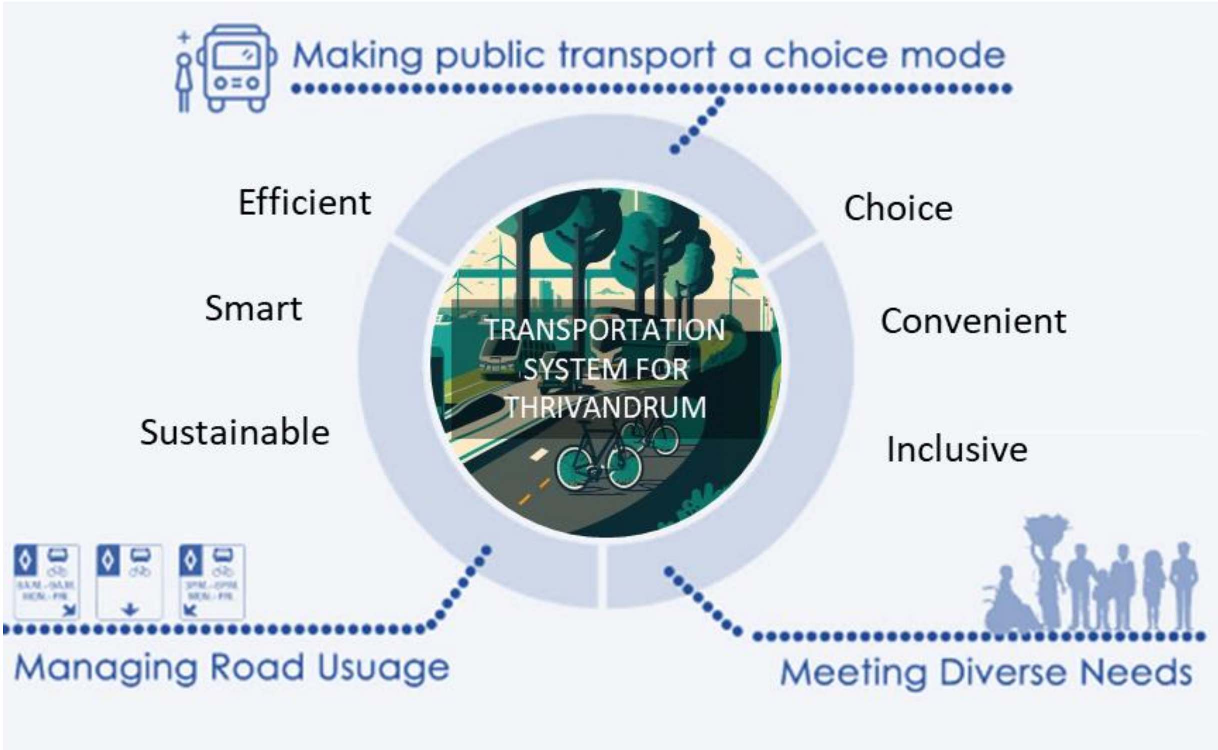


Figure 4 Thiruvananthapuram CMP Study Aim

1.4 STUDY TIME-FRAME

The study time for the study is considered as 30 years, in line with the MoHUA CMP toolkit Guidelines. The horizon years for implementation of proposed strategies and investment plan is as follows-

- Short-Term: 2027
- Medium Term: 2031
- Long term: 2041, 2051

1.5 APPROACH

The approach proposed for the project is the 4Ds approach, which represents **Define, Diagnose, Design and Develop (4Ds)** for designing the unique methodology for assignment accomplishment. This approach aims at developing holistic proposals by addressing the transportation needs of all modes in detail.

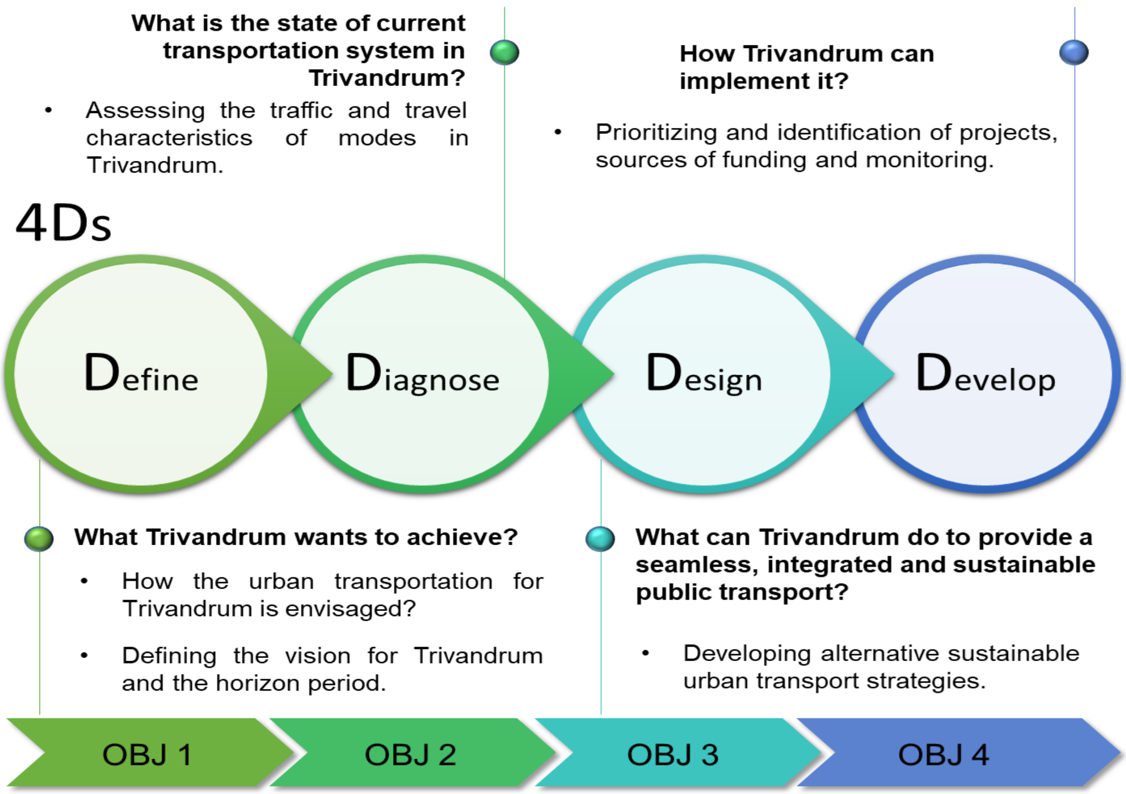


Figure 5 Proposed 4Ds Approach for the study

1.6 METHODOLOGY

The methodology proposed for the study is as presented below.

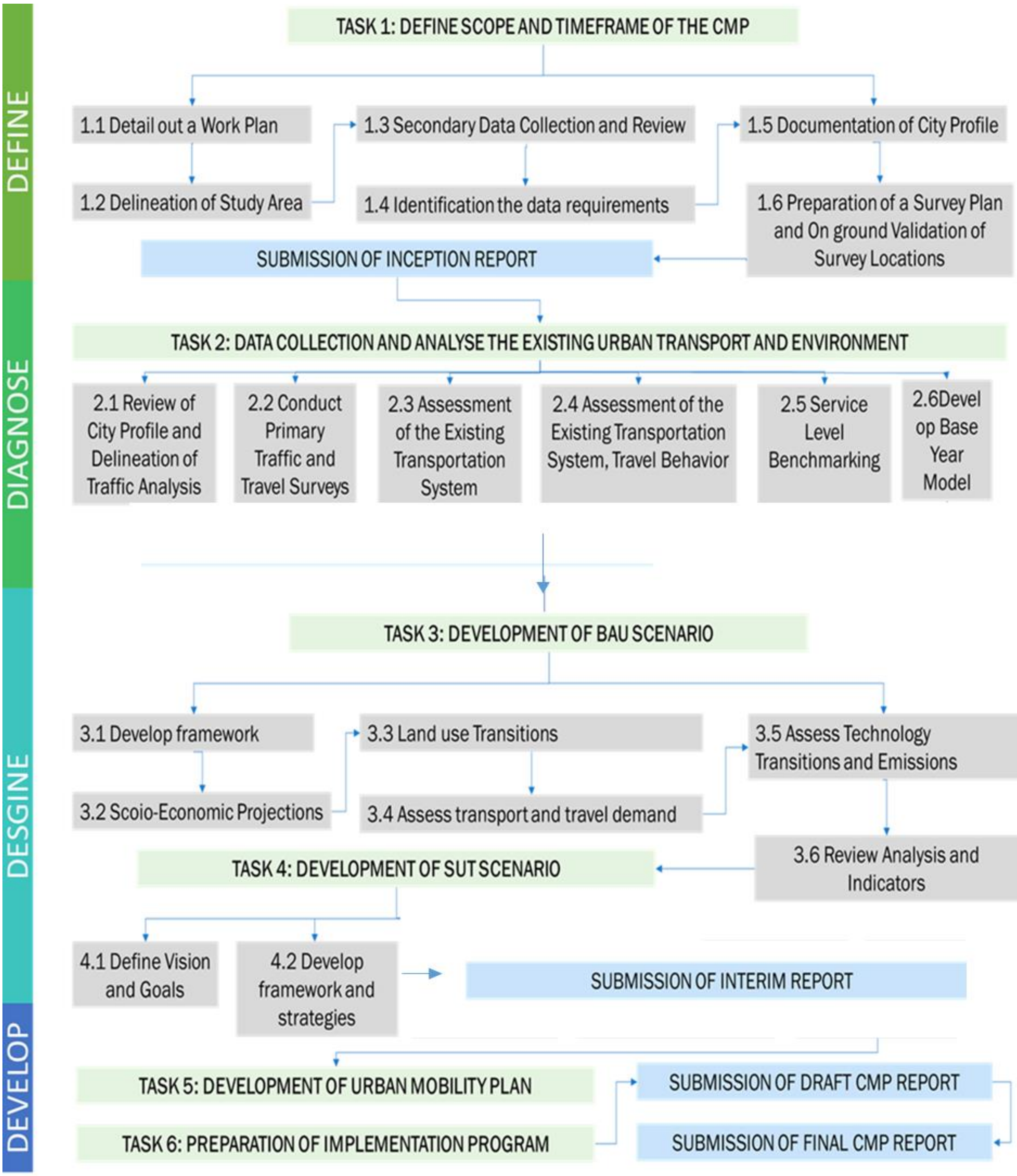


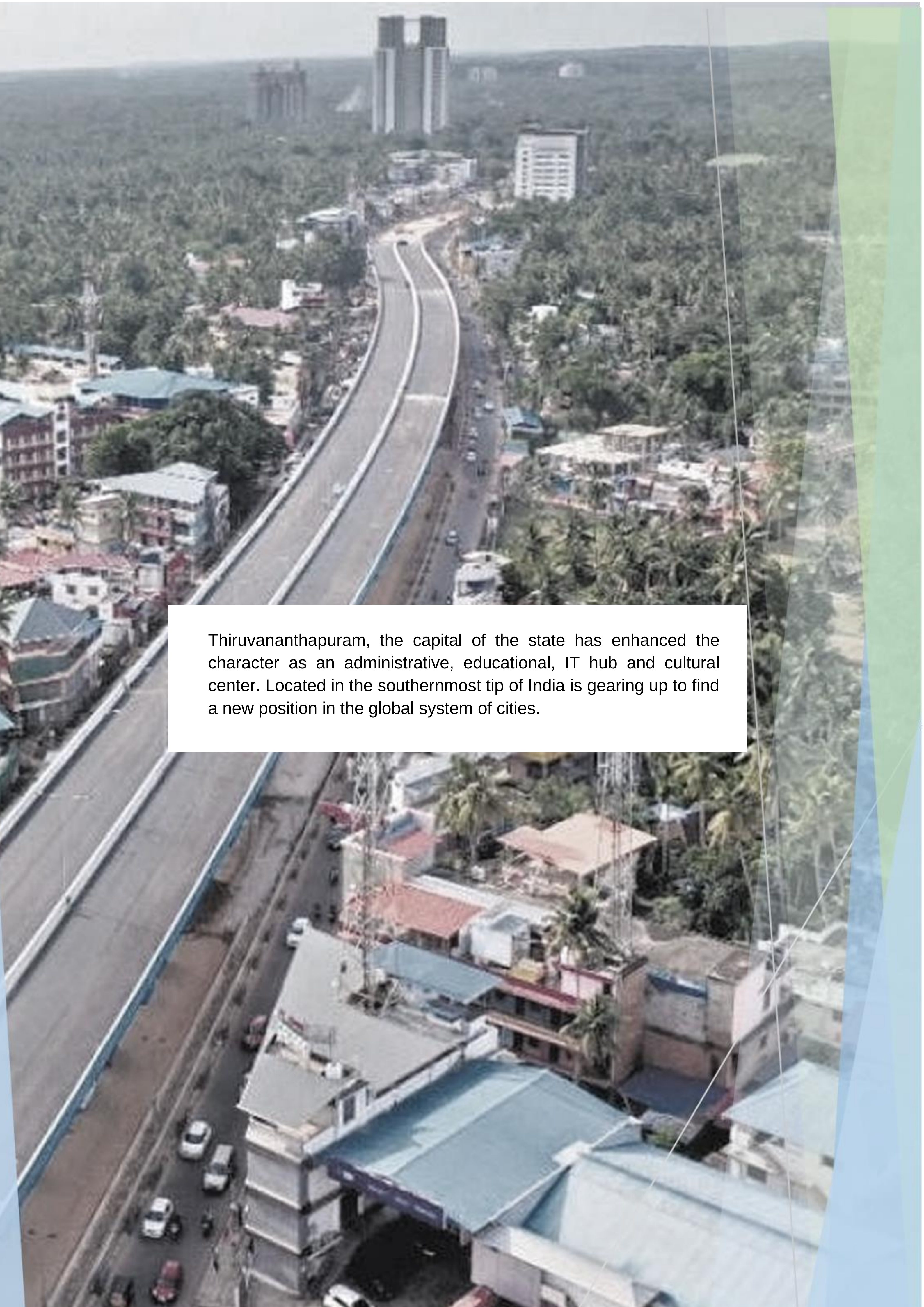
Figure 6 Methodology

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

02

STUDY AREA PROFILE



Thiruvananthapuram, the capital of the state has enhanced the character as an administrative, educational, IT hub and cultural center. Located in the southernmost tip of India is gearing up to find a new position in the global system of cities.

2 STUDY AREA PROFILE

Thiruvananthapuram the state capital, is a renowned tourism centre with presence of beaches, backwaters, heritage areas along with the presence of huge number of educational institutions of advanced studies and research institutions. The IT hub of Thiruvananthapuram is known to be the first ever established IT park in India, which is huge employment centre for people from across the country. The upcoming Port facilities, healthcare facilities, etc. contribute to the future prospects of the city making it a landmark in the Country.

Figure 7 Images depicting the diverse profile of the Thiruvananthapuram city

2.1 GEOGRAPHIC LOCATION

Geographical situated on the southernmost tip of the country at 8.5241° N, 76.9366° E Latitude and longitude coordinates. Located in the southern State of Kerala, it is the administrative capital of the Thiruvananthapuram District.

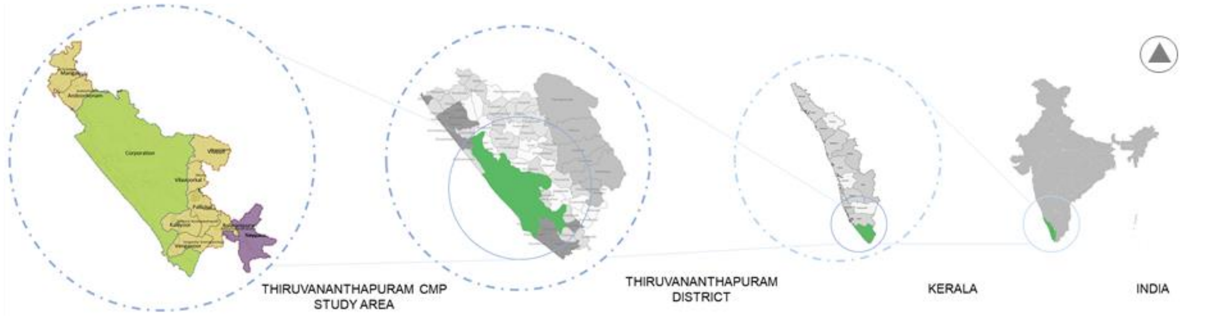


Figure 8 Location Map of Thiruvananthapuram

It is located within a distance of 200km from the major cities and towns in the southern region (Refer Figure 10). Physiography of Thiruvananthapuram region changes from plane coastal to highly undulating highland making a varied topography.

Figure 9 Connectivity Map of Thiruvananthapuram (Source: Compilation from LSGD data -2022)

Figure 10 Map Showing Major Nodes and Linkages for Regional Connectivity

2.2 REGIONAL CONNECTIVITY PROFILE

The study area is well connected to other urban centres via National and State Highways, regional railways and by domestic airways.

- City can be accessed from the North South Corridor National Highway (NH) 44, via NH 544 (old NH-47) at Salem, and at Kochi via NH 66. NH-66 passes to the centre of the study area, which is the main spine of city's road network. The city is also connected by the State Highways (SH)- SH 1, SH2, SH 45, While SH1and 2 ply through the city.
- Thiruvananthapuram central station and nine stations that serve the study area catering to 41 thousand passengers daily (Refer Section 2.10).
- While air connectivity to domestic[8] and international[9] urban centres is catered by over 600 weekly operations (Refer Section 2.9 for further details).
- Kerala State Road Transportation Corporation (KSRTC) and various other private players operate sub-urban and regional services in the study area. KSRTC alone operates nearly 701 buses on sub-urban and regional routes.

Figure 11 Photographs of Major Nodes and Linkages for Regional Connectivity

[8] Offering connectivity to Chennai, Hyderabad, Mumbai, Daman, Bengaluru, Kochi, Delhi, Kannur, and Kozhikode.

[9] Kuwait, Doha, Dubai. Abu Dhabi, Bahrain, Colombo, Sharjah, Singapore and Muscat.

2.3 STUDY AREA DELINEATION AND ADMINISTRATIVE BOUNDARIES

The study area comprises of Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and eight adjoining panchayats spread over an area of 371.94 sqkm (91908 Acre), as shown in Table 1.

Table 2-1 Thiruvananthapuram Planning Area Details (Source: LSGD Secondary Data, Census-2011)

S NO.	ADMINISTRATION	AREA (SQ KM)
1	Thiruvananthapuram Municipal Corporation	212.84
2. Panchayats		
2a	Mangalapuram	21.66
2b	Andoorkonam	13.96
2c	Vilavoorkal	12.02
2d	Vilappil	19.42
2e	Balaramapuram	10.53
2f	Kalliyoor	17.23
2g	Pallichal	21.7
2h	Venganoor	13.8
3. Municipality		
3a	Neyyattinkara	28.78
TOTAL		**371.94**

Thiruvananthapuram Municipal Corporation has 100 wards spread over an area of 212.84 sqkm of area. The ward wise list of the above-mentioned study area is presented in the Annexure.

Figure 12 Map Showing the Administrative Boundaries in the Study Area

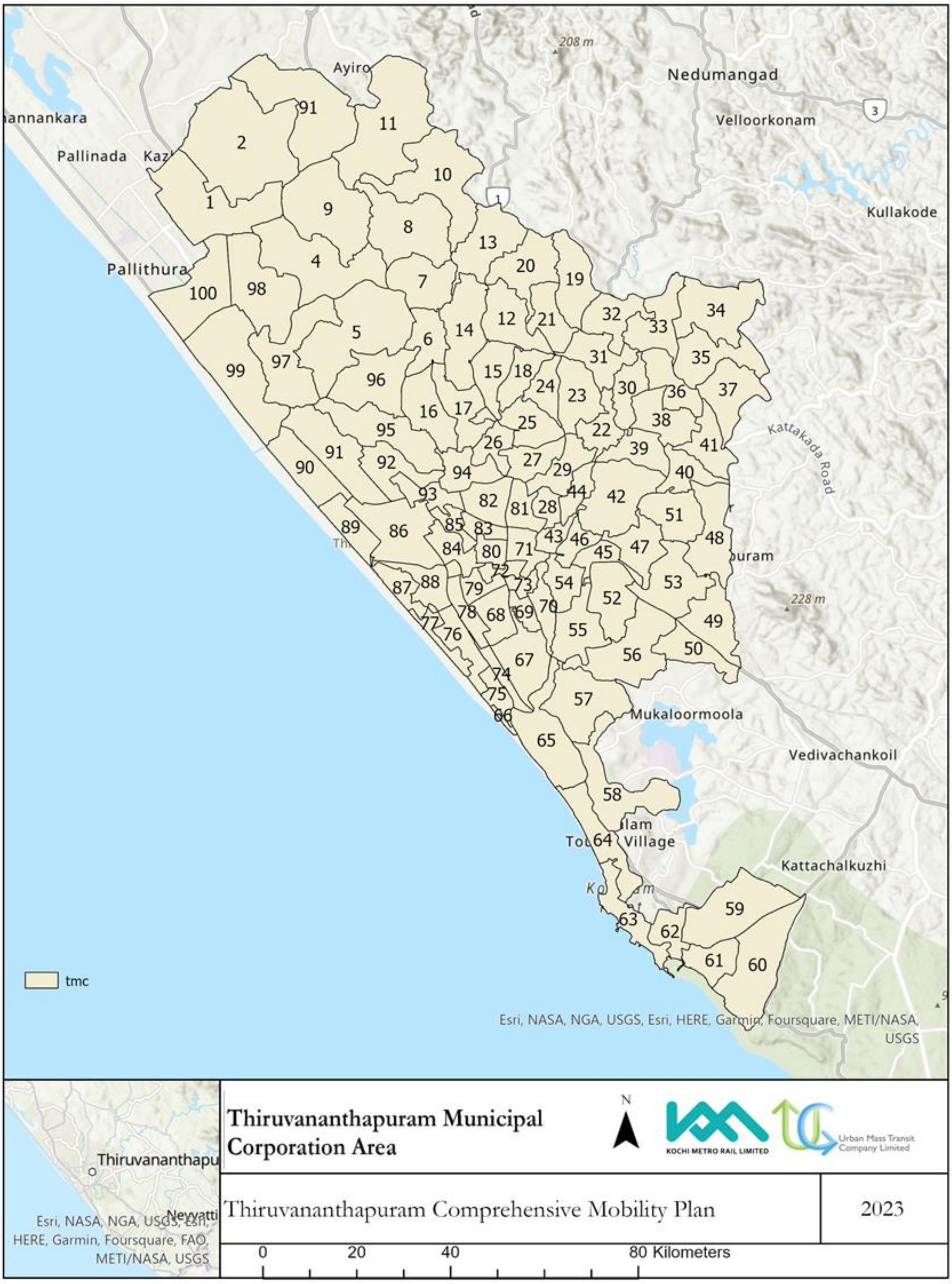


Figure 13 Thiruvananthapuram Municipal Corporation Boundary with Wards (Source: Thiruvananthapuram Municipal Corporation, 2022)

Neyyattinkara is a town and municipality in the Thiruvananthapuram district of Kerala, India. Neyyattinkara is situated 20 km east of Thiruvananthapuram city on NH- 66 and is an important outgrowth of the city. Neyyattinkara and the neighbouring areas has many cottage industries and handloom. Neyyattinkara Municipality is spread over an area of 28.78sqkm, housing 0.69 Lakh population as per census 2011.

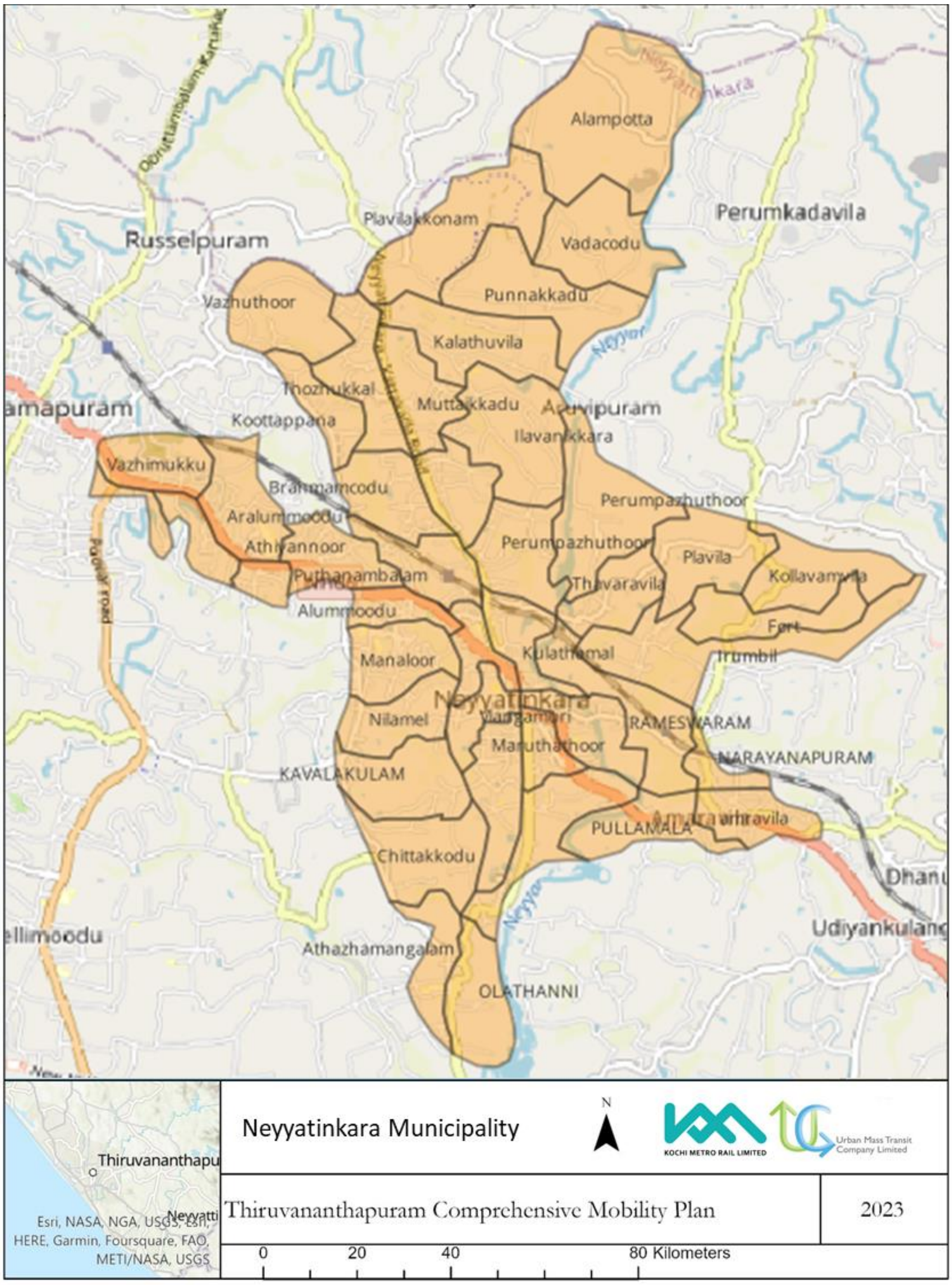


Figure 14 Neyyattinkara Municipality Boundary with Wards (Source: Neyyattinkara Municipality, 2022)

2.4 URBAN GROWTH PATTERN

The urban sprawl in Thiruvananthapuram has taken place predominantly in east and south directions. Settlements have primarily emerged along the major transport corridors. Rapid urbanization can be observed that along the major mobility corridors such as NH-66, NH Bypass, MC Road, Perookooda road, etc.

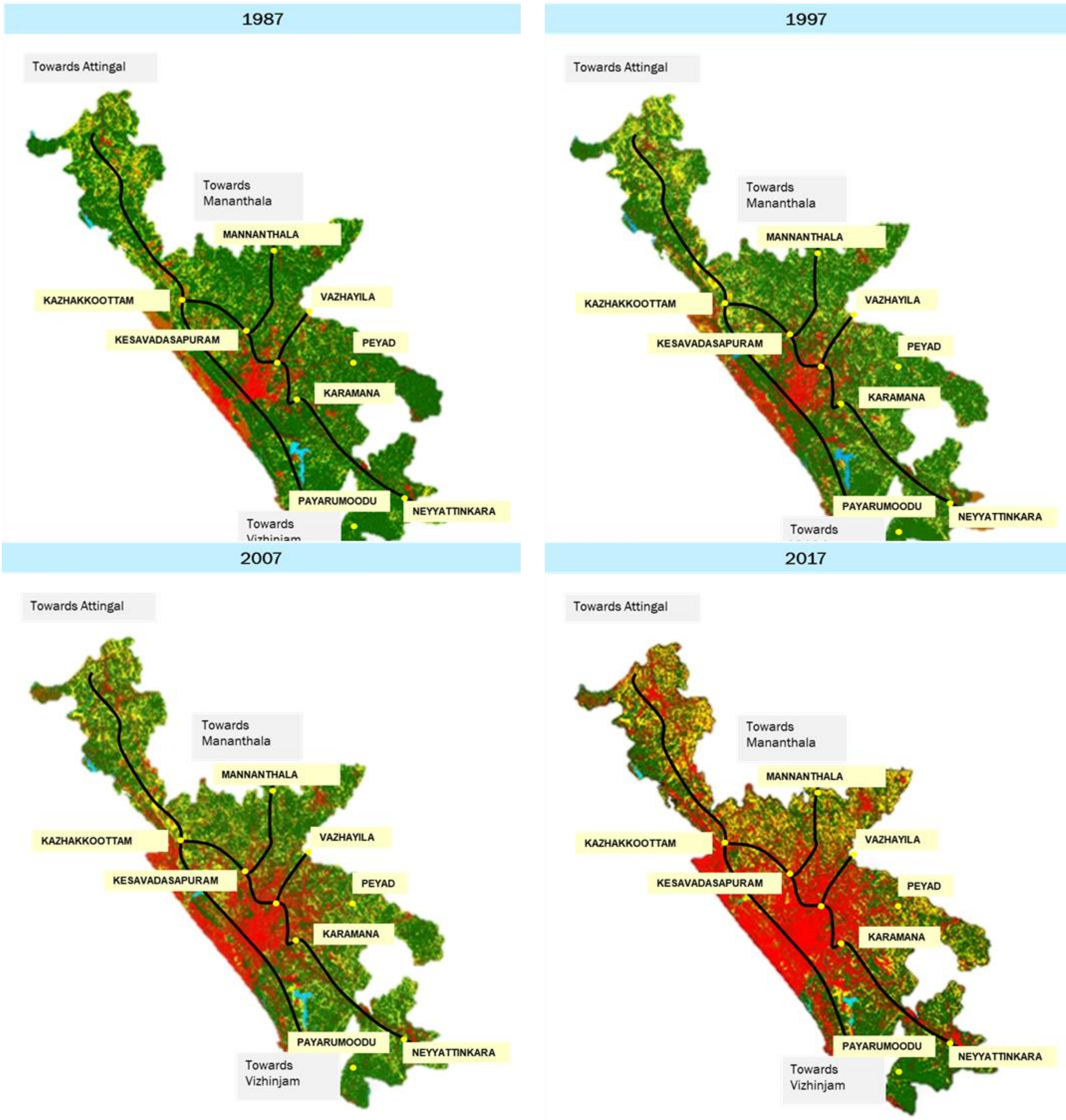


Figure 15 Urban Growth Pattern (Source: A Case Study of Thiruvananthapuram Urban Agglomeration, India. Journal of the Indian Society of Remote Sensing, 2017)

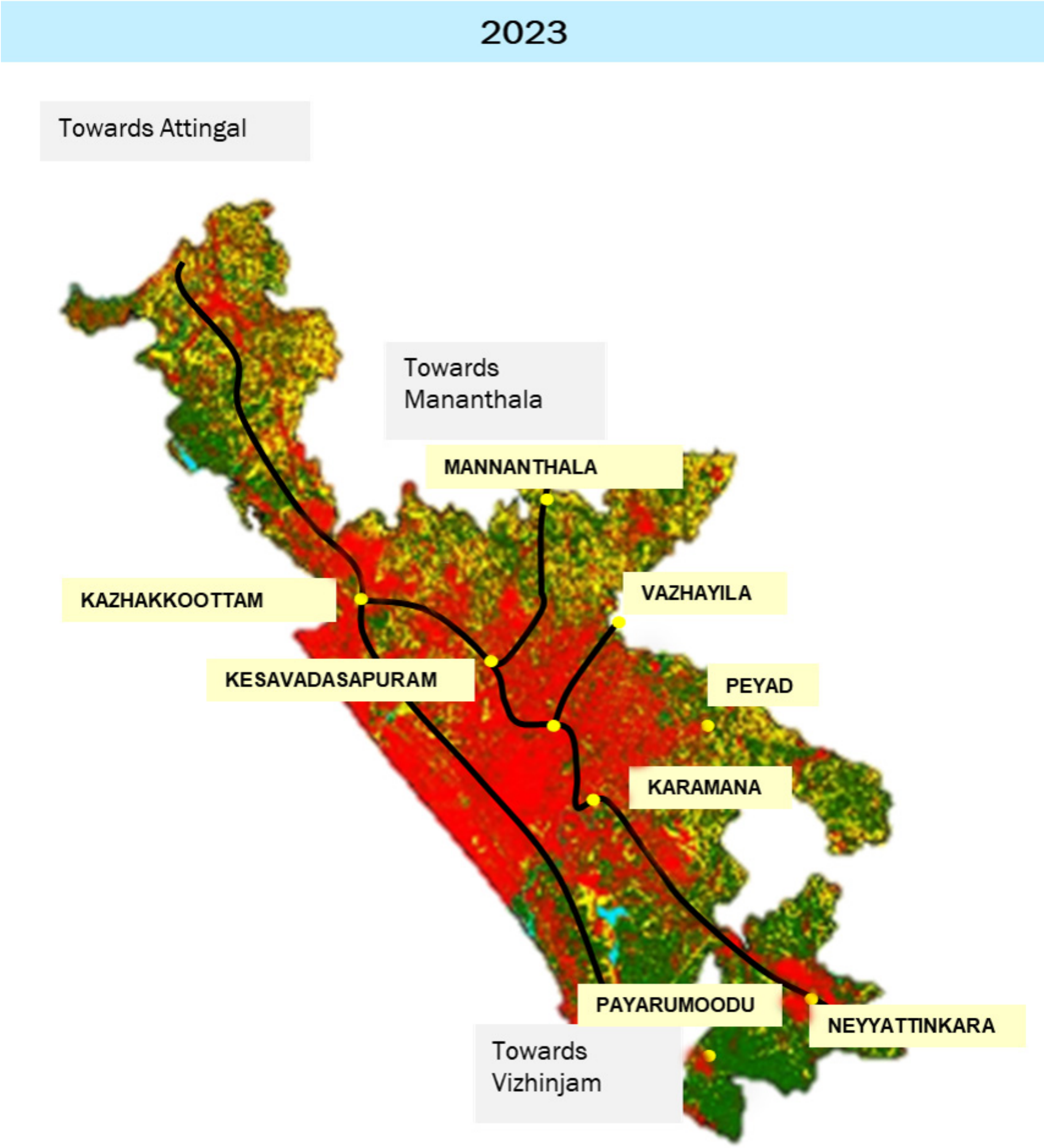


Figure 16 Urban Growth Pattern (Source: A Case Study of Thiruvananthapuram Urban Agglomeration, India. Journal of the Indian Society of Remote Sensing, 2017& 2023 Satellite Imagery, NRSC)

The current growth pattern is somewhat semi-radial with Techno-Park being the major growth magnet on north, Vizhinjam International seaport and Neyyyattinkara in the south, Mannanthala, Peroorkada, Nedumangad, Peyad in the east.

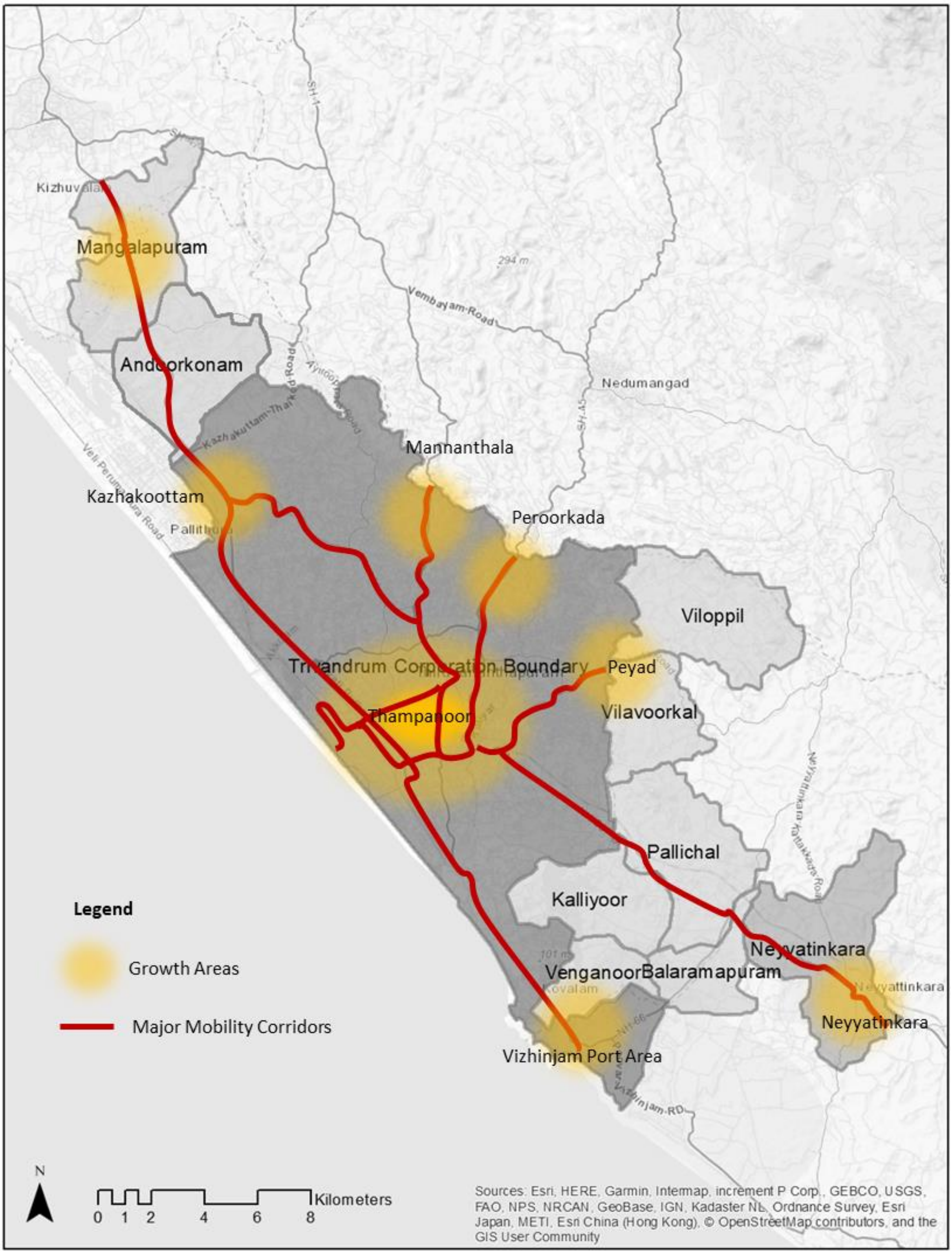


Figure 17 Major Urban Growth Areas (Source: Primary Assessment for secondary data sources)

2.5 DEMOGRAPHIC PROFILE

Thiruvananthapuram planning area comprises of the city of Thiruvananthapuram, municipality of Neyyattinkara, along with eight adjoining panchayats had recorded a total population of 13.3 lakhs. The population of Thiruvananthapuram Corporation as per 2011 census is 9.69 lakhs.

The Draft Master Plan Report for 2040 has presumed that 1.45% growth rate would be sustained in the coming years and a constant growth was used to predict the future population, as it is expected that more people would be attracted to the city by the implementation of large projects such as Vizhinjam sea port, Techno Park expansion etc, which is anticipated to balance the declining growth rate. Accordingly, the corporation area was projected to house a population of 10.12 lakhs by 2041.

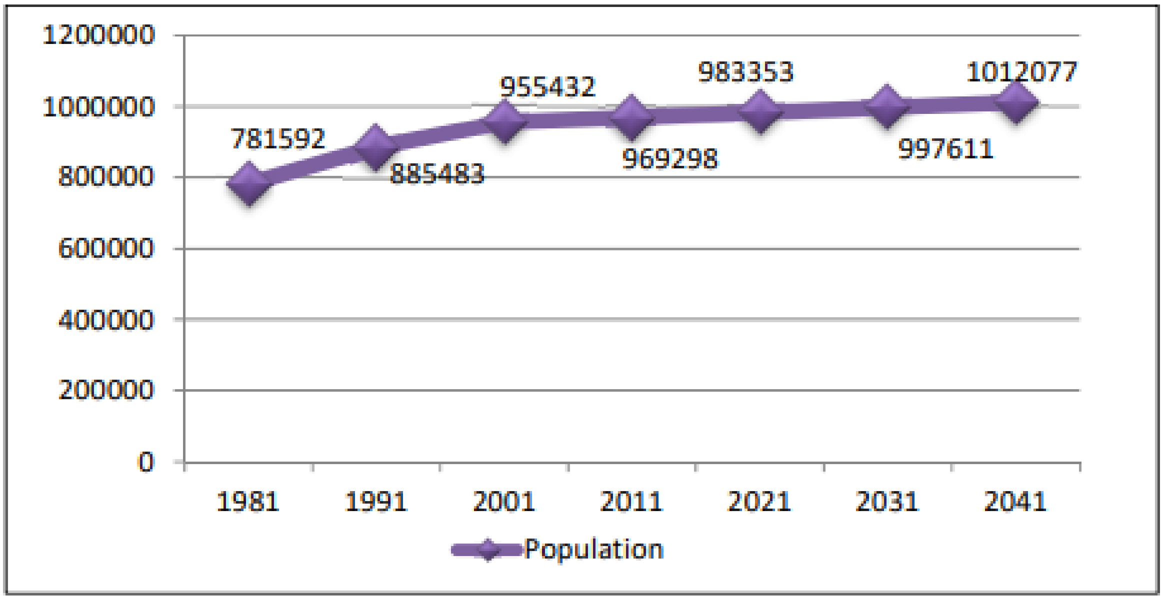


Figure 18 *Population Forecasted for Thiruvananthapuram Corporation (Source: Draft Master Plan Report 2040, Year - 2022)*

Linear population growth is considered for the base year projections in line with the draft proposed Master Plan -2040.

The base year (2023) population of 16.27 lakhs is estimated based on the census population of 2011 and recent studies conducted in the study area (including draft master plan). However, considering the intensive economic growth in the study area, the estimated population needs to be validated based on upcoming census data. For evaluating the sustainable urban transport scenario, population of about 28.47 lakhs (section 7.3.2) is considered for the year 2051 in the study area, which is a highly optimistic scenario.

Table 2-2 Thiruvananthapuram Study Area Population Details (Source: Census-2011, Draft Master Plan 2040 and UMTC Estimates 2023)

POPULATION IN LAKHS	2011	2023
Thiruvananthapuram Municipal Corporation	9.69	9.86
Rest of the Study Area	3.63	3.69
Floating Population	-	2.71
TOTAL POPULATION	13.32	16.27

Thiruvananthapuram, being a prominent tourism and institutional centre, the study area experiences floating population of students, visitors, employees and migrant workers. Based on the records of Tourism department[10] and LSGD master plan[11] studies, an additional 20% of total population was observed as floating population in the region during pre-covid conditions (2018,2019) and only 10% of total population in 2021 due to the covid impact. However, the draft document on Master Plan considers about 20% of floating population in the region. Thus, a floating population of 2.71 lakhs has been considered for the base year 2023.

The population density of the study area is observed to be 3645 ppsqkm, accounting to be third dense urban area in the state followed by Kochi and Kozhikode.

Table 2-3 Thiruvananthapuram Study Area Population Density Details (Source: Census-2011, Draft Master Plan 2040 and UMTC Estimates 2023)[12]

POPULATION DENSITY IN PEOPLE PER SQKM (ppsqkm)	2011	2021	2023
Thiruvananthapuram Municipal Corporation	4554	4620	4634
Rest of the Study Area	2282	2316	2322
Total Study area	**3582**	**3635**	**3645**

10 Kerala Tourism Statistics-2019, A study on In-migration, Informal Employment and Urbanization in Kerala- 2017.

11 Draft Report for Master Plan for Thiruvananthapuram-2040,2022.

12 Population Density Calculated using the area details presented in Table 1 and population details presented in Table 2.

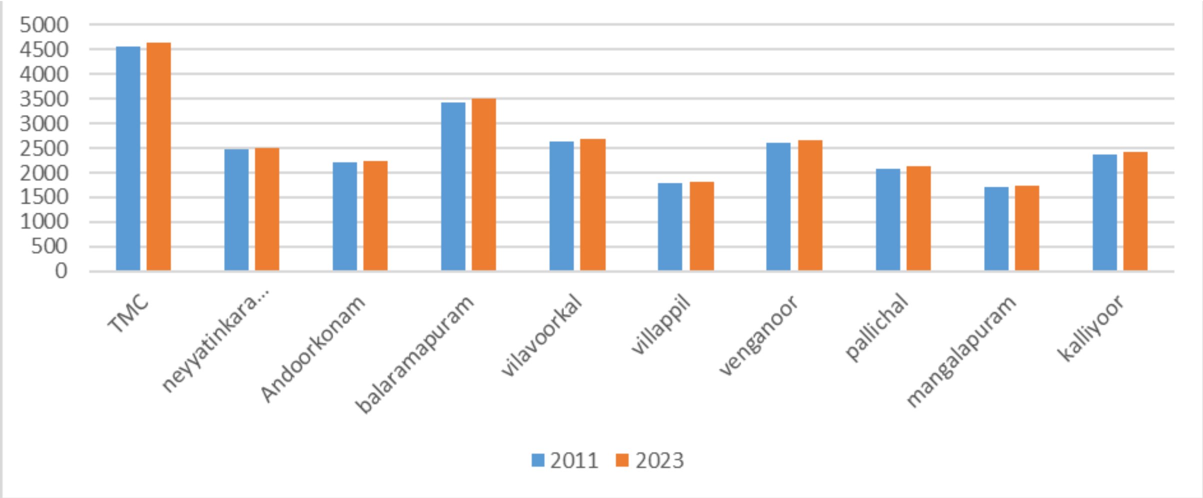


Figure 19 Thiruvananthapuram Study Area Population Density Details (Source: Census-2011, Draft Master Plan 2040 and UMTC Estimates 2023)

The average household size in Thiruvananthapuram is 3.55[13], out of which 51% of resident population are male and 49% female. As per census 2011 the sex ratio is 1064 females per 1000 males.

Figure 20 *Population Sex Ratio*

[13] As per previous CMP-2015. The average household is observed to decrease from 4.0 as per census 2011.

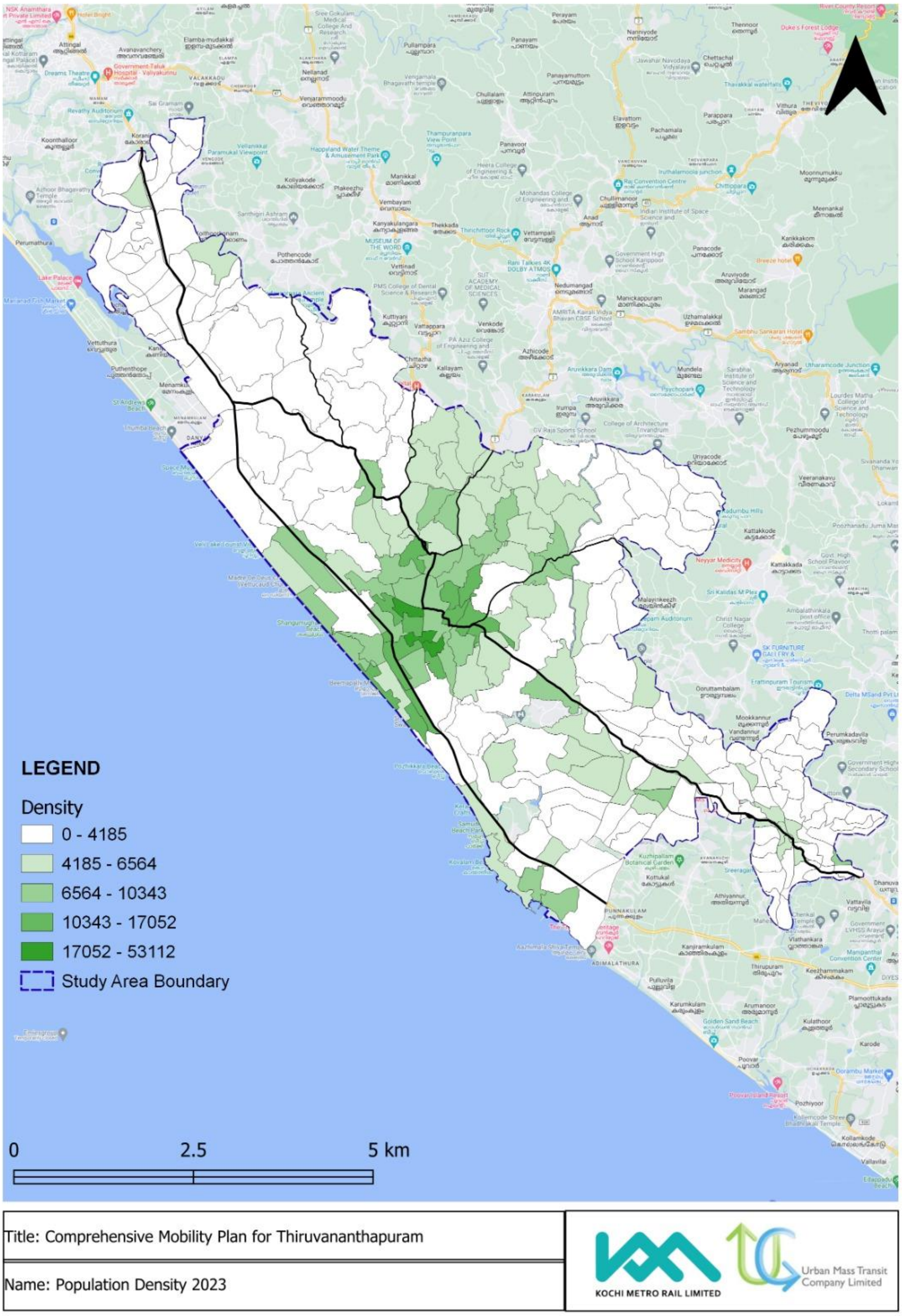


Figure 21 Population Density Distribution

2.6 LANDUSE

The share of transportation accounts to about 7% in the total area and about 10% of the total developed area within the corporation limits indicating decent share of transportation in land use mix.

Table 2-4 Land use Distribution (Source: Master Plan 2031, Draft Proposed Master Plan-2040)

LAND USE	EXISTING LAND USE (2012)	EXISTING LAND USE (2019)	PROPOSED LAND USE (2040)
Agricultural Land	21.59%	18.67%	
Commercial	1.17%	1.8%	
Mixed Use		0.7%	37.1%
Industrial & IT Parks	0.84%	1.2%	1.1%
Residential	55.75%	47.1%	
Public & Semi-Public	12.91%	5.5%	9.6%
Transportation	2.99%	7.2%	6.7%
Vacant Land		3.6%	
Waste Lands	0.25%	0.1%	
Water Bodies	2.40%	1.9%	2.1%
Wetlands / Conservation areas		6.0%	4.2%
Educational	1.79%	2.8%	
Health Services		0.6%	
Heritage		0.1%	0.3%
Recreation & Tourism Zone	0.31%	1.1%	1.4%
Communication		0.1%	
Religious		1.3%	
Core Area Zone			1.3%
Priority Development Zone			36.2%
Others		0.1%	
	100.0%	**100.0%**	**100.0%**

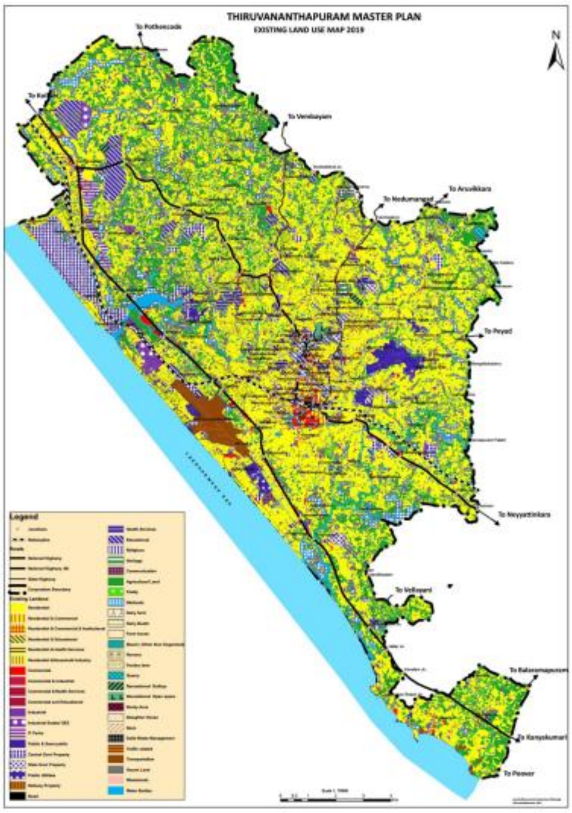


Figure 22 Existing Land use of City-2019 (source- Draft Proposed Master Plan,2040

The proposed draft Master Plan 2040 prioritizes 36.2% of the land under priority development zone, which falls between the NH-66, NH Bypass, MC Road and Peroorkada Road. Further, 25.9sqkm of area has been demarked for development of transit-oriented zones along NH-66 and NH Bypass indicating the potential for developing a high-capacity transportation system to strengthen the development.

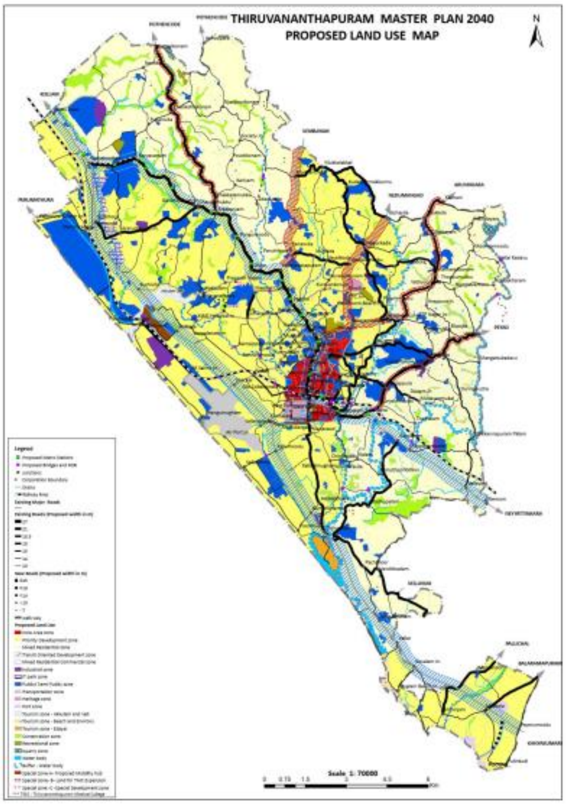


Figure 23 Proposed Land use of City-2040 (source- Draft Proposed Master Plan,2040)

2.7 ECONOMIC PROFILE

Work Participation Ratio (WPR) for Thiruvananthapuram Corporation is 36% percent as per census 2011, which increased from 29.7 percent as per 2001 census. The WPR of the city is observed to be higher than the state average ratio of 34% owing to the prominence of the state capital. Main workers constituted 86% of the total work force in the corporation area.

Table 2-5 Total Resident Workers in Corporation area[14]

YEAR	POPULATION (IN LAKHS)	WORKERS (IN LAKHS)	WPR
2011	9.69	3.48	36%

Thiruvananthapuram Corporation being the state capital, houses more than 2000 government offices as per the records of State Department Contact Directory, 2022.

The government sector employees a significant share of the population in Thiruvananthapuram, accounting to over 20%[15] of the total working population.

Figure 24 Photographs of State Secretariat, Thiruvananthapuram

[14] Census-2011

[15] Draft Master Plan -2040, 2022

Techno-Park is the major employment generating industry, located in Kazhakkoottam region. It is the largest IT park in India in terms of built-up area and spread over an area of 10.6million sqft.

Currently there are about 470 companies in the Techno-Park area employing nearly 70,000[16] people.

Figure 25 Photographs of Techno-Park Area, Thiruvananthapuram

Other than Techno-Park, city has few other large and medium scale industries such as Kerala State Electronics Development Corporation (KELTRON), Thiruvananthapuram Rubber Works at Chakkai, Travancore Titanium Products Ltd, English Indian Clays Limited, Kerala Automobiles Ltd, Hindustan Latex, BrahMos Aerospace Private Limited, Kinfra Apparel Park (KIAP), etc. Handloom weaving at Balaramapuram along with Wooden Crafts & Carvings Development Society at Neyyattinkara are prevalent in the southern region of the study area.

In 2012, industrial area was around 1.82 sqkm which has increased to 2.6sqkm as on 2019 as per existing land use documentation[17].

As per the records of Directorate of Industries and Commerce (DIC), Government of Kerala there are about 25 thousand industrial units in Thiruvananthapuram. Large and medium industries employ around 40,000 people[18].

Figure 26 Photographs of Major Industries in Thiruvananthapuram - Kerala State Electronics Development Corporation (KELTRON) -Left, Travancore Titanium Products Ltd – Middle and Kinfra Apparel Park - Right

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[16] Techno-park Data, Ref: ETPK/CR/KMRL/2023/126, 2023

[17] Draft Master Plan -2040, 2022

[18] Industrial Profile of Thiruvananthapuram-MSME, Annual Survey of Industries 2018-19(Volume I)-2022

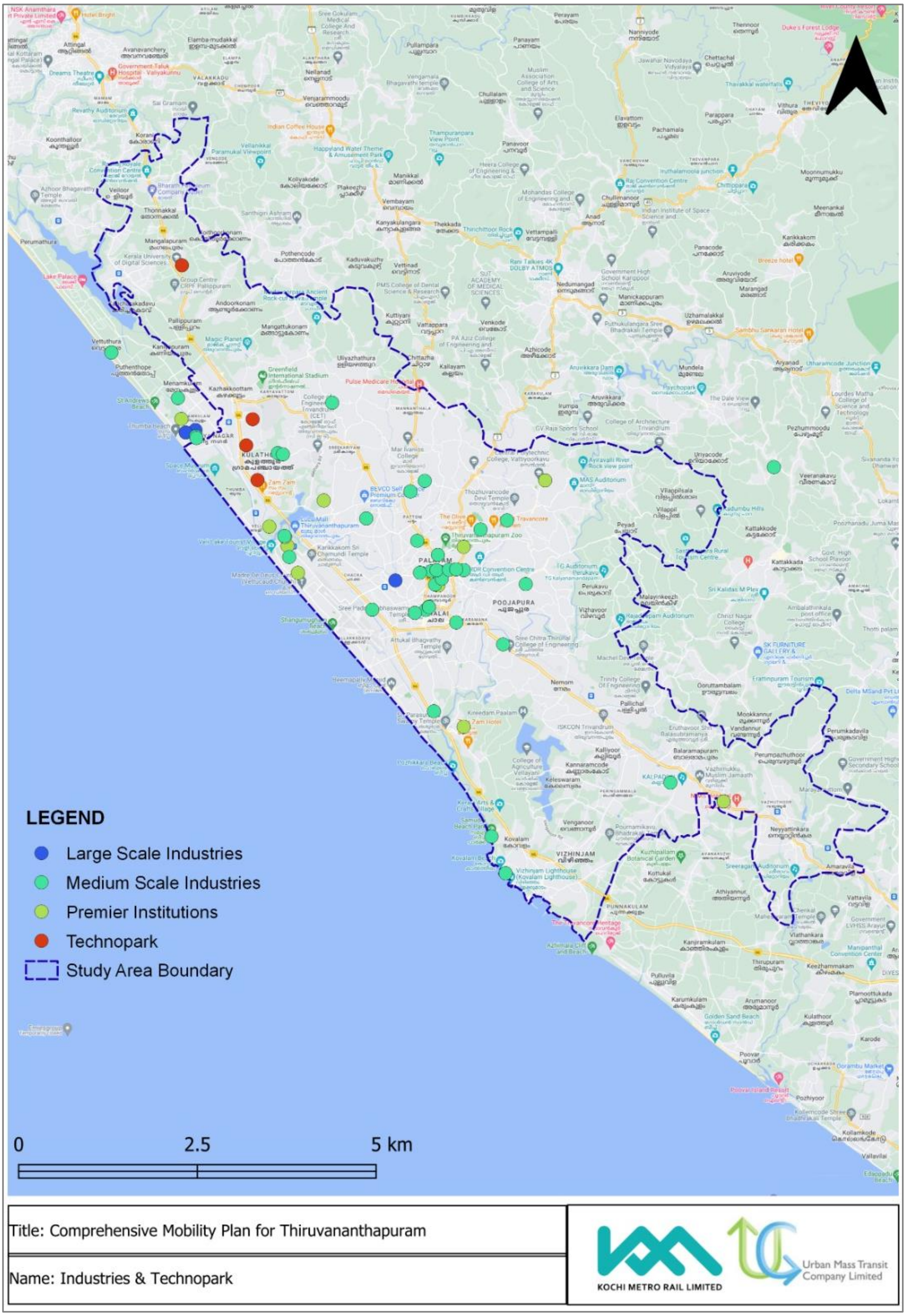


Figure 27 Map showing major industries and Techno-Park areas in the study area

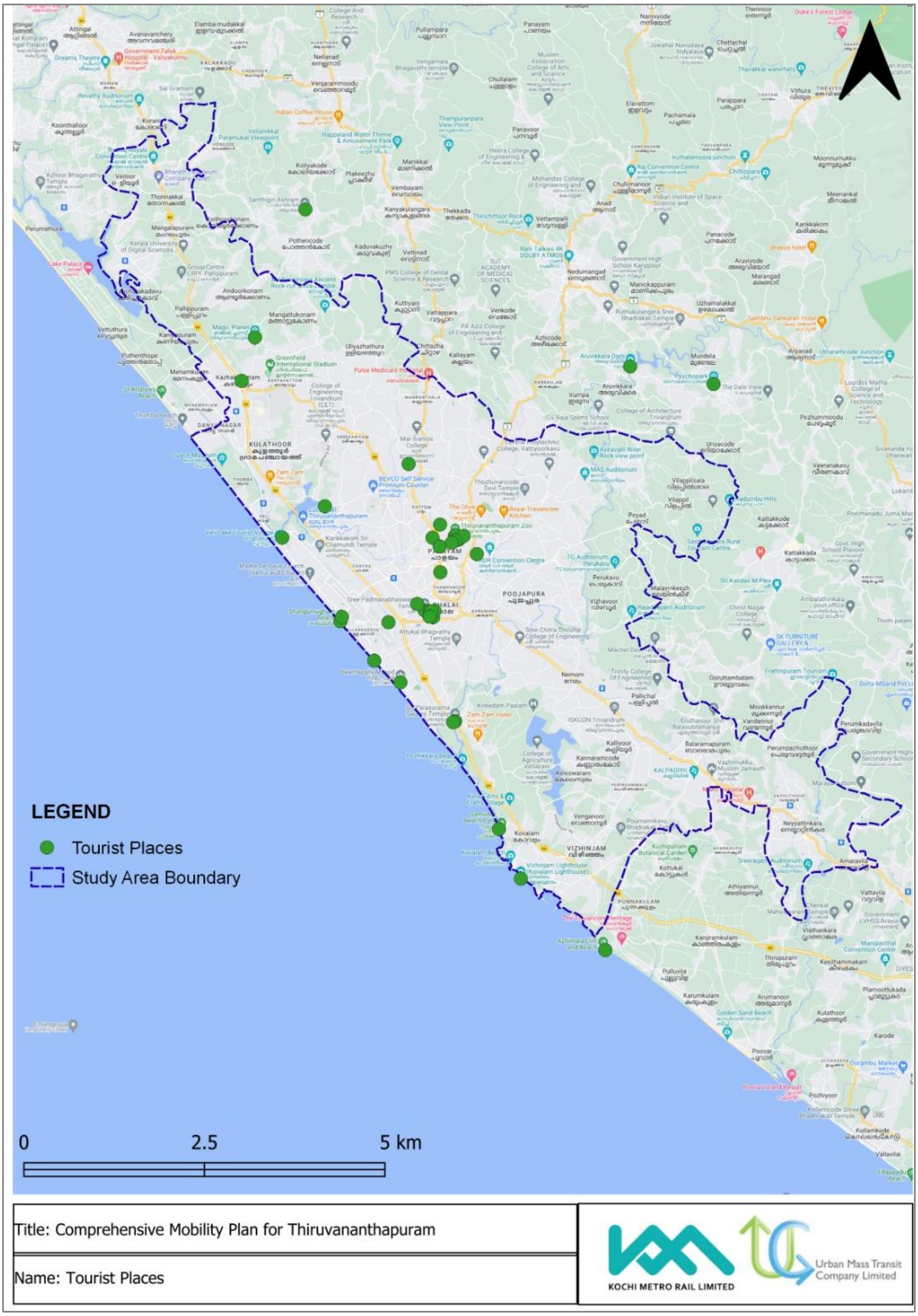


Figure 28 Map showing major Tourist Attractions in the study area

Tourism also contributes largely to the economy of Thiruvananthapuram. Thiruvananthapuram is a gateway to spirituality with Padmanabha Swamy temple which is considered as the richest temple in the world, gateway to serene beaches and back waters of Kovallam, Varkala, Pavoor, etc. Jatayu Center is the newest attraction on the national tourism list.

As per the Department of tourism records, nearly 30 lakh tourists visited Thiruvananthapuram annually before COVID and about 12 lakh tourist post-COVID, as son 2021[19].

Figure 29 Photographs of Major Tourism Centres in and around Thiruvananthapuram – Padmanabha Swamy Temple (Top Left), Jatayu Center (Top Right), Kovallam (Bottom Left) and Kowdiar Palace (Bottom Right).

Thiruvananthapuram, has gained fame over the past few years as the pinnacle of Ayurveda treatments and naturopathy and is a destination for chartered flights to India for Medical tourism.

Nearly 30% of the foreign tourist avail medical tourism.

In addition, Vizhinjam International Transhipment Deepwater Multipurpose Seaport towards the south of the study area. This seaport is envisioned to put India on the global maritime map by stimulating hinterland gateway traffic and creating new supply-chain networks.

The seaport is envisioning to provide about 1 lakh indirect employment in the region.

[19] Kerala Tourism Statistics-2019, 2021- Department of Tourism, GoK

Figure 30 Photograph of Vizhinjam International Seaport

Trade is largely concentrated in the core city along Chalai and Palayam areas. Chalai bazar the central point for the supply of commodities in the region. The market is spread through the narrow 2 km road connecting Killipalam and East Fort, which runs from East to West. The Palayam Junction is widely popular for the Connemara Market. The M.G. Road is the recent and the main thoroughfare in the town, along which various shops and shopping centres are positioned.

In addition, World Vegetable Market in Kochuveli is a prominent trading location in the study area. With a vast range of fresh produce, fruits, and organic vegetables, this market complex caters to the vegetable needs of the region.

Figure 31 Photographs of Major Commercial and Trade Centres in Thiruvananthapuram Chalai Market (Top Left), Connemara Market (Top Right), World Vegetable Market (Bottom Left) and MG Road (Bottom Right)

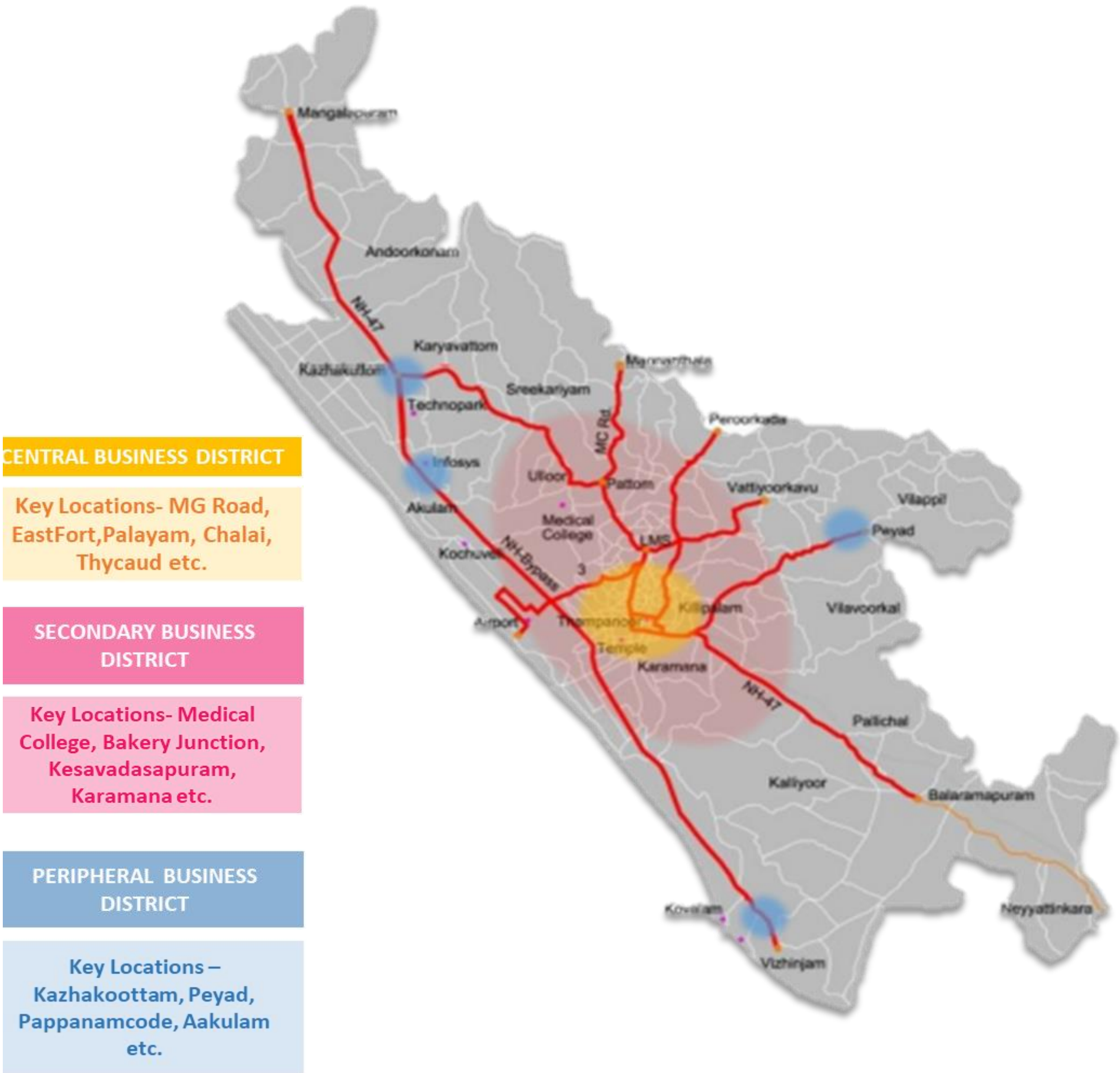


Figure 32 Major Economic Activity Generation Nodes in the study area (Source: Primary and Secondary Data Assessment, 2022)

Thus, the central business district in the study area houses the Palayam, East Fort, Chalai, Thycaud and so. The secondary business centres house areas such as Kesavadapuram, Karamana, MC area, etc and the peripheral business centres which area recent and upcoming business centres include Kazhakoottam, Peyad, Pappanamcode, Aakulam, Vizhinjam and so on.

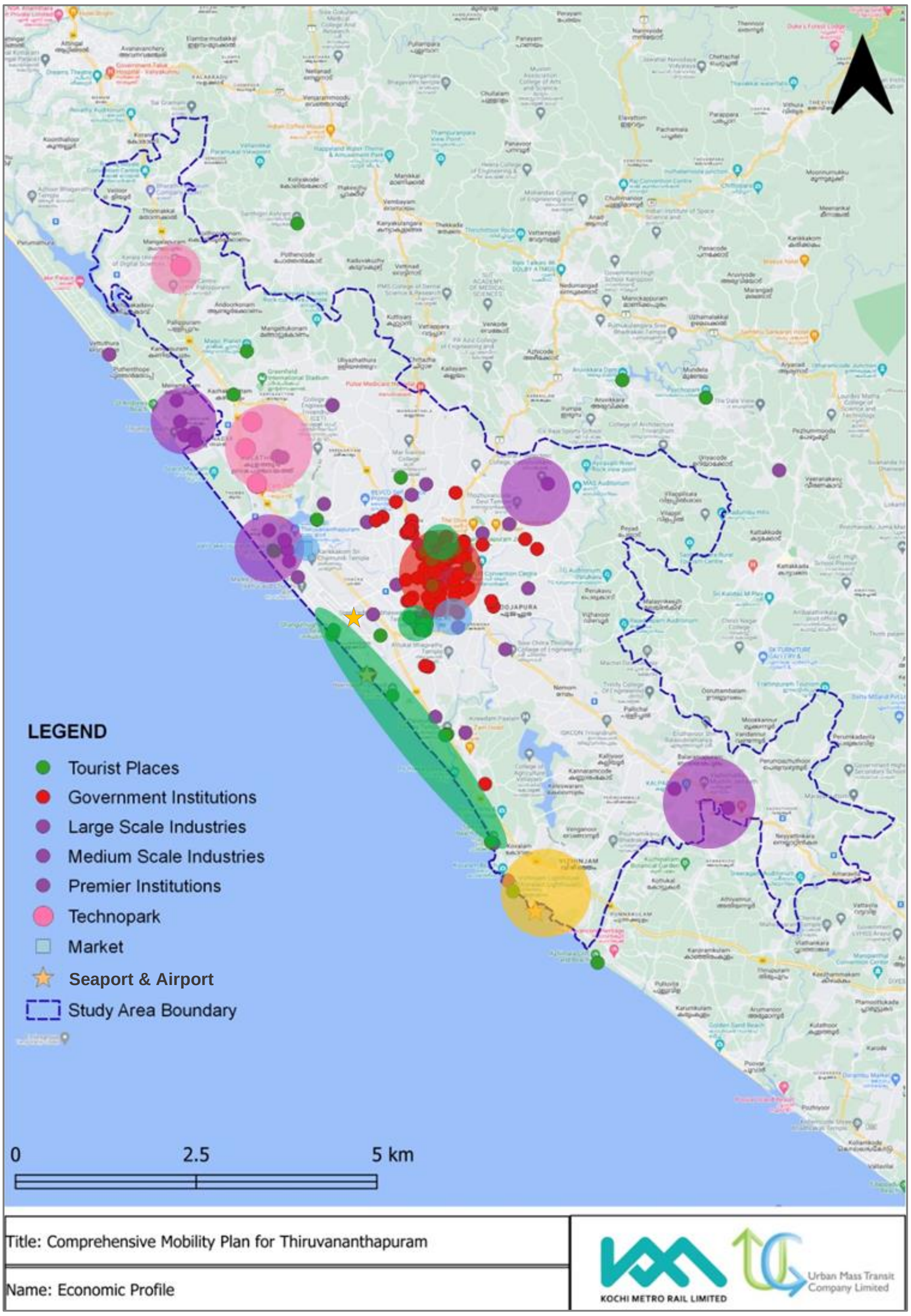


Figure 33 Map Showing the clustering of economic activity nodes in the study area (Source: Primary and Secondary Data Assessment, 2022)

Economic activity nodes are observed to be well spread across the study area, acting as anchor points for the city growth. The core and central region predominantly house the various government institutions, while the northern region of the stud area is evolving as a prominent IT hub, the coastal region especially towards the south is a tourist destination for recreation and medical tourism and the southern region houses industries and seaport, which is envisioned to be gateway of interaction imports-exports and trade.

The potential future employment generating prospects of the city lie with tourism industry, civil aviation and cargo, software development parks, arts and culture, multipurpose seaport at Vizhinjam etc.

2.8 ROAD NETWORK

The city has partial ring and radial type of network. The major roads are:

- NH-66 passing through heart of the city covering important traffic generating points like Pappanamcode, Karamana, Killipalam, Thampanoor, Palayam, Pattom, Kesavadasapuram, Ulloor, Sreekaryam and Kazhakoottam
- Main Central Road (MC Road)
- Thiruvananthapuram Shencottah Road
- NH bypass between Kazhakkoottam and Kovalam
- Palayam-Chakkai Road
- MG Road between East Fort and LMS Jn

Table 2-6 List of Major Roads in the city

S NO.	CORRIDORS	FROM	TO	LENGTH (KM)
1	Nh-66	Mangalapuram	Neyyattinkara	40
2	NH bypass	Kazhakoottam	Vizhinjam	25
3	MC Road	Kesavadasapuram	Mannanthala	5
4	Nedumangad Road	Thampanoor	Peroorkada	8
5	Vattiyoorkavu Road	LMS	Vattiyoorkavu	5
6	Peyad Road	Karamana	Peyad	8
7	Kovalam Road	Over bridge	NH Bypass	5
8	Airport Road	Palayam	Airport	8
Total				**104**

However, it is observed that a well-defined and clear hierarchy of road network needs to be developed in study area as the current major roads in the city are National Highways.

Figure 34 Road Network showing Major Roads (Primary Surveys, 2022)

2.9 VEHICLES REGISTERED

The vehicles registered in the study area as on 2022 is over 10lakhs. The Cumulative Annual Growth Rate of registered vehicles is observed to be around 6.4%. The growth rate of vehicles (CAGR) has reduced from 10.5%in 2018 to 6.4% in 2022 due to COVID-19 impact.

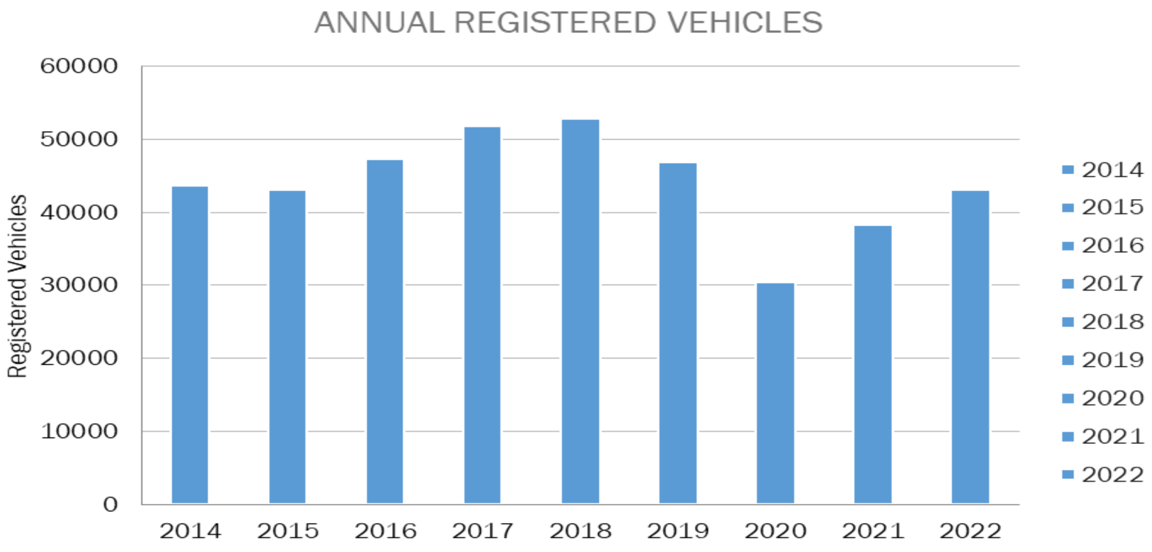


Figure 35 Annual Vehicles Registered (Source: RTO Thiruvananthapuram and Kazhakuttam-2022)

It is observed that Thiruvananthapuram has the highest vehicle registrations with over 10lakhs in the state followed by Kozhikode with 6.18 vehicles. And the majority of about 60% vehicles registered are two-wheelers indicating the growing dependence on private modes.

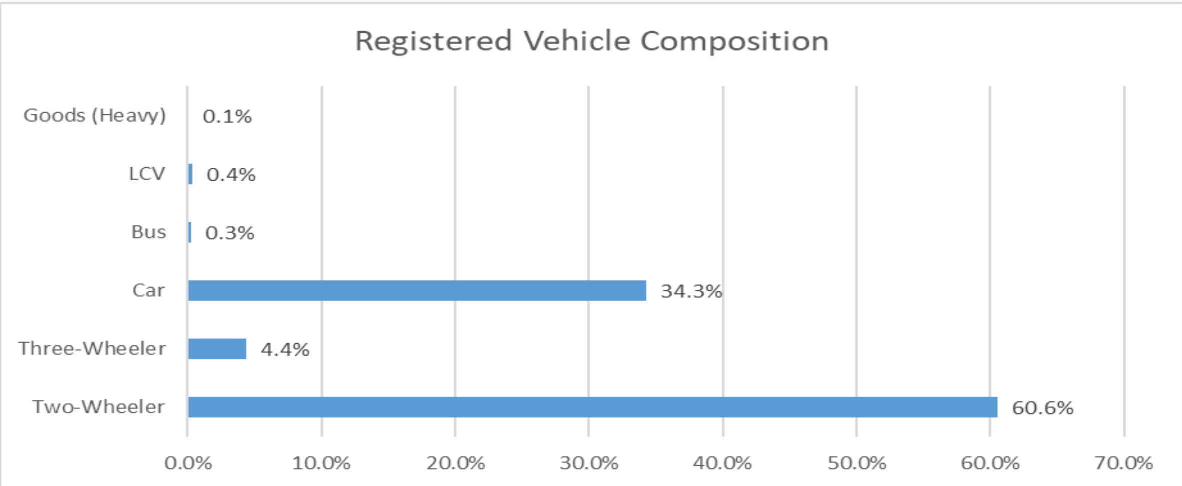


Figure 36 Registered Vehicles Composition (Source: RTO Thiruvananthapuram and Kazhakuttam-2022)

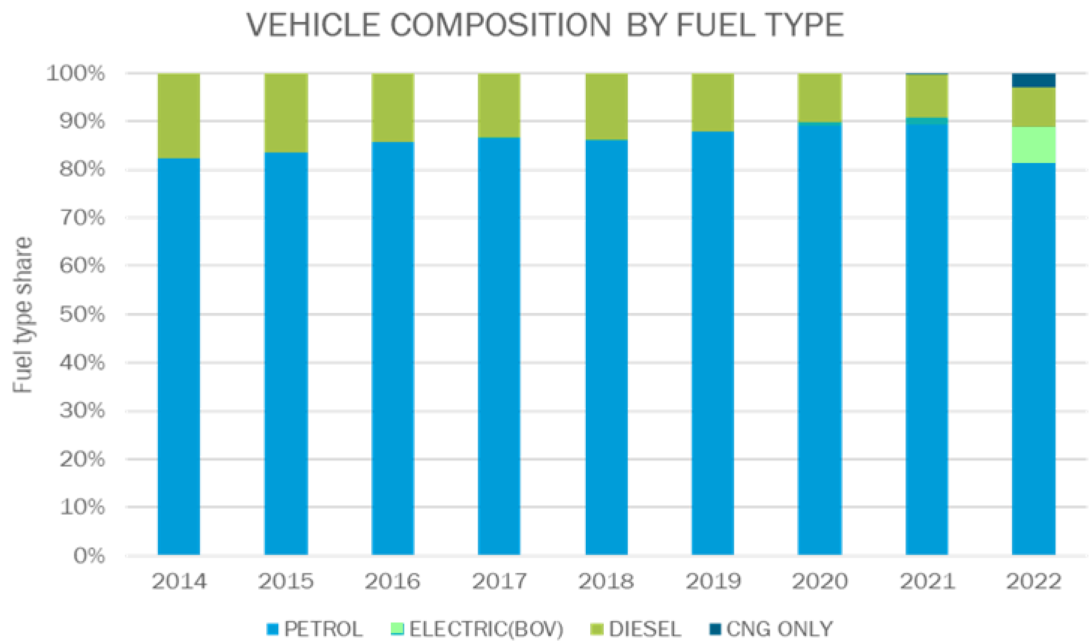


Figure 37 Registered Vehicles Composition by fuel technology (Source: RTO Thiruvananthapuram and Kazhakuttam-2022)

Electric vehicles share has been increasing steadily since 2021, however currently 80% of the vehicles registered in the study area are petrol vehicles.

2.10 AIR BASED PUBLIC TRANSPORTATION (REGIONAL)

The airport is approximately 3.7 kilometres towards west from the city center in 583-acre campus. The details of the of the regional airport of Thiruvananthapuram is as follows,

- The domestic terminal was the first terminal of the airport. It has an area of 9,200 m2 (99,000 sq. ft) and can handle 400 passengers at a time. All airlines except Air India are served.
- The international terminal covers an area of 35,000 m2 (380,000 sq. ft) roughly handling 1500 passengers). The annual handling capacity of the terminal will be 1.8 million.
- Number of Passenger Terminals: 2
- Terminal 3, which is under construction, which shall accommodate about 800 passengers at once

It is the eighth busiest airport in India in terms of international traffic and the twenty second–busiest overall.

Figure 38 Images of Thiruvananthapuram Airport

As per the 2022 AAI Thiruvananthapuram records, 80 daily domestic and international flights which has increased to 582 weekly operations in March, 2023 with a growth rate of 31.5%. The daily passenger flow is observed to about 11 thousand, with international passenger owing to nearly 42% of the total passengers.

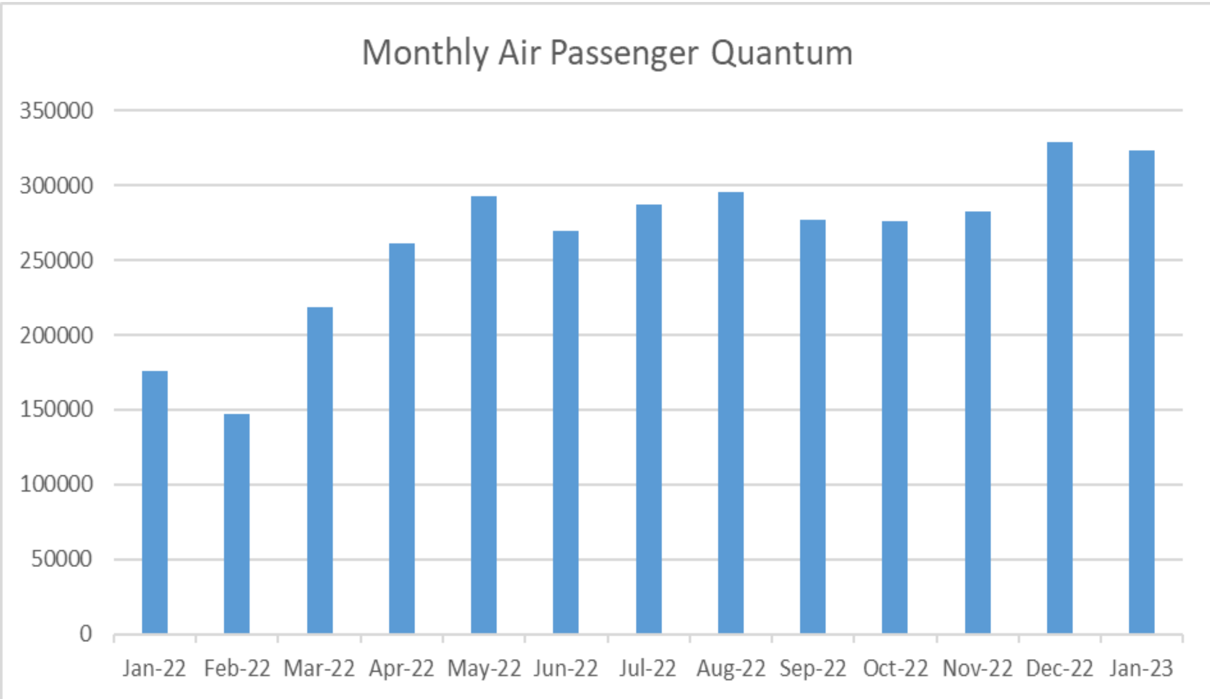


Figure 39 Monthly Ai Passenger Volume (Source: AAI Thiruvananthapuram)

2.11 RAIL BASED PUBLIC TRANSPORTATION

Six railway stations operate within city limits, including Thiruvananthapuram central station and five other stations. Thiruvananthapuram, Pettah, Kochuveli, Kazhakoottam and Veli Railway Stations are located towards the north and Nemom railway station to the south within the corporation limits are the prominent six stations. While Kaniyapuram, Murukkumpuzha, serve the northern area and Balaramapuram and Neyyattinkara railway stations serve southern part of the study area.

2.11.1 Thiruvananthapuram Central Railway Station

Central railway station is the major station in the study area located at Thampanoor, 8 km from the airport, with 5 platforms and a daily footfall of over 35,000 passengers.

It offers connectivity to Taxi stand, pre-paid Auto service, and Thiruvananthapuram Central bus station of the KSRTC in its vicinity.

Figure 40 Thiruvananthapuram Central Railway Station (Primary Site Visits -2022)

2.11.2 Kochuveli Railway Station

Kochuveli also known as Thiruvananthapuram North railway station is a satellite station, located near NH-66 city bypass, at a distance of 8 km from the city. It is a satellite station developed to ease the congestion in the Central Station. The nearest bus stops to access the station is present on Kazhakoottam-Kovalam bypass road, however seamless connection to the city bus transfers is to be developed.

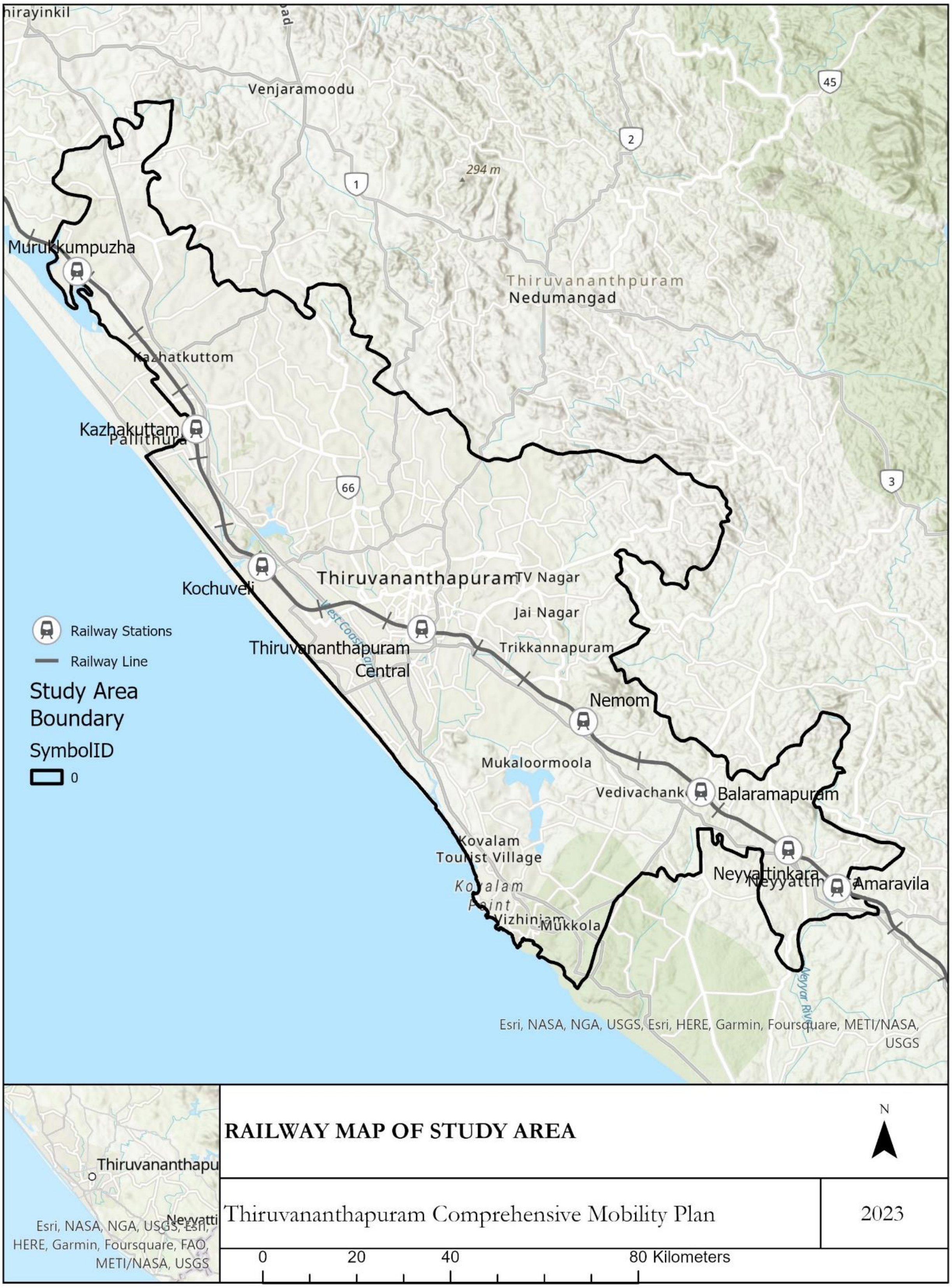


Figure 41 Railway Map of the Study Area

2.11.3 Pettah Railway Station

Thiruvananthapuram Pettah railway station is dedicated for inter-city trains mostly for the incoming trains from Kollam direction (from north) to ease the crowd at Thiruvananthapuram Central. This the nearest station to the Airport, however seamless connection to the city bus and airport transfers are to be developed.

2.11.4 Kazhakoottam Railway Station

Kazhakkoottam is currently the 4th most revenue generating railway station in Thiruvananthapuram district. It is the closest station to the Techno Park.

2.11.5 Nemom Railway Station

Nemom Railway Station caters to the southern part of the study area. A proposal to developed Nemom Railway Station into a second satellite terminal station for the Thiruvananthapuram Central is in the pipeline to decongest the Central Railway Station.

The railway system of Thiruvananthapuram provided services to 41 thousand passengers daily as per the data as received from Southern Railway-2022, indicating a strong intercity interaction of Thiruvananthapuram with its surrounding areas.

2.12 BUS BASED PUBLIC TRANSPORTATION

Thiruvananthapuram being the capital of the state, is well connected to other parts of the state using public transport.

The major portion of the city's public transit system is held by the Kerala State Road Transport Corporation (KSRTC).

The features of the public transport system as below[20]:

- Around 77% of the major roads are covered by Public Transport out 534 km
- The average headway calculated for peak hours (morning 8 a.m. to 10 a.m. and evening 4 p.m. to 6 p.m.) was 10 minutes (KSRTC schedule data 2022)
- The peak hour occupancy of the buses is 41 people (average).
- The presence of organized public transport system is easily seen, in the form of a huge fleet size of 90 city circular services and 361 sub-urban services plying in the study area.
- About 25 thousand passengers commute daily using city circular services as per 2022 data.

[20] KSRTC 2022

The public transport network formed together by the KSRTC and the private buses, covers 80 percent of the major roads indicating a strong presence of public transport services.

Table 2-7 Bus Services Details (Source: KSRTC 2022 Revised fare notification)

TYPE OF SERVICE	MINIMUM FARE (INR)
Ordinary/Mofussil Services including City/Town/City Circular/City Shuttle Services	10
City Fast Services	12
Fast Passenger/Limited Stop Fast Passenger Services	15
Super-Fast Services	22
Express/Super Express Services	28
Super Air Express	35
Super Deluxe/Semi Sleeper Services	40
Luxury/High-Tech and Air-Conditioned Services	60
Single Axle Services	60
Multi Axle Services	100
Low Floor Air-Conditioned Services	26
Low Floor Non-Air-Conditioned Services	10
A/C Sleeper Services	130

Figure 42 Photographs of KSRTC Fleet

Figure 43 KSRTC Route Map and Depots

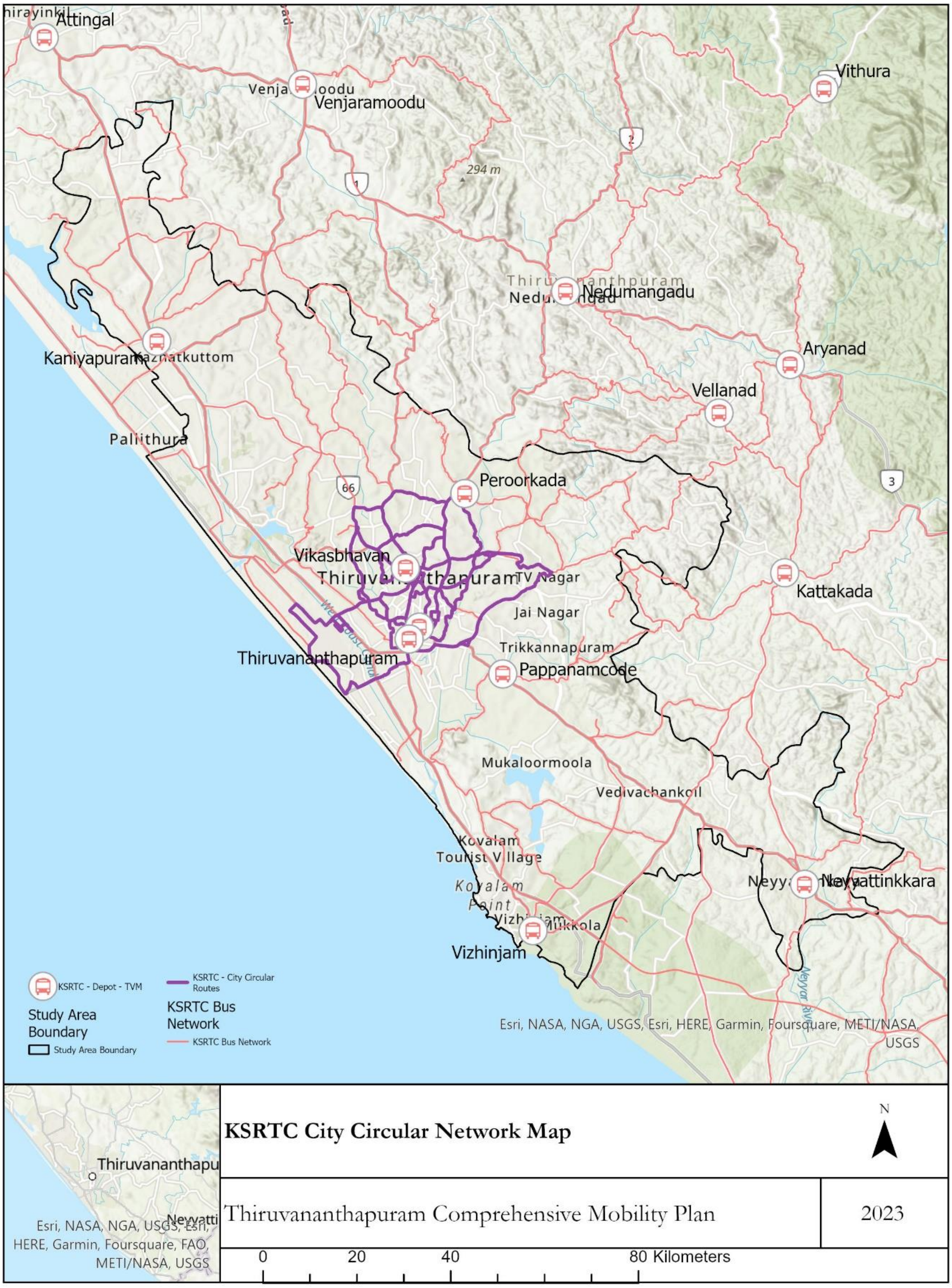


Figure 44 KSRTC City Circular Network

Multiple interchanges, depots and terminals facilitate the overall functioning of the KSRTC buses (Refer Figure 44).

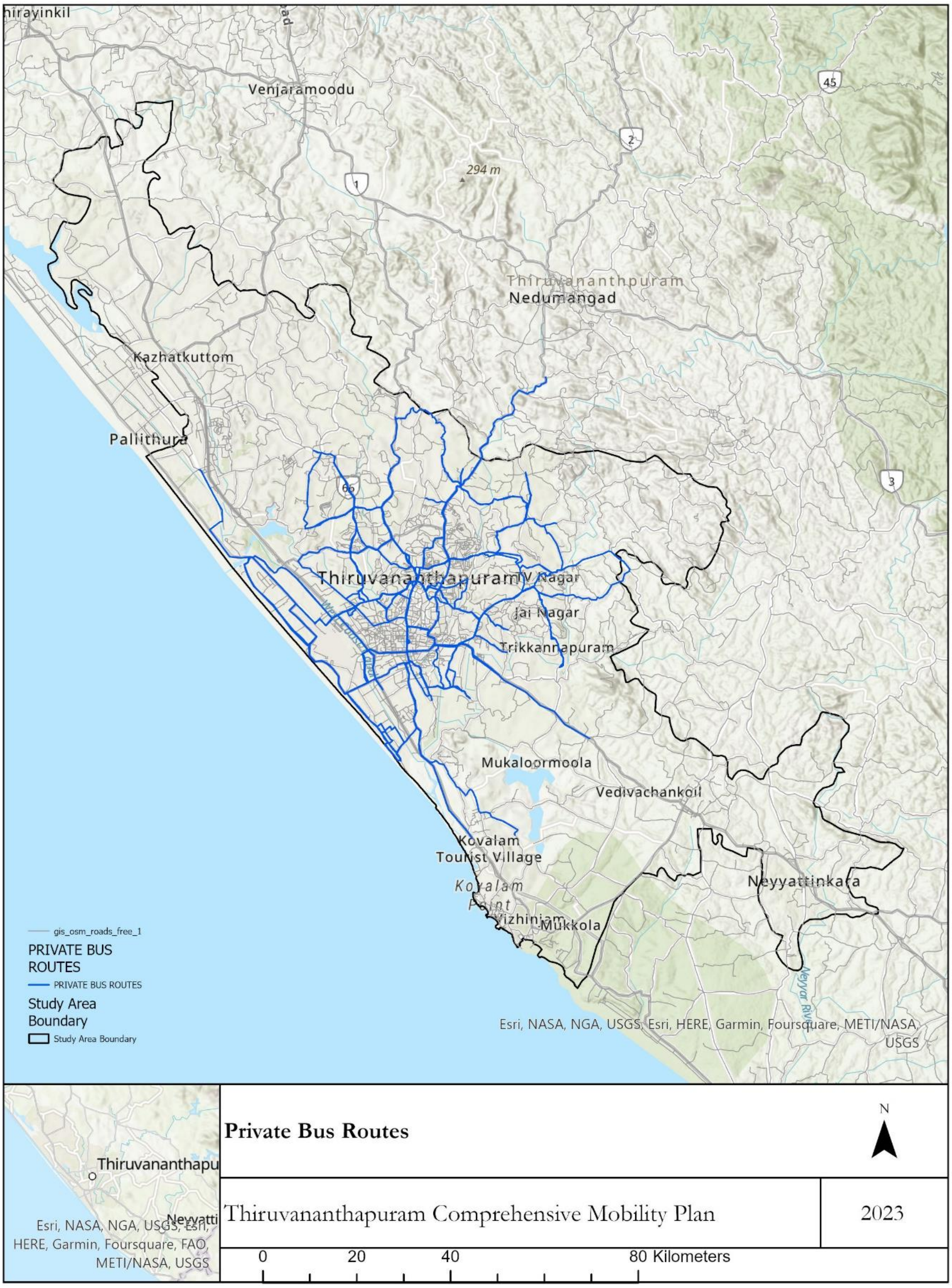


Figure 45 KSRTC City Circular Network

Along with KRSTC the city bus services are provided by private operators. The city currently has 108 private bus permits. The major transportation corridors are the National Highway 66, Medical College Road, and Shencottah Road.

2.13 INTERMEDIATE PUBLIC TRANSPORTATION

Auto-rickshaws and shared auto-rickshaws are the inter-mediated public transport modes in Thiruvananthapuram that provide door to door connectivity. Currently, there are two types of IPT Systems-Auto Rickshaw and Taxi.

Figure 46 Intermediate Public Transport Modes (Source: Primary Site Visits-2022)

- The average number of passengers carried per trip is 2.3 for Auto and 2.7 for Taxi.
- These modes are largely used by the floating population for work and other purposes. However, the taxis are predominantly used for tourism purposes.
- Electric auto rickshaws have been rolled out in the city in the recent years, as a part of Smart City Projects.
- The base fare for private services is about INR 30.
- As per the 26th April, 2022 government notification the hire charges for auto-rickshaws are as follows,

Table 2-8 Bus Services Details (Source: RTO -2023)

DISTANCE (KM)	RATE (INR)
Up to 1.5	30
Beyond 1.5	15 per kilometre

Despite the availability of public transport system, the usage of para-transit is high. These IPT services usually ply on the major mobility corridors competing with the existing public transportation system. Thus, the city needs integration of both the modes for the transportation system to function as a whole. Further, the city lacks any organized system to support these modes.

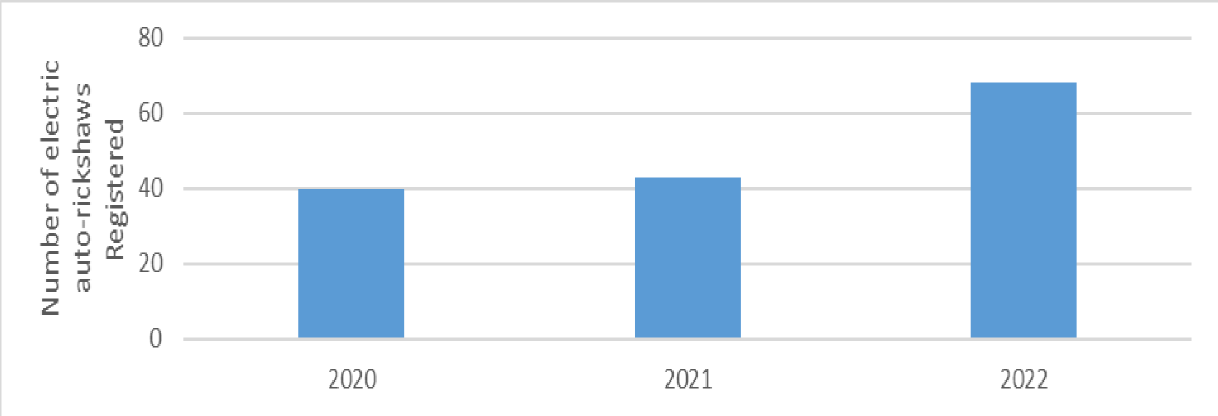


Figure 47 Electric Auto-rickshaws registered (Source: RTO Thiruvananthapuram and Kazhakuttam-2022)

There is a growing presence of E-Auto rickshaws in the study area. The number of electric auto-rickshaws have doubled in the last one year. Hence, the supporting charging infrastructure needs to be developed in the study area.

Kerala State Electricity Board (KSEB) has is setting up Electric Vehicle (EV) Charging Points on electric poles and auto-rickshaw stands across various locations in the study area to promote the usage of EVs. Over 45 charging points and stations have already been setup in the study area.

Figure 48 Electric Auto-rickshaws Charging Stations

The charging points area integrated with mobile applications (ElectreeFi) and drivers can make payment through these applications. KSEB changers INR 13 (excluding GST) for fast charging and INR 9 (excluding GST) for pole mounted charging.

Figure 49 Location of Electric Auto-rickshaws Charging Stations

2.14 NON-MOTORIZED MODES

Based on the studies, conducted in Thiruvananthapuram there is a significant share of Non-Motorized Trips observed in the city. Owing to the high pedestrian movement is the core or city centre due to various activity nodes such as religious places, transit hubs, government institutions, commercial markets, etc. the city has taken up improvement measures in major areas such East Fort, MG Road, etc.

Figure 50 Recent Improvements for Pedestrian Infrastructure across the city

The improvements include even development of plaza near the Padmanabha Swami Temple, Sky walk near East Fort, foot over bridge at Pattom, development of pedestrian sidewalks, Pedestrian Safety Enhancement Controller (PeSCo) near Cotton Hill School and etc, to ensure the safety of the pedestrians.

Figure 51Existing Improved Safety Measure for Pedestrian

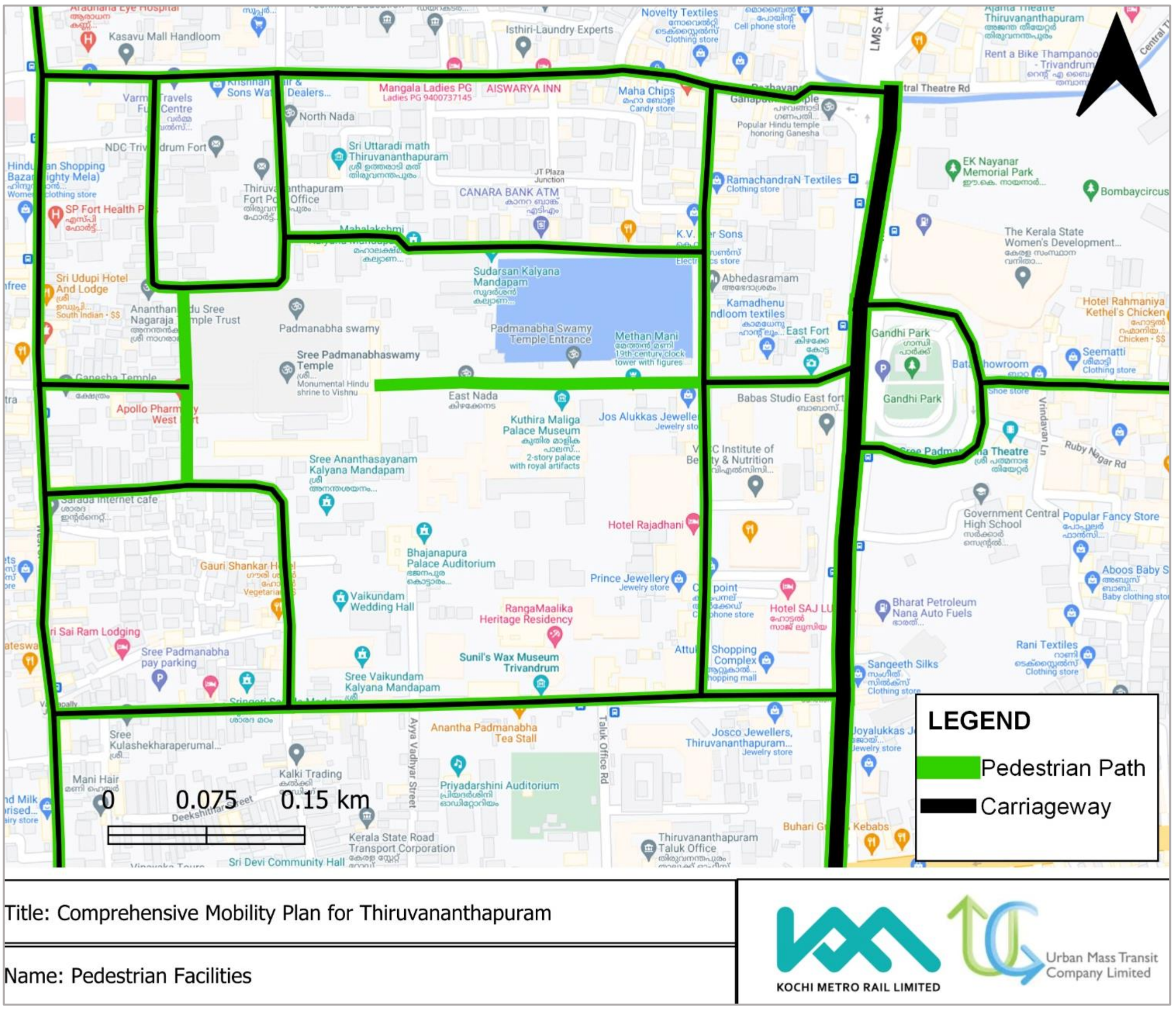


Figure 52 Existing pedestrian network in the core are – East fort

However, the NMT network and infrastructure is currently inadequate to support the existing demand and safety. Only 15% of the network in the city has footpath infrastructure. The Level of Service for the Available Pedestrian Facilities in the city is 3, indicating the need for improvement. The details of the assessment are presented in the Chapters 4 and 5.

Figure 53 Condition of Footpaths and Pedestrian Movements

Similar to every other city, NMT challenges such as lack of clear walk-able space, safety and prioritization issues at intersections and crossings, inaccessibility due to encroachments and haphazard on street parking etc. are seen.

Despite of various improvement and efforts made by the Municipal Corporation and Smart City Corporation, encroachments and haphazard parking is significantly observed in areas such Fort, Chalai, Kazhakoottam, Peroorkada, Attukal and Manacaud.

These encroachments coupled with inaccessible footpaths, lack of safety and sufficient mid-block crossings often push the pedestrian movements towards the fast vehicle lanes raising safety concerns.

Cycle corridors are not available in any of the major corridors in the city, except for 6km bicycle lane demarcation.

Figure 54 Condition of Bicyclist Movements and temporary cycle tracks

However, the proposals have been laid out to develop exclusive cycle tracks and walkway on identified road stretches of Pipeline Road. New initiatives like development of Bicycle Park have also come up in Akkulam Tourist Village.[21]

The public transport share of the city very good compared to the other Indian cities. This indicates the need to develop proper NMT network, in order to further boost the usage of public transport system and increase the safety of pedestrians which will also add to good first and last mile connectivity.

[21] Source- Smart City Corporation

2.15 FREIGHT MOVEMENT

There are two major markets in CBD area- East -Fort and Palayam. Apart from Chalai market, four other sub-markets (Manakkadu, Palayam, Vizhinjam and Anayara World Market are present in the study area. Further, there are seven zonal markets – Kazhakkoottam, Pangode, Peroorkada, Poojappura, Thirumala and Vattiyoorkavu and other local markets within city corporation which are considerable activity nodes with light freight movements.

Palayam

Kochuveli

Beemapally

Chalai

Figure 55 Main Market Areas (Source: Primary Site Visits-2022)

Currently, there are no restrictions levied at present, on the entry-exit of trucks in the city. The areas like Chalai and Palayam have limited right of way availability and with the movement and parking of trucks on–street in an unorganized manner creates chaos and disrupts the traffic movement.

Figure 56 Good Vehicles in Chalai (Source: Primary Site Visits-2022)

A mini trick parking area is located on power house road having area of 0.25 ha parked with 60-70 trucks during peak hour. The Vizhinjam port designed primarily to cater to the container transhipment business is another major cargo terminal in the study area.

2.16 SEAPORT & HARBOUR

Vizhinjam is an important port and a fishing harbour in the study area and is currently being developed as an international Transhipment and Deep-Water Multipurpose Seaport. This internal seaport is expected to generate over 1 lakh indirect employment. The proposed land use plan is as presented below.

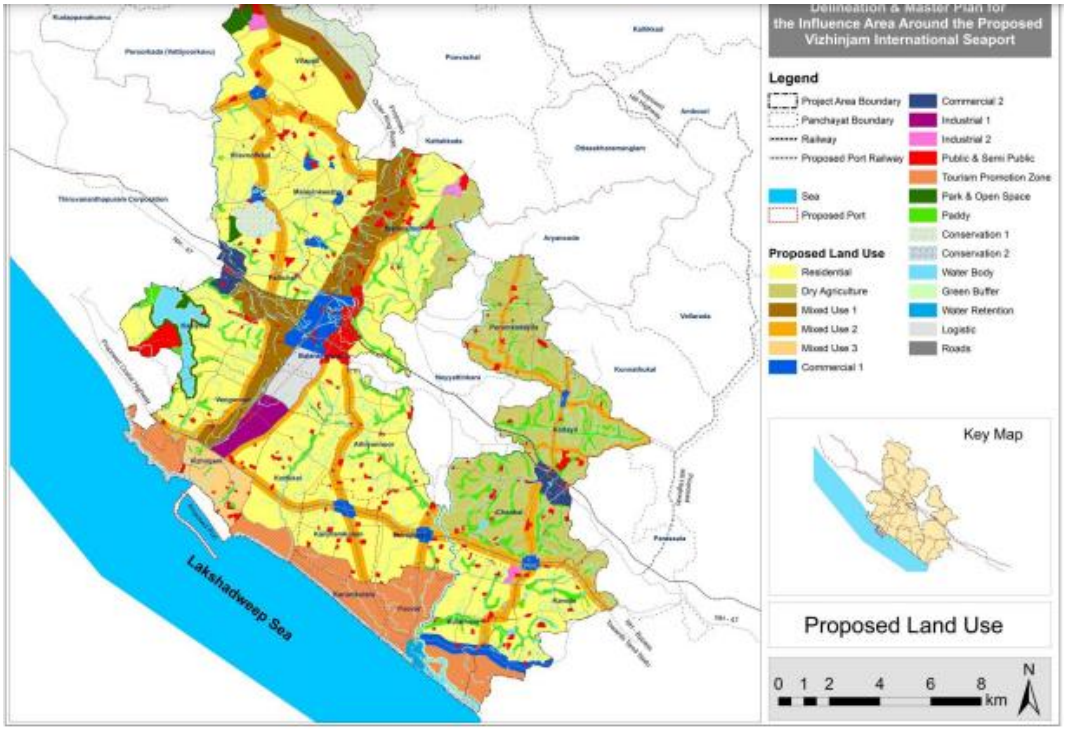


Figure 57 Vizhinjam Master Plan (Source: Delineation & Master Plan for the Influence Area Around Vizhinjam International Seaport)

The proposed land use map assigns 1.29% of the land for industrial development, 6.37% land as Tourism Promotion Zone and 7% under roads and logistics.

The proposed road network creates organically gridiron pattern with the hierarchy in structure. The concept is to integrate the existing road of the region with the proposed roads. The proposed hierarchies of roads are 60mt, 45m, 30m, 24m and 18m wide as per the proposed master plan.

Further, as the main line of broad gauge that passes through Nemom, Neyyattinkara and Balaramapuram railway stations are approximately 10 Km from the Vizhinjam Port location. A single line rail to Vizhinjam Port with automatic signalling has been suggested in the Vizhinjam Port DPR.

The DPR and the proposed Master Plan suggest the need to explore the possible of high-capacity public transportation system connecting Vizhinjam to Thiruvananthapuram.

2.17 ROAD SAFETY

Road safety is a crucial factor considering the increasing number of vehicles on Thiruvananthapuram roads. The fatality shares of accidents in 2012 was around 8.6% which increased to 9.6% in 2022 as per traffic police records. The number of fatalities per lakh population is 12.48 in the study area indicating an alarming value and the need to improve the road safety in the study area.

