COMPREHENSIVE MOBILITY PLAN FOR KOCHI

DRAFT FINAL REPORT

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

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Urban Mass Transit Company Limited

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ABBREVIATIONS

APIS	Advance Passenger Information System
ATCS	Adaptive Traffic Control System
BAU	Business As Usual
BRT	Bus Rapid Transit
CBD	Central Business District
CMC	Cochin Municipal Corporation
CMP	Comprehensive Mobility Plan
CSEZ	Cochin Special Economic Zone
CSML	Cochin Smart City Mission Limited
CVC	Classified Volume Count
DPR	Detailed Project Report
GCDA	Greater Cochin Development Authority
GIDA	Goshree Islands Development Authority
GIS	Geographical Information System
GoI	Government of India
GPS	Global Positioning System
HBW	Home Based Work
IL & FS	Infrastructure Leasing and Financial Services
IPT	Integrated Public Transport
IT/ITES	Information Technology and Information Technology Enabled Services
ITMS	Intelligent Traffic Management System
ITS	Intelligent Transport System
JnNURM	Jawaharlal Nehru Urban Renewal Mission
KCR	Kochi City Region
kmph	Kilometres per hour
KMRL	Kochi Metro Rail Ltd
KMTA	Kochi Metropolitan Transport Authority
KOMN	Kochi Open Mobility Network
KSINC	Kerala Shipping & Inland Navigation Corporation Ltd
KSRTC	Kerala State Road Transport Corporation
KSWTD	Kerala State Water Transport Department
KURTC	Kerala Urban Road Transport Corporation
MMMH	Multi-Modal Mobility Hubs
MNL	MultiNomial Logit

MoHUA	Ministry Of Housing and Urban Affairs
MoRTH	Ministry of Road Transport and Highways of India
MoRTH	Ministry Of Road Transport & Highways
MRTS	Mass Rapid Transit System
NATPAC	National Transport Planning and Research Centre
NH	National Highway
NMT	Non-Motorised Transport
NUTP	National Urban Transport Policy
PBS	Public Bicycle Sharing
PCE	Passenger Car Equivalent
PCTR	Per Capita Trip Rate
PIS	Passenger Information System
PPHPD	Passengers Per Hour Per Direction
PPP	Public Private Partnership
PT	Public Transport
RoW	Right Of Way
RPZ	Resident Parking Zone
SEZ	Special Economic Zone
SH	State Highway
SLB	Service Level Benchmarks
SPM	Suspended Particulate Matter
SRTS	Safe Routes to School
SUT	Sustainable Urban Transport
TMC	Turning Movement Count
TOD	Transit Oriented Development
ULBs/ ULB	Urban Local Bodies/ Urban Local Body
UMTA	Unified Metropolitan Transport Authority
UMTC	Urban Mass Transit Company
WPR	Workforce Participation Ratio

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EXECUTIVE SUMMARY

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Sustainable Urban Transportation is the core module of Kochi 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. A sustainable transportation is an integrated system which facilitates mobility in a way that preserves the social, environmental, and economic interests of the city through an affordable, efficient, low carbon transportation option supporting the economy and regional development while minimising the impact on the use of land, health, and environment.

Sustainable Urban Transportation planning has proven to gauge numerous comprehensive socio-economic and 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 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 Kochi.

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 promoting Public Transport, NMVs and pedestrians.
4. Developing an efficient MRTS network to cater to the future needs.

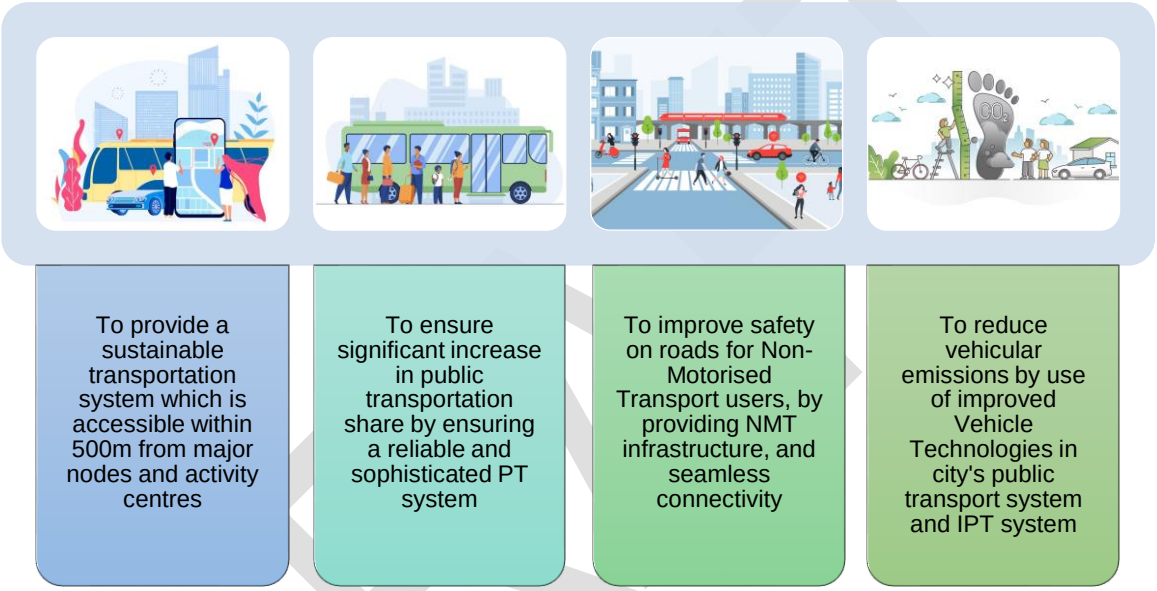
Thus, considering the overall traffic and transportation perspectives, both regional and national level guidelines and approaches promote sustainable urban transport framework for 20 to 30-year horizon period. Thus, CMP for Kochi is a necessary strategic vision document highlighting the national and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

STUDY AIM & OBJECTIVES

The growth of Kochi city being strongly fostered by tourism, trade and commerce thus reducing the impact of urban development on environment is a conscious component of the city's urban planning. Thus, the aim of the project is,

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

The proposed objectives for the project are as follows,



Kochi CMP Study Objectives

The project will endeavour to fulfil these objectives thorough various strategies and polices will be a part of the subsequent reports. However, on a broader note, the strategies which would be considered as part CMP for Kochi would range from land use transport strategies to mode wise strategies to technological strategies to management strategies of traffic and freight.

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

STUDY AREA PROFILE

The study area comprises of The Greater Cochin Development Authority GCDA) area and the Goshree Islands Development Authority (GIDA) (as listed below in Table) area spread over 732 sq. km. The study area consists of the Kochi Municipal Corporation, 9 Municipalities and 29 panchayats.

Kochi Planning Area Details (Source: Census-2011)

S No.	Administration	S No.	Administration
1.	Kochi Municipal Corporation (KMC)		
2. Municipalities (9)			
2.1	Aluva Municipality	**2.6**	North Paravoor Municipality
2.2	Angamaly Municipality	**2.7**	Perumbavoor Municipality
2.3	Eloor Municipality	**2.8**	Thrikkakara Municipality
2.4	Kalamasserry Municipality	**2.9**	Thripunithura Municipality
2.5	Maradu Municipality		
3. Panchayats (29)			
3.1	Pallippuram (GIDA)	**3.16**	Chengamanadu
3.2	Kuzhuppilly (GIDA)	**3.17**	Nedumbasserry
3.3	Edavanakkad (GIDA)	**3.18**	Sreemoolanagaram
3.4	Kottuvally	**3.19**	Kanjoor
3.5	Ezhikkara	**3.20**	Vazhakulam
3.6	Nayarambalam (GIDA)	**3.21**	Kumbalangy
3.7	Alangad	**3.22**	Elamkunnapuzha (GIDA)
3.8	Varappuzha	**3.23**	Njarackal (GIDA)
3.9	Cheranallur	**3.24**	Vadavukode- Puthencruz
3.10	Kadamakkudy (GIDA)	**3.25**	Udayamperoor
3.11	Mulavukad (GIDA)	**3.26**	Kumbalam
3.12	Kadungalloor	**3.27**	Chellanam
3.13	Choornikkara	**3.28**	Mulamthuruthy
3.14	Edathala	**3.29**	Chottanikkara
3.15	Keezmad		

The **GCDA- Greater Cochin Development Authority**, constituted in the year 1976 under Town Planning Act overlooks the development of the mainland of Ernakulum with 9 municipalities and 21 panchayats in north, east and southern part of the city; while **GIDA- Goshree Islands Development Authority**, regulates the development of the Islands consisting of 8 Panchayats in the study area. Kochi city is administered by the local civil body- **Kochi Municipal Corporation (KMC)** which governs an area of 94.88 square kilometres. The urban centres towards the eastern side of the city are administered by the respective Municipalities and Gram Panchayats.

Kochi Planning Area Statement (Source: Census-2011)

ADMINISTRATION	AREA (SQ. KM)
Kochi Municipal Corporation	95
9 Municipalities	162
29 Gram Panchayats	475
TOTAL STUDY AREA	**732**

- The urban development in the study area is observed to be around the nodal point of its seaport & trade settlements i.e., Fort Kochi, Ernakulam Market etc. Over the time, the urban growth has emerged along the major linkages such as Palarivattom-Edapally road, Sahodaran Ayyapan Road, NH66 Bypass etc. Today, the major growth is observed between east and south along the Angamaly, Kakkanad and Kumbalam, along the major highways and roads due to the development of the economic development centres and new linkages.
- The population residing in the study area of 732 Sq. Km as per 2011 Census was about 20 lakhs. As per 2011 records of the Census of India, the Cumulative Annual Growth Rate (CAGR) is 0.11% for the Kochi Corporation and the study area is found to be 1.41%, indicating the higher growth rates in around the corporation areas, owing to the spread of the economic activity centres in the study area. Considering the growth in line with Draft Master Plan 2040 and historic growth rates as per Census records, the projected population in the study area is observed to be 23.63 lakhs for the base year 2023 with an estimated growth rate of 2% owing to the economic developments in the region.
- The city is observed to have a significant share of floating population. Fort Kochi, Vypin and Kakkanad region being important IT & tourism nodes attracts migrant population in addition to the floating population. Thus, it becomes crucial to consider the same while planning and estimating the urban and population growth for the horizon years.

- The population density of the city is observed to be 7034 ppsq.km., accounting to be densest area in the study against the over density of 3229 ppsq.km. for the whole study area in 2023.
- The average household size in Kochi is 3.9, out of which 51% of resident population are female and 49% male. As per census 2011 the sex ratio is 1029 females per 1000 males in the urban areas.
- The share of transportation accounts to about 12.52% in the total area of Kochi Corporation which is in line with the URDPFI guidelines (12-14% of Developed Area), indicating decent share of transportation in land use mix.
- The proposed Draft Master Plan 2040 prioritizes 11.48% i.e., 1090 Ha of the land within the Kochi Corporation limits for Transit Oriented Development along the metro corridor and its extension, taking a 500m buffer on either side of the alignment of the metro line. This area is expected to be developed vertically incorporating the concepts of multi-modal integration, NMT provisions, active and engaging recreational spaces while strengthening the ridership of the Mass Rapid Transit (MRT) System.
- The study area of Kochi is the most sought-after destination for the employment in the state owing the presence of Petroleum refining, construction, plywood, fishing, furniture, textiles and wearing apparel, mining and quarrying, food processing, cement manufacturing, building and maintenance of ships and boats, information technology, healthcare, hospitality, transportation, storage, wholesale and retail and communication industrial sectors. It is the economic and commercial center of the state.
- The steady expansion of economic activities within the city as well as in the hinterlands and extensive regional network of communication and transportation facilities has enabled the city of Kochi to exert strong economic influence beyond its administrative boundaries. Commercial activities are mainly concentrated in the Central Business District (CBD) of the City of Kochi. The central city of Kochi comprising of Broadway, Ernakulam market, Mather bazaar, cloth bazaar etc. is major hub of wholesale and retail trade. Sea foods, spices, tea coffee, nuts and coir products comprise of the major export commodities. Beyond the Corporation limits and within the GCDA area at Kakkanad is one of the major destinations for IT & ITES companies. Technology and industrial campuses viz., Infopark, Cochin Special Economic Zone, KINFRA Export Industrial Park, Industrial belt in Eloor, Cochin Shipyard Limited, the largest shipbuilding and repair facility in India, BPCL, FACT, International Container Transhipment Terminal, Cochin Port Trust are the major employers in the study area. The IT Park employs more than 40,000 professionals.
- Tourism has contributed heavily to the economy of Kochi and is the highest contributor (10%) towards the State's GDP and provides 23.5% direct and indirect employment in the

state. Kochi attracts the maximum foreign (45%) and domestic (22%) tourists in the state. Fort Kochi, Mattancherry, Mangalavanam mangroves, beaches and backwaters are the major attractions in the region. Kochi is also gaining prominence in MICE events (Meetings, Incentives, Conferences and Exhibitions) and tourism because of the booming resort and convention centre infrastructure.

- Work Participation Ratio (WPR) in the study area is 37.91%. The Kochi Corporation has a WPR of 38.03% as per 2011 census, which increased from 34.51 percent as per 2001 census. This is an indicator of primary sector despite the rise of tertiary sector opportunities in the rural areas of the district. The WPR is observed to be higher than the state average ratio of 34% owing to the prominence of the economic activities in the region.

REGIONAL CONNECTIVITY AND VEHICLES REGISTRATION

- Kochi has a dense and extensive transportation network that connects it to interstate destinations and far beyond by road, rail, waterway, and air. Major regional links among National Highways viz., NH-66, NH-544, NH-85, NH-966A and NH-966B, State Highways viz., SH-15, SH-16, SH-41, SH-63, SH-66, and SH-1 Main Central Road passes through the study area boundary and touches two prominent satellite town Angamaly and Perumbavoor.
- The rail transport in the city is administered by the Southern Railway Zone of Indian Railways. The total length of the rail line within the study area is 95 kilometres. The major stations are Ernakulam Junction (South) and Ernakulam Town (North). Other major stations in the study area are Aluva, Thripunithura, Edapally, Kalamasserry, Kumbalam, Angamaly and Cochin Harbour Terminus in Willington Island.
- The railway system provided services to 65 thousand passengers daily as per the data as received from Southern Railway as of Dec 2022, indicating a strong regional interaction.
- Kochi is well connected to other parts of the state using KSRTC & private bus services. Kochi city and the neighbouring satellite towns mainly depend upon the bus transport, for meeting the travel demands of majority of the people.
- The KSRTC services operate from Ernakulam, Angamaly, Perumbavoor, Muvattupuzha, Kothamangalam, Piravom, Aluva, North Paravoor, and Koothattukulam cater to major share of suburban services.
- Private operates run 428 sub-urban and regional services connecting study area with its surroundings as per RTO, 2022 records.
- The Cochin International Airport (CIAL) is the largest and busiest airport in Kerala, located at Nedumbassery 28 km north of Kochi city. It caters to approximately 30,000 passengers

daily through 83 flights. The airport on an average handles 13000 International passengers and 15000 domestic passengers.

- The National Waterway – 3 i.e., the Kollam – Kottapuram Waterway passes through the region, which inland navigational route. In addition to the main stretch, Champakkara and Udyogamandal canals are connecting the industrial centres of Kochi to Port Inland Waterways Authority of India (IWAI) under the Ministry of Shipping are under development of national waterways.
- Cochin Port is one of India major ports situated in a strategic location, the port offers calm and tranquil channels for ships year-round, even during the Monsoon season. It enjoys excellent connectivity through both rail and road networks. The primary shipping channel divides the port into Ernakulam and Mattancherry channels.
- The port provides a range of cargo handling facilities, wharfs at Mattancherry and Ernakulam, Container Terminal at Vallarpadam, LNG Terminal at Puthuvype, an offshore Single Point Mooring (SPM), and a dedicated cruise terminal. Approximately 40 cruise vessels visit Cochin Port annually.
- The study area has registered about 18.46 lakhs vehicles as of August 2023. The study area together has the highest number of vehicles registered in the state, while Ernakulam RTO alone stands third in the State followed by Thiruvananthapuram and Kozhikode, owning the availability of alternative public transportation options.
- Ernakulam shows the highest vehicle registration in the study area followed by North Paravur and Perumbavoor. The annual growth rate of vehicles registered has reduced from 6.5% in 2019 to 3.4% in 2023 due to 2018 floods and the COVID-19 pandemic.
- From 2014 to 2022 it is observed that a total of 2.1 Lakh Cars and 5.25 Lakh Two wheelers are registered in the study area across various RTOs ans sub-RTOs. Two-wheelers and cars consitute nearly 67% and 27% of the vehicles registered in the study area respectivily. Petrol and diesel fuled vehicles comprise of 84% and 14% respectively. Approximately 1% each of the vehicles registered are electric or hybrid, and CNG fueled vehicles.

CITY BASED PUBLIC TRANSPORTATION

- The metro system offers rapid public transportation in the city. This system has been operational since 2017, with 1 elevated line having a length of 27.31 km and 24 metro stations from Aluva to SN Junction. The 1.2 km length of Phase 1B from SN Junction to Thripunithura is made operational in 2024. The current operation length of metro is about 28.12km, with an average daily ridership of nearly 95 thousand.

- The system has 25 trains commissioned, while a fleet Size of 13 trains cater to the peak demand at 8 minutes headway. Each train is a 3-car system. The depot is located at Muttom. KMRL offers payment / ticketing through Kochi1 Card, Kochi1 mobile application or monthly passes. Ticket charges varies from INR 10 and the maximum fare is INR 60.
- To enhance the ridership e-bus Feeder Services have been introduced. Apart from Feeders and e-Autos, PBS services are available at metro stations as well as at strategic locations in the neighbourhood. The Phase II connectivity to Infopark via Palarivattom and Kakkanad from JLN Stadium is under implementation. Upon completion this will add 11.2 km to the existing network.
- The city bus services in Kochi are provided mainly by private operators and state-owned bus company, Kerala State Road Transport Corporation (KSRTC). KSRTC city buses run on various routes within the city and connect major areas of Ernakulam, including Fort Kochi, Mattancherry, and Vyttila. About 926 services across 49 routes are operated by KSRTC daily in the study area, which are largely mofussil services. While private buses operate 1053 services including 20 city circular services with a fleet size of 59. The base fare of city bus services in INR 10 for both KSRTC and Private buses. The peak hour occupancy of the buses is 39 people (average). About 1 lakh passengers commute daily using KSRTC bus services as per 2022 data. 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. Recently the KSRTC and KMRL have started bus-based Feeder Services (70 services) as well to enhance the connectivity.
- To enhance the reach of MRT System, bus-based Feeder Services were introduced in the city. Midi Electric bus feeders operate on 7 major routes connecting various major locations to the metro stations.
- Kerala State Water Transport Department (KSWTD) operates the passenger water transport in Kochi. The ferries operated by the private operators, tourism department and Kerala Shipping and Inland Navigation Corporation (KSINC) act as principal link between the mainland and the islands.
- Ferry Services are available between Ernakulam, Willington Island, Fort Kochi and Vypin at a 15 minutes' frequency. 12,000 to 15,000 daily passengers use the services. Two RO-RO services are available connecting Fort Kochi and Fort Vypin, but these services are intermittently operational.
- KMRL has implemented an integrated water transport network in Greater Kochi, first phase, (Vyttila- Infopark) of which was completed in October 2021. Water Metro Services are operational along five corridors. The full-fledged operation of the water metro project is expected to have better waterway connectivity along the western coastline in the city.

The boats with passenger capacity of 50 and 100, will be operating at an optimal speed of about 15 kilometres per hour, with the potential to increase up to 22 kilometres per hour.

- Three-seater capacity auto rickshaws are privately run intermediate modes of transport providing point to point transport for the public. The Kochi Municipal Corporation is currently in the process of electrification of the IPT fleet as part of the Smart City Initiatives.
- Apart from these, a combination of conventional autos and e-autos (privately held) operate from Aluva, Petta & Vyttila towards various locations within 5 km radius from the respective metro stations in association with KMRL. These carry on an average approx. 110 (Petta) to 345 (Aluva) passengers daily, as per the KMRL sources. The minimum hire charges or base fare for IPT is ₹ 30.00 for a distance up to 1.5 km. Beyond the minimum, fare increases at ₹ 15.00 per km i.e., ₹ 1.50 for every 100 meters.
- Kochi is one of those Indian Cities which is actively working towards improving its NMT network through various methods. It has already implemented a Public Bicycle Sharing System adjoining the major metro stations. Major pedestrian Infrastructure and cycle track construction has been undertaken by KMRL as well as by CSML, under the Smart City Mission; apart from the existing pedestrian facilities developed by the ULBs. Under the development/ improvement of NMT initiatives taken up by KMRL, the corridors from Aluva to Edapally Junction (9.3km), Manorama Junction to SN Junction (18.11km) along the metro alignment and in the vicinity of metro stations; Kaloor – Kadavanthra Road (3.2km) as a part of Station Oriented Development (SOD) of Kaloor & Kadavanthra Metro Stations. The key features of the works are the restoration of footpaths, junction improvements, revamping of existing drain/ construction of new drains, construction of footpaths, tree planting, street furniture, landscaping, streetlights, etc.

FREIGHT

- Kochi port and Vallarpadom Container Terminal are the major freight generators in the city with considerable container movements. Other freight generator industries are fisheries, fertilizer industries and other retail products. Container as well as other goods movement mainly happens towards south through NH 544, North through NH 66, and Northeast to NH 544. Other freight terminals are in Kalamasserry, Aroor, Willington Island etc.
- Commercial Vehicles are restricted from 8 AM to 8 PM in the city limits and from Landmark Junction, Bolgatty Junction, Thevara Ferry & Thevara Junction to Kochi city under City Traffic Police West Division. While in the City Traffic Police East Division these are applicable along Edapally Junction, Palarivattom Bypass, Vyttila Junction, Petta to Kochi City, apart from Karingachira to Kizakkekotta (Thripunithura) during peak time. Ernakulam

Rural Traffic have imposed restrictions to commercial vehicles along Karothukuzhi Junction to Pump Junction during daytime, while at DPO Junction to Railway Square, Aluva- Varappuzha Road, & Thattampady - Neerickode road are always restricted (day & night).

- Goods traffic movement is also handled through waterways in Kochi. There are three oil barges and four water barges operating from Thevara jetty and two water barges operating from Murikkumpaadam jetty. Other goods movements include 16 barges operating from Thevara to FACT by KSINC. Kottappuram- Kollam stretch (168 km) of the West Coast canal along with Champakkara canal (14 km) – Kochi-Ambalamugal and Udyogamandal canal (23 km) – Kochi-Pathalam bridge has been declared as the National Waterway-3 (NW-3) (205 km). Out of 11 goods terminals in NW-3 operated by Inland Waterways Authority of India (IWAI), five are located within or close to Kochi city. These are at Aluva, Kakkanad, Maradu, Bolgatty Island and Wellington Island.
- The airport manages on an average 160 Tonnes of goods per day.

ROAD SAFETY

Road safety is a crucial factor considering the increasing number of vehicles in Kochi. The fatality rate of accidents in 2014 which was around 9 has increased to 15.44 in 2022 as per DCRB records. The fatality rate of pedestrians and cyclists in the city limits stands at 28%, indicating the need for improvement in NMT infrastructure facilities and dedicated cycle tracks to segregate the fast-moving moto vehicles from the NMT users. The number of fatalities per lakh population i.e., 15.44 in the study area is alarming and presses the need to improve the road safety in the study area.

EXISTING TRAVEL AND TRAFFIC CHARACTERISTICES

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. Extensive on ground surveys were carried out, between the month of December 2022 and March 2023 excluding the public holidays.

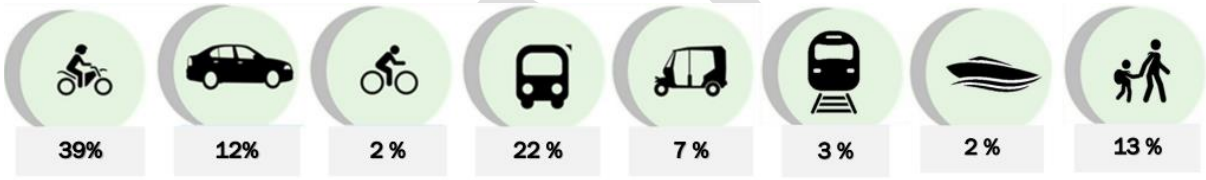
- The surveyed road network indicates that on 28% of the corridors have Right of Way (ROW) availability over 18m. The exiting surveyed corridors constitute carriageway between 18m to 36m indicating the availability of reasonable road space in terms of lane configurations on Major corridors. 77% of the surveyed network has 2-lane and above configuration. Four (4) and above lanes constitute about 16% of the total network. The share of network with divided carriage is about 14%. 25% of the major network has footpath availability in the study area. And only 7% 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 or encroachments hindering the road space allocated for traffic flow and pedestrian movement.

- The average journey speed during peak hours in the Central Business District (CBD) is 19.5 kmph, while it is observed to be about 28 kmph in non-core area. The average delay of 4 minutes is observed in the study area during peak hours on major corridors. The major reason for delay is largely due to traffic and signals. Maximum delay of 14 to 15 minutes is observed on NH 544 and NH 66.
- It is observed that highest traffic volumes are observed on NH-66 road and NH 544, indicating strong North-South interaction at northern and southern borders. It is observed that about 58% of the vehicle composition at study area boundary constituted by two-wheeler, 27% by cars and about 7% is constituted by Goods.
- The highest traffic volumes at intersection locations are observed at Palarivattom, Vyttila, Maradu, Edapally and near Aluva Metro Station Junctions. This indicates high traffic volumes in the city core and there is a need to address and decongest the core area.
- About 60% of the vehicle composition at intersections constituted by two-wheeler and about 27% is constituted by car.
- The primary survey assessment shows a daily footfall of nearly 68 thousand passengers at the major public transportation terminals in the study area. It is seen that Ernakulam Junction Railway Station and Aluva Railway Station are the major railway stations with high passenger footfalls. While Vyttila Hub, Angamaly Bus Stand, North Paravoor Bus Stand, Thripunithura Bus Stand and Aluva Bus Stand are the major bus terminals in the study area.
- The surveys indicate that highest pedestrian footfall is observed at High Court Junction followed by Vyttila Junction, Subhash Park, Edapally, Aluva & Palarivattom Junctions due the adjoining activity nodes such as colleges, transport 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.
- The parking assessment was carried out at major locations in the study area, it indicated that highest on-street parking accumulation in the city centre Banerji Road, Kaloor Kadavanthra Road, near Jose Junction and Shanmugham Road while the highest off-street parking accumulation was observed at Ernakulam Railway Station and Vyttila Mobility Hub.

SOCIO-ECONOMIC & TRAVEL CHARACTERISTICS

- The sex ratio derived from the household survey is 1015 females per 1000 males.
- The average household size is observed to be 3.9 with average number of 1.5 earning members per household.
- The classification based on the category of vehicles owned indicates that 11% of the households own no vehicle while, on an average 1.2 vehicles are owned in every household.
- The Per Capita Trip Rate (PCTR) was observed to be 1.32 including the walk trips. The PCTR for motorized trips is about 1.11.
- The major modes of travel are observed to be two wheelers (39%) and auto-rickshaw with a modal share of 7% while the share of bus based public transport accounts to only 22%, clearly indicating that private mode dominance mode over public buses. Considering all Public Transit modes, the mode share is at 25%.



Mode Share (Including NMT) (Primary Surveys-2022-23)

- The observed average trip length in is observed to be 7.53 Km including the walk trips and 8.58 km excluding the walk trips, and motorized is 8.47 km.
- The survey indicated that over 82% of the trips are made daily.
- Nearly 55% of the trips made are work-based trips and about 27% of the trips are made for educational purposes. This indicates that nearly 82% of the trips being made are regular and daily trips in the study area.
- The average waiting time for bus services is observed to 6 minutes. The longest waiting time is observed for buses with a wait time of 35 minutes.
- The household's access to the nearest PT or IPT stop is 0.7 km which is considered as a comfortable walking distance. Similarly, the average time taken to reach the PT or IPT stops in 10 minutes.
- 89% of the IPT vehicles surveyed are self-owned, while only 11% are rented or hired and mostly consist of 3-seaters (89.4%).

- 85% of the vehicles depended on petrol for fuel followed by 13.8 % on diesel, 0.87% and 0.33% on CNG and electricity respectively among the sample interviewed.
- It is observed that majority of the vehicles in the study area run on pertrol owing to 90% of the total composition.

GOODS VEHICLE CHARACTERISTICS

- Goods parking survey were carried out at Vallarpadom, Wellington Island & BPCL Goods Parking Terminals apart from the goods parking at Kalamasserry, Angamaly, Perumbavoor etc. Total of 18 major and minor locations were taken up for the survey.
- About 65% of the trips are made on weekly basis and 25% occasional basis indicating considerable number of intercity interactions.
- Among the surveyed vehicles, 34% mentioned having no parking to low parking facilities, while 42% had proper facilities to park the vehicles.
- Major operational concerns raised by the goods operators included:
    - Width of the roads – 80% of the operators found the city to have narrow roads.
    - Terminal & General Facilities – 62% found the city lacked terminal facilities & 74% general facilities with respect to goods operations.
    - Quality of roads - 47% expressed concerns of the quality of roads.
    - 65% of the operators found the ban on the major streets as a hindrance owing to the lack of terminal & general facilities.

KEY OBSERVATION IN THE CITY

- Urban sprawl is observed in the areas away from the CBD and ribbon development can be observed along the major corridors connecting these sprawls to the CBD. This 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.
- Public Transit options are multiple from buses run by KSRTC and private bus operators, metro services, water connectivity through KSWTD and KMRL, Ro-Ro services, rail, and air connectivity.
- Opportunities for integration of rail, road, water, and metro services are high considering the ongoing infrastructure developments in the study area. Apart from Vyttila Hub, on completion of the metro services extension to Thripunithura Railway Station from SN

Junction, it will act as a good intermodal hub connecting the two station and ensure ease of travel for people coming to the CBD from the southern region of Kerala.

- The land use in the area have been evolving over time from predominantly residential to public, mixed, and commercial, generating pressure on existing transport infrastructure. The major densification is observed along the NH, NH-Bypass and the major corridors.
- Efforts are underway by various ULBs, KMRL and CSML for urban place making and NMT infra development. This needs to be enhanced and clear demarcation of activities or road spaces needs to be developed leading to equitable distribution of the road space.
- 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 increasing the safety concerns of tourists.
- 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 lack dedicated cycle tracks.
- 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. Unorganized and haphazard parking on streets hinders the traffic flow due to encroachment of the road space.
- Bus stops lack dedicated boarding alighting spaces, leading to an added congestion on the road due to already present heavy traffic.

  Considerable trucks are parked along the roads near the industrial areas and along highways.

SERVICE LEVEL BENCHMARKING

The service level benchmarks (SLB)[1] issued by MoHUA specify parameters to measure the effectiveness of existing land use-transport planning in Kochi 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	BENCHMARK	OVERALL, LOS	INFERENCE AS PER MOUD GUIDELINES
1	Public Transport Facilities	2	The study area indicates the availability of good public transportation services and some amount of integration. However, further enhancement of

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

SN	BENCHMARK	OVERALL, LOS	INFERENCE AS PER MOUD GUIDELINES
			integration of the services would cater to the growing travel demand in the city
2	Pedestrian infrastructure facilities	3	The city has fewer pedestrian facilities which need further improvements and maintenance at certain sections especially at intersections and unobstructed footpaths it.
3	Non-Motorized Transport Facilities	3	The city has made efforts to improve the NMT facilities this needs further enhancement at many parts of the study area.
4	Intelligent Transport System Facilities	3	The study area needs enhancement of 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	3	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	1	Level of pollution in a study area is low, however, to ensure the maintenance of the quality PT modes needs to be encouraged and the usage of public modes rather than the private modes.
9	Integrated land use Transport system	3	Need to improve the coherence between study area structure and public transport system.

SUSTIANBLE URBAN MOBILITY MEASURES

The mobility vision for Kochi is to have a “People Centric Sustainable, Efficient and World Class Urban Transport System that provides the residents of Kochi, 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 Kochi 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.

Sustainable Mobility Strategies

LAND USE AND TRANSPORT PLAN

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.

MULTI NODAL URBAN FORM DEVELOPMENT CONCEPT

The structure of the study area resembles a compact node in the core Kochi Corporation area with growth centres emerging around it such as Aluva, Angamaly, Thripunithura, Kakkanad, North Paravoor, Vallarpadom, Kalamasserry, etc. Thus, a multi-nodal development concept is recommended for Kochi in ring radial structure.

Multi-Nodal development structure recommended Kochi would decongest the core area. 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

CENTRES AND SUB- CENTRES	AREA NAMES	DESCRIPTION
CORE AREA	Broadway, Ernakulam, Kaloor, Thevara, Kadavanthra, Vyttila, Edapally Palarivattom, Wellington Island	Commercial activities are mainly concentrated in the CBD of the City of Kochi. These have Govt. institutions, Colleges, major hospitals, Cochin Shipyard etc. Ernakulam market is the hub of wholesale and retail trade. Cochin Port Trust, Container Terminal are major hubs catering to the export activities. It also houses the famous JLN International Stadium at Kaloor.
Immediate Proximity Sub-Centers	Vallarpadom, Cheranallur, Kalamasserry. Kakkanad, Thripunithura, Kundannur	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 apart from IT Parks and Port and ICT Terminal. 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	North Paravoor, Aluva, Kizhakkambalam	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, Tourism centres, industries, and residential clusters. These are a mix of employment generations nodes and residential nodes. They 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.

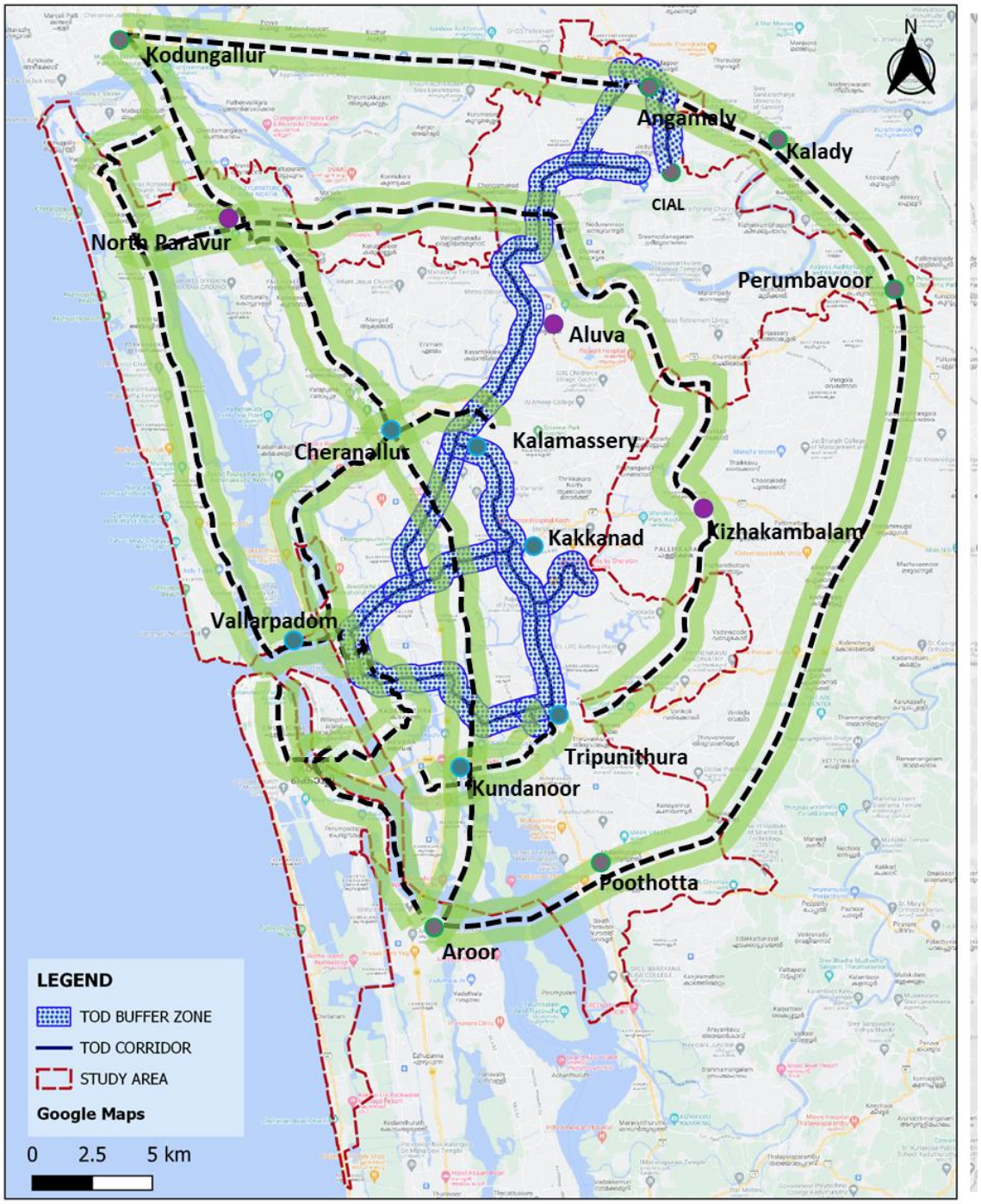
CENTRES AND SUB- CENTRES	AREA NAMES	DESCRIPTION
Low Proximity Sub-Centers	Kodungallur, Angamaly, Kalady, Perumbavoor, Poothotta, Aroor	These are the important satellite towns of the city. However, owing the growth pattern towards the north, Angamaly has significant trip interaction with the city centre. 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

The study recommends developing of 114.6km corridors under the principles of Transit Oriented Development (TOD) anf 103.5km of network as Growth corridors to connect the identified growth centers to foster multi-nodal development while strengthen its natural ribbon growth. The salient features of these Growth and TOD Corridors are as follows,

- The TOD and Growth corridors are proposed to have 1 km and 500m wide mixed-use development band.
- It is recommended for higher densification with used and activity generators using Floor Space Index as a vital tool. FSI upto 4 is recommended for the residential area in the study area. A FSI up to 3-4 for TOD corridors and 2 for Growth corridors with mixed residential and commercial zone are recommended.
- This provides 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.
- These corridors would foster Non-Motorised Transport users through well-defined and seamless design pedestrian and bi-cycle infrastructure.



Recommended TOD Corridor

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. 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 – RING RADIAL PATTERN

Kochi city has a radial network development like any other port city. In Kochi, these major radials are either state/national highways, and are important mobility corridors. There is a possibility to develop semi rings which bind these radial roads together providing a semi ring radial pattern for the road network. 384km of Road Network has been identified for strengthening ring and radial network in the city with 167 km of radials and 181km of ring corridors. The details of the same are presented below:

Recommended Semi-Radial Network

SN	NAME OF THE CORRIDOR	LENGTH (KM)	TYPOLOGY	PHASE
1	SH 63 High Court-Vypin-Cherai	22.9	Radial Road	PHASE II
2	NH 66 (Old NH 17) Edapally-Paravur	28.6	Radial Road	IN PROGRESS
3	SH 41 (Palarivattom- Kakkanad-Kizhakkambalam)	12.0	Radial Road	PHASE I
4	SH 15 (Thripunithura-Vaikom)	22.6	Radial Road	PHASE II
5	NH 47 Bypass (Edapally-Vyttila) NH 47(Vyttila-Aroor)	16.7	Radial Road	PHASE II
6	Aroor Road (Thoppumpady-Edakochi-Aroor)	9.8	Radial Road	PHASE II
7	SH 66 (Fort Kochi- Chellanam)	20.9	Radial Road	PHASE II
8	Inner Ring Road - Goshree Bridge at Vallarpadom to Thevara via Seaport Airport Road via Thripunithura	39.6	Ring Road	PHASE II
9	Middle Ring Road – Cherai-Paravoor-Aluva-Thripunithura-Kundannur-Thevara	70.4	Ring Road	PHASE II
10	Outer Ring Road – Kodungallur-Angamaly -Perumbavoor-Mulamthuruthy-Aroor	71.2	Ring Road	PHASE III
11	SH 16 (Aluva - Kuruppumpady)	23.55	Radial Road	PHASE II
12	Airport-Mattoor Road	9.41	Radial Road	PHASE I

NETWORK STRUCTURE – GRID IRON PATTERN (INTERNAL ROAD)

The interior networks largely fall under grid iron pattern. During the primary survey it was observed that 77% of the road network have lane configuration of 2 lanes or less. To strengthen the interior networks of the Ring-Radial pattern, the upgradation of lane capacities and new links in the horizon year in the study area are tabulated below. These are broadly divided as North-South and East-West Corridors covering 200 km and 130 km route length.

Recommended Corridors in the Study Area

SN	NAME OF THE CORRIDOR	DIRECTION	PHASE
1	Ravipuram to Vaduthala	North-South	Phase I
2	BOT Bridge Jn to Madhava Pharmacy	North-South	Phase I
3	Thevara Ferry to Thevara Jn	North-South	Phase I
4	Ravipuram Jn to Kothad Ferry	North-South	Phase I
5	Atlantis Jn to Vaduthala	North-South	Phase I
6	Chilavannur Ferry to Kumaranasan Jn	North-South	Phase I
7	Deshabhimani to Puthukalavattam	North-South	Phase I
8	Vyttila to SN Jn	North-South	Phase I
9	Changampuzha Jn to Cheranallur	North-South	Phase I
10	Arakkakadavu Bridge to Anchumana	North-South	Phase I
11	Assisi Convent to Fort Kochi	North-South	Phase I
12	Mundamveli Jn to Fort Kochi	North-South	Phase I
13	Kalathara Rd to Fort Kochi	North-South	Phase I
14	Vattathara to Kumbalangi Vazhi	North-South	Phase I
15	Aroor to Mattancherry	North-South	Phase I
16	Pambayimoola to NH 966B	North-South	Phase I
17	New Bus Terminal at Karrikamurri to North Railway Station	North-South	Phase I
18	Kuzhuveli Temple Rd to Puthiya Road	North-South	Phase I
19	Peruvaram to Karimpadam	North-South	Phase I
20	Vaniyakkad Jn to Vedimara Jn	North-South	Phase I
21	Thirumuppam Jn to Thekey Naluvazhi	North-South	Phase I

SN	NAME OF THE CORRIDOR	DIRECTION	PHASE
22	Panar Paalam to Bypass Jn	North-South	Phase I
23	Kadamakkudy to Perumpadanna Jn	North-South	Phase I
24	Mulanthuruthy to Thiruvankulam Jn	North-South	Phase I
25	Thrikkapuram to Cheriyappilly	North-South	Phase I
26	Pathipalam to Gandhi Circle	North-South	Phase I
27	Rayonpuram to Vallom	North-South	Phase I
28	Vattakattupady to Perumbavoor	North-South	Phase I
29	Perumbavoor Bus Stand to Aashupathripadi	North-South	Phase I
30	Bhajanamadom to Aimuri Jn	North-South	Phase I
31	Thiruvairanikulam to Kalady Jn	North-South	Phase I
32	Nayathode to Arikkal	North-South	Phase I
33	Athani to Vattapparambu Jn	North-South	Phase I
34	Koonammavu to Mannam	North-South	Phase I
35	Kochukadavantra to Perandoor Jn	North-South	Phase I
36	Kathrikadavu to Periyar Nagar	North-South	Phase I
37	Kalamasserry to Cochin Bank Junction	North-South	Phase I
38	Atlantis Jn to Manakkapadi	East-West	Phase I
39	Pallimukku to Vyttila	East-West	Phase I
40	Govt Guest House on Park Avenue Road to Shenoy Jn	East-West	Phase I
41	Abad Jn to Convent Jn	East-West	Phase I
42	Vyttila Jn to Corporation Boundary	East-West	Phase I
43	Marine drive on Shanmugam road to Padma Jn	East-West	Phase I
44	Padma Jn to Chakkaraparambu	East-West	Phase I
45	Puthiya road Bypass to GHSS	East-West	Phase I
46	Vennala jn to Eechamukku	East-West	Phase I
47	Pachalam to Anchumana	East-West	Phase I
48	Vaduthala on Chittoor Road to Edapally on NH bypass	East-West	Phase I

SN	NAME OF THE CORRIDOR	DIRECTION	PHASE
49	SH66 to Kacherippady Jn	East-West	Phase I
50	Cochin Port Jn to Kavunthazham Jn	East-West	Phase I
51	Manasserry on Saudia-Chellanam Road to Jayalaxmi Jn	East-West	Phase I
52	Kappalandimukku to Veli	East-West	Phase I
53	Fort Kochi to Mattancherry	East-West	Phase I
54	Ponnurunni Challikavattom Road	East-West	Phase I
55	Link Road 2	East-West	Phase I
56	Nadakkavu Jn to Arakkunnam	East-West	Phase I
57	Vedimara Jn to Anachal	East-West	Phase I
58	Vazhikulangara Jn to Anachal	East-West	Phase I
59	Shap Pady to Pallikavala	East-West	Phase I
60	Aanappara Jn to Angamaly South	East-West	Phase I
61	NAD Jn to Thorappu Jn	East-West	Phase I
62	Kariyad Jn to Mattur College	East-West	Phase I
63	Mangalapally Jn to Thiruvankulam	East-West	Phase I
64	Vyttila Jn to Mathoor Jn	East-West	Phase I
65	Koonammavu to Thottakkattukara Jn	East-West	Phase I
66	Colonypady to Kaitharam Schoolpady	East-West	Phase I
67	Kannanchira to Thonniyakavu	East-West	Phase I
68	Vallom to Kaduval	East-West	Phase I
69	South Vallam to Gandhi Circle	East-West	Phase I
70	Oushadhi Jn to Aashupathripadi	East-West	Phase I
71	Perumbavoor Bus Stand to Marakkar Road	East-West	Phase I
72	Pooppani to Children's Park	East-West	Phase I
73	Pump Jn to Palakkatuthazham Jn	East-West	Phase I

DEVELOPMENT OF MISSING LINKS/NEW LINKS

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

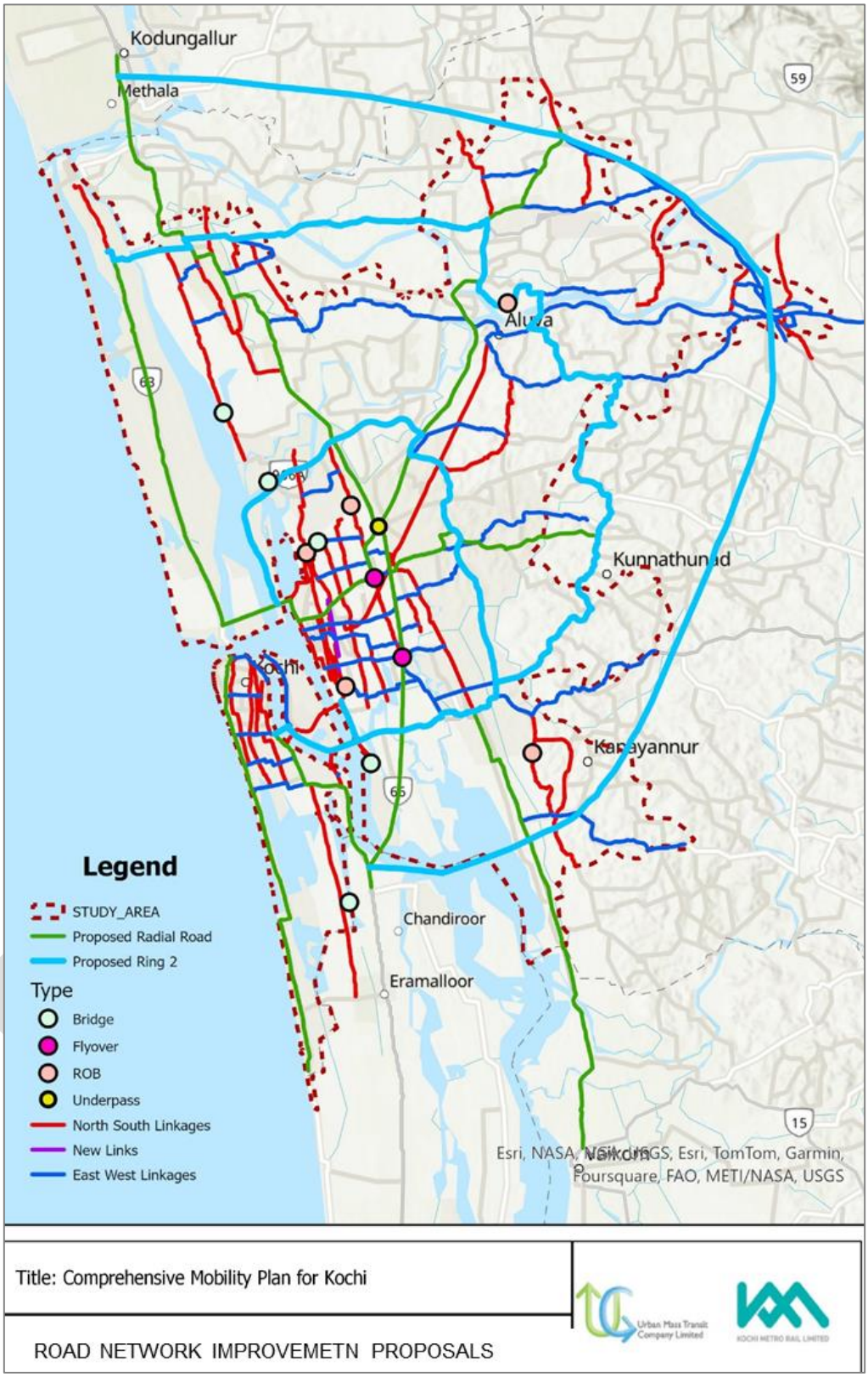
SN	NAME OF THE CORRIDOR	PROPOSED WIDTH	PHASE
1.	Road from Manikathu X Rd to Sahodaran Ayyapan Road.	12 M	PHASE I
2.	Link Road I - from Krishnapuram Rd. to Krishnapuram Rd.	15 M	PHASE I
3.	Corridor Connecting North & South Railway Station	9 M	PHASE I
4.	Thripunithura Railway Station Link Road	18 M	PHASE I

DEVELOPMENT OF GRADE SEPARATORS

Adequate road infrastructure and completeness of network structure is always necessary to support smooth flow of passengers. Efficient infrastructure enables better mobility for people and goods. 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 10 crossing which includes 5 railway crossings and 5 bridges. The locations are presented below.

Recommended Upgradation of Grade Separators

SN	NAME OF THE CORRIDOR	TYPOLOGY	PHASE
1	Atlantis ROB	ROB	PHASE I
2	Vaduthala ROB	ROB	PHASE I
3	Ponekkara ROB	ROB	PHASE II
4	Kureekad ROB	ROB	PHASE I
5	Periyar ROB	ROB	PHASE II
6	Bridge over Perandoor Canal	Bridge	PHASE I
7	Kadamakkudy Chathanad Bridge	Bridge	PHASE II
8	Kadamakkudy - Pizhala Bridge	Bridge	PHASE I
9	Thevara - Kumbalam Bridge	Bridge	PHASE II
10	Kumbalangy - Keltron Ferry Road Bridge	Bridge	PHASE I



Recommended Road Network Improvement Proosals

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 paratransit, appropriate Mass Rapid Transit (MRT) Options and infrastructure development plans and intermodal integration plans.

HIGH DEMAND MOBILITY CORRIDORS

The major mobility corridors in the study area along with existing and under construction MRTS corridors are listed below:

Major Mobility Corridors (UMTC)

SN	NAME OF THE CORRIDOR	LENGTH (KM)	REMARK
1	Aluva To SN Junction	27.3	Existing MRTS
2	SN Junction to Thripunithura	1.8	Phase 1B - Under Construction MRTS
3	JLN Stadium to Infopark	11.3	Phase 2 - Under Construction MRTS
4	High Court – Fort Kochi	14	Mobility Corridors
5	Paravoor To Aroor	35	Mobility Corridors
6	Kalamasserry - Thripunithura Via Kakkanad	14.1	Mobility Corridors
7	Aluva to Angamaly	13	Mobility Corridors
8	Petta to Thoppumpady via Kundannur	8.5	Mobility Corridors
9	High Court to Munambam	30	Mobility Corridors
10	Thripunithura to Poothotta	14	Mobility Corridors
11	Vallarpadam to Kalamasserry	16	Mobility Corridors

The assessment resulted in the identification of potential corridors for the development of higher capacity mass transit system. Mass Transit System designed to move large numbers of people on special guideways will lower travel time and mitigate congestion. About 28.12km of existing MRTS network is operational in the city. In addition, 11.3km of Phase 2 metro network in under construction. The study on further assessment recommends nearly 97km of additional length for development of Mass transit systems. Base on the estimated demand on the corridors and the carrying capacity of the available modes of MRT systems, the study identifys suitable rail and bus based systems. The same is based on the prilemenary assessement. However, a detailed study must be carried out subsequently for identifying the most suitable system for implementation. The recommended MRT corridors are as follows:,

Demand on recommended MRT Corridors & PHPDT for 2051

SN	NAME OF THE CORRIDOR	LENGTH (KM)	SYSTEM	PHASE
1	Aluva To Thripunithura	28.2	Existing Rail Based	
3	JLN Stadium to Infopark	11.3	Under Construction Rail Based	
4	Kalamasserry - Thripunithura Via Kakkanad	14.1	Rail Based	Phase II
5	Aluva to Angamaly via CIAL	18	Rail Based	Phase I
6	Paravoor To Aroor	35	Bus Based	Phase II
7	High Court to Munambam	30	Bus Based	Phase III

CITY BUS RATIONALIZATION

Thus, it is crucial to improve, augment, strengthen and integrated the city bus services with the other modes. A route-to-route overlap analysis has been carried out for bus services in Kochi is observed that about 22% of the routes have above 60% average route overlap with the proposed trunk routes or MRTS corridors. 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. It is recommended to rationalise 31 routes (13 KSRTC Routes & 18 Private Bus Routes) which are observed to be overlapping with the current and proposed Mass Transit Corridors by re-outing to alternative corridors. The details of the routes are as follows,

Recommended Private Bus routes for Rationalization.

SN	NAME OF CORRIDOR	OVERLAP WITH	RECOMMENDATION	PHASE
1	Aluva-Angamaly	Proposed MRTS	Re-route overlap	Phase II
2	Angamaly-Thripunithura	Proposed MRTS	Re-route overlap	Phase II
3	Piravom-Angamaly	Proposed MRTS	Re-route overlap	Phase II
4	Ernakulam Boat Jetty-Angamaly	Existing MRTS	Re-route overlap	Phase I
5	Perumbavoor-Ernakulam Boat Jetty	Existing MRTS	Re-route overlap	Phase I
6	Aluva-Kakkanad	Existing MRTS	Re-route overlap	Phase I
7	Kalamasserry-Aluva	Existing MRTS	Re-route overlap	Phase I
8	Aluva-Thripunithura	Existing MRTS	Re-route overlap	Phase I
9	Angamaly-Thoppumpady	Existing MRTS	Re-route overlap	Phase I
10	Angamaly-Eloor	Existing MRTS	Re-route overlap	Phase I
11	Perumbavoor-Ernakulam South	Existing MRTS	Re-route overlap	Phase I
12	Infopark-Aluva	Existing MRTS	Re-route overlap	Phase I

SN	NAME OF CORRIDOR	OVERLAP WITH	RECOMMENDATION	PHASE
13	Aluva Pvt. BS-Chittoor Ferry	City Bus Service	Re-route overlap	Phase I
14	Cherukara-Kaloor Pvt. BS	City Bus Service	Re-route overlap	Phase I
15	Eloor Depot-Thripunithura	City Bus Service	Re-route overlap	Phase I
16	Eramalloor-North Paravoor	City Bus Service	Re-route overlap	Phase I
17	High Court Jn.-Puzhakkaredath	City Bus Service	Re-route overlap	Phase I
18	Kadannoth Jn.-Thevara Jn	Existing MRTS	Re-route overlap	Phase I
19	Kaloor Pvt. BS-Koothattukulam	City Bus Service	Re-route overlap	Phase I
20	Kaloor Pvt. BS-Moothakunnam	City Bus Service	Re-route overlap	Phase I
21	Kaloor Pvt. BS-Piravom	City Bus Service	Re-route overlap	Phase I
22	Kaloor Pvt. BS-Thalayolaparambu	City Bus Service	Re-route overlap	Phase I
23	Malavana Ferry-North Paravur	City Bus Service	Re-route overlap	Phase I
24	North Paravur-Kadathu Kadavu	City Bus Service	Re-route overlap	Phase I
25	Pizhalakadavu-Malavana Ferry	City Bus Service	Re-route overlap	Phase I
26	Ponkunnam BS-Kaloor Pvt. Bs	City Bus Service	Re-route overlap	Phase I
27	Puthukalavattam-Thripunithura	City Bus Service	Re-route overlap	Phase I
28	South Chittoor-Thripunithura	City Bus Service	Re-route overlap	Phase I
29	Thevara Jn-Puthuvankunnu	Existing MRTS	Re-route overlap	Phase I
30	Thripunithura-Irumpanam C	Proposed MRTS	Re-route overlap	Phase I

NEW CITY BUS ROUTES

Apart from the bus route rationalization it is suggested to enhance the feeder services along the existing and proposed metro corridor in a phased manner. Circular services are proposed connecting the metro stations to the nearest residential and activity centres.

Proposed Feeder Services

SN	ROUTE NAME	PHASE
1	Thottakkattukara Jn - East Kadungalloor - Elookkara - Uliyannoor Rd - NH 544	PHASE I
2	Aluva Jn - Pump Jn - Mahilalayam Jn - Mangalapally Jn - Desom Jn - NH 544	PHASE III
3	SN Junction - NH 85 - Irumpanam Junction - Seaport Airport Road - Irumpanam Eroor Road	PHASE II
4	NH 85 - SH 15 - Statue Junction - Vadakkekotta Junction	PHASE II
5	NH 85 - SH 15 - Mini Bypass Thripunithura Road - NH 85	PHASE I

SN	ROUTE NAME	PHASE
6	SH 15 - NH 85 - Kundannur - NH 66 - Chambakkara Kannadikadu Road	PHASE I
7	SH 15 - Chambakkara Kannadikadu Road - NH 66 - Church Road	PHASE I
8	Vyttila - SH 15 - Church Road - Janatha Road - Janatha Junction - SH 15	PHASE I
9	Janatha Jn - Tank Bund Rd - Amalabhavan Rd - Kadavanthra - SH 15	PHASE I
10	Kadavanthra Jn - Kallupalam Jn - Chakkola Jn - Thevara Jn - Pallimukku Jn - SH 15	PHASE I
11	South Metro - Pallimukku - Foreshore Road - TDM Hall - South Metro	PHASE I
12	Maharaja College Metro - Chittoor Road - TDM Hall - Park Ave - KPCC Junction - Metro Station	PHASE I
13	Maharajas College Metro - KPCC Junction - Market Road - Shanmugham Road - Banerjee Road - MG Road	PHASE I
14	Vyttila - Mathoor - NH 85 - SH 15	PHASE I
15	Vyttila - Mathoor - Puthiya Road - NH 66	PHASE I
16	SH 15 - Kaloor Kadavanthra Road - Thammanam Junction - Chakkaraparambu - NH 66 - Vyttila	PHASE I
17	Ernakulam South - Kadavanthra Jn - Kumaranasan Jn - Mahatma Gandhi Rd	PHASE I
18	Changampuzha Park - Madam Jn - Perandoor Jn - Pottakuzhi - Mamangalam Jn	PHASE I
19	Town Hall Metro - Golden Jubilee Road - SRM Road - High Court - Banerjee Road	PHASE I
20	Banerjee Road - Golden Jubilee Road - SRM Road - Pottakuzhy Road - Perandoor Road	PHASE I
21	Mamangalam Jn - Pottakuzhi - Kaloor Jn - Palarivattom Jn	PHASE I
22	Banerji Road - Mahakavi Vailoppilli Road - Thammanam Junction - Kaloor Junction	PHASE I
23	Palarivattom Jn - Civil Line Rd - NH 66 - Anchumana Temple Rd - Mamangalam Jn	PHASE II
24	Pipeline Jn - Kakkanad - Seaport Airport Rd - Thrikkakara Temple Jn - Parutheli Jn - Edapally	PHASE II
25	VP Marakkar Rd - Vattekunnam Rd - NH 66 - Edapally - NH 544	PHASE I
26	Edapally - NH 66 - Juwan Cross Rd - Ponekkara - Changampuzha Park - Edapally	PHASE I
27	Kalamasserry Town Hall - VP Marakkar Rd - NH 544	PHASE I
28	Toll Jn - Parutheli Jn - Thrikkakara Temple Jn - Kinder Hospital - NH 544	PHASE I
29	Kalamasserry - Eloor - Manjummel - TVS Road - NH 544	PHASE I
30	TVS Road - Manjummel - Kunnumpuram Jn - Indiraji Bridge Rd - VP Marakkar Rd - Kalamasserry Town Hall	PHASE I
31	Companypady Jn - Pathalam Jn - Aanavathil Jn - Kalamasserry - NH 544	PHASE I

SN	ROUTE NAME	PHASE
32	Companypady Jn - Pathalam Jn - Muppathadam Jn - Elookkara - Uliyannoor Rd - NH 544	PHASE I
33	Kinder Hospital - Thrikkakara Temple Jn - Seaport Airport Rd - HMT Rd - Kalamasserry - NH 544	PHASE I
34	Kalamasserry Metro - HMT Road - HMT School - Pipeline Road - NAD Road	PHASE I
35	Pulinchodu - Hospital Jn - Pump Jn - Aluva Jn - NH 5444	PHASE I
36	Seaport Airport Road - Infopark Expy - Infopark Road - SH 41	PHASE II
37	Seaport Airport Road - Thuthiyoor Road - Palachuvadu - Padamugal - SH 41	PHASE II
38	Seaport Airport Road	PHASE II
39	Infopark Road - Smart City Road - LuLu IT Tower - MariApps - Smart City Substation	PHASE II
40	Paravoor Jn - UC Kaniyankunnu Jn - East Kadungalloor Jn - Thottakkattukara Jn - NH 544	PHASE III
41	Desom Jn - Chowara - Neduvannoor - Kaprassery - Desom	PHASE III
42	Chengamanadu - Kaprassery - Neduvannoor - Akaparambu - Athani - NH 544	PHASE III
43	Athani Jn - Chengamanadu - Panchayat Road - NH 544	PHASE III
44	Athani - Akaparambu - Nedumbassery - NH 544	PHASE III
45	Angamaly - Angamaly South - Aanappara Jn - Mallussery - Peechanikkad - SH 19	PHASE III
46	Angamaly South - Aanappara Jn - Athani Jn - Nh 544	PHASE III
47	Akaparambu - Nedumbassery - AJ Nagar - Angamaly - NH 544	PHASE III
48	Pulinchodu Metro - Nazareth Road - Manthrakkal Road - Pipeline Road - Kombara - NAD Road - SH 16	PHASE I
49	Irumpanam Junction - Chithrapuzha Road - Makalliyam Junction	PHASE III
50	Irumpanam Junction - Hill Palace Road - NH 85	PHASE III
51	SH 41 - Athani - Kollamkudimugal Road - Manathu Road - Kakkanad Jct Road	PHASE III
52	Seaport Airport Road - Manathu Road - Navodaya North - Edapally Pukkattupady Road	PHASE III
53	Seaport Airport Road - Edapally Pukkattupady Road - Kangarappady Medical College Road - HMT Road	PHASE III
54	Thripunithura - Hill Palace Rd - Karingachira Jn - Irumpanam Jn - SN Jn - East Fort Gate -	PHASE II
55	Infopark Metro - Cognizant - Member Padi Junction - Infopark Road	PHASE II

BUS FLEET AUGMENTATION

Based on the route rationalization plan, new routes 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 MoHUA norms and demand is presented in the Table below:

Fleet Requirement Over the Years

YEAR	POPULATION (in Lakhs)	EXISTING FLEET	RECOMMENDED FLEET	SCRAPPED BUSES	ADDITIONAL FLEET REQUIRED
2023	23.63	1027	1182		
2027	26.61		1331	133	437
2031	30.08		1504	150	190
2041	35.95		1798	180	324
2051	47.62		2381	238	641

INLAND WATER TRANSPORT

Inland Waterways are recommended on 3 routes in the study area and the details of the same are as presented below. This is apart from the 15 routes under implementation by KMRL.

Potential Water ways

SN	ROUTES	PHASE
1	Edakochi – Aroor – Panangad – South Paravur	PHASE III
2	Kadamakkudy – Kottapuram	PHASE III
3	Varappuzha to CIAL/ Kalady	PHASE III

PUBLIC TRANSPORT TERMINALS

It is also recommended for the de-centralization of sub-urban services for the city centre and terminate services at the peripheral terminals. This is recommended for KSRTC and City services, creating a Hub and Spoke model between major hubs and minor hubs for city and suburban services. The proposed typology of the stations is suggested in the table below along with status of the stations.