Table 2-9 Types of Road Accidents in Thiruvananthapuram City (Source: Traffic Police-2022)

YEAR	NO. OF ACCIDENTS	FATALITIES
2012	1933	167
2013	2000	195
2014	2007	175
2015	2199	164
2016	2453	180
2017	2113	172
2018	2115	168
2019	1962	205
2020	1214	269
2021	1438	117
2022	1823	169

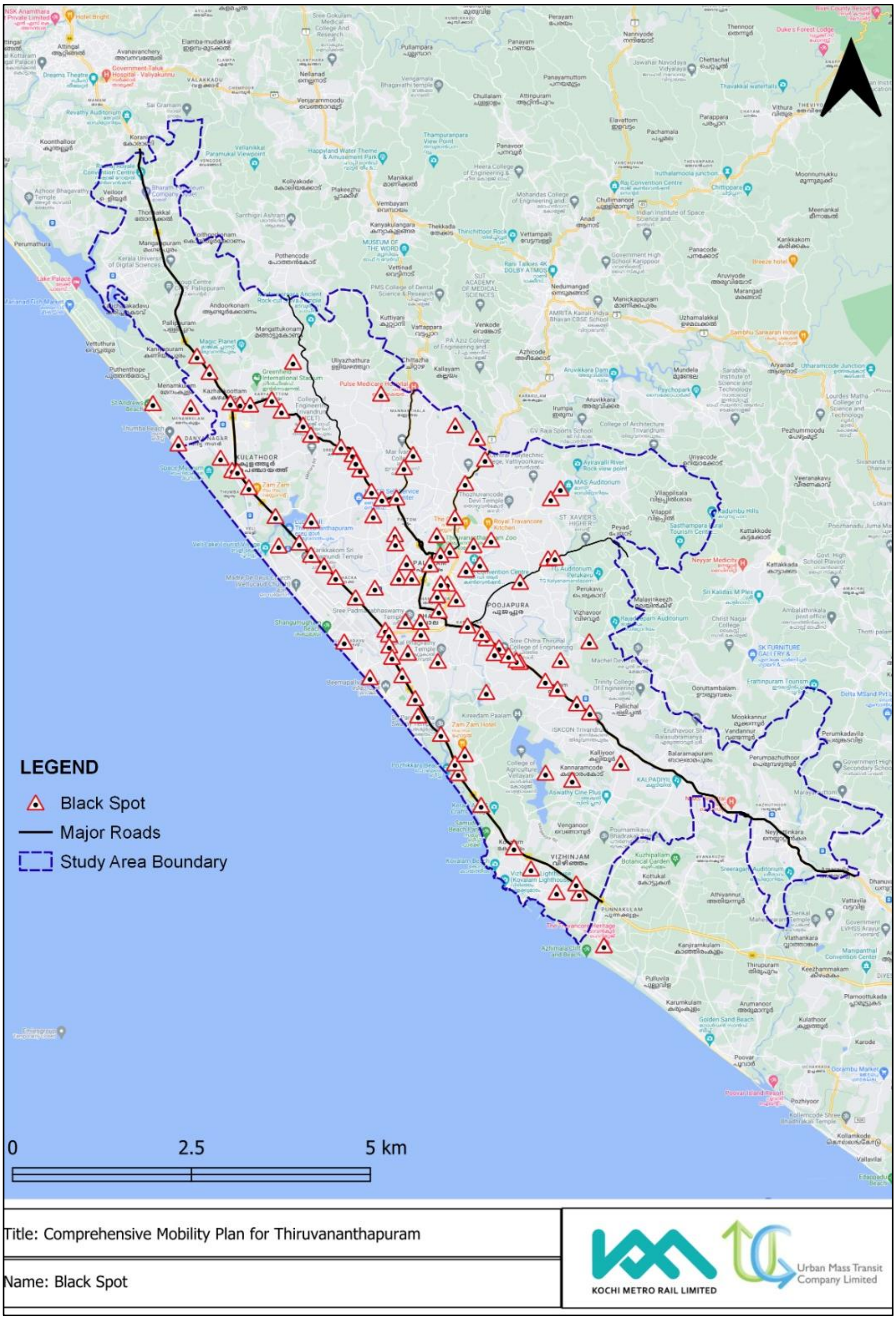


Figure 58 Black Spots in the Study area (Source: Police Department – Thiruvananthapuram, 2022)

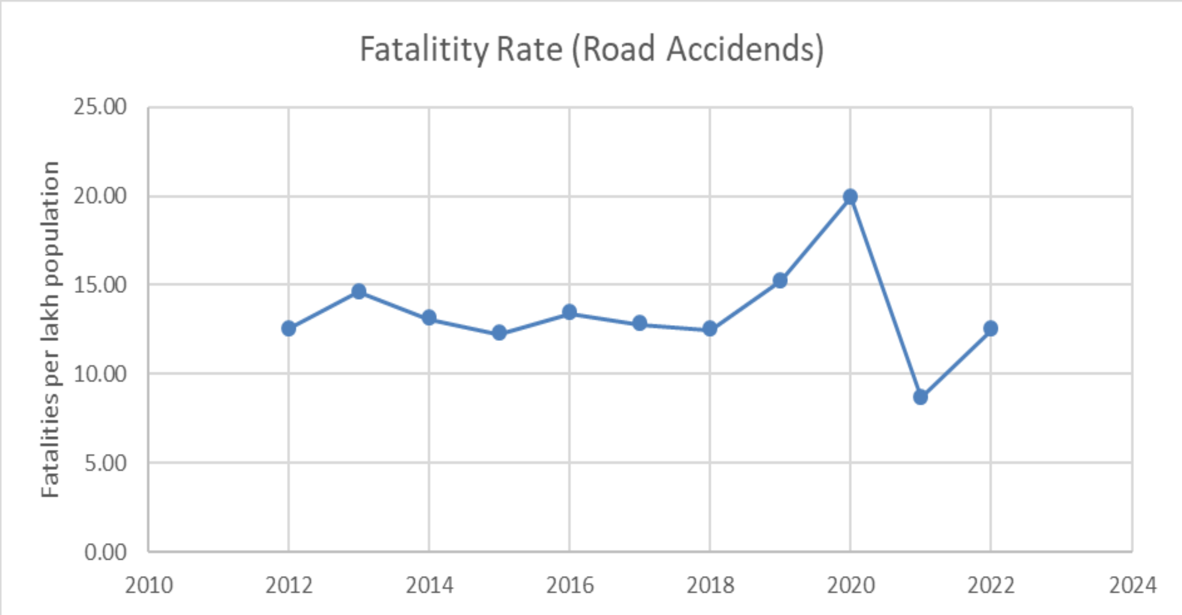


Figure 59 Fatality Rate per Lakh Population (Source: Traffic Police-2022)

As on 2022, there are 165 Black Spots in the study area, of which 48% of them are identified along the NH-66 and NH Bypass.

Table 2-10 List of Black Spots in the study area

S.No.	TYPE OF ROAD	BLACK SPOTS
1	NH 66	Near Eanchakkal Signal
2	NH 66	Near Arya's Hotel
3	NH 66	Near Gurumandiram Pangappara
4	Other	Anayara
5	Other	Vattavilakku Jn Powdikkonam
6	NH 66	Near Pangappara Health Centre
7	Other	Mla Road, Near Balavan Nagar
8	Other	Pongomoodu
9	NH 66	Near Kaimanam Signal Point
10	NH 66	Chakkai
11	NH 66	Kottayathukavu Vetturoad
12	Other	Near Chowara Junction
13	Other	Infront Of Jyothi Nilayam School
14	Other	Plankalamukku
15	NH 66	Near Qrs,Kallampally
16	NH 66	Kesavadasapuram
17	Other	Opposite Beer Parler,Madhavapuram
18	Other	Near Poultry Fram Kudapanakkunnu
19	NH 66	Thoppadi Thiruvallam ,Thiruvallam

S.No.	TYPE OF ROAD	BLACK SPOTS
20	Other	Maruthumkuzhy
21	NH 66	Pravachambalam Junction
22	NH 66	Near Pappanamcode Sreeragam Auditoriam
23	Other	Near Manikkavilakam Co-Operative Bank,Near Cycle Spare Parts Shop
24	NH 66	Aakkulam -Chackai Bypass Road ,Karikkakam
25	NH 66	Near Chowara
26	Other	Near Punnamoodu St.Sebastian Church
27	NH 66	Near Vazhamuttam Junction,Thiruvallam
28	Other	Near Kanakakunnu
29	NH 66	Between Kuzhiila And Akkulam Bridge
30	Other	Arayalloor
31	Other	Near Attakulangara Vanitha Jail
32	Other	Near Thennoorkonam Junction
33	Other	Velankanni Junction
34	Other	Near Geethanjali Hospital, Mukkola
35	NH 66	Near Mankuzhy Jn
36	NH 66	Nemom
37	Other	Near Palayam Bus Stop,Infront Of Palayam Christian Church
38	NH 66	In Front Of Indus Motors Near Lords Junction
39	NH 66	Pachalloor, Bypass Road,Thiruvallam
40	Other	Near Kakkamoola
41	Other	Near Premier Park Hotel, Eanchakkal
42	Other	Infront Of Akkulam Fish Stall
43	NH 66	Opposite Of Fathima Building, Ambalathinkara
44	Other	In Front Of SBI, Pottakuzhy, Pattom
45	Other	Near Kaimanam Lekshmi Kalyana Mandapam
46	NH 66	Chakka Flyover
47	NH 66	Karakkamnadapam
48	Other	Near Tharangini Jn Vazhayila-Mukkola Road
49	NH 66	Pongummoodu
50	NH 66	Near Kesavadasapuram Jn
51	Other	Perunelly,Tc 42/620(1) Number House
52	NH 66	Near Pappanamcode White Dammar
53	Other	Near Vizhinjam Ib Junction
54	NH 66	Near Service Co-Operative Society, Muttathara,Enchaikkal Bypass
55	NH 66	Near Marikar Motors Marappalam,Pattom-Plamoodu Road
56	Other	Near Highness Bar,In Vellayambalam Sasthamangalam Road
57	NH 66	Infront Of Halais Hotel, Vetturoad
58	Other	Near Domestic Airport
59	Other	Near Thankamma Stadium Road

S.No.	TYPE OF ROAD	BLACK SPOTS
60	NH 66	Near Alsaj Hotel
61	NH 66	Near Kochuloor Petrol Pump
62	NH 66	Near South Park Maruthi Service Road
63	Other	Barton Hill
64	NH 66	Thulavila
65	Other	Infront Of Phq
66	NH 66	Infront Of Evm Honda Showroom Neeramankara
67	Other	Near Madampana Jn
68	Other	Near Public Lab
69	NH 66	Neeramankara Jn
70	NH 66	Karaykkamandapam
71	NH 66	Near Hp Petrol Pump, Karikkakam Bypass Road
72	Other	East Fort
73	Other	Near Palathara Jn
74	NH 66	Infront Of Sarathyi Motors Muttathara
75	Other	Medanada, Kannanthanam Crusher
76	NH 66	Enchykkal Jn
77	NH 66	Railway Over Bridge Chakkai
78	NH 66	Karyavattam
79	Other	Kannettumukku
80	Other	Punnamoodu, Chanalkkara
81	Other	Near Plankalamukku
82	NH 66	Near Bathsaida Church, Mukkola Bypass
83	SH	Near Nalanchira Amset
84	Other	Near Over Bridge Jn
85	NH 66	Infront Of Bata Showroom Karamana
86	NH 66	Muttathara
87	Other	Infront Of Thundathil Lp School
88	NH 66	Bypass Road Gurunagar
89	Other	Nandancode
90	NH 66	Infront Of Muttathara Beverrage By Pass Road
91	NH 66	Near Ambalathinkara
92	NH 66	Near Chuducaud Temple
93	Other	Model School Jn
94	Other	Skoda Volksvagon Service Center Near Pottakuzhi
95	NH 66	Near Chudukadu Temple,Pachalloor,Thiruvallam
96	Other	Near Vijayamohini Mill Bus Stop
97	Other	Near Vazhottukonam Juction
98	NH 66	Near Thiruvallam Toll Gate
99	Other	Near Mosque,Pachalloor,Thiruvallam

S.No.	TYPE OF ROAD	BLACK SPOTS
100	NH 66	Thoppadi , Pachalloor
101	Other	Near Sm Earth Movers, Koralamkuzhi
102	Other	Near Good Morning Super Market ,Stationkadavu
103	NH 66	Infront Of Thakkaram Restaurant
104	Other	Vayalikkada Jn
105	Other	West Street
106	Other	Pallichal Thodu
107	NH 66	Chenthi Junction
108	Other	Near Naveen Tiles Shop,Sasthamangalam-Maruthankuzhy Road
109	NH 66	Near Sainik School,Kazhakuttam
110	Other	Near Valiyavila Junction
111	Other	Edapazhinji Bridge
112	NH 66	Near Enjakkal
113	SH	Near Nalanchira Kurissady Junction
114	NH 66	Paruthikuzhi Bilal Nagar
115	NH 66	Nemom
116	NH 66	Old Karaykkamandapam
117	Other	Sm Lock Poonthura
118	Other	Kakkamoola Kayalkkara
119	Other	Near General Hospital Thiruvananthapuram
120	Other	Insteff Gate,Stationkadavu
121	NH 66	Kariyavattom
122	Other	Near Naveen Tiles Sasthamangalam
123	NH 66	Near Icci Bank Road, Kalpalayam
124	NH 66	Pazhaya Karykkamandapam
125	Other	Near Idapzhinji Dhanalakshmi Bank
126	NH 66	Near Kovalam Junction
127	NH 66	Near Koshi Elctricals Ulloor
128	NH 66	In Front Of Nemom Victory School
129	Other	Near Panavila Jn
130	Other	Thampanoor Flyover

S.No.	TYPE OF ROAD	BLACK SPOTS
131	NH 66	Infront Of Sreeragam Auditoriyam
132	Other	Menamkulam
133	Other	In Front Of Public Office, Coperation Office
134	NH 66	Opposite To Tsc Hospital
135	Other	Near Kowdiar
136	NH 66	Infront Of Pachalloor Thookku Mudipura
137	Other	Theatre Juntion
138	Other	Near Attukal Hospital, Medamukku
139	Other	Rajeevgandhi Nagar Thumba
140	Other	Near Vijaya Mohini Mill Bus Stop
141	NH 66	Infront Of Darsana Auditoriyam
142	Other	Chakkai,In Front Of Chakkai Kseb,Kadakampally
143	NH 66	Kazhakuttom Elevated Highway Under Road
144	Other	Near Medical College Skywalk
145	Other	Medical College
146	Other	Opposite Thamarassery Bakery,Vazhayila
147	NH 66	Near Nandhilath G-Mart ,Neeramankara
148	NH 66	Chakkai Bypass Road
149	Other	Near Panavila Flyover
150	NH 66	Near O By Tamara Hotel , Venpalavattom
151	Other	Punnamoodu
152	Other	Near Vazhayila Christ Nagar Jn
153	NH 66	Neeramankara Traffic Signal
154	Other	Chakkai,Near Brahmos,Kadakampally
155	Other	Pottakuzhi Signal
156	NH 66	Near Infosys
157	Other	Near Chanalkkara, Poonkulam
158	NH 66	Sreekaryam Jn
159	NH 66	Near Karimbuvila Bypass Road
160	Other	Infront Of Smart Super Market, Koliyyor
161	NH 66	Infront Of Muttathara Beverage

2.18 PREVIEW OF PREVIOUS STUDIES

The review of pervious land use and transportation studies are as presented in the following sections -

2.18.1 DISTRICT URBANIZATION REPORT - 2011

The report was prepared by the Town and Country Planning Department, as a status review of the district.

A four tier hierarchy of roads viz. major roads, sub major roads, minor roads, sub minor roads were proposed from the existing road network aiming to improve connectivity between the future settlements in the hierarchy. International Container Port at Vizhinjam was proposed to bring in more business and livelihood in trade related functions.

Table 2-11 Major Recommendations - District Urbanization Report - 2011

PROPOSALS	OBSERVATIONS
A four tier hierarchy of roads	NH-66 and NH-Bypass has been developed as the major arterials in the city.
International Container Port at Vizhinjam	Redevelopment of Palayam and Chalai market was done to a considerable extent.
It was proposed to develop Thiruvananthapuram Corporation as the first order settlement and first order node with a ring of secondary and tertiary settlements	The linkages to connect the sub-urban area is been developed under the proposed Thiruvananthapuram Outer Ring Roads.

Thiruvananthapuram Corporation is being strategies to be developed as the primary node and the development of outer ring road and costal road are being taken up to provide connectivity to the sub-urban areas.

2.18.2 THIRUVANANTHAPURAM MONORAIL PROJECT

A feasibility study for implementing a suitable MRTS in Thiruvananthapuram was carried out and a DPR for Thiruvananthapuram Monorail Project in December 2012 was submitted.

The salient features were as follows:

- Route Length – 22.5 km
- Number of stations – 19 (all elevated)
- Expected daily traffic – 2021 – 2,67,465
- Number of trains in 2018 – 22 (3coaches per train)

Figure 60 Proposed Route Map (Source: Thiruvananthapuram Monorail Project in December 2012)

The proposed corridor is one of the major spines of the city however, the project has not been implemented.

2.18.3 MASTER PLAN 2031

The Master Plan 2031 was prepared in the year 2012, by Department of Town and Country Planning. The major recommendations as per the Master Plan are as below:

Table 2-12 Major Recommendations – Master Plan -2031

PROPOSALS	OBSERVATIONS
Bus Terminal at Enchakkal, Mobility Hub at Veli & Logistic Center at Vizhinjam	Proposals still in planning stages

PROPOSALS	OBSERVATIONS
Bypass proposed for providing smooth traffic flow, from Parassala to Kazhakkoottam	Outer Ring which is under construction shall provide to connectivity to theses area.
Cycle tracks proposed connecting work centers, educational insitutuinos, transport works and other nodes.	Bicycle park developed at Akkulam. Smart City Thiruvananthapuram Ltd developed 7-km, 1.2m wide painted/ demarcated lanes along Corporation office, Kowdiar –Vellayambalam, stretches.
LRTS proposed for two routes: ○ Route1-Manacaud–LMS-Pattom-Kesavadasapuram-Ulloor-Medical College-Kumarapuram- Venpalavattom-Pettah-Chackai-Kallumoodu Jn- Manacaud ○ Route 2- Manacaud–LMS-Pattom-Kowdiar-Vellayambalam-Sasthamangalam-Edapanzhji-Poojappura-Karamana-Kalady-CHirammukku-Manacaud	The proposed corridors are important roads in the city however, the project has not been implemented.
Export oriented SEZs at Vizhinjam	International Sea Port developed at Vizhinjam
Outer Ring Road connecting Thiruvallam on NH bypass to Chakai, etc. Inner Ring Road circling the CBD areas	NHAI started inviting tenders (bids) for Thiruvananthapuram Outer Ring Road's construction works in February 2023 with a 2 year construction deadline.
Flyover proposed across MG Road at pazhavangadi	Constructed.
Bypass for NH 66 proposed with a right of way 40m-50m with status of Arterial Road	In progress
Inland Water Transport Network - extended to Kovalam and Kasargode	To be developed
Propose Multimodal Mobility Hub at Akkulam	To be developed
Decentralization of City bus Services by locating 8 bus depots across the city – Thampanoor, Sreekaryam, Mannanthala, Peroorkada, Vattiyoorkavu, Nemom, Vizhinjam, Eanchakkal	Sub-urban services have been decentralised from the city core and East fort currently operates the city bus services.
Proposed Truck Terminals at Enchakkal, Nemom, Vizhinjam, and Chalai Bypass	To be developed

2.18.4 COMPREHENSIVE MOBILITY PLAN (CMP) - 2015

The Comprehensive Mobility Plan was prepared in 2015 for the horizon year of 2034.The objective of the CMP was to ensure mobility solutions for Thiruvananthapuram that are sustainable and in conformity with sustainable mobility.

The higher order system selection for major corridors as show:

Table 2-13 Major Corridors in Thiruvananthapuram

SL. NO.	ROAD NAME	CORRIDOR	PPHPD-2024	PPHPD-2034
1	NH Bypass	Kazhakkoottam to Chakkai	2,000	2,800
		Chakkai to Thiruvallam	3,000	3,500
		Thiruvallam to Vizhinjam	800	1,000
2	NH-66	Mangalapuram to Kazhakkoottam	5,000	6,000
		Kazhakkoottam to Kesavadasapuram	10,500	12,000
		Kesavadasapuram to Thampanoor	11,500	14,500
		Thampanoor to Pappanamcode	9,000	10,000
		Pappanamcode to Neyyattinkara	6,000	6,700
3	MC Road	Kesavadasapuram to Vattappara	2,700	3,300
4	Nedumangad Rd	Thampanoor to Karakulam	2,000	2,800
5	Malayinkeezh Rd	Palayam to Peyad	2,000	2,600

The major recommendations as per the Master Plan are as below:

Table 2-14 Major Recommendations – CMP-2015

PROPOSALS	OBSERVATIONS
Light rail system: Pallippuram–Neyyattinkara corridor. Bus Rapid Transit System Corridors: 34 kms of mobility corridors were proposed for BRT system	The proposed corridors are important roads in the city however, the project has not been implemented.
Multi Modal Mobility Hub at Eanchakkal	Yet to be developed
Outer Ring Road from Vizhinjam to Mangalapuram of about 47kms was proposed	NHAI started inviting tenders (bids) for Thiruvananthapuram Outer Ring Road's construction works in February 2023 with a 2 year construction deadline.
Inner Ring Road from Vettu Road, to Thiruvallam	Yet to be developed
An elevated 4-lane road of 13.5 km was proposed between Kazhakkoottam and Eanchakkal	Under Construction
Development Plan for Inland waterways	Yet to be developed
Provision of footpaths measuring 90km in length on major roads	Partly developed
Skywalks –Chalai-East Fort and KSRTC-Railway station	Constructed at East Fort, KSRTC-Railway station sky walks to be developed
Provision of bi-cycle lanes of 42.37 km	To be developed

PROPOSALS	OBSERVATIONS
Truck terminals at Chalai (Mini), Balaramapuram, Vizhinjam, Eanchakkal AND Mangalapuram	Yet to be developed
The roads measuring 24.8 km were proposed for paid on street parking. Multi-Level Car Parking (MLCP): MLCPs were proposed at nine locations in the city.	Partly developed

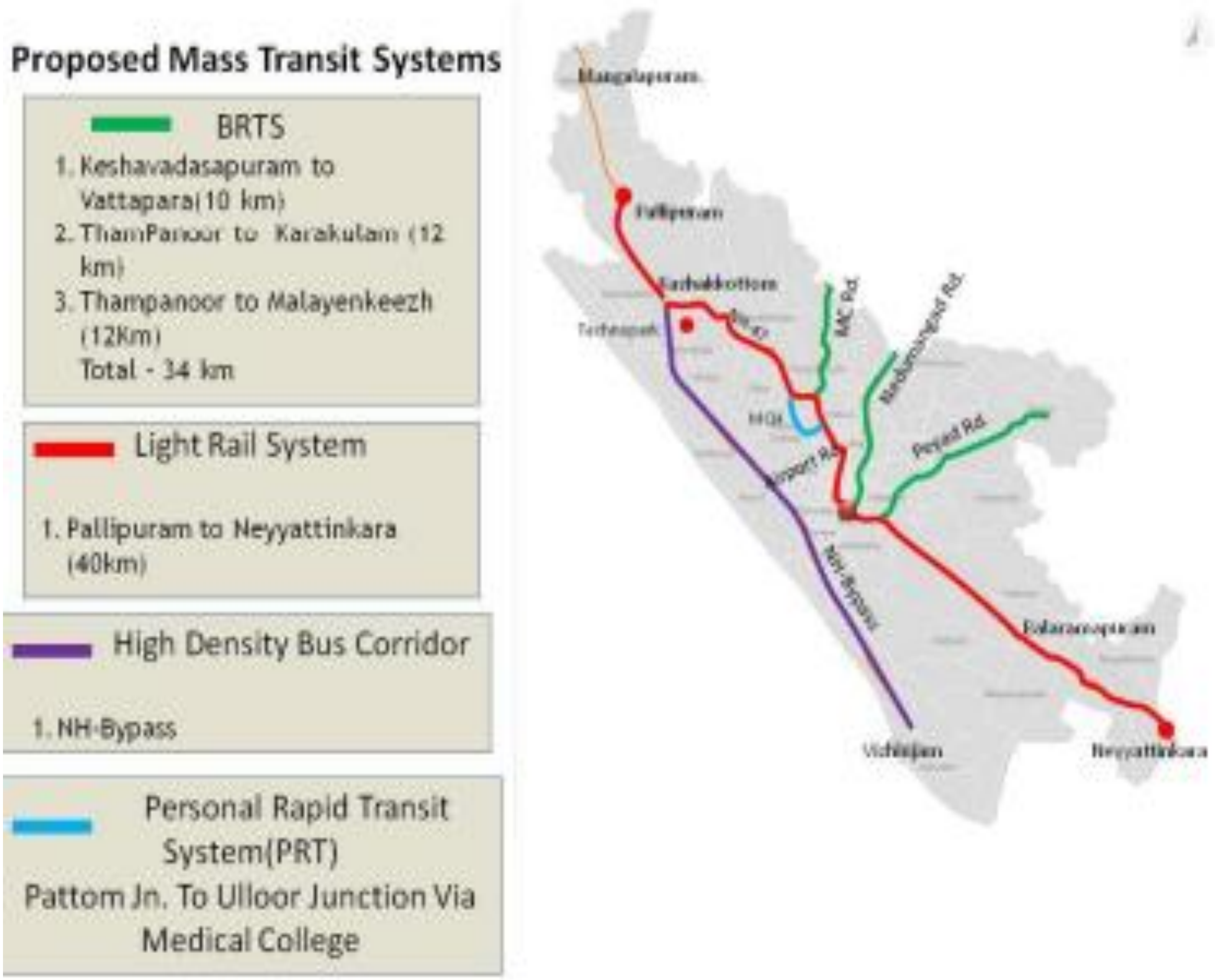


Figure 61 Proposed MRTS systems (Source: Comprehensive Mobility Plan-2015)

2.18.5 DETAILED PROJECT REPORT – THIRUVANANTHAPURAM LIGHT METRO RAIL PROJECT

A revised DPR was approved by KRTL's board in October 2020 and by Kerala's state government in February 2021. The features are as follows,

- Phase-I of Light Metro covers 21.821 km with 19 stations,
- Route - Techno city in North to Karamana in South.

Figure 62 Thiruvananthapuram Metro Rail Map (Source: Detailed Project Report – Thiruvananthapuram Light Metro Rail 2020)

2.18.6 FEASIBILITY STUDY LINKING TECHNOPARK WITH THE PROPOSED THIRUVANANTHAPURAM LIGHT METRO RAIL

The assessment was carried out linking Technopark with the proposed alignment between Techno city to Karamana, the proposed alignment and Technopark area including Phase I, Phase II and Phase III were considered.

Based on the detailed evaluation the alignment from Kazhakoottam to Technopark via Technopark Campus along Thettiyar Thodu (a small canal) and NH Bypass was recommended with Light Metro starting from Technopark Station at Line I, and abutting the Technopark campus and traversing along the Canal (Thettiyar thodu) till Phase III Campus entrance and along NH Bypass for further alignment.

Length of corridor	**5.47km**
Total number of stations	5
Interstation Distance (Average)	0.98
Available ROW	7.5m to 9.5m along Canc 42m-48m along NH

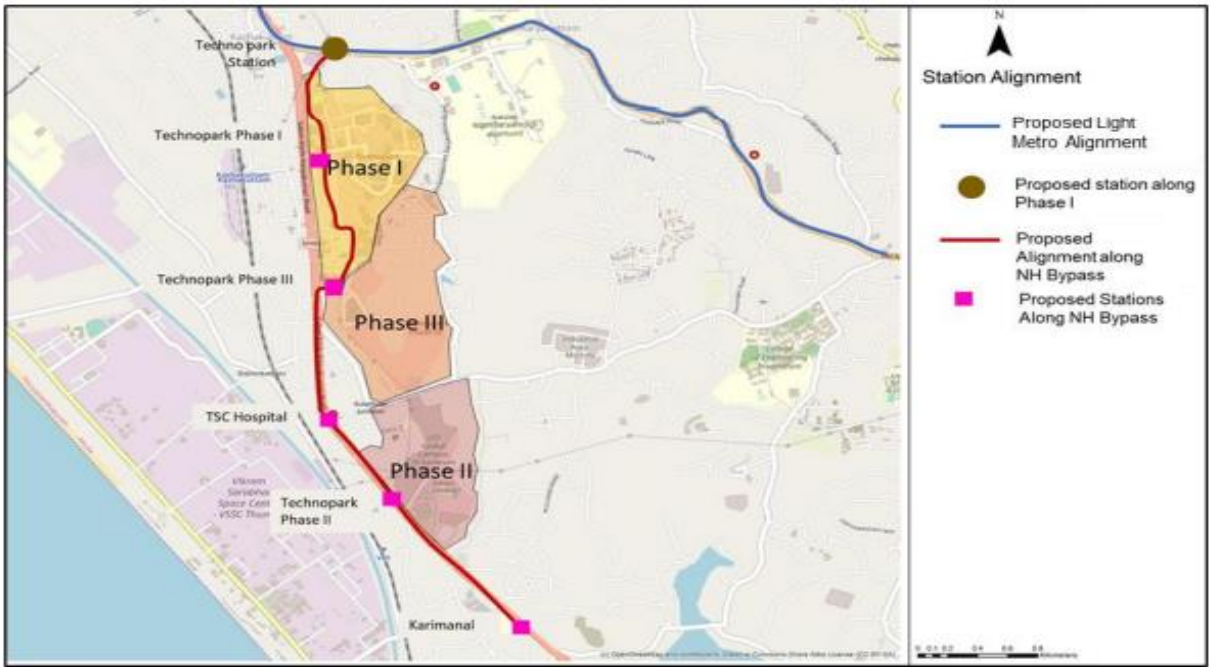


Figure 63 Proposed Alignment - Option 3 (Source: Feasibility Study Linking Technopark With The Proposed Thiruvananthapuram Light Metro Rail)

2.18.7 THIRUVANANTHAPURAM – KASARAGOD HIGH SPEED RAIL (SILVER LINE PROJECT)

Thiruvananthapuram – Kasaragod (Kerala) Silver Line corridor is a 530.6 km approved semi high-speed rail line connecting Thiruvananthapuram (Thiruvananthapuram) and Kasargod in Kerala through 11 stations.

In 2020, the Kerala state government's cabinet approved the line's Detailed Project Report (DPR) with a minor change to the alignment. The line is expected to be extended to Mangaluru (Mangalore) in Karnataka in the future. The work is yet to be started.

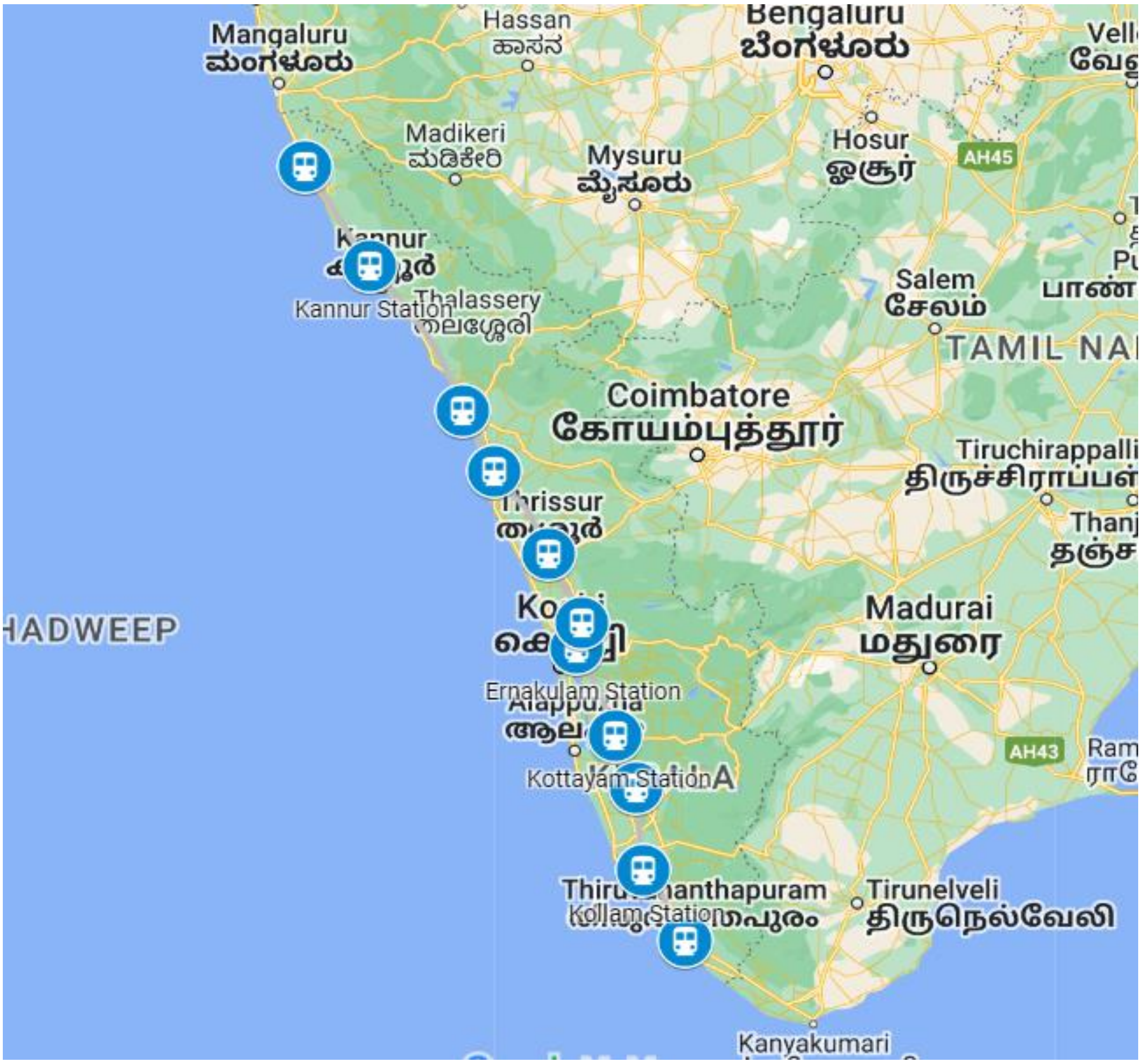


Figure 64 Proposed Route Map

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

03

TRAVEL CHARACTERISTICES & CHALLENGES

3 TRAVEL CHARACTERISTICES & CHALLENGES

The existing travel and traffic characteristics are analysed using the primary data collected through various traffic surveys, base year travel demand model developed to replicate the on ground traffic and transportation scenario in the study area.

3.1 SOCIO-ECONOMIC CHARACTERISTICS

- The sex ratio derived from the house hold survey is the sex ratio is 1064 females per 1000 males.

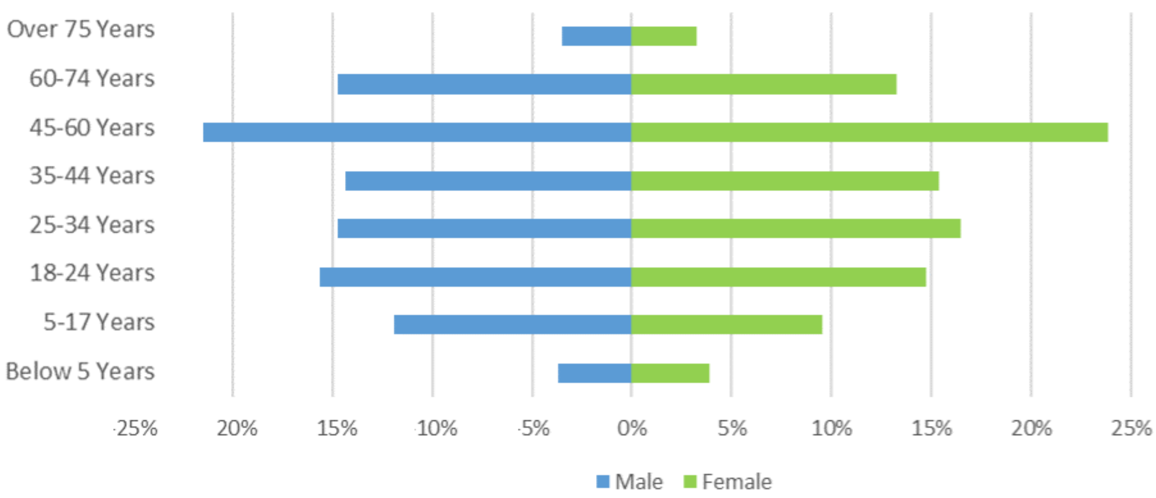


Figure 65 Age-Sex Pyramid (Primary Surveys-2022-23)

- The average household size is observed to be 3.45 with average number of 1.4 earning members per household.
- The average number of students per household is about 1.3 with an average of 1.9 members making trips on regular basis.
- The average monthly income as per the Household survey is about INR 30,498.

- The classification based on the category of vehicles owned indicates that 16% of the households own no vehicle while, 70% of the households own two-wheelers and 36% of the households own cars.

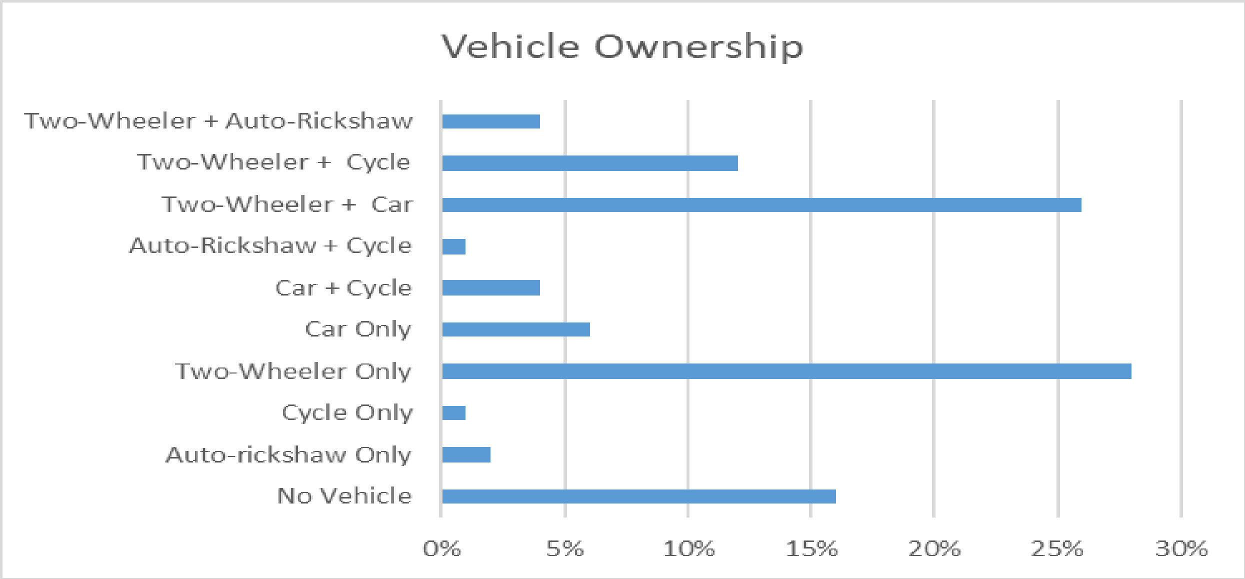


Figure 66 Distribution Households Based on Vehicle Ownership (Primary Surveys-2022-23)

3.2 EXISTING TRAVEL CHARACTERISTICS:

- The Per Capita Trip Rate (PCTR) was observed to be 1.24 including the walk trips and 1.02 excluding the walk trips. The PCTR for motorized trips is about 0.94.
- The major modes of travel are observed to be two wheelers with a modal share of 40% while the share of bus based public transport accounts to only 21%, clearly indicating that private mode dominance mode over public buses. The mode share of the passenger trips are as presented in the figure below.

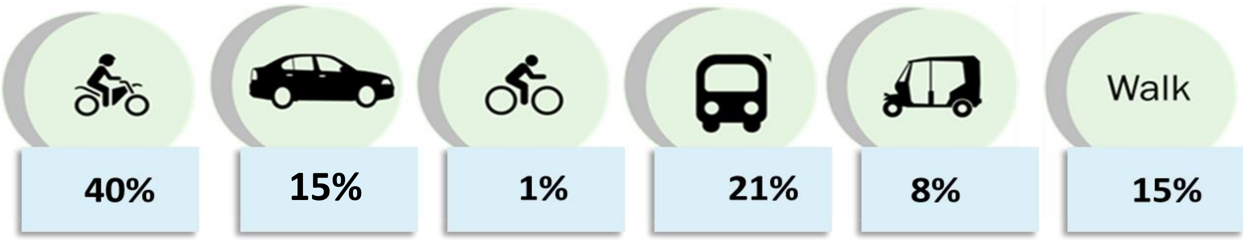


Figure 67 Mode Share (Primary Surveys-2022-23)

Note: The increase in the usage of private modes can also be observed as a post covid scenario. Thus, the travel characterises shall be viewed in two ways, current travel pattern & optimistic travel pattern. Since the inclination towards public transport is slowing improving due to better facilities and comfort of travel, pre covid scenario also becomes a part of this comparison. The same shall be considered while assessing the alternative scenarios.

- The observed average trip length in is observed to be 7.8Km including the walk trips and 8.9km excluding the walk trips.

Table 3-1 Average Trip Lengths (Primary Surveys-2022-23)

AVERAGE TRIP LENGTHS	ATL (KM)
Total	7.8
Motorized	9.0

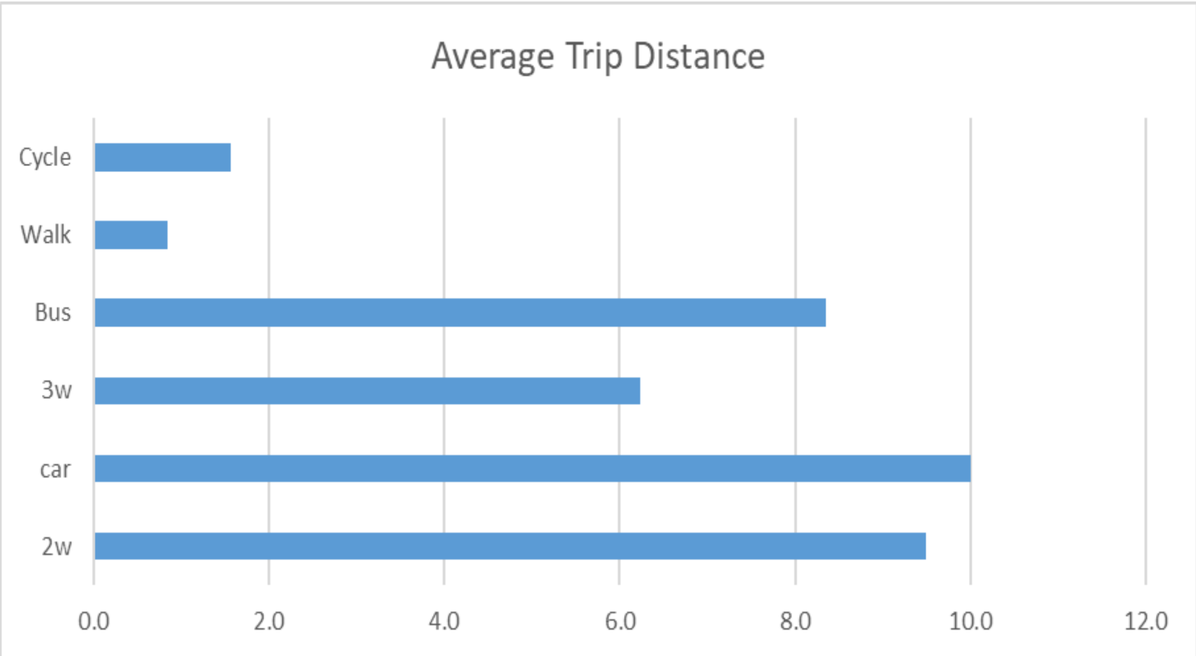


Figure 68 Mode-wise Average Trip Lengths (Primary Surveys-2022-23)

- The major mode of access and dispersal modes is walk with a share of 85.4% of the total access and dispersal modes.

- The average trip length of access and dispersal trips is observed to be 0.89km including walk trips and 1.4km for trips excluding walk.

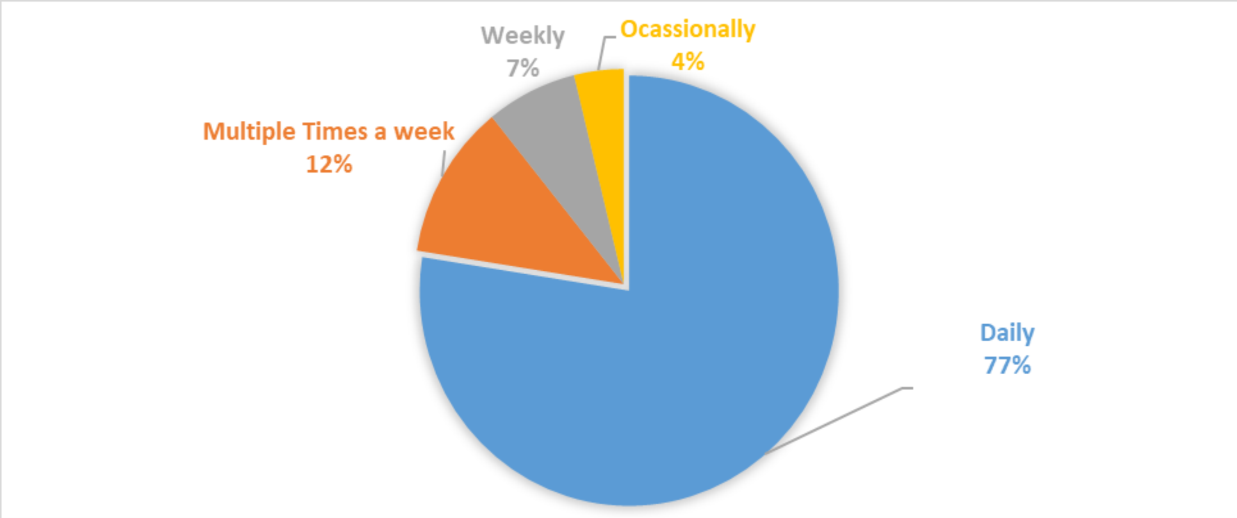


Figure 69 Trip Frequency Composition (Primary Surveys-2022-23)

- The survey indicated that over 75% of the trips are made daily.

- Nearly 55% of the trips made are work-based trips and about 34% of the trips are made for educational purposes. This indicates that nearly 80% of the trips being made are regular and daily trips in the study area.

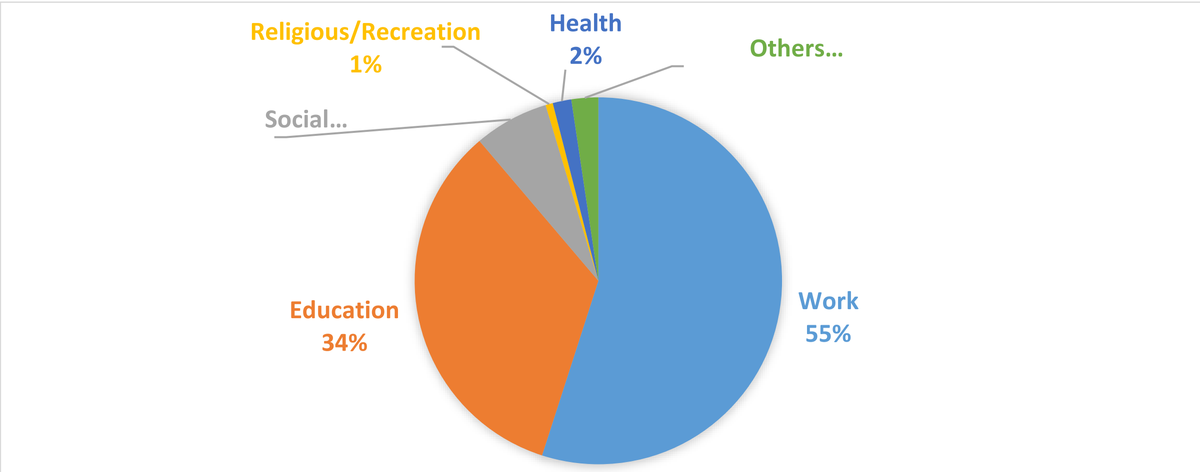


Figure 70 Trip Purpose Composition (Primary Surveys-2022-23)

- The average waiting time for public transport services is observed to 8.2 minutes. The longest waiting time is observed for buses with a wait time of 12 minutes.

- The household's access to the nearest PT or IPT stop is 0.62 km which is considered as a comfortable walking distance. Similarly, the average time taken to reach the PT or IPT stops in 7 minutes.

3.3 PUBLIC TRANSPORTATION (PT) PASSENGER VOLUMES

The primary survey assessment shows a peak hour footfall of nearly sixty thousand passengers at the major public transportation terminals in the study area. It is seen that Thiruvananthapuram Central Railway Station and Pettah are the major railway stations with high passenger footfalls and Thampanoor Bus Terminal and East Fort are the major bus terminals in the study area. The quantum of passenger flow is as presented in the table below.

Table 3-2 Peak Hour Passenger Volumes at Major PT Terminals (Primary Surveys-2022-23)

LOCATION	NAME	PASSENGERS		TOTAL PASSENGERS
		IN	OUT	
TS1	Kazhakkoottam Railway Station	605	638	1243
TS2	Pettah Railway Station	1652	2097	3749
TS3	EastFort Bus Terminnal	4107	5333	9440
TS4	Thampanoor Bus Terminal	10257	10088	20345
TS5	Thiruvananthapuram Central Railway Station	5143	4377	9520
TS6	Pappanamcode Bus Stop & Depot	3346	3050	6396
TS7	Neyyattinkara Railway Station	509	335	844
TS8	Vizhinjam Bus Stop & Depot	2312	2621	4933
TS9	Thiruvananthapuram Airport	4083	5974	10057

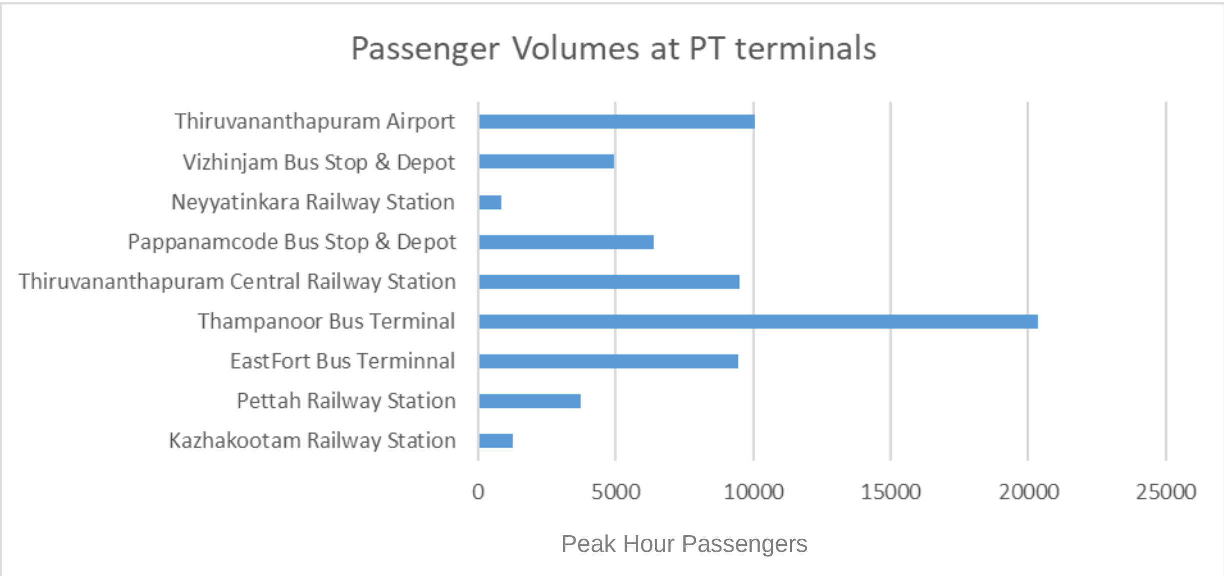


Figure 71 Peak Hour Passenger Volumes at Major PT Terminals (Primary Surveys-2022-23)

The primary survey assessment shows a daily footfall of nearly 36 thousand passengers at the major bus stops in the study area with an average passenger occupancy of 32 persons per bus. It is seen that Thampanoor bus stop has the highest footfall due to its proximity to various transportation terminals and activity centres followed by Medical college and Neyyattinkara bus stops. Palayam and East fort bus stops are also observed to cater to nearly 4,000 passengers daily. The volumes indicated the presence of significant demand for public transportation services.

Table 3-3 Passenger Volumes at Major Bus Stop (Primary Surveys-2022-23)

LOCATION	NAME	TOTAL PASSENGERS	AVERAGE PASSENGER LOAD (PASSENGER PER BUS)
BS1	Kazhakoottam	808	41
BS2	Sreekaryam	2776	34
BS3	Medical College	6325	33
BS4	Kesavadasapuram	2930	31
BS5	Pattom	2000	34
BS6	Palayam	3912	28
BS7	Vazhutacaud	1148	35
BS8	Thampanoor	7791	32
BS9	East Fort	3993	24
BS10	Neyyattinkara	4317	31

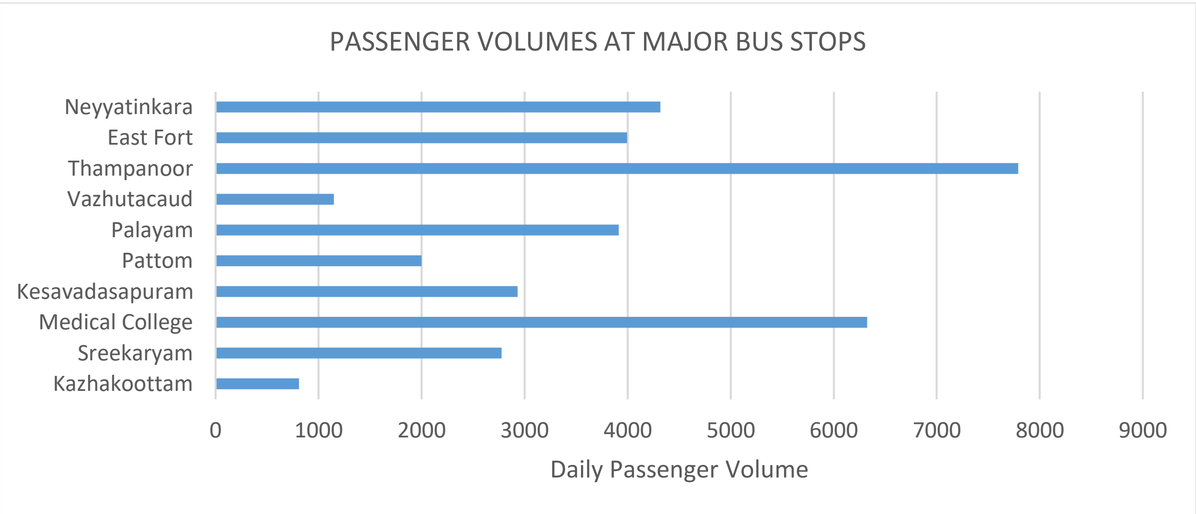


Figure 72 Passenger Volumes at Major Bus Stops (Primary Surveys-2022-23)

3.4 ROAD NETWORK CHARACTERISTICES

- The surveyed network indicates that on 28% of the corridors have Right of Way (ROW) availability over 18m. The distribution of ROW on the surveyed network in presented in the below figure.
- The exiting surveyed corridors constitute carriageway between 18m to 24m indicating the availability of reasonable road space in terms of lane configurations on Major corridors. However, only 35% of the survey network had ROW over 12m.
- 58% of the surveyed network has 2-lane and above configuration. 4lanes constitute about 16% of the total network, which are largely along the NH-66, NH-Bypass, MC road, MG Road, etc.
- The share of network with divided carriage is about 38%.
- 14.2% of the major network has footpath availability in the study area. And only 5% of the network has footpaths over 2m widths indicating the need to improve pedestrian infrastructure in the study area.
- The analysis indicates that about 59% of the major network has on-street parking hindering the road space allocated for traffic flow and pedestrian movement.

Table 3-4 Network Characteristics of Major Roads in the study area (Primary Surveys-2022-23)

NAME OF THE ROAD	LENGTH (KM)	PAVEMENT TYPE	PAVEMENT CONDITION	NO. OF LANES	DIVIDED/ UNDIVIDED	ONE WAY/ TWO WAY
NH-66 (Mangalapuram to Neyyattinkara)	40	Flexible	Good	2+2	Undivided	Two Way
NH bypass (Kazhakoottam to Kovallam)	25	Flexible	Good	4+4	Divided	Two Way
MC Road (Kesavadasapuram to Mannanthala)	5	Flexible	Good	2+2	Partly Undivided	Two Way
Nedumangad Road (Vellayambalam to Nedumangad)	8	Flexible	Fair	2+2	Partly Undivided	Two Way
Vattiyoorkavu Road (SRK Hospital Jn - Mukkola)	5	Flexible	Fair	1+1	Undivided	Two Way
Peyad Road (Karamana to Peyad)	8	Flexible	Good	1+1	Undivided	Two Way
Kovalam Road (Kovallam to Pulinkudi)	5	Flexible	Good	4+4	Divided	Two Way
Airport Road (Chackai to Airport Junction)	8	Flexible	Good	2+2	Divided	Two Way

Figure 73 Road Network Lane Typology

- The average running speed in the study area is 21.3kmph, while the journey speed during the peak hours is about 19.5kmph.

Table 3-5 Peak Hour Journey Speeds on Major Roads in the study area (Primary Surveys-2022-23)

SN	NAME OF THE ROAD	DISTANCE (KM)	PEAK HOUR SPEED (KMPH)	OFF-PEAK HOUR SPEED (KMPH)
1	Maruthankuzhi-Kesavadasapuram Rd	1.6	27.3	28.6
2	Thirumala- Peyad - Malayinkeezhurd	1.2	23.8	24.5
3	Kowdiar Ave	1.2	22.8	24.1
4	Panavel -Kochi Rd	1.5	22.7	24.8
5	Peroorkada Vattiyoorkavu Rd	11.2	22.7	24.2
6	Mukkikada Edathara Rd	1.9	22.2	23.3
7	Vazhuthacaud-Poojappura	2	21.8	22.7
8	Pappanamcode Malayinkeezhu Rd	6.1	21.5	22.2
9	Chekkalamukku-Powdikonam	2.5	21.3	22.9
10	Peroorkada	1.2	21.1	23.5
11	Kazhakoottam-Thaikod Rd	3.6	20.6	21
12	Poojappuram Rd	2.8	20.3	20.3
13	Powdikonam-Pothencode Rd	1.1	20.1	21.2
14	Powdikonam Jn	1.1	20.1	21.1
15	Tvm-Neyyar Dam Rd	1.6	19.7	21.5
16	Peroorkada Rd	0.5	18.9	19.2
17	Medical College - Ulloor Rd	1	18.8	18.8
18	PMG Rd	1.3	18.5	20.6
19	Market Rd	0.5	18	18
20	Ulloor Brg	1.4	17.2	28.7
21	Vettamukku Rd	0.7	17	18.3
22	CV Raman Pillai Rd	3.2	16.8	17.6
23	LMS Vellayambaam Rd	3.2	16.6	17.7
24	Poonthi Rd	3	16.4	18.4
25	Pottakuzhy Road	1.1	15.8	18
26	Edathara Temple	0.8	15.6	17.6

SN	NAME OF THE ROAD	DISTANCE (KM)	PEAK HOUR SPEED (KMPH)	OFF-PEAK HOUR SPEED (KMPH)
27	Chilkoor Vallakkadavu	2.6	15.4	23.1
28	Mangattukadavu Thirumala Rd	2.9	14.9	17
29	Bakery Flyover Rd	0.9	14.9	16.4
30	Ulloor-Akkulam Rd	4.8	14.4	15.7
31	Tvm-Neyyar Rd	0.5	14.1	16.9
32	Pattom Kowdiar Rd	1.4	14	15.7
33	Muttathara Road	2.6	12.8	17.3
34	Thampnoor Flyover	0.8	12.4	15.1
35	Nemom Punnamoodu Rd	0.8	12.2	14.8
36	Sasthamangalam Rd	0.7	11.8	13.1
37	Nh66 (Managalpuram to Neyyattinkara)	41.9	21.1	28.6
38	Kuravankonam -Ambalamukku Rd	1.3	11.3	15.3
39	Kumarapura Road	0.8	10.4	13.4
40	Sreekariyam -Pothencode	7.1	10.2	10.7
41	Thiruvananthapuram -Nagercoil	17.1	10.1	10.9
42	Poojappura Main Rd	0.5	10.1	11.1
43	Palayam Airport Rd	9.1	9.9	11.7
44	Pachalloor To Punkulam Rd	10.5	9.5	10.4
45	Manorama Rd	1.2	9.2	9.4
46	Vizhinjam Poovar Rd	6.8	8.9	9.2
47	Pallicheal Vizhinjam	5.8	8.8	9.1
48	Mahatma Gandhi Rd	3.3	7.7	10
49	Trivendrum Vizhinjam Rd	4.2	6.5	7.5
50	Railway Station Rd (Over Bridge to Station)	0.6	4.3	4.4

Table 3-6 Peak Hour Delays on Major Roads in the study area (Primary Surveys-2022-23)

SN	NAME OF THE ROAD	DISTANCE (KM)	DELAY (MINS)	CAUSE OF DELAY
1	NH66 (Mangalapuram to Neyyattinkara)	41.9	30.9	Traffic &Traffic Signal, Construction works
2	Kuravankonam Junction –Ambalamukku Junction	1.3	1.8	Traffic &Traffic Signal
3	Mutada Rd (Paruthippara to Muttada)	0.7	2.0	Traffic &Traffic Signal
4	Palayam UPAS (Aasan Square) – Swadeshabhimani Square)	0.3	0.4	Traffic &Traffic Signal
5	Kumarapura Road (Murijapalam Junction to Kumarapura)	0.8	1.0	Traffic &Traffic Signal
6	Sreekariyam –Pothencode	7.1	2.1	Traffic &Traffic Signal
7	Poojappura Main Rd (Poojappura Junction to Thirumala Junction)	2.5	0.3	Traffic &Traffic Signal
8	Palayam Airport Rd	9.1	8.7	Traffic &Traffic Signal
9	New Theatre Rd (Thampanoor Junction to Flyover)	0.3	2.0	Traffic &Traffic Signal
10	Pachalloor To Punkulam Rd (Pachalloor Junction to Shanthi Nagar)	10.5	6.3	Traffic &Traffic Signal
11	Mahatma Gandhi Rd (LMS to Manacaud)	3.3	5.9	Signal
12	Railway Station Rd (Over Bridge to Station)	0.6	0.2	Traffic &Traffic Signal

- The average delay of 17 minutes is observed in the study area during peak hours on major corridors. The major reasons for Delay is largely due to traffic and signals.

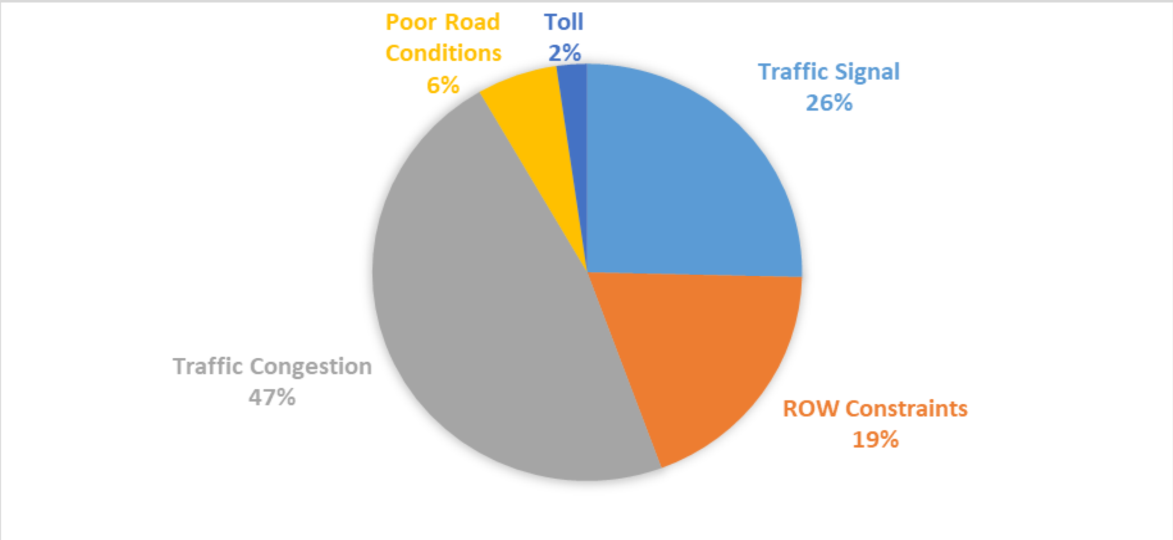


Figure 74 Causes of Delay in Travel Time (Primary Surveys-2022-23)

3.5 TRAFFIC VOLUMES

- It is observed that highest outer cordon traffic volumes are observed on NH-66- Attingal road followed by Panvel Kochi Kanyakumari Highway.
- It is observed that about 46% of the vehicle composition at outer cordons in constituted by two-wheeler and about 26% is constituted by Goods.

Table 3-7 Vehicular Volumes at Outer Cordon Locations (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)			DAILY (PCUS)
		INBOUND	OUTBOUND	TOTAL	TOTAL
OC_1	NH-66 Attingal	21021	22742	43763	45117
OC_2	Pothenvide	16623	16853	33476	32242
OC_3	Vembayam	14185	15188	29373	29103
OC_4	Nedumangad Highway	7379	7284	14663	13798
OC_5	Panvel Kochi Kanyakumari Highway	16277	16550	32827	33089
OC_6	Pulinkudi	9223	9161	18384	16803

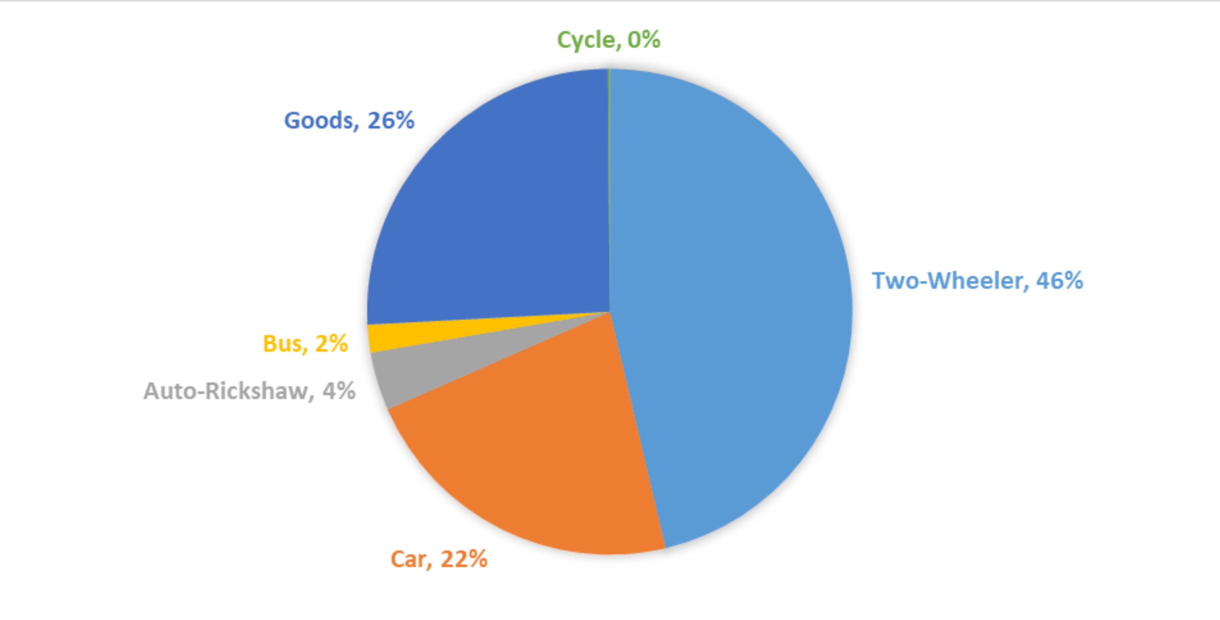


Figure 75 Vehicular Composition at Outer Cordon Locations (Primary Surveys-2022-23)

- It is observed that highest traffic volumes at screen line locations are observed on Karamana Bridge followed by Thiruvallam Bridge and at Pettah.
- It is observed that about 71% of the vehicle composition at screen lines in constituted by two-wheeler and about 16% is constituted by car.

Table 3-8 Vehicular Volumes at Screen Line Locations (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)			DAILY (PCUS)
		INBOUND	OUTBOUND	TOTAL	TOTAL
SC_1	Menamkulam	16408	16213	32621	31409
SC_2	Aruvikkara dam	3567	3655	7222	6550
SC_3	Kundamankadavu E-W	29521	29075	58596	53778
SC_4	Pettah E-W	33241	37286	70527	71533
SC_5	Thampanoor E-W	37343	41898	79241	83189
SC_6	Karamana Bridge N-S	62642	58168	120810	116471
SC_7	Thiruvallam Bridge N-S	38810	40097	78907	77223
SC_8	Pallichal	16934	14775	31709	29718
SC_9	Bridge Lane, Neyyattinkara	20566	20429	40995	38863

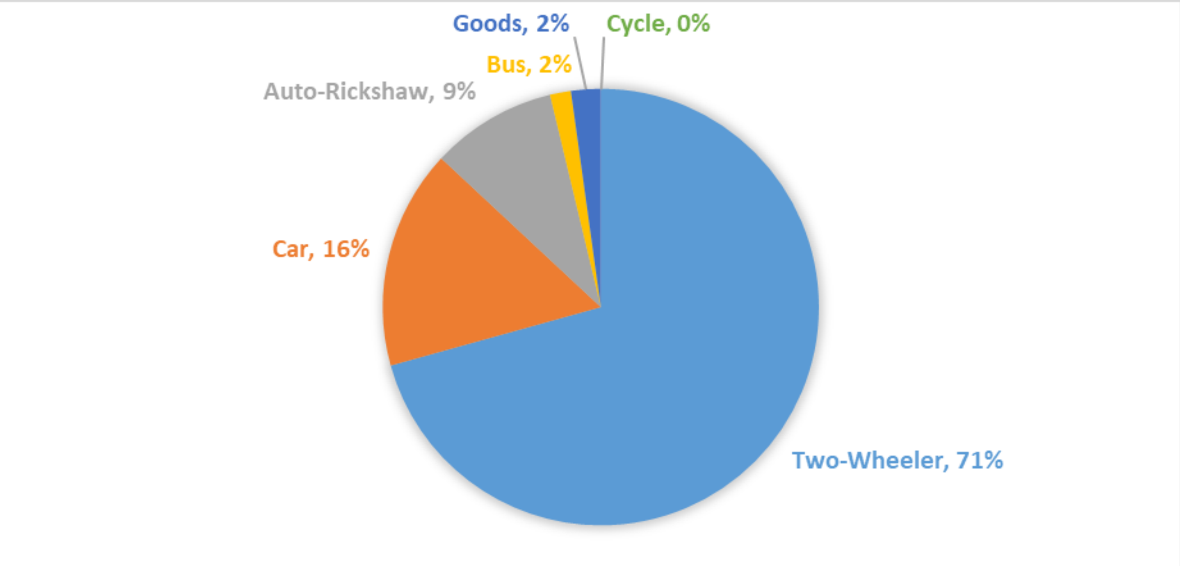


Figure 76 Vehicular Composition at Screen Line Locations (Primary Surveys-2022-23)

- It is observed that highest traffic volumes at mid-blocks locations are observed on NH Bypass near Lulu Mall, followed by Ulloor Bridge and at Mangalapuram Road.
- It is observed that about 53% of the vehicle composition at mid-blocks in constituted by two-wheeler and about 33% is constituted by car.

Table 3-9 Vehicular Volumes at Mid-Block (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)	DAILY (PCUS)
		TOTAL	TOTAL
MB_1	NH66	39566	40390
MB_2	Mangalapuram	48285	48392
MB_3	Vattapara Thattatumala Road	22915	22498
MB_4	Sreekariyam Road	20487	19221
MB_5	Ulloor Bridge	54484	55202
MB_6	Lulu Mall	86361	82900
MB_7	Pulimoodu	39866	38435
MB_8	Pappanamcode Malayinkeezhu	13380	12247
MB_9	Mannanthala	27517	26556

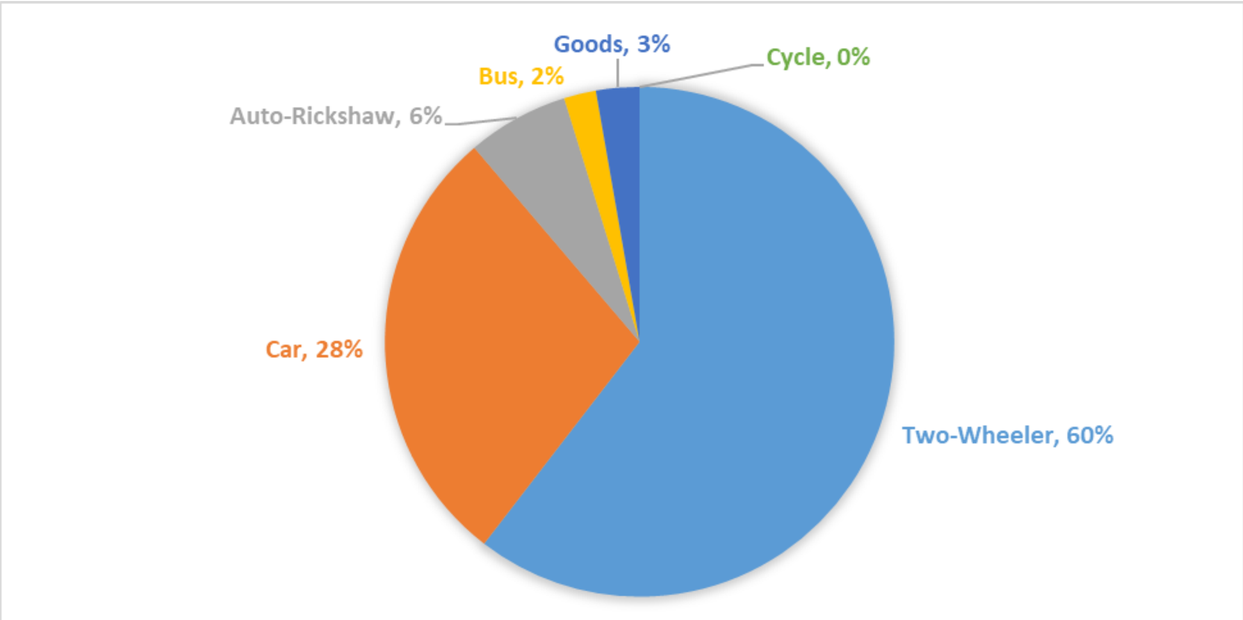


Figure 77 Vehicular Composition at Screen Line Locations (Primary Surveys-2022-23)

- It is observed that highest traffic volumes at intersections locations are observed at Palayam, followed by Pattom, Challa and Thampanoor. This indicates that the high volumes are observed in the city core and there is a need to address and decongest the core area.
- It is observed that about 54% of the vehicle composition at intersections in constituted by two-wheeler and about 26% is constituted by car.

Table 3-10 Vehicular Volumes at Major Intersections (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)	DAILY (PCUS)
		TOTAL	TOTAL
TVC1	Kazhakoottam	93484	91292
TVC2	Sreekaryam	68120	67661
TVC3	Kesavadasapuram	100511	102363
TVC4	Pattom	128101	131267
TVC5	Vjt Hall Palayam	174070	182858
TVC6	Thampanoor	99812	116892
TVC7	Karamana	118426	116281
TVC8	Pappanamacode	112117	105576
TVC9	Balaramapuram	75685	75138
TVC10	Vellayambalam	105834	104836
TVC11	Kowdiyar	100006	97925
TVC12	Peroorkada	95911	96324
TVC13	Sasthamangalam	70276	70352
TVC14	Manacaud Junction	73715	80454
TVC15	Vizhinjam	28481	30786
TVC16	Chakka	121349	120053
TVC17	Eanchakkal	81456	81911
TVC18	Medical College	76959	84064
TVC19	Poojappura	35275	34364
TVC20	Edapazhji Junc	75563	74045

3.6 PEDESTRIAN VOLUMES

The surveys indicate that highest pedestrian footfall at Medical College followed by Thampanoor due the adjoining activity nodes such as colleges, transportation terminals, commercial areas, etc. This also indicates the need to improve the pedestrian facilities in areas with high footfall to improve their safety and promote the walking behaviour in the city.

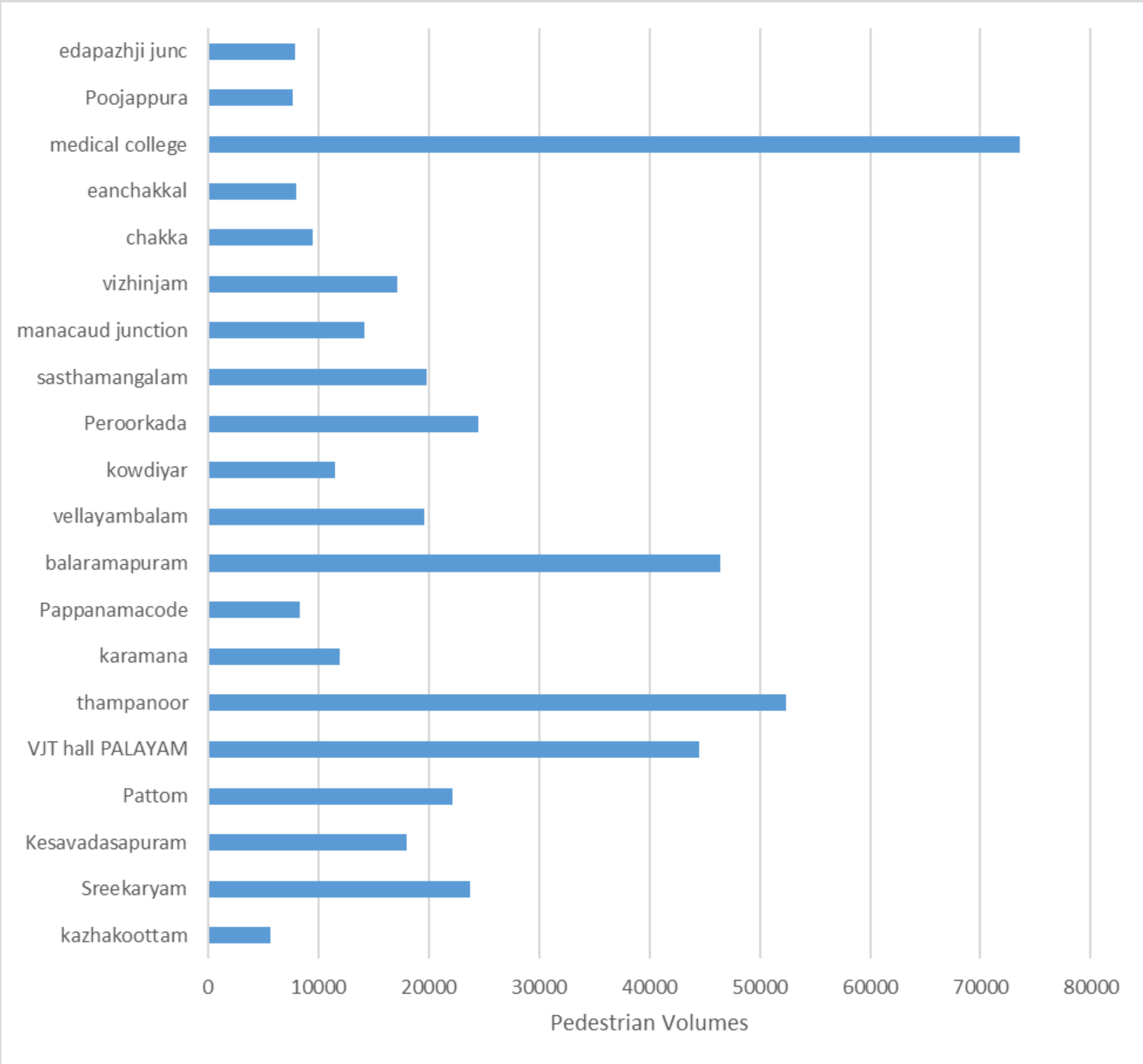


Figure 78 Pedestrian Volumes at Major Intersections (Primary Surveys-2022-23)

The degree of conflict between the vehicles and pedestrian was assessed at major intersections in the study area. The assessment resulted that Palayam, Thampanoor and Medical College have highest degree of conflicts and which require immediate measures to ensure pedestrian safety.

Table 3-11 Degree of Pedestrian Conflict (Primary Surveys-2022-23)

LOCATION	NAME	DEGREE OF CONFLICT (PV^2x10^8)
PC1	Kazhakoottam	24.50
PC2	Sreekaryam	24.89
PC3	Kesavadasapuram	24.86
PC4	Pattom	30.15
PC5	Vjt Hall Palayam	35.17
PC6	Thampanoor	33.65
PC7	Karamana	29.37
PC8	Pappanamacode	25.95
PC9	Balaramapuram	27.84
PC10	Vellayambalam	26.97
PC11	Kowdiyar	26.05
PC12	Peroorkada	26.81
PC13	Sasthamangalam	24.14
PC14	Manacaud Junction	23.07
PC15	Vizhinjam	27.65
PC16	Chakka	26.85
PC17	Eanchakkal	23.67
PC18	Medical College	30.55
PC19	Poojappura	18.01
PC20	Edapazhji Junc	23.95

3.7 PARKING

The parking assessment was carried out at major locations in the study area, it indicated that highest on-street parking accumulation in Attajulangara, Sasthamangalam, Vanross Junction and East Fort areas while the highest off-street parking accumulation was observed near Gandhi Park. The average parking density at major location in the study area is about 180 with an average parking duration of 40mins.

This indicates high intensity of parking on major corridors for longer time periods and need for parking action in the study area.

Table 3-12 Parking Accumulation at Major Roads and Areas (Primary Surveys-2022-23)

CODE	LOCATION	PEAK PARKING DENSITY (ECS/KM)	AVERAGE PARKING DURATION (MINS)
ONP1	Mg Road Between Attajulangara And LMS	421	45
ONP2	NH 66-Plamoodu To Kesavadasapuram	126	45
ONP3	Mettukada-Vellayambalam	119	30
ONP4	Sreekaryam-Chekkamukku	154	25
ONP5	Vellayambalam - Sasthamangalam	295	45
ONP6	East Fort	212	35
ONP7	Sreekumar Theatre Road	248	45
ONP8	Medical College-Ulloor Rd	167	60
ONP9	Chalai Market Road	162	45
CODE	LOCATION	PEAK PARKING ACCUMULATION (ECS)	AVERAGE PARKING DURATION (MINS)
OFP1	Palayam Market	136	40
OFP2	Power House Rd	185	20
OFP3	Gandhi Park	212	25
OFP4	Chandrasekharan Nair Stadium	165	20
OFP5	Attukal Shopping Complex	114	20
OFP6	Karimpanal Arcade	108	35
OFP7	KSRTC Stand East Fort	154	30
OFP8	Thiruvananthapuram Municipal Corporation	153	30

Further, it is observed that highest composition of vehicles parked are two-wheeler with a share over 65%. And it also observed that 53% of the vehicle parked more that 30mins are two-wheelers.

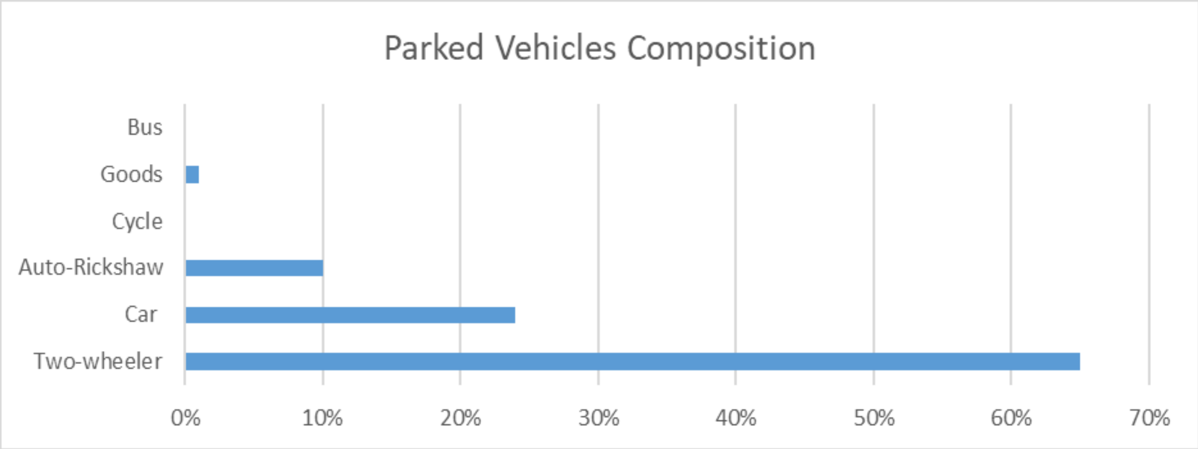


Figure 79 Parked Vehicles Composition (Primary Surveys-2022-23)

3.8 INTEMEDIATE PUBLIC TRANSPORT CHARACTERISTICS:

- About 85% of the intermediate public transport vehicles plying in the city are self-owned.
- The average number of operational hours is 10hours with about 14 trips at an average.
- These are observed to travel at an average of 121 km daily with an average route length of 10.2 km.
- The average daily expenditure of IPT is INR 1256, while the average daily revenue is INR 1507.

3.9 GOODS VEHICLE CHARACTERISTICES:

- About 42% of the trips are observed on occasional basis, indicating predominant intra-city interactions.

- The survey indicated that majority (56%) of the operators have parking facilities available within their premises. Other operators often park their vehicles on the streets. The major issues expressed by the goods operators are,
    1. Lack of Parking facilities
    2. Lack general facilities and terminals
    3. Lack of weighing facilities

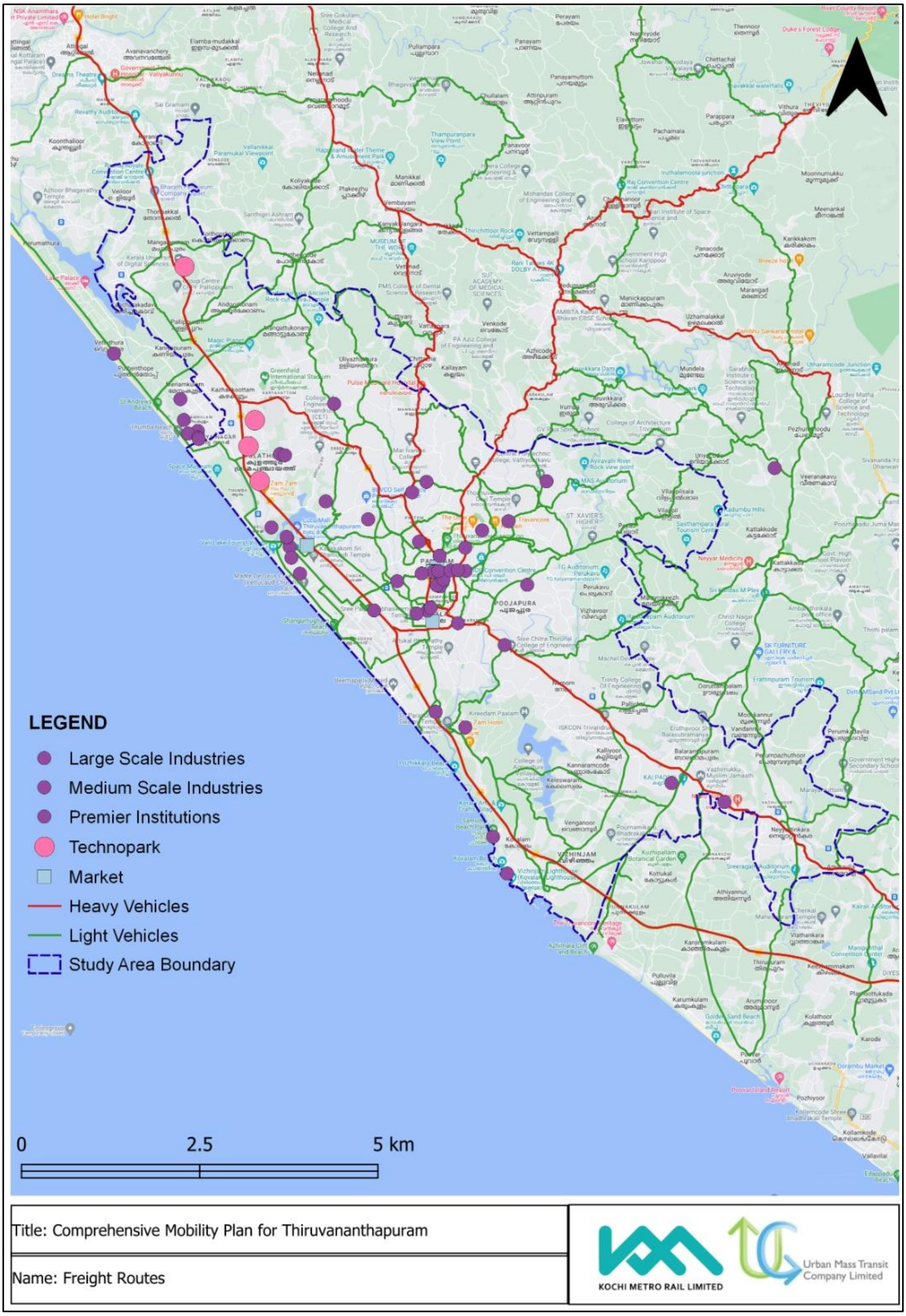


Figure 80 Map showing the major routes used by goods vehicles (Primary Surveys-2022-23)

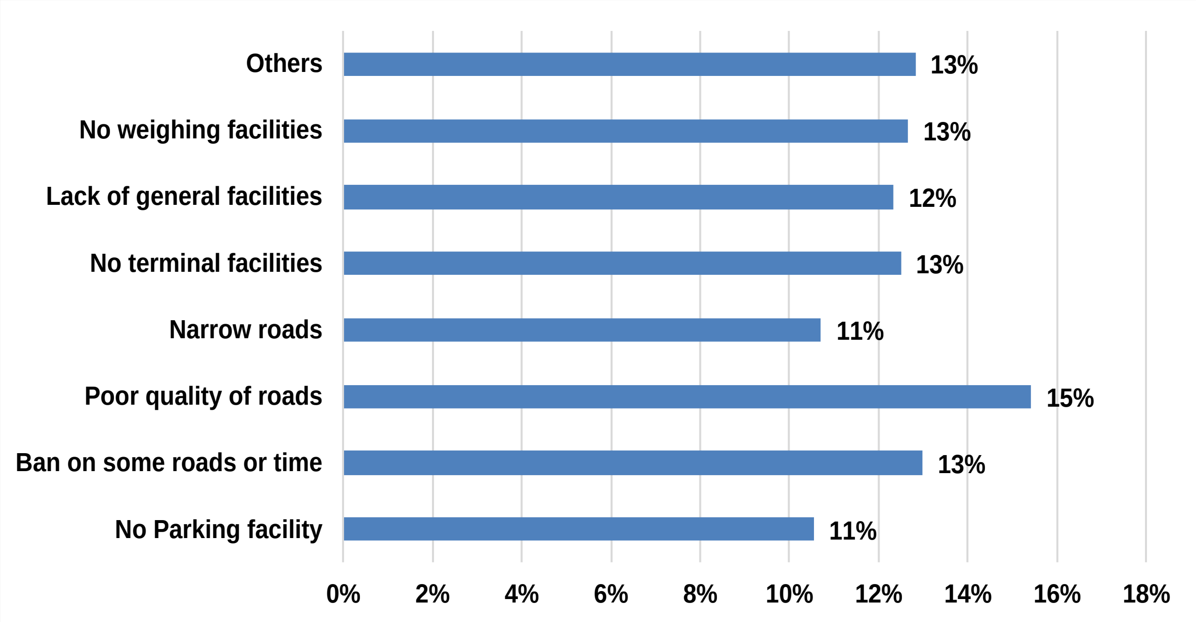


Figure 3-81 Goods Operator Difficulties

- The average number of trips made by goods vehicles is 3.7.
- It is observed that majority of the heavy goods vehicles ply through NH-66, Bypass Road, Kesavadaspuram- Nedumangad corridor and Peyad corridors.
- Heavy vehicle (MAV) movements during the peak periods are observed to be restrictions on the major corridors in the city 8-11am and 4-6pm.

3.10 KEY OBSERVATION AND CHALLENGES

This section summarizes the key observations related to transportation sector in the study area:

1. Ribbon development can be observed in the city, which limits the possibility of expansion on the main roads, land use fluctuation, high utilization of land parcels on the major mobility corridors. An integrated planning approach towards the land use and transportation can be strategies to convert such development of growth corridors or transit –oriented corridors.

- The land use in the area have been evolving over time from predominantly residential to public and commercial, generating pressure on existing transport infrastructure. The major densification is observed within the NH, NH-Bypass, MC Road and Peroorkada road

- In heritage areas like Padmanabhaswamy temple, the streets act as traffic channelizer, without leaving an opportunity for the space around them to be appreciated and suitably developed. There is no clear demarcation of activities or road spaces leading to a lack of equitable distribution of the road space.

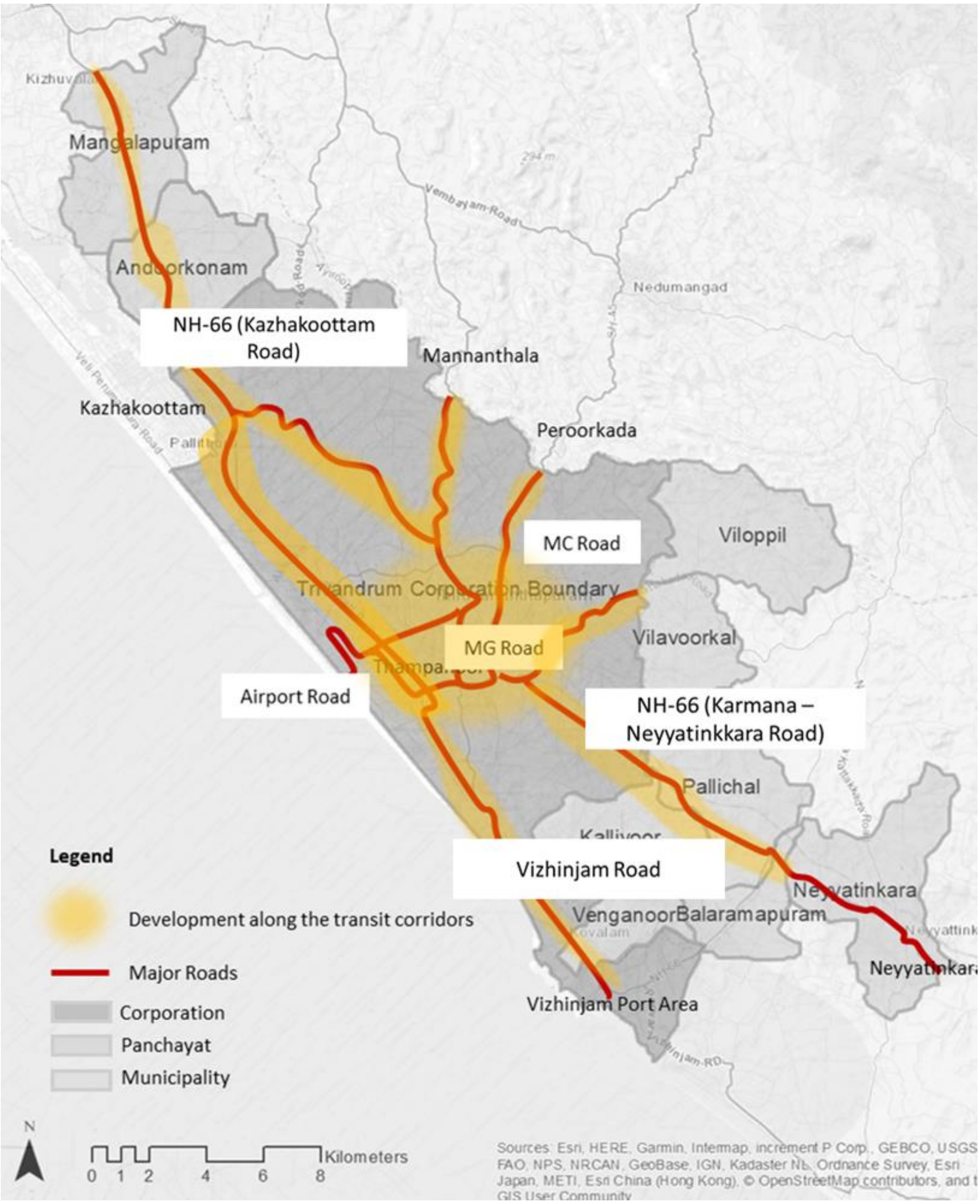


Figure 82 Development along the Main Transit Corridors

Figure 83 Lack of Activity Demarcation in Fort Area

- City has many eminent tourist attraction points with high footfall. Due to the lack of dedicated pedestrian ways, the areas around these landmarks are often overcrowded hindering the traffic movement and also increasing the safety concerns of tourists.

Figure 84 Overcrowding in Prominent Areas

- Poor pedestrian infrastructure in areas like Chalai and Palayam, Sreekaryam etc. Which are major commercial hubs with high pedestrian influx. Due to narrow streets, lack of pedestrian infra, the areas are not safe to walk. 14.2% of the major network has footpath availability in the study area.

As these streets lack organization of road space in addition to lack of pedestrian infrastructure, the comfort and safety of pedestrian is often compromised. The streets with a good RoW availability also are not equipped with cycle tracks.

Figure 85 Bad Street Conditions

- Major corridors are often encroached by on street parking, due to which the access to footpaths is hindered, leading pedestrians to move on to the vehicular lanes adding to safety concerns. The average parking density at major location in the study area is about 180 with an average parking duration of 40mins.

Figure 86 Traffic Congestion along the Major Roads

- Unorganized and haphazard parking on streets hinders the traffic flow due to encroachment of the road space.

Figure 87 Traffic Congestion along Major Roads

- The average congestion level on the major mobility corridors in the study area is 1.2 indicating the utilization is over 120%.
- Bus Terminals like East Fort being a major terminal lack proper bus bays and dedicated boarding alighting spaces, leading to an added congestion on the road due to already present heavy traffic.
- There are high interactions of Techno Park with the other parts of the city, yet the bus infrastructure near the Techno Park area is underdeveloped.

Figure 88 East Fort Terminal

- Lack of provisions for goods movement and infrastructure accessing the industrial areas causes hindrance in the traffic flow, especially in areas like Chalai and Palayam.
- Crucial junctions like Medical College, due to presence of heavy traffic throughout the day, still lacks additional pedestrian infrastructure for proper crossing for the pedestrians. The degree of conflict of pedestrian with the vehicular volume at peak hours on major corridors is over 26 (PV^2x10^8) [22] indication highest value of critically and the need to develop pedestrian safety infrastructure.

[22] Ideal value for degree of conflict is $2x10^8$.

3.11 TRAVEL CONDITION ASSESSMENT INDICATORS

The below mentioned indicators derived from the CMP Toolkit, 2014 by MoHUA will be used for assessing the travel conditions in the study area. The data extracted from the primary surveys and the outputs of travel demand model are presented against the indicators as presented in the Table 27.

Table 3-13 Travel Condition Assessment Indicators

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
i) Mobility and Accessibility			
1	**Modal Share (%) of Motorized Modes (From Traffic Survey Results)**		
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	65%
	Public Modes	% of trips made by public transport modes	21%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	14%
2	**Trip Length (Km)**		
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car and Auto users in the study area	9.0
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.5
ii) Infrastructure and Land use			
1	**Infrastructure Quality**		
1.1	**Average Speed (Kmph) (All Modes)**	**Average speed of all modes**	**21.3**
	Average Speed (Kmph) (PvT)	Average speed of private modes	21.8
	Average Speed (Kmph) (PT)	Average speed of public transport modes	16.2
1.2	**Accessibility to Public Transport (Population)**		
	Access to PT	Population having access to PT	6.0
2	**Land use parameters**		
2.1	**Land use mix intensity**		
	Land use mix intensity	Job and housing balance (employment / residing population)	0.4

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
iii) Safety			
1	**Safety**		
1.1	Quality of footpath infrastructure	% of roads with more than 2m footpath	5.0%
2	**Security**		
2.1	Percentage of road lighted		80.0%
2.2	Percentage of footpaths lighted	-	53.0%
iv) Environmental Impacts			
1	**Emissions**		
1.1	Local Emissions (Tonnes/day)		10.7
1.2	GHG Emissions (Tonnes/day)		72.1
2	**Depletion of land resource**		
2.1	Consumption of land for transport activity	Percentage of total land used in transport for different type of transport infrastructure – road, parking bus lanes, railways, etc.	6.7%
iv) Technology			
1	**Vehicle Fuel Technology**		
1.1	Vehicle Fuel Technology	Percent of public transport fleet in compliance with Indian emissions standards	45%
2	**ITS Transitions**		
2.1	Availability of Traffic Surveillance – CCTV	Share of Stations with CCTV on BRTS, Terminals, MRT Stations and Signalized Intersections	38%
2.2	Passenger Information System (PIS) for Public Transport	Share of Terminals, MRT Stations having PIS	10%
2.3	Global Positioning System / GPRS	Share of Public Transport Vehicles and IPT with onboard GPS/GPRS which are connected to common control center	25%
2.4	Signal Synchronization	Share of signalized signals which are synchronized in the city	50%

3.12 SERVICE LEVEL BENCHMARKING

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. The service level benchmarks (SLB)[23] issued by MoHUA specify parameters to measure the effectiveness of existing land use-transport planning in the study area and set benchmarks for achieving the same.

In Service Level Benchmark, four levels of Service (LoS) have typically been specified. They are LOS1, LOS2, LOS3 and LOS4. The LOS1 represents the highest performance level whereas LOS4 represents the Lowest.

3.12.1 PUBLIC TRANSPORT FACILITIES

This benchmark indicates the city-wide level of services provided by public transport systems during peak hours.

Table 3-14 Level of Service for Public Transport Facilities

LOS	PRESENCE OF ORGANIZED PUBLIC TRANSPORT SYSTEM IN URBAN AREA (%)	EXTENT OF SUPPLY/ AVAILABILITY OF PUBLIC TRANSPORT	SERVICE COVERAGE OF PUBLIC TRANSPORT IN THE CITY	AVG WAITING TIME FOR PUBLIC TRANSPORT USERS	LEVEL OF COMFORT IN PUBLIC TRANSPORT	% OF FLEET AS PER URBAN BUS SPECIFICATION
1	>= 60	>= 0.6	>= 1	<= 4	<= 1.5	75 – 100
2	40-60	0.4-0.6	0.7- 1	4—6	1.5 - 2	50 – 75
3	20-40	0.2-0.4	0.3 - 0.7	6—10	2 - 2.5	25 – 50
4	<20	<0.2	< 0.3	> 10	> 2.5	< 25
Indicator LoS	**3.00**	**2**	**3.00**	**3**	**1.00**	**3.0**
TOTAL INDICATOR LOS VALUE:15 (OVERALL LOS -2)						
OVERALL: LOS1 <12, LOS2: 12-16, LOS3:17-20, LOS4 21-24						

[23] SLBs for Urban Transport- MoUD, Government of India -2013 – The Socaring and raking is as per the benchmarks given by MoUD

Based on the above indicators, the overall score of the benchmark computes to 15 with LOS for the parameter "Public Transport Facilities" being 2. Thus, indicating a reasonably good city bus services which can be further improved.

Though the overall level of service is 2, the city bus system in the study area needs immediate intervention in the extent of supply of public transport, service coverage and average waiting time, which define the reliability and efficiency of the system,

3.12.2 PEDESTRIAN INFRASTRUCTURE FACILITIES

This benchmark indicates the percentage of road length along arterial and major road network, Public Transport corridors, and intersections, having adequate pedestrian facilities.

Table 3-15 Pedestrian Infrastructure Facilities

LEVEL OF SERVICE (LOS)	SIGNALIZED INTERSECTION DELAY (%)	STREET LIGHTING (LUX)	% OF CITY COVERED
1	<25	> = 8	> = 75
2	25 – 50	6-8	50 - 75
3	50 – 75	4-6	25 - 50
4	> = 75	< 4	<25
Indicator LoS	3	3	4
TOTAL INDICATOR LOS VALUE: 10 (OVERALL LOS :3)			
OVERALL - LOS1: 3-5, LOS2: 6-8, LOS3: 9-10, LOS4 11-12			

Based on the above indicators, the overall score of the Benchmark for pedestrian infrastructure facilities computes to 10 with a level of service of 3. Thus, indicating that the city lacks adequate Pedestrian facilities and requires major improvements/investments in this category.

3.12.3 NON-MOTORISED TRANSPORT (NMT) FACILITIES

This benchmark indicates the percentage of dedicated cycle track/lane along the arterial and major road network, and public transport corridors, with a minimum of 2.5 m width. It is characterized by continuous length, encroachment on NMT lanes, and parking facilities.

Table 3-16 Non-Motorized Transport Facilities

LOS	% OF NETWORK COVERED	ENCROACHMENT ON NMT ROADS BY VEHICLE PARKING (%)	NMT PARKING FACILITIES AT INTERCHANGES (%)
1	> = 50	< = 10	> = 75
2	50 – 25	10 – 20	50 - 75
3	25 – 15	20 – 30	25 - 50
4	< 15	> 30	<25
Indicator LoS	**4**	**4**	**2**
TOTAL INDICATOR LOS VALUE: 10 (OVERALL LOS 3)			
OVERALL - LOS1: 3-5, LOS2: 6-8, LOS3: 9-10, LOS4 11-12			

Based on the above indicators, the overall score of the Benchmark for computes to 10, with a LOS of 3. Thus, indicating poor performance in the provision of Non-Motorized Transport facilities.

3.12.4 LEVEL OF USAGE OF ITS FACILITIES

This benchmark indicates the efforts to add information technology to transport infrastructure and vehicles in an effort to manage factors that are typically at odds with each other.

Table 3-17 ITS Facilities

LOS	AVAILABILITY OF TRAFFIC SURVEILLANCE (%)	PASSENGER INFORMATION SYSTEM (PIS) (%)	GLOBAL POSITIONING SYSTEM / GPRS (%)	SIGNAL SYNCHRONIZATION (%)	INTEGRATED TICKETING SYSTEM (%)
1	>=75	>=75	>=75	>=75	>=75
2	50 - 75	50 – 75	50 – 75	50 - 75	50 - 75
3	25 - 50	25 – 50	25 – 50	25 - 50	25 - 50
4	< 25	< 25	< 25	< 25	< 25
Indicator LoS	**2**	**4**	**3**	**2**	**4**
TOTAL INDICATOR LOS VALUE: 14 (OVERALL LOS 3)					
OVERALL - LOS1: 5-7, LOS2: 8-10, LOS3: 11-15, LOS4 16-20					

Based on the above indicators, the overall score of this Benchmark computes to 15, with a LOS of 3. This throws light on the need further improvements in terms of synchronized signals, PIS facilities at all bus stops in the city.

3.12.5 TRAVEL SPEEDS

This benchmark provides an indication of effective travel time or speed of public or private vehicles by considering indications of congestion or traffic density.

Table 3-18 Travel Speeds

LoS	AVERAGE TRAVEL SPEED OF PERSONAL VEHICLES	AVERAGE TRAVEL SPEED OF PUBLIC TRANSPORT
1	> =30	< =20
2	25 – 30	**15 - 20**
3	**15 – 25**	**10 - 15**
4	< 15	> 10
Indicator LoS	**3**	**2**
TOTAL INDICATOR LOS VALUE: 5 (OVERALL LOS 3)		
OVERALL - LOS1: 2, LOS2: 3-4, LOS3: 5-6, LOS4 7-8		

The LOS for Travel speeds in the city computes to LoS 3 with a score of 5, indicating the need for improving the network conditions in the study area.

3.12.6 AVAILABILITY OF PARKING SPACES

This benchmark indicates the restrictions on free parking spaces for all vehicles in the study region.

Table 3-19 Availability of Parking Spaces

LOS	AVAILABILITY OF ON STREET PAID PUBLIC PARKING SPACES (%)	RATIO OF MAXIMUM AND MINIMUM PARKING FEE IN THE CITY
1	> =75	> 4
2	50 – 75	2 – 4
3	25 – 50	1 – 2
4	**< 25**	1
Indicator LoS	**4**	**3**
TOTAL INDICATOR LOS VALUE: 7 (OVERALL LOS 4)		
OVERALL LOS1: 2, LOS2: 3-4, LOS3: 5-6, LOS4: 7-8		

Based on the above indicators, the overall score of the Benchmark for computes to 7, with a LOS level of 4. The excessive availability of free on-street parking needs to be controlled by the authorities to regulate heavy vehicular traffic. The on-street parking facilities shall need to be charged, and the same may be used to provide for improved NMT infrastructure in the city.

3.12.7 ROAD SAFETY

This benchmark monitors the extent to which road users, and especially vulnerable road users, are impacted within the overall set of road users.

Table 3-20 Road Safety Measures

LOS	FATALITY RATE PER LAKH POPULATION	FATALITY RATE FOR PEDESTRIAN AND NMT (%)
1	< =2 persons	< =20
2	2 -4 persons	20 -40
3	4 - 6 persons	40 - 60
4	> 6 persons	> 60
Indicator LoS	**4**	**3**
TOTAL INDICATOR LOS VALUE: 7 (OVERALL LOS 4)		
OVERALL LOS1: 2, LOS2: 3-4, LOS3: 5-6, LOS4: 7-8		

Based on the above indicators, the overall score of the Benchmark computes to 7. The overall LoS for the parameter "Road Safety" is 4. NMT and pedestrians are hence observed to be unsafe on the streets.

3.12.8 POLLUTION LEVELS

This benchmark indicates the Level of air Pollutants in the city i.e., average level of pollution

Table 3-21 LOS Range for Pollution Levels

LOS	ANNUAL MEAN CONCENTRATION OF SULPHUR DIOXIDE (SO2)	ANNUAL MEAN CONCENTRATION RANGE OF OXIDES OF NITROGEN (NO2)	ANNUAL MEAN CONCENTRATION OF SUSPENDED PARTICULATE MATTER(SPM)	ANNUAL MEAN CONCENTRATION OF RSPM (SIZE LESS THAN 10 MICRONS)
1	0 – 30	0 – 30	0 – 70	0 - 40
2	**30 – 60**	**30 – 60**	**70 – 140**	40 – 80
3	60 – 90	60 – 90	140 – 210	**80 – 120**
4	> 90	> 90	> 210	> 210
Indicator LoS	**2**	**2**	**2**	**3**
TOTAL INDICATOR LOS VALUE:9 (OVERALL LOS 2)				
OVERALL LOS1: <=5, LOS2: 6-9, LOS3: 10-13, LOS4: 14-16				

Based on the above indicators, the overall score of the Benchmark computes to 9 with a LOS of 2. This indicates the city needs considerable improvements in emission standards, and should adopt and encourage public transport use to keep pollution in check.

3.12.9 INTEGRATED LAND USE TRANSPORT SYSTEM

This benchmark indicates the effectiveness of land use and transport arrangements and identifies the level of integrated land use transport system expected to result in overall trip reduction and mode shift in favour of public transit.

Table 3-22 Integrated Land Use Transport System

LOS	POPULATION DENSITY	MIXED LAND USE ZONING	INTENSITY OF DEVELOPMENT-CITY WIDE (FSI)	INTENSITY OF DEVELOPMENT ALONG TRANSIT CORRIDOR	ROAD NETWORK PATTERN & COMPLETENESS	% OF AREA UNDER ROADS	% NETWORK WITH EXCLUSIVE ROW FOR TRANSIT
1	> =175	> = 30	> = 2	> = 3	Clear pattern (ring-radial or grid-iron) and complete network	> = 15	>=30
2	150-175	15-30	1.5 - 2.0	2 – 3	**Somewhat clear pattern (ring-radial or grid-iron) but somewhat incomplete network**	12 – 15	20 – 30
3	125-150	5 – 15	1.0 - 1.5	**1.5 – 2**	somewhat unclear pattern and incomplete network	**10 – 12**	10 – 20
4	**< 125**	**<5**	**<1**	<1.5	no clear pattern incomplete / sparse network	< 10	**< 10**
Indicator LoS	**4**	**4**	**3**	**3**	**2**	**3**	**4**
TOTAL INDICATOR LOS VALUE:23 (OVERALL LOS 4)							
LOS1: <=8, LOS2: 9-15, LOS3: 16-22, LOS4: 23-28							

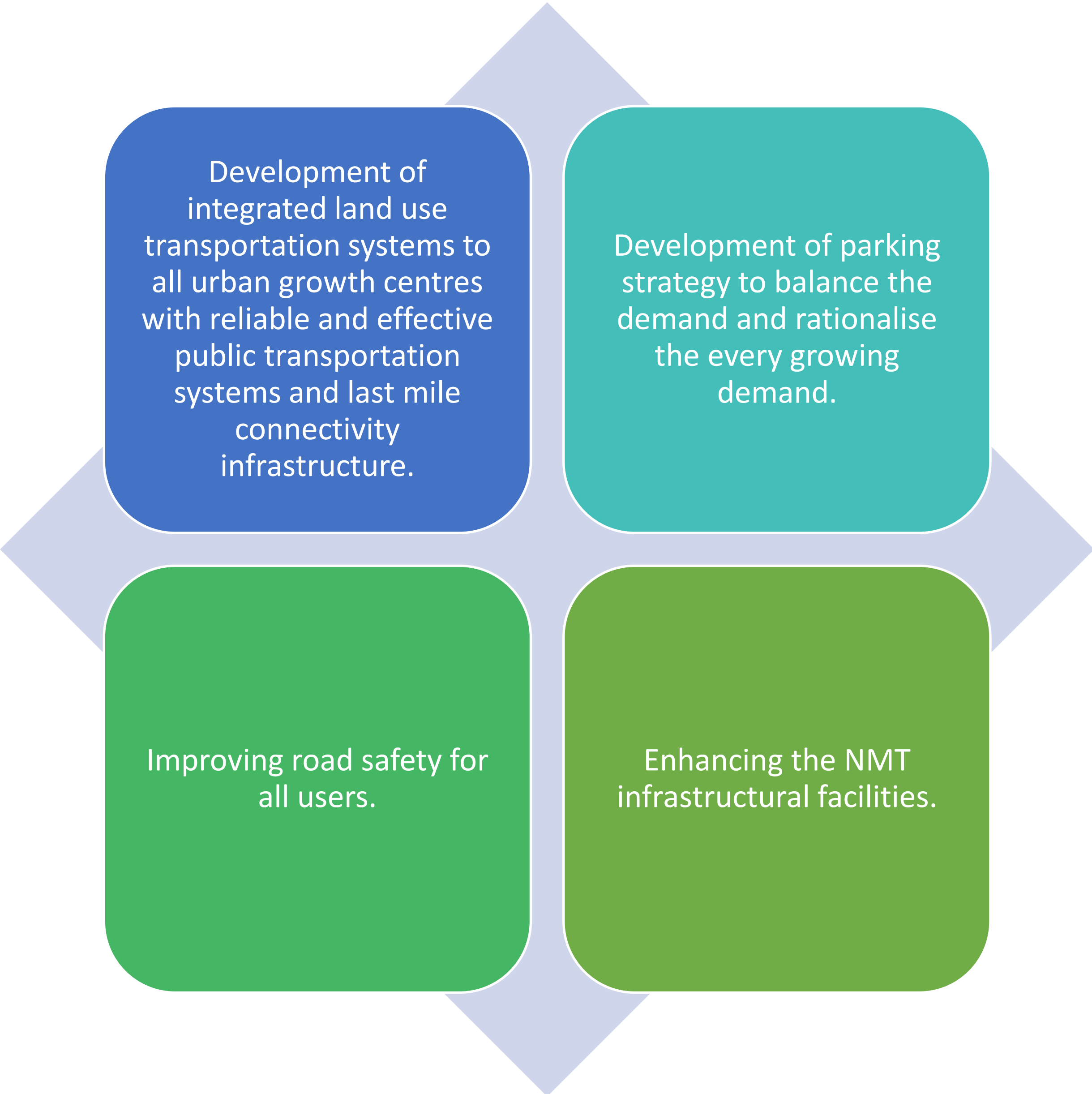
3.12.10 SUMMARY OF INDICES

The summary of the indices is as presented below:

SN	BENCH MARK	OVERALL LOS	INFERENCE AS PER MOUD GUIDELINES
1	Public Transport Facilities	2	The study area indicates the availability of good public transportation services. However, integration of the services and developing a high capacity PT system would further enhance and cater to the growing travel demand in the state capital city
2	Pedestrian infrastructure facilities	3	The city has minimal pedestrian facilities which need immediate improvements especially at intersections and unobstructed footpaths it.
3	Non-Motorized Transport Facilities	3	The city has minimal NMT facilities which needs considerable improvements as many parts of the study area are not served by it.
4	Level of usage of Intelligent Transport System (ITS) Facilities	3	The study area lacks adequate ITS facilities.
5	Travel speed (Motorized and Mass transit)	3	The study area has considerable travel speeds for the existing but with small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed in the horizon years.
6	Availability of Parking places	4	The authorities need to initiate immediate actions with respect of providing paid parking spaces and demand management for parking.
7	Road safety	4	Need considerable improvements in road design and available road infrastructure, traffic management and other such reasons which contribute significantly to road safety.
8	Pollution levels	2	Level of pollution in a study area is not alarming, however the quality can be improved by encouraging and introduction the usage of public modes rather than the private modes.
9	Integrated land use Transport system	4	Need to improve the coherence between study area structure and public transport system.

Note: The LOS1 represents the highest performance level whereas LOS4 represents the Lowest.

Based on the above the order priority of immediate improvements required in the study area is as follows,



KOCHI METRO RAIL LIMITED

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04

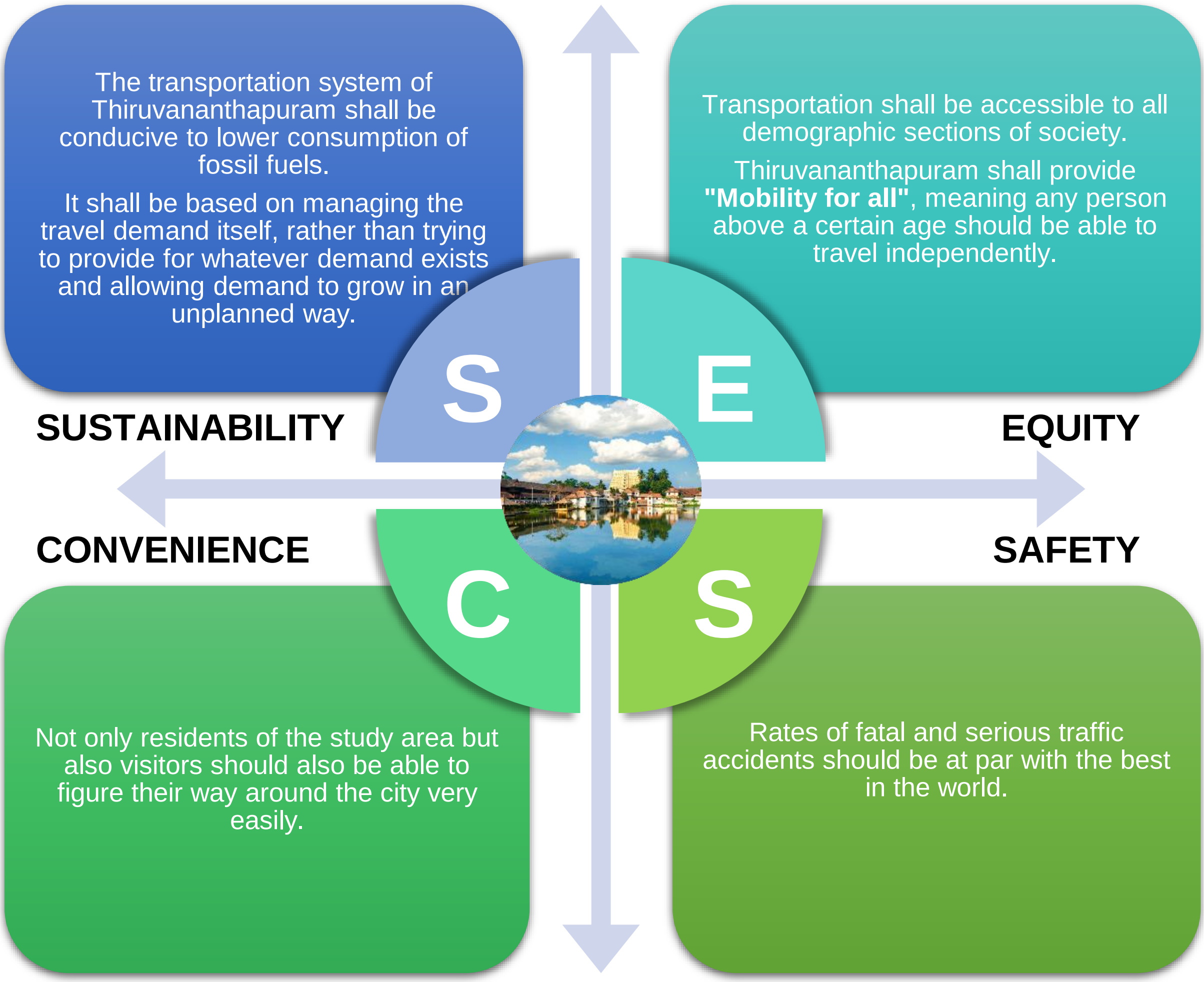
SUSTAINABLE MOBILITY VISION & GOALS

4 SUSTAINABLE MOBILIY VISION & GOALS

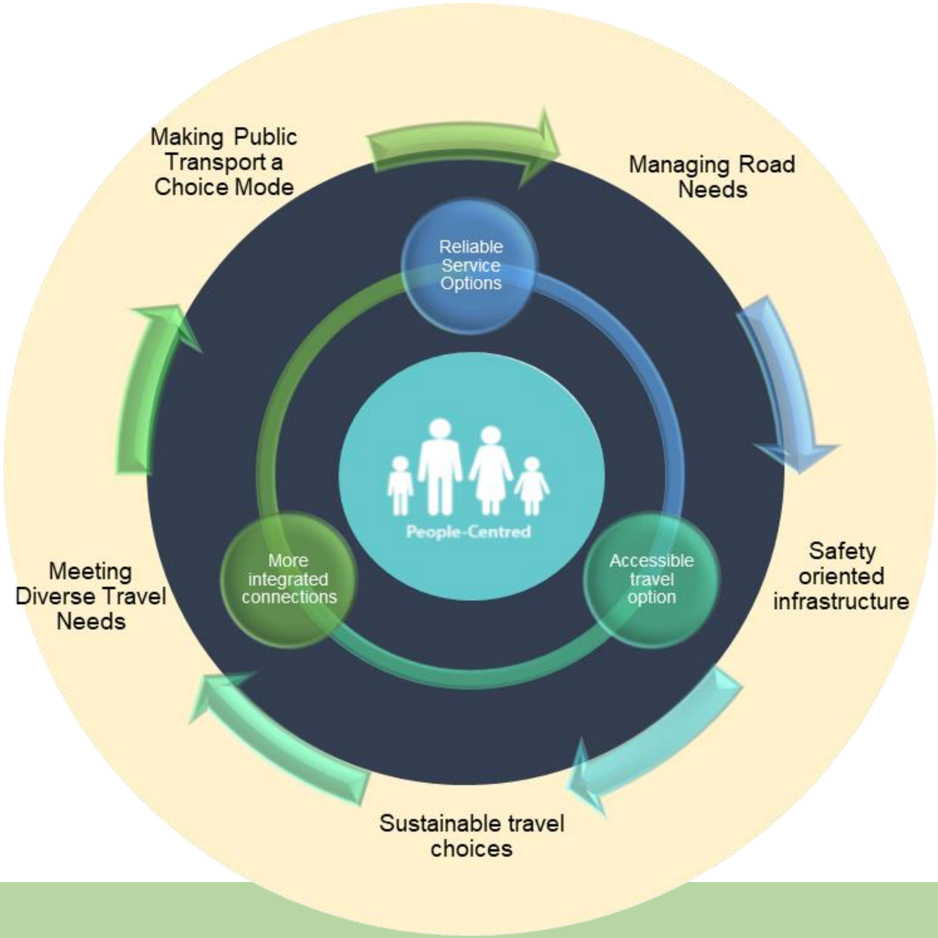
4.1 VISION

The study envisions desirable accessibility and mobility pattern for people and goods in the study area of Thiruvananthapuram 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 vision for Thiruvananthapuram are:



In order to provide a sustainable transportation system for the residents of the study area



"People Centric Sustainable, Efficient and World Class Urban Transport System that provides the residents of Thiruvananthapuram, safe, comfortable reliable and convenient mobility options while catering to their affordability, and providing them with seamless integration"

Figure 89 Thiruvananthapuram CMP Study Aim

Thus, the focus of the study is to develop a robust Transportation System for Thiruvananthapuram in a sustainable and resilient manner by developing a range of non-motorised and public transportation modes or options, complementing one another within a safe environment.