Typology of the Public Bus Terminals

SN	NAME	STATUS	TYPOLOGY	TYPE	PHASE
1.	Aluva KSRTC Stand	Existing	Terminal - City	Major	
2.	Angamaly KSRTC Stand	Existing	Terminal - Sub Urban (North)	Major	
3.	Chilavannoor	Proposed	Station	Minor	Phase II
4.	CIAL	Proposed	Station	Minor	Phase II

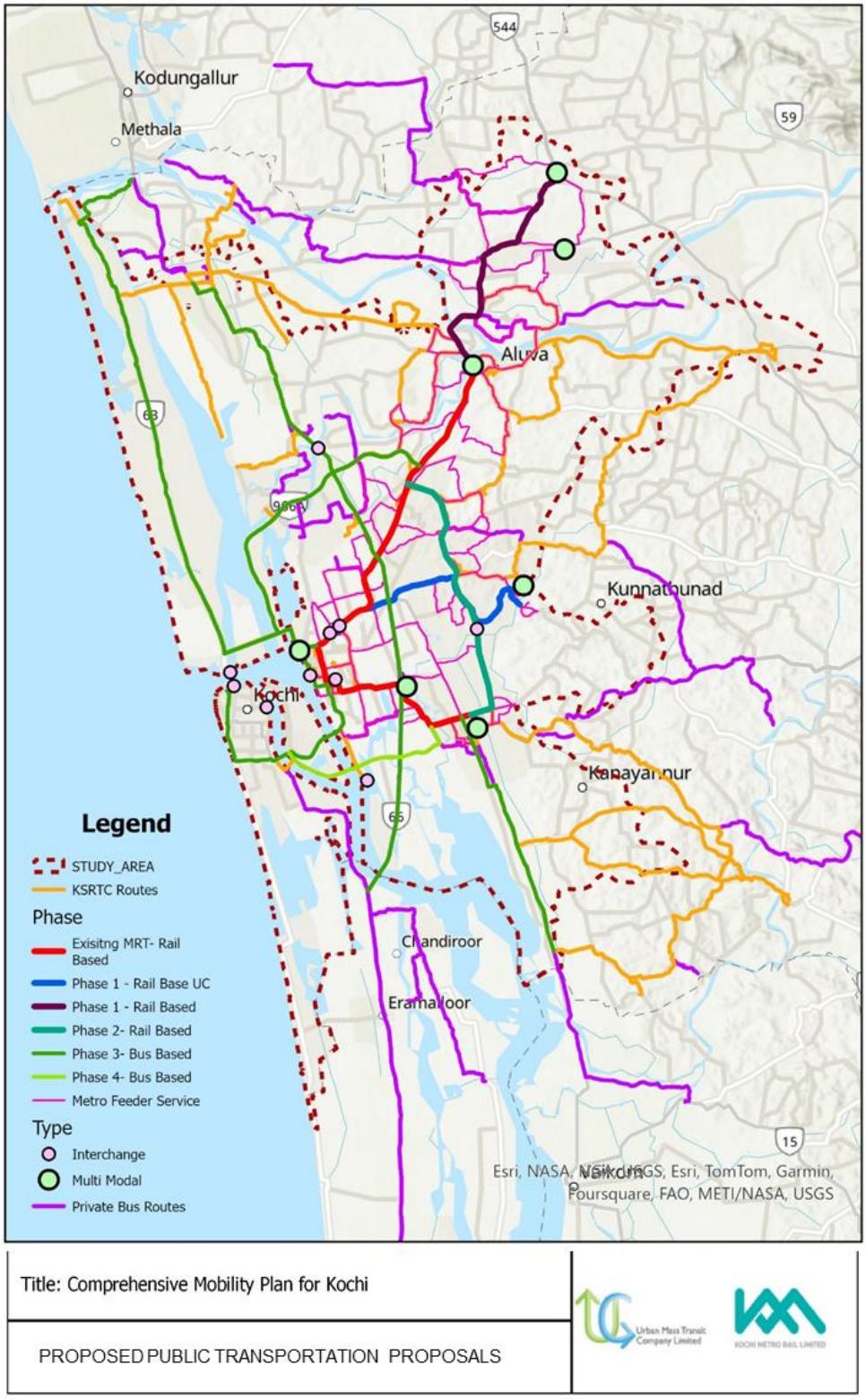
SN	NAME	STATUS	TYPOLOGY	TYPE	PHASE
5.	Edakochi	Proposed	Station	Minor	Phase II
6.	Ernakulam Boat Jetty	Existing	Station	Minor	
7.	Fort Kochi	Existing	Station	Minor	
8.	High Court	Proposed	Terminal - City	Major	Phase II
9.	Kaloor Private Bus Stand	Existing	Station	Minor	
10.	Karikkamuri KSRTC Terminal	Proposed	Terminal - City	Major	Phase II
11.	Konthuruthy	Proposed	Station	Minor	Phase II
12.	Kumbalam	Proposed	Terminal -Sub Urban (South)	Major	Phase II
13.	Mattancherry	Existing	Station	Minor	
14.	North Paravur Bus Stand	Existing	Terminal	Major	
15.	Perumbavoor KSRTC Terminal	Existing	Terminal - Sub Urban (North-East)	Major	
16.	Perumbavoor Pvt. Bus Stand	Existing	Terminal - City	Major	
17.	Perumpadappu	Proposed	Station	Minor	Phase II
18.	Puthukalavattam	Proposed	Station	Minor	Phase II
19.	Thevara Ferry	Proposed	Station	Minor	Phase II
20.	Thrikkakara Pvt. Bus Stand	Existing	Station	Major	
21.	Thripunithura Pvt. Stand	Existing	Terminal – Sub Urban (South-East)	Minor	
22.	Thripunithura Bus Terminal	Proposed	Terminal – City	Major	Phase II
23.	Vaduthala	Proposed	Station	Minor	Phase II
24.	Vyttila Mobility Hub	Existing	Terminal - Sub Urban (East)	Major	
25.	Vyttila Mobility Hub	**Extension**	Terminal - City	Major	Phase II

MULTI-MODAL MOBILITY HUBS (MMMH)

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 Hubs and integration of modes are recommended for easing out the transfers across various transit modes, minimize congestion, ensure smooth transition between modes, and reduce pollution. The details are as presented below,

Multi-modal mobility Hubs

SN	NAME	CONNECTIVITY	CATEGORY	PHASE
MULTI MODAL MOBILITY HUBS				
1.	Aluva	Bus (City & Regional) + Metro	Major	Phase II
2.	Angamaly	Metro + Bus	Major	Phase II
3.	CIAL	Metro + Air + Bus	Major	Phase II
4.	High Court	Water + Bus + Metro (Through Walkway)	Major	Phase II
5.	Thripunithura	Metro + Rail + Bus	Major	Phase II
6.	Vyttila	Metro + Water + Bus (City & Regional)	Major	Phase II (Extension)
7.	Smart City	Metro + Bus + Water	Major	Phase II
MULTI MODAL INTERCHANGE FACILITIES				
8.	Cheranallur	Water + Bus	Minor	Phase II
9.	Chittethukara	Metro + Water + Bus	Minor	Phase II
10.	Ernakulam Jetty	Water + Bus	Minor	Phase II
11.	Ernakulam South	Metro + Rail + Bus	Minor	Phase II
12.	Ernakulam Town	Metro + Rail + Bus	Minor	Phase II
13.	Fort Kochi	Water + Bus (City) + Ro-Ro	Minor	Phase II
14.	Kaloor	Bus (City) + Metro	Minor	Phase II
15.	Mattancherry	Water + Bus	Minor	Phase II
16.	Thevara	Water + Bus	Minor	Phase II
17.	Vypin	Water + Bus	Minor	Phase II



Proposed Public Transport Network Transitions

Proposed Public Transport Network Transitions

INTERMEDIATE PUBLIC TRANSPORT STRATEGY

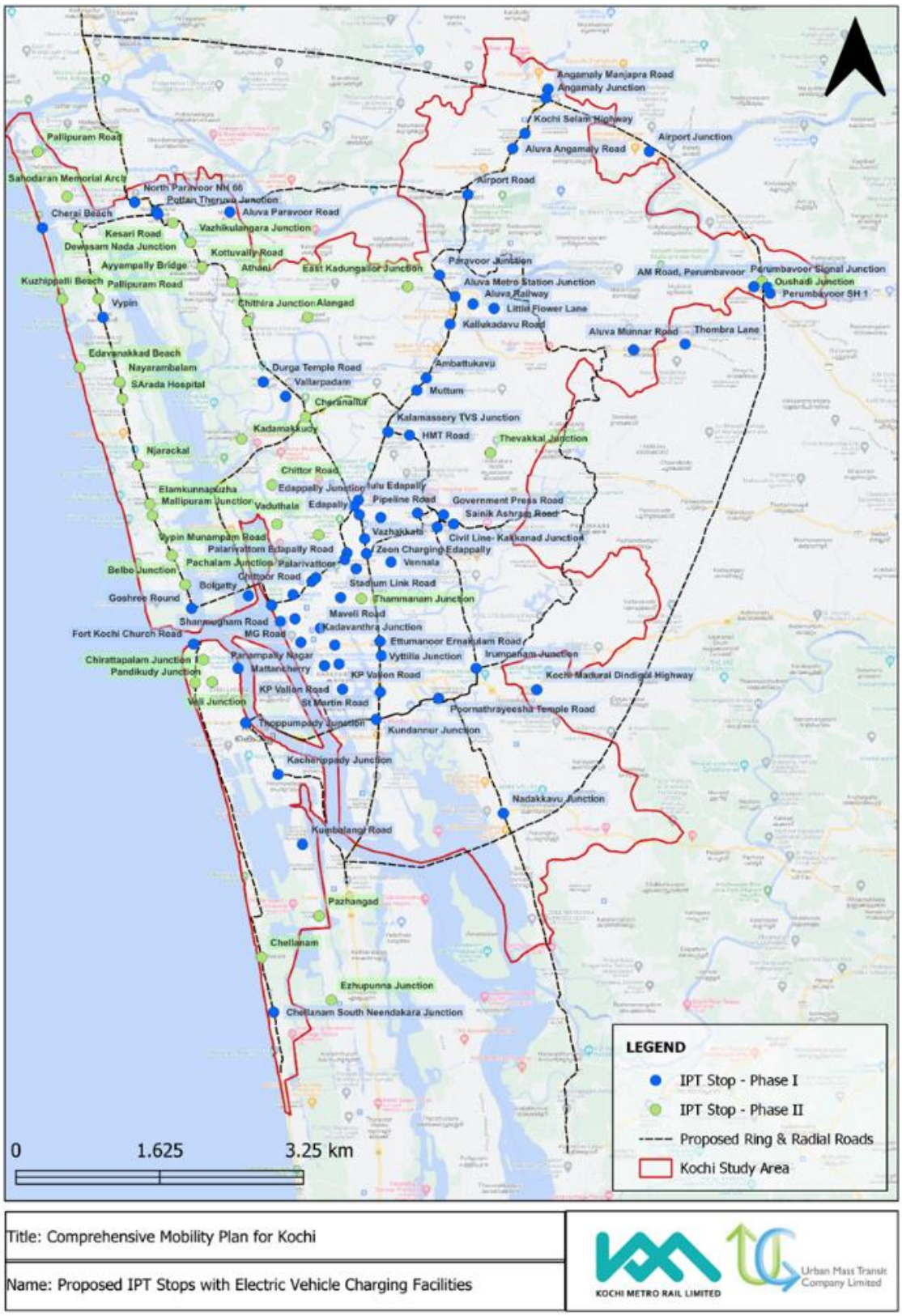
The study recommends provision of infrastructure facilities for the operation of IPT. The allocation of IPT will be governed by Corporation or ULB or Smart City in ordination with RTA and Traffic Police Departments. Currently, 105 e-autos are acting as feeder services in the study area, 75 e-autos being owned by KMRL and 30 by Ernakulam Jilla Auto Rickshaw Drivers Cooperative Society (EJADCS). 15 charging points are provided by KMRL across 5 locations viz., Aluva, Kalamasserry, Kaloor, Edapally and Vyttila. The infrastructure facilities shall include, Halt and Go Stops along with charging facilities. These are recommended at all the major activity nodes with considerable distance from the bus-stands and a minimum distance of 250m from the junctions to avoid chaos. 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 for Three-seater auto rickshaw.

S N	NAME	CHARGING SLOTS (No.)	PHASE
1	HMT Road	3	PHASE I
2	Vazhakulam	3	PHASE I
3	Sainik Ashram Road	3	PHASE I
4	Pipeline Road	5	PHASE I
5	Palarivattom	8	PHASE I
6	Pipeline Road	8	PHASE I
7	Stadium Link Road	8	PHASE I
8	Vennala	3	PHASE I
9	Ettumanur Ernakulam Road	5	PHASE I
10	KP Vallon Road	3	PHASE I
11	Government Press Road	3	PHASE I
12	Edapally	5	PHASE I
13	Zeon Charging Edapally	3	PHASE I
14	Palarivattom Edapally Road	8	PHASE I
15	Chittoor Road	5	PHASE I
16	MG Road	5	PHASE I
17	Panampally Nagar	8	PHASE I
18	Banerjee Road	5	PHASE I
19	Maveli Road	3	PHASE I
20	Poornathrayeesa Temple Road	3	PHASE I
21	St Martin Road	3	PHASE I
22	KP Vallon Road	3	PHASE I
23	Kochi Madurai Dindigul Highway	3	PHASE I
24	Kumbalangi Road	5	PHASE I
25	Bolgatty	5	PHASE I
26	Shanmugham Road	5	PHASE I

S N	NAME	CHARGING SLOTS (No.)	PHASE
27	lulu Edapally	8	PHASE I
28	Aluva Munnar Road	3	PHASE I
29	Perumbavoor SH 1	8	PHASE I
30	Kallukadavu Road	3	PHASE I
31	Muttom	3	PHASE I
32	North Paravoor NH 66	3	PHASE I
33	NH 66 Paravoothara	3	PHASE I
34	Aluva Paravoor Road	3	PHASE I
35	Durga Temple Road	5	PHASE I
36	Ambattukavu	5	PHASE I
37	Little Flower Lane	5	PHASE I
38	Aluva Angamaly Road	5	PHASE I
39	Angamaly Manjapra Road	5	PHASE I
40	Thombra Lane	5	PHASE I
41	Kochi Selam Highway	3	PHASE I
42	Thevakkal Junction	3	PHASE II
43	Pallipuram Road	5	PHASE II
44	Sahodaran Memorial Arch	5	PHASE II
45	Cherai Beach	5	PHASE I
46	Oushadhi Junction	3	PHASE II
47	Kundannur Junction	5	PHASE I
48	Vyttila Junction	10	PHASE I
49	AM Road	5	PHASE I
50	Edapally Junction	10	PHASE I
51	Palarivattom Junction	5	PHASE I
52	High Court Signal Junction	8	PHASE I
53	Goshree Round	8	PHASE I
54	Kadavanthra Junction	13	PHASE I
55	Kacherippady Junction	8	PHASE I
56	Chellanam South Neendakara Junction	8	PHASE I
57	Jose Junction	8	PHASE I
58	Thoppumpady Junction	5	PHASE I
59	Pottan Theruvu Junction	8	PHASE I
60	Angamaly Junction	8	PHASE I
61	Aluva Metro Station Junction	5	PHASE I
62	Perumbavoor Signal Junction	8	PHASE I
63	Kaloor Junction	10	PHASE I
64	Irumpanam Junction	3	PHASE I
65	Civil Line- Kakkanad Junction	8	PHASE I
66	Kalamasserry TVS Junction	3	PHASE I
67	Airport Road	5	PHASE I

S N	NAME	CHARGING SLOTS (No.)	PHASE
68	Airport Junction	8	PHASE I
69	Nadakkavu Junction	3	PHASE I
70	Cheranallur	8	PHASE II
71	Athani	3	PHASE II
72	Kesari Road	8	PHASE II
73	Vazhikulangara Junction	3	PHASE II
74	Kottuvally Road	8	PHASE II
75	Pallipuram Road	8	PHASE II
76	Ayyampally Bridge	3	PHASE II
77	Dewasam Nada Junction	3	PHASE II
78	Kuzhuppilly Beach	3	PHASE II
79	Vypin	3	PHASE I
80	Edavanakkad Beach	3	PHASE II
81	Nayarambalam	5	PHASE II
82	Sarada Hospital	3	PHASE II
83	Njarackal	5	PHASE II
84	Elamkunnapuzha	3	PHASE II
85	Mallipuram Junction	3	PHASE II
86	Vypin Munambam Road	3	PHASE II
87	Belbo Junction	3	PHASE II
88	Pachalam Junction	5	PHASE II
89	Vaduthala	3	PHASE II
90	Chittoor Road	5	PHASE II
91	Kadamakkudy	3	PHASE II
92	Vallarpadam	5	PHASE I
93	Chithira Junction	5	PHASE II
94	Alangad	3	PHASE II
95	Paravoor Junction	3	PHASE I
96	Fort Kochi Church Road	3	PHASE I
97	Chirattapalam Junction	3	PHASE II
98	Veli Junction	3	PHASE II
99	Pandikudy Junction	5	PHASE II
100	Mattancherry Ferry	5	PHASE I
101	Aluva Railway	10	PHASE I
102	East Kadungallur Junction	3	PHASE II
103	Pazhangad	3	PHASE II
104	Ezhupunna Junction	3	PHASE II
105	Chellanam	3	PHASE II
106	Keerthi Nagar Junction	3	PHASE II



Proposed Halt and Go Stops with Electric Vehicle charging facilities.

The average trip length being under 8 for auto rickshaws it is advised to promote the usage of electric vehicles. These battery-operated vehicles 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. 106 locations are recommended, though a detail assessment could be carryout while implementation.

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 492 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 4.6 Km of pedestrian priority streets where pedestrian, NMT and public transport only allowed during the peak periods. The streets identified are the major corridors at Fort Kochi area and core city with high commercial and recreational 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 Kochi core city by the development agency. The details of the network recommended for improvement is as presented below.

Corridors with Proposed Footpath

SN	Name	Length (Km)	Min. Footpath Width (M)
1.	AG Milne Road	0.84	3
2.	Airport Road	8.36	2
3.	AK Xavier Road	0.46	2
4.	Aluva - Perumbavoor Road	13.02	2
5.	Aluva - Pukkattupady Road	4.25	2
6.	Amalabhavan Road	0.94	2
7.	Amaravati Road	1.84	2
8.	Andamkulam - Kochangadi Road	0.94	2
9.	Anjumana Road	1.14	2
10.	Aroor - Thoppumpady Road	6.36	2
11.	Aryad Athipozhi Road	1.48	2
12.	Banerji Road	6.72	2.5
13.	Bastian Street	0.26	2
14.	Bazaar Road	1.89	2
15.	Bellar Road	0.29	2
16.	Bishop Kureethara Road	1.24	2

SN	Name	Length (Km)	Min. Footpath Width (M)
17.	Bristow Road	3.69	3
18.	Chathanad Road	9.76	2
19.	Cheralai Road	1.42	2
20.	Cheranallur Road	1.39	2
21.	Chilavannur Road	1.66	2
22.	Chithrapuzha - Karimughal Road	7.69	2
23.	Chithrapuzha - Ponjassery Road	1.18	2
24.	Chullickal Road	0.44	2
25.	Church Road	0.76	2
26.	Edapally - Thrikkakara Road	3.43	2
27.	Edayaar - Kadungalloor Road	8.01	2
28.	Elanjikkal Lane	0.37	2
29.	Fathima Church Road	1.14	2
30.	Goshree Road	3.41	2
31.	Hill Palace Road	3.36	2
32.	Hospital Road	0.67	2.5
33.	IAC Road	4.43	2
34.	Indira Gandhi Road	3.98	3
35.	Infopark Road	7.59	2
36.	Janatha Road	0.27	2
37.	Kadamakkudy Road	3.93	2
38.	Kalabhavan Road	0.76	2.5
39.	Kalamasserry - Thorappu Road	5.71	2
40.	Karippalam Road	0.84	2
41.	KB Jacob Road	1.93	2
42.	Kizhavana Road	0.47	2
43.	KJ Herschel Road	3.59	2
44.	Kochery Road	0.48	2
45.	Kumaranasan Road	0.69	2
46.	Kumbalangi Road	7.50	2
47.	Mahakavi Vailoppilli Road	4.15	2
48.	Mahatma Gandhi Road	5.45	3
49.	Manikathu Road	1.08	2
50.	Manjummel Road	2.99	2
51.	Manthra Road	1.75	2
52.	Meisthirippady - Eramam Road	6.52	2
53.	Mohammad Abdul Rahman Road	1.01	2
54.	Moulana Azad Road	2.98	2
55.	Mulanthuruthy - Arakkunnam Road	9.05	2
56.	Mundamveli Road	1.36	2
57.	NAD Road	8.26	2
58.	Nazareth Road	0.71	2
59.	NH 544	25.01	2.5

SN	Name	Length (Km)	Min. Footpath Width (M)
60.	NH 66	37.63	2
61.	NH 85	9.53	2
62.	NH 966 B	5.90	3
63.	NH 966A	15.02	2
64.	Old NH 47	2.57	3
65.	Panampally Nagar Avenue	1.21	2
66.	Panangad Road	3.67	2
67.	Park Avenue	0.31	2.5
68.	Pattarupadam Road	2.81	2
69.	Pottakuzhi - Mamangalam Road	1.73	2
70.	Pottakuzhy Road	0.86	2
71.	Poysha Road	1.89	2
72.	Pullupalam Road	0.86	2
73.	Puthenpally - Chennur Road	4.49	2
74.	Ravipuram - Kothad Road	11.63	2
75.	Republic Road	3.72	2
76.	S Chittoor Road	2.56	2
77.	S Moolankuzhi Road	0.51	2
78.	Sahodaran Ayyappan Road	3.49	2.5
79.	Santo Gopalan Road	1.38	2
80.	Seaport - Airport Road	11.35	2
81.	SH 1	7.68	2
82.	SH 15	19.30	2.5
83.	SH 16	12.81	2
84.	SH 41	8.88	2
85.	SH 63	22.59	2
86.	SH 66	22.24	2
87.	Shanmugham Road	7.72	2
88.	Shihab Thangal Road	0.51	2
89.	SRM Road	2.52	2
90.	St. Francis Church Road	0.40	2
91.	Stadium Link Road	2.53	2
92.	Statue Road	0.45	2
93.	Swami Vivekananda Road	2.28	2.5
94.	Tank Bund Road	1.11	2
95.	Thammanam - Pullepady Road	3.89	2
96.	Thevara - Edapally Road	11.87	2
97.	Thuthiyoor - Eroor Road	8.25	2
98.	Tower Road	0.28	2
99.	Town Hall Road	0.64	2
100	Thrikkakara - Pukkattupady Road	7.35	2
101	University Road	2.30	2
102	Vadakkumbhagom - Marampally Road	7.74	2

Proposed Pedestrian Priority Streets

SN	NAME	LENGTH (KM)
1	Veli Road	0.90
2	Basin Road	0.45
3	Broadway	0.89
4	Burger Street	0.18
5	Jew Town Road	0.86
6	Princess Street	0.29
7	Quiros Street	0.34
8	River Road	0.51
9	Rose Street	0.18

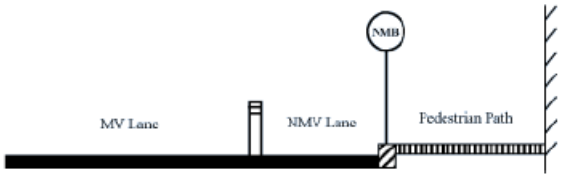
BICYCLE NETWORK

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 287 Km of shared and dedicated bicycle network. As per the MoHUA guidelines, 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 for roads having width 18m & more and 12m to 18m respectively, based on site assessment.

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 Kochi. Non-Motorized Vehicles (NMV) lanes can generally be classified into four main categories and are listed below. In case of Kochi, Non-Motorized Vehicles (NMV) lane typologies 1, 2 and 4 are suggested.

Types of NMV Lanes

SN	Type of NMV Lane	Cross Section
1	NMV lanes shared with MVs and designated by signs	

SN	Type of NMV Lane	Cross Section
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

SN	NAME	LENGTH	TYPOLOGY
1	AG Milne Road	0.84	1
2	AK Xavier Road	0.46	1
3	Amalabhavan Road	0.94	1
4	Amaravati Road	1.84	1
5	Andamkulam - Kochangadi Road	0.94	1
6	Anjumana Road	1.14	1
7	Aroor - Thoppumpady Road	6.36	1
8	Aryad Athipozhi Road	1.48	1
9	Banerji Road	6.72	2
10	Basin Road	0.45	4
11	Bastian Street	0.26	1

SN	NAME	LENGTH	TYPOLOGY
12	Bazaar Road	1.89	1
13	Bellar Road	0.29	1
14	Bishop Kureethara Road	1.24	1
15	Bristow Road	3.69	1
16	Broadway	0.89	4
17	Burger Street	0.18	4
18	Cheralai Road	1.42	1
19	Cheranallur Road	1.39	1
20	Chilavannur Road	1.66	1
21	Chullickal Road	0.44	1
22	Church Road	0.76	1
23	Elanjikkal Lane	0.37	1
24	Fathima Church Road	1.14	1
25	Goshree Road	3.41	2
26	Hospital Road	0.67	1
27	Indira Gandhi Road	3.98	1
28	Janatha Road	0.27	1
29	Jew Town Road	0.86	4
30	Kalabhavan Road	0.76	1
31	Karippalam Road	0.84	1
32	KB Jacob Road	1.93	1
33	Kizhavana Road	0.47	1
34	KJ Herschel Road	3.59	1
35	Kochery Road	0.48	1
36	Kumaranasan Road	0.69	1
37	Kumbalangi Road	7.50	1
38	Mahakavi Vailoppilli Road	4.15	1
39	Mahatma Gandhi Road	5.45	2
40	Manikathu Road	1.08	1

SN	NAME	LENGTH	TYPOLOGY
41	Manthra Road	1.75	1
42	Mohammad Abdul Rahman Road	1.01	1
43	Moulana Azad Road	2.98	1
44	Mundamveli Road	1.36	1
45	Nazareth Road	0.71	1
46	NH 544	25.01	1
47	NH 66	37.63	2
48	NH 85	9.53	2
49	NH 966 B	5.90	2
50	NH 966A	15.02	2
51	Old NH 47	2.57	2
52	Panampally Nagar Avenue	1.21	2
53	Park Avenue	0.31	2
54	Pattarupadam Road	2.81	1
55	Pottakuzhi - Mamangalam Road	1.73	1
56	Pottakuzhy Road	0.86	1
57	Poysha Road	1.89	1
58	Princess Street	0.29	4
59	Pullupalam Road	0.86	1
60	Quiros Street	0.34	4
61	Ravipuram - Kothad Road	11.63	1
62	River Road	0.51	4
63	Rose Street	0.18	4
64	S Chittoor Road	2.56	1
65	S Moolankuzhi Road	0.51	1
66	Sahodaran Ayyappan Road	3.49	1
67	Santo Gopalan Road	1.38	1
68	SH 15	19.30	1
69	SH 63	22.59	1

SN	NAME	LENGTH	TYPOLOGY
70	Shanmugham Road	7.72	2
71	Shihab Thangal Road	0.51	2
72	SRM Road	2.52	1
73	St. Francis Church Road	0.40	1
74	Stadium Link Road	2.53	2
75	Statue Road	0.45	1
76	Swami Vivekananda Road	2.28	1
77	Tank Bund Road	1.11	1
78	Thammanam - Pullepady Road	3.89	1
79	Thevara - Edapally Road	11.87	1
80	Tower Road	0.28	1
81	Town Hall Road	0.64	1
82	Veli Road	0.90	1
83	SH 66	2.63	1

DEVELOPMENT OF RECREATIONAL BICYCLE CIRCUIT

To encourage the bicycle culture and induce it in the lifestyle of people in the city, it is proposed to develop bicycle circuit. This will help to promote healthy lifestyle and create a bicycling culture in the city. Thus, to attract more people into the same, two bicycle circuits have been proposed under recreational bicycle circuit with a total length of 22 Km.

The recreational bicycle circuits are proposed at the areas with most attractions, Fort Kochi area and Marine Drive. These two circuits connect Fort Kochi Beach, Jawahar Park, Mattancherry Palace, Kerala Folklore Museum, Mangalavanam Bird Sanctuary, Queens Way, Mangroves etc.

Similar bicycle friendly plans are proposed to be developed connecting heritage spots in Mattancherry, Wellington Island, North Paravur, Marine Drive along backwaters and beaches of Kadamakkudy, Vypin, Kuzhuppilly, Njarackal, Cherai, Munambam, Chellanam, Kumbalangi, Panangad etc. Bicycle infrastructure improvements is recommended along the circuit as mentioned in the above network improvement proposal to facilitate cyclists to enjoy a traffic-free heritage ride (Similar to the initiatives at Shihab Thangal Road, Panampally Nagar, Kochi).

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 **Thevara, Fort Kochi, Thripunithura, Nayarambalam North Paravur and Mattancherry.** 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

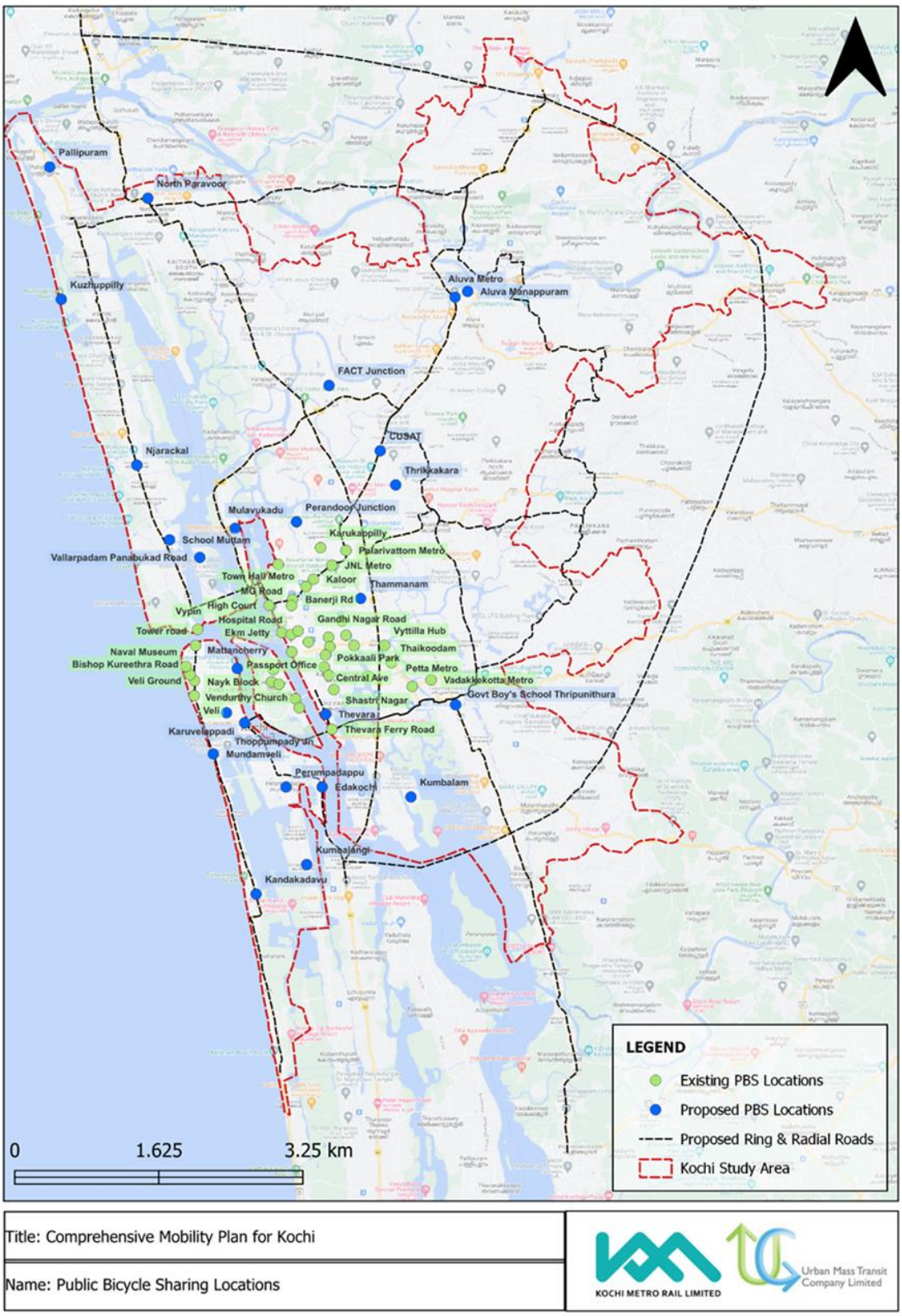
NMT priority streets prioritize people and are typically most appropriate in corridors with commercial activity on both edges of the street such as River Road, Broadway, Basin Road, Town Road, Heritage Roads, etc. NMT priority street for Kochi are strategically selected streets in which pedestrian volume 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. At Fort Kochi, it is recommended to develop about 4.6 Km as NMT priority streets where pedestrian and bicyclist movement is only allowed during the peak periods.

Recommended NMT Priority Streets

SN	NAME	LENGTH (KM)
1	Veli Road	0.90
2	Basin Road	0.45
3	Broadway	0.89
4	Burger Street	0.18
5	Jew Town Road	0.86
6	Princess Street	0.29
7	Quiros Street	0.34
8	River Road	0.51
9	Rose Street	0.18

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. Proposed locations are tabulated along below.



PBS Locations

Proposed PBS Locations

SN	LOCATION	PBS TYPE	CYCLES PER STATION
1	Venduruthy Bridge	Low	10
2	Venduruthy Church	Low	10
3	Naval Base Parade Ground	Low	10
4	Thevara Ferry Road	Low	10
5	Nayk Block	Low	10
6	Vidyut Block	Low	10
7	Shastri Nagar	Low	10
8	Central Ave	Low	10
9	Passport Office	Low	10
10	Goshree Chathiyath Road	Low	10
11	Karukappilly	Low	10
12	Palarivattom Metro	Low	10
13	JNL Metro	Low	10
14	Kaloor	Low	10
15	Town Hall Metro	Low	10
16	Banerji Rd	Low	10
17	High Court	Low	10
18	MG Road	Low	10
19	Ernakulam Jetty	Low	10
20	Hospital Road	Low	10
21	Foreshore Road	Low	10
22	Maharajas College	Low	10
23	Ernakulam Junction	Low	10
24	Fathima Church Road	Low	10
25	Elamkulam	Low	10
26	Gandhi Nagar Road	Low	10

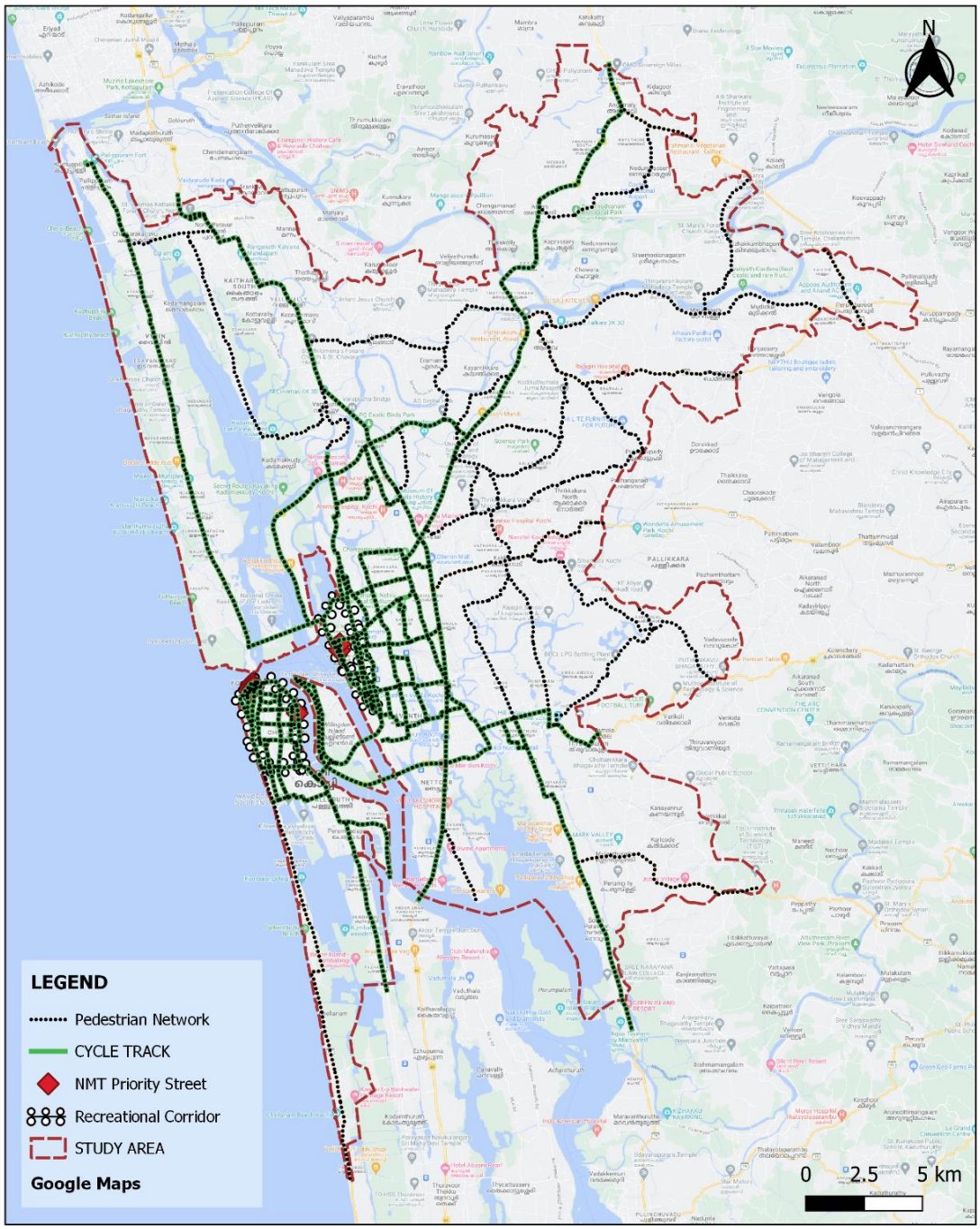
SN	LOCATION	PBS TYPE	CYCLES PER STATION
27	Kadavanthra Metro	Low	10
28	Elamkulam	Low	10
29	Vyttila Hub	Low	10
30	Thaikoodam	Low	10
31	Petta Metro	Low	10
32	Vadakkekotta Metro	Low	10
33	Pokkaali Park	Low	10
34	Panampally Nagar Central Park	Low	10
35	Veli	Low	10
36	Veli Ground	Low	10
37	Bishop Kureethara Road	Low	10
38	Naval Museum	Low	10
39	Tower road	Low	10
40	Vypin	Low	10
41	Thoppumpady Jn	Low	10
42	North Paravoor	Medium	15
43	FACT Junction	Medium	15
44	Aluva Metro	Medium	15
45	Aluva Manappuram	Medium	15
46	Govt Boy's School Thripunithura	Medium	15
47	Thevara	Medium	15
48	Thammanam	Medium	15
49	Perandoor Junction	Medium	15
50	Pallipuram	Medium	15
51	Kuzhuppilly	Medium	15
52	Kumbalangi	High	25
53	Kandakadavu	Medium	15

SN	LOCATION	PBS TYPE	CYCLES PER STATION
54	Perumpadappu	Medium	15
55	Edakochi	Medium	15
56	Kumbalam	Medium	15
57	Njarackal	Medium	15
58	School Muttam	Medium	15
59	Vallarpadam Panambukad Road	Medium	15
60	Mulavukadu	Medium	15
61	Mundamveli	Medium	15
62	Karuvelappadi	Medium	15
63	Mattancherry	Medium	15
64	CUSAT	High	25
65	Thrikkakara	High	25

NON-MOTORISED TRANSPORT OUT-REACH PROGRAM

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. 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.



Title: Comprehensive Mobility Plan for Kochi	
Map: NMT Network	

Proposed NMT Network

TRAFFIC PARKS

Traffic Training Parks or Traffic Parks are places where children can learn about traffic rules, signage, and road safety. They are also known as transportation parks, traffic gardens, or safety villages. These facilities are designed to teach children, about road safety and traffic rules in a controlled and interactive environment. Typically equipped with miniature streets, road signs, traffic signals, and various vehicles such as bicycles, pedal cars, and sometimes even small electric cars. It is recommended to encourage Traffic Parks in coordination with the RTO offices in the study area. Such parks would assist in instilling road safety awareness and skills in individuals, particularly children, who are vulnerable road users.

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.

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

SN	NAME	PHASE
1	Angamaly Jn.	PHASE II
2	Aluva Metro Station Jn.	PHASE I
3	Athani Jn., Aluva	PHASE II
4	Athani Jn., Kakkanad	PHASE II
5	Atlantis Jn.	PHASE I
6	BOT Bridge	PHASE I
7	CIFT Jn.	PHASE I
8	Companypady	PHASE II
9	CPT Jn.	PHASE I
10	Desom	PHASE II
11	Edapally	PHASE I
12	Elamkulam	PHASE I
13	GCDA Jn.	PHASE I
14	Goshree Jn.	PHASE I
15	High Court Jn.	PHASE I
16	Hill Palace	PHASE II
17	HMT Jn. 2	PHASE II
18	Hospital Jn.	PHASE I

SN	NAME	PHASE
19	IMG Jn.	PHASE II
20	Infopark Gate Jn.	PHASE II
21	Irumpanam Jn.	PHASE II
22	Jose Jn.	PHASE I
23	Judges Avenue Jn.	PHASE II
24	Kacherippady Jn.	PHASE I
25	Kadavanthra Jn.	PHASE I
26	Kakkanad Jn.	PHASE II
27	Kalamasserry TVS Jn.	PHASE II
28	Kaloor Jn.	PHASE I
29	Kannankulangara	PHASE II
30	Karingachira	PHASE II
31	Kathrikadavu	PHASE I
32	Kundannur Jn.	PHASE II
33	Kumaranasan	PHASE I
34	Kunnumpuram	PHASE I
35	Madavana Jn.	PHASE II
36	Madhava Pharmacy	PHASE I

SN	NAME	PHASE
37	Mavelipuram Signal Jn.	PHASE II
38	Mini Bypass Jn., Maradu	PHASE I
39	Nettoor Jn.	PHASE II
40	Pachalam Jn.	PHASE I
41	Palarivattom Bypass Jn.	PHASE I
42	Palarivattom Circle	PHASE I
43	Paramara Jn.	PHASE I
44	Paravoor Jn.	PHASE II
45	Parippu	PHASE I
46	Pettah Jn.	PHASE I
47	Perumbavoor Jn.	PHASE II
48	Potten Theruv Jn.	PHASE I
49	PT Jacob Jn.	PHASE I

SN	NAME	PHASE
50	Pump Jn., Aluva	PHASE II
51	Puthiyakavu	PHASE II
52	Pyary Jn.	PHASE I
53	Ravipuram Jn.	PHASE I
54	Samskara Jn.	PHASE I
55	SN Jn.	PHASE I
56	Subhash Chandra Bose Jn.	PHASE I
57	Thammanam	PHASE I
58	Thevara Jn.	PHASE I
59	Thiruvankulam	PHASE II
60	Thoppumpady	PHASE I
61	Vallathol Jn.	PHASE II
62	Vyttila Jn.	PHASE I

Geometric improvements and signalization serve only for short term duration. The traffic level at few crucial junctions crossed or is close to the 10000 PCU mark during peak hours, viz., Aluva, Vyttila, Edapally, Palarivattom Bypass junctions. Considering the recent construction of flyovers in these locations, additional flyovers are not recommended at these junctions.

Improvements Proposed at Identified Junctions

SN	NAME	TYPOLOGY
1	Angamaly Jn.	Design
2	Aluva Metro Station Jn.	Design & Signal
3	Athani Jn., Aluva	Design & Signal
4	Athani Jn., Kakkanad	Design
5	Atlantis Jn.	Design & Signal
6	BOT Bridge	Design
7	CIFT Jn.	Design & Signal
8	Companypady	Design & Signal
9	CPT Jn.	Design
10	Desom	Design & Signal
11	Edapally	Signal
12	Elamkulam	Design & Signal
13	GCDA Jn.	Design & Signal

SN	NAME	TYPOLOGY
14	Goshree Jn.	Signal
15	High Court Jn.	Signalized
16	Hill Palace	Design & Signal
17	HMT Jn. 2	Design & Signal
18	Hospital Jn.	Design
19	IMG Jn.	Design & Signal
20	Infopark Gate Jn.	Design
21	Irumpanam Jn.	Design & Signal
22	Jose Jn.	Design
23	Judges Avenue Jn.	Design
24	Kacherippady Jn.	Design
25	Kadavanthra Jn.	Design & Signal
26	Kakkanad Jn.	Design & Signal
27	Kalamasserry TVS Jn.	Design & Signal

SN	NAME	TYPOLOGY
28	Kaloor Jn.	Design & Signal
29	Kannankulangara	Design
30	Karingachira	Design & Signal
31	Kathrikadavu	Design & Signal
32	Kundannur Jn.	Design & Signal
33	Kumaranasan	Design & Signal
34	Kunnumpuram	Design & Signal
35	Madavana Jn.	Design & Signal
36	Madhava Pharmacy	Signal
37	Mavelipuram Signal Jn.	Design & Signal
38	Mini Bypass Jn., Maradu	Design & Signal
39	Nettoor Jn.	Design & Signal
40	Pachalam Jn.	Design
41	Palarivattom Bypass Jn.	Design & Signal
42	Palarivattom Circle	Design & Signal
43	Paramara Jn.	Design & Signal
44	Paravoor Jn.	Design

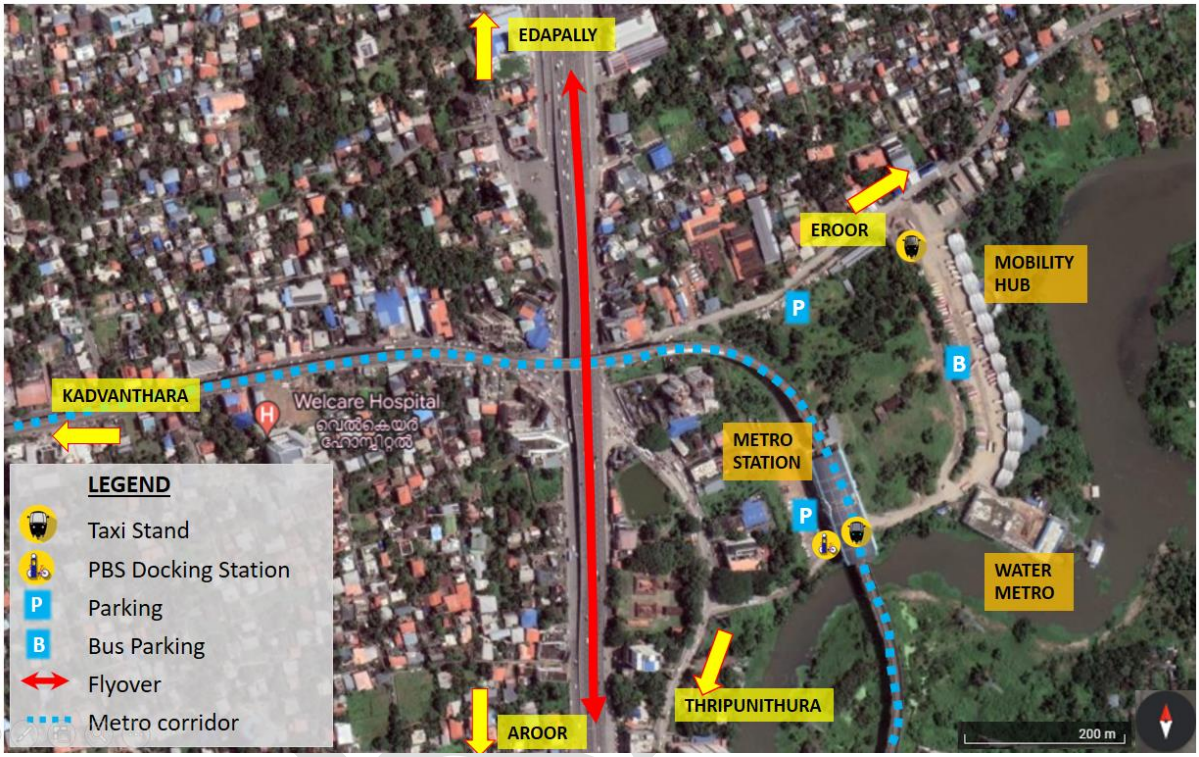
SN	NAME	TYPOLOGY
45	Parippu	Design
46	Pettah Jn., Maradu	Design & Signal
47	Perumbavoor Jn.	Design
48	Potten Theruv Jn.	Design & Signal
49	PT Jacob Jn.	Design & Signal
50	Pump Jn., Aluva	Design & Signal
51	Puthiyakvu	Design
52	Pyary Jn.	Design & Signal
53	Ravipuram Jn.	Design
54	Samskara Jn.	Design
55	SN Jn.	Design & Signal
56	Subhash Chandra Bose Jn.	Design & Signal
57	Thammanam	Design & Signal
58	Thevara Jn.	Design & Signal
59	Thiruvankulam	Design & Signal
60	Thoppumpady	Design & Signal
61	Vallathol Jn.	Design & Signal
62	Vyttila Jn.	Design & Signal

AREA IMPROVEMENT PLAN

VYTTILA JUNCTION AND VYTTILA MOBILITY HUB

Vyttila Junction is a major node and serves as a focal point in the transport network of Kochi city. Over the past two decades, with the rapid growth of the city towards the eastern and northeastern direction, the junction which was once part of the NH Bypass has transformed into an integral part of the city. It is surrounded by commercial establishments, shopping centres, multi-storeyed residential units, restaurants, and offices, which contribute to its vibrant and bustling atmosphere. One of the busiest intersections in the city, it connects NH 66, Sahodaran Ayyappan (SA) Road and SH 15. Apart from these, roads viz., Mahakavi Vailoppilli road is a crucial link to Palarivattom via Thammanam and Vyttila- Mathoor road to the residential suburb of Eroor.

As per the primary surveys, the six-lane flyover caters to 40% of the total traffic at the junction. Also 67% of the junction comprises of east – west and north- south movement. The junction has good amount of pedestrian activity as well. It is observed that during morning peak it handles 5150 pedestrians along and across the junction. Indicating high volume of pedestrian activity, whereas it needs mention that the location lacks any kind of sidewalk while the crossing facility is not pedestrian friendly. Existing major road networks and nodes are shown below.



Satellite Imagery of Vyttila Junction and Vyttila Mobility Hub along with major roads and development.

Suggested immediate improvement measures at Vyttila Junction and Mobility Hub are:

1. Review the feasibility of widening the underpass near the ROB along with the development of service roads to channelize the traffic from SA Road through the underpass along with the traffic from the Thammanam direction.
2. Pedestrian infrastructure development along the sidewalks and at grade crossing facilities with user friendly refuge islands as well as lane markings at the junction.
3. Opening the bottle neck at the entry point of Vyttila-Mathoor road by providing a flare to facilitate the left turning movement and channelizing the traffic from Eroor direction and restrict two-way traffic at the entry. Diversion of traffic from Eroor through hub to SH-15.
4. Skywalk connecting the Metro Station to the Water Metro Terminal.
5. Well-lit pedestrian network to channelize the pedestrian movement in and around the hub with crossing facilities, refuge islands as well as lane markings as appropriate.

6. Provision for MLCP to accommodate the parking demand at the Hub and Metro Station
7. Segregation of city and mofussil bus services.
8. Urban place making to improve the aesthetics of the area.
9. Passenger information system, way finding signage and information kiosks at strategic points.

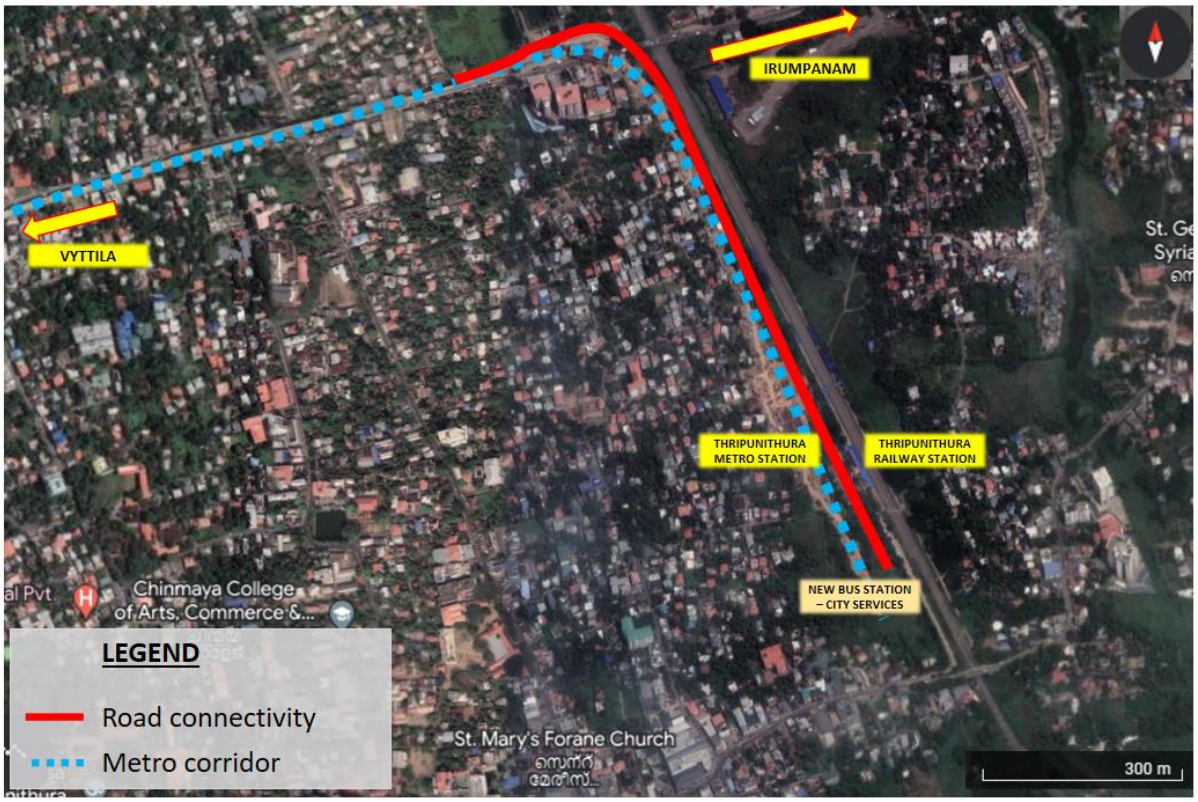
Conceptual Plan of suggested improvement measures at Vyttila Junction and Vyttila Mobility Hub

To mitigate the congestion at Vyttila, the draft Master Plan has recommended a detailed town planning scheme for the area, including the feasibility of a flyover in the east west direction. Along with the above-mentioned measures, implementation of traffic signal optimization strategies, infrastructure improvements and traffic management strategies are required after evaluating the detailed plan to effectively address the congestion and ensure smooth traffic flow at the junction. The goal is to create a more efficient and user-friendly transportation hub while ensuring the smooth flow of traffic and enhancing the overall travel experience for commuters.

THRIPUNITHURA MULTIMODAL CONNECTIVITY

Thripunithura Railway Station located on the Ernakulam – Kottayam rail route caters to the residential community in the vicinity and is the nearest railway node for travellers from the eastern part of Ernakulam and Idukki district, which has no rail connectivity. Passenger services provide connectivity to within the state while Express trains provide regional connectivity to Chennai, Bengaluru, Kanyakumari etc. The extension of the metro corridor from SN Junction to Thripunithura Railway Station is expected to finish shortly. This has opened possibility of a critical

road connection to the Railway Station, which otherwise had a narrow access from the southern end and smaller streets. It is suggested to also extend city bus services to the vicinity by providing a Minibus Station, to reduce the dependency on private vehicles & enhance intermodal connectivity.



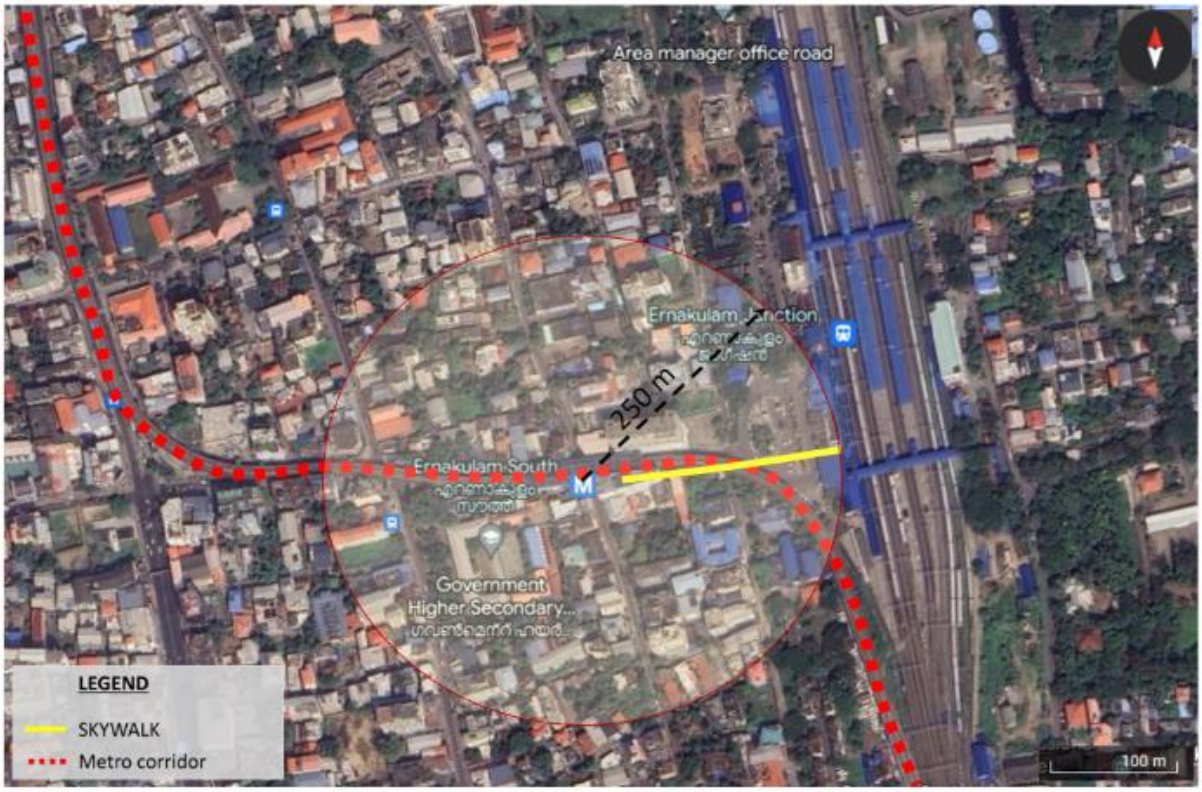
Proposals at Thripunithura Railway Station Area

SKYWALK AT ERNAKULAM SOUTH RAILWAY STATION

The CBD area in Kochi has two major railway stations viz., Ernakulam South and Ernakulam North Railway Station. These being in the city centre has thick urban developments in the vicinity leading to space constraints for widening of the RoW. The existing metro corridor from Aluva to SN Junction has Ernakulam South metro station falling within the 300 m radii of the railway stations.

This transfer which ideally is a mere distance of 250 m becomes lengthier in terms of time and distance considering the egress from metro, walk to the metro exist point and further across the street to the railway station. Further the connectivity to the station at the ground level has considerable conflict points due to the vehicular movements, on-street parking, as well as luggage movements etc. Preparation of detailed station improvement plan is recommended for the railway station to ensure dedicated NMT facilities, channelized vehicular movements and organized parking facilities. To reduce the travel time and distance as well as to provide seamless integration

it is suggested to provide skywalk connectivity form the concourse level of the metro station to the railway premises as conceptually shown in the figure.



Skywalk Proposal for Ernakulam South Railway station from Metro Station

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 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

SN	LOCATION	EFFECTIVE LENGTH (M)	PARKING BAYS								
			LHS			RHS			TOTAL		
			2W	4W	CYCLE	2W	4W	CYCLE	2W	4W	CYCLE
1	Aluva Bypass	300	60	20	20	0	0	0	60	20	20

SN	LOCATION	EFFECTIVE LENGTH (M)	PARKING BAYS								
			LHS			RHS			TOTAL		
			2W	4W	CYCLE	2W	4W	CYCLE	2W	4W	CYCLE
2	Banerji Road	300	30	10	10	30	10	10	60	20	20
3	Changampuzha Park	500	0	0	0	0	0	0	0	0	0
4	Edapally	500	50	15	10	50	15	10	100	30	20
5	Jose Jn	100	10	3	5	10	2	5	20	5	10
6	Kaloor - Kadavanthra Road	200	14	10	6	14	10	6	28	20	12
7	Perumbavoor Old Muvattupuzha Road	500	50	20	10	50	20	10	100	40	20
8	Rajaji Road	200	5	15	5	5	15	5	10	30	10
9	Shanmugham Road	600	100	5	5	100	5	5	200	10	10
10	TD Road	400	110	20	10	0	0	0	110	20	10
11	Subhash Park	300	20	45	10	0	0	0	20	45	10

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 ECS for Off-street Parking Spaces Capacities

Location	Area (m^2)	ECS	Composition				Bays				Type
			2W	4W	Bus	Cycle	2W	4W	Bus	Cycle	
Aluva Railway Station	2272	145	60%	30%	0%	10%	87	44	0	15	Surface
Ernakulam South Bus Stand	1000	64	70%	20%	0%	10%	45	13	0	6	Surface
Ernakulam South Railway Station	2048	130	70%	25%	0%	5%	91	33	0	7	Surface
Marine Drive Pay & Park	3000	300	35%	45%	15%	5%	105	135	45	15	Convert to MLCP
Mattancherry Dutch Palace	440	28	0%	60%	30%	10%	0	17	8	3	Surface

Location	Area (m^2)	ECS	Composition				Bays				Type
			2W	4W	Bus	Cycle	2W	4W	Bus	Cycle	
Thripunithura Railway Station	3050	195	90%	5%	0%	5%	176	10	0	10	Convert to MLCP
Vyttila Hub - 1	2000	300	40%	40%	10%	10%	120	120	30	30	Convert to MLCP
Vyttila Hub - 2	2000	300	40%	40%	10%	10%	120	120	30	30	Convert to MLCP

CONCEPT - PARKING POLICY

PARKING PRICING

Parking pricing and time limits are important parking management mechanisms 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 Kochi 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:

- Marine Drive/ Broadway on street parking facility
- High Court area
- Infopark Area core area
- Edapally Junction
- Aluva core area

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:

- Parking underneath Aluva, Maradu flyovers
- Parking near Edapally flyover
- Kaloor (near JLN Stadium)
- Infopark area

DISTANCE FROM TRANSIT

High parking charges should be levied on parking in places that are well-connected with transit facilities. This should be done to discourage private vehicle use. The On-Street Parking locations around the following locations are suggested to have higher parking price,

- Ernakulam North Railway Station
- Ernakulam South Railway Station
- Vyttila Mobility Hub
- Major Railway Stations

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

	DAILY CHARGES	SUBSIDISED CHARGES

VEHICLE TYPE	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[2].

MOBILITY AS A SERVICE (MAAS)

MaaS, is a concept that aims to promote collaboration between the public and private transport operators towards creating a platform where all mobility needs of an individual are met on one platform providing an option to plan and pay for their travel. It provides a form to integrate various transportation modes into a single platform, simplifying trip planning, booking, and payment processes. It can be operated by public transit agencies, private companies, or a combination of both and accessed through mobile apps, websites, or physical kiosks.

The key components of Mobility as a Service (MaaS) include:

1. Trip Planning: MaaS systems provide users with real-time information about different transportation options, such as schedules, fares, and routes, enabling them to plan their trips in advance.
2. Booking: MaaS systems allow users to book and pay for transportation services through a single digital platform, making the process more convenient and seamless.

[2] Source: Bus Karo 2.0

3. Payment: MaaS systems support various payment methods, such as credit cards, digital wallets, or mobile payments, depending on the user's preference and the service provider's policy.
4. Customer Support: MaaS systems offer customer support services, such as feedback, complaints, and assistance, to ensure a high level of user satisfaction.

The role of the government in fostering MaaS development is significant, with the National Urban Transport Policy (NUTP 2006) mentioning the establishment of Unified Metropolitan Transport Authority (UMTA) in cities with a population of over one million. MaaS promotes collaboration between public and private transport operators, enhancing the usage of public transportation through real-time passenger information and smart ticketing. The need for MaaS in Indian cities is significant due to their urbanization and complex transportation structures, with various transportation modes and operators both public and private. Kochi is among the pioneer cities in India that has understood the importance and made efforts to provide a multimodal transport solution involving cycling, walking, and public transport considering the cities urbanization trends.

Though multiple facilities are available, initiatives to ensure integration of various features of the MaaS platform, such as mobility and non-mobility modes using technology and innovation for functional platforms, and offering flexible fare structures, including digital payment options are needed to provide a seamless travel experience for commuters in Kochi. Data sharing and privacy are vital for personalized travel experiences, and clear rules are essential for managing data and information flow in the ecosystem. Such MaaS platforms through data analytics in due course shall facilitate efficient capacity utilization, and influence commuters' travel behaviour because of the enhanced travel experience.

For Kochi, it is recommended to have a detailed assessment of the extent of available technology interventions and gap identification be carried out to develop and integrate the various services under a single umbrella under the aegis of KMTA/ KMRL/ PPP.

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.

Electric Feeder Services (e-buses) are operational along three routes by KMRL. It is suggested to expand the services and promote utilization of e-buses. Whereas E-rickshaws are highly recommended in the city. As a part of the CSML and Kochi Corporation initiative, E-Rickshaws are currently operational in the city. It is recommended that these e-auto be allowed to ply in the core area to provide connectivity during the restricted vehicle hours to provide connectivity.

SMART BUS SHELTER

Smart 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. A suggested list of bus shelters for implementation is provided below. On a pilot basis, 122 bus shelters are listed, and this will be further augmented to include all the bus shelters in the study area.

Proposed Bus Stops for Smart Bus Shelters on Pilot Basis

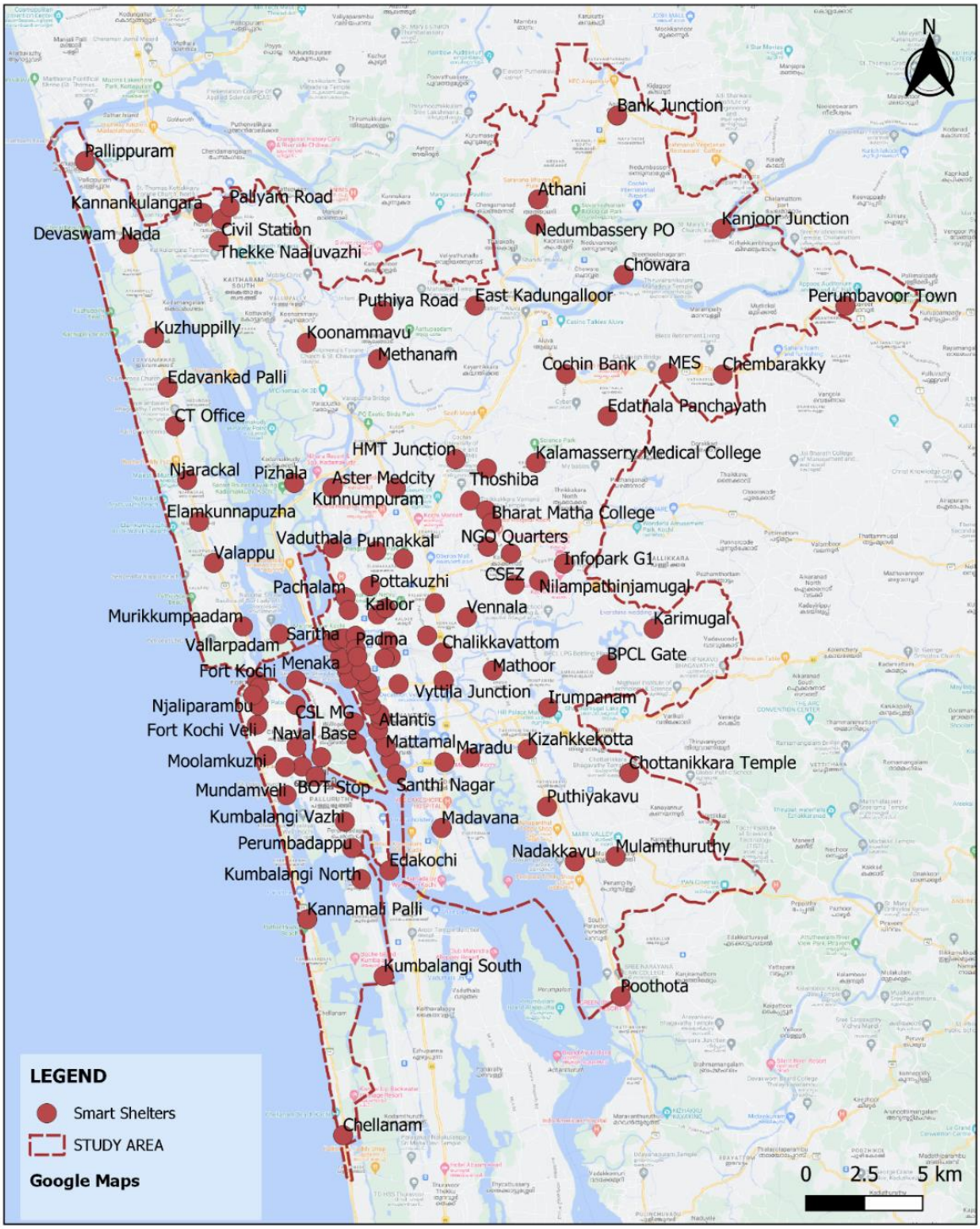
SN	Location
1	Karuvelappadi
2	CIFT
3	Perumpadappu
4	Fort Kochi Veli
5	Kumbalangi Vazhi
6	Mattancherry Govt. Hospital
7	BOT Stop
8	Taluk Hospital Fort Kochi
9	Kumbalangi North
10	Fort Kochi
11	Kokers
12	Njaliparambu
13	Mundamveli
14	Moolankuzhi
15	Kazhuthumuttu
16	Naval Base
17	Thoppumpady
18	Wellington Island
19	Chembarakky
20	MES
21	Cochin Bank
22	Edakochi
23	Chellanam
24	Bank Junction

SN	Location
25	Kanjoor Junction
26	Kalamasserry Medical College
27	HMT Junction
28	Methanam
29	Kunnumpuram
30	Punnakkal
31	Judgemukku
32	CUSAT University Ground
33	Toshiba
34	CSEZ
35	Nilampathinjamugal
36	NGO Quarters
37	Kakkanad Civil Station
38	Mulamthuruthy
39	Nadakkavu
40	Mathoor
41	Vennala
42	Pallippuram
43	Devaswam Nada
44	Kuzhuppilly
45	Edavanakkad Palli
46	Thekke Naluvazhi
47	Paliyam Road
48	Kannankulangara

SN	Location
49	Civil Station
50	Vaduthala
51	Aster Medicity
52	Pizhala
53	Koonammavu
54	Ayyappankavu
57	Pottakuzhi
58	Changampuzha Park
59	Vyttila Junction
60	Mathrubhoomi
61	Kaloor
62	Gandhi Nagar
63	Kumaranasan Junction
64	Kizakkekotta
65	Irumpanam
66	Murikkumpaadam
67	Vallarpadam
68	Shenoys
69	Thammanam
70	CT Office
71	Njarackal
72	Elamkunnapuzha
73	Valappu
74	High Court
75	Menaka
76	St, Teresa's College
77	Subhash Park
78	Kacherippady
79	St. Alberts
80	Saritha
81	High Court - Banerji Road
82	Kadavanthra Junction
83	Kundannur Junction
84	Maharajas

SN	Location
85	Padma
86	Ernakulam Medical Centre
87	Maradu
88	Challikavattom
89	Kathrikadavu
90	Santhi Nagar
91	SH College
92	CSL MG
93	CSL
94	Thevara
95	Mattamal
96	Valanjambalam
97	Medical Trust Hospital
98	Ravipuram
99	Atlantis
100	Ernakulam Boat Jetty
101	Hospital Junction
102	Ernakulam South
103	Jose Junction
104	Madavana
105	Chottanikkara Temple
106	Puthiyakavu
107	Poothotta
108	Chowara
109	Nedumbassery PO
110	Athani
111	Kumbalangi South
112	Perumbavoor Town
113	East Kadungalloor
114	Puthiya Road
115	Edathala Panchayat
116	Infopark G1
117	Kannamaly Palli
118	Kavunthazham

SN	Location
119	BPCL Gate
120	Karimughal
121	Pachalam
122	Bharat Matha College



Title: Comprehensive Mobility Plan for Kochi	
Map: Smart Bus Shelters	

Proposed Locations for Smart Bus Shelters

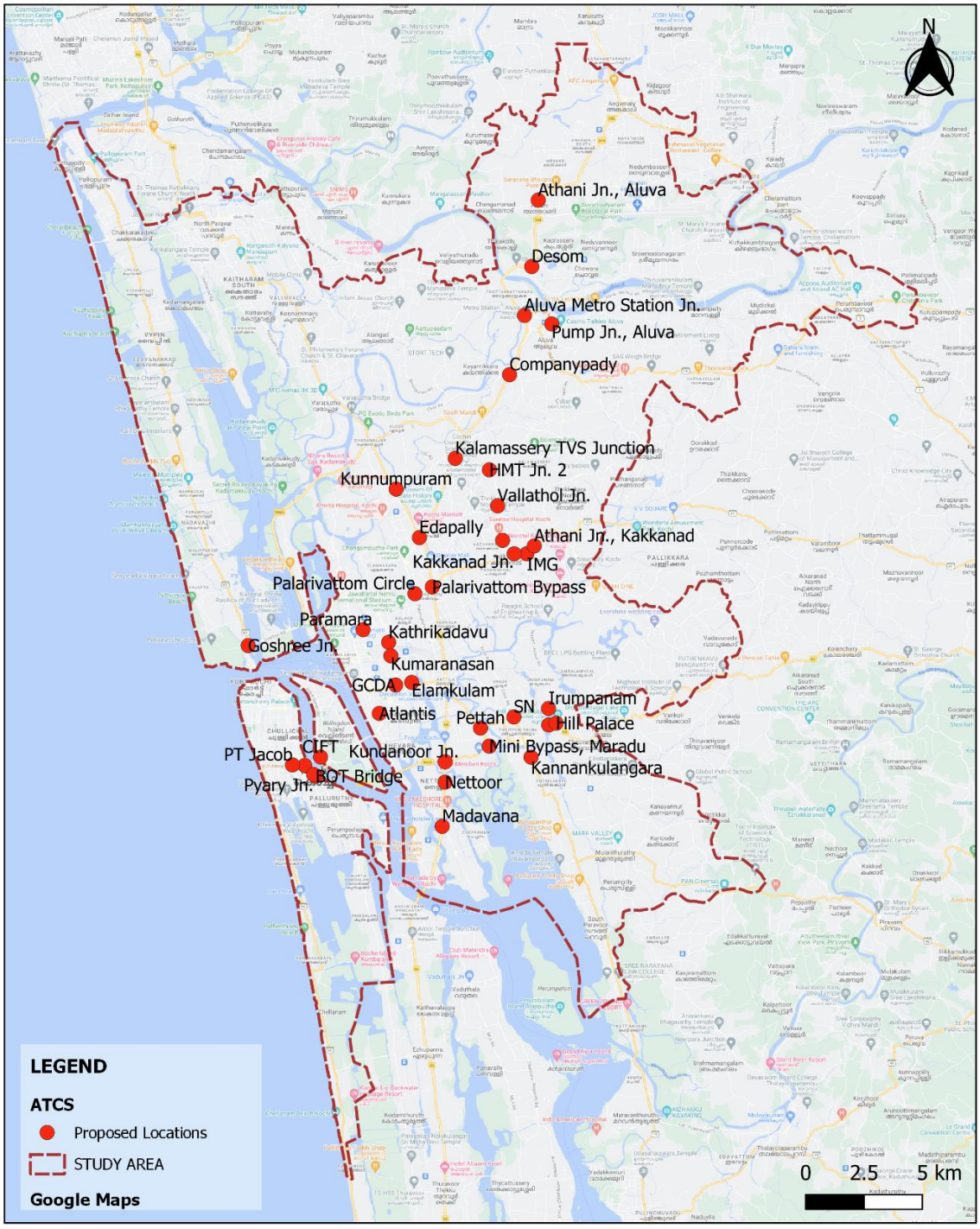
ADAPTIVE TRAFFIC CONTROL SYSYTEM (ATCS)

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

SN	JUNCTION	PHASE
1.	Aluva Metro Station Jn.	PHASE I
2.	Athani Jn., Aluva	PHASE II
3.	Athani Jn., Kakkanad	PHASE II
4.	Atlantis Jn.	PHASE I
5.	BOT Bridge	PHASE I
6.	CIFT Jn.	PHASE I
7.	Companypady	PHASE II
8.	Desom	PHASE II
9.	Edapally	PHASE I
10.	Elamkulam	PHASE I
11.	GCDA Jn.	PHASE I
12.	Goshree Jn.	PHASE I
13.	Hill Palace	PHASE II
14.	HMT Jn. 2	PHASE II
15.	IMG Jn.	PHASE II
16.	Irumpanam Jn.	PHASE II
17.	Kakkanad Jn.	PHASE II
18.	Kalamasserry TVS Jn.	PHASE II
19.	Kannankulangara	PHASE II
20.	Karingachira	PHASE II
21.	Kathrikadavu	PHASE I
22.	Kundannur Jn.	PHASE I
23.	Kumaranasan	PHASE I

SN	JUNCTION	PHASE
24.	Kunnumpuram	PHASE I
25.	Madavana Jn.	PHASE II
26.	Mavelipuram Signal Jn.	PHASE II
27.	Mini Bypass Jn., Maradu	PHASE I
28.	Nettoor Jn.	PHASE II
29.	Palarivattom Bypass Jn.	PHASE I
30.	Palarivattom Circle	PHASE I
31.	Paramara Jn.	PHASE I
32.	Pettah Jn.	PHASE I
33.	PT Jacob Jn.	PHASE I
34.	Pump Jn., Aluva	PHASE II
35.	Pyary Jn.	PHASE I
36.	SN Jn.	PHASE I
37.	Thoppumpady	PHASE I
38.	Vallathol Jn.	PHASE II



Title: Comprehensive Mobility Plan for Kochi	Urban Mass Transit Company Limited / KOCHI METRO RAIL LIMITED
Map: ATCS Proposals	

ATCS Proposals in the Study Area

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

NAME	CAPACITY	AREA REQUIRED (SQ. M.)	RECOMMENDED TERMINAL TYPE
Angamaly	400	120000	Major
CIAL	500	-	Hub
Cheranallur	400	120000	Major
Edapally	200	60000	Major
Ernakulam Boat Jetty	50	15000	Minor
Irumpanam	400	120000	Major
Kalamasserry	400	120000	Major
Kumbalam	400	120000	Major
Kundannur	200	60000	Minor
Mamala	200	60000	Minor
North Paravur	400	120000	Major
Perumbavoor	500	140000	Major
Thykoodam	200	60000	Minor
Vallarpadam	500	140000	Hub
Wellington Island	500	140000	Hub

The recent boom in digital transactions and online delivery services, urban freight has piqued up considerably apart from the existing regional freight. Owing to the urban growth and densification of the city towards eastern and north-eastern as well as southern directions beyond Kalamasserry, Cheranallur and Kundannur in the recent decades, it is recommended to prepare a detailed freight management strategy for the city to develop a long-term freight management plan.

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.

SN	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)	59%	61%	33%
	Public Modes	% of trips made by public transport modes	31%	33%	64%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	10%	6%	3%
2	**Trip Length (Km)**				
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car, and Auto users in the study area	10.6	11.2	10.9
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.61	10.4	13.6
3	**Travel Time (Minutes)**				
	Travel Time (PvT Modes)	Average Travel Time of the Two-wheeler, Car, and Auto users in the study area	27.3	33.4	27.4
	Travel Time (PT Modes)	Average Travel Time of the Public Transport users in the study area	33.9	55	34
4	**Accessibility to Public Transport (Population in lakh)**				
	Access to PT	Population having access to PT	11	15	22

Impact Assessment for Network Characteristics

INDICATOR TYPE	DESCRIPTION	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Infrastructure Quality				
Average Speed (Kmph) (PvT)	Average speed of private modes	23.3	20.11	25
Average Speed (Kmph) (PT)	Average speed of public transport modes (Bus, Metro & Ferry)	15.25	11.34	21
Safety				
Quality of footpath infrastructure	% of city covered with Footpaths (Arterial and Sub-Arterial)	7%	29%	100%

Environmental Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU (2051)	SUT (2051)
GHG Emissions (Tonnes/day)	36.53	72.93	49.59
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%

Availability of Traffic Surveillance

PARAMETER	DESCRIPTION	BASE YEAR (2023)	SUT (2051)	BAU (2051)
Traffic Surveillance – CCTV	Share of Stations with CCTV on Terminals, Stations, and Signalized Intersections	58.33%	**100%**	**80%**

Passenger Information System

PARAMETER	DESCRIPTION	BASE YEAR (2023)	SUT (2051)	BAU (2051)
Passenger Information System (PIS) for PT	Terminals, Stations having PIS	54.10%	**100%**	**50%**

Global Positioning System

PARAMETER	DESCRIPTION	BASE YEAR (2023)	SUT (2051)	BAU (2051)
Global Positioning System / GPRS	Share of PT and IPT with on-board GPS/GPRS connected to common control center	8.2%	**100%**	**80%**

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.

Proposal Phases

SN	SHORT TERM PROPOSALS	MEDIUM TERM PROPOSALS	LONG TERM PROPOSALS
1.	City Bus, MRTS, Water Transport	City Bus, MRTS, Water Transport	City Bus, MRTS, Water Transport
2.	Intermediate Public Transport	Public Transport Terminals	Freight Terminals
3.	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras
4.	Footpath, Cycle Tracks, PBS	Intermediate Public Transport	Ring Roads
5.	Freight Terminals	Freight Terminals	
6.	On-street & Off-street Parking, MLCP	Off-street Parking, MLCP	
7.	Upgradation of Links	Ring Roads	
8.	New / Missing Links, Radials	ROBs/RUB/Canal Crossings	
9.	ROBs/RUB/Canal Crossings		

PROJECT COSTING

The tentative block cost estimation is done in reference to the district scheduled rates for year 2023. The overall short-term project cost is estimated to be **6356.40** 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 **7746.68** crores and **5567.29** crores for long term measures.

Estimated Project Costs

SN	PROJECTS	TOTAL COST (IN CRORES)	PHASING RS (IN CRORES)		
			2023-2027	2027-2041	2041-2051
1	Improvement of Road Network	2595.01	1409.65	917.89	267.47
2	Improvement of Non-Motorised Transport Facilities	493.34	493.34	0.00	0.00
3	Improvement of Public Transport System	14037.48	4125.24	6030.91	3881.33
4	Improvement of Freight Transportation System	2046.53	0.00	708.18	1338.35
5	Intelligent Transportation System Facilities	489.50	324.19	85.17	80.14
6	Improvement of Parking Facilities	8.51	3.99	4.52	0.00
Overall CMP Proposals		**19670.36**	**6356.40**	**7746.68**	**5567.29**

Estimated Project Costs

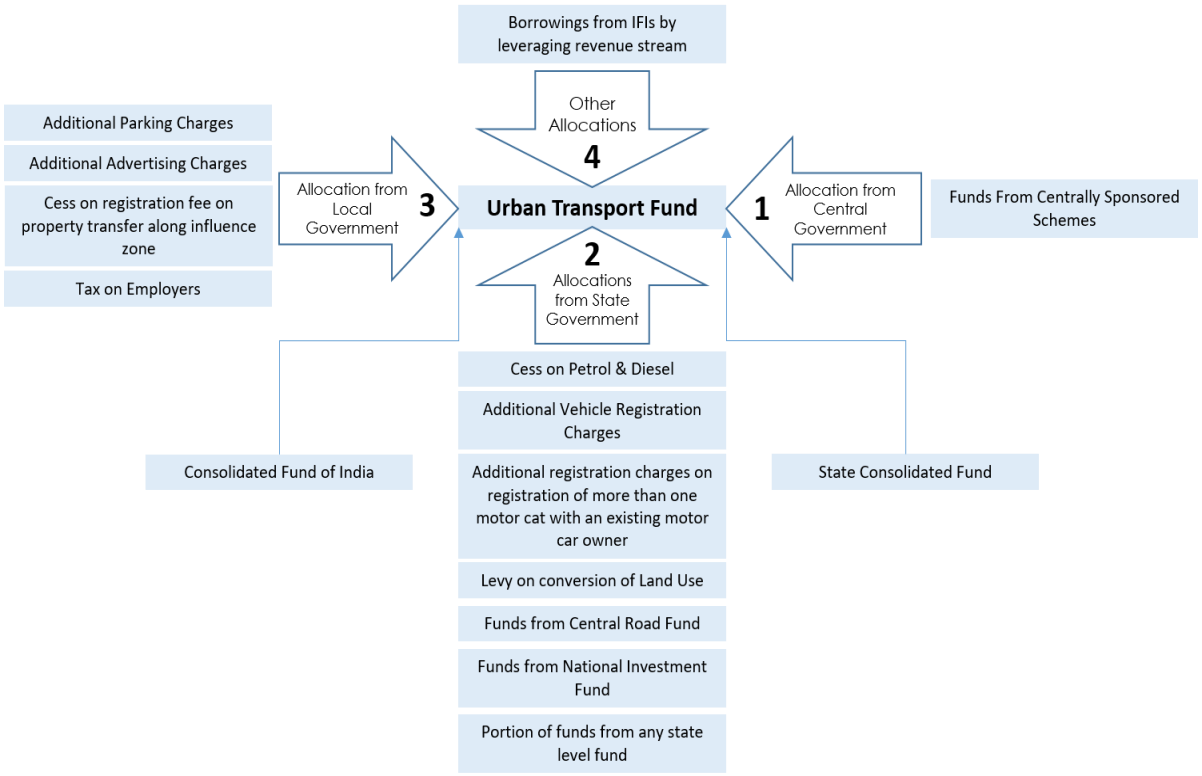
Sl. No	Projects	Unit	Total Quantity	Project Phasing Quantities			Unit Rate (in Crore)	Total Cost (in Crores)	Phasing Rs (in Crores)		
				2023-2027	2027-2041	2041-2051	2027		2023-2027	2027-2041	2041-2051
Improvement of Road Network											
1	Upgradation of Existing Roads	Km.	677.79	380.14	226.45	71.20	2.770	1991.58	1052.93	671.18	267.47
2	New Links	Km.	5.00	5.00	0.00	0.00	3.693	18.47	18.47	0.00	0.00
3	Flyover upgradation (2-Lane)	No.	0.00	0.00	0.00	0.00	42.841	0.00	0.00	0.00	0.00
4	ROB/ Canal Crossing Upgradation (2-Lane)	No.	5.00	3.00	2.00	0.00	51.409	264.25	154.23	110.02	0.00
5	River Bridge	No.	5.00	3.00	2.00	0.00	42.841	220.21	128.52	91.68	0.00
6	Flyover (4-Lanes)	No.	0.00	0.00	0.00	0.00	59.977	0.00	0.00	0.00	0.00
7	Underpass	No.	0.00	0.00	0.00	0.00	42.841	0.00	0.00	0.00	0.00
8	Junction Improvements	No.	62.00	37.00	25.00	0.00	1.500	100.50	55.50	45.00	0.00
Total Project Cost								**2595.01**	**1409.65**	**917.89**	**267.47**
Improvement of Non-Motorised Transport Facilities											
1	Footpath	Km.	286.57	286.57	0.00	0.00	1.625	465.68	465.68	0.00	0.00
2	NMT Only Lanes	Km.	4.60	4.60	0.00	0.00	2.556	11.76	11.76	0.00	0.00
3	Shared Cycle Tracks	Km.	184.36	184.36	0.00	0.00	0.026	4.77	4.77	0.00	0.00
4	Dedicated Cycle Tracks	Km.	3.70	102.21	0.00	0.00	0.052	5.28	5.28	0.00	0.00
5	Public Bike Sharing Stations	No.	65.00	65.00	0.00	0.00	0.018	1.20	1.20	0.00	0.00
6	Public Bike Sharing Cycles	No.	800.00	800.00	0.00	0.00	0.007	5.32	5.32	0.00	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
Total Project Cost								**494.00**	**494.00**	**0.00**	**0.00**
Improvement of Public Transport System											
1	Bus Fleet Augmentation	No.	1592.00	437.00	514.00	641.00	1.808	3356.62	790.18	994.52	1571.93
2	Improvement of Bus Terminals / Multi Modal Mobility Hubs	No.	12.00	0.00	12.00	0.00	1.950	25.04	0.00	25.04	0.00
3	New Public Transportation Station	No.	18.00	0.00	18.00	0.00	1.773	34.14	0.00	34.14	0.00
4	In Land Water Ways System	Km	78.00	0.00	0.00	78.00	10.467	1107.29	0.00	0.00	1107.29
5	MRT System (Metro)	Km	27.10	13.00	14.10	0.00	256.543	7205.74	3335.06	3870.68	0.00
6	BRTS System	Km	65.00	0.00	35.00	30.00	29.545	2308.65	0.00	1106.54	1202.11
Total Project Cost								**14037.48**	**4125.24**	**6030.91**	**3881.33**
Improvement of Freight Transportation System											
1	Proposed New Truck Terminals	Sq. m	1395000.00	0.00	560000.00	835000.00	0.001	2046.53	0.00	708.18	1338.35
Total Project Cost								**2046.53**	**0.00**	**708.18**	**1338.35**
Technological and Intelligent Transportation System Facilities											
1	New Signal Installations	No.	44.00	27.00	17.00	0.00	0.295	13.35	7.98	5.37	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
2	Adaptive Traffic Control System	No.	38.00	21.00	17.00	0.00	0.886	34.74	18.61	16.12	0.00
3	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	Km.	450.00	250.00	100.00	100.00	0.591	291.10	147.73	63.23	80.14
4	Smart Bus Shelters	No.	2800.00	300.00	1250.00	1250.00	0.133	148.91	148.91	0.00	0.00
5	Electric Charging Stations - 2w and 3w	No.	525.00	384.00	141.00	0.00	0.003	1.40	0.96	0.44	0.00
Total Project Cost								**489.50**	**324.19**	**85.17**	**80.14**
Improvement of Parking Facilities											
1	On street Parking	Km.	4.00	4.00	0.00	0.00	0.554	2.22	2.22	0.00	0.00
2	Off street Parking (MLCP)	No.	4.00	0.00	4.00	0.00	1.108	4.52	0.00	4.52	0.00
2	Off street Parking (Surface))	No.	4.00	4.00	0.00	0.00	0.443	1.77	1.77	0.00	0.00
Total Project Cost								**8.51**	**3.99**	**4.52**	**0.00**
Overall Comprehensive Traffic and Transportation Plan Proposals											
Total Project Cost								**19670.36**	**6356.40**	**7746.68**	**5567.29**

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/KMC	PWD/ NHAI / Private	PWD / NHAI / Private
2	New Links	PWD/NHAI/KMC	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/KMC	PWD/ NHAI / Private	PWD / NHAI / Private

SN	PROJECTS	AGENCIES RESPONSIBLE	IMPLEMENTATION OPERATION	
			CONSTRUCTION	OPERATION/MAINTAIN
5	Flyover (4-Lanes)/ Bridges/ Underpasses	PWD / KMC / State Govt. / NHAI	State Govt. / KMC	PWD / NHAI / Private
6	Junction Improvements	PWD / KMC / State Govt. / NHAI	State Govt. / KMC	PWD / NHAIs
Improvement of Non-Motorised Transport Facilities				
1	Footpath	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
2	NMT Only Lanes	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
3	Shared Cycle Tracks	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
4	Dedicated Cycle Tracks	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
5	Public Bike Sharing Stations	KMC / Smart City / KMRL / Private	KMC / Smart City / KMRL / Private	KMC / Smart City /KMRL / Private
6	Public Bike Sharing Cycles	KMC / Smart City / KMRL / Private	KMC / Smart City / KMRL / Private	KMC / Smart City / KMRL / Private
7	Public Education and Awareness program	KMC / Smart City / KMRL / Private / NGOs /State Govt.	KMC / Smart City / KMRL / NGOs	KMC / Smart City / KMRL / 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/KMC / Smart City	KSRTC/KMC / Smart City / Private	KSRTC/KMC / Smart City / Private
3	New Public Transportation Station	KSRTC/ KMRL /KMC / Smart City	KSRTC/ KMRL/ KMC / Smart City / Private	KSRTC/ KMRL/ KMC / Smart City / Private
4	In Land Water Ways System	KMRL /KMC / Smart City	KMRL /KMC / Smart City	KMRL /KMC / Smart City
5	MRT System (BRT/LRT/MRT)	KMRL	KMRL	KMRL
Improvement of Freight Transportation System				
1	Proposed New Truck Terminals	State Govt. / KMC	State Govt. / Private	Private
Technological and Intelligent Transportation System Facilities				
1	New Signal Installations	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police
2	Adaptive Traffic Control System	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police

SN	PROJECTS	AGENCIES RESPONSIBLE	IMPLEMENTATION OPERATION	
			CONSTRUCTION	OPERATION/MAINTAIN
3	Smart City Bus Shelters	KSRTC/ KMC/ Smart City / Traffic Police	KSRTC/ KMC/ Smart City / Traffic Police / Private	KSRTC/ KMC/ Smart City / Traffic Police / Private
4	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police
5	Electric Charging Stations - 2w and 3w	KMC / Smart City / KSEB / Private	KMC / Smart City / KSEB / Private	KMC / Smart City / KSEB / Private
Improvement of Parking Facilities				
1	On street Parking	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police / Private	KMC/ Smart City / Traffic Police / Private
2	Off street Parking (MLCP)	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police / Private	KMC/ Smart City / Traffic Police / Private
3	Off street Parking (Surface))	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police / Private	KMC/ 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. Following is the list of departments and Organizations involved in urban affairs and urban transport in Kochi.

- Kochi Municipal Corporation (KMC)
- Greater Cochin Development Authority (GCDA)
- Goshree Islands Development Authority (GIDA)
- Kochi Metro Rail Limited (KMRL)
- Kochi Metropolitan Transport Authority (KMTA)
- Cochin Smart Mission Limited (CSML)
- 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)
- CIAL, Kochi

Kochi Metropolitan Transport Authority was setup for the city on 1st November 2020, under the Kerala Metropolitan Transport Authority Act, 2019. KMRL played a pivotal role in setting up KMTA. The initiatives and activities taken up by the Urban Transport wing of KMRL to promote integration and seamless travel experience across various modes of transport in Kochi and assist GoK in formulation of the Kerala Metropolitan Transport Authority Bill, 2019 as per the NUTP policy 2006.

Apart from these other efforts include, bringing more than 800 private buses operational in the city under 7 cluster-based bus operating companies for integrated bus operations as well as installation of GPS in private bus services. Introduction of journey planner mobile application 'Chalo' in 2018. Efforts to promote the adoption of Kochi1 card across various class of public transport users. To assure feeder services and ensure last-mile connectivity, facilitated in aggregating 15000 auto-rickshaws under one single umbrella 'Ernakulam District Auto Rickshaw Drivers Co-Operative Society', fare integration in association with CEPT and measures to enhance metro ridership in association with CPPR, bus route rationalization plan for Greater Kochi Region, etc.

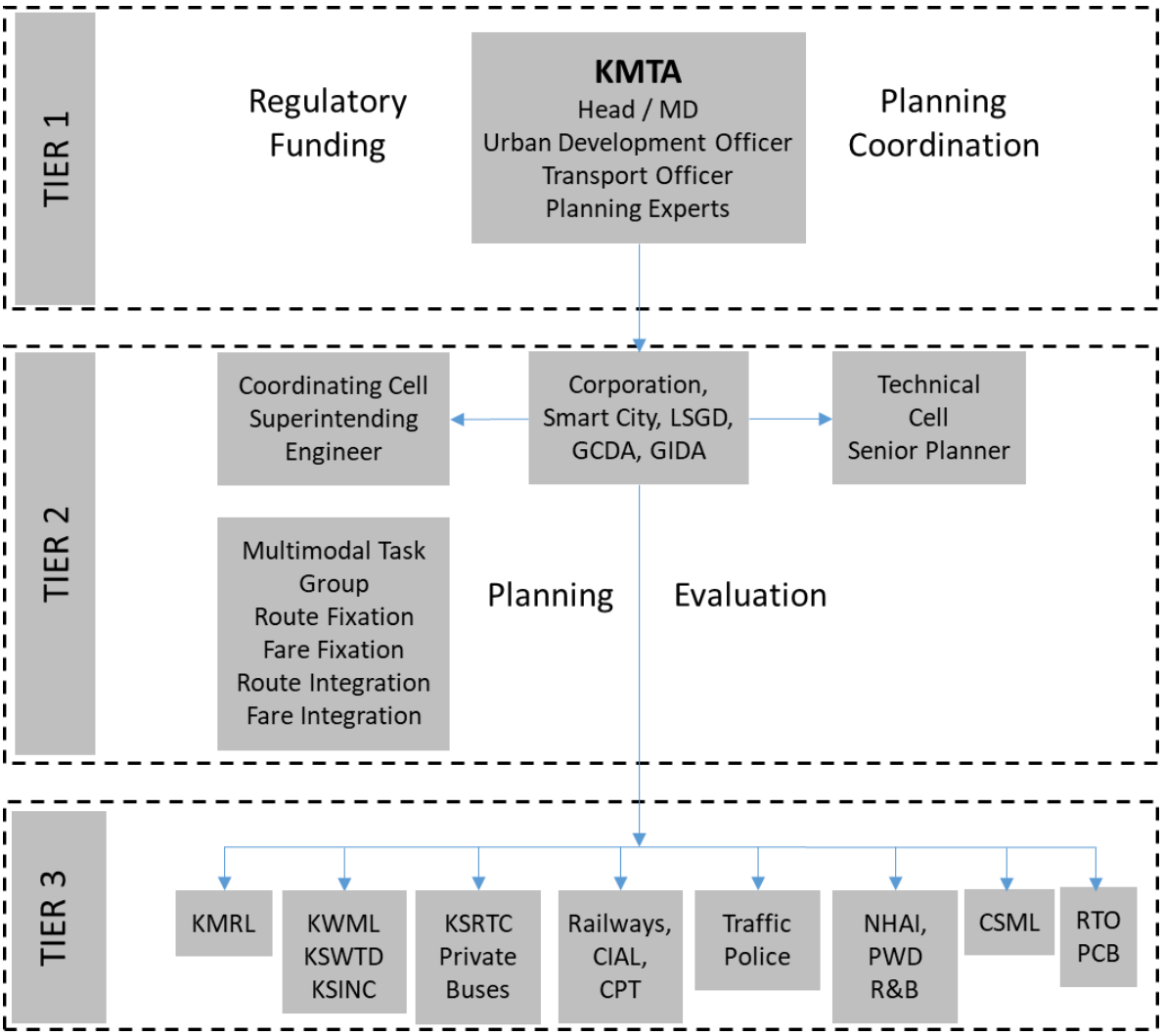
The noteworthy initiatives taken up by KMTA within months of operation include setting up of Kochi Open Mobility Network (KOMN) becoming pioneers in India to integrate, plan, and regulate the various commute modes. KOMN enabled by open specifications of Beckn strives integration of urban transport modes which is an inclusive and interoperable.

With a view to coordinate all urban transport activities in the city, it is recommended that KMTA be revived at the city level that acts as a planning and coordinating body for all matters related to urban transport in the city. This would enable planned development of urban transport infrastructure considering the duties and powers vested in Kochi MTA by the KMTA Act 2019.

It is also recommended to consider at least the 732 km area consisting of GCDA and GIDA as the Urban Mobility Area for Kochi apart from the prescribed Kochi Municipal Corporation limits as per the KMTA Act 2019, considering the urban growth of the city.

INSTITUTIONAL SETUP

It is recommended that the city level UMTA be revived with appropriate professionals so that it’s functioning falls in line with that of the KMTA act and commands greater authority.



Recommended Structure for UMTA Setup

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

01

INTRODUCTION

1 INTRODUCTION

Sustainable Urban Transportation is the core module of Kochi 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. A sustainable transportation is an integrated system which facilitates mobility in a way that preserves the social, environmental, and economic interests of the city through an affordable, efficient, low carbon transportation option supporting the economy and regional development while minimising the impact on the use of land, health, and environment.

Figure 1 Concept of Sustainable Urban Transportation

Sustainable Urban Transportation planning has proven to gauge numerous comprehensive socio-economic and 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 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 Kochi.

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

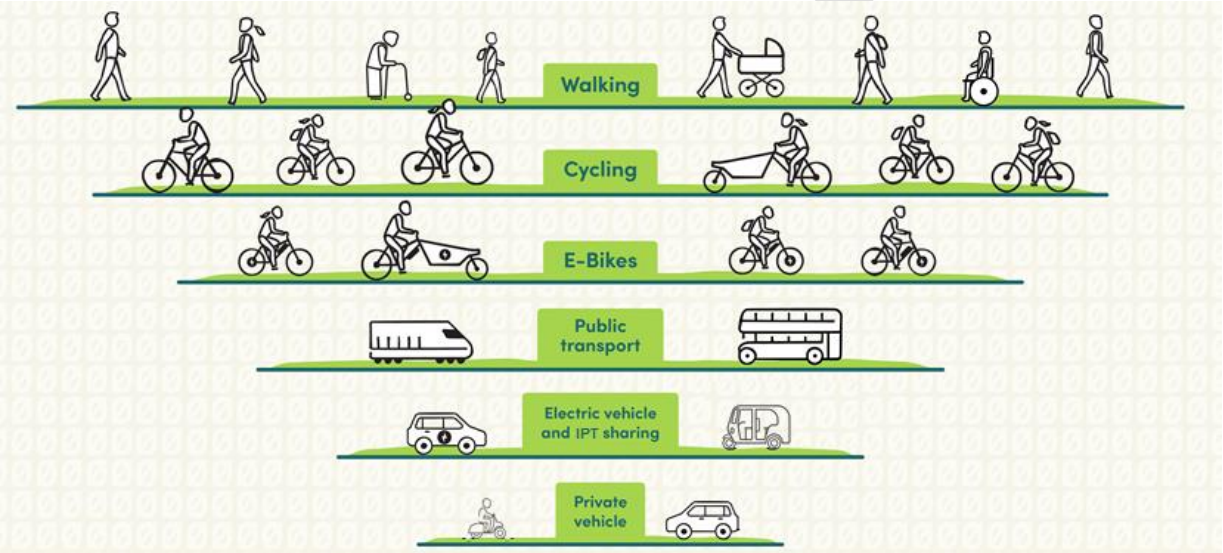


Figure 3 Hierarchy of Urban Transportation System

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 Kochi is prepared on similar lines focusing on equitable road space usage for users as the core of the CMP vision (Refer Chapter 9).

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) conducted for Kochi.

2011	DEVELOPMENT PLAN FOR KOCHI CITY REGION 2031	Recommends strengthening of regional linkages, preparation of an integrated multi-modal traffic and transportation plan, identification of MRTS routes and travel demand management measures.
2014	TRANSIT ORIENTED DEVELOPMENT ACTION PLAN FOR KOCHI	Identifies and illustrates the TOD principles, discusses, and defines their applicability in Kochi on the identified Metro Transit Oriented Corridor
2015	NON-MOTORISED TRANSPORTATION PLAN FOR KOCHI	The study was done for the existing 22km corridor of Kochi Metro, covering an area of 2km to the either side of the metro alignment.
2016	INTEGRATED PUBLIC TRANSPORT SOLUTIONS FOR GREATER KOCHI	Aimed at seamless integration of public transport services in the city of Kochi and enhancing the ridership along the transit corridors.
	INTRODUCTION OF LOW CARBON CITY BUS SERVICES IN GREATER KOCHI	Developed an efficient, cost effective and sustainable public transport system.
2017	PARKING MASTER PLAN	Facilitate the organized parking which will complement the sustainable, safe, and efficient urban transport system
	COMPREHENSIVE MOBILITY PLAN - 2017	Recommends integrated strategies to develop a robust transportation system.
	DETAILED PROJECT REPORT FOR INTEGRATED WATER TRANSPORT SYSTEM FOR KOCHI	Utilizing water bodies for transportation in a safe and efficient manner.
2018	ALTERNATE ANALYSIS AND DPR FOR MASS RAPID TRANSIT SYSTEM TO ANGAMALY	To identify an appropriate mass transit system to connect the existing metro line to the Angamaly.
	ALTERNATE ANALYSIS AND DPR FOR MASS RAPID TRANSIT SYSTEM TO INFOPARK KOCHI	To identify an appropriate mass transit system to connect the existing metro line to the Infopark, Kochi campus.
2020	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, seaports in an integrated manner.

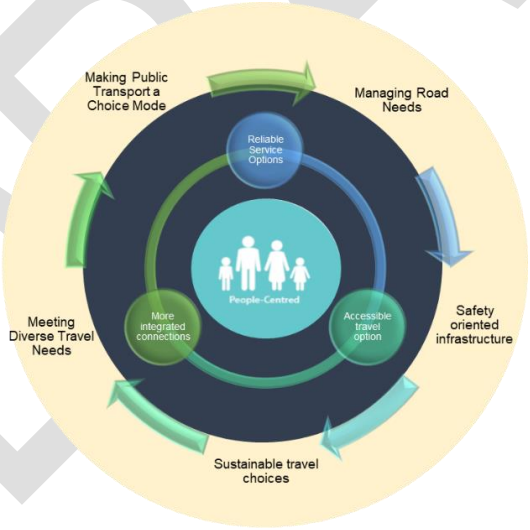
This previous studies emphasis predominantly on the following principles:

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 Kochi is a necessary strategic vision document highlighting the national and regional framework for Urban Transportation.

1.3 STUDY AIM

The growth of Kochi city being strongly fostered by tourism, trade and commerce thus reducing the impact of urban development on environment is a conscious component of the city's urban planning. In addition, Ministry of Housing and Urban Affairs recommends focus on the movement of people and goods rather than private vehicles that adversely affect the environment, thereby reducing pollution levels and providing enhanced mobility options for all.



Thus, the aim of the project is,

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

Figure 4 Kochi CMP Study Aim

1.4 STUDY OBJECTIVES

The proposed objectives for the project are as follows,

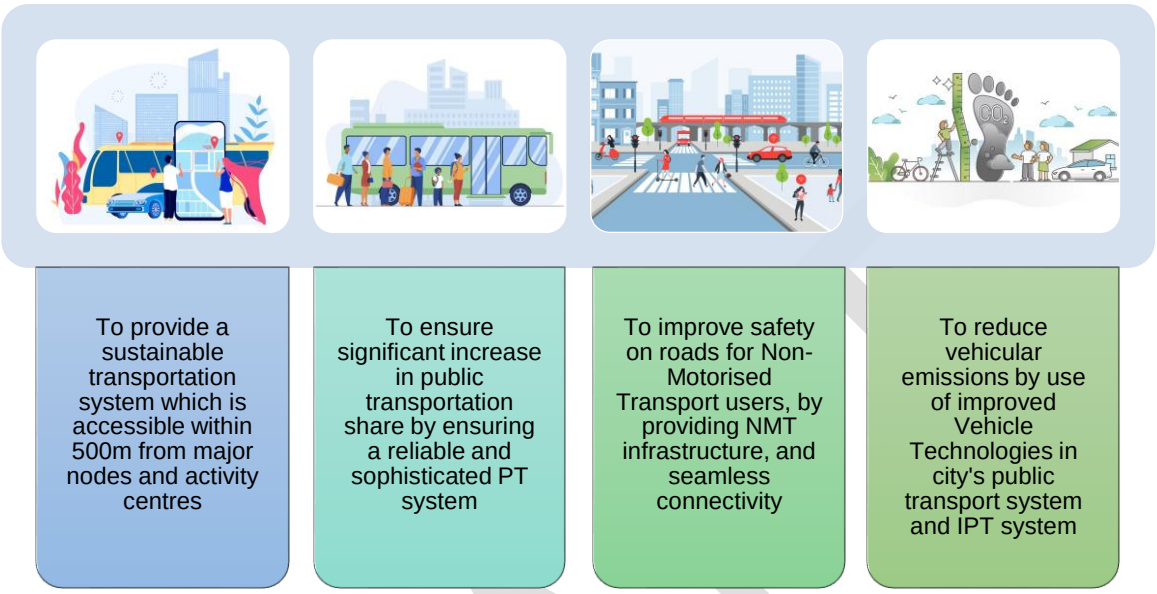


Figure 5 Kochi CMP Study Objectives

The project will endeavour to fulfil these objectives thorough various strategies and polices will be a part of the subsequent reports. However, on a broader note, the strategies which would be considered as part CMP for Kochi would range from land use transport strategies to mode wise strategies to technological strategies to management strategies of traffic and freight.

1.5 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

1.6 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.

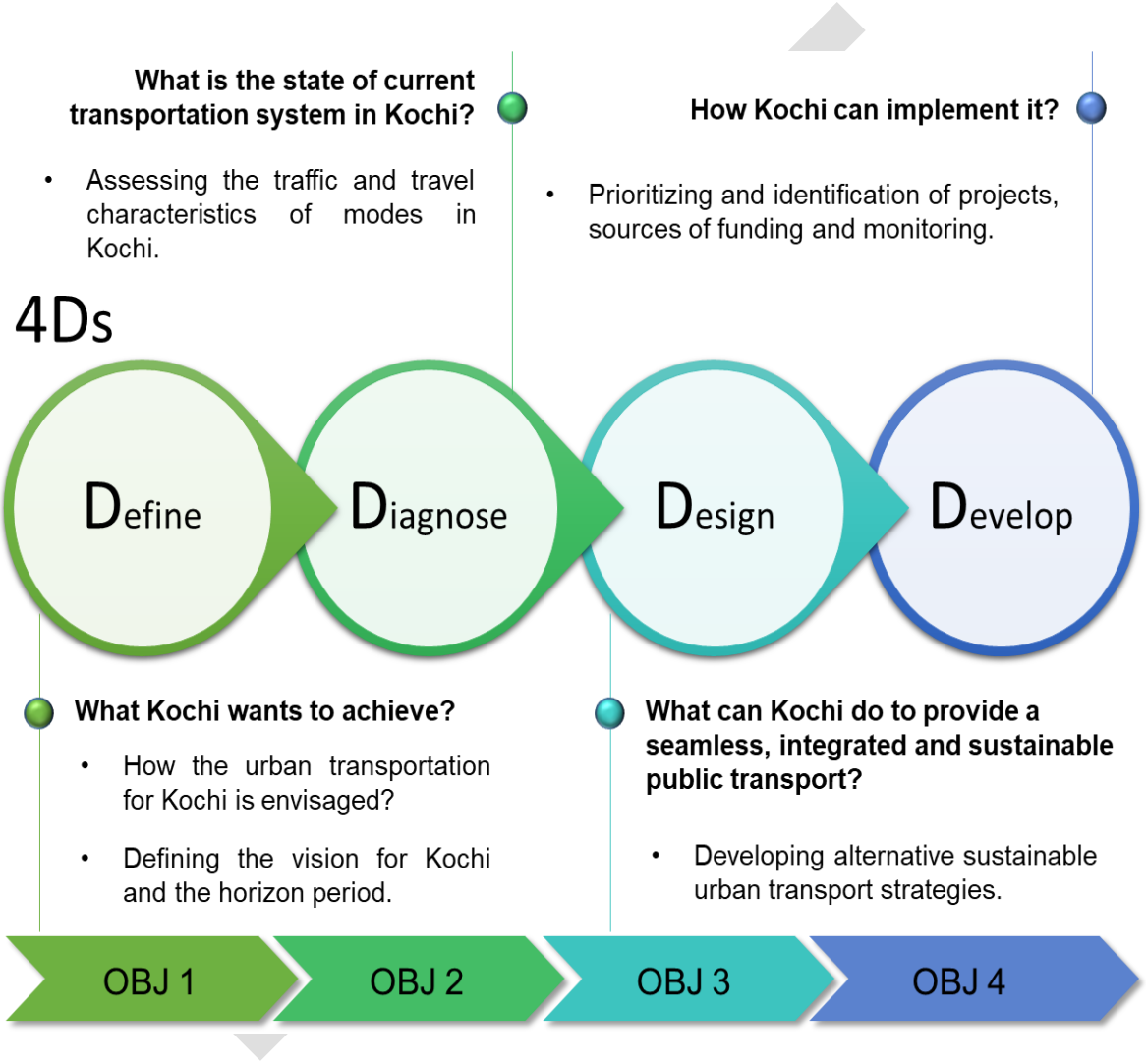


Figure 6 Proposed 4Ds Approach for the study

1.7 METHODOLOGY

The methodology proposed for the study is as presented below.

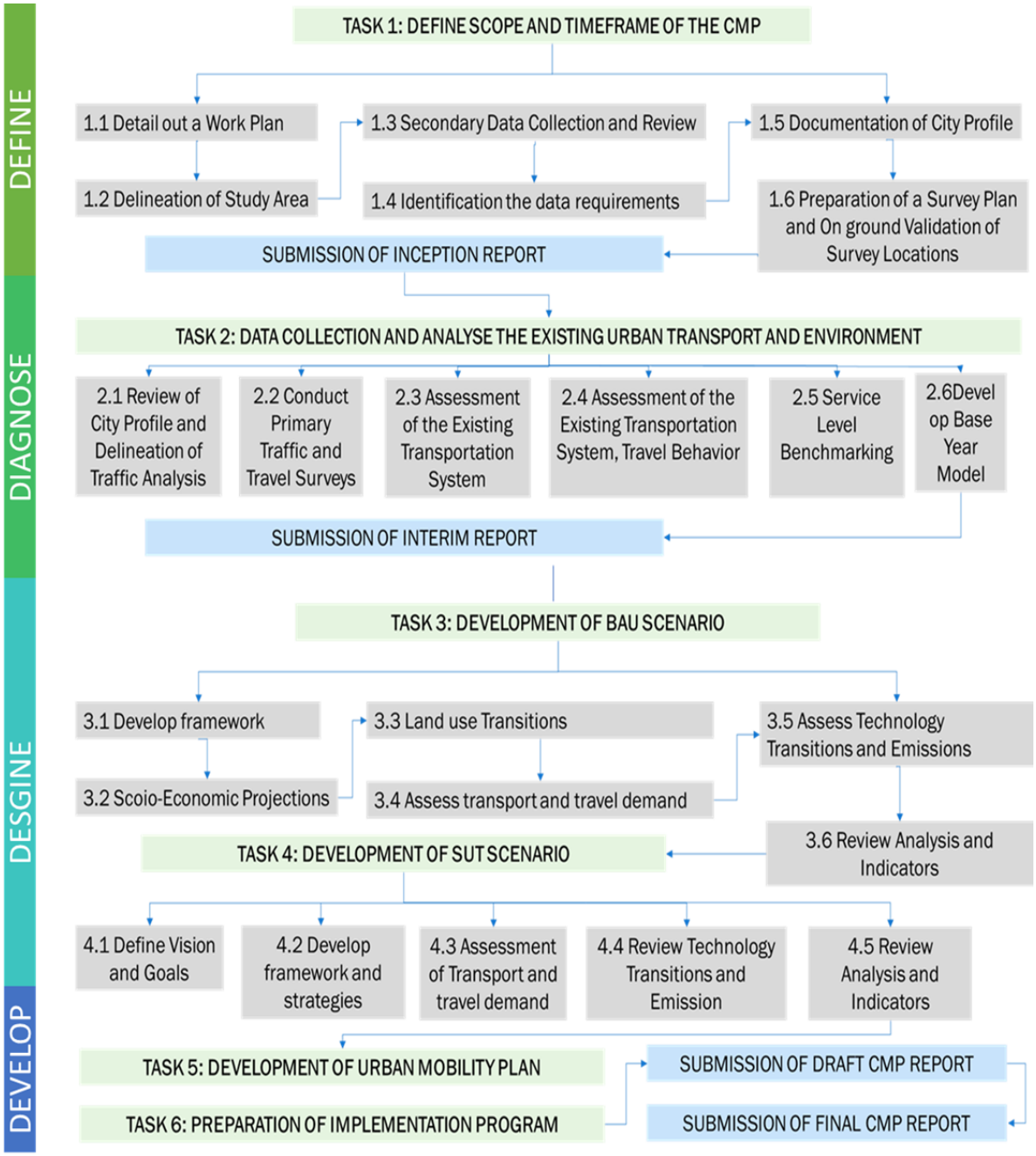


Figure 7 Methodology

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

02

STUDY AREA PROFILE

2 STUDY AREA PROFILE

Figure 8 Skyline at Marine Drive (Day & Night)

Kochi, the Queen of Arabian sea, is the economic capital and the most cosmopolitan city of Kerala. It is the nerve centre of trade and commerce of Kerala and is considered as the 'Gateway of South India'. This port city is also the headquarters of the Southern Naval Command of the Indian Navy.

It has prominent presence of IT & ITES, tourism, multiple engineering, medical and educational institutions, petrochemical industries, and shipbuilding industry along with the presence of an international cruise terminal and Kochi holds a strategic position on the world map as well. It is a major tourist destination is famous for its diverse heritage, vibrant culture, backwaters, and beaches.

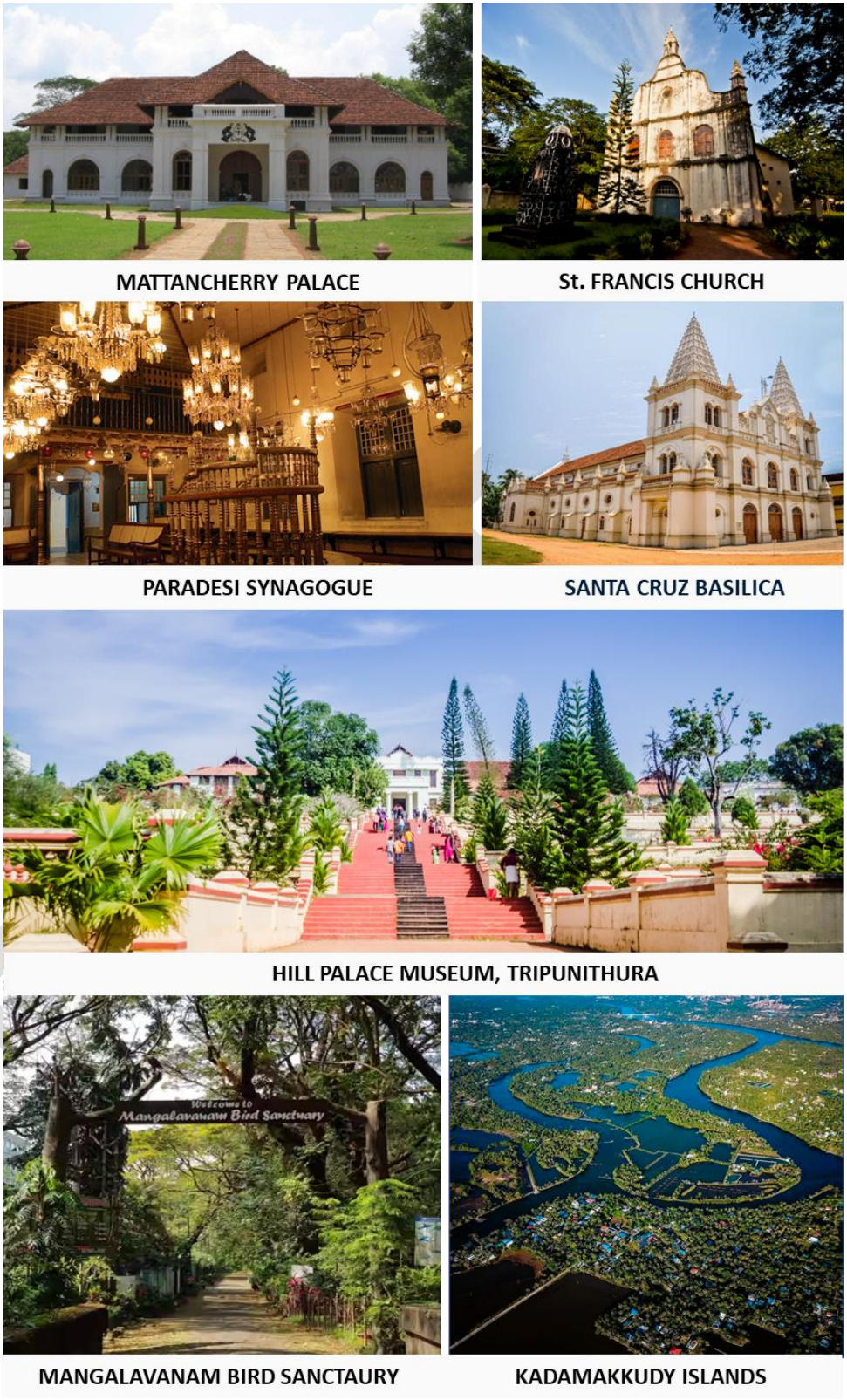


Figure 9 Historical Prominence & Natural Attractions in Kochi

2.1 GEOGRAPHICAL PROFILE

Kochi is located on the southern coast of the Indian state Kerala, within 210 km from its state capital, Thiruvananthapuram.

It is located within 500 km from Mangalore, Mysuru, Coimbatore and within 150 km from like Thrissur, Palakkad, Kozhikode, Alappuzha, and Kottayam.

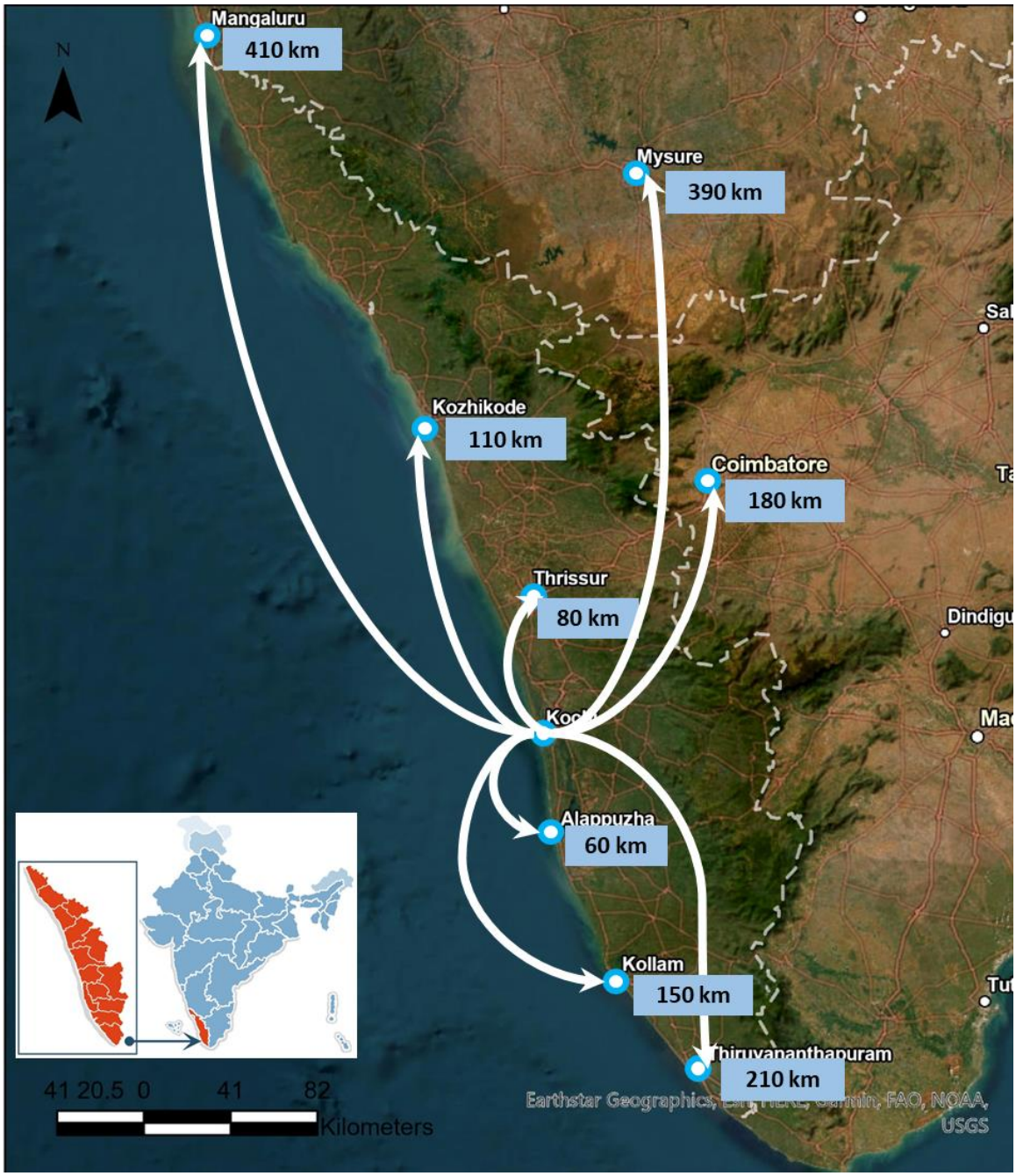


Figure 10 Connectivity Map – Kochi (Source: UMTC)

2.2 STUDY AREA DELINATION AND ADMINISTRATIVE BOUNDARIES

The study area comprises of The Greater Cochin Development Authority GCDA) area and the Goshree Islands Development Authority (GIDA) (as listed below in Table) area spread over 732 sq. km. The study area consists of the Kochi Municipal Corporation, 9 Municipalities and 29 panchayats.

Table 1 Kochi Planning Area Details (Source: Census-2011)

S No.	Administration	S No.	Administration
1.	Kochi Municipal Corporation (KMC)		
2. Municipalities (9)			
2.1	Aluva Municipality	**2.6**	North Paravur Municipality
2.2	Angamaly Municipality	**2.7**	Perumbavoor Municipality
2.3	Eloor Municipality	**2.8**	Thrikkakara Municipality
2.4	Kalamasserry Municipality	**2.9**	Thripunithura Municipality
2.5	Maradu Municipality		
3. Panchayats (29)			
3.1	Pallipuram (GIDA)	**3.16**	Chengamanadu
3.2	Kuzhuppilly (GIDA)	**3.17**	Nedumbasserry
3.3	Edavanakkad (GIDA)	**3.18**	Sreemoolanagaram
3.4	Kottuvally	**3.19**	Kanjoor
3.5	Ezhikkara	**3.20**	Vazhakulam
3.6	Nayarambalam (GIDA)	**3.21**	Kumbalangy
3.7	Alangad	**3.22**	Elamkunnapuzha (GIDA)
3.8	Varappuzha	**3.23**	Njarackal (GIDA)
3.9	Cheranallur	**3.24**	Vadavukode- Puthencruz
3.10	Kadamakkudy (GIDA)	**3.25**	Udayamperoor
3.11	Mulavukadu (GIDA)	**3.26**	Kumbalam
3.12	Kadungalloor	**3.27**	Chellanam
3.13	Choornikkara	**3.28**	Mulamthuruthy
3.14	Edathala	**3.29**	Chottanikkara
3.15	Keezmad		

Table 2 Kochi Planning Area Statement (Source: Census-2011)

DEVELOPMENT AUTHORITIES	AREA (SQ. KM)
GCDA (Including KMC)	632
GIDA	100
TOTAL STUDY AREA	**732**

The **GCDA- Greater Cochin Development Authority**, constituted in the year 1976 under Town Planning Act overlooks the development of the mainland of Ernakulum with 9 municipalities and 21 panchayats in north, east and southern part of the city; while **GIDA- Goshree Islands Development Authority**, regulates the development of the Islands consisting of 8 Panchayats in the study area.

Kochi city is administered by the local civil body- **Kochi Municipal Corporation (KMC)** which governs an area of 94.88 square kilometres. The urban centres towards the eastern side of the city are administered by the respective Municipalities and Gram Panchayats.

Table 3 Kochi Planning Area Statement (Source: Census-2011)

DEVELOPMENT AUTHORITIES	AREA (SQ. KM)
Kochi Municipal Corporation	95
9 Municipalities	162
29 Gram Panchayats	475
TOTAL STUDY AREA	**732**

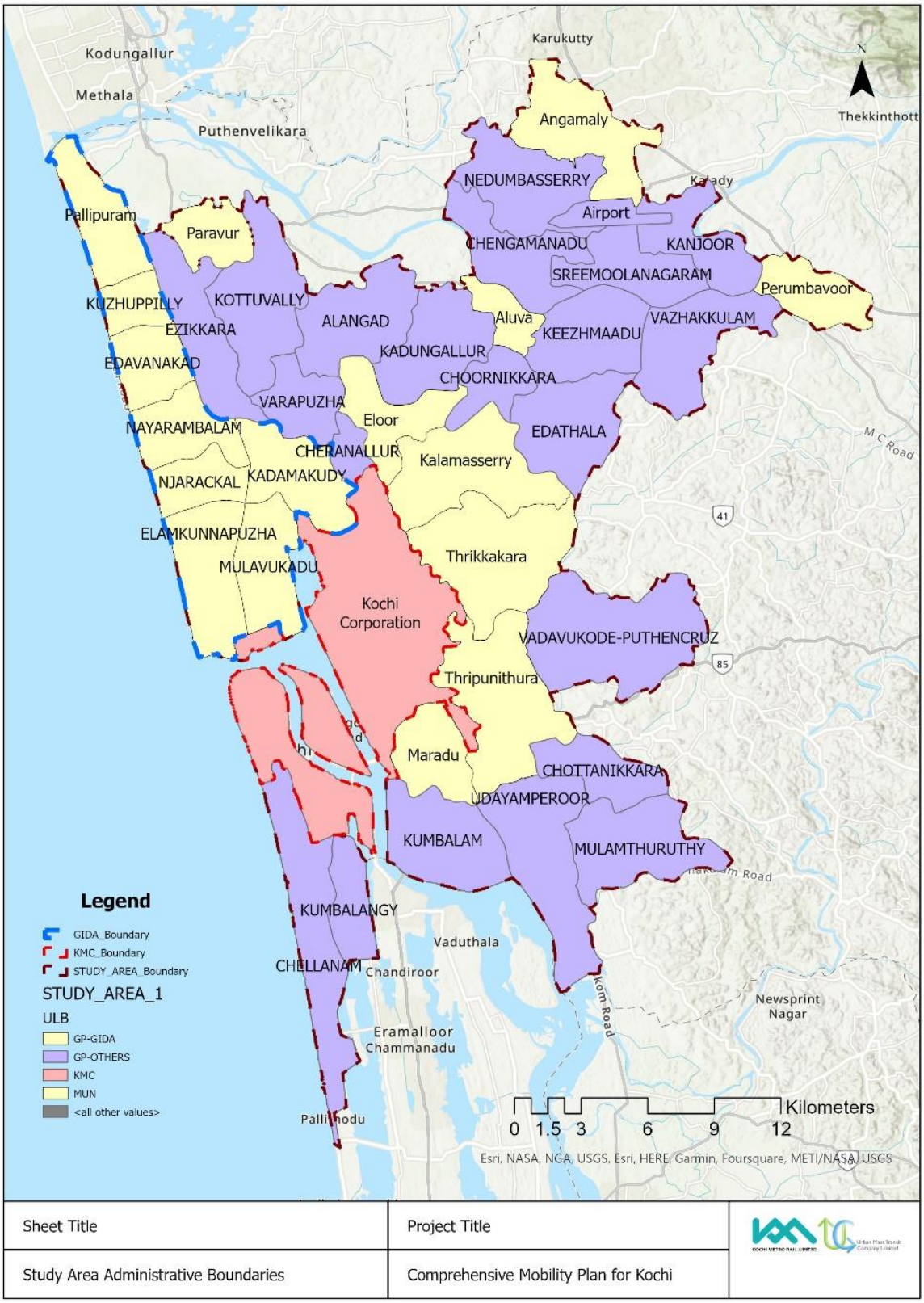


Figure 11 Map Showing the Administrative Boundaries in the Study Area

2.3 URBAN GROWTH PATTERN

The urban development in the study area is observed to be around the nodal point of its seaport & trade settlements i.e., Fort Kochi, Ernakulam Market etc. Over the time, the urban growth has emerged along the major linkages such as Palarivattom-Edapally road, Sahodaran Ayyapan Road, NH66 Bypass etc. Today, the major growth is observed between east and south along the Angamaly, Kakkanad and Kumbalam, along the major highways and roads due to the development of the economic development centres and new linkages.