4.2 GOALS

To ensure urban transport solutions are sustainable and in conformity with vision for Thiruvananthapuram, following goals have been formulated:

GOAL 1

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.

GOAL 2

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

GOAL 3

Develop traffic and transport solutions that are economically/ financially viable and environmentally sustainable 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.

The Vision and Goals set for Thiruvananthapuram Transportation System have been translated into mobility targets for the horizon year under sustainable scenarios in comparison with the Business as Usual Scenario.

The following Table shows the goals set to be achieved in the horizon year by implementing all the proposals recommended in this study (Chapter 8).

Table 4-1 Goals Set for Mobility System for Thiruvananthapuram for *2051*

NAME OF THE INDICATOR	BASE YEAR	BAU (2051)	HORIZON YEAR (2052) – TARGET
Private Transport (PVT) Trips	66%	69%	<50%
Public Transport Trips	25%	18%	>40%
IPT Modes	9%	13%	<10%
Avg. Network Speed (kmph)	21.3	18.2	>22
% of city covered with Footpaths (Arterial and Sub-Arterial)	5.0%	22%	100%
% of city covered with Cycle Tracks (Arterial and Sub-Arterial)	4%	20%	>50%
Local Emissions (Tonnes/day)	10.7	31.3	Reduce by 30% of BAU
GHG Emissions (Tonnes/day)	72.1	120.1	Reduce by 30% of BAU

These goals and objectives set for the transportation needs of the study area can be achieved by formulating a series of strategies as per CMP Toolkit – 2014 and NUTP -2006 guidelines. Each of the strategies were evaluated to see their suitability and applicability for the study area.

4.3 STUDY OBJECTIVES

The proposed objectives for the project are as follows,

To provide a sustainable transportation system which is accessible within 500m from the activity generating areas like workplaces, educational institutes etc

To ensure significant increase in public transportation share while supplying highly reliable and sophisticated PT system

To improve safety on roads for Non-Motorised Transport users by providing appropriate infrastructure for cyclists and pedestrians which ultimately help boost the public transport.

To reduce vehicular emissions by usage of alternative fuel options like E-Vehicles and streamlining their usage into the city's public transport as well as intermediate public transport system.

Figure 90 Thiruvananthapuram CMP Study Objectives

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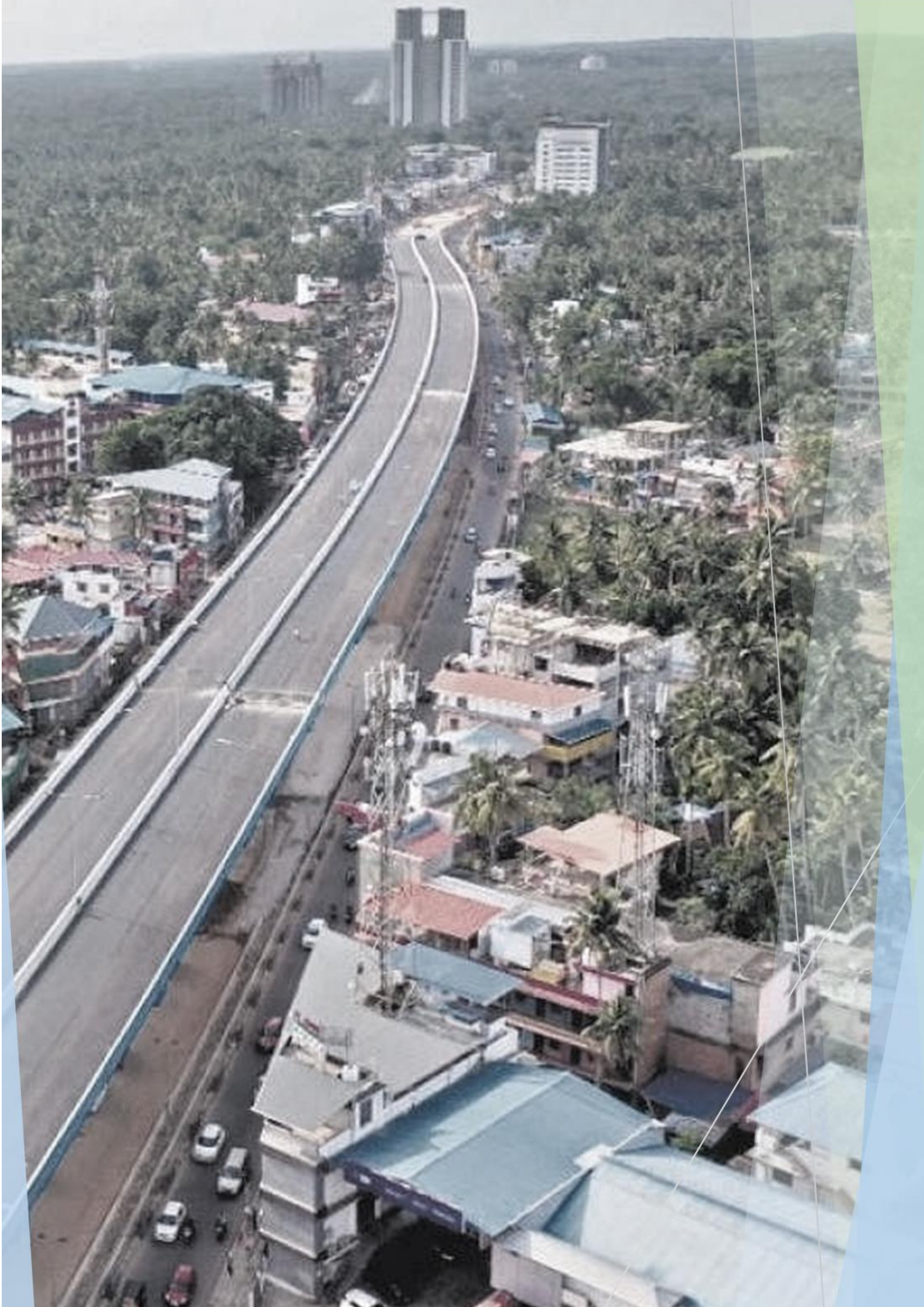
05

SUSTAINABLE URBAN MOBILITY MEASURES



5 SUSTAINABLE URBAN MOBILITY MEASURES

Various transportation policies at National level such as the National Urban Transport Policy, Transportation Policies and Strategies recommended by MoHUA and other global cities identify the following as the guiding principle for planning and implementing sustainable urban transportation systems. The principles of Sustainable Urban Transportation are as presented in Figure 91.

Creating dense and low private mode dependent neighbourhoods.	Developing Transit Oriented cities.	Developing a inclusive urban transportation system.
Designing a pedestrian and bicycle friendly city while promoting avtive travel.	Planning a robust high-quality public transport network with improved access to all.	Setting up a seamlessly integated urban transportation system.
Developing a well-connected, optimized road network with equitable road space allocation for all users.	Implementing an effective Parking Management system influencing the parking demand and private vehicle usage.	Ensuring safety and security in urban transport.
Utilizing inteligent transportation systems for operations, comunications and management of transportation ecology.	Devloping infrastructure and policies to promote the usage of clean and zero-emission vehicles.	Creating infrastrucutre and planning of freigh transportation.

Figure 91 Principles of Sustainable Urban Transportation

In line with these principles, the mobility goals for Thiruvananthapuram 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 the study area.

- Land Use and Transport Strategy
- Road Network Development Strategy
- Public Transit Improvement Strategy
- Intermediate Public Transit Improvement Strategy
- Non-Motorized Transport Strategy
- Freight Management Strategy
- Traffic Engineering and Travel Demand Management Strategy
- Technological Transition Strategy

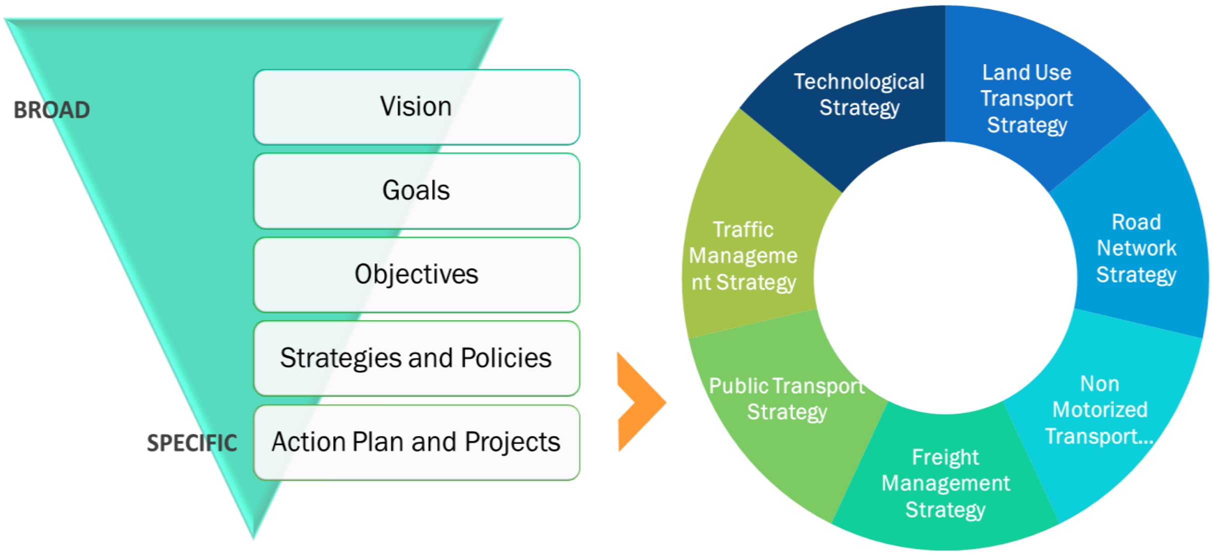


Figure 92 Thiruvananthapuram CMP Urban Transport Strategies

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 CMP. The sections below discuss these strategies.

5.1 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/ bicycling neighbourhoods

5.1.1 MULTI NODALURBAN FORM DEVELOPMENT CONCEPT

The urban form and its spatial structure are articulated by two structural elements, Nodes and Linkages. 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. Nodes have a hierarchy related to their importance and contribution to urban functions, such as production, management, retailing and distribution. The lowest level of linkages includes streets, which are the defining elements of the urban spatial structure.

Various development concepts are established worldwide and have been implemented across the world.

- The Multi nodal transit network is one such concept where the major transit corridors and economic activity nodes are dispersed around the main city Centre.
- Another concept is the compact development observed in cities like Barcelona, Curitiba where the development of the city region is restricted up to certain limits.

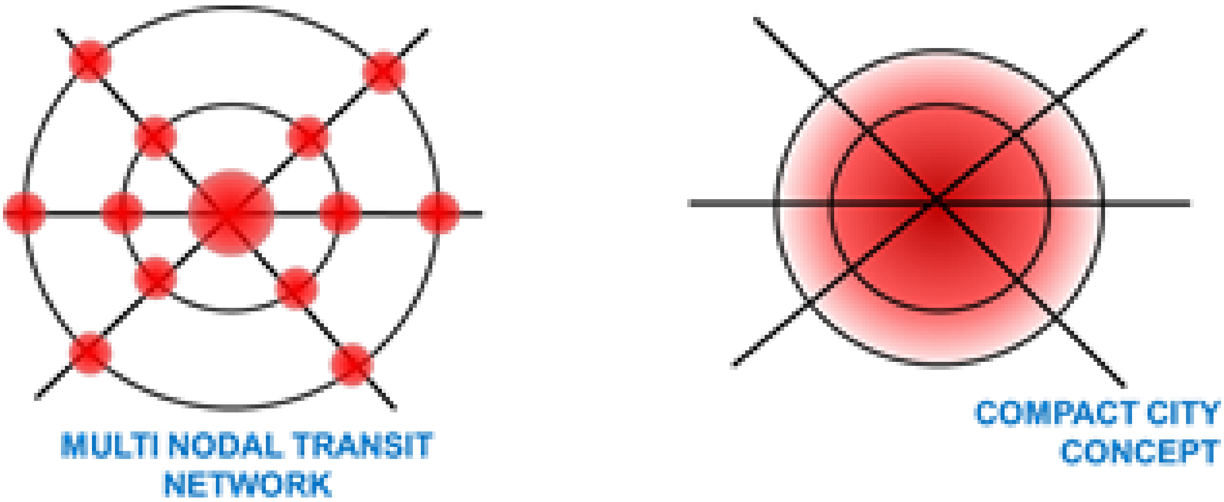


Figure 93 Urban Form Development Concepts

The structure of the study area resembles a compact node in the core Palayam area with growth centres emerging around it such as Kazhakoottam, Nemom, Neyyattinkara, Mannanthala, Nedumangad, Attingal, Vizhinjam, Balaramapuram, Peyad, etc . Thus, a multi-nodal development concept is recommended for Thiruvananthapuram in in semi-ring radial structure.

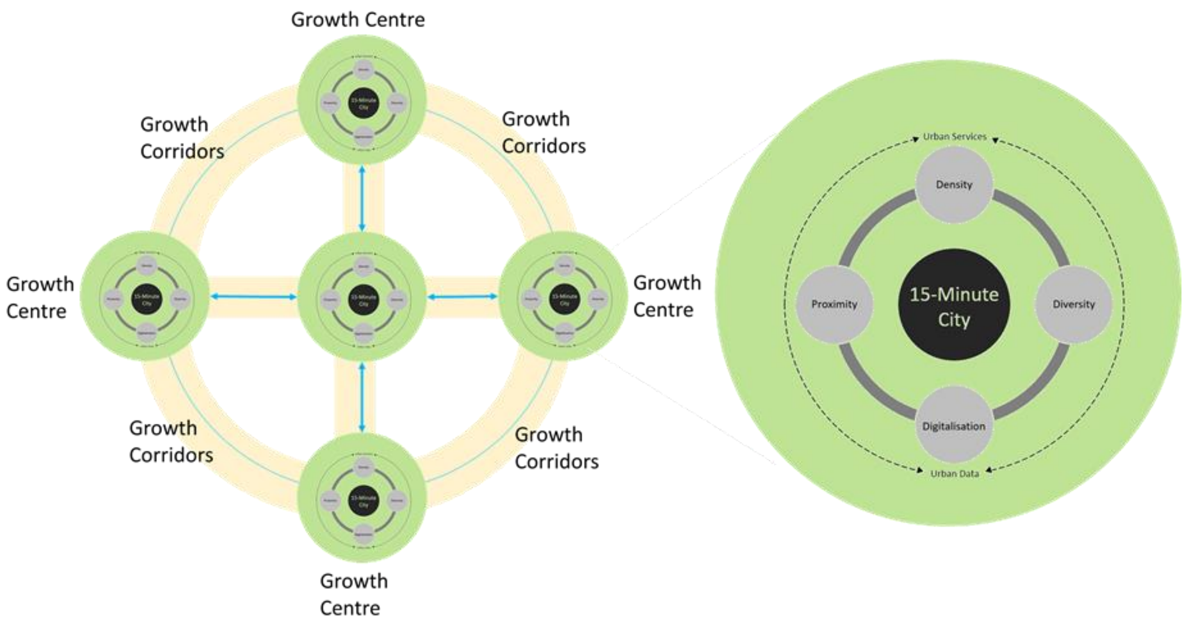


Figure 94 Multi-Nodal Urban Form Development Concept for Thiruvananthapuram

Multi-Nodal development structure recommended Thiruvananthapuram would decongest the core area and for efficient and equitable distribution of transport demand throughout the city, it is imperative to develop sub-city centre in different places of the city. These growth centres or sub-centres shall be connected through efficient city public transportation systems strengthen by high density growth corridors on either side.

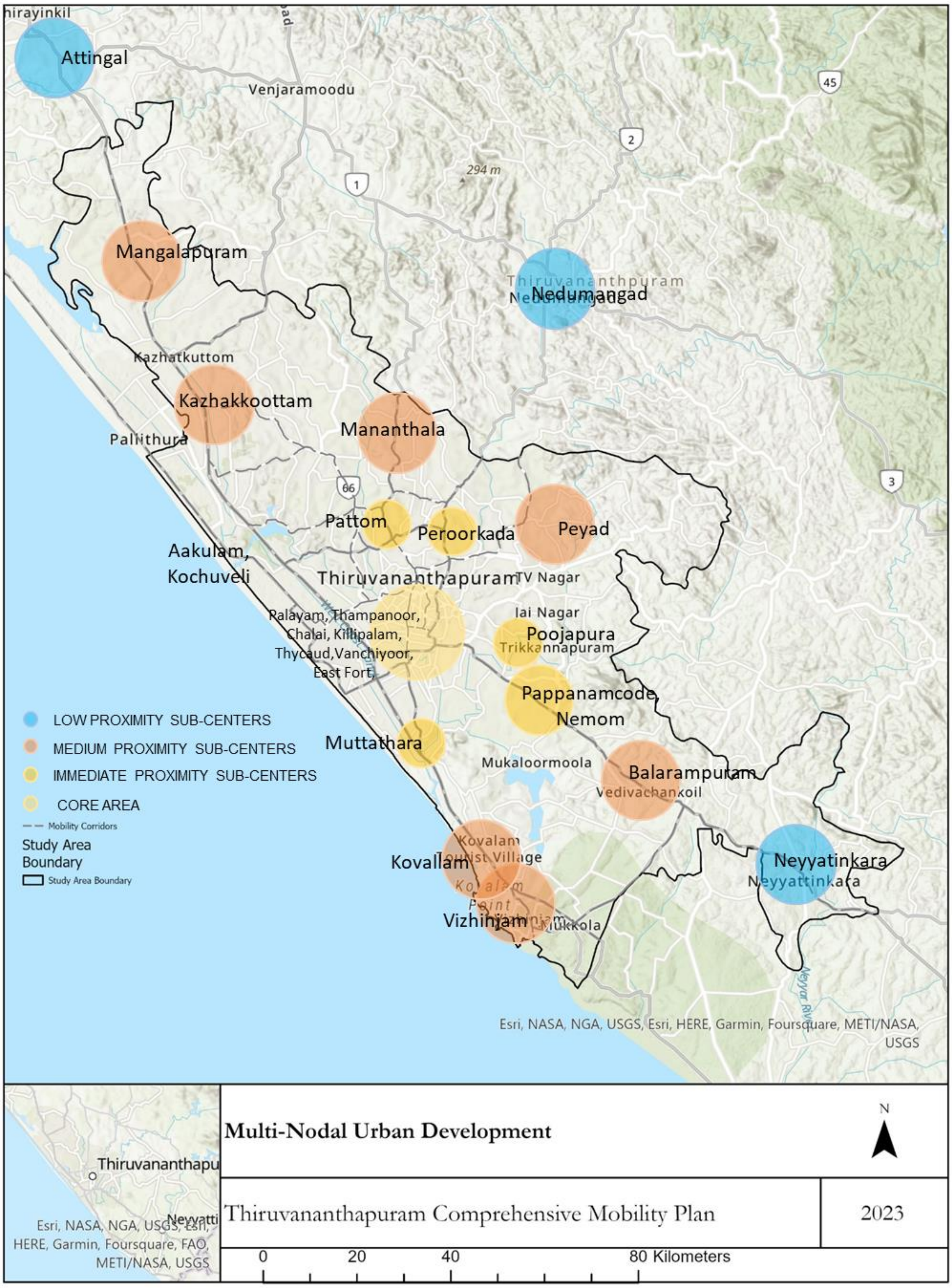


Figure 95 Multi-Nodal Urban Form Development for Thiruvananthapuram

Multiple sub-centres are recommended based on the proximity to the main city centre, i.e., within immediate, medium proximity and Low proximity for development as shown in the table below.

Table 5-1 Proximity of Core and Sub-Centres

CENTRE AND SUB- CENTRES	AREA NAMES	DESCRIPTION
CORE AREA	Palayam, Thampanoor, Chalai, Killipalam, Thycaud, Vanchiyoor, East Fort, Vazhuthacaud	Constitute the core areas of the study area and major activity attraction nodes housing commercial, government offices, heritage zones, transit stations, etc. These areas constitute to high travel demand are required to be connected by high quality of public transport and NMT infrastructure, Parking and Traffic management strategies. The same has been proposed in the following sections.
IMMEDIATE PROXIMITY SUB-CENTERS	Pattom, Peroorkada, Poojapura, Pappanamcode, Nemom, Muttathara, Aakulam, Kochuveli	These are major development node within the study area with considerable travel demand owing to the educational and governmental institutional, Commercial centres, Transit stations, etc. These areas have the maximum potential for immediate development owing to the proximity. These areas require high quality of public transport and NMT infrastructure, Traffic management strategies for the ease of vehicles and passengers. The same has been proposed in the following sections.
MEDIUM PROXIMITY SUB-CENTERS	Kazhakkoottam, Mannanthala, Peyad, Balarampuram, Kovallam, Vizhinjam, Mangalapuram	These are the newly developing growth centre with potential economic activity to act as strong growth anchoring nodes in the study area. These areas house, IT Parks, Seaport, Tourism centres, industries and commercial zones. These high employment generations nodes require strong and seamless connectivity to the city centre, thus, provision of high quality public transportation system and improved road connectivity for passenger vehicles and goods are considered.
LOW PROXIMITY SUB-CENTERS	Nedumangad, Neyyattinkara, Attingal	These are their important satellite towns of the city. However, owing the growth pattern towards the south, Neyyattinkara has significant trip interaction with the city centre. The linear growth between these towns and core area requires improved connectivity, thus, provision of high quality public transportation system and improved road connectivity are considered.

It is vital to develop and strengthen these areas with activity generators such as colleges, industries, employments hubs and so on as part of the land use strategies in Master Plan.

5.1.2 GROWTH CORRIDORS AND TRANSIT ORIENTED DEVELOPMENT CONCEPT

To maximize the passenger throughput, these corridors should be developed on the concepts of high density, mixed land use must the developed along the major mobility corridors in the city.

- 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 the figure below.

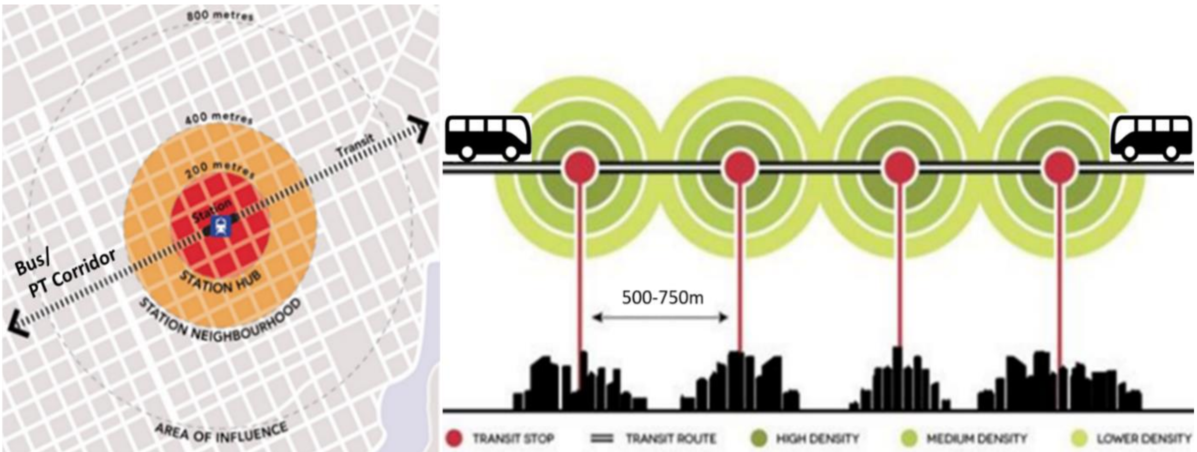


Figure 96 Concept of Public Transit Oriented Urban Land Use Development[24]

This 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.

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

3) **ENGAGE PRIVATE SECTOR:** Encourage private sector participation in the planning and implementation process specifically in real estate development.

4) **BARRIER FREE ENVIRONMENT:** Build and retrofit the pedestrian environment to meet or exceed accessibility guidelines and standards and create a walkable neighbourhood. 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

Figure 97 Walkable neighbourhood (source: TOD institute, U.S), multimodal integration (source: ITDP)

5) **HIGH QUALITY TRANSIT SYSTEM:** Encourage high-quality transit system design and provide customers transport amenity and information

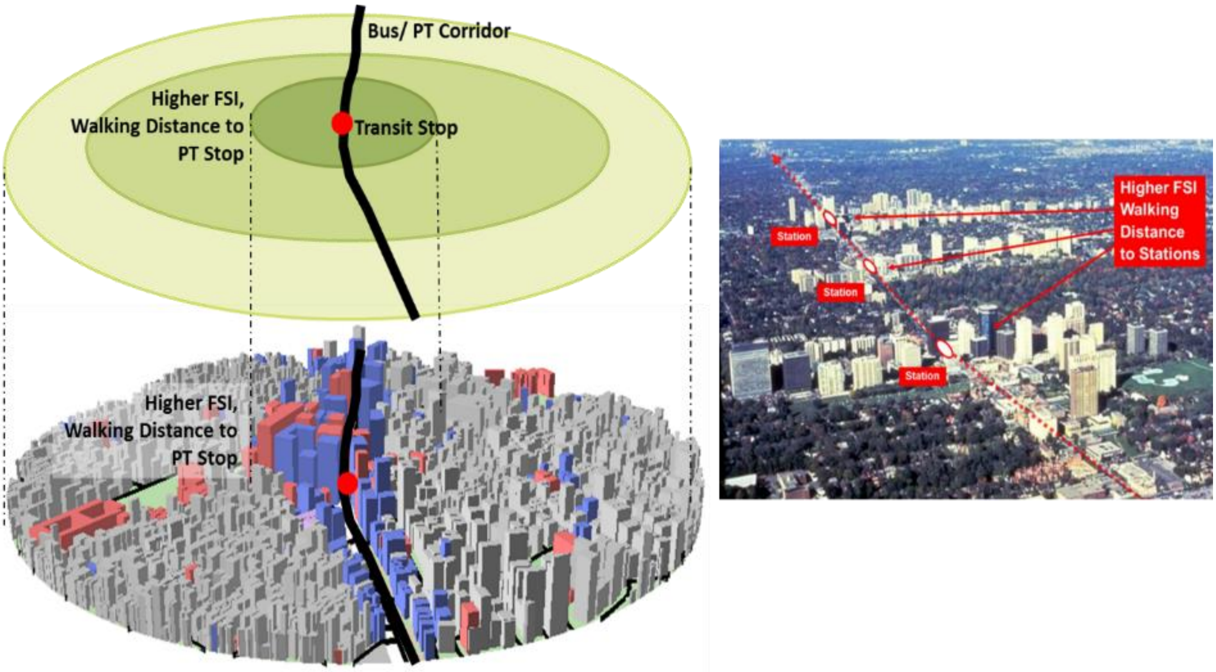


Figure 98 Building Height and Scale Along the Mobility Corridors

6) **Land Value Capture:** Implement land value capture as a financing mechanism for upgrading infrastructure.
7) **GREEN BUILDINGS & INFRASTRUCTURE:** Prioritize and implement sustainable building practices
8) **RIGHT SIZE INFRASTRUCTURE:** Gauge the carrying capacities of existing infrastructure and accordingly propose increased densities in station areas or upgrade infrastructure
9) **TECHNOLOGY INTEGRATION:** Employing integration of innovative technologies within zones area; such as smart parking, fare integration, information integration etc.
10) **SAFETY AND SECURITY:** Incorporate design principles that optimize natural surveillance with strategies such as adequate street lighting and active frontages and ensuring safety by introducing 24X7 CCTV surveillance.
11) **PARKING**: Parking structures/shared parking lots are two ways to reduce the amount of space occupied by parking facilities.

Thiruvananthapuram being the capital of the state and its increasing eminence as an educational and IT-Hub in its region it has high potential to attract rural-urban migration. Thus, considering the same and the Master Plan-2040, it is recommended to develop Growth Corridors (GC) under the concept of Transit Oriented Development (TOD).

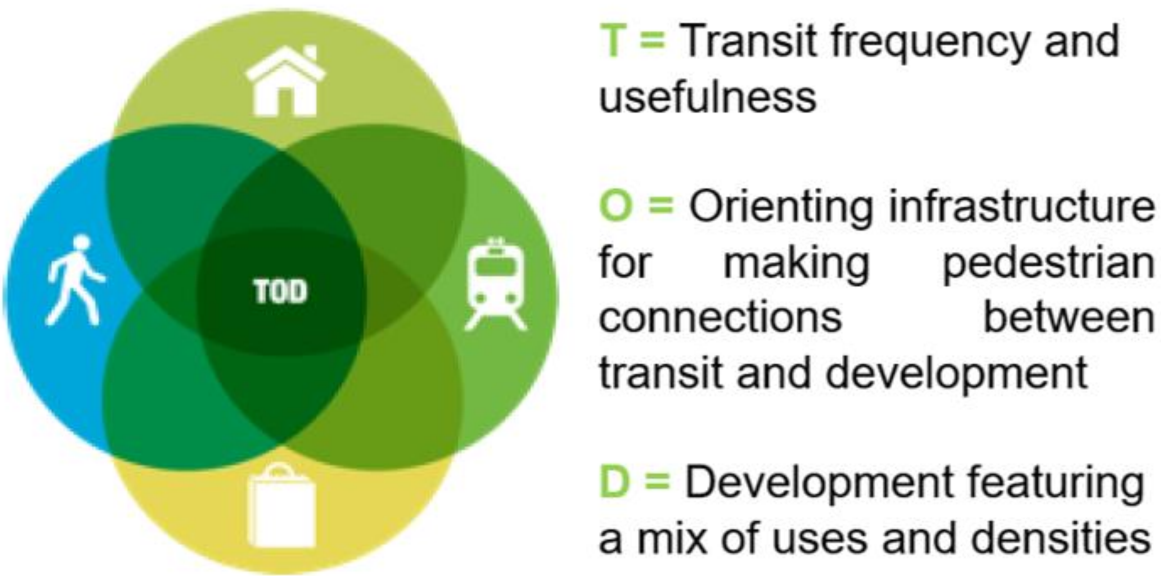


Figure 99 *Concept Of TOD – Work, Residence, Transit In Proximity*[25]

[25] Source: www.completecommunitiesde.org

Under the Land Use Transport Plan, 2 TOD corridors with an influence area of 120.5sqkm along the 65km of identified corridors and 5 Growth corridors influence area of 26.7 sqkm along the 89km of identified corridors are recommended.

The recommend corridors are as follows,

Table 5-2 Recommended TOD and Growth Corridors

SN	NAME OF THE CORRIDOR	LENGTH (KM)	TYPOLOGY
1	NH-66 (Mangalapuram to Neyyattinkara)	38.1	TOD Corridor
2	NH-Bypass (Kazhakkoottam to Vizhinjam)	27.0	TOD Corridor
3	Outer Ring Road	64.0	Growth Corridor
4	MC Road	4.2	Growth Corridor
5	Peroorkada Road	6.4	Growth Corridor
6	Peyad Road	7.4	Growth Corridor
7	Pothencode Road	7.3	Growth Corridor

The salient features of the proposed corridors are as follows,

- The TOD Corridors with 1km and Growth Corridors with 500m influence area are proposed and of mixed-use development band. The plots along these corridors will be encouraged with higher floor space index.

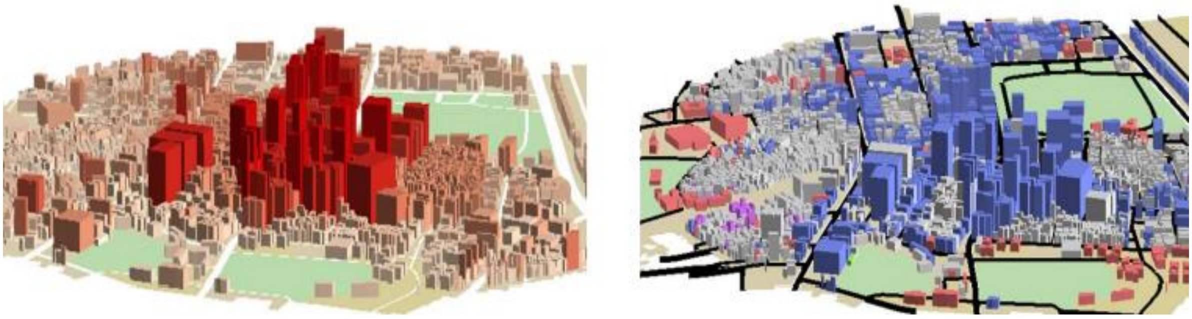


Figure 100 *Representation Of High Density (Left) And Mixed Use Zones (Right) Around The Transit Zones.*

- These are recommended for higher densification with used and activity generators using Floor Space Index as a vital tool. FSI value of 3 to 4 is recommended for the residential area in the study area.
    - A FSI up to 3-4 for TOD corridors and Growth corridors with mixed residential and commercial zone is recommended.

- These zones are recommended to provide high quality highway access suitable for industry, logistic infrastructure, educational and skill development institutions, business facilities, residential and other support social infrastructure.

- These corridors would provide access to public transport with 5mins of walk form the trip origins.

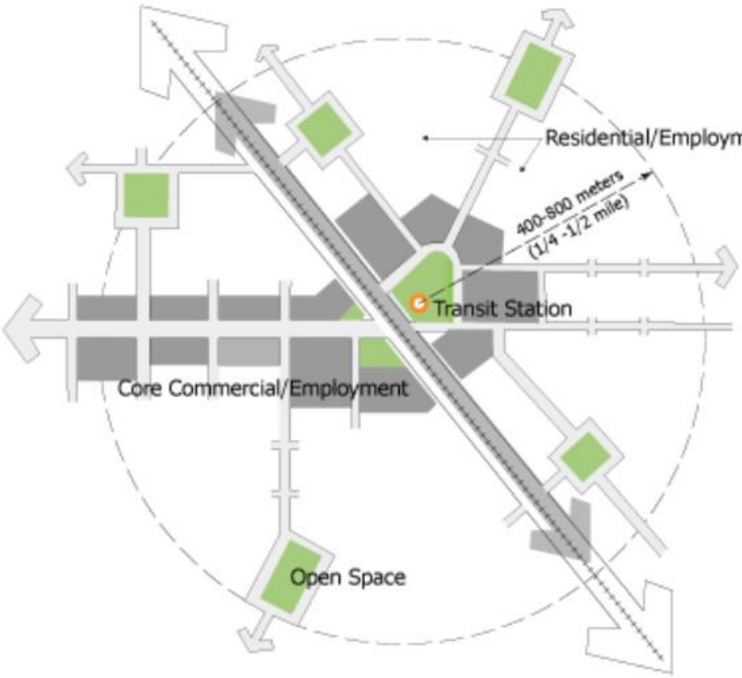


Figure 101 *Walkable Core Transit Area (500m) Around A Transit Station*[26]

- These corridors would foster Non-Motorised Transport users through well-defined and seamless design pedestrian and bi-cycle infrastructure.

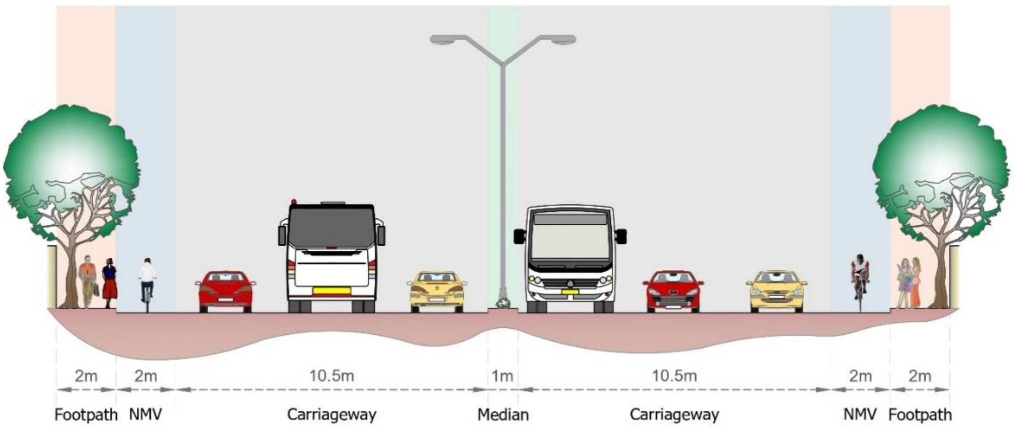
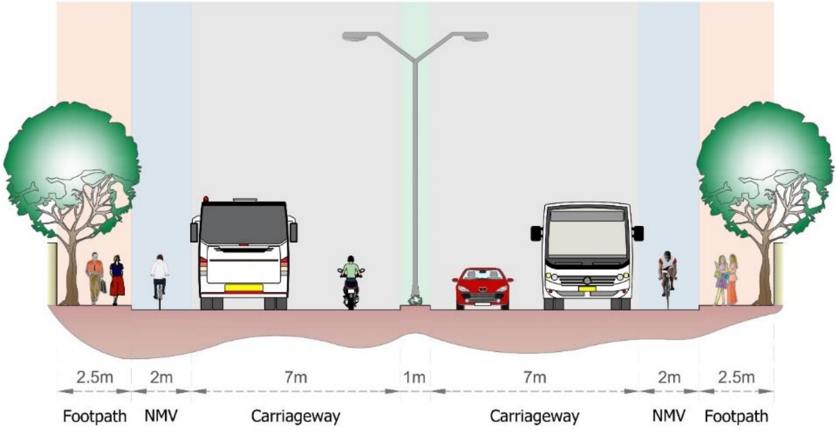
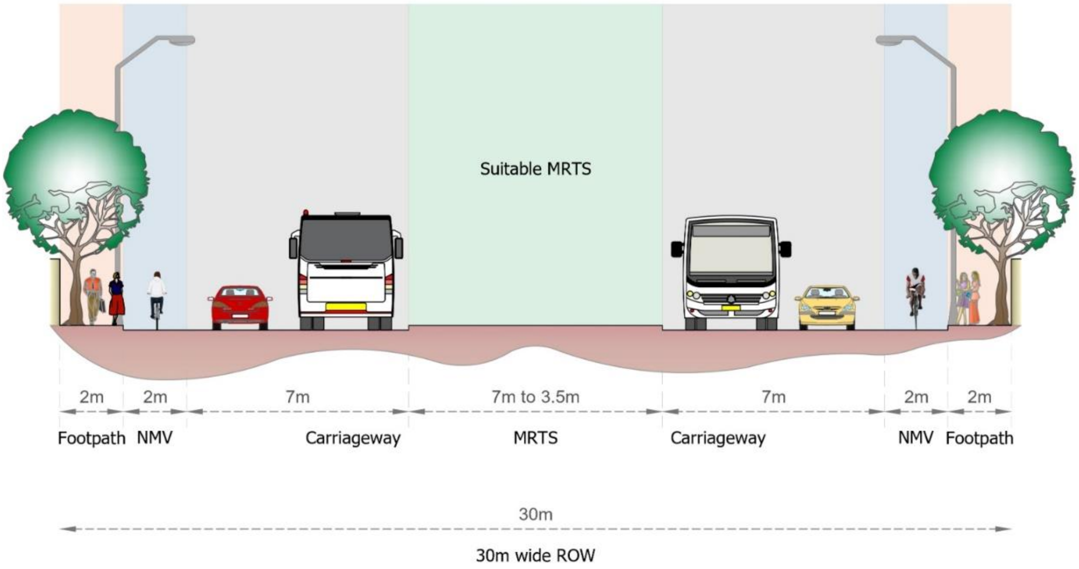


Figure 102 Typical Cross Section of 30m Wide Road for TOD / Growth corridors

[26] Source: The Neat American Metropolis – Ecology, Community, and the American Dream – Peter Calthrope





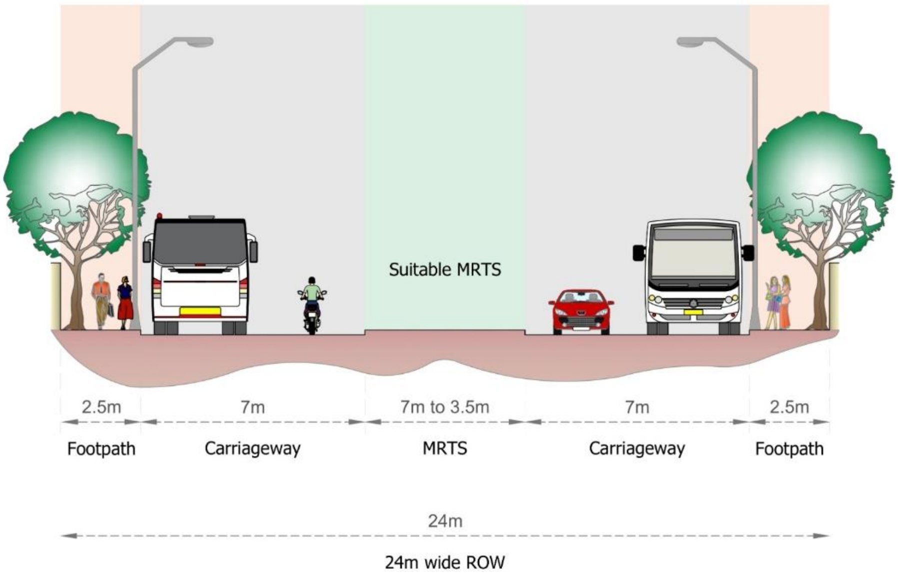


Figure 103 Typical Cross Section of 24m Wide Road (without MRTS Provision)-Top , 30m and 24m wide Road (With MRTS Provision)-middle and Bottom for TOD / Growth Corridors

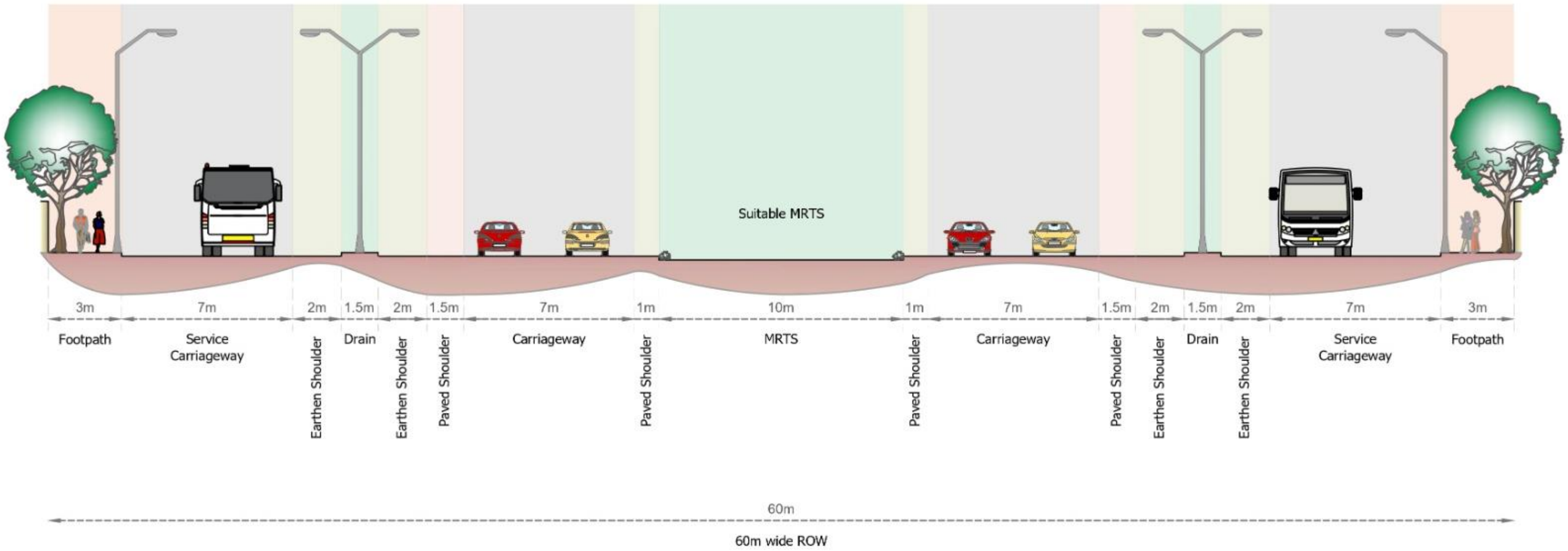


Figure 104 Typical Cross Section of 60m wide Road (With MRTS Provision) for TOD/ Growth Corridors

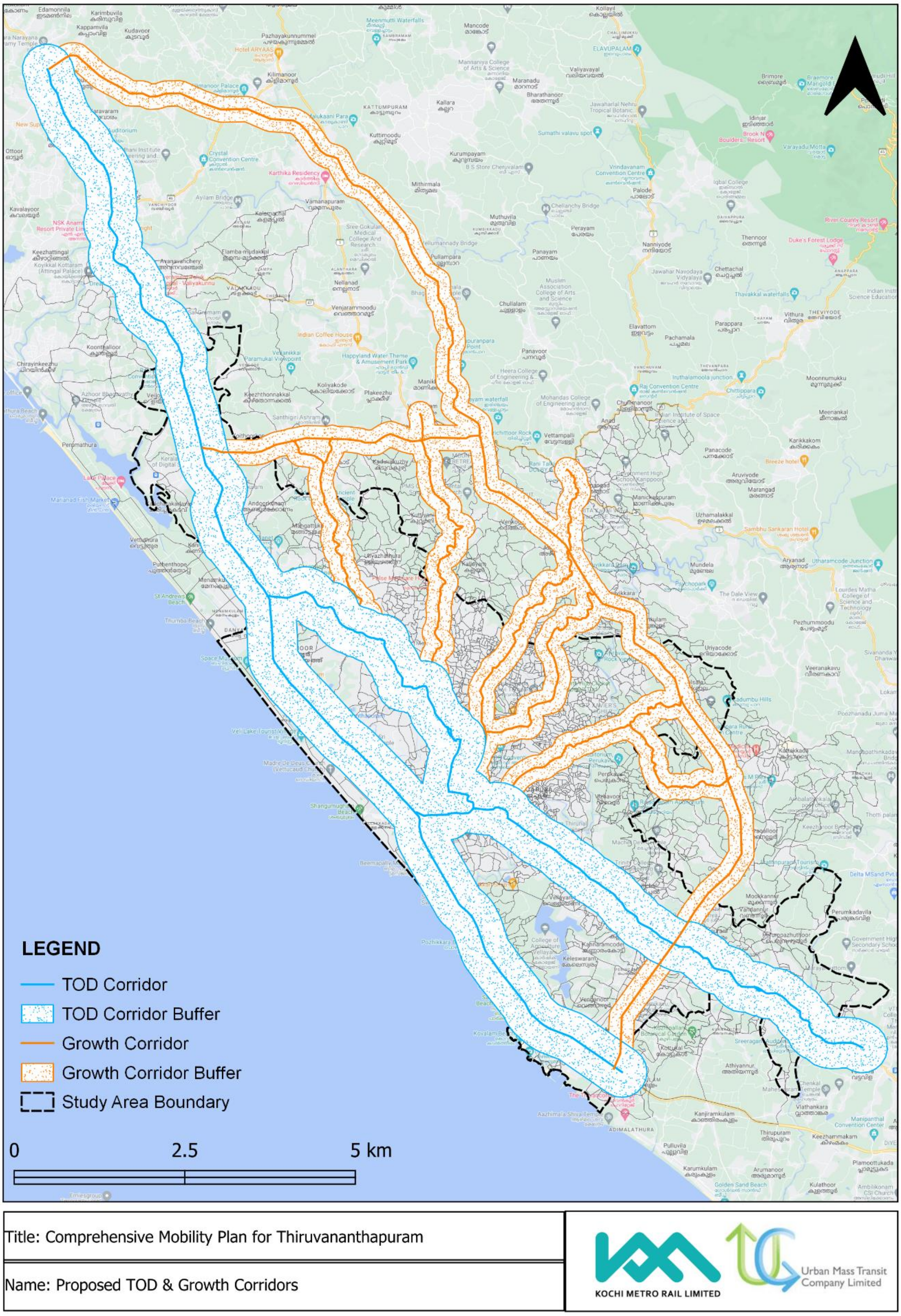
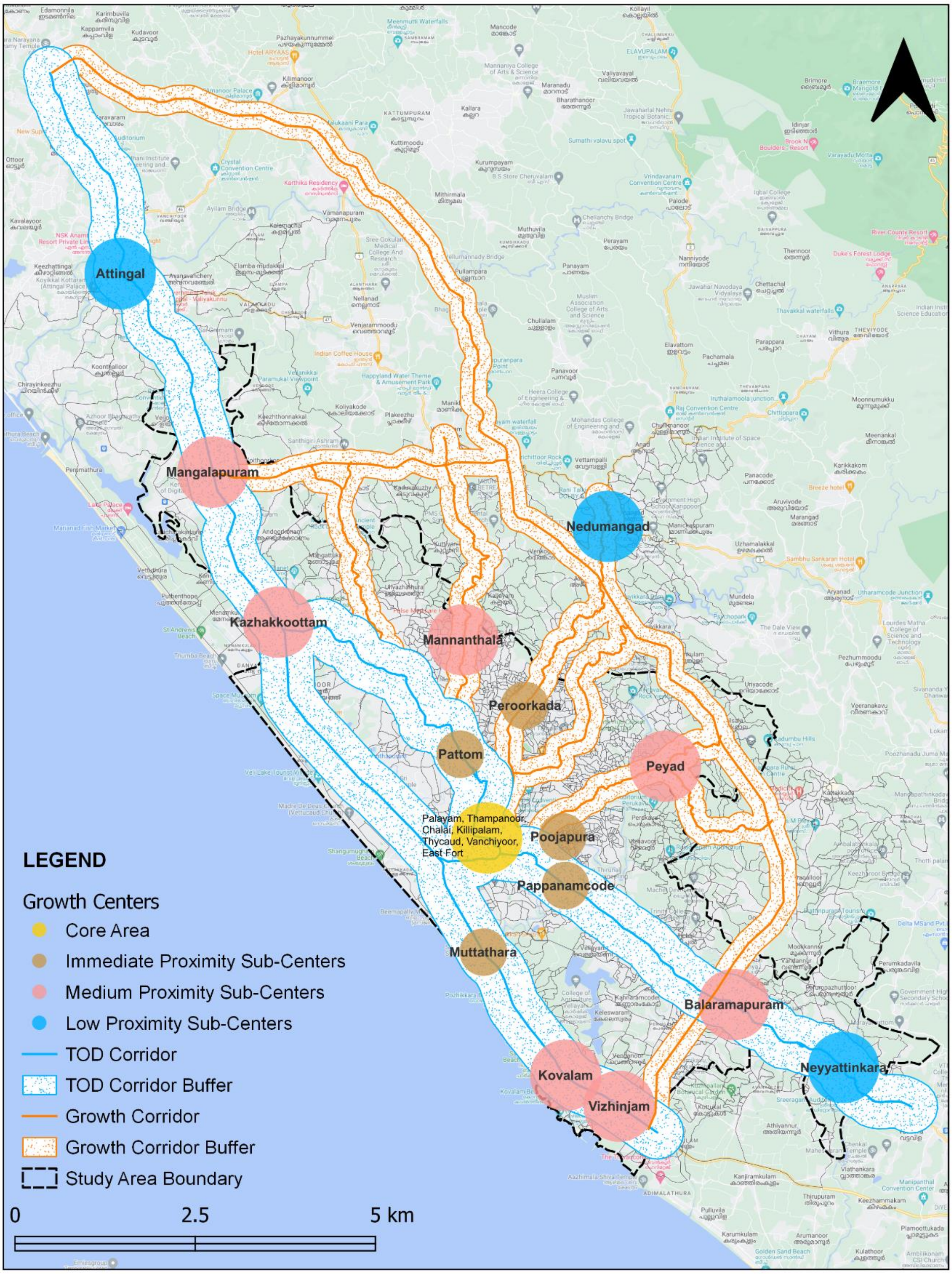


Figure 105 Recommended TOD and Growth Corridors



Title: Comprehensive Mobility Plan for Thiruvananthapuram	
Name: Proposed TOD & Growth Corridors	

Figure 106 Recommended TOD and Growth Corridors With growth centers

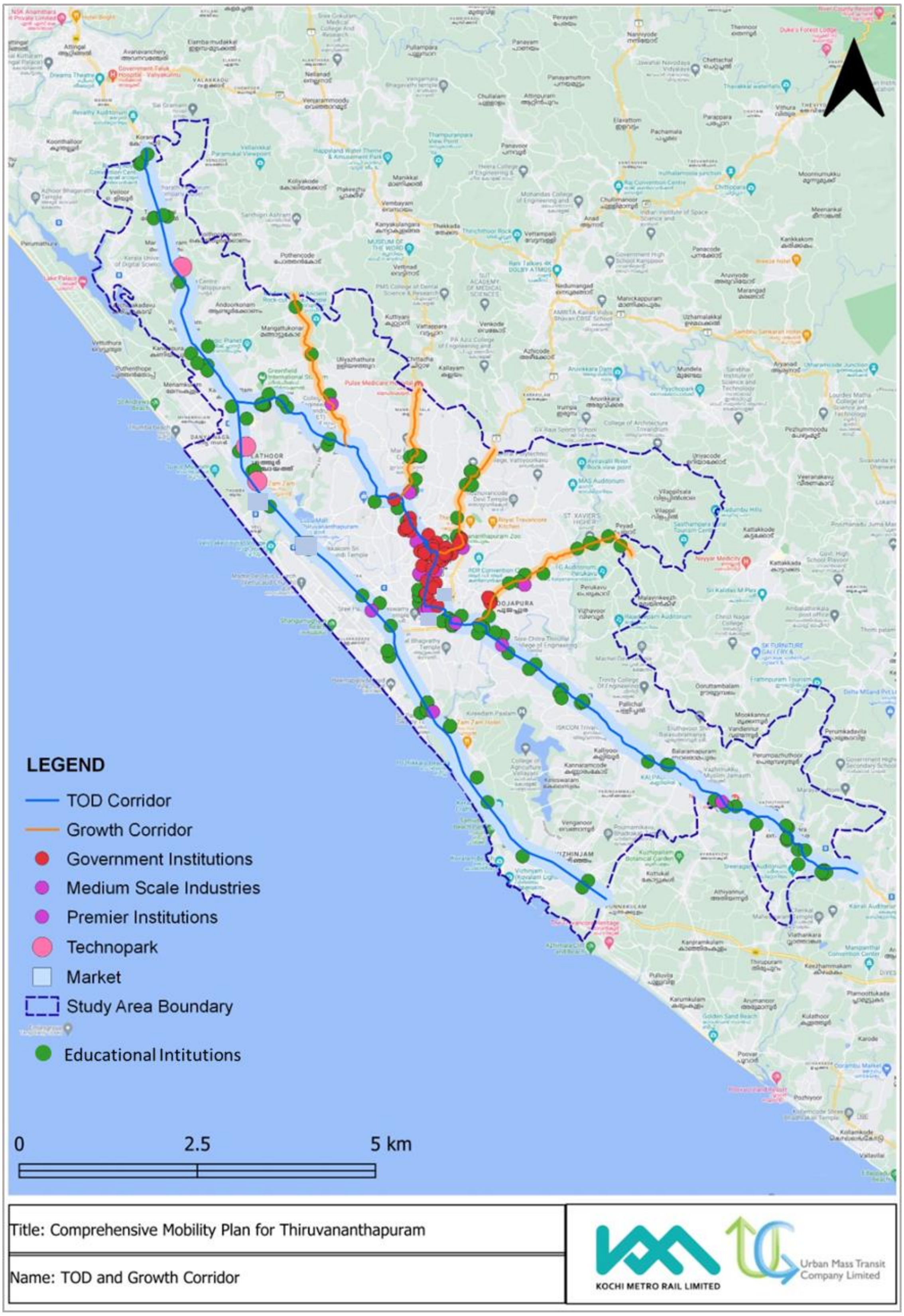


Figure 107 Map showing various existing activity nodes along the TOD and Growth Corridors within the Study Area

5.2 ROAD NETWORK STRATEGY

Road network is a system of interconnected paved carriageways which are designed to carry buses, cars, goods vehicles or any other moving travel mode and also include infrastructure facilities to move non-motorized transportation users. The road network generally forms the most basic level of transport infrastructure with urban areas. It is the backbone of any form of mobility. In order to provide mobility solutions for the Study Area. it is vital that there is effective integration between land use and transport in the entire region.

The Road network strategy includes:

- Development of clear network pattern.
- Upgradation of existing road network capacities.
- Development of new links.
- Development of River bridges, ROBs, RUBs wherever necessary.

5.2.1 NETWORK STRUCTURE

The road network spatially displays topologic and geometric variations in their structure. This strategy aims at defining a clear network pattern and hierarchy of roads. Considering the proposed land use, semi-ring and radial network structure has been proposed.

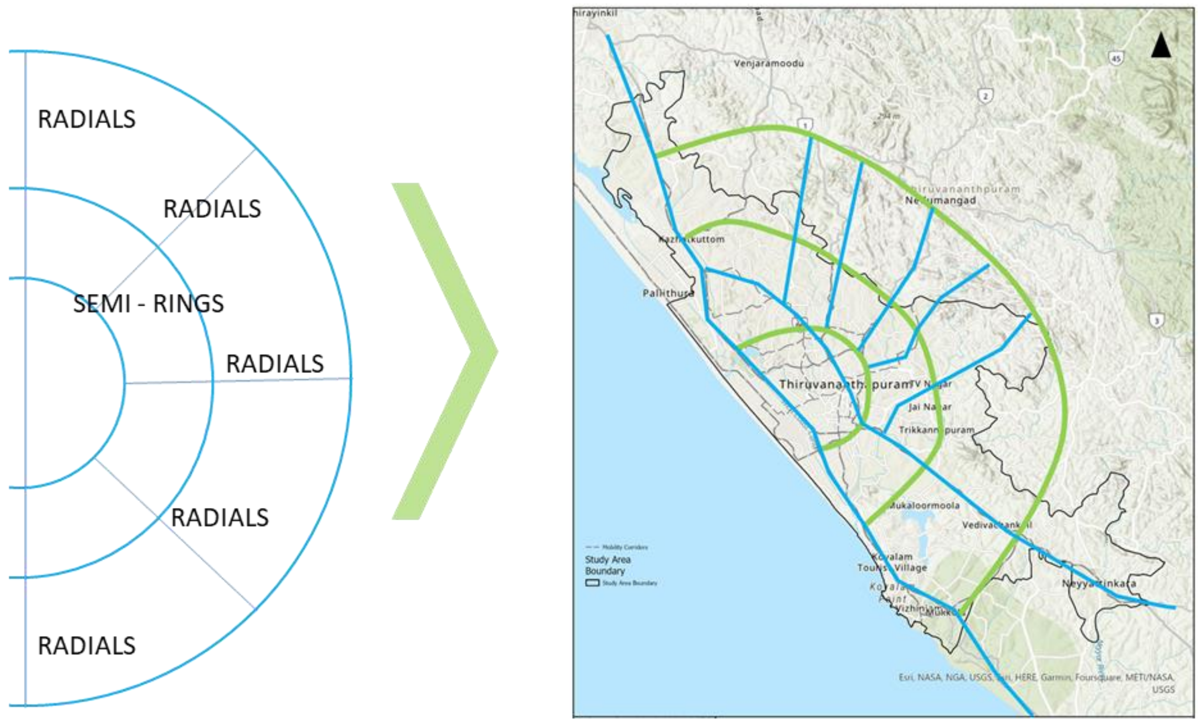


Figure 108 Conceptual Representation of Recommended Semi-Radial Network

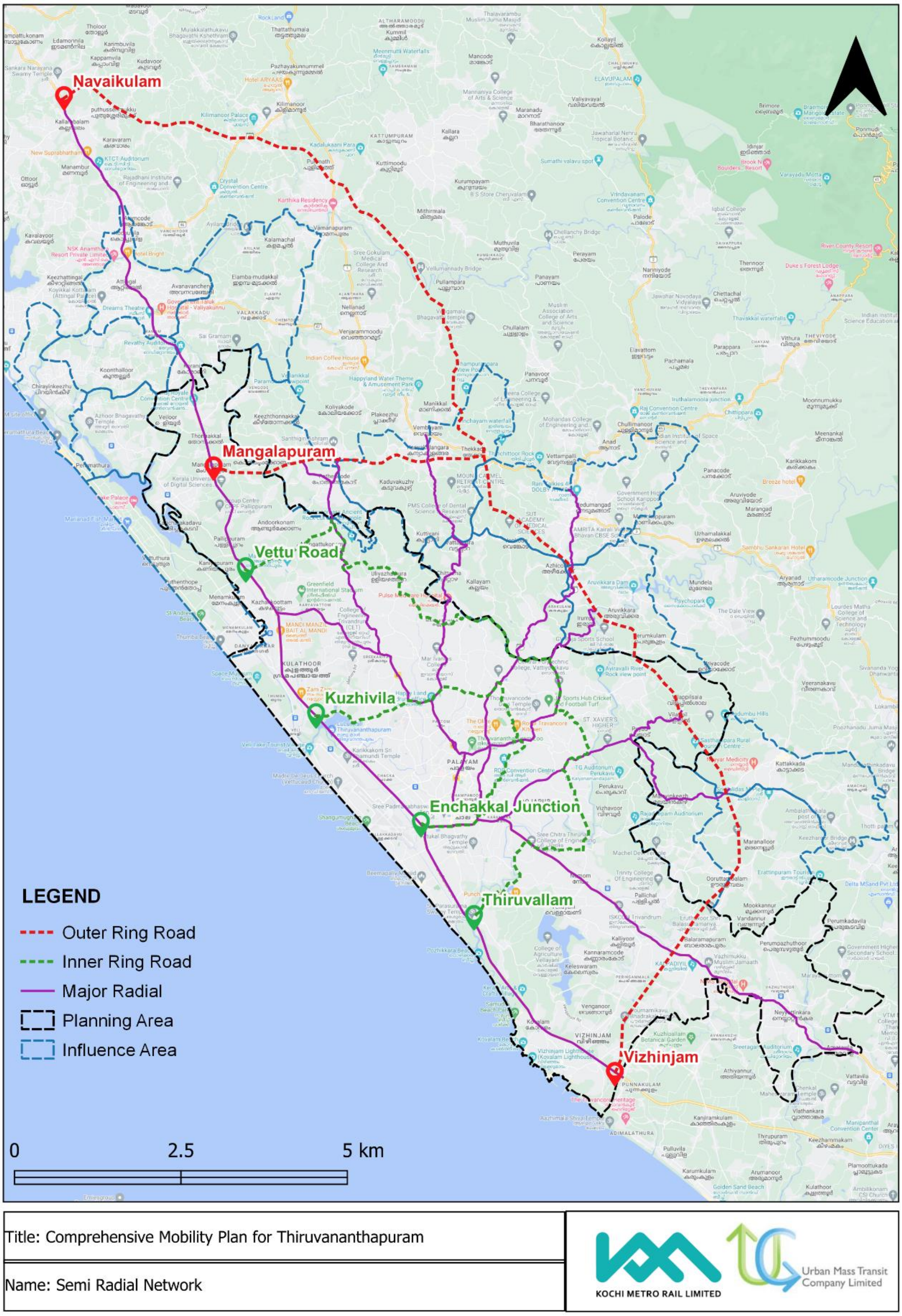


Figure 109 Recommended Semi-Radial Network

Semi-Ring and Radial Roads area recommended for developing a clear network pattern in the study area is as follows,

Table 5-3 Recommended Semi-Radial Network

SN	NAME OF THE CORRIDOR	LENGTH (KM)	ROW (M)	TYPOLOGY
1	Vizhinjam to Mangalapuram (Southern Ring)	34	60	Outer Ring Road
2	Mangalapuram to Navaikulam (Northen Ring)	30	60	Outer Ring Road
3	Vettu Road to Thiruvallam via Peroorkada	42.0	30	Inner Ring Road
4	Eanchakkal Junction to Kuzhivila via Kesavadasapuram	20.0	30	Inner Ring Road
5	NH-66	38.1	24	Major Radial
6	NH-Bypass	27.0	24	Major Radial
7	MC Road	4.2	24	Major Radial
8	Peroorkada Road	6.4	24	Major Radial
9	Peyad Road	7.4	21	Major Radial
10	Pothencode Road	7.3	21	Major Radial
11	Nettayam Road	5.2	21	Major Radial

About 221.6 km of the network is recommended for developing a clear network pattern in the study area. Since these corridors include all the major spines within the study area, thus should be designed based on the standards.

Thiruvananthapuram can take up the project to develop such Street Design Standards, which can be further used for other streets as well.

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:

- Uniform carriage way
- Continuous kerb, footpath and bi-cycle lanes
- Service roads where feasible
- Restriction or preferably prohibition of parking on the carriageway/shoulders
- At-grade/grade-separated public transport systems as per the public transport/mass transport master plan

The typical cross-sections for these mobility corridors are as depicted in the Figures Below.

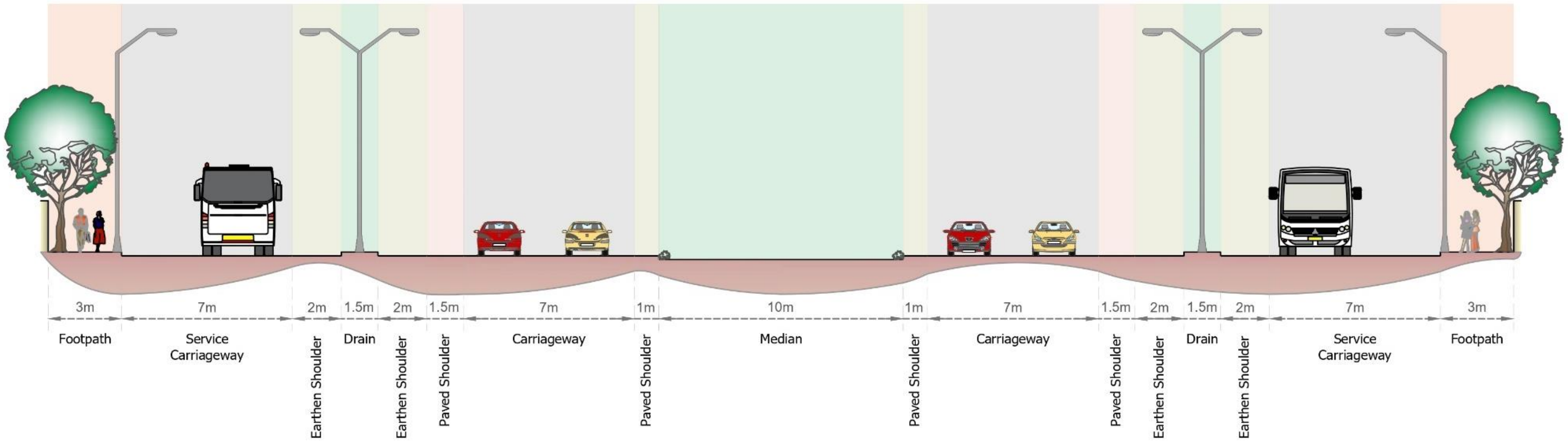


Figure 110Typical Cross Section of 60m Wide Road

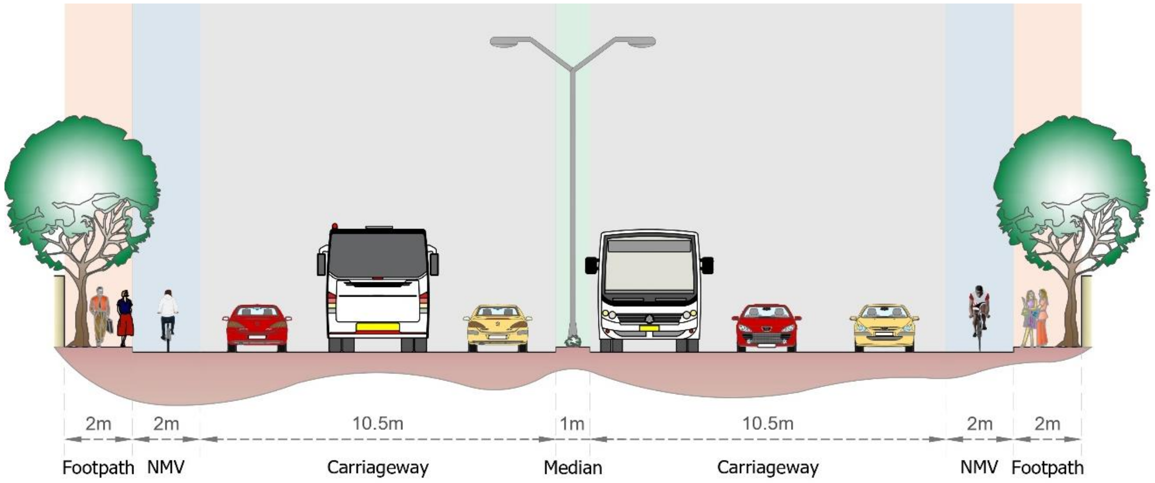


Figure 111 Typical Cross Section of 30m Wide Road

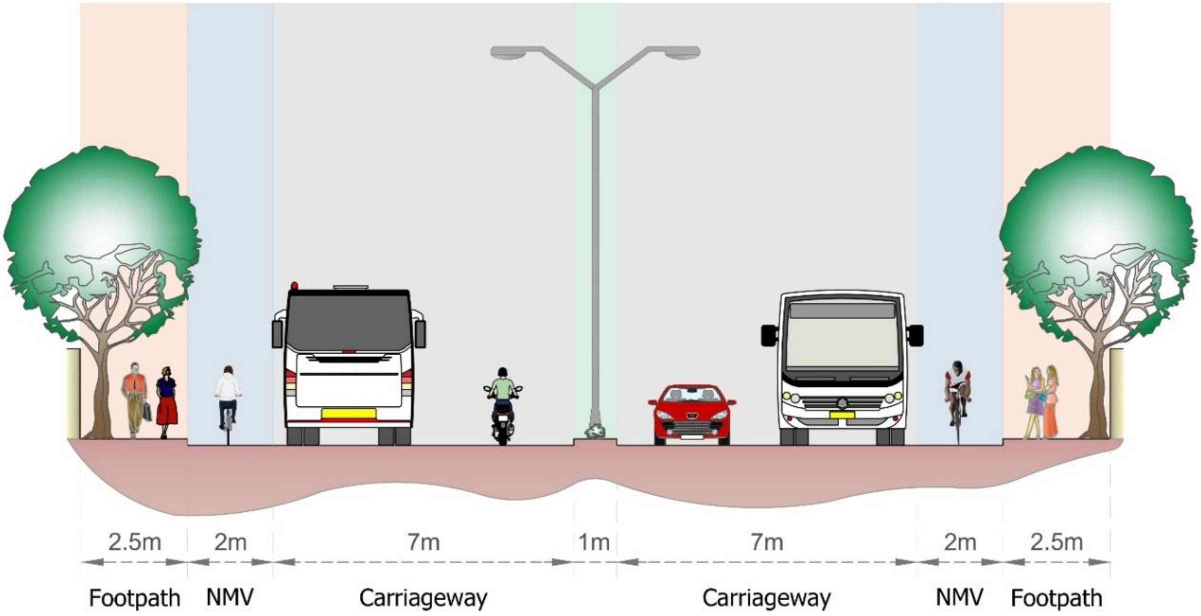


Figure 112 Typical Cross Section of 24m Wide Road

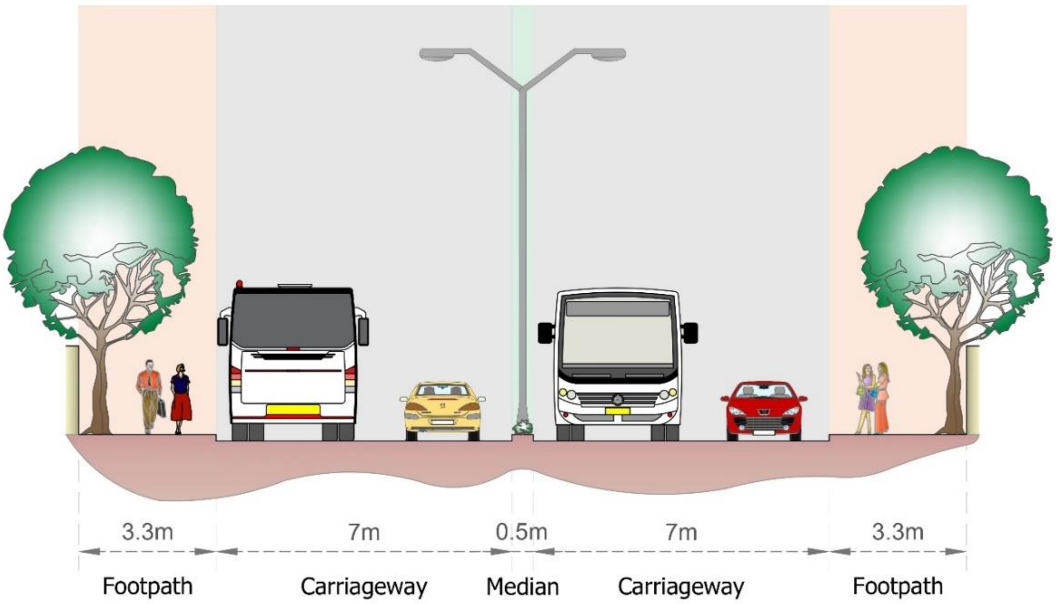


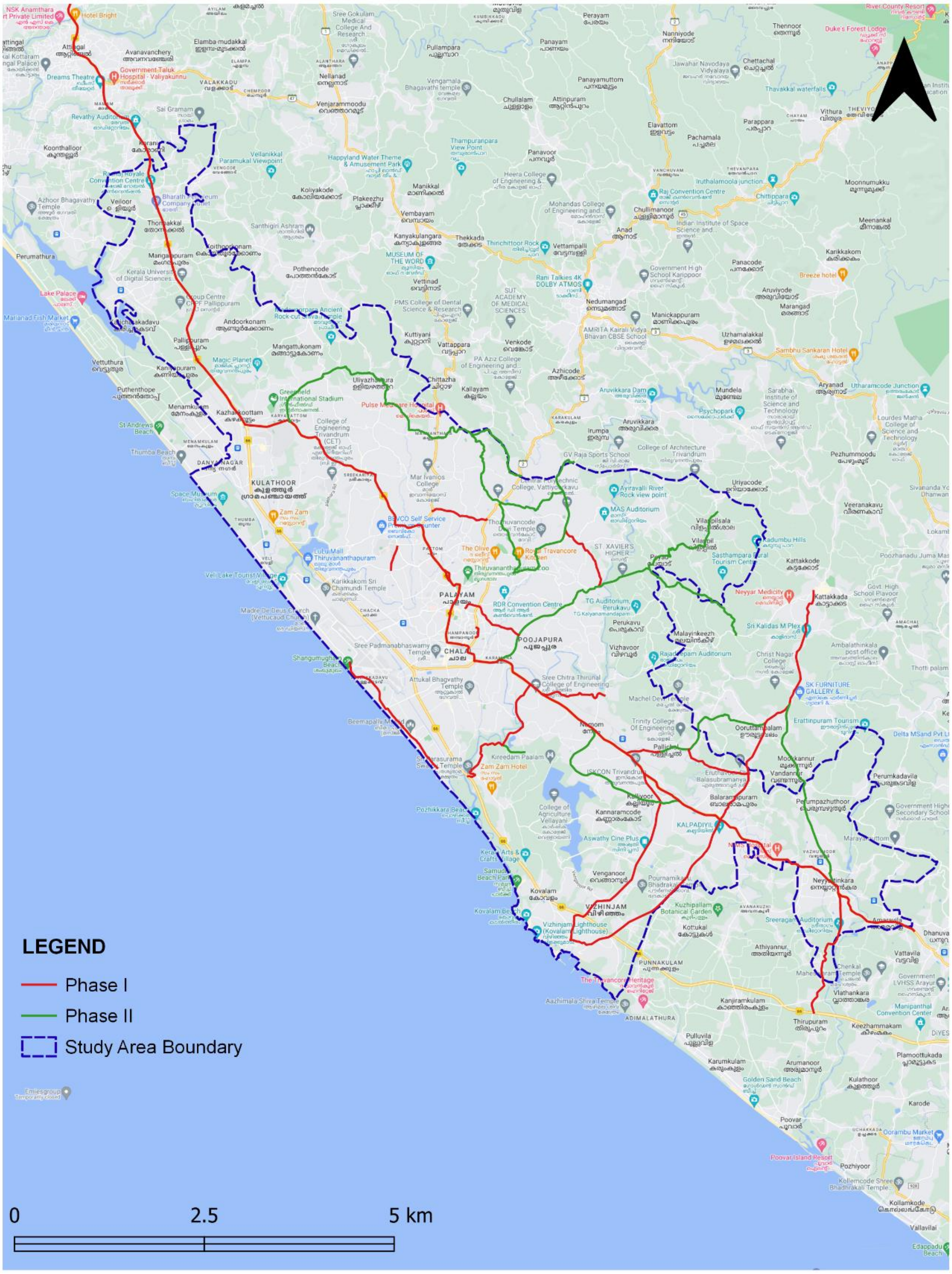
Figure 113 Typical Cross Section of 21m Wide Road

5.2.2 UPGRADATION OF EXISTING ROAD NETWORK CAPACITIES

The study recommends 170.6 km of network widening after considering the functional hierarchy and development need. The widening of roads is proposed for upgradation of existing lane capacities, provision or improvement of NMT facilities. The proposal is phased out into two considering the importance of the road and its connectivity. In Phase I, which is the priority one, a total of 93.4 km of road widening. Whereas in Phase II a total of 77.2 km road will be widened. The corridors suitable for upgradation of lane capacities or widening based on the horizon year demand in the study area are as follows,

Table 5-4 Recommended Roads for capacity upgradation

S. N.	Name of the Corridor	Length (Km)	Proposed Widening of Existing Road (M)	Typology
PHASE - I				
1	NH-66	10.0	27	Arterial
2	Medical College - Kumarapuram	2.5	21	Arterial
3	Vizhinjam - Pallichal	7.5	21	Arterial
4	Vazhuthacaud	2.6	21	Arterial
5	Amman Kovil (Thycaud) - Thycaud Jn	2.5	21	Arterial
6	Kaimanam- Thiruvallam	5.4	21	Arterial
7	Paruthiapara - Ambalamukku	2.4	21	Arterial
8	Mannarakonam - Kundamanbhagam	3.2	14	Sub-Arterial
9	Thycaud - Mettukada	1.0	14	Sub-Arterial
10	Pappanamcode - Pamamcode Bridge	2.5	14	Sub-Arterial
11	Coastal Road	6.0	14	Sub-Arterial
12	Balaramapuram - Ooruttambalam	18.8	30	Arterial
13	Vellapally - Mukkampalamoodu	2.8	18	Sub-Arterial
14	Trivandrum – Nagarcoil Highway	20.8	45	Arterial
15	Poovar - Neyyattinkara	5.4	30	Arterial
PHASE - II				
16	Mannanthala - Vazhayila	6.4	21	Arterial
17	Peroorkada - Mukkolakkal	10.8	21	Arterial
18	Peroorkada - Sasthamangalam	4.2	21	Arterial
19	Peyad Road	7.4	30	Arterial
20	Nettayam Road	5.2	21	Arterial
21	Peroorkada - Nettayam	3.2	14	Sub-Arterial
22	Mannanthala - Karyavattom	10.1	14	Sub-Arterial
23	Peyad - Vilappilsala	4.9	24	Arterial
24	Thachottukavu – Anthiyoorkkonam	5.2	30	Arterial
25	Pallichal - Ooruttambalam	5.3	24	Arterial
26	Nemom - Punnamoodu	6.8	18	Sub-Arterial
27	Neyyattinkara - Kattakkada	7.7	18	Sub-Arterial



Title: Comprehensive Mobility Plan for Thiruvananthapuram	
Name: Recommended Roads for Capacity Upgradation	

Figure 114 Recommended Roads for Capacity Upgradation

5.2.3 DEVELOPMENT OF MISSING LINKS/NEW LINKS

In order to decongest the existing roads and to foster the ease of commuting new roads or missing links have been identified and recommended in the study area. The details of the same are as presented below,

Table 5-5 Recommended New Links

S. No.	Name of the Corridor	Proposed Road Widths (M)	Phase
1	Manchadi Jn - Poonthi Road	19	Phase II
2	Manchadi Jn - Pulayanarkotta via Kunnam Sivan Kovil Road	10	Phase II
3	Port Road	45	Phase II
4	Kottiyodu Road - Medical College	14	Phase II
5	Edavacode - Keraladithyapuram road	10	Phase III
6	Kalady south Jn - Kaimanam Thiruvallam Road	10	Phase III

5.2.4 DEVELOPMENT OF GRADE SEPARATORS

Adequate road infrastructure and completeness of network structure 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.

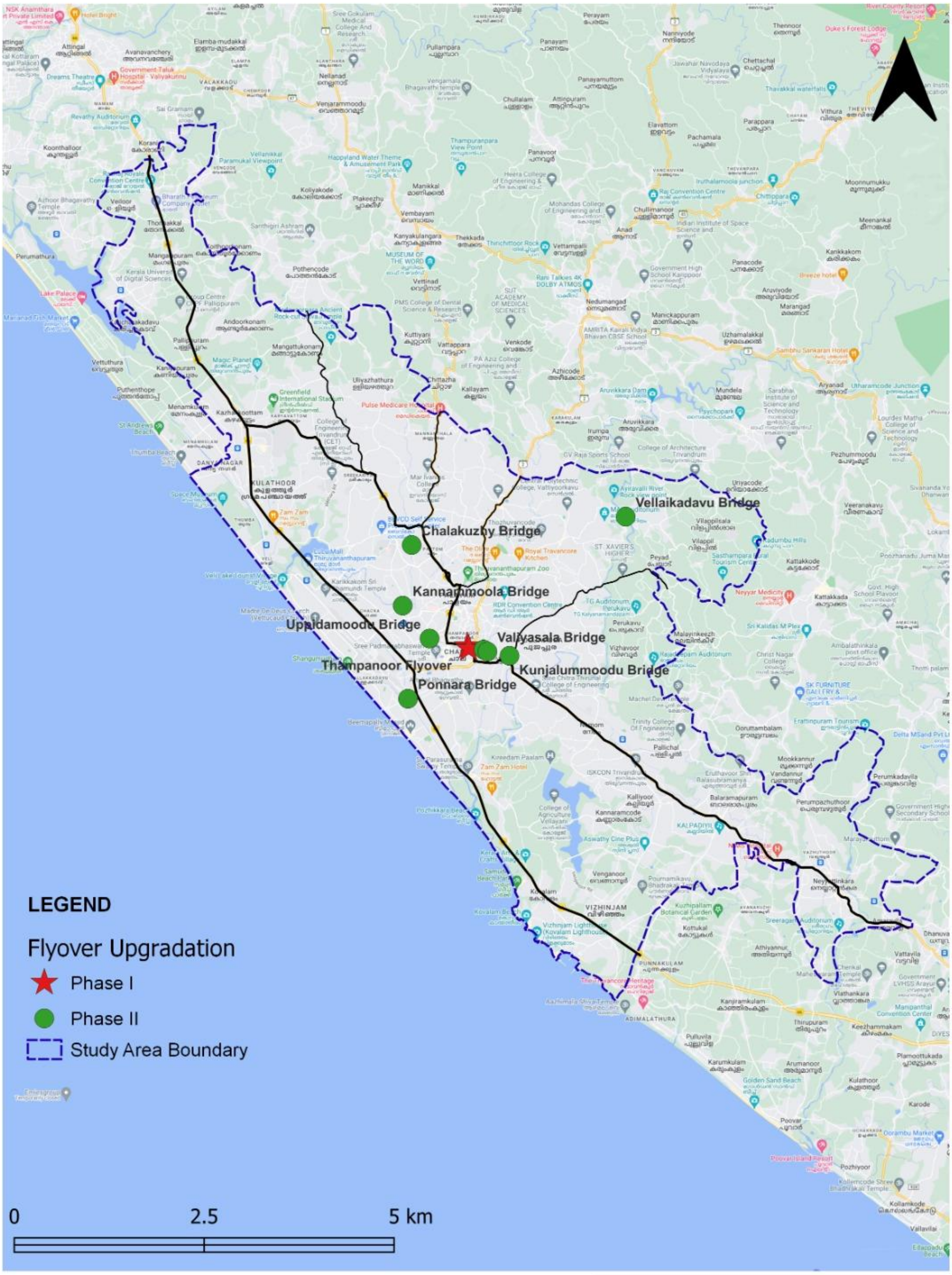
As the study area is physically segregated by the Railway track and canals, road bridges are proposed to enable smooth flow across the study area. The study recommends 21 crossing which includes 12 flyovers, 4 railway crossings and 5 river crossings. The locations are presented below.

Table 5-6 Recommended Upgradation of Grade Separators

S. No.	Name of the Corridor	Typology	Phase
1	Thampanoor Flyover	Flyover	Phase I
2	Thampanoor	ROB	Phase I
3	Uppidamoodu Bridge	ROB	Phase Ii
4	Kannammoola Bridge	ROB	Phase II
5	Valiyasala Bridge	ROB	Phase II
6	Chalakuzhy Bridge	River Crossing	Phase II
7	Valiyashala Bridge	River Crossing	Phase II
8	Kunjalummoodu Bridge	River Crossing	Phase II
9	Ponnara Bridge	River Crossing	Phase II
10	Vellaikadavu Bridge	River Crossing	Phase II

Table 5-7 Recommended New Grade Separators

S. No.	Name of the Corridor	Phase
1	Medical College	Phase II
2	Thampanoor	Phase II
3	Pattom	Phase II
4	Ulloor	Phase II
5	Station Kadavu	Phase II
6	Eanchakkal	Phase II
7	Sreekaryam	Phase II
8	Peroorkada	Phase II
9	Kochuveli	Phase II
10	Attakulangara	Phase II



Title: Comprehensive Mobility Plan for Thiruvananthapuram

Name: Upgradation of Grade Separators

Figure 115 Recommended Upgradation of Grade Separators

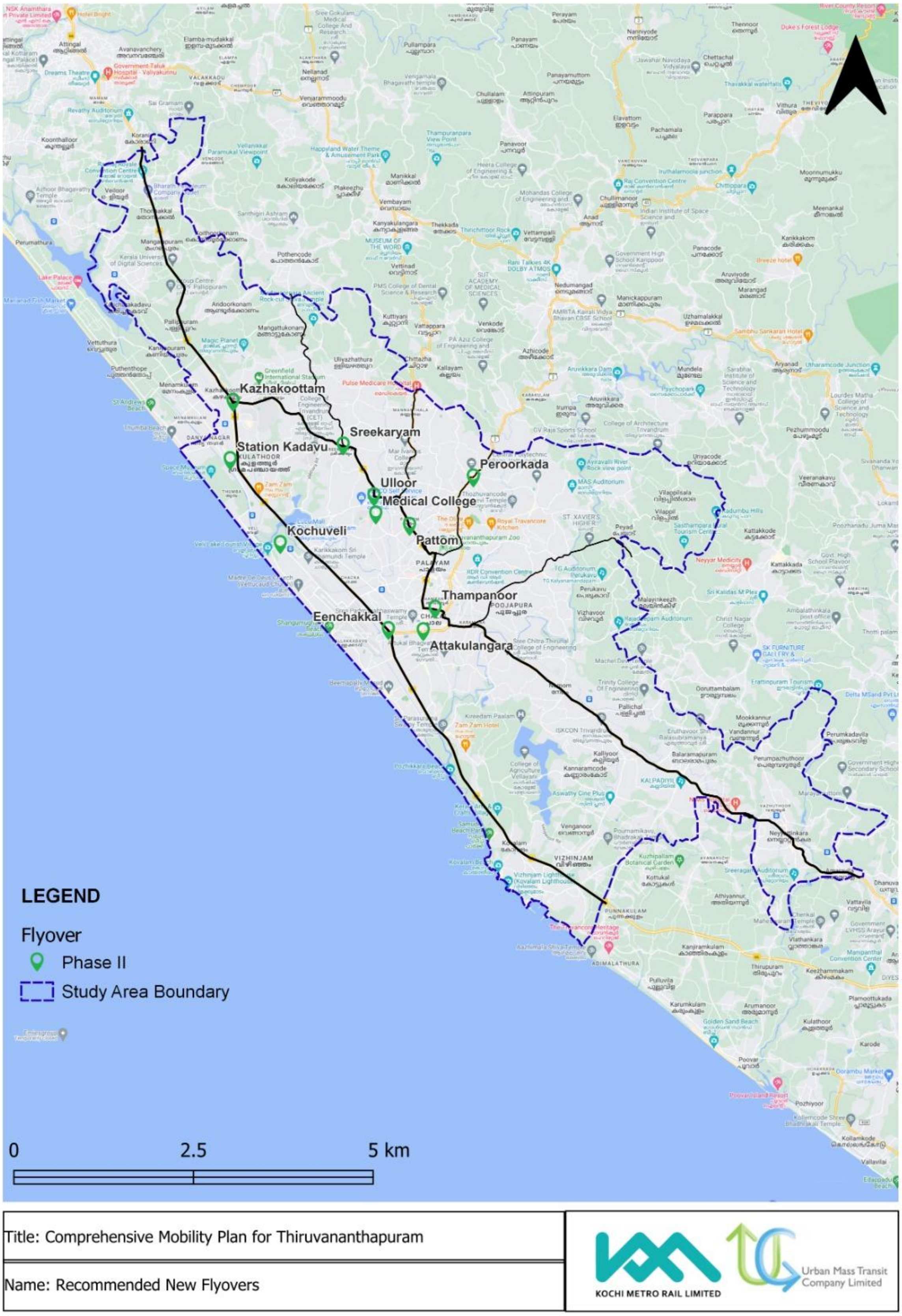


Figure 116 Recommended New Flyovers

5.3 PUBLIC TRANSPORT STRATEGY

Public transport is one of the most environmentally sustainable forms of transport. The public transport improvement strategy includes service improvements for buses, trams and para-transit, appropriate system options and infrastructure development plans and intermodal integration plans.

This strategy deals with development of hierarchy of public transport modes in Study Area, which are integrated with other and avoid competing with each other. The hierarchy of systems aims at improving the efficiency of the public transport system and providing a seamless, integrated public transit services to the users.

The proposals under public transport improvement strategy are:

- Development of High Demand Mobility Corridors
- City Bus Rationalization and Augmentation
- Inland Water Ways
- Development of PT Terminals

The major mobility corridors in the study have been identified through primary assessment of the traffic and transportation data collected through primary and secondary sources and travel demand model outputs.

Figure 117 Available Hierarchy of Public Transit Systems

5.3.1 HIGH DEMAND MOBILITY CORRIDORS

The major mobility corridors in the study area are,

Table 5-8 Major Mobility Corridors in the Study Area

SN	NAME OF THE CORRIDOR	LENGTH (KM)
1	NH-66 (Mangalapuram to Neyyattinkara)	40.1
2	NH-Bypass (Kazhakkoottam to Vizhinjam)	27.0
3	MC Road	4.2
4	Peroorkada Road	6.4
5	Peyad Road	7.4
6	Pothencode Road	7.3
7	Attakulangara-Eanchakkal Road	2.7
8	Palayam- Airport Road	3.5
9	Bakery Junction Road to Thampanoor	2.0
10	Pottakuzhy Road – Medical College Road	3.1
11	Pattom-Kowdiar Road	2.3
12	CV Raman Road	3.2
13	Nettayam Road	5.2

The assessment resulted in the identification of potential high demand mobility corridors for development. A high demand mobility system is designed to move large numbers of people at one time.

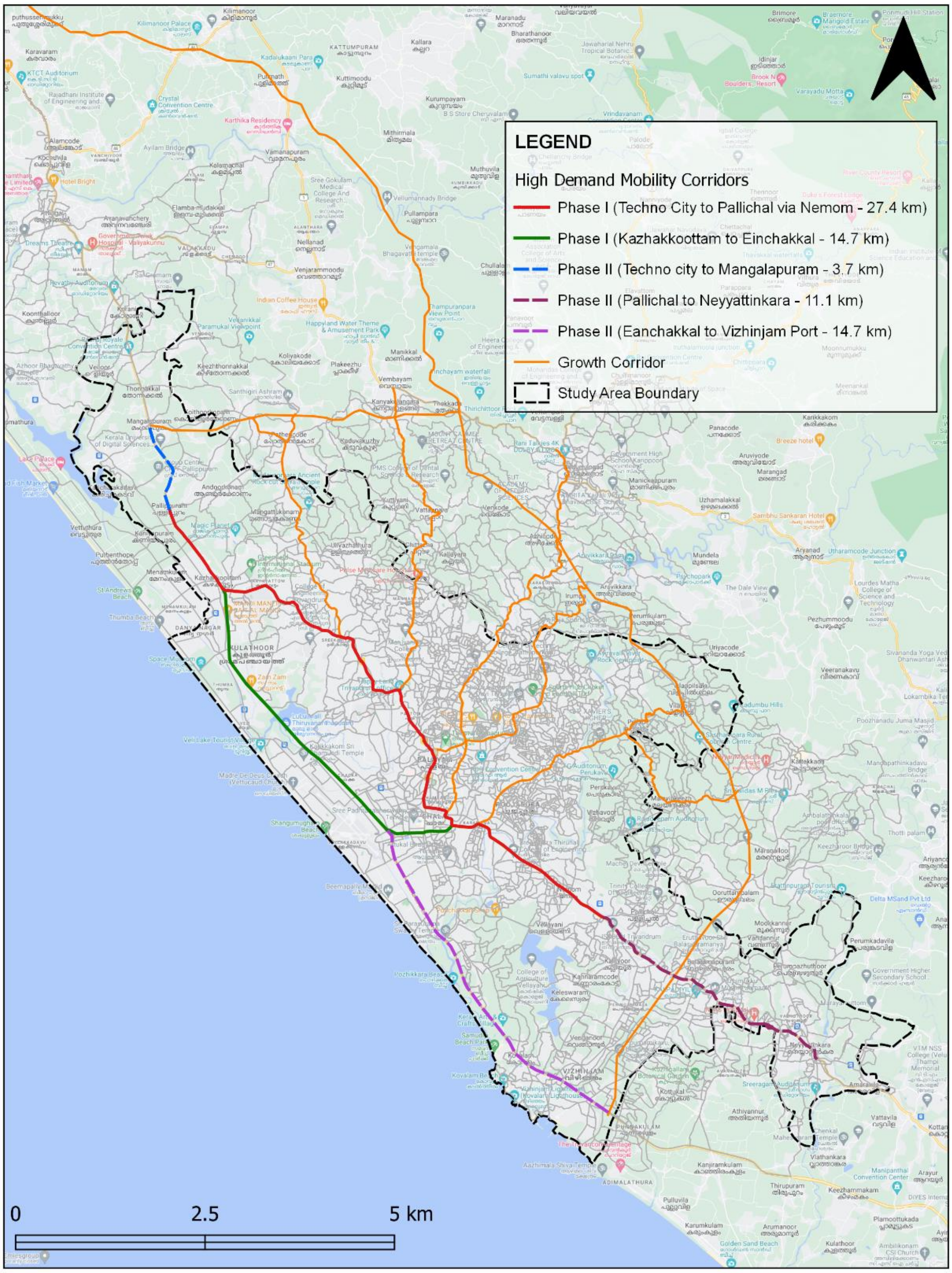
In case of the Thiruvananthapuram about 71.6 km of High Demand Mobility corridors have been identified with a Max PPHPD of 5000 to nearly 20000 in the horizon years. Considering the demand on the high demand mobility corridors the most suitable mass transit modes can be explored as part of Alternative Analysis study in line with the MoHUA.

The suitable corridor has been identified based PPHPD however, a detailed study has to be carried out assess the feasibility of these corridors based on other screening criteria.

Table 5-9 High Demand Mobility Corridors in the Study Area

SN	NAME OF THE CORRIDOR	LENGTH (KM)
PHASE I		
1	Techno City to Pallichal via Karmana, Nemom	27.4
2	Kazhakkoottam to Killipalam VIA Eanchakkal	14.7
PHASE II Extension Corridors		
1	Pallichal to Neyyattinkara	11.1
2	Techno city to Mangalapuram	3.7
3	Eanchakkal to Vizhinjham	14.7

Other than the corridors provided in the table above, the remaining growth corridors (Section 8.1.2) needs to be explored to be developed as high demand mobility corridors in the future. Which includes MC Road, Peroorkada Road, Peyad Road and Pothencode Road.



Title: Comprehensive Mobility Plan (CMP) for Thiruvananthapuram

Name: High Demand Mobility Corridors

Figure 118 High Demand Mobility Corridors in the Study Area

Table 5-10 Estimated Demand on High Demand Phase I Mobility Corridors

SN	NAME OF THE CORRIDOR	LENGTH (KM)	Demand - SUT (2051 - PPHPD)
1	Techno City to Pallichal via Karmana, Nemom	27.4	19747
2	Kazhakkoottam to Killipalam VIA Eanchakkal	14.7	6513
***PPHPD – Passenger per hour per direction**			

5.3.2 CITY BUS RATIONALIZATION

City Bus systems play a major role in achieving sustainable mobility. These systems have higher coverage and form a strong base for the development of high demand mobility corridors. Thus, it is crucial to improve, augment, strengthen and integrated the city bus services with the other modes. This study strategizes Route Rationalization for the same.

A recent study on city bus was conducted by KSRTC on route rationalization in the year 2019 and all the city buses are running based on the rationalized routes.

Further, a route-to-route overlap analysis has been carried out for bus services in Thiruvananthapuram is observed that about 34% of the routes have above 60% average route overlap with the proposed trunk routes. Thus, these routes were cross-analysed with the headways, modelled demand and trips per route to improve the efficiency of the bus system though rationalization.

Currently there 108 Private bus permits in Thiruvananthapuram, of with 70 permits / routes are operational. It is recommended to retain the cap on the private bus permits. Further, it is recommended to rationalise 20 routes which are observed to be overlapping with the high demand mobility corridors from Kesavadapuram to Pallichal by re-outing from alternative corridors.

The rationalized routes need to be re-routed to various other parts of the city which is having limited access by the buses. This needs to be done hand to

Table 5-11 Route Rationalization Proposals

RATIONALIZATION OF ROUTES	2027
Total No. of Routes	70
Total No. of Routes for Curtailed/Modified	20

The details of the routes are as follows,

Table 5-12 Recommended Private Bus routes for Rationalization

SN	NAME OF THE CORRIDOR	NATURE OF OVERLAP	RECOMMENDATION	PHASE
1	Pappanamcode-Kundappanakunnu	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
2	Medical College-Chiramukku	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
3	Medical Clg-Valiyavila	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
4	Pravanchalbalam-Poonthura	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
5	Kochiravila-Medical College	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
6	Pomngumoodu-Thrikannapuram	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
7	Pallimukku-Pongumoodu	Overlap with Proposed High Demand Corridor	Re-routing the overlap section	Phase II
8	Thiruvallam-Nettayam	Overlap with City Circular Services	Re-routing the overlap section	Phase I
9	Konchiravila-Vayalikkada	Overlap with City Circular Services	Re-routing the overlap section	Phase I
10	Sreekariyam-Veli	Overlap with City Circular Services	Re-routing the overlap section	Phase I
11	Srekaryam-Kochuveli	Overlap with City Circular Services	Re-routing the overlap section	Phase I
12	Kalady-Pulayanarkotta	Overlap with City Circular Services	Re-routing the overlap section	Phase I
13	Pappanamcode-Karikkakom Temple	Overlap with City Circular Services	Re-routing the overlap section	Phase I
14	Pulayanarkotta-Poonthura	Overlap with City Circular Services	Re-routing the overlap section	Phase I
15	Kundamanbhagom-Akg Nagar	Overlap with City Circular Services	Re-routing the overlap section	Phase I
16	Thrikannapuram-Madhavapuram	Overlap with City Circular Services	Re-routing the overlap section	Phase I
17	Medical College-Thrikannapuram	Overlap with City Circular Services	Re-routing the overlap section	Phase I
18	Akg Nagar-Pappanamcode	Overlap with City Circular Services	Re-routing the overlap section	Phase I
19	Kodunganoor-Kalady	Overlap with City Circular Services	Re-routing the overlap section	Phase I
20	Pongumoodu-Thiruvallam	Overlap with City Circular Services	Re-routing the overlap section	Phase I

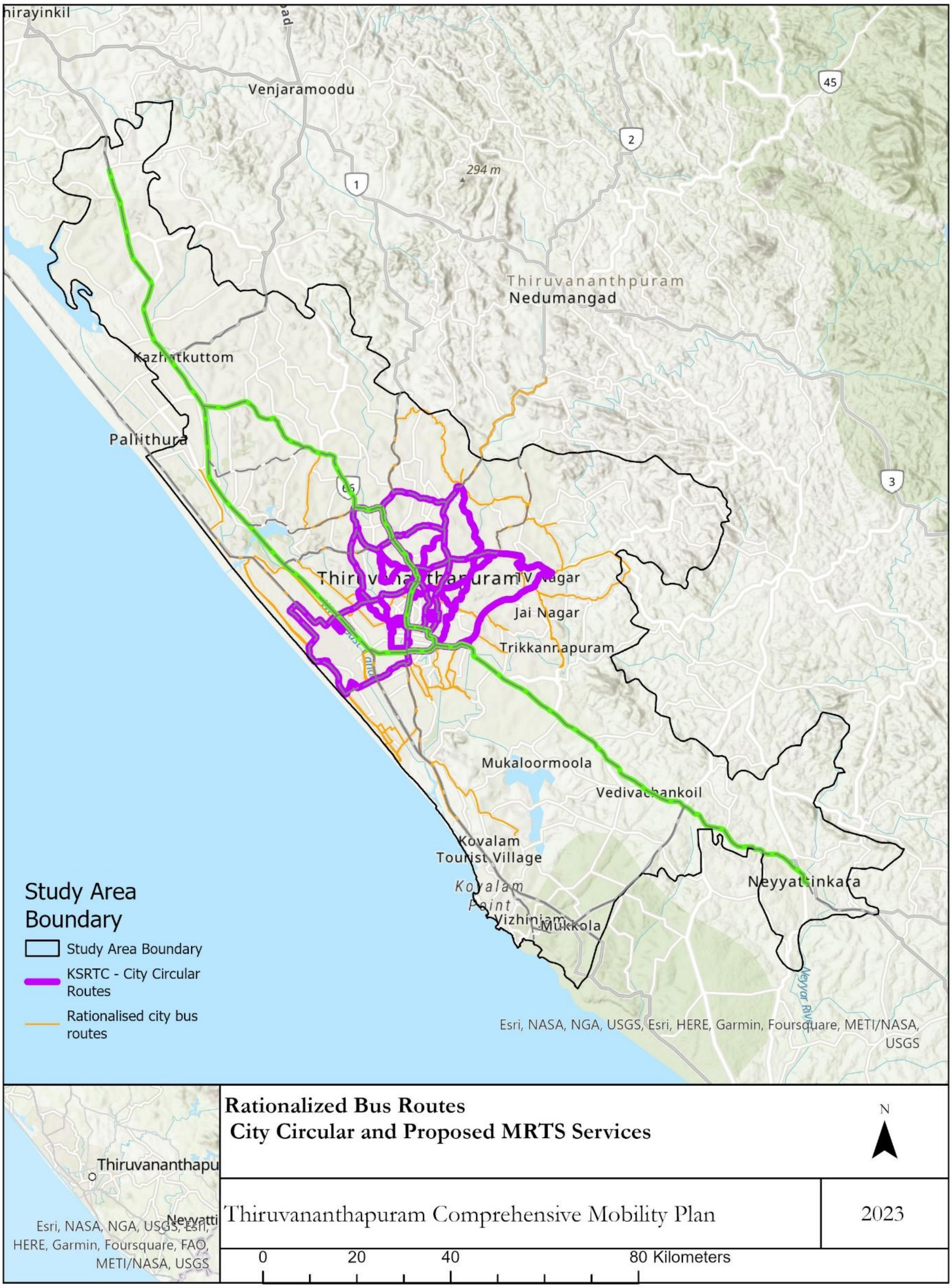


Figure 119 Rationalised Private City Bus Routes

5.3.3 PUBLIC TRANSPORT FLEET AUGMENTATION

The existing assessment of KSRTC bus routes in the study area indicate that there are around 479 KSRTC buses plying with the study area dedicated under city (partly sub-urban) operations of which 38 buses are dedicated to City circular operations commuting nearly about 25 thousand passengers.

Based on the route rationalization plan, high demand mobility corridors and estimated demand, the number of buses required the study area for the horizon years are computed. Fleet requirement is over the years is estimated based on various norms and demand and is presented in the Table below

Table 5-13 Fleet Requirement Over the Years [27]

FLEET REQUIREMENT	2023	2031	2041	2051
Fleet Requirement (MouHA norm)				
Existing Bus Fleet	479	-	-	-
Proposed Bus Fleet	-	1066	1231	1422
Addl. Fleet Required	-	587	165	191
Fleet Requirement (CIRT norm)				
Existing Bus Fleet	479	-	-	-
Proposed Bus Fleet	-	711	821	948
Addl. Fleet Required	-	232	110	127
Fleet Requirement (SUT Scenario)				
Existing Bus Fleet	479	-	-	-
Proposed Bus Fleet	-	650	787	946
Addl. Fleet Required	-	171	137	159
Suggested Fleet Requirement				
Proposed Standing Bus Fleet	479	650	787	946
Buses to be Scrapped	-	-	65	79
Addl. Fleet Required (Including Scrapped Buses)	**0**	**171**	**202**	**238**

On comparison with CIRT and MoHUA norms and Demand assessment for SUT scenario, CMP suggests a standing bus fleet of 650 by 2031 and 946 buses with 80% fleet being Electric by 2051.

[27] The proposed fleet size includes the fleet required on the proposed new routes.

5.3.4 NEW CITY BUS ROUTES

On assessment have been 11 corridors have identified as high demand city bus corridors as secondary corridors to the primary proposed MRTS corridors. The bus systems are recommended to operate at high frequency of 5mins in the horizon years (2027). The details of the same are as presented below,

Table 5-14 High Demand City Bus Routes in the Study Area

SN	NAME OF THE CORRIDOR	LENGTH (KM)
1	MC Road	4.2
2	Peroorkada Road	6.4
3	Peyad Road	7.4
4	Pothencode Road	7.3
5	Nettayam Road	5.2
6	Attakulangara-Eanchakkal Road	2.7
7	Palayam- Airport Road	3.5
8	Bakery Junction Road to Thampanoor	2.0
9	Pottakuzhy Road – Medical College Road	3.1
10	Pattom-Kowdiar Road	2.3
11	CV Raman Road	3.2

The study proposed 2 additional city circular routes to existing rationalized city circular routes. The proposed are integrated with the proposed mass transit system network. A total fleet size of 17 is proposed on 2 routes for 2027 and 27 buses by 2052. The headway of these routes varies from 5mins to 15mins during the peak hours and 15mins to 45mins during the off-peak hours. The list of proposed routes is as follows,

Table 5-15 Proposed New Routes

S.NO.	ROUTE NAME	DISTANCE IN KMS	PHASE	BUSES			
				2027	2031	2041	2051
1	Bypass –Kochuveli Loop	18	Phase I	7	8	10	12
2	Kazhakkoottam Loop	22	Phase I	9	11	13	15
TOTAL		40		17	20	23	27

Figure 120 High Demand Bus Routes network

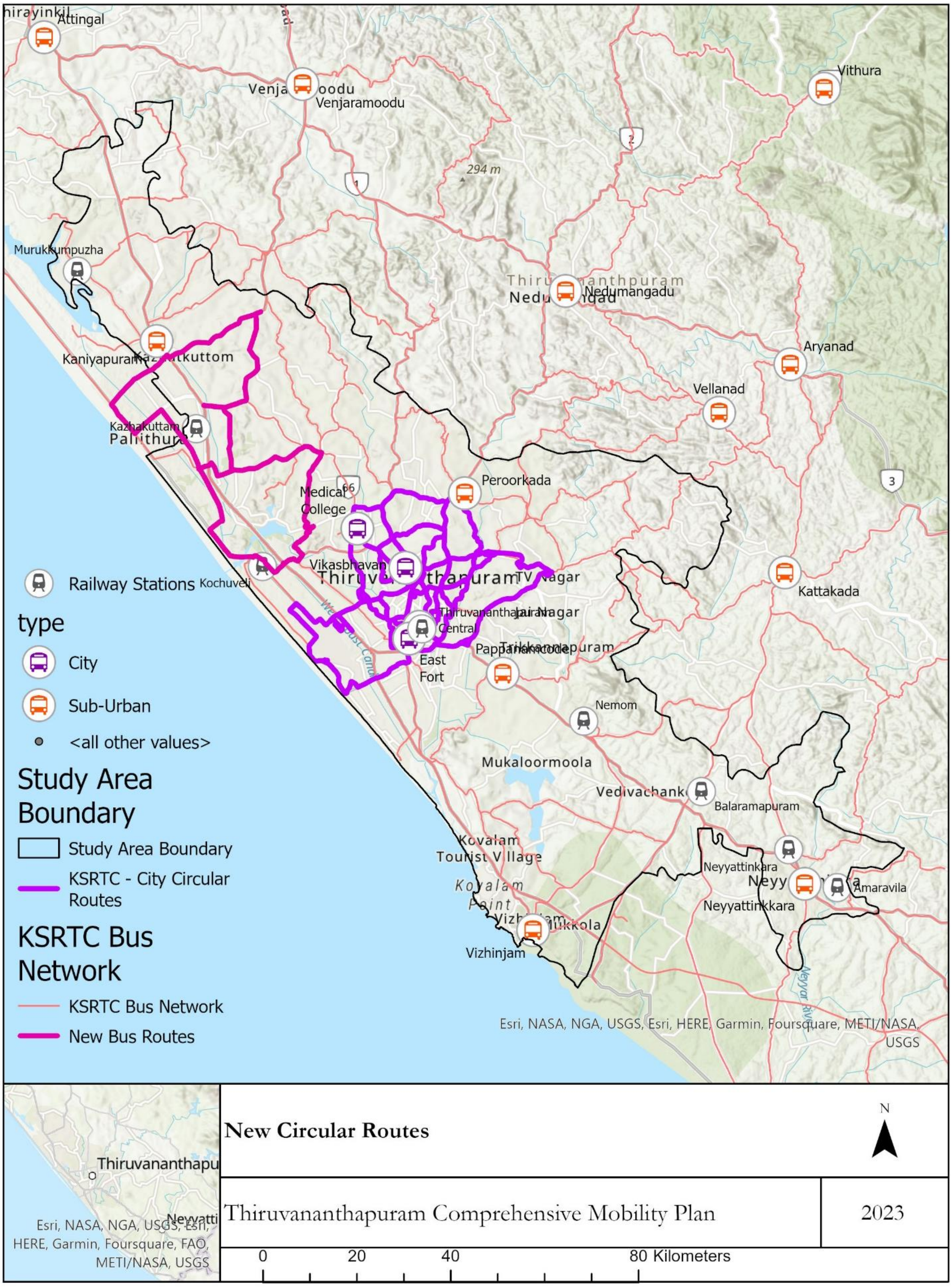


Figure 121 New City Bus Routes

5.3.5 INLAND WATER TRANSPORT

Inland Waterways are recommended on 5 routes of 51 km in the study area and the details of the same are as presented below,

Table 5-16 Inland Water Transport Routes

SN	ROUTES	LENGTH (KM)	PHASE
1	Kovalam to Thiruvallam bridge	4.7	Phase I
2	Thiruvallam to Karamana bridge	11.0	Phase I
3	Murukkumpuzha to Kochuveli via Veli	19.1	Phase II
4	Kochuveli to Thiruvallam via Airport	10.4	Phase II
5	Jagathy to Thiruvallam	5.2	Phase Ii

Electric boats of capacity 25-35 capacity with an operating speed of 14kmph at 15-20 mins headway is recommended. Smaller boats are recommended as majority of the corridors are operate parallel to the mass transit corridors. However, these can be operated under tourism circuit along with daily commuting.



Table 5-17 Inland Water Transport Fleet

SN	ROUTES	LENGTH (KM)	MAX DEMAND (PHPDT) -2031	FLEET REQURIED (2031)
1	Kovalam to Thiruvallam bridge	4.7	301	4
2	Thiruvallam to Karamana bridge	11.0	267	9
3	Murukkumpuzha to Kochuveli via Veli	19.1	240	15
4	Kochuveli to Thiruvallam via Airport	10.4	205	11
5	Jagathy to Thiruvallam	5.2	145	9

A holistic infrastructure is recommended to be developed, with Stations and Terminals.

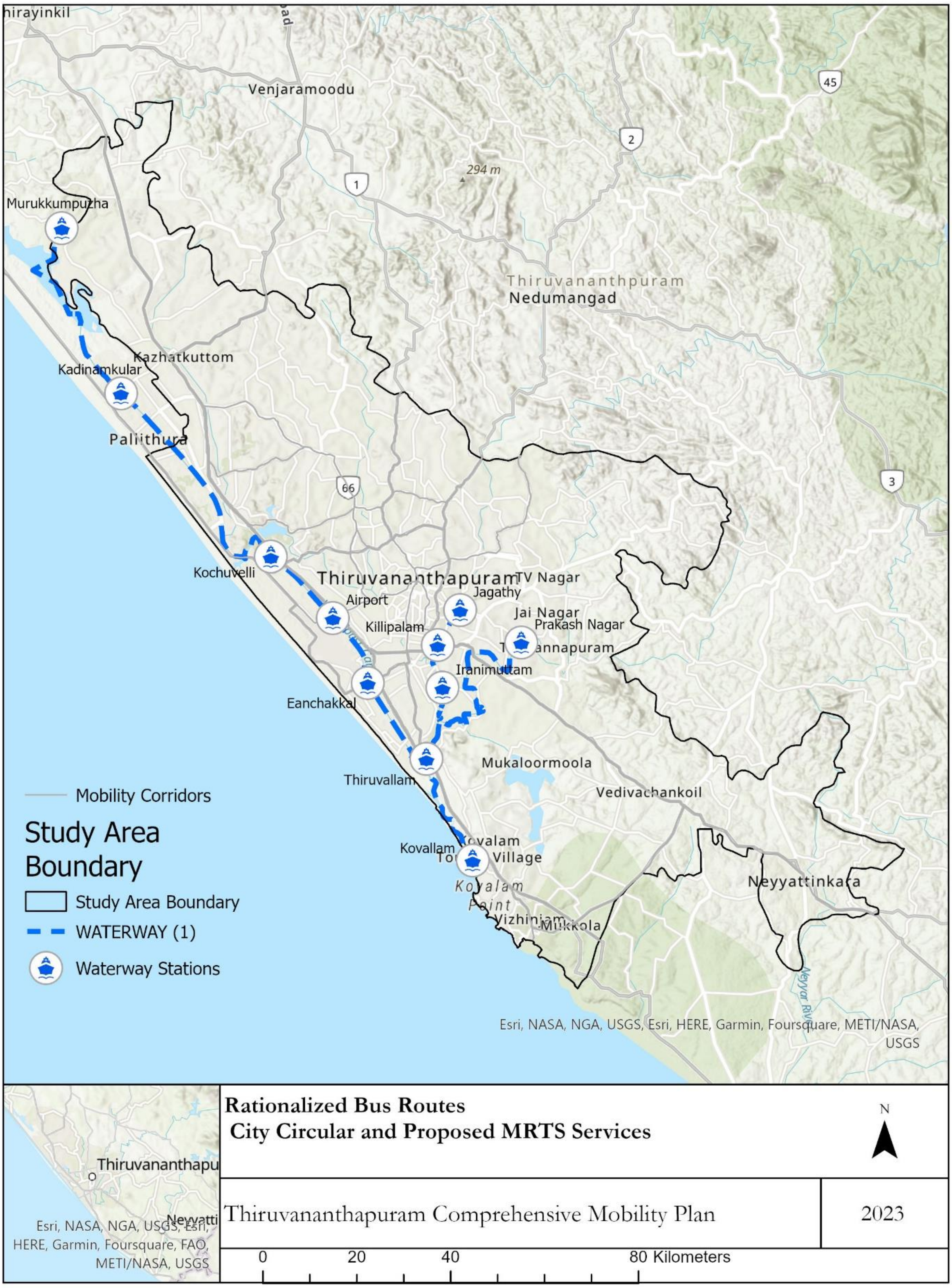


Figure 122 Inland Water Transport Routes

11 Inland Waterways Station and terminals are recommended the details of the same are as presented below,

Table 18 Inland Water Transport Stations

SN	ROUTES	Typology	PHASE
1	Kochuvelli	Station	Phase I
2	Airport	Station	Phase I
3	Eanchakkal	Station	Phase I
4	Thiruvallam	Station	Phase I
6	Kovallam	Terminal	Phase I
6	Iranimuttam	Station	Phase I
7	Prakash Nagar	Terminal	Phase I
8	Killipalam	Station	Phase II
9	Jagathy	Terminal	Phase II
10	Kadinamkular	Station	Phase II
11	Murukkumpuzha	Terminal	Phase II

5.3.6 PUBLIC TRANSPORT TERMINALS

The public transport terminals, which includes the airport, railway station, bus terminals and inland water terminals in the city plays a vital role in connecting people from one place to the other. The development of all these terminals enhance better connectivity and enhanced transitions. The identified existing airport and railway stations; and the proposed inland waterway terminal are shown in table below.

Table 19 Public Transport Terminals – Airport, Railway & Waterway

SN	TERMINAL	TYPE	TYPOLOGY
1	Thiruvananthapuram International Airport	Airport	Domestic and International Services
2	Thampanoor Railway Station	Railway	Regional Services
3	Kochuveli Railway Station	Railway	Regional Services
4	Nemom Railway Station	Railway	Regional Services
6	Kovalam	Waterway	Sub-urban Services
6	Prakash Nagar	Waterway	Sub-urban Services
7	Jagathy	Waterway	Sub-urban Services
8	Murukkumpuzha	Waterway	Sub-urban Services

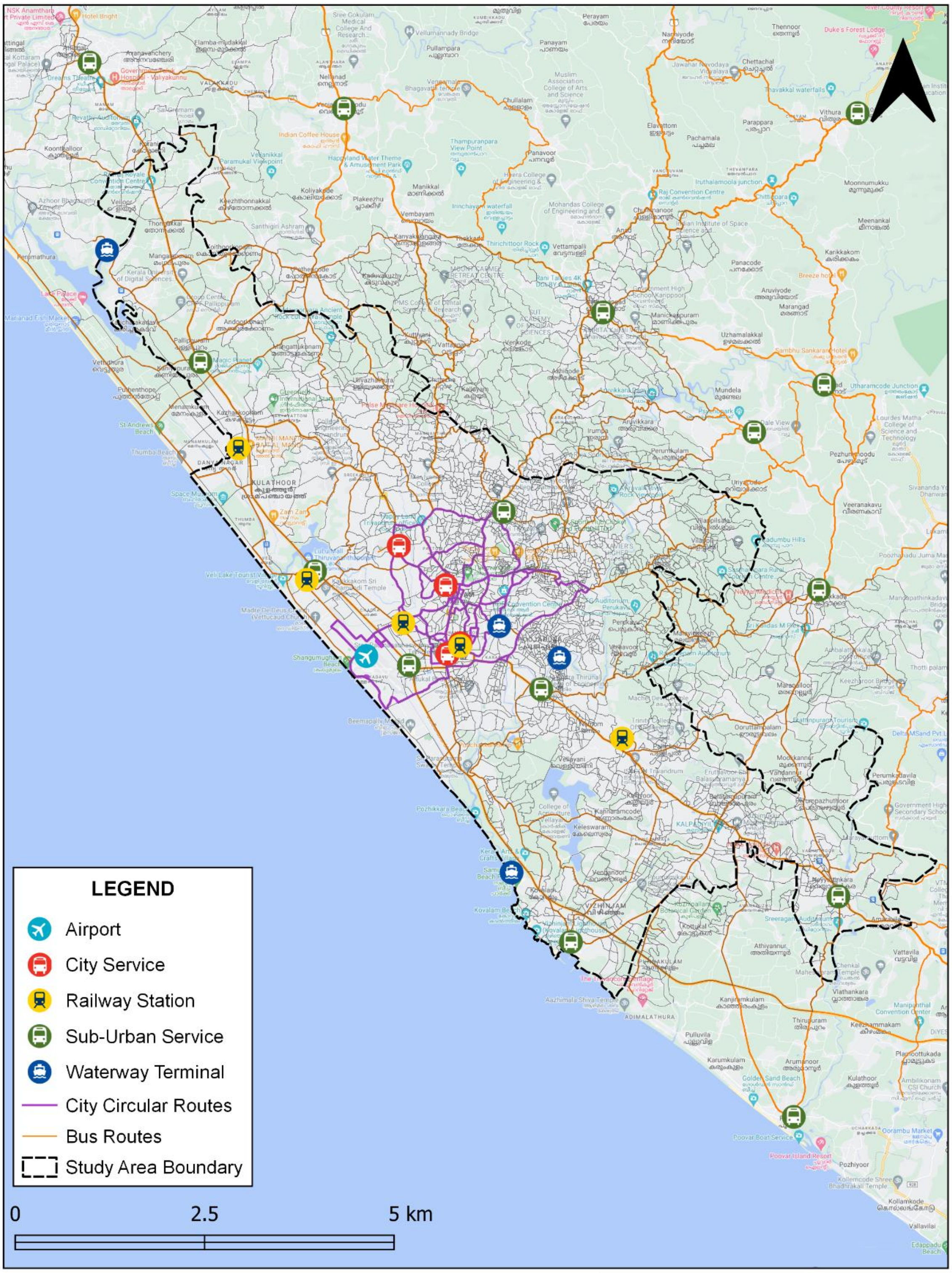
Figure 123 Proposed Development of Railway Terminal in Surat, Gujarat

Figure 124 Proposed Development of Bus Terminal in Warangal, Telangana

It is also recommended for the de-centralization of KSRTC sub-urban services for the city center from East Fort Terminal and limited services form Thampanoor Bus terminals. The KSRTC services operate in Hub and spoke model between major hubs and minor hubs for city and sub-urban services.