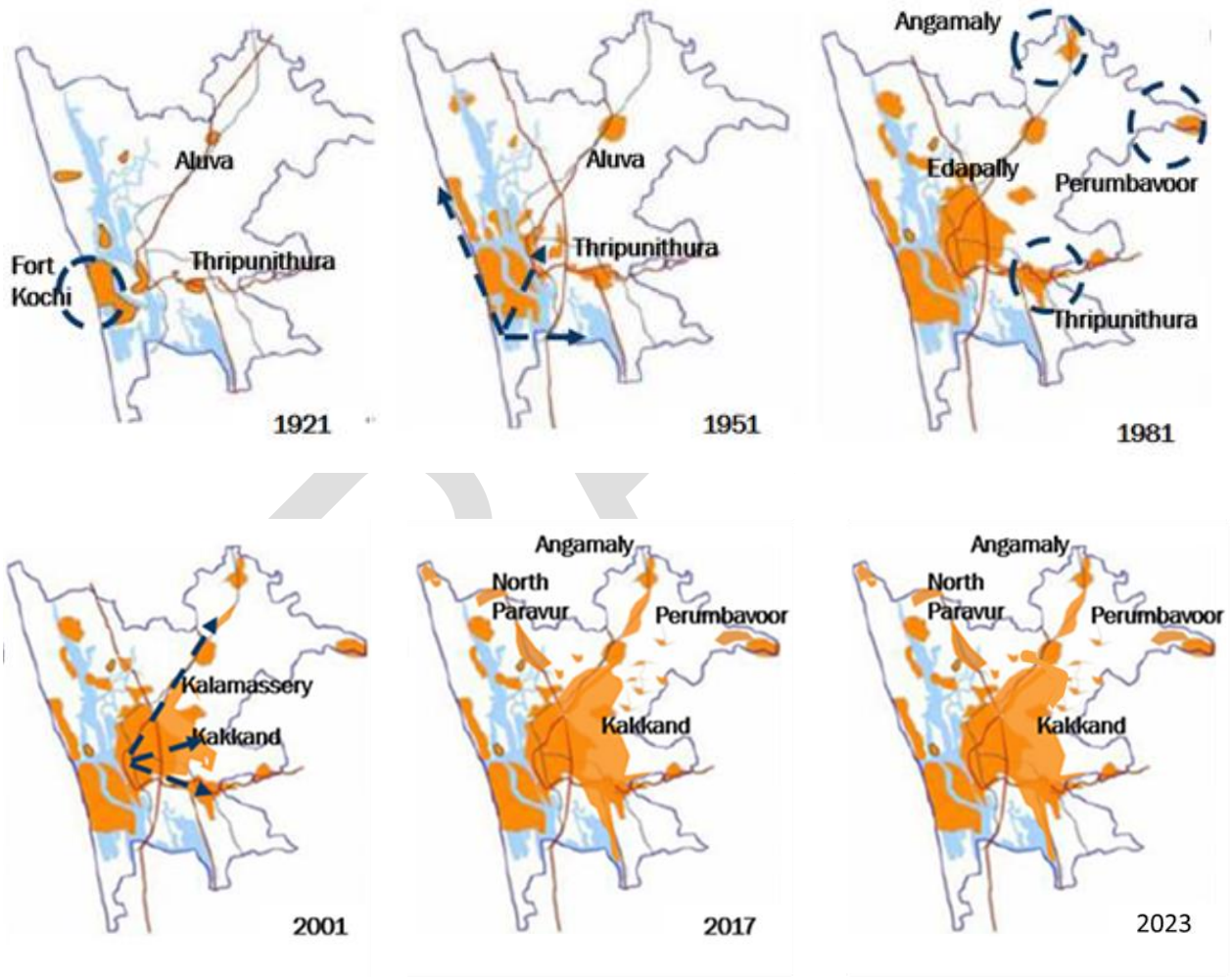


Figure 12 Urban Growth Pattern in the Study Area (Source: City Development Plan, Kochi 2005; IIHS 2017; ISRO –Remote Sensing Data Base)

2.4 DEMOGRAPHIC PROFILE

The population residing in the study area of 732 Sq. Km as per 2011 Census was about 20 lakhs. As per records of the Census of India, the Cumulative Annual Growth Rate (CAGR) is 0.11% for the Kochi Corporation and the study area is found to be 1.41%, indicating the higher growth rates in around the corporation areas, owing to the spread of the economic activity centres in the study area.

Table 4 Kochi Study Area Population Details

POPULATION IN LAKHS	2001	2011	CAGR
Kochi Municipal Corporation	5.96	6.02	0.11%
9 Municipalities	3.80	4.38	1.44%
29 Gram Panchayats	6.83	8.67	2.42%
TOTAL STUDY AREA	**16.58**	**19.07**	**1.41%**

(Source: Census-2011, Draft Master Plan 2040 and UMTC Estimates 2023)

Considering the growth in line with Draft Master Plan 2040 and historic growth rates as per Census records, the projected population in the study area is observed to be 23.63 lakhs. The details of the same are as presented in the table below.

Table 5 Kochi Study Area Population Details for Base Year

DEVELOPMENT AUTHORITIES	2011	2023	CAGR
Kochi Municipal Corporation	6.02	6.67	0.9%
9 Municipalities	4.38	5.41	1.8%
29 Gram Panchayats	8.67	11.54	2.4%
TOTAL STUDY AREA	19.07	23.63	1.8%

(Source: Census-2011, Draft Master Plan 2040 and UMTC Estimates 2023)

The city is observed to have a significant share of floating population. Fort Kochi, Vypin and Kakkanad region being important IT & tourism nodes attracts migrant population in addition to the floating population. Thus, it becomes crucial to consider the same while planning and estimating the urban and population growth for the horizon years.

Table 6 Study Area Population Density Details in People Per Sq. km (PPSQKM)

DEVELOPMENT AUTHORITIES	2011	2023
Kochi Municipal Corporation	6345	7034
9 Municipalities	2703	3342
29 Gram Panchayats	1825	2430
TOTAL STUDY AREA	2605	3229

(Source: Census-2011, Draft Master Plan 2040 and UMTC Estimates 2023)

The population density of the city is observed to be 7034 ppsq.km., accounting to be densest area in the study against the over density of 3229 ppsq.km. for the whole study area in 2023.

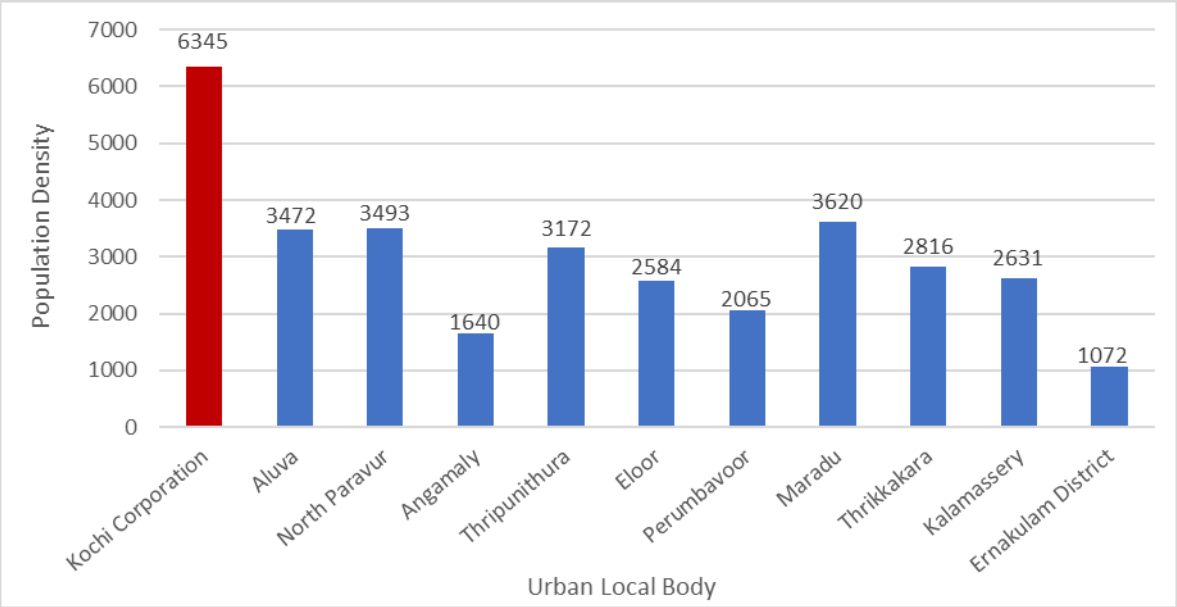


Figure 13 Study Area Population Density Details (Source: Draft Master Plan 2040 and UMTC Estimates 2023)

The average household size in Kochi is 3.9, out of which 51% of resident population are female and 49% male. As per census 2011 the sex ratio is 1029 females per 1000 males in the urban areas.

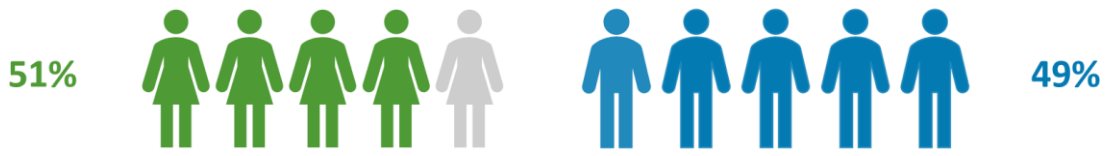


Figure 14 Population Sex Ratio

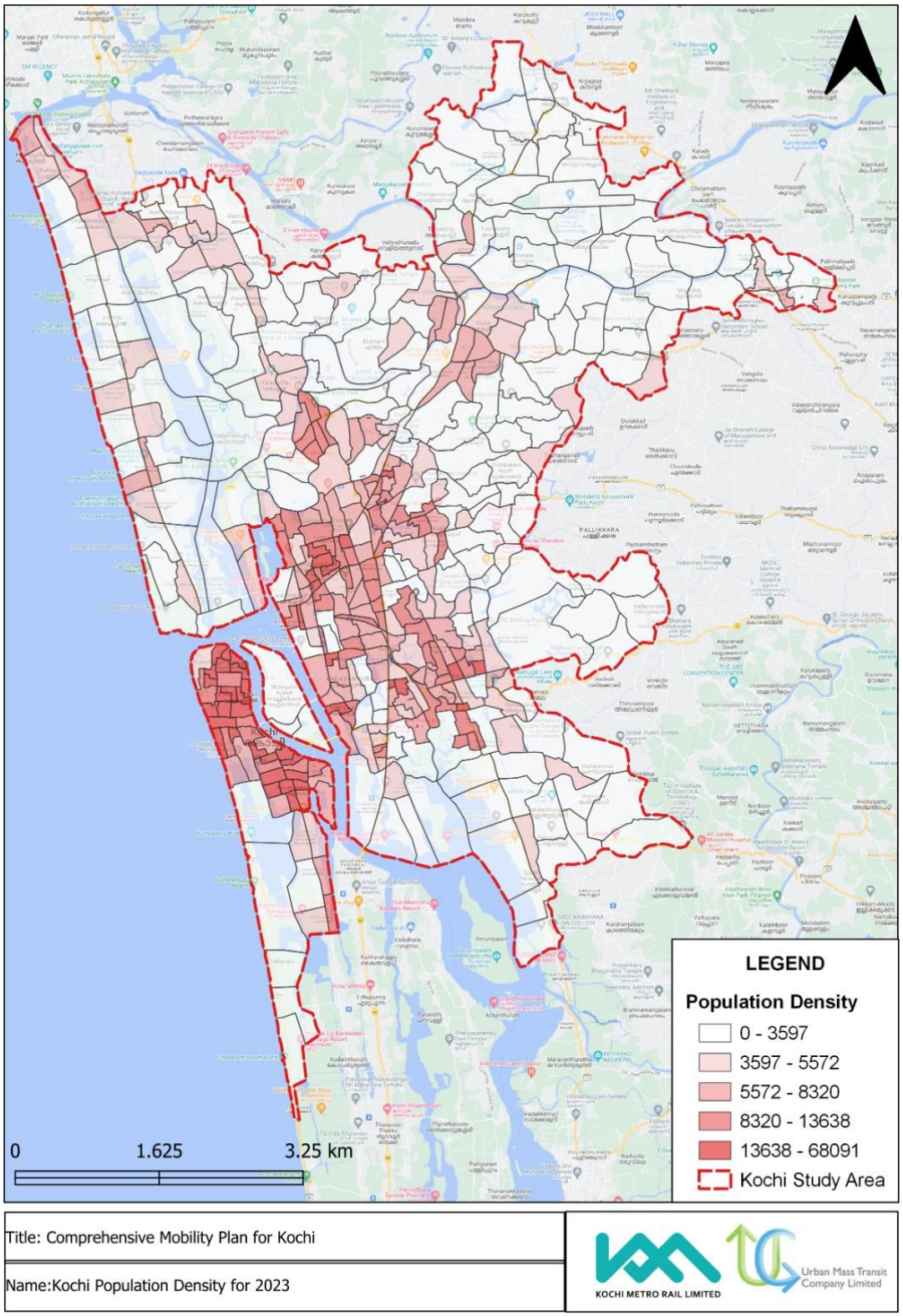


Figure 15 Population Density 2023 (Source: Draft Master Plan 2040 and UMTC Estimates 2023)

2.5 LANDUSE

The share of transportation accounts to about 12.52% in the total area of Kochi Corporation which is in line with the URDPFI guidelines (12-14% of Developed Area), indicating decent share of transportation in land use mix.

Table 7 Land use Distribution in Kochi Corporation

LAND USE	EXISTING LAND USE (2020)	PROPOSED LAND USE (2040)
Dry Agricultural Land Use	4.35%	0.885%
Commercial	4.35%	1.391%
Mixed Use	3.50%	2.898%
Industrial & IT Parks	1.35%	1.002%
Residential	36.53%	36.362%
Public & Semi-Public	0.41%	7.430%
Traffic & Transportation	12.52%	12.679%
Vacant Land	6.73%	
Solid Waste Management	0.01%	
Water Bodies	18.61%	18.855%
Buffer	-	1.370%
Wetlands / Eco-Sensitive/Conservation areas	2.29%	2.656%
Paddy	0.03%	-
Educational	1.68%	-
Health Services	0.60%	
Heritage	0.02%	0.938%
Recreation & Tourism Zone	1.25%	1.623%
Communication	0.03%	
Religious	1.05%	
Transit Oriented Development	-	11.488%
Govt. Property (Railway property, State and Central Govt.)	3.11%	
Public Utilities	0.18%	0.358%
Others	1.40%	
Special Zone A - Wholesale Market	-	0.011%
Special Zone B - Urban Agriculture Facilitation Centre	-	0.001%
Special Zone C - IT Industries	-	0.053%
	100.00%	**100.000%**

(Source: Draft Master Plan-2040)

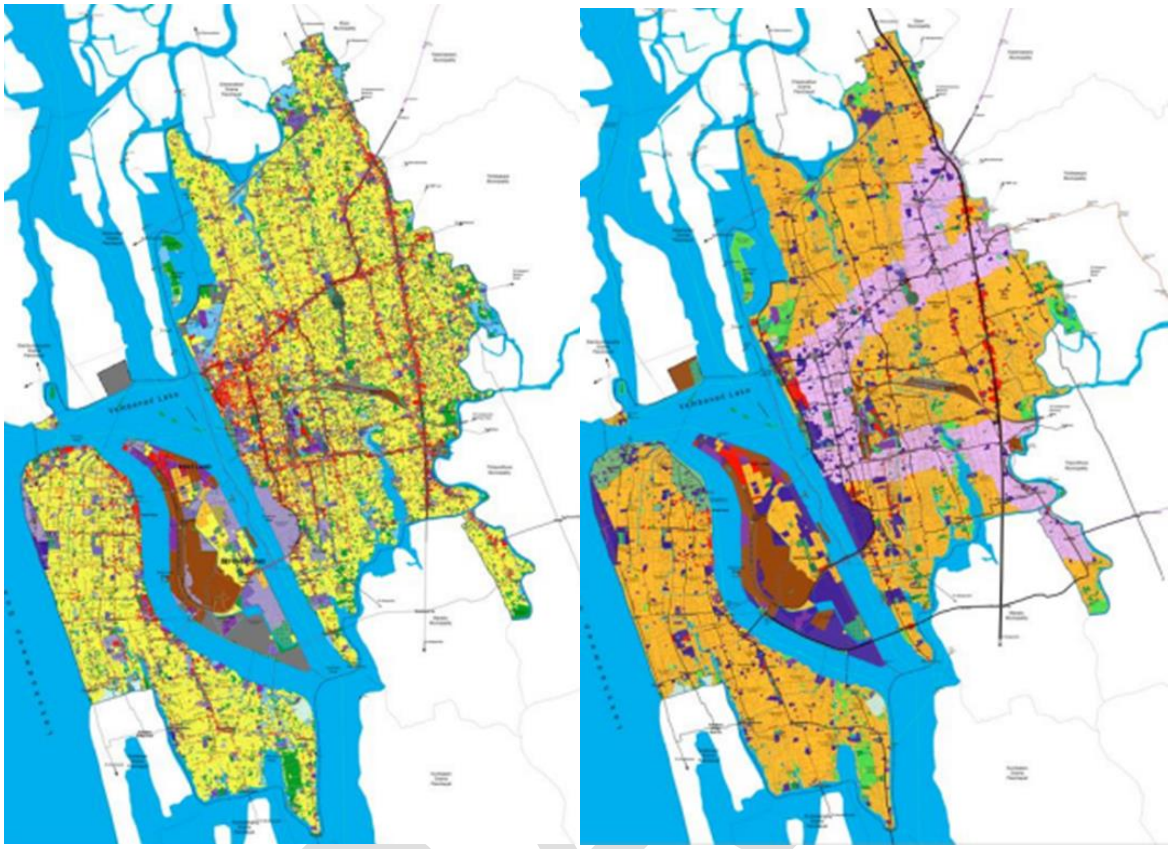


Figure 16 Existing Land use of City-2020 (Left) and Proposed Land use of City-2040 (Right) (source- Draft Proposed Master Plan,2040

The proposed draft Master Plan 2040 prioritizes 11.48% i.e., 1090 Ha of the land within the Kochi Corporation limits for Transit Oriented Development along the metro corridor and its extension, taking a 500m buffer on either side of the alignment of the metro line. This area is expected to be developed vertically incorporating the concepts of multi-modal integration, NMT provisions, active and engaging recreational spaces while strengthening the ridership of the Mass Rapid Transit (MRT) System.

2.6 ECONOMIC PROFILE

The study area of Kochi is the most sought-after destination for the employment in the state owing the presence of Petroleum refining, construction, plywood, fishing, furniture, textiles and wearing apparel, mining and quarrying, food processing, cement manufacturing, building and maintenance of ships and boats, information technology, healthcare, hospitality, transportation, storage, wholesale and retail and communication industrial sectors. It is the economic and commercial center of the state.

The steady expansion of economic activities within the city as well as in the hinterlands and extensive regional network of communication and transportation facilities has enabled the city of Kochi to exert strong economic influence beyond its administrative boundaries.

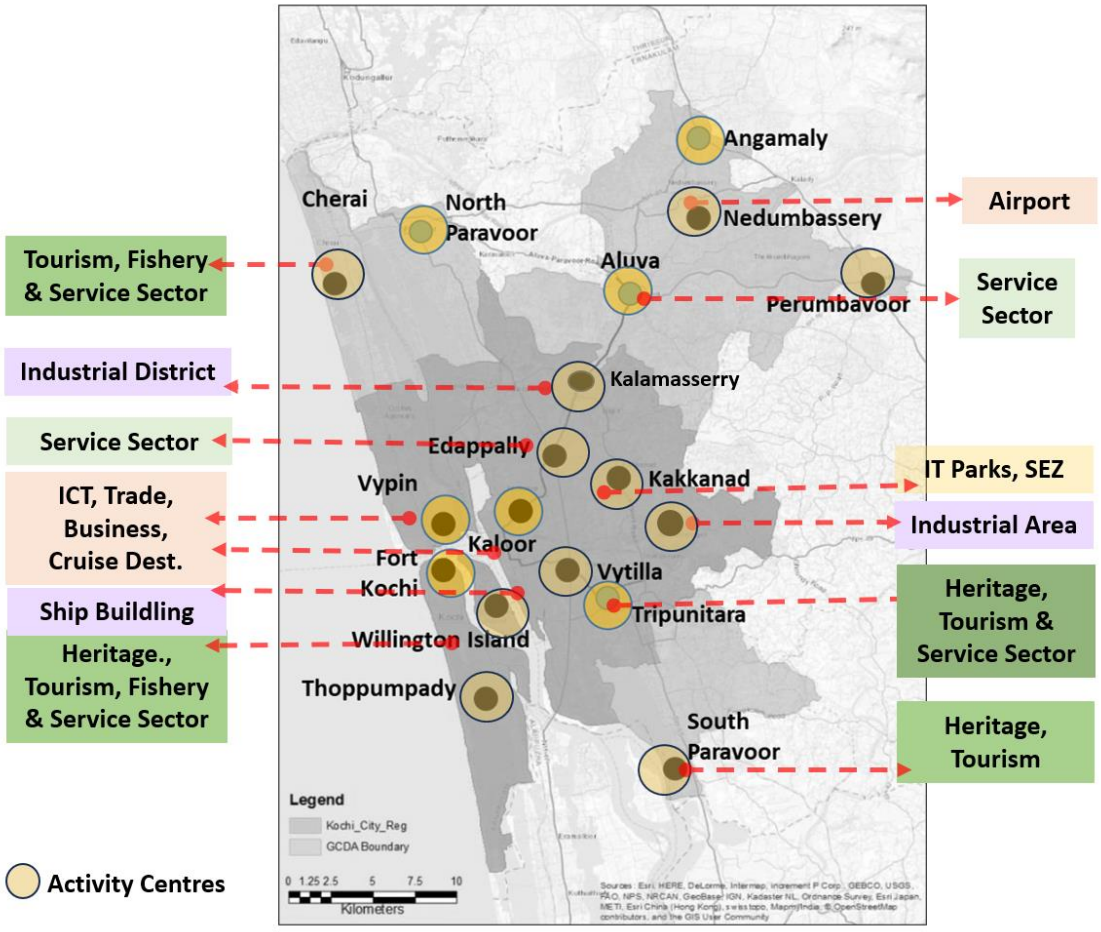
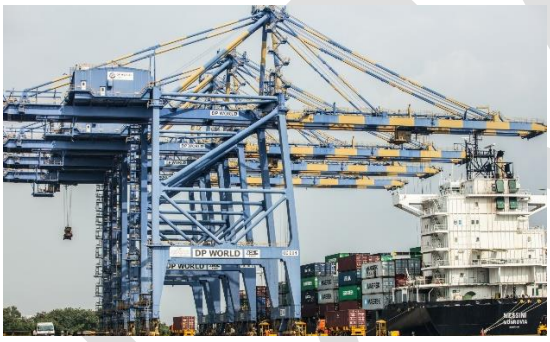


Figure 17 Major Economic Activity Generation Nodes in The Study Area (Source: Primary and Secondary Data Assessment, 2022)

Commercial activities are mainly concentrated in the Central Business District (CBD) of the City of Kochi. The central city of Kochi comprising of Broadway, Ernakulam market, Mather bazaar, cloth bazaar etc. is major hub of wholesale and retail trade. Sea foods, spices, tea coffee, nuts and coir products comprise of the major export commodities.

Beyond the Corporation limits and within the GCDA area at Kakkanad is one of the major destinations for IT & ITES companies. Technology and industrial campuses viz., Infopark, Cochin Special Economic Zone, KINFRA Export Industrial Park, Industrial belt in Eloor, Cochin Shipyard Limited, the largest shipbuilding and repair facility in India, BPCL, FACT, International Container Transhipment Terminal, Cochin Port Trust are the major employers in the study area. The IT Park employs more than 40,000 professionals.

Kochi Infopark



International Container Transhipment Terminal

GAIL India Limited

Cochin Shipyard Limited

BPCL

Figure 18 Major Employment Generators in the Study Area

Tourism has contributed heavily to the economy of Kochi and is the highest contributor (10%) towards the State's GDP and provides 23.5% direct and indirect employment in the state. Kochi attracts the maximum foreign (45%) and domestic (22%) tourists in the state. Fort Kochi, Mattancherry, Mangalavanam mangroves, beaches and backwaters are the major attractions in the region. Kochi is also gaining prominence in MICE events (Meetings, Incentives, Conferences and Exhibitions) and tourism because of the booming resort and convention centre infrastructure.

Work Participation Ratio (WPR) in the study area is 37.91%. The Kochi Corporation has a WPR of 38.03% as per 2011 census, which increased from 34.51 percent as per 2001 census.

This is an indicator of primary sector despite the rise of tertiary sector opportunities in the rural areas of the district. The WPR is observed to be higher than the state average ratio of 34% owing to the prominence of the economic activities in the region.

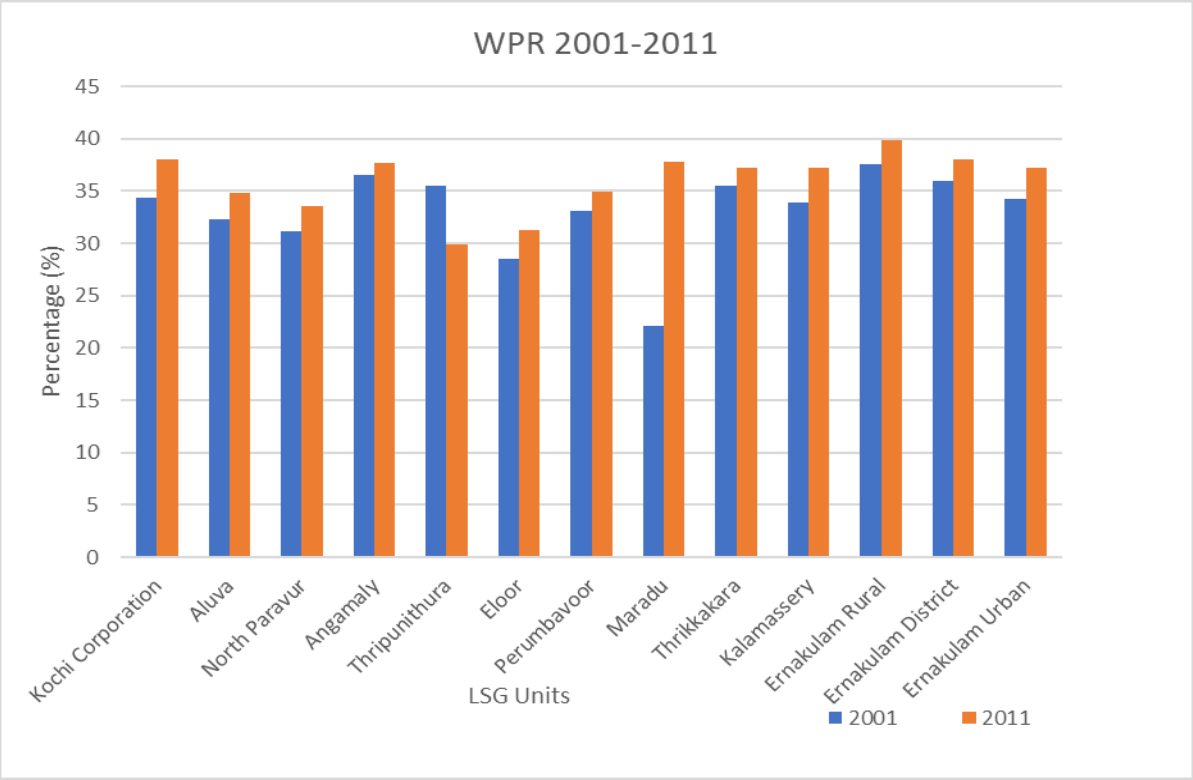


Figure 19 Temporal change of WPR of Corporation, District and LSGs (2001-2011) ((Source: Master Plan (Draft) for Kochi Municipal Corporation Area -2040).

The influence of the study area on other parts of the state is evident from the fact that the size of the floating population to the city is as high as 46% of the resident population *(Master Plan (Draft) for Kochi Municipal Corporation Area -2040).*

2.7 REGIONAL CONNECTIVITY

Kochi has a dense and extensive transportation network that connects it to interstate destinations and far beyond by road, rail, waterway, and air.

2.7.1 ROAD NETWORK REGIONAL CONNECTIVITY

A well-established regional connectivity is observed in the city with the Highways. Major regional links available in the city are as follows:

1. National Highways viz.,
   NH-66 (Thalappady –Parassala),
   NH-544 (Walayar- Edapally),
   NH-85 (Kundannur– Bodhimettu),
   NH-966A (Kalamasserry –Vallarpadom and
   NH-966B (Kundannur – Wellington Island).
2. State Highways viz.,
   SH-15 connects the city to Kottayam, Pala, Kumily, Changanacherry, Pathanamthitta etc.
   SH-16 (Aluva-Munnar Highway)
   SH-41 (Palarivattom-Thekkady Road) provides a corridor to the eastern parts of the district.
   SH-63 (Vypeen- Pallipuram Road) and
   SH-66 (Alappuzha – Thoppumpady road)
   SH-1 Main Central Road graces through the study area boundary and touches two prominent satellite town Angamaly and Perumbavoor

Table 8 List of Major Regional Roads in the city

SN	HIGHWAY	FROM	TO	LENGTH (km)
1	NH-66	North Paravur	Kumbalam	37
2	NH-544	Edapally	Angamaly	25
3	NH-85	Maradu	Shasthamugal	11
4	NH-966A	Vallarpadam	Kalamasserry	15
5	NH-966B	Wellington Island	Kundannur Junction	6
6	SH-15	Vyttila	Poothotta	18
7	SH-16	Aluva	Perumbavoor	17
8	SH-41	Palarivattom	Manakakkadavu Bridge	10
9	SH-63	Vypin	Munambam	25.5
10	SH-66	Chellanam	Thoppumpady	19
11	Seaport – Airport Road	Irumpanam Junc./ Karingachira	Kalamasserry	13

Q

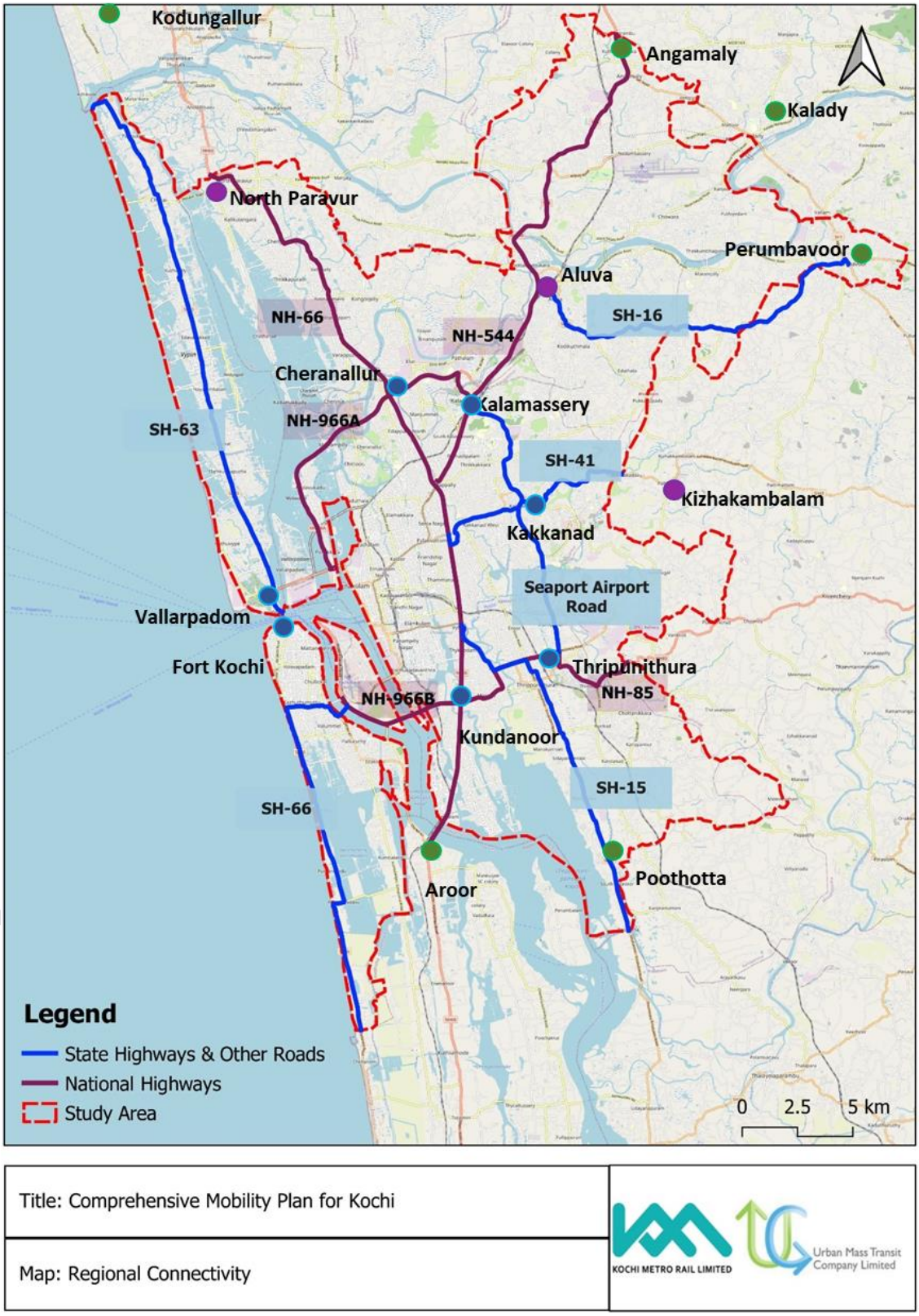


Figure 20 Road Network showing Major Road (Primary Surveys, 2022)

2.7.2 RAIL BASED REGIONAL CONNECTIVITY

The rail transport in the city is administered by the Southern Railway Zone of Indian Railways. The total length of the rail line within the study area is 95 kilometres. The major stations are Ernakulam Junction (South) and Ernakulam Town (North). Other major stations in the study area are Aluva, Thripunithura, Edapally, Kalamasserry, Kumbalam, Angamaly and Cochin Harbour Terminus in Willington Island.

2.7.2.1 ERNAKULAM JUNCTION RAILWAY STATION

Ernakulam Junction railway station (also known as Ernakulam South) is the busiest railway junction station in South India and second largest in terms of passenger revenues in Kerala.

This station handles about 30 thousand passengers and 128 scheduled trains daily as per the railway records, 2022.

Figure 21 Some of the Major Railway Stations in the Study Area viz. Ernakulam Junction, Aluva, Thripunithura, & Ernakulam Town (Clockwise) (Source: Various)

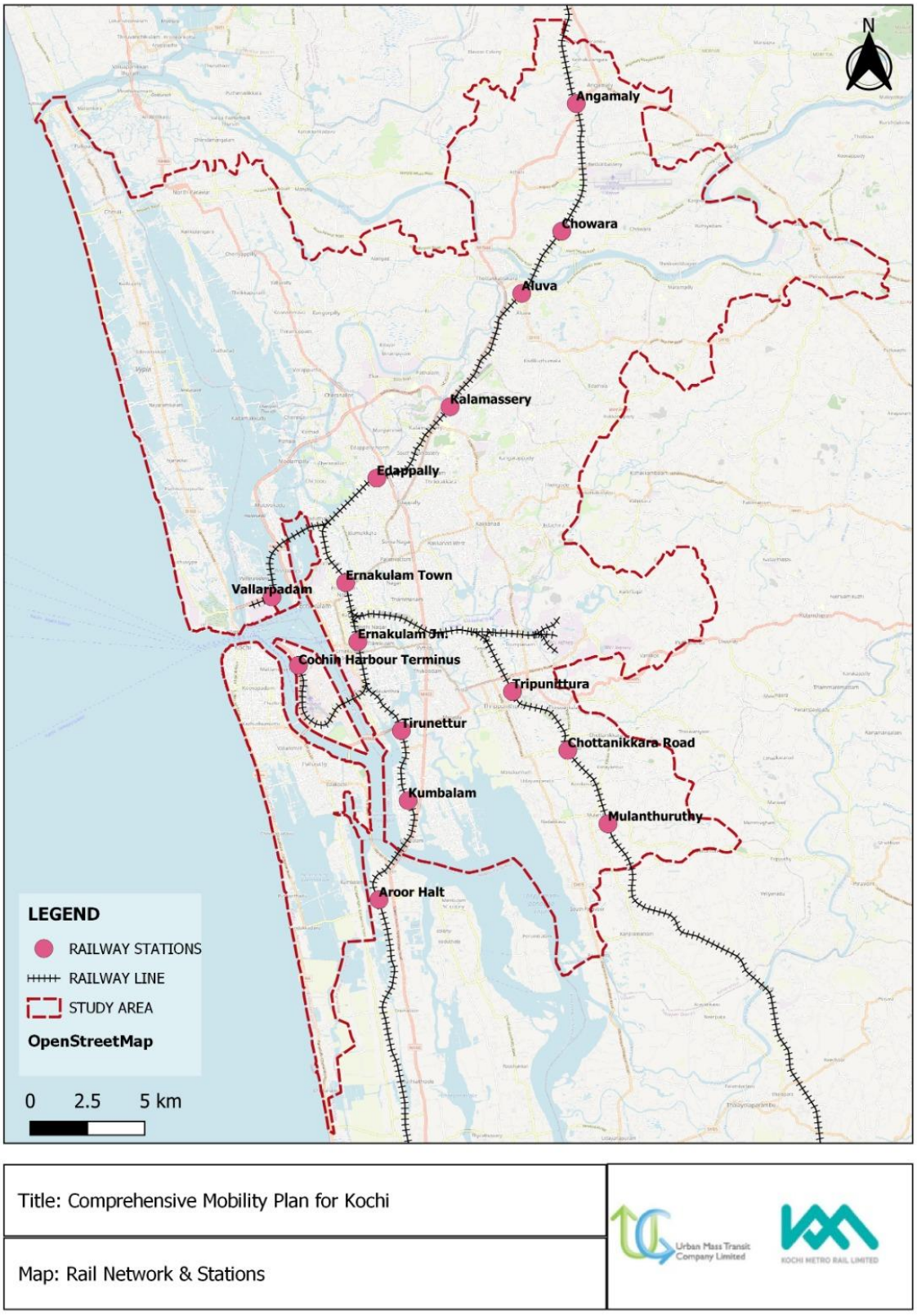


Figure 22 Railway Network and stations in the study area

2.7.2.2 ERNAKULAM TOWN RAILWAY STATION

Ernakulam Town railway station is situated between Kaloor and Kacherippady.

This station handles about 13 thousand passengers and about 95 scheduled trains daily as per the railway records, 2022.

2.7.2.3 TRIPUNITHURA RAILWAY STATION (TRTR)

Thripunithura railway station is a railway terminal located at Thripunithura, Kochi. Thripunithura is the entry point for travellers from Idukki district, which is not connected by rail network.

This station handles about 4 thousand passengers and about 29 scheduled trains daily as per the railway records, 2022.

2.7.2.4 ALUVA RAILWAY STATION

Aluva Railway Station is a convenient station to alight for passengers traveling to Kalamasserry, North Paravoor, Idukki district, Kodungallur, Perumbavoor, Kakkanad Kizhakkambalam, Kothamangalam and Muvattupuzha. It also serves passengers to and from Cochin International Airport.

This station handles about 13 thousand passengers and about 126 scheduled trains daily as per the railway records, 2022.

2.7.2.5 ANGAMALY RAILWAY STATION

It Is the nearest railway station of Cochin International Airport. The proposed rail line to Sabarimala is starting from here.

This station handles about 6 thousand passengers and about 48 scheduled trains daily as per the railway records, 2022.

The other minor stations in the study area are as follows:

- Ernakulam Goods (ERG) (not operational)
- Tirunettur (TNU)
- Mattancherry Halt (MTNC) (not operational)
- Cochin Harbour Terminus (CHTS) (not operational)
- Kumbalam (KUMM)
- Edapally (IPL)
- Chottanikkara Road (KFE)
- Aroor Halt (AROR)

The railway system provided services to 65 thousand passengers daily as per the data received from Southern Railway as of Dec 2022, indicating a strong regional interaction.

2.7.3 BUS BASED REGIONAL CONNECTIVITY

Kochi is well connected to other parts of the state using KSRTC & private bus services. Kochi city and the neighbouring satellite towns mainly depend upon the bus transport, for meeting the travel demands of majority of the people.

The KSRTC services operate from Ernakulam, Angamaly, Perumbavoor, Muvattupuzha, Kothamangalam, Piravom, Aluva, North Paravoor, and Koothattukulam cater to major share of suburban services.

KSRTC operates 998 sub-urban and regional services for the study area.

Figure 23 KSRTC Fleet Types

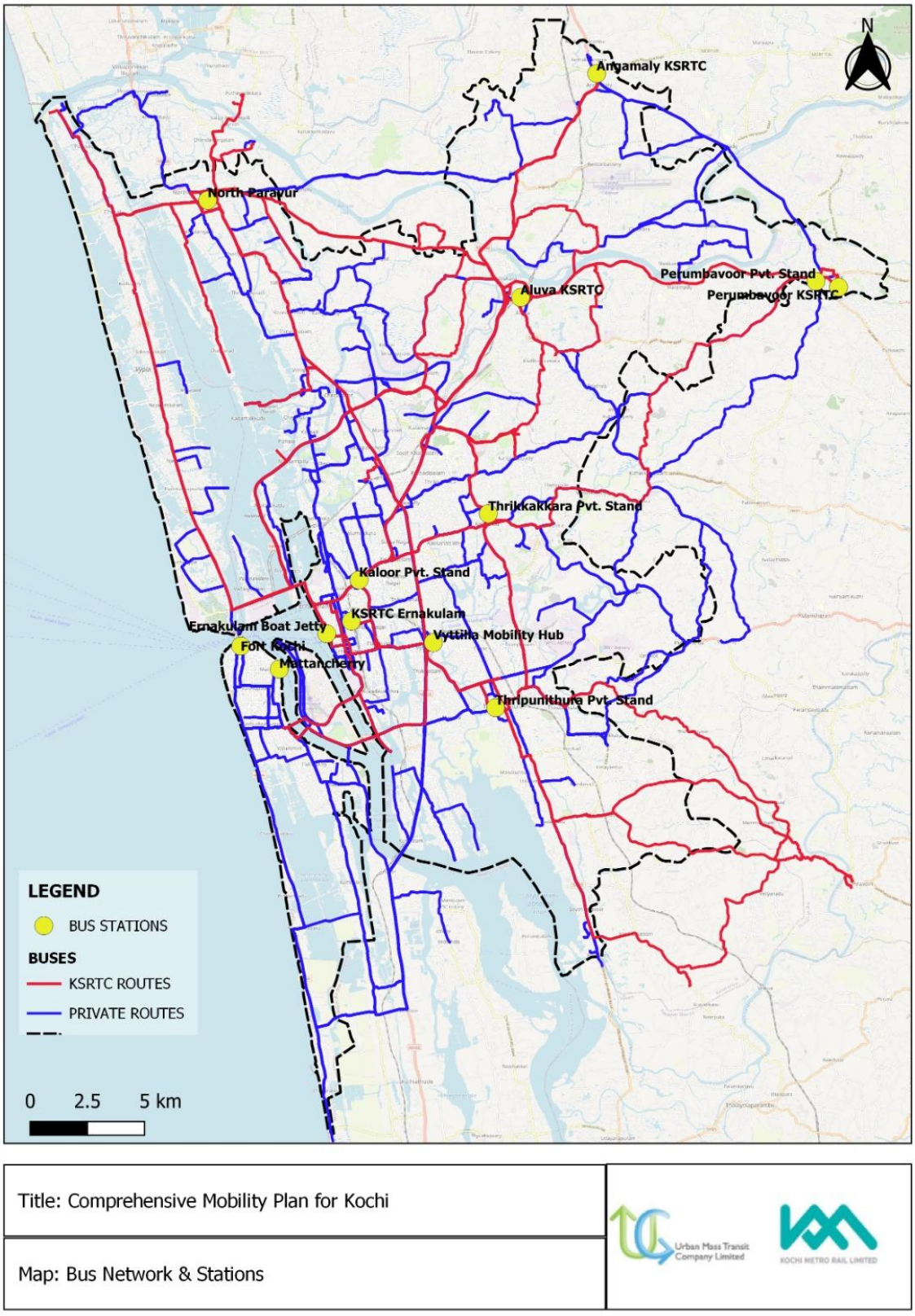


Figure 24 Regional Bus Network and stations in the study area

Private operates run 428 sub-urban and regional services connecting study area with its surroundings as per RT0, 2022 records.

Figure 25 Colour Coded Private Bus Services in Kochi - Blue (Rural Services), Maroon (Limited Stop Services)

Table 9 Bus Services Details (Source: Motor Vehicle Department)

TYPE OF SERVICE	MINIMUM FARE (₹)
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

2.7.4 AIR BASED REGIONAL CONNECTIVITY

The Cochin International Airport (CIAL) is the largest and busiest airport in Kerala, located at Nedumbassery 28 km north of Kochi city.

It caters to approximately 30,000 passengers daily through 83 flights. The airport on an average handles 13000 International passengers and 15000 domestic passengers.

The airport has the facility to accommodate up to 1500 cars in its solar panel shaded car parking facility. A charging facility is also provided for electric cars in the parking area.

Figure 26 Cochin International Airport Limited (CIAL) (Source: https://www.cial.aero)

International Terminal (T3) expansion under development shall added to the existing apron area of the International Terminal and 5 lakh square feet to the terminal building with the development of five-star hotel within the premises, Commercial Zone in front of the International Terminal, Transit Accommodation, Golf Villas, and sporting facilities.

2.7.5 WATER BASED REGIONAL CONNECTIVITY

The National Waterway – 3 i.e., the Kollam – Kottapuram Waterway passes through the region, which inland navigational route.

In addition to the main stretch, Champakkara and Udyogamandal canals are connecting the industrial centres of Kochi to Port Inland Waterways Authority of India (IWAI) under the Ministry of Shipping are under development of national waterways.

Cochin Port is one of India major ports situated in a strategic location, the port offers calm and tranquil channels for ships year-round, even during the Monsoon season. It enjoys excellent connectivity through both rail and road networks. The primary shipping channel divides the port into Ernakulam and Mattancherry channels.

The port provides a range of cargo handling facilities,

- wharfs at Mattancherry and Ernakulam,
- Container Terminal at Vallarpadam,
- LNG Terminal at Puthuvype, an offshore Single Point Mooring (SPM), and a dedicated cruise terminal.

Approximately 40 cruise vessels visit Cochin Port annually. The figure below illustrates several proposed projects within the port.

The city has immense potential to enhance and build upon its connectivity options further.

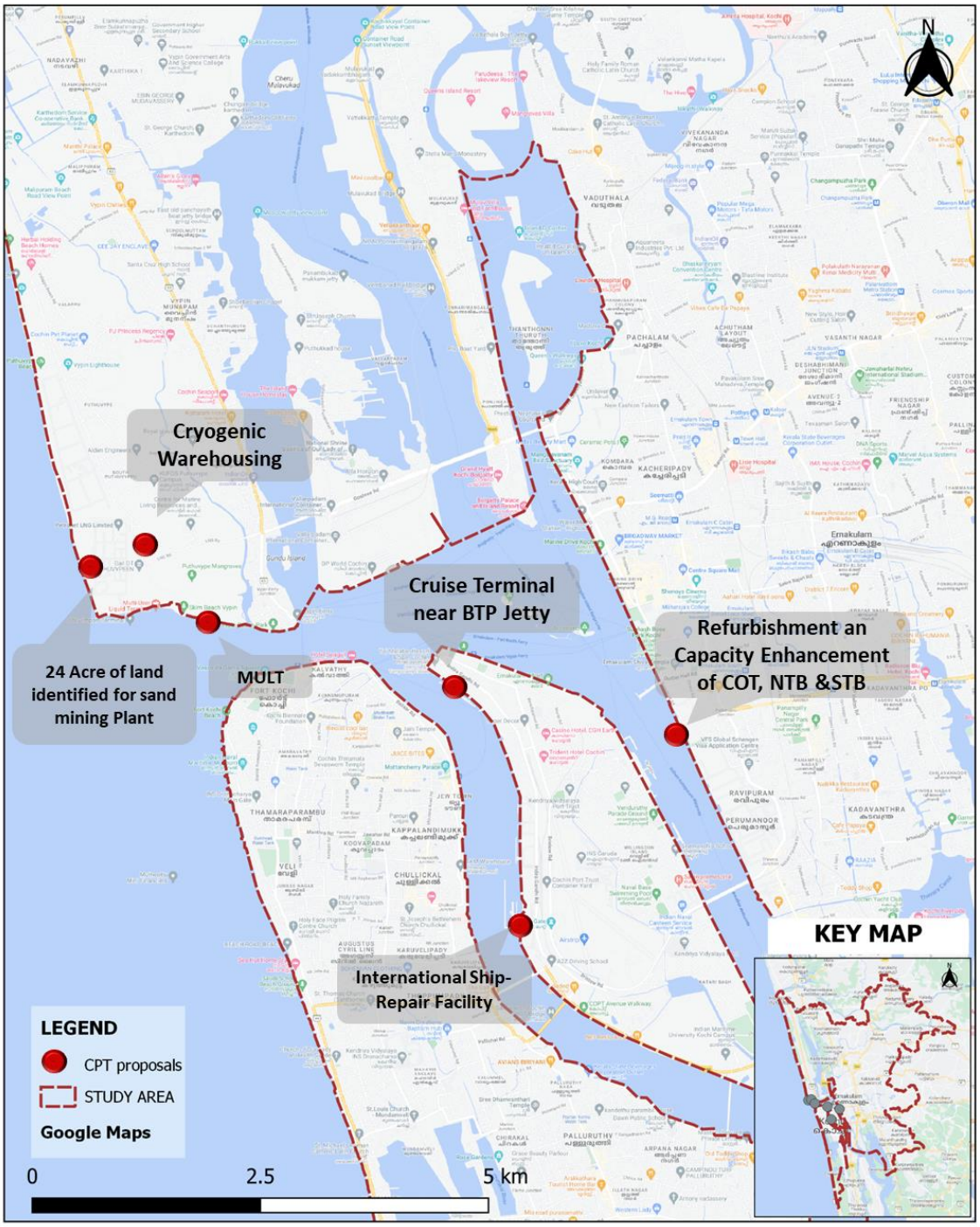


Figure 27 Locations of Proposed Projects in Cochin Port (Source: Draft Proposed Master Plan,2040)

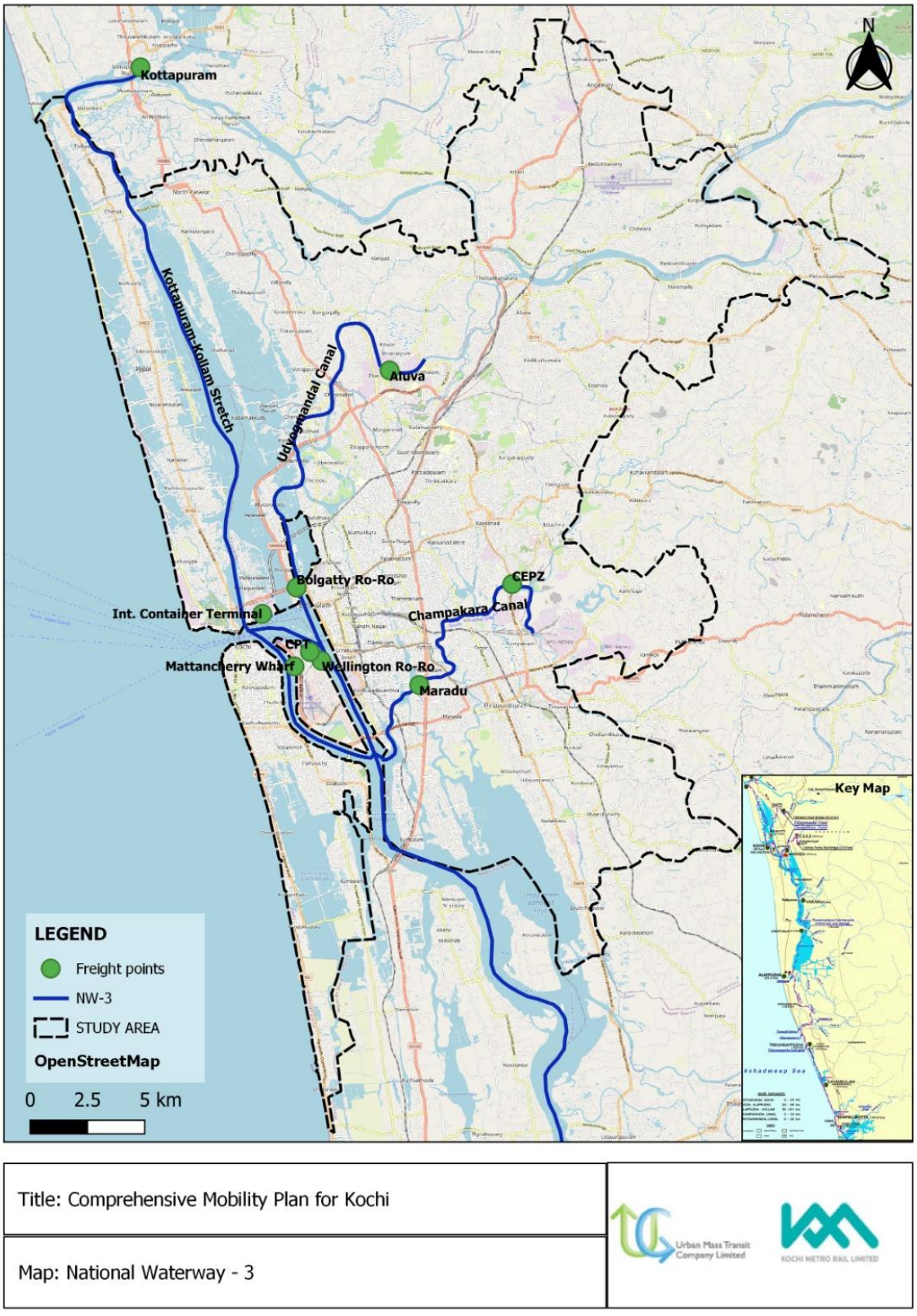


Figure 28 National Waterway in the study area

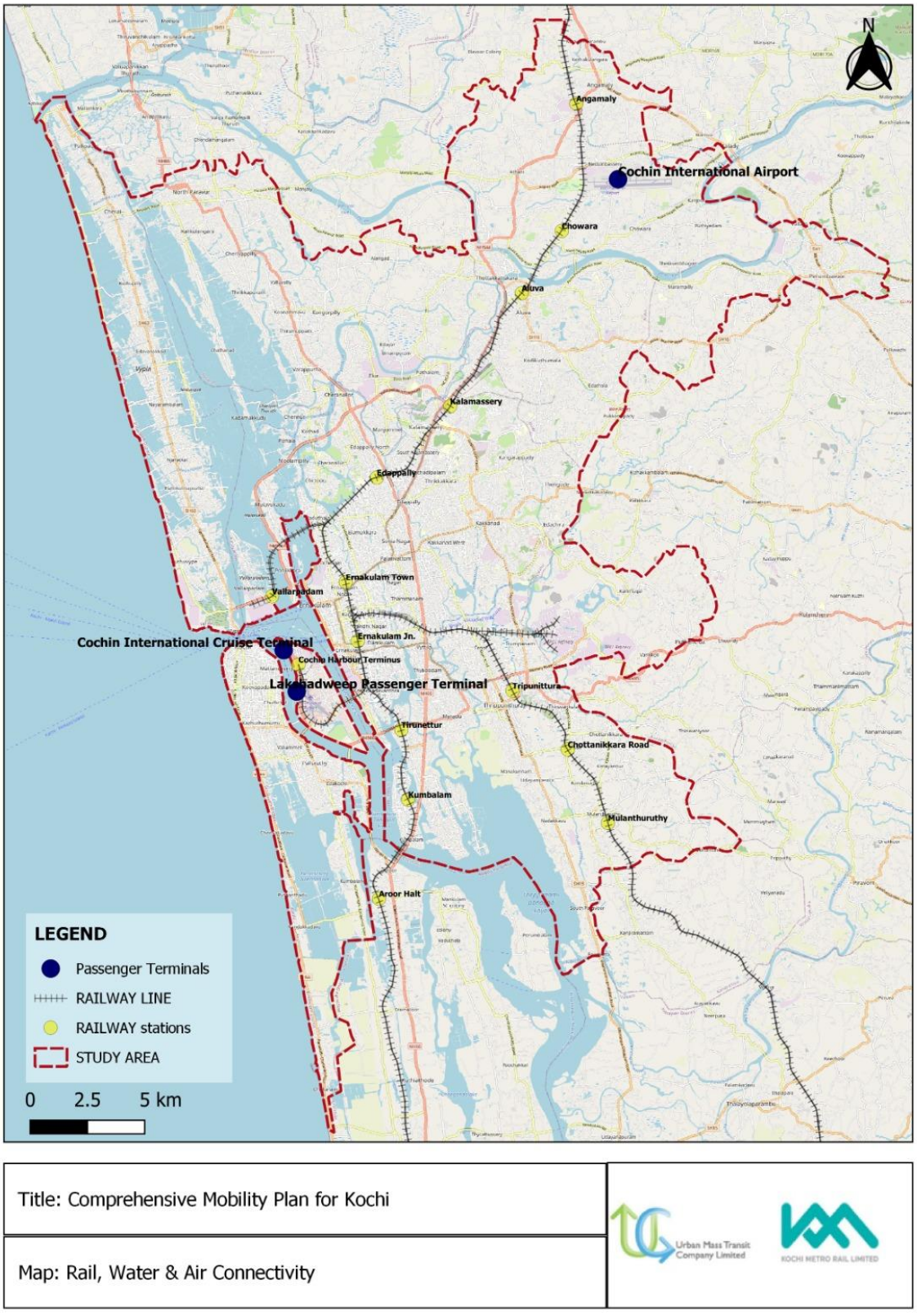


Figure 29 Seaport and Terminals in the study area

2.8 VEHICLES REGISTERED

The study area has registered about 18.46 lakhs vehicles as of August 2023. The study area together has the highest number of vehicles registered in the state, while Ernakulam RTO alone stands third in the State followed by Thiruvananthapuram and Kozhikode, owing to the availability of alternative public transportation options.

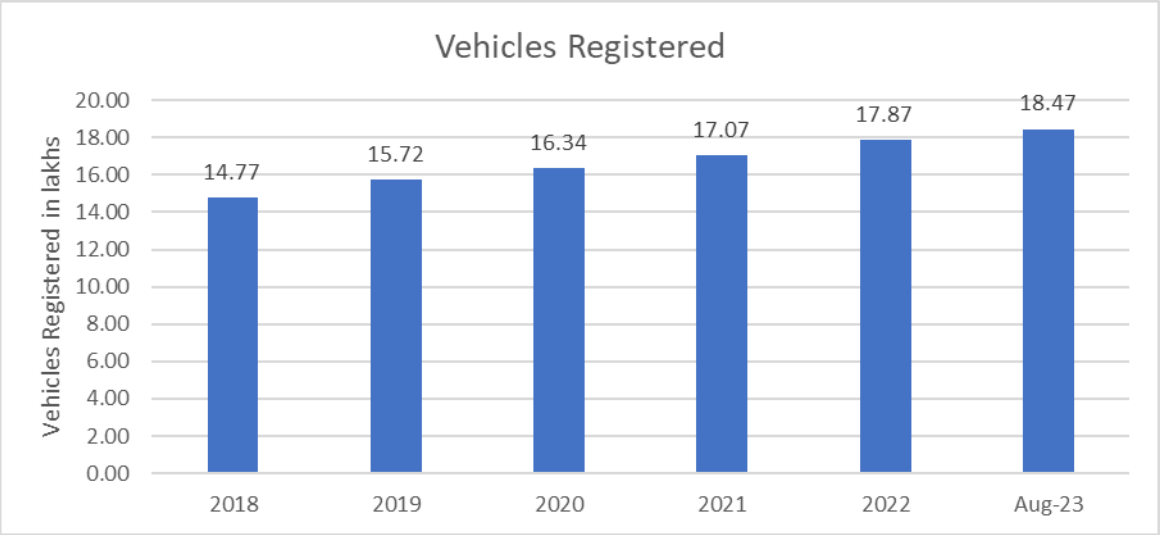


Figure 30 Year Wise Total Vehicles Registered (Source: RTO, 2023)

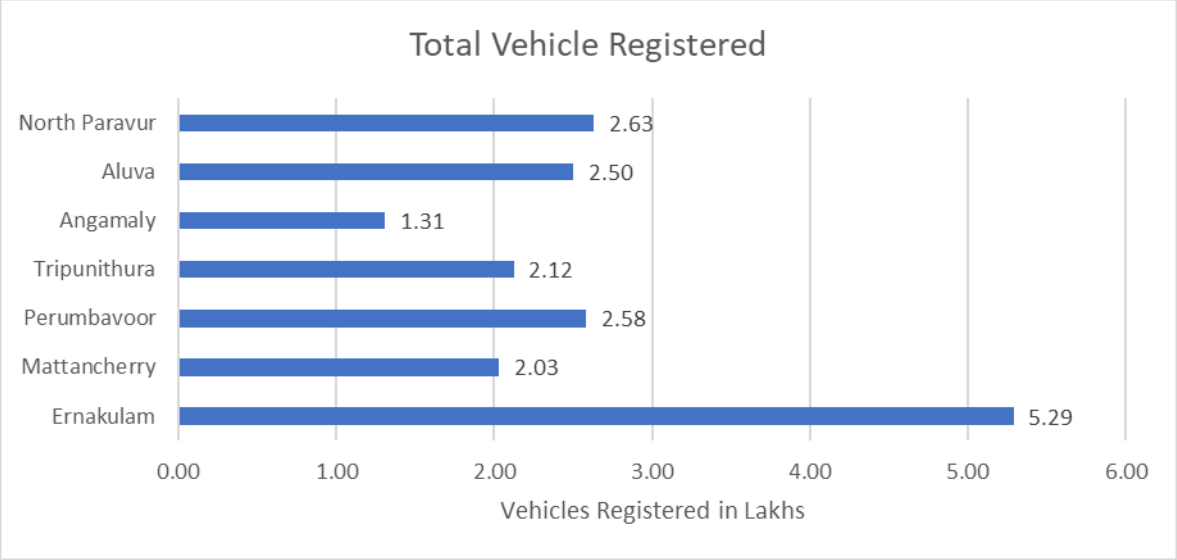


Figure 31 Zone Wise Total Vehicles Registered in Study Area (Source: RTO, 2023)

Ernakulam shows the highest vehicle registration in the study area followed by North Paravur and Perumbavoor. The annual growth rate of vehicles registered has reduced from 6.5% in 2019 to 3.4% in 2023 due to 2018 floods and the COVID-19 pandemic.