Table 56 KSRTC Terminals Usage

SN	TERMINAL	AREA (Acres)	TYPOLOGY
1	Thampanoor	2.72	City Services / limited sub-urban
2	East fort	1.9	City Services
3	Vikas bhavan	2.85	City Services
4	Medical College	1.1	City Services
6	Peroorkada	2.44	Sub-urban Services (north-east)
6	Pappanamcode	2.05	Sub-urban Services (South-east)
7	Enchakkal	5.8	Sub-urban Services (South)
8	Anayara	3.5	Sub-urban Services (north)
9	Vizhinjam	2.3	Sub-urban Services (South



Title: Comprehensive Mobility Plan for Thiruvananthapuram
Name: Public Transport Terminals

Figure 125 Public Transport Terminals

5.3.7 MULTI – MODAL MOBILITY INTERGHANGES AND HUBS

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 transfer terminal is technically called as Multi – Modal Mobility Hubs (MMMH). 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 the city to minimize congestion and also reduce the pollution hazards.

The main objective of these hubs is to provide Urban Transport Infrastructure with several amenities under one roof and encourage the following:

- To meet some of the objectives of the Indian National Urban Transport Policy (NUTP).
- To provide an integrated transport facility with adequate amenities and conveniences to cater to the requirements of all users group.
- To ensure smooth flow of traffic to and from the terminal so that there is no congestion / disturbance caused to the traffic along the main road.
- Minimum / no conflict between passengers, buses, private vehicles and other road users to achieve minimum passenger and vehicle processing time.
- To encourage use of public transport and provide first-last mile connectivity through provision of park and ride facilities in the proposed bus terminal.
- To facilitate commuters to park their personal vehicles & access to public modes of Mass Transport.

MMMH imbibe following civil infrastructure components like:

- Bus Depot / Terminal / stand
- Integrated passenger amenities
- Park & Ride Facilities

Transport related facilities:

- Bus station for bus connectivity to different places
- KSRTC bus reservation counters
- Railway reservation counters
- Air booking / reservation counter
- Counter for Taxi / Auto-rickshaw services
- Counter for Tourism

The Minimum Basic facilities provided at such locations are as follows:

- Clean drinking water facility
- Clean hygienic Toilet facility
- Comfortable rest places for the passengers
- Multi-level 2-wheeler and 4- wheeler parking facility
- Police out post for security and safety of passengers
- 24 Hour Chemist Shop
- Post office counter
- Services bill payment counter
- ATM counters
- Food Court
- Departmental / Retail Stores

The MMMH are the role models for the transport infrastructure, under which the passengers get maximum benefits related to public transport and are perennial source of revenue, helping in the financial sustainability and development of the public transport systems.

Multi-modal mobility Hubs are also recommended for easing out the transfers across various transit modes. The details are as presented below,

Table 5-20 Multi-modal mobility Hubs

<table>
<tr><th>SN</th><th>HUB / INTERCHANGE</th><th>TYPOLOGY</th><th>MODES</th><th>CATEGORY</th><th>REMARKS</th><th>PHASE</th></tr>
<tr><td colspan="7">MULTI-MODAL MOBILITY HUBS</td></tr>
<tr><td>1</td><td>Thampanoor Railway and Bus Terminus</td><td>City and Sub-urban and regional interchanges</td><td>MRT, Bus, Rail</td><td>Major</td><td rowspan="5">Integrated Hub infrastructure with passenger and transportation facilities</td><td>Phase I</td></tr>
<tr><td>2</td><td>Kochuveli</td><td>City and Sub-urban and regional interchanges</td><td>MRT, Bus, Rail, Ferry</td><td>Major</td><td>Phase I</td></tr>
<tr><td>3</td><td>Thiruvananthapuram Airport</td><td>City and Sub-urban and regional interchanges</td><td>MRT, Bus, Rail, Ferry</td><td>Major</td><td>Phase I</td></tr>
<tr><td>4</td><td>Nemom</td><td>City and Sub-urban and regional interchanges</td><td>MRT, Bus, Rail</td><td>Major</td><td>Phase II</td></tr>
<tr><td>5</td><td>Techno Park</td><td>City interchanges</td><td>MRT and Bus</td><td>Major</td><td>Phase I</td></tr>
<tr><td colspan="7">MULTI-MODAL INTERGHANGE FACLILITES</td></tr>
<tr><td>1</td><td>Ulloor</td><td>City interchanges</td><td>MRT and Bus</td><td>Minor</td><td rowspan="4">Transfer facilities such as bus bays, pick up and drop of bays, park and ride</td><td>Phase II</td></tr>
<tr><td>2</td><td>Thiruvallam</td><td>City interchanges</td><td>Bus and Ferry</td><td>Minor</td><td>Phase II</td></tr>
<tr><td>3</td><td>Killipalam</td><td>City interchanges</td><td>MRT, Bus, Ferry</td><td>Minor</td><td>Phase II</td></tr>
<tr><td>4</td><td>University</td><td>City interchanges</td><td>MRT and Bus</td><td>Minor</td><td>Phase III</td></tr>
</table>

SN	HUB / INTERCHANGE	TYPOLOGY	MODES	CATEGORY	REMARKS	PHASE
5	Anayara	City and Sub-urban and regional interchanges	Bus and Ferry	Minor	facilities, skywalks, footpaths, etc.	Phase III
6	Kazhakkoottam	City interchanges	MRT and Bus	Minor		Phase II
7	Vizhinjam	City interchanges	MRT and Bus	Minor		Phase III
8	Neyyattinkara	City and Sub-urban and regional interchanges	MRT and Bus	Minor		Phase III

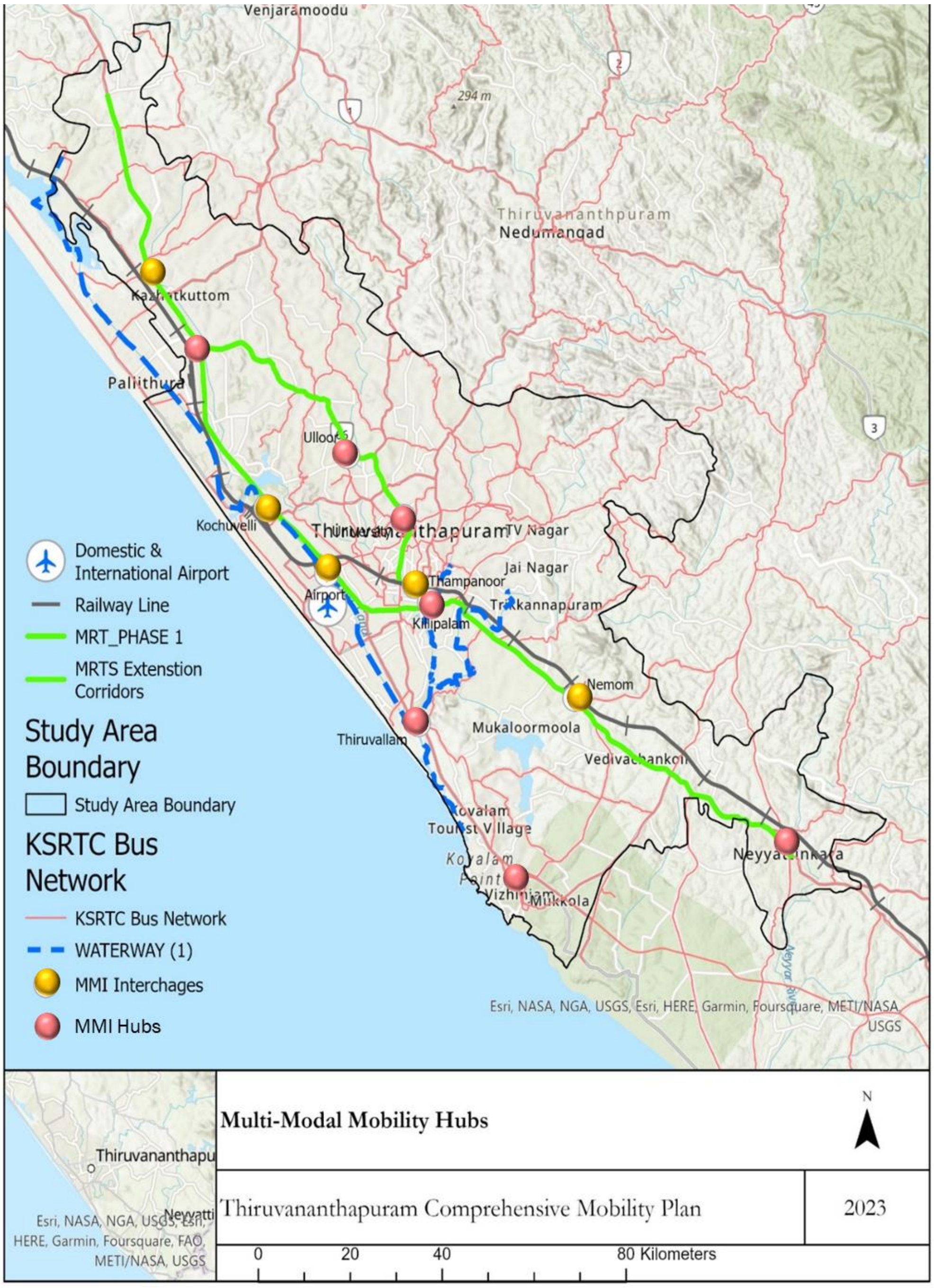


Figure 126 Multi-Modal Mobility Interchanges

5.4 INTERMEDIATE PUBLIC TRANSPORT STRATEGY

IPT modes of transport, such as auto-rickshaws and shared auto-rickshaws serve the mobility the needs users which lack reliable Public Transit (PT) services, they act as feeders to the existing public transport system expanding their coverage. Thus, an integrated system will aid ease of access for users. They play a key role in improving sustainability for urban transport promoting shared 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 study recommends provision of infrastructure facilities for the operation of IPT. The allocation of IPT will be governed by Corporation or ULB or Smart City in ordination with RTA and Traffic Police Departments. The infrastructure facilities shall include,

5.4.1 HALT AND GO STOPS

The stops are recommended at all the major activity nodes with considerable distance from the bus-stands to avoid chaos. These stops are recommended to be locate at a minimum distance of 250m from the junctions. The capacity of these stop will be demand based assessed by the traffic police with a minimum holding capacity of 3.

Figure 127 Proposed Halt and Go Stops

Table 5-21 Proposed Halt and Go Stops with Electric Vehicle charging facilities

S. No.	Location Name	Capacity	Phase
1	Balaramapuram	8 TSR	Phase I
2	Chackai	5 TSR	Phase I
3	Edapazhanji jn.	5 TSR	Phase I
4	Enchakkal	8 TSR	Phase I
5	Karamana	5 TSR	Phase I
6	Kazhakoottam	8 TSR	Phase I
7	Kesavadasapuram	8 TSR	Phase I
8	Kowdiyar	5 TSR	Phase I
9	Manacaud	5 TSR	Phase I
10	Medical College	8 TSR	Phase I
11	Palayam	8 TSR	Phase I
12	Pappanamcode	5 TSR	Phase I
13	Pattom	8 TSR	Phase I
14	Peroorkada	5 TSR	Phase I
15	Poojappura	5 TSR	Phase I
16	Sasthamangalam	5 TSR	Phase I
17	Sreekaryam	5 TSR	Phase I
18	Thampanoor	8 TSR	Phase I
19	Vellayambalam jn.	5 TSR	Phase I
20	Vizhinjam	5 TSR	Phase I
21	Airport jn	3 TSR	Phase II
22	All Saints jn.	5 TSR	Phase II
23	Ambalamukku	3 TSR	Phase II
24	Ambalathara	3 TSR	Phase II
25	Anayara	3 TSR	Phase II
26	Attakulangara	5 TSR	Phase II
27	Ayurveda College	8 TSR	Phase II
28	Bakery Jn.	5 TSR	Phase II
29	Choorakattupalayam	5 TSR	Phase II
30	Devaswom Board jn.	3 TSR	Phase II
31	DPI jn.	5 TSR	Phase II
32	East Fort	8 TSR	Phase II
33	General hospital Jn (GH jn)	8 TSR	Phase II
34	Housing board Jn.	3 TSR	Phase II
35	Jacob's Jn.	3 TSR	Phase II
36	Jagathy	3 TSR	Phase II
37	Kaithamukku	3 TSR	Phase II
38	Kannamoola	3 TSR	Phase II
39	Killippalam	8 TSR	Phase II
40	Kochuveli	5 TSR	Phase II
41	Kumarapuram	5 TSR	Phase II
42	Kuravankonam	5 TSR	Phase II
43	Kuzhivila	3 TSR	Phase II

S. No.	Location Name	Capacity	Phase
44	Law college jn	3 TSR	Phase II
45	Maruthankuzhy	3 TSR	Phase II
46	Melepazhavangadi	3 TSR	Phase II
47	Mettukada	3 TSR	Phase II
48	Model School Jn.	3 TSR	Phase II
49	Nettayam	3 TSR	Phase II
50	Old Collectorate jn.	5 TSR	Phase II
51	Paruthippara	3 TSR	Phase II
52	Pettah	5 TSR	Phase II
53	Plamoodu	5 TSR	Phase II
54	PMG	5 TSR	Phase II
55	Pongumoodu	3 TSR	Phase II
56	Punnapuram jn	3 TSR	Phase II
57	SP fort jn	5 TSR	Phase II
58	Statue	5 TSR	Phase II
59	Thampuranmukku	3 TSR	Phase II
60	Thirumala	3 TSR	Phase II
61	Thiruvallam	5 TSR	Phase II
62	Valiyathura	3 TSR	Phase II
63	Vattiyoorkavu	3 TSR	Phase II
64	Vazhapally jn	3 TSR	Phase II
65	Vazhuthacaud	3 TSR	Phase II
66	Vettu road	5 TSR	Phase II
67	West Fort	5 TSR	Phase II
68	Women's College jn.	3 TSR	Phase II

* TSR - Three-Seater Auto Rickshaw

Charging Stations for E-Rickshaws: Encouraging the operation of Electric rickshaws over the diesel rickshaw is necessary. The average trip length being under 8 for auto rickshaws it is advised to promote the usage of electric vehicles.

These batteries operated vehicle are ideal for short distances and last mile connectivity. Considering the speed of these vehicles it is easier to capture the users' preferences to utilize it for shorter distances over the longer distance trips.

E-stations are advised to be provided at major mobility network intersections. The following locations are recommended, though a detail assessment could be carryout while implementation.

The charging points will be similar to the KESB electric pole points for two-wheelers and e-autorickshaw.

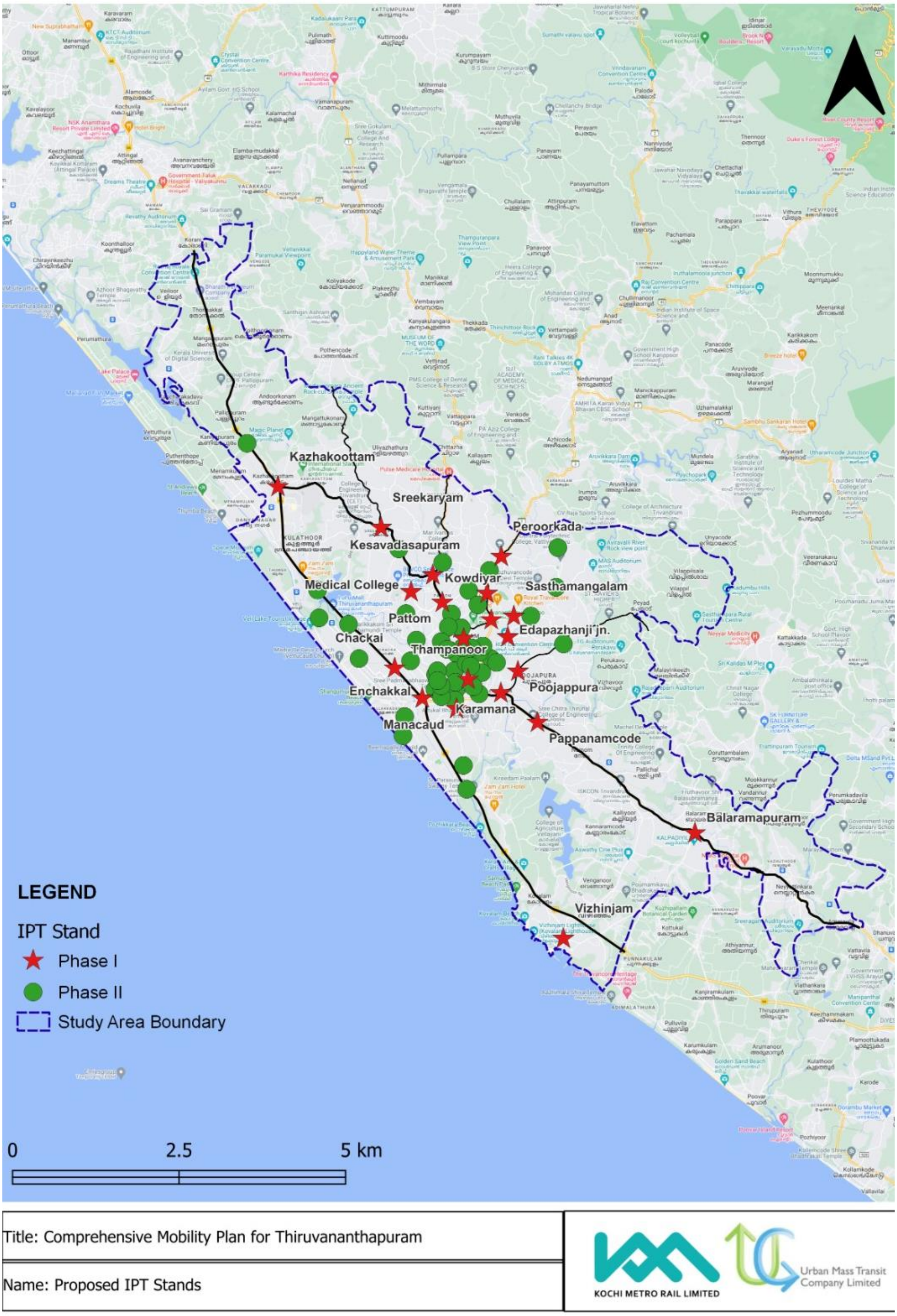


Figure 128 Proposed Halt and Go Stops with Electric Vehicle charging facilities

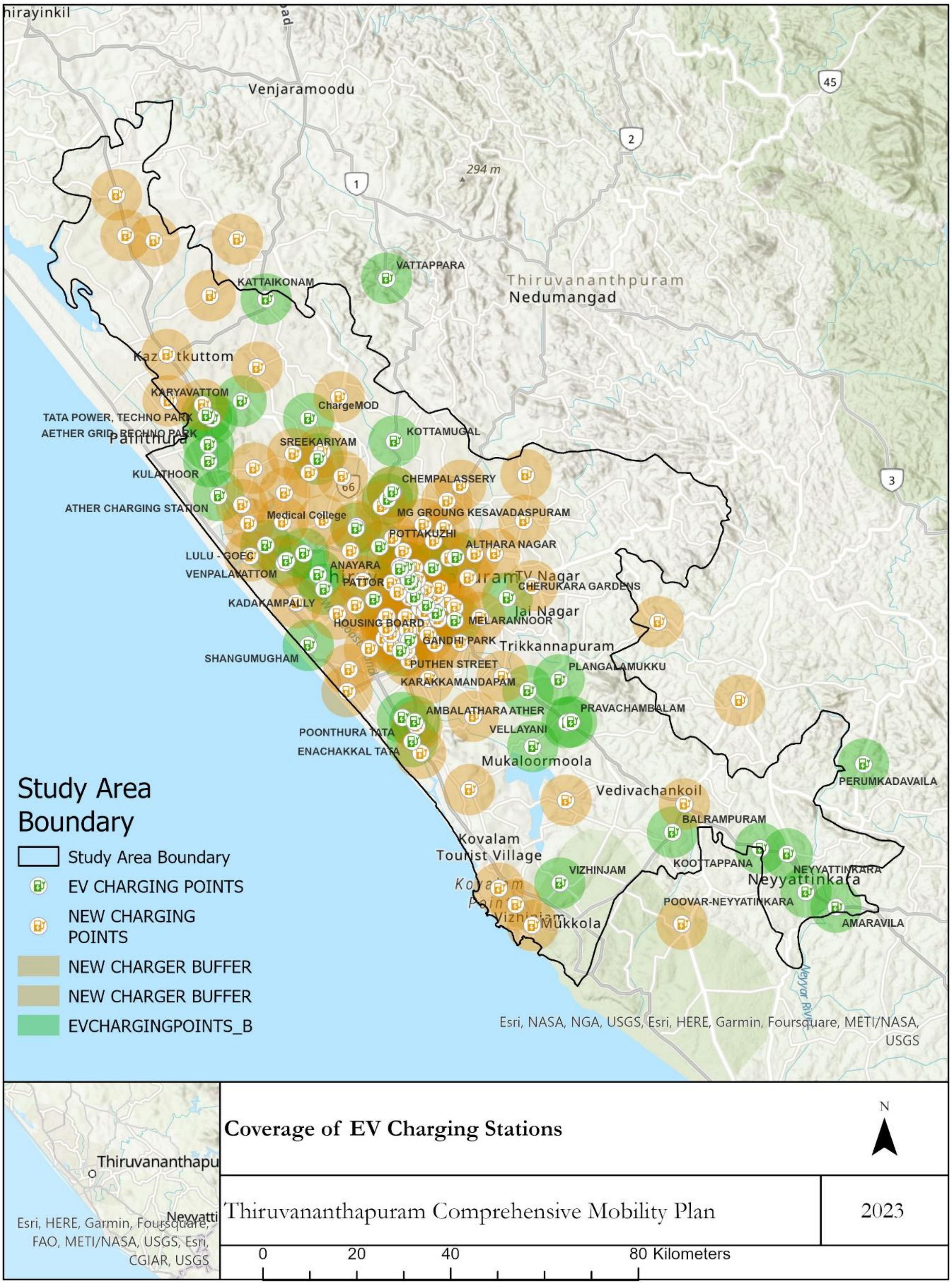


Figure 129 Coverage of Proposed and existing Electric Vehicle charging facilities

5.5 NON-MOTORISED TRANSPORTATION STRATEGY

Non-Motorized Transport (NMT) strategy is a key element in successfully encouraging clean urban transport. It can be a very attractive mode of transport for relatively short distances, it makes up the largest share of trips.

The key to reversing the trend towards more private vehicle use is making walking and cycling attractive, together with improving public transport. This can be done by a range of activities including construction of sidewalks and bicycle lanes, bicycle sharing programs, urban planning and pedestrian-oriented development. NMT is a highly cost-effective transportation strategy and brings about large health, economic and social co-benefits, particularly for the urban poor.

The strategies framed for improving non-motorized transport infrastructure include:

- Provision a complete footpath network in the city.
- Introduce cycle tracks for safe movement of cyclists in the city.
- Redesign the intersections to ensure better accessibility for pedestrians and bicycles.
- Last and First Mile connectivity
- Encourage NMT through community outreach programs.

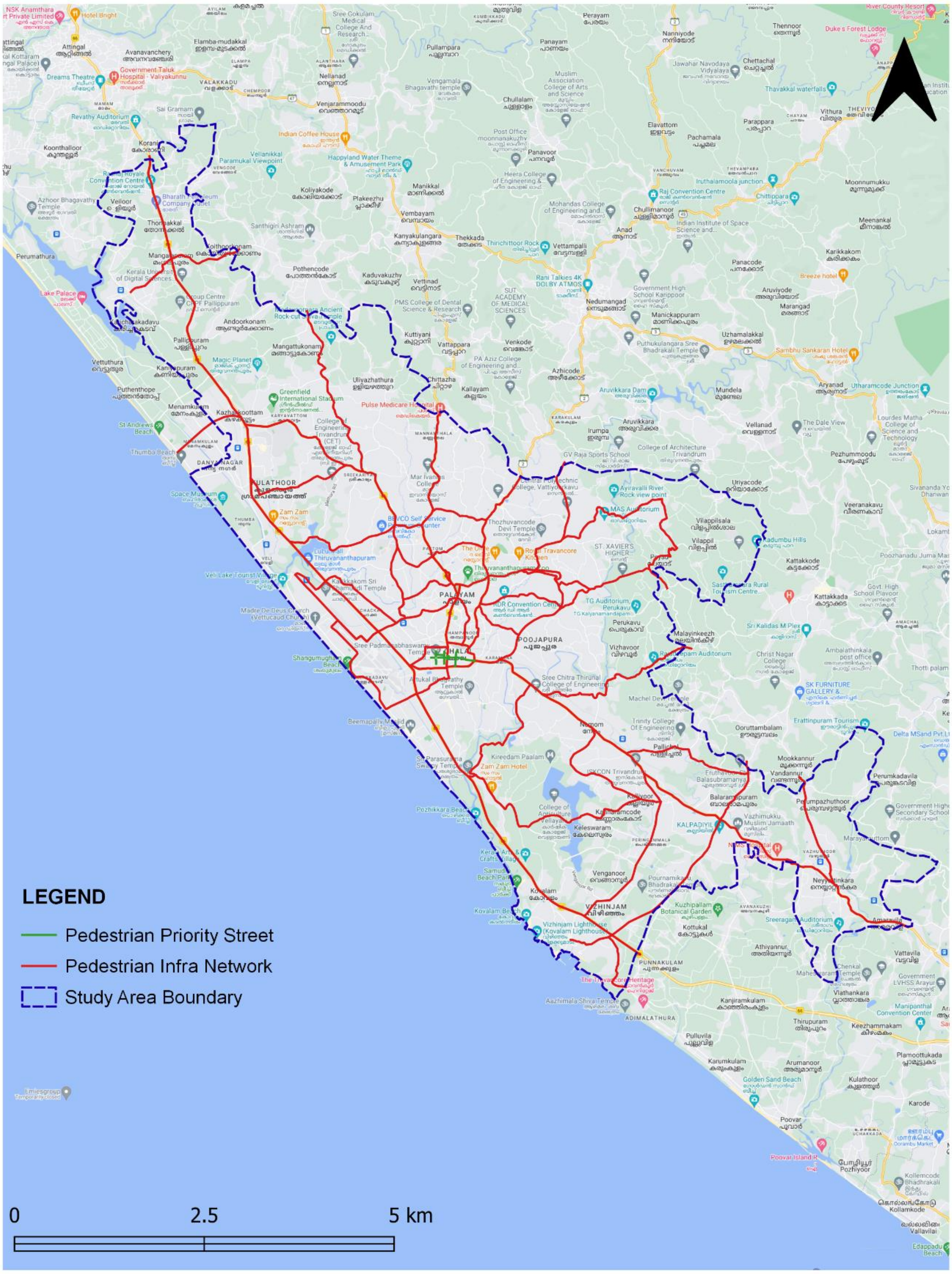
5.5.1 PEDESTRIAN NETWORK

This strategy identifies a pedestrian network within the road network, this network is recommended to house pedestrian infrastructure facilities such as continuous footpath, safe pedestrian crossings at mid-blocks, junctions, priority to pedestrian movements in junction and corridor designs.

The study identifies 262 Km of network to be developed with dedicated pedestrian infrastructure (footpath). The proposed network covers about 100% of the major road network in the study area.

It is also recommended to develop about 3.5 Km out of 262 Km of pedestrian priority streets where pedestrian and NMT movement are only allowed during the whole day except at night to allow fright movement. The streets identified are the major corridors in the core city with high commercial and religious activity and having a higher pedestrian footfall. The proposed pedestrian priority streets are recommended to be take-up as a part of the improvement of Thiruvananthapuram core city by the development agency.

The details of the network recommended for improvement is as presented below.



Title: Comprehensive Mobility Plan for Thiruvananthapuram	
Name: Pedestrian Facilities	

Figure 130 *Proposed Pedestrian Network*

Table 5-22 *Corridors with Proposed Footpath*

S. No.	Name	Length (Km)	Min. Footpath Width (M)
1	Vizhinjam-Poovaar Road	8.23	3
2	Vettamukku Road	5.16	2
3	Veli-Venpalavattom Road	1.61	2
4	Veli-Perumathura Road	2.45	3
5	Vazhuthacaud-Poojappura Road	2.10	2
6	Vattiyoorkkav-Puliyarakkonam Road	5.35	2
7	Valiyathura-Muttathara Road	4.92	3
8	Ulloor-Akkulam Road	4.84	3
9	Trivandrum-Vizhinjam Road	0.40	3
10	Trivandrum-Nagarcoil Highway	20.83	2
11	Trivandrum-Bakery-Palayam Road	2.12	2.5
12	Thiruvananthapuram-Neyyar Road	3.52	2
13	Thirumala-Peyad-Malayinkeezhu Road	6.24	2
14	Thampanoor Road	2.66	2.5
15	Sreekaryam-Pothencode Road	7.63	2
16	Sreekaryam-Kullathoor Road	4.57	3
17	Sasthamangalam Road	1.05	3
18	Sachivothama Road	1.52	3
19	Pravachambalam-Ooruttambalam Road	5.32	2
20	Pottakuzhy Road	1.10	3
21	Pothencode-Murukkumpuzha Road	5.21	2
22	Poojappura Road	3.88	2
23	Peyad-Vellanad Road	2.02	2
24	Peyad-Puliyarakonam Road	2.35	2
25	Pettah-Venpalavattom Road	3.58	3
26	Pazhaya Road	0.93	3
27	Pattom-Kowdiar Road	2.29	3
28	Pappanamcode-Malayinkeezhu Road	7.51	2
29	Pallimukku-Kannammoola Road	0.96	3
30	Pallichal-Vizhinjam Road	5.76	2
31	Palayam-Airport Road	9.36	3
32	Palayam PMG Road	0.40	2.5
33	Pachalloor-Poonkulam Road	11.23	2
34	NH66 Bypass	12.00	3
35	NH66	39.83	2
36	Neyyattinkara-Kattakkada Road	4.60	2
37	Nemom-Punnamoodu Road	5.13	2
38	Muttada Road	2.29	3
39	MG Road	2.37	2.5
40	Medical College-Ulloor Road	0.81	3
41	Medical College-Kumarapuram Road	0.95	3
42	MC Road	5.07	3
43	Maruthunkuzhi-Kachani Road	2.33	2
44	Maruthankuzhi-Kachani Road	3.23	2
45	LMS Vellayambalam Road	1.23	2.5
46	LMS Attakulangara Road	1.01	2.5
47	Kumarapuram-Kannanmoola Road	2.25	3
48	Kowdiar Ave	4.64	3
49	Kovalam Road	2.60	3

S. No.	Name	Length (Km)	Min. Footpath Width (M)
50	Kazhakoottam Road	2.98	3
51	Kannammoola-Thekkummoodu Road	2.24	3
52	Kaimanam-Thiruvallam Road	5.65	2
53	C V Raman Pillai Road	3.14	2.5
54	Balaramapuram-Ooruttambalam Road	2.72	2.5
55	Attakulangara-Enchakkal Road	1.51	3
56	Attakkulangara-Killippalam Bypass Road	1.17	3
57	Airport Road	1.95	2.5

Table 5-23 *Proposed Pedestrian Priority Streets*

S. No.	Name	Length (Km)
1	West Nada	0.11
2	Vadakkenada	0.16
3	Sabapathi Coil St.	0.30
4	Pazhavangadi St.	0.47
5	Padmatheertham N St.	0.33
6	Padmanabhaswamy Temple Road	0.37
7	Kothuval St.	0.35
8	Chotthupurai Street	0.16
9	Chalai Market Road	1.26

5.5.2 CROSS SECTIONS AND GUIDELINES FOR PEDESTRIAN NETWORK

The footpath design should be uniform across the city. Depending on the volume of pedestrians, the area requires footpaths with minimum clear walking 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 minimum width of 2m should be maintained on the major corridors with additional space for multi-utility zones.

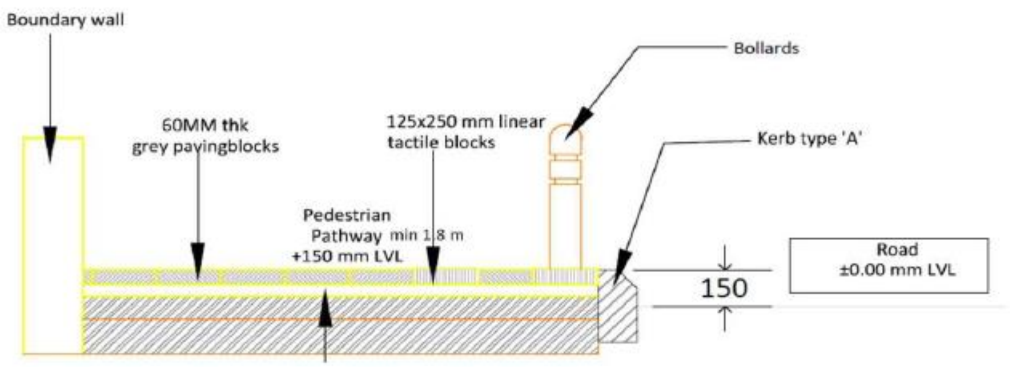


Figure 131 *Detailed Cross-Section of Footpath*

The typical cross-sections for of corridors of various right-of-way widths are as presented below.

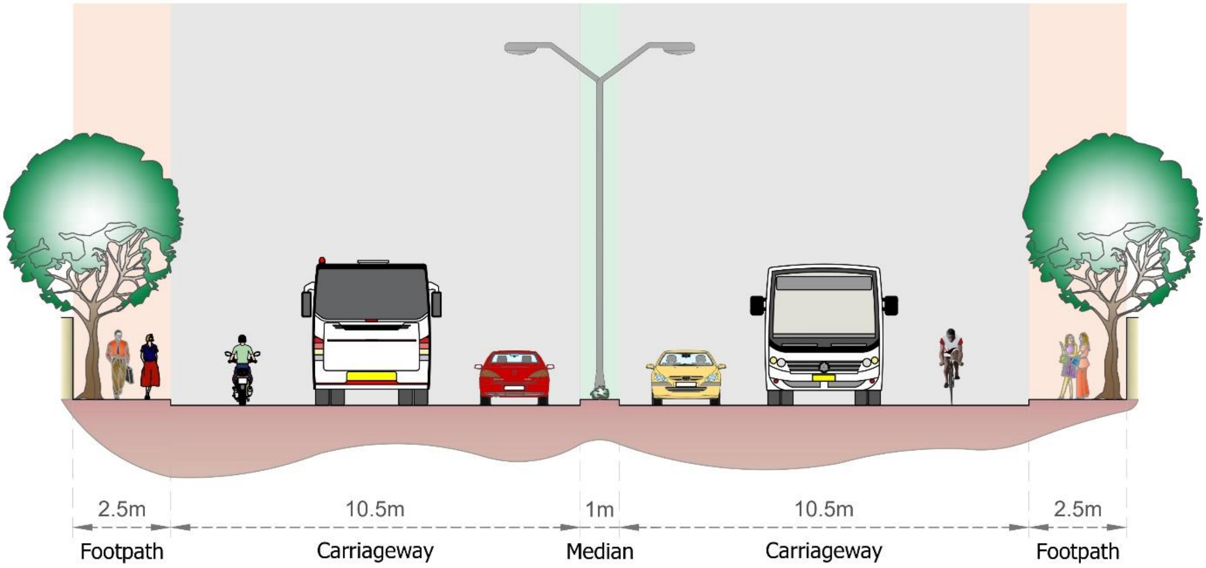


Figure 132 *Typical Cross Section of 27m Wide Road with Footpath*

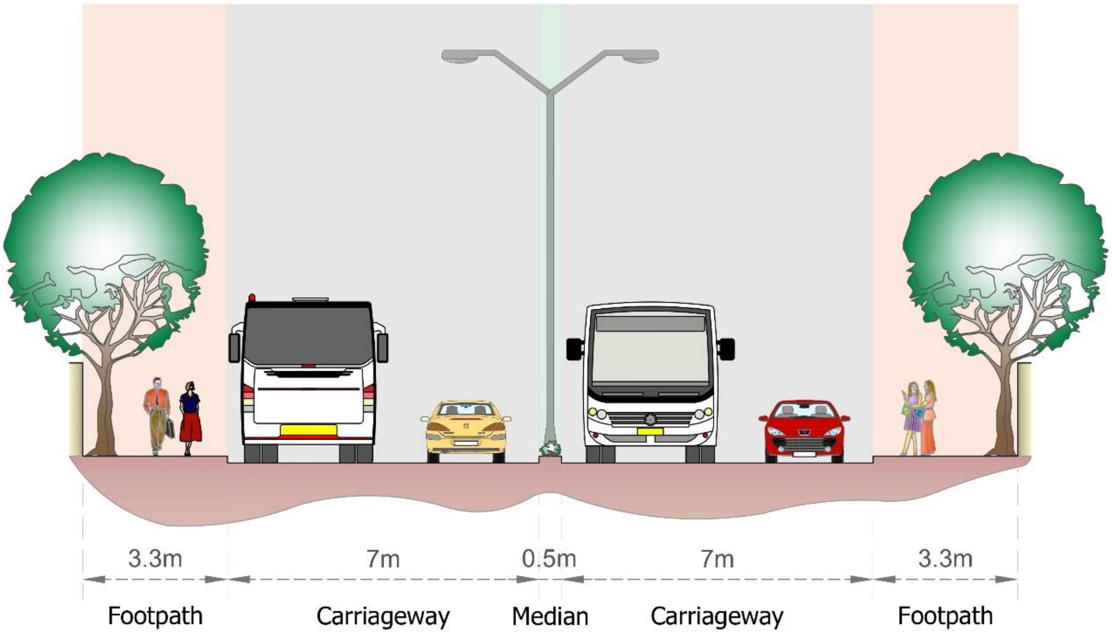


Figure 133 *Typical Cross Section of 21m Wide Road with Footpath*

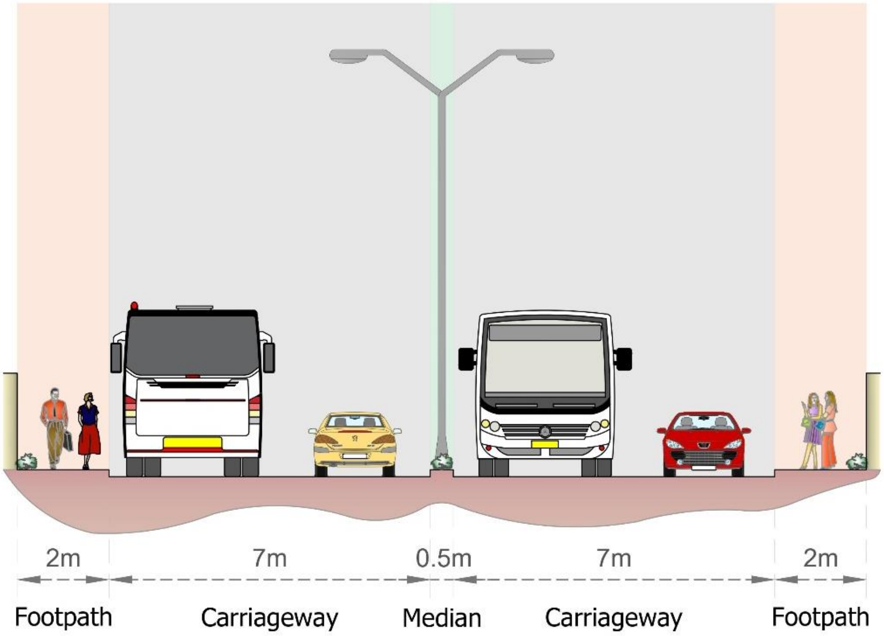


Figure 134 *Typical Cross Section of 18.5m Wide Road with Footpath*

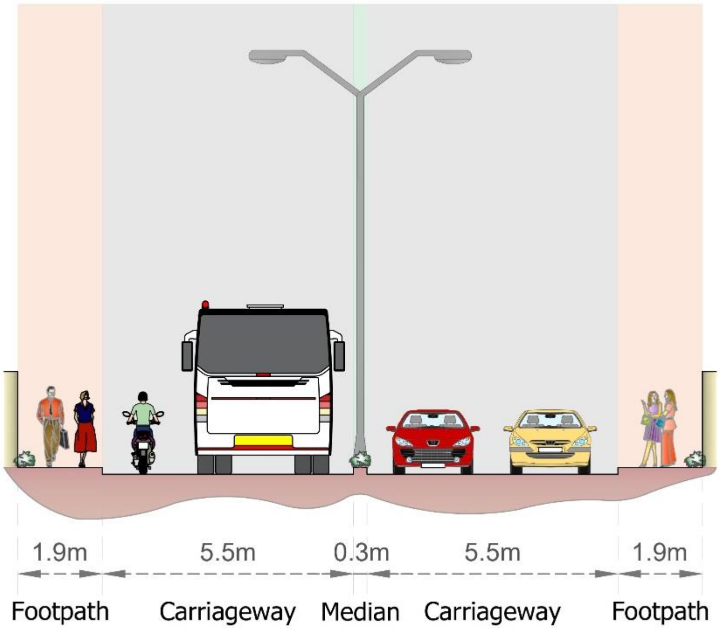


Figure 135 *Typical Cross Section of 15m Wide Road with Footpath*

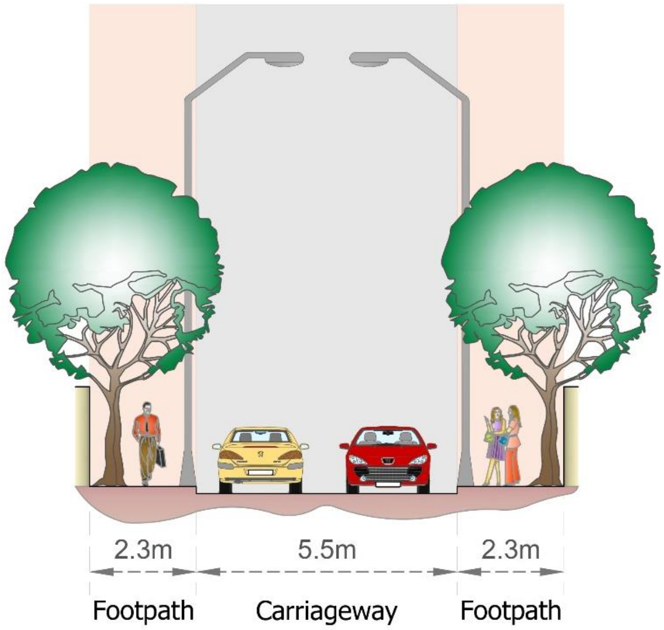


Figure 136 *Typical Cross Section of 10m Wide Road with Footpath*

5.5.3 BICYCLE NETWORK

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 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. The existing share of bicycle trips in Thiruvananthapuram is observed to be decreasing in the horizon years, hence it becomes important it safeguard the interests of these bicycle users and promote the usage of bicycle.

The bicycle network for Thiruvananthapuram has been identified targeting two major supply end parameters, which are,

1. Provision of Bicycles lanes connecting the core area of the city.
2. Provision of Bicycle lanes connecting major tourist attractions, heritage gates and universities.

The strategy primarily focuses on developing a network targeting the reactional/ health enthusiasts and tourists. Thus, linking the major corridors with the tourist and recreational places would form a bicycle tourist circuit there by increasing the utility of the infrastructure and promoting bicycle culture amongst the dependent users.

The study proposes 90 Km of dedicated bicycle network. The proposed network covers only 40% of the major road network in the city due to the hilly terrain of the city. It is recommended to maintain a minimum of 2m wide dedicated bicycle track for bi-directional sections and a minimum of 3m for uni-directional tracks.

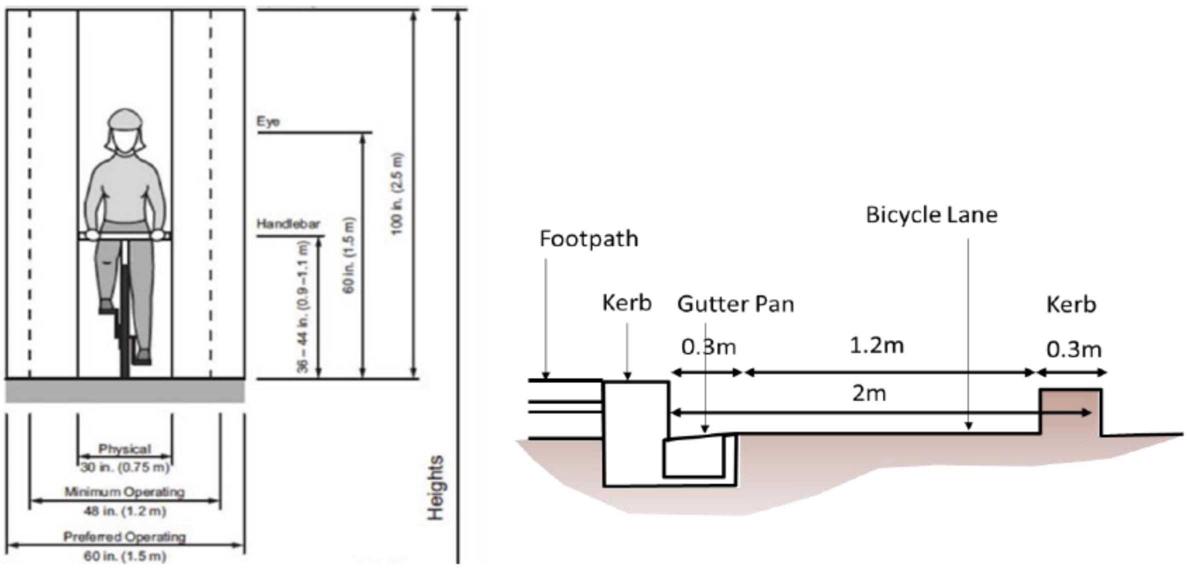
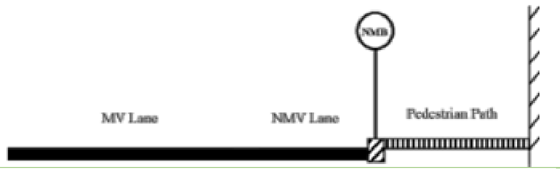
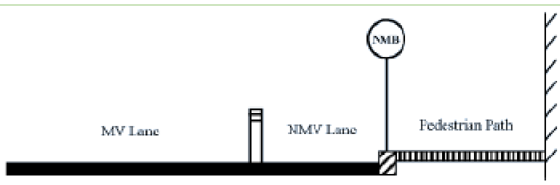


Figure 137 *Proposed Bicycle Operating Widths*

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 for Thiruvananthapuram. Non-Motorized Vehicles (NMV) lanes can generally be classified into four main categories and are listed below. In case of Thiruvananthapuram, Non-Motorized Vehicles (NMV) lane typology 2, 3 and 4 are suggested.

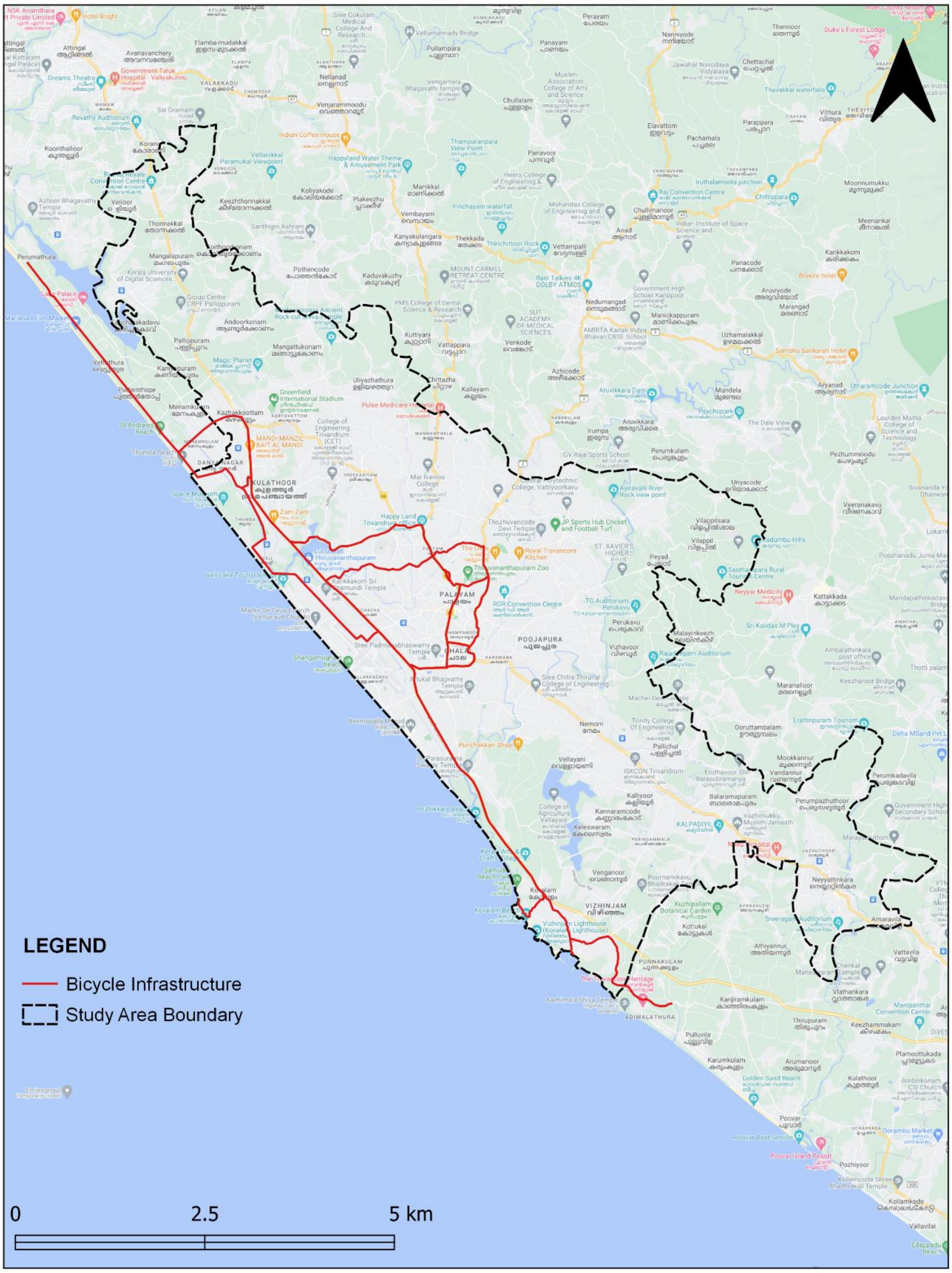
Table 5-24 *Types of NMV Lanes*

S. No.	Type of NMV Lane	Cross Section
1	NMV lanes shared with MVs and designated by signs	
2	NMV lanes designated by lane markings (e.g., striping) and within the highway right-of-way	
3	NMV-exclusive lanes physically separated from MVs by barriers (e.g., concrete blocks, steel railing, raised curb) and within the highway right-of-way	

S. No.	Type of NMV Lane	Cross Section
4	NMV-exclusive lanes within an independent right-of-way (often referred to as NMV paths)	

Table 5-25 *Proposed Corridors for Bicycle Infrastructure*

S. No.	Name	Length	Typology
1	Attakkulangara-Killippalam Bypass Road	1.24	3
2	Attakulangara-Enchakkal Road	1.51	3
3	Beach Road	2.09	2
4	C V Raman Pillai Road	3.50	3
5	Chilakkoor-Vallakkadavu Road	9.57	2
6	Kazhakoottam Road	2.98	3
7	Kovalam Road	9.25	2
8	Kowdiar Ave	1.22	3
9	LMS Vellayambalam Road	1.23	3
10	NH66 Bypass	23.26	3
11	Poonthi Road	7.15	3
12	Thampanoor Road	1.88	3
13	Veli-Airport-Palayam Road	9.74	3
14	Veli-Perumathura Road	3.48	2
15	VSSC Road	0.74	2
16	Ulloor – Akkulam Road	4.84	3
17	NH66 (Ulloor to Overbridge Jn)	7.12	3
18	West Nada	0.11	4
19	Vadakkenada	0.16	4
20	Sabapathi Coil St.	0.30	4
21	Pazhavangadi St.	0.47	4
22	Padmatheertham N St.	0.33	4
23	Padmanabhaswamy Temple Road	0.37	4
24	Kothuval St.	0.35	4
25	Chotthupurai Street	0.16	4
26	Chalai Market Road	1.26	4



Title: Comprehensive Mobility Plan for Thiruvananthapuram

Name: Proposed Bicycle Network

Figure 138 *Proposed Bicycle Network for Improvement*

Typical cross sections of various right of way for the proposed bicycle network are as shown in below.

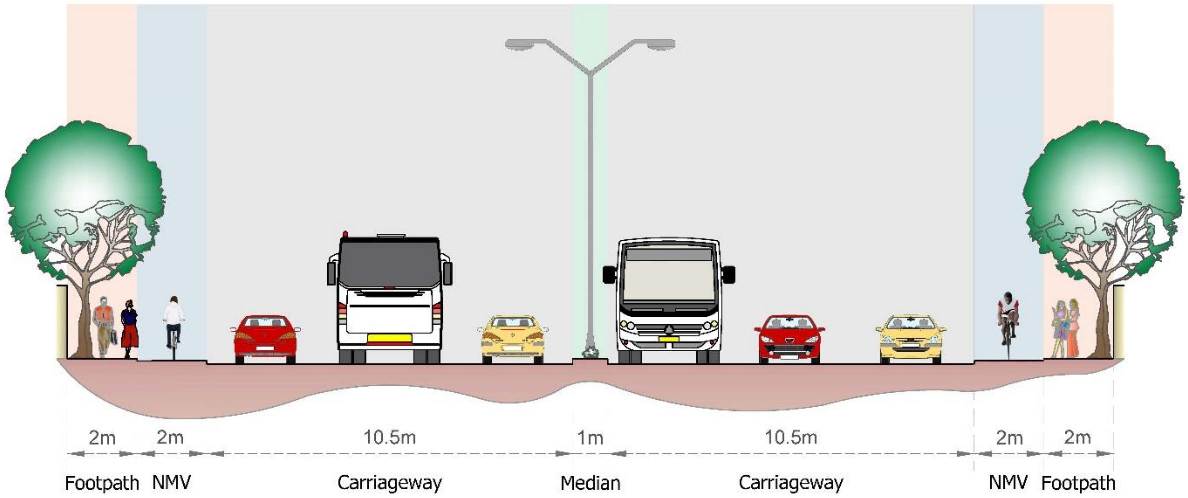


Figure 139 *Typical Cross Section of 30m Wide Road with Bicycle Tracks*

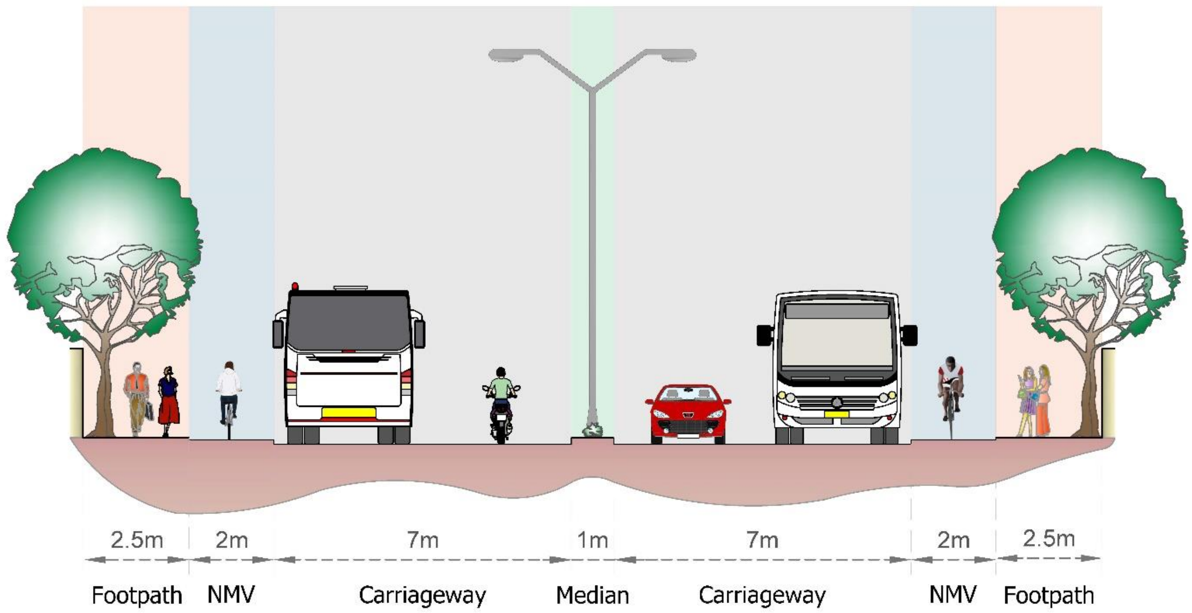


Figure 140 *Typical Cross Section of 24m Wide Road with Bicycle Tracks*

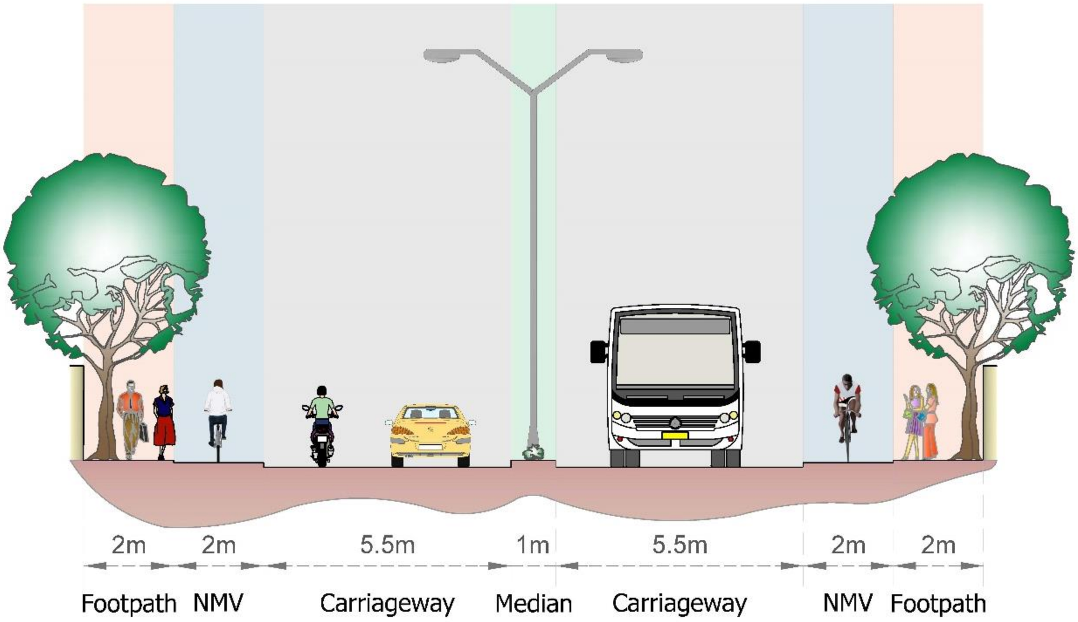


Figure 141 *Typical Cross Section of 20m Wide Road with Bicycle Tracks*

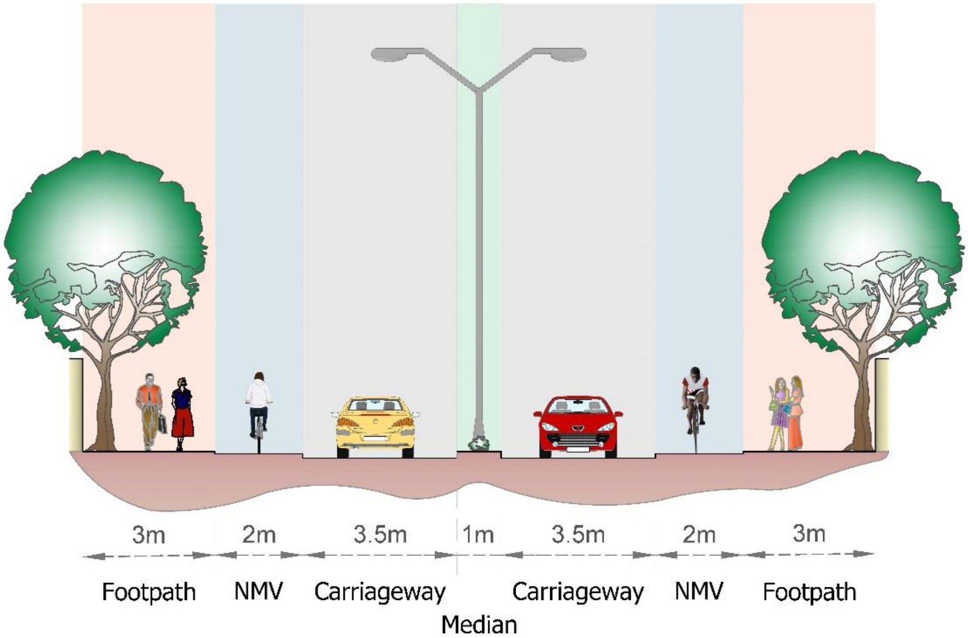


Figure 142 *Typical Cross Section of 18m Wide Road with Bicycle Tracks*

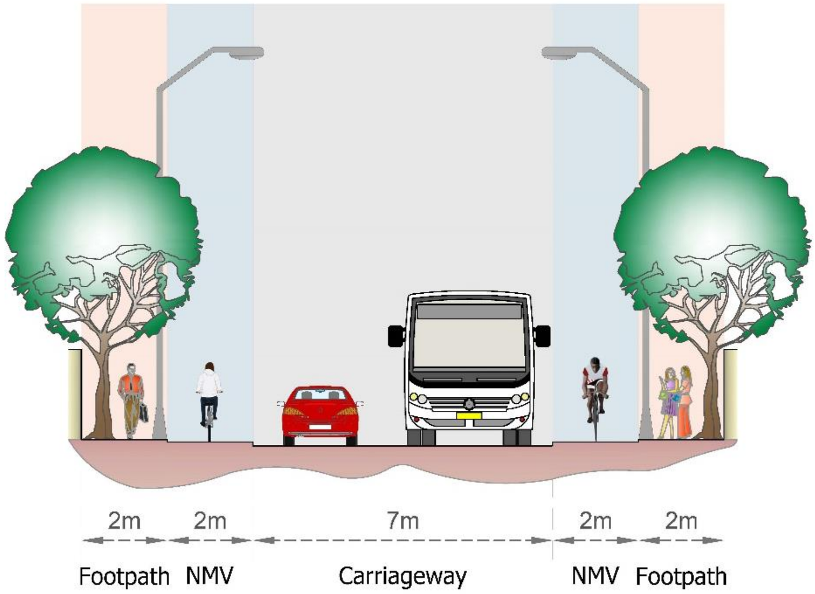


Figure 143 *Typical Cross Section of 15m Wide Road with Bicycle Tracks*

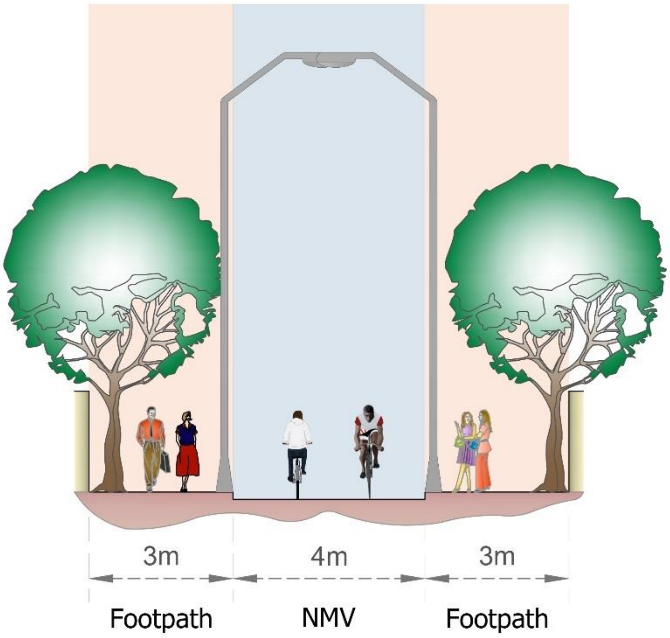


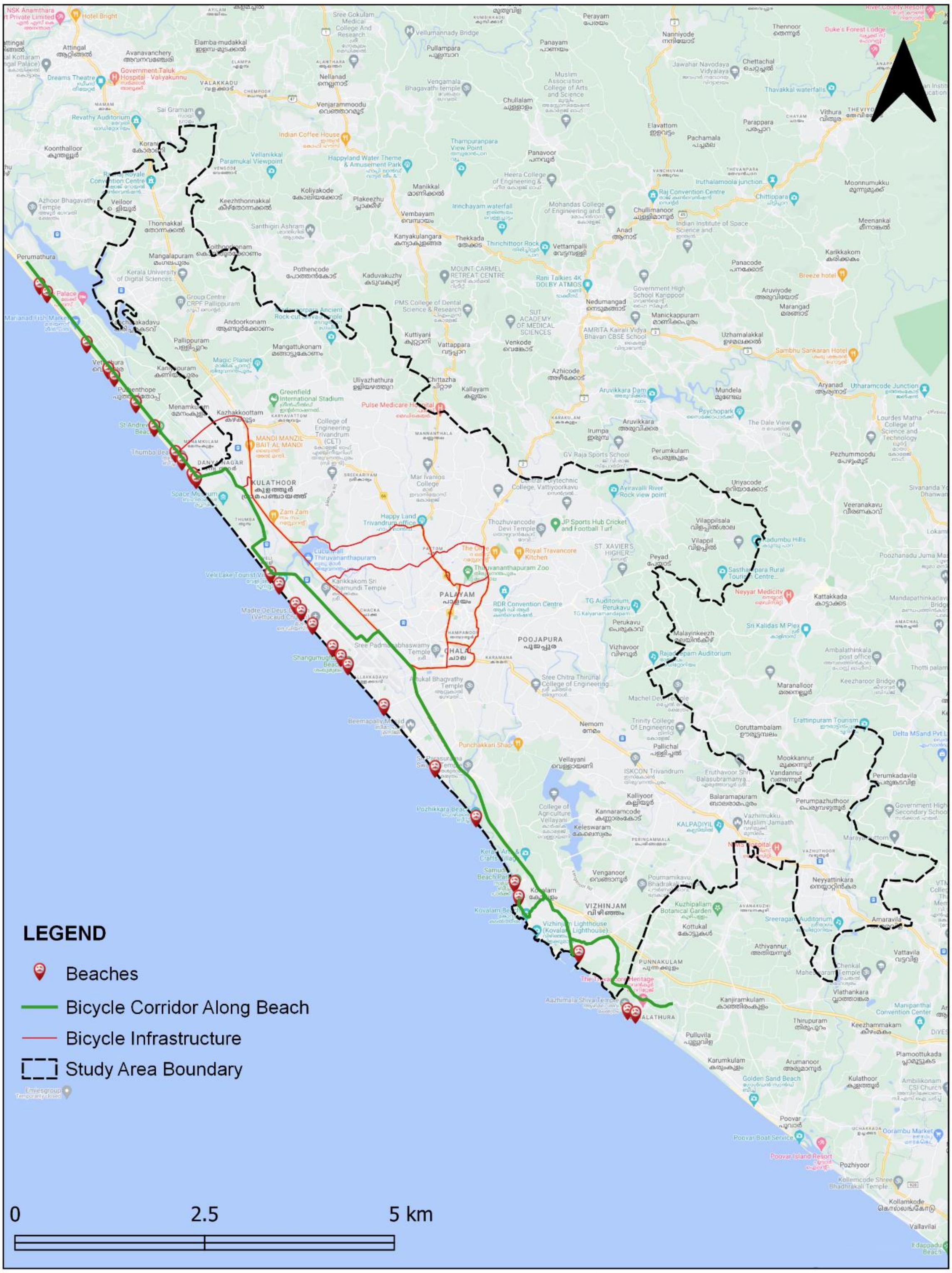
Figure 144 *Typical Cross Section of 10m Wide NMT Priority Corridor*

5.5.4 DEVELOPMENT OF BICYCLE CORRIDOR ALONG BEACH

Western side of Thiruvananthapuram city is covered by Arabian sea hence creating numerous numbers of beaches. A proper bicycle corridor connecting those beaches will enhance the tourism activity as well as health-oriented activity. The proposed corridor of 47 Km connecting various identified beaches in Thiruvananthapuram is provided i below. This will also encourage local people to use bicycle more often than other motorised vehicles. As of now some localities are using bicycle along the same corridor, due to lack of proper bicycle infrastructure facilities, which includes dedicated cycle tract and cycle holding facilities, people are unable to utilize the corridor to the maximum.

Table 5-26 *Identified Beaches for Proposed Bicycle Corridor*

S. No.	Name
1	Gloria Beach
2	Puthukurichy Beach
3	Deshamulam Beach
4	Vettuthura Beach
5	Puthenthope North Beach
6	Puthenthope Beach
7	St. Andrews Beach
8	Thumba Arattuvazhi Beach
9	Thumba Beach
10	Kochuthura Beach
11	Pallithura Beach
12	Veli Beach
13	Kochuveli Beach
14	Mosconagar Beach
15	Sealand Beach
16	Vettukadu Beach
17	Kannanthura Beach
18	Thaikkuttam Beach
19	Shangumugham Beach
20	Valiathura Beach
21	Poonthura Beach
22	Pozhikkara Beach
23	Samudra Beach
24	Kovalam Beach
25	Hawah Beach
26	Vizhinjam Beach
27	Chowara Beach
28	Somatheeram Beach

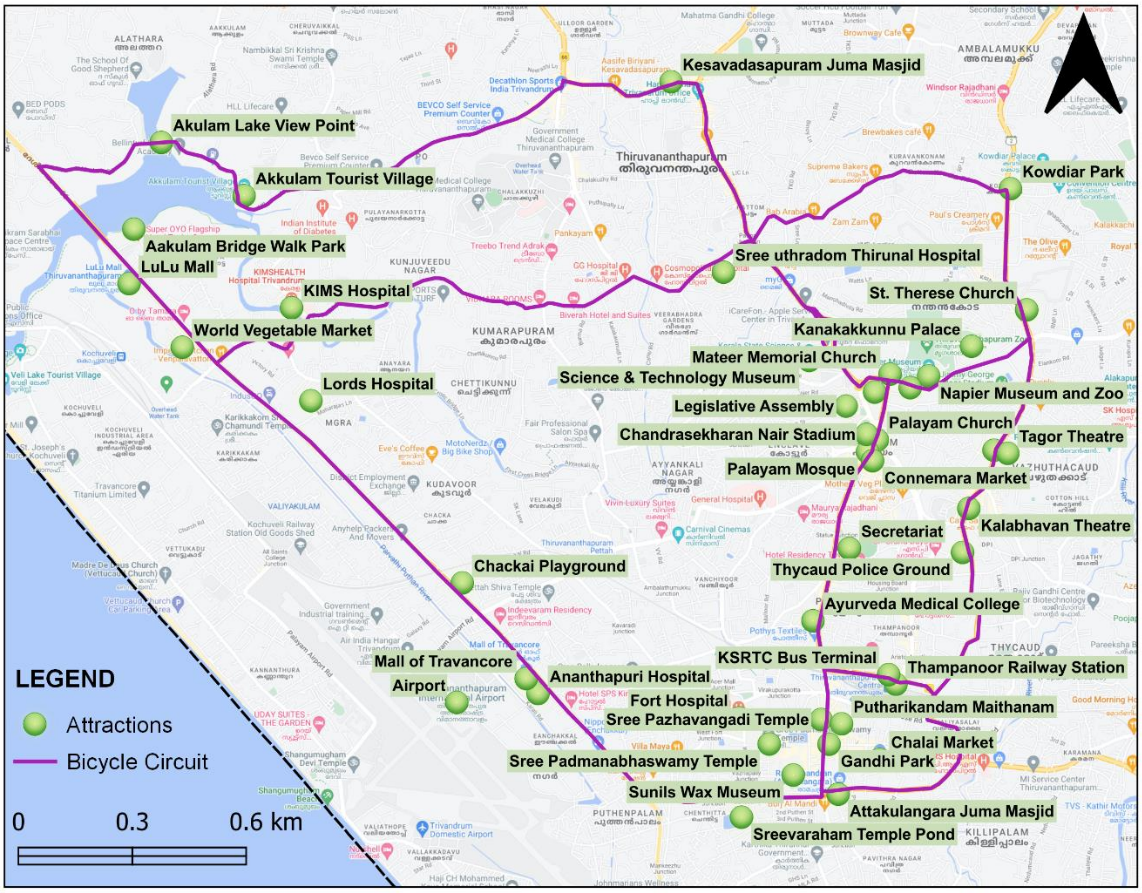


Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED / Urban Mass Transit Company Limited
Name: Proposed Bicycle Corridor Connecting Beaches	

Figure 145 *Proposed Bicycle Corridor Connecting Beaches*

5.5.5 DEVELOPMENT OF BICYCLE CIRCUITS CONNECTING TOURIST ATTRACTIONS

Tourism is one of the major revenue generators in Kerala and in Thiruvananthapuram. In the year 2019 (before the impact of Covid'19), a total of 310451 foreign and 3038167 domestic tourists visited Thiruvananthapuram, which is around 18% of total tourists visiting Kerala. The proposed bicycle circuits of 49 Km connecting major tourist attractions is provided below.



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED / Urban Mass Transit Company Limited
Name: Proposed Bicycle Circuits Connecting Tourist Attractions	

Figure 146 *Proposed Bicycle Circuits Connecting Major Tourist Attractions*

The considerations developing the proposed bicycle corridor are as follows,

- Provision of minimum 2m wide dedicated bicycle track.
- In case of NMT priority streets, the shared NMT and PT space is recommended for bicyclists.
- The dedicated tracks are proposed to have ceramic treatment with colour pigmentation to enable clear visibility.
- It is proposed to provide bicycle parking spaces at every heritage site/ tourist attraction to ease the parking needs of the bicyclists. It is proposed to have about 25 bicycle spaces at

every gate and about 100 bicycle spaces at tourist spaces like Zoological Park, Sree Padmanabhaswamy Temple, Beaches and Museums.

- The whole corridor needs to maintain and bicycle track pavement marking stencil.
- Map Kiosks needs to be provided at every kilometre, with area plane, corridor details and major attraction in the area.
- Wayfinding and signages are recommended to be provided as per IRC standards.

Figure 147 *Representation of Wayfinding and Map Kiosk used in Various Cities Across the World*[28]

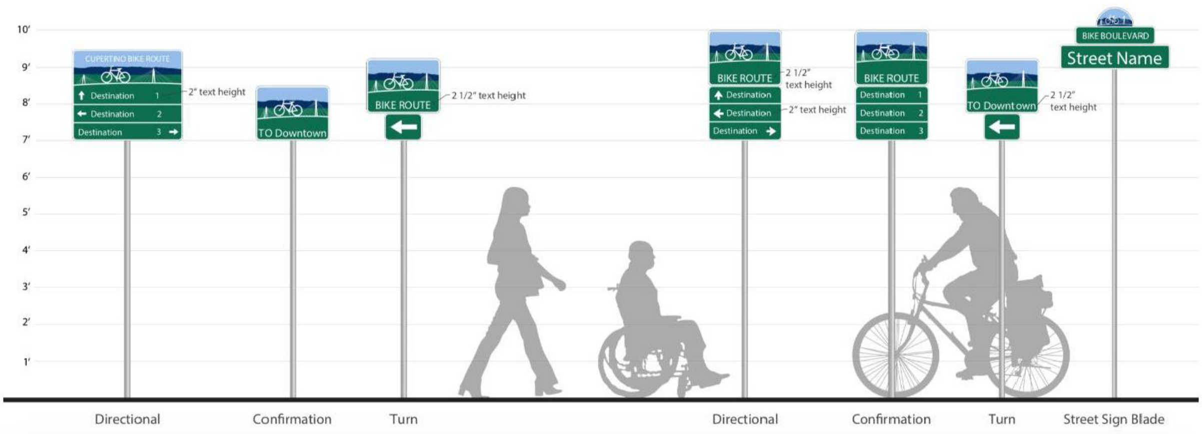


Figure 148 *Representation of Wayfinding and Signage Boards Heights*[29]

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[28] Image Source: Images extracted from multiple online sites for reference purposes

[29] Image Source: Wayfinding Sign Project

5.5.6 SAFE ROUTES TO SCHOOL

Thiruvananthapuram city has about 335 educational institutions with about 3 lakh student population who are largely depended riders. It is important to cater to the needs of these dependent riders who commute on daily basis. The majority of these trips are under 2.5km, which can be catered by NMT modes of transport such as walk and bicycling. This strategy at a conceptual level guide to promote sustainable or green travel conditions for these users under Safe Routes to School strategy.

Safe Routes to School (SRTS) is an approach that promotes walking and bicycling to school through infrastructure improvements, enforcement, tools, safety education, and incentives to encourage walking and bicycling to school.

The components to developed and improved for initiating SRTS in Thiruvananthapuram are,

- Designing and implementing complete streets infrastructure in the school zones
- Design and monitor traffic calming measures in the school zones
- Encourage and promote safe bicycling and walking
- Expand bicycle and pedestrian infrastructure
- Conduct and evaluate safety through periodic road safety audits

The key elements of safe routes to school portograms are as follows,

- **EDUCATE:** Conducting education activities to target parents, neighbourhoods and other drivers in the community to remind them to yield to pedestrians, to drive safely and take other actions to make it safer for pedestrians and bicyclists.
- **ENCOURAGEMENT:** Conduct special events like Walk and Bike to School Day and ongoing activities like walking school buses and bike trains involving children, parents, teachers, school administrators to generate excitement about walking and bicycling safely to school.
- **ENFORCEMENT:** increase driver awareness of laws, and they also can improve driver behaviour by reducing speeds to pay attention to their environment.
- **ENGINEERING:** Various methods including the recommendation in the above mentions NMT strategy need to be implemented to create safer settings for walking and bicycling while recognizing that a roadway needs to safely accommodate all modes of transportation.

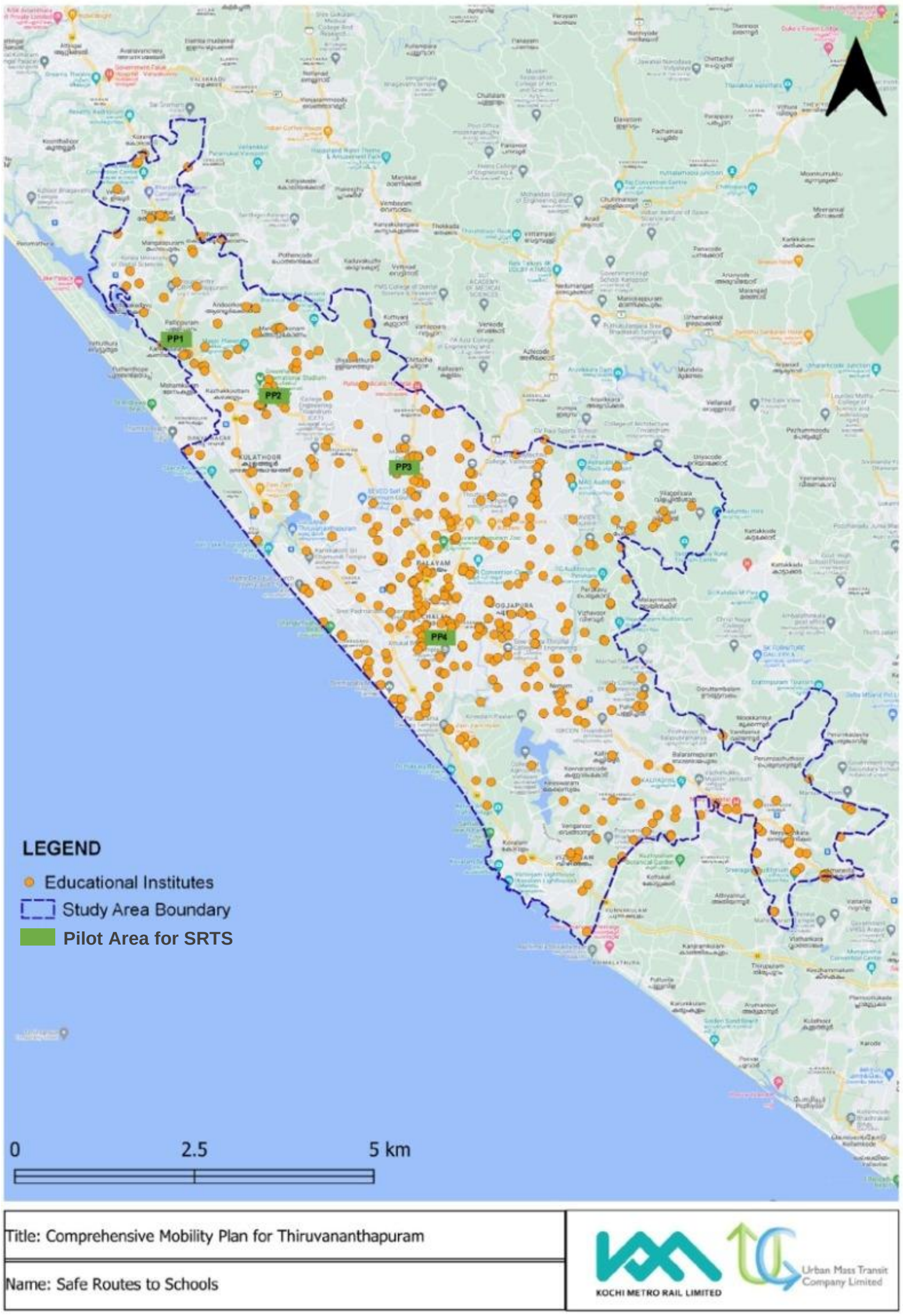


Figure 149 *Proposed Pilot Areas for SRTS Thiruvananthapuram*

The areas recommended for implementing the pilot projects for SRTS have been identified based on the following,

- Concentration of educational institutions
- Non-motorised footfall of students
- Proximity to residential neighbourhoods
- Degree of safe road infrastructure for NMT users

The pilot areas identified are as presented below.

Table 5-27 *Pilot Areas Identified for SRTS Thiruvananthapuram*

S. No.	Code	Name
1	PP1	Kaniyapuram and Pallippuram Areas
2	PP2	Indiraji Nagar, Karyavattom and Kurrissadi Areas
3	PP3	Tilak Nagar and Mayuram Areas
4	PP4	Pavithra Nagar Area

It is recommended to take up pilot projects for SRTS in these areas in light with the consideration and elements suggested above.

5.5.7 NON-MOTORISED TRANSPORT PRIORITY CORRIDORS

NMT priority streets prioritize people and are typically most appropriate in corridors with commercial activity on both edges of the street such as Padmanabhaswamy Temple Street, Chalai Market Road, etc.

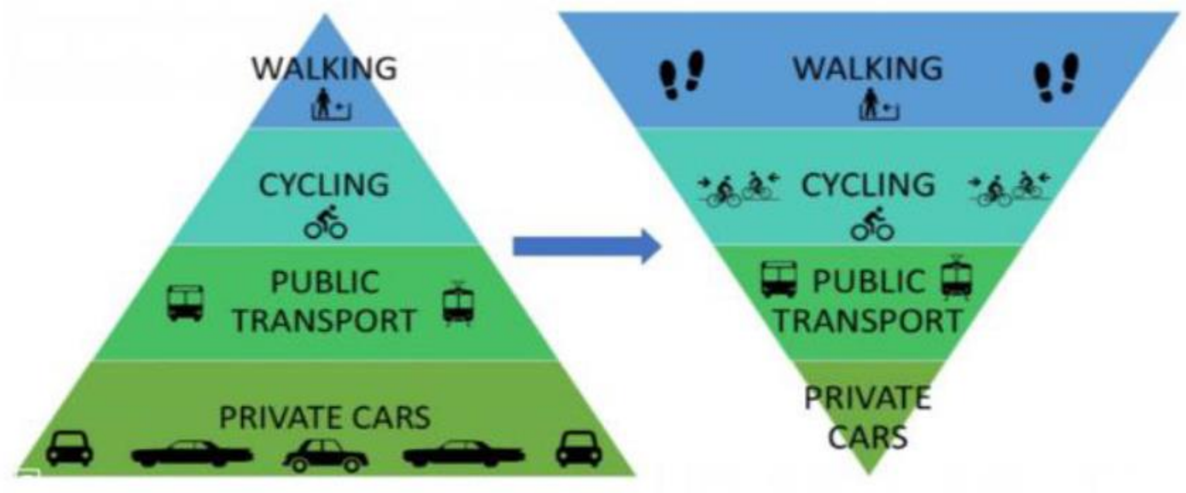


Figure 150 *Mode Priority in NMT Streets*

Figure 151 *Representation of before and After of NMT Streets*

NMT priority street for Thiruvananthapuram are strategically selected streets in which pedestrian volume is high where the vehicular traffic is to be restricted. The identified streets offer opportunities for diverse activities such as shopping or sitting, dining or dawdling, promenading, etc. These recommended streets when well designed, and maintained become a prime destination with high footfall and result in economic benefits for adjacent businesses and create a virtual image for the city often attracting tourists as well.

For Thiruvananthapuram it is recommended to develop about 13km as NMT priority streets where pedestrian and bicyclist movement are only allowed except at night for fright loading and unloading. The streets identified are the major corridors in the East Fort connecting Shree Padmanabhaswamy Temple and Chalai Market.

The considerations for developing these corridors are as follow,

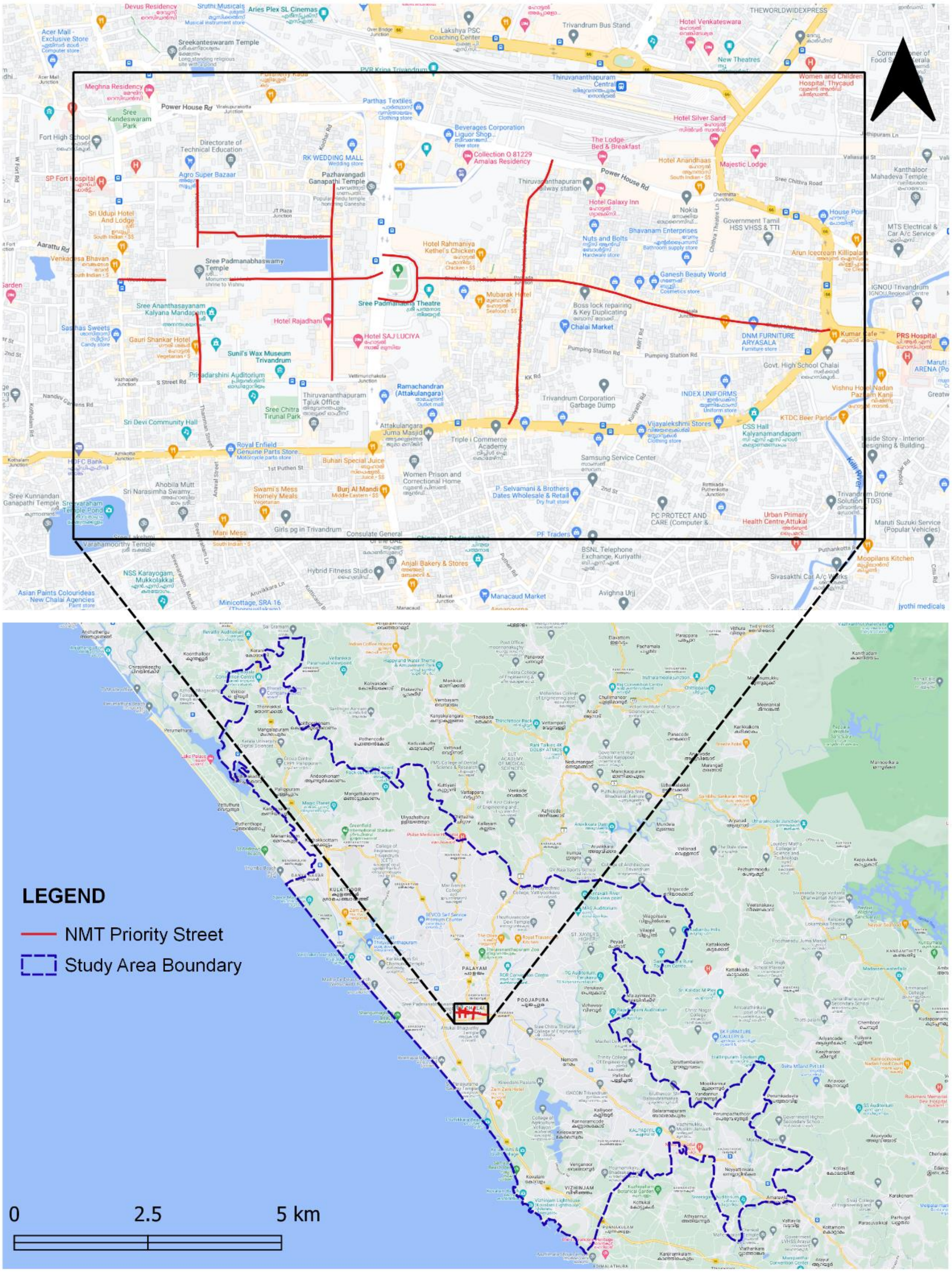
- Provision of minimum clear pathways for NMT users and a clear access for emergency vehicle access.
- The clear paths proposed are not required to be straight and direct however they must be continuous and navigable.
- The freight vehicles are allowed to enter to these NMT priority streets during the night time, i.e., night 10pm to morning 6am.
- Provision of smooth and level surface to optimize walking accessibility and accessibility ramps and tactile paving to assist the visually impaired.
- It is recommended to use durable and slip-resistant materials.
- It is recommended to install street furniture, artwork, seating, tables, benches, trees, landscaping, cycle racks, and water fountains to add character and support a range of activities to boost the local business.

Figure 152 *Representation of NMT Streets from Bengaluru*

Some of the examples of such streets in India are Mall Street in Shimla, Gangtok, Church Street Bengaluru, Swarna Temple Street Amritsar, etc.

Table 5-28 *Recommended NMT Priority Streets*

S. No.	Name	Length (Km)
1	West Nada	0.11
2	Vadakkenada	0.16
3	Sabapathi Coil St.	0.30
4	Pazhavangadi St.	0.47
5	Padmatheertham N St.	0.33
6	Padmanabhaswamy Temple Road	0.37
7	Kothuval St.	0.35
8	Chotthupurai Street	0.16
9	Chalai Market Road	1.26



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED Urban Mass Transit Company Limited
Name: NMT Priority Steets	

Figure 153 *Recommended NMT Priority Streets*

5.5.8 PUBLIC BIKE SHARING SYSTEM

Public bike sharing systems have gained significant popularity in recent years as an eco-friendly and convenient transportation option in urban areas. These systems allow users to rent bicycles for short-term use and provide a sustainable solution to reduce traffic congestion, improve air quality, and promote active and healthy lifestyles. Key features of the PBS system are as follows:

- **Accessibility:** Public bike sharing systems offer easy access to bicycles for both residents and visitors. Stations are strategically placed throughout the city, providing convenient pick-up and drop-off locations.
- **Rental Process:** Users typically register and pay for bike rentals through mobile apps or kiosks at the stations. The rental process is user-friendly, allowing for quick and efficient transactions.
- **Flexible Membership Options:** Public bike sharing systems offer various membership options, including pay-as-you-go, daily, monthly, and annual subscriptions. This flexibility caters to the diverse needs of users, whether they are occasional riders or frequent commuters.
- **Bike Availability and Tracking:** Real-time information about bike availability and station capacity is crucial for users to plan their trips effectively. Many systems employ GPS technology to track bikes and provide up-to-date information on bike availability through mobile apps or websites.

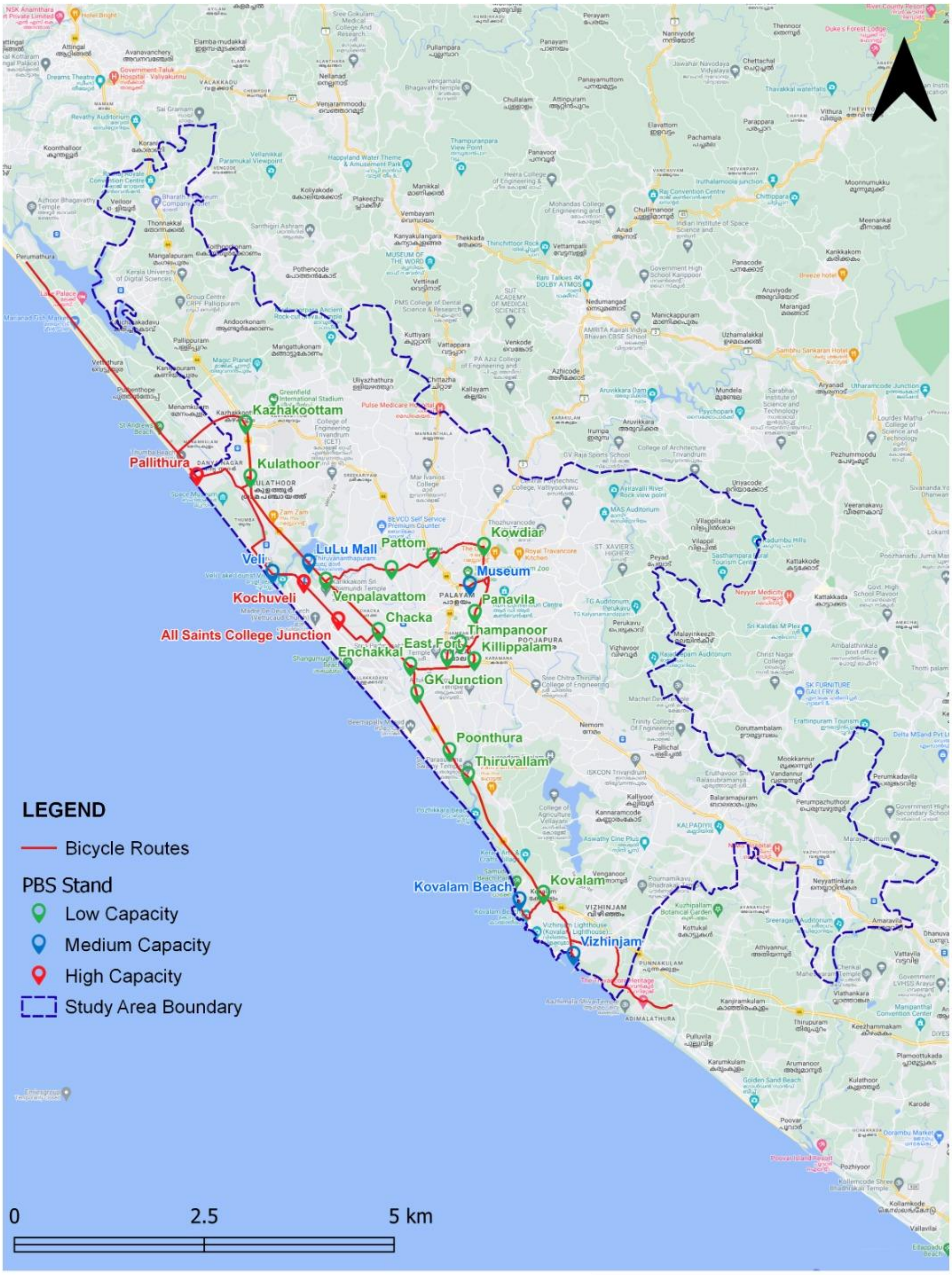
The benefits of implementing the PBS system in the city are as follows:

- **Bike Distribution and Rebalancing:** Ensuring an adequate supply of bikes at each station can be challenging, especially during peak hours or in densely populated areas. Balancing bike distribution across the network to meet user demand is essential.
- **Parking and Security:** Proper parking infrastructure and security measures are necessary to protect the bikes from theft or vandalism. Stations should have secure locking mechanisms and surveillance systems to ensure the safety of the bikes.
- **Maintenance and Repair:** Regular maintenance and timely repair of bikes are crucial to ensure their optimal performance and user satisfaction. Effective maintenance strategies should be implemented to address issues such as flat tires, broken gears, or faulty brakes promptly.
- **User Education and Safety:** Promoting safe cycling practices and educating users about traffic rules and bike handling techniques are essential. Public bike sharing systems should prioritize user safety by providing helmets, reflective gear, and clear guidelines for riders.

Public bike sharing systems play a vital role in promoting sustainable transportation and improving urban mobility. By providing affordable and accessible bicycles, these systems offer an environmentally friendly alternative to traditional modes of transportation. The public bike sharing systems will be provided near all the major tourist attraction points and other attraction centres.

Table 5-29 *Proposed PBS Locations*

S. NO.	LOCATION	PBS TYPE	CYCLES PER STATION
1	Kazhakoottam	Low Capacity	10
2	Kulathoor	Low Capacity	10
3	Chacka	Low Capacity	10
4	Venpalavattom	Low Capacity	10
5	Enchakkal	Low Capacity	10
6	GK Junction	Low Capacity	10
7	Poonthura	Low Capacity	10
8	Thiruvallam	Low Capacity	10
9	Kovalam	Low Capacity	10
10	East Fort	Low Capacity	10
11	Thampanoor	Low Capacity	10
12	Killippalam	Low Capacity	10
13	Panavila	Low Capacity	10
14	Kowdiar	Low Capacity	10
15	Pattom	Low Capacity	10
16	Kumarapuram	Low Capacity	10
17	Veli	Medium Capacity	15
18	LuLu Mall	Medium Capacity	15
19	Kovalam Beach	Medium Capacity	15
20	Vizhinjam	Medium Capacity	15
21	Museum	Medium Capacity	15
22	Pallithura	High Capacity	25
23	Mukkolakkal	High Capacity	25
24	Kochuveli	High Capacity	25
25	All Saints College Junction	High Capacity	25



Title: Comprehensive Mobility Plan for Thiruvananthapuram	
Name: Proposed Public Bicycle Sharing (PBS)	

Figure 154 Proposed PBS Locations

5.5.9 NON-MOTORISED TRANSPORT OUT-REACH PROGRAMS

It is essential to promote public awareness and revive the bicycling culture and reducing the dependency on private modes. Thus, an outreach and education strategy for promoting the system is recommended. The outreach and education goals need to be defined at the planning stage of the system itself to focus the efforts of the implementation.

- Introduce the concept of the Non-Motorized Transport, its purpose and the benefits to the various stakeholders
- Create profile of the system as a big impact, with incremental steps for achieving the long-term vision for mobility in the city
- Enhance the understanding that Non-Motorized Transport positively impact economic health and environmental stability of the city
- Introduce the concept of specific systems as an important strategy in making the best use of transportation resources
- Establish communication channels for the public to receive information and interact with the implementing agencies

Figure 155 *Bicycle Promotional and Out-Reach Programs in India*

Following strategies can be adopted for an effective public outreach

- Create a network of allies and provide platforms for them to actively participate as disseminators of benefits
- Use proactive and creative communication media to promote key messages. Communication media can be print, broadcasts, short films, event marketing etc.
- Programmes can be conducted in schools and colleges advocating the need for Non-Motorized Transport. Events like Car Free Day, Happy Streets, Cycle Day can also be promoted.
- Encourage various university and school students to use bicycles under Safe Routes School or Pedal to School programs.
- Conduct Heritage Bicycle rides, etc.
- Encourage Bicycling as a recreational activity by creating Bicycle tracks along the lakes and further connecting them. Call for weekly bicycle competitions etc.

5.6 TRAFFIC MAMAGEMENT MEASURES

Traffic demand measures 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, traffic flow, area improvements 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.

The proposals under public transport improvement strategy are:

- Junction Improvements
- Area Improvements
- Pavement Markings and Signage's
- Parking Management Plan

5.6.1 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, while providing well designated mid-block crossings for pedestrians.
- 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 such as zebra crossings, pelican signals, refuse islands etc.
- Bus stops near junctions to be re-located
- Providing signs/lane-markings/lighting

Typical junction improvement measures are shown below.

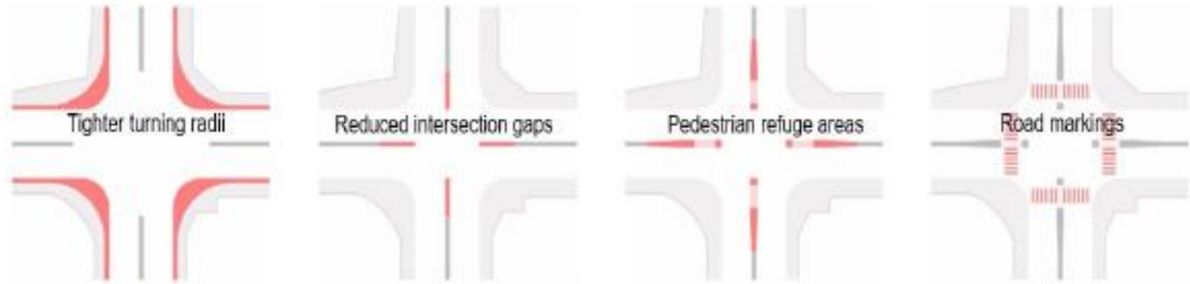


Figure 156 *Typical Junction Improvement Measures*

Junctions 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.

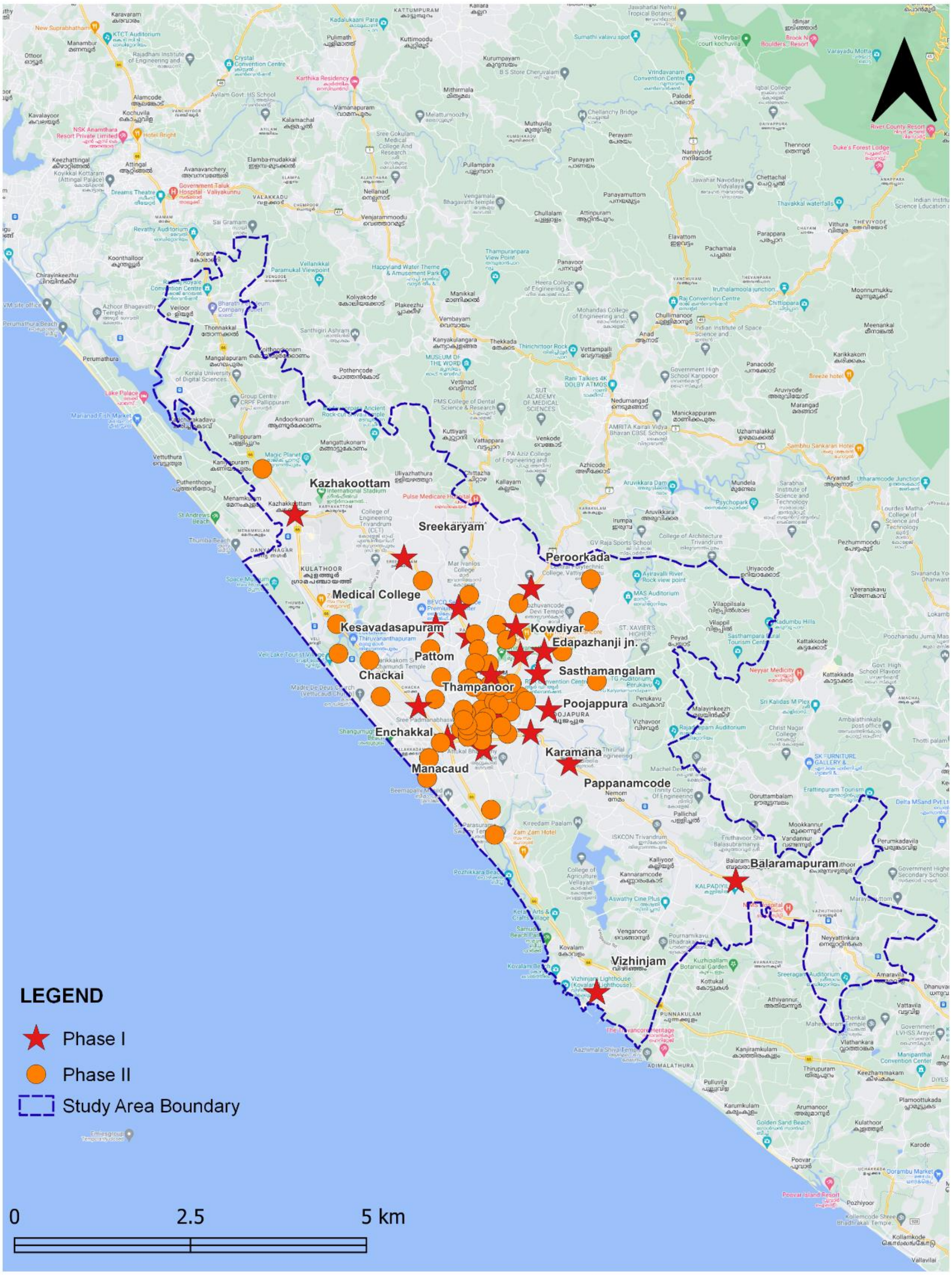
Intersection improvements are recommended to facilitate the movement of public transport, safe movement and crossing of pedestrians at junctions. List of junctions proposed for improvement in their geometry are given below.

Table 5-30 *Identified Junctions for Improvement*

S N	Name	Phase
1	Balaramapuram	Phase I
2	Chackai	Phase I
3	Edapazhanji jn.	Phase I
4	Enchakkal	Phase I
5	Karamana	Phase I
6	Kazhakoottam	Phase I
7	Kesavadasapuram	Phase I
8	Kowdiyar	Phase I
9	Manacaud	Phase I
10	Medical College	Phase I
11	Palayam	Phase I
12	Pappanamcode	Phase I
13	Pattom	Phase I
14	Peroorkada	Phase I
15	Poojappura	Phase I
16	Sasthamangalam	Phase I
17	Sreekaryam	Phase I
18	Thampanoor	Phase I
19	Thirumala	Phase I
20	Vellayambalam jn.	Phase I
21	Vizhinjam	Phase I
22	Airport jn	Phase II
23	All Saints jn.	Phase II
24	Ambalamukku	Phase II
25	Ambalathara	Phase II
26	Anayara	Phase II
27	Attakulangara	Phase II
28	Ayurveda College	Phase II

S N	Name	Phase
29	Bakery Jn.	Phase II
30	Choorakattupalayam	Phase II
31	Devaswom Board jn.	Phase II
32	DPI jn.	Phase II
33	East Fort	Phase II
34	General hospital Jn (GH jn)	Phase II
35	Housing board Jn.	Phase II
36	Jacob's Jn.	Phase II
37	Jagathy	Phase II
38	Kaithamukku	Phase II
39	Kannamoola	Phase II
40	Killippalam	Phase II
41	Kochuveli	Phase II
42	Kumarapuram	Phase II
43	Kuravankonam	Phase II
44	Kuzhivila	Phase II
45	Law college jn	Phase II
46	Marappalam	Phase II
47	Maruthankuzhy	Phase II
48	Melepazhavangadi	Phase II
49	Mettukada	Phase II
50	Model School Jn.	Phase II
51	Nettayam	Phase II
52	Old Collectorate jn.	Phase II
53	Overbridge	Phase II

S N	Name	Phase
54	Paruthippara	Phase II
55	Pazhavangadi	Phase II
56	Pettah	Phase II
57	Plamoodu	Phase II
58	PMG	Phase II
59	Pongumoodu	Phase II
60	Punnapuram jn	Phase II
61	RBI	Phase II
62	RMS	Phase II
63	SP fort jn	Phase II
64	Statue	Phase II
65	Thampuranmukku	Phase II
66	Thirumala	Phase II
67	Thiruvallam	Phase II
68	Uppidamoodu	Phase II
69	Valiyathura	Phase II
70	Vallakkadavu	Phase II
71	Vattiyoorkavu	Phase II
72	Vazhapally jn	Phase II
73	Vazhuthacaud	Phase II
74	Vettimurichakotta	Phase II
75	Vettu road	Phase II
76	West Fort	Phase II
77	West Nada	Phase II
78	Women’s College jn.	Phase II



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED / Urban Mass Transit Company Limited
Name: Junction Improvements	

Table 5-31 *Identified Junctions for Improvement*

Traffic signals are necessary for safe movement of traffic at a junction. IRC 93:1985 provides the guidelines on designs and installation of road traffic signals. The IRC 93 suggests 5 warrants for the installation of signals at any junction. Traffic control signals should not be installed, unless one or more of the signal warrants specified herein are met. Information should be obtained by means of traffic and engineering studies and compared with the requirements set forth in the warrants. If these requirements are not met, a traffic signal should not be put into operation.

Geometric improvements and signalization serve only for short term duration. The traffic level at few junctions reaches the 10000 PCU mark during peak hours as shown below. The crucial junction being Pattom, VJT Hall Palayam, Thampanoor, Karamana junctions. The situation will deteriorate considerably with growing population of private modes in the city.

Hence improvements to these junctions need to be considered for signalization/ roundabouts or grade separators. The type of junction has to be suited to the road type, the environment and capacity, in order to maintain good readability both of the road and of the junction, as well as a satisfactory level of safety. According to the above, for example, junctions or roundabouts should not be used on motorways, and signalized junctions need not to be used on rural roads, except in very special cases. The following shows guidelines for the selection of junction type according to traffic flows.

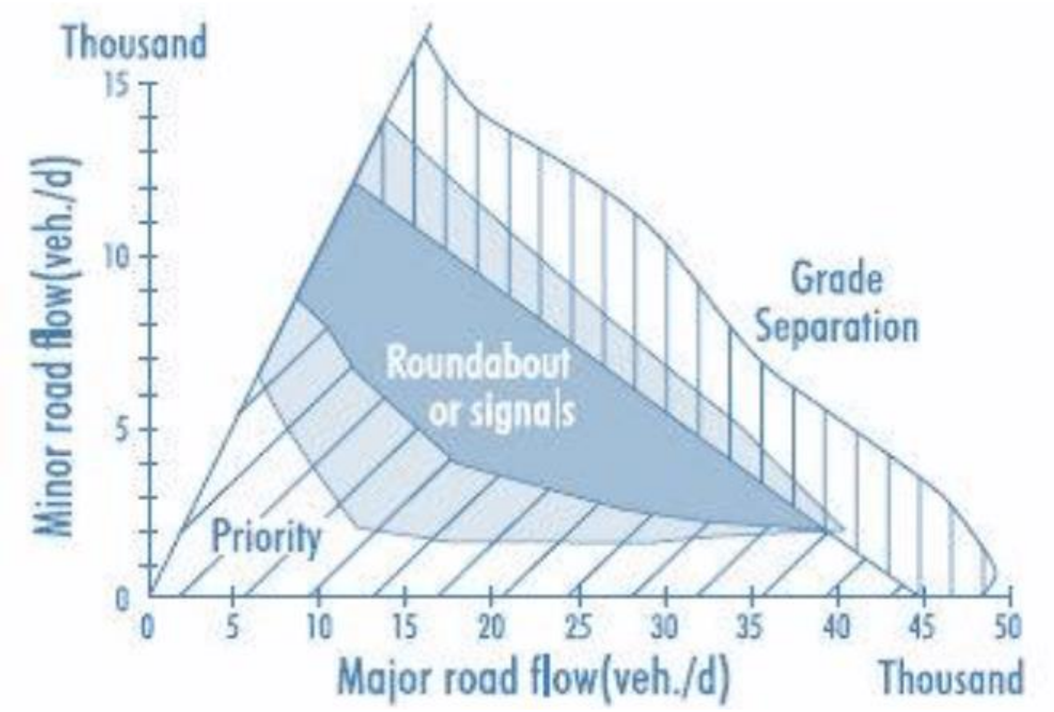


Figure 157 *Junction Typology Based on Traffic Flows (IHT)*

Table 5-32 *Improvements Proposed at Identified Junctions Phase I*

S. NO.	JUNCTION	TYPOLOGY
1	Kazhakoottam	Signalized
2	Sreekaryam	Grade Separator
3	Kesavadasapuram	Grade Separator
4	Pattom	Grade Separator
5	VJT Hall Palayam	Grade Separator
6	Thampanoor	Grade Separator
7	Karamana	Grade Separator
8	Pappanamacode	Grade Separator
9	Balaramapuram	Grade Separator
10	Vellayambalam	Grade Separator
11	Kowdiyar	Grade Separator
12	Peroorkada	Grade Separator
13	Sasthamangalam	Grade Separator
14	Manacaud Junction	Grade Separator
15	Vizhinjam	Signalized
16	Chakka	Grade Separator
17	Eanchakkal	Grade Separator
18	Medical College	Grade Separator
19	Poojappura	Grade Separator
20	Edapazhji Junction	Grade Separator

5.6.2 PAVEMENT MARKINGS AND SIGNAGES

Even though road signs and markings are provided on major road stretches of Thiruvananthapuram, 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.

Figure 158 *Mandatory Signs*

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.

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.

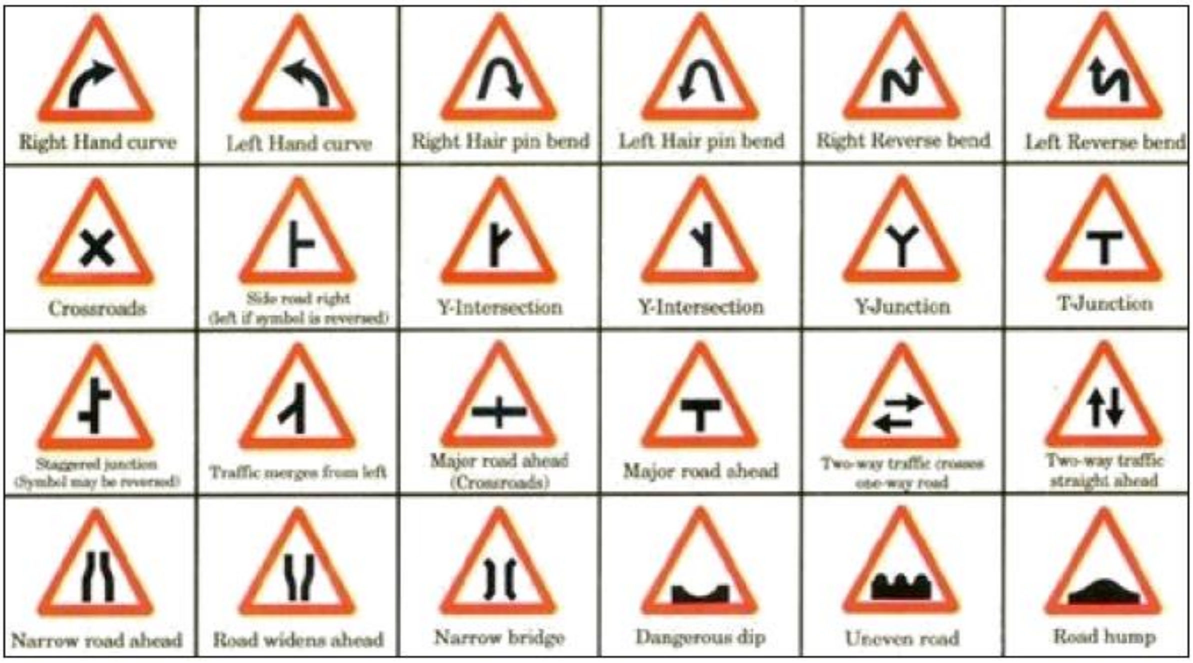


Figure 5-159 Cautionary or Warning Signs

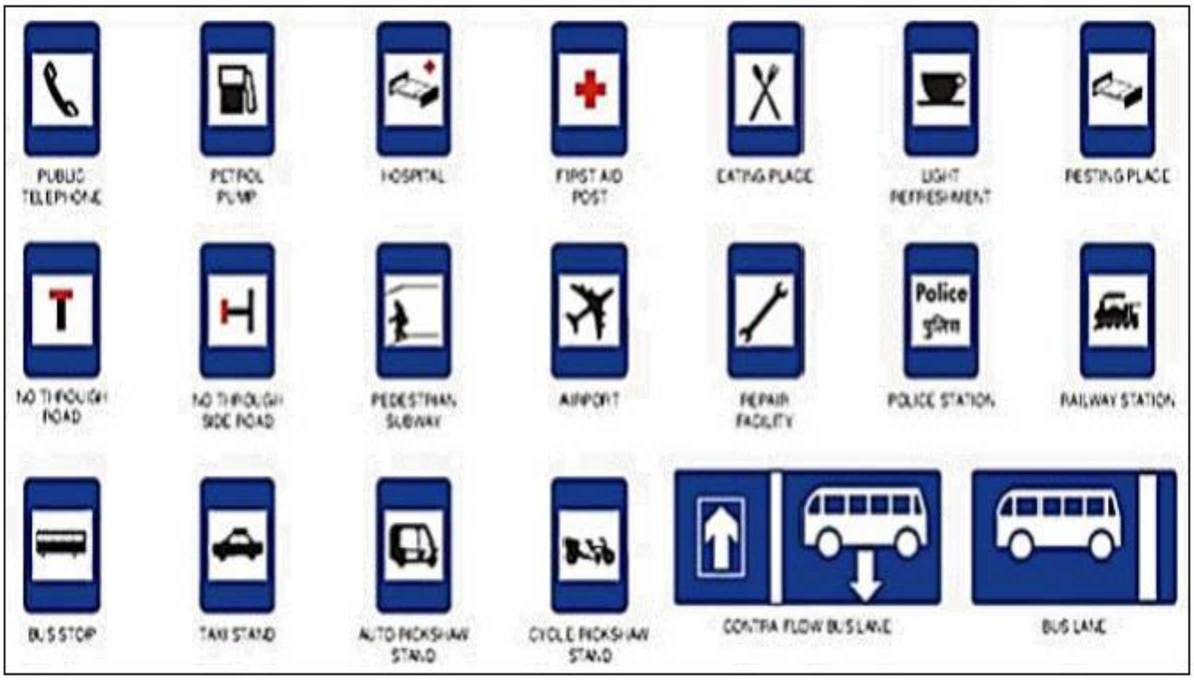


Figure 160 *Informatory Signs*

5.6.3 AREA IMPROVEMENT PLAN

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 programmers shall be organized

5.6.3.1 EAST FORT & THAMPANOOR: COMMERCIAL & RELIGIOUS AREA

East Fort is the main commercial and religious area of the city with Chalai Market and Sree Padmanabhaswamy Temple. The Chalai Market houses for all sorts of people need in day-to-day life, which includes groceries, mobile phones, etc. Tampanoor area hosts for major bus station and railway station of the city with huge passenger footfall daily. The surrounding areas of both these areas are having lot of public and private services, educational institutions, multiplex, etc. Both these areas attract high volumes of traffic and higher pedestrian footfall. Existing major road networks with their right of way and major attraction points are identified and shown below.