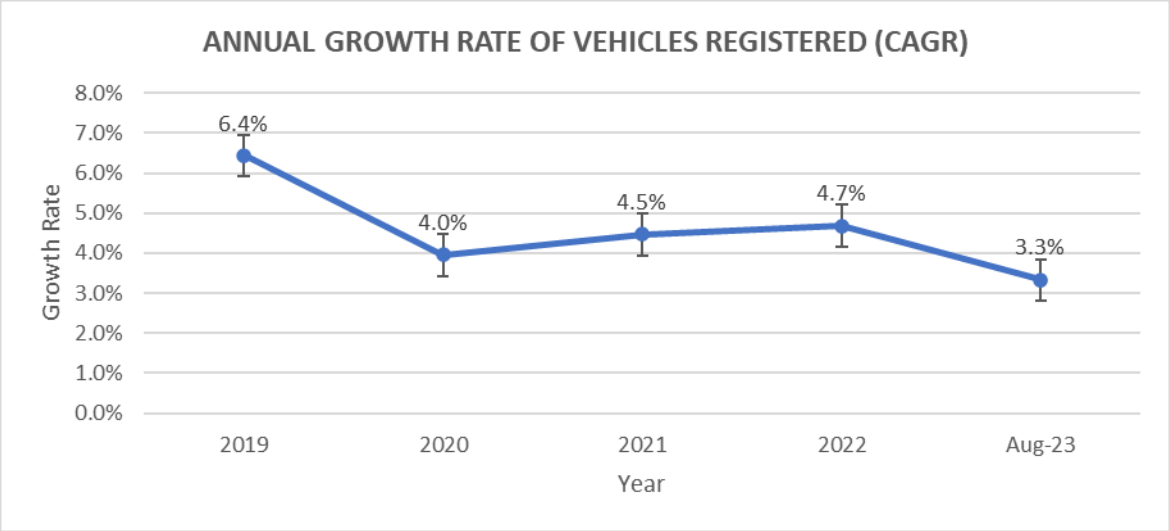


Figure 32 Annual Growth Rate of Vehicles Registered in Study Area (Source: RTO, 2023)

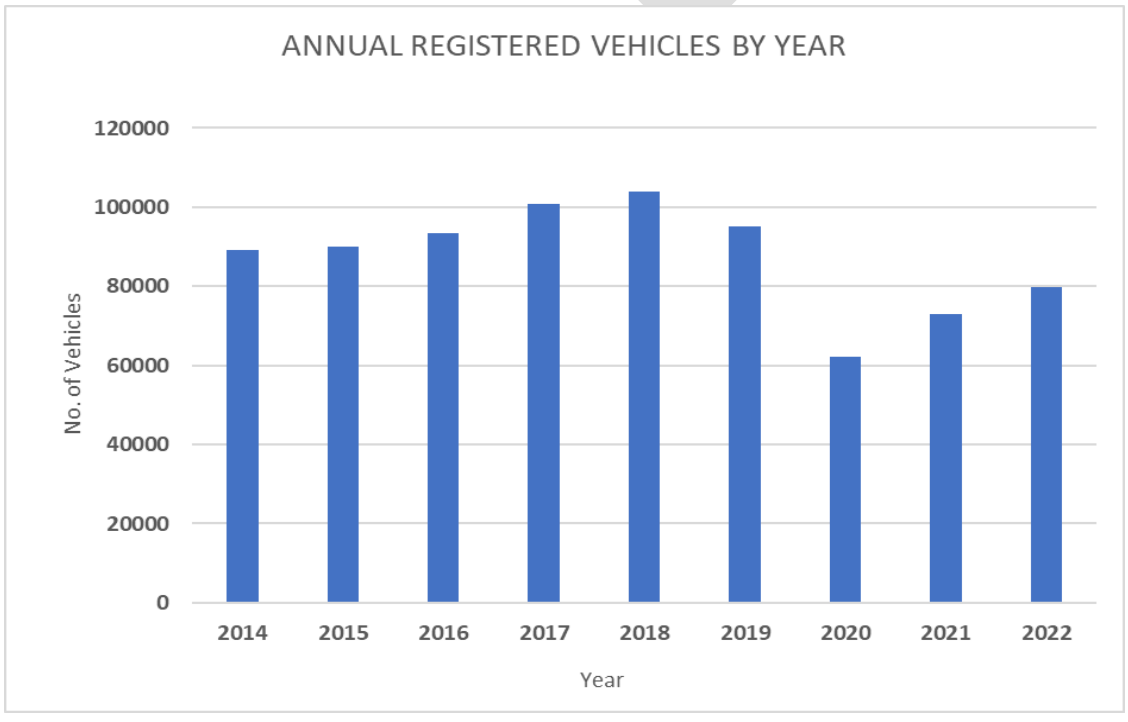


Figure 33 Annual Vehicles Registered (Source: RTO, 2023)

From 2014 to 2022 it is observed that a total of 2.1 Lakh Cars and 5.25 Lakh Two wheelers are registered in the study area across various RTOs ans sub-RTOs. Two-wheelers and cars consitute nearly 67% and 27% of the vehicles registered in the study area respectivily.

Thus, on average, there is one private vehicle available for three people in the study area.

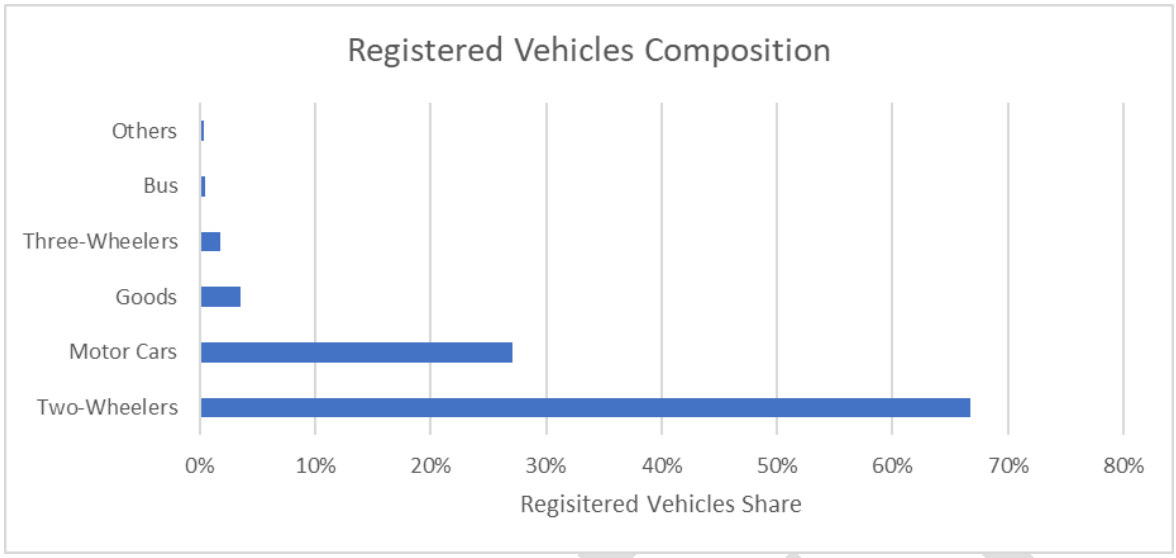


Figure 34 Registered Vehicles Composition (Source: RTO, 2023)

Petrol and diesel fuled vehicles comprise of 84% and 14% respectively. Approximately 1% each of the vehicles registered are electric or hybrid, and CNG fueled vehicles.

This indicates that the major share share of registered vehicles rely on conventional/ fossil fuels.

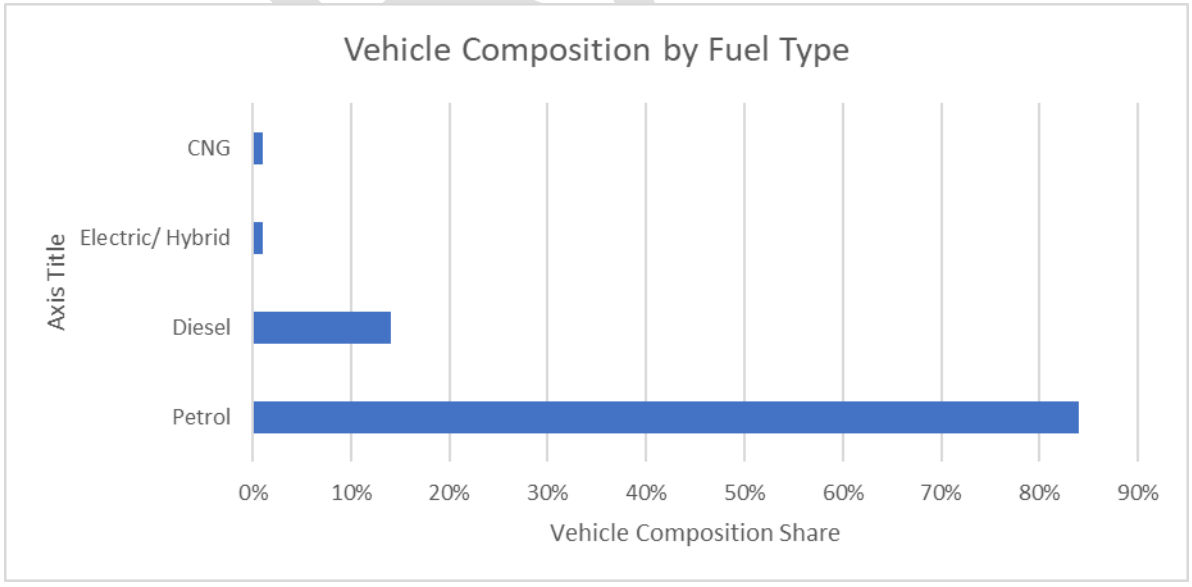


Figure 35 Registered Vehicles Composition (Source: RTO, 2023)

2.9 CITY BASED PUBLIC TRANSPORTATION

2.9.1 MASS RAPID TRANSIT SYSTEM (METRO)

This system has been operational since 2017, with 1 elevated line having a length of 27.31 km and 24 metro stations from Aluva to SN Junction. The 1.2 km length of Phase 1B from SN Junction to Thripunithura is made operational in 2024. The current operation length of metro is about 28.12km.

The average daily ridership during December 2022 to February 2023 was 78,605.

Transportation features of the system are as follows,

- 25 trains commissioned.
- Fleet Size of 13 trains
- Peak hour Headway at 8 minutes.
- 3 Car System
- The depot is located at Muttom.
- Offer payment / ticketing through Kochi1 Card, Kochi1 mobile application or monthly passes.
- Base Fare is INR 10, and the maximum fare is INR 60.

Figure 36 Metro Corridor to Petta (Left), Metros arriving at Town Hall Station (Middle), Metro Electric Feeder Service at Perumbavoor (Right)

To enhance the ridership e-bus Feeder Services have been introduced. Apart from Feeders and e-Autos, PBS services are available at metro stations as well as at strategic locations in the neighbourhood.

The Phase II connectivity to Infopark via Palarivattom and Kakkanad from JLN Stadium is under implementation. Upon completion this will add 11.2 km to the existing network.

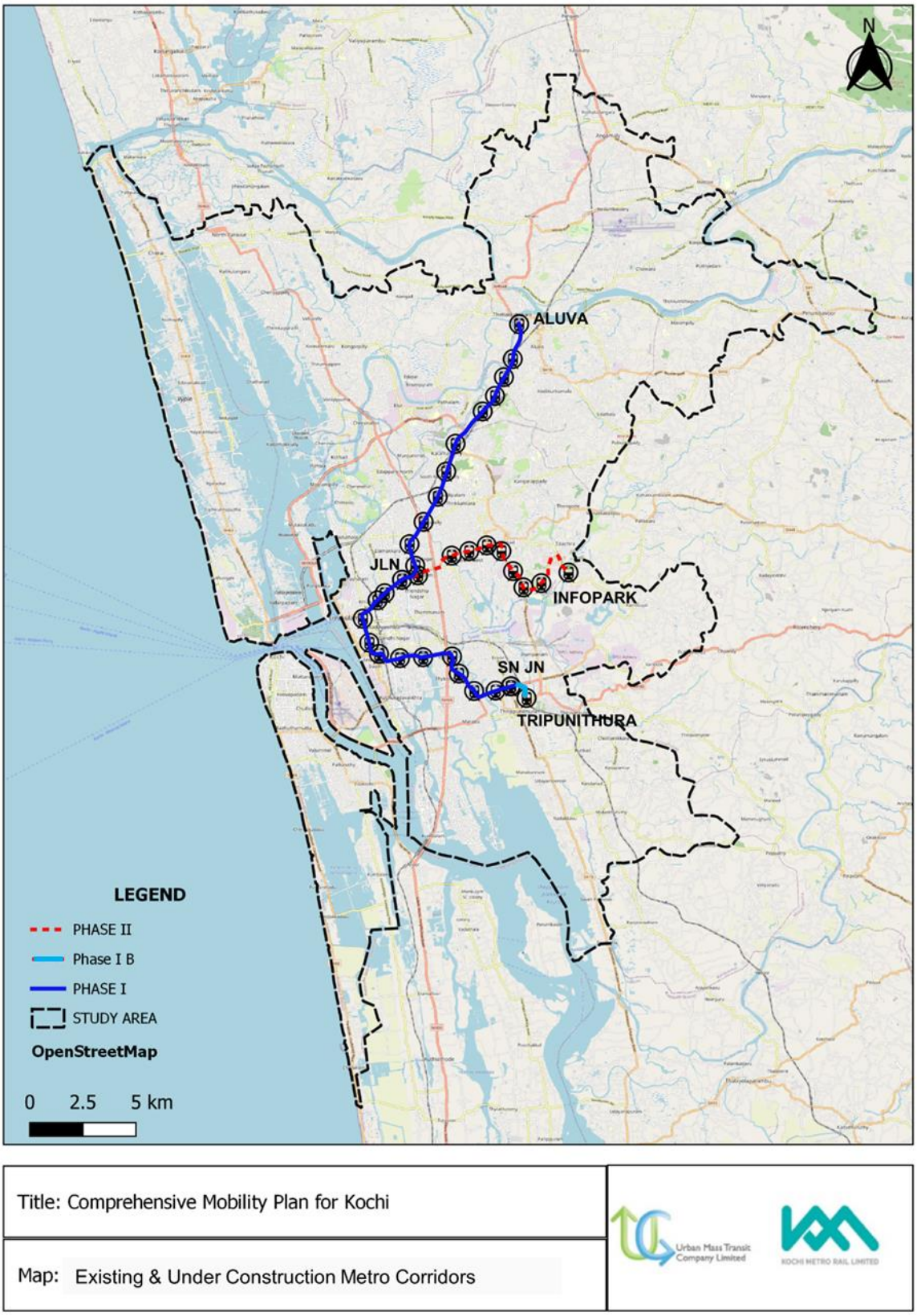


Figure 37 Existing Metro Corridor & Metro Under Construction

2.9.2 CITY BUS SYSTEMS

The city bus services in Kochi are provided mainly by private operators and state-owned bus company, Kerala State Road Transport Corporation (KSRTC).

The features of the public transport system as below:

- KSRTC city buses run on various routes within the city and connect major areas of Ernakulam, including Fort Kochi, Mattancherry, and Vyttila. About 926 services across 49 routes are operated by KSRTC daily in the study area, which are largely mofussil services.
- While private buses operate 1053 services including 20 city circular services with a fleet size of 59.
- The base fare of city bus services in INR 10 for both KSRTC and Private buses.
- The peak hour occupancy of the buses is 39 people (average).
- About 1 lakh passengers commute daily using KSRTC bus services as per 2022 data.

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.

Figure 38 Colour Coded Private Bus Services in Kochi - Green (City Services)- Left, KSRTC City Ordinary Bus - Right

Recently the KSRTC and KMRL have started bus-based Feeder Services (70 services) as well to enhance the connectivity.

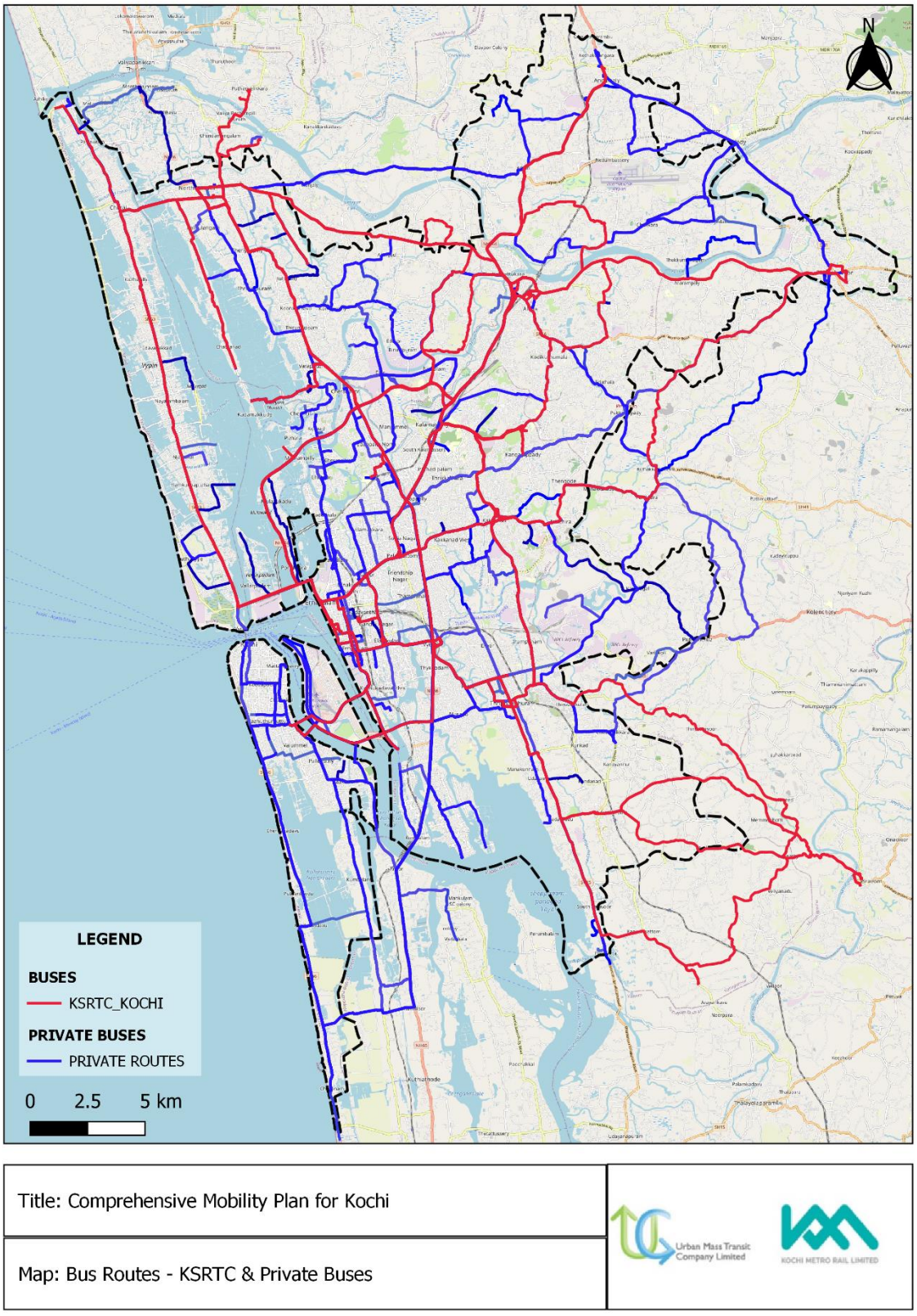


Figure 39 Bus Routes in the Study Area - KSRTC & Private Buses

2.9.3 FEEDER SERVICES

To enhance the reach of MRT System, bus-based Feeder Services were introduced in the city. Midi Electric bus feeders operate on 7 major routes connecting various major locations to the metro stations. The details of the feeder system are as follows,

Table 10 Feeder Buses - Operational Details

S.NO.	ROUTE NAME	DISTANCE	NO. OF BUSES
1	Aluva- Angamaly	Aluva- Angamaly-15km Aluva- Infopark -15km	1
2	Aluva- Perumbavoor	Aluva- Perumbavoor -17km Perumbavoor I Infopark – 26km	1
3	Aluva- CIAL	Aluva- CIAL – 12km	2
4	Edapally-North Paravoor	Edapally-North Paravoor – 18km Edapally-Infopark – 10km	1
5	Kaloor –Njarackal	Kaloor –Njarackal -15km Kaloor –Infopark -12km Kaloor –Kakkanad -8km	1
6	Kaloor –Fort Kochi	Kaloor –Fort Kochi – 18km Vyttila-Thoppumpady -12km Kaloor-Infopark -10km Thoppumpady-Eramalloor-16km	1
7	Vyttila-Eramalloor	Vyttila-Eramalloor-17km Vyttila-Thoppumpady -12km Kaloor InfoPark-10km Thoppumpady-Eramalloor-16km	1

2.9.4 KSWTD FERRY & RO-RO SERVICE

Kerala State Water Transport Department (KSWTD) operates the passenger water transport in Kochi. The ferries operated by the private operators, tourism department and Kerala Shipping and Inland Navigation Corporation (KSINC) act as principal link between the mainland and the islands.

Ferry Services are available between Ernakulam, Willington Island, Fort Kochi and Vypin at a 15 minutes' frequency. 12,000 to 15,000 daily passengers use the services. Two RO-RO services are available connecting Fort Kochi and Fort Vypin, but these services are intermittently operational.

- Total ferry/ boats: 10
- No of Boat Jetties: 21 (operational)
- Operational Hours: 6 am to 9.30 pm

Figure 40 Entry to Ferry Services at Ernakulam Boat Jetty (Left), Ro-Ro Service at Fort Kochi (Right)

2.9.5 WATER METRO

Kochi Metro Rail Limited has implemented an integrated water transport network in Greater Kochi, first phase, (Vyttila- Infopark) of which was completed in October 2021. Water Metro Services are operational along five corridors – High Court to Vypeen & Vyttila to Kakkanad, High Court-Bolgatty-Mulavukad North-South Chittoor and South Chittoor-Eloor-Cheranalloor. The full-fledged operation of the water metro project is expected to have better waterway connectivity along the western coastline in the city. The boats with passenger capacity of 50 and 100, will be operating at an optimal speed of about 15 kilometres per hour, with the potential to increase up to 22 kilometres per hour.

- No of boat jetties in the system: 38
- Route Length: 76 km
- No of boats, Phase 1: 78

Figure 41 Water Metro Service at Kaniyampuzha (Source: Online)

Table 11 Water Metro Routes in Kochi

SN	ROUTE NAME	ROUTE	STATUS
1	High Court - Fort Kochi	High Court - Vypeen - Fort Kochi	Operational
2	Vyttila - Infopark	Vyttila - Eroor - Kakkanad - Infopark	Operational
3	High Court - Mattancherry	High Court - Willingdon Island (Ferry side) - Mattancherry	Proposed
4	Ernakulam - Moolampilly	Ernakulam - High Court - Bolgatty - Thanthoninthuruth - Ponnarimangalam - Mulavukad Hospital - Mulavukad Panchayat - Mulavukad North - Korumkotta - S Chittoor - Moolampilly	Proposed (Oart Operational)
5	High Court - Kumbalam	High Court - Ernakulam - Thevara - Nettoor - Kumbalam	Proposed
6	Fort Kochi - Mattancherry	Fort Kochi - Willingdon Island - Mattancherry	Proposed
7	Ernakulam - Vypeen	Ernakulam - Embarkation - Fort Kochi - Vypeen	Proposed
8	Edakochi - Vyttila	Edakochi - Kumbalam - Nettoor - Thykoodam – Vyttila	Proposed
9	Edakochi - Vypeen	Edakochi - Thoppumpady - Mattancherry - Willingdon Island (Ferry Side) - Fort Kochi - Vypeen	Proposed
10	Moolampilly - Cheranallur	Moolampilly - South Chittoor - Pizhala - Chennur - Kothad - Cheranallur	Proposed
11	Cheranallur - Varappuzha	Cheranallur - Eloor - Varappuzha	Proposed
12	Moolampilly - Njarackal	Moolampilly – S Chittoor - Pizhala - Paliyamthuruth - Kadamakkudy - Njarackal	Proposed
13	Moolampilly - Thundathumkadavu	Moolampilly - S Chittoor - Pizhala - Cheriyamthuruth -Thundathumkadavu	Proposed
14	Njarackal - High Court	Njarackal - Elamkunnapuzha - Mulavukad Viewpoint - High Court	Proposed
15	Pizhala - Amrita Hospital	Pizhala - Aster Medicity - Amrita Hospital	Proposed

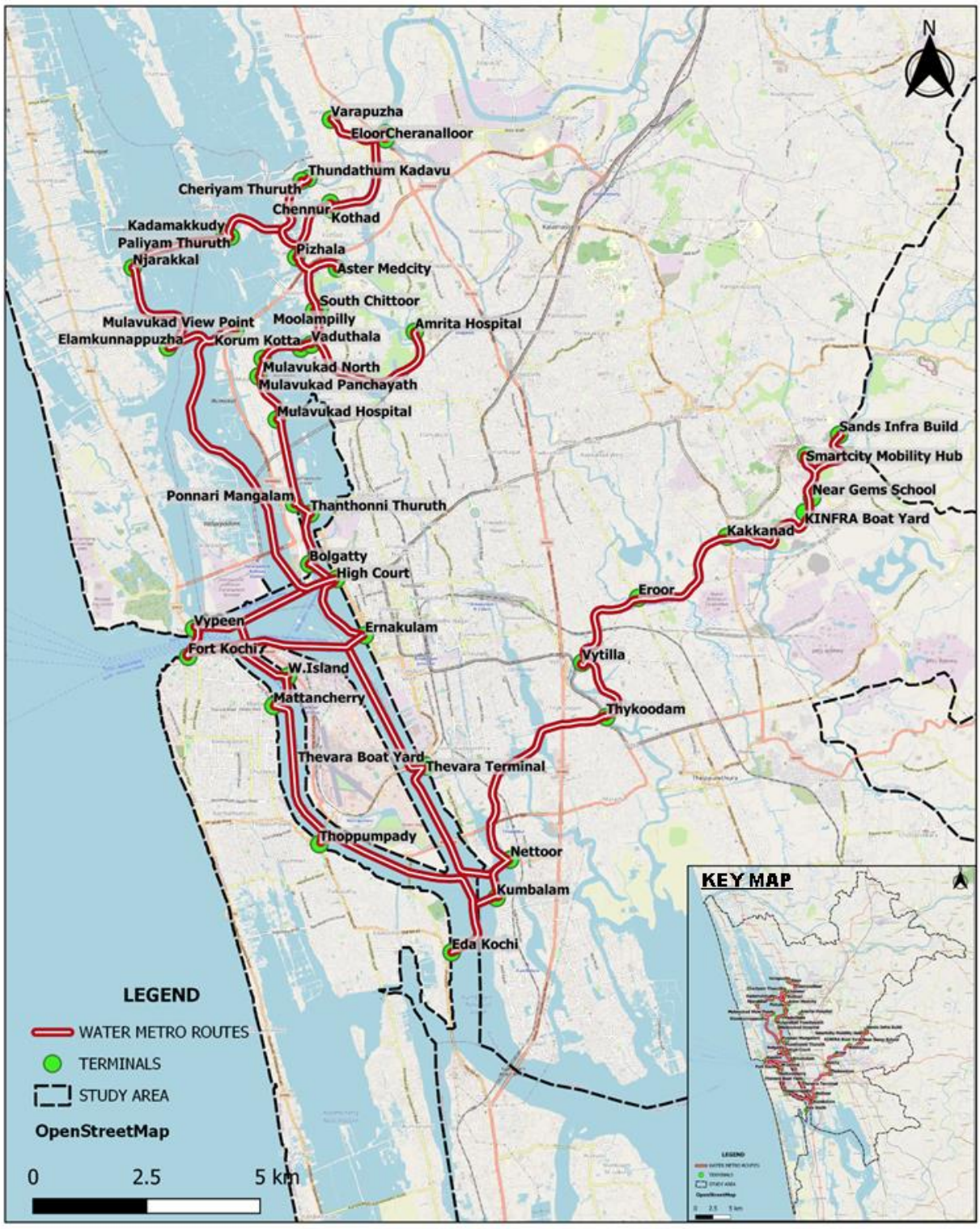


Figure 42 Water Metro Terminals & Routes – All Routes (Source: KMRL)

2.10 INTERMEDIATE PUBLIC TRANSPORTATION

These 3-seater capacity auto rickshaws can be easily seen on the streets of Kochi. These are privately run intermediate modes of transport providing point to point transport for the public. They are generally used by users as an access or egress mode to the formal PT system or are also used as a competitor to public transport or as an alternative to PT system in absence of personal vehicle as a main mode connecting from one destination to another. The Kochi Municipal Corporation is currently in the process of electrification of the IPT fleet as part of the Smart City Initiatives.

Apart from these, a combination of conventional autos and e-autos (75 owned by KMRL & 30 - by Ernakulam Jilla Auto Rickshaw Drivers Cooperative Society (EJADCS) operate from Aluva, Petta & Vyttila towards various locations within 5 km radius from the respective metro stations in association with KMRL. These carry on an average approx. 110 (Petta) to 345 (Aluva) passengers daily, as per the KMRL sources. 15 charging points are provided by KMRL across 5 locations viz., Aluva, Kalamasserry, Kaloor, Edapally and Vyttila

Figure 43 IPT in Kochi (Source: https://www.thehindu.com/)

The minimum hire charges or base fare for IPT is ₹ 30.00 for a distance up to 1.5 km. Beyond the minimum, fare increases at ₹ 15.00 per km i.e., ₹ 1.50 for every 100 meters.[3]

Despite the availability of public transport system, the usage of paratransit 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. Further, the city lacks any organized system to support these modes.

There is a growing presence of E-Auto rickshaws in the city. Hence, the supporting charging infrastructure shall be planned.

[3] As per G.O.(P)No.14/2022/TRANS Dated, Thiruvananthapuram 26th April 2022, issued by Govt. of Kerala Transport (B) Department. Notification.

2.11 NON-MOTORIZED MODES

Kochi is one of those Indian Cities which is actively working towards improving its NMT network through various methods. It has already implemented a Public Bicycle Sharing System adjoining the major metro stations. Major pedestrian Infrastructure and cycle track construction has been undertaken by KMRL as well as by CSML, under the Smart City Mission; apart from the existing pedestrian facilities developed by the ULBs. A decent footpath coverage along all the major transit corridors and major links in the city region was observed during the reconnaissance survey, however, it was found to be discontinuous and poorly maintained. Shared cycle tracks were observed in the city, developed as part of the smart city project along Marine Drive and near Aluva Metro Station which were found to be encroached by vehicles most of the time with few users. The urban centres away from the city core lack sufficient footpath coverage and cycle tracks.

Figure 44 Condition of Footpaths & NMT Facilities (Source: Primary Site Visits-2022)

Under the development/ improvement of NMT initiatives taken up by KMRL, the corridors from Aluva to Edapally Junction (9.3km), Manorama Junction to SN Junction (18.11km) along the metro alignment and in the vicinity of metro stations; Kaloor – Kadavanthra Road (3.2km) as a part of Station Oriented Development (SOD) of Kaloor & Kadavanthra Metro Stations. The key

features of the works are the restoration of footpaths, junction improvements, revamping of existing drain/ construction of new drains, construction of footpaths, tree planting, street furniture, landscaping, streetlights, etc. The road name and approximate length are tabulated below:

Table 12 NMT Improvement by KMRL (Source: KMRL)

Sl No	Road Name	Approx. Length
1.	SH Road	1000m
2.	Market Road	400 m
3.	Bank road	310m
4.	Civil Station Road	500m
5.	Metro Yard Road	200m
6.	HMT Main Road	1600m
7.	CUSAT Road	600m
8.	TVS Road	1000m
9.	Restoration work Aluva to Edapally	12500m
10.	SA Road	3000m
11.	Kadavanthra to Streetscape	500 m
12.	Chittoor Junction to South Metro Station	150m
13.	Vyttila Junction to Metro Station, Water Metro Terminal to Vyttila Mobility Hub	2000m
14.	Poornathrayeesa Temple and NSS Higher Secondary School Road	1000m
15.	Eroor Road	390m
16.	Theverakavu Road	440m
17.	Sanskrit College Road	500m
18.	Chambakkara Bridge to Petta	800m
19.	Petta Junction Improvement	500m
20.	Kaloor – Kadavanthra Road	3200m

Considering the public transport share of the city, compared to the other Indian cities it is the need of the hour to augment the NMT network, to boost the usage of public transport system and increase the safety of pedestrians. Such simple and cost-effective steps will also add to good first and last mile connectivity.

2.12 FREIGHT MOVEMENT

Kochi port and Vallarpadom Container Terminal are the major freight generators in the city with considerable container movements. Other freight generator industries are fisheries, fertilizer industries and other retail products. Container as well as other goods movement mainly happens towards south through NH 544, North through NH 66, and Northeast to NH 544. Other freight terminals are in Kalamasserry, Aroor, Willington Island etc.

For local freight movement, the Smart City Mission- CSML has plans on shifting to electric Mobility in Kochi through the introduction of e- LCVs. This push for e-mobility to ferry goods is part of Eco Logistics, a low-carbon action plan that will be implemented jointly by the Kochi Corporation and ICLEI-South Asia.

Commercial Vehicles are restricted from 8 AM to 8 PM in the city limits and from Landmark Junction, Bolgatty Junction, Thevara Ferry & Thevara Junction to Kochi city under City Traffic Police West Division. While in the City Traffic Police East Division these are applicable along Edapally Junction, Palarivattom Bypass, Vyttila Junction, Petta to Kochi City, apart from Karingachira to Kizakkekotta (Thripunithura) during peak time. Ernakulam Rural Traffic have imposed restrictions to commercial vehicles along Karothukuzhi Junction to Pump Junction during daytime, while at DPO Junction to Railway Square, Aluva- Varappuzha Road, & Thattampady - Neerickode road are always restricted (day & night).

Figure 45 Freight Movement at Kochi

2.12.1 Goods movement by water

Goods traffic movement is mainly handled by from Murikkumpaadam jetty and Thevara jetty. There are three oil barges and four water barges operating from Thevara jetty and two water barges operating from Murikkumpaadam jetty. Other goods movements include 16 barges operating from Thevara to FACT by KSINC. Kottappuram- Kollam stretch (168 km) of the West Coast canal along with

Champakkara canal (14 km) – Kochi-Ambalamugal and Udyogamandal canal (23 km) – Kochi-Pathalam bridge has been declared as the National Waterway-3 (NW-3) (205 km). Out of 11 goods terminals in NW-3 operated by Inland Waterways Authority of India (IWAI), five are located within or close to Kochi city. These are at Aluva, Kakkanad, Maradu, Bolgatty Island and Wellington Island. Apart from these IWAI terminals, FACT has their own terminals in their factories outside city limits. NW-3 handled goods traffic to the tune of 408,790 MT in the year 2019. Most of the traffic movement on NW-3 is contributed by the movement of raw materials belonging to M/s Fertilizers and Chemicals Travancore Ltd (FACT) from Cochin port to the jetties at FACT factories. LAG (Liquefied Ammonia Gas) (44%) constitutes the highest share of traffic followed by Phosphoric Acid (24%) and Rock Phosphate (21%). LAG is transported to FACT's Cochin Division and Petrochemical Division; Phosphoric acid and Sulphur is transported to FACT's Cochin Division and Udyogamandal Division while most of the Rock Phosphate is transported to FACT's Cochin Division jetty.

With the view of decongesting the Kochi city by providing an alternate transport route for the Vallarpadam container terminal, IWAI has set up a pair of Ro-Ro terminals at Willingdon Island and Bolgatty jointly with the Cochin Port Trust. The transportation of containers along this route is being carried out successfully since February 2011. Currently two services plies along the corridor to facilitate freight movement. The route length being hardly 3.5 km compared to the 16 km route through road.

Major share of traffic con NW- 3 originates from the Q10 berth-Cochin port and FACT, PD (Petrochemical Division) jetty. The Q10 berth-Cochin Port is used to transport Phosphoric acid, Rock phosphate and Sulphur to multiple destinations. FACT, PD jetty is used for transporting LAG, whereas the FACT Ammonia Jetty is used for transporting LAG, Phosphoric Acid, Rock Phosphate and Sulphur. Among the destination locations, FACT, CD (Cochin Division) jetty accounts for the largest share of traffic and handles multiple commodities i.e., Rock Phosphate, Sulphur, LAG and Phosphoric Acid. This is followed by FACT, UD (Udyogamandal Division) jetty, which receives Phosphoric Acid, Rock Phosphate, Sulphur and FACT, PD jetty, which receives only LAG.

The airport manages on an average 160 Tonnes of goods per day.

2.13 ROAD SAFETY

Road safety is a crucial factor considering the increasing number of vehicles in Kochi. The fatality rate of accidents in 2014 which was around 9 has increased to 15.44 in 2022 as per DCRB records.

The fatality rate of pedestrians and cyclists in the city limits stands at 28%, indicating the need for improvement in NMT infrastructure facilities and dedicated cycle tracks to segregate the fast-moving moto vehicles from the NMT users.

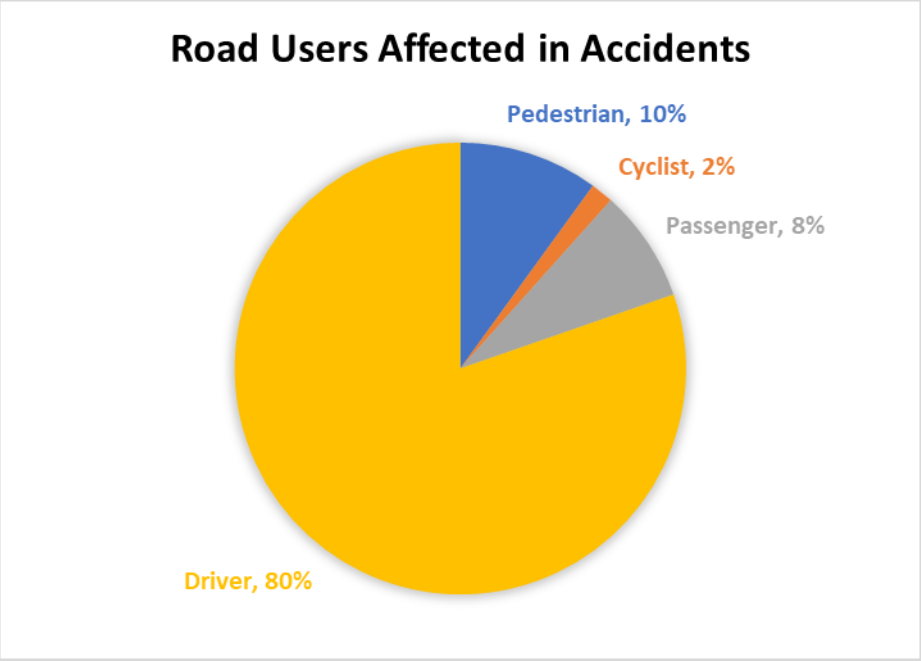


Figure 46 Percentage share of Road Users affected in accidents within City limits in the Year 2022 (Source: Secondary Data, DCRB, Kochi City, 2023)

The number of fatalities per lakh population i.e., 15.44 in the study area is alarming and presses the need to improve the road safety in the study area.

Table 13 Accidents in the Study Area over the last 5 Years (Source: Secondary Data, DCRB, Kochi City, 2023)

YEAR	ACCIDENTS	FATALITIES
2018	4434	333
2019	4600	352
2020	2875	222
2021	3536	298
2022	4821	353

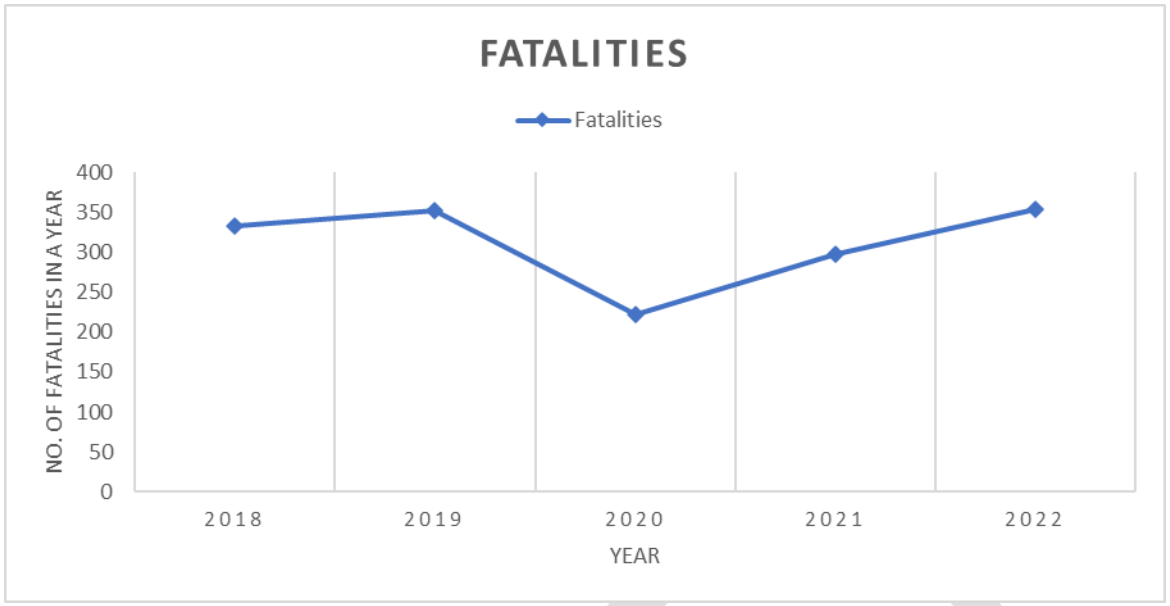


Figure 47 Yearly Fatalities during 2018-22 in the Study Area (Source: DCRB, Ernakulam City & Rural Police)

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

03

PREVIEW OF PREVIOUS STUDIES

3 PREVIEW OF PREVIOUS STUDIES

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

3.1 DEVELOPMENT PLAN FOR KOCHI CITY REGION 2031, DEPARTMENT OF TOWN AND COUNTRY PLANNING, KERALA, 2011

The development plan prepared in the year 2011, for the Kochi city region envisioned Kochi as a Global City with development of various major urban centres and promoting a transit-oriented development. The plan identifies 13 planning divisions in the study area and recommended a densification of the Ernakulam mainland and residential development towards the municipalities in the suburbs such as Thrikkakara, Kalamasserry and Maradu and Kumbalam, Vadavukode etc. The commercial suburbs proposed by the DP at Edapally, Vyttila and Thripunithura can be seen realised in the present day. Transport related recommendations of the plan are as follows:

Table 14: Major Recommendations – KCR 2031, 2011

PROPOSALS	OBSERVATIONS
Strengthening of regional linkages: Chellanam- Fort Kochi, Vypin- Munambam, Palluthy- Kumbalangy etc.	SH-66 & SH-63 provides the radial connections from Vypin to Munambam and Chellanam to Thoppumpady respectively.
Preparation of an integrated multi-modal traffic and transportation plan comprising road, rail, water and air network and link areas of future development to this integrated transport network.	Vyttila Mobility Hub is in place.
Identification of Routes for MRTS	Metro System in place connecting Aluva & SN Junction via Edapally, Palarivattom, MG Road & Vyttila.
Other travel demand management measures link signalisation, parking management etc.	17 Signalized Junctions in the City limits have Intelligent Traffic Management System (ITMS) facility and 11 on these junctions' function in VA

PROPOSALS	OBSERVATIONS
	mode, while at three locations are operated manually from 8 AM to 10:30 PM
Medium- and Long-term plan like Container Terminal Road, widening of Seaport-Airport Road and other missing links	The NH 966A, Container Terminal Road is in place and widening activities of Seaport-Airport Road are underway.

3.2 TRANSIT ORIENTED DEVELOPMENT ACTION PLAN FOR KOCHI, 2014

The Strategic Transit Oriented Development Plan for Kochi, conducted by UMTC for KMRL identifies and illustrates the TOD principles, discusses, and defines their applicability in Kochi on the identified Metro Transit Oriented Corridor The project discusses the typology of the twenty-two station areas along the existing metro corridor based on their existing characteristics of predominant land use, population density, network density and the location of the station. Based on the station typologies the population and employment for all the stations areas are estimated as also the envisaged land use mix percentages.

- The density along the metro corridor (2014) = less than 100 pph
- Proposed minimum population density of each metro station = 500 pph
- Proposed minimum dwelling unit density= 200 dwelling unit per hectare
- Existing employment density: commercial – 40 sqm/ employee, tertiary- 100 sqm/employee
- Proposed employment density: commercial – 28 sqm/ employee, tertiary- 60 sqm/ employee

Guidelines for compact high-density development along with supporting strategic proposals for non-motorised transport etc. are discussed for all these station areas. This project also discusses the demand and cost estimation for water supply, sewerage, drainage, and solid waste management as part of the physical infrastructure component for the horizon year 2034.

3.3 INTRODUCTION OF LOW CARBON CITY BUS SERVICES IN GREATER KOCHI, 2016

The study was done by UMTC in 2016 for developing an efficient, cost effective and sustainable public transport system through assessment of existing public transport scenario, rationalisation

of existing routes operated by KSRTC/KURTC, fleet and infrastructure assessment, viability assessment of the system, development of business plan and environmental and social impact assessment.

- As a part of the study, 12 new city bus routes and 42 feeder routes were identified, along with their infrastructural requirements and implementation plan.
- The study estimated a fleet requirement of 444 buses for city bus services, 151 buses for suburban services and 103 buses for feeder services by 2026.

3.4 DETAILED PROJECT REPORT FOR INTEGRATED WATER TRANSPORT SYSTEM FOR KOCHI, 2015

The study was conducted in the year 2017 by UMTC for KMRL, to utilize the water bodies for transportation in a safe and efficient manner as the existing ferry services barely satisfy the safety norms and conditions and the commuters from the island were dependent on them for their daily trips. The hub and spoke system have been proposed for the water transportation system in Kochi to identify certain major islands as hubs with one major boat jetty developed as a hub and the neighbouring smaller islands and jetties as the spokes which would be connected to the hub. 16 water transport routes were identified as a part of the study where the services along the high demand routes will be implemented first.

- Estimated fleet for phase 1- 75.
- Estimated Ridership for all routes: 15000.
- Estimated PPHPD: 950

Table 15 Proposed Water Metro Routes

Route	Origin	Destination	Route Description	Route Length (km)
1	South Chittoor	Ernakulam	South Chittoor, Mulavukadu Panchayat, Ponnarimangalam, Thanthoninthuruth	8.20
2	Edakochi	Thevara	Edakochi, Kumbalam, Thevara	3.74
3	Ernakulam	Vypin	Ernakulam, Embarkation Jetty, Fort Kochi, Vypin	6.40
4	Ernakulam	Mattancherry	Ernakulam, Embarkation, Fort Kochi, Mattancherry	6.10
5	High Court	Mulavukadu	High Court, Bolgatty, Thanthoninthuruth,	11.00

Route	Origin	Destination	Route Description	Route Length (km)
			Ponnarimangalam. Mulavukadu Panchayat, Mulavukadu Hospital, Korrankota, Mulavukadu North	
6	Vyttila	Info Park	Vyttila, Eroor, Kakkanad & Info Park	8.00
7	Kumbalam	Thevara	Kumbalam, Nettoor, Thevara	4.00
8	Info Park	Edakochi	Info Park, Vyttila, Kakkanad, Thykoodam, Thevara, Kumbalam, Edakochi	12.60
9	Mulavukadu	South Chittoor	Mulavukadu Panchayat, Moolampilly, Pizhala, Kothad, South Chittoor	8.00
10	Edakochi	Vypin	Edakochi, Thoppumpady, Mattancherry, Fort Kochi Vypin	13.60
11	South Chittoor	Cheranallur	South Chittoor, Moolampilly, Pizhala, Kothad, Chennur, Varappuzha, Eloor & Cheranallur	6.00
12	Elamkunnapuzha	High Court	Elamkunnapuzha - Mulavukadu West, Bolgatty, High Court	15.00
13	Kadamakkudy	Paliyam Thuruth	Kadamakkudy- Paliyam Thuruth (Pizhala Island) - Kothad	6.00
14	Chennur	Thundathum Kadavu	Chennur North-Chariyam Thuruth North-Thundathum Kadavu.	3.00
15	Chariyamthuruth	Chennur	Chariyam Thuruth South- Pizhala Hospital - Chennur South	3.00
16	Kothad	Amrita Hospital	Kothad - Medicity Hospital-Amrita Hospital.	3.00

3.5 NON-MOTORISED TRANSPORTATION PLAN FOR KOCHI, 2015

The study was done for the existing 22km corridor of Kochi Metro, by UMTC covering an area of 2km to the either side of the metro alignment. As a part of the project, roads were classified under several categories of NMT corridors and their subsidiary levels as well as for decongestion, connectivity improvement and urban place making.

1. NMT Only Corridors: Broadway

2. Primary NMT Corridors: Edapally Panvel Highway (approximately 2.5 Km with average RoW 20 m), Salem Kochi – Kanyakumari Highway (approximately 17.7 Km and average RoW of 28 m), SA Road (Vyttila junction to Kadavanthra, approximately 0.9Km and RoW of 20 m), Banerji Road (approximately 4 Km and RoW of 18 m), Shanmugham Road (approximately 0.9 Km with an average RoW of 28 m), Abraham Madamakkal Road (approximately 1.1 Km and RoW of 18 m), Goshree road and Goshree Chathiyath road (approximately 2 Km with RoW more than 15 m)
3. Secondary NMT Corridors: 28 links, mainly consisting of sub-arterial roads and collectors were categorised under secondary NMT corridors.
4. The roads proposed for decongestion are as follows: Aluva Market Road, Edapally Raghavan Pillai Road, Deshabhimani Road, Chitoor Road, Jew Street, Ernakulam Market Road.
5. Under the project the areas selected for immediate connectivity improvement were: Pulinchodu, Companypady, FOB to Ambattukavu, Kunnathery Road and Muttom Station
6. Certain areas were selected for Urban Place making, which includes station area plans and typical street design and intersection design proposals. The areas selected were, Panampally Nagar Canal Front, Kochi City Centre, South Railway Station and Interchange Hub, Padma Sarovaram and Aluva Town.

3.6 INTEGRATED PUBLIC TRANSPORT SOLUTIONS FOR GREATER KOCHI, 2015

The study conducted in the year 2016 by UMTC, aimed at paving way for seamless integration of public transport services in the city of Kochi and enhancing the ridership along the transit corridors. The two major components of the study were city bus service improvement and metro feeder service plan. City bus route rationalisation aimed at eliminating the overlap of the existing routes with the mass rapid transit system and identifying alternate economically viable routes.

- The city bus routes for Greater Kochi Region were rationalized based on the "*Hub and Spoke Model" or "Trunk and Feeder Model"*.
- The study recommended the reduction of the total number of routes from 767 to 364, which includes 13 major trunk corridors and various other feeder routes.
- The study also recommended the approximate fleet size required along with the specifications regarding vehicle technology, fare structuring, infrastructure plan for bus shelters, terminals, multimodal strategies and depots, business plan and implementation plan.

The objective of the feeder service plan was to provide feeder connectivity to all zones within the catchment area of the metro stations and in the range of 2 km as primary influence area and connecting major activity centres.

- The feeder service plan recommended 40 metro feeder routes whose lengths varied from 2km to 15 km,
- It required 175 vehicles falling in the mini/midi category to operate. The study also contains a detailed infrastructural, operational and implementation plan for the feeder services.

3.7 COMPREHENSIVE MOBILITY PLAN - 2017

Comprehensive Mobility Plan for Greater Kochi Region prepared in the year 2017 by UMTC envisions to provide the commuters a world class mobility experience which is also safe, reliable, universal, accessible, and sustainable.

- The plan aims at increasing the vehicular speed in Kochi from 23 kmph to 27 kmph and increase the public transport mode share of Kochi from 49% to 70%.
- It is suggested in CMP to provide a segregated or at/grade dedicated public transport corridor for the mobility corridors.

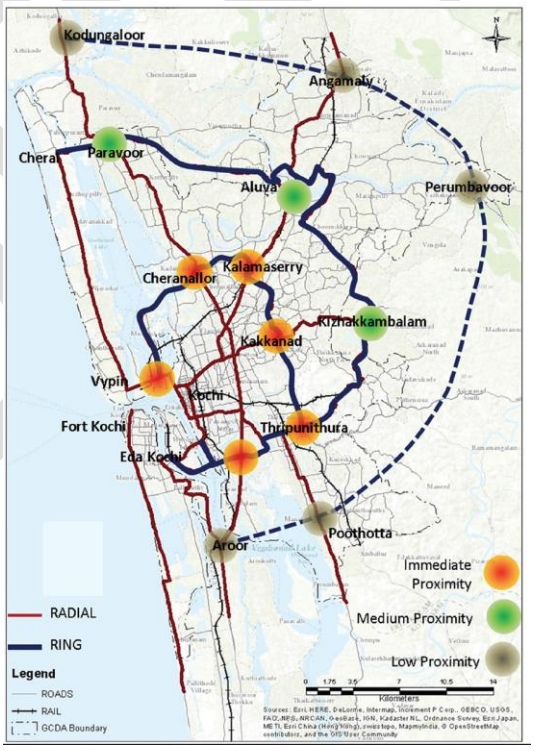


Figure 48 Sustainable Urban Transport Plan Proposed As per CMP 2017

Accordingly, CMP also suggested the 8 mass transit system corridors and 10 trunk routes for bus augmentation, along with an NMT plan for the Kochi City region, freight management plan and several traffic management measures.

Table 16 Mass Transit Corridors Recommended by CMP Kochi, 2017

Line Name	System	PPHPD-2035	Length (km)
Aluva, MG Road, Vyttila, Thripunithura	Existing Metro	17800	29
Aluva Angamaly	Rail Based Rapid Transit	10700	13
Paravoor Aroor	Bus Rapid Transit	9800	35
JNL Stadium- Kakkanad	Rail Based Rapid Transit	10300	8
MG Road- Vypin- Cherai- Moothakunnam	Bus Rapid Transit	7100	33
High court- Fort Kochi	Rail Based Rapid Transit	13200	7

The major recommendations of the CMP 2017 are:

Table 17: Major Recommendations – CMP-2017

PROPOSALS	OBSERVATIONS
The study recommends a Ring Radial network in Kochi with 8 radials and 3 rings.	The proposed corridors are important roads in the city however, only partial implementation.
Ring-radial network to be developed on the concepts of ToD.	Yet to be developed
1. Widening of Roads 47.57 Km **2. Outer Ring Road 75 km** **3. Rail Crossings 4 Nos**	Yet to be developed
NMT Plan **1. Completion of footpaths along 384 km roads** **2. Development of bicycle friendly streets** **3. Area based NMT recommendations as well as along & outside metro corridor** **4. Public Bike Sharing Systems & Docking Stations.**	1. Footpaths are being developed by ULBs, KMRL and under Smart Cities Mission by CSML. 2. Efforts are being made by the authorities. 3. PBS system implemented along the metro corridor and its catchment area.
Public Transport Plan	

PROPOSALS	OBSERVATIONS
1. Route Rationalization **2. Bus Augmentation** **3. Higher Order Mass Transit Systems** **4. Feeder Routes – 40 routes identified** **5. Water Transport Services**	1. Palarivattom – Kakkanad Corridor under construction 2. Feeder Routes – 8 routes operational 3. Water Metro Services started along two corridors – High Court- Vypin & Vyttila-Kakkanad.
Multi-modal Integration	Partly developed
1. Freight Policy **2. Freight Terminals** **3.Water Freight – Ro-Ro Terminals at Aroor & Kottapuram**	Yet to be developed
Traffic Management Measures viz., **1. Junction Improvements (21),** **2. Traffic Management Centres,** **3.Smart Signalization (60),** **4. Travel Demand Management Measures,** **5. Parking Policy**	Partly developed, Smart Signals installed at 17 Junctions, Traffic Control Centres set up under Smart Cities Mission program by CSML. Junction improvement carried out by ULBs & CSML
Unified Metropolitan Transport Authority (UMTA) to be set up at the city level	Kochi Metropolitan Transport Authority has been setup as of November 2020 as per the Kerala Metropolitan Transport Authority Act 2019.

3.8 PARKING MASTER PLAN

The study was done in the year 2017 along with the CMP for Greater Kochi Region with an objective “to use parking as an economic tool and hence to facilitate the organized parking which will complement the sustainable, safe and efficient urban transport system”.

The study proposes a zone-based planning policy, where the study area was divided into the following zones namely:

- Zone A-CBD/Core city area/Commercial Areas
- Zone B- Along the mobility corridors
- Zone C- Sensitive Areas
- Zone D- Roads other than mobility corridors
- Zone E- Panchayat region

Different zone-specific strategies are proposed based on the characteristics of the respective zone such as

- **Land use-based strategies:** Reclamation of public spaces, reducing residential street requirements, Identification of areas and streets to be clearly identified as pedestrian/ parking and no parking areas, Implementation of land use-based fares,
- **Shared Mobility Strategies:** Promoting shared mobility, shared parking facilities and variable office hours, remote parking, and shuttle services.
- **Fare Strategies:** Introduction of paid on-street parking, increase parking fee and introduction of technology for fare collection, Incentives for employees using public transport,
- **Parking Supply Management Strategies:** Elimination of parking minimums and establishment of maximums and parking caps, Ban on Excessive parking on- street and ensure paid parking spaces, Parking restrictions in Transit rich and dense areas, Establishment of Parking Control centres Prevention of misuse of footpaths for parking, Provision of limited parking near interchanges and extension of feeder services, Provision of Multi-Level Parking Spaces, and restriction of heavy vehicles.
- **Passive Demand Management Strategies:** Safe pedestrian facilities and cycle tracks, Off street parking facilities for feeders. Promoting public transport, Parking supply for NMT and electric vehicles. The study has also suggested several parking rates that varies based on the category of vehicle and zones. The study lays down parking standards based on vehicle restrictions and suggests guidelines for smart parking.

Four mass transport corridors mentioned in the CMP, with a total length of 71.4-Km were selected in the Alternate analysis study. The mass transport corridors as considered are given as under:

1. Extension of Phase I corridor from Petta to Thripunithura Railway Station (along Refinery Road) and Aluva to Angamaly
2. Kariyad Junction to Airport
3. JLN Stadium to Kakkanad to Info Park II\
4. South Station to Fort Kochi

3.9 ALTERNATE ANALYSIS AND DPR FOR MASS RAPID TRANSIT SYSTEM TO INFOPARK KOCHI, 2018

The study was submitted in 2018 by UMTC to KMRL, following the CMP 2017, to identify an appropriate mass transit system to connect the existing metro line to the Infopark, Kochi campus.

Five alternate routes were analysed via some important nodes in the city namely, Kalamasserry, Cochin SEZ, JNL Stadium, Kakkanad, Thripunithura, Palarivattom, Vennala and Chakkaraparambu.

Based on the PPHPD values and conditions of various corridors joining the mentioned nodes, an MRTS was proposed between JNL Stadium and Infopark via Cochin SEZ. The proposed corridor also provides connectivity to the water metro at Rajagiri, Vennala residential area and BPCL through a feeder network. The system will be developed as an expansion of the existing system. The length of the corridor is 11.2 km, and 11 Stations are proposed along the corridor.

Figure 49 Proposed MRTS Corridor connecting Palarivattom and Kakkanad

3.10 ALTERNATE ANALYSIS AND DPR FOR MASS RAPID TRANSIT SYSTEM TO ANGAMALY, 2018

The study was done by UMTC, following the submission of CMP 2017 and Alternate analysis of Phase 2 of Kochi Metro from JNL Stadium and Kakkanad, to identify an appropriate mass transit system to connect the existing metro line to Angamaly.

Based on the PPHPD values and conditions of various corridors joining the mentioned nodes, extension of the existing MRTS from Aluva to Angamaly was and a detailed project report was also submitted for the same. 13 stations are proposed along the 19.9 km stretch as an extension to the existing metro.

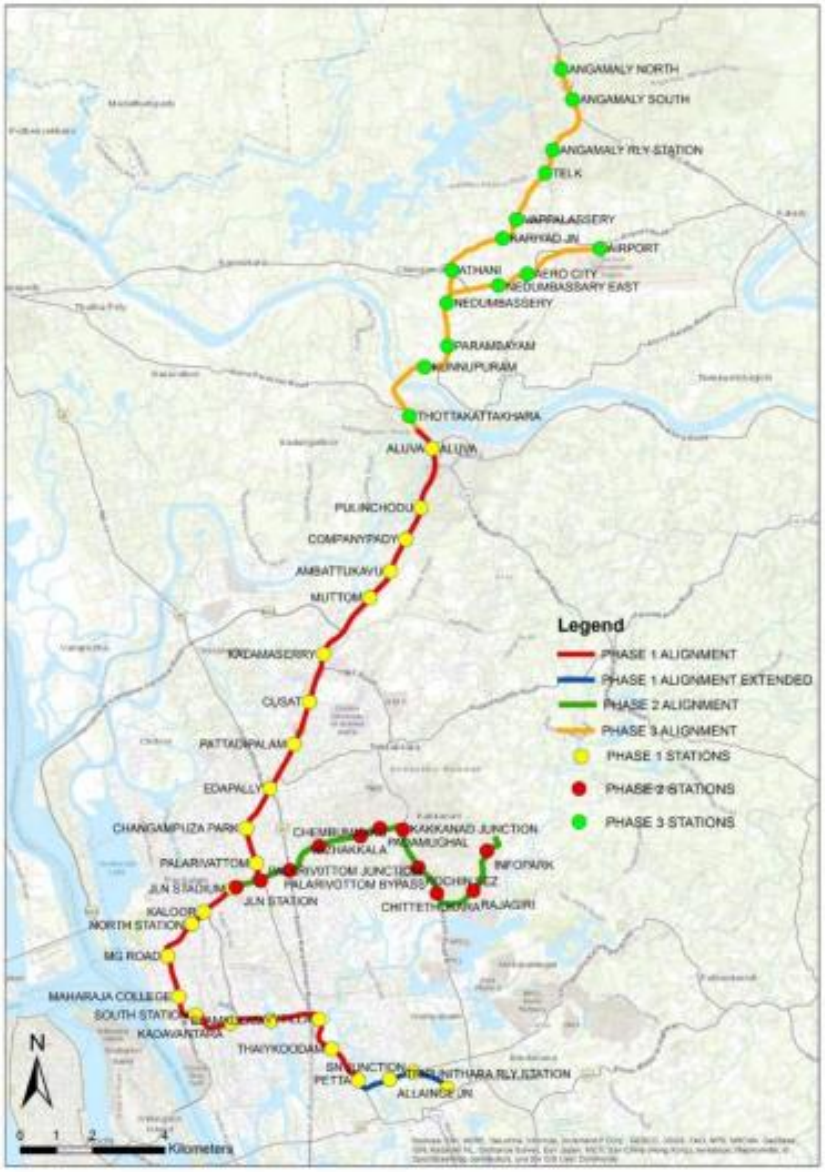


Figure 50 Proposed Phase III corridor along with the Phase II alignment and Existing Corridor

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

Thiruvananthapuram – Kasaragod (Kerala) Silver Line corridor or K-Rail, is a 530.6 km approved semi high-speed rail line connecting Thiruvananthapuram and Kasaragod in Kerala through 11 stations. The operational speed of the corridor is expected to be 200 kmph. The corridor is expected to reduce the total travel time to less than 4 hours, compared with the present 10 to 12 hours' journey time.

Ernakulam and Kochi Airport are two of the major intermediate station on the Silver Line. The proposed alignment of K Rail falls on the western side of greater Kochi, and has two stops in the study area, one at Cochin International Airport and another at Kakkanad.

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

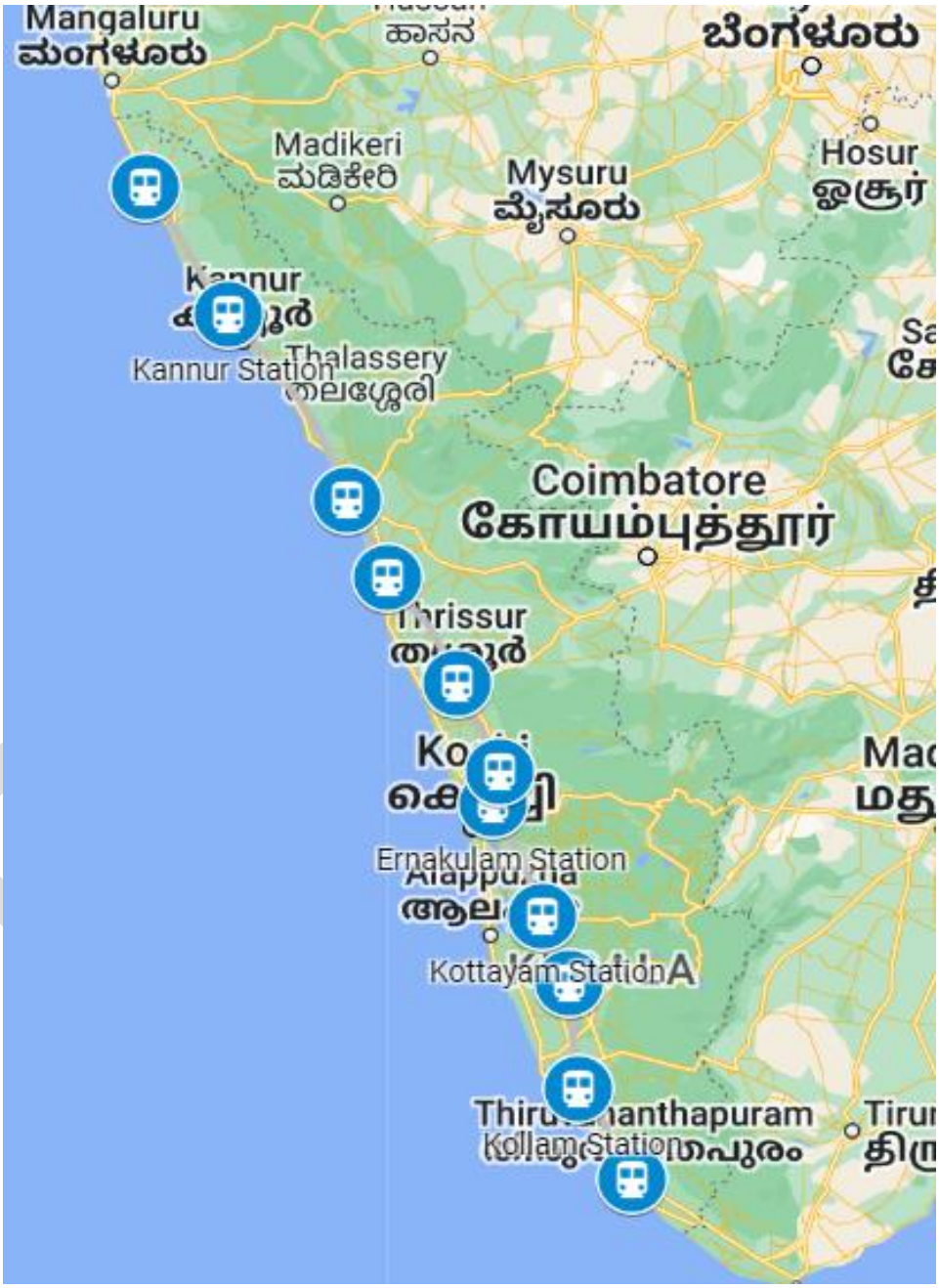


Figure 51 Proposed Route Map (Source: K-Rail)

3.12 IURWTS – INTEGRATED URBAN REGENARATION AND WATER TRANSPORT SYSTEM PROJECT - 2020

The study aims for rejuvenation of the major canals in the city of Kochi by reclaiming the river edge as a public asset, improve its spatial structure and restoration. This is expected to further develop canal network for inland navigation, tourism, and recreational purposes. The major canals considered for the project includes a total length of 34.98 km viz.,

1. Edapally Canal – 11.23 km
2. Chilavannoor Canal -9.88 km
3. Perandoor Canal – 11.15 km
4. Thevara Canal – 1.41 km
5. Market Canal – 0.66 km
6. Konthuruthy Canal – 0.65 km

Post rejuvenation, Edapally Canal, Chilavannoor Canal, Perandoor Canal & Thevara Canal are expected to be used for inland navigation considering small hop-in hop-off services with a carrying capacity of 25 pax. These are depicted in the map below.