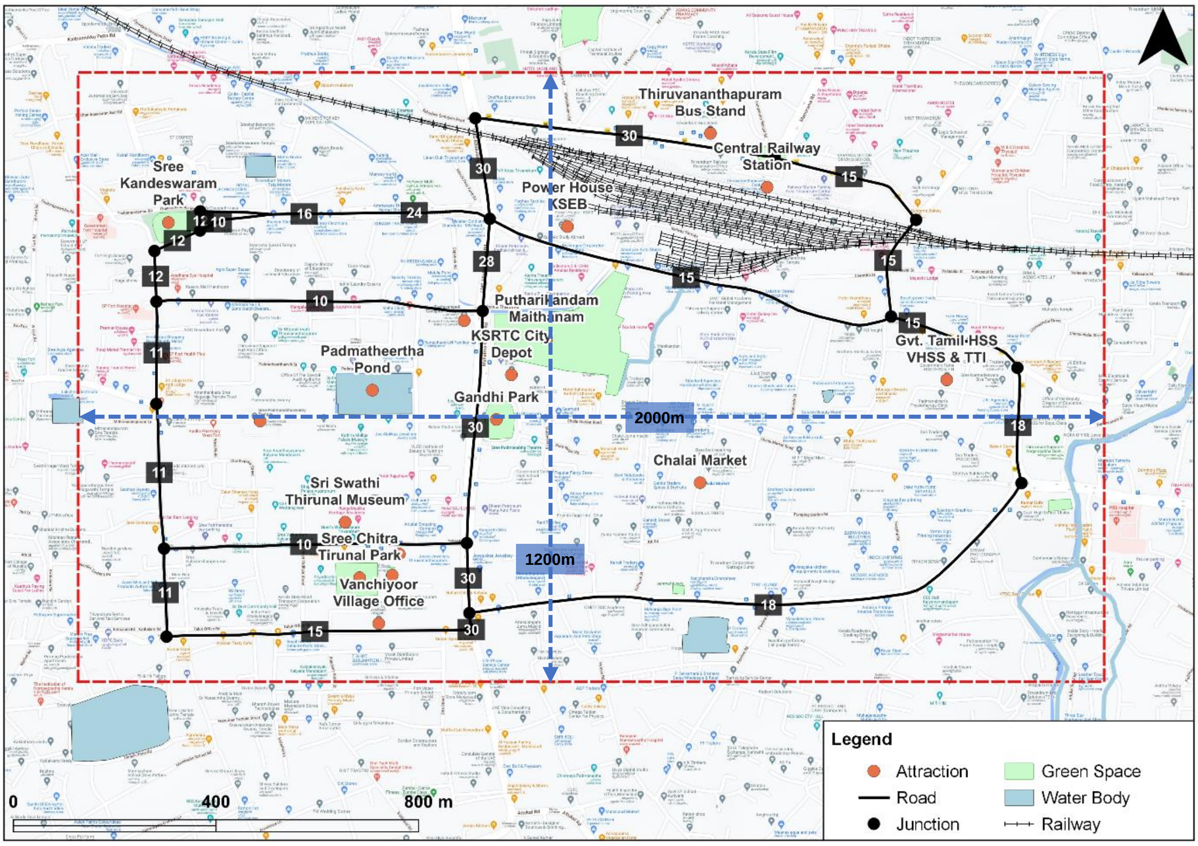


Figure 161 *Contextual Map of East Fort & Thampanoor Area*

5.6.3.1.1 ISSUES IDENTIFIED

- Lot of the roads in the East Fort area near the Shree Padmanabhaswamy Temple area is having limited right of way and having authorized as well as unauthorized on street parking because of the religious importance of the area.
- Other roads are having ample right of way of more than 15m but due to encroachments, parking activities and poor traffic management, effective road way width is limited.
- Pedestrian facilities are provided in some of the roads, but due to high amount of traffic and on-street parking, the safety for the pedestrians is compromised.

- NMT facilities in the entire area is not available which makes people hesitate to use NMTs.
- The area on the road opposite to Gandhi Park is acting as a bus stand for private buses. Buses used to stop and hold at this area for longer time, which creates a chaotic situation to the through traffic. Same is observed on the opposite side of the Thiruvananthapuram bus stand.
- The entire Chalai Market region is chaotic due to the vehicular movement through those narrow road, which is also unsafe for pedestrians and consumers.
- During the time of the rainy season, the entire area gets chocked due to overflow of drain and as a result of the same, the roads are getting flooded. The reason for the same is due to negligence of drains by the local authority.
- There is no integration between the central railway station and the bus stand, which hesitates people to use public transportation and tends to avail personal vehicles.

5.6.3.1.2 PROPOSED INTERVENTIONS AND IMPROVEMENTS

- Based on the higher footfall, and to improve the mobility at Chalai Market area and Sree Padmanabhaswamy Temple area, complete pedestrianisation of the roads are proposed at both these areas. Even though complete pedestrianisation is proposed, fright movement to these locations are permitted at night time.
- Wide footpath has been proposed on all the major roads identified in the area.
- Cycle track is proposed on the major road identified for enhancing the sustainable and safe mobility.
- Since lot of buses are stopping in front of the Thiruvananthapuram Bus stand and East Fort bus stand, bus bays with proper waiting area for the passengers are proposed at both the locations.
- IPT bays are proposed at East Fort and Thiruvananthapuram Bus stand to improve the first and last mile connectivity.
- To access the Chalai Market from the east side, bus bays and IPT bays are proposed.

- Foot over bridge have been proposed directly from the central railway station foot over bridge to Thiruvananthapuram Bus Stand to have a proper integration of both the central railway station and Thiruvananthapuram Bus Stand.
- Parking locations identified (4 locations – Central Railway Station, Sree Padmanabhaswamy Temple, Sree Chitra Tirunal Park and Putharikandam Maithanam) in the area are proposed with multilevel parking facility. The identified locations are within a walkable distance from the major attraction points.

The conceptual map of the area is provided below.

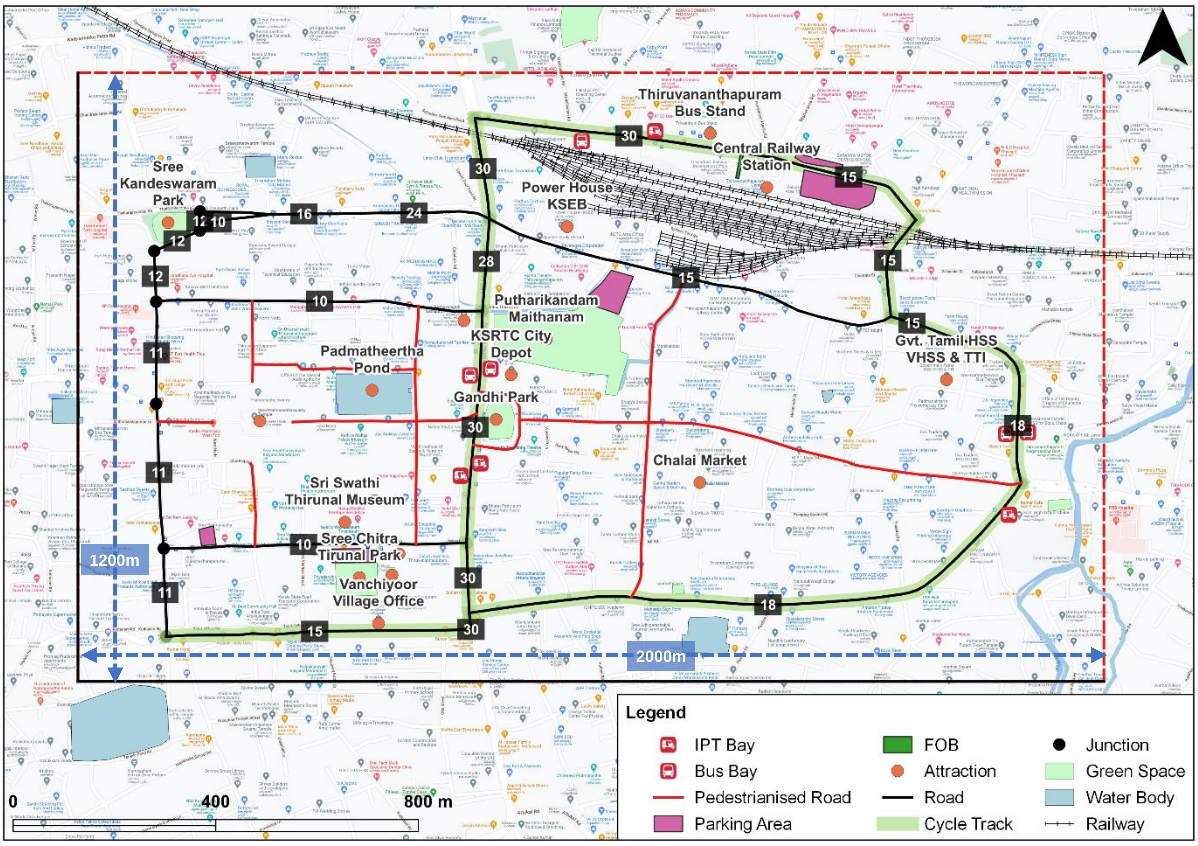


Figure 162 *Conceptual Map of Area Management Plan for East Fort & Thampanoor Area*

5.6.3.1.3 THAMPANOOR

Thampanoor is the core area of the Thiruvananthapuram city with KSRTC bus terminal and Thiruvananthapuram central railway station. The railway station, is the busiest railway station of the state in terms of daily passengers. The pedestrian vehicular interaction in the area is on the higher side due to passenger movement between the railway station and bus terminal. As to improve the safety of the passengers and to enhance the integration, a foot over bridge (FOB) has been proposed from the railway station foot over bridge to KSRTC bus terminal. Designated IPT and bus bays are proposed in the area for improving the first and last mile connectivity. The parking facilities near Thampanoor area is also identified. The vehicular movement and various improvements proposed at the area is as shown below.

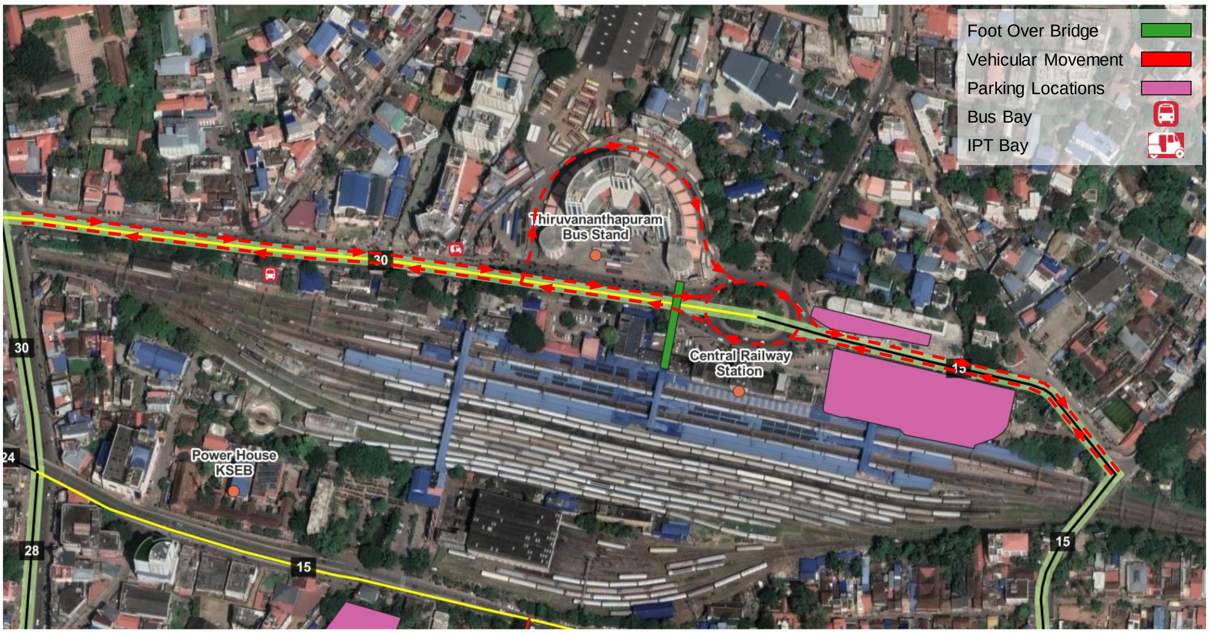


Figure 163 *Proposals at Thampanoor*

5.6.3.1.4 EAST FORT

East fort area hosts one of the important religious centres in the state with Shree Padmanabhaswamy Temple. The private buses in the city are utilizing this area as a bus terminal, which make the place chaotic in terms of pedestrian and vehicular interactions. PT and IPT bays are proposed to channelize the bus movement and utilize the area to the minimum for buses. The proposed bus bay near the Gandhi Park area is to be developed by utilizing some of the land owned by the KSRTC for KSRTC city depot. Also, to enhance the safety and mobility of the devotees towards the temple and adjacent area, some of the roads are made as NMT priority corridors. The available parking locations near the East Fort area are identified. The vehicular movement and various proposals at the area is as shown below. The cross-section of the proposed NMT priority corridor is provided below.

Figure 164 *Proposals at East Fort Area*

5.6.3.1.5 CHALAI MARKET

This is one of the busiest markets in the city. The areas have limited right of way availability and with the movement and parking of trucks on–street in an unorganized manner creates chaos and disrupts the traffic and pedestrian movement even after imposing one-way regulations. To overcome the current situation and to enhance safe movement of pedestrians, the two main corridors below. Inside the market area, Kothuval Street and Chalai Market Road are proposed as NMT priority corridor. Kothuval Street is connecting Power House Road in the north of Chalai Market and Bypass Road in the south. The cross-section of the proposed NMT priority corridors is provided below.

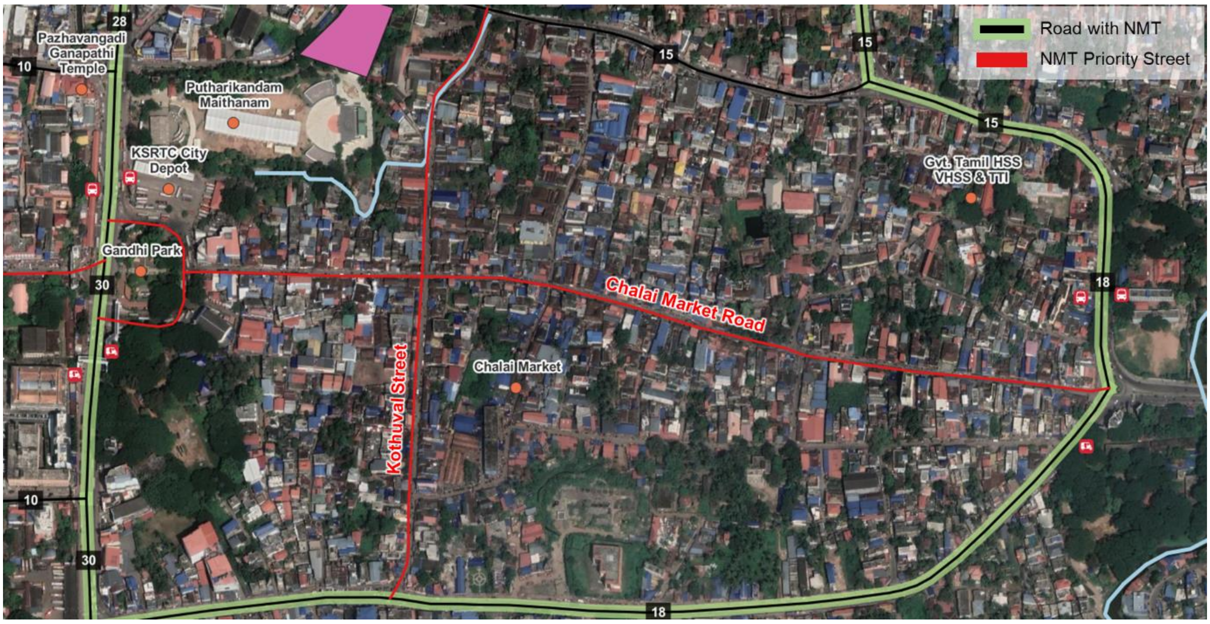


Figure 165 *Proposed NMT Priority Corridors at Chalai Market Area*

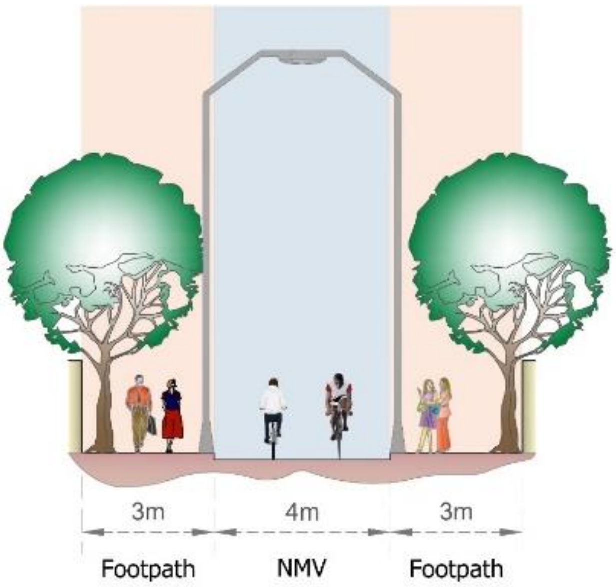


Figure 166 *Cross-Section of Proposed NMT Priority Corridors*

5.7 PARKING MANAGEMENT STRATEGY

Similar to other cities in the country and state, the city experiences intense on-street parking and under-utilized off-street parking. The other parking issues are:

- Inadequate information for motorists on parking availability and price.
- Inadequate user options in terms of off-street parking, paid and convenient parking versus free and inconvenient parking.
- Concerns over spill over parking congestion in nearby areas if parking supply is inadequate.
- Inadequate or lack of Parking Pricing methods along the commercial streets such as at East Fort, Thampanoor, Palayam, etc.
- Lack of convenient Parking Pricing methods, such as mechanical meters at designated parking spaces especially at terminals, etc.
- Inefficient use of existing off street parking capacity especially in Thiruvananthapuram Corporation parking spaces.

In addition, the excessive use of private modes use has resulted in the dependency on private vehicles and increased demand for parking spaces. Thus, the strategies should supplement the steps being taken to reduce the dependency on private mode and encourage transportation alternatives. Thus, a Parking Management Strategy is proposed for the study area.

Parking Management Strategy includes a variety of strategies that encourage more efficient use of existing parking facilities, improve the quality of service provided to parking facility users and improve parking facility design. An effective management plan can help address a wide range of transportation problems as discussed above and help to achieve a variety of transportation and land use development objectives.

The proposed parking strategies should address these issues which will in turn will increase the parking turnover rate and reduce the spillage of parking activities. The various measures suggested for parking are:

- Designated Parking Spaces (On and Off-Street)
- Parking Pricing: with temporal variations
- Enforcement
- Proof of Parking
- Parking Standards Near Transit Stations
- Shared Parking
- Parking Permits

Based on the survey results of On and Off-Street Parking, some locations have been identified as designated On and Off-Street Parking areas. This section details out the specifications of the identified locations.

5.7.1 DESIGNATED ON-STREET PARKING SPACES

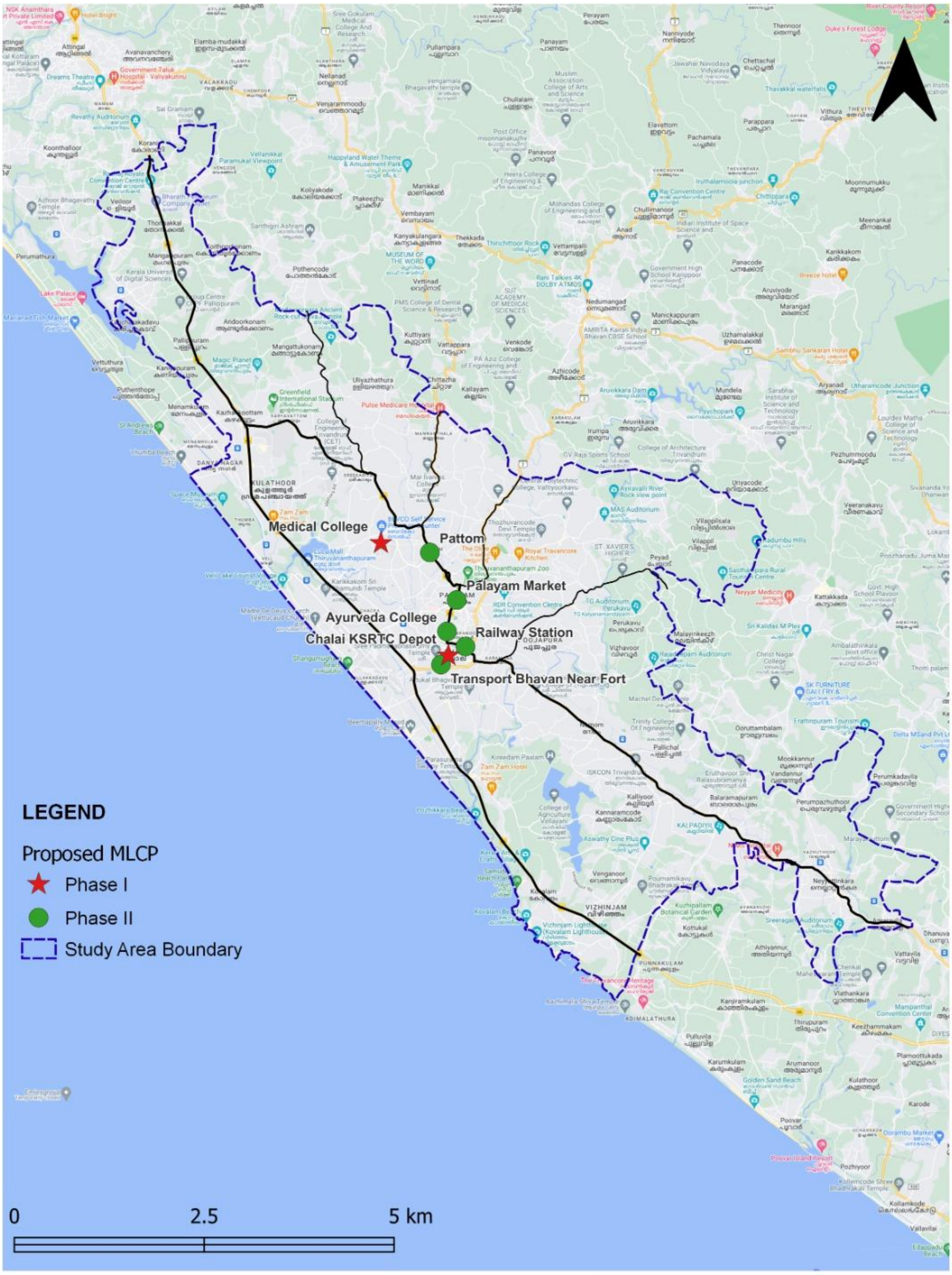
Designated On-Street Parking is recommended on the following locations with optimum lengths for to be effective use of the available parking bays. It is suggested to restrict free On-Street Parking on the other stretches around these corridors. In addition to the motorized parking, some minimum number bicycle parking spaces have also been provided at each location to encourage the use on Non-Motorized Transport in the study area.

Table 5-33 *Proposed On-street Parking Spaces Capacities*

Location	Effective Length (m)	Parking Bays								
		LHS			RHS			Total		
		2W	4W	Cycle	2W	4W	Cycle	2W	4W	Cycle
MG Road Between Attakulangara and LMS	812	382	64	30	372	69	25	754	133	55
NH 66-Plamoodu to Kesavadasapuram	758	-	-	-	326	70	30	326	70	30
Mettukada - Vellayambalam	577	137	81	30	86	94	25	223	175	55
Sreekaryam - Chekkamukku	757	454	35	30	352	57	25	806	92	55
Vellayambalam - Sasthamangalam	717	188	96	30	259	78	25	447	174	55
East Fort	820	402	53	30	560	18	25	962	71	55
Sreekumar Theatre - Vanross Junction	906	545	44	30	466	64	25	1011	108	55
Medical College - Ulloor Road	715	361	45	30	361	41	25	722	86	55

5.7.2 DESIGNATED OFF-STREET PARKING SPACES

Designated Off-Street Parking is recommended on the following locations with optimum area for effective use of the available parking bays. It is suggested to restrict free On-Street Parking on the other stretches around these areas. In addition to the motorized parking, some minimum number of bicycle parking bays have also been provided at each location to encourage the use on Non-Motorized Transport in the study area.



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED Urban Mass Transit Company Limited
Name: Proposed Multi Level Car Parking	

Figure 167 Proposed Parking Spaces

Table 5-34 *Proposed Off-street Parking Spaces Capacities*

Location	Area (m^2)	ECS (Proposed)	Composition			Bays			Type
			2W	4W	Cycle	2W	4W	Cycle	
Palayam Market	600	52	36%	46%	18%	30	39	35	Surface
Power House Road	1300	116	57%	26%	18%	160	72	116	Surface
Gandhi Park	600	50	44%	36%	20%	43	35	39	Surface
Chandrasekharan Nair Stadium	300	25	42%	31%	28%	15	11	13	Surface
Attukal Shopping Complex	700	61	27%	48%	25%	22	39	31	Surface
Karimpanal Arcade	500	42	48%	31%	21%	23	15	19	Surface
KSRTC Stand East Fort	800	64	68%	18%	14%	49	13	31	Surface
Thiruvananthapuram Municipal Corporation	800	66	19%	62%	19%	10	32	21	Surface
Chalai KSRTC Depot	630	1054	63%	12%	24%	62	12	20	MLCP
Medical College	360	552	77%	10%	13%	120	15	20	MLCP
Transport Bhavan Near Fort	405	1065	63%	22%	16%	80	28	20	MLCP
Palayam Market	630	1054	63%	12%	24%	62	12	20	MLCP
Railway Station	450	765	75%	5%	20%	185	13	20	MLCP
Pattom	525	790	69%	13%	18%	78	15	20	MLCP
Ayurveda College	216	533	62%	8%	31%	116	15	20	MLCP

*MLCP – Multi-level parking

5.7.3 CONCEPT - PARKING POLICY

5.7.3.1 PARKING PRICING

Parking pricing and time limits are important parking management mechanisms in order to promote short-term parking enhance turnover of parking bays at proposed designated locations and ensure access to limited on-street parking in high parking demand areas. For the study area, the following pricing methods are suggested to be implemented.

5.7.3.2 DISTANCE FROM OFF-STREET PARKING FACILITY

The parking on streets adjacent to off-street parking facilities should be priced 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. Thus, parking around all the designated parking should be priced higher based on the land use values of those locations.

5.7.3.3 TIME-OF-THE DAY / OCCUPANCY BASED PRICING

Dynamic pricing is suggested to be incorporated to achieve higher parking turn-over rates. For Thiruvananthapuram Time and Occupancy based pricing methods are recommended.

The occupancy-based pricing is based on either a target average occupancy on street at the locations known to saturate easily. The following locations can be considered for occupancy-based parking pricing:

- Thampanoor
- East Fort
- Palayam
- MG Road
- LMS Vellayambalam Road
- Ulloor Road
- Kesavadasapuram

The 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. The following locations can be considered for Time-based parking pricing:

- Kazhakkoottam
- Sreekaryam
- Enchakkal

5.7.3.4 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. The On-Street Parking locations around the following locations are suggested to have higher parking price,

- Central Railway Station
- Kochuveli Railway Station
- Thambanoor KSRTC Bus Stand
- East Fort Bus Stand

The tentative parking prices based on the demand and willing to pay is as shown below.

Table 5-35 *Peak Hour Parking Fees*

Vehicle Type	Morning/ Evening Peak Hours (3-4 Hrs Each)			
	Up to 1 hr	2 hr	3 hr	4 hr
Two-Wheeler	5	10	15	20
Private Car	20	40	60	80
Large Car/ SUV	30	50	70	90

Table 5-36 *Short Term Parking Fees*

Vehicle Type	Day (8AM to 8PM)												Night (8PM to 8AM	Full Day
	Up to 1 hr	Up to 2 hrs	Up to 3 hrs	Up to 4 hrs	Up to 5 hrs	Up to 6 hrs	Up to 7 hrs	Up to 8 hrs	Up to 9 hrs	Up to 10 hrs	Up to 11 hrs	Up to 12 hrs		
Two-Wheeler	5	5	5	10	10	10	15	15	15	20	20	20	5	25
Private Car	15	30	45	60	75	90	105	120	120	120	120	120	10	130
Large Car/ SUV	25	40	55	70	85	100	115	130	130	130	130	130	20	150

Table 5-37 *Long Term Parking Fees*

Vehicle Type	Daily Charges			Subsidised Charges	
	Day 12 hrs (8AM to 8PM)	Night 12 hrs (8PM to 8AM)	24 hrs Day + Night	Quarterly	Annually
Two-Wheeler	200	50	250	250	1000
Private Car	1200	100	1300	1000	4000
Large Car/ SUV	1300	200	1500	1250	5000

A detailed Parking Policy Study should be carried out capturing the land values and dynamic parking conditions to identify feasibility of the locations and the parking fees at proposed locations.

5.7.3.5 ENFORCEMENT

Enforcement is the most crucial tool of Parking Management Strategy. The success and failure of the parking strategy is dependent of the extent of the enforcement. In Thiruvananthapuram, especially along the major transit corridors and activity areas the parking enforcement shall be carried out through the following mechanisms:

1. Ensuring that all on-street parking areas and parking lots off-street are clearly marked and easily identified. Specifically, the following standards shall be followed:
   - On street parking spaces shall be designed as per IRC: SP: 12:2015.
   - Boundaries of all on-street parking spaces will be marked by white line as indicated in IRC:35-1997.
   - Signage clearly marking the parking and 'No Parking' areas shall be marked as per IRC:67-2001.
2. Clear demarcation and implementation of 'No Parking' areas. These areas shall include:
   - Prohibition of parking for at least 75 m distance from all junctions.
   - Prohibition of parking at least 10 m distance from all zebra crossings.
   - Prohibition of parking at least 45m on either side of the transit is terminal entry and exit points.
3. Un-designated On-Street private vehicle parking within the immediate vicinity of the transit stations should be restricted, at least during the peak hours.

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

5.7.3.6 PROOF OF PARKING

This strategy aims at serving two purposes - controlling the vehicle population and resolve parking issues. It should be mandated that residents should procure a No Objection Certificate from the concerned 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.

5.7.3.7 PARKING STANDARDS NEAR TRANSIT STATIONS

Reduced parking standards near transit within a buffer zone of 300 m around the transit line. All Public Transit corridors, the high mobility corridors 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.

5.7.3.8 SHARED PARKING

This strategy aims to optimize parking capacity by allowing complementary land uses to share spaces, rather than providing separate spaces. Sharing parking spaces typically allow 20-40% more users compared with assigning each space to an individual motorist, since some potential users are usually away at any particular time.

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

A detail Parking Policy Study should be carried out to check the potential of the proposed locations.

5.7.3.9 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 5-38 *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 resident's home

Potential areas where RPZ can be implemented are:

- Karyavattom area
- Kulathoor area
- Sreekaryam area

The suggested strategies when engineered, implemented and enforced together shall reduce up to 15% of the parking demand. The typical reduction of the suggested strategies is presented below.

Table 5-39 *Typical Reductions*

Strategy	Description	Typical Reduction
Designated Parking Spaces (Parking Design and Operation)	Improve parking facility design and operations to help solve problems and support parking management.	Varies
Parking Pricing	Charge motorists directly and efficiently for using parking facilities.	10-30%
Improve Enforcement	Ensure that parking regulation enforcement is efficient, considerate and fair.	Varies
Proof of Parking	Produce a No Objection Certificate from the Development Authority to control the on-street vehicle population and resolve parking issues	5-10%
Shared Parking	Parking spaces serve multiple users and destinations.	10-30%
Parking Permits	Restrict parking to help ease parking congestion in residential areas around major demand generators.	5-10%
Bicycle Facilities	Provide bicycle storage and changing facilities.	5-15%

A detail Parking Policy and Management Study should be carried out for the feasibility of the above identified proposals for implementation.

5.8 TECHNOLOGICAL TRANSITIONS

5.8.1 PASSENGER INFORMATION SYSTEMS (PIS)

In the case of public transit, PIS refers to an information system, which provides real-time, dynamic information for passengers. This may include both predictions about arrival and departure times, and information about the nature and causes of disruptions. The system utilizes vehicle location data from AVL systems to disseminate information on the current location of the bus to passengers and predict arrival times at bus stops (Green City Streets n.d.). This is particularly useful on low-frequency routes and when buses deviate from scheduled times due to unforeseen circumstances[30].

The first generation of PIS involved the use of light-emitting diode (LED) display boards at bus stops to indicate estimated arrival times for the next bus Through the urban bus specifications recommended by the Ministry of Housing and Urban Affairs (MoHUA), this system was used inside buses to announce next-stop information; however general observations (EMBARQ India 2014) indicate that several systems remain unused or non-functional. Few cities experimented with the option of communicating this information via SMS, but with limited success. Current advancements in telecommunications, such as smart phones, create the potential to track buses in real time through mobile phone Apps, which is currently been adopted by BMTC in Bangalore for their city bus systems.

Figure 168 *PIS System*

In case of Thiruvananthapuram, the initiative has been made by KSRTC to implement PIS system inside all the buses, all terminals and bus stops.

[30] Source: Bus Karo 2.0

6.1.1.1 VECHICLE 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 CMP suggests the used of electric vehicles.

6.1.1.2 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 169 *Electric Vehicles*

In case of Thiruvananthapuram, newly formed circular service buses are provided with Electrical buses, which needs to be further expanded.

Whereas, E-rickshaws are highly recommended in the city. 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.

5.8.2 SMART CITY BUS SHELTER

Smart city bus shelters are modernized and technologically advanced bus shelters that aim to enhance the overall experience for commuters and improve the efficiency of public transportation systems. These bus shelters incorporate various features and technologies to provide a more convenient, comfortable, and connected environment for passengers. Here are some key aspects of smart city bus shelters:

1. **Real-Time Information:** Smart bus shelters are equipped with digital display boards or screens that provide real-time information about bus arrival and departure times, route details, and any service disruptions or delays. This information helps passengers plan their journeys more effectively and reduces the uncertainty associated with waiting for buses.
2. **Interactive Touchscreens:** Many smart bus shelters feature interactive touchscreens or kiosks that allow passengers to access additional information, such as maps, fare details, and nearby points of interest. These touchscreens may also provide access to other services like weather updates, emergency contacts, and local news.
3. **Passenger Amenities:** Smart bus shelters prioritize passenger comfort by providing seating arrangements, lighting for enhanced visibility and safety, and shelter from inclement weather conditions. Some shelters may have charging stations for mobile devices, free Wi-Fi connectivity, and even air conditioning or heating systems for extreme weather conditions.
4. **Safety and Security:** Smart bus shelters are designed to ensure the safety and security of passengers. They may include surveillance cameras for monitoring activities, emergency call buttons to contact authorities in case of emergencies, and well-lit areas to discourage criminal activities.
5. **Sustainability Features:** Many smart bus shelters incorporate environmentally friendly features. These may include solar panels to generate electricity for lighting and charging stations, rainwater harvesting systems, and energy-efficient lighting systems. These sustainability measures help reduce the carbon footprint and promote eco-friendly practices.
6. **Integration with Mobile Applications:** Smart bus shelters can be integrated with mobile applications that provide real-time bus tracking, ticketing services, and other travel-related information. Passengers can use these apps to plan their journeys, purchase tickets, and receive notifications about their bus arrivals.

Smart city bus shelters are part of the larger vision of creating intelligent and connected urban spaces. By leveraging technology and innovation, these shelters aim to enhance the overall public transportation experience, encourage the use of public transit, and contribute to the development of smarter, more sustainable cities. The identified locations for implementing the smart bus shelters in Thiruvananthapuram by Smart City is provided below.

Figure 170 *EV Charging Station at Thiruvananthapuram*

Figure 171 *Smart City Bus Shelters*

S. No.	Smart Bus Shelters
PHASE I	
1	Women's College Bus Stop
2	Panavila Bus Stop
3	Killipalam Bus Stop Along Model Boys School
4	Killipalam Bus Stop Opp. Model Boys School
5	Railway Station Bus Stop
6	Ayurveda College Bus Stop
PHASE II	
1	Vazhuthacaud Bus Stop Near Police HQ
2	Vazhuthacaud Bus Stop Near Juma Masjid
3	Kalabhavan Bus Stop
4	Vazhuthacaud Bus Stop Near Annie Mascrene Square - Thycaud
5	Mettukada Junction Bus Stop - Thycaud
6	Thycaud Bus Stop Near W&C Hospital
7	Kanakakunnu Palace - 1
8	Kanakakunnu Palace - 2
9	Public Office Building
10	Museum
11	LMS
12	Bakery Junction
13	Palayam
14	Saphalyam
15	Statue North
16	Statue South
17	Overbridge Junction
18	Model School
19	East Fort
20	Government Hospital Junction
21	Kerala University
22	Bakery Junction
23	VJT Hall

5.8.3 ADAPTIVE TRAFFIC CONTROL SYSYTEM (ATCS)

The Adaptive Traffic Control System (ATCS) is an advanced traffic management technology that uses real-time data and intelligent algorithms to optimize traffic flow and improve the efficiency of signalized intersections. It is designed to adapt to changing traffic conditions dynamically and provide optimal signal timings for different traffic volumes and patterns. Here are some key aspects of the Adaptive Traffic Control System:

1. **Real-Time Traffic Monitoring:** ATCS utilizes various sensors, such as video cameras, radar, and inductive loop detectors, to collect real-time data on traffic flow, vehicle counts, and occupancy at intersections. This data is continuously analyzed to assess current traffic conditions.
2. **Intelligent Signal Optimization:** The ATCS employs advanced algorithms and predictive models to optimize signal timings based on the collected data. It takes into account factors such as traffic volume, congestion levels, queue lengths, and pedestrian activity to dynamically adjust signal phases and timings.
3. **Traffic Responsive Operation:** Unlike traditional traffic control systems that operate on fixed signal timings, ATCS responds to the prevailing traffic conditions. It can automatically adjust signal timings based on the demand and prioritize the movement of vehicles along the most congested routes.
4. **Coordination of Multiple Intersections:** ATCS can coordinate signal timings across multiple intersections within a road network to create a coordinated and synchronized traffic flow. This helps to minimize stops, reduce delays, and enhance the overall efficiency of traffic movement.
5. **Emergency Vehicle Pre-emption:** ATCS can provide special priority and pre-emption for emergency vehicles such as ambulances and fire trucks. It can detect the approach of emergency vehicles and modify the signal timings to give them a clear and unobstructed path.
6. **Data Analysis and Performance Monitoring:** ATCS generates valuable data on traffic patterns, congestion levels, and signal performance. This data can be analyzed to identify traffic trends, optimize signal timings further, and make informed decisions for transportation planning and infrastructure improvements.

Benefits of ATCS include reduced travel times, improved traffic flow, decreased congestion and delays, enhanced safety for motorists and pedestrians, and reduced environmental impact by minimizing vehicle emissions. By dynamically adapting to changing traffic conditions, ATCS helps optimize the use of existing road infrastructure and contributes to more efficient and sustainable transportation systems.

Figure 172 *AI Cameras for Traffic Monitoring*

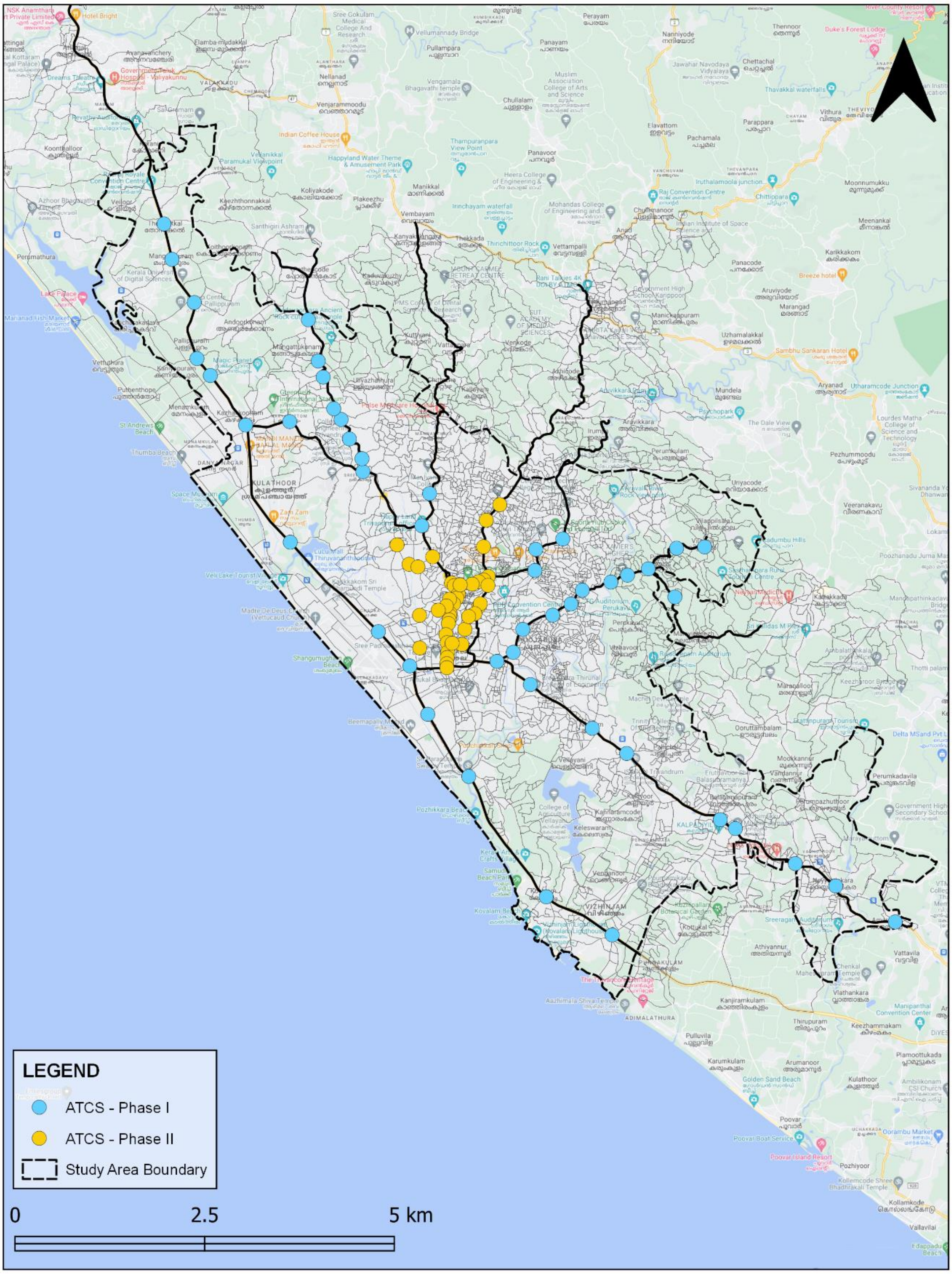
It's worth noting that the specific implementation and capabilities of ATCS may vary depending on the location and system provider. However, the overall goal remains consistent: to intelligently manage and optimize traffic flow for enhanced mobility and efficiency. The proposed intersections at which the ATCS is planning to be implemented are listed in the following Table.

Table 5-40 *Proposed Intersection for ATCS*

S. No	Junction
1	Medical College Junction
2	GG Hospital
3	Pottakkuzhi
4	Pattom
5	Plamoodu
6	PMG
7	Mascot Hotel
8	War Memorial
9	Palayam
10	VJT Hall
11	Statue South

S. No	Junction
12	Statue Middle
13	Statue North
14	Pulimoodu
15	Ayurveda College
16	Overbridge
17	Pazhavangadi
18	East Fort
19	Vettumurichakotta
20	Attakulangara
21	Peroorkkada
22	Amabalamukku
23	Kowdiar
24	Vellayambalam
25	Keltron House
26	Museum
27	Corporation
28	LMS Junction
29	Althara Junction
30	SMC Junction
31	Vazhuthacaud
32	Xanadu (Women's College)
33	Panavila
34	Model School
35	Thampanoor
36	RMS Junction, Thampanoor
37	Asan Square
38	AKG Center Junction
39	General Hospital
40	Pattoor
41	Nalumukku

46 additional locations have been identified for the implementation of adaptive traffic control system for the future years. Which is provided in the figure below.



Title: Comprehensive Mobility Plan (CMP) for Thiruvananthapuram	KOCHI METRO RAIL LIMITED Urban Mass Transit Company Limited
Name: Adaptive Traffic Control System (ATCS)	

Figure 173 *Proposed Intersection for ATCS*

5.9 FREIGHT STRATEGY

Freight movement in indicates the level of economic activities in the city. The location of economic nodes decides the movement of goods traffic and managing the goods traffic movement is vital to maintain the acceptable level of congestion during peak hours within the city.

Restricting the heavy goods vehicle movement in major mobility corridors during peak hours (8AM to 9 PM) is the long-term strategy that need to be considered to avoid excess congestion caused by goods traffic during peak hours.

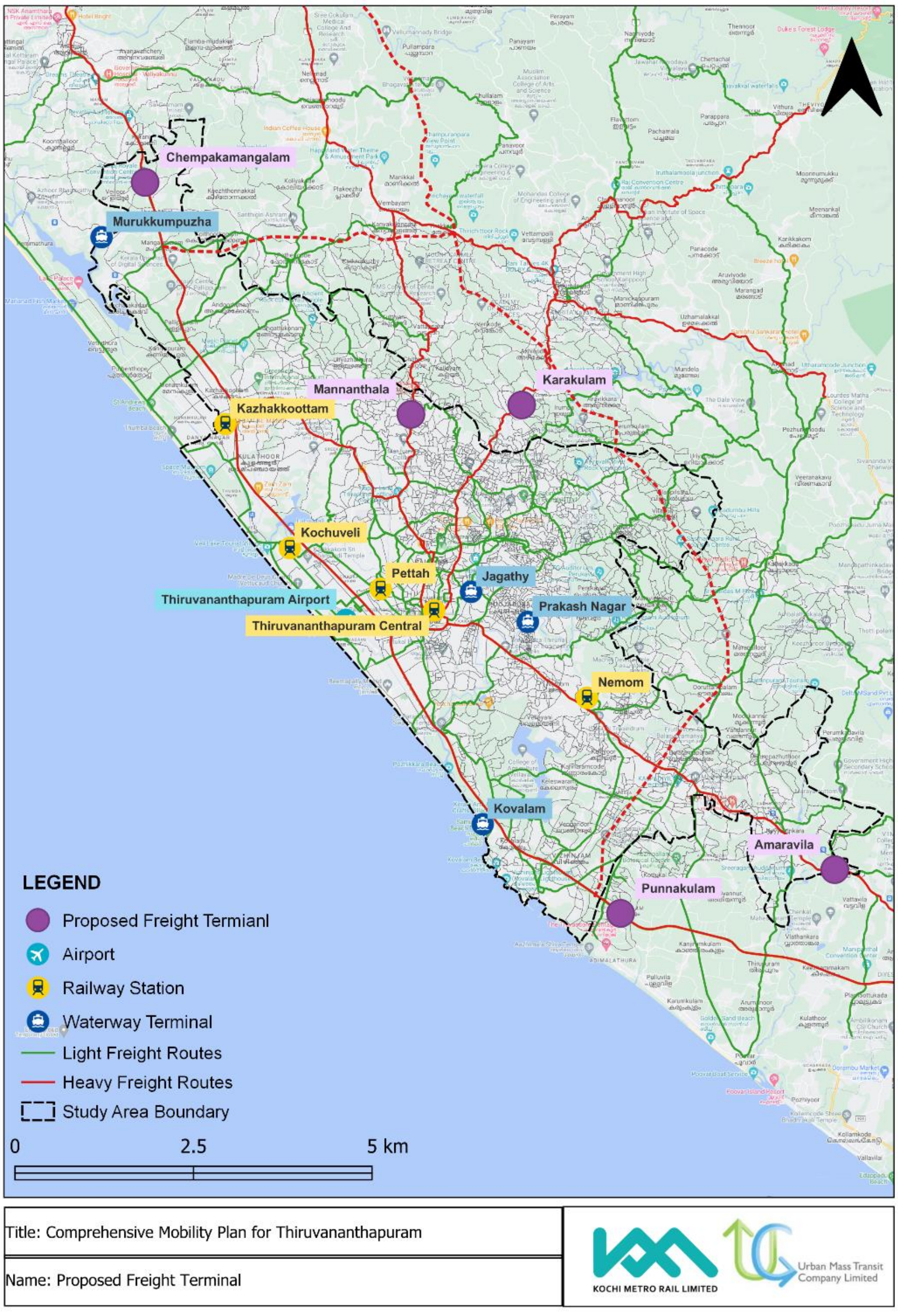


Figure 174 *Proposed Freight Terminals*

Table 5-41 *Proposed Freight Terminals with Capacity*

S. No.	Location	Trucks	Area Required (Sq. M.)
1	Chempakamangalam	500	140000
2	Mannanthala	250	70000
3	Karakulam	300	86000
4	Amaravila	250	70000
5	Punnakulam	500	140000

The proposed Chempakamangalam feight terminal can be developed into a logistic hub in the future based on the demand.

5.10 MOBILITY IMPROVEMENT MEASURES AND NUTP OBJECTIVES

The thrust of The National Urban Transport Policy (NUTP) is, “Moving people not vehicles”. The NUTP Guidelines suggested by the Ministry of Housing and Urban Affairs (MoHUA) focus is on the following Sustainable Transportation principles:

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

The transportation strategies and policies are recommended to prioritize infrastructure and action plans development to promote safe and convenient movement of Non-Motorised Transportation Users, followed by public transportation systems. The CMP Thiruvananthapuram is prepared on similar lines focusing on equitable road space usage for users as the core of the CMP vision.


എല്ലാ ടെർമിനലുകളിലും സ്റ്റോപ്പുകളിലും പാസഞ്ചർ ഇൻഫർമേഷൻ സിസ്റ്റം (P.I.S)
സ്മാർട്ട് ബസ് ഷെൽട്ടറുകൾക്കായി 29 സ്ഥലങ്ങൾ
അഡാപ്റ്റീവ് ട്രാഫിക് കൺട്രോൾ സിസ്റ്റത്തിന്റെ 41 ലൊക്കേഷനുകൾ
മെച്ചപ്പെടുത്തലുകൾക്കായി 77 ജംഗ്ഷനുകൾ
നടപ്പാത അടയാളപ്പെടുത്തലും അടയാളങ്ങളും
71.6km എം.ആർ.ടി.എസ് ഇടനാഴി
11 പുതിയ ബസ് റൂട്ടുകൾ
സിറ്റി ബസ് റൂട്ട് റാഷണലൈസേഷൻ
2051 ഓടെ ബസ് ഫ്ളീറ്റ് 946 ആയി ഉയർത്തുക
63km ഉൾനാടൻ ജലഗതാഗതം
മൾട്ടിമോഡൽ ഇന്റഗ്രേഷനുള്ള 8 ലൊക്കേഷനുകൾ
സാങ്കേതികവിദ്യ സ്ട്രാറ്റജി
ഗതാഗത ഭൂവിനിയോഗ സ്ട്രാറ്റജി
ട്രാഫിക് മാനേജ്മെന്റ് സ്ട്രാറ്റജി
ജന കേന്ദ്രീകൃത മൊബിലിറ്റി പ്ലാൻ
റോഡ് നെറ്റ്വർക്ക് സ്ട്രാറ്റജി
നോൺ-മോട്ടറൈസ്ഡ് ട്രാൻസ്പോർട്ട് സ്ട്രാറ്റജി
പൊതു ഗതാഗത സ്ട്രാറ്റജി
ചരക്ക് മാനേജ്മെന്റ് സ്ട്രാറ്റജി
വികേന്ദ്രീകൃത വികസനത്തിന് 16 നോഡുകൾ
65km ട്രാൻസിറ്റ് ഓറിയന്റഡ് കോറിഡോർ വികസനം
25km ഗ്രോത്ത് കോറിഡോർ വികസനം
222km റിംഗ് ആൻഡ് റേഡിയൽ നെറ്റ്വർക്ക് ഘടന
171km റോഡ് വീതികൂട്ടൽ
വികസനത്തിനായി 108km പുതിയ ലിങ്കുകൾ
21 റോഡ് ക്രോസിംഗുകൾ
262km കാൽനട ശൃംഖല
83km സൈക്കിൾ ശൃംഖല
13km NMT മുൻഗണനാ ഇടനാഴി
47km ബീച്ച് സൈക്കിൾ കോറിഡോർ
20km സൈക്കിൾ ടൂറിസം സർക്യൂട്ട്
സ്കൂളിലേക്കുള്ള സുരക്ഷിതമായ വഴിക്കായി 4 പൈലറ്റ് ഏരിയകൾ
PBS-ന് 25 ലൊക്കേഷനുകൾ
ആകെ 5 ലക്ഷം ചതുരശ്ര മീറ്ററിൽ 5 ട്രക്ക് ടെർമിനലുകൾ

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

06

IMPLEMENTATION PLAN

6 IMPLEMENTATION PLAN

6.1 PHASING AND PRIORTIZATION OF PROJECTS

“Prioritization” as an activity, identifies all individual projects that need to be executed in order to achieve the transportation goals of the city. This phase weaves the projects in one logical sequence, thus forming an "implementation program" which shall be discussed in the Chapter7. The implementation program outlines the following elements:

1) A sequence in which the projects should be undertaken. It should be noted that the "duration" of a project does not necessarily indicate its "priority". Some very long duration project may have to be started 5 years after the implementation of the CMP commences whereas some short duration projects may have to be started immediately. Priorities of projects would be reflected in the suggested sequence.
2) Identification of all projects in two categories, as “Critical” and “Desirable.” It should be noted that “Critical” does not necessarily mean “High priority”, and vice versa. Also, as with priority, the duration of a project does not necessarily indicate its criticality. Some Critical projects may have to be logically started 10 or 15 years down the line, but are still critical for achieving the stated objectives of the CMP. In other words, not implementing “Desirable” projects may have only a mild impact on achieving the transportation objectives, but not implementing “Critical” projects would severely compromise the essence of the vision and objectives of CMP.

Each project is prioritized based on scoring it across seven criteria:

1. Mobility
2. Accessibility
3. Safety
4. Energy
5. Environment
6. Carbon-di-Oxide Mitigation
7. Project Cost

The Phase I indicate Short-term measure (2023-2027), while Phase II indicates Medium Term measure (207-2031-2041) and Phase III indicates long term measures (2051)

6.1.1 PROPOSAL 1: PUBLIC TRANSPORT SYSTEM

Table 6-1: Phasing and Prioritization Of Public Transport System Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Improved City Bus System	Critical	High	Phase I, II,III
Development of High Demand Mobility Corridor	Critical	High	Phase I, II
Development of Inland Water Transportation	Critical	High	Phase I, II
Public Terminals	Critical	Medium	Phase II
Intermediate Public Transport	Critical	High	Phase I,II

6.1.2 PROPOSAL 2: NON-MOTORISED TRANSPORT FACILITY IMPROVEMENT

Table 6-2: Phasing and Prioritization of Pedestrian Facility Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Footpath	Critical	High	Phase I

Table 6-3: Phasing and Prioritization of Bicycling Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Segregated Cycle Tracks	Critical	High	Phase I,II
Public Bick Sharing Schemes	Critical	High	Phase I,II

6.1.3 PROPOSAL 3: FREIGHT MANAGEMENT PLAN

Table 6-4: Phasing and Freight Management Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Freight Terminals	Critical	Medium	Phase II, III

6.1.4 PROPOSAL 4: PARKING MANAGEMENT PLAN

Table 6-5: Phasing and Prioritization of Parking Management Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
On-street Parking	Desirable	Medium	Phase I
Off-street Parking	Desirable	Medium	Phase I, II
MLCP	Desirable	Medium	Phase I, II

6.1.5 PROPOSAL 5: INTELLIGENT TRANSPORTATION SYSTEMS

Table 6-6: Phasing and Prioritization of Its Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras	Desirable	Medium	Phase II, III

6.1.6 PROPOSAL 6: ROAD NETWORK PLAN

Table 6-7: Phasing and Prioritization of Road Network Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Upgradation of New Links	Critical	High	Phase I, II, III
Development Ring Roads	Desirable	Medium	Phase II, III
New / Missing Links	Desirable	Medium	Phase II, III
ROBs/RUB/Canal Crossings	Desirable	Medium	Phase II, III

All the proposals discussed so far can be broadly grouped under three categories:

- Short Term Improvements (Phase I): these are short term proposals that need to be reviewed and implemented within 2-5 years as per the requirement.
- Medium Term Improvements (Phase II): the projects than need to reviewed implemented between 5-20 years as per the requirement.
- Long Term Improvements (Phase III): the projects than need implemented between above 20 years.

Accordingly, long term, medium term and short-term proposals for Thiruvananthapuram are presented below.

6.1.7 SHORT TERM PROPOSALS

Table 6-8: List of Short-Term Proposals

S. NO	PROJECTS
1	Junction, Corridor Improvements
2	Pedestrian Network Improvements
3	Bicycles Corridors Improvements
4	Area Improvement Plans
5	Parking Management Plan
6	Improved Public Transportation System (Bus, Waterways & MRTS)

6.1.8 MEDIUM TERM PROPOSALS

Table 6-9: List of Medium-Term Proposals

S. NO	PROJECTS
1	Upgradation of Existing Roads / Development of New Links
2	Flyover / ROBS / RUBS/ Canal Crossings
3	Dedicated Cycle Tracks
4	Pedestrian Network Improvements
5	New Bus Terminal
6	Improved Bus System
8	Off-Street Multi-Level Parking
9	ITS Systems

6.1.9 LONG TERM PROPOSALS

Table 6-10: List of Medium-Term Proposals

S. NO	PROJECTS
1	Development of New Links
2	Upgradation of Existing Roads
3	Flyover / ROBS / RUBS/ Canal Crossings
4	Improved Bus System
2	Truck Terminals

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.

6.2 PROJECT COSTING

The projects identified in the earlier section are divided into three categories based on the phasing of projects for implementation. The long-term, medium-term and short-term projects have come as the output of transportation assessment carried out specifically to understand the future demand and system requirement. Some of these evolved projects have potential to enter into Public Private Partnership (PPP). It is important to highlight that the CMP serves only to identify schemes and once these schemes are detailed for feasibility and engineering purpose, some of these costs may vary. The tentative block cost estimation is done in reference with the district scheduled rates for year 2020.

The projects proposed are to be implemented in three phases.

- Phase I - To be implemented between 2023 and 2027
- Phase II – To be implemented between 2027 and 2041
- Phase III - To be implemented between 2041 and 2051

The overall short-term project cost is estimated to be **7212.91** crores. All junction improvement schemes, footpath implementation, cycle track network development, removal of encroachment will fall into this category. While the approximate cost of medium-term projects is **3149.00** crores and **4045.83** crores for Long term measures.

Table 6-11: Estimated Project Costs

SL.NO	PROJECTS	TOTAL COST (IN CRORES)	PHASING RS (IN CRORES)		
			2023-2027	2027-2041	2041-2051
1	Improvement of Road Network	2308.37	382.96	1825.24	100.18
2	Improvement of Non-Motorised Transport Facilities	459.97	173.05	286.92	0.00
3	Improvement of Public Transport System	10802.50	6630.08	803.78	3368.64
4	Improvement of Freight Transportation System	758.26	0.00	197.28	560.98
5	Intelligent Transportation System Facilities	67.25	19.96	31.26	16.03
6	Improvement of Parking Facilities	11.39	6.87	4.52	0.00
Overall CMP Proposals		**14407.74**	**7212.91**	**3149.00**	**4045.83**

Table 6-12: Estimated Project Costs

Sl.No	Projects	Unit	Total Quantity	Project Phasing Quantities			Unit Rate (in Crore)	Total Cost (in Crores)	Phasing Rs (in Crores)		
				2023-2027	2027-2041	2041-2051	2027		2023-2027	2027-2041	2041-2051
Improvement of Road Network											
1	Upgradation of Existing Roads	Km.	170.6	93.40	77.20	0.00	2.770	487.52	258.71	228.82	0.00
2	New Links	Km.	108.0	0.00	88.00	20.00	3.693	447.94	0.00	347.77	100.18
3	Flyover upgradation (2-Lane)	No.	1.0	1.00	0.00	0.00	42.841	42.84	42.84	0.00	0.00
4	ROB/ Canal Crossing Upgradation (2-Lane)	No.	9.0	1.00	8.00	0.00	51.409	491.49	51.41	440.09	0.00
5	Flyover (4-Lanes)	No.	11.0	0.00	11.00	0.00	59.977	705.97	0.00	705.97	0.00
6	Junction Improvements	No.	77.0	20.00	57.00	0.00	1.500	132.60	30.00	102.60	0.00
Total Project Cost								**2308.37**	**382.96**	**1825.24**	**100.18**

Sl.No	Projects	Unit	Total Quantity	2023-2027	2027-2041	2041-2051	Unit Rate 2027	Total Cost	2023-2027	2027-2041	2041-2051
Improvement of Non-Motorised Transport Facilities											
1	Footpath	Km.	262.0	100.00	162.00	0.00	1.625	444.19	162.50	281.69	0.00
2	NMT Only Lanes	Km.	3.5	3.51	0.00	0.00	2.556	8.97	8.97	0.00	0.00
3	Shared Cycle Tracks	Km.	79.0	54.00	25.00	0.00	0.026	2.09	1.40	0.69	0.00
4	Dedicated Cycle Tracks	Km.	33.5	3.51	30.00	0.00	0.052	1.84	0.18	1.66	0.00
5	Public Bike Sharing Stations	No.	25.0	0.00	25.00	0.00	0.018	0.49	0.00	0.49	0.00
6	Public Bike Sharing Cycles	No.	335.0	0.00	335.00	0.00	0.007	2.38	0.00	2.38	0.00
Total Project Cost								**459.97**	**173.05**	**286.92**	**0.00**

Sl.No	Projects	Unit	Total Quantity	Project Phasing Quantities			Unit Rate (in Crore)	Total Cost (in Crores)	Phasing Rs (in Crores)		
				2023-2027	2027-2041	2041-2051	2027		2023-2027	2027-2041	2041-2051
Improvement of Public Transport System											
1	Bus Fleet Augmentation	No.	611.0	171.00	202.00	238	1.808	1283.69	309.20	390.84	583.65
2	Improvement of Bus Terminals / Multi Modal Mobility Hubs	No.	10.0	2.00	8.00	0.00	1.950	20.59	3.90	16.69	0.00
3	New Public Transportation Station	No.	11.0	7.00	4.00	0.00	1.773	20.00	12.41	7.59	0.00
4	In Land Water Ways System	Km	64.5	28.80	34.70	1.00	10.467	704.32	301.46	388.66	14.20
5	MRT System (BRT/LRT)	Km	57.5	42.90	0.00	14.60	139.933	8773.90	6003.11	0.00	2770.79
Total Project Cost								**10802.50**	**6630.08**	**803.78**	**3368.64**
Improvement of Freight Transportation System											
1	Proposed New Truck Terminals	Sq.m		0.00	156000.00	350000.00	0.001	758.26	0.00	197.28	560.98
Total Project Cost								**758.26**	**0.00**	**197.28**	**560.98**
Technological and Intelligent Transportation System Facilities											
1	New Signal Installations	No.	2.0	2.00	0.00	0.00	0.295	0.59	0.59	0.00	0.00
2	Adaptive Traffic Control System	No.	41.0	20.00	21.00	0.00	0.886	37.64	17.73	19.92	0.00
3	Smart City Bus Shelters	No.	23.0	6.00	17.00	0.00	0.266	6.43	1.60	4.84	0.00
4	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	Km.	40.0	10.00	10.00	20.00	0.000	22.35	0.00	6.32	16.03
5	Electric Charging Stations - 2w and 3w	No.	77.0	20.00	57.00	0.00	0.003	0.23	0.05	0.18	0.00
Total Project Cost								**67.25**	**19.96**	**31.26**	**16.03**

Sl.No	Projects	Unit	Total Quantity	Project Phasing Quantities			Unit Rate (in Crore)	Total Cost (in Crores)	Phasing Rs (in Crores)		
				2023-2027	2027-2041	2041-2051	2027		2023-2027	2027-2041	2041-2051
Improvement of Parking Facilities											
1	On street Parking	Km.	6.0	6.00	0.00	0.00	0.554	3.32	3.32	0.00	0.00
2	Off street Parking (MLCP)	No.	4.0	0.00	4.00	0.00	1.108	4.52	0.00	4.52	0.00
3	Off street Parking (Surface))	No.	8.0	8.00	0.00	0.00	0.443	3.55	3.55	0.00	0.00
Total Project Cost								**11.39**	**6.87**	**4.52**	**0.00**
Overall Comprehensive Traffic and Transportation Plan Proposals											
Total Project Cost								**14407.74**	**7212.91**	**3149.00**	**4045.83**

6.3 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 dedicating 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.

6.3.1 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 projects 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.

6.3.2 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.

6.3.2.1 VIABILITY GAP FUNDING

In a recent initiative, the Government of India has established a special financing facility called "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 centers and other tourism infrastructure projects

6.3.2.2 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.

Pimpri-Chinchwad Municipal Corporation has 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 is given below:

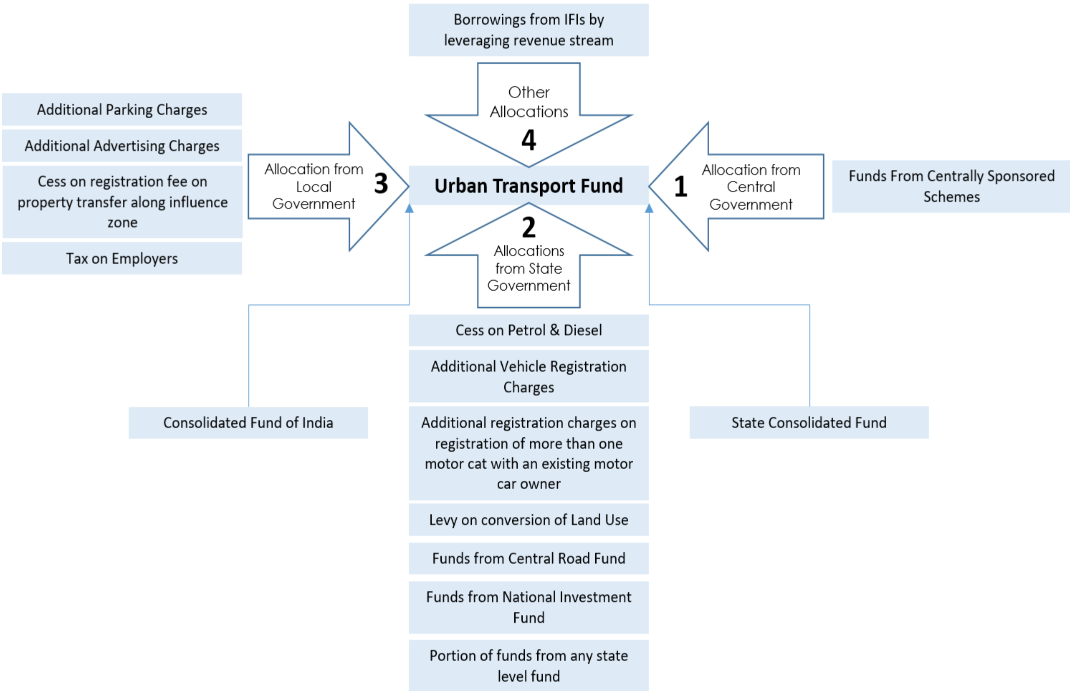


Figure 175 Sources of Funds For Urban Transport Fund

6.3.2.2.1 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.

6.3.2.2.2 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 considering 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 centre 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.

6.3.2.2.3 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.

6.3.2.2.4 ADVERTISING

This is another important source of revenue for the city. When properly utilised, 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 greater good for the society from these overpasses is minimal.

6.1 IMPLEMENTING AGENCIES

Based on roles and responsibilities of various institutions, the agencies responsible for implementing the proposed projects in the CMP are as follows-

Table 6-13: Details of Implementation Agency

SN	Projects	Agencies Responsible	Implementation Operation	
			Construction	Operation/Maintain
Improvement of Road Network				
1	Upgradation of Existing Roads	PWD/NHAI/TMC	PWD/ NHAI / Private	PWD / NHAI / Private
2	New Links	PWD/NHAI/TMC	PWD/ NHAI / Private	PWD / NHAI / Private
3	Flyover upgradation (2-Lane)	PWD/NHAI	PWD/ NHAI / Private	PWD / NHAI / Private
4	ROB/ Canal Crossing Upgradation (2-Lane)	PWD/NHAI/TMC	PWD/ NHAI / Private	PWD / NHAI / Private
5	Flyover (4-Lanes)	PWD / TMC / State Govt. / NHAI	State Govt. / TMC	PWD / NHAI / Private
6	Junction Improvements	PWD / TMC / State Govt. / NHAI	State Govt. / TMC	PWD / NHAIs
Improvement of Non-Motorised Transport Facilities				
1	Footpath	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
2	NMT Only Lanes	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
3	Shared Cycle Tracks	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
4	Dedicated Cycle Tracks	TMC / Smart City / PWD	TMC / Smart City / PWD	TMC / Smart City / PWD/ Traffic Police
5	Public Bike Sharing Stations	TMC / Smart City / Private	TMC / Smart City / Private	TMC / Smart City / Private
6	Public Bike Sharing Cycles	TMC / Smart City / Private	TMC / Smart City / Private	TMC / Smart City / Private
7	Public Education and Awareness program	TMC / Smart City / Private / NGOs /State Govt.	TMC / Smart City / NGOs	TMC / Smart City / Private /NGOs

SN	Projects	Agencies Responsible	Implementation Operation	
			Construction	Operation/Maintain
Improvement of Public Transport System				
1	Bus Fleet Augmentation	KSRTC	State Govt.	KSRTC
2	Improvement of Bus Terminals / Multi Modal Mobility Hubs	KSRTC/TMC / Smart City	KSRTC/TMC / Smart City / Private	KSRTC/TMC / Smart City / Private
3	New Public Transportation Station	KSRTC/ SPV /TMC / Smart City	KSRTC/SPV/ TMC / Smart City / Private	KSRTC/TMC / Smart City / Private /SPV
4	In Land Water Ways System	KSRTC/ SPV /TMC / Smart City	KSRTC/SPV/ TMC / Smart City / Private	KSRTC/TMC / Smart City / Private /SPV
5	MRT System (BRT/LRT)	KSRTC/ SPV /TMC / Smart City	KSRTC/SPV/ TMC / Smart City / Private	KSRTC/TMC / Smart City / Private /SPV
Improvement of Freight Transportation System				
1	Proposed New Truck Terminals	State Govt. / TMC / Traffic Police	State Govt. / Private	Private
Technological and Intelligent Transportation System Facilities				
1	New Signal Installations	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police
2	Adaptive Traffic Control System	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police
3	Smart City Bus Shelters	KSRTC/ TMC/ Smart City / Traffic Police	KSRTC/ TMC/ Smart City / Traffic Police / Private	KSRTC/ TMC/ Smart City / Traffic Police / Private
4	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police
5	Electric Charging Stations - 2w and 3w	TMC / Smart City / KSEB / Private	TMC / Smart City / KSEB / Private	TMC / Smart City / KSEB / Private
Improvement of Parking Facilities				
1	On street Parking	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police / Private	TMC/ Smart City / Traffic Police / Private
2	Off street Parking (MLCP)	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police / Private	TMC/ Smart City / Traffic Police / Private
3	Off street Parking (Surface))	TMC/ Smart City / Traffic Police	TMC/ Smart City / Traffic Police / Private	TMC/ Smart City / Traffic Police / Private

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

07

PROJECT IMPACT ASSESSMENT & OUTCOMES

7 PROJECT IMPACT ASSESSMENT AND OUTCOMES

Projects evolved in CMP will help to achieve sustainable development goals by means of reducing private mode share and travel time. This chapter presents the impact of the proposed strategies under Sustainable Urban Transport scenario in comparison to the Business as Usual scenario. The impact assessment is based on the following parameters as suggested in the CMP – Toolkit 2014.

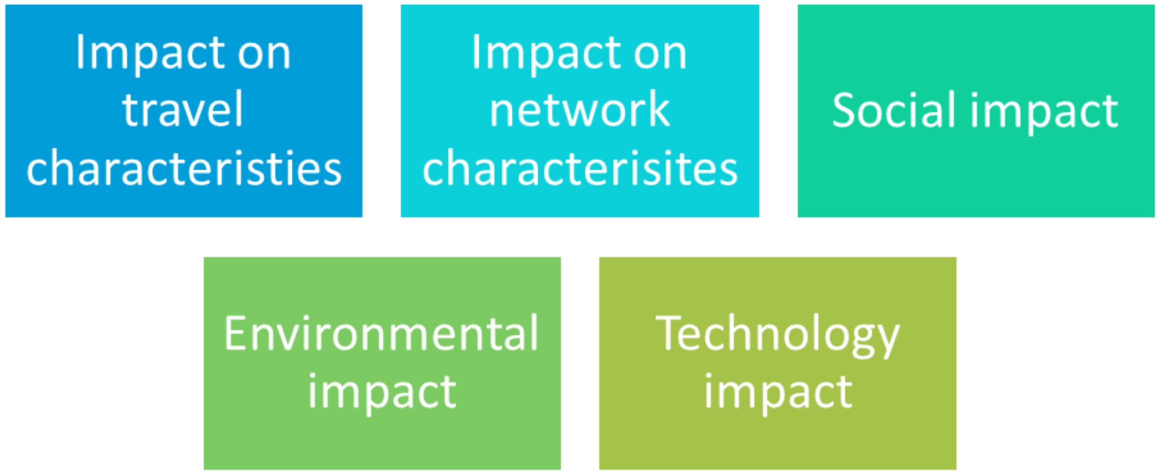


Figure 176 Parameters for Impact Assessment

7.1 IMPACT ON TRAVEL CHARACTERISTICES

The anticipated impacts of proposed projects on travel characteristics are assessed based on the following parameters,

- **Mode Share** - Variations in the composition of trips made by various modes (users).
- **Average Trip Lengths -** Average travel Time of users of various mode in the study area
- **Average Travel Time** – Average travel Time of users of various mode in the study area
- **Accessibility to Public Transport** – Share of Population Having Access to PT in Thiruvananthapuram.

The impact on the above are as presented in the table below.

Table 7-1 Impact Assessment for Travel Characteristics.

S.NO.	INDICATOR TYPE	DESCRIPTION	Base Year (2023)	BAU (2051)	SUT[(2051)
	Impact on Network Characteristics				
1	**Modal Share (%)-Motorized Modes**				
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	66%	69%	48%
	Public Modes	% of trips made by public transport modes	25%	18%	41%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	9%	13%	11%
2	**Trip Length (Km)**				
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car and Auto users in the study area	9	11.2	10.6
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.5	9.2	11.1
3	**Travel Time (Minutes)**				
	Travel Time (PvT Modes)	Average Travel Time of the Two-wheeler, Car and Auto users in the study area	24	34	28
	Travel Time (PT Modes)	Average Travel Time of the Public Transport users in the study area	32	40	32
4	**Accessibility to Public Transport (Population in lakh)**				
	Access to PT	Population having access to PT	7	7.2	8.6

7.2 IMPACT ON NETWORK CHARACTERISTICES

The anticipated impacts of proposed projects on network characteristics are assessed based on the following parameters,

- **Demand on corridors** – PUC and Passenger demand on major mobility corridors.
- **Congestion Levels** - Variations in the composition of trips made by various modes (users).
- **Average Speed** – Average speed of modes on the network in each scenario.
- **Footpath Coverage** – Percentage of major network covered with footpath.

The impact on the above are discussed in the following sections.

Reduction in intensity of vehicles on major roads is observed along with the distribution onto other roads in SUT scenario. However, the impact on SUT scenario on travel demand is presented is observed to improve in intensity as well as the coverage due to introduction of new routes and improved frequency of PT transit systems.

Table 7-2 Impact Assessment for Network Characteristics- Demand (PT PHPDT)

SN	CORRIDOR NAMES	LENGTH	Base 2023	BAU (2051)	SUT (2051)
1	Mangalapuram to Neyyattinkara (NH 66)	42.2	10580	13784	19747
2	Kazhakkoottam to Killipalam (NH-Bypass)	14.7	3031	4176	6513

The impact on the congestion levels is assessed and it observed that the only 2,2% of the network has levels over 0.8 in SUT scenario. The same has been presented in the following figure and tables along with demand estimates on the major mobility corridors. The congestion on major mobility corridors is presented below.

Table 7-3 Impact Assessment for Network Characteristics- Congestion

SN	NAME OF THE ROAD	DISTANCE (KM)	V/C (Base Year)	BAU V/C (2051)	SUT V/C (2051)
1	Maruthankuzhi Kesavadasapuram Rd	1.6	0.98	1.62	0.88
2	Thirumala Peyad Malayinkeezhurd	1.2	0.98	1.59	0.80

SN	NAME OF THE ROAD	DISTANCE (KM)	V/C (Base Year)	BAU V/C (2051)	SUT V/C (2051)
3	Kowdiar Ave	1.2	0.98	1.57	0.84
4	Panvel -Kochi Rd	1.5	0.98	1.58	0.88
5	Peroorkada Vattiyoorkavu Rd	11.2	0.98	1.47	0.85
6	Mukkikada Edathara Rd	1.9	0.98	1.31	0.84
7	Vazhuthacaud-Poojappura	2	0.98	1.41	0.84
8	Pappanamcode Malayinkeezhu Rd	6.1	0.87	1.15	0.72
9	Chekkalamukku-Powdikonam	2.5	0.98	1.33	0.83
10	Peroorkada	1.2	0.98	1.29	0.81
11	Kazhakoottam-Thaikod Rd	3.6	0.85	1.13	0.74
12	Poojappuram Rd	2.8	0.82	1.18	0.84
13	Powdikonam-Pothencode Rd	1.1	0.88	1.15	0.81
14	Peroorkada Rd	0.5	0.79	1.10	0.78
15	Medical College Ulloor Rd	1	0.87	1.18	0.79
16	PMG Rd	1.3	0.86	1.42	0.81
17	Market Rd	0.5	0.99	1.63	0.83
18	CV Raman Pillai Rd	3.2	0.81	1.34	0.84
19	LMS Vellayambaam Rd	3.2	0.89	1.47	0.74
20	Nemom Punnamoodu Rd	0.8	0.79	1.30	0.81
21	Sasthamangalam Rd	0.7	0.87	1.44	0.81
22	Nh66	41.9	1.04	1.48	0.88
23	Vizhinjam Poovar Rd	6.8	1.06	1.11	0.82
24	Pallicheal Vizhinjam	5.8	1.03	1.43	0.85
25	Mahatma Gandhi Rd	3.3	1.23	2.02	0.87
26	Trivendrum Vizhinjam Rd	4.2	1.34	2.08	0.91
27	Railway Station Rd (Over Bridge to Station)	0.6	1.45	2.12	1.02

The average speed of vehicles on the network was measured for the horizon years in the model and is observed that vehicle speed in the SUT scenario have increased owing to the improvements in road network and public transport proposals.

Table 7-4 Impact Assessment for Network Characteristics

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR (2023)	BAU (2051)	SUT (2051)
1 Infrastructure and Land use					
1	**Infrastructure Quality**				
	Average Speed (Kmph) (PvT)	Average speed of private modes	21.8	19.4	22.6
	Average Speed (Kmph) (PT)	Average speed of public transport modes	16.2	15.6	20.4
2	**Safety**				
	Quality of footpath infrastructure	% of city covered with Footpaths (Arterial and Sub-Arterial)	32%	50%	100.0%

7.3 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.

Table 7-5 Broad Impact of Proposed Projects

PROJECT	ROW/LAND ACQUISITION	IMPROVE MOBILITY	REDUCTION IN TRAVEL TIME
Improved Bus Systems	No	Yes	Yes
Mass Transit System	Yes	Yes	Yes
Bus Terminals	Yes	Yes	NA
Freight Terminals	Yes	Yes	NA
Bus Shelters	Yes	Yes	Yes
ROBs/ New Roads/Flyovers	Yes	Yes	Yes
Bypass/Ring Roads	Yes	Yes	Yes
Foot Path	No	Yes	NA

PROJECT	ROW/LAND ACQUISITION	IMPROVE MOBILITY	REDUCTION IN TRAVEL TIME
Cycle Tracks	Yes	Yes	Yes
Major Junction Improvements	No	Yes	Yes

Some of the broad indicators for social changes are quantified and are presented in below.

Table 7-6 Social Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU SCENARIO (2051)	SUT SCENARIO (2051)
Private Transport (PVT) Trips	66%	69%	48%
Intermediate Public Transport (IPT) Trips	9%	13%	11%
Public Transport Trips	25%	18%	41%
Walkability (Arterial & Sub-Arterial)	32%	50%	100%
Cyclability (Arterial & Sub-Arterial)	0%	20%	80%
Public Transport Accessibility	70%	72%	83%
Average distance to nearest stop from house of a PT user	0.9	0.9	0.6
Percent of public transport vehicles that provide disability access (by public transport mode)	0	0	50%
Percent public transport stations / bus stops that provide disability access	0	0	50%
Percent length of public footpaths (km) that provide disability access	0	0	75%

7.4 ENVIRONMENTAL IMPACTS

Environmental and social screening is intended to provide inputs into identification of potential impacts with the implementation of the CMP. Screening is conducted by identifying the interaction of environmental components on the project activities for various projects. Screening conducted for the identified projects and respective impacts identified are presented in the Table 6.2-3.

Table 7-7 Impacts of Proposed Project Implementation

	PROJECT	SUB COMPONENTS	IMPACTS
1	Transit Hubs (based on TOD principles)	Development of serviced land for high density development Public transport interchange hubs	• Construction activity around the highway.
2	Pedestrian / NMT Infrastructure Improvement	Land acquisition for road widening wherever necessary	• Relocation of existing vending activity. • Removal of squatters and encroachers from the footpaths, if any. • Causing livelihood loss even though they are un-authorized.
		Construction of new footpath	• Improvement in safety of pedestrians due to measures proposed.
3	Public Transport Planning	Terminals/Depots/ Transport Hubs/Bus Stops/ MRT Systems	• Acquisition of land for the facilities causes 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. • Temporary interruption to traffic and increases 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.

	PROJECT	SUB COMPONENTS	IMPACTS
4	Road Network Improvements	Road Widening/New Link/Flyovers	• Land acquisition causes loss of livelihood, property dismantling etc. • Temporary interruption to traffic and increases 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
		Junction Improvements	• May cause removal / displacement of squatters & Encroachers. • Air and noise pollution from construction impacts • Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
5	Freight Management	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

An understanding of vehicles, fuels and CO emissions from electricity use in transportation system is essential to learning the implications of travel demand on CO2 emissions and air quality.

The transport sector relies primarily on fossil fuels. The dependence on fossil fuels is linked to the domination of internal combustion engine technology on a global scale. In future, however, multiple transitions can affect vehicles and associated infrastructures. In the case of Thiruvananthapuram, there would be:

1. A change in fuels due to greater use of cleaner petrol and diesel; more efficient engines.
2. More electricity for transportation such as buses, e-rickshaws well as promoting electric vehicles.

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 below.

Table 7-8 Environmental Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Local Emissions (Tonnes/day)	10.7	31.3	12.5
GHG Emissions (Tonnes/day)	72.1	120.1	81.2
Exposure to Transport Noise	>75	>75	<75

Thus, the timely implementation of the proposed project shall result in improved travel times, cleaner air and improved travel experience in the city.

7.4.1 ENVIRONMENTAL IMPACT ASSESSMENT & MITIGATION MEASURES

This section provides a summary of the screening conducted to determine the potential environmental impacts associated with the proposed expansion of roads under Comprehensive Mobility Plan. It covers all the major roads that come under Thiruvananthapuram.

Road projects can produce negative impacts. The impacts of road improvement, as the one being proposed, although usually more limited, can still be significant, not only on natural resources and systems but also on the social environment.

A wide variety of direct and indirect negative impacts have been attributed to road construction or improvement project. Though sharing a common concern over most environmental attributes, depending on their past experience in various projects, different agencies tend to lay varying emphasis on different biophysical and socio-environmental components and issues.

(i) **Land Acquisition and Involuntary Relocation/Resettlement**: These essentially include:

- Adverse social impacts on affected persons/households/business due to acquisition of land and property.
- Impacts due to removal of squatters and encroachers in the existing R.O.W., majority of whom might belong to economically and socially vulnerable sections of the society and thus needing rehabilitation/ compensation
- Stresses on the host community where project affected persons are relocated

(ii) **Community Impacts –** these include:

- Community severance
- Loss of roadside community businesses and social activities
- Bypassing of communities
- Reduced convenience of traditional modes of transport
- Gentrification effect, viz. displacement of low-income and socially vulnerable sections due to increase in market value of land/property as a consequence of improved infrastructure.

7.4.2 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Environmental Management Plan recommended for the proposed NH-66 Improvement Project is discussed in this section. The EMP discussed below includes:

- Specific actions to be taken related to specific issues
- Responsible agencies for implementation and supervision
- Time frame for implementing mitigation measures
- Cross-reference to documents and specifications
- Project level environmental monitoring
- Cost of Mitigation Measures
- Environmental Monitoring Plan

7.4.2.1 ENVIRONMENTAL MITIGATION MEASURES

In order to mitigate the adverse impacts likely to crop up during construction stage and operation stage, the environmental management plan is worked out indicating the impacts, measures to be adopted and authorities' responsibility to implement during construction and operation phase of the project. Generic mitigation measures applicable to the proposed project are outlined in Tables for Pre-construction, Construction and Operational phase respectively.

7.4.2.2 ENVIRONMENTAL MONITORING PLAN

The environmental monitoring plan is prepared to check the effectiveness of the mitigation measures during the construction and operational phases. To ensure the effective implementation of the EMP, an appropriate environmental monitoring plan is prepared with objectives outlined below:

- To evaluate the performance of mitigation measures proposed in EMP
- To evaluate the adequacy of Environmental Impact Assessment
- To suggest improvements in management plan, if required
- To satisfy the legal and community obligations

At the project level, the vital parameters or performance indicators that will be monitored during construction and/or operational phases of the project include:

- Ambient air quality measures such as PM10, PM2.5 SO2, CO, NOx, HC, etc.
- Noise levels
- Traffic volume and characteristics
- Tree plantation survival rate

The recommended environmental monitoring plan is presented below. The methods for sampling and analysis will be as per prevalent requirements of CPCB and Indian Standard (IS) codes.

Table 7-9 Project Specific Environmental Mitigation Measures

ADVERSE IMPACT	MITIGATION MEASURES
PRE-CONSTRUCTION STAGE	
The impact of road generated noise, which could affect residents along the road.	The road design shall provide for constructing noise barriers near residential areas. Fixing of traffic signs such as 'No Honking' etc.
The impact of road generated dust, which could affect residents along the road.	Regular air monitoring shall be done & accordingly dust suppression methods shall be applied.
Increased traffic speed as result of 4 lanning &/or 2 lanning of road could increase the number of accidents.	Safe pedestrian pathway shall be included.
CONSTRUCTION STAGE	
Construction of the road to 4 lanning/2 lanning will affect traffic movement and generates dust due to drilling/excavation, unloading of construction materials and exposure of stored material to wind.	Construction will be taken phase-wise so that road surface is open for traffic movement and major construction work during off-peak/night hours.
	Area under construction will be covered and equipped with dust collector. Construction material shall be covered or stored in such a manner so as to avoid affected by wind direction.
	Vehicles carrying construction materials will have covered top and beds. The fall height will be kept low so that least amount of dust is airborne, during unloading of materials.
Operation of construction equipment and delivery trucks generates air & noise pollution.	Stationary construction equipment will be kept at least 500m away from residential areas.

ADVERSE IMPACT	MITIGATION MEASURES
	Idling of delivery vehicles will not be allowed at construction site
	Construction equipment with noise level more than 70 dB (A) not to be allowed at site. Mufflers to be used to reduce the noise level.
	The operation of equipment and activities such as drilling, excavation to be restricted during night time as the site has dense residential pockets in most of the stretches of the project road.
Unplanned dumping of excavated material	The excavated material to be deposited in relatively low-lying areas away from residential areas and water bodies. Care should be taken that dumped material does not block natural drainage system.
OPERATION PHASE	
1. Increase in traffic volume over time and pollution level and poor road surface	Strict compliance with emission standards to reduce vehicular emission load for SO_x, NOx, CO, $PM_{10.5}$ etc.
2. Increased vehicular speed due to un-interruption from pedestrian may increase road accidents	Enforcement of strict road safety measure is needed

Generic Environmental Mitigation Measures

Table 7-10 Pre-Construction Stage Mitigation Measures

S. NO.	ADVERSE IMPACT	MITIGATION MEASURES	CROSS REFERENCE TO DOCUMENTS	TIME FRAME	RESPONSIBILITY	
					IMPLEME-NTATION	SUPER VISION
1	Improvement schemes suggest cutting the number of trees	Try to save the tree to the possible extent. An approval from appropriate Authority of Maharastra is required so that new trees can be planted to maintain the ecological balance. Compensatory afforestation and additional trees for landscaping		Before Start of Construction of relevant section	TMC	PIA
2	Local Traffic Arrangements	Temporary traffic arrangements during construction within ROW have to be planned. This plan shall be periodically reviewed with respect to site conditions	MoRTH:112	During site clearance and Construction	Contractor	TMC
3	Pedestrian Safety	Special considerations shall be given in the local traffic management to the pedestrian safety especially at congested locations. Adequate provisions to segregate through the local traffic. Guard railing all along the urban section.	MoRTH:112.2	At Congested locations	Contractor	TMC
4	Land Acquisition	Acquisition of land is minimized to the maximum extent. Land shall be acquired as per the Government Land Acquisition Policy, applicable. To avoid impact of land outside ROW, construction activities shall be restricted within Row, wherever possible.	Land Acquisition Policy by GOI. MoRTH 201.2	Before Start of Construction of the project road	Contractor	TMC

S. NO.	ADVERSE IMPACT	MITIGATION MEASURES	CROSS REFERENCE TO DOCUMENTS	TIME FRAME	RESPONSIBILITY	
					IMPLEME-NTATION	SUPER VISION
5	Air Quality	NOC from concerned State Pollution Control Board shall be obtained. Adequacy of measures shall be checked to control air pollution.	MoRTH 111	Before start of the project road	Contractor	TMC
6	Water Quality	NOC from concerned State Pollution Control Board shall be obtained. Adequacy of measures shall be checked to control water pollution.	MoRTH 111	Before start of the project road	Contractor	TMC
7	Noise Level	NOC from concerned State Pollution Control Board shall be obtained. Noise screening by trees plantation scheme proposed as noise barriers. Adequacy of measures shall be checked to control noise pollution.	MoRTH 111	Before start of the project road	Contractor	TMC
8	Relocation of utility lines/community utilities	Affected utilities shall be relocated with prior approval of the concerned agencies. All the R & R activities shall be reasonably completed as per RAP. All the cultural properties that have been identified as affected shall be relocated as per resettlement plan.	MoRTH 110	Before start of the project road	Contractor	TMC
9	Road Drainage	Provision of adequate size and number of cross-drainage structures (Culverts) as well as drains along the road	MoRTH 306	Throughout the project road	Design Consultant	PIA

7.4.2.3 INSTITUTIONAL STRENGTHENING

The implementation of an environmentally sound transport strategy involves a number of institutions/organizations at various levels, with each organization having a distinct role to play. Introducing environmental dimensions in formulating and implementing a transport strategy would require that these institutions should have additional responsibilities for ensuring that the strategy does not result in any significant adverse environmental impacts.

In order to examine the existing capacities & identify the additional responsibilities that the concerned Organizations/Institutions may take up to address environmental issues, these Organizations are categorized in four groups – Apex Organizations, Project Implementation Agencies, Transport Service Organizations and Regulatory Organizations.

Thiruvananthapuram Corporation is the apex organization and being the regional funding authority has to be regular interactions with various Project Implementing Agencies. The existing capabilities of these organizations for environmental management will have to be carefully assessed. The envisaged roles & responsibilities of these organizations and additional strengthening requirements to meet the environmental obligations are given below.

Table 7-11 Institutional Strengthening & Training Requirements

ORGANIZATION	ROLES & RESPONSIBILITIES	STRENGTHENING REQUIRED
Municipal Corporation	Review the Implementation of EMPs Facilitate implementation of policy directives/emission laws etc. for pollution prevention/mitigation by interacting with various Gov. Depts. Like Environment Dept., Urban Development Dept. etc. Review the environmental management capabilities of implementing agencies to assist them in developing their capabilities. Obtain and analyze environmental information generated by organizations like KSPCB (Kerala State Pollution Control Board), etc.	Enhance the capabilities of the TMC by out sourcing whenever required. Training coordinated by TMC with support of EMCB Consultants on: • Environmental assessment • Appreciation of Environmental impacts and EMPs procedure and responsibilities for EMP implementation, monitoring & reporting etc.

7.4.2.4 ROLE OF IMPLEMENTING AUTHORITIES IN CONSTRUCTION PHASE MITIGATION

Implementing Organizations for Construction Stage Mitigation:

The project implementing authorities like TMC has major role in enforcement mitigation of measures during construction phase. These measures can be taken care by the contractors assigned the project under supervision of implementing authorities.

Mechanisms for Implementing Mitigation:

The project implementing agency shall include a section in their tender document for the project, which is aimed at getting the mitigation measure implemented during construction stage. Various points recommended for incorporation as:

- Construction should be scheduled in such a manner that excavated site does not remain exposed during monsoons.
- Construction should be taken up stage wise to reduce inconvenience to users.
- Covering trucks carrying construction materials which are susceptible to getting air borne.
- Enclosing the construction sites for the reasons of public safety, containment of dust and aesthetics.
- Specification of noise level for construction equipment. Values recommended are
    - Drilling 75 dB A)
    - Vibrator 75 dB (A)
    - Dumpier 75 dB (A)
- Assurance from the Contractor that noise level shall not be exceeding the ambient noise standards of 50 dB (A) during day time and 40 dB (A) as project sites have residential buildings and sensitive receptors.
- Specifications for operating construction equipment away from sensitive receptor, unless it is not feasible, in which case temporary noise shield to be used.
- Specification for the sites to be used for the disposal of the excavated material at the TMC /PWD specified sites.

7.4.2.5 COST ESTIMATES FOR IMPLEMENTING EMP

The cost estimates for EMP implementation during construction and operational phase are summarized below. The estimate has been prepared for the task as mentioned below:

- Air Pollution monitoring during construction and operation stages
- Noise monitoring during construction and operation stages
- Water quality monitoring during construction and operation stages
- Soil Quality monitoring during construction
- Monitoring of tree survival rate (Compensatory Avenue Plantation)
- Dust Suppression at Site

Table 7-12 Cost Estimates for EMP Implementation

S. NO.	ITEM NO.	ASSUMPTION	RATE ADOPTED (IN RS.)	TOTAL COST (IN RS.)
CONSTRUCTION PHASE				
1	Air Quality Monitoring	20 representative samples for 24 hours (Once every – pre-monsoon & post monsoon for 24 months)	6000/-per sample	400000
2	Noise Monitoring	20 representative samples for 24 hours Once every – pre-monsoon & post monsoon for 24 months)	2,000/-per day	160000
3	Water quality monitoring	10 representative samples Once every – pre-monsoon & post monsoon for 24 months)	3500/- per sample	160000
4	Soil Quality testing	10 representative samples (Once every – pre-monsoon & post monsoon for 24 months)	2800/- per sample	120000
5	Compensatory avenue plantation of twice the number of trees to be cut and their fencing and maintenance for two years	1000 Nos	600/tree	1200000
6	Dust Suppression at Site(3 trips/day for 365 days for 2 years)	3000 nos.	500/Tanker	3000000
Total				**50,40,000**

Notes: Operational Phase Air quality, water quality and Noise level and Soil quality monitoring will be for one year.

7.4.2.6 CONCLUSION

Summary of Key Issues and Mitigation Commitments:

This section provides a summary of conclusions and recommendations drawn following completion of the Initial environmental assessment. These conclusions and recommendations are intended to provide:

- Guidance to TMC as to policy decisions which will affect the roadway design, implementation and future planning for the CMP.
- Direction for further environmental impact assessment work to be conducted in the stage of project development and implementation.

It is intended that the conclusions and recommendations included in this report will generate discussion, and interpretation of the environmental assessment scope of work.

The following general conclusions are drawn:

- The initial Screening and scoping helped to address the probable issues that have already been, and/or are expected to be addressed in subsequent stages of road design.
- The Initial environmental assessment should be considered as a preliminary assessment. Most conclusions and recommendations require confirmation following more detailed assessment in subsequent stages of project development.
- Overall, it is concluded that The CMP can be developed without causing significant adverse environmental impacts to the natural, economic or cultural environment of the study area, assuming the mitigation measures identified in this report are incorporated into design; the most important of these are;
- The widening of the road may be limited to available RoW especially at congested locations,
- Appropriate mitigation measures as suggested in environmental assessment shall be incorporated especially in case of educational institutes, religious structures, Health care facilities, etc.
- In general, it is suggested that the choice of developing additional lanes to the right or left side of the existing carriageway, and /or the routing of re-alignments may be made so as to minimize:
- The relocation of residences, business / commercial establishments; and/or institutional facilities such as government buildings and schools,
- The relocation of cultural properties (Church, temples, masjid, etc.),

7.5 TECHNOLOGY TRANSITIONS (VEHICLES AND FUELS)

The impact of the proposals in each of the scenario is accessed under technological transitions is measures under this section.

7.5.1 VEHICLE FUEL TRANSITION

An understanding of vehicles, fuels and CO emissions from electricity use in transportation system is essential to learning the implications of travel demand on CO2 emissions and air quality.

The transport sector relies primarily on fossil fuels. The dependence on fossil fuels is linked to the domination of internal combustion engine technology on a global scale. In future, however, multiple transitions can affect vehicles and associated infrastructures. In the case of Thiruvananthapuram, there would be:

1. A change in fuels due to greater use of cleaner petrol and diesel; more efficient engines.
2. More electricity for transportation such as buses, e-rickshaws well as promoting electric vehicles.

Table 7-13 Vehicle Fuel Transition Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Percent of public transport fleet in compliance with Indian emissions standards	45%	65%	85%

7.5.2 ITS TRANSITION

The efforts to add information technology to transport infrastructure and vehicles in an effort to manage factors that are typically at odds with each other are measured under this section based on the following parameters.

- Availability of Traffic Surveillance
- Passenger Information System (PIS)
- GPS/GPRS Systems
- Signal Synchronization

7.5.2.1 AVAILABILITY OF TRAFFIC SURVEILLANCE

Transitions due to level of usage of ITS under availability of traffic surveillance for BAU and SUT scenario is shown below.

Table 7-14 Availability of Traffic Surveillance

PARAMETER	DESCRIPTION	BAU (2051)	SUT (2051)	BAU (2051)
Availability of Traffic Surveillance – CCTV	Share of Stations with CCTV on Terminals, Stations and Signalized Intersections	73%	80%	95%

7.5.2.2 PASSENGER INFORMATION SYSTEM (PIS)

Transitions due to level of usage of ITS under availability of passenger information system for BAU and SUT scenario is shown below.

Table 7-15 Passenger Information System

PARAMETER	DESCRIPTION	BAU (2051)	SUT (2051)	BAU (2051)
Passenger Information System (PIS) for Public Transport	Share of Terminals, Stations having PIS	16%	50%	100%

7.5.2.3 GLOBAL POSITIONING SYSTEM (GPS/GPRS)

Transitions due to level of usage of ITS under availability of Global Positioning System for BAU and SUT scenario is shown below.

Table 7-16: Global Positioning System

PARAMETER	DESCRIPTION	BAU (2051)	SUT (2051)	BAU (2051)
Global Positioning System / GPRS	Share of Public Transport Vehicles and IPT with onboard GPS/GPRS which are connected to common control center	34%	50%	**100%**

7.6 OUTCOMES IN SERVICE LEVEL BENCHMARKING

SERVICE LEVEL BENCHMARKING	2023	2051
Public Transport Facilities	LOS 2	LOS 1
Pedestrian Infrastructure Facilities	LOS 3	LOS 1
Non-Motorised Transport Facilities	LOS 3	LOS 2
Level of usage of Intelligent Transport System (ITS) Facilities	LOS 3	LOS 1
Travel Speed (Motorized and Mass Transit)	LOS 3	LOS 1
Availability of Parking Places	LOS 4	LOS 2
Road Safety	LOS 4	LOS 2
Pollution Levels	LOS 2	LOS 1
Integrated Land Use and Urban Transport	LOS 4	LOS 1

LOS 1 – Excellent, Needs to be Maintained
LOS 2 – Good, Can be Improved
LOS 3 – Needs Significant Improvement
LOS 4 – Poor, Needs Immediate Action

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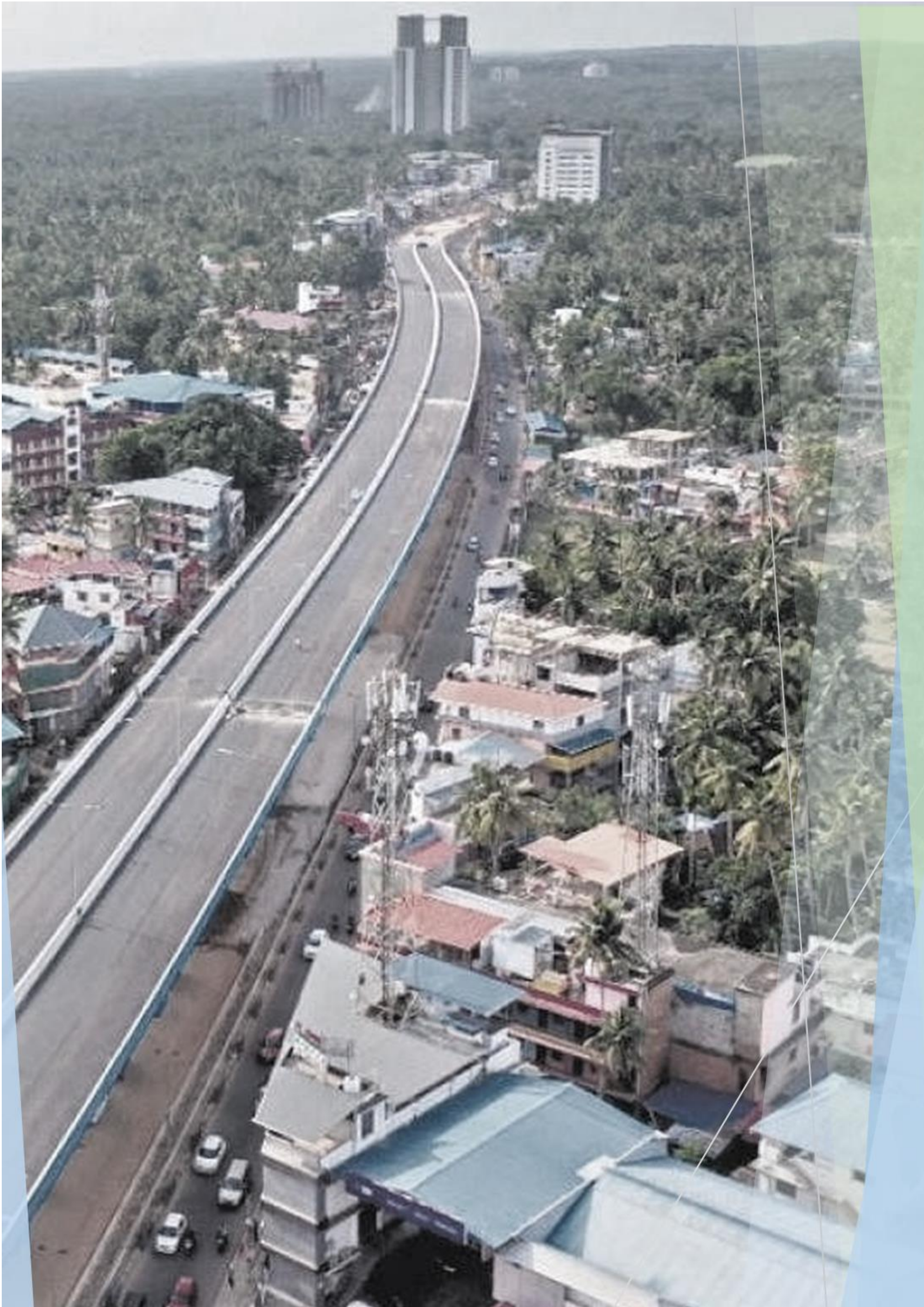
08

INSTITUTIONAL FRAMEWORK



8 INSTITUTIONAL FRAMEWORK

8.1 BACKGROUND

City transport system generally involves several organizations that look after various forms and aspects of the transport system and network and have overlapping functions and areas of work. Therefore, to delineate areas and to remove ambiguity of functions the institutional framework has been proposed.

Following is the list of departments and Organizations involved in urban affairs and urban transport in Thiruvananthapuram

- Thiruvananthapuram Municipal Corporation (TMC)
- Thiruvananthapuram Development Authority (TRIDA)
- Smart City Thiruvananthapuram Limited (SCTL)
- Local Self Government Department (LSGD)
- State Urban Development Department
- Public Works Department (PWD)
- Roads and Buildings Department (R&B)
- National Highway Authority of India (NHAI)
- Traffic Police Department
- Kerala State Road Transport Corporation (KSRTC)
- Railways
- Regional Transport Authority (RTA)
- Airport Authority of India, Thiruvananthapuram

In view of bringing the institutional setup in a proper structure, it is important to understand the issues with the present Institutional set up, listed below.

- No clear segregation between the planning and implementing bodies
- Lack of coordination amongst all the departments in the urban transport sector
- All departments related to urban transport do not function in coherence.

Road projects are implemented in isolation with other projects which should otherwise be an integral part of road development like footpath, cycle tracks, pedestrian facilities etc. No control over mushrooming IPT modes in the city, which lead to issues of congestion along with contesting with the buses for passengers. Operation issues in public transport due to poor route and service planning. No dedicated organization that is in charge of long-term urban transport planning for the city.

With a view to coordinate all urban transport activities in the city, it is recommended that a UMTA be set up at the city level that acts as a planning and decision-making body for all matters related to urban transport in the city.

8.2 INSTITUTIONAL SETUP

It is recommended that the city level UMTA be set up on an executive order for the ease of formation however, it must be given a legal backing so that it's functioning falls under an act and commands greater authority.

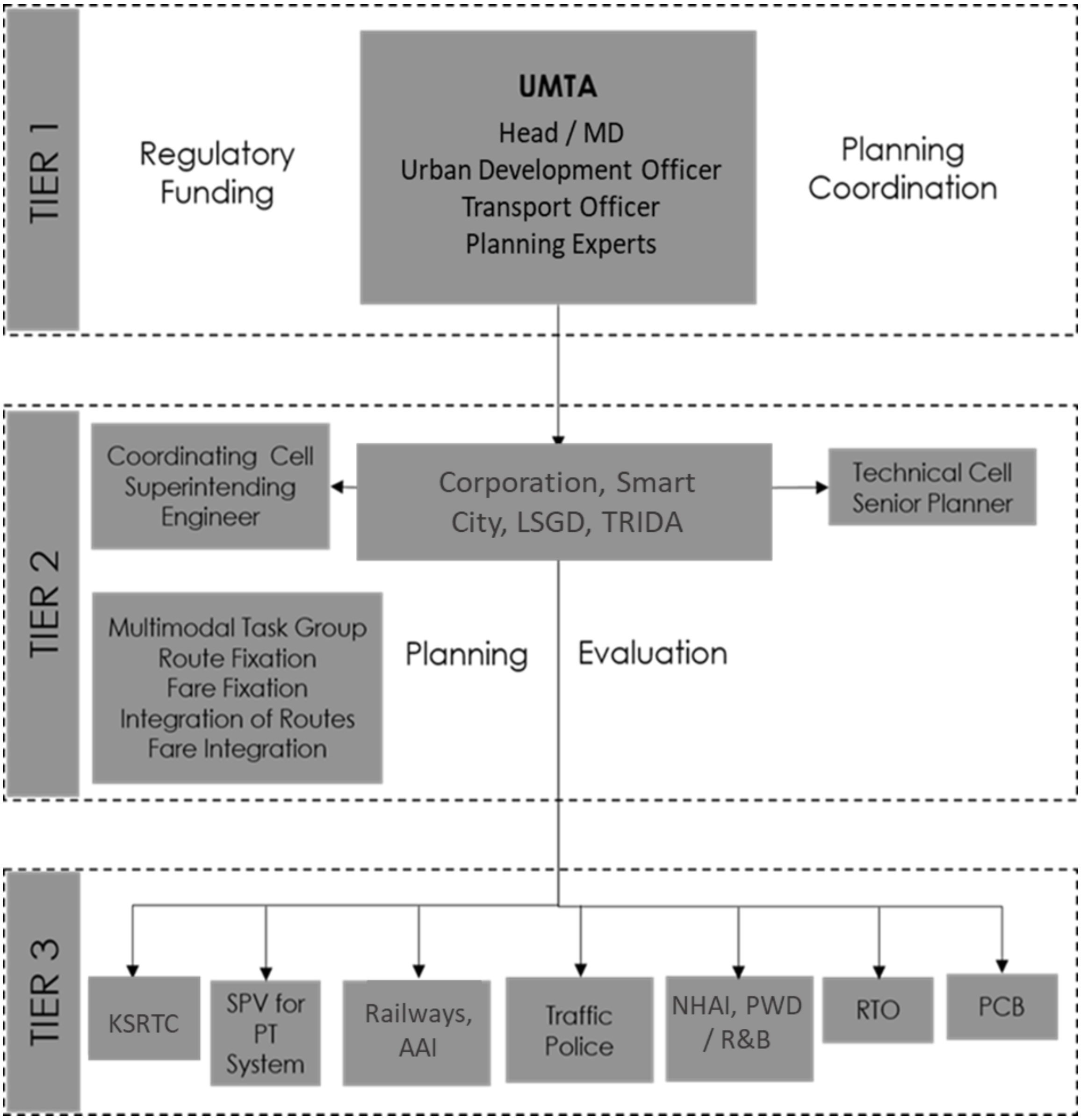


Figure 177 Recommended Structure for UMTA Setup

8.3 BROAD FUNCTIONS OF UMTA

The following functions are proposed to fall under the purview of the city level UMTA

Undertake overall planning for public transport in the city, covering all modes - road, rail, and water and air transport systems

- Allocate routes amongst different operators
- Procure public bus services for different routes through contracting, concessions, etc. Ensure compliance of terms and conditions of license
- Recommend revocation of license for non-compliance of terms and conditions of the license
- Carry out surveys and manage a database for scientific planning of public transport requirements
- Co-ordinate fare integration among different operators of public transport and determine the basis for sharing of revenues earned from common tickets or passes.
- Operate a scheme of passes for the users of public transport and channelize subsidies to operators for any concessions that are offered in accordance with government policy.
- Regulate the Arrangement amongst Operators for the Sharing of Their Revenue Derived from The Use of Passes promote efficiency in public transport operation

Protect the interest of the consumers

- Settle disputes between different operators and between operators and infrastructure providers
- Levy fees and other charges at such rates and in respect of such services as may be determined by regulations;

8.4 LEGAL BACKING OF UMTA

In order to give UMTA objectives, functions and operations a legal status, a draft Act has to be prepared by UMTA to be taken up for approval by the State Cabinet after finalization. The draft Act shall cover the following:

- Objectives and functions of UMTA
- Operational area of UMTA
- Powers and delegation of powers of UMTA
- Authority to have power to acquire land by agreement
- Power of Government to transfer to the Authority lands belonging to it or to other ULBs, etc.
- Power of Authority to borrow
- Laying of annual estimate of income and expenditure
- Authority to approve or amend such estimate
- Estimates to be submitted to Government for sanction
- Supplementary estimates may be prepared and submitted when necessary
- Provisions regarding expenditure
- Accounts and audit
- Schedule of officers and employees to be submitted for sanction of Government
- Appointments, etc., by whom to be made
- Powers of entry
- Directions by the Authority
- Members and officers to be public servants
- Power to make rules
- Power to make regulations

8.5 MANPOWER REQUIREMENT AND STAFFING PLAN

UMTA shall have to avail the services of an expert team of traffic and transportation planners, engineers, urban planners and other technical advisers. In order to strengthen its human resource, UMTA shall have to form a schedule of officers and employees whom it shall deem it necessary and proper to maintain for the purposes of UMTA Act. In addition to this, various powers related to appointment, promotion, suspension, etc. shall also have to be worked out as per the Government's schedule.