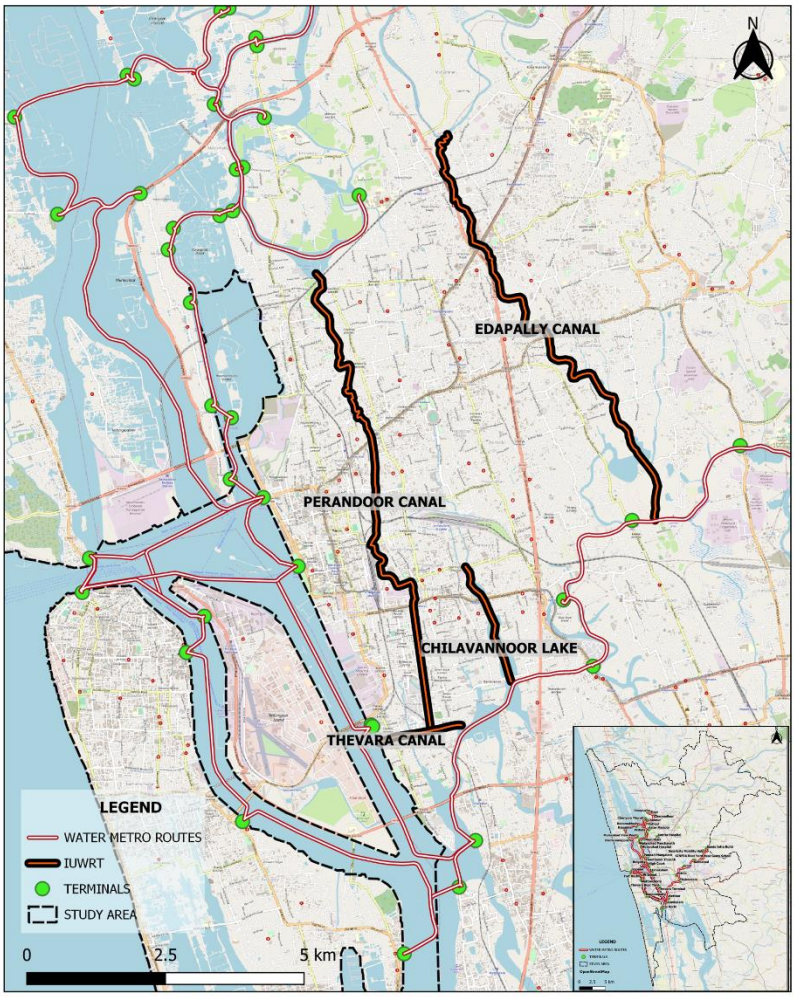


Figure 52 IURWTS Corridors under consideration (Source: IURWTS DPR)

3.13 MASTER PLAN - 2040

The Mater Plan-2040 for Kochi Municipal Corporation has been prepared in 2022 and it awaits the final approval from the state government.

The Draft Master Plan 2040 is recommending an integrated land use and transportation strategy to ensure seamless connectivity. The key strategies and recommendations are as follows,

Table 18 Strategies & Recommendations as per the Draft Master Plan 2040

STRATEGIES	MAJOR RECOMMENDATIONS
Development of an effective road network strategy at a regional and city level.	1. Restore the grid iron pattern within the city, widen the major travel corridors and establish new links in the - North-South corridors – 20 links, 131 km and - East-West corridors – 15 links, 55 km - All public roads with a minimum ROW of 5 m shall be widened to an ROW of 7m. 2. Development of ring and radial type road network outside the city, to enhance the network connectivity. - Middle Ring Road connecting Cherai to Thripunithura via Aluva & Kizhakkambalam - Outer Ring Road connecting Kodungallur to Aroor via Angamaly, Kalady, Perumbavoor and Poothotta 3. Underpass at Edapally Junction, Flyover at Vyttila Junction connecting SA Road to SH 15, apart from Bridges & RoBs 4. Coastal Highway Project – 14m width for SH 66, K.J. Herschel Road & SH 63 at Vypin
Integration of Land Use and Transport sectors through concepts like Transit Oriented Development (TOD) etc.	A total area of 10.84 sq.km is proposed as ToD Zone, considering 500 m to each side of - Banerjee Road (Aluva – Ernakulam Road), - MG Road (Madhava Pharmacy Jn to Pallimukku), - Sahodaran Ayyappan (SA) Road and - Vaikom Road (Vyttila Jn – Corporation Boundary) with width varying based on physical conditions, revenue divisions, walkability/access, and such other factors.
Prioritizing Non-	

STRATEGIES	MAJOR RECOMMENDATIONS
Motorised Transport, shared mobility and improving the efficiency of existing public transport facilities.	1. NMT Corridors across three categories: - Category 1 – only NMT corridors - Category 2 – dedicated NMT provisions (walk /cycling or both) - Category 3 - NMT provisions within shared traffic conditions 2. TOD areas to mandatorily prepare plans incorporating NMT provisions.
Make Kochi walkable and cyclable by retrofitting existing and proposed roads to be "Healthy & Green Streets" by ensuring equitable distribution of road space to create an urban environment that is healthy & liveable	3. Grade separated Pedestrian Facilities at Kaloor, Kunnumpuram, Pallimukku, Town Hall Jn. and NH 66 4. Skywalks connecting - South railway Station & South Metro Station - North Railway Station and Town Hall Metro Station - Vyttila Metro Station to Vyttila Water Metro Station - MG Road Metro Station – High Court Water Metro Station – Proposed MLCP at Marine Drive – Broadway- Ernakulam Market 5. Area-wise NMT recommendations for Kochi City Center, Fort Kochi, Transit Oriented Development Zones 6. Bus systems to act as a feeder system for both water-based and rail-based metro systems. 7. Route Rationalization and Fleet Augmentation
Ensuring Multi-Modal Integration as a key principle to be followed at all transit stations.	The identified location proposed to be developed as Multi-Modal Hubs (MMH) are: 1. Vyttila (water, rail & road based) – existing 2. Ernakulam Jetty (water & road based) 3. High Court (water & road based with connectivity to nearby rail-based metro services) 4. Vypin (water & road based) 5. Mattancherry (water & road based) 6. Thevara (water & road based)
Ensuring seamless movement on roads through junction improvement schemes and grade-separated facilities.	1. Junction Improvements proposed at 14 major junctions within Corporation limits
Formulation of a Freight management plan	1. Regional Freight Hub at the existing International Container Terminal.

STRATEGIES	MAJOR RECOMMENDATIONS
	2. A Multi-modal Logistics Park in Willingdon Island 3. Freight Complexes – Nodes for processing freights at 9 strategic locations water based/ rail based or road based. 4. Maximize freight movement through water. 5. At final pickup node LCV or E-vehicles can cater to the freight movement to the final destinations.
Incorporation of technology for various uses such as smart parking, real-time traffic management etc.	1. MLCPs at strategic locations (6 locations) 2. "Park and Ride" facilities need to be incorporated at major transport terminals 3. Provision of parking spaces for each building use is to be mandatorily followed as per KMBR in force.

Hop-On Hop-Off Ferry System:

By utilizing the existing water metro infrastructure and to utilize it as a part of the tourism sector, a Hop-On Hop-Off Ferry System is envisioned for the city. Tourists can get on any designated „Hop-On" Ferry Station, see the extensive backwater system that is synonymous to Kochi along a pre-determined route and „Hop-Off" at any other designated ferry station. The project is intended to boost the synergy between tourism and transport. To facilitate the project, additional jetties proposed include.

- Menaka Jetty
- Foreshore Road Jetty
- SH College Jetty
- Palluruthy Jetty
- Thoppumpady Jetty
- Cochin Harbour Jetty
- Warehouse Jetty
- COPT Avenue Jetty
- KIC Jetty

Figure 53: Proposed Public Transportation Plan (Source: Master Plan -2040 –Draft Report)

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

04

EXISTING TRAVEL AND TRAFFIC CHARACTERISTICES


COCHIN SHIPYARD
COCHIN SHIPYARD

4 EXISTING TRAVEL AND TRAFFIC CHARACTERISTICES

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.

4.1 PRIMARY SURVEYS

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 March 2023 excluding the public holidays. The surveys were initiated on 13th December 2022 and were completed by 8th March 2023.

Table 19 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	Household Interview with opinion survey
18	Road Network Inventory with lux levels
19	Vehicles Survey at Petrol Pump
20	Establishment and Workplace survey
21	Goods Operator Survey

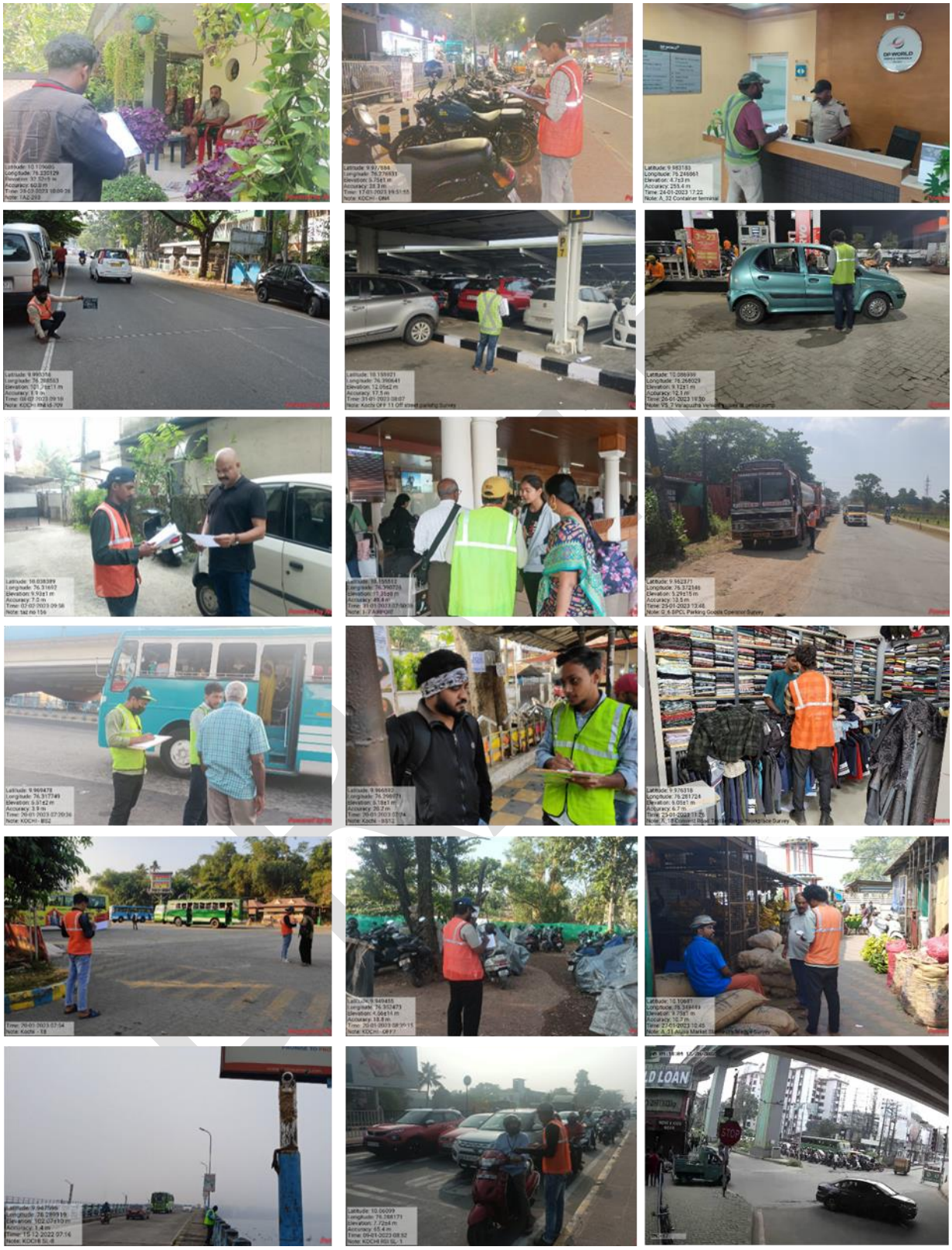


Figure 54 Photographs while capturing passenger travel and vehicle characteristics (Primary Surveys-2022-23)

The methodology adopted for the surveys and the detail of the summary is presented in the Annexure. The summary of the assessment is presented in this section.

4.1.1 ROAD NETWORK CHARACTERISTICES

- The surveyed network indicates that on 28% of the corridors have Right of Way (ROW) availability over 18m.
- The exiting surveyed corridors constitute carriageway between 18m to 36m indicating the availability of reasonable road space in terms of lane configurations on Major corridors.
- 77% of the surveyed network has 2-lane and above configuration. Four (4) and above lanes constitute about 16% of the total network.
- The share of network with divided carriage is about 14%.
- 25% of the major network has footpath availability in the study area. And only 7% 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 or encroachments hindering the road space allocated for traffic flow and pedestrian movement.
- The average journey speed during peak hours in the Central Business District (CBD) is 19.5 kmph, while it is observed to be about 28 kmph in non-core area.

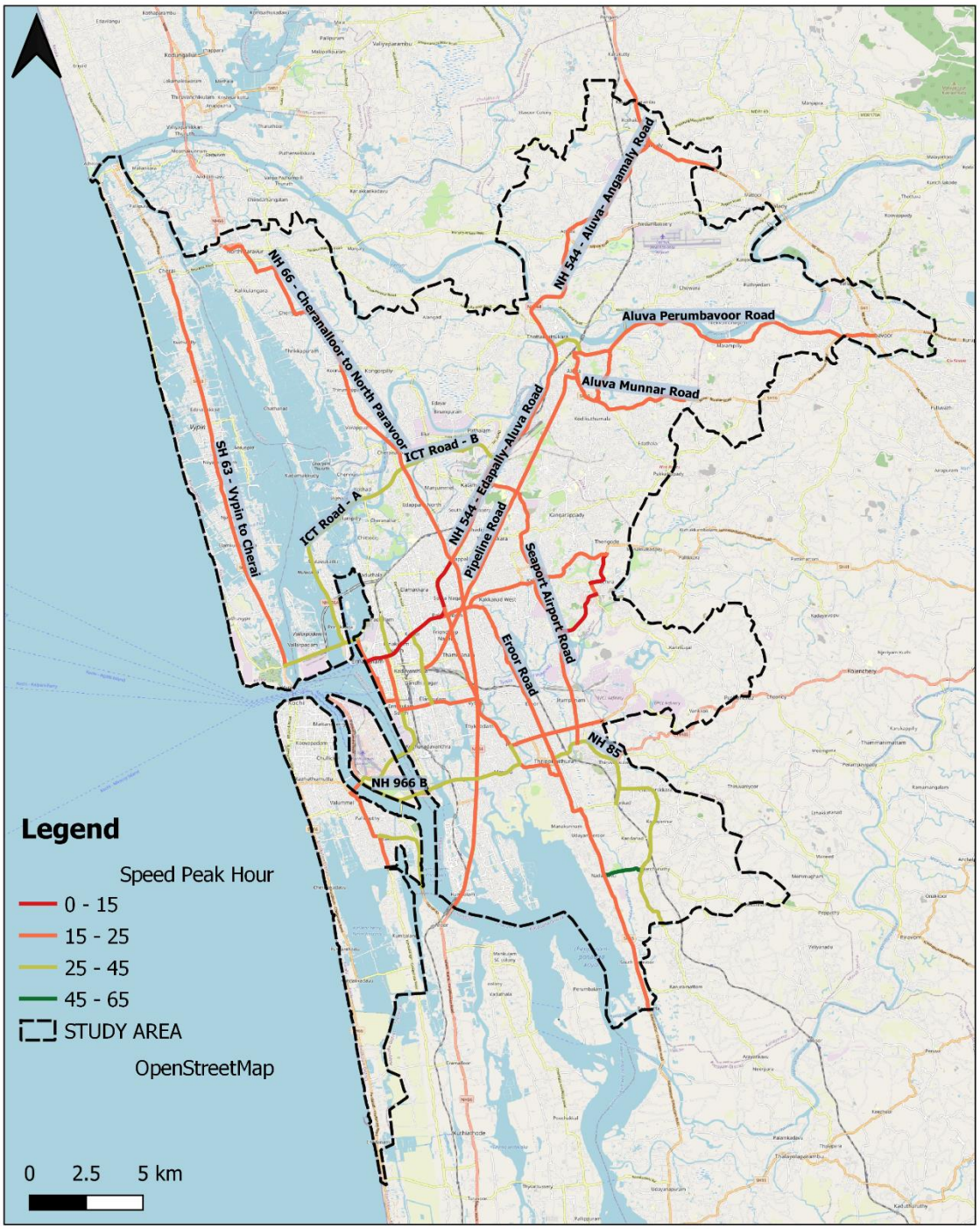
Table 20 Speed along Major Corridors during Peak Hour and Off-Peak Hour in the Study Area ((Primary Surveys-2022-23)

S.No.	Name of the Road	Distance (Km)	Delay (MIN)	Speed (km/ hr)	
				Peak	Off Peak
1	Palarivattom-Edapally Road (Old NH 47)	2.82	7.35	13.44	32.26
2	NH 544 - Edapally-Aluva Road	14.26	14.50	18.01	25.92
3	NH 544 - Aluva- Angamaly Road	11.65	7.00	20.12	25.20
4	NH 66 - AROOR BRIDGE to Kundannur	5.87	3.92	23.48	25.15
5	NH 66 - Kundannur to Edapally	9.86	6.48	18.06	20.20
6	NH 66 - Edapally to Cheranallur	4.65	4.83	18.59	21.45
7	NH 66 - Cheranallur to North Paravoor	14.34	12.82	17.33	18.71
8	Pipeline Road	14.64	8.95	17.44	21.21
9	Seaport Airport Road	13.81	8.20	18.52	22.68
10	ICT Road	4.79	2.00	25.52	31.04
11	Shanmugham Road	1.42	3.40	17.09	53.40
12	Abraham Madamakkal Road	1.12	2.75	17.91	67.18

S.No.	Name of the Road	Distance (Km)	Delay (MIN)	Speed (km/ hr)	
				Peak	Off Peak
13	Sahodaran Ayyapan Road	3.49	3.90	15.21	21.24
14	Ettumanur Ernakulam Road	17.69	4.35	23.53	26.04
15	Aluva Munnar Road	8.55	6.65	20.37	27.67
16	Aluva Perumbavoor Road	13.02	7.50	19.53	24.04
17	Edayapuram Road	2.67	1.00	21.37	24.66
18	SH 63 - Vypin to Cherai	18.29	6.50	19.77	22.39
19	Chittoor Road	1.73	1.25	25.94	37.73
20	Banerji Road	3.93	10.25	12.18	25.90
21	MG Road - Madha Pharmacy Jn to Pallimukku	2.48	3.80	15.66	26.09
22	MG Road - Pallimukku to Vendurthy Bridge	4.88	3.00	27.90	39.06
23	Thopumpady Edakochi Road	2.47	0.60	18.42	19.90
24	Kumbalangi Road	1.46	0.70	17.15	19.88
25	Edakochi Road	3.78	2.00	28.35	37.80
26	Nadakkavu Mulamthuruthy Rd	1.76	0.05	60.37	62.15
27	Chottanikkara Mulamthuruthy Rd	5.36	1.70	26.35	30.62
28	Refinery Road	2.67	4.10	19.79	40.08
29	Mini Bypass Thripunithura	2.25	0.20	18.73	19.26
30	Kundannur Bridge	5.47	0.18	44.21	45.28
31	Kaloor Kadavanthra Road	3.26	1.10	27.55	32.60
32	Mahakavi Vailoppilli Road	4.19	5.70	16.38	26.05
33	Alinchuvadu Vennala Road	1.59	0.70	18.74	21.72
34	Civil Line Road	4.40	6.85	19.15	38.05
35	Infopark Expressway	2.63	2.25	14.68	18.57
36	Kakkanad Infopark Road	0.56	1.00	16.89	33.78
37	Infopark Thengode Road	1.84	2.50	9.22	11.64
38	MC Road Angamaly Perumbavoor	3.31	2.00	18.06	22.07
39	Ernakulam Thekkady Road	4.01	4.00	15.51	20.91
40	Park Avenue Road	0.84	1.75	18.37	50.51
41	Eroor Road	5.40	1.45	21.32	23.57
42	Durbar Hall Road	0.57	0.55	22.01	34.12

Table 21 Peak Hour Delays on Major Roads in the study area (Primary Surveys-2022-23)

S.No.	NAME OF THE ROAD	DISTANCE (KM)	DELAY (MIN)	CAUSE OF DELAY
1	Palarivattom-Edapally Road (Old NH 47)	2.82	7.35	Traffic & Traffic Signal
2	NH 544 - Edapally-Aluva Road	14.26	14.50	Traffic & Traffic Signal
3	NH 544 - Aluva- Angamaly Road	11.65	7.00	Traffic & Traffic Signal
4	NH 66 - AROOR BRIDGE to Kundannur	5.87	3.92	Traffic Signal
5	NH 66 - Kundannur to Edapally	9.86	6.48	Traffic & Traffic Signal
6	NH 66 - Edapally to Cheranallur	4.65	4.83	Traffic & Traffic Signal
7	NH 66 - Cheranallur to North Paravoor	14.34	12.82	Traffic & Traffic Signal
8	Pipeline Road	14.64	8.95	Traffic & Traffic Signal
9	Seaport Airport Road	13.81	8.20	Traffic & Traffic Signal
10	ICT Road	4.79	2.00	Traffic Signal
11	Shanmugham Road	1.42	3.40	Traffic & Traffic Signal
12	Abraham Madamakkal Road	1.12	2.75	Traffic
13	Sahodaran Ayyapan Road	3.49	3.90	Traffic & Traffic Signal
14	Ettumanur Ernakulam Road	17.69	4.35	Traffic
15	Aluva Munnar Road	8.55	6.65	Traffic & Traffic Signal
16	Aluva Perumbavoor Road	13.02	7.50	Traffic & Traffic Signal
17	Edayapuram Road	2.67	1.00	Traffic Signal
18	Banerji Road	3.93	10.25	Traffic & Traffic Signal
19	MG Road - Madha Pharmacy Jn to Pallimukku	2.48	3.80	Traffic & Traffic Signal
20	MG Road - Pallimukku to Vendurthy Bridge	4.88	3.00	Traffic & Traffic Signal
21	Edakochi Road	3.78	2.00	Traffic
22	Refinery Road	2.67	4.10	Traffic
23	Mahakavi Vailoppilli Road	4.19	5.70	Traffic
24	Civil Line Road	4.40	6.85	Traffic & Traffic Signal
25	Infopark Expressway	2.63	2.25	Traffic
26	Kakkanad Infopark Road	0.56	1.00	Traffic
27	Infopark Thengode Road	1.84	2.50	Traffic
28	MC Road Angamaly Perumbavoor	3.31	2.00	Traffic Signal
29	Ernakulam Thekkady Road	4.01	4.00	Traffic
30	Park Avenue Road	0.84	1.75	Traffic & Traffic Signal
31	Eroor Road	5.40	1.45	Traffic



Title: Comprehensive Mobility Plan for Kochi	
Map: Journey Speed for Major Roads during Peak Hour	

Figure 55 Journey Speed for Major Roads during Peak Hour

- The average delay of 4 minutes is observed in the study area during peak hours on major corridors. The major reason for delay is largely due to traffic and signals. Maximum delay of 14 to 15 minutes is observed on NH 544 and NH 66.

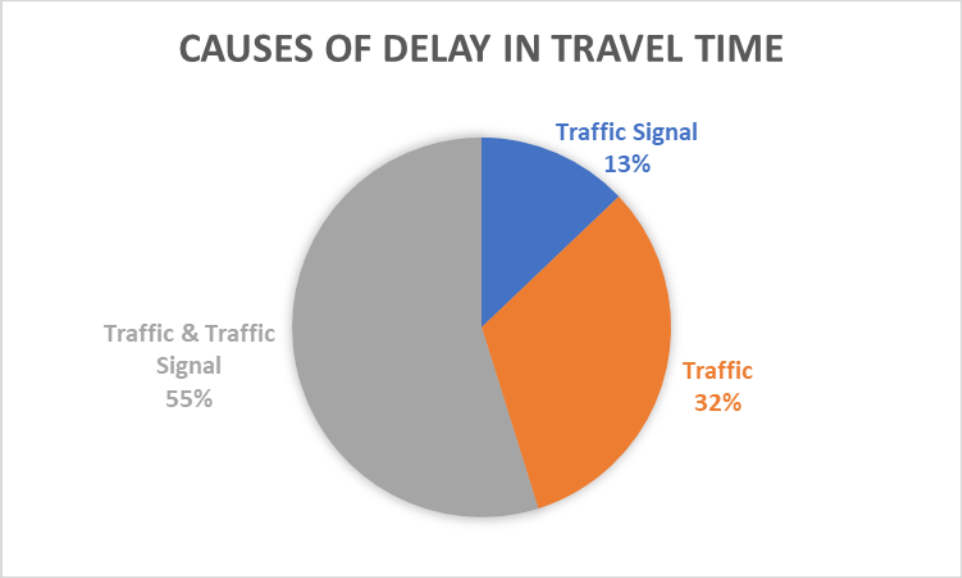


Figure 56 Causes of Delay in Travel Time (Primary Surveys-2022-23)

4.1.2 TRAFFIC VOLUMES

4.1.2.1 OUTER CORDON SURVEY

- It is observed that highest outer cordon traffic volumes are observed on NH-66 (at Aroor) road followed by NH 544 (at Angamaly), indicating strong North-South interaction at northern and southern borders.
- It is observed that about 58% of the vehicle composition at outer cordons in constituted by two-wheeler, 27% by cars and about 7% is constituted by Goods.

Table 22 Vehicular Volumes at Outer Cordon Locations (Primary Surveys-2022-23)

Code	Road Name	Landmark	Peak Vehicles (COUNT)			(Peak PCUs)
			Inbound	Outbound	Total	Total
OC_1	NH 66	Paravur Bridge	1022	1744	2766	2581
OC_2	NH 544	Angamaly Bridge	3177	2127	5304	5317
OC_3	Aluva Munnar Road	Sub RTO, Perumbavoor	1525	1060	2585	2418
OC_4	SH 1 MC Road	Sree Bhavani Wood Industries	1283	1295	2578	2545
OC_5	SH 41 – Kakkanad Pallikkara Road	Manakakkadavu Bridge	1063	470	1533	1370
OC_6	NH 85	Thrippakkudath Sree Dharma Sastha Temple	763	763	1526	1478

Code	Road Name	Landmark	Peak Vehicles (COUNT)			(Peak PCUs)
			Inbound	Outbound	Total	Total
OC_7	Arakkunnam	Honda Service & Spares	370	498	868	801
OC_8	SH 15 - Ettumanur Ernakulam Road	Poothotta Bridge	1407	482	1889	1665
OC_9	NH 66	Aroor Kumbalam Railway Bridge	1661	4709	6370	5716
OC_10	SH 66	St Xavier's Roman Catholic Church	239	387	626	540

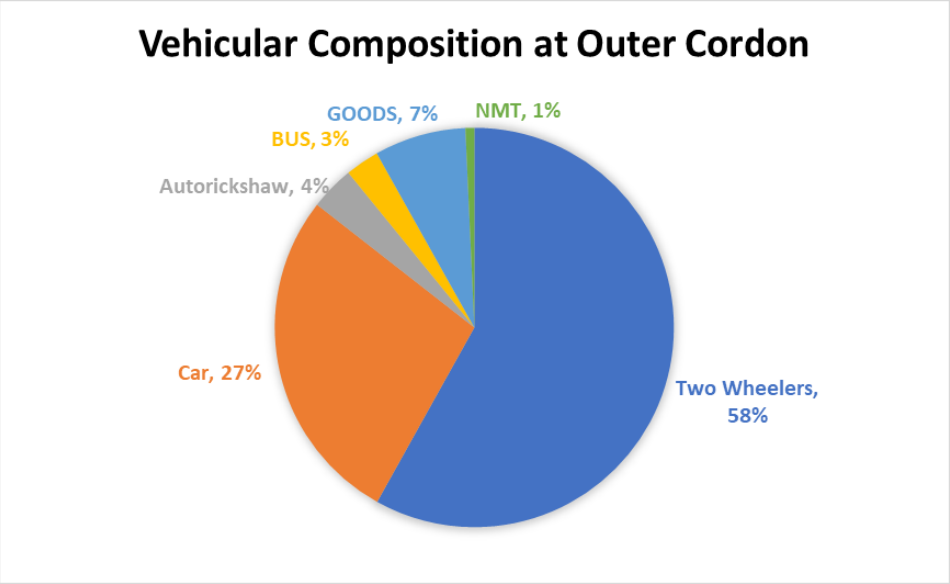


Figure 57 Vehicular Composition at Outer Cordon Locations (Primary Surveys-2022-23)

4.1.2.2 SCREENLINE SURVEY

- It is observed that highest traffic volumes at screen line locations are observed on Banerji Road, Venduruthy Bridge and NH 85. Considerable inbound traffic (to the city centre) along the major radials.
- It is observed that about 63% of the vehicle composition at screen lines in constituted by two-wheeler and about 25% is constituted by car.

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

Code	Location	Peak Vehicles (COUNT)			(Peak PCUs)
		Inbound	Outbound	Total	Total
SL_1	Varappuzha Bridge	1262	4392	5654	4927
SL_2	NH- Desom ROB	4274	2810	7084	6746
SL_3	Salem Kochi Highway ROB, Angamaly	2279	2847	5126	4909

Code	Location	Peak Vehicles (COUNT)			(Peak PCUs)
		Inbound	Outbound	Total	Total
SL_4	Marampally Bridge	636	339	975	842
SL_5	Edapally ROB	1650	3633	5283	4665
SL_6	Banerji Road ROB	3133	4441	7574	6988
SL_7	Chambakkara Bridge	4673	1810	6483	5829
SL_8	Venduruthy	5042	2225	7267	6264
SL_9	Mamala Bridge	1034	1368	2402	2210
SL_10	Seaport- Airport Bridge	2702	1117	3819	3505
SL_11	Aroor Edakochi Bridge (To Thoppumpady)	1703	800	2503	2170
SL_12	Mulamthuruthy ROB	618	479	1097	1094

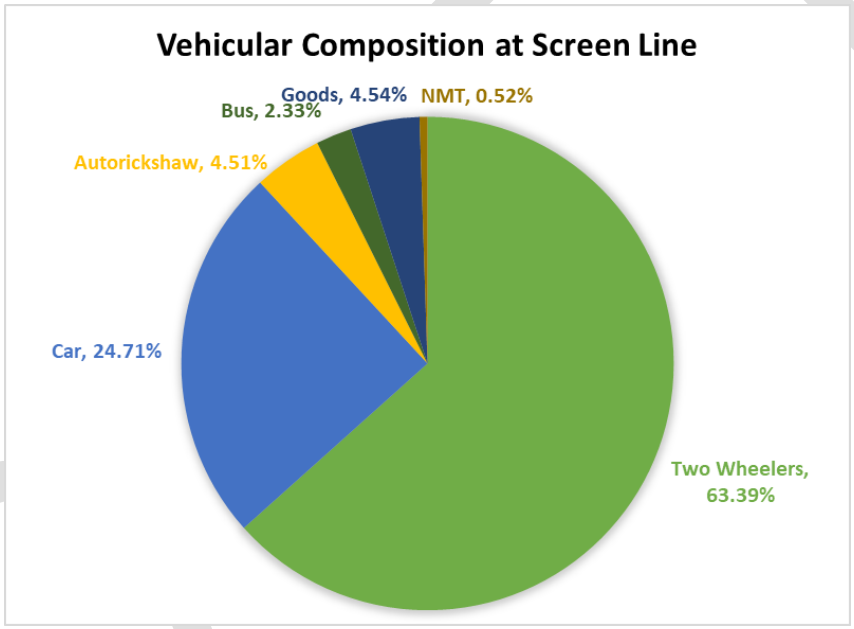


Figure 58 Vehicular Composition at Screen Line Locations (Primary Surveys-2022-23)

4.1.2.3 MID BLOCK SURVEY

- Highest amount of traffic is observed on NH 544, followed by Seaport Airport Road.
- It is observed that about 59% of the vehicle composition at mid-blocks in constituted by two-wheeler and about 28% is constituted by car.

Table 24 Vehicular Volumes at Mid-Block (Primary Surveys-2022-23)

Code	Location	(Peak Vehicles) Total	(Peak PCUs) Total
MB_1	SH63 - Pallipuram Road	2246	2005
MB_2	NH 544 Salem Kochi Highway	8017	7655
MB_3	Chittoor Road	1499	1283

MB_4	SH 16 Aluva- Munnar Road	3023	2824
MB_5	Seaport- Airport Road	5858	5287
MB_6	Ettumanur Ernakulam Road	3716	3448
MB_7	Ponjassery	838	757

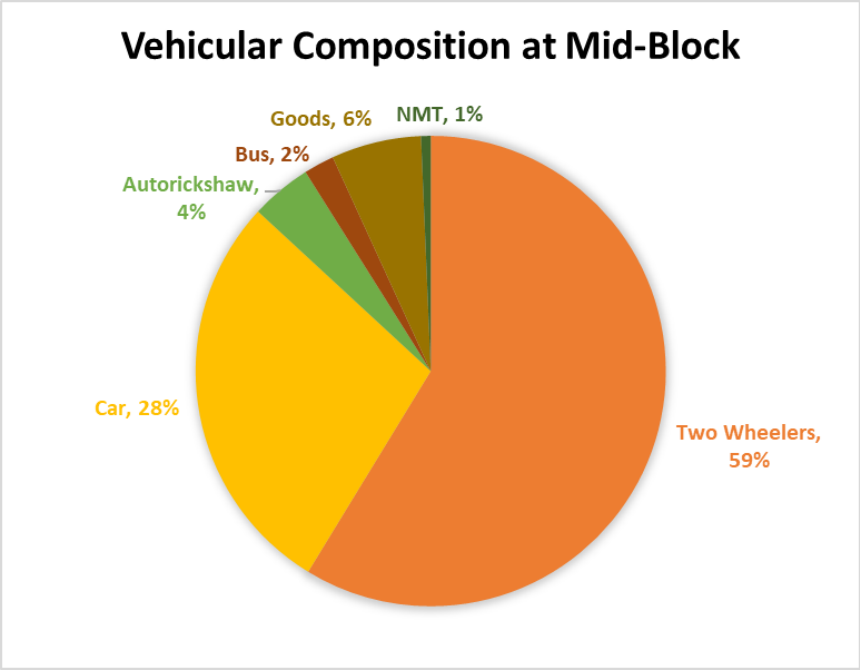


Figure 59 Vehicular Composition at Mid-Block Locations (Primary Surveys-2022-23)

4.1.2.4 INTERSECTION TURNING VOULUME COUNTS

- The highest traffic volumes at intersection locations are observed at Palarivattom, Vyttila, Maradu, Edapally and near Aluva Metro Station Junctions. This indicates high traffic volumes in the city core and there is a need to address and decongest the core area.
- About 60% of the vehicle composition at intersections constituted by two-wheeler and about 27% is constituted by car.

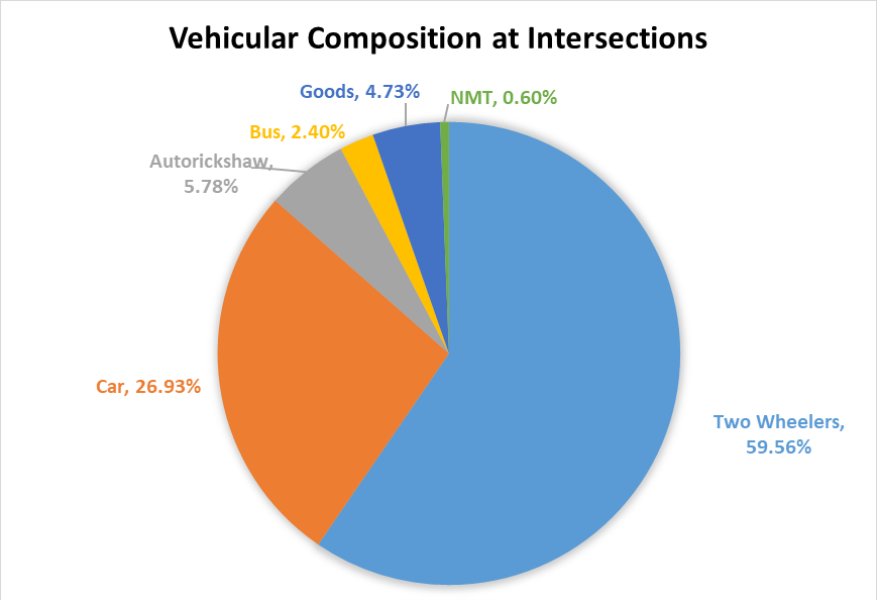


Figure 60 Vehicular Composition at Intersections (Primary Survey 2022-23)

Table 25 Vehicular Volumes at Major Intersections (Primary Surveys-2022-23)

Code	Location	Peak (Vehicles)	Peak (PCUs)
TMC-1	Pottan Theruvu Junction	4339	4069
TMC-2	Angamaly Junction	6147	6166
TMC-3	Airport Road	6614	6459
TMC-4	Perumbavoor Signal Junction	4911	4690
TMC-5	Aluva Metro Station Junction	10154	9843
TMC-6	Cheranallur Junction	8092	7242
TMC-7	Kalamasserry TVS Junction	5705	5384
TMC-8	Edapally Junction	15890	14535
TMC-9	Civil Line- Kakkanad Junction	7800	7187
TMC-10	Palarivattom Junction	19969	18306
TMC-11	Irumpanam Junction	6701	6346
TMC-12	Kaloor Junction	7042	6689
TMC-13	High Court Signal Junction	4375	4387
TMC-14	Goshree Round	4218	3746
TMC-15	Jose Junction	4729	4421
TMC-16	Kadavanthra Junction	7975	7408
TMC-17	Vyttila Junction	17600	16089
TMC-18	Karimughal Junction	2466	2252

Code	Location	Peak (Vehicles)	Peak (PCUs)
TMC-19	Cochin Port	6116	5503
TMC-20	Maradu	14424	12951
TMC-21	Kacherippady Junction	5175	4625
TMC-22	Nadakkavu Junction	4507	4138
TMC-23	Chellanam South Neendakara Jn.	988	845
TMC-24	Airport Junction	4788	4526
TMC-25	Thoppumpady Junction	5919	5248

4.1.3 PUBLIC TRANSPORTATION (PT) PASSENGER VOLUMES

The primary survey assessment shows a daily footfall of nearly 68 thousand passengers at the major public transportation terminals in the study area. It is seen that Ernakulam Junction Railway Station and Aluva Railway Station are the major railway stations with high passenger footfalls. While Vyttila Hub, Angamaly Bus Stand, North Paravoor Bus Stand, Thripunithura Bus Stand and Aluva Bus Stand are the major bus terminals in the study area. The quantum of passenger flow is as presented in the table below.

Table 26 Passenger Volumes at Major PT Terminals during Peak Hour (Primary Surveys-2022-23)

SL. NO.	NAME	PASSENGERS		TOTAL PASSENGERS
		IN	OUT	
T-1	Thripunithura Railway Station	795	872	1667
T-2	Ernakulam Junction	3742	3986	7728
T-3	Ernakulam Town Railway Station	1748	2189	3937
T-4	Aluva Railway Station	3567	3048	6615
T-5	Angamaly Railway Station	596	556	1152
T-6	Mulamthuruthy Railway station	467	453	920
T-7	Kochi Airport - Domestic	2326	2398	4724
T-7	Kochi Airport - International	1392	1986	3378
T-8	Vyttila Hub	2785	2488	5273
T-9	Kaloor Bus Stand	1358	1612	2970
T-10	Ernakulam Jetty bus stand	633	610	1243
T-11	Aluva KSRTC Stand	2626	1986	4612
T-12	Angamaly Stand	2720	2388	5108
T-13	North Paravoor Bus Stand	2899	2499	5398
T-14	Perumbavoor KSRTC Bus Stand	1667	1294	2961
T-15	KSRTC Ernakulam	2165	1793	3958

SL. NO.	NAME	PASSENGERS		TOTAL PASSENGERS
		IN	OUT	
T-16	Thripunithura Bus Stand	2786	2371	5157
T-17	Fort Kochi Bus Stand	711	698	1409

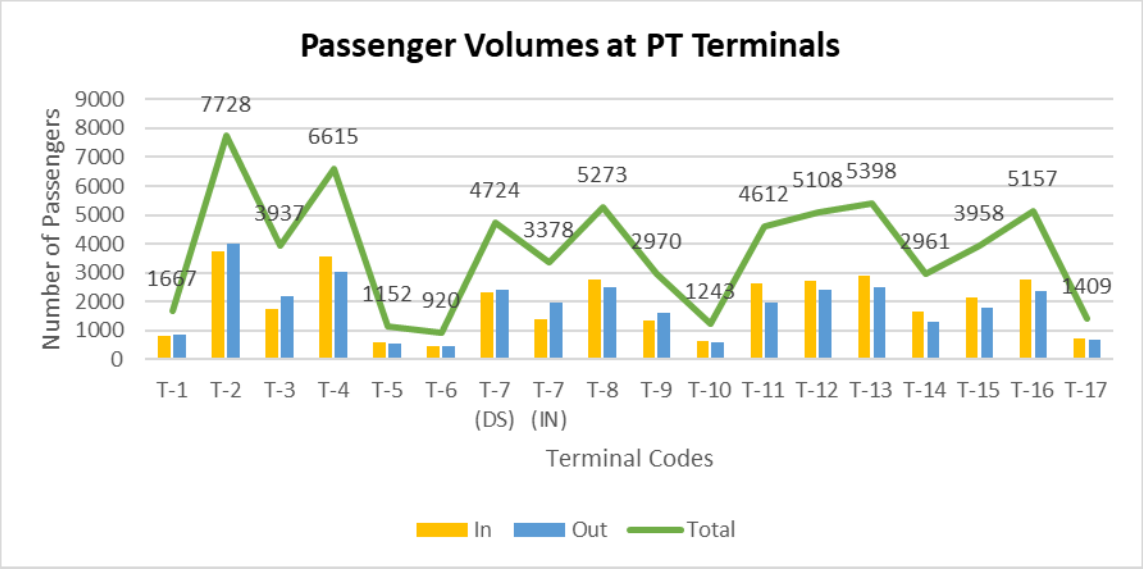


Figure 61 Passenger Volumes at Major PT Terminals during Peak Hour (Primary Surveys-2022-23)

The primary survey assessment shows a daily footfall of nearly 16 thousand passengers at the major bus stops in the study area with an average passenger occupancy of 35 persons per bus. It is seen that High Court Bus Stop has the highest footfall due to its proximity to activity centres, as well as being a major transfer point for people travelling from the northern Goshree islands followed by Civil Station, Kakkanad. The volumes indicated the presence of significant demand for public transportation services.

Table 27 Passenger Volumes at Major Bus Stop during Peak Hour (Primary Surveys-2022-23)

LOCATION	NAME	TOTAL PASSENGERS	AVERAGE PASSENGER LOAD
BS-1	Thoppumpady Bus Stop	1400	80
BS-2	Vyttila Bus Stop	1406	36
BS-3	Angamaly	186	22
BS-4	EDAPALLY	598	35
BS-5	Thevara Junction	1049	100
BS-6	Ernakulam Boat Jetty	113	48
BS-7	Ernakulam Town	391	65

LOCATION	NAME	TOTAL PASSENGERS	AVERAGE PASSENGER LOAD
BS-8	High Court Bus Stop	2085	102
BS-9	Palarivattom	762	89
BS-10	North Kalamasserry Junction	656	39
BS-11	Pulinchodu Junction	231	56
BS-12	Kadavanthra Junction	238	59
BS-13	Civil Station Kakkanad	2016	101
BS-14	Cherai Junction	366	27
BS-15	Kundannur Junction	1061	45
BS-16	Edayaar Bus Stop	40	27
BS-17	Varappuzha Toll Junction	574	26
BS-18	Vadakkekotta	1001	33
BS-19	Aroor Bus Stop	318	25
BS-20	Mattancherry	308	71
BS-21	Penta Menaka	596	28
BS-22	Vypin Boat Ferry	251	23

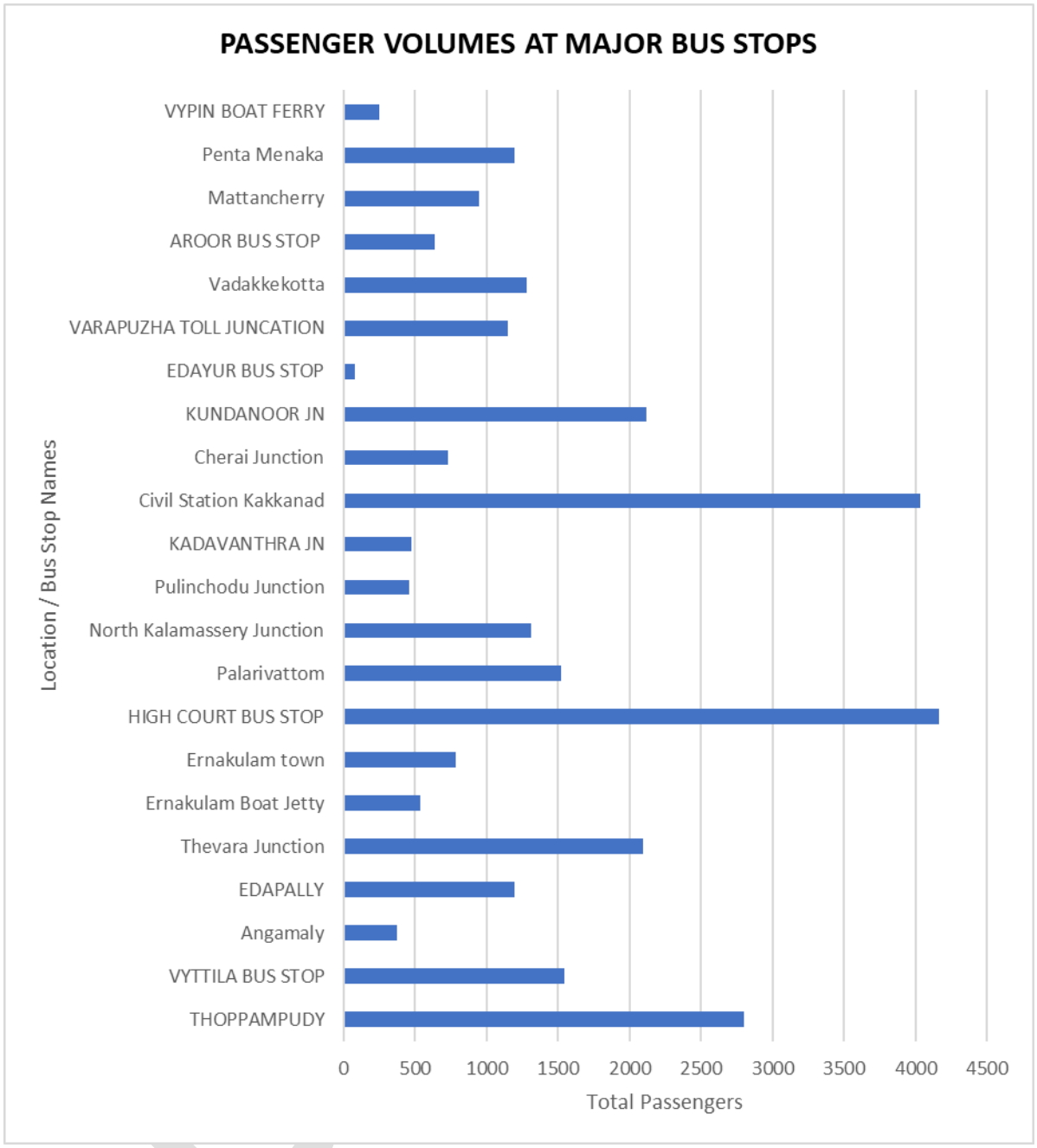


Figure 62 Passenger Volumes at Major Bus Stops during Peak Hour (Primary Surveys-2022-23)

4.1.4 PEDESTRIAN VOLUMES

The surveys indicate that highest pedestrian footfall is observed at High Court Junction followed by Vyttila Junction, Subhash Park, Edapally, Aluva & Palarivattom Junctions due the adjoining activity nodes such as colleges, transport 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.

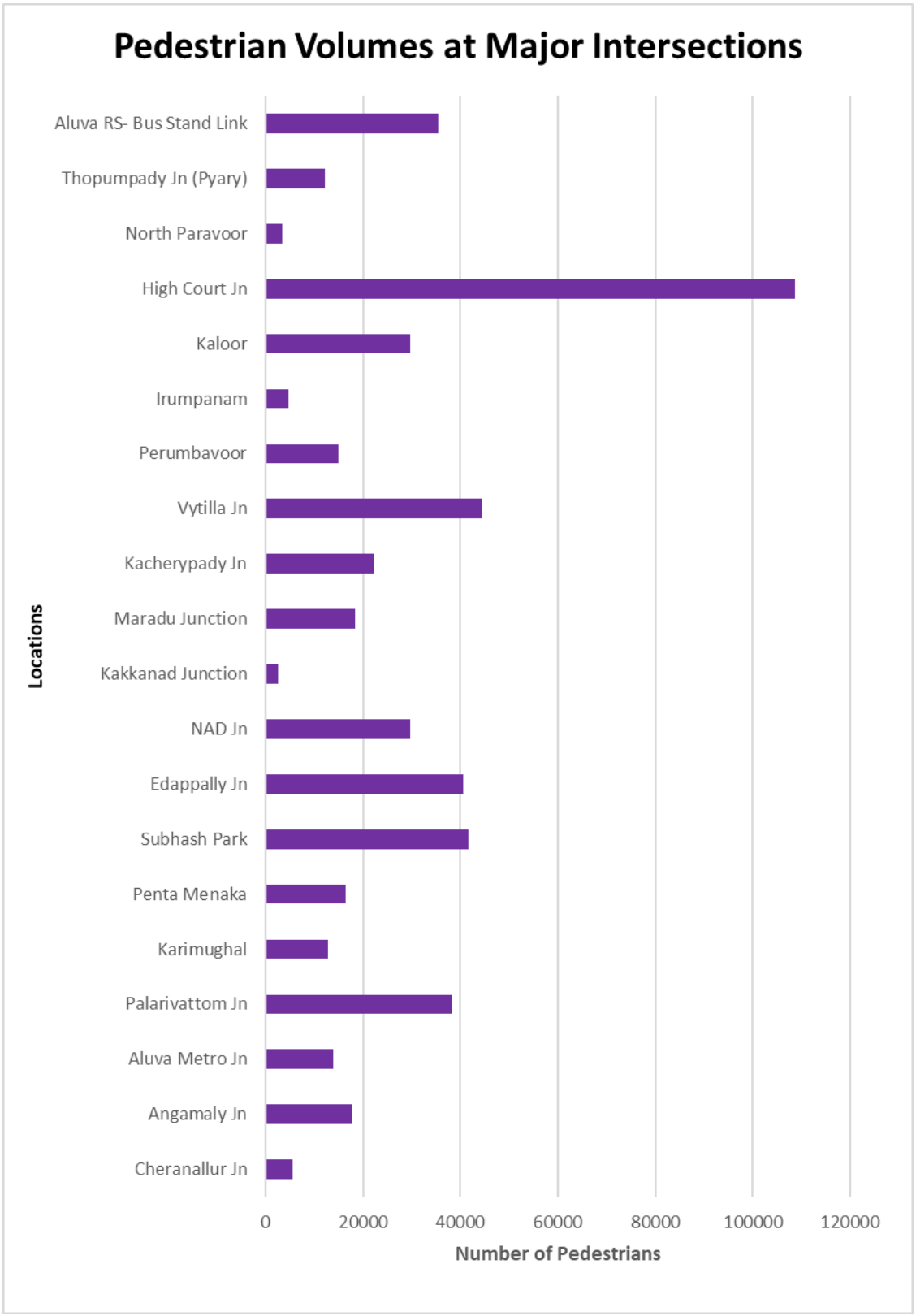


Figure 63 Pedestrian Volumes at Major Intersections (Daily) (Primary Surveys-2022-23)

Table 28 Pedestrian Count (Primary Surveys-2022-23)

CODE	LOCATION	PEDESTRIAN COUNT (PEAK)		DAILY
		MORNING	EVENING	
Ped 1	Cheranallur Junction	545	669	5615
Ped 2	Angamaly Junction	923	1878	17793
Ped 3	Aluva Metro Junction	1156	1513	14001
Ped 4	Palarivattom Junction	2784	2845	38247
Ped 5	Karimughal Junction	683	1672	12895
Ped 6	Penta Menaka	600	1627	16491
Ped 7	Subhash Park	2475	3502	41681
Ped 8	Edapally Junction	2854	4109	40649
Ped 9	NAD Junction	3646	2341	29677
Ped 10	Kakkanad Junction	278	305	2492
Ped 11	Maradu Junction	1397	1891	18446
Ped 12	Kacherippady Junction	1222	2392	22174
Ped 13	Vyttila Junction	5150	4147	44421
Ped 14	Perumbavoor Signal Junction	1000	1645	14925
Ped 15	Irumpanam Junction	411	419	4783
Ped 16	Kaloor Junction	2477	2380	29813
Ped 17	High Court Junction	9369	12704	108739
Ped 18	North Paravoor – Pottan Theruvu Junction	296	299	3517
Ped 19	Thoppumpady Junction (Pyary)	1548	763	12119
Ped 20	Aluva Railway Station - Bus Stand Link	2315	2700	35434

4.1.5 PARKING – ON-STREET & OFF-STREET

The parking assessment was carried out at major locations in the study area, it indicated that highest on-street parking accumulation in the city centre Banerji Road, Kaloor Kadavanthra Road, near Jose Junction and Shanmugham Road while the highest off-street parking accumulation was observed at Ernakulam Railway Station and Vyttila Mobility Hub.

Table 29 On-street Parking - Parking Accumulation at Major Roads (Primary Surveys-2022-23)

CODE	LOCATION	PARKING ACCUMULATION (ECS)
ON 1	Edapally	267
ON 2	Aluva Bypass	480
ON 3	TD Road	266
ON 4	Shanmugham Road	459
ON 5	Kaloor Kadavanthra Road	902
ON 6	Rajaji Road	423
ON 7	Banerji Road	728
ON 8	Changampuzha Park	494
ON 9	Perumbavoor Old Muvattupuzha Road	560
ON 10	Jose Jn	606
ON 11	Subhash Park	320

Table 30 Off-street Parking - Parking Accumulation at various locations (Primary Surveys-2022-23)

CODE	LOCATION	PARKING ACCUMULATION (ECS)
OFF 1	Maradu Flyover	216
OFF 2	Marine Drive Pay & Park	518
OFF 3	Perumbavoor Private Stand	50
OFF 4	Ernakulam South Bus Stand Parking	639
OFF 5	Ernakulam South Railway Station	462
OFF 6	Aluva Railway Station	246
OFF 7	Thripunithura Railway Station	125
OFF 8	Mattancherry Dutch Palace	376
OFF 10	Vyttila Hub	268
OFF 11	Kochi Airport	1531

Further, it is observed that highest composition of vehicles parked on street constitute of two-wheelers and cars with a share over 71%. Also, it also observed that the vehicles are parked for

more than 1.5 hours. This indicates high intensity of parking on major corridors which are of longer time periods and need for parking action in the study area.

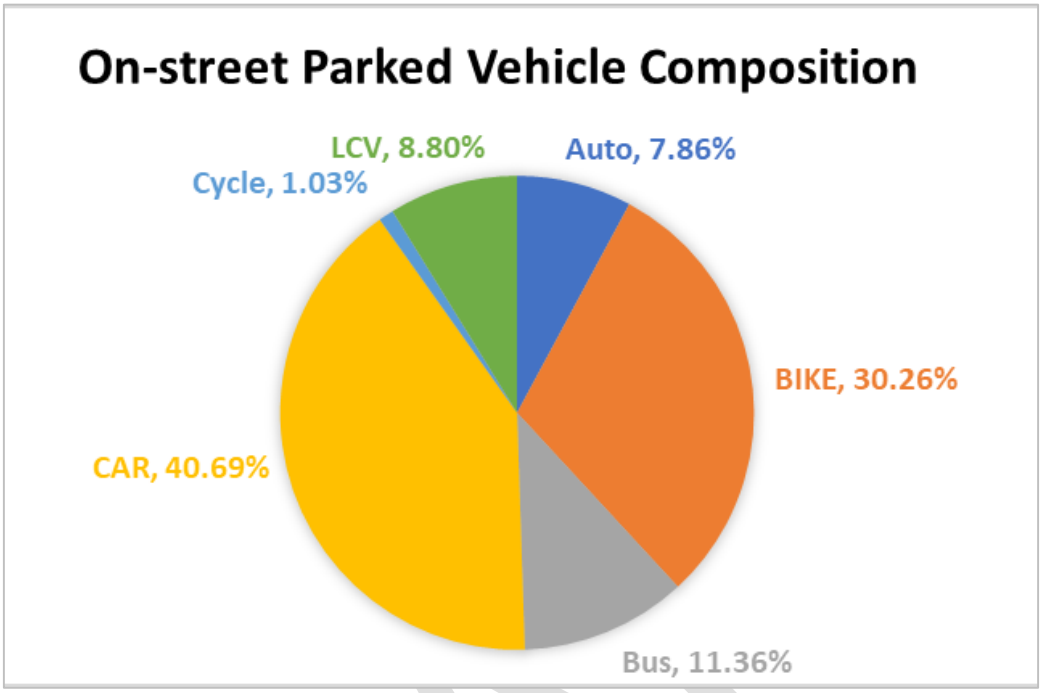


Figure 64 On-Street Parked Vehicles Composition (Primary Surveys-2022-23)

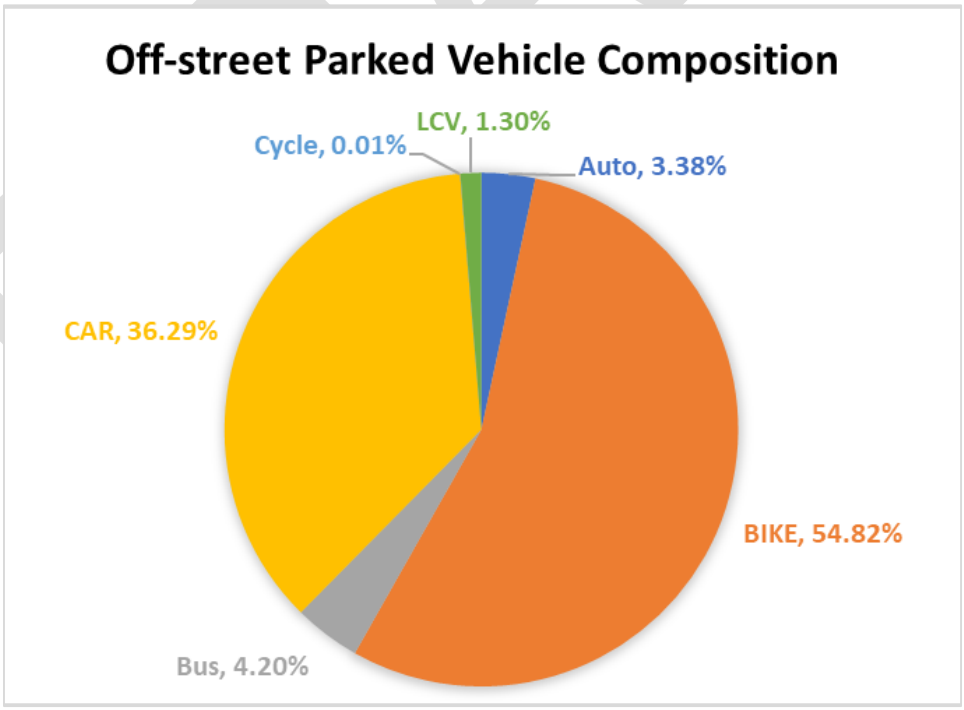


Figure 65 Off-Street Parked Vehicles Composition (Primary Surveys-2022-23)

4.1.6 HOUSEHOLD INTERVIEW

4.1.6.1 SOCIO-ECONOMIC CHARACTERISTICS

- The sex ratio derived from the household survey is the sex ratio is 1015 females per 1000 males.

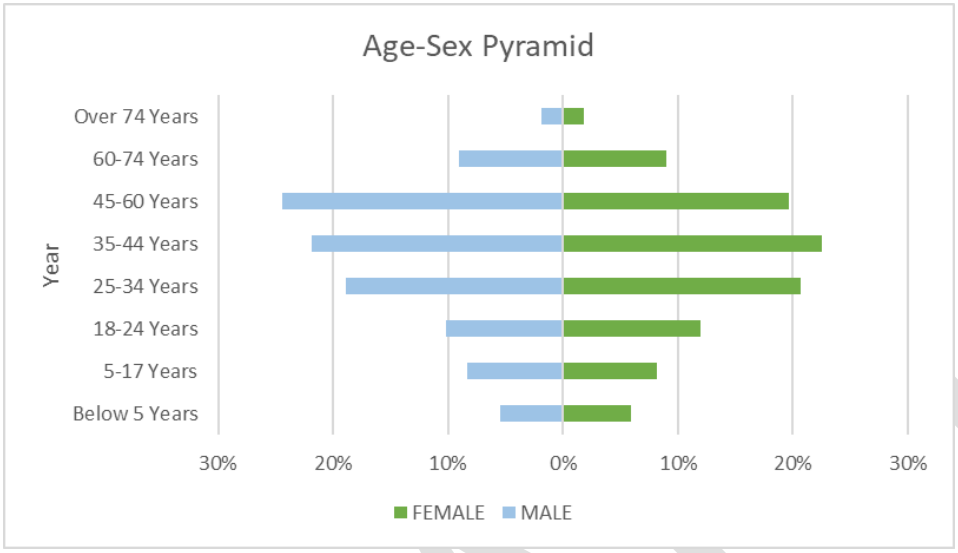


Figure 66 Age-Sex Pyramid (Primary Surveys-2022-23)

- The average household size is observed to be 3.9 with average number of 1.5 earning members per household.
- The classification based on the category of vehicles owned indicates that 11% of the households own no vehicle while, on an average 1.2 vehicles are owned in every household.

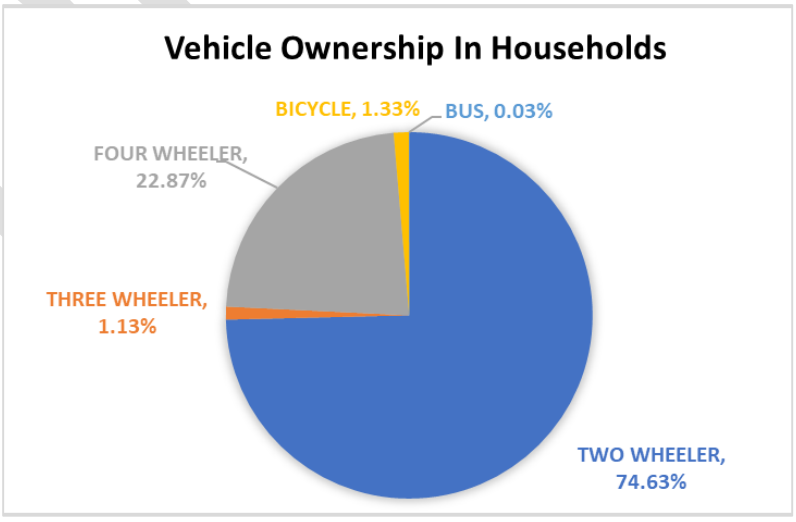


Figure 67 Vehicle Ownership in households (Primary Surveys-2022-23)

4.1.6.2 EXISTING TRAVEL CHARACTERISTICS:

- The Per Capita Trip Rate (PCTR) was observed to be 1.32 including the walk trips. The PCTR for motorized trips is about 1.11.
- The major modes of travel are observed to be two wheelers (39%) and auto-rickshaw with a modal share of 7% while the share of bus based public transport accounts to only 22%, clearly indicating that private mode dominance mode over public buses. Considering all Public Transit modes, the mode share is at 25%.