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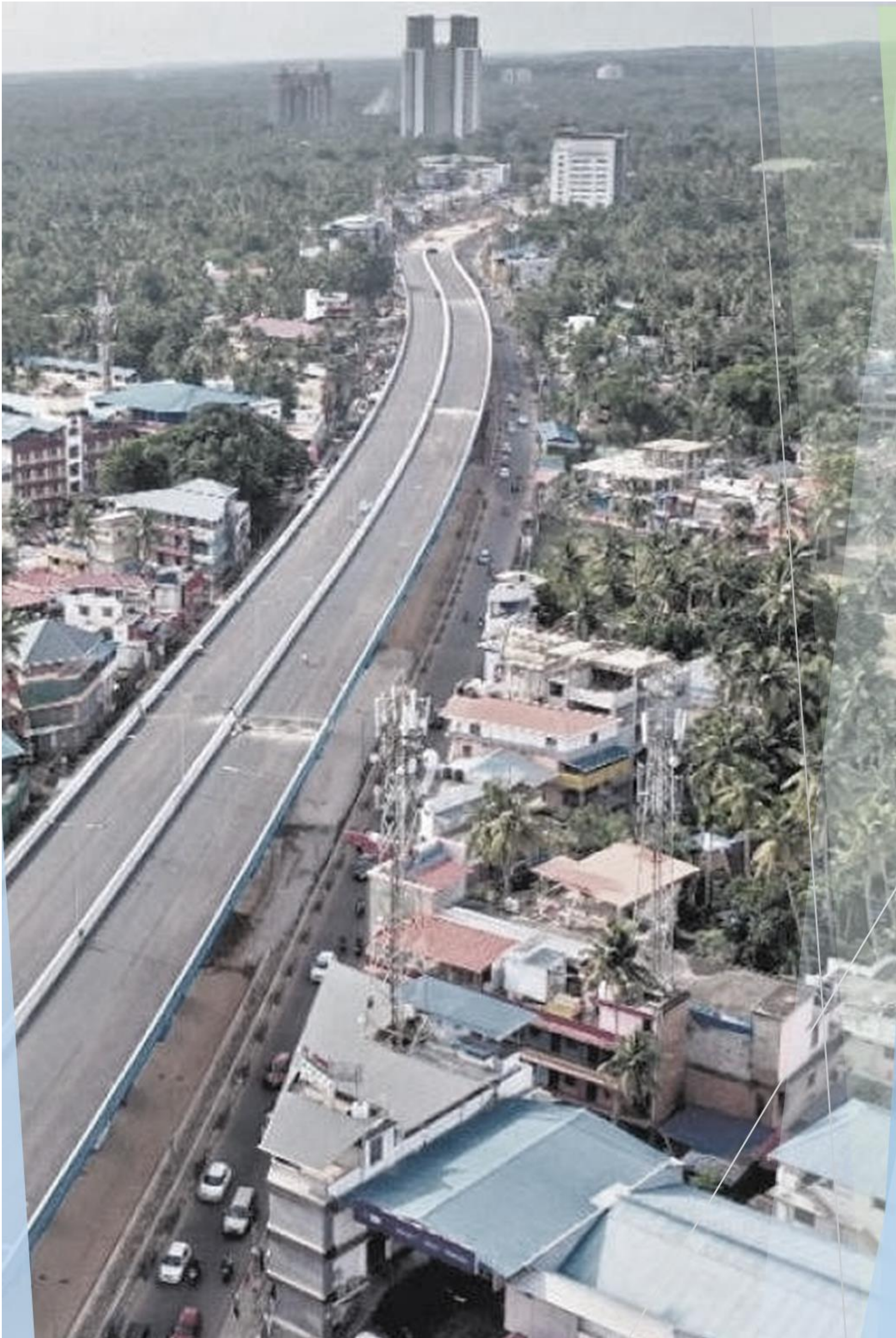
ANNEXURE



ANNEXURE

ANNEXURE 1- WARD DETAISL OF STUDY AREA

The study area comprises of Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and eight adjoining panchayats spread over an area of 371.94 sqkm. The ward wise list of the above mentioned study area is presented in the Table Below,

WARD NO	WARD NAME	ADMINISTRATION AREA
1	Kazhakuttom	Thiruvananthapuram Municipal Corporation
2	Chandavila	Thiruvananthapuram Municipal Corporation
3	Kattayikonam	Thiruvananthapuram Municipal Corporation
4	Sreekariyam	Thiruvananthapuram Municipal Corporation
5	Cheruvaikal	Thiruvananthapuram Municipal Corporation
6	Ulloor	Thiruvananthapuram Municipal Corporation
7	Edavacode	Thiruvananthapuram Municipal Corporation
8	Chellamangalam	Thiruvananthapuram Municipal Corporation
9	Chempazhanthy	Thiruvananthapuram Municipal Corporation
10	Powdikonam	Thiruvananthapuram Municipal Corporation
11	Njandoorkonam	Thiruvananthapuram Municipal Corporation
12	Kinavoor	Thiruvananthapuram Municipal Corporation
13	Mannanthala	Thiruvananthapuram Municipal Corporation
14	Nalanchira	Thiruvananthapuram Municipal Corporation
15	Kesavadasapuram	Thiruvananthapuram Municipal Corporation
16	Medical College	Thiruvananthapuram Municipal Corporation
17	Pattom	Thiruvananthapuram Municipal Corporation
18	Muttada	Thiruvananthapuram Municipal Corporation
19	Kudappanakunnu	Thiruvananthapuram Municipal Corporation
20	Pathirapally	Thiruvananthapuram Municipal Corporation
21	Chettivilakam	Thiruvananthapuram Municipal Corporation
22	Sasthamangalam	Thiruvananthapuram Municipal Corporation
23	Kowdiar	Thiruvananthapuram Municipal Corporation
24	Kuravankonam	Thiruvananthapuram Municipal Corporation
25	Nanthencode	Thiruvananthapuram Municipal Corporation
26	Kunnukuzhy	Thiruvananthapuram Municipal Corporation
27	Palayam	Thiruvananthapuram Municipal Corporation
28	Thycaud	Thiruvananthapuram Municipal Corporation

WARD NO	WARD NAME	ADMINISTRATION AREA
29	Vazhuthacaud	Thiruvananthapuram Municipal Corporation
30	Kanjirampara	Thiruvananthapuram Municipal Corporation
31	Peroorkkada	Thiruvananthapuram Municipal Corporation
32	Thuruthumoola	Thiruvananthapuram Municipal Corporation
33	Nettayam	Thiruvananthapuram Municipal Corporation
34	Kachani	Thiruvananthapuram Municipal Corporation
35	Vazhottukonam	Thiruvananthapuram Municipal Corporation
36	Vattiyoorkavu	Thiruvananthapuram Municipal Corporation
37	Koduganoor	Thiruvananthapuram Municipal Corporation
38	PTP Nagar	Thiruvananthapuram Municipal Corporation
39	Pangode	Thiruvananthapuram Municipal Corporation
40	Thirumala	Thiruvananthapuram Municipal Corporation
41	Valiyavila	Thiruvananthapuram Municipal Corporation
42	Poojapura	Thiruvananthapuram Municipal Corporation
43	Valiyasala	Thiruvananthapuram Municipal Corporation
44	Jagathy	Thiruvananthapuram Municipal Corporation
45	Karamana	Thiruvananthapuram Municipal Corporation
46	Arannoor	Thiruvananthapuram Municipal Corporation
47	Mudavanmughal	Thiruvananthapuram Municipal Corporation
48	Thrikannapuram	Thiruvananthapuram Municipal Corporation
49	Nemom	Thiruvananthapuram Municipal Corporation
50	Ponnumangalam	Thiruvananthapuram Municipal Corporation
51	Punnakkamughal	Thiruvananthapuram Municipal Corporation
52	Pappanamcode	Thiruvananthapuram Municipal Corporation
53	Estate	Thiruvananthapuram Municipal Corporation
54	Nedumcaud	Thiruvananthapuram Municipal Corporation
55	Kalady	Thiruvananthapuram Municipal Corporation
56	Melamcode	Thiruvananthapuram Municipal Corporation
57	Punchakari	Thiruvananthapuram Municipal Corporation
58	Poonkulam	Thiruvananthapuram Municipal Corporation
59	Venganoor	Thiruvananthapuram Municipal Corporation
60	Mulloor	Thiruvananthapuram Municipal Corporation
61	Kottappuram	Thiruvananthapuram Municipal Corporation
62	Vizhinjam	Thiruvananthapuram Municipal Corporation
63	Harbar	Thiruvananthapuram Municipal Corporation
64	Vellar	Thiruvananthapuram Municipal Corporation
65	Thiruvallam	Thiruvananthapuram Municipal Corporation
66	Poonthura	Thiruvananthapuram Municipal Corporation
67	Ambalathara	Thiruvananthapuram Municipal Corporation

WARD NO	WARD NAME	ADMINISTRATION AREA
68	Kamaleswaram	Thiruvananthapuram Municipal Corporation
69	Kalippankulam	Thiruvananthapuram Municipal Corporation
70	Attukal	Thiruvananthapuram Municipal Corporation
71	Chala	Thiruvananthapuram Municipal Corporation
72	Manacaud	Thiruvananthapuram Municipal Corporation
73	Kuriyathy	Thiruvananthapuram Municipal Corporation
74	Puthenpally	Thiruvananthapuram Municipal Corporation
75	Manikavilakam	Thiruvananthapuram Municipal Corporation
76	Beemapally East	Thiruvananthapuram Municipal Corporation
77	Beemapally	Thiruvananthapuram Municipal Corporation
78	Muttathara	Thiruvananthapuram Municipal Corporation
79	Sreevaraham	Thiruvananthapuram Municipal Corporation
80	Fort	Thiruvananthapuram Municipal Corporation
81	Thampanoor	Thiruvananthapuram Municipal Corporation
82	Vanchiyoor	Thiruvananthapuram Municipal Corporation
83	Sreekanteswaram	Thiruvananthapuram Municipal Corporation
84	Perunthanni	Thiruvananthapuram Municipal Corporation
85	Palkulangara	Thiruvananthapuram Municipal Corporation
86	Chakkai	Thiruvananthapuram Municipal Corporation
87	Valiyathura	Thiruvananthapuram Municipal Corporation
88	Vallakkadavu	Thiruvananthapuram Municipal Corporation
89	Sanghumugham	Thiruvananthapuram Municipal Corporation
90	Vettucaud	Thiruvananthapuram Municipal Corporation
91	Karikkakam	Thiruvananthapuram Municipal Corporation
92	Kadakampally	Thiruvananthapuram Municipal Corporation
93	Pettah	Thiruvananthapuram Municipal Corporation
94	Kannanmoola	Thiruvananthapuram Municipal Corporation
95	Anamugham	Thiruvananthapuram Municipal Corporation
96	Akkulam	Thiruvananthapuram Municipal Corporation
97	Kulathoor	Thiruvananthapuram Municipal Corporation
98	Attipra	Thiruvananthapuram Municipal Corporation
99	Powndukadavu	Thiruvananthapuram Municipal Corporation
100	Pallithura	Thiruvananthapuram Municipal Corporation
1	Aralummoodu	Neyyattinkara Municipality
2	Puthanambalam	Neyyattinkara Municipality
3	Moonnukallinmoodu	Neyyattinkara Municipality
4	Koottappana	Neyyattinkara Municipality
5	Pallivilakam	Neyyattinkara Municipality
6	Punnakkadu	Neyyattinkara Municipality

WARD NO	WARD NAME	ADMINISTRATION AREA
7	Kalathuvila	Neyyattinkara Municipality
8	Vadakode	Neyyattinkara Municipality
9	Muttaikkad	Neyyattinkara Municipality
10	Elavanikara	Neyyattinkara Municipality
11	Mambazhakkara	Neyyattinkara Municipality
12	Mullaravila	Neyyattinkara Municipality
13	Perumbazhuthoor	Neyyattinkara Municipality
14	Alampotta	Neyyattinkara Municipality
15	Plavila	Neyyattinkara Municipality
16	Thozhukkal	Neyyattinkara Municipality
17	Vazhuthoor	Neyyattinkara Municipality
18	Kollavamvila	Neyyattinkara Municipality
19	Thavaravila	Neyyattinkara Municipality
20	Kulathamal	Neyyattinkara Municipality
21	Chaykottukonam	Neyyattinkara Municipality
22	Maruthathoor	Neyyattinkara Municipality
23	Irumbil	Neyyattinkara Municipality
24	Fort	Neyyattinkara Municipality
25	Vlangamuri	Neyyattinkara Municipality
26	Krishnapuram	Neyyattinkara Municipality
27	Rameswaram	Neyyattinkara Municipality
28	Narayanapuram	Neyyattinkara Municipality
29	Amaravila	Neyyattinkara Municipality
30	Pullamala	Neyyattinkara Municipality
31	Pirayumoodu	Neyyattinkara Municipality
32	Olathanni	Neyyattinkara Municipality
33	Chundavila	Neyyattinkara Municipality
34	Athazhamangalam	Neyyattinkara Municipality
35	Kavalakulam	Neyyattinkara Municipality
36	Panangattukari	Neyyattinkara Municipality
37	Nilamel	Neyyattinkara Municipality
38	Manaloor	Neyyattinkara Municipality
39	Ooruttukala	Neyyattinkara Municipality
40	Alummoodu	Neyyattinkara Municipality
41	Town	Neyyattinkara Municipality
42	Brahmamkode	Neyyattinkara Municipality
43	Athiyannoor	Neyyattinkara Municipality
44	Vazhimuku	Neyyattinkara Municipality
1	Kailathukonam	Mangalapuram Gram Panchayat

WARD NO	WARD NAME	ADMINISTRATION AREA
2	Chempakamangalam	Mangalapuram Gram Panchayat
3	Poikayil	Mangalapuram Gram Panchayat
4	Punnaikkunnam	Mangalapuram Gram Panchayat
5	Kudavoor	Mangalapuram Gram Panchayat
6	Muringamon	Mangalapuram Gram Panchayat
7	Pattam	Mangalapuram Gram Panchayat
8	Thonnakkal	Mangalapuram Gram Panchayat
9	Mangalapuram	Mangalapuram Gram Panchayat
10	Karamoodu	Mangalapuram Gram Panchayat
11	Edavilakam	Mangalapuram Gram Panchayat
12	Varikamukku	Mangalapuram Gram Panchayat
13	Murukkumpuzha	Mangalapuram Gram Panchayat
14	Kozhimzda	Mangalapuram Gram Panchayat
15	Mundakkal	Mangalapuram Gram Panchayat
16	Valikonam	Mangalapuram Gram Panchayat
17	Mullasseri	Mangalapuram Gram Panchayat
18	Kottarakkari	Mangalapuram Gram Panchayat
19	Veiloor	Mangalapuram Gram Panchayat
20	Sasthavattam	Mangalapuram Gram Panchayat
1	Karichara	Andoorkonam Gram Panchayat
2	Velloor	Andoorkonam Gram Panchayat
3	Koithur Konam	Andoorkonam Gram Panchayat
4	Thiruvelloor	Andoorkonam Gram Panchayat
5	Andoorkonam	Andoorkonam Gram Panchayat
6	Keezhavoor	Andoorkonam Gram Panchayat
7	Parambilpalam	Andoorkonam Gram Panchayat
8	Paichira	Andoorkonam Gram Panchayat
9	Pallicha Veedu	Andoorkonam Gram Panchayat
10	Kunninakam	Andoorkonam Gram Panchayat
11	Kaniyapyuram	Andoorkonam Gram Panchayat
12	Alummoodu	Andoorkonam Gram Panchayat
13	Thekkevila	Andoorkonam Gram Panchayat
14	Valiya Veedu	Andoorkonam Gram Panchayat
15	Pallipuram	Andoorkonam Gram Panchayat

WARD NO	WARD NAME	ADMINISTRATION AREA
16	Kandal	Andoorkonam Gram Panchayat
17	Sreepadam	Andoorkonam Gram Panchayat
18	Maithani	Andoorkonam Gram Panchayat
1	Kundamanbhagam	Vilavoorkal Gram Panchayat
2	Kurisumuttam	Vilavoorkal Gram Panchayat
3	Puthtuveettu Mele	Vilavoorkal Gram Panchayat
4	Panangode	Vilavoorkal Gram Panchayat
5	Peyad	Vilavoorkal Gram Panchayat
6	Pavacha Kuzhy	Vilavoorkal Gram Panchayat
7	Ezhakode	Vilavoorkal Gram Panchayat
8	Office Ward	Vilavoorkal Gram Panchayat
9	Pottayil	Vilavoorkal Gram Panchayat
10	Vilavoorkal	Vilavoorkal Gram Panchayat
11	Malayam	Vilavoorkal Gram Panchayat
12	Moolaman	Vilavoorkal Gram Panchayat
13	Choozhattukotta	Vilavoorkal Gram Panchayat
14	Vengoor	Vilavoorkal Gram Panchayat
15	Vizhavoor	Vilavoorkal Gram Panchayat
16	Thuduppottukonam	Vilavoorkal Gram Panchayat
17	Perukavu	Vilavoorkal Gram Panchayat
1	Vellaikadavu	Vilappil Gram Panchayat
2	Mailadi	Vilappil Gram Panchayat
3	Chovaloor	Vilappil Gram Panchayat
4	Padavancode	Vilappil Gram Panchayat
5	Cherukode	Vilappil Gram Panchayat
6	Karode	Vilappil Gram Panchayat
7	Puttumelkonam	Vilappil Gram Panchayat
8	Nooliyode	Vilappil Gram Panchayat
9	Kavinpuram	Vilappil Gram Panchayat
10	Vilappilsala	Vilappil Gram Panchayat
11	Karuvilanchi	Vilappil Gram Panchayat

WARD NO	WARD NAME	ADMINISTRATION AREA
12	Minnamcode	Vilappil Gram Panchayat
13	Thuruthum Moola	Vilappil Gram Panchayat
14	Alakunnam	Vilappil Gram Panchayat
15	High School Ward	Vilappil Gram Panchayat
16	Pirayil	Vilappil Gram Panchayat
17	Office Ward	Vilappil Gram Panchayat
18	Peyad	Vilappil Gram Panchayat
19	Vittiyam	Vilappil Gram Panchayat
20	Puliyarakonam	Vilappil Gram Panchayat
1	Eruthavoor	Balaramapuram Gram Panchayat
2	Russelpuram	Balaramapuram Gram Panchayat
3	Parakkuzhi	Balaramapuram Gram Panchayat
4	Punnackadu	Balaramapuram Gram Panchayat
5	Thalayal	Balaramapuram Gram Panchayat
6	Pulliyil	Balaramapuram Gram Panchayat
7	Town Ward	Balaramapuram Gram Panchayat
8	Thoppu	Balaramapuram Gram Panchayat
9	Anthiyoor	Balaramapuram Gram Panchayat
10	Ramapuram	Balaramapuram Gram Panchayat
11	Kottukalkonam	Balaramapuram Gram Panchayat
12	Palachalkonam	Balaramapuram Gram Panchayat
13	Panayarakkunnu	Balaramapuram Gram Panchayat
14	Nellivila	Balaramapuram Gram Panchayat
15	Idamanakkuzhi	Balaramapuram Gram Panchayat
16	R C Theruvu	Balaramapuram Gram Panchayat
17	Chamavila	Balaramapuram Gram Panchayat
18	Aythiyoor	Balaramapuram Gram Panchayat
19	Manali	Balaramapuram Gram Panchayat
20	Office Ward	Balaramapuram Gram Panchayat
1	Pappanchani	Kalliyoor Gram Panchayat
2	Vellayani	Kalliyoor Gram Panchayat

WARD NO	WARD NAME	ADMINISTRATION AREA
3	Mukaloormoola	Kalliyoor Gram Panchayat
4	Sarvodayam	Kalliyoor Gram Panchayat
5	Santhivila	Kalliyoor Gram Panchayat
6	Kulakudiyoorkonam	Kalliyoor Gram Panchayat
7	Upaniyoor	Kalliyoor Gram Panchayat
8	Ookode	Kalliyoor Gram Panchayat
9	Chenkode	Kalliyoor Gram Panchayat
10	Vallamcode	Kalliyoor Gram Panchayat
11	Pakaloor	Kalliyoor Gram Panchayat
12	Punnamoode	Kalliyoor Gram Panchayat
13	Office	Kalliyoor Gram Panchayat
14	Peringamala	Kalliyoor Gram Panchayat
15	Kuzhithalachal	Kalliyoor Gram Panchayat
16	Hospital	Kalliyoor Gram Panchayat
17	Kannankuzhi	Kalliyoor Gram Panchayat
18	Kakkamoola	Kalliyoor Gram Panchayat
19	Poonkulam	Kalliyoor Gram Panchayat
20	Signal Station	Kalliyoor Gram Panchayat
21	A G C (Agricultural College)	Kalliyoor Gram Panchayat
1	Pamamcodu	Pallichal Gram Panchayat
2	Mookkunnimala	Pallichal Gram Panchayat
3	Kannancodu	Pallichal Gram Panchayat
4	Kulangarakonam	Pallichal Gram Panchayat
5	Nadukkadu	Pallichal Gram Panchayat
6	Naruvamoodu	Pallichal Gram Panchayat
7	Vellappally	Pallichal Gram Panchayat
8	Mukkampalamoodu	Pallichal Gram Panchayat
9	Thannivila	Pallichal Gram Panchayat
10	Vadakkevila	Pallichal Gram Panchayat
11	Poonkode	Pallichal Gram Panchayat
12	Bhagavathinada	Pallichal Gram Panchayat

WARD NO	WARD NAME	ADMINISTRATION AREA
13	Keleswaram	Pallichal Gram Panchayat
14	Panchayat Office Ward	Pallichal Gram Panchayat
15	Vedivechan Kovil	Pallichal Gram Panchayat
16	Kurandivila	Pallichal Gram Panchayat
17	Ayanimoodu	Pallichal Gram Panchayat
18	Mottamoodu	Pallichal Gram Panchayat
19	Peringode	Pallichal Gram Panchayat
20	Edakkodu	Pallichal Gram Panchayat
21	Pallichal	Pallichal Gram Panchayat
22	Kundaratheri	Pallichal Gram Panchayat
23	Pravachambalam	Pallichal Gram Panchayat
1	Vellar	Venganoor Gram Panchayat
2	Kadavinmoola	Venganoor Gram Panchayat
3	Muttackadu	Venganoor Gram Panchayat
4	Panangodu	Venganoor Gram Panchayat
5	Venniyoor	Venganoor Gram Panchayat
6	Nellivila	Venganoor Gram Panchayat
7	Mavuvila	Venganoor Gram Panchayat
8	Office Ward	Venganoor Gram Panchayat
9	Peringammala	Venganoor Gram Panchayat
10	Eduva	Venganoor Gram Panchayat
11	Mangalathukonam	Venganoor Gram Panchayat
12	Kattachalkuzhy	Venganoor Gram Panchayat
13	Chavadinada	Venganoor Gram Panchayat
14	Sisilipuram	Venganoor Gram Panchayat
15	Venganoor	Venganoor Gram Panchayat
16	Dr. Ambedkar Gramam	Venganoor Gram Panchayat
17	Kalluvettan Kuzhy	Venganoor Gram Panchayat
18	Azhakulam	Venganoor Gram Panchayat
19	Thozhichal	Venganoor Gram Panchayat
20	Kovalam	Venganoor Gram Panchayat

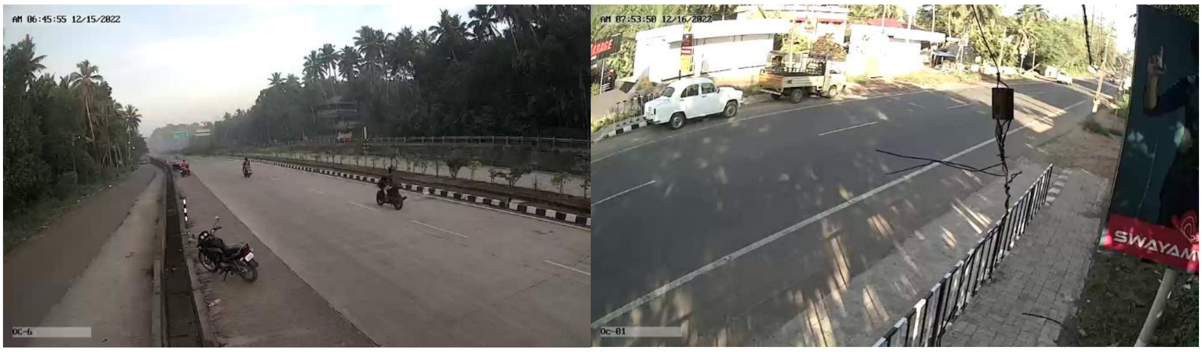
ANNEXURE 2 - PRIMARY SURVEYS METHODOLOGY

CLASSIFIED TRAFFIC VOLUME COUNTS (CVC) AND ROAD SIDE (ORIGIN – DESTINATION) SURVEY AT OUTER CORDON LOCATION

Objective: The survey aims to assess the floating population, interaction of the surrounding regions with the study area and to establish the peak to daily flow ratios.

Conduct:

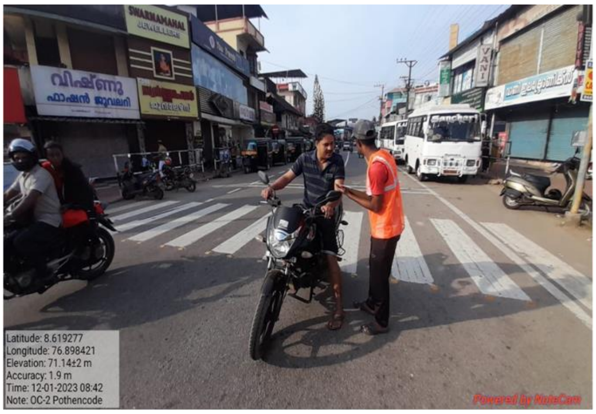
- Video traffic counts was carried out on typical working day at all locations listed.
- At each identified location both **directional classified volume counts were carried out by vehicle type for a period of 24 hours**.
- The RSI survey was conducted for **24 hours at outer cordon locations** with a **sample of 10% of the traffic** on a typical working day. Manual interviewing **passenger vehicles and goods for OD, occupancy, travel cost, time etc. was carried out**



Location: The survey will be conducted at six (6) outer cordon points

Outer Cordon Survey Locations

CODE	Location Name
OC_1	NH-66 Attingal
OC_2	Pothenvide
OC_3	Vembayam
OC_4	Nedumangad Highway
OC_5	Panvel Kochi Kanyakumari Highway
OC_6	Pulinkudi


Latitude: 8.619277
Longitude: 76.898421
Elevation: 71.14±2 m
Accuracy: 1.9 m
Time: 12-01-2023 08:42
Note: OC-2 Pothencode
Powered by NoteCam


Latitude: 8.721349
Longitude: 76.812878
Elevation: 147.35±25 m
Accuracy: 3.0 m
Time: 12-01-2023 08:01
Note: OC-01 trivendram
Powered by NoteCam


Latitude: 8.626891
Longitude: 76.900249
Elevation: 67.83±3 m
Accuracy: 2.2 m
Time: 12-01-2023 09:07
Note: OC-2 Pothencode
Powered by NoteCam


Latitude: 8.619266
Longitude: 76.898419
Elevation: 71.14±1 m
Accuracy: 5.2 m
Time: 12-01-2023 08:41
Note: OC-2 Pothencode
Powered by NoteCam


Latitude: 8.721447
Longitude: 76.812852
Altitude: 47.9±19 m
Accuracy: 7.4 m
Time: 12-01-2023 08:08
Note: OC-01 trivendram
Powered by NoteCam


Latitude: 8.721287
Longitude: 76.812905
Altitude: 43.0±39 m
Accuracy: 5.0 m
Time: 12-01-2023 08:02
Note: OC-01 trivendram
Powered by NoteCam


Latitude: 8.720161
Longitude: 76.812695
Elevation: 143.15±14 m
Accuracy: 2.0 m
Time: 12-01-2023 08:23
Note: OC-01 trivendram
Powered by NoteCam


Latitude: 8.721037
Longitude: 76.812925
Altitude: 41.6±69 m
Accuracy: 3.9 m
Time: 12-01-2023 08:01
Note: OC-01 trivendram
Powered by NoteCam

CLASSIFIED TRAFFIC VOLUME COUNTS (CVC) AND VEHICLE OCUPANCY AND ROAD SIDE (ORIGIN – DESTINATION) SURVEY AT SCREEN LINE LOCATIONS

Objective: The survey aims to assess and the validate the traffic and passenger flows at identified locations mode wise and to establish the peak to daily flow ratios. Further, to assess and the validate the traffic and passenger flows at identified locations mode wise and in evaluating the travel characteristics and mode wise travel pattern.

Conduct:

- Video traffic counts was carried out on typical working day at all locations listed.
- At each identified location both **directional classified volume counts was carried out by vehicle type for a period of 24 hours**.
- Passenger occupancy by vehicle type. i.e. cars, jeeps, vans, buses, trucks, MAVs, LCV's tractors, motorized two wheelers and so on was captured.
- The RSI survey was conducted for **24 hours at screen line locations** with a **sample of 10% of the traffic** on a typical working day. Manual interviewing **passenger vehicles and goods for OD, occupancy, travel cost, time etc. was carried out.**

Location: The survey was conducted at nine (09) screen lines points along the north-south and east-west screen lines.

Screen Line Survey Locations

CODE	Location Name
SC_1	Menamkulam
SC_2	Aruvikkara dam
SC_3	Kundamankadavu E-W
SC_4	Pettah E-W
SC_5	Thampanoor E-W
SC_6	Karamana Bridge N-S
SC_7	Thiruvallam Bridge N-S
SC_8	Pallichal
SC_9	Bridge Lane Road Neyyattinkara












CLASSIFIED TRAFFIC VOLUME COUNTS (CVC) AND VEHICLE OCUPANCY AT MID-BLOCK LOCATIONS

Objective: The survey aims to assess and the validate the traffic and passenger flows at identified locations mode wise and to establish the peak to daily flow ratios.

Conduct of the Survey: Video counts were carried out on typical working day at all locations listed. At each identified station, both directional counts will be carried out by vehicle type for 24 hours. Along with occupancy by vehicle type. i.e., cars, jeeps, vans, buses, trucks, MAVs, LCV's tractors, motorized two wheelers and so on was captured.

Location: The survey was conducted at nine (9) mid-block points

Mid- Block Survey Locations

CODE	Location Name
MB_1	NH66
MB_2	Mangalapuram
MB_3	Vattapara Thattatumala Road
MB_4	Sreekariyam Road
MB_5	Ulloor Bridge
MB_6	Lulu Mall
MB_7	Pulimoodu
MB_8	Pappanamcode Malayinkeezhu
MB_9	Mannanthala

CLASSIFIED TURNING MOVEMENT COUNTS AND PEDESTRIAN COUNTS AT INTERSECTIONS

Objectives: The survey aims to in identifying and analysing the critical movements, validate mode-wise traffic flows in all directions at the intersection and for deriving inputs for designing the intersection to perform more efficiently. And to quantify the extent of pedestrian movement in order to design facilities for such movement.

Conduct: Video traffic counts were carried out on a typical working day for a duration of 16 hours at all locations listed below. At each identified intersection, for all arms both directional counts were carried out by vehicle type. i.e., cars, jeeps, vans, buses, trucks, MAVs, LCV’s tractors, motorized two wheelers and slow-moving vehicles. Similarly, video/manual counts for a period of 12 hours on important locations where heavy pedestrian movement and critical junction in the city

Locations: The survey was conducted at twenty (20) critical intersections.

Turning Movement Counts Survey Locations

CODE	Location Name
TVC_1	Kazhakoottam
TVC_2	Sreekaryam
TVC_3	Kesavadasapuram
TVC_4	Pattom
TVC_5	VJT Hall Palayam
TVC_6	Thampanoor
TVC_7	Karamana
TVC_8	Pappanamacode
TVC_9	Balaramapuram
TVC_10	Vellayambalam
TVC_11	Kowdiyar
TVC_12	Peroorkada
TVC_13	Sasthamangalam
TVC_14	Manacaud Junction
TVC_15	Vizhinjam
TVC_16	Chakka
TVC_17	Eanchakkal
TVC_18	Medical College
TVC_19	Poojappura
TVC_20	Edapazhji Junction

PASSENGER TERMINAL COUNTS SURVEY AND ORIGIN AND DESTINATION SURVEYS

Objective: The survey aims to evaluate the percentage of people using Bus/Rail transport and to identify the characteristics of travellers.

Conduct: The survey was conducted for a period of 16 hours at Bus/Rail Terminals and the travel and traffic characteristics of the intercity & intra city bus travellers are captured along with trip characteristics, counts of bus and passengers and details to estimate the rail/bus passengers the existing demand and supply scenarios for the same.

Locations: The surveys were conducted at all the nine (9) public transit terminals present in Thiruvananthapuram.

Terminal Survey Locations

CODE	Location Name
PT_1	Kazhakoottam Railway Station
PT_2	Pettah Railway Station
PT_3	East Fort Bus Terminal
PT_4	Thampanoor Bus Terminal
PT_5	Thiruvananthapuram Central Railway Station
PT_6	Pappanamcode Bus Depot
PT_7	Neyyattinkara Railway Station
PT_8	Vizhinjam Bus Depot
PT_9	Thiruvananthapuram Airport

PUBLIC TRANSPORT STOP WAITING, BOARDING AND ALIGHTING SURVEY AND ORIGIN AND DESTINATION SURVEYS

Objective: To evaluate the number of people using Public Transport for their daily travel in the city and to identify the characteristics of travellers.

Conduct: Manual interviews of passengers boarding and alighting the public transport quantum of boarding and alighting at the identified bus stops for a period of 16 hours. Data pertaining to travel and traffic characteristics of the PT travellers are captured along with trip characteristics and details to estimate the PT passengers the existing demand and need for additional supply were captured.

Locations: The survey will be conducted in ten (10) bus stop locations.

Bus Stop Survey Locations

CODE	Location Name
BS_1	Kazhakoottam Bus Stop
BS_2	Sreekaryam Bus Stop
BS_3	Medical College Bus Stop
BS_4	Kesavadasapuram Bus Stop
BS_5	Pattom Bus Stop
BS_6	Palayam Bus Stop
BS_7	Vazhuthacaud Bus Stop
BS_8	Thampanoor Bus Stop
BS_9	East Fort Bus Stop
BS_10	Neyyattinkara Bus Stop

STATED PREFERENCE SURVEYS FOR PT, IPT, PRIVATE USERS (2W AND CAR) AND NMT (CYCLE AND WALK) USERS AND OPINION SURVEY

Objective: The survey aims to evaluate the preferences of commuters and to identify their travel characteristics. And to capture user travel characteristics and their opinion regarding the public transport systems and other transport infrastructure.

Conduct: The survey was conducted through manual interviews wherein the user trip characteristics, deals and their preferences in regard to the public transit were collected.

Locations: The survey was conducted at workplaces and major activity centers in the city through roadside interviews at the identified locations.

Stated Preference Survey Locations

CODE	Location Name
SP_1	Managalapuram
SP_2	Kazhakoottam
SP_3	Chavadimukku
SP_4	Sreekaryam
SP_5	Pongummoodu
SP_6	Ulloor
SP_7	Kesavadasapuram
SP_8	Pattom
SP_9	Medical College
SP_10	PMG
SP_11	Palayam
SP_12	Overbridge
SP_13	Thampanoor
SP_14	Killipalam
SP_15	Karamana
SP_16	Pappanamcode
SP_17	Vellayani
SP_18	Nemom
SP_19	Pravanchabalam
SP_20	Pallichal
SP_21	Neyyattinkara

CODE	Location Name
SP_22	LMS Vellayambalam Road
SP_23	Thampanoor flyover
SP_24	Women's College
SP_25	War Memorial - Kochulloor

INTERMEDIATE PUBLIC TRANSPORT (IPT) OPERATOR SURVEY

Objective: The survey aims to evaluate the travel characteristics of Intermediate Public Transport in the study area.

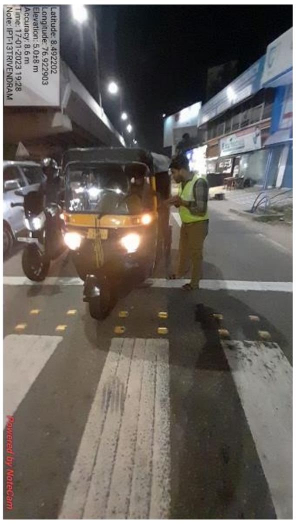
Conduct: The survey was conducted through interviews at major IPT Stops capturing the operator trip details.

Location: The survey was conducted at across the 15 major junctions which were observed to be the major IPT catchments nodes in Thiruvananthapuram.

IPT operator survey locations

CODE	Location Name
IPT_1	Kazhakoottam
IPT_2	Kesavadasapuram
IPT_3	Pattom
IPT_4	Thampanoor
IPT_5	Neyyattinkara
IPT_6	LMS Junction
IPT_7	Kowdiyar
IPT_8	Sasthamangalam
IPT_9	Ayurveda College
IPT_10	Manacaud Junction
IPT_11	General Hospital
IPT_12	Pettah
IPT_13	Chakka
IPT_14	Bakery Junction
IPT_15	Medical College






ON STREET PARKING NUMBER PLATE SURVEYS

Objective: The principal objective of the study is to assess the demand for parking and characteristics of the parked vehicles.

Conduct: The survey will be conducted for a period of 12 hours on important commercial areas where parking is predominant wherein the note the vehicle type and registration number of parked vehicles every 15 mins and associated parking fees data are to be collected.

Locations: The survey will be conducted at along a total length of nine (9) kms with on-street parking activity

On-Street Parking Survey Locations

CODE	Location Name
ONP_1	MG Road Between Attakulangara and LMS
ONP_2	NH 66-Plamoodu to Kesavadasapuram
ONP_3	Mettukada - Vellayambalam
ONP_4	Sreekaryam - Chekkamukku
ONP_5	Vellayambalam - Sasthamangalam
ONP_6	East Fort
ONP_7	Sreekumar Theatre - Vanross Junction
ONP_8	Medical College - Ulloor Road
ONP_9	Chalai Bypass




OFF STREET PARKING NUMBER PLATE SURVEYS

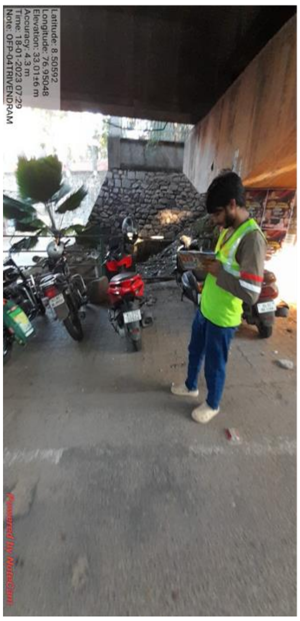
Objective: The principal objective of the study is to assess the demand for parking and characteristics of the parked vehicles.

Conduct: The survey was conducted for a period of 12 hours on important commercial areas where parking is predominant wherein the note the vehicle type and registration number of parked vehicles every 15 mins and associated parking fees data were collected.

Locations: The survey was conducted at the eight (8) off street Parking locations

Off-Street Parking Survey Locations

CODE	Location Name
OFP_1	Palayam Market
OFP_2	Power House Road
OFP_3	Gandhi Park
OFP_4	Chandrasekharan Nair Stadium
OFP_5	Attukal Shopping Complex
OFP_6	Karimpanal Arcade
OFP_7	KSRTC Stand East Fort
OFP_8	Thiruvananthapuram Municipal Corporation





HOUSEHOLD INTERVIEW SURVEYS

Objective: The house hold survey aims to capture the data which is used for describing the travel patterns in the city and travel preferences of its residents.

Conduct: Collection of data on socio-economic characteristics, household members and their travel diary with their opinion of study area residents is to be carried out by manual interview within the delineated traffic analysis zones. Details relating to Socio-economics, Household member characteristics, and travel diary of each individual member of the household will be captured.

Samples: A total cleaned sample set shall comprise 4000 cleaned and completely filled samples.

ROAD NETWORK INVENTORY

Objective: Road network inventory aims at updating the network database with the existing features of roadway sections covering all arterial, sub arterial and other important local/connecting links in the study area.

Conduct: The survey has been conducted on the major road sections identified within the study area, a full-scale inventory survey to be undertaken to create a road network database. Manual carriage way section wise details were carried out on a typical working day.

Road Stretches: Road length of approx. two hundred (350) km

Title: Comprehensive Mobility Plan for Trivandrum	
Map: Road Network Inventory	

SPEED AND DELAY SURVEY AT PEAK AND OFF-PEAK HOURS

Objective: The principal objective of the study is to find out the journey speed, running speed and types of delay, such as stopped delay and operational delay to evaluate the level of service or quality of traffic flow of a road or entire road network system.

Conduct: The survey was conducted using GPS during peak and off period in both directions. Data such as delay information on different road stretches and at intersections/level crossings in the study area.

Road Stretches: Road length of approx. 250 km in Thiruvananthapuram.

VEHICLE SURVEY AT PETROL PUMPS

Objective: Road network inventory aims at updating the network database with the existing features of roadway sections covering all arterial, sub arterial and other important local/connecting links in the study area.

Conduct: The survey will be conducted at petrol pumps identified within the study area, capturing the details such as type of fuel, make, model, year of manufacture, mileage, etc.

Locations: The survey shall be conducted at 10 petrol pumps

Vehicles Survey at Petrol Pump

CODE	Location Name
VS_1	Supplyco Ulloor Road

CODE	Location Name
VS_2	Indian Oil Peroorkada
VS_3	Bharat Petroleum Kesavadasapuram
VS_4	HP Petroleum Pattom
VS_5	Supplyco Nathancodu
VS_6	Indian Oil Kovalam Bypass Road
VS_7	Arvind Fuels Eanchakkal
VS_8	HP Palayam
VS_9	Bharat Petroleum Chalai
VS_ 10	Indian Oil Muttathara

ESTABLISHMENT AND WORKPLACE SURVEYS

Objective: The survey aims to evaluate the travel patterns to workplaces.

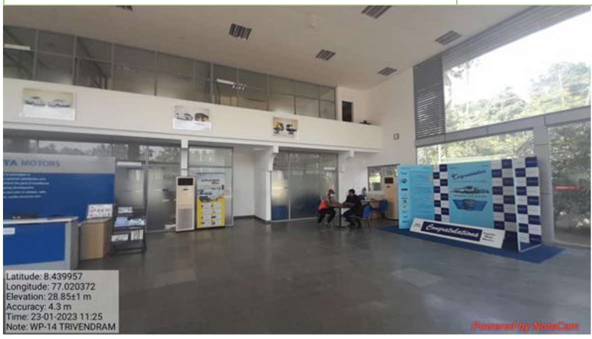
Conduct: The workplace and establishment surveys were conducted to collect data regarding the travel costs (whole and distributed costs), trips characteristics and related socio-economic data. This survey assists in assessing the journey to work, travel arrangements in the study area, modes used for work trips and the associated costs, the average distance travelled for work in the study area.

Locations: The surveys were conducted at workplaces and major activity centers in the city, through interviews at the identified 24 locations

Establishment and Workplace Survey Locations

CODE	Location Name
WP_1	Kazhakoottam
WP_2	Chavadimukku
WP_3	Ulloor
WP_4	Kesavadasapuram
WP_5	Pattom
WP_6	Palayam
WP_7	Thampanoor
WP_8	Chalai
WP_9	Karamana
WP_10	Pappanamcode
WP_11	Vellayani
WP_12	Nemom
WP_13	Pravanchabalam
WP_14	Pallichal
WP_15	Vazhuthacaud

CODE	Location Name
WP_16	General Hospital
WP_18	Kochuveli Market
WP_19	Medical College
WP_20	Pettah
WP_21	Hospital Junction








GOODS OPERATOR SURVEYS

Objective: The survey aims to evaluate the travel patterns of goods vehicles in the study area.

Conduct: The surveys were conducted at major good focal points through manual interviews capturing the goods vehicle trip characteristics.

Locations: The survey was conducted in the following 5 locations.

Goods Operator Survey Locations

CODE	Location Name
GO_1	Kochuveli Market
GO_2	Chalai Market
GO_3	Vizhinjam Port
GO_4	Market Road Kazhakoottam
GO_5	Palayam Market
GO_6	Neyyattinkara Market






ANNEXURE 3 - SERVICE LEVEL BENCHMARKING

COMPUTATION OF INDICES

In Service Level Benchmark, four levels of Service (LoS) have typically been specified. They are LOS1, LOS2, LOS3 and LOS4. The LOS1 represents the highest performance level whereas LOS4 represents the Lowest. This section describes the computation process for all the indicators.

PUBLIC TRANSPORT FACILITIES

This benchmark indicates the city-wide level of services provided by public transport systems during peak hours in Thiruvananthapuram. The overall level of service for this benchmark is based on the following indicators:

i. Presence of Organized Public Transport System in Urban Area
ii. Availability of Public Transport
iii. Service Coverage of Public Transport in the City
iv. Average Waiting Time for Public Transport Users
v. Level of Comfort in Public Transport
vi. Percentage of Fleet as per Urban Bus Specifications

PRESENCE OF ORGANIZED PUBLIC TRANSPORT SYSTEM IN URBAN AREA

Computation of presence of organized public transport system in urban area is shown below.

Presence of Organized Public Transport

S. No.	Computation	Unit	Description	Data Source	Value
a.	Total buses	No.	Buses operating on road.	KSRTC +Private (2022)	559
b.	The total number of buses under the ownership of STU/SPV or under concession agreement	No.	Organized public transport – run by a company or SPV formulated specifically for the operation or public transport within the city or under concession agreement.	KSRTC +Private (2022)	198
c.	Presence of Public Transport System in Urban Area	%	Calculate= [b / a]*100		35
LOS					3
LOS1: >= 60, LOS2: 40 to 60, LOS3: 20 to 40, LOS4: Below 20					

Based on the above, the corresponding LoS for the indicator ‘Presence of Organized Public Transport System in Urban Area’ is 0.35, indicating the presence of public transportation in the Thiruvananthapuram Region.

EXTENT OF SUPPLY / AVAILABILITY OF PUBLIC TRANSPORT SYSTEM

The computation of the extent of supply/availability of public transport system is shown below.

Availability of Public Transport

S. No.	Computation	Unit	Description	Data Source	Value
a.	No of Buses/ train coaches available in a city on any day.	No.	Number of public transport vehicles operating in the city, which may be lower than the number of vehicles owned by the utility or that authorized to ply. Daily average values over a time period of a month may be considered. (1 train coach is equivalent to 3 buses).	KSRTC +Private (2022)	559
b.	Total Population of the city (lakhs)	No.	Current population should be considered. Past census figures should be used as base, and annual growth rate should then be used to arrive at current population.	Estimated Population UMTC 2022	13.53
c.	PT Availability /1000 population	Ratio	Calculate= [a / b]		0.41
LOS					2
LOS1: >= 0.6, LOS2: 0.4 to 0.6, LOS3: 0.2 to 0.4, LOS4: Below 0.2					

Based on the above, the corresponding LoS for the indicator 'Extent of Supply/Availability of Public Transport System' is 2. Thus, indicating deficiency in supply of organized city based public transport.

SERVICE COVERAGE OF PUBLIC TRANSPORT IN THE CITY

The computation of the Service Coverage of Public Transport in the study area, shows the public transport network in the city.

Service Coverage of Public Transport

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total length in road of the corridors on which public transport systems ply in the city.	Road Kms.	Total length of the public transport corridor within the urban limits should be considered. Corridors along which the service frequency is one hour or less should only be considered. Public transport systems may be road or rail or water based, and include public or private transport service provider	KSRTC +Private (2022)	256
b.	Area of the urban limits of the city	Area in sq. Kms.	Area of the urban limits should be considered. This may correspond to the urban limits demarcated by the development authority / metropolitan area, or any other such urban planning agency which need to be covered by public transport. This need not be restricted to municipal boundaries	KSRTC +Private (2022)	374
c.	Service Cover	Ratio	Calculate= [a / b]		0.7
LOS					3.0
LOS1: >= 1, LOS2: 0.7 to 1, LOS3: 0.3 to 0.7, LOS4: Below 0.3					

Based on the above table, the corresponding LoS is 3 for Thiruvananthapuram area. Thus, indicating the need to improve service coverage of public transport in the study area.

AVERAGE WAITING TIME FOR PUBLIC TRANSPORT USERS:

The computation of the Average Waiting Time of Public Transport users in the study area is given below..

Average Waiting Time of Public Transport Users

S. No	Calculation	Unit	Data Source	Value
a.	Average Waiting time for Public Bus	Min	Primary Surveys at Bus Stops and Households- 2022	8.2
LOS				**3**
LOS1: <= 4, LOS2: 4 to 6, LOS3: 6 to 10, LOS4: Above 10				

Based on the above table, the corresponding LoS is 3 for Thiruvananthapuram area. Thus, indicating the need to improve the headway of public transport in the study area.

LEVEL OF COMFORT IN PUBLIC TRANSPORT

The computation of the level of comfort in Public Transport users in the study area is given below..

Level of Comfort In Public Transport Users

S. No	Calculation	Unit	Description	Data Source	Value
A.	Passenger Count on Bus at Key Identified Routes	No.	Passenger count survey should be carried out on bus of each identified route in both directions.	Primary Surveys-2022	32
B.	Seats Available in The Bus		Count the number of seats available in a bus of each type on each identified route.	Primary Surveys-2022	42
C.	Passenger Comfort- Load Factor (Passengers Per Seat)		Calculate= [A / B]		0.8
LOS					**1.0**
Los1: <= 1.5, Los2: 1.5 To 2, Los3: 2 To 2.5, Los4: Above 2.5					

Based on above table, the corresponding LoS is 1. Thus, indicating contented level of comfort in public transport in the study area.

PERCENTAGE OF FLEET AS PER URBAN BUS SPECIFICATIONS

The computation of the Percentage of Fleet as per Urban Bus Specifications is shown below.

Percentage of Fleet as Per Urban Bus Specifications

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Total number of buses in the city	No.	Total fleet	KSRTC +Private (2022)	559
b.	Total number of buses as per urban bus specifications in the city	No.	Fleet as per UBS	KSRTC +Private (2022)	256
c.	% of Fleet as per Urban Bus Specifications	%	Calculate= [b / a] * 100		45.8
LOS					3.0
LOS1: >= 75, LOS2: 50 to 75, LOS3: 25 to 50, LOS4: Below 25					

Based on above table, the corresponding LoS for this indicator is 3 for Thiruvananthapuram area. Thus, indicating deficiency in supply of fleet as per Urban Bus Specifications.

LEVEL OF SERVICE FOR PUBLIC TRANSPORT FACILITIES

Level of Service for Public Transport Facilities for Thiruvananthapuram Area

LOS	Presence of Organized Public Transport System in Urban Area (%)	Extent of Supply/ Availability of Public Transport	Service Coverage of Public Transport in The City	Avg. Waiting Time for Public Transport Users	Level Of Comfort in Public Transport	% of Fleet as per Urban Bus Specification
1	>= 60	>= 0.6	>= 1	<= 4	<= 1.5	75 – 100
2	40-60	0.4-0.6	0.7- 1	4—6	1.5 - 2	50 – 75
3	20-40	0.2-0.4	0.3 - 0.7	6—10	2 - 2.5	25 – 50
4	<20	<0.2	< 0.3	> 10	> 2.5	< 25
Indicator LoS	**3**	**2**	**3**	**3**	**1**	**3**
LOS VALUE:15 (LOS -2)						
OVERALL: LOS1 <12, LOS2: 12-16, LOS3:17-20, LOS4 21-24						

Based on above table, the overall score of the benchmark for Thiruvananthapuram region computes to 15 with LOS for the parameter “Public Transport Facilities” being 2. Thus, indicating a reasonably good city bus services which can be further improved.

PEDESTRIAN INFRASTRUCTURE FACILITIES

This benchmark indicates the percentage of road length along arterial and major road network, Public Transport corridors, and intersections, having adequate pedestrian facilities. The overall level of service for this benchmark is based on the following indicators:

1. Signalized Intersection Delay
2. Street Lighting (LUX)
3. Percentage of City Covered

SIGNALIZED INTERSECTION DELAY

The computation of the Signalized Intersection Delay is shown below.

Signalized Intersection Delay

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total number of signalized intersections having average waiting time more than 45 seconds for pedestrians	No.	Calculate the average total waiting time of passengers of all arms of signalized intersection and divide by 2 to get average waiting time. If there is any foot over/under bridge at any arm, then waiting time for that particular arm is zero	Primary Survey 2022 (RNI)	15
b.	Total number of signalized intersections	No.	Identify the total number of signalized intersections surveyed in a city	Primary Survey 2022 (RNI)	35
c.	Signalized intersections Delay (%)	%	Calculate= [a / b] * 100		43
LOS					3
LOS1: >= 75, LOS2: 50 to 75, LOS3: 25 to 50, LOS4: Below 25					

The existing traffic signals do not have a pedestrian phasing thereby increasing the intersection delay for pedestrians, this retains the LoS value for the indicator ‘Signalized Intersection Delay’ at 3.

STREET LIGHTING

The computation of the service level for street lighting is shown below.

Street Lighting

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total length of roads	km	Length of major Network in the study area i.e., arterial / sub-arterial roads or public transit corridors	Primary Survey 2022 (RNI)	245
b.	Lux Level	%.	Cumulative frequency of LUX levels	Primary Survey 2022	35
c.	Street Lighting		Value		7
LOS					2
LOS1: >= 8, LOS2: 6-8, LOS3: 4-6, LOS4: Below 4					

The calculation of the Street lighting is based on lux data collected by undertaking primary surveys. The LoS value for the indicator ‘Street lighting’ is 2 for Thiruvananthapuram area. This indicates that Thiruvananthapuram area requires adequate visibility along the footpaths. Though some locations had streetlights, but with low intensities.

PERCENTAGE OF CITY COVERED

The computation of the percentage of city covered by footpaths is shown below.

Percentage of City Covered by Footpaths

S. No.	Computation	Unit	Description	Source	Value
a.	Total length of road network	Km	Calculate the total length of road network	Primary Survey 2022 (RNI)	350
b.	Total length of footpath of a city	Km	Total length of footpath of a city (footpath width >= 1.8m)	Primary Survey 2022 (RNI)	49
c.	Percentage of City Covered by Footpaths	%	Calculate= [b / a] * 100		14
LOS					**4**
LOS1: >= 75, LOS2: 50 to 75, LOS3: 25 to 50, LOS4: Below 25					

The LoS value for the indicator ‘Percentage of City Covered’ is 4 for Thiruvananthapuram area. Though the city has footpaths along the arterial roads, it lacks a clear walking space of 1.8m. Thus, indicating the need for immediate attention for improving construct continuous and usable footpaths across the city.

LEVEL OF SERVICE FOR PEDESTRIAN INFRASTRUCTURE FACILITIES

Based on table below, the overall score of the benchmark for Thiruvananthapuram region for pedestrian infrastructure facilities computes to 10 with a level of service of 3. Thus, indicating that the city lacks adequate Pedestrian facilities and requires major improvements/investments in this category.

Pedestrian Infrastructure Facilities

Level of Service (Los)	Signalized Intersection Delay (%)	Street Lighting (Lux)	% of City Covered
1	<25	> = 8	> = 75
2	25 – 50	6-8	50 - 75
3	50 – 75	4-6	25 - 50
4	> = 75	< 4	<25
Indicator LoS	3	3	4
OVERALL - LOS1: 3-5, LOS2: 6-8, LOS3: 9-10, LOS4 11-12			

NON-MOTORISED TRANSPORT (NMT) FACILITIES

This benchmark indicates the percentage of dedicated cycle track/lane along the arterial and major road network, and public transport corridors in Thiruvananthapuram region, with a minimum of 2.5 m width. It is characterized by continuous length, encroachment on NMT lanes, and parking facilities.

The overall level of service for this benchmark is based on the level of service for the following indicators:

1. Percentage of Network Covered
2. Encroachment on NMT roads by Vehicle Parking
3. NMT Parking facilities at interchanges

PERCENTAGE OF NETWORK COVERED

The calculation of the percentage of network covered by NMT Facilities is shown below.

Percentage of Network Covered by NMT Facilities

S. No.	Calculation	Unit	Description	Value
a.	Total length of road network	Km	Primary Survey 2022 (RNI)	350
b.	Total length of NMT network (minimum of 2.5 m width)	Km	Primary Survey 2022 (RNI)	15
c.	Percentage of network covered	%	Calculate= [b / a] * 100	4.2
LOS1: >= 50, LOS2: 25 to 50, LOS3: 15 to 25, LOS4: Below 15				

Based on above table, percentage of city covered by NMT network is 4.2% with a LOS of 4. Thus, indicating the absence of Non-Motorized Vehicles (NMV) network in the city.

ENCROACHMENT ON NMT ROADS BY VEHICLE PARKING

As Thiruvananthapuram has no NMT network, this indicator is not applicable. Thus, accounting to a LoS value of 4.

NON-MOTORISED TRANSPORT (NMT) PARKING FACILITIES AT INTERCHANGE

The computation of the NMT parking facilities at interchange is shown below. The corresponding LoS value is 2 for Thiruvananthapuram region, indicating significant number of interchanges have NMT parking within 250 m around them.

NMT Parking Facilities at Interchange

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Total number of interchanges (major Bus, Terminals and Railway stations)	No	-	Primary Survey 2022 (RNI)	12
b.	Total number of interchanges having Bicycle parking (within 250m radius)	No	-	Primary Survey 2022 (RNI)	8
c.	NMT parking facility at interchanges	%	Calculate= [b / a] * 100		67
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

LEVEL OF SERVICE FOR NON-MOTORIZED TRANSPORT (NMT) FACILITIES

Based on the below table, the overall score of the Benchmark for computes to 10, with a LOS of 3. Thus, indicating poor performance in the provision of Non-Motorized Transport facilities.

Non-Motorized Transport Facilities

LOS	% of Network Covered	Encroachment on NMT Roads by Vehicle Parking (%)	NMT Parking Facilities at Interchanges (%)
1	> = 50	< = 10	> = 75
2	50 – 25	10 – 20	50 - 75
3	25 – 15	20 – 30	25 - 50
4	< 15	> 30	<25
Indicator LoS	**4**	**4**	**2**
OVERALL - LOS1: 3-5, LOS2: 6-8, LOS3: 9-10, LOS4 11-12			

LEVEL OF USAGE OF ITS FACILITIES

This benchmark indicates the efforts to add information technology to transport infrastructure and vehicles in an effort to manage factors that are typically at odds with each other. The overall level of service for this benchmark is based on the following indicators:

1. Availability of Traffic Surveillance
2. Passenger Information System (PIS)
3. GPS/GPRS Systems
4. Signal Synchronization
5. Integrated Ticketing System

AVAILABILITY OF TRAFFIC SURVEILLANCE

The calculation of the availability of traffic surveillance is shown below.

Availability of Traffic Surveillance

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total number of Bus stations on BRTS, Terminals, Metro Stations and Signalized Intersections having CCTVs	No	-	Smart city & Traffic Police Department	98
b.	Total number of Bus stations on BRTS, Terminals, Metro Stations and Signalized Intersections	No	-	Primary Survey 2022	72
c.	Availability of Traffic Surveillance – CCTV	%	Calculate= [b /a] * 100		**73**
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

The LoS value for indicator ‘Availability of Traffic Surveillance’ is 2.

PASSENGER INFORMATION SYSTEM (PIS)

The calculation of the Availability of Passenger Information System (PIS) is show in table below. The LoS accounts to 4 indicating the need to improve PIS at terminals. But still has a scope to improve the services especially at the bus terminals Thus, a significant investment is required in this sector.

Passenger Information System

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total number of Terminals, Metro Stations having PIS	No	-	Primary Survey 2022	25
b.	Total number of Terminals, Metro Stations	No	-	Primary Survey 2022	4
c.	Passenger Information System (PIS) for Public Transport	%	Calculate= [b /a] * 100		16
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

GLOBAL POSITIONING SYSTEM (GPS/GPRS)

The calculation of Global Positioning System (GPS/GPRS) is shown below.

Global Positioning System

S. No	Calculation	Unit	Description	Data Source	Value
a.	Public transport vehicles and IPT with functional onboard GPS/ GPRS, connected to common control center	No.	Calculate total No. of Public Transport Vehicles and IPT with onboard GPS/GPRS which are connected to common control center	KSRTC, RTO Primary Survey 2022	190
b.	Total public transport vehicles and IPT	No.	Calculate total no. of Public Transport Vehicles and IPT	KSRTC, RTO Primary Survey 2022	559
c.	Global Positioning System / GPRS	%	Calculate= [a / b] * 100		34
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

The, corresponding LoS value for the indicator ‘Global Positioning System (GPS/GPRS)’ is 3.

SIGNAL SYNCHRONIZATION

To improve the traffic flow along the road networks, the signals along the corridor are inter connected. The phasing of the signal at any specific intersection are in tune with the phasing of the intersection before and after it to provide a continuous green phase for the traffic stream. It helps in reducing congestion and stopping time at each intersection. The computation of benchmarking for signal synchronization as shown below.

Signal Synchronization

S. No	Calculation	Unit	Description	Data Source	Value
a.	No. of signals which are synchronized	No.	Calculate total No. of signalized signals which are synchronized in	Traffic Police Department and Primary Surveys	72
b.	Total no. of signalized intersections	No.	Calculate Total no. of signalized intersections in the city	Traffic Police Department and Primary Surveys	120
c.	Signal Synchronization	%	Calculate= [a / b] * 100		60
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

The LOS for signal synchronization parameter computes to 2.

INTEGRATED TICKETING SYSTEM

The calculation of Integrated Ticketing System is shown below.

Integrated Ticketing System

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Total number of modes and operators in the city (buses, IPT, metro etc) which have integrated ticketing system	No.	Calculate number of public transport modes and operators for each route in the city which are integrated	KSRTC, RTO Primary Survey 2022	0
b.	Total Number of modes and operators in the city (Buses, IPT, Metro etc)	No.	Calculate the total number of public transport modes and operators for each route in the city	KSRTC, RTO Primary Survey 2022	2
c.	Integrated Ticketing System	%	Calculate= [a / b] * 100		0
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

In absence of city based public transport system none of the modes have an integrated ticketing system. Hence there is no change in LoS value for indicator ‘Integrated Ticketing System’ which is 4.

LEVEL OF SERVICE FOR ITS FACILITIES

Based on the table below, the overall score of this Benchmark computes to 15, with a LOS of 3. This throws light on the need for drastic improvements in terms of synchronized signals, PIS facilities at all bus stops in the city.

ITS Facilities

LOS	Availability of Traffic Surveillance (%)	Passenger Information System (PIS) (%)	Global Positioning System / GPRS (%)	Signal Synchronization (%)	Integrated Ticketing System (%)
1	>=75	>=75	>=75	>=75	>=75
2	50 - 75	50 – 75	50 – 75	50 - 75	50 - 75
3	25 - 50	25 – 50	25 – 50	25 - 50	25 - 50
4	< 25	< 25	< 25	< 25	< 25
Indicator LoS	**2**	**4**	**3**	**2**	**4**
OVERALL - LOS1: 5-7, LOS2: 8-10, LOS3: 11-15, LOS4 16-20					

TRAVEL SPEEDS

This benchmark provides an indication of effective travel time or speed of public or private vehicles by considering indications of congestion or traffic density. The overall level of service for this benchmark is based on the following indicators:

1. Travel speed of personal vehicles along key corridors
2. Travel speed of public Transport along key corridors

TRAVEL SPEED OF PERSONAL VEHICLES ALONG KEY CORRIDORS

The computation of Travel Speed of Personal Vehicles along Key Corridors is based on Speed and Delay Survey data. The surveys involved identification of the key corridors using motorized transport in the city. On these average speeds during peak hours on working days were calculated. The LoS's ranges are shown below.

LOS Range for Average Travel Speeds of Personal Vehicles

LOS	Average Travel Speed of Personal Vehicles (Kmph)
1	> =30
2	25 – 30
3	15 – 25
4	< 15

The observed average travel speed for personal vehicles indicates an LOS value of 3.

TRAVEL SPEED OF PUBLIC TRANSPORT ALONG KEY CORRIDORS

The calculation of travel speed of public transport along key corridors is based on Speed and Delay Survey data. Based on the LoS's below, the LoS was determined to be 2 for public transport system in the Thiruvananthapuram area.

LOS Range for Average Travel Speeds of Public Transport

LOS	Average Travel Speed of Public Transport (Kmph)
1	> =20
2	15 – 20
3	10 – 15
4	< 10

This indicates that public transport modes in Thiruvananthapuram area face high congestion along the network and will require traffic management plans to improve travel times.

LEVEL OF SERVICE FOR TRAVEL SPEEDS

The LOS for Travel speeds in the city computes to 3 with a score of 5.

Travel Speed

LOS	Average Travel Speed of Personal Vehicles (Kmph)	Average Travel Speed of Public Transport (Kmph)
1	> =30	> =20
2	25 – 30	15 – 20
3	15 – 25	10 – 15
4	< 15	< 10
Indicator LOS	**3**	**2**
OVERALL - LOS1: 2, LOS2: 3-4, LOS3: 5-6, LOS4 7-8		

AVAILABILITY OF PARKING SPACES

This benchmark indicates the restrictions on free parking spaces for all vehicles in Thiruvananthapuram region. The overall level of service for this benchmark is based on the level of service for the following indicators:

1. Availability of On-Street Paid Public Parking Spaces
2. Ratio of Maximum and Minimum parking fee in the city

AVAILABILITY OF ON-STREET PAID PUBLIC PARKING SPACES

The computation of the availability of on-street paid parking spaces is shown below.

Availability of On-Street Paid Parking

S. No	Computation	Unit	Description	Data Source	Value
a.	Total available on-street paid parking spaces in ECS allotted for all vehicles	ECS	-	Primary Survey, 2022	1342
b.	Total available on-street parking spaces in ECS allotted for all vehicles	ECS	-	Primary Survey, 2022	5416
c.	Availability of paid parking spaces	%	Calculate= [a /b] * 100		25
LOS1: >= 75, LOS2: 75 to 51, LOS3: 26 to 50, LOS4: Below 25					

The LoS for the indicator 'Availability of On-Street Paid Public Parking Spaces' is 4.

RATIO OF MAXIMUM AND MINIMUM PARKING FEE IN THE CITY

It is the ratio of maximum parking fee being charged per 2 hours for public parking, to the minimum parking fee being charged per 2 hours for public parking at a location in the city. This indicator is based on on-street parking survey data and off-street parking operations data from the operators or the local authority.

The calculation of the ratio of maximum and minimum paid parking is shown below.

Ratio of Maximum and Minimum Parking Fee

S.NO	CALCULATION	UNIT	DESCRIPTION	VALUE
a.	Maximum parking fee being charged per 2 hours in the city for public parking	INR	Primary Surveys, 2022	40
b.	Minimum parking fee being charged per 2 hours in the city for public parking	INR	Primary Surveys, 2022	20
c.	Availability of paid parking spaces		Calculate= [a /b]	2
LOS1: >4, LOS2: 3-4, LOS3: 1-2, LOS4: 1				

As there is much variation in the minimum and maximum parking charges in the city, the ratio of the same is 2 with a LOS level of 3.

LEVEL OF SERVICE FOR AVAILABILITY OF PARKING SPACES

Based on the above indicators, the overall score of the Benchmark for computes to 7, with a LOS level of 4. The excessive availability of free on-street parking needs to be controlled by the authorities to regulate heavy vehicular traffic. The on-street parking facilities shall need to be charged, and the same may be used to provide for improved NMT infrastructure in the city.

Availability of Parking Spaces

LOS	Availability of on Street Paid Public Parking Spaces (%)	Ratio of Maximum and Minimum Parking Fee in the City
1	> =75	> 4
2	50 – 75	2 – 4
3	25 – 50	1 – 2
4	< 25	1
Indicator LoS	**4**	**3**
OVERALL LOS1: 2, LOS2: 3-4, LOS3: 5-6, LOS4: 7-8		

ROAD SAFETY

This benchmark monitors the extent to which road users, and especially vulnerable road users, are impacted within the overall set of road users. The overall level of service for this benchmark is based on the following indicators:

1. Fatality rate for lakh population
2. Fatality rate for pedestrian and NMT

FATALITY RATE PER LAKH POPULATION

The calculation of fatality rate per lakh population is shown below.

Fatality Rate Per Lakh Population

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total number of fatalities recorded in road accidents within city limits in the given calendar year	No.	Record of fatalities from police records. Data should be considered pertaining to the urban limits or jurisdiction of police department for the urban areas within that district.	Police Commissioner Office, 2022	169
b.	Population of the urban agglomeration in that year	No.	Population of the urban agglomeration as per the latest census should be projected to arrive at current population, considering the projected growth rate.	Estimated Population-2022, UMTC	1353860
c.	Fatality rate per 1,00,000 population	Ratio	Calculate= [(a*100000) / b].		12
LOS1: <=2, LOS2: 2-4, LOS3: 4-6, LOS4: Greater than 6					

There has been a drastic increase in the number of fatalities per lakh population. Based on the above, the corresponding LoS value for the indicator ‘Fatality Rate per Lakh Population’ is 4 for Thiruvananthapuram area. This indicates poor safety in the Thiruvananthapuram area and actions are required to improve the same.

FATALITY RATE OF PEDESTRIAN AND NON-MOTORISED TRANSPORT

The calculation of fatality rate of pedestrian and NMT is shown below.

Fatality Rate of Pedestrian and NMT Users

S. No	Calculation	Unit	Description	Data Source	Value
a.	Total number of fatalities recorded of persons who were pedestrians or on non-motorized transport vehicles, in road accidents within city limits in given year	No.	From the records from police, the number of persons of above, who were pedestrians or on non-motorized vehicles (such as bicycles, cycle-carts / cycle rickshaws, etc.)	Police Commissioner Office, 2019	87
b.	Total number of fatalities recorded in road accidents within city limits in the given calendar year	No.	Record of fatalities from police records. Data was pertaining to the urban limits or jurisdiction of police department for the urban areas within that district	Police Commissioner Office, 2019	169
c.	Fatality rate for pedestrian and NMT	%	Calculate = [(a / b)*100].		51
LOS1: >=20, LOS2: 20-40, LOS3: 40-60, LOS4: Greater than 60					

Based on the above table, the corresponding LoS value for the indicator ‘Fatality Rate of Pedestrian and NMT’ is 3.

LEVEL OF SERVICE FOR ROAD SAFETY

Based on the above indicators, the overall score of the benchmark for Thiruvananthapuram Region computes to 7. The overall LoS for the parameter “Road Safety” is 4. NMT and pedestrians are hence observed to be unsafe on the streets of Thiruvananthapuram area.

LOS	Fatality Rate per Lakh Population	Fatality Rate for Pedestrian and NMT (%)
1	< =2 persons	< =20
2	2 -4 persons	20 -40
3	4 - 6 persons	40 - 60
4	> 6 persons	> 60
Indicator LoS	**4**	**3**
OVERALL LOS1: 2, LOS2: 3-4, LOS3: 5-6, LOS4: 7-8		

POLLUTION LEVELS

This benchmark indicates the level of air pollutants in the city i.e., average level of pollution. The overall level of service for this benchmark is based on the level of service for the following indicators:

1. Annual Mean Concentration Range of Sulphur Dioxide (SO2)
2. Annual Mean Concentration Range of Oxides of Nitrogen (NOX)
3. Annual Mean Concentration Range of Suspended Particulate Matter (SPM)

4. Annual Mean Concentration Range of RSPM

The data collected for pollution levels is as shown below.

Pollution Levels

LOS	Description	Data Source	Value
1	Annual Mean Concentration of SO2	Pollution Control Board (PCB) zonal office	23
2	Annual Mean Concentration Range of Oxides of Nitrogen		62
3	Annual Mean Concentration of SPM		103
4	Annual Mean Concentration of RSPM		84

LEVEL OF SERVICE FOR POLLUTION LEVELS

Based on the above indicators, the overall score of the Benchmark computes to 9 with a LOS of 2. This indicates the city needs considerable improvements in emission standards, and should adopt and encourage public transport use to keep pollution in check.

LOS Range for Pollution Levels

LOS	Annual Mean Concentration of Sulphur Dioxide (SO_2)	Annual Mean Concentration Range of Oxides of Nitrogen (NO_2)	Annual Mean Concentration of Suspended Particulate Matter (SPM)	Annual Mean Concentration of RSPM (Size less than 10 microns)
1	0 – 30	0 – 30	0 – 70	0 - 40
2	30 – 60	30 – 60	70 – 140	40 – 80
3	60 – 90	60 – 90	140 – 210	80 – 120
4	> 90	> 90	> 210	> 210
Indicator LoS	**1**	**3**	**2**	**3**
OVERALL LOS1: <=5, LOS2: 6-9, LOS3: 10-13, LOS4: 14-16				

INTEGRATED LAND USE TRANSPORT SYSTEM

This benchmark indicates the effectiveness of land use and transport arrangements and identifies the level of integrated land use transport system expected to result in overall trip reduction and mode shift in favour of public transit. The overall level of service for this benchmark is based on the level of service for the following indicators:

1. Population Density (Gross)
2. Mixed Land Use on Major Transit Corridors / Network
3. Intensity of Development – City Wide

Intensity of Development along Transit Corridor

4. Clear Pattern and completeness of the Network
5. Percentage of Area under Roads

POPULATION DENSITY

The calculation of Population Density is shown below.

Population Density

S. No	Calculation	Unit	Description	Data Source	Value
a.	Master Plan, or from remote sensing/satellite image or from Google compute developed area.	Ha.	Total developed area	LSGD, 2022	22886
b.	Population of current year or the year for which data is available.	No.		UMTC Estimates, 2022	13,53,860
c.	Population density	Ratio	Population density= [b / a]		59
LOS1: >=175, LOS2: 150-175, LOS3: 125-150, LOS4: <125					

The LoS value for the indicator ‘Population Density’ is 4 in Thiruvananthapuram.

MIXED LAND USE ZONING

The percentage of mixed land use along the major corridors was calculated as less than 5% for Thiruvananthapuram region. The corresponding LoS value for the indicator ‘Mixed Land Use Zoning’ is 4 for Thiruvananthapuram region. This indicates the need to strategies the planning regulations to improve mixed non- residential usage along the mobility corridor to improve the usage of public modes as envisaged.

LOS Range for Share of Mixed Land Use Zoning

LOS	Mixed Land –Use on Major Transit Corridor / Network (% Area Under Non-Residential Use)
1	>= 30
2	15 – 30
3	5 – 15
4	< 5

INTENSITY OF DEVELOPMENT-CITY WIDE

The calculation of Intensity of Development-City Wide is shown below. The corresponding LoS value for the indicator ‘Intensity of Development-City Wide’ is 3.

Development Intensity – City Wide

S. No	Calculation	Unit	Description	Data Source	Value
a.	Floor space Index (applicable to most part of the city as per Master Plan/DP.	No.	As per Master plan/Development plan as applicable to developed/developable area, i.e., Intensity of Development -City (FSI (Floor Space Index - Master Plan/DP)	LSGD	1.5
LOS1: >=2, LOS2: 1.5-2, LOS3: 1.0-1.5, LOS4: <1					

INTENSITY OF DEVELOPMENT ALONG TRANSIT CORRIDORS

The calculation of intensity of development along transit corridors is shown below. The corresponding LOS value is 3. There is currently no development control guideline promoting higher density development along mass transit corridors in the city.

Intensity of Development Along Transit Corridors

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Floor space Index (applicable to most part of the city as per Master Plan/DP.	No.	As per Master plan/ Development plan as applicable to developed/ developable area	LSGD	1.5
b.	FSI along transit corridors.	No.	As per Master plan/ Development plan as applicable to areas along transit corridors	LSGD	3
c.	Intensity of Development along Transit Corridors	Ratio	Calculate Ratio = [b/ a].	LSGD	2
LOS1: >=3, LOS2: 2-3, LOS3: 1.5-2, LOS4: <1.5					

ROAD NETWORK PATTERN AND COMPLETENESS

This is a qualitative indicator and is based on the extent of clarity and completion of existing and proposed road network of the city. Thiruvananthapuram region has a somewhat clear pattern radial pattern with somewhat incomplete rings in the road network. The indicator’s LoS ranges are given below.. The corresponding LoS value for the ‘Road Network Pattern and Completeness’ is 2.

LOS Range for Road Network Pattern and Completeness

LOS	Clear Pattern and Completeness of the Network
1	Clear pattern (ring-radial or grid-iron) and Complete network
2	Somewhat clear pattern (ring-radial or grid-iron) but somewhat incomplete network
3	Somewhat unclear pattern and incomplete network
4	No clear pattern incomplete / sparse network

PERCENTAGE OF AREA UNDER ROADS

The calculation of percentage of area under roads is shown below. Based on the above, the corresponding LoS value is 3. This indicates that certain areas could require network augmentation.

Percentage of Area Under Roads

S. No.	Calculation	Unit	Description	Data Source	Study Area
a.	Measure overall developed area	km. sq.	Measure developed area of a city	LSGD	22886
b.	Measure overall area under road network.	km. sq.	Total area under roads	LSGD	2692.51
c.	Percentage of area under road network	%	Calculate Ratio = [b / a] * 100.		11.76
LOS1: >=15, LOS2: 12-15, LOS3: 10-12, LOS4: <10					

PERCENTAGE NETWORK WITH EXCLUSIVE ROW FOR TRANSIT (FOR > 1 MILLION POPULATION)

There has been no exclusive RoW assigned for public transit in the city. Thus, the LoS value for the indicator ‘Percentage Network with Exclusive RoW for Transit’ is 4.

LEVEL OF SERVICE FOR INTEGRATED LAND USE TRANSPORT SYSTEM

Based on the table below, the overall score of the Benchmark for computes to 24. The Benchmark’s LoS is at 4 indicating need to develop a coherence between city structure and public transport system in Thiruvananthapuram.

Integrated Land Use Transport System

LOS	Population Density	Mixed Land Use Zoning	Intensity Of Development-Citywide (FSI)	Intensity Of Development Along Transit Corridor	Road Network Pattern & Completeness	% Of Area Under Roads	% Network With Exclusive Row for Transit
1	> =175	> = 30	> = 2	> = 3	Clear pattern (ring-radial or grid-iron) and complete network	> = 15	>=30
2	150-175	15-30	1.5 - 2.0	2 – 3	Somewhat clear pattern (ring-radial or grid-iron) but somewhat incomplete network	12 – 15	20 – 30
3	125-150	5 – 15	1.0 - 1.5	1.5 – 2	somewhat unclear pattern and incomplete network	10 – 12	10 – 20
4	< 125	<5	<1	<1.5	no clear pattern incomplete / sparse network	< 10	< 10
Indicator LoS	**4**	**4**	**3**	**3**	**2**	**3**	**4**
LOS1: <=8, LOS2: 9-15, LOS3: 16-22, LOS4: 23-28							

ANNEXURE 4 – PLANNING FORECASTE

SOCIO-DEMOGRAPHIC DISTRIBUTION

The CMP 2015 report suggested the population of 16.33 lakhs for the year 2034. The same is presented below:

Population - CMP 2015 (in Lakhs)

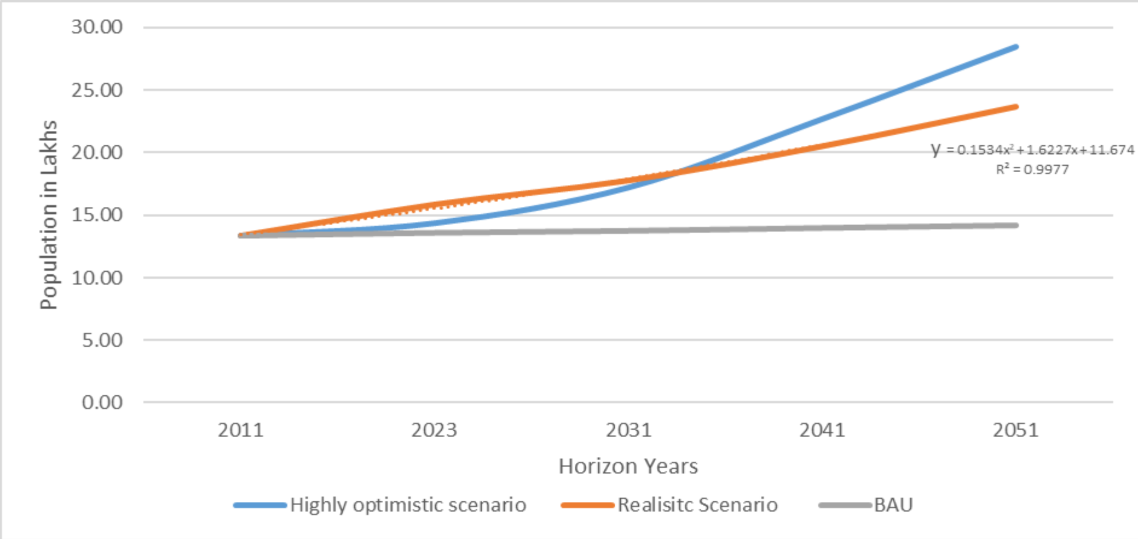
	2014	2024	2034
Population	13.36	15.06	16.33

On comparing the results of the projection method with the growth pattern, envisioned master plans in the study area, linear method has been considered for socio economic projections for Business as usual scenario. The Draft Master Plan Report for 2040 has presumed that 1.45% growth rate would be sustained in the coming years and a constant growth was used to predict the future population.

However, considering the economic growth envisaged in the study area that more people would be attracted to the city by the implementation of large projects such as Vizhinjam sea port, Techno park expansion etc. The scenarios have been considered to evaluate the suitable population trend for the study area.

Comparison of Projected Population Scenario (in Lakhs)

	2031	2041	2051
Highly optimistic scenario	17.77	22.67	28.47
Realistic Scenario	17.19	20.52	23.70
Business As Usual Scenario	13.72	13.95	14.15



Comparison of Projected Population Methods

The Business as Usual Scenario yields low growth inclining towards a negative trend in the horizon years. This scenario is considered as a pessimistic scenario deviating with the urbanization trends and goals of the State as well as the Nation. Further, Thiruvananthapuram is the State capital such declining trends would be considered alarming, thus, this population projection scenario is not recommended.

The Realistic scenario considers a content annual growth against the declining trend and highly optimistic growth with incremental progression. This constant growth rate is anticipated to balance the declining growth rate in the study area, when supported by the land use improvements proposed by the master plan in Section 7.3.1.

The highly optimistic scenario yields high growth rates in line with national growth rates but largely drifting from the regional and state growth rates and would require aggressive and rapid urbanization. Though the values are optimistic this scenario are a little far away from the regional context. Thus, this population projection scenario is not recommended.

CMP 2015 considered Cumulative Annual Growth Rate (CAGR) of 1.20% & 0.81% is considered for the projected years of 2024 & 2034 respectively. However, considering the rapid economic development in the study area (IT Park, Seaport, Tourism, Industries, etc.), a realistic scenario using polynomial second order method estimates a CAGR of 2.55%.

The realistic scenario is considered close to natural conditions and can be achieved the land use strategies proposed in the master plan, supporting the sustainable urbanization. Thus, final population projections considered for the study area is as presented in the below. Further, considering the tourism, IT, International Seaport, Educational and industrial growth envisioned for the study area a floating population of more that 30% is considered in the study area.

Projected Population (in Lakhs)

	2031	2041	2051
Residing Population in Study Area	17.17	20.52	23.70
Floating Population	3.46	6.69	10.46
TOTAL POPULATION	20.63	27.21	34.16

The CMP 2015 report suggested the employment of 6.24 lakhs for the year 2034. The same is presented below:

Employment - CMP 2015 (in Lakhs)

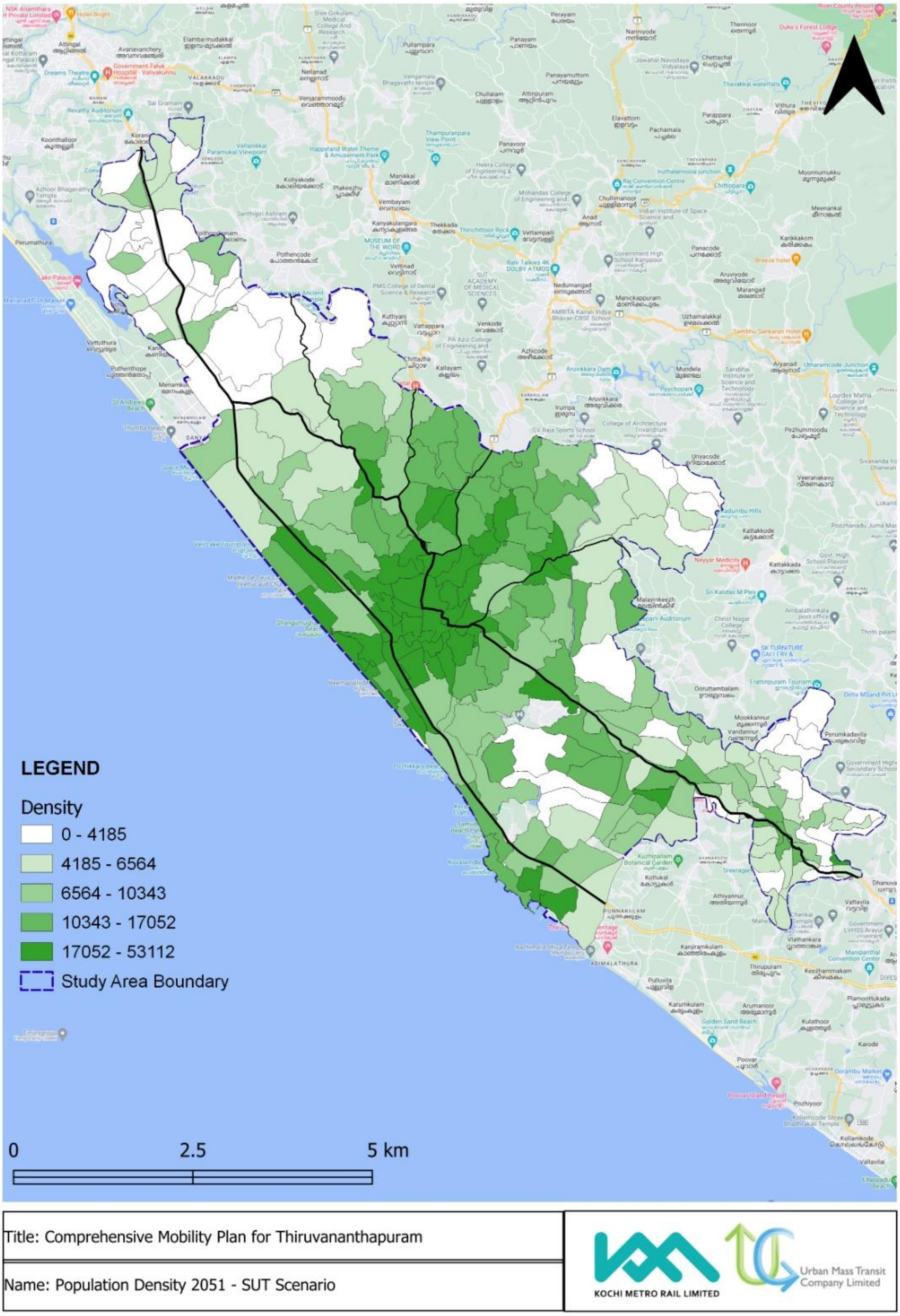
	2014	2024	2034
Employment	2.88	4.49	6.24

Similarly, the employment projection for the same considering the population influx in the city considering Vizhinjam sea port, Techno park expansion etc. In additional to proposed economic nodes, the TOD corridors which are recommend for high mixed used are also considered while distributing the employment in the study area. The activity nodes along the TOD are assumed to house nearly 80% employment, in addition to the industrial, IT Park intensification and Seaport Development. Thus, projected employment for 10.6 lakhs in 2051, the same has been presented below-

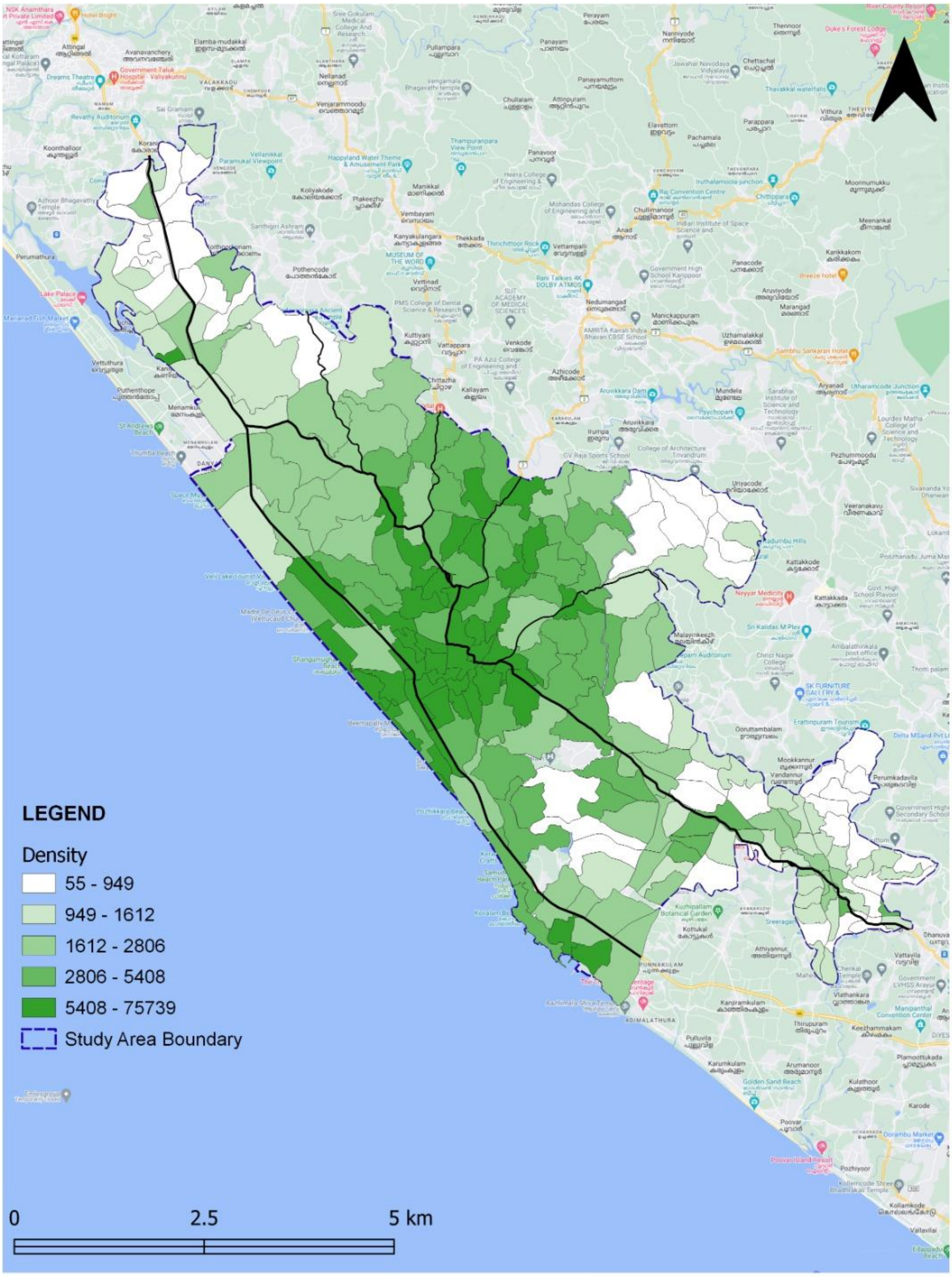
Projected Employment (in Lakhs)

	2031	2041	2051
STUDY AREA	8.3	10.9	13.7

Based on the land use transitions the projected population and employment has been distributed across the traffic analysis zones in the city.



Projected Population Distribution – 2051 SUT



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED / Urban Mass Transit Company Limited
Name: Employment Density 2051 - SUT Scenario	

Projected Employment Distribution – 2051 SUT

LANDUSE FORECASTE AS PER MASTER PLAN

The land use transitions for SUT scenario considers the growth pattern on assessing growth and variation of the existing land use plan of 2012 and 2019 with proposed Master Plan proposal for 2040.

The proposed Master Plan has put forward about 78% of the land area for built-up use enabling availability of ample land for all kinds of development activities in the city. It is proposed to adopt a mixed development scenario in most of the development zones, other than for those zones dedicated for specific purposes.

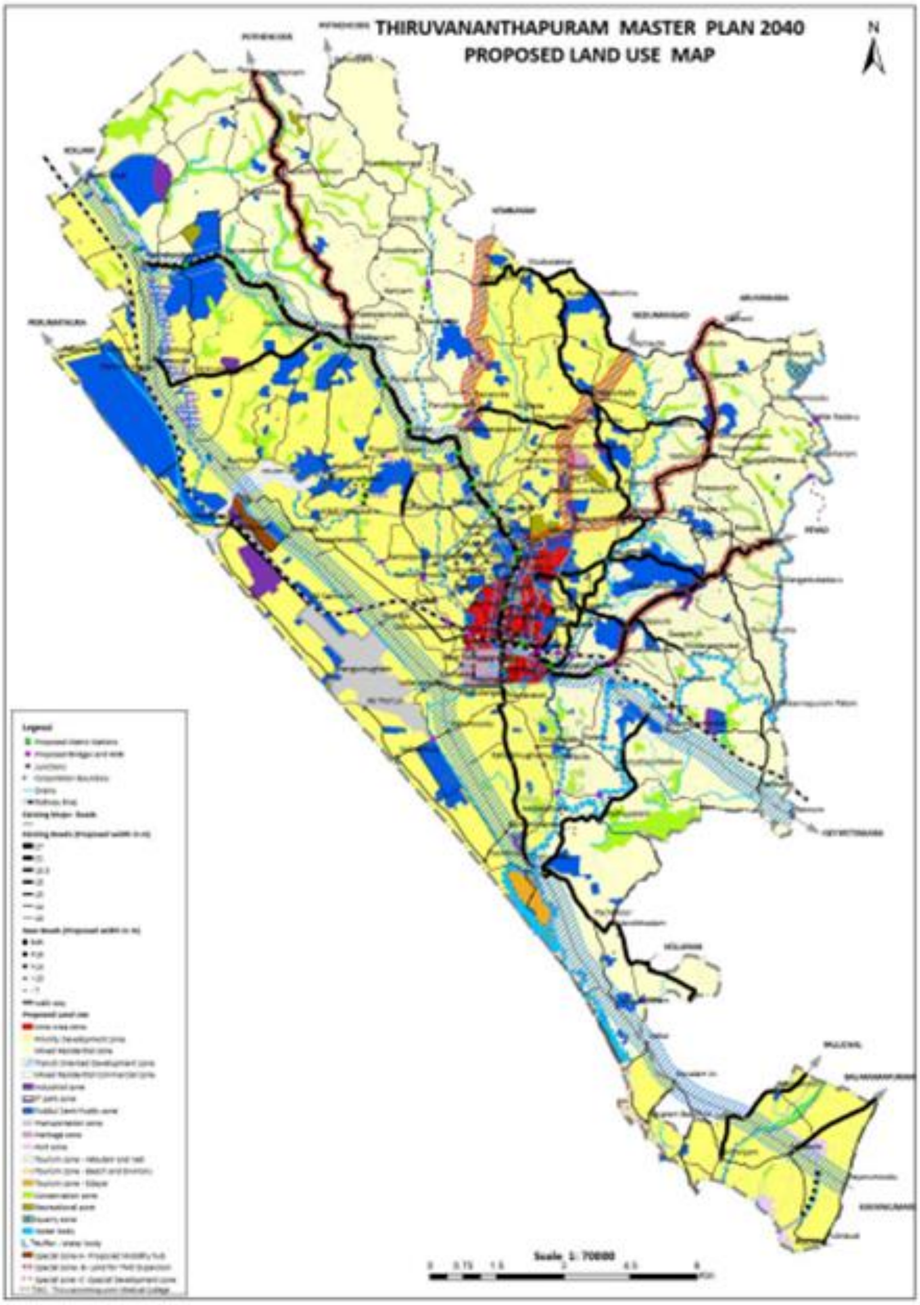
Land use Distribution (Source: Master Plan 2031, Draft Proposed Master Plan-2040)

LAND USE	EXISTING LAND USE (2019)	PROPOSED LAND USE (2040)
Developed Area (excld. Transportation) in SQKM	256.14	260.4
Transportation in SQKM	**24.93**	29.8
Undeveloped Area in SQKM	90.87	81.8
Total	371.94	371.94
Developed Area (excld. Transportation)	69%	70%
Transportation	7%	8%
Undeveloped Area	24%	22%
Total	100%	100%

The proposed growth pattern considerations in line with Proposed Master Plan 2040 are as follows,

- It is proposed to develop existing major industrial area of the city including the government owned industrial Estates as an intensive industrial use area and intensive industrial estate area catering to the demand.
- It is proposed to develop Techno Park Phase I, II and III area extensively for IT park uses and ancillary uses, catering to the demand.
- Transit Oriented Development (TOD) is proposed with the objective of capturing early the opportunity offered for mixed development, on implementation of higher order transport facilities in the future mass transit services along national highways.
- The regional major transport corridors such as Pothencode, Aruvikkara (via Kachani), Kattakada and of State highways that link the city to the other urban areas as well as surrounding developments are prioritised to have planned mixed development.

- The area under Vizhinjam Port would act as one of the focal points of development in the city.
- This special tourism area at Akkulam & Veli, Edayar to Kovalam, Edayar Islands are considered for development along with heritage areas of the city i.e., Kowdiar area and Fort area and its surroundings.



Proposed Land use of City-2040 (source- Master Plan,2040)

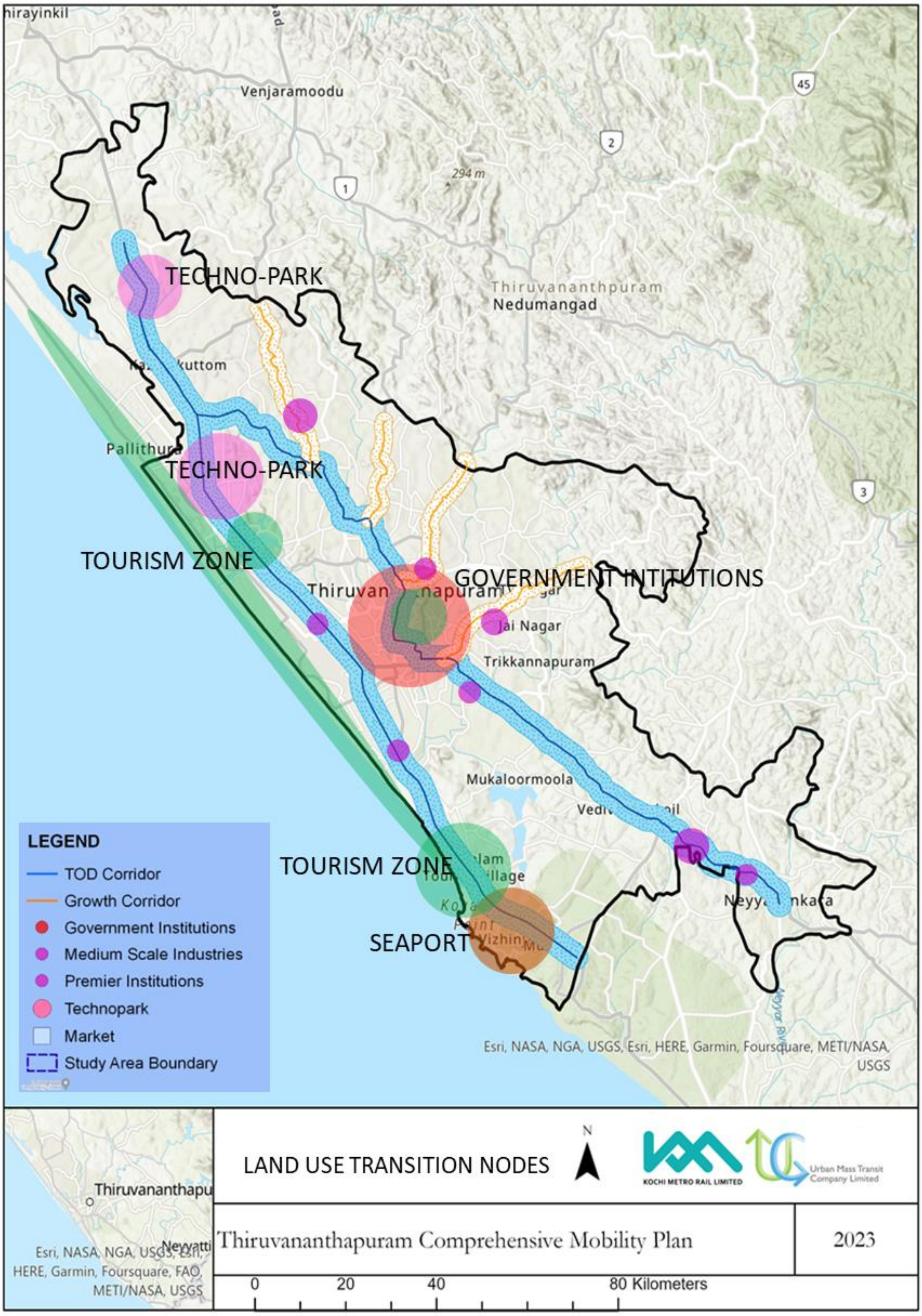


Figure 178 Proposed Land use Transitions Nodes

ANNEXURE 5 – BASE YEAR TRAVEL DEMAND MODEL

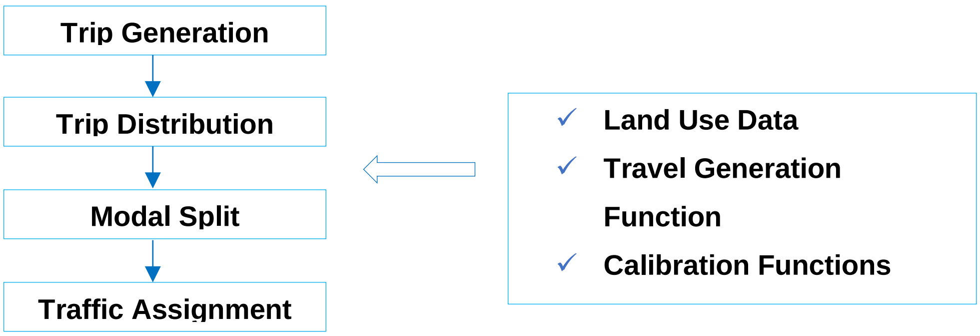
The assessment of travel condition in the study area is carried thorough an urban transport model. The details of the same are presented in the following sections.

URBAN TRANSPORT MODEL - INTRODUCTION

An urban transport model to replicate the Trivandrum transportation system (roads, Congestion delays, transit system, etc.) was developed. This model would be used for forecasting, using altered model inputs to reflect future year scenarios. By simulating roadway conditions and travel demand on those roadways, deficiencies in the system would be assessed. Potential major future network enhancements such as introduction of an MRTS or land use modifications would be analysed using this tool. The model is planned at an aggregated level and its efficacy can be established at a planning level.

There are several software programs that are available for developing travel demand models, however, the Consultants have used CUBE (a state-of-the-art Travel Demand Modelling software developed by CITILABS- USA) for developing the Transport Demand Model.

The model is based on a conventional 4-stage transport model approach, which includes:



Four stage modelling approach

- Trip Generation — It is computed by calibrating a regression equation that relates the total trip generations observed from each zone to demographic data of the zone (such as population and employment places contained within the zone). This equation helps in calculating the number of origins and destinations for each zone in the future years where the population or employment would be altered by the forecasted values. This is the critical stage of the transport model that links between the forecasted demographics to the model.

- Trip Distribution — The trips generated in the Trip generation stage are then distributed to places of attraction such as an office complex or an IT park or schools etc. The distribution is carried out by a Gravity Model which would distribute more trips to larger employment zones but will also bear in mind the costs of travel. A higher cost of travel between a zone pair would naturally reduce its attractiveness in the distribution function. This stage attaches the origins and destinations for complete trips.

- Mode Choice — This stage determines the selection of mode for each of the trips to obtain the number of cars, two wheelers. Auto rickshaws and bus trips that run between a zone pair. This is being calibrated in this model by the use of a Combined Distribution and mode choice function (Tanner Function).

- Assignment — This stage consists of 2 distinct processes, the highway assignment and the public transport assignment. The highway assignment uses an algorithm to determine the exact route on which a particular trip is made. To achieve this a Wardrop Equilibrium assignment that works on the principle that the cost of travel between alternate routes tend to be equal, has been used. The Public Transport Assignment on the other hand assigns passenger to buses and metros. The assignment uses a multi path assignment process and also uses an advanced feature of Cube Voyager – the crowd model - which cuts off passengers from boarding a crowded vehicle.

Following steps were involved in developing the transport model.

- Step 1: Development of Traffic Zone System
- Step 2: Development of Transport Network
- Step 3: Population and Employment Distribution (Based on Prior Model)
- Step 4: Development of OD Matrices (Using the Analyst Routine available in CUBE Voyager)
- Step 5: Calibration of new and fresh functions and Validation
- Step 6: Base Year Travel Characteristics
- Step 7: Updating Network and Forecasting Traffic for future years

Build Network

We built the Network and zone system

↓

Synthesize Base year Matrices

We built the OD matrices by using HHI and RSI data

↓

Prepare Observed Matrices

Employing counts at various points in the city (Freshly collected) balanced the matrices by using "Most Likely Trip Matrix estimation from Counts".

↓

Calibrate Model Functions

Validate model

↓

Prepared Demographic projections

We forecatsed the population and employment for the future years

↓

Obtain Forecast Ridership

We coded on all important corridors, a mass transit system and ran the model to establish forecast demand on corridors for the years 2027, 2031, 2041 and 2051

NETWORK DEVELOPMENT

Transport network developed for the model comprises of two components,

- Highway Network for vehicles
- Transit Network for public transport system

Each of the networks is described in detail below:

- Modes: The modes that are modelled under the study includes Two-wheeler, Private Cars, Intermediate Public Transport, Public Transport i.e., Bus.
- Zoning: The trip patterns were evaluated in relation to the study area zoning to better understand the primary travel patterns on the corridor and the major origin attraction zones.
- Network: The highway (road) network considered all the Key arterials, sub arterials and collectors. The transit system considered with the existing public transport system in all its forms, i.e., bus with their routes, frequency, fare structure etc.

- Planning Period: Year 2023 is considered as the base year, 2027, 2031, 2041 and 2051 has been set as the horizon year for the estimation of Demand.

HIGHWAY NETWORK

The network and zone system from the AutoCAD with all the necessary attributes have been converted to a shape file and has been exported to CUBE and stored as separate layers. The process involved in the highway network development is as below.

- Export Road network i.e., Node-link file as shape file
- Build Highway Network from Line Shape File
- Export zone shape file
- Add Automatic centroids
- Revise Centroids
- Add Automatic centroid connector
- Update link node database

The coded highway network for the study area represents the nodes (intersections), linkages between them and characteristics of the street and highway system to support estimation of traffic volumes, speeds, and vehicle travel times on individual links of the system plus zone-to-zone travel times. Connectivity between the network and zones is provided through centroid connectors. The functional characteristics of different kinds of roads has been coded and analysed to divide it into functional classes. Accordingly, the roads in Trivandrum area have been divided into the following classes.

Lane Configuration

ROADWAY CLASS	LANE DETAILS
1	2L- UD- 2W-Collector Road
2	2L-UD-2W-Sub Arterial Road
3	2L –UD- 2W – Arterial Road
4	4L – D – 2W-Arterial
5	2L – 2W – UD-State Highway
6	2L – 2W – D-National Highway
7	4L – 2W – D-National Highway

L: Lane, 1W: One Way, 2W: Two Way, UD: Undivided, D: Divided

The speed flow curves have been developed for each roadway class and one of the key inputs for the highway assignment is Vehicle Operating Cost and Value of Travel Time has been fed into the model as input in the highway network. The equation for the speed flow curve is given below.

$$T_f = T_o * (1 + \alpha * (V/C)^{\beta})$$

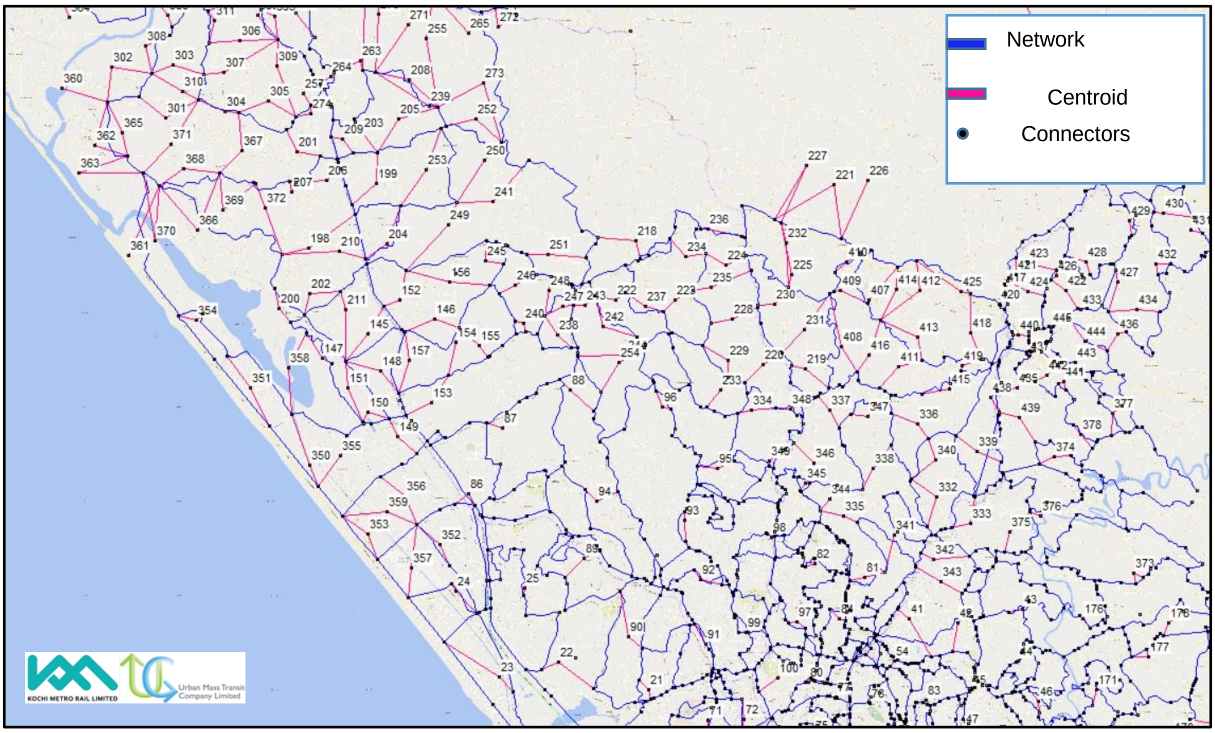
Were,

T_f	Final Link travel time
T_0	Original (free flow) link travel time
α	coefficient (often set at 0.15)
β	exponent (often set at 4.0)
V	assigned traffic volume
C	the link capacity

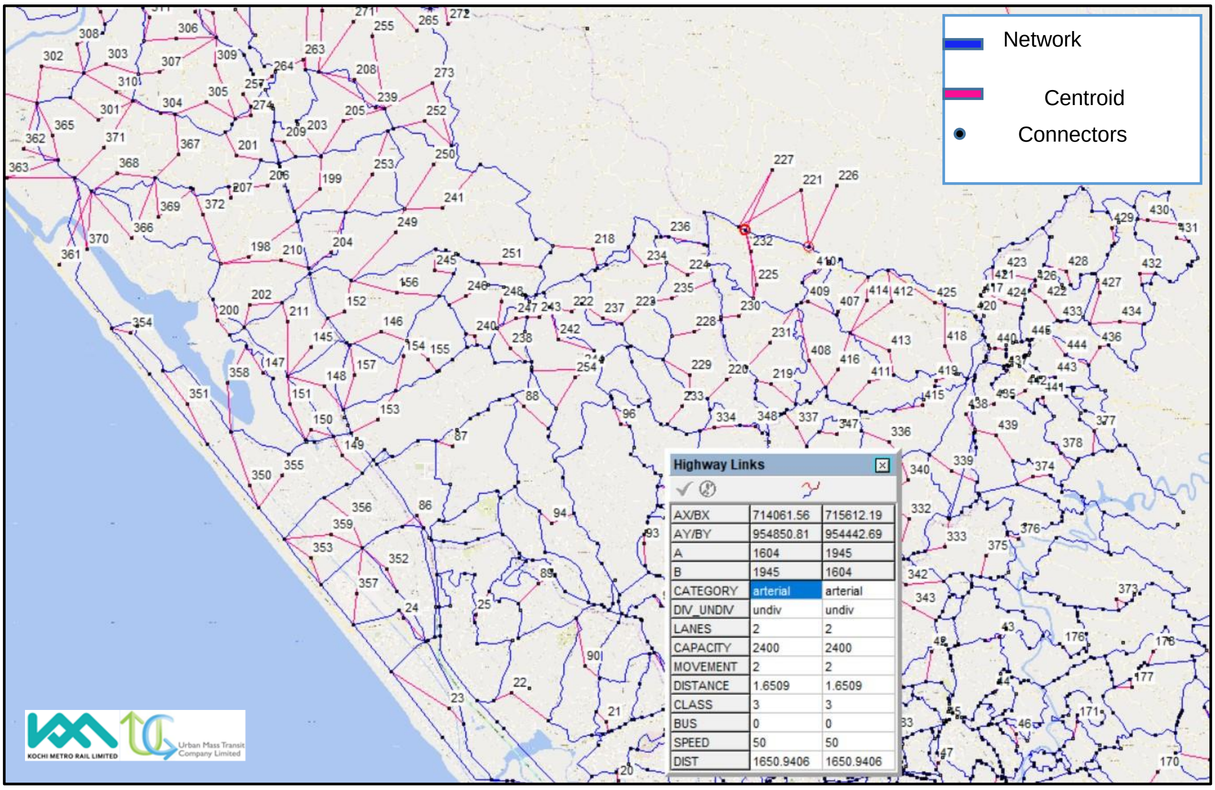
Source: IRC SP 30, 2019

CLASS	COEFFICIENT (A)	EXPONENT (B)
1	1.75	2.50
2	3.50	4.00
3	1.70	2.50
4	2.60	3.50
5	4.10	3.50
6	4.00	4.00
7	3.75	3.50

As mentioned in the Introduction of this chapter the network has various issues with the function class of the road and in many instances distances of links are incorrect. We have updated/corrected the link attributes, missing links, and prevailing traffic management movement. Also, traffic volume counts and Screen line survey counts were also incorporated into the network attributes of the corresponding link. In this study 7,796 links and 10,050 nodes are modelled. The snapshot of the coded network along with centroid connectors and all assigned attributes are shown in the figures below.



Highway Network along with centroid connect



Highway Network with Link Attributes

TRANSIT NETWORK

The transit network represents the connectivity, headways, speeds, and accessibility of the Public Transport. The transit routes are specified as those using the transport links and having stops/stations at determined locations. The access to the stops/stations from zone centroids and other nodes is provided by defining exclusive walk links. The access and egress links (walk, transfer) were generated automatically through the “Generate” command in the software.

Public Transport Assignment

PT Routes (.LIN file)

- Route name
- Mode Number
- Identifier
- Headway

PT System (.PTS file)

- Mode Number
- Connectors (walk, auto)
- Name
- Initial Wait curve

PT NET LEG (.NTL file)

- From node to node
- Mode
- Distance

PT Fare System (.FAR file)

- Identifier
- Name
- Structure (Distance, Zone based)

PT Costs (.FAC file)

- Identifier
- Mode (auto, walk)
- Transfers
- Penalty

Outputs

- On\Off
- Sectional Loading

Transit Network input files

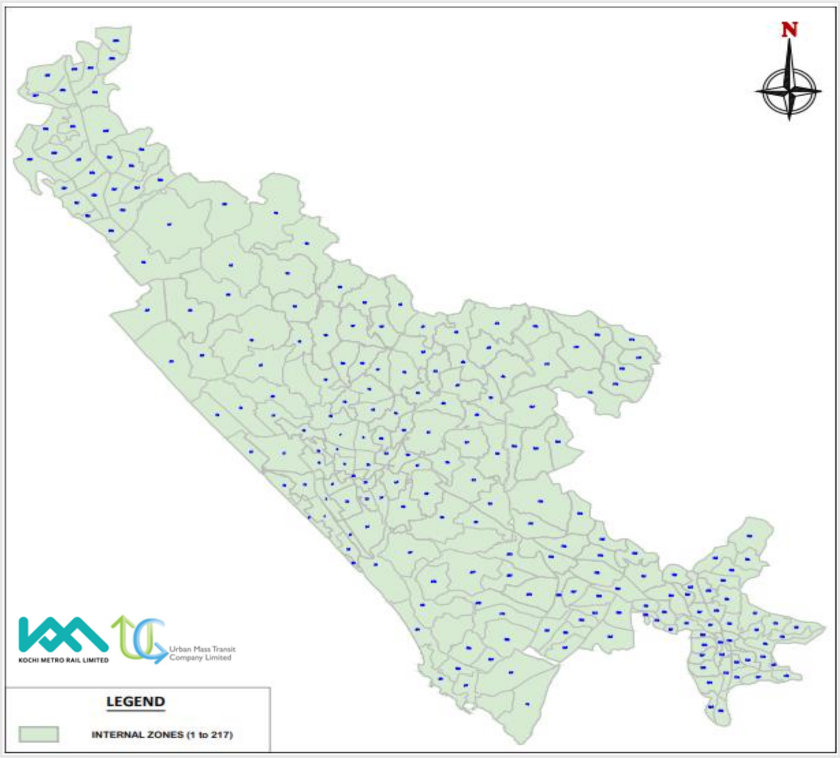
Public Transport Network includes all roads on which public transport buses operate. Details of bus routes, frequencies, seating capacities, maximum load factor, and fares have been collected and coded. In addition, in this study, the road network is properly connected to all zone centroids by means of dummy links called connectors. Currently, about 420 KSRTC bus routes and 70 Private Bus routes are operated in the Trivandrum. Information on the same was collected from KSRTC and updated into the system. Fare structure and frequency was also updated.

Transit Network in the study area showing Coded KSRTC bus routes

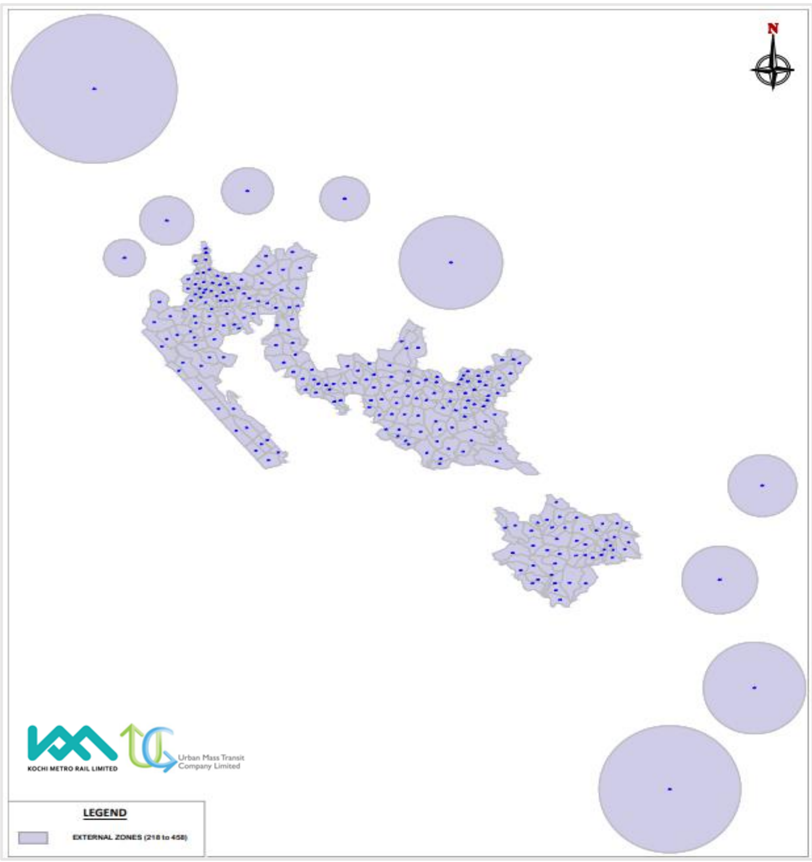
Transit Network in the study area showing Coded Private Bus Routes

ZONING

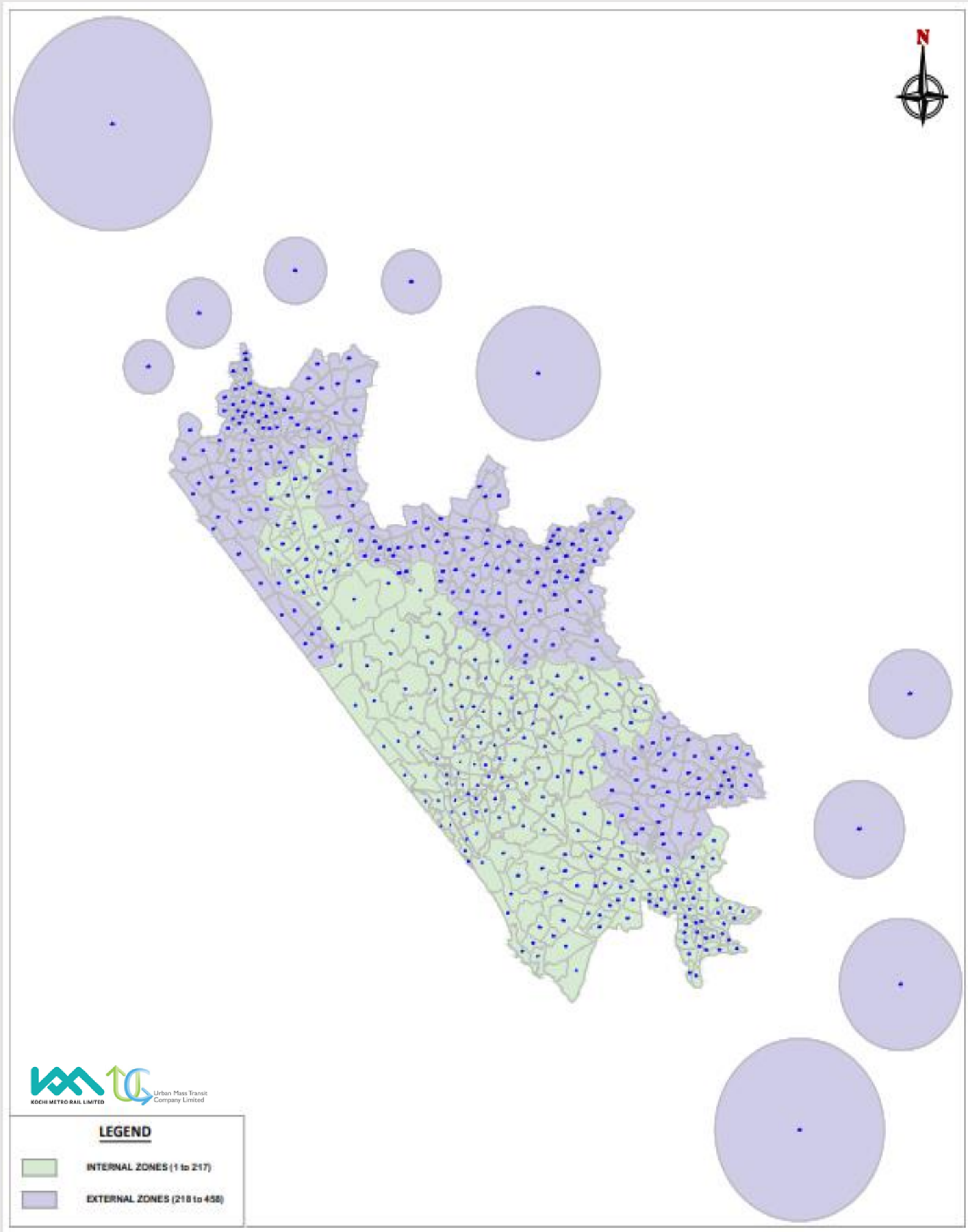
The study area considered is expanded Planning area that is Study area of 371 Sq.km. and an influence area, together accounting to an area of 1194 Sq.km. The study area is subdivided into a number of zones. For the study purpose the zoning system was adopted consisting of 458 zones, in that 1 to 217 are internal zones and 218 to 458 are external zones. The internal and external zones are shown in figure below respectively.



Traffic Analysis Internal Zones



Traffic Analysis Zones – External Zones

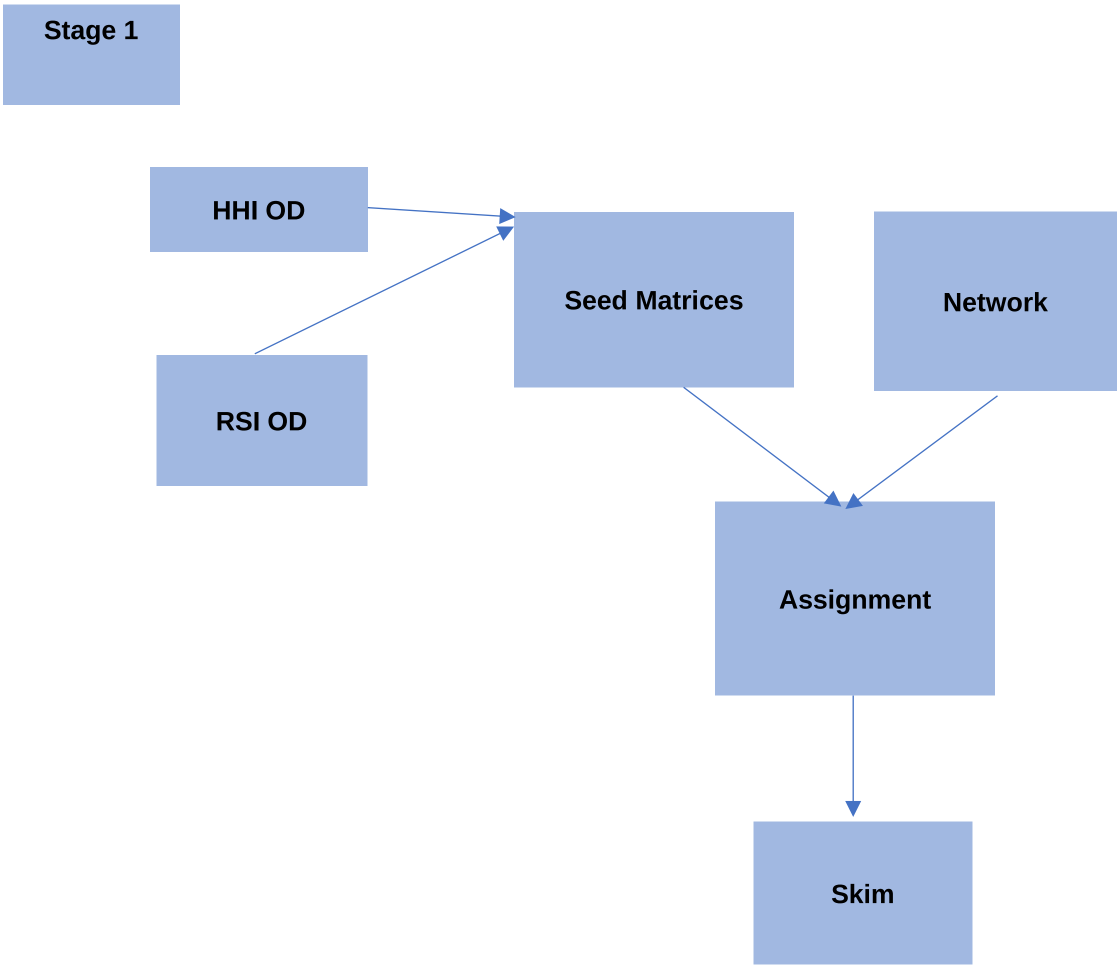


Trivandrum Traffic Analysis Zones

STRENGTHENING OF MATRICES

DEVELOPMENT OF OD MATRICES

To begin with we built the OD data from Household Interview Survey and to strengthen matrices we have replaced the cells in the OD from RSI OD which we built it from Road Side Interview Survey to validate it to ground traffic condition.



Highway Assignment

These matrices have been validated across screen lines to prove that they are reflecting ground conditions and are called as the observed matrices as they are balanced to observed data. The mode wise matrices were developed for morning peak hour. From the primary surveys it has been observed that the morning peak is during 8.45 AM to 9.45 AM. The model was built for the morning peak as this represents the journey to work period which is the most suitable time to build the transportation model for planning purposes These are to be used in the next stage to calibrate fresh model functions.

VALIDATION AND CALIBRATION OF BASE YEAR TRANSPORT NETWORK AND MATRICES

ASSIGNMENT

The process of allocating OD matrices to the network is called Assignment. This is carried out in two parts in CUBE. The first is the Highway Assignment which assigns traffic in terms of passenger car units (PCU) through a multiuser class, capacity restrained equilibrium assignment. First truck traffic and NMT are assigned (preloads) and Bus traffic data from bus route data is attached as fixed flows and then the PCU matrices are loaded.

The second part is the public transport assignment which assigns Trips (People not PCU'S) to the public Transport network (Buses/ Metro's etc).

The assignment includes multi path and crowd modelling features. These features in CUBE have proved to provide much more accurate results in congested networks as the capacity of each of the public transport system is also defined. The crowd model simply deters people from getting into overcrowded public transport systems.