Table 31 Mode Share (Including NMT) (Primary Survey 2022-23)

S. NO.	MODE	PERCENTAGE
1.	Two-Wheeler	39%
2.	Car/ Four-Wheeler	12%
3.	Auto rickshaw/ Three-Wheeler	7%
4.	Bus	22%
5.	Metro	3%
6.	Ferry	2%
7.	Walk	13%
8.	Bicycle	2%

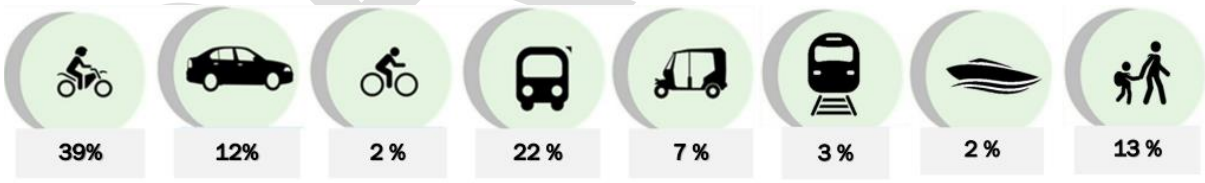


Figure 68 Mode Share (Including NMT) (Primary Surveys-2022-23)

- The observed average trip length in is observed to be 7.53 Km including the walk trips and 8.58 km excluding the walk trips, and motorized is 8.47 km.

Table 32 Average Trip Lengths (Primary Surveys-2022-23)

AVERAGE TRIP LENGTHS	ATL (IN KM)
Total	7.53
Motorized	8.47

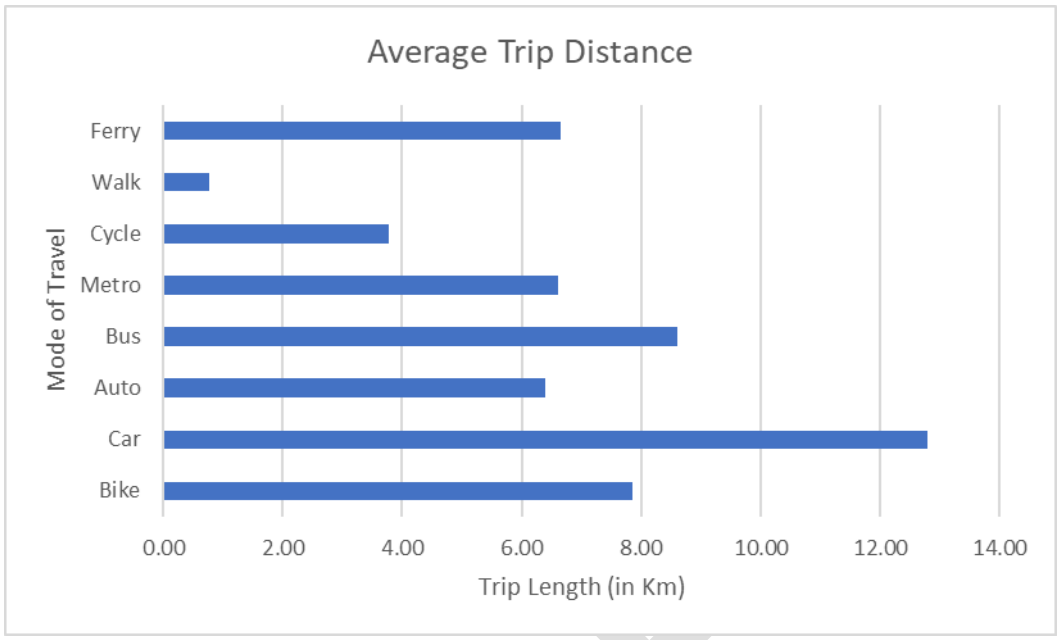


Figure 69 Mode-wise Average Trip Lengths (Primary Surveys-2022-23)

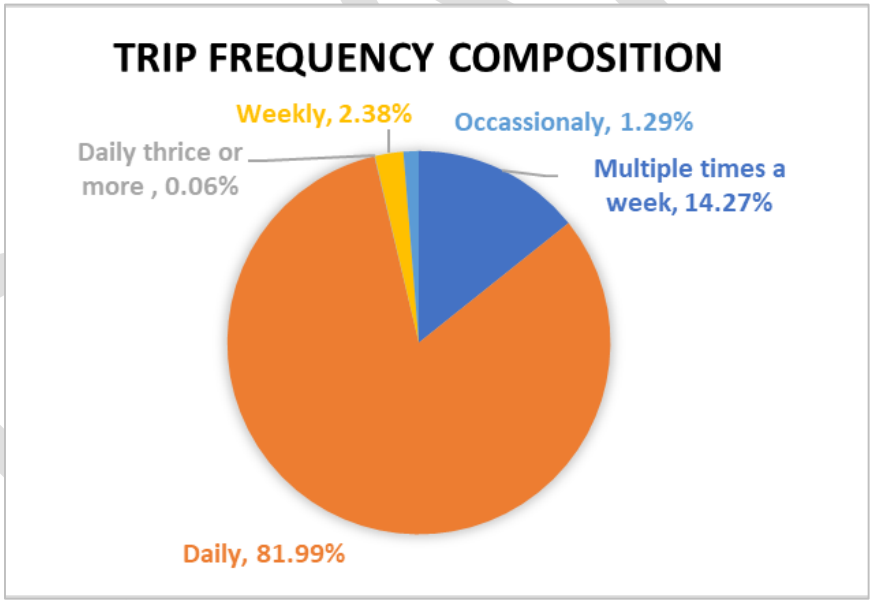


Figure 70 Trip Frequency Composition (Primary Surveys-2022-23)

- The survey indicated that over 82% of the trips are made daily.
- Nearly 55% of the trips made are work-based trips and about 27% of the trips are made for educational purposes. This indicates that nearly 82% of the trips being made are regular and daily trips in the study area.

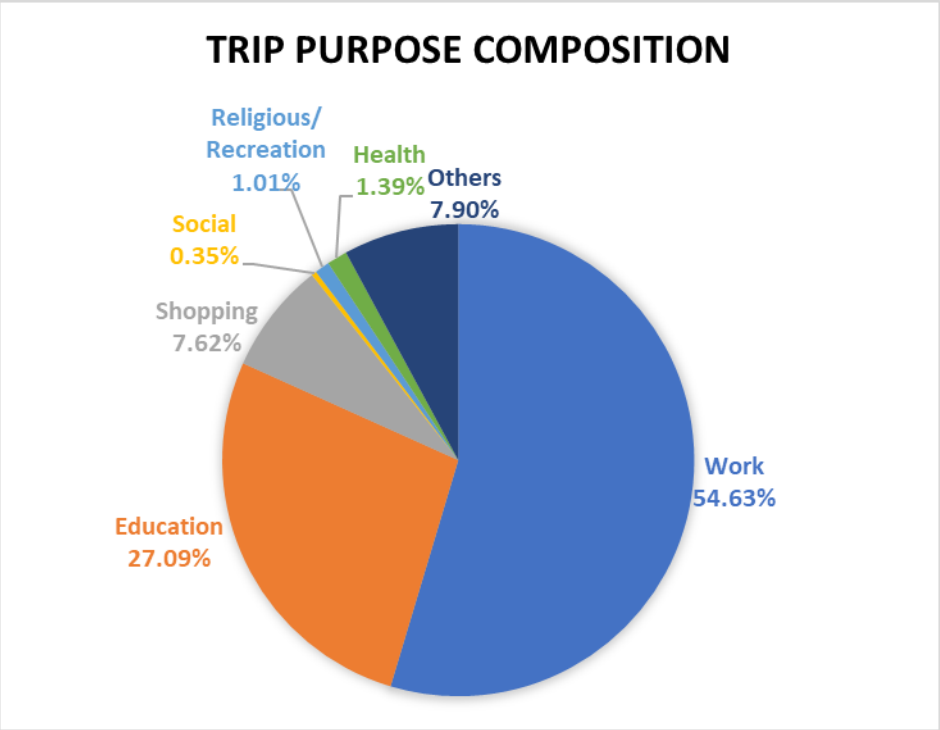


Figure 71 Trip Purpose Composition (Primary Surveys-2022-23)

- The average waiting time for bus services is observed to 6 minutes. The longest waiting time is observed for buses with a wait time of 35 minutes.
- The household's access to the nearest PT or IPT stop is 0.7 km which is considered as a comfortable walking distance. Similarly, the average time taken to reach the PT or IPT stops in 10 minutes.
- 89% of the IPT vehicles surveyed are self-owned, while only 11% are rented or hired and mostly consist of 3-seaters (89.4%).
- 85% of the vehicles depended on petrol for fuel followed by 13.8 % on diesel, 0.87% and 0.33% on CNG and electricity respectively among the sample interviewed.

4.1.7 VEHICLE TECHNOLOGY AT SURVEYS PETROL PUMPS:

- It is observed that majority of the vehicles in the study area run on pertrol owing to 90% of the total composition.
- The average vehicle mileage in the study area based on vehicle composition is presented in Figure 73.

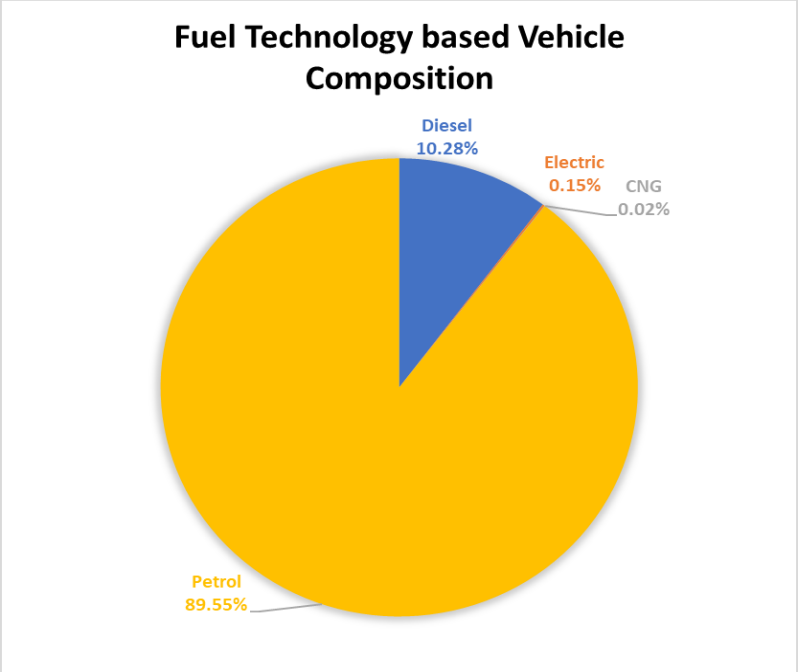


Figure 72 Fuel Technology based Vehicle Composition (Primary Surveys-2022-23)

Table 33 Fuel Technology based Vehicle Composition (Primary Surveys-2022-23)

	2-WHEELER	3-WHEELER	4-WHEELER	BUS
Diesel	0.58%	61.54%	42.90%	100.00%
Electric	0.14%	0%	0.15%	0%
CNG	0%	1.54%	1.00%	0%
Petrol	99.27%	36.92%	56.95%	0.00%

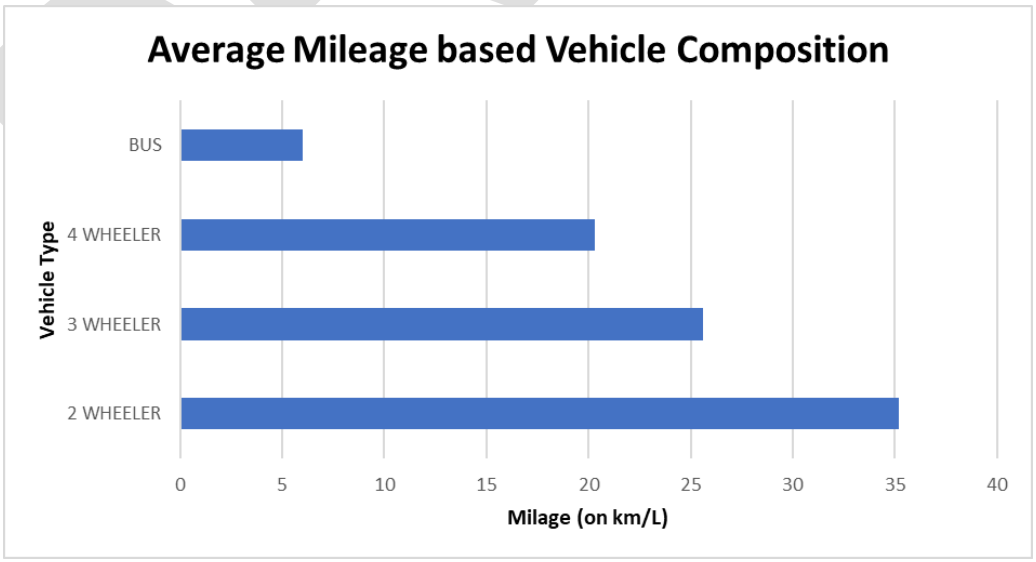


Figure 73 Average Mileage based Vehicle Composition (Primary Surveys-2022-23)

4.1.8 GOODS VEHICLE CHARACTERISTICS

- About 65% of the trips are made on weekly basis and 25% occasional basis indicating considerable number of intercity interactions.
- Among the surveyed vehicles, 34% mentioned having no parking to low parking facilities, while 42% had proper facilities to park the vehicles.
- Major operational concerns raised by the goods operators included:
    - Width of the roads – 80% of the operators found the city to have narrow roads.
    - Terminal & General Facilities – 62% found the city lacked terminal facilities & 74% general facilities with respect to goods operations.
    - Quality of roads - 47% expressed concerns of the quality of roads.
    - 65% of the operators found the ban on the major streets as a hindrance owing to the lack of terminal & general facilities.

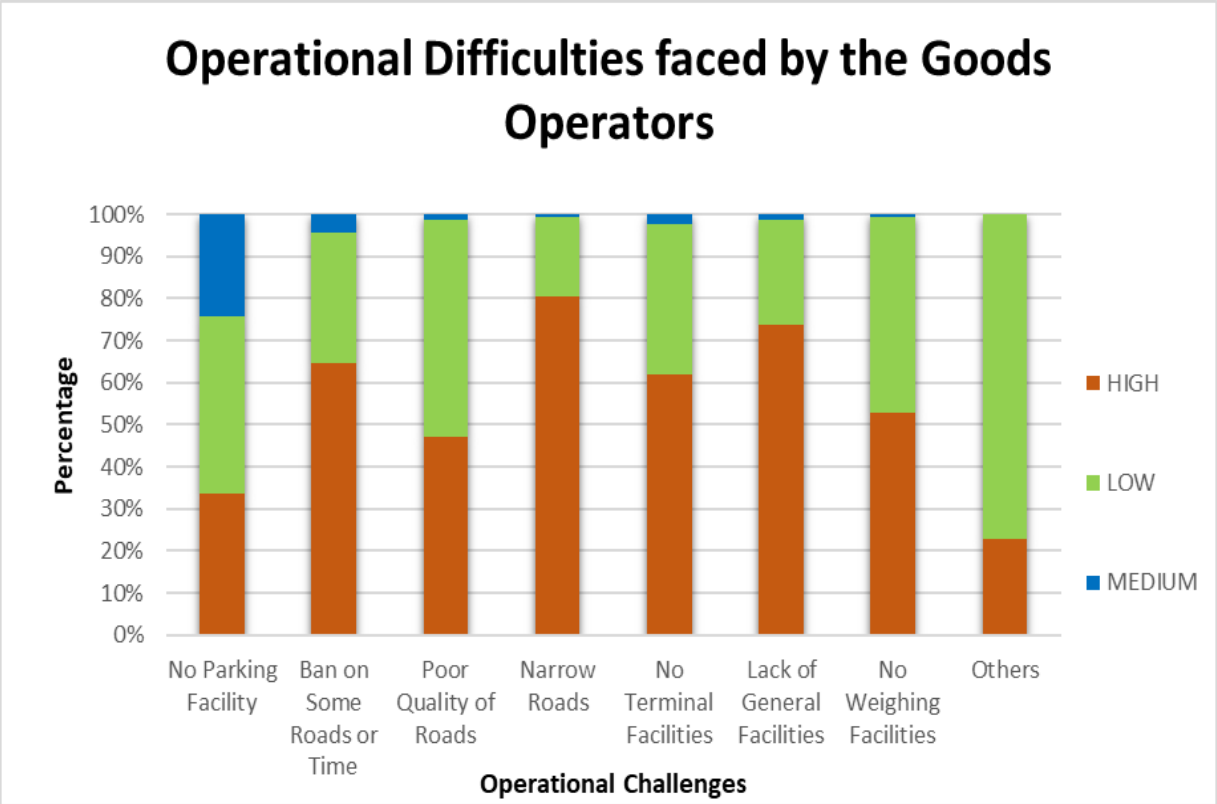


Figure 74 Operational Difficulties faced by the Goods Operators (Source: Primary Survey 2022-23)

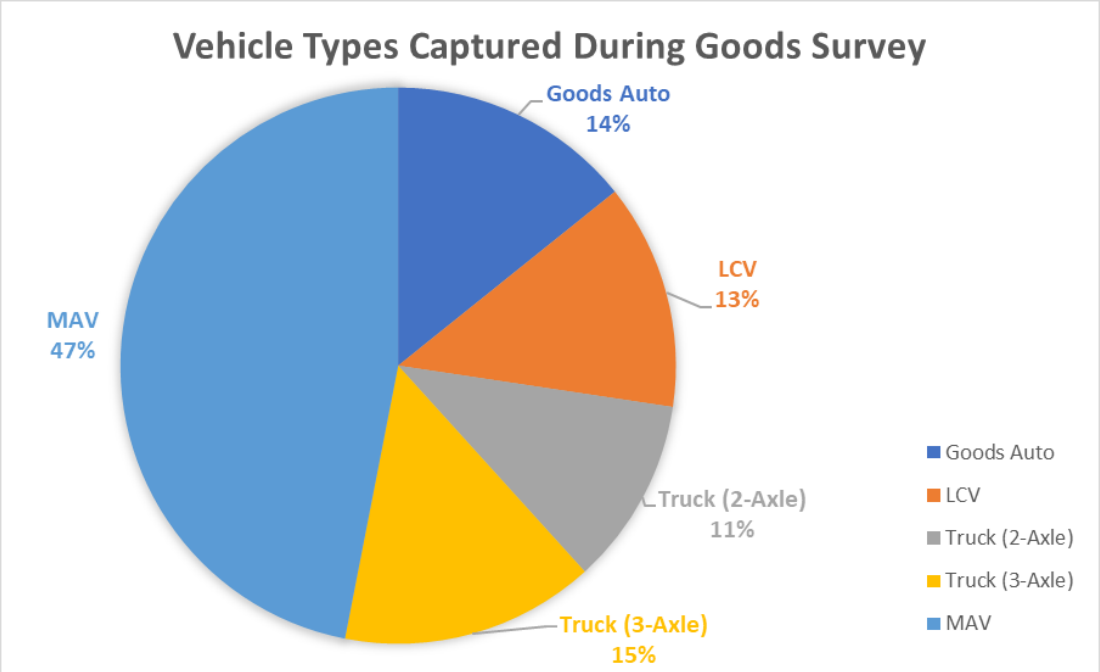


Figure 75 Vehicle Types Captured During Goods Operator Survey (Source: Primary Survey 2022-23)

4.2 KEY OBSERVATION IN THE CITY

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

- Urban sprawl is observed in the areas away from the CBD and ribbon development can be observed along the major corridors connecting these sprawls to the CBD. This 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.

Figure 76 Connectivity Options in Kochi: Bus Services at Vypin (Top), Ro-Ro Services at Fort Kochi (Middle), Vyttila Mobility Hub (Bottom Left) Ernakulam Jetty (Bottom Right)

- Public Transit options are multiple from buses run by KSRTC and private bus operators, metro services, water connectivity through KSWTD and KMRL, Ro-Ro services, rail, and air connectivity.

Figure 77 Ferry Services at Fort Kochi

- Opportunities for integration of rail, road, water, and metro services are high considering the ongoing infrastructure developments in the study area. Apart from Vyttila Hub, on completion of the metro services extension to Thripunithura Railway Station from SN Junction, it will act as a good intermodal hub connecting the two station and ensure ease of travel for people coming to the CBD from the southern region of Kerala.
- The land use in the area have been evolving over time from predominantly residential to public, mixed, and commercial, generating pressure on existing transport infrastructure. The major densification is observed within the NH, NH-Bypass and along the major corridors.

Figure 78 Dedicated Pedestrian Facilities provided along Banerji Road and NH 544 (Near Aluva)

- Efforts are underway by various ULBs, KMRL and CSML for urban place making and NMT infra development. This needs to be enhanced and clear demarcation of activities or road spaces needs to be developed leading to equitable distribution of the road space.

Figure 79 Lack of Activity Demarcation: Fort Kochi (Top Left), Bus Stop at Fort Kochi (Bottom Left) Thoppumpady Junction (Top Right), MG Road (Bottom Right)

- 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 increasing the safety concerns of tourists.
- 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 lack dedicated cycle tracks.
- 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.

Figure 80 Pedestrian Infrastructure Existing Condition or No Facility: MG Road - City Centre (Left), Sea Port Airport Road (Near Infopark Entry) (Middle), Near Collectorate, Kakkanad (Right)

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

Figure 81 Parking issues along Major Activity Nodes and Roads: Angamaly, NH544 (Top Left) Irumpanam Junction (Top Right), Two wheelers parked near Vyttila Mobility Hub (Bottom Left), SH-16, Near Aluva (Bottom Right)

- Bus stops lack dedicated boarding alighting spaces, leading to an added congestion on the road due to already present heavy traffic.
- Considerable trucks are parked along the roads near the industrial areas and along highways.

Figure 82 Trucks and Buses parking along Seaport Airport Road

4.3 BASE YEAR TRAVEL DEMAND ASSESSMENT

The assessment of travel condition in the study area is carried thorough an urban transport model.

4.3.1 URBAN TRANSPORT MODEL - INTRODUCTION

An urban transport model to replicate the Kochi 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. The model is based on a conventional 4-stage transport model approach.

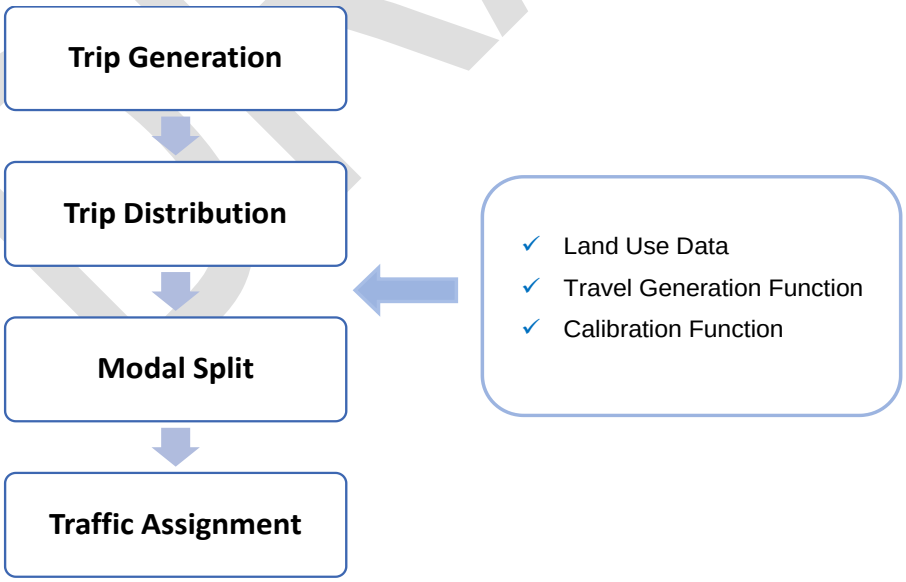


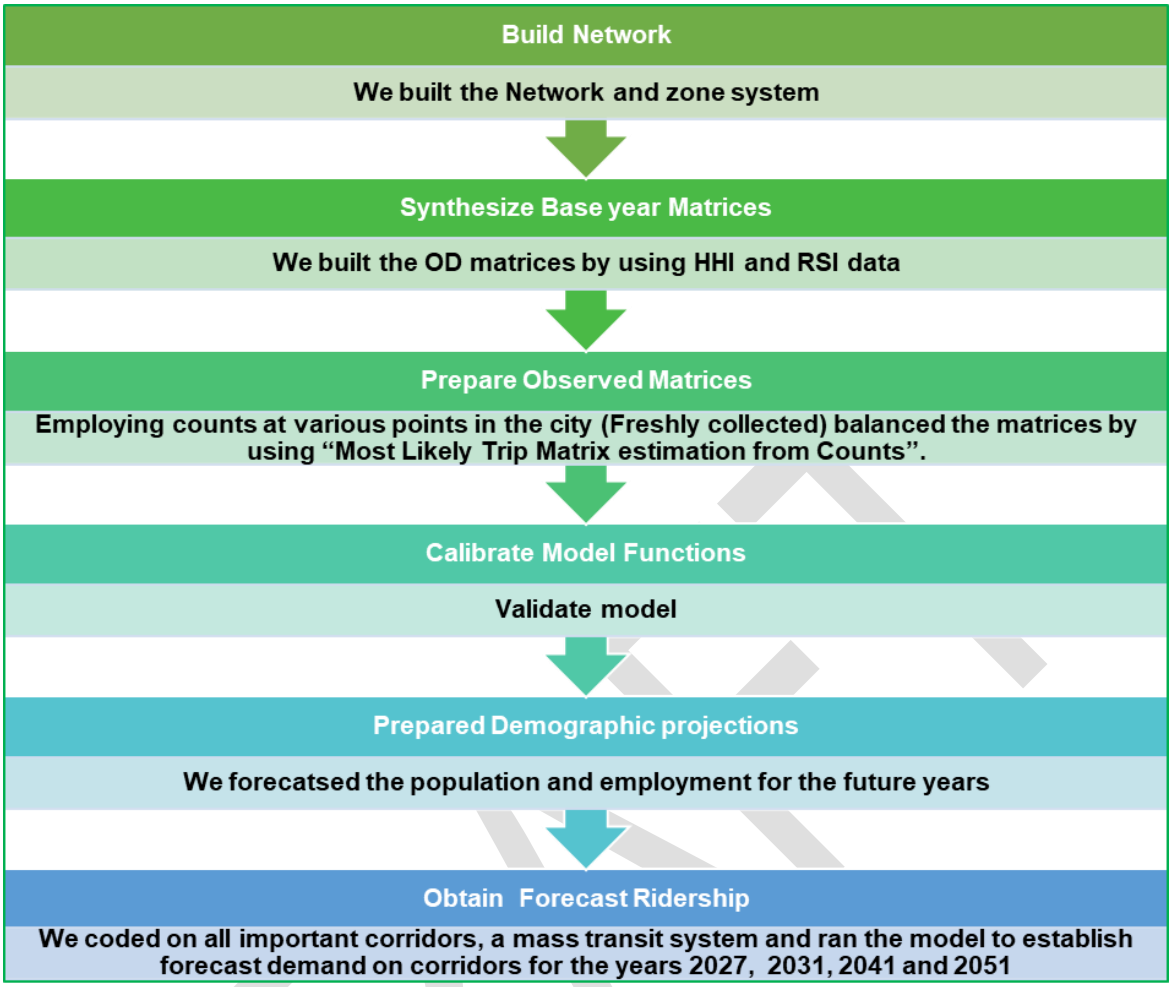
Figure 83 Four stage modelling approach

These are described below:

- 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 using 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.

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
- 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.



4.3.2 NETWORK DEVELOPMENT

Transport network developed for the model comprises of two components,

- Highway Network for vehicles
- Transit Network for public transport system i.e. Buses, MRTS etc.

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, MRTS etc.
- 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.

4.3.2.1 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 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 Kochi Study area have been divided into the following classes.

Table 34 Lane Configuration

Code	CLASSIFICATION
1	1L-2W-UD
2	1.5L-2W-UD
3	2L-2W-UD
4	4L-2W-UD
5	4L-2W-D
6	6L-2W-D
22	Centroid Connectors

L: Lane, 1W: One Way, 2W: Two Way, UD: Undivided, D: Divided

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 4472 links and 1573 nodes are modelled. The coded highway network is shown in the map below.

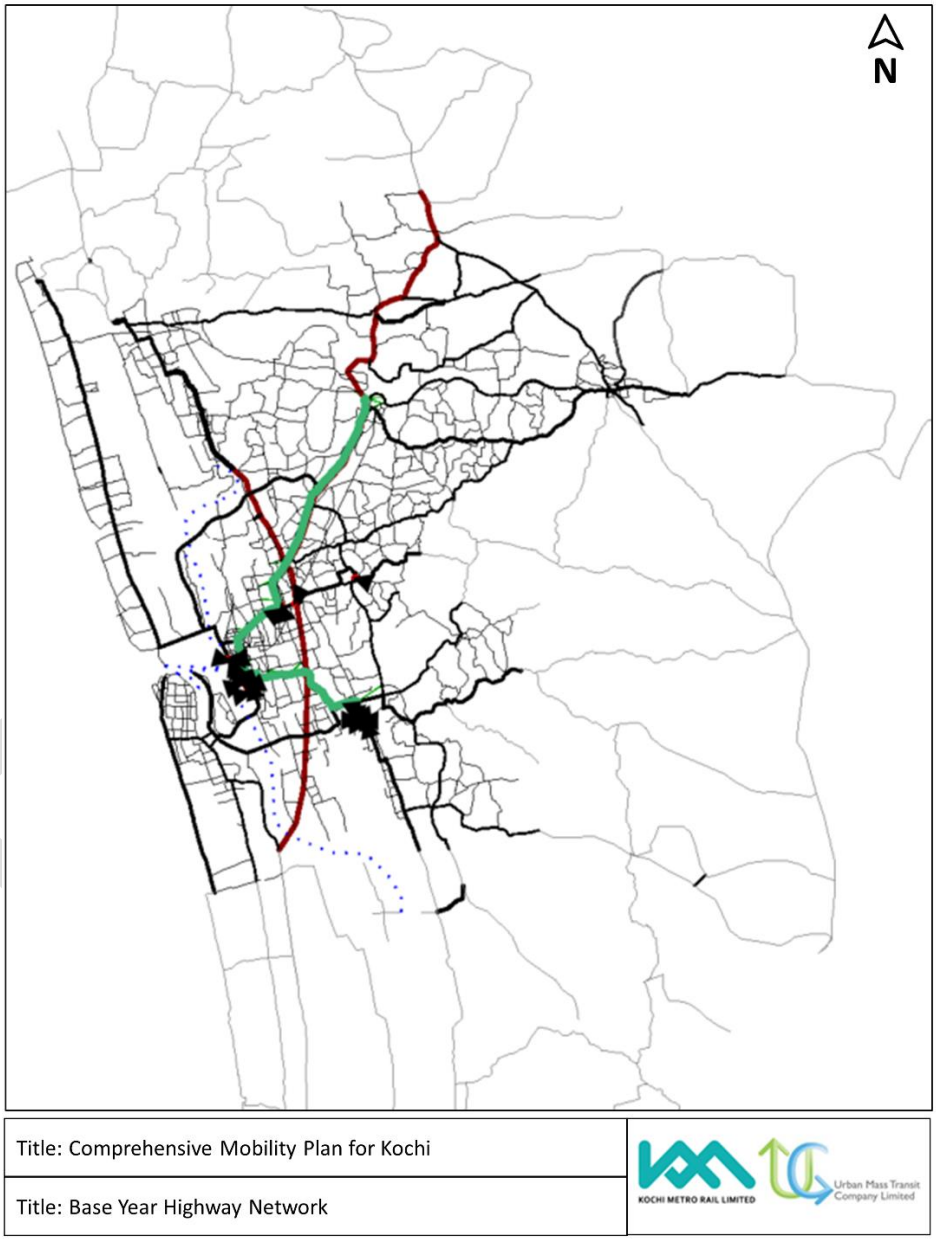


Figure 84 Base Year Highway Network – 2023

4.3.3 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.

Figure 85 Transit Network -Base Year 2023

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 148 KSRTC bus routes and 421 Private Bus routes are operational during peak hour in the city. Information on the same was

collected from KSRTC and RTO Dept., Kochi and updated into the system. Fare structure and frequency was also updated.

4.3.4 ZONING

The study area considered is expanded Planning area that is Study area of 732 Sq.km. and an influence area, together accounting to an area of 1908.35 Sq.km. The study area is subdivided into several zones. For the study purpose the zoning system was adopted consisting of 532 zones, in that 1 to 439 are internal zones and 501 to 593 are external zones. The internal and external zones are shown in figure below respectively.

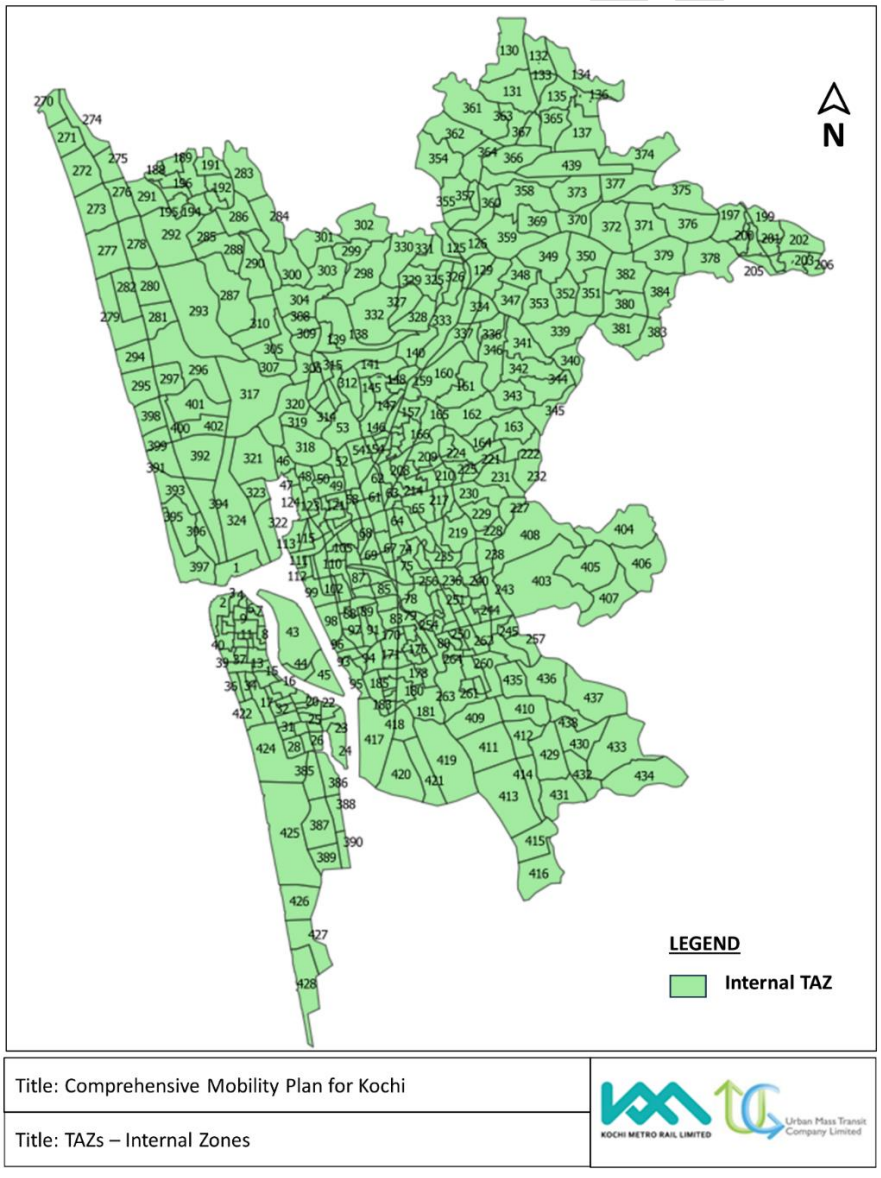


Figure 86 Traffic Analysis Internal Zones

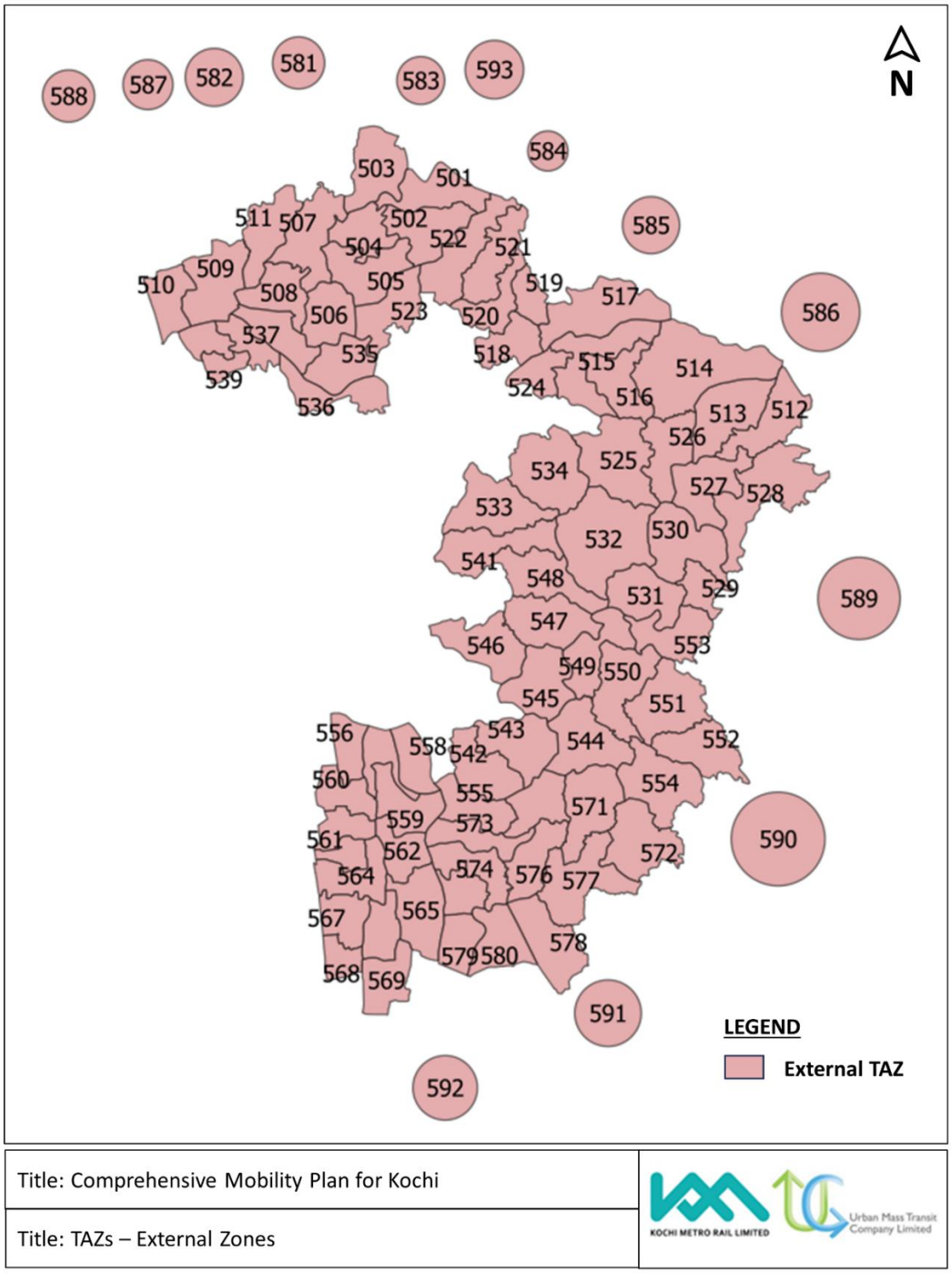


Figure 87 Traffic Analysis Zones – External Zones

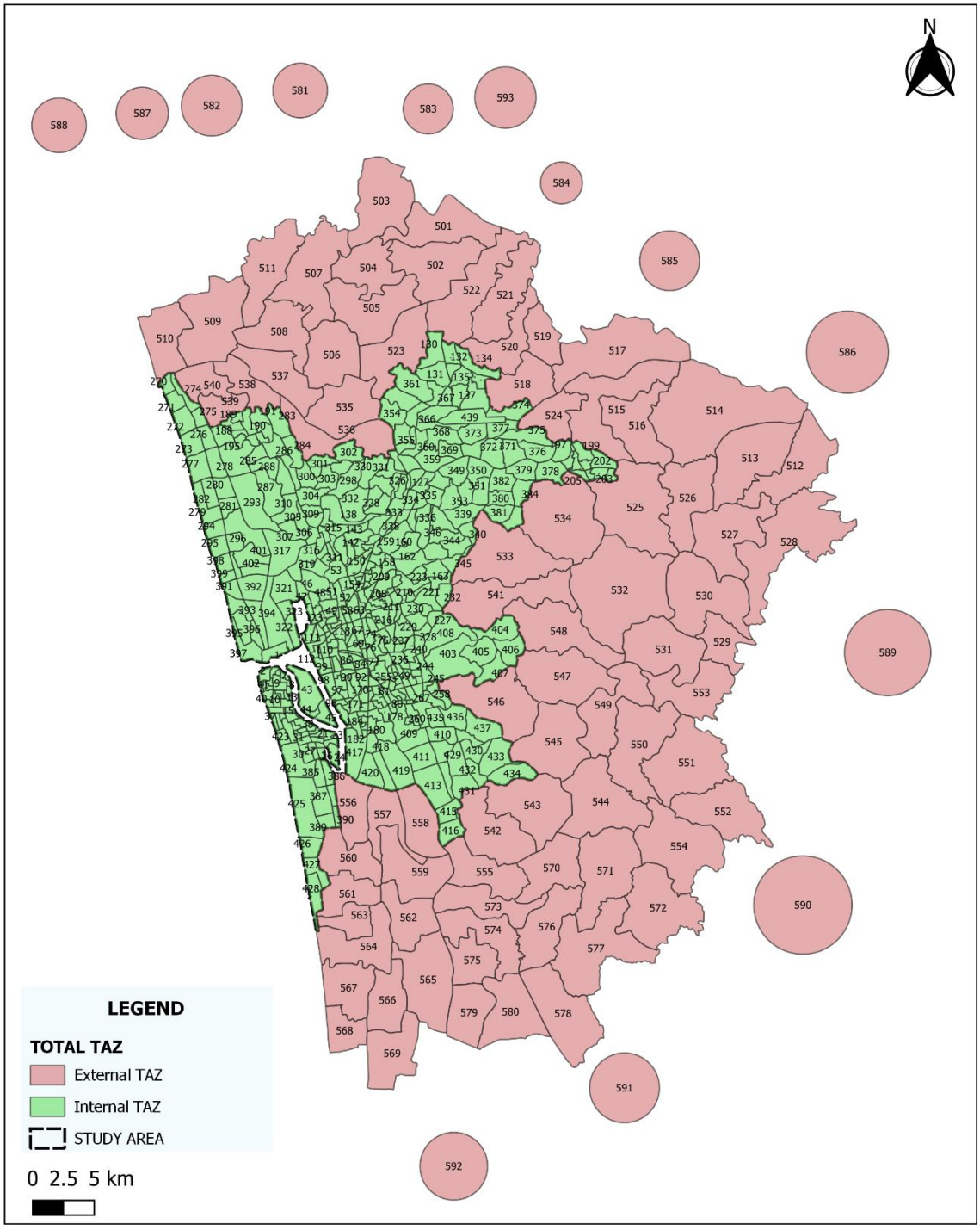


Figure 88: Kochi Traffic Analysis Zones

The list of TAZs is presented at Annexure: TAZ WISE DETAILS OF STUDY AREA. A total of 283024 OD pairs were utilized in the base year. Using the zonal expansion factors, O-D trip matrices have been generated for the intra-city and intercity trips by modes for the peak hour matrices. Data source from which various travel patterns covered is presented in table given below.

Table 35 Travel Pattern

INTRA/INTERCITY TRIPS	CATEGORY	DATA SOURCE
Intra-city trips	Home based trips	HIS / Public Transport Terminals
Inter-city trips	Internal – External	Outer Cordon O-D surveys (Supplemented by HIS and O-D surveys at Terminals)
	External – Internal	Outer Cordon O-D surveys (Supplemented by HIS and O-D surveys at Terminals)
	External – External	Outer Cordon O-D surveys

4.3.5 BASE YEAR MODEL

The framework for four stage model gets inputs from the demand matrices, planning variables such as population, employment, resident workers, students etc., for building a mathematical equation for simulating the base year and future travel demand for the purpose of planning and policy making.

Each stage has its significance as described in section below. Each stage undergoes series of iterations until the difference between observed and modelled outputs converges to desired level. Models developed for each stage has been described in forthcoming sections.

4.3.5.1 TRIP GENERATION MODEL

Trip generation is the first stage of travel demand modelling which involves the process of estimating total number of trips produces by (O_i) and attracted to (D_j) each zone of a study area. Trip generation model outputs the scalar data (column data).

Trips produced and attracted in each TAZ is influenced by various factors, the trip generation model is a multiple linear regression process which derives the algebraic equation between dependent variable (trips produced/attracted) and independent variables (planning variables).

The planning variables considered for this study are population, employment. The statistical significance of these factors is tested by comparing the calculated t-statistic at 99% confidence level (1% level of significance).

Pearson Correlation Coefficient, t-statistic, and F-statistic along with logical checks were considered for arriving at significant independent variable. Home based work (HBW) trip production is highly correlated with population with a correlation coefficient of 0.95 and trip attraction for HBW is correlating with employment in a TAZ with correlation coefficient of 0.91. Similarly, the correlation coefficient for trip production and trip attraction for other purposes are shown in table below.

Table 36 Trip Generation Models

Trip Production Equations			
Zone Type	**mX**	**C**	**R Sqr.**
1	0.08	125	0.82
2	0.03	100	0.94
3	0.08	100	0.90
4	0.2	50	0.90
5	0.3	50	0.90
6	0.38	50	0.90
7	0.5	50	0.90

Trip Attraction Equations			
Zone Type	**mX**	**C**	**R Sqr.**
1	0.04		0.85
2	0.08		0.58
3	0.11		0.06
4	0.15		0.04
5	0.18		0.86
6	0.3		0.65
7	0.5		

The trips production and attraction resulted from the model is inclusive of intra zonal trips, which is excluded using the intra zonal model before trip distribution stage.

4.3.5.2 TRIP DISTRIBUTION MODEL

Trip generation outputs are fed into the trip distribution model to generate the production-attraction matrix. Trip generation output is a scalar data (column data), which is converted to scalar data (matrix data) using the trip distribution model. Return trips should be added to the trips generated and intra zonal trips are to be excluded before trip distribution.

In this study doubly constrained gravity model is used for trip distribution, which works based on the principle of Newton's concept of gravity. This model assumes that the distribution of trips is directly proportional to the relative attraction between the zones and inversely proportional to the spatial separation between them as measured as a function of travel distance and travel time. The general mathematical expression for trip distribution model is,

$$T_{ij} = A_i O_i B_j D_j Fc_{ij}$$
$$Fc_{ij} = GC^{n} \cdot e^{-\beta . GC}$$

Where,

Fc_{ij} is the deterrence function.

n and β, are the calibrated parameters for the Generalized Cost.

The Generalized Cost (GC) is calculated as given below,

GC (Private) = (Travel Distance * VOC) + (Travel Time * VOT)

GC (Public Transport) = Fare + (Travel Time * VOT)

Where, VOC = Vehicle operating costs, estimated using the household interview survey data.

VOT = Value of Time estimated using the mode choice model parameters as presented in the next section.

Table 37 Vehicle Operating Costs

MODE	VOC (RS/KM)
TW	3.92
Car	14.64

The parameters n and β are calibrated using SPSS as a non-linear regression is presented below,

- Function Type – Combined
- Direction Parameters – Doubly Constrained Model

Table 38 Calibrated Deterrence Function

TRIP PURPOSE	a	b	c	R^2	OBSERVED AVG. TL (KM)	MODELED AVG. TL (KM)	COINCIDENCE RATIO
HBW	1	0.1917	-0.1760	0.45	10.2	11.6	0.80

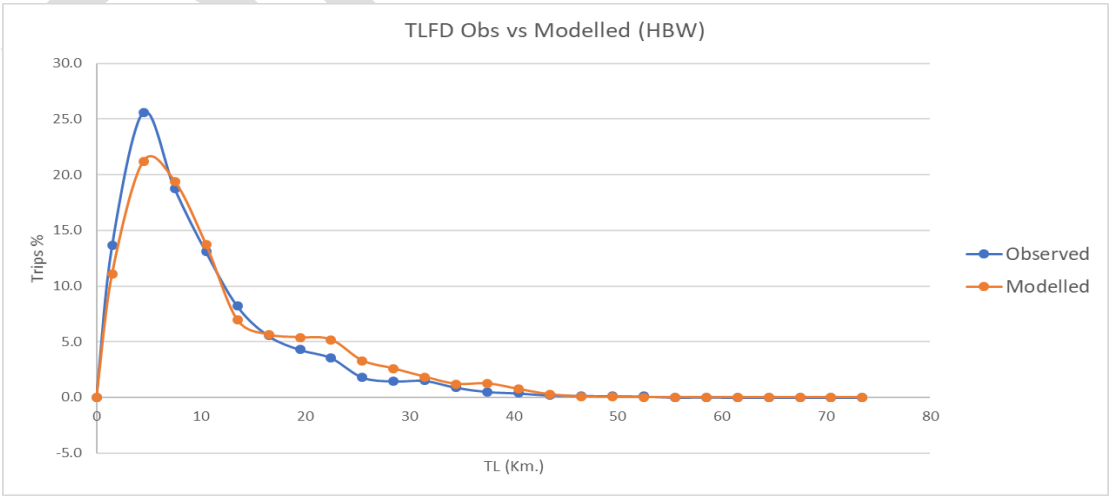


Figure 89 Observed and Modelled trip length frequency distribution (HBW)

- Minimum fare for city bus has been considered as Rs.10 and a unit distance fare of 1 Rs/Km is considered based on the fare matrix shared by client.
- Seating capacity of 46 passengers and crushing capacity of 74 passengers per bus has been considered.

The comparison of trip length frequency distribution between observed and modelled trips is shown below.

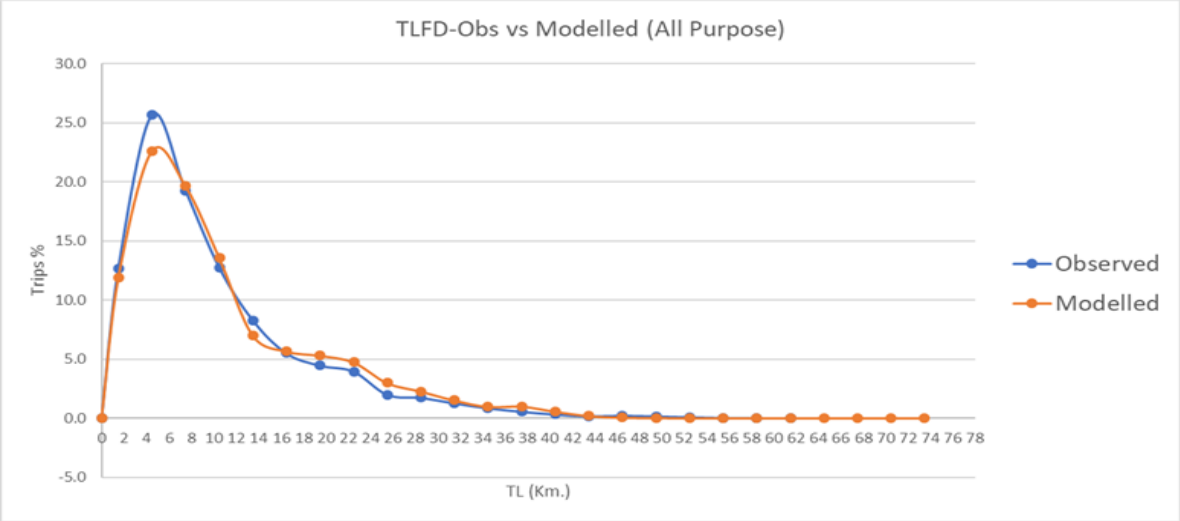


Figure 90 observed and modelled trip length frequency distribution (all purpose)

4.3.6 MODE CHOICE MODEL

The function of mode choice model is to split the travel patterns by modes. Trip distribution model results an aggregated matrix populated between zones; the mode choice model splits the single matrix to mode wise matrices based on number of travel modes considered in the model. In this study multinomial logit (MNL) model has been developed to model the choice of mode. MNL model is a utility-based model, which assumes that people choose their mode which has the highest utility (least disutility).

In this study the model modes are two-wheeler, car, taxi, auto-rickshaw, and bus. The choice probabilities of MNL model are given as,

$$P_j = \frac{e^{vj}}{\sum_{all} e^{vi}}$$

Where,

Pj = probability of choosing mode j,

Vj = deterministic component of utility for mode j

i and j are indices for modes.

Revealed preference data (Household Interview Survey data) has been used to build the multinomial logit choice model and the calibrated utility equations using Biogeme software to determine the choice probabilities and they are given below,

Utility equation for Two-Wheeler,	**V1 = - 0.27*GC TW + 9**
Utility equation for Car,	**V2 = - 0.27*GC Car + 12**
Utility equation for Auto,	**V3 = - 0.27*GC Auto + 11**
Utility equation for Bus,	**V4 = - 0.27 GC PT**

Where,

GC = Generalized Cost for Mode = Total Travel Time (Wait time + Access Time + In Vehicle Time + Egress Time) for respective modes X Value of Time (VOT) + Actual Travel Cost in terms of fuel or fare

Value of time estimated can be estimated using the calibrated mode choice model.

VOT for TW = 1.85 Rs/Minute.

VOT for Car = 3.10 Rs/Minute

VOT for Auto = 1.67 Rs/Minute

VOT for PT = 1.48 Rs/Minute

The table below shows the output of the mode choice model and percentage error with the observed mode share (Excluding NMT).

Table 39 Observed vs Modelled Mode Share (Excluding NMT)

MODE	OBSERVED MODE SHARE (%)	MODELLED MODE SHARE (%)	% ERROR
Two-Wheeler	46%	45%	-1.5%
Car	14%	14%	1.0%
Auto Rickshaw	11%	10%	-9.6%
PT	29%	31%	4.8%
Total	**100%**	**100%**	

4.3.6.1 TRIP ASSIGNMENT MODEL

Trip assignment involves the highway assignment and public transport assignment. In highway assignment the private mode matrices from the mode choice model will be assigned to the network based on the routes having least cost. In public transport assignment the passengers

are loaded to the bus routes, which works based on the principle of crowd model, in which the seating capacity and crush capacity of the system must be defined. in highway assignment the demand is allowed to take any route which has least cost such as travel time, travel distance but the transit assignment is performed over the fixed routes.

4.3.6.2 HIGHWAY ASSIGNMENT

In this study, for highway assignment the Bureau of Public Roads (B.P.R) method is used to calculate the congested travel time. The general mathematic form of BPR function is,

Congested Travel Time, $Tc = T0\left[1 + \alpha\left(\frac{V}{C}\right)^{\beta}\right]$

Where, T_0 = Link Free flow time

V = Link Volumes

C = Link Capacity

α and β are the Calibrated Parameters

the capacity per hour per lane, free flow speed, congested speed and calibrated BPR functions for different road class is given in table below:

Table 40 Calibrated BPR Functions

LINK CLASS	LANE CONFIGURATION	CAPACITY PCU/HR/ LANE	CAPACITY PER DIRECTION. (PCU/HR)	V_F	V_C	A	B
1	1L-2W-UD	720	360	28	16	0.78	1.1
2	1.5L-2W-UD	720	540	36	20	0.78	0.97
3	2L-2W-UD	1200	1200	39	22	0.8	0.97
4	4L-2W-UD	1250	2500	46	24	0.9	1.28
5	4L-2W-D	1500	3000	52	27	0.9	1.1
6	6L-2W-D	1560	4680	57	32	0.8	4
22	Centroid Connectors	99999	99999	60	52	0.15	4

* 2W – Two way; UD – Undivided; D – Divided

4.3.6.3 TRANSIT ASSIGNMENT

Public transport assignment is carried out intuitively by VISUM based on the crowd model. The crowd model is an iterative process, which evaluates the attractive routes and loads the demand and the balance between demand and capacity (seating and crush capacity of bus) continues based on the link travel time and wait times.

4.3.6.4 COMMERCIAL VEHICLE ESTIMATION

Goods vehicles demand is preloaded to the network before performing the highway (private vehicle) assignment. The commercial vehicle demand has been estimated using VISUM module which works on the principle of entropy maximization and estimated the demand based on the commercial vehicle volume counts. The daily commercial vehicle demand is estimated using T Fuzzy program. The program uses the paths connecting the OD pairs, the observed link volumes of commercial vehicles, seed matrix and the associate confidence levels for the link volumes.

4.3.6.5 EXTERNAL PASSENGER TRIPS

The external travel patterns such as internal to external (I-E), external to internal (E-I) and external to external (E-E) are obtained from the combined demand matrices merged from various origin destination (O-D) surveys. The estimated external demand is presented in table below.

Table 41 External Trips (Primary Survey 2022-23)

MODE	TRIPS (in Thousands)
Two-Wheeler	16.59
Car	22.39
Auto-Rickshaw	8.82
Bus	0.98
Total	**48.26**

4.3.6.6 CONVERSION FACTORS

Passenger trips are converted to PCUs by using conversion factors, where the conversion factors are calculated using the vehicle occupancy and PCE (Passenger Car Equivalent).

PCU = Passenger Trips * Conversion Factors

The mode wise occupancy and PCE values adopted for this study is presented in table below.

Table 42 Mode wise Occupancy & Conversion Factors

CATEGORY	MODES	OCCUPANCY	PCE	CONVERSION FACTORS
Private Vehicles & IPT, PT	Two-wheeler	1.45	0.75	0.518
	Car	2.61	1.00	0.383
	Auto	2.93	1.20	0.545
	Bus	35.0	2.04	0.063
	Cycle	1.03	0.47	0.486
Commercial Vehicles	Goods Auto + LCV		1.34	1.34
	Truck (2A + 3A)		2.20	2.20
	MAV + TT		2.66	2.66

The resulting PCU matrix is multiplied with the peak hour percentage (9.5%) to perform the peak hour assignment. The software performs the capacity restraint assignment, and it iterates till the convergence condition is achieved.

4.3.7 BASE YEAR SYNTHETIC MODEL VALIDATION

Validation is a check between observed and modelled demand (iterative trial and error process). The iteration is continued till there difference between the observed and modelled numbers are within a range of ± 10%. The model is validated for the volume counts at screen line, outer cordon for peak hour (8:45 AM to 9:45 AM) and they are presented in the Table below. The models are validated using GEH values at both the links and turns considering turning volume count and mid-block count data for morning peak hours.

GEH VALUE	2W		AUTO		CAR		GOODS		PT	
	Links	Turns	Links	Turns	Links	Turns	Links	Turns	Boarding	Alighting
<5%	60%	94%	86%	92%	45%	90%	87%	91%	89%	90%
>10%	9%	1%	4%	1%	13%	1%	2%	0%	0%	0%

4.3.8 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 31% in comparison to 59% of the trips being made by private modes (share of trips excluding NMT).

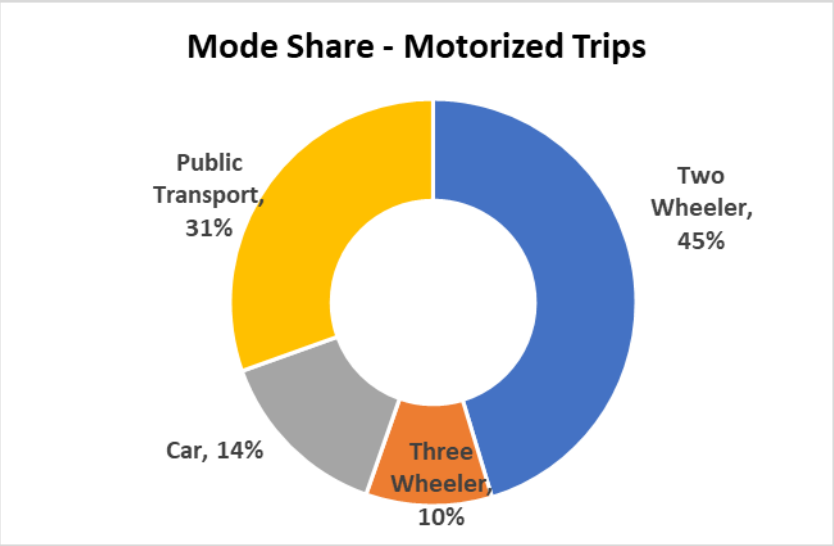


Figure 91 Mode Share for Base Year (2023) – Excluding NMT trips.