Fare Structure Adopted

Public Transport Fare Structure Considered

PUBLIC TRANSPORT FARE STRUCTURE ADOPTED IN THE MODEL							
Cost Per Km (Paise)		**103**	**100**	**108**	**105**	**175**	**100**
Minimum Fare (Rs)		**12**	**10**	**22**	**15**	**26**	**10**
Minimum Km (Km)		**2.5**	**2.5**	**10**	**5**	**5**	**2.5**
SERVICE TYPE		**CITY FAST**	**ORDINARY/ MOFUSSIL SERVICES INCLUDING CITY/ TOWN/ CITY CIRCULAR/ CITY SHUTTLE/ JNNURM NON-AC SERVICES**	**SUPER-FAST SERVICES**	**FAST PASSENGER/ LIMITED STOP FAST PASSENGER SERVICES**	**LOW FLOOR AIR CONDITIONED (JNNURM A/C SERVICES)**	**PRIVATE BUS**
Stage	**Distance (Km)**	**Fare (INR)**	**Fare (INR)**	**Fare (INR)**	**Fare (INR)**	**Fare (INR)**	**Fare (INR)**
1	2.5	12	10	22	15	26	10
2	5	15	13	22	15	26	13
4	10	20	18	22	21	36	18
6	15	25	23	28	26	44	23
8	20	31	28	33	31	54	28
10	25	36	33	39	36	62	33
12	30	41	38	44	42	70	38
14	35	46	43	49	47	80	43
16	40	51	48	55	52	88	48
18	45	56	53	60	57	96	
20	50	61	58	66	63	106	
22	55	67	63	71	68	114	

PUBLIC TRANSPORT FARE STRUCTURE ADOPTED IN THE MODEL							
Cost Per Km (Paise)		103	100	108	105	175	100
Minimum Fare (Rs)		12	10	22	15	26	10
Minimum Km (Km)		2.5	2.5	10	5	5	2.5
SERVICE TYPE		CITY FAST	ORDINARY/ MOFUSSIL SERVICES INCLUDING CITY/ TOWN/ CITY CIRCULAR/ CITY SHUTTLE/ JNNURM NON-AC SERVICES	SUPER-FAST SERVICES	FAST PASSENGER/ LIMITED STOP FAST PASSENGER SERVICES	LOW FLOOR AIR CONDITIONED (JNNURM A/C SERVICES)	PRIVATE BUS
Stage	Distance (Km)	Fare (INR)	Fare (INR)	Fare (INR)	Fare (INR)	Fare (INR)	Fare (INR)
24	60	72	68	76	73	124	
26	65	77	73	82	78	132	
28	70	82	78	87	84	140	
30	75	87	83	93	89	150	
32	80	92	88	98	94	158	
34	85	97	93	103	99	166	
36	90	103	98	109	105	176	
38	95	108	103	114	110	184	
40	100	113	108	120	115	194	
42	105	118	113	125	120	202	
44	110	123	118	130	126	210	
46	115	128	123	136	131	220	
48	120	134	128	141	136	228	
50	125	139	133	147	141	236	
52	130	144	138	152	147	246	
54	135	149	143	157	152	254	
56	140	154	148	163	157	264	
58	145	159	153	168	162	272	
60	150	164	158	174	168	280	
62	155	170	163	179	173	290	
64	160	175	168	184	178	298	
66	165	180	173	190	183	306	
68	170	185	178	195	189	316	
70	175	190	183	201	194	324	
72	180	195	188	206	199	334	
74	185	200	193	211	204	342	
76	190	206	198	217	210	350	
78	195	211	203	222	215	360	
80	200	216	208	228	220	368	
120	300	319	308	336	325	544	
160	400	422	408	444	430	718	
200	500	525	508	552	535	894	

OBSERVED VALIDATION (PASSENGER VEHICLES)

The observed highway and public transport matrices were assigned on the network, and the assigned traffic volume was compared across screen lines. The model performs well across screen lines within a confidence range of +/-14%. The validation results are given in Table below. Based on this, we now proceed to the calibration of the travel demand model.

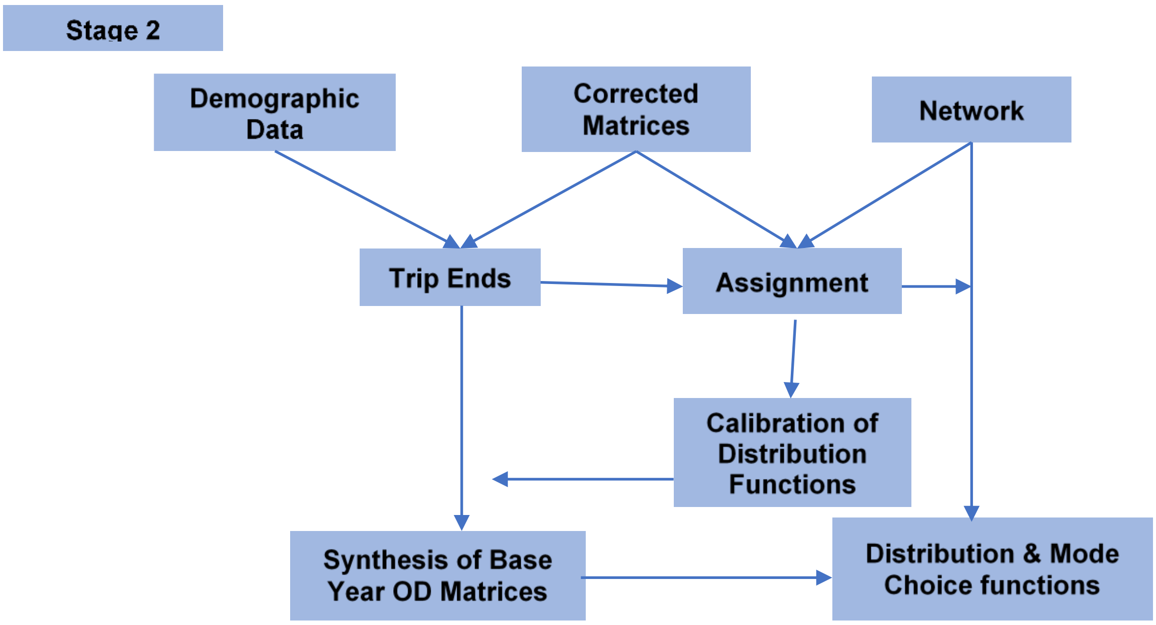
Observed Model Validation

OBSERVED MODEL VALIDATION			
	Observed value	**Assigned value**	**Variation**
North - South Corridor			
CAR	3,723	3,501	6%
TW	17,615	15,458	12%
AUTO	1,850	1,701	8%
East – West Corridor			
CAR	3,722	3,291	12%
TW	14,761	16,012	-8%
AUTO	2,420	2,547	-5%

CALIBRATION OF TRAVEL DEMAND MODEL

We have calibrated distribution functions for 4 modes using the cost skims from the highway assignments along with the trip matrices and base year planning data.

These distribution function have been used to establish the base year synthetic OD data using trip generation equation.



Process to Calibrating Model Parameters

TRIP END MODELS:

Using the validated trip matrices Trip end models were developed by relating the trip produced from and attracted to the zones with the Land use. Simple Regression equations have been calibrated.

Generation Model

TP= 98.36+0.08 * Population (R^2 = 0.98)

Attraction Model

TA= -46.5 + 0.1837 * Employment (R^2 = 0.65)

COMBINED MODE CHOICE CUM DISTRIBUTION MODEL

The trip distribution and model split phase is carried out using a combined mode choice cum distribution function of the form:

Tijm=ri Gi sj Aj Fijm

Were,

T= number of inter zonal trips by mode m

G= Total generation trip ends by zone

A= Total attraction trip ends by zone

i= Generation Zone

j= Attraction Zone

r, s = Balancing factors (constants)

Fij= deterrence function for mode m

Fij= Km eβ ijm Cα ijm

Were,

K= Constant Factor

C=Generalized Cost

B= Calibration Constant -Exponential function

α=Calibration Constant- Power function

Double Constraints are imposed by ensuring that.

$$\sum_{jm} \mathbf{Tij} = \mathbf{Gi} \quad \text{And} \quad \sum_{im} \mathbf{Tij} = \mathbf{Ai}$$

The Calibrated parameters are given in below.

Deterrence Functions

DETERRENCE FUNCTIONS			
	K	A	β
Car	0.18	0.33	0.0065
TW	1.245	-0.162	0.007
AUTO	1.845	-0.5	0.006
BUS	0.34	0.38	0.021

SYNTHETIC VALIDATION (PASSENGER VEHICLE)

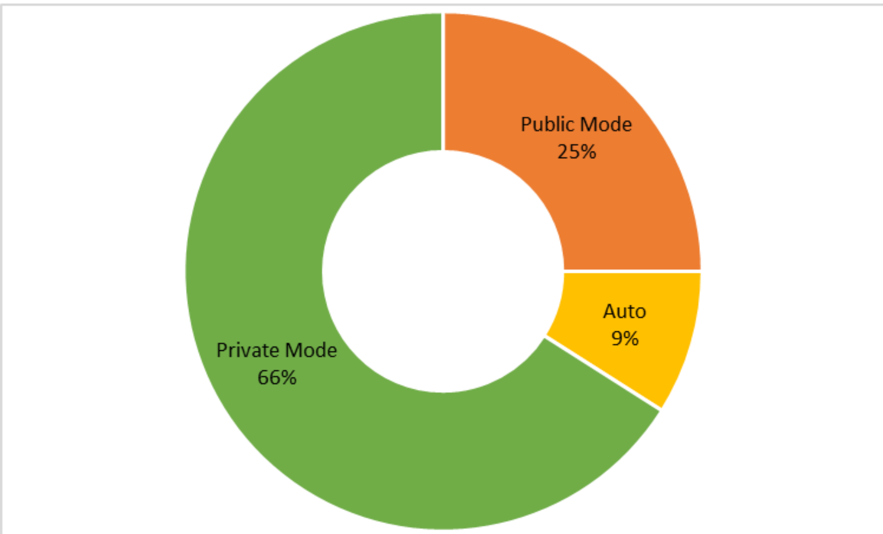
Using the deterrence functions and planning data in the base year we have established synthetic base year matrices. The Synthetic mode share have been presented below.

Synthetic mode wise trips

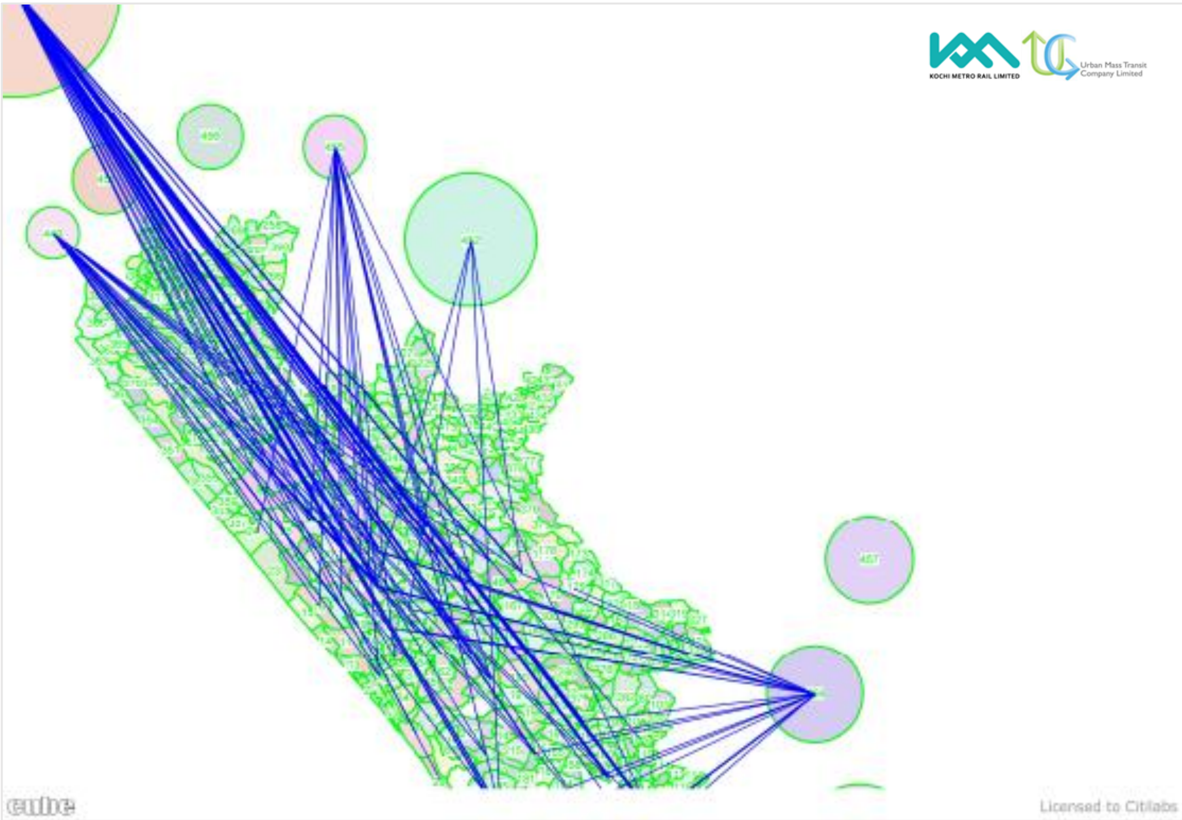
SYNTHETIC MODE SHARE	
Mode	Mode Share
Public	25%
Auto	9%
Private	66%
Total	100%

BASE YEAR TRAVEL DEMAND OUTCOMES

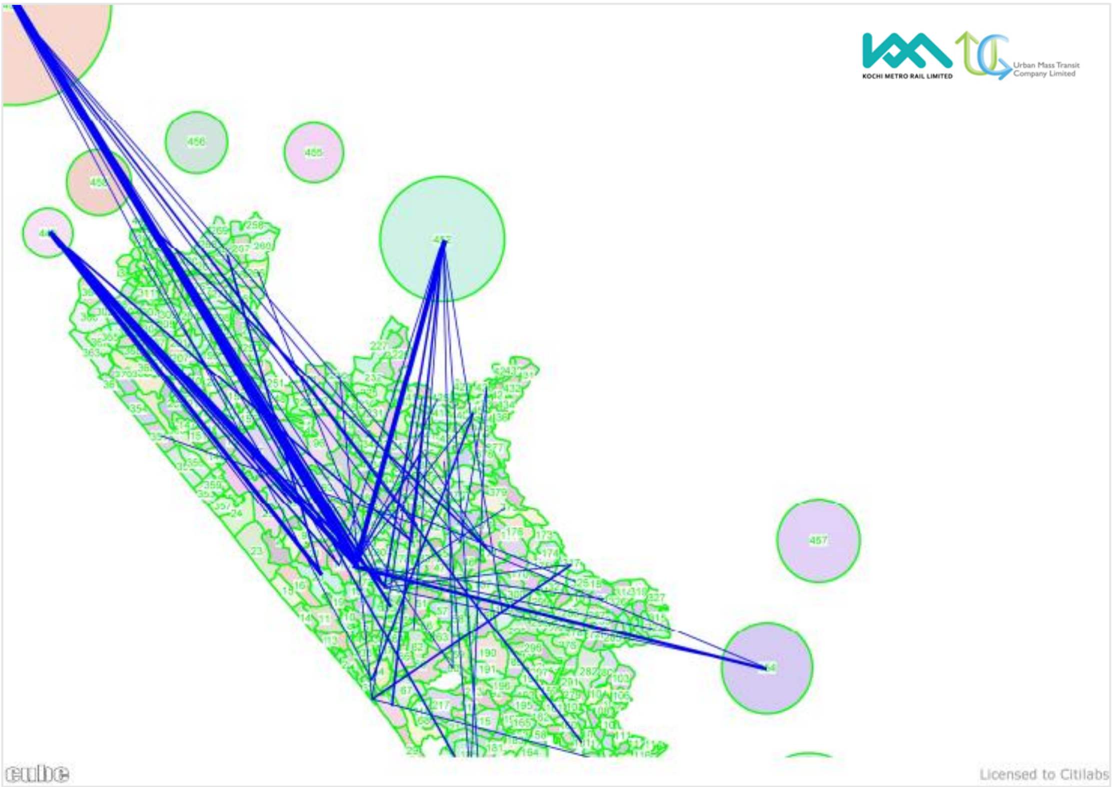
The mode share observed in the study area indicates high dependency towards private modes. The share of public is about 25% in comparision to 66% of the trips being mage by private modes (share of trips excluding walk).



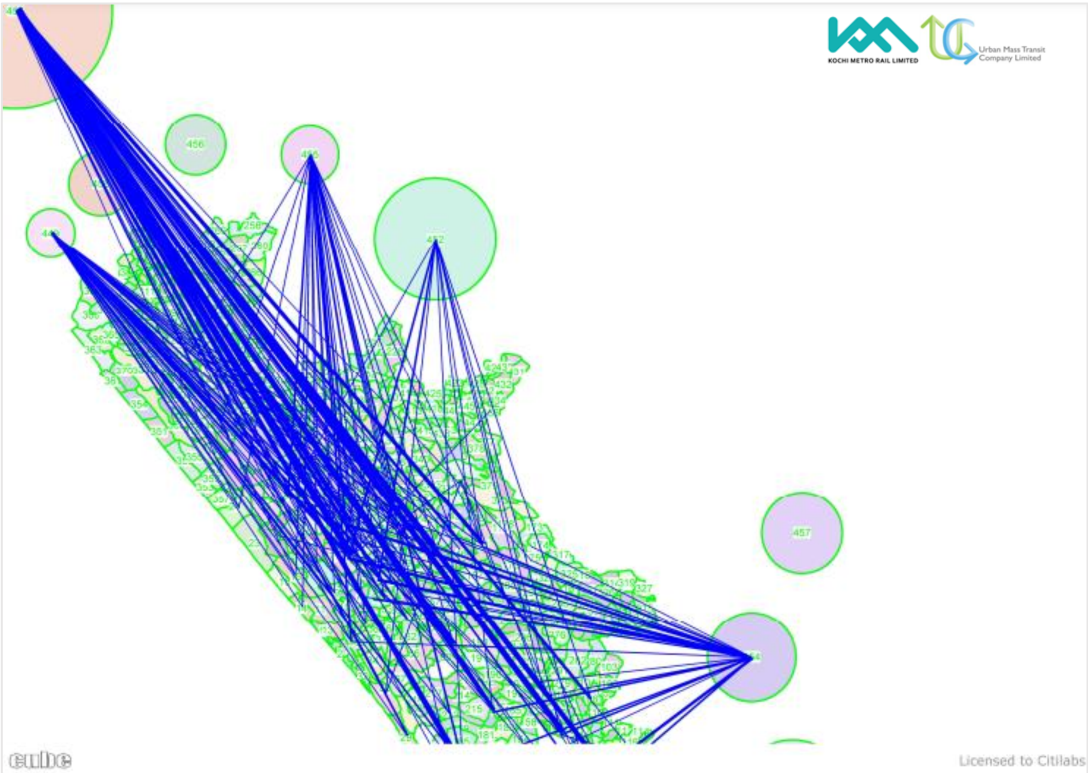
Mode Share for Base Year (2023) –Excluding NMT trips



Desire Line Diagram representing the trip interactions of Private Modes Users -2023



Desire Line Diagram representing the trip interactions of Public Transport Modes Users -2023



Desire Line Diagram representing the trip interactions of all Motorised Modes Users -2023

synthetic model results with the previous studies (CMP 2015). This surge or inclination towards private modes, might be a result of immediate post-COVID situation.

And with the recovery of public transportation usage in the city similar to pre-COVID conditions, an alternative base scenario[31] has been developed to assess travel characterises. The results are presented in the table below.

Mode Wise Motorised Trips Comparison (Excluding walk and bicycle trips)

MODE SHARE				
Mode	2014 (Base Year, CMP 2015)	2024 (BAU[32], CMP 2015)	2023 (Base Year, Post-COVID Scenario)	2023 (Base Year, Pre-COVID Scenario)
Private	50%	58%	66%	60%
Public	40%	31%	25%	30%
Auto	10%	11%	9%	10%
Total	**100%**	**100%**	**100%**	**100%**

[31] The alternative base scenario was developed with following –
i. Revised OD matrices with Screen line matrices data preceding the house hold matrices at surveyed locations.
ii. Peak period matrices were computed to derive peak hour matrices to capture improved trip interactions.
iii. Variation of KSRTC passenger data from December 2022 and February 2023.

[32] BAU – Business as Usual Scenario with no significant changes in the urban transportation system like implementation of Proposed Metro and BRT system, etc.

Hereby, it is observed that the travel conditions of Base Year pre-COVID scenario is in-line with the projected Business as Usual Scenario (BAU) 2024 of CMP 2015.

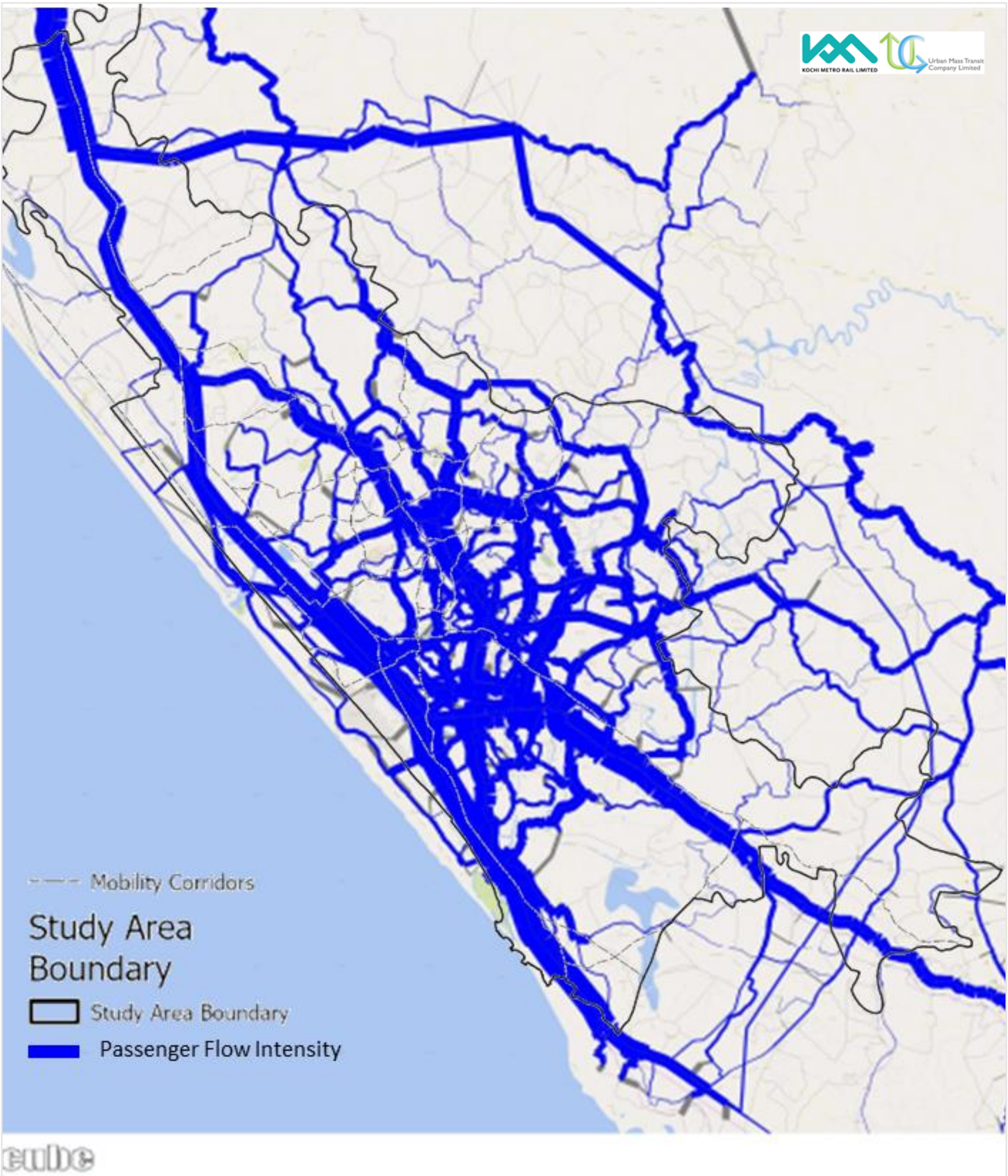


Diagram representing Passenger flow of Private and IP Modes Users -2023

Passenger flow diagram indicates significant passenger movements on the NH-66, NH Bypass, Ulloor- Kesavadapuram-Muttada corridor, Thiruvananthapuram- Bakery- Palayam Road, CVR Road, Eanchakkal- Killipalam Road, Thiruvananthapuram- Vizhinjam Road, Power House road, MC Road, Mannanthala Corridor etc.

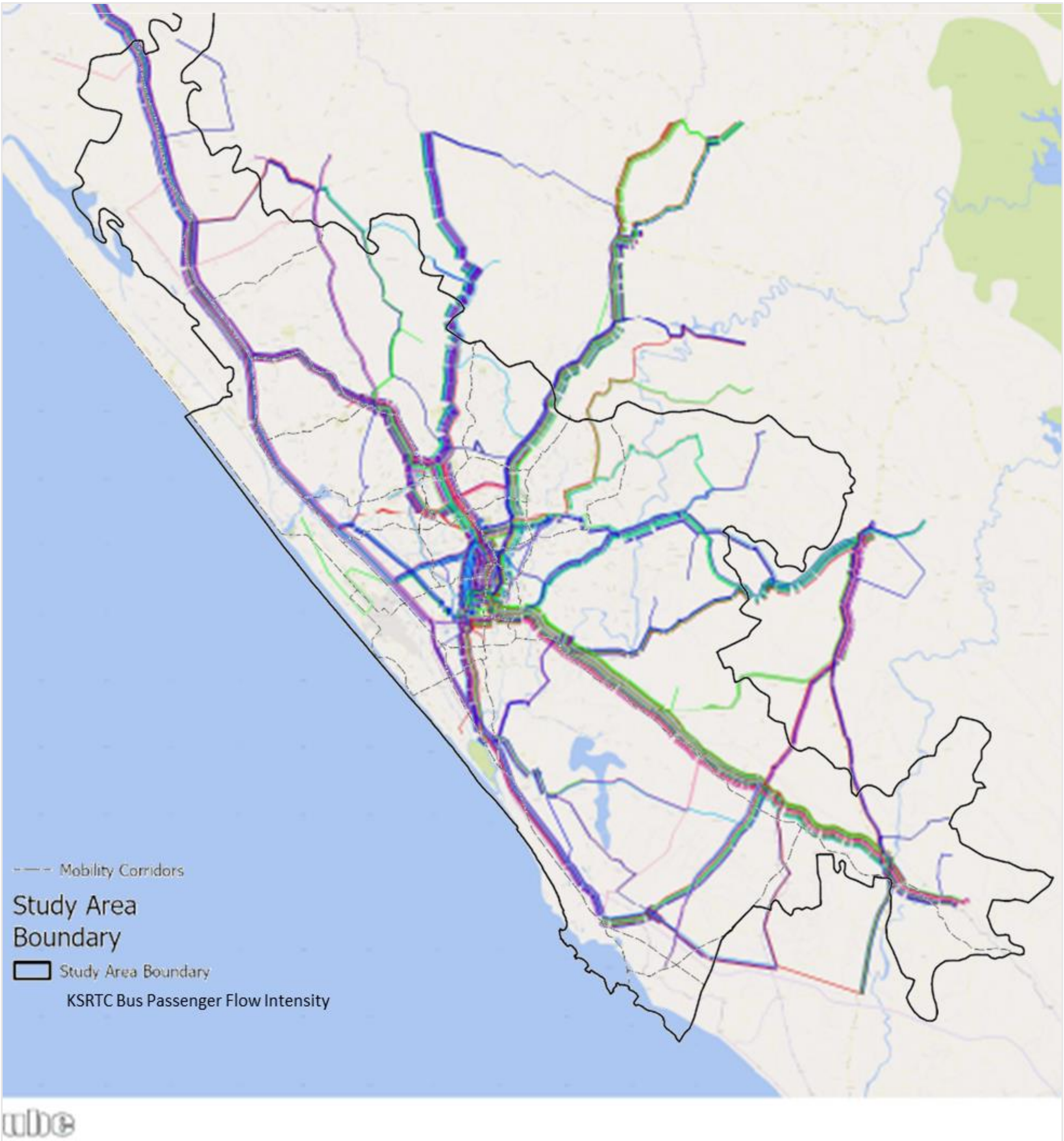


Diagram representing KSRTC Passenger flow -2023

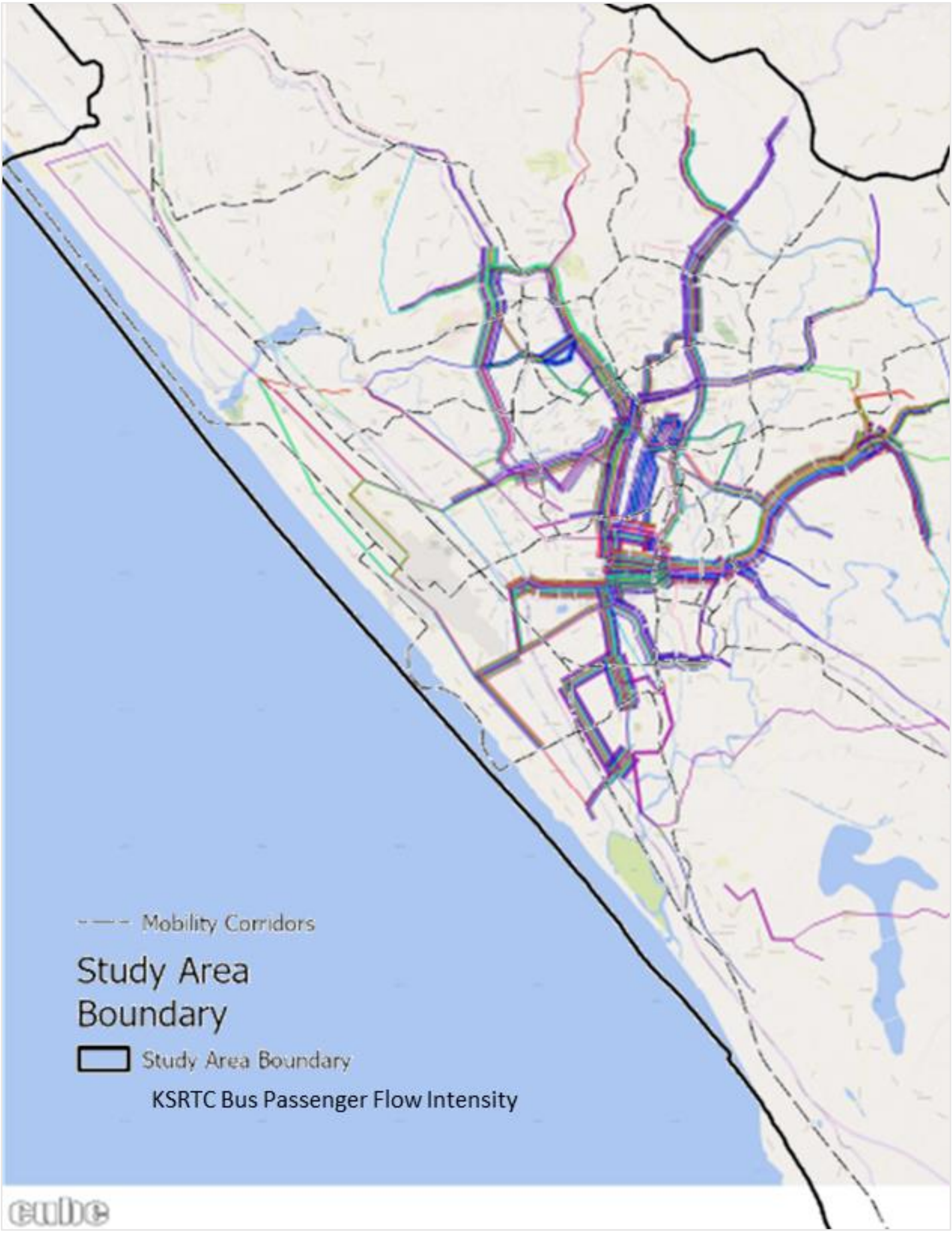


Diagram representing Private Bus Passenger flow -2023

The congestion levels on major mobility corridor with values over 0.8 are as presented in the table below

Congestion levels on Major Mobility Corridors

SN	NAME OF THE ROAD	DISTANCE (KM)	V/C (Base Year)
1	Maruthankuzhi Kesavadasapuram Rd	1.6	0.98
2	Thirumala Peyad Malayinkeezhurd	1.2	0.98
3	Kowdiar Ave	1.2	0.98
4	Panvel -Kochi Rd	1.5	0.98
5	Peroorkada Vattiyoorkavu Rd	11.2	0.98
6	Mukkikada Edathara Rd	1.9	0.98
7	Vazhuthacaud-Poojappura	2	0.98
8	Pappanamcode Malayinkeezhu Rd	6.1	0.87
9	Chekkalamukku-Powdikonam	2.5	0.98
10	Peroorkada	1.2	0.98
11	Kazhakoottam-Thaikod Rd	3.6	0.85
12	Poojappuram Rd	2.8	0.82
13	Powdikonam-Pothencode Rd	1.1	0.88
14	Peroorkada Rd	0.5	0.79
15	Medical College Ulloor Rd	1	0.87
16	PMG Rd	1.3	0.86
17	Market Rd	0.5	0.99
18	CV Raman Pillai Rd	3.2	0.81
19	LMS Vellayambaam Rd	3.2	0.89
20	Nemom Punnamoodu Rd	0.8	0.79
21	Sasthamangalam Rd	0.7	0.87
22	Nh66	41.9	1.04
23	Vizhinjam Poovar Rd	6.8	1.06
24	Pallicheal Vizhinjam	5.8	1.03
25	Mahatma Gandhi Rd	3.3	1.23
26	Trivendrum Vizhinjam Rd	4.2	1.34
27	Railway Station Rd (Over Bridge to Station)	0.6	1.45

TRAVEL CONDITION ASSESSMENT INDICATORS

The below mentioned indicators derived from the CMP Toolkit, 2014 by MoHUA will be used for assessing the travel conditions in the study area. The data extracted from the primary surveys and the outputs of travel demand model are presented against the indicators as presented in the Table 27.

Travel Condition Assessment Indicators

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
i) Mobility and Accessibility			
1	**Modal Share (%) of Motorized Modes (From Traffic Survey Results)**		
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	65%
	Public Modes	% of trips made by public transport modes	21%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	14%
2	**Trip Length (Km)**		
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car and Auto users in the study area	9.0
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.5
ii) Infrastructure and Land use			
1	**Infrastructure Quality**		
1.1	**Average Speed (Kmph) (All Modes)**	**Average speed of all modes**	**21.3**
	Average Speed (Kmph) (PvT)	Average speed of private modes	21.8
	Average Speed (Kmph) (PT)	Average speed of public transport modes	16.2
1.2	**Accessibility to Public Transport (Population)**		
	Access to PT	Population having access to PT	6.0
2	**Land use parameters**		
2.1	**Land use mix intensity**		
	Land use mix intensity	Job and housing balance (employment / residing population)	0.4

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
iii) Safety			
1	**Safety**		
1.1	Quality of footpath infrastructure	% of roads with more than 2m footpath	5.0%
2	**Security**		
2.1	Percentage of road lighted		80.0%
2.2	Percentage of footpaths lighted	-	53.0%
iv) Environmental Impacts			
1	**Emissions**		
1.1	Local Emissions (Tonnes/day)		10.7
1.2	GHG Emissions (Tonnes/day)		72.1
2	**Depletion of land resource**		
2.1	Consumption of land for transport activity	Percentage of total land used in transport for different type of transport infrastructure – road, parking bus lanes, railways, etc.	6.7%
iv) Technology			
1	**Vehicle Fuel Technology**		
1.1	Vehicle Fuel Technology	Percent of public transport fleet in compliance with Indian emissions standards	45%
2	**ITS Transitions**		
2.1	Availability of Traffic Surveillance – CCTV	Share of Stations with CCTV on BRTS, Terminals, MRT Stations and Signalized Intersections	38%
2.2	Passenger Information System (PIS) for Public Transport	Share of Terminals, MRT Stations having PIS	10%
2.3	Global Positioning System / GPRS	Share of Public Transport Vehicles and IPT with onboard GPS/GPRS which are connected to common control center	25%
2.4	Signal Synchronization	Share of signalized signals which are synchronized in the city	50%

ANNEXURE 6 - BUSINESS AS USUAL SCENARIO

BAU Scenario for future patterns of activity, growth and travel assumes that there will be no significant change in passenger's preferences with no major changes in infrastructure, technology, economics, or policies, such that current (base) circumstances can be expected to continue unchanged. This scenario represents the future based on the continuation of past trends and is often used as a reference point or benchmark for assessing the need for policy interventions. The BAU scenario extrapolates existing trends and assumes no radical policy interventions for sustainable development and emission mitigation.

However, it does incorporate infrastructure development on the on-going projects and projects to be implemented in the immediate years. Future transport demand is based on the preferences of different socio-economic groups in the base year.

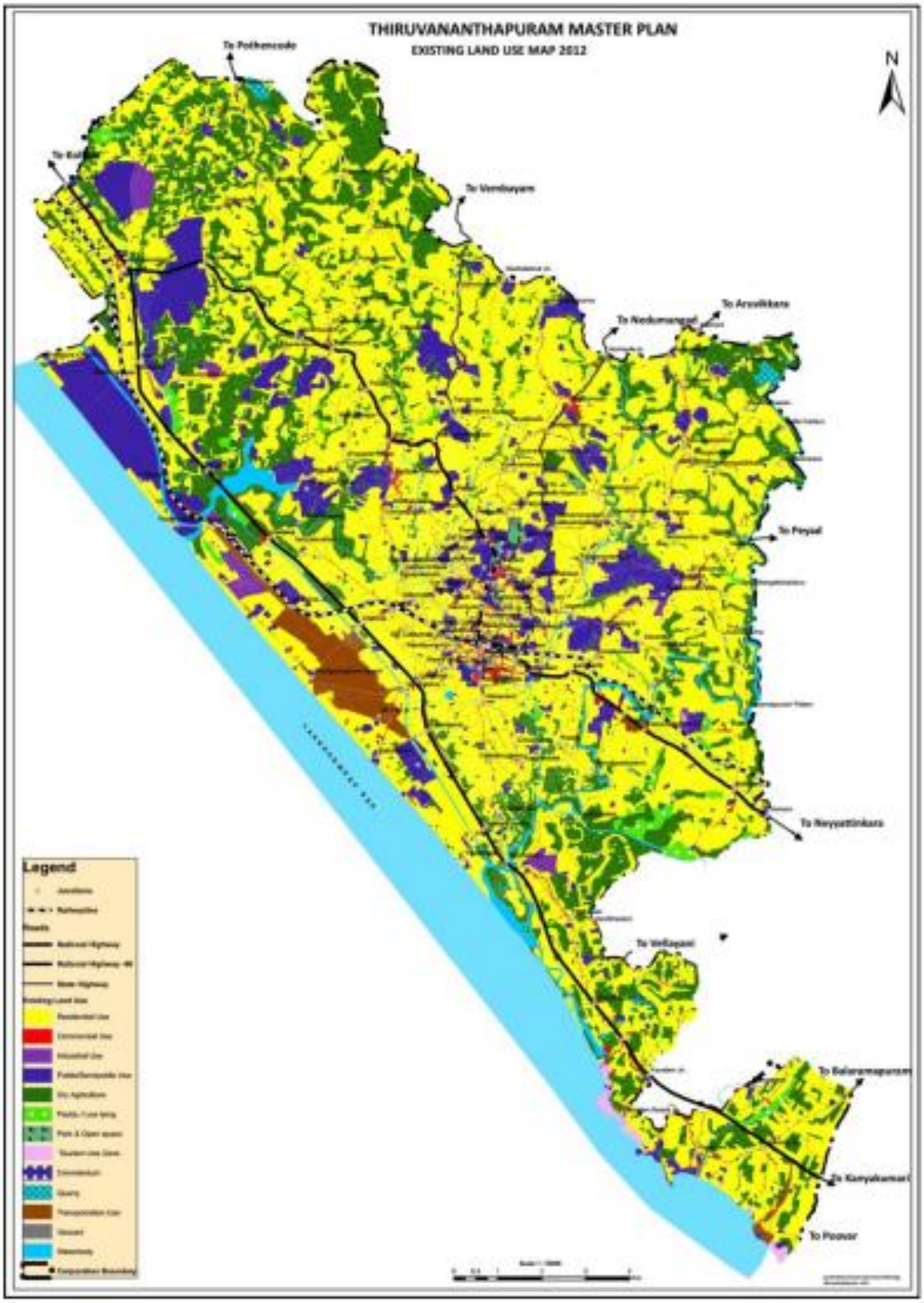
The BAU scenario predicts increased private vehicle ownership with higher demand for motorization. In terms of technologies, the scenario foresees continued reliance on fossil fuel vehicles.

LANDUSE TRANSITIONS

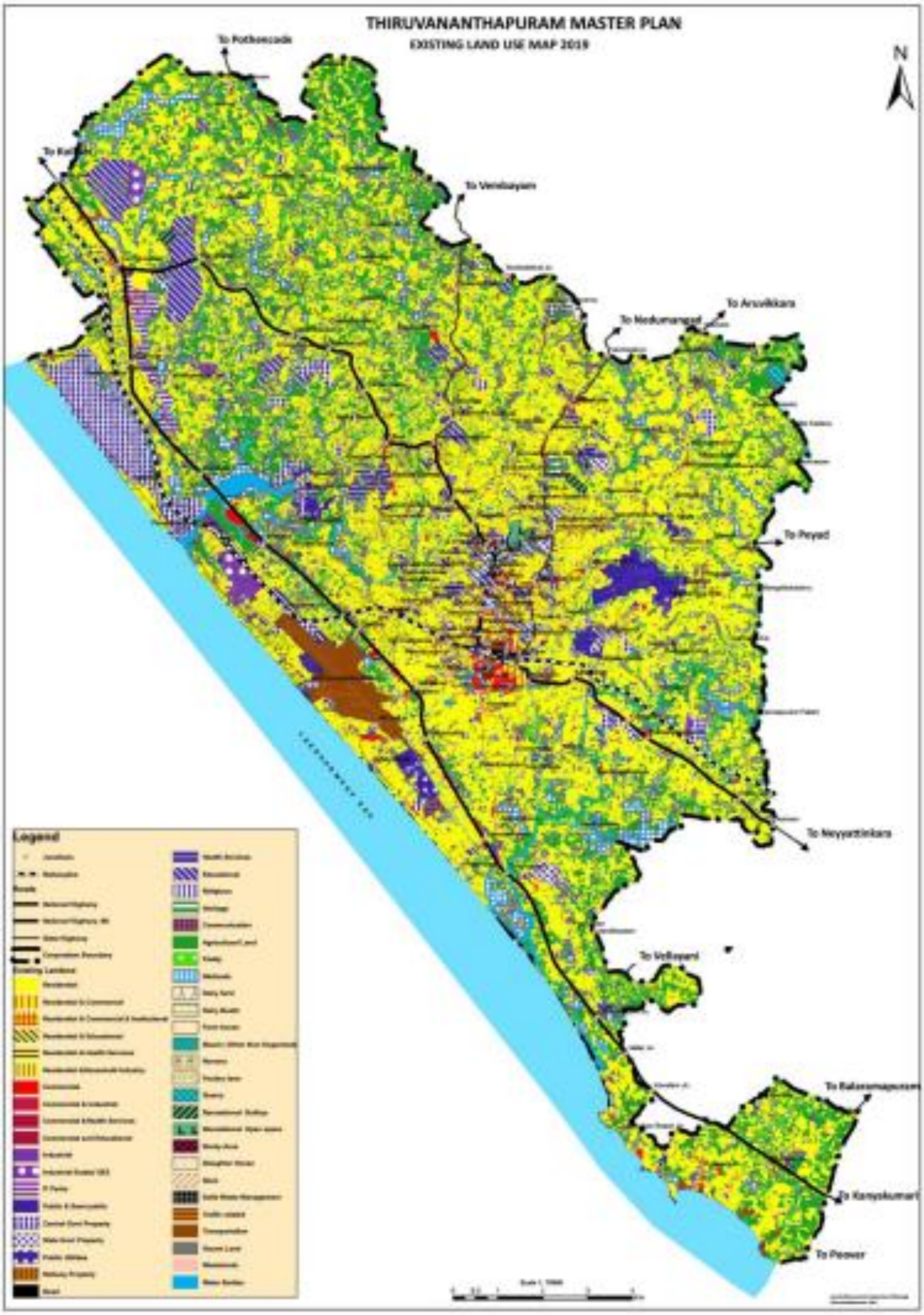
The land use transitions for BAU scenario considers the current growth pattern on assessing growth and variation of the existing land use plan of 2012 and 2019. The growth pattern is observed to be concentrated along the along the national highways and densification in the core area and Kesavdaspuram and along MC and Peroorkada Roads.

Land use Distribution (Source: Master Plan 2031, Draft Proposed Master Plan-2040)

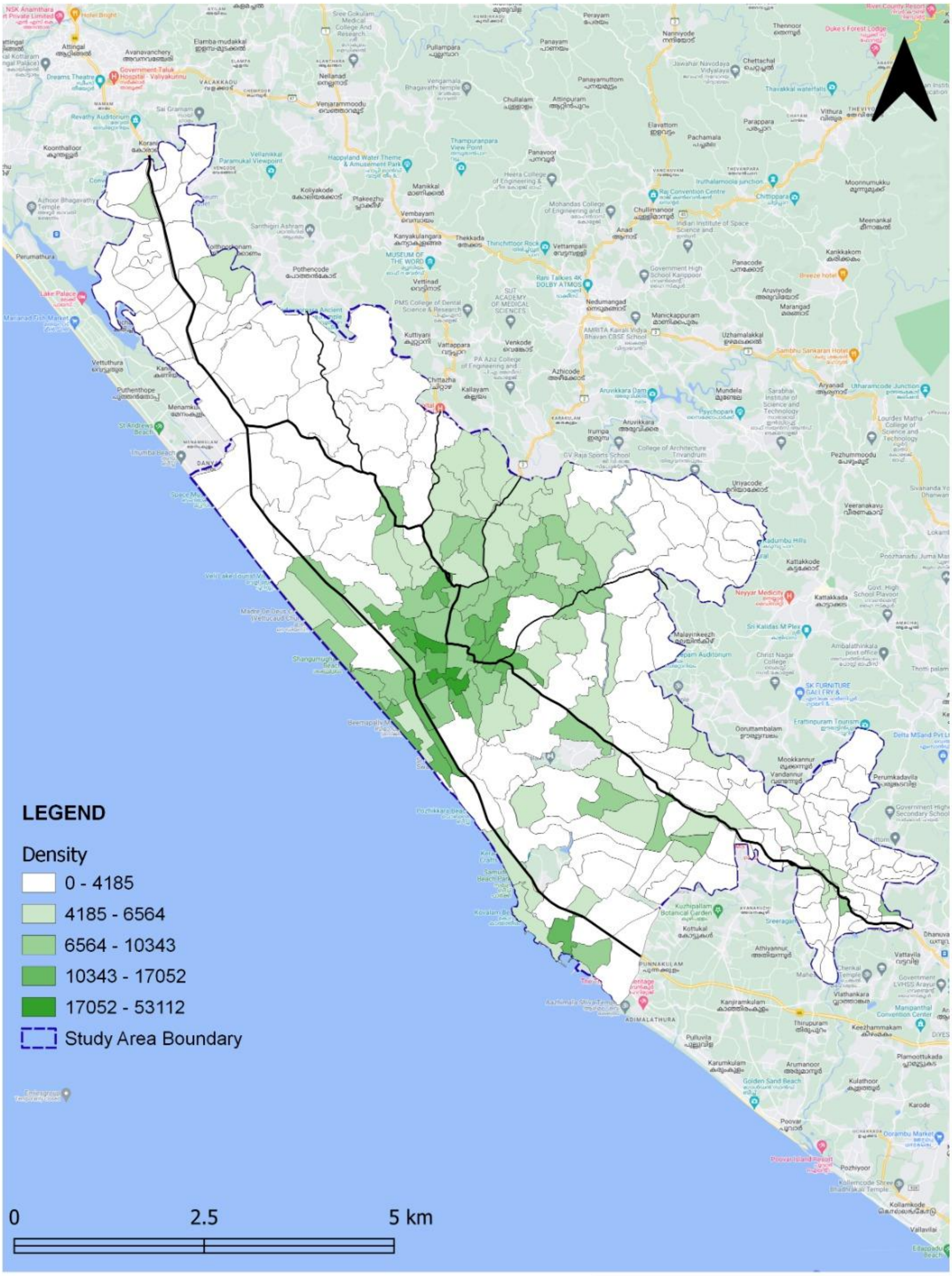
LAND USE	EXISTING LAND USE (2012)	EXISTING LAND USE (2019)
Developed Area (excld. Transportation) in SQKM	254.01	256.14
Transportation in SQKM	**11.18**	**24.93**
Undeveloped Area in SQKM	106.75	90.87
Total	371.94	371.94
Developed Area (excld. Transportation)	68%	69%
Transportation	3%	7%
Undeveloped Area	29%	24%
Total	100%	100%



Existing Land use of City-2012 (source- Master Plan,2012)

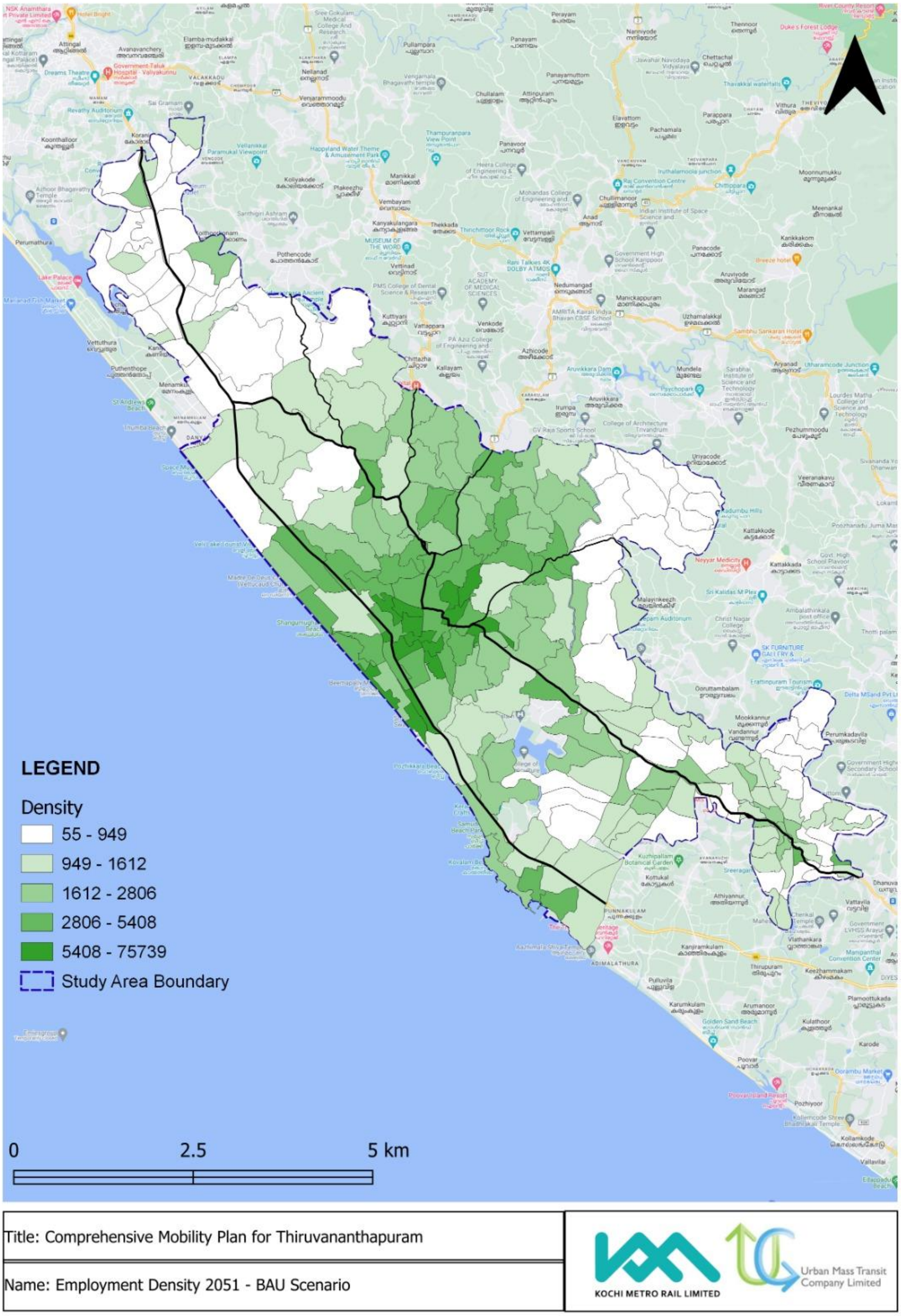


Existing Land use of City-2019 (source- Draft Proposed Master Plan,2040)



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED Urban Mass Transit Company Limited
Name: Population Density 2051 - BAU Scenario	

Population Distribution -2051-BAU



Employment Distribution -2051-BAU

NETWORK TRANSITIONS

The network transitions for BAU scenario considered the ongoing and committed road network and public transport projects. The following on-going projects and improvements are considered,

- Kazhakoottam Highway Underpass
- Development of Sreekaryam and Eanchakkal Flyover
- Kazhakoottam-Kadampattukonam Widening
- Kazhakoottam-Paripally Widening
- Development of bund road from Madhupalam to Punchakkari bridge
- Development of Pedestrian infrastructure and Street rejuvenation on major corridors of the city

TECHNOLOGY TRANSITIONS

The existing transport sector in the study relies primarily on fossil fuels (Petrol and diesel). The CMP-Toolkit 2014 indicates that the aggregate fuel efficiency is expected to improve in the BAU scenario where India will achieve the 4.5 lit per 100 km global target in 2051. Considering the current vehicle technologies and initiatives the following fuel mix is considered for BAU.

The estimated mix of vehicle in terms of their fuel usage for base year is obtained from the sampling of vehicles during house hold surveys and for horizon year similar trend of fuel mix is linked to the BAU scenario.

Fuel Mix for BAU Scenario

VEHICLE TYPE	% FUEL TYPE - 2051			
	PETROL	DIESEL	ELECTRICITY	TOTAL
Cars	41.00%	49.00%	10.00%	100.00%
2Ws	75.00%	0.00%	15.00%	100.00%
3Ws	0.00%	78.00%	12.00%	100.00%
Buses	0.00%	60.00%	40.00%	100.00%

HORIZON YEAR RESULTS

The demographic and network considerations are used to assess the horizon travel characteristics in the study. The impact on the network and travel characteristics are as presented in this following section.

However, in the absence of strengthening the public transportation through high capacity PT network and NMT facilities the travel demand on the major corridors will be served by private and auto-rickshaws. The projected mode share for Horizon year is as presented below.

Mode Share for Horizon Year under BAU Scenario

NAME OF THE INDICATOR	BASE YEAR (2023)	BAU (2051)
Private Transport (PVT) Trips	66%	69%
Public Transport Trips	25%	18%
IPT Modes	9%	13%

The increased dependency on private modes on roads reflects the increased congestion levels on roads which is as depicted in the table below.

Horizon Year Congestion levels

SN	NAME OF THE ROAD	DISTANCE (KM)	V/C (Base Year)	V/C (2051)
1	Maruthankuzhi Kesavadasapuram Rd	1.6	0.98	1.62
2	Thirumala Peyad Malayinkeezhurd	1.2	0.98	1.59
3	Kowdiar Ave	1.2	0.98	1.57
4	Panvel -Kochi Rd	1.5	0.98	1.58
5	Peroorkada Vattiyoorkavu Rd	11.2	0.98	1.47
6	Mukkikada Edathara Rd	1.9	0.98	1.31
7	Vazhuthacaud-Poojappura	2	0.98	1.41
8	Pappanamcode Malayinkeezhu Rd	6.1	0.87	1.15
9	Chekkalamukku-Powdikonam	2.5	0.98	1.33
10	Peroorkada	1.2	0.98	1.29
11	Kazhakoottam-Thaikod Rd	3.6	0.85	1.13
12	Poojappuram Rd	2.8	0.82	1.18
13	Powdikonam-Pothencode Rd	1.1	0.88	1.15
14	Peroorkada Rd	0.5	0.79	1.10
15	Medical College Ulloor Rd	1	0.87	1.18
16	PMG Rd	1.3	0.86	1.42
17	Market Rd	0.5	0.99	1.63
18	CV Raman Pillai Rd	3.2	0.81	1.34
19	LMS Vellayambaam Rd	3.2	0.89	1.47
20	Nemom Punnamoodu Rd	0.8	0.79	1.30
21	Sasthamangalam Rd	0.7	0.87	1.44
22	Nh66	41.9	1.04	1.48
23	Vizhinjam Poovar Rd	6.8	1.06	1.11
24	Pallicheal Vizhinjam	5.8	1.03	1.43
25	Mahatma Gandhi Rd	3.3	1.23	2.02
26	Trivendrum Vizhinjam Rd	4.2	1.34	2.08
27	Railway Station Rd	0.6	1.45	2.12

The average volume to capacity ratio (V/C) along major corridors is about 1.5 respectively, with service level of service, LOS- D, which indicates that the traffic volume has approached an unstable flow and needs immediate interventions.

ASSESSMENT OF ENERGY AND ENVIRONMENT - EMISSIONS

The impacts of travel conditions in the based year on environment is represented through carbon emission- Green House Gases and Local emissions. The local and GHG / CO2 emission for the base year has been extracted from the secondary data collected form Pollution Control Board and Vehicle kilometres travelled and projected to the horizon year.

Carbon Emissions in Horizon Year (BAU 2051)

SN	INDICATOR TYPE	DESCRIPTION	BAU (2051)
1	GHG Emissions	Equivalent CO2 emissions per passenger Km	120.1
2	Local Emissions	Equivalent CO2 emissions per passenger Km	31.3

TRAVEL CONDITION ASSESSMENT INDICATORS

The below mentioned indicators derived from the CMP Toolkit, 2014 by MoHUA will be used for assessing the travel conditions for horizon years. The outputs of travel characteristics for the horizon year are presented against the indicators as presented in the below

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR	HORIZON YEAR
i) Mobility and Accessibility				
1	**Modal Share (%)-Motorized Modes**			
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	66%	69%
	Public Modes	% of trips made by public transport modes	25%	18%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	9%	13%
2	**Trip Length (Km)**			
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car and Auto users in the study area	9	11.2
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.5	9.2
ii) Infrastructure and Land use				

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR	HORIZON YEAR
1	**Infrastructure Quality**			
1.1	**Average Speed (Kmph) (All Modes)**	**Average speed of all modes**	**21.3**	**18.2**
	Average Speed (Kmph) (PvT)	Average speed of private modes	21.8	19.4
	Average Speed (Kmph) (PT)	Average speed of public transport modes	16.2	15.6
2	**Land use parameters**			
2.1	**Land use mix intensity**			
	Land use mix intensity	Job and housing balance (employment / residing population)	0.4	0.4
iii) Safety				
1	**Safety**			
1.1	Quality of footpath infrastructure	% of roads with more than 2m footpath	5.0%	22%
iv) Environmental Impacts				
1	**Emissions**			
1.1	Local Emissions (Tonnes/day)		10.7	31.3
1.2	GHG Emissions (Tonnes/day)		72.1	120.1
2	**Depletion of land resource**			
2.1	Consumption of land for transport activity	Percentage of total land used in transport for different type of transport infrastructure – road, parking bus lanes, railways, etc.	6.7%	8.9%
iv) Technology				
1	**Vehicle Fuel Technology**			
1.1	Vehicle Fuel Technology	Percent of public transport fleet in compliance with Indian emissions standards	45%	65%

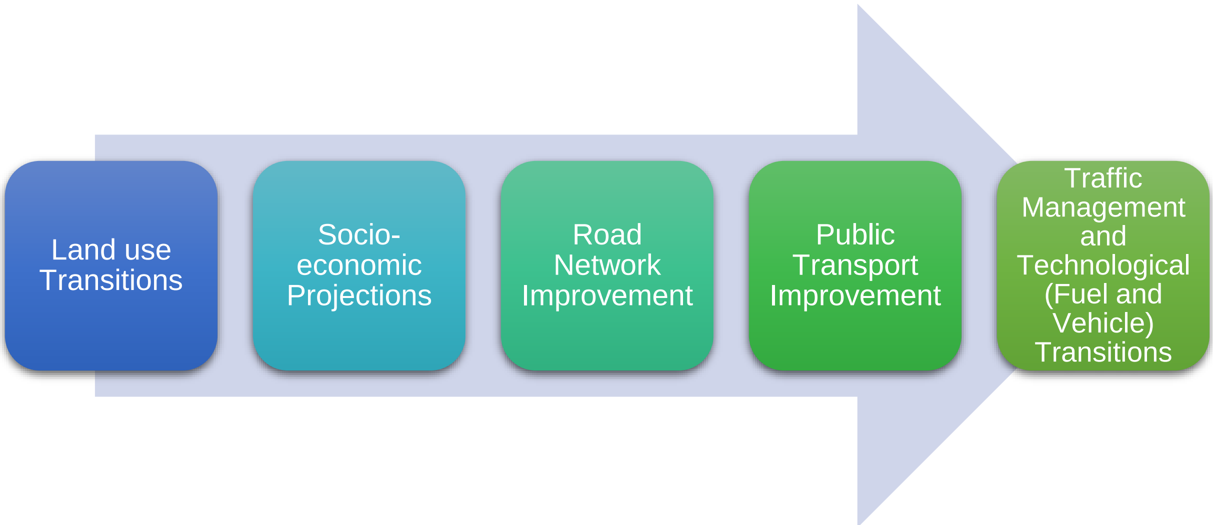
It is observed that in the absence of an integrated and comprehensive planning approach, the share of private modes has increased owing to increased congestion levels reduced travel speeds in the study area. The increase congestion level indicates complete exhaustion of the carrying capacity of the major mobility corridors in the peak hours.

ANNEXURE 7- SUSTAINABLE URBAN TRANSPORT (SUT) SCENARIO

The sustainable urban transport scenario visualizes social, economic, environmental and technological transitions through which societies respond to climate change, local environment and mobility challenges. The scenario assumes the following:

- Deep emission cuts using low carbon energy sources (such as renewable's, natural gas, nuclear power)
- Use of highly efficient technologies (e.g., improved vehicle efficiency)
- Adoption of behavioural and consumption styles consistent with sustainable development
- Changes in urban development
- Enhanced use of non-motorized and public transport infrastructures.

Thus, to assess the suitable sustainable urban transport strategies for Thiruvananthapuram alternate sustainable scenarios have been developed. The strategies and alternate proposals developed for Thiruvananthapuram were assessed in various permutations to recommend the most suitable combination scenario and strategies. The transitions considered in developing the scenarios is as follows,



Thus, scenario includes the iteration of optimistic travel pattern with higher inclination towards public transport due to better facilities and comfort of travel under pre covid scenario.

LANDUSE TRANSITIONS

The land use transitions for SUT scenario considers the growth pattern on assessing growth and variation of the existing land use plan of 2012 and 2019 with proposed Master Plan proposal for 2040.

The proposed Master Plan has put forward about 78% of the land area for built-up use enabling availability of ample land for all kinds of development activities in the city. It is proposed to adopt a mixed development scenario in most of the development zones, other than for those zones dedicated for specific purposes.

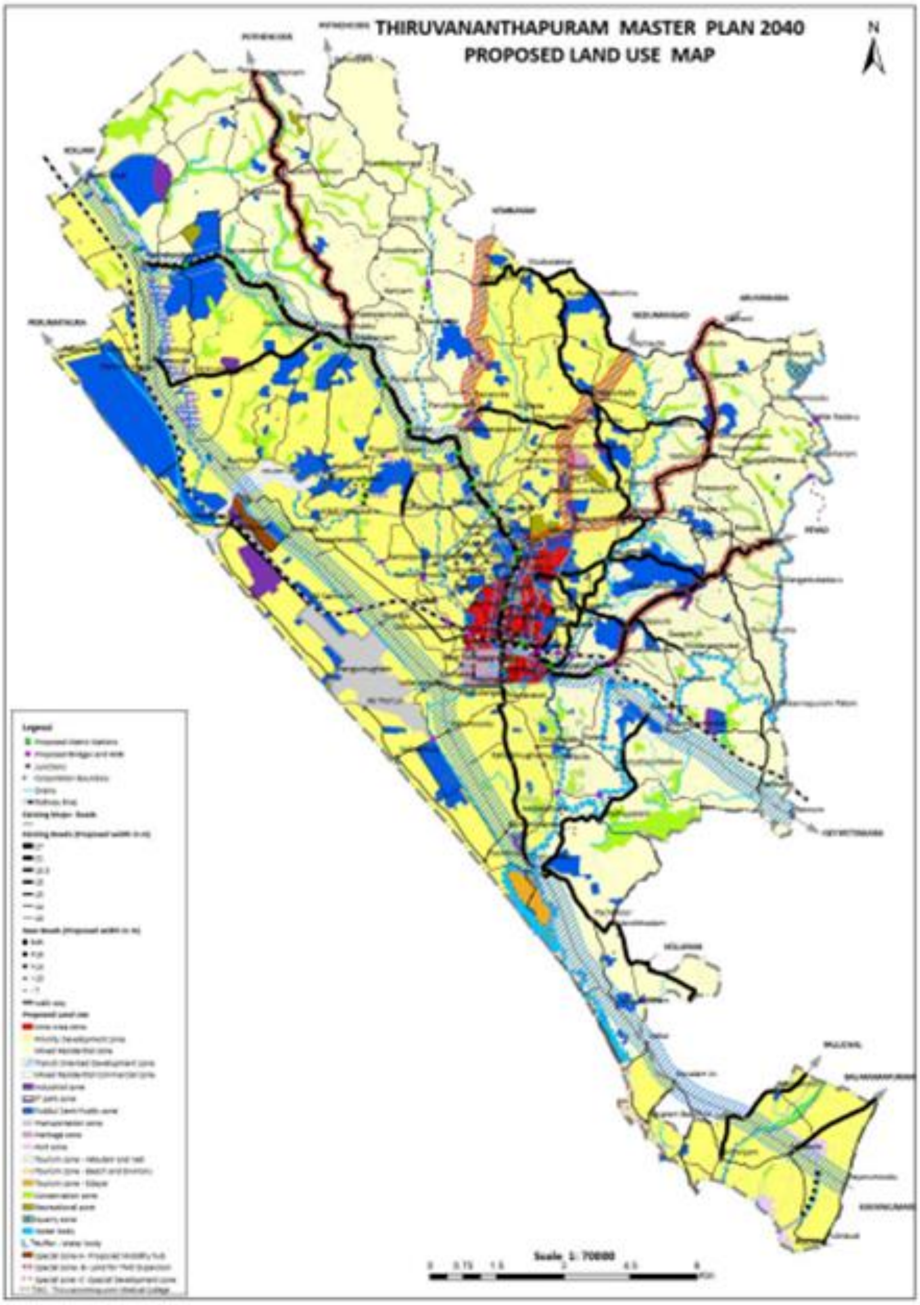
Land use Distribution (Source: Master Plan 2031, Draft Proposed Master Plan-2040)

LAND USE	EXISTING LAND USE (2019)	PROPOSED LAND USE (2040)
Developed Area (excld. Transportation) in SQKM	256.14	260.4
Transportation in SQKM	**24.93**	29.8
Undeveloped Area in SQKM	90.87	81.8
Total	371.94	371.94
Developed Area (excld. Transportation)	69%	70%
Transportation	7%	8%
Undeveloped Area	24%	22%
Total	100%	100%

The proposed growth pattern considerations in line with Proposed Master Plan 2040 are as follows,

- It is proposed to develop existing major industrial area of the city including the government owned industrial Estates as an intensive industrial use area and intensive industrial estate area catering to the demand.
- It is proposed to develop Techno Park Phase I, II and III area extensively for IT park uses and ancillary uses, catering to the demand.
- Transit Oriented Development (TOD) is proposed with the objective of capturing early the opportunity offered for mixed development, on implementation of higher order transport facilities in the future mass transit services along national highways.
- The regional major transport corridors such as Pothencode, Aruvikkara (via Kachani), Kattakada and of State highways that link the city to the other urban areas as well as surrounding developments are prioritised to have planned mixed development.

- The area under Vizhinjam Port would act as one of the focal points of development in the city.
- This special tourism area at Akkulam & Veli, Edayar to Kovalam, Edayar Islands are considered for development along with heritage areas of the city i.e., Kowdiar area and Fort area and its surroundings.



Proposed Land use of City-2040 (source- Master Plan,2040)

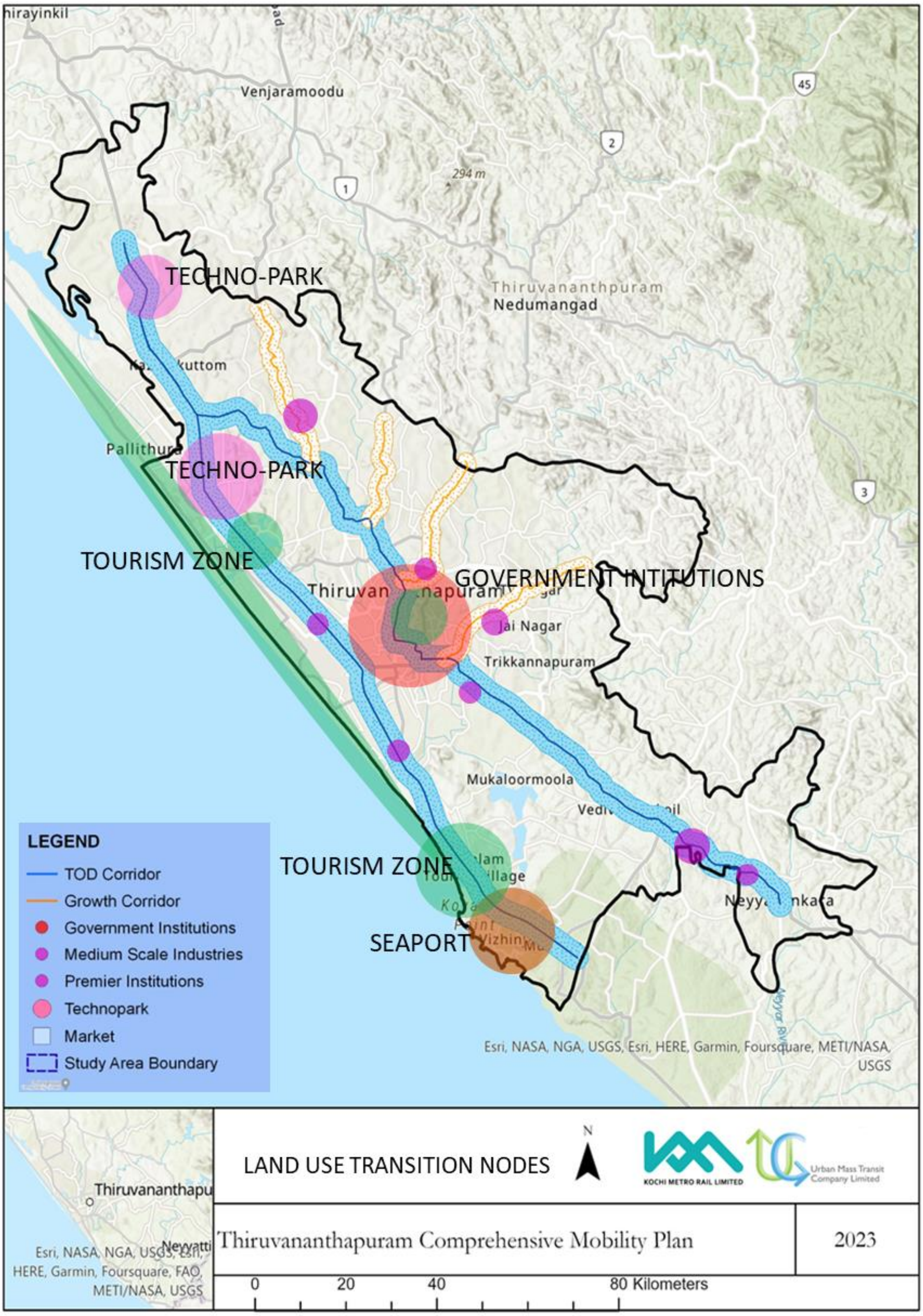
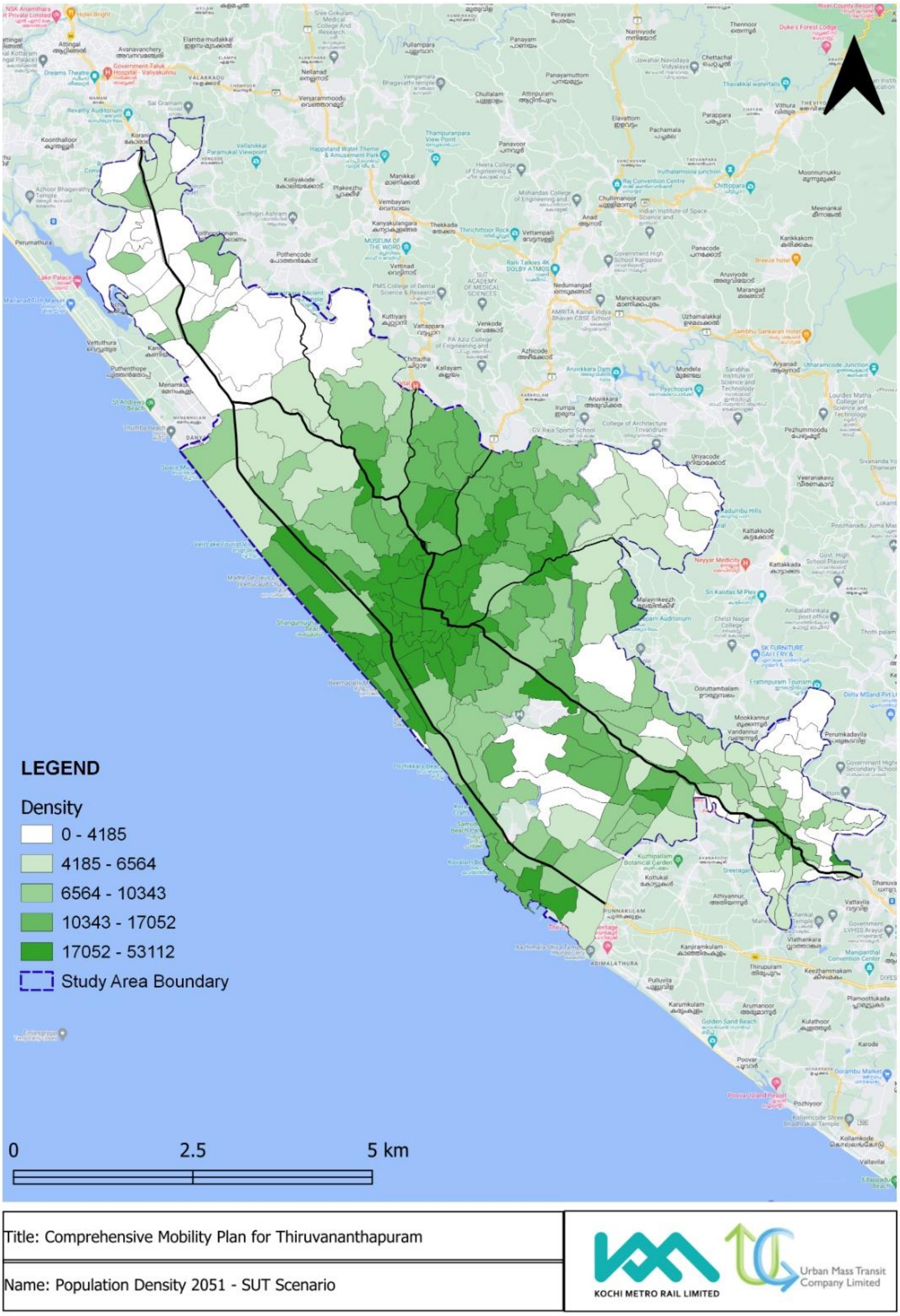
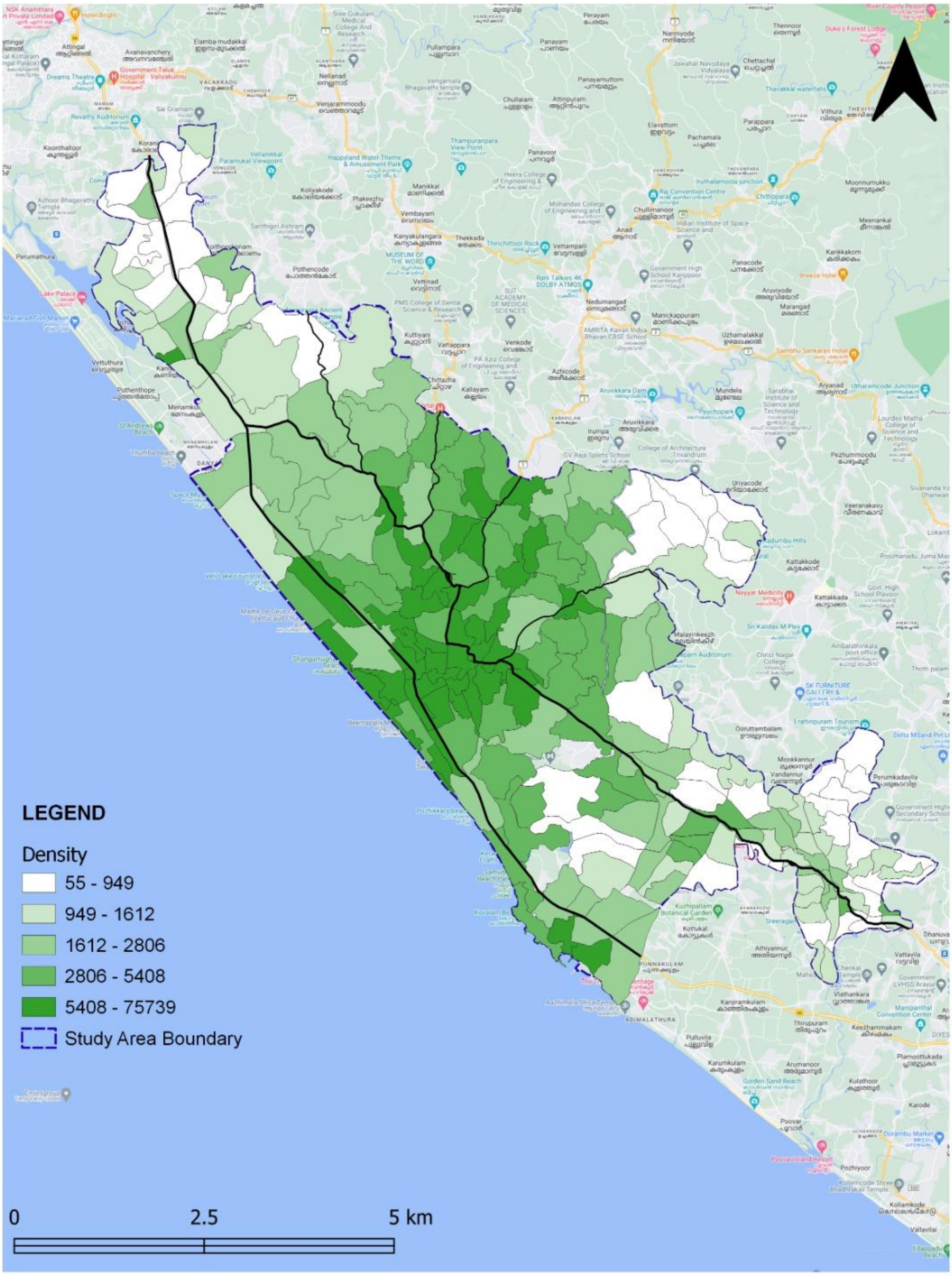


Figure 179 Proposed Land use Transitions Nodes



Projected Population Distribution – 2051 SUT



Title: Comprehensive Mobility Plan for Thiruvananthapuram	
Name: Employment Density 2051 - SUT Scenario	

Projected Employment Distribution – 2051 SUT

PARKING

The parking assessment was carried out at major locations in the study area, it indicated that highest on-street parking accumulation in Attajulangara, Sasthamangalam, Vanross Junction and East Fort areas while the highest off-street parking accumulation was observed near Gandhi Park. The average parking density at major location in the study area is about 180 with an average parking duration of 40mins.

This indicates high intensity of parking on major corridors for longer time periods and need for parking action in the study area.

Table 0-1 Parking Accumulation at Major Roads and Areas (Primary Surveys-2022-23)

CODE	LOCATION	PEAK PARKING DENSITY (ECS/KM)	AVERAGE PARKING DURATION (MINS)
ONP1	Mg Road Between Attajulangara And LMS	421	45
ONP2	NH 66-Plamoodu To Kesavadasapuram	126	45
ONP3	Mettukada-Vellayambalam	119	30
ONP4	Sreekaryam-Chekkamukku	154	25
ONP5	Vellayambalam - Sasthamangalam	295	45
ONP6	East Fort	212	35
ONP7	Sreekumar Theatre Road	248	45
ONP8	Medical College-Ulloor Rd	167	60
ONP9	Chalai Market Road	162	45
CODE	**LOCATION**	**PEAK PARKING ACCUMULATION (ECS)**	**AVERAGE PARKING DURATION (MINS)**
OFP1	Palayam Market	136	40
OFP2	Power House Rd	185	20
OFP3	Gandhi Park	212	25
OFP4	Chandrasekharan Nair Stadium	165	20
OFP5	Attukal Shopping Complex	114	20

OFP6	Karimpanal Arcade	108	35
OFP7	KSRTC Stand East Fort	154	30
OFP8	Thiruvananthapuram Municipal Corporation	153	30

Further, it is observed that highest composition of vehicles parked are two-wheeler with a share over 65%. And it also observed that 53% of the vehicle parked more that 30mins are two-wheelers.

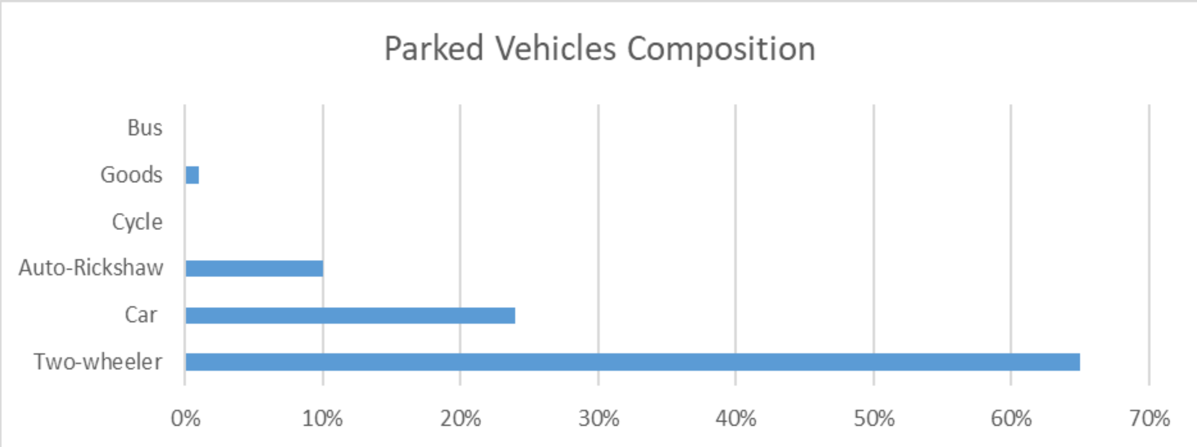


Figure 180 Parked Vehicles Composition (Primary Surveys-2022-23)

NETWORK TRANSITIONS

The network transitions for considered the ongoing and committed road network and public transport projects along with Road Network and Public Transportation proposals recommended in Chapter 8. The following improvements are considered,

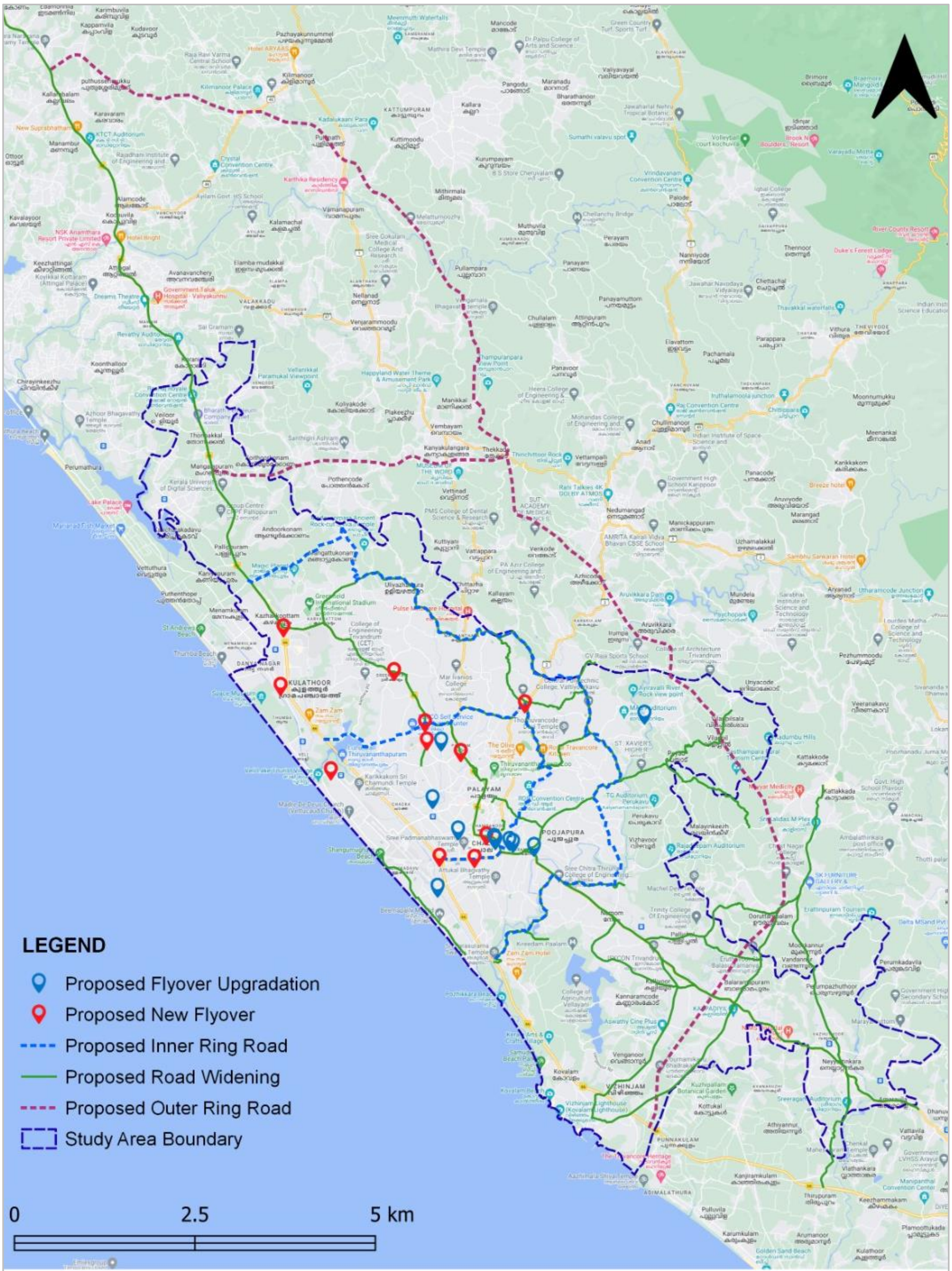
Road Network Improvement (Refer Section 8.2) –

- Development of clear network pattern - 222 km of the network is recommended for strengthen the ring and radial pattern.
- Upgradation of existing road network capacities – 170 km of the major corridors are recommended for capacity upgradations.
- Development of new links - 6 new linages are recommended.

- Development of River bridges, ROBs, RUBs wherever necessary – 10 grade separators are recommended for improving the capacities and linkages.

Public Transport Network Improvement (Refer Section 8.3) –

- Development of High Demand Mobility Corridor – 71.6 km
- City Bus Rationalization and Augmentation - 20 overlapping routes are recommended for rationalization, 11 corridors of 47km are recommended as high bus demand routes, 3 out of 9 bus depots are recommended for decentralization of city and sub-urban operations,
- Inland Water Ways – 5 inland waterway corridors have been recommended.
- Development of PT Terminals – Development of 5 Multi-modal mobility hubs and 8 Multi-modal integration facilities along with 9 bus terminal improvements have been recommended.



Title: Comprehensive Mobility Plan for Thiruvananthapuram	KOCHI METRO RAIL LIMITED Urban Mass Transit Company Limited
Name: Network Structure	

Proposed Road Network Transitions

Proposed Public Transport Network Transitions

TECHNOLOGY TRANSITIONS

The existing transport sector in the study relies primarily on fossil fuels (Petrol and diesel). The CMP-Toolkit 2014 indicates that the aggregate fuel efficiency is expected to improve in the BAU scenario where India will achieve the 4.5 lit per 100 km global target in 2051. Considering the current vehicle technologies and initiatives the following fuel mix is considered for SUT.

The estimated mix of vehicle in terms of their fuel usage for base year is obtained from the sampling of vehicles during house hold surveys and for horizon year the initiatives taken by the State Government, Smart city, KSEB have been considered to equate the following trend of fuel mix linked to the SUT scenario.

Fuel Mix for BAU Scenario

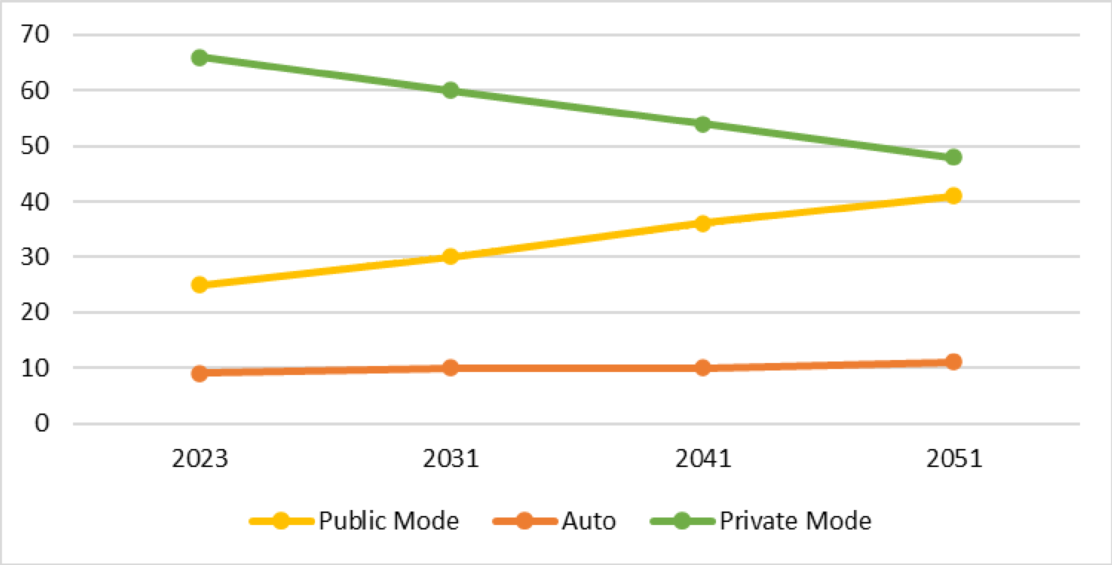
VEHICLE TYPE	% FUEL TYPE - 2051			
	PETROL	DIESEL	ELECTRIC	TOTAL
Cars	40.00%	30.00%	30.00%	100.00%
2Ws	45.00%	0.00%	55.00%	100.00%
3Ws	0.00%	25.00%	75.00%	100.00%
Buses	0.00%	0.00%	100.00%	100.00%

SUT SCENARIO OUTCOMES

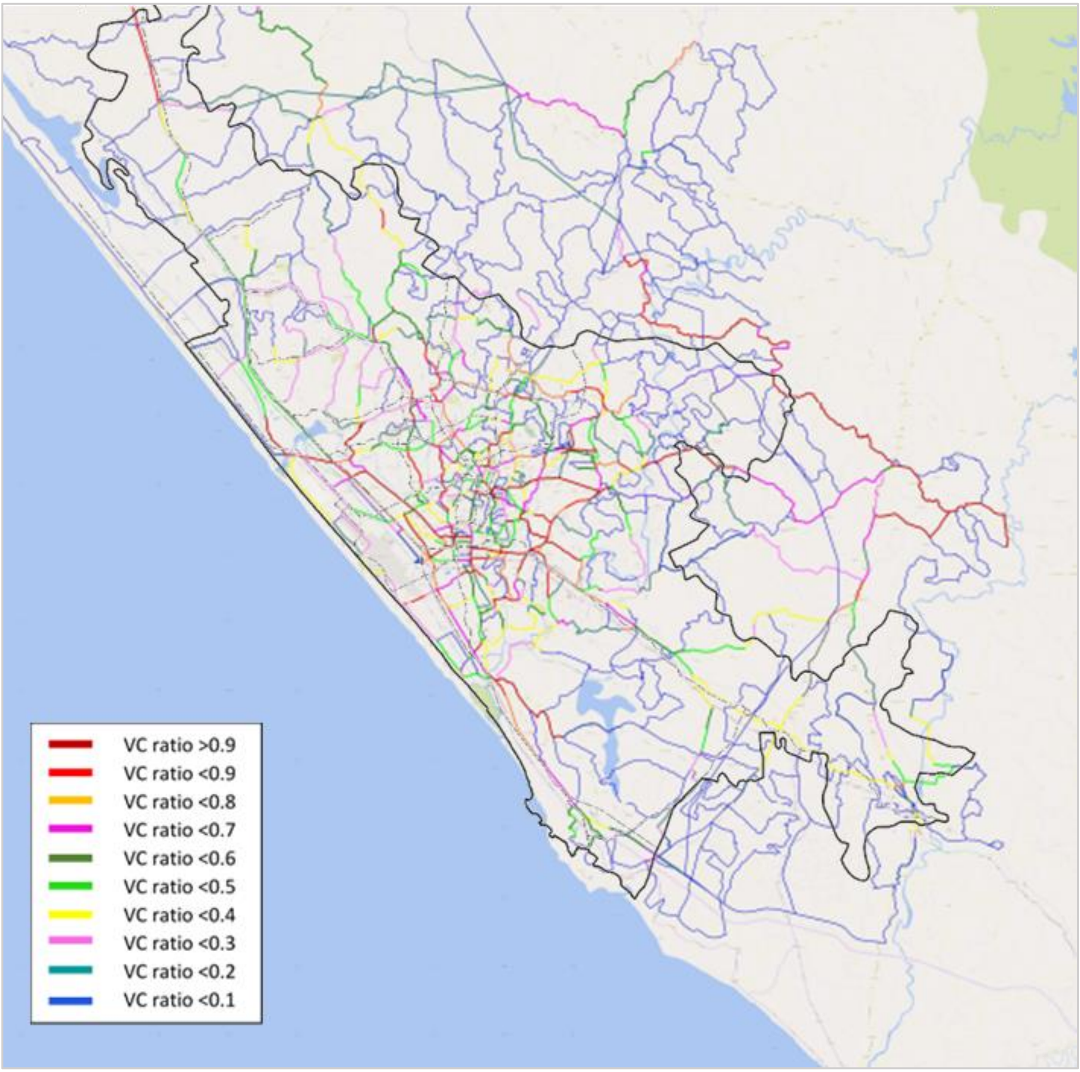
The holistic and integrated implementation of proposals indicate a trend towards the sustainable growth. The share of public is expected to increase to 29% by 2051 (share of trips excluding walk).

Mode Share for Horizon Years – Excluding NMT trips

Mode	2023	2031	2041	2051
Public	25%	30%	36%	41%
Auto	9%	10%	10%	11%
Private	66%	60%	54%	48%
Total	100%	100%	100%	100%

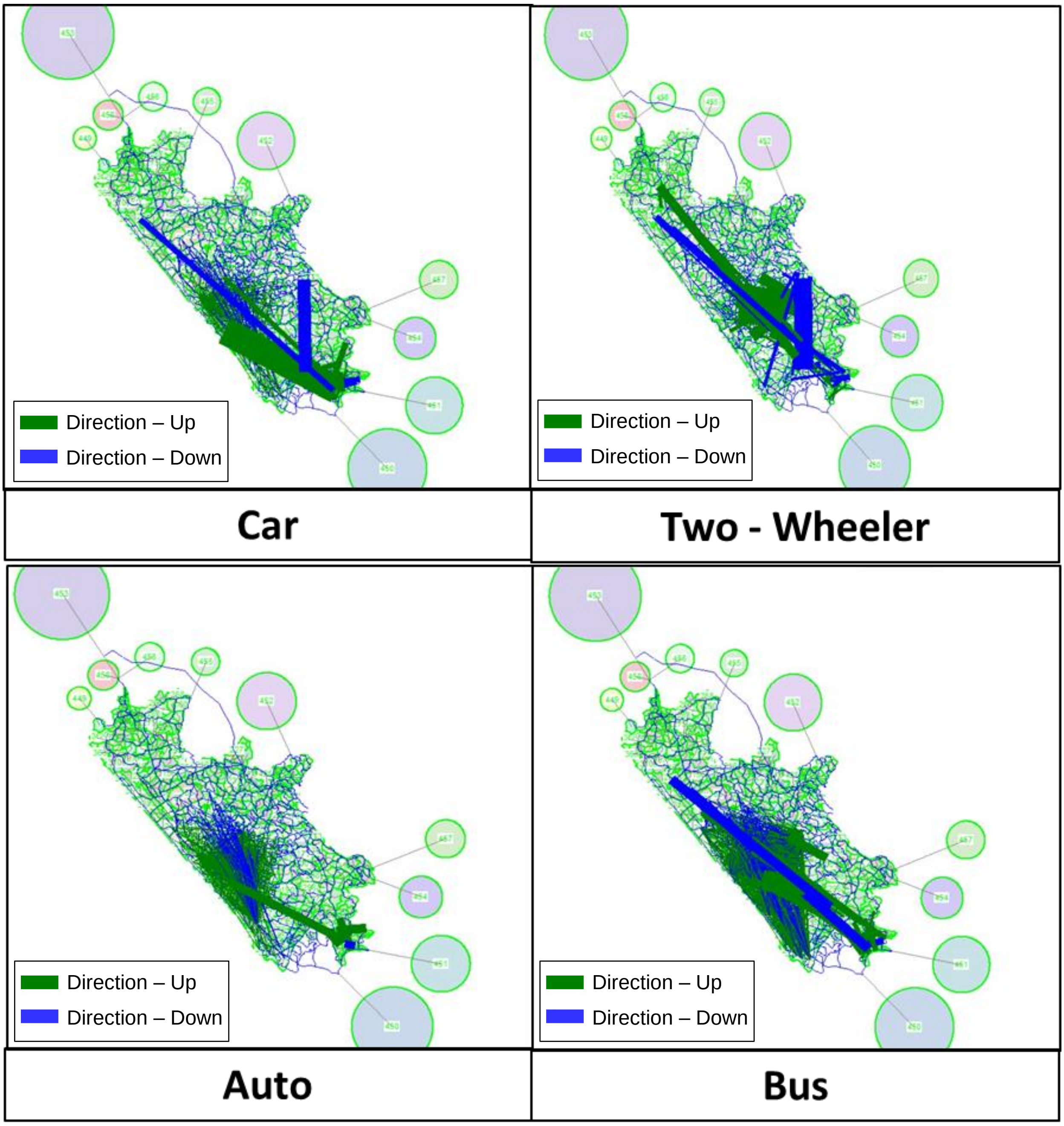


Mode Share for Horizon Years –Excluding NMT trips



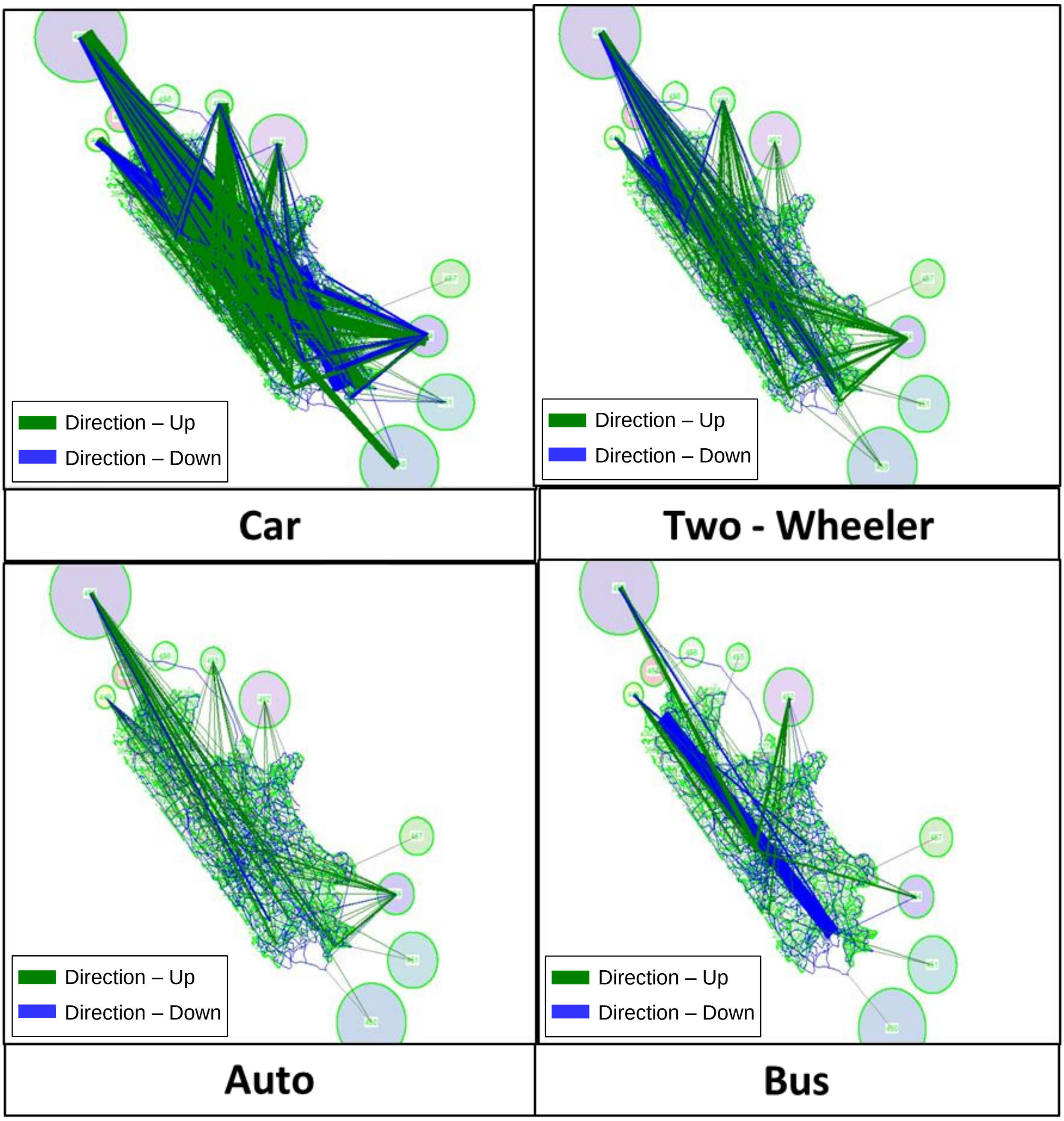
Network Congestion Map for Horizon Year (2051)

INTERNAL – INTERNAL TRIP INTERACTIONS



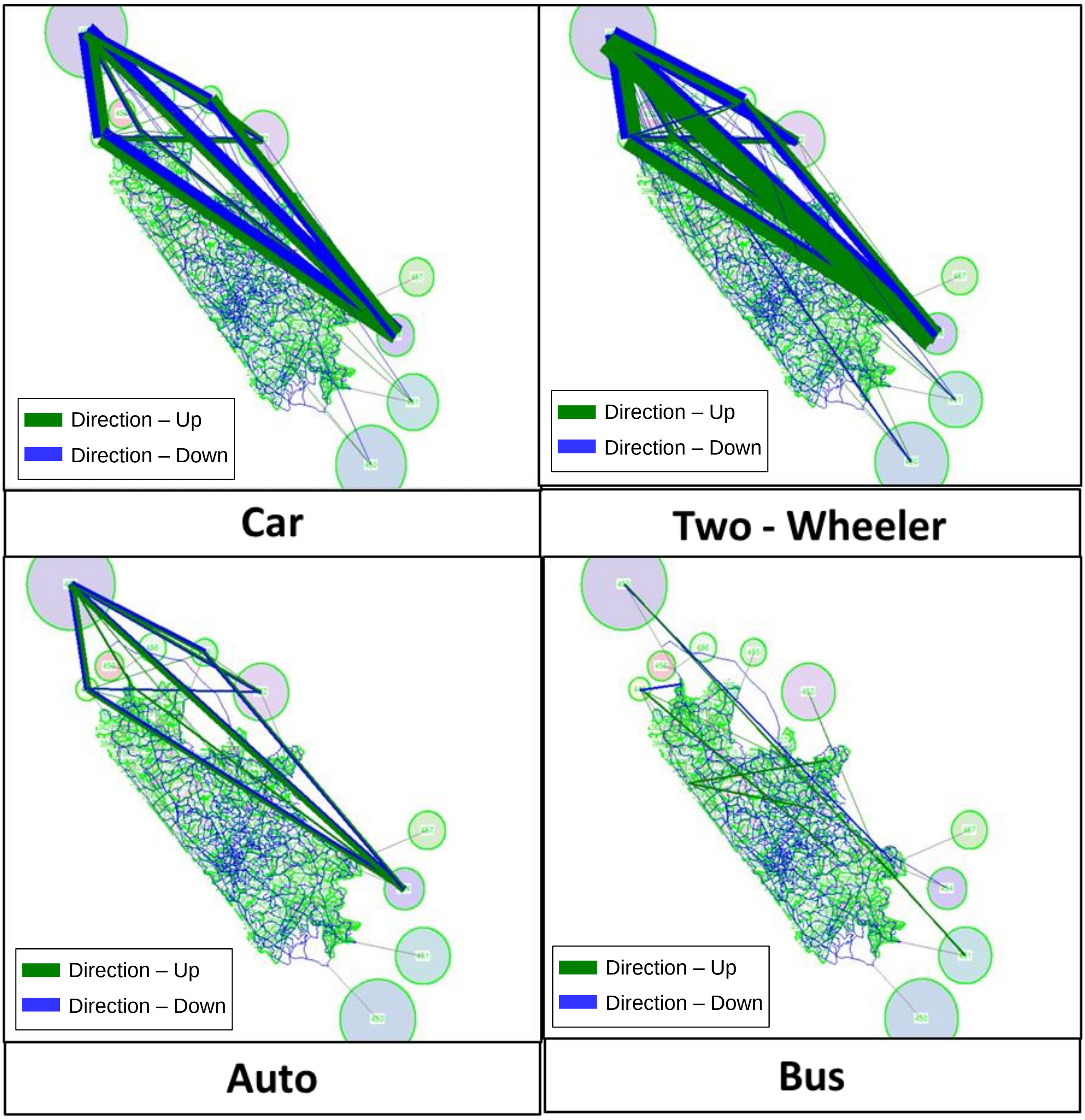
Desire Line Diagram representing within the study area trip interactions of all Motorised Modes Users –SUT Horizon Year 2051

INTERNAL – EXTERNAL and EXTERNAL – INTERNAL TRIP INTERACTIONS



Desire Line Diagram representing the trip interactions of the study area with its surroundings of all Motorised Modes Users –SUT Horizon Year 2051

EXTERNAL - EXTERNAL TRIP INTERACTIONS



Desire Line Diagram representing the external trip interactions passing through the study area of all Motorised Modes Users –SUT Horizon Year 2051

Diagram representing Passenger flow for all Motorised Modes Users –SUT-2051

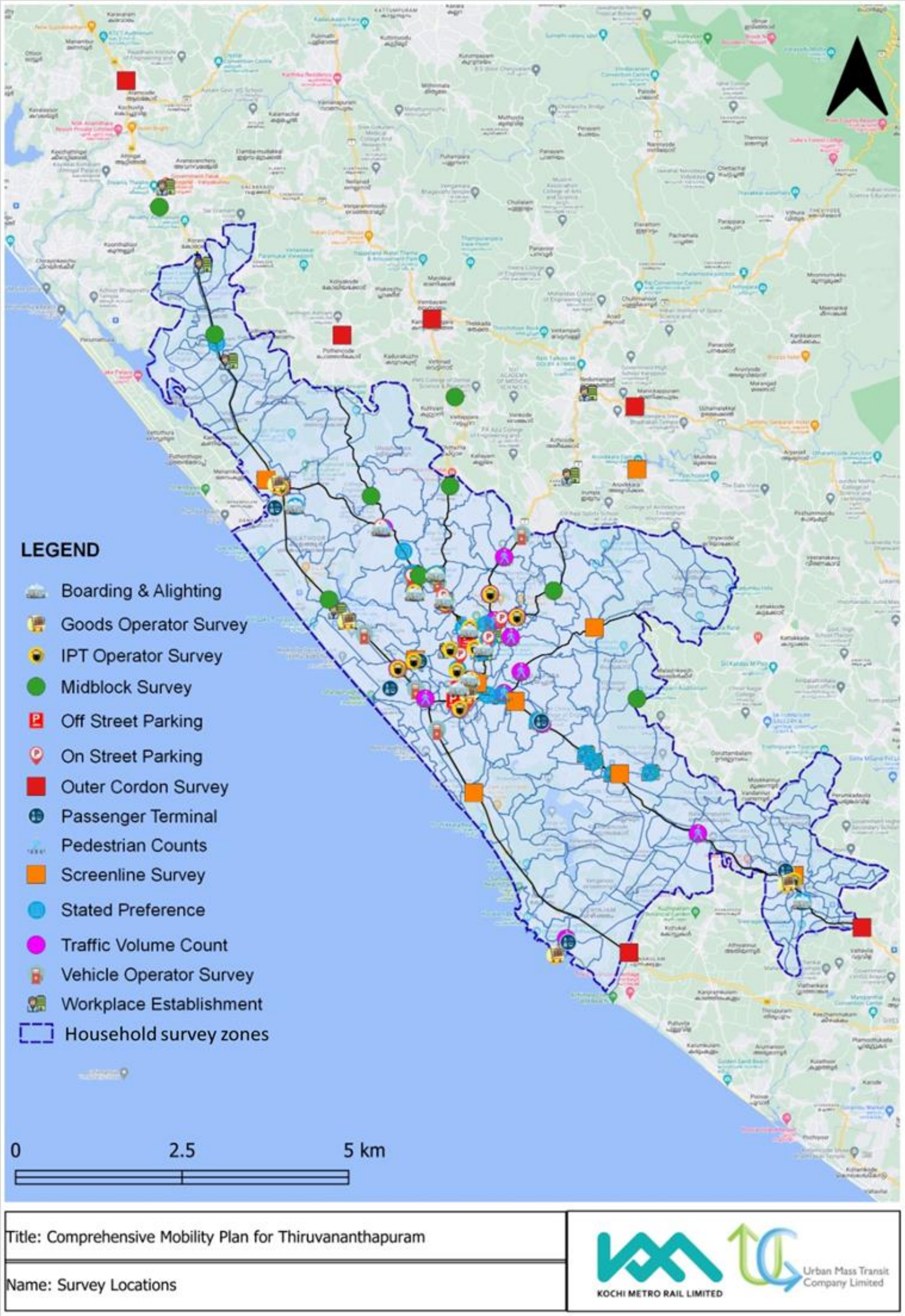
The details of the SUT Scenario outcomes are presented in the impact assessment chapter.

ANNEXURE 8 – SURVEY DATA

On the basis of the preliminary field visits and scope of the study extensive on ground surveys were carried out, between the month of December, 2022 and February, 2023 excluding the public holidays. The surveys were initiated on 13th December, 2022 and were completed by 27th February, 2023.

Primary Data Collection – Travel and Traffic Surveys

SN	PARTICULARS OF SURVEY
1	Classified Volume count at cordon locations
2	Classified Volume counts surveys at Screen Line locations and vehicle occupancy
3	Classified Volume counts surveys at Mid-Block locations and vehicle occupancy
4	Classified Turning Volume Counts at Junctions
5	RSI at Screen Line location (10% sample size of daily vehicle volumes)
6	RSI at Cordon locations (10% sample size of daily vehicle volumes)
7	Passenger Terminal Counts
8	Passenger Terminal Origin and Destination Surveys (10 % sample of the daily passenger count)
9	Public Transport (PT) Stop Waiting, Boarding and Alighting (B/A) survey – Bus/ Metro/ Ferry
10	Public Transport (PT) Stop Passenger Origin and Destination Surveys (10 % sample size of the daily B/A) at PT stops -– Bus/ Metro/ Ferry
11	Stated Preference Surveys for PT, IPT, Private Users (2W and Car) and NMT (cycle and walk) users along major activity centres
12	Pedestrian Volume Counts at critical junctions
13	Speed and Delay Study at peak and off-peak hours
14	IPT Operator Survey (Taxi/auto)
15	Parking Survey -On street with inventory
16	Parking Survey -off street with inventory
17	House Hold Interview with opinion survey
18	Road Network Inventory
19	Vehicles Survey at Petrol Pump
20	Establishment and Workplace survey
21	Goods Operator Survey



Map showing the locations of various Primary Surveys

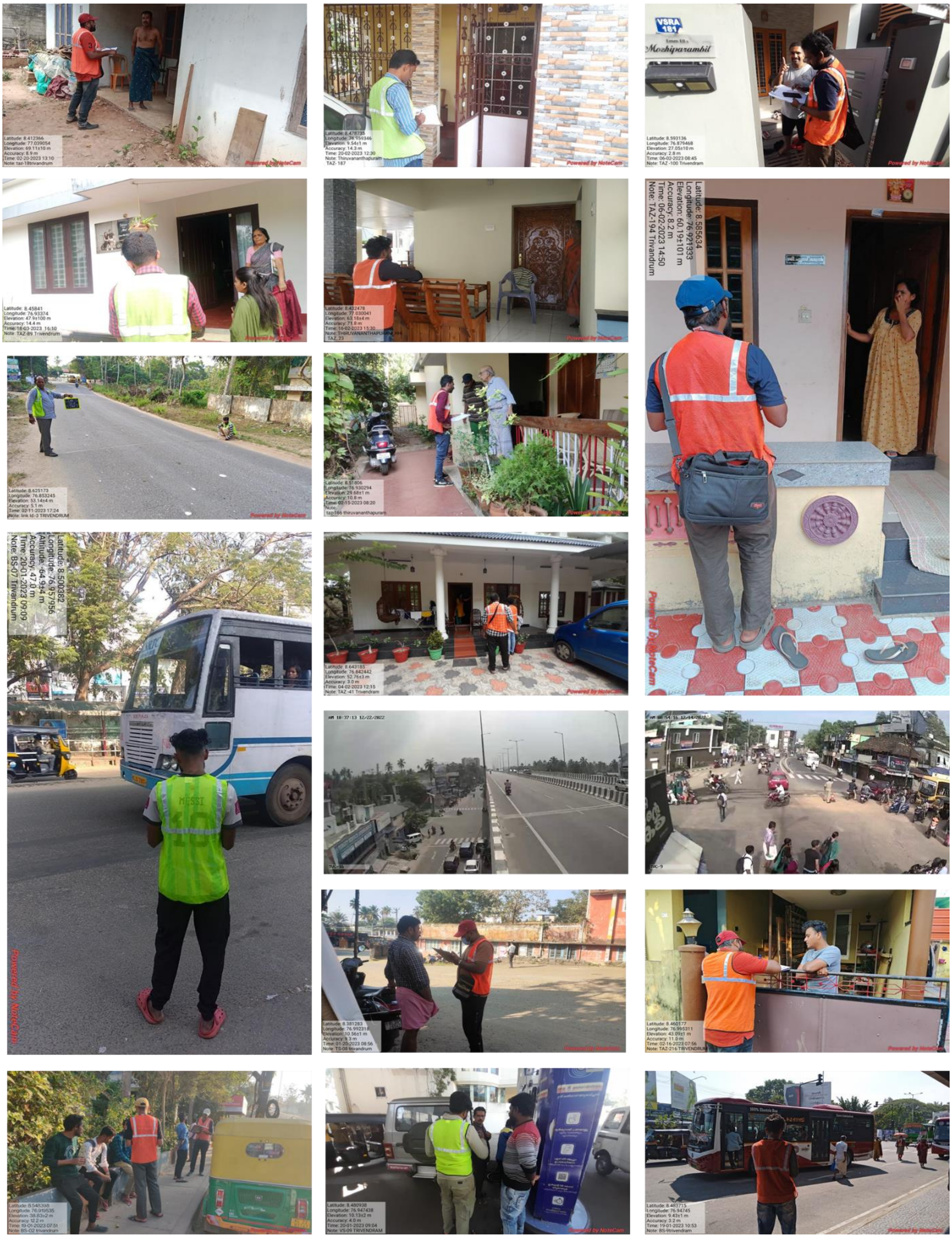


Figure 181 Photographs while capturing passenger travel and vehicle characteristics (Primary Surveys-2022-23)

The methodology adopted for the surveys and the details of the summary is presented in the Annexure. The summary of the assessment is presented in this section.

ROAD NETWORK CHARACTERISTICES

- The surveyed network indicates that on 28% of the corridors have Right of Way (ROW) availability over 18m. The distribution of ROW on the surveyed network in presented in the below figure.
- The exiting surveyed corridors constitute carriageway between 18m to 24m indicating the availability of reasonable road space in terms of lane configurations on Major corridors. However, only 35% of the survey network had ROW over 12m.
- 58% of the surveyed network has 2-lane and above configuration. 4lanes constitute about 16% of the total network, which are largely along the NH-66, NH-Bypass, MC road, MG Road, etc.
- The share of network with divided carriage is about 38%.
- 14.2% of the major network has footpath availability in the study area. And only 5% of the network has footpaths over 2m widths indicating the need to improve pedestrian infrastructure in the study area.
- The analysis indicates that about 59% of the major network has on-street parking hindering the road space allocated for traffic flow and pedestrian movement.

Table 0-2 Network Characteristics of Major Roads in the study area (Primary Surveys-2022-23)

NAME OF THE ROAD	LENGTH (KM)	PAVEMENT TYPE	PAVEMENT CONDITION	NO. OF LANES	DIVIDED/ UNDIVIDED	ONE WAY/ TWO WAY
NH-66 (Mangalapuram to Neyyattinkara)	40	Flexible	Good	2+2	Undivided	Two Way
NH bypass (Kazhakoottam to Kovallam)	25	Flexible	Good	4+4	Divided	Two Way
MC Road (Kesavadasapuram to Mannanthala)	5	Flexible	Good	2+2	Partly Undivided	Two Way
Nedumangad Road (Vellayambalam to Nedumangad)	8	Flexible	Fair	2+2	Partly Undivided	Two Way

Vattiyoorkavu Road (SRK Hospital Jn - Mukkola)	5	Flexible	Fair	1+1	Undivided	Two Way
Peyad Road (Karamana to Peyad)	8	Flexible	Good	1+1	Undivided	Two Way
Kovalam Road (Kovallam to Pulinkudi)	5	Flexible	Good	4+4	Divided	Two Way
Airport Road (Chackai to Airport Junction)	8	Flexible	Good	2+2	Divided	Two Way

Figure 182 Road Network Lane Typology

- The average running speed in the study area is 21.3kmph, while the journey speed during the peak hours is about 19.5kmph.

Table 0-3 Peak Hour Journey Speeds on Major Roads in the study area (Primary Surveys-2022-23)

SN	NAME OF THE ROAD	DISTANCE (KM)	PEAK HOUR SPEED (KMPH)	OFF-PEAK HOUR SPEED (KMPH)
1	Maruthankuzhi-Kesavadasapuram Rd	1.6	27.3	28.6
2	Thirumala- Peyad - Malayinkeezhurd	1.2	23.8	24.5
3	Kowdiar Ave	1.2	22.8	24.1
4	Panavel -Kochi Rd	1.5	22.7	24.8
5	Peroorkada Vattiyoorkavu Rd	11.2	22.7	24.2
6	Mukkikada Edathara Rd	1.9	22.2	23.3
7	Vazhuthacaud-Poojappura	2	21.8	22.7
8	Pappanamcode Malayinkeezhu Rd	6.1	21.5	22.2
9	Chekkalamukku-Powdikonam	2.5	21.3	22.9
10	Peroorkada	1.2	21.1	23.5
11	Kazhakoottam-Thaikod Rd	3.6	20.6	21
12	Poojappuram Rd	2.8	20.3	20.3
13	Powdikonam-Pothencode Rd	1.1	20.1	21.2
14	Powdikonam Jn	1.1	20.1	21.1
15	Tvm-Neyyar Dam Rd	1.6	19.7	21.5
16	Peroorkada Rd	0.5	18.9	19.2
17	Medical College - Ulloor Rd	1	18.8	18.8
18	PMG Rd	1.3	18.5	20.6
19	Market Rd	0.5	18	18
20	Ulloor Brg	1.4	17.2	28.7
21	Vettamukku Rd	0.7	17	18.3
22	CV Raman Pillai Rd	3.2	16.8	17.6
23	LMS Vellayambaam Rd	3.2	16.6	17.7
24	Poonthi Rd	3	16.4	18.4
25	Pottakuzhy Road	1.1	15.8	18
26	Edathara Temple	0.8	15.6	17.6

SN	NAME OF THE ROAD	DISTANCE (KM)	PEAK HOUR SPEED (KMPH)	OFF-PEAK HOUR SPEED (KMPH)
27	Chilkoor Vallakkadavu	2.6	15.4	23.1
28	Mangattukadavu Thirumala Rd	2.9	14.9	17
29	Bakery Flyover Rd	0.9	14.9	16.4
30	Ulloor-Akkulam Rd	4.8	14.4	15.7
31	Tvm-Neyyar Rd	0.5	14.1	16.9
32	Pattom Kowdiar Rd	1.4	14	15.7
33	Muttathara Road	2.6	12.8	17.3
34	Thampnoor Flyover	0.8	12.4	15.1
35	Nemom Punnamoodu Rd	0.8	12.2	14.8
36	Sasthamangalam Rd	0.7	11.8	13.1
37	Nh66 (Managalpuram to Neyyattinkara)	41.9	21.1	28.6
38	Kuravankonam -Ambalamukku Rd	1.3	11.3	15.3
39	Kumarapura Road	0.8	10.4	13.4
40	Sreekariyam -Pothencode	7.1	10.2	10.7
41	Thiruvananthapuram -Nagercoil	17.1	10.1	10.9
42	Poojappura Main Rd	0.5	10.1	11.1
43	Palayam Airport Rd	9.1	9.9	11.7
44	Pachalloor To Punkulam Rd	10.5	9.5	10.4
45	Manorama Rd	1.2	9.2	9.4
46	Vizhinjam Poovar Rd	6.8	8.9	9.2
47	Pallicheal Vizhinjam	5.8	8.8	9.1
48	Mahatma Gandhi Rd	3.3	7.7	10
49	Trivendrum Vizhinjam Rd	4.2	6.5	7.5
50	Railway Station Rd (Over Bridge to Station)	0.6	4.3	4.4

Table 0-4 Peak Hour Delays on Major Roads in the study area (Primary Surveys-2022-23)

SN	NAME OF THE ROAD	DISTANCE (KM)	DELAY (MINS)	CAUSE OF DELAY
1	NH66 (Mangalapuram to Neyyattinkara)	41.9	30.9	Traffic &Traffic Signal, Construction works
2	Kuravankonam Junction –Ambalamukku Junction	1.3	1.8	Traffic &Traffic Signal
3	Mutada Rd (Paruthippara to Muttada)	0.7	2.0	Traffic &Traffic Signal
4	Palayam UPAS (Aasan Square) – Swadeshabhimani Square)	0.3	0.4	Traffic &Traffic Signal
5	Kumarapura Road (Murijapalam Junction to Kumarapura)	0.8	1.0	Traffic &Traffic Signal
6	Sreekariyam –Pothencode	7.1	2.1	Traffic &Traffic Signal
7	Poojappura Main Rd (Poojappura Junction to Thirumala Junction)	2.5	0.3	Traffic &Traffic Signal
8	Palayam Airport Rd	9.1	8.7	Traffic &Traffic Signal
9	New Theatre Rd (Thampanoor Junction to Flyover)	0.3	2.0	Traffic &Traffic Signal
10	Pachalloor To Punkulam Rd (Pachalloor Junction to Shanthi Nagar)	10.5	6.3	Traffic &Traffic Signal
11	Mahatma Gandhi Rd (LMS to Manacaud)	3.3	5.9	Signal
12	Railway Station Rd (Over Bridge to Station)	0.6	0.2	Traffic &Traffic Signal

- The average delay of 17 minutes is observed in the study area during peak hours on major corridors. The major reasons for Delay is largely due to traffic and signals.

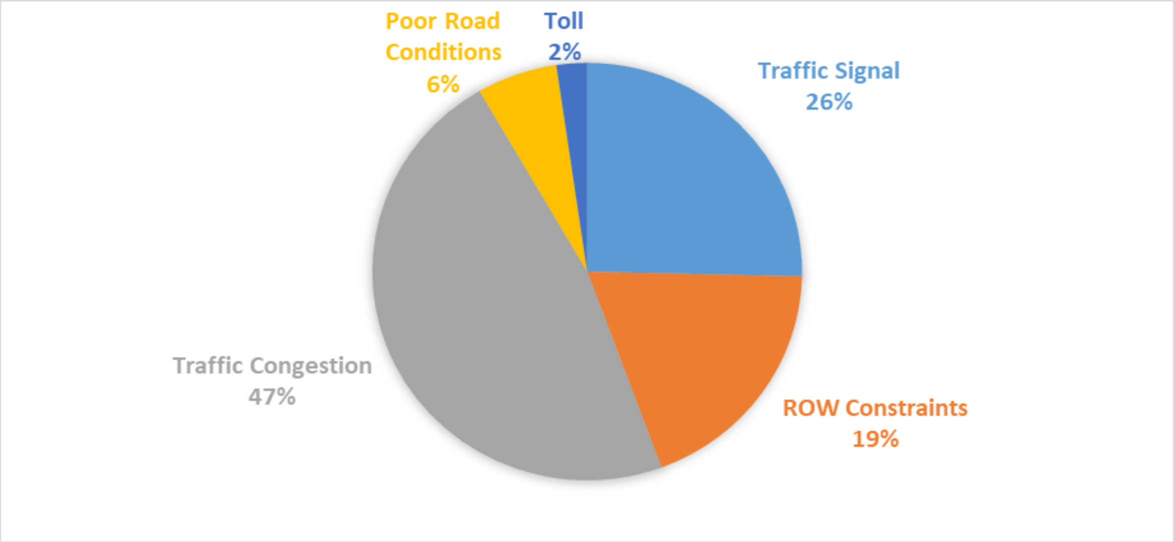


Figure 183 Causes of Delay in Travel Time (Primary Surveys-2022-23)

TRAFFIC VOLUMES

- It is observed that highest outer cordon traffic volumes are observed on NH-66- Attingal road followed by Panvel Kochi Kanyakumari Highway.
- It is observed that about 46% of the vehicle composition at outer cordons in constituted by two-wheeler and about 26% is constituted by Goods.

Table 0-5 Vehicular Volumes at Outer Cordon Locations (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)			DAILY (PCUS)
		INBOUND	**OUTBOUND**	**TOTAL**	**TOTAL**
OC_1	NH-66 Attingal	21021	22742	43763	45117
OC_2	Pothenvide	16623	16853	33476	32242
OC_3	Vembayam	14185	15188	29373	29103
OC_4	Nedumangad Highway	7379	7284	14663	13798
OC_5	Panvel Kochi Kanyakumari Highway	16277	16550	32827	33089
OC_6	Pulinkudi	9223	9161	18384	16803

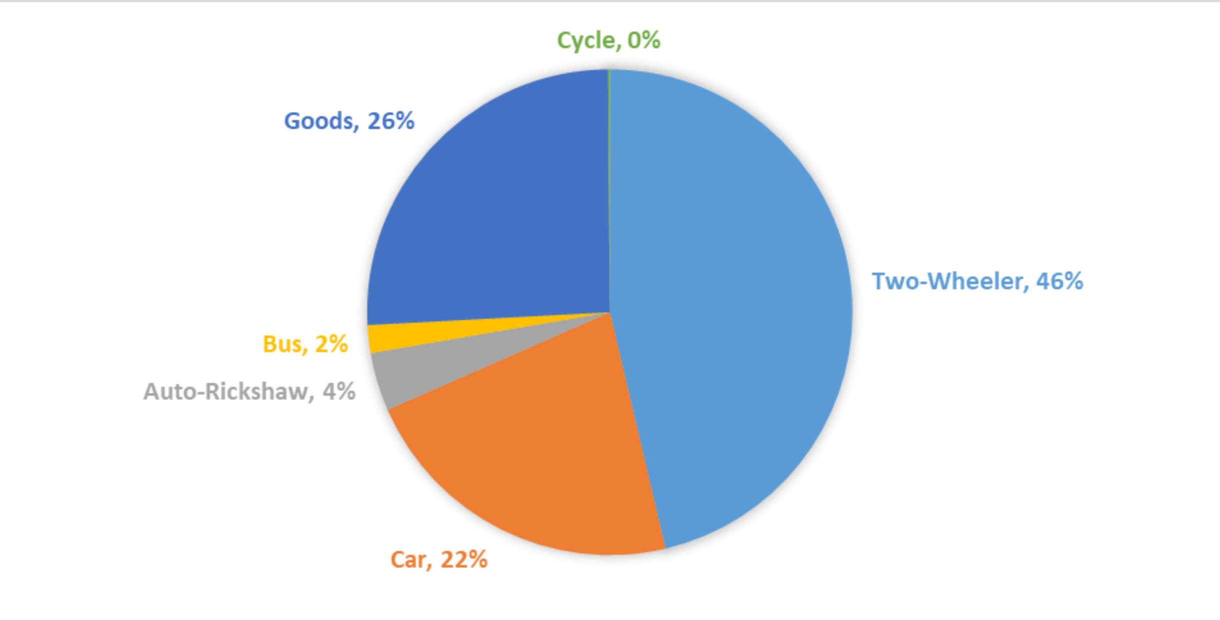


Figure 184 Vehicular Composition at Outer Cordon Locations (Primary Surveys-2022-23)

- It is observed that highest traffic volumes at screen line locations are observed on Karamana Bridge followed by Thiruvallam Bridge and at Pettah.
- It is observed that about 71% of the vehicle composition at screen lines in constituted by two-wheeler and about 16% is constituted by car.

Table 0-6 Vehicular Volumes at Screen Line Locations (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)			DAILY (PCUS)
		INBOUND	**OUTBOUND**	**TOTAL**	**TOTAL**
SC_1	Menamkulam	16408	16213	32621	31409
SC_2	Aruvikkara dam	3567	3655	7222	6550
SC_3	Kundamankadavu E-W	29521	29075	58596	53778
SC_4	Pettah E-W	33241	37286	70527	71533
SC_5	Thampanoor E-W	37343	41898	79241	83189
SC_6	Karamana Bridge N-S	62642	58168	120810	116471
SC_7	Thiruvallam Bridge N-S	38810	40097	78907	77223
SC_8	Pallichal	16934	14775	31709	29718
SC_9	Bridge Lane, Neyyattinkara	20566	20429	40995	38863

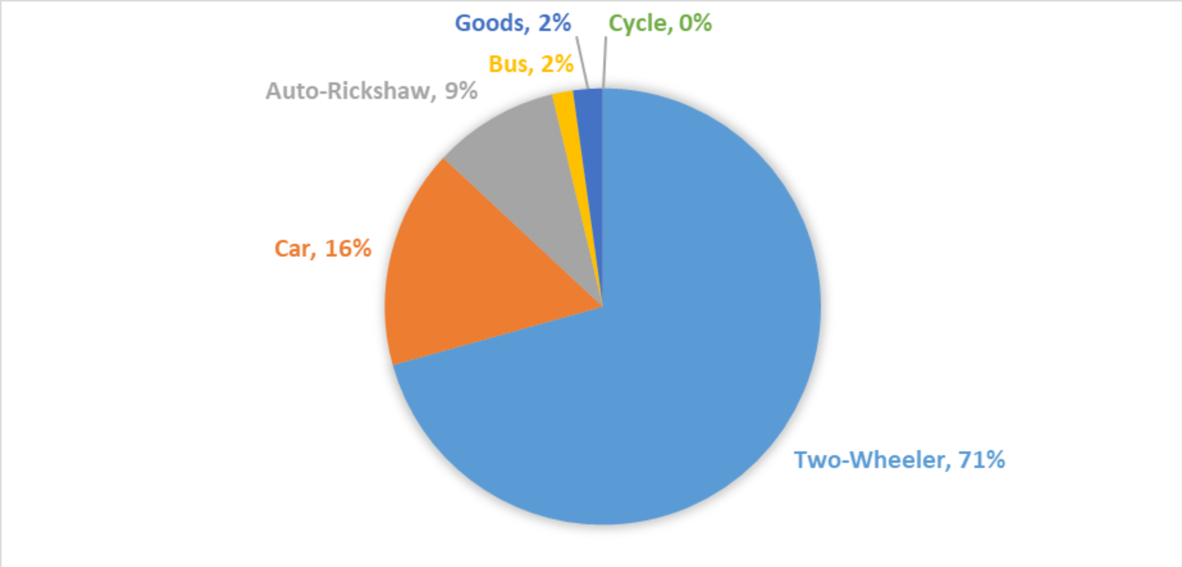


Figure 185 Vehicular Composition at Screen Line Locations (Primary Surveys-2022-23)

- It is observed that highest traffic volumes at mid-blocks locations are observed on NH Bypass near Lulu Mall, followed by Ulloor Bridge and at Mangalapuram Road.
- It is observed that about 53% of the vehicle composition at mid-blocks in constituted by two-wheeler and about 33% is constituted by car.

Table 0-7 Vehicular Volumes at Mid-Block (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)	DAILY (PCUS)
		TOTAL	TOTAL
MB_1	NH66	39566	40390
MB_2	Mangalapuram	48285	48392
MB_3	Vattapara Thattatumala Road	22915	22498
MB_4	Sreekariyam Road	20487	19221
MB_5	Ulloor Bridge	54484	55202
MB_6	Lulu Mall	86361	82900
MB_7	Pulimoodu	39866	38435

MB_8	Pappanamcode Malayinkeezhu	13380	12247
MB_9	Mannanthala	27517	26556

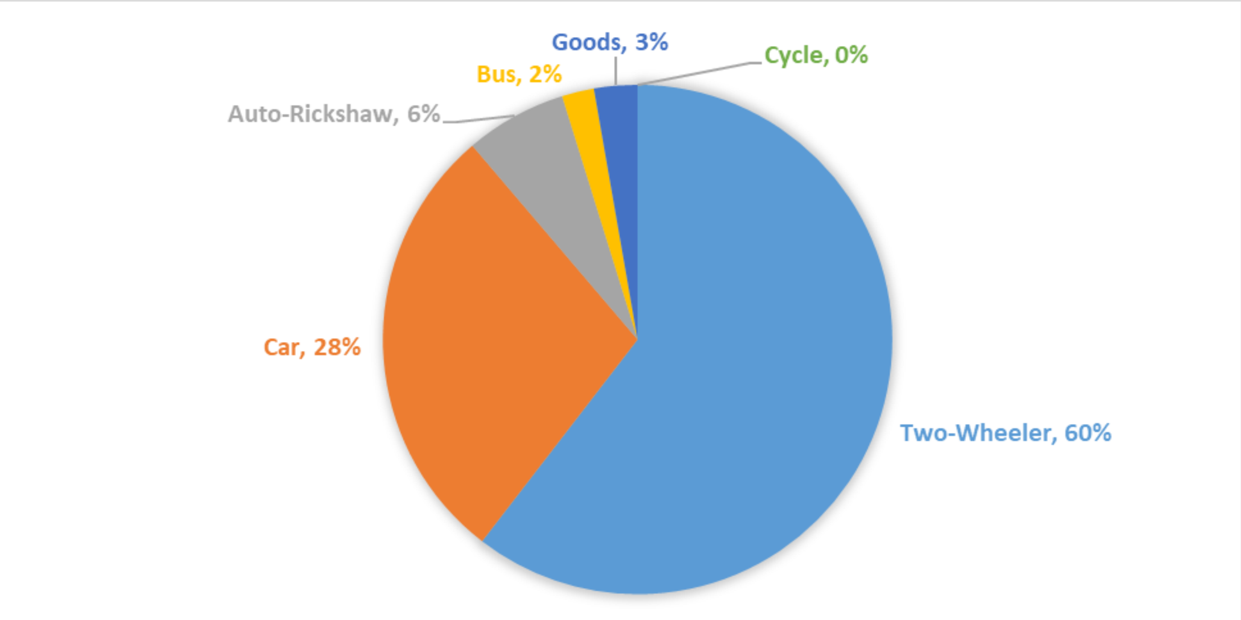


Figure 186 Vehicular Composition at Screen Line Locations (Primary Surveys-2022-23)

- It is observed that highest traffic volumes at intersections locations are observed at Palayam, followed by Pattom, Challa and Thampanoor. This indicates that the high volumes are observed in the city core and there is a need to address and decongest the core area.
- It is observed that about 54% of the vehicle composition at intersections in constituted by two-wheeler and about 26% is constituted by car.

Table 0-8 Vehicular Volumes at Major Intersections (Primary Surveys-2022-23)

LOCATION	NAME	DAILY (VEHICLES)	DAILY (PCUS)
		TOTAL	TOTAL
TVC1	Kazhakoottam	93484	91292
TVC2	Sreekaryam	68120	67661
TVC3	Kesavadasapuram	100511	102363

LOCATION	NAME	DAILY (VEHICLES)	DAILY (PCUS)
		TOTAL	TOTAL
TVC4	Pattom	128101	131267
TVC5	Vjt Hall Palayam	174070	182858
TVC6	Thampanoor	99812	116892
TVC7	Karamana	118426	116281
TVC8	Pappanamacode	112117	105576
TVC9	Balaramapuram	75685	75138
TVC10	Vellayambalam	105834	104836
TVC11	Kowdiyar	100006	97925
TVC12	Peroorkada	95911	96324
TVC13	Sasthamangalam	70276	70352
TVC14	Manacaud Junction	73715	80454
TVC15	Vizhinjam	28481	30786
TVC16	Chakka	121349	120053
TVC17	Eanchakkal	81456	81911
TVC18	Medical College	76959	84064
TVC19	Poojappura	35275	34364
TVC20	Edapazhji Junc	75563	74045

PUBLIC TRANSPORTATION (PT) PASSENGER VOLUMES

The primary survey assessment shows a peak hour footfall of nearly sixty thousand passengers at the major public transportation terminals in the study area. It is seen that Thiruvananthapuram Central Railway Station and Pettah are the major railway stations with high passenger footfalls and Thampanoor Bus Terminal and East Fort are the major bus terminals in the study area. The quantum of passenger flow is as presented in the table below.

Table 0-9 Peak Hour Passenger Volumes at Major PT Terminals (Primary Surveys-2022-23)

LOCATION	NAME	PASSENGERS		TOTAL PASSENGERS
		IN	**OUT**	
TS1	Kazhakkoottam Railway Station	605	638	1243
TS2	Pettah Railway Station	1652	2097	3749
TS3	EastFort Bus Terminnal	4107	5333	9440
TS4	Thampanoor Bus Terminal	10257	10088	20345
TS5	Thiruvananthapuram Central Railway Station	5143	4377	9520
TS6	Pappanamcode Bus Stop & Depot	3346	3050	6396
TS7	Neyyattinkara Railway Station	509	335	844
TS8	Vizhinjam Bus Stop & Depot	2312	2621	4933
TS9	Thiruvananthapuram Airport	4083	5974	10057

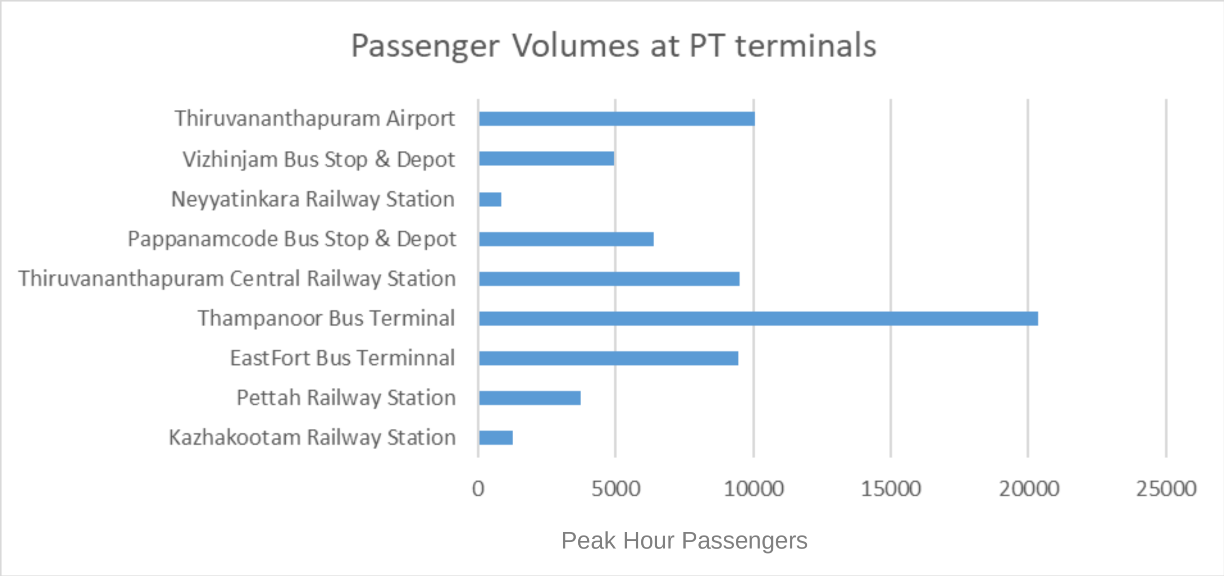


Figure 187 Peak Hour Passenger Volumes at Major PT Terminals (Primary Surveys-2022-23)

The primary survey assessment shows a daily footfall of nearly 36 thousand passengers at the major bus stops in the study area with an average passenger occupancy of 32 persons per bus. It is seen that Thampanoor bus stop has the highest footfall due to its proximity to various transportation terminals and activity centres followed by Medical college and Neyyattinkara bus stops. Palayam and East fort bus stops are also observed to cater to nearly 4,000 passengers daily. The volumes indicated the presence of significant demand for public transportation services.

Table 0-10 Passenger Volumes at Major Bus Stop (Primary Surveys-2022-23)

LOCATION	NAME	TOTAL PASSENGERS	AVERAGE PASSENGER LOAD (PASSENGER PER BUS)
BS1	Kazhakoottam	808	41
BS2	Sreekaryam	2776	34
BS3	Medical College	6325	33
BS4	Kesavadasapuram	2930	31
BS5	Pattom	2000	34

BS6	Palayam	3912	28
BS7	Vazhutacaud	1148	35
BS8	Thampanoor	7791	32
BS9	East Fort	3993	24
BS10	Neyyattinkara	4317	31

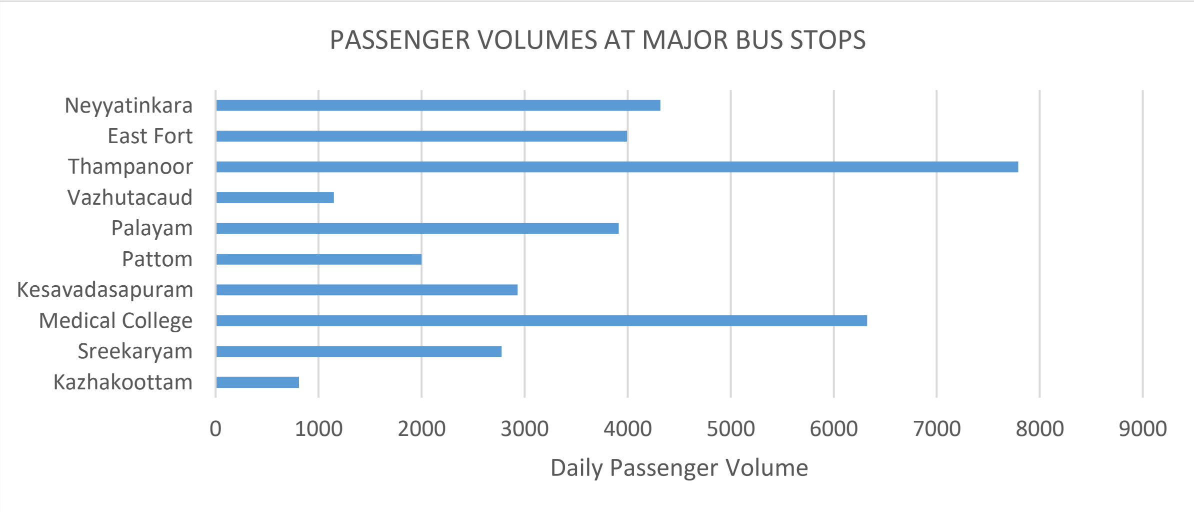


Figure 188 Passenger Volumes at Major Bus Stops (Primary Surveys-2022-23)

PEDESTRIAN VOLUMES

The surveys indicate that highest pedestrian footfall at Medical College followed by Thampanoor due the adjoining activity nodes such as colleges, transportation terminals, commercial areas, etc. This also indicates the need to improve the pedestrian facilities in areas with high footfall to improve their safety and promote the walking behaviour in the city.

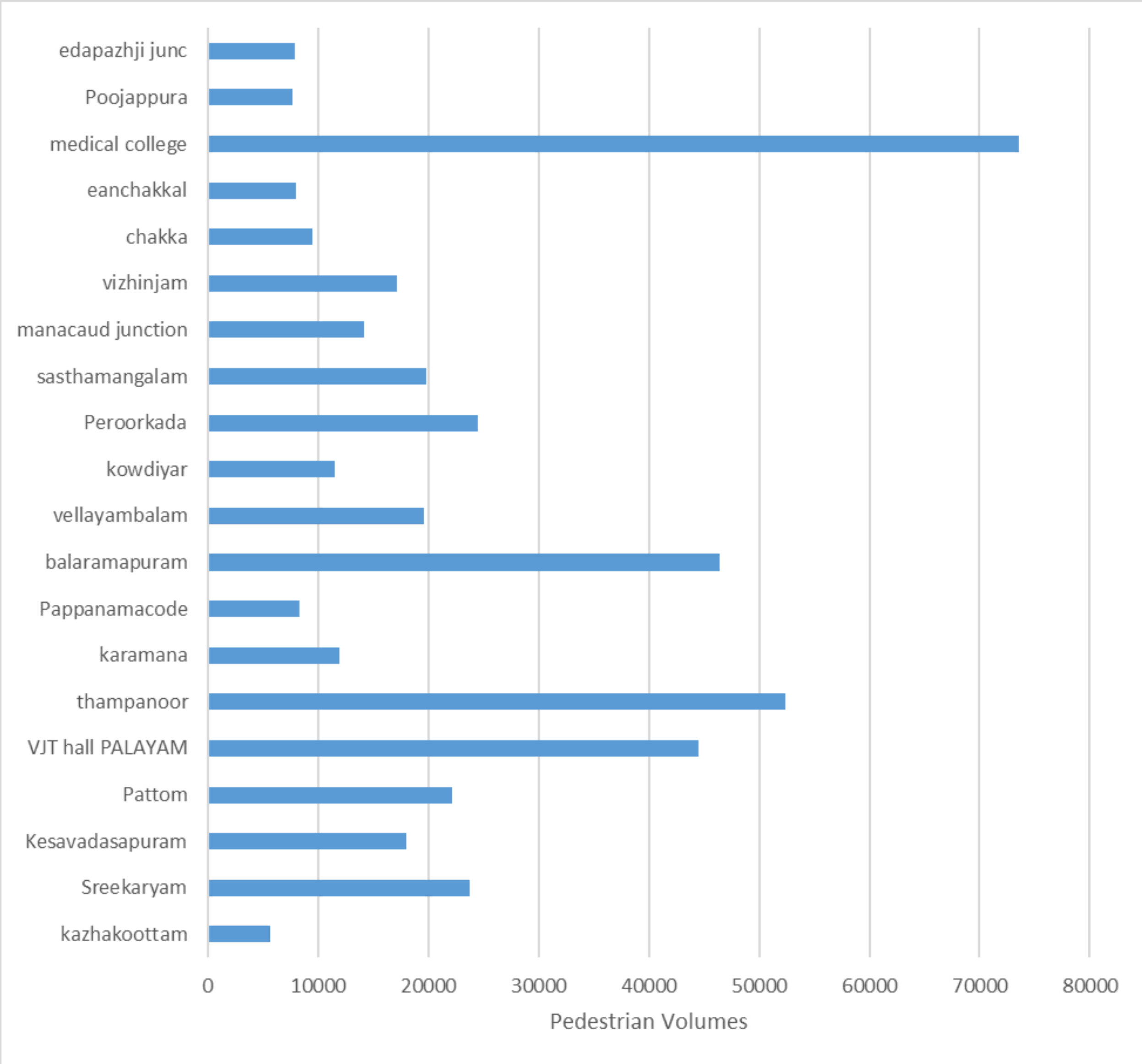


Figure 189 Pedestrian Volumes at Major Intersections (Primary Surveys-2022-23)

The degree of conflict between the vehicles and pedestrian was assessed at major intersections in the study area. The assessment resulted that Palayam, Thampanoor and Medical College have highest degree of conflicts and which require immediate measures to ensure pedestrian safety.

Table 0-11 Degree of Pedestrian Conflict (Primary Surveys-2022-23)

LOCATION	NAME	DEGREE OF CONFLICT (PV^2x10^8)
PC1	Kazhakoottam	24.50
PC2	Sreekaryam	24.89
PC3	Kesavadasapuram	24.86
PC4	Pattom	30.15
PC5	Vjt Hall Palayam	35.17
PC6	Thampanoor	33.65
PC7	Karamana	29.37
PC8	Pappanamacode	25.95
PC9	Balaramapuram	27.84
PC10	Vellayambalam	26.97
PC11	Kowdiyar	26.05
PC12	Peroorkada	26.81
PC13	Sasthamangalam	24.14
PC14	Manacaud Junction	23.07
PC15	Vizhinjam	27.65
PC16	Chakka	26.85
PC17	Eanchakkal	23.67
PC18	Medical College	30.55
PC19	Poojappura	18.01
PC20	Edapazhji Junc	23.95

SOCIO-ECONOMIC CHARACTERISTICS

- The sex ratio derived from the house hold survey is the sex ratio is 1064 females per 1000 males.

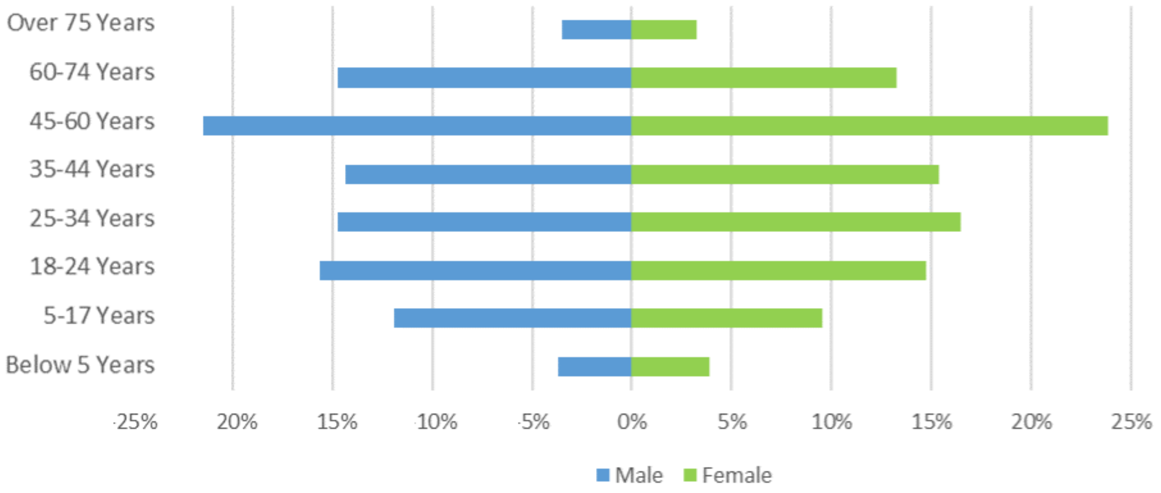


Figure 190 Age-Sex Pyramid (Primary Surveys-2022-23)

- The average household size is observed to be 3.45 with average number of 1.4 earning members per household.
- The average number of students per household is about 1.3 with an average of 1.9 members making trips on regular basis.
- The average monthly income as per the Household survey is about INR 30,498.

- The classification based on the category of vehicles owned indicates that 16% of the households own no vehicle while, 70% of the households own two-wheelers and 36% of the households own cars.

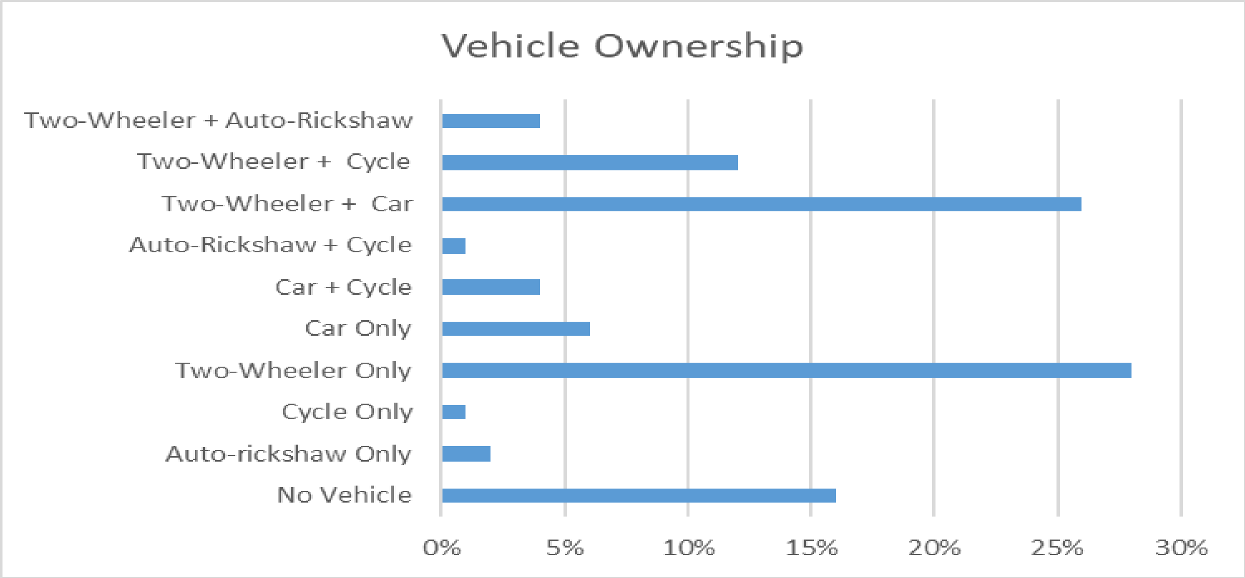


Figure 191 Distribution Households Based on Vehicle Ownership (Primary Surveys-2022-23)

EXISTING TRAVEL CHARACTERISTICS:

- The Per Capita Trip Rate (PCTR) was observed to be 1.24 including the walk trips and 1.02 excluding the walk trips. The PCTR for motorized trips is about 0.94.
- The major modes of travel are observed to be two wheelers with a modal share of 40% while the share of bus based public transport accounts to only 21%, clearly indicating that private mode dominance mode over public buses. The mode share of the passenger trips are as presented in the figure below.

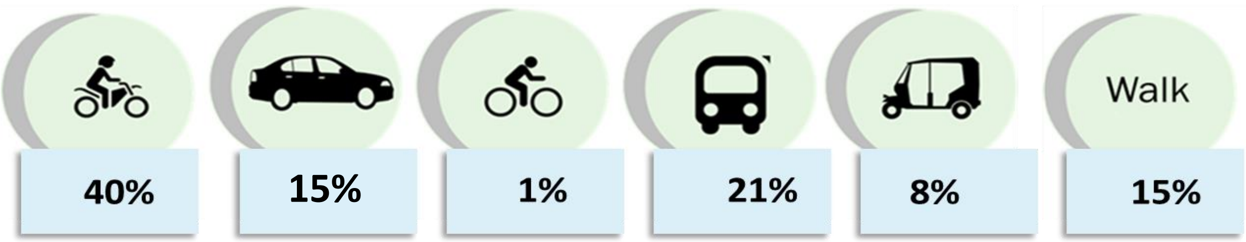


Figure 192 Mode Share (Primary Surveys-2022-23)

Note: The increase in the usage of private modes can also be observed as a post covid scenario. Thus, the travel characterises shall be viewed in two ways, current travel pattern & optimistic travel pattern. Since the inclination towards public transport is slowing improving due to better facilities and comfort of travel, pre covid scenario also becomes a part of this comparison. The same shall be considered while assessing the alternative scenarios.

- The observed average trip length in is observed to be 7.8Km including the walk trips and 8.9km excluding the walk trips.

Table 0-12 Average Trip Lengths (Primary Surveys-2022-23)

AVERAGE TRIP LENGTHS	ATL (KM)
Total	7.8
Motorized	9.0

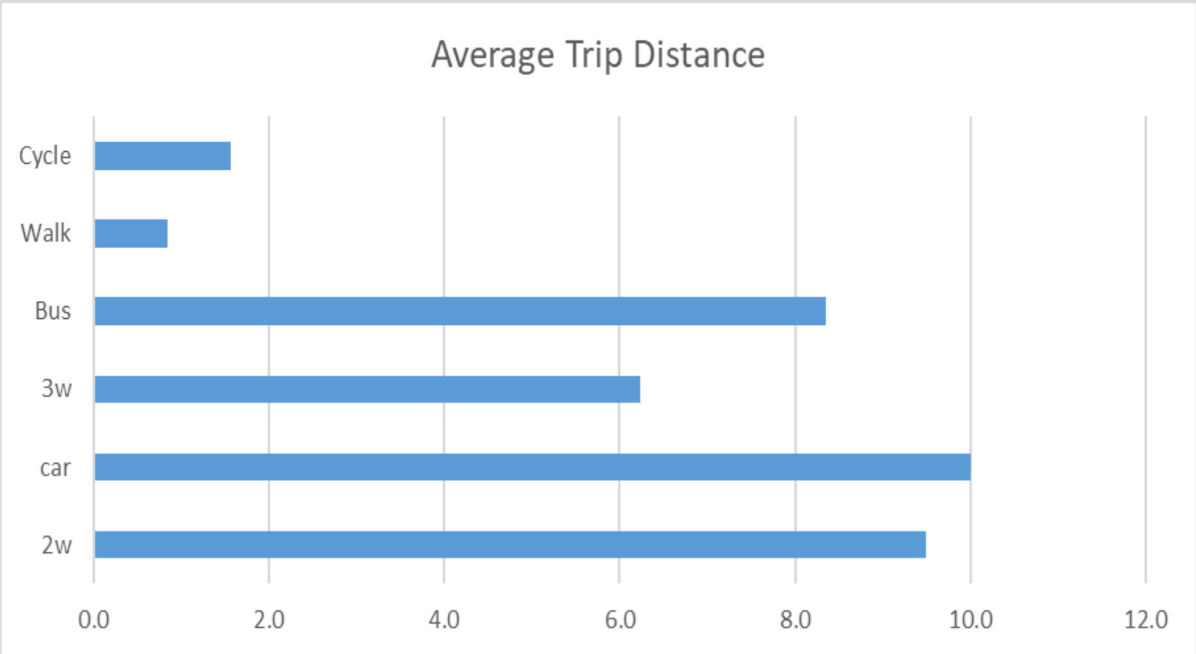


Figure 193 Mode-wise Average Trip Lengths (Primary Surveys-2022-23)

- The major mode of access and dispersal modes is walk with a share of 85.4% of the total access and dispersal modes.
- The average trip length of access and dispersal trips is observed to be 0.89km including walk trips and 1.4km for trips excluding walk.

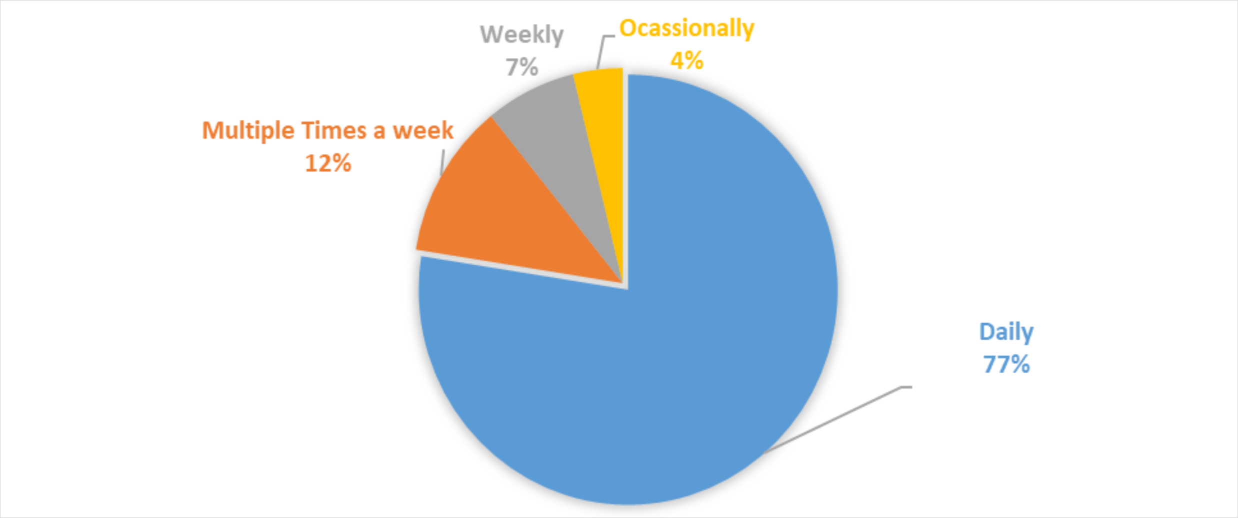


Figure 194 Trip Frequency Composition (Primary Surveys-2022-23)

- The survey indicated that over 75% of the trips are made daily.
- Nearly 55% of the trips made are work-based trips and about 34% of the trips are made for educational purposes. This indicates that nearly 80% of the trips being made are regular and daily trips in the study area.

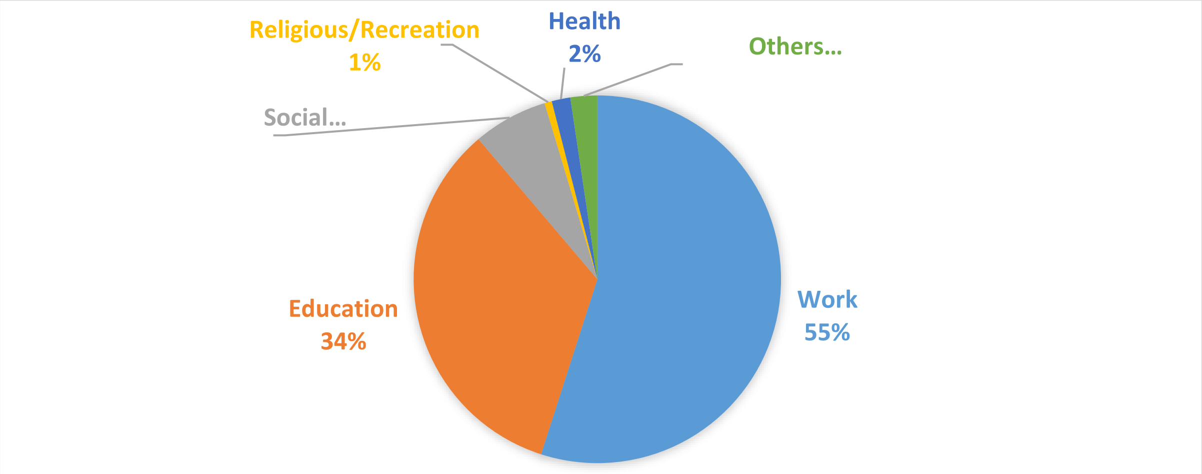


Figure 195 Trip Purpose Composition (Primary Surveys-2022-23)

- The average waiting time for public transport services is observed to 8.2 minutes. The longest waiting time is observed for buses with a wait time of 12 minutes.
- The household's access to the nearest PT or IPT stop is 0.62 km which is considered as a comfortable walking distance. Similarly, the average time taken to reach the PT or IPT stops in 7 minutes.

INTEMEDIATE PUBLIC TRANSPORT CHARACTERISTICS:

- About 85% of the intermediate public transport vehicles plying in the city are self-owned.
- The average number of operational hours is 10hours with about 14 trips at an average.
- These are observed to travel at an average of 121 km daily with an average route length of 10.2 km.
- The average daily expenditure of IPT is INR 1256, while the average daily revenue is INR 1507.

VEHICLE TYPOLOGY AT SURVEYS PETROL PUMPS:

- It is observed that majority of the vehicles in the study area run on petrol owing to 63% of the total composition.

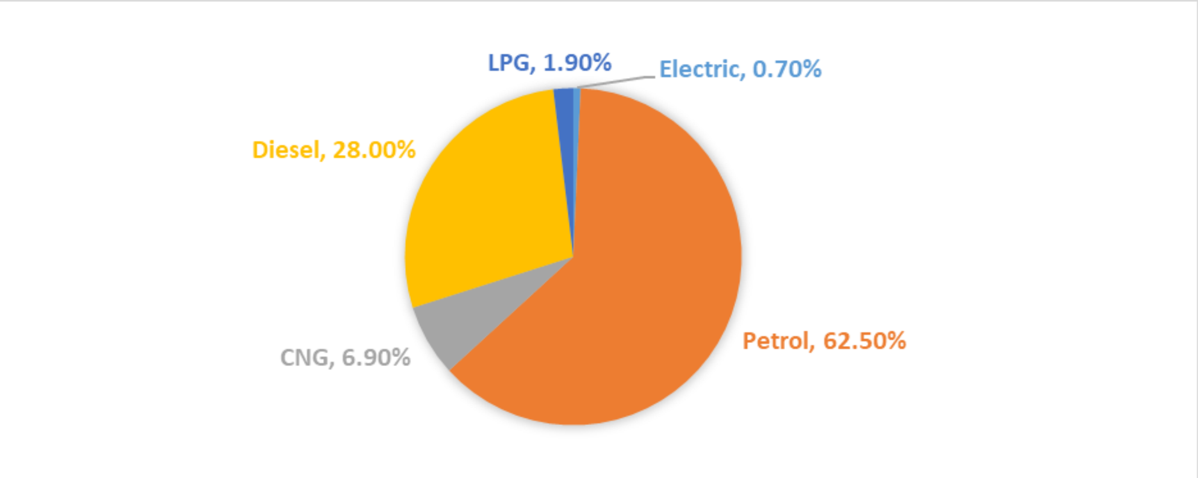


Figure 196 Fuel Technology based Vehicle Composition (Primary Surveys-2022-23)

Table 0-13 Fuel Technology based Vehicle Composition at Petrol Pumps (Primary Surveys-2022-23)

	CNG	DIESEL	LPG	PETROL	ELECTRIC
3wheeler	25.1%	54.0%	7.8%	12.7%	0.4%
2wheeler	0.0%	0.0%	0.0%	98.9%	1.2%
Bus	0.0%	100.0%	0.0%	0.0%	0.0%
Car	6.1%	31.1%	0.0%	62.5%	0.3%
Truck	0.0%	100.0%	0.0%	0.0%	0.0%

GOODS VEHICLE CHARACTERISTICES:

- About 42% of the trips are observed on occasional basis, indicating predominant intra-city interactions.

- The survey indicated that majority (56%) of the operators have parking facilities available within their premises. Other operators often park their vehicles on the streets. The major issues expressed by the goods operators are,
    1. Lack of Parking facilities
    2. Lack general facilities and terminals
    3. Lack of weighing facilities

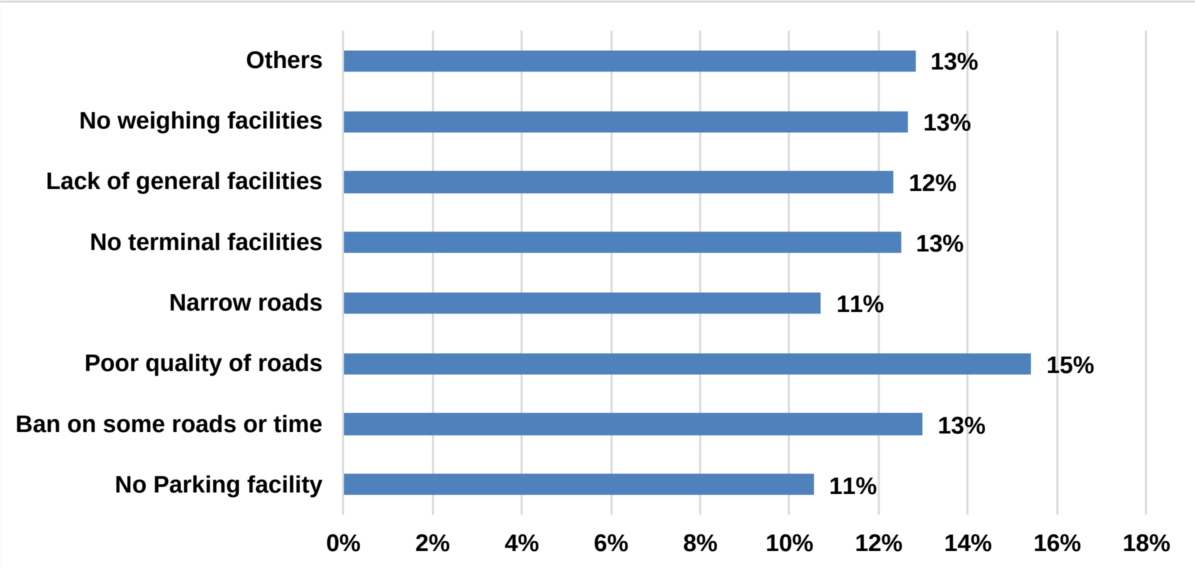


Figure 0-197 Goods Operator Difficulties

- The average number of trips made by goods vehicles is 3.7.
- It is observed that majority of the heavy goods vehicles ply through NH-66, Bypass Road, Kesavadaspuram- Nedumangad corridor and Peyad corridors.
- Heavy vehicle (MAV) movements during the peak periods are observed to be restrictions on the major corridors in the city 8-11am and 4-6pm.

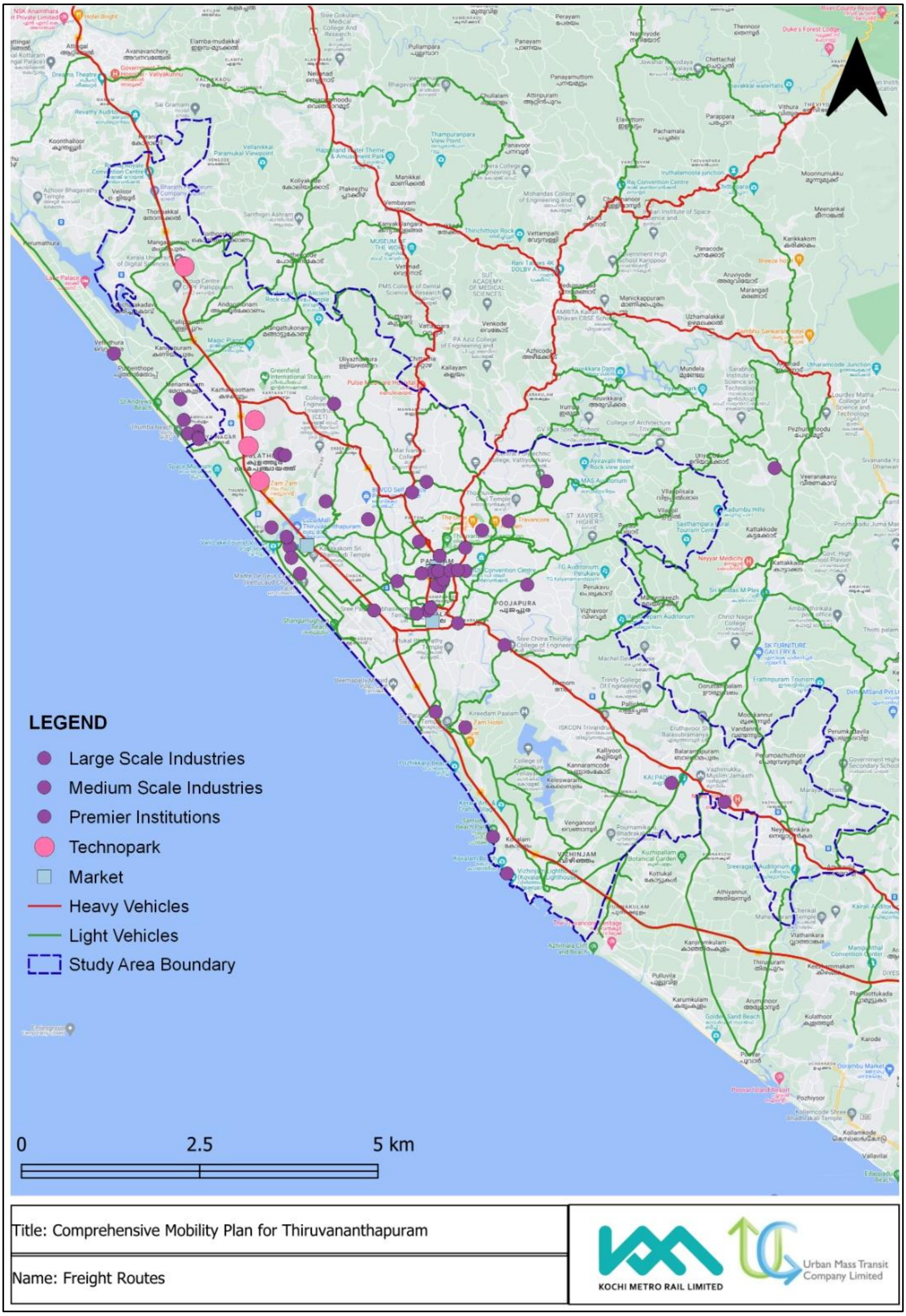


Figure 198 Map showing the major routes used by goods vehicles (Primary Surveys-2022-23)

ANNEXURE 9 – STAKEHOLDER CONSULTATION

Two stakeholder meetings are conducted as part of the study. The first one was conducted on 05th January 2023 and second one on 29th July 2023.

STAKEHOLDER MEETING – I

The first stakeholder meeting was conducted on 05th January 2023 with an objective to collect inputs from the stakeholders and to extend support for the study. The meeting was chaired by Mr. Geromic George, IAS, District Collector, Thiruvananthapuram.

Photographs of Stakeholder Meeting – I

The review meeting was attended by various key dignitaries and key stakeholders asmentioned in the table below.

Sl. No.	Name of Attendee	Designation	Department
1	Anu Kumari, IAS	District Development Commissioner	Thiruvananthapuram District Collectorate
2	Binu Francis	Secretary	Thiruvananthapuram Corporation
3	Rajeev R.	Assistant Executive Engineer	Thiruvananthapuram Corporation
4	C. Anil Kumar	Personal Assistant of Mayor	Thiruvananthapuram Corporation
5	Adv. S. Kumar	Chairperson	Attingal Municipality
6	Abdul Sajeem S	Municipal Secretary	Nedumangad Municipality
7	Manikantan R.	Secretary	Neyyattinkara Municipality
8	P K Rajamohan	Chairman	Neyyattinkara Municipality
9	S. Presana Kumar	Councillor	Neyyatinkara Municipality
10	Hari Kumar	President	Andoorkonam Panchayat
11	V. Mohanan	President	Balaramapuram Panchayat
12	K. K. Chandhu Krishna	President	Kalliyoor Panchayat
13	Suma V	President	Mangalapuram Panchayat
14	T. Mallika	President	Pallichal Panchayat
15	R. S. Sinu Kumar	President	Venganoor Panchayat
16	W. R. Harinarayanaraj	Managing Director	CRDP
17	C. V. Sundara Rajan	Advisor (Consultant)	CRDP
18	Varun S V	Accounts Manager	CRDP
19	S. Radhakrishnan	Former Deputy Collector & LAC	CRDP
20	Sreelekshmi P. S.	Content Editor	I&PRD
21	Sreelekha M. P.	Intern	KIIFB
22	Arun E. S.	Intern	KIIFB
23	L. S. Murali	Principal Consultant	KIIFB
24	Jacob Sam Looper	Zonal Traffic Officer	KSRTC
25	G. Anil Kumar	Executive Director	KSRTC
26	Asha P. A.	Town Planner	LSGD (Planning)
27	Rajesh T. N.	Town Planner	LSGD (Planning)
28	Rajesh P. N.	Additional Town Planner	LSGD (Planning)
29	Anju W. C.	Deputy Town Planner	LSGD (Planning)
30	Joshy K.	Deputy Transport Commissioner	Motor Vehicle
31	B. Anish Kini	Scientist	NATPAC
32	Shaheem S.	Principal Scientist	NATPAC
33	Salma Salim	IA	PRD
34	Pradeep P.	Traffic Inspector	Railways
35	A. Vijuvin	Senior Divisional Operation Manager	Railways
36	Jacob Sanjay John	Deputy Collector (LA)	Revenue
37	Darshan Singh	Chief Airport Officer	TIAL
38	Mukesh M.	COO	TIAL
39	Parmees E. Y.	Head, Master Planning	TIAL
40	Mahesh Guptan	Head, Corporate Communication	TIAL
41	Sheen Tharayil	ACP, Traffic	Traffic South Police, City
42	Rajesh V.	Assistant Town Planner	TRIDA
43	C. R. Krishna Kumar	ALM	VISL
44	Amoosha R.	Junior Project Officer	VISL

Sl. No.	Name of Attendee	Designation	Department
		KMRL Team	
45	Dr. M. P. Ramnavas	Director (Projects)	KMRL
46	Ajith Nair	General Manager (Design)	KMRL
47	Gokul T. G.	Sr. Deputy General Manager (Design)	KMRL
48	Kuriachan Simon	Deputy General Manager (Design)	KMRL
49	Anjana K. G.	Manager	KMRL
50	RM Alagappan	Project Consultant	KMRL
51	Sri Navya Annem	Project Consultant	KMRL
52	Megha Naidu	Project Consultant	KMRL
53	Midhun Thalassery	Project Consultant & On-site Project Officer	KMRL

STAKEHOLDER MEETING – II

The second stakeholder meeting was conducted on 29th July 2023 with an objective of the meeting was to gain insight into the draft Comprehensive Mobility Plan (CMP). The meeting was chaired by Shri. V Sivankutty, Minister for General Education and Labour, Government of Kerala.

Photographs of Stakeholder Meeting – II

The minutes of the stakeholder Metting II is as follows

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

UMTC/2022-23/PF-68/SCM/02

Minutes of Stakeholders Consultation Meeting-2 Comprehensive Mobility Plan for Thiruvananthapuram

Date & Time: 29.07.2023 & 04:00PM TO 05:30PM

Venue: Symphony Banquet Hall, KTDC Mascot Hotel, Thiruvananthapuram

Kochi Metro Rail Limited (KMRL) has been entrusted to prepare Comprehensive Mobility Plan (CMP) for Thiruvananthapuram as a part of the Mandate referred in Government Order - Government of Kerala, Transport (C) Department G.O.(Ms) No.43/2022/TRANS dated 01.09.2022. In the light of above, KMRL has appointed and authorized ' Urban Mass Transit Company' (UMTC) to plan and strategize the urban transportation needs of the developing city. As a part of the project initiation and the statutory procedures of Ministry of Housing and Urban Affairs, Govt. of India, KMRL has conducted the Draft Comprehensive Stakeholders Consultation Meeting-2 on 29th of July, 2023 at KTDC Mascot Hotel, Thiruvananthapuram to have esteemed views on the strategies identified for CMP, the proposals and phasing identified for Thiruvananthapuram along with their block cost estimates from the key stakeholders in the city.

The review meeting was attended by various key dignitaries and key stakeholders including Hon'ble Ministers, MPs, MLA s, Public representatives and officials of various Departments at Thiruvananthapuram.(The list of attendees attached in Annexure 1)

The Director (Projects) ,Kochi Metro Rail Ltd greeted Hon'ble Chair, Shri V Sivankutty, Minister for General Education and Labour and the house with a welcome note. The role of urban transportation systems in strengthening the economic growth of the city has been conversed and the need of the hour to plan and implement an integrated and sustainable public transport system for Thiruvananthapuram while assisting in reducing the dependency on private vehicles, congestion and pollution levels in the city.

The Hon'ble Chair Shri. V Sivankutty, Minister for General Education and Labour, Government of Kerala, Thiruvananthapuram reviewed the Stakeholders Consultation Meeting. As an introductory note to the meeting, Hon'ble Minister mentioned the following:

" The primary objective of the meeting is to gain insight into the draft Comprehensive Mobility Plan (CMP) that has been developed for the Thiruvananthapuram Capital. The involvement of stakeholders plays a crucial role in shaping the CMP. The study primarily concentrates on Thiruvananthapuram area, which encompasses 100 wards of the Thiruvananthapuram Corporation, along with 8 panchayats (Mangalapuram, Andoorkonam, Vilavoorkal, Vilappil, Balaramapuram, Kalliyoor, Pallichal, and Venganoor), as well as Neyyattinkara Municipality. The CMP provides an intricate overview of public transportation, addressing current needs and challenges, while also anticipating future requirements. The project is grounded in scientific and technical research, covering aspects such as road development, multi level parking parking, water transport, footpaths, mobility hubs, high-demand corridors, and more. A detailed examination of the Mass Rapid Transit (MRT) system (Metro rail, Mono rail etc) will be conducted based on insights gleaned from this meeting and subsequent study. Requesting all stakeholders to share their valuable insights and suggestions"

The Hon'ble Chair, deliberated on the necessity of developing a robust transportation system in the region for the next 30 years as the horizon period shall benefit the citizens with a sustainable, efficient and comfortable travel options.

After the chair's introduction a detailed presentation was made by KMRL (and UMTC).

<u>The points for discussion in the presentation</u>

- KMRL explained the study area, the existing city profile, with major primary survey and secondary data findings. The spatial growth pattern over decades, the directions of growth and major economic centres were also focussed in the presentation.
- The challenges faced in the city in terms of urban transport and the potentials of the city were clearly explained with case examples of initiatives taken by Thiruvananthapuram Corporation and other ULBs in developing and enhancing urban transport.

- Service Level Benchmarking for the nine parameters with their corresponding Level of Service for 2023 (base year) was explained and showcased in the presentation.
- The Service Level Benchmarking for 2051, (horizon year) under a 'Business As Usual' case scenario was also presented where each strategy was associated with a Level of Service figure for the horizon taking only into consideration the existing and under construction transport proposals.
- The Vision for Thiruvananthapuram city, and the broad categories of strategies were described to give an understanding on the heads upon which proposals were devised for the study area.
- The need for each of the strategies, the approach taken, the areas identified, spatial locations and the phases that shall be undertaken were explained for each of the strategies identified.
    - A multi-nodal development concept with Transit Oriented Development corridors and growth corridors were identified along which High Demand Mobility Corridors were proposed under the Public Transport strategy.
    - Semi-ring radial structure with proposed Outer Ring Road, Inner Ring Roads, Radials etc. and their connectivity details with distance and phasing were explained in the presentation.
    - Typical cross section examples, road network upgradation with missing links development, grade separators and their upgradation were also provided.
    - The concept of trunk-feeder and direct services under Public Transport along with case examples were briefed in the presentation. The new bus routes identified and the existing bus routes that need to be rationalised were proposed along with support infrastructure like terminals, multimodal hubs and multimodal interchange facilities.
    - Inland water transportation corridor with stations, routes and their potential length and connectivity were also assessed and put forth in the presentation.
    - The pedestrian network in terms of footpath development, bicycle network, tourist circuits, bicycle corridor along beach, identification of safe routes to

school for every ward etc. considered in the proposals. The importance of developing NMT network, to provide safe first and last mile connectivity to the commuters, were explained at length and the NMT priority corridors within core city area case examples at various locations across the country were also showcased by the consultants.

- Junction improvement measures, area improvement measures like improving the circulation pattern, pedestrianisation of streets etc. were also briefly touched upon in the presentation.
- The parking management strategy identified, with indicative locations, their proposed capacity and strategy were discussed for the case of Thiruvananthapuram.
- Technology related initiatives like Smart Bus Shelters, Adaptive Traffic Control Systems (ATCS), smart junctions etc. were identified and detailed in the presentation.
- The current movement pattern of freight vehicles, their parking and the identification of new freight terminals were done with proposed freight movement strategy for vehicles during their time restrictions inside the city.

- The impact assessment of the proposed projects in terms of improved levels of service (LOS) for horizon year 2051, the phasing of projects, project cost etc. were briefed in the presentation.

<u>The following queries & suggestions were raised by the stakeholders:</u>

The Hon'ble Chair initiated the discussions.

1. **Shri. Kadakampally Surendran, Member of Kerala Legislative Assembly**

   Hon'ble MLA enquired about the timeframe of study initiation and the progress achieved.

The Consultants informed the study began in November 2022 and that during the eight-month period, the Consultants have progressed till the draft stage of the study.

2. Shri. Sundar Rajan, Advisor, CRDP

Aakulam is the fastest growing area of the city with 30 registered housing societies around the lake. There should be a dedicated cycle track, jogging track women safety and child safety. This is an opportunity for Thiruvananthapuram to develop this area including all these. Improvement of the Aakulam Lake, water harvesting area, NISH area also should be considered.

3. Shri. L.S Murali, Principal Consultant, KIIFB

Details regarding development around the proposed terminals need to be provided. Also, the details regarding route rationalization need to be elaborated in terms of number of routes, exact origin-destination, fleet size etc.

- *The Consultants informed that the details regarding proposed bus terminals are provided in the Draft CMP Report which shall be uploaded in the official website of KMRL.*
- *The Consultants also responded that CMP shall identify the projects and strategies which need to be taken up as a separate assignment through conducting feasibility studies and Detailed Project Reports (DPR). The need, benefit and broad level details only shall be assessed in CMP. However, the details like list of routes, number of fleet, O-D details, etc. are provided in the Draft Final CMP report.*

. **4. Shri. S.N Raghuchandran Nair(President-TCCI)**

The Plan on Metro/ any Mass Transit Corridors, the details regarding the alignment, stations, connectivity towards Vizhinjam, Nemom railway station etc.

- *The Consultants informed that the details regarding provision of any Mass Rapid Transit (MRT) Corridor shall be assessed under the Alternative Analysis Report (AAR), which is a second stage of the study awarded to the Consultants. However, the High Demand Mobility Corridors identified in the CMP study is shown in the figure below, which will be analysed in the AAR study for providing any MRT system.*

HIGH DEMAND MOBILITY CORRIDOR

SN	NAME OF THE CORRIDOR	LENGTH (KM)
	PHASE I	
1	Techno City to Pallichal via Karamana, Nemom	27.4
2	Kazhakkoottam to Killipalam VIA Eanchakkal	14.7
	PHASE II Extension Corridors	
1	Pallichal to Neyyattinkara	11.1
2	Techno city to Mangalapuram	3.7
3	Eanchakkal to Vizhinjam	14.7

72 KILOMETER MRT CORRIDORS

42 KILOMETER PHASE 1

30 KILOMETER PHASE 2 EXTENSIONS

72 Kms are recommended for a Mass Transit Systems

5. Shri. M.R Gopan (Councillor)

All proposals need to be vetted with different departments of Local Self Government Departments. In addition, public opinion on the draft CMP needs to be taken to understand the perspective of the common men of Thiruvananthapuram.

- *The Consultants acknowledged the need and assured that people can express their views/ opinion once the document gets uploaded on the official website of KMRL.*

6. Shri. Darshan Singh, Airports Authority of India

The connectivity of airport with the proposed High Demand Mobility Corridors, the Multimodal Hubs, the extension of PT routes towards airport, the Inland Water Transport network, the connectivity of proposed ring-radial network with airports need to be explored. The cargo terminal proposals also need to be considered for airport connectivity.

- *The Consultants assured that due connectivity shall be provided to the airport and that all information related to the future projections of airport and their passenger loading have been considered in the modelled network.*

7. Shri. Sanal Kumar (Excecutive Committee Member-TCCI)

Population projection figures that stand at 13.5 lakhs need to be re-assessed as the Corporation population was 9.5 lakhs as per 2011 Census. Since there has not been any Census updating in 2021, the final population figures may vary. Also, the elevated highways did not find a mention in the current presentation, as they act as a very significant road in reducing the traffic congestion. Pattom flyover proposal has not considered the influx of student population of the three major schools of the region. It is also requested that railways be also taken into consideration in the CMP proposals.

- *The Consultants informed that the figure 13.5 lakhs is for the whole study area, which includes Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and 8 Panchayats. The Consultants have considered a decadal growth rate of 1.45% for population as per the draft Master Plan document. The final figures, however, may slightly vary depending upon the Census 2021 figures.*
- *The Consultants acknowledged the importance of having rail terminals at strategic locations of the city. However, it was informed by the Consultants that taking Indian Railways into confidence and proposing rail terminals shall fall out of scope of the CMP study, keeping in line with the MoHUA Guidelines.*

8. Shri Padmakumar (Thiruvananthapuram Corporation UDF Councillor)

The proposals given in the CMP reflect the proposals provided in CMP 2015 as well as Masterplan. Some of the proposals have already been implemented and some of them are at tendering stage. The consultants may update their list of proposals in accordance to the on-going status of Masterplan and previous CMP projects.

- *The Consultants have informed that the phasing has been done in accordance to the project implementation status of the committed proposals under CMP 2015 as* *well as Master Plan Document. The Consultants also informed that until the implementation gets complete and the operationalisation begins, all projects till then are considered as Committed Proposals and hence has been taken into cognizance in the current CMP Study.*

9. Councillor

The identified Mass Transit/ High Mobility Corridors may further be detailed upon in terms of their alignment, system and projected traffic numbers.

- *The Consultants have affirmed that the same shall be incorporated along with system and corridor comparison in the next stage of the study, the Alternative Analysis Report.*

10. Shri. V.K Prasanth, MLA, Vattiyoorkav

The details regarding how the projects would be environmentally responsive need to be provided. Most proposals are either provided in NATPAC 2015 Study or in the Master Plan Document. In addition, what are the new proposals contributed by the Consultants to this study need to be elaborated. Also, projects like Silver-line K-Rail and similar projects have not been included in the study. The model road extension (49.5km elevated highway) has not been touched upon in this study.

The Consultants responded that the environmental sensitivity of projects shall be assessed during the feasibility stage of each identified project. Moreover, the study currently covers the impact assessment and the benefits it brings in terms of improved network performance, reduced congestion levels and enhanced PT modal share. The levels of service that shall be achieved are also undertaken in this study. The consultants informed that aspects like K-Rail and other rail proposals that provide regional connectivity shall fall out of scope of CMP and comes under the 'Regional Plan' projects.

11. Shri.V. Ajith Kumar MD KRDCL

The details regarding how the projects would be environmentally responsive need to be provided. Most proposals are either provided in NATPAC 2015 Study or in the Master Plan Document. In addition, what are the new proposals contributed by the Consultants to this study need to be elaborated. Also, projects like Silver-line K-Rail and similar projects have not been included in the study. The model road extension (49.5km elevated highway) has not been touched upon in this study.

- *The Consultants responded that the environmental sensitivity of projects shall be assessed during the feasibility stage of each identified project. Moreover, the study currently covers the impact assessment and the benefits it brings in terms of improved network performance, reduced congestion levels and enhanced PT modal share. The levels of service that shall be achieved are also undertaken in this study. The consultants informed that aspects like K-Rail and other rail proposals that provide regional connectivity shall fall out of scope of CMP and comes under the 'Regional Plan' projects.*

13. Shri. T Elangovan, Ex-Director, NATPAC

Draft Masterplan for Trivandrum Corporation did not find any mentioning in the presentation. Also, some of the proposals provided in the presentation are from the previous Master Plan which need to be taken care of.

- *The Consultants informed that the proposals provided in the Masterplan have been considered as 'Committed Proposals', which have been showcased in the strategies. Since CMP acts a guiding document which envisages proposals for the next 30-year horizon period, it is pertinent to consider all the proposals that are provided in Master Plan in order to avoid duplication.*

14. Dr. Samson Mathew (Director NATPAC)

The study does not mention how trip attraction and trip production activities are being moved to the satellite cities once the Land Use Transport Integration concept gets implemented. The details on how NH Bypass corridor, which lies along the Panvel-Kanyakumar Highway shall act as Mass Transit corridor for city traffic to be detailed out. Integrate Coastal Highway and Parvathy Puthanar project into this project.

- *The Consultants informed that once the land-use transport integration takes place in the study area, the trip patterns would automatically change significantly, which shall change the trip production and attraction activities simultaneously. However, studies can then be taken up to assess the before-after changes of the trip pattern matrices.*

KMRL-UMTC addressed the comments and requested to share the proposals and studies conducted, further thanked the stakeholders for the valuable suggestions and these shall be addressed appropriately in the study. KMRL informed that the draft CMP will be uploaded in the official portal of KMRL and the feedback /comments shall be marked in the required form.

The meeting concluded with vote of thanks to the Chair and the stakeholders.

The draft Comprehensive Mobility Plan report is uploaded in KMRL official portal for soliciting the comments & feedback.

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

ANNEXURE 1-LIST OF ATTENDEES

Sl. No.	Name of Attendee	Designation	Department
1.	Shri V. Sivankutty	Minister	Minister of Education & Labour, Kerala
2.	Shri Antony Raju	Minister	Minister of Transport, Kerala
3.	Shri. Adv G.R Anil	Minister	Minister of Food & Civil Supplies, Kerala
4.	Shri Kadakampally Suredran	MLA	MLA, Kazhakootam
5.	Shri V.K Prasanth	MLA	MLA, Vattiyoorkav
6.	Georomic George, IAS	District Collector	Thiruvananthapuram Collectorate
7.	Dr. Aswathy Srinivas IAS	Sub Collector	Thiruvananthapuram Collectorate
8.	Binu Francis	Secretary	Thiruvananthapuram Corporation
9.	Sajikumar.V	Additional Secretary	Thiruvananthapuram Corporation
10.	Ajit Raveendran	Chief Engineer	Thiruvananthapuram Development Authority
11.	Denzil Fernandez	Deputy Town Planner	LSGD
12.	Vinod Kumar	Town Planner	LSGD
13.	S.Ajaykumar	Sr.Town Planner	LSGD
14.	Minnu Pathrose	Dy.Town Planner	LSGD
15.	Negul KR	Dy.Town Planner	LSGD
16.	Rajesh.V	Asst Town Planner	Thiruvananthapuram Development Authority
17.	Dr.Samson mathew	Director	NATPAC
18.	V.S Sanjay kumar	Principal scientist	NATPAC
19.	Wilson.K.C	Sr. Scientist	NATPAC
20.	Shaheem.S	PV. Scientist	NATPAC
21.	Ebin Sam	Scientist	NATPAC
22.	Toja.M.Thomas	Asst.Transport Commissioner	MVD
23.	Unnikrishnan	AMVI	MVD

Sl. No.	Name of Attendee	Designation	Department
24.	P.S Pramoj Sankar	Additional Transport Commissioner	MVD
25.	B.L Meena	RO	NHAI
26.	Abishek Thomas Varghese	DGM	NHAI
27.	S.K Mallik	GM T-RO	NHAI
28.	Anil Kumar G	Executive Director	South Zone, KSRTC
29.	Pradeep Kumar	Executive Director	Operations, KSRTC
30.	Mahesh Guptan		TIAL
31.	Darshan Singh	CAO	Airport
32.	Nagaraju Chakilam IPS	Commissioner of Police	Police
33.	Dhanesh Aravind	Section Engineer	K-RAIL
34.	Pradeep.P	T.I Planning	S.Railway
35.	S Anil	Transportation Inspector	Railways
36.	Sundar Rajan	Advisor	CRDP
37.	Varun S.V	LA Officer	CRDP
38.	Shameer	(Urban Planner-CRDP Consultant)	CRDP
39.	S.N Raghuchandran Nair	President	TCCI
40.	Sanal Kumar	Executive Committee Member	TCCI
41.	Renjith Ramanujam	CEO	Awake, Trivandrum
42.	R.Anil Kumar	Secretary	Awake, Trivandrum
43.	Robin Alex Panicker	Treasurer	Awake, Trivandrum
44.	Sanjeev Nair	CEO	Technopark
45.	Vasandh Varadha	AGM	Technopark
46.	Harinarayan.Raj	MD	KITCO
47.	Ajith.S	Project Engg	KITCO
48.	K.G Santhosh	ADPR (I/C)	I & PRD
49.	Amith M.S	Assistant Information	I & PRD
50.	Harikumar.S	President	Andoorkonam Panchayath
51.	Jayakumar P	Secretary	SRA Ellipode , Souhrida residents association
52.	Prathap Chandran	Joint Secretary	Fort Residents Association
53.	Adv.M.Murali Kumar	President	Fort Residence Association
54.	Asha N.P	DEO	KRTL
55.	L.S Murali,	Principal Consultant	KIIFB
56.	Anil Ravi	EGM	KRTL

Sl. No.	Name of Attendee	Designation	Department
57.	Kavitha L S	Councillor	Thiruvananthapuram Corporation
58.	M Binu	Councillor	Thiruvananthapuram Corporation
59.	D Ramesan	Councillor	Thiruvananthapuram Corporation
60.	Stanley D'cruz	Councillor	Thiruvananthapuram Corporation
61.	Asha Babu	Councillor	Thiruvananthapuram Corporation
62.	Surakumari R	Councillor	Thiruvananthapuram Corporation
63.	Johnson Joseph	Councillor	Thiruvananthapuram Corporation
64.	Adv. Amsu Vamadevan	Councillor	Thiruvananthapuram Corporation
65.	Ajith Raveendran	Councillor	Thiruvananthapuram Corporation
66.	Kasthuri M S	Councillor	Thiruvananthapuram Corporation
67.	V Meena Dinesh	Councillor	Thiruvananthapuram Corporation
68.	S Madhusoodanan Nair	Councillor	Thiruvananthapuram Corporation
69.	Sathi Kumari S	Councillor	Thiruvananthapuram Corporation
70.	G Madhavadas	Councillor	Thiruvananthapuram Corporation
71.	Rajalekshmi O	Councillor	Thiruvananthapuram Corporation
72.	P Rema	Councillor	Thiruvananthapuram Corporation
73.	Padma S (Saritha.S)	Councillor	Thiruvananthapuram Corporation
74.	Adv. V.G.Girikumar	Councillor	Thiruvananthapuram Corporation
75.	Padmalekha O	Councillor	Thiruvananthapuram Corporation
76.	Manju G S	Councillor	Thiruvananthapuram Corporation

Sl. No.	Name of Attendee	Designation	Department
77.	M R Gopan	Councillor	Thiruvananthapuram Corporation
78.	V Prameela	Councillor	Thiruvananthapuram Corporation
79.	C Omana	Councillor	Thiruvananthapuram Corporation
80.	Paniadima J	Councillor	Thiruvananthapuram Corporation
81.	Nissamudeen M	Councillor	Thiruvananthapuram Corporation
82.	Satyavathy V	Councillor	Thiruvananthapuram Corporation
83.	Vijayakumari V	Councillor	Thiruvananthapuram Corporation
84.	D Sajulal	Councillor	Thiruvananthapuram Corporation
85.	R Unnikrishnan	Councillor	Thiruvananthapuram Corporation
86.	K K Suresh	Councillor	Thiruvananthapuram Corporation
87.	S M Basheer	Councillor	Thiruvananthapuram Corporation
88.	Sudheer J	Councillor	Thiruvananthapuram Corporation
89.	Janaki Ammal. S	Councillor	Thiruvananthapuram Corporation
90.	P. Rajendran Nair	Councillor	Thiruvananthapuram Corporation
91.	P. Padmakumar	Councillor	Thiruvananthapuram Corporation
92.	P. Asok Kumar	Councillor	Thiruvananthapuram Corporation
93.	Irene Tr.	Councillor	Thiruvananthapuram Corporation
94.	Shajitha Nazar	Councillor	Thiruvananthapuram Corporation
95.	Seraphine Freddy	Councillor	Thiruvananthapuram Corporation
96.	D.G. Kumaran	Councillor	Thiruvananthapuram Corporation

Sl. No.	Name of Attendee	Designation	Department
97.	Suresh Kumar. S	Councillor	Thiruvananthapuram Corporation
98.	Naja B	Councillor	Thiruvananthapuram Corporation
99.	Sreedevi A	Councillor	Thiruvananthapuram Corporation
100.	Medayil Vikraman	Councillor	Thiruvananthapuram Corporation
101.	Sindhu.T	PA to Dr.Shashi Tharoor MP	
102	Joy j	PA To Kadakampally Surendran MLA	
103	Anil	PA to Mayor	
104	Sujdev TC	TPC	
105	Mohan v	RD	Education
106	Unni D.S	Officer	Education & Labour
107	Junior Engineer		VSSC
108	Sajeev S.J		EPRC
109	Revathy M.P	Social worker	Corporation
110	Cherry Cherian	Lighting and software consultant	
KMRL TEAM			
111	Dr.M.P.Ramnavas	Director (Projects)	KMRL
112	Sanjay kumar	Director (Systems)	KMRL
113	Ajith A	General Manager (Design)	KMRL
114.	Anand Elamon	Chief Project Manager	KMRL
115.	Gokul T.G	Sr. Deputy General Manager (Urban Transport)	KMRL
116	Unni.B	Sr. Deputy General Manager (Planning)	KMRL
117	Anjana K.G	Manager(Civil)	KMRL
UMTC TEAM			
118.	Kishor Nathani	Chief Operating Officer	UMTC
119.	Rajneesh Porwal	Senior Vice President	UMTC
120.	S. Ramakrishna	Senior Technical Advisor	UMTC
121.	J. Siva Niranjan	Assistant Vice President	UMTC
122.	Vivek E. M.	- Project Manager - Technical	UMTC
123.	Sucheta Y. -	Assistant Manager	UMTC

Sl. No.	Name of Attendee	Designation	Department
124.	Srinavya Annem -	Assistant Manager - Technical	UMTC
125.	Anupama Warrier -	Assistant Manager	UMTC
126.	Amulya Pothkanuri	Assistant Manager	UMTC
127.	Midhun Thalassery -	Project Officer	UMTC

COMPLIANCE OF THE COMMENTS RECEIVED

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
Stakeholder Meeting - Comments - 29 July 2023			
1	Kadakampally Surendran, MLA	When was the study initiated and the timeframe for the same	Study began in November 2022 and that during the eight-month period, the Consultants have completed the draft report during stakeholder meeting.
2	Sundar Rajan, Advisor, CRDP	Aakulam is the fastest growing area of the city with 30 registered housing societies around the lake. There should be a dedicated cycle track, jogging track women safety and child safety. This is an opportunity for Thiruvananthapuram to develop this area including all these. Improvement of the Aakulam Lake, water harvesting area, NISH area also should be considered.	The point is well taken. Although the footpaths (*Refer Section 5.5.1 of CMP Report*) proposed in the study area covers the Aakulam area, the bicycle track proposed in the study area is extended to incorporate the area (*Refer Section 5.5.3 of CMP Report*).
3	L.S Murali, Principal Consultant, KIIFB	Details regarding development around the proposed terminals need to be provided. Also, the details regarding route rationalization need to be elaborated in terms of number of routes, exact origin-destination, fleet size etc.	Details regarding proposed bus terminals are provided in the CMP Report (*Refer Section 5.3.6 of CMP Report*) CMP shall identify the projects and strategies which need to be taken up as a separate assignment through conducting feasibility studies and Detailed Project Reports (DPR). The need, benefit and broad level details only shall be assessed in CMP. However, the details like list of routes, number of fleet, O-D details, etc. are provided in the CMP report (*Refer Section 5.3.3 of CMP Report*).
4	S.N Raghuchandran Nair, President, TCCI	The Plan on Metro/ any Mass Transit Corridors, the details regarding the alignment, stations, connectivity towards Vizhinjam, Nemom railway station etc.	The details regarding provision of any Mass Rapid Transit (MRT) Corridor shall be assessed under the Alternative Analysis Report (AAR), which is a separate study.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
5	M.R Gopan, Councillor, Thiruvananthapuram Corporation	All proposals need to be vetted with different departments of Local Self Government Departments. In addition, public opinion on the draft CMP needs to be taken to understand the perspective of the common men of Thiruvananthapuram.	The point was well taken. The draft CMP report along with the presentation was uploaded in the KMRL website and was made accessible to everyone. More so draft shall be submitted to Thiruvananthapuram corporation for Government approval.
6	Darshan Singh, Thiruvananthapuram International Airport	The connectivity of airport with the proposed High Demand Mobility Corridors, the Multimodal Hubs, the extension of PT routes towards airport, the Inland Water Transport network, the connectivity of proposed ring-radial network with airports need to be explored. The cargo terminal proposals also need to be considered for airport connectivity.	The due connectivity is provided to the airport and that all information related to the future projections of airport and their passenger loading have been considered in the modelled network.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
7	Sanal Kumar, Excecutive Committee Member, TCCI	Population projection figures that stand at 13.5 lakhs need to be re-assessed as the Corporation population was 9.5 lakhs as per 2011 Census. Since there has not been any Census updating in 2021, the final population figures may vary. Also, the elevated highways did not find a mention in the current presentation, as they act as a very significant road in reducing the traffic congestion. Pattom flyover proposal has not considered the influx of student population of the three major schools of the region. It is also requested that railways be also taken into consideration in the CMP proposals.	The population of 13.5 lakhs is for the whole study area, which includes Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and 8 Panchayats. Considering the recent economic development in the study area, an additional population of 2.7 lakhs is considered as the floating population. Hence a total of 16.3 lakhs population is considered in the study area for the base year 2023. However, considering the intensive economic growth in the study area, the estimated population is anticipated to be much higher needs to be validated based on upcoming census data. The study has analysed the footfall and passenger travel characteritices at the major railway stations and thereby has identified and recommeded terminal developments and Multimodal development nodes and interchage facilites with the railway and bus station as in the case of Thampanoor Railway Station (*Refer Section 5.3.6 of CMP Report*).
8	Padmakumar, Councillor, Thiruvananthapuram Corporation	The proposals given in the CMP reflect the proposals provided in CMP 2015 as well as Masterplan. Some of the proposals have already been implemented and some of them are at tendering stage. The consultants may update their list of proposals in accordance to the on-going status of Masterplan and previous CMP projects.	The phasing of various proposals has been done in accordance to the project implementation status of the committed proposals under CMP 2015 as well as Master Plan Document. Until the implementation gets complete and the operationalisation begins, all projects till then are considered as Committed Proposals and hence has been taken into cognizance in the CMP Study.
9	Councillor, Thiruvananthapuram Corporation	The identified Mass Transit/ High Mobility Corridors may further be detailed upon in terms of their alignment, system and projected traffic numbers.	Alignment, system and projected traffic numbers along with system and corridor comparison should be taken up

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
			as an Alternative Analysis Report, which is a separate study.
10	V.K Prasanth, MLA	The details regarding how the projects would be environmentally responsive need to be provided. Most proposals are either provided in NATPAC 2015 Study or in the Master Plan Document. In addition, what are the new proposals contributed by the Consultants to this study need to be elaborated. Also, projects like Silver-line K-Rail and similar projects have not been included in the study. The model road extension (49.5km elevated highway) has not been touched upon in this study.	The environmental sensitivity of projects shall be assessed during the feasibility stage of each identified project. Moreover, the study currently covers the impact assessment and the benefits it brings in terms of improved network performance, reduced congestion levels and enhanced PT modal share. The levels of service that shall be achieved are also undertaken in this study. The Detailed Project Report prepared for K-Rail has been reviewed and considering the regional demand at terminal of daily boarding and alighting each of over 30 thousand passengers, multi-modal connectivity has been recommended at Thiruvananthapuram station, Kochuveli and the Thiruvananthapuram Airport in line with these previous studies. The road network strategy prepared also includes the committed and on-going projects as a part of TCRIP – model road.
12	T Elangovan, Ex-Director, NATPAC	Draft Masterplan for Trivandrum Corporation did not find any mentioning in the presentation. Also, some of the proposals provided in the presentation are from the previous Master Plan which need to be taken care of.	The proposals provided in the Masterplan have been considered as 'Committed Proposals', which have been showcased in the strategies. Since CMP acts a guiding document which envisages proposals for the next 30-year horizon period, it is pertinent to consider all the proposals that are provided in Master Plan in order to avoid duplication.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
12	Dr. Samson Mathew, Director, NATPAC	The study does not mention how trip attraction and trip production activities are being moved to the satellite cities once the Land Use Transport Integration concept gets implemented. The details on how NH Bypass corridor, which lies along the Panvel-Kanyakumar Highway shall act as Mass Transit corridor for city traffic to be detailed out. Integrate Coastal Highway and Parvathy Puthanar project into this project.	Once the land-use transport integration takes place in the study area, the trip patterns would automatically change significantly, which shall change the trip production and attraction activities simultaneously. However, studies can then be taken up to assess the before-after changes of the trip pattern matrices.
Stakeholder Meeting - Feedback Form - 29 July 2023			
13.01	Adv. Amsu Vamadevan, Councillor, Thiruvananthapuram Corporation	Make sure that the study is covering the development strategy that has to be initiated if Light Metro is happening in Thiruvananthapuram.	In the CMP, various proposed and committed projects are taken into confidence, which includes the Light Metro study conducted in the study area during the year 2014.
13.02		Whether the high demand mobility corridors are feasible. If so, what will be the suitable corridors.	The high demand mobility corridor is identified based on the demand on those particular corridors, which is identified feasible.
14	Mukunda Kumar, LIC & New India	Expansion of: 1. Over bridge junction to easy access to Vandhi poor home, SL theatre road and PVR theatre road. 2. Uppidammoodu flyover near Vanchiyoor Court. 3. Gandhi Park - Karamana elevated parallel flyover through Chalai market road, Killippalam. 4. At Balaramapuram Junction 5. Station Kadavu Junction 6. All the existing road cum underpass cum flyover 3 in 1	CMP has identified various junctions, flyovers, ROBs, bridges for upgradation. (*Refer Section 5.2.4 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
15.01	Ajith Raveendran, Councillor	On the presentation, there was lack of aminities centre, which are essential on mass mobility. Humble submission is to consider different types of aminities centres in between 30 - 35Km	Transportation Amenities in terms of Public transport terminals, Mutimodal hubs, inland waterways staions and terminals, ATC systems locations, Electric Charging Station locations, smart bus stop locations, freight terminals and logistic hubs, etc, have been identified as pasr of CMP.
15.02		Incorporate water mobility network	The proposed inland water way network is presented in the CMP Report (*Refer Section 5.3.5 of CMP Report*).
15.03		Lack of senior citizen friendly footpaths and differently abled capacities.	Various proposals outlaid in the report are developed with a focus on ensuring universal accessibility.
16.01	Darshan Singh, Thiruvananthapuram International Airport	Airport to be considered as economic growth center in the study.	The point is well taken refer Section 2.7 of CMP Report.
16.02		The airport & Vizhinjam Seaport will develop the economic conditions of the city and the connectivity by road & waterways to be considered.	All the economic growth centers have provided due importance in the CMP report, which includes the airport and upcoming Vizhinjam seaport. Connectivity via high demand mobility corridor, bus network, rail and waterway.
16.03		Consider Airport for Multi-Model transport transit point only as Hub may call for ask of larger land parcels/acquicitions. Kindly evaluate.	Considering the integration with various modes, which include bus, rail, air, water, etc a Multi-Model Mobility Hub have been proposed at the Airport. This needs to be assessed in detail before implementation based on various factors, which include land availability.
16.04		Consider ROW for utilities such as water, drain, power while planning roads & other mobility plans & sequence projects in parallel	Standard ROW are considered in the report with standard cross-sections, which incorporate all the utilities.However detailed designs should be made before upgrading the same.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
16.05		The present road connecting the Airport Terminal 2 at Chackai & Terminal 1 at Shangumugam is congested during peak hour.	The proposed high demand mobilty corridors and waterway and proper multi-model integration of various modes helps in decongests the roads connecting both the terminals.
16.06		Kindly present the milestone based project plan	The phasing of various proposals has been done in accordance to the project implementation status of the committed proposals (*Refer Section 6.1 of CMP Report*).
17	Sanjeev Nair, CEO Technopark	More details on Metro along Technopark	The details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a sseparate study. Various High Demand Mobility Corridors identified in the CMP study, which includes NH 66 bypass along the Technopark will be analysed in the AAR study for providing any MRT system.
18	Ajith Ravindran, CE, TDA	In the presentation, it is noted that there is shortage of land for various activities, which means land acquisition has a major role. Kindly look into the details of land acquisition.	CMP has considered the proposed landuse plan for 2040 prepared by the Draft Master Plan 2040. The proposal are made based on analysing the importance of the location and forecasted demand. The land availability in the area are looked in a holistic manner. However, while implementing the proposals, a detailed study need to be undertaken.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
19.01	KRDCL	The choice of public transport for Thiruvananthapuram - It is seen that two options viz. BRTS and Metro has been given for the public transport system in Thiruvananthapuram city. Out of this, the option of BRTS will not be practically feasible since it requires additional two lines of road exclusively for the BRTS. It will not be practivally possible to acquire additional land to widen the existing roads in the busy road corridors in Thiruvananthapuram.	The high demand corridors has already been identified. Cost benefit analysis of each kind of system need to be undertaken. The details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a seperate study. Various High Demand Mobility Corridors identified in the CMP study, will be analysed in the AAR study for providing any MRT system.
19.02		The alignment for the proposed public transport system has not been clearly spelt out in the CMP. In the earlier alignment from Pallippuram to Karamana via Old NH 47 touch Sreekaryam, Ulloor, Kesavadasapuram, Pattom and Thampanoor was selected since this was the busiest corridor for the movement of intra city traffic. It is felt that the scenario continues on date also. Hence it is suggested that the earlier alignment chosen for the Light Metro should be adhered to and new routes if any being proposed shall be dovetailed into this alignment.	The alignement proposed for the light metro in the DPR prepared during 2014 has been incorporated as one of the high demand mobility corridors in addition to the other corridors identified. However, the details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a second stage of the study awarded to the Consultants. The details of public transport system proposed in study area is provided in Section 5.3 of CMP Report.
19.03		A serious problem faced by Thiruvananthapuram is the heavy road blocks on the roads leading to Airport and Thiruvananthapuram Central Railway Station. Since timing of these two modes of transport are pre-devided, it is required that a dedicated arterial route through the City is required for both Railway Station and Airport. This aspect shall be gone into.	The study aims is *"to provide the users in Thiruvananthapuram an* ***efficient, smart, convenient and inclusive*** *sustainable travel mode choices while fostering as* ***safe, comfortable and seamless travel*** *experience in the study area"*. Various proposals put forward in the document helps in achieving the same.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
19.04		Major reason for the heavy road blocks in Thampanoor area is the narrow ROB on the southern end of Thiruvananthapuram Central Railway Station and the unscientific queuing of vehicles in front of the Railway Station. It is suggested that the ROB should be widened and the queue in front of the Railway Station can be shortened by properly realigning the entry scheme of Railway Station in Thampanoor.	The CMP has proposed for the upgradation of the Thapanoor ROB as well as Thampanoor flyover (*Refer Section 5.2.4 of CMP Report*). Also, Thampanoor Railway station have been identified in the CMP report for development (*Refer Section 5.3.6 of CMP Report*).
19.05		The second entry of Thiruvananthapuram Central Railway Station remains under utilised to a large extent inspite of the fact that this is as convenient as the first entry for the passengers. Ways and means to increase the utilisation of the second entry shall be gone into.	The point is well taken. The same will be considered while development of the Thiruvananthapuram Central (Thampanoor) Railway Station as mentioned in Section 5.3.6 of CMP Report.
19.06		The entry and exit of the traffic to and from the Thiruvananthapuram Central Railway Station from Thycaud side should be made through underbridge below the existing ROW on the southern end.	
19.07		Many of the roads in the City cannot be widened since the sides are heavily built up. On such roads bus bays shall be provided as a two tier system to take care of the bypassing traffic.	Bus bays are not feasible on all roads. On those roads, bus stops are proposed without bays. Even though this may create queue at the bus stop location, the priority have been given to public transport while comparing with private modes, which enhace people to use public transport.
Comments from Feedback Link Shared			

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
20	Archana, Doctor	Trivandrum is a fastest growing city which required a modern transport like Metro	As part of the PT Strategy, CMP has identified 5 corridors of 71.6KM as High demand mobility Corridors which are recommended for MRTS. Subsequently an AAR Study needs to be carried out for finalising the suitable mode on the identified corridors. (*Refer Section 5.3.1 of CMP Report*)
21.01	Vinod Kamalaraj, Software Architect	Regarding the Kazhakoottam - Eanchyakal - Killipalam corridor: Once the extension to Vizhinjam is done, the branching would be cumbersome. Positioning the Eanchyakall-Killipalam route to Thampanoor, and planning for a future extension from Thampanoor - Vazhuthacaud - Peroorkada - Vazhayila - NDD might be better. The first phase in this case can be till Vellayambalam or Kawadiar. This way, eventually there would be 3 corridors: Managalapuram-Neyyattinkara, Eanchaykkal-Nedumancaud and Kazhakottam-Vizhinjam	Corridors towards, Neddumangad and Peroorkada should be explored based on the future demand as stated in the report. (*Refer Section 5.3.1 of CMP Report*)
21.02		For the high frequency bus network, could the following be the routes: a. Vizhinjam - East Fort - Peroorkada - Nedumancaud b. Kochuveli - Medical College - Pattom - Kaudiar - Vellayambalam - Vattiyoorkavu - Nettayam c. Pothencode - Medical College - Kannamoola - Thampanoor - Pallichal - Vizhinjam? Providing cross town frequent services would be great for the city.	Routes mentioned are falling on the high demand mobility corridors and proposed high frequency bus network. (*Refer Section 5.3.1 and Section 5.3.4 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
21.03		For the suburban hubs, having Peroorkada as a hub for North-East etc would mean that there are more transfers required, and more one seat rides are always preferrable to people. Having the hubs geographically opposite (Peroorkada for the South-West, Pappanamcode for North-East) would give more transit options in the core areas, and provide more one seat rides. ie, a Aruvikkara-Peroorkada service would make a person going from Aruvikkara to East Fort take 2 buses, whereas a Aruvikkara - Pappanamcode service would increase transit options in the core, increase one seat rides AND decongest East Fort area as a transit hub	Based on geographical locations and trip pattern of services, development of trasit hubs are developed for city and regional services. (*Refer Section 5.3.6 of CMP Report*)
21.04		One problem with Trivandrums KSRTC designed routes is the variability that makes corridor identification and numbering difficult. Please redesign the entire bus network around fewer corridors, less variability, and route numbers that are corridor numbers.	City circular services operated by KSRTC are designed similar to MRTS system operation, where each bus have provided with distinct colour and number. The same can be taken forward for sub urban services as well. CMP is a vision document. However, a detail City bus improvement staudy needs to be carried for the same.
21.05		In the Video Series on KSRTC, the MD mentions that making a new subsidiary is NOT difficult. Could a KSTRC-TrivandrumDistrict be considered, a-la swift, so that this agency can be responsible for the bus transportation of Trivandrum?	Although KSRTC is a state level organisation, UMTA kind of agency can be implemented for area/district wise. (*Refer Section 8.2 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
21.06		When the private bus routes are rationalized, can the routes give out to them be to places that are not adequately covered by KSRTC currently, ie, routes where city buses ply less than on an hourly frequency? Examples would be: East Fort - Old Collectorate - Gowreeshapattam - Medical College - Gandhipuram - Kattaikonam Kuravankonam - Choozhampala - Mukkola - Maruthoor Veli - Kazhakoottam - Thundathil - Airoorpara - Vattapar (This would be a good connection route from MC road to Technopark)	The point is well taken and updated In the CMP report. (*Refer Section 5.3.3 of CMP Report*)
22	Rajesh S M, Associate Architect	Please speed up the implementation of metro for atleast in Technocity-Pallichal route	The details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a second stage of the study awarded to the Consultants. Various High Demand Mobility Corridors identified in the CMP study will be analysed in the AAR study for providing any MRT system.
23.01	Unnikrishnan, Media Professional	The PHPDT number shown in the report seems to be interesting. For 2051, projected PHPDT is only 13784. Why, there is a depreciation in PHPDT number when comparing with the previous study?	For the year 2051 SUT scenario, projected PHPDT is 19747, which is on the higher side compared to the previous studies. When comparing the BAU scenario for the year 2051 with that of the previous studies there is a reduction in PHPDT number, this is due to the impact of the COVID as well as the proposals outlined in those studies hasn't got fully implemented.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
23.02		Whether the impact study of the investments made by the Vizhinjam kind of projects are properly accessed?	After analysing the secondary data from major projects in the study area, various proposals are made in the CMP report. For instance, considering the impact of the Vizhinjam port various proposals like, connectivity of outer ring road, road widening, high demand mobility corridors, NMT facilities, etc are made.
23.03		The numbers estimated in the report seems to be fabricated based on pre conception without proper study. Explain how there is a reduction in PHPDT number while comparing with the 2018 report for the year 2021?	The ridership figures mentioned in the report is based on primary and secondary survey data. The data has been carefully analysed and the model has been developed in the modeling software. 2018 PHPDT number is from the DPR in which the recommended system is operational from 2018. Hence slightly higher PHPDT values are observed in the DPR. However, the 2021 and 2023 values of CMP report with the DPR of 2014 are comparable. Aiming the sustainable development, the demand estimated on the corridor is as presented in Section 5.3.1 of CMP Report.
24	Aswany, House wife	We want metro as soon as possible covering all important cities	The details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a seperate study.
25.01	Abhiram Krishna, Graduate - Urban Analyst	MRTS 1)Karamana - Peyad stretch should be also included In MRTS corridor as Phase - 1 B 2)Palayam - Vattiyoorkavu stretch should be included in MRTS corridor as Phase -2 Extension 3)Palayam - Peroorkada - Nedumangadu stretch should be included in MRTS corridor as Extension	The details regarding provision of any Mass Rapid Transit System (MRTS) or Bus Rapid Transit System (BRTS) shall be assessed under the Alternative Analysis Report (AAR), which is a second stage of the study awarded to the Consultants.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
25.02		BRTS 1) Pattom - Kesavadasapuram - Mannanthala (from Pattom Metro Station) 2) Vattiyoorkavu - Nettayam - Karakulam (from Vattiyoorkavu Station) 3) Vattiyoorkavu - Moonnamoodu - Puliyarakonam (from Vattiyoorkavu Station) 4) Peyad - Puliyarakonam (from Peyad Station) 5) Ambalamukku - Muttada - Kesavadasapuram - Pattom (from Ambalamukku Station)	
25.03		Future MRTS Proposals Outer Ring Road 1)South Corridor: Vizhinjam - Nedumangadu Phase Extension 2)North Corridor: Nedumangadu - Managalapuram Phase extension BRTS could be surveyed for MRTS according to occupancy	
25.04		Junction Redevelopment Thirumala (phase -1) Enchakkal (phase - 2)	The point is well taken refer Section 5.6.1 of CMP Report.
26	Sudarsana, Software	Connect Kovalam as well as that is one of the tourist places	Various proposals like high demand mobility corridors, bus, inland water metro, NMT facilities are provided to access Kovalam (*Refer Section 5 of CMP Report*).

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
27.01	Ceeyel, Professional	Ridership figures seems to be inflated. The same mistakes as committed by KMRL in Kochi Metro.	The ridership figures mentioned in the report is based on primary and secondary survey data. The data has been carefully analysed and the model has been developed in the modeling software. The value is also matching with the similar cities.
27.02		Kochi Metro Rail Ltd. should change its name as KERALA METRO RAIL LIMITED to represent the business properly. (KMRL in short)	Shall be taken up with the state government appropriately.
Comments from Town Planning Department Received on 27.08.2023			
28.01	Town Planning Department, Thiruvananthapuram	The preparation of Master Development Plan for the Outer Area Growth Corridor along 78 km Outer Ring Road (ORR) connecting Vizhijam with Mangalapuram and Navaikulam is a prestigious project of Government of Kerala and this is proposed to be implemented through preparation of land pooling schemes. The 70 M wide ORR is proposed TOD corridor with bus based transit through dedicated bus lanes and with mixed use, high density development on both sides. As the ORR with will have considerable influence on Thiruvananthapuram City's traffic and transportation system, this proposal has to be considered in the CMP, especially the regional connectivity and High Capacity Mass Transport Corridor at later phases.	The Outer Ring Road project has been considered as growth corridor while preparing the CMP report. (*Refer Section 5.1.2 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.02		The ORR proposal mentioned above prepared by CRDP II may be considered and suitably incorporated in the CMP, as the Outer Ring Road in the CMP Report is seen mentioned as from Mangalapuramto Parippallywhere as this is from Mangalapuram - Navayikulam (as per CRDP report). Also, there are contradictions in the road widths proposed by CRDP & in CMP.In this regard, consultations with CRDP II authorities who is dealing with OAGC is seen desirable to bring more clarity on the matter.	The point is well taken and updated In the CMP report. (*Refer Section 5.2.1 of CMP Report*)
28.03		The National TOD policy specifies for the development of high density mixed use development along transit corridors and around transit station. Draft TOD Policy for the State is under the consideration of State Government. Also, two TOD corridors are proposed in the draft Thiruvananthapuram Master. Hence, the station locations in the MRTS corridor shall be indicated in the CMP report and ways to increase transit ridership, first and last mile connectivity, park and ride facilities etc may be suggested.	The details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a second stage of the study awarded to the Consultants. The point will be considered while preparing AAR.
28.04		NH 66 & NH bypass are seen mentioned in different names in the report. Standardisation in the usage of the nomenclature of road is recommended.	The point is well taken and updated In the CMP report.
28.05		Contradictions are seen in the width of NH bypass & NH 66. In certain portions width of NH bypass is seen as 24m where as in certain other area it is seen as 45m.	ROW corresponding to NH bypass is mentioned to be as 24m. The corridor with an ROW of 45m is the Thiruvananthapuram Nagarcoil Highway (*Refer Section 5.2.2 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.06		NH 66 from Kazhakoottam to Karamana is proposed to have a width of 24m only in the CMP report where as it is proposed to have a width of 27m in the draft master Plan. This may be verified and corrected.	The proposed width of NH 66 is 27m which is mention in Section 5.2.2 of CMP Report.
28.07		In the proposals, the MRTS phase 2 lacks clarity. In certain maps, phase 2 is shown from Nemom to Neyyattinkara and in certain other maps, additional phase 2 from Enchakkal to Vizhinjam is shown. These contradictions may be avoided.	Two extensions (Pallichal to Neyyattinkara and Techno city to Mangalapuram) and one additional corridor (Eanchakkal to Vizhinjham) were proposed in the Phase 2. (*Refer Section 5.3.1 of CMP Report*)
28.08		The grade separators (above ground) proposed in the core area, especially Kowdiar, Vellayambalam& VJT hall area, may cause hindrance to the existing visual appeal of the area, which may be revisited.	Grade separators proposed in the CMP can be under ground or above ground. This needs to be assessed in detail before implementation.
28.09		River crossing are seen mentioned as Canal crossing in the report. This may be verified and corrected.	The point is well taken and updated In the CMP report. (*Refer Section 5.2.4 of CMP Report*)
28.10		In page 162, NUTP 2006 is seen referred rather than latest NUTP 2014.	NUTP 2014 is not a notified document and NUTP 2006 is the latest notified document. For reference purpose, the notified document is used. Meanwhile, the recommentations in the NUTP 2014 is cosiderd while preparing the CMP report.
28.11		Legends are seen in several maps for better understandability of the maps eg : desire lines with blue & green strips,in page 177-179.	The point is well taken and updated In the CMP report. (*Refer Annexure 7 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.12		In the cross section of roads proposed, the cycle lanes are seen provided next to high speed mobility lanes at the same level of road. It is not seen desirable considering the vulnerability of the cyclist to road accidents. Cycle lanes may be segregated with level difference with that of lanes intended for motorised traffic. Also, the cross section may be planned such that the cycle lanes are not intervened with bus movements at cross sections where bus stops are planned.	The point is well taken and updated In the CMP report (*Refer Section 5.5.3 of CMP Report*). However, the detailed designs will be prepared before the implementation.
28.13		In the TOD corridor, the high dense mixed use developments are proposed for 1km. It is desirable to bring clarity on the matter whether a total of 1km mixed used development is proposed along the TOD corridor or on both sides of the corridor.Similar is the case with Growth Corridor where 500m mixed use developments are planned.	Along TOD corridor, a total of 2km development area is proposed with 1km on both sides. Similarly, along growth corridor a total of 1km is considered with 500m on both sides.
28.14		It is mentioned in the report (pg 192) that the present FSI is 1.5 and it has to be increased. Clarity is required whether 1.5 is FSI presently utilised in the study area. As per the building rules prevailing in the state FSI permitted is much higher than 1.5. Needs attention & correction.	FSI of 3 to 4 have been recommended for the residential area in the study area in the report. (*Refer Section 5.1.2 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.15		In table 8-6, 8-7 in page 207, Thampanoor Flyover & ROB are proposed under upgradation works and again Thampanoor flyover is mentioned under new proposal. Clarity is required regarding from where to where is the flyovers proposed, is it a single long flyover and what will be the status of the existing flyover at Thampanoor.	The proposed new flyover at Thampanoor is an integrated flyover with the existing one connecting RMS Junction. The existing flyover is proposed to widen from two lanes to 4 lanes.
28.16		Railway lines may be shown in all maps.	The maps are used to understand the proposals outlayed in the report. Only relevant layers are incorporated in each map, which helps in recognizing the proposals.
28.17		Regarding the phasing of the works, phase 1, phase 2 and phase 3 are seen mentioned in the report. Same area is seen both in phase 1 & phase 2. Clarity is required in the phasing of implementation works.eg: Thampanoor flyover.	The proposals in the CMP are classified into various phases based on the implementation strategy. Some of them are phased into short term (Phase I), medium term (Phase 2) and long term (Phase III). (*Refer Section 6.1 of CMP Report*)
28.18		Vettu road which is a major road in the city is not seen considered in the study.	One of the inner ring roads proposed in the CMP is connecting Vettu Road and Thiruvallam (*Refer Section 5.2.1 of CMP Report*). Also, the Vettu Road junction improvement is also proposed in the CMP report (*Refer Section 5.6.1 of CMP Report*).
28.19		The location of the starting point of the High Demand Mobility Corridor (Phase 1) may be changed to Technocity.	The starting point of the High Demand Mobility Corridor (Phase 1) is from Technocity.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.20		Regarding the MRTS alignment the station points need to be specified. Also feeder networks to these stations by circular bus routes needs to be considered. This assumes significance, so the efforts to bring in TOD concept in the corridor are also to be initiated at the earliest.	The details regarding provision of any Mass Rapid Transit (MRT) system shall be assessed under the Alternative Analysis Report (AAR), which is a second stage of the study awarded to the Consultants. The point will be considered while preparing AAR.
28.21		Growth Corridors are seen limited to the study area. These Growth Corridors may be extended further upto the OAGC.	The point is well taken and updated In the CMP report. (*Refer Section 5.1.2 of CMP Report*)
28.22		The proposal of upgrading the Railway Stations in the study area including the major one at Thampanoor under AMRIT Bharat Station Scheme may also be considered and suitable proposals for Multi modal integration may be included in the report.	Various public transport terminals are identifed for the development in the CMP report which include Thampanoor Railway station. (*Refer Section 5.3.6 of CMP Report*)
28.23		Road crosssections are seen for RoW, which is not at all proposed in the CMP report. eg: 27m shown in pg 238.	NH 66 have been proposed to widened by 27m in Section 5.2.2 of CMP Report
28.24		In the proposed corridor for bicycle infrastructure, Manaveeyam road is seen mentioned. Presently Manaveeyam road is being developed under smart city mission,The proposals therein may also be examined and suitably modified.	The point is well taken and updated In the CMP report. (*Refer Section 5.5.3 of CMP Report*)

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.25		In page 247, the list of beaches for proposed bicycle corridor is seen mentioned. Both Veli beach and Kochuveli beach are seen mentioned. It is to be verified whether beaches are the one and the same. Also, Kovalam beach is seen mentioned twice and Hawa Beach is not seen mentioned. This may be verified.	The point is well taken and updated In the CMP report. (*Refer Section 5.5.4 of CMP Report*)
28.26		Legend of fig 190 in page 252 & fig 206 in page 276 is not complete.	The point is well taken and updated In the CMP report. (*Refer Section 5.5.6 and Section 5.6.3.1.5 of CMP Report*)
28.27		More attention may be given to Air transportation Sector, especially in the context of space constrains of existing airport and the future developments induced by Vizhijam International Sea Port and proposed OAGC.	The point is well taken and updated In the CMP report. (*Refer Section 5.3.6 of CMP Report*)
28.28		NMT priority streets are seen mentioned in pg 255, viability of such NMT priority streets needs to be checked considering the existing uses andactivity pattern in such area.	The NMT priority streets are proposed in locations near the market and religious place. The implementation of similary NMT priority streets in other part of India had shown growth in the mobility and interations at those locations.
28.29		There are many contradictions seen in the report shared in the website of KMRL and that presented on 29.7.2023.	The presentation made on 29.07.2023 is a summarized version of the entire report. Due to time restrictions, the presentation was short and all the proposals outlaid in the report may not have been conveyed in detail to the audience.
28.30		MLCP proposed in Transport Bhavan near fort mentioned in page 280 may be reexamined in the context of the proposal being in the heritage zone.	The MLCP near the Transport Bhavan is proposed based on the view of NMT priority street proposed in the nearby area. However, the same needs to be studied in detail before implementing.

S. N.	Name/Designation/ Organisation	Comment	Response/Compliance
28.31		In Pg 278, in table 8-33, certain locations are seen mentioned as MG Road, East Fort etc. It may be mentioned from which place to which place, so as to get clarity.	The point is well taken and updated In the CMP report. (*Refer Section 5.7.1 of CMP Report*)
28.32		Shifts in map layersare seen in several maps included in the report, disturbing readability, which needs to be corrected.	The point is well taken and the maps have been updated.

ANNEXURE 10 – SELF APPRAISAL CHECKLIST

Sl.	Item	Details	
	Vision/Goal	People Centric Sustainable, Efficient and World Class Urban Transport System that provides the residents of Thiruvananthapuram, safe, comfortable reliable and convenient mobility options while catering to their affordability, and providing them with seamless integration	
	Study Area	The study area comprises of Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and eight adjoining panchayats spread over an area of 371.94 sqkm (91908 Acre),	
1	***Introduction***		
1.1	**Socio Economic Characteristics**		
1.11	Current Population	16.27 Lakhs	
1.12	Population growth rate (annual)-projected	2.56%	
1.13	Projected population	34.16 Lakhs for 2051	
1.14	Per capita income	INR 9038	
1.15	Average Household size	3.45	
1.16	Average household income	INR 30,498	
1.17	Expenditure on transport	15087	
1.18	Area	371.94 sqkm (91908 Acre)	
1.19	Population Density	3645ppsqkm	
1.2	**Land use (%)**	**Existing Year**	**Master Plan**
1.21	Residential	47.10%	37.10%
1.22	Commercial	1.80%	1.30%
1.23	Public & Semi Public	5.50%	9.60%
1.24	Recreation	1.10%	1.40%
1.25	Industrial	1.20%	1.10%
1.26	Transportation	7.20%	6.70%
1.3	**Number of registered vehicles**		
1.31	Average annual growth of vehicles	6.4% (covid impact, pre covid - 10%)	
1.32	Transportation Modes Registered	10 lakhs	
a	Bus (including Mini Bus)	0.30%	
b	IPT	4.40%	
c	Car	34.30%	
d	Two Wheeler	60.60%	

Sl.	Item	Details
e	NMV	-
f	Freight (LCV & HCV)	0.80%
1.4	**Road network Characteristics**	
a	Total road length	1280km
b	Distribution by Right of Way	The surveyed network indicates that on 28% of the corridors have Right of Way (ROW) availability over 18m.
1.5	Rail Network	Six railway stations operate within city limits, including Thiruvananthapuram central station and five other stations and a daily footfall of over 40,000 passengers
1.6	Airport	International Airport located at3.7km form city center with daily passenger flow is observed to about 11 thousand
1.7	Public Transport Service	KSRTC (90 city circular services and 361 sub-urban services) and Private Operators (108 Permits)
1.8	Goods Terminal	None
1.9	Workforce Participation Rate (WFPR)	36.00%
2	**Existing Situation**	
2.1	**Traffic Zones**	458.00
2.2	**Zonal Households**	3552
2.3	**Surveys Undertaken**	
2.31	Road Network Inventory	350km
2.32	Speed & Delay Survey in peak and Off peak hour	350km
2.33	Classified Traffic Volume Counts Surveys	
a	Outer Cordon location	6.00
b	Mid Block location	9.00
c	Screen Line location	9.00
d	Roadside Origin-Destination Survey at cordon points	6.00
2.34	Classified Turning Movement Survey at Intersections	20.00
2.35	Pedestrian Volume Survey	20.00
2.36	Parking Survey	
a	On street Locations	9.00

Sl.	Item	Details
b	Off Street Locations	8.00
2.37	Commuter Survey at Public Transport Terminals	9.00
2.38	Mass Transport and Intermediate Public Transport (IPT) Passengers	500.00
2.39	Vehicle Operators' Survey	18.00
2.4	Household Survey	4000.00
2.4	**Survey Results**	
2.41	Origin-Destination survey	Chapter 3 and Annexure 8
2.42	Intra-city Public Transport Survey	
2.43	Intercity Bus Passenger Survey	
2.44	IPT Surveys	
2.45	Speed and delay surveys	
2.46	Parking survey	
2.47	Pedestrian Surveys	
2.48	Inventory surveys	
2.49	Mid Block Survey	
2.5	Screen Line Count Survey	
2.51	Intersection Surveys	
2.52	Travel Characteristics	
a	Socio Economic Characteristics	
b	Travel Characteristics	
3	***Urban Transport Benchmarking***	
3.1	**Air Quality Status in the city**	
3.1.1	SO2 Level	23
3.1.2	NO2 Level	62
3.1.3	CO Level	106
3.1.4	PM 2.5	103
3.1.5	PM10	84
3.2	**Comprehensive Environmental Pollution Index (CEPI)**	75.6
3.3	**Urban Transport Benchmarking**	
3.3.1	Public Transport	2
a	Presence of Organized Public Transport System in Urban Area	3

Sl.	Item	Details
b	Extent of supply - availability of public transport	2
c	service coverage of public transport in the city - bus route net- work density	3
d	Average Waiting time for intra city public transport users	3
e	% fleet as per urban bus specifications operating	3
3.3.2	Travel Speeds along Major Corridors	3
a	Average Travel speeds of personal vehicles	3
b	Average Travel speeds of public transport	2
3.3.3	Road Safety	4
a	Fatalities per lakh population	4
3.3.4	Pollution Levels	2
a	SO2	2
b	Oxides of Nitrogen	2
c	CO	3
d	PM 2.5	2
e	PM 10	3
3.3.5	Overall	3
4	***Junction Improvement Plans***	Chapter5
4.1	**Junction improvement plans**	
4.2	**Submissions**	
4.3	**Suggested Improvement Measures**	
4.3.1	Geometric Design	
4.3.2	Lane Markings	
4.3.3	Relocation of Bus Stops and Petrol Pumps	
4.3.4	Junction Signalisation	
4.3.5	Approach to Service Lanes	
4.3.6	Traffic Management Measures	
4.3.7	Pedestrian Infrastructure Proposals	
4.3.8	Alignment Improvement of Approach Roads	
4.3.9	Area Traffic Plans (ATP)	
5	***Base Year Model***	
5.1	Land use Forecast	Annexure 5

Sl.	Item	Details
5.2	Trip generation model developed (home based work trips mode wise)	
5.3	Trip Attraction model developed(home based work trips mode wise)	
5.4	Trip Distribution by using Gravity model	
5.5	Modal Split	
5.6	Trip Assignment (link v/c condition)	
5.7	Model Validation	
6	***Strategies for Transport Development***	Annexure 5,6,7
6.1	**Development Scenarios**	
6.1.1	Scenarios developed	
6.1.2	Selected Scenario	
6.1.3	Considerations under CMP Scenario	
6.2	**Transport Scenarios**	
6.2.1	Demand Forecast	
6.2.2	Scenario Evaluation Criteria	
6.2.3	Scenarios developed	
6.2.4	Scenario selected on the basis of pre defined evaluation criteria	
7	***Mobility Management Measures***	Chapter 5
7.1	**Core Area Improvement**	
7.2	**Traffic Control and Road Safety**	
8	***Transport System Plan***	
8.1	**Focus**	
8.2	**Road Network Development Plan**	
8.2.1	Mobility Corridors	
8.2.2	Road Widening	
8.2.3	Missing Links	
8.2.4	Railway Over/Under Bridges at Level Crossings	
8.2.5	Flyover Proposals	
8.3	**Public Transport Plan**	
8.3.1	Focus	

Sl.	Item	Details
8.3.2	Proposed Mass Rapid Transit Corridors	
a	Mass Rapid Transit	
b	Bus System Improvement Plan	
c	Typical Cross-sectional details of Right of Way	
8.3.3	Bus Infrastructure Requirement	
8.3.4	Intra-city Interchanges	
8.3.5	Para Transit Improvement Plan	
8.3.6	Other Measures	
8.4	**NMT Improvement Plan**	
8.4.1	Recommended Measures	
8.4.2	Grade Separated Pedestrian Facilities (GSPF)	
8.5	**Regional Traffic**	
8.5.1	Inter State Bus Terminals (ISBT)	
8.5.2	Passenger Rail Terminals	
8.5.3	Freight Terminals	
8.6	**Parking**	
8.7	**Integration of Land use and Transport Planning**	
9	***Regulatory and Institutional Measures***	
9.1	**Regulatory Measures**	
9.2	**Institutional Measures**	
10	Fiscal Measures	
10.1	Fare Policy for Public Transport	
10.2	Automatic Fare Revision	
10.3	Parking Pricing Strategy	
11	***Mobility Improvement Measures and NUTP Objectives***	
12	***Serice Level Benchmarking***	
13	***Stake Holder Consultations***	
13.1	**Stakeholders consulted for preparing CMP**	Annexure 9
13.2	**Major Inputs**	

Sl.	Item	Details
14	***Investment and Implementation Program (Phasewise)***	short-term project cost is estimated to be 7212.91 crores. All junction improvement schemes, footpath implementation, cycle track network development, removal of encroachment will fall into this category. While the approximate cost of medium-term projects is 3149.00 crores and 4045.83 crores for Long term measures.
14.1	**Public Transport Projects**	10802.5 Cr
14.2	**Road Infrastructure Improvement Projects**	2308.37 Cr
14.3	**Parking**	11.39 Cr
14.4	**Junction Improvement**	132.60 Cr

KOCHI METRO RAIL LTD.

JLN Metro Station, 4th Floor, Kaloor, Ernakulam, Kerala 682017

Urban Mass Transit Company Limited

URBAN MASS TRANSIT COMPANY

Head Office: Ground Floor, Unit No. G-09, 23 &24, Salcon Rasvilas,
District Centre, Saket,
Delhi - 110017
Branch Office: Second Floor, Unit No. SF 1 and 2, Balayogi Paryatak Bhavan,
Tourism Plaza 6-3-869/A, Green Lands, Begumpet,
Hyderabad- 500016, Telangana.