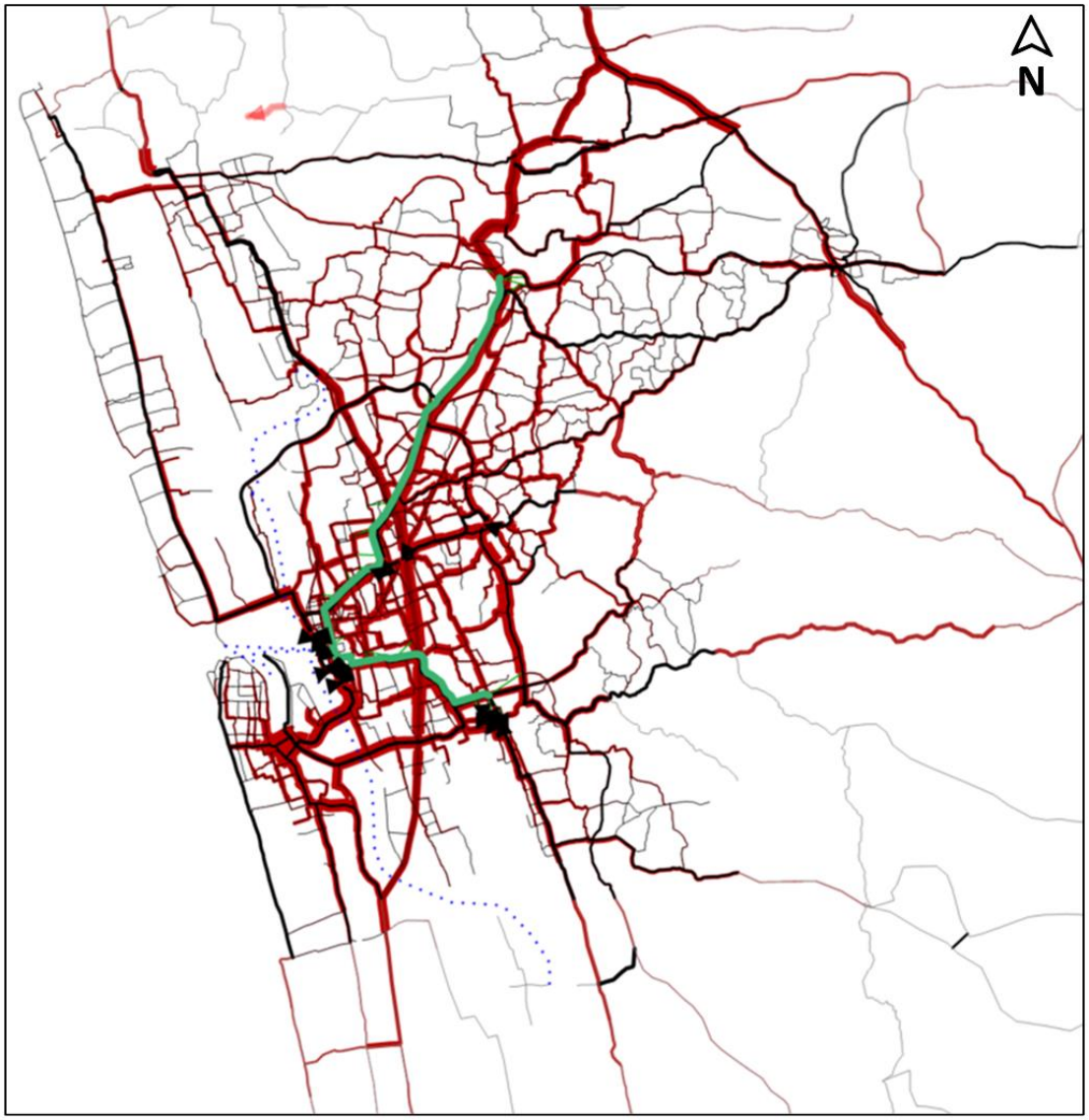
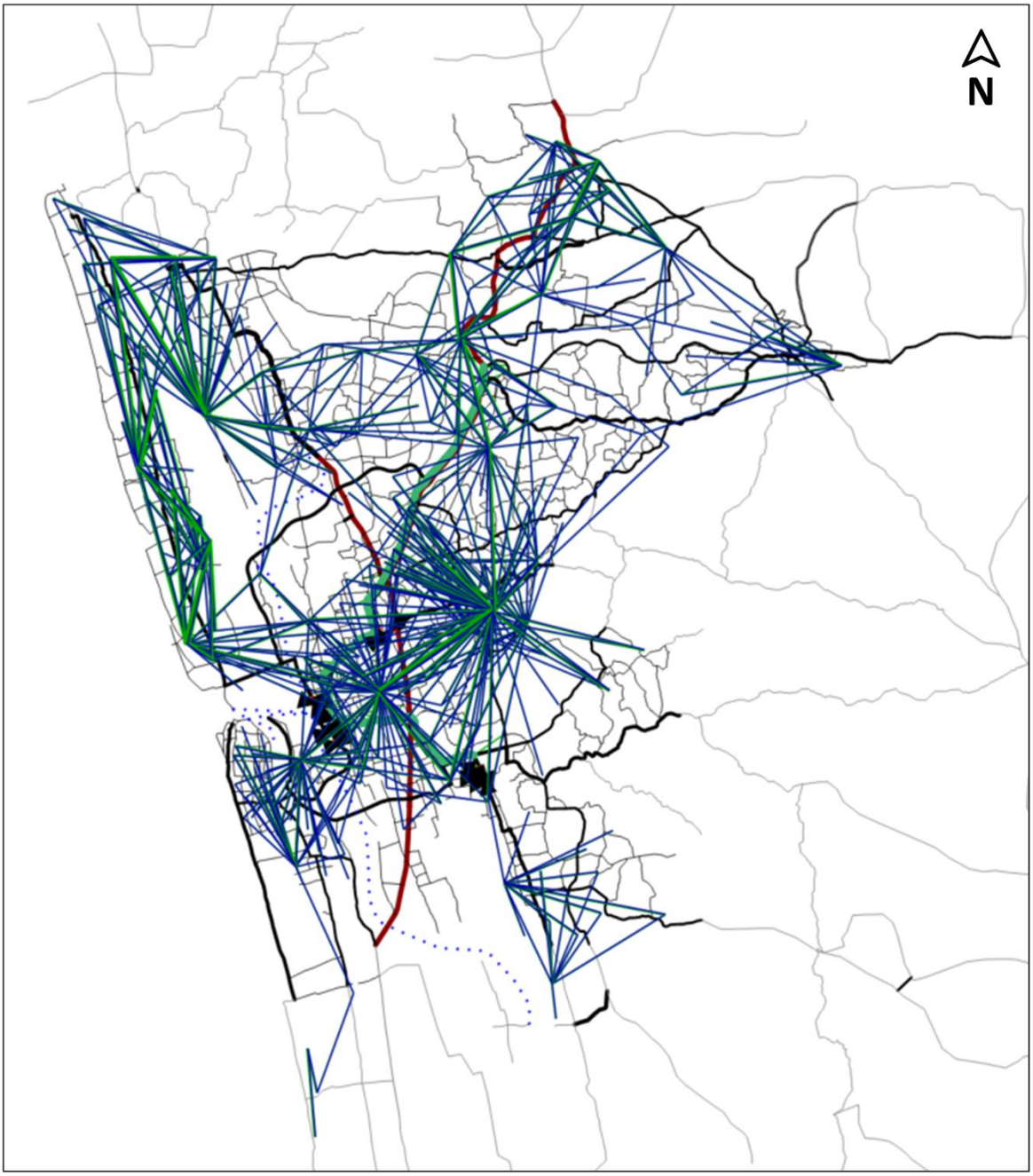


Figure 92 Volume Capacity Ratio Map for Base Year (2023)



Title: Comprehensive Mobility Plan for Kochi	
Title: Desire Line Diagram - Interactions of Motorized Users	

Figure 93: Desire Line Diagram representing the trip interactions of all Motorised Modes Users -2023

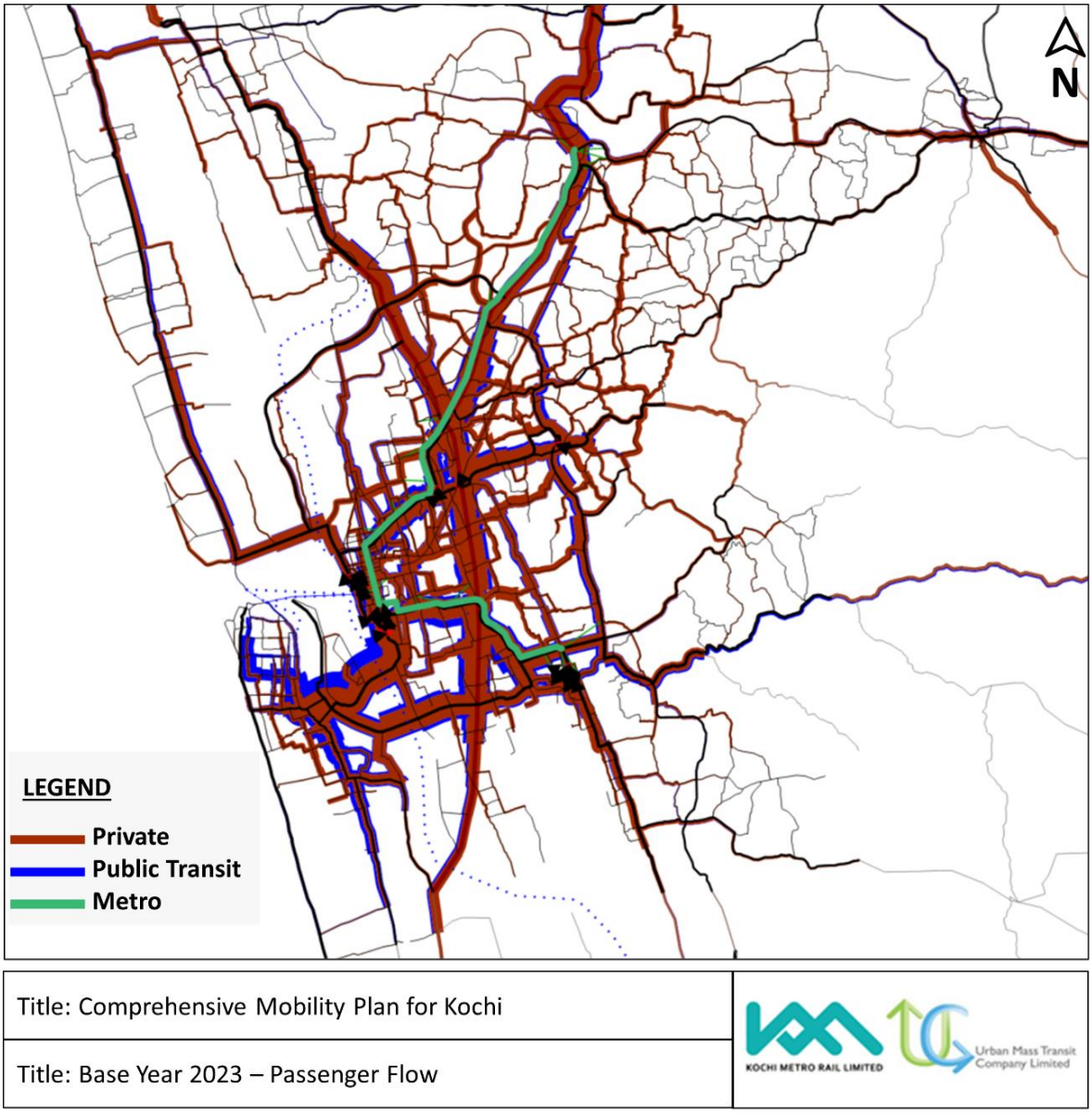
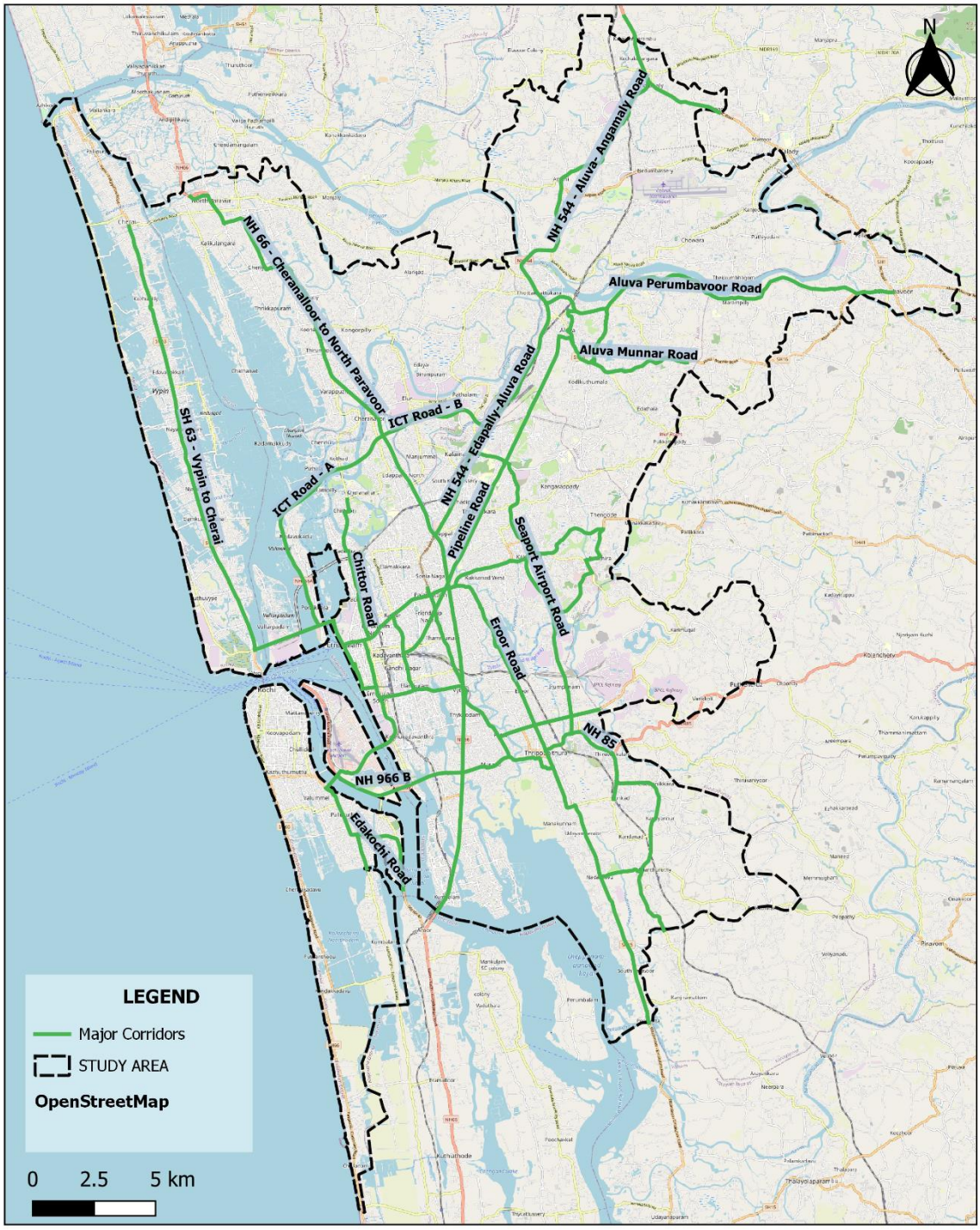


Figure 94: Diagram representing Passenger flow of Private and PT Modes Users -2023

Passenger flow diagram indicates significant passenger movements on the NH-66, NH-544, NH-966B, MG Road, SA Road, Palarivattom- Kakkanad Road and Seaport Airport Road, apart from the internal roads in the city.

The congestion levels on major mobility corridor with values over 0.8 are as presented in the *Table 43* (All the major corridors are shown in the map for reference).



Title: Comprehensive Mobility Plan for Kochi	
Map: Major Corridors	

Figure 95 Major Corridors

Table 43 Congestion levels on Major Mobility Corridors

SN	NAME OF THE ROAD	DISTANCE (KM)	V/C (Base Year)
1	NH 544 – Edapally- Aluva	10.8	1.49
2	Aluva Munnar Road	13	1.14
3	SH 41 (Chithrapuzha Ponjassery Rd)	9	1.14
4	SH63 (Vypin to Cherai)	23	1.12
5	Seaport-Airport Road	11.6	1.76
6	Thoppumpady- Edakochi Road	8.2	1.45
7	Banerji Road	4	0.90
8	Chittoor Road	5.5	1.43
10	ICT Road	17.8	0.70
11	Palarivattom- Kakkanad Road	3.6	0.95
12	MG Road	4.6	1.30
13	Shanmugham Road	1.1	0.70

4.4 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 44.

Table 44 Travel Condition Assessment Indicators

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
i) Mobility and Accessibility			
1	**Modal Share (%)- Motorized Modes (From Model Results)**		
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	59%
	Public Modes	% of trips made by public transport modes	31%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	10%

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
2	**Trip Length (Km) (From Model Results)**		
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car, and Auto users in the study area	10.6
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.61
ii) Infrastructure and Land use			
1	**Infrastructure Quality**		
1.1	Average Speed (Kmph) (PvT)	Average speed of private modes	23.3
	Average Speed (Kmph) (PT)	Average speed of public transport modes	15.25
1.2	**Accessibility to Public Transport (Population)**		
	Access to PT	Population having access to PT	0.6
2	**Land use parameters**		
2.1	**Land use mix intensity**		
	Land use mix intensity	Job and housing balance (employment / residing population)	0.42
iii) Safety			
1	**Safety**		
1.1	Quality of footpath infrastructure	% of roads with more than 2m footpath	7%
2	**Security**		
2.1	Percentage of road lighted		95%
2.2	Percentage of footpaths lighted		49%
iv) Environmental Impacts			
1	**Emissions**		
1.1	GHG Emissions (Tonnes/ Day)		36.53
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.	12%

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR
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	36%
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	3%
2.4	Signal Synchronization	Share of signalized signals which are synchronized in the city	53%

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

05

SERVICE LEVEL BENCHMARKING

5 SERVICE LEVEL BENCHMARKING

Benchmarking helps to establish baseline measures of performance, and helps monitor the agency's individual performance over time, and how it compares with the other organizations, and improving performance by sharing of lessons learnt from different entities. The service level benchmarks (SLB)[4] issued by MoHUA specify parameters to measure the effectiveness of existing land use-transport planning in Kochi 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.

5.1 PUBLIC TRANSPORT FACILITIES

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

Table 45 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**	**1**	**1**	**2**	**2**	**4**
TOTAL INDICATOR LOS VALUE:13 (OVERALL LOS -2)						
OVERALL: LOS1 <12, LOS2: 12-16, LOS3:17-20, LOS4 21-24						

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

Based on the above indicators, the overall score of the benchmark computes to 13 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, comfort level and average waiting time, which define the reliability and efficiency of the system.

5.2 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 46 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.

5.3 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 47 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.

5.4 LEVEL OF USAGE OF ITS FACILITIES

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

Table 48 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**	**2**	**4**	**3**	**3**
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 14, 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.

5.5 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 49 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.

5.6 AVAILABILITY OF PARKING SPACES

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

Table 50 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.

5.7 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 51 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**	**2**
TOTAL INDICATOR LOS Value: 6 (OVERALL LOS 3)		
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 6. The overall LoS for the parameter "Road Safety" is 3. Road safety of all road users, esp., NMT and pedestrians are hence observed to be unsafe on the streets.

5.8 POLLUTION LEVELS

This benchmark indicates the Level of air Pollutants in the city i.e., average level of pollution (Source: PCB, 2023)

Table 52 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	**1**	**1**	**1**	**1**
TOTAL INDICATOR LOS VALUE :4 (OVERALL LOS 1)				
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 4 with a LOS of 1. This indicates the city emission levels are under control. The standards are met

with and to maintain the same, public transport usage should be enhanced while the growing dependency on private vehicles should be curbed.

5.9 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 53 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**	**1**	**4**	**2**	**2**	**3**
TOTAL INDICATOR LOS VALUE :20 (OVERALL LOS 3)							
OVERALL: LOS1: <=8, LOS2: 9-15, LOS3: 16-22, LOS4: 23-28							

5.10 SUMMARY OF INDICES

The summary of the indices is as presented below:

SN	BENCHMARK	OVERALL, LOS	INFERENCE AS PER MOUD GUIDELINES
1	Public Transport Facilities	2	The study area indicates the availability of good public transportation services and some amount of integration. However, further enhancement of integration of the services would cater to the growing travel demand in the city
2	Pedestrian infrastructure facilities	3	The city has fewer pedestrian facilities which need further improvements and maintenance at certain sections especially at intersections and unobstructed footpaths it.
3	Non-Motorized Transport Facilities	3	The city has made efforts to improve the NMT facilities this needs further enhancement at many parts of the study area.
4	Level of usage of Intelligent Transport System (ITS) Facilities	3	The study area needs enhancement of 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	3	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	1	Level of pollution in a study area is low, however, to ensure the maintenance of the quality PT modes needs to be encouraged and the usage of public modes rather than the private modes.
9	Integrated land use Transport system	3	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,

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06

BUSINESS AS USUAL SCENARIO


COCHIN SHIPYARD
COCHIN SHIPYARD

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.

6.1 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 2020. The growth pattern is observed to be concentrated along the national highways & neighbouring municipalities.

Table 54 Land use Distribution for Kochi Municipal Corporation (Source: Draft Proposed Master Plan-2040)

LAND USE	EXISTING LAND USE (IN HA) (2020)	EXISTING LAND USE (IN %) (2020)
Developed Area (excld. Transportation)	5131.03	54.1%
Transportation	**1187.72**	**12.5%**
Undeveloped Area	638.48	6.7%
Agriculture, Mangroves etc.	765.36	8.1%
Water Bodies	1765.4	18.6%
Total	**9487.99**	**100.0%**

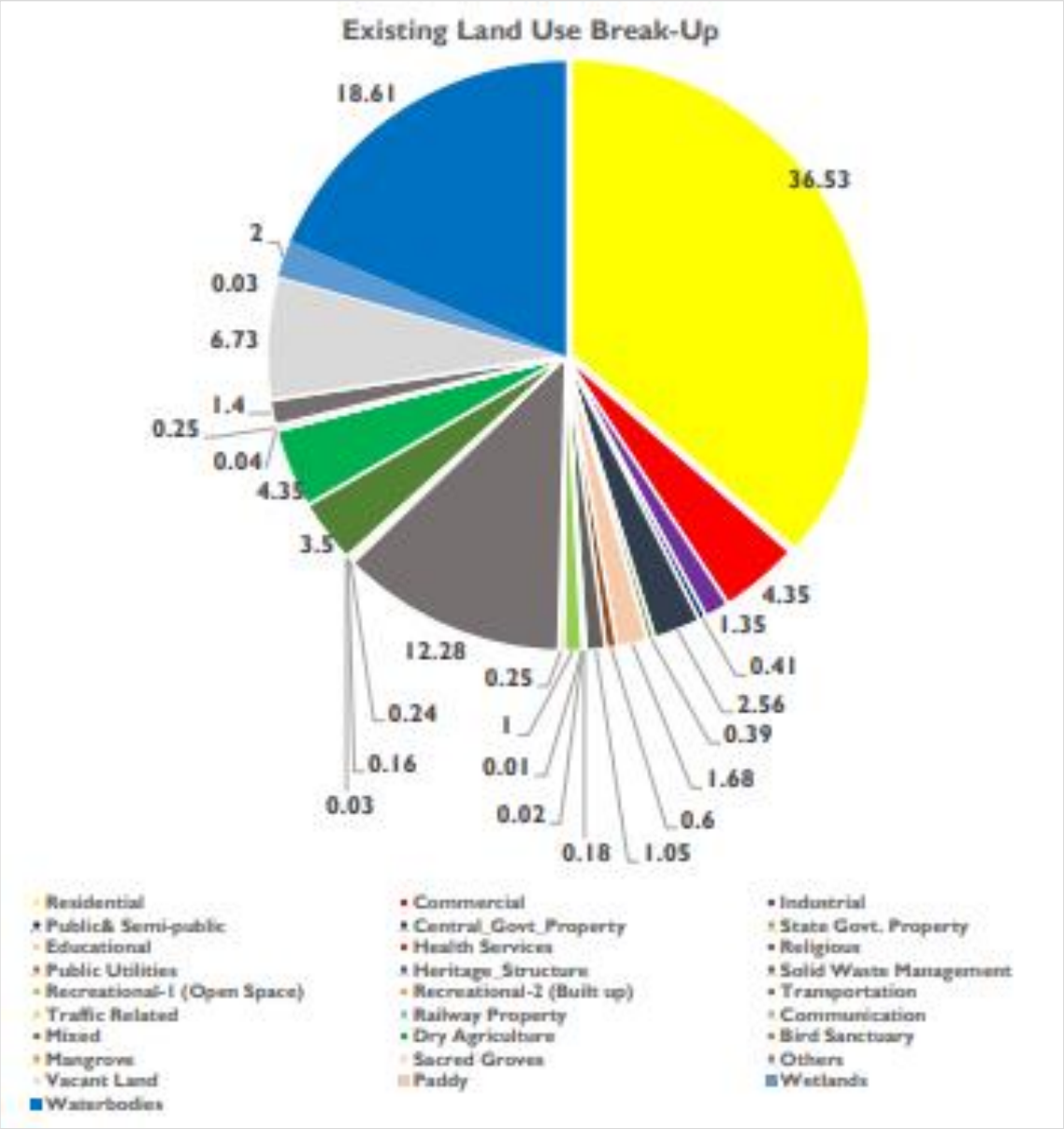

Figure 96 Existing Land use of City Centre -2020 (Source- Draft Master Plan,2040)

6.2 SOCIO-DEMOGRAPHIC DISTRIBUTION

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 the study. Thus, projected population for the study area is 39.70 lakhs in 2051, the same has been presented below-

Table 55 Projected Population (in Lakhs) (Source: Draft Master Plan for Kochi and UMTC Estimates)

Area	2011	2023	2031	2041	2051
Kochi Municipal Corporation	6.02	6.67	6.81	6.83	6.85
Municipality	4.37	5.42	6.36	7.98	10.30
Gram Panchayats	8.67	11.54	13.97	17.74	22.52
Study Area	**19.06**	**23.63**	**27.14**	**32.55**	**39.67**

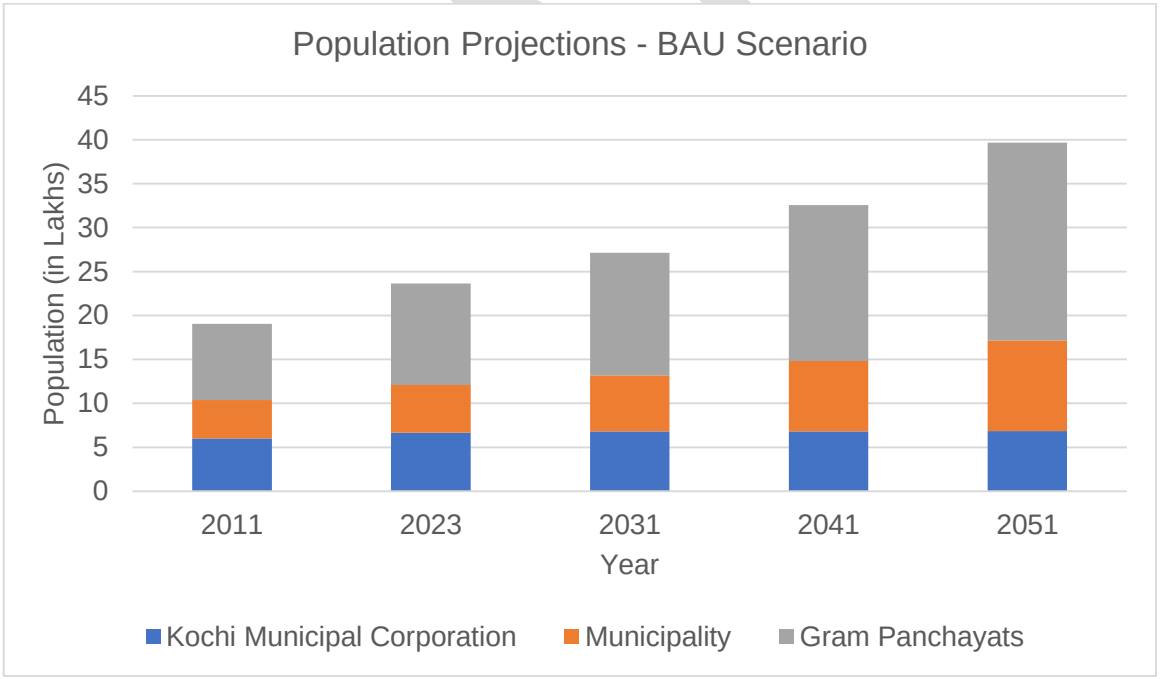

Figure 97 Projected Population (in Lakhs)

Similarly, the employment projection for the study area is calculated considering the population influx, workforce participation ratio (WPR) and upcoming developments viz., Kochi-Bengaluru Industrial Corridor, and the expansion of IT & ITES based services. Cochin Shipyard Limited, Cochin Port, Multi-modal Logistics Park in the vicinity of Cochin Port, BPCL, SEZ, GIFT city, Industrial Parks etc. The IT sector at Kakkanad itself is expected to have a direct employment of

over 1.5 lakh, assuming the current office built-up area under Smart City Kochi and Infopark Phase I & II are being completely occupied. The GCDA has proposed development proposal of Kochi Economic City (KEC), considering that the proposal is yet in initial stages of development, the influences are being considered in the growth patterns for the horizon years.

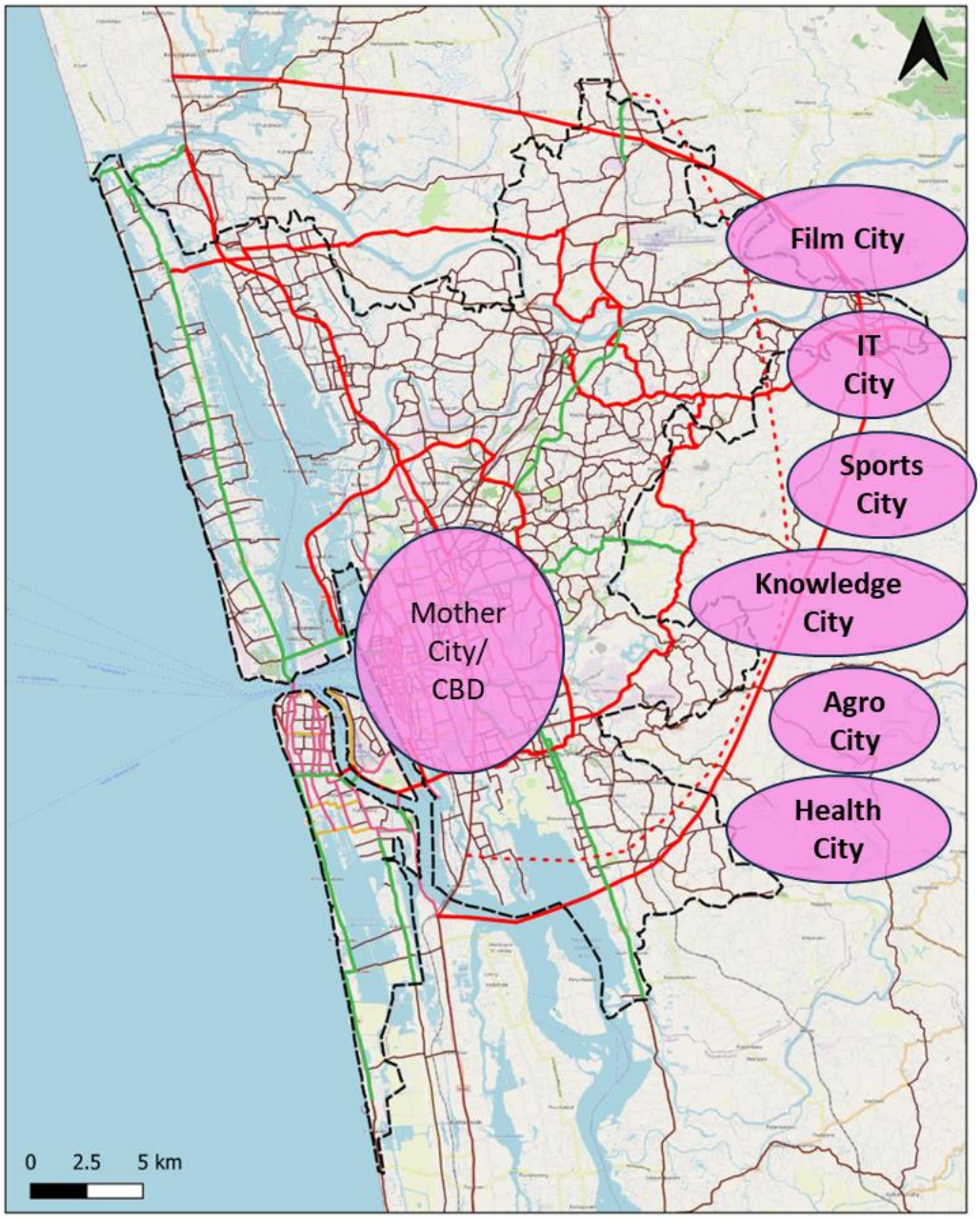

Figure 98 Kochi Economic City Proposal by GCDA (Source: GCDA)

Thus, projected employment for 2051 is 20.01 lakhs the same has been presented below-

Table 56 Projected Employment (in Lakhs)

Area	2023	2031	2041	2051
Kochi Municipal Corporation	3.67	3.93	4.12	4.26
Municipality	3.18	3.76	4.69	5.92
Gram Panchayats	4.31	5.43	7.31	9.82
Study Area	11.17	13.12	16.11	20.01

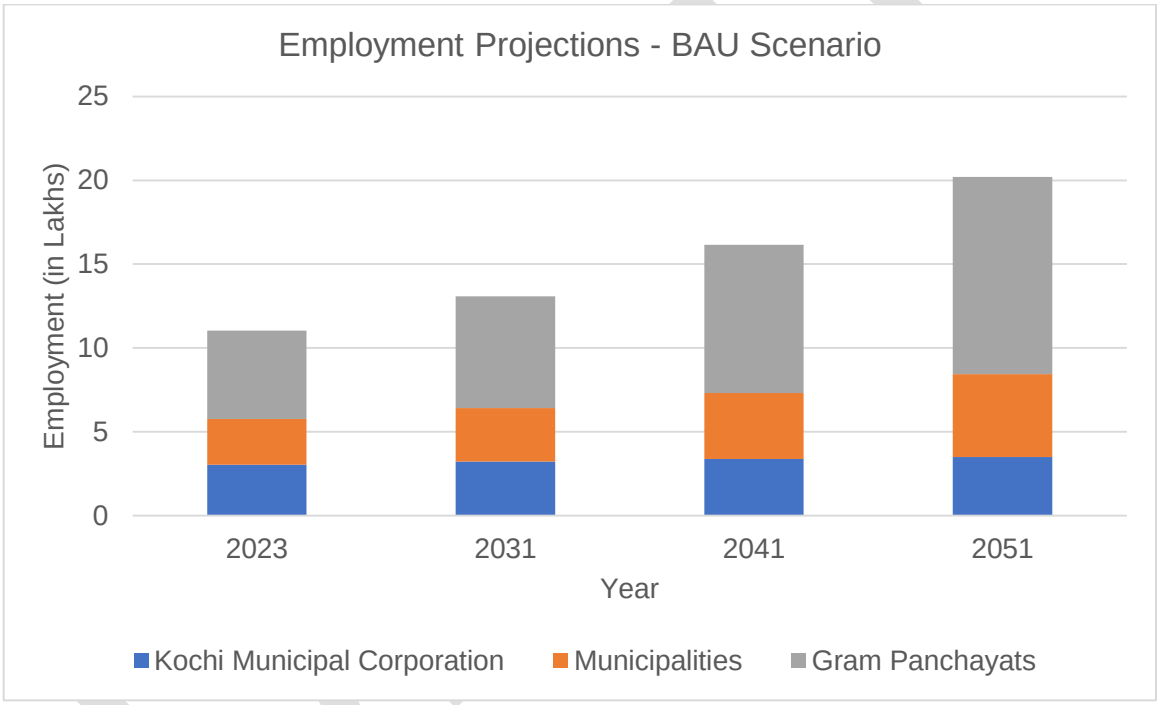

Figure 99 Projected Employment (in Lakhs)

Based on the land use transitions the projected population and employment has been distributed across the traffic analysis zones in the city. The distribution of population based on the on-going or business as usual trend using historic data collected from census and projection population from the draft report of the Master Plan 2040. The population and employment density maps for 2051 are presented in the figures below.

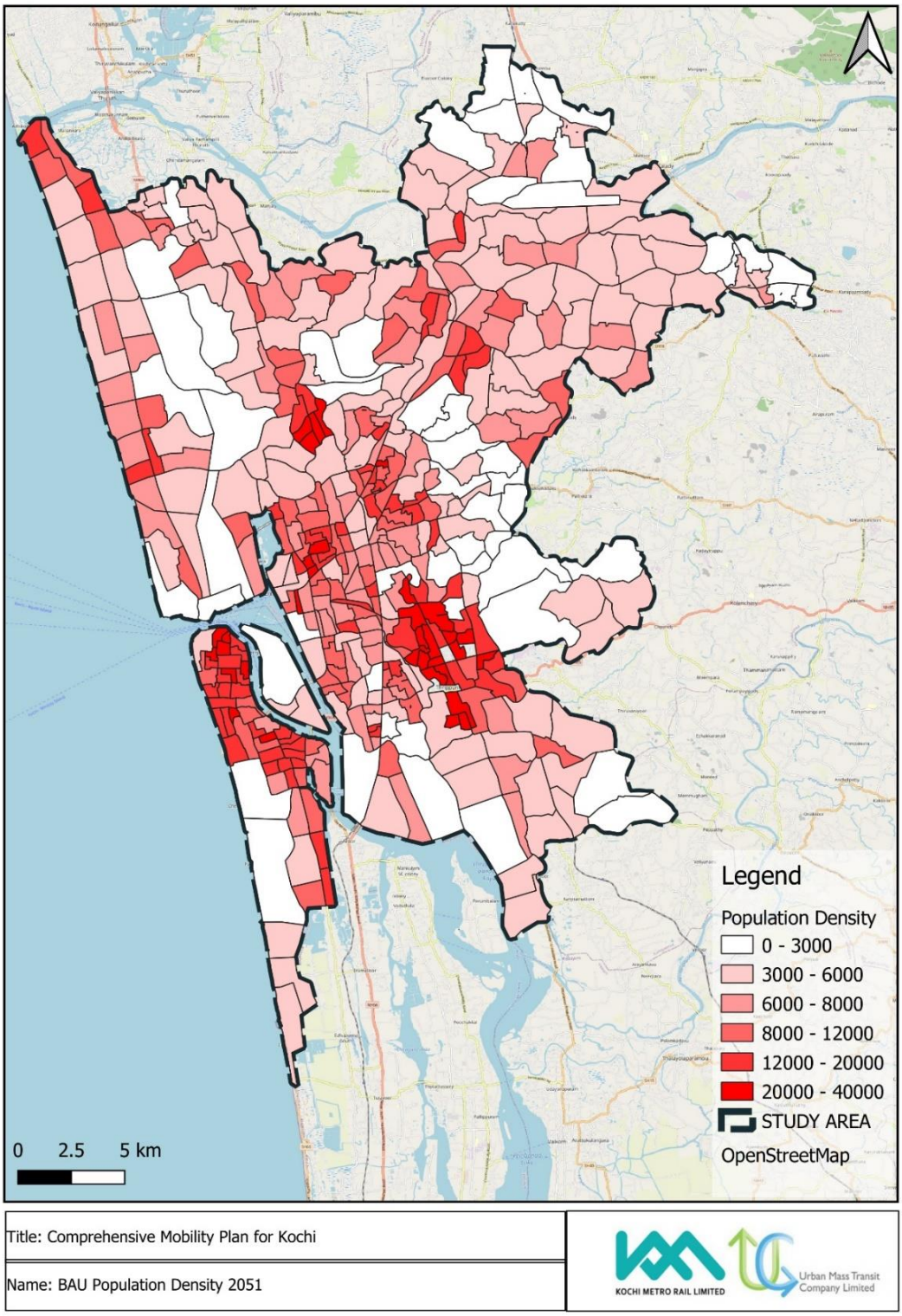

Figure 100 Population Distribution – 2051 – BAU

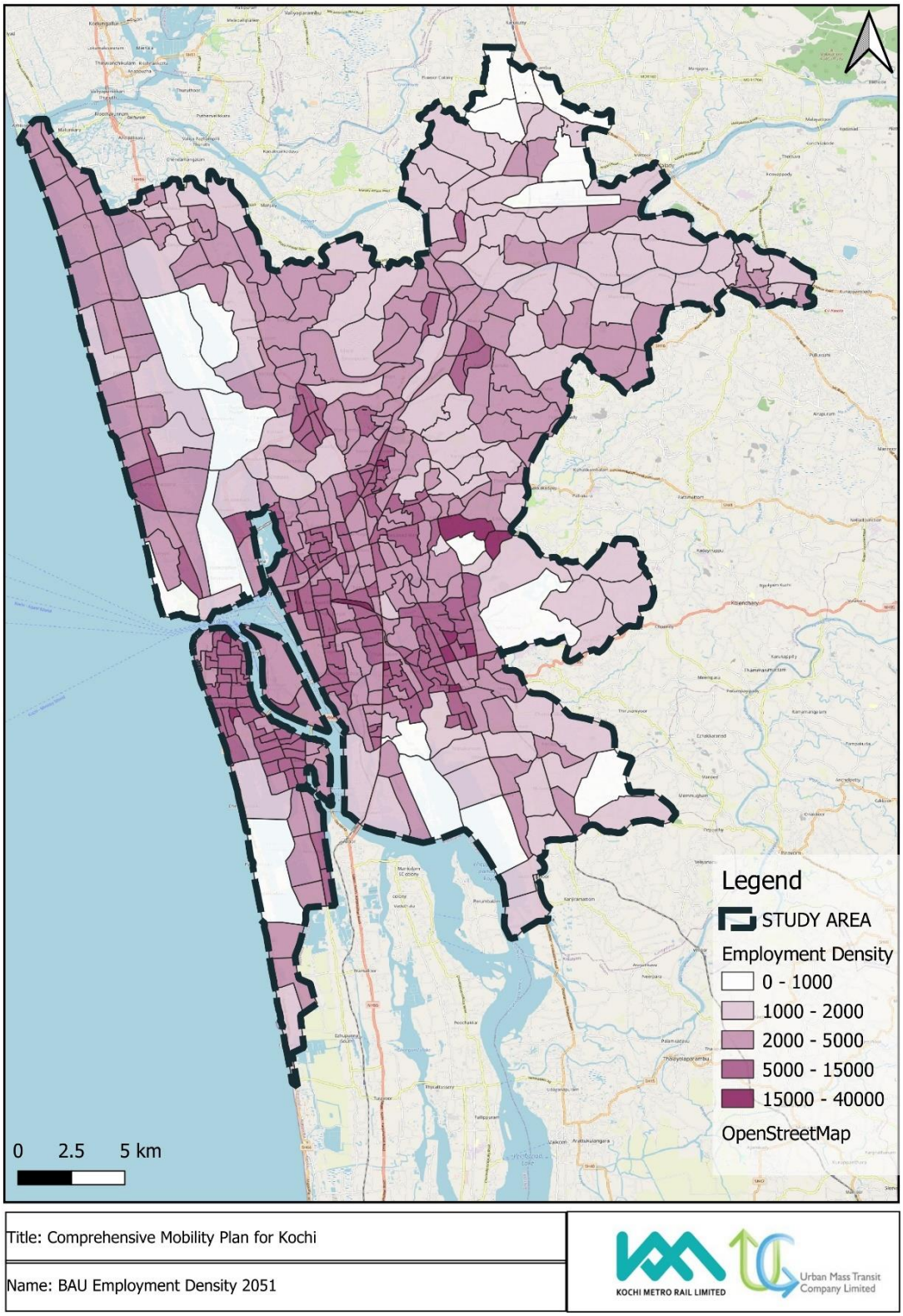

Figure 101 Employment Distribution – 2051 – BAU

6.3 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,

- Six Lanning of Kodungallur to Edapally section of NH- 66 (Old NH-17)
- Construction of Airport Seaport Road - Kalamasserry Aluva – Phase II
- NH Bypass – Kundannur to Angamaly
- Four Lanning of SN Junction -Poothotta Road
- Kumbalangi - Perumpadappu Road widening from Kumbalangi to Covent Junction
- Ring Road project - road widening of the stretch NES junction to Pambayimoola, P Gangadharan Road and Indira Gandhi Road. Construction of new road connecting Kannenganttu road and Indira Gandhi Road
- Widening of the stretch from Kaniyampuzha bridge to Mathoor
- RoB at Vaduthala, Atlantis, Kureekad, Periyar
- Kadamakkudy Pizhala Bridge
- Kumbalangi - Keltron Ferry Bridge
- Kumbalam - Thevara Bridge in Ernakulam District
- Angamaly-Kochi Airport Bypass
- Mattupuram Chennamangalam Bridge in North Paravur
- Completion of Phase 1B of Kochi Metro
- Completion of Phase 2 of Kochi Metro from JLN to Infopark Phase II
- Committed 15 routes of Water Metro

6.4 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 household surveys and for horizon year similar trend of fuel mix is linked to the BAU scenario.

Table 57 Fuel Mix for BAU Scenario

VEHICLE TYPE	% FUEL TYPE - 2051			
	PETROL	DIESEL	CNG/ LNG	ELECTRICITY
Cars	53.00%	17.00%	3.00%	27.00%
2Ws	62.00%	0.00%	0.00%	38.00%
3Ws	0.00%	63.00%	4.00%	33.00%
Buses	0.00%	60.00%	0.00%	40.00%

6.5 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.

Table 58 Mode Share (Excluding NMT) for Horizon Year under BAU Scenario

NAME OF THE INDICATOR	BASE YEAR (2023)	BAU (2051)
Private Transport (PVT) Trips	59%	61%
Public Transport Trips	31%	33%
IPT Modes	10%	6%

The increased dependency on private modes on roads reflects the increased congestion levels on roads which is as depicted in the table below.

Table 59 Horizon Year Congestion levels

SN	NAME OF THE ROAD	V/C (Base Year)	V/C (2051)
1	Aluva-Edapally – NH 544	1.49	1.10
2	Kaloor Kadavanthara Road	0.60	1.04
3	Aluva Munnar Road	1.14	1.98
4	SH 41 (Chithrapuzha Ponjassery Rd)	1.14	1.99
5	SH63	1.12	1.94

SN	NAME OF THE ROAD	V/C (Base Year)	V/C (2051)
6	Seaport-Airport Road	1.76	1.87
7	Aroor Thoppumpady	1.45	1.57
8	Banerji Road	0.90	1.62
9	Chittoor Road	1.43	2.37
10	ICT Road	0.70	1.31
11	Palarivattom- Kakkanad Road	0.95	1.65
12	MG Road	1.30	1.83
13	SA Road	1.09	1.90
14	Shanmugham Road	0.70	1.22

The volume to capacity ratio (V/C) along major corridors is above 1, with service level of service, LOS- D, which indicates that the traffic volume has approached an unstable flow and needs immediate interventions.

6.6 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.

Table 60 Carbon Emissions in Horizon Year (BAU 2051)

SN	INDICATOR TYPE	DESCRIPTION	BAU (2051)
1	GHG Emissions	Equivalent CO2 emissions per passenger Km	72.93

6.7 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 (Model Results)**			
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	59%	61%

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR	HORIZON YEAR
	Public Modes	% of trips made by public transport modes	31%	33%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	10%	6%
2	**Trip Length (Km)**			
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car, and Auto users in the study area	10.6	11.2
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.61	10.4
ii) Infrastructure and Land use				
1	**Infrastructure Quality**			
1.1	Average Speed (Kmph) (PvT)	Average speed of private modes	23.3	20.11
	Average Speed (Kmph) (PT)	Average speed of public transport modes	15.25	11.34
1.2	**Accessibility to Public Transport (Population)**			
	Access to PT	Population having access to PT	0.60	0.73
2	**Land use parameters**			
2.1	**Land use mix intensity**			
	Land use mix intensity	Job and housing balance (employment / residing population)	0.42	0.51
iii) Safety				
1	**Safety**			
1.1	Quality of footpath infrastructure	% of roads with more than 2m footpath	7.0%	29%
iv) Environmental Impacts				
1	**Emissions**			
1.1	Emissions (Tonnes/day)		36.53	72.93
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.	12%	12.68%
iv) Technology				
1	**Vehicle Fuel Technology**			

S.NO.	INDICATOR TYPE	DESCRIPTION	BASE YEAR	HORIZON YEAR
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 hour.

KOCHI METRO RAIL LIMITED

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07

SUSTAINABLE MOBILITY VISION & GOALS

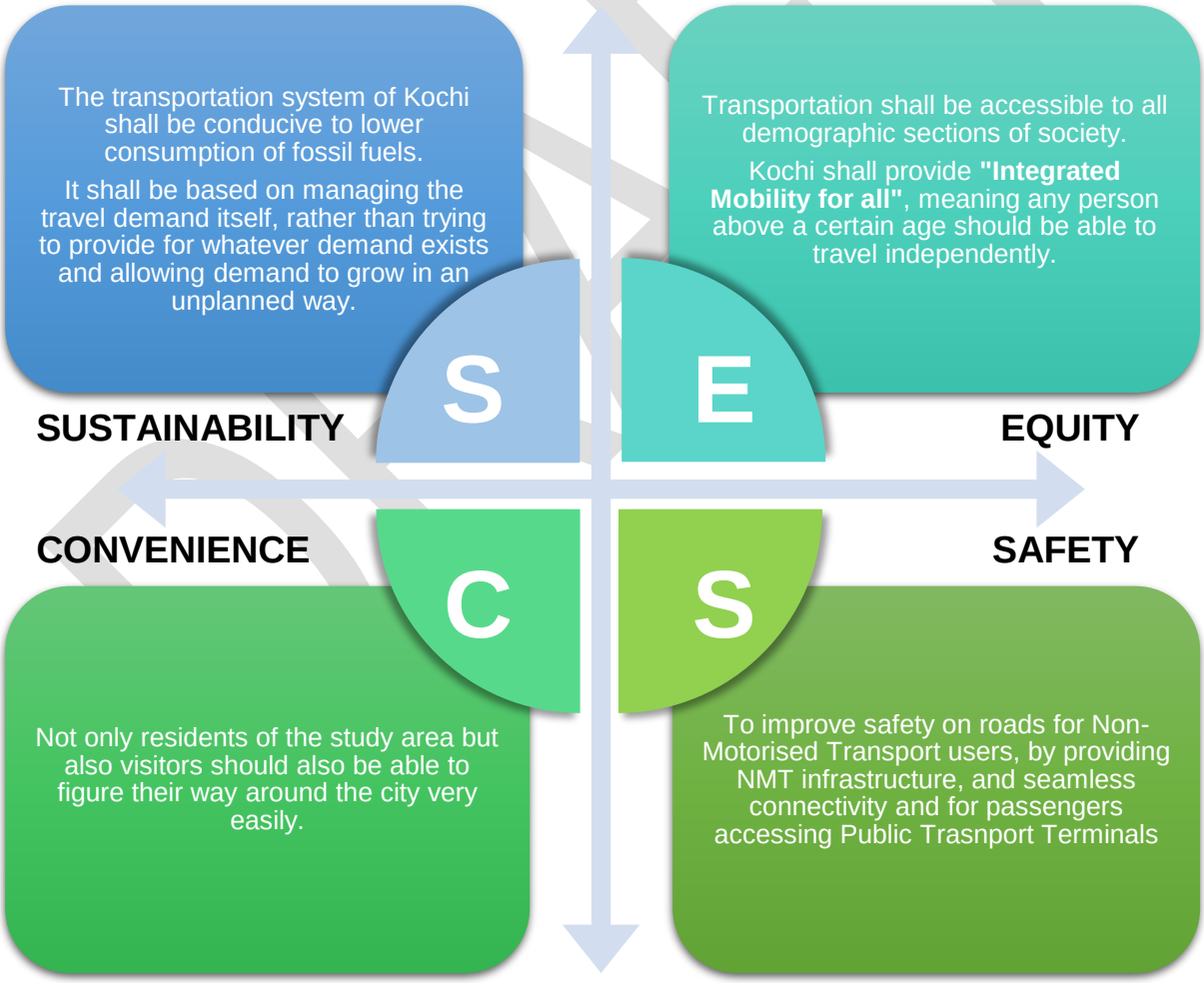

noel

7 SUSTAINABLE MOBILIY VISION & GOALS

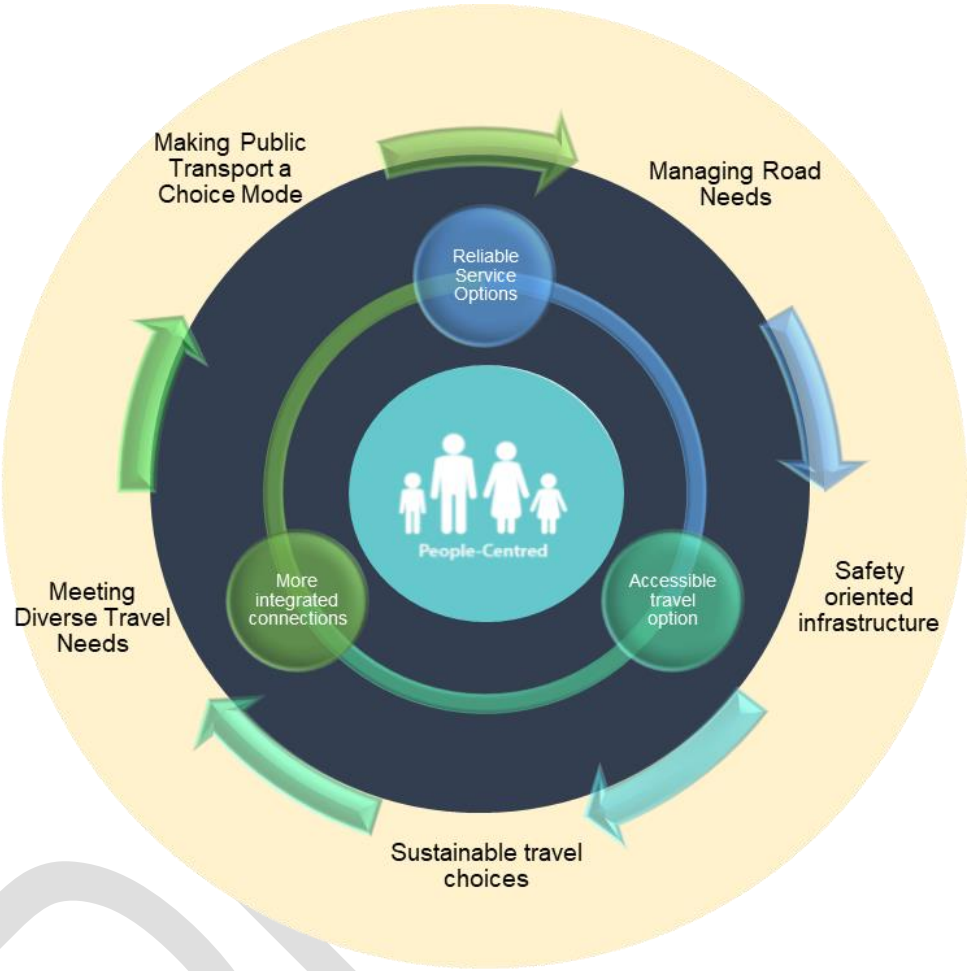
7.1 VISION

The mobility vision for Kochi is to have a “People Centric Sustainable, Efficient and World Class Urban Transport System that provides the residents of Kochi, safe, comfortable reliable and convenient mobility options while catering to their affordability and providing them with seamless integration.

The four major elements that outline the vision for Kochi are:



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 Kochi, safe, comfortable reliable and convenient mobility options while catering to their affordability and providing them with seamless integration".

Figure 102 Kochi CMP Study Aim

Thus, the focus of the study is to develop a robust Transportation System for Kochi 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.

7.2 GOALS

To ensure urban transport solutions are sustainable and in conformity with vision for Kochi, 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 Kochi Transportation System have been translated into mobility targets for the horizon year under sustainable scenarios in comparison with the Business-as-Usual Scenario.

Table 61 shows the goals set to be achieved in the horizon year by implementing all the proposals recommended in this study (Chapter 8).

Table 61 Goals Set for Mobility System for Kochi for 2051

NAME OF THE INDICATOR	BASE YEAR	BAU (2051)	HORIZON YEAR (2051) – TARGET
Private Transport (PVT) Trips	59%	61%	<45%
Public Transport Trips	31%	33%	>40%
IPT Modes	10%	6%	<10%
Avg. Speed Private Mode (kmph)	23.3	20.11	>23
Avg. Speed PT Mode (kmph)	15.25	11.34	>18
% of city covered with Footpaths (Arterial and Sub-Arterial)	7.0%	29%	100%
% of city covered with Cycle Tracks (Arterial and Sub-Arterial)	0%	10%	>50%
GHG Emissions (Tonnes/day)	36.53	72.93	Reduce by 30% of BAU

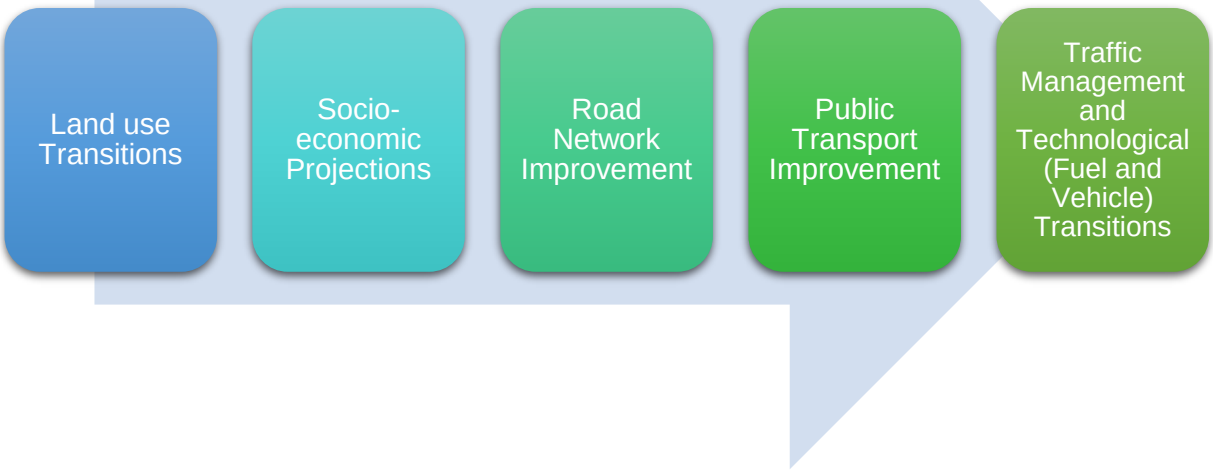
These goals and objectives set for the transportation needs of the study area can be achieved by formulating a series of strategies as per CMP Toolkit – 2014 and NUTP -2006 guidelines. Each of the strategies were evaluated to see their suitability and applicability for the study area.

7.3 DEVELOPMENT OF 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 Kochi, alternate sustainable scenarios have been developed. The strategies and alternate proposals developed for Kochi were assessed in various permutations to recommend the most suitable combination scenario and strategies. The transitions considered in developing the scenarios is as follows,



7.3.1 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 2020 with proposed Master Plan proposal for 2040.

The proposed Master Plan has put forward about 63.6% of the 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 the development zones, other than for those zones dedicated for specific purposes.

Table 62 Land use Distribution for KMC (Source: Draft Proposed Master Plan-2040)

LAND USE	EXISTING LAND USE (2019)	PROPOSED LAND USE (2040)
Developed Area (excl. Transportation) in Ha	5131.03	6030
Transportation Area in Ha	**1187.72**	**1203**
Undeveloped Area in Ha	638.48	0
Agriculture, Mangroves etc.	765.36	466.1
Water Bodies	1765.4	1789
Total	**9487.99**	**100%**
Developed Area (excluding Transportation)	54.1%	63.6%
Transportation	12.5%	12.7%
Undeveloped Area	6.7%	0%
Agriculture, Mangroves etc.	8.1%	4.9%
Water Bodies	18.6%	18.9%
Total	**100%**	**100%**

The proposed growth pattern considerations in line with Proposed Master Plan 2040 are as follows,

- It is proposed to develop IT and ITES based industries 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 mass transit services.
- Augmentation of eco-tourism, health tourism etc. and MICE destinations

- Land pooling and facilitation of vertical development while providing adequate connectivity infrastructure.

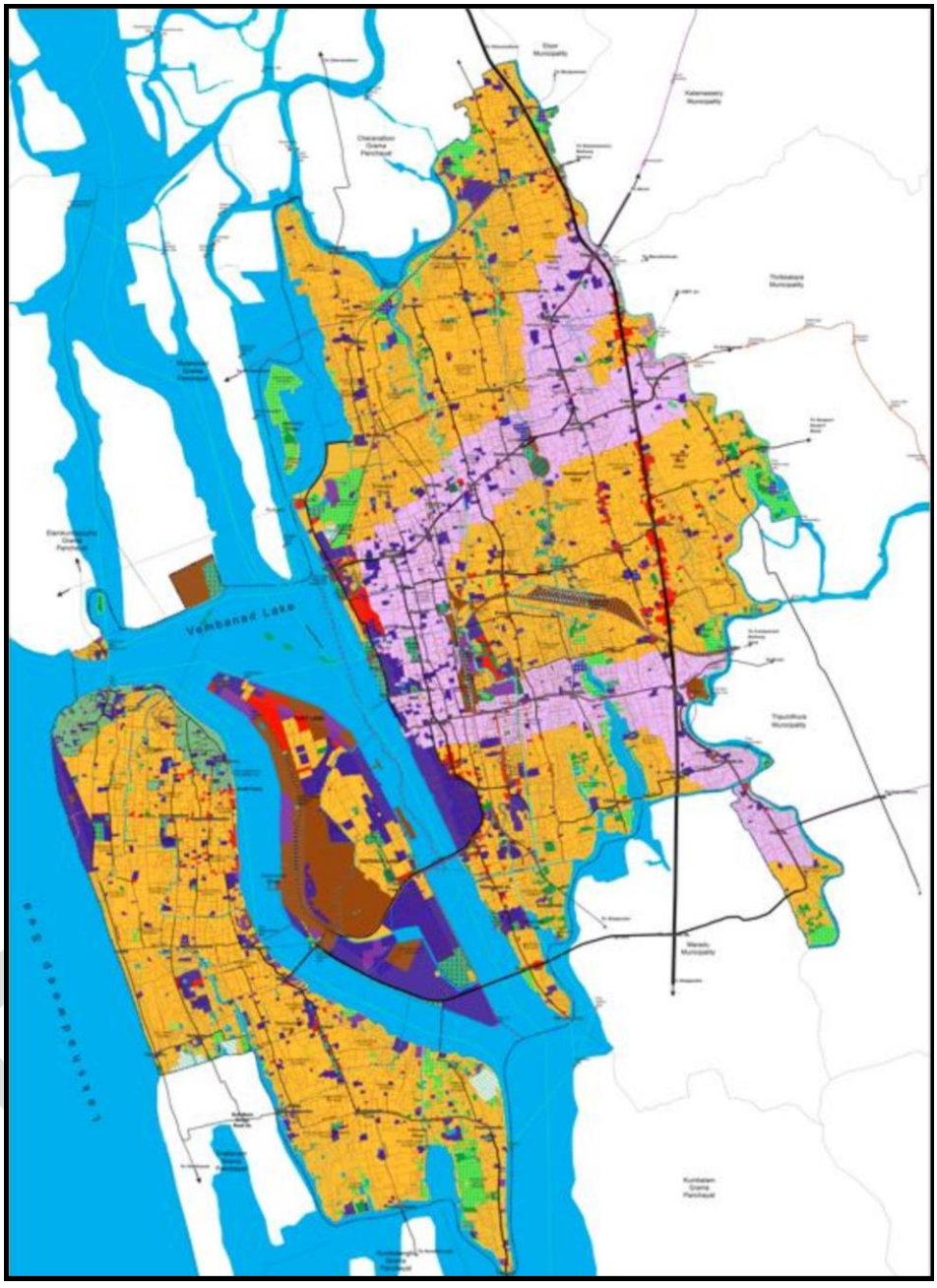


Figure 103 Proposed Land use of City (KMC) -2041 (Source: Draft Master Plan,2040)

Similarly, proposed land use transitions for Municipalities & Gram Panchayats are considered based on the available 2031 Master Plans and Structural Plan for Kochi City Region and similar trends have been considered for 2041 and 2051. Then further as part of this study integrated land use transportation strategy has been considered along the major mobility corridors and decentralized growth centre.

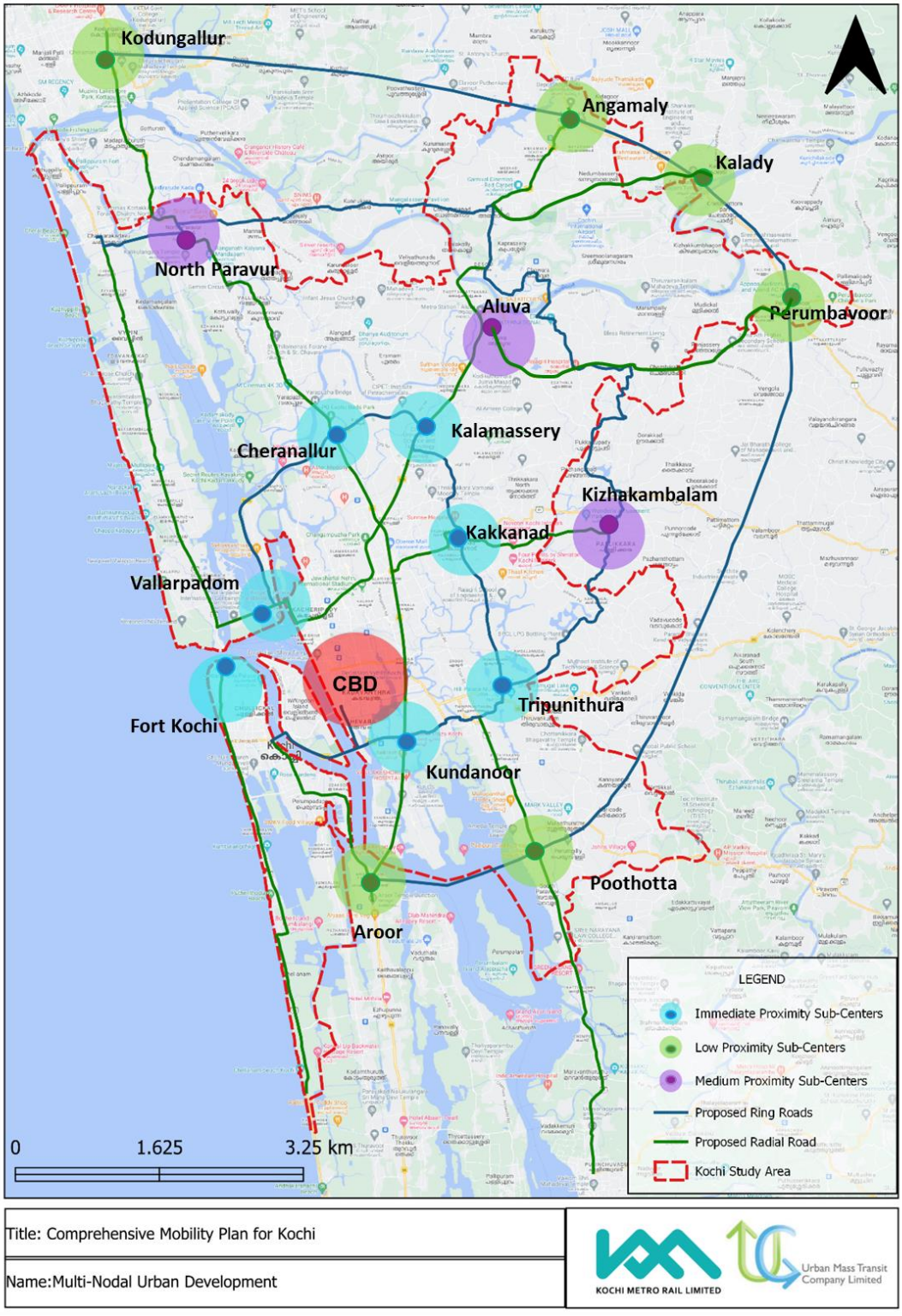


Figure 104 Integrated Land Use Transport Plan

7.3.2 SOCIO-DEMOGRAPHIC DISTRIBUTION

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 2041 has presumed that 2.81% 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 Kochi Bengaluru industrial corridor, GIFT city, Infopark expansion etc. The following scenario have been considered to evaluate the suitable population trend for the study area.

Table 63 Comparison of Projected Population Scenario (in Lakhs)

	2031	2041	2051
SUT Scenario	30.08	35.95	47.62

The scenario considers 2.81% as a constant annual growth rate (CAGR) in line with Master Plan 2040 considerations having a polynomial growth. The scenario is considered close to natural conditions and can be achieved through the land use strategies proposed in the master plan, supporting the sustainable urbanization. The 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 20% is considered in the study area.

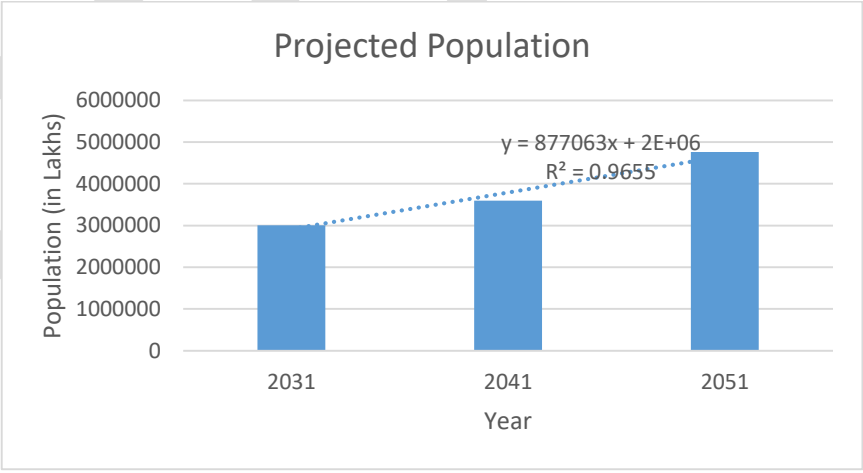


Figure 105 Population Projections SUT Scenario

Similarly, the employment projection for the same considering the population influx in the city considering IT boom and industrial 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 22.13 lakhs in 2051, the same has been presented below-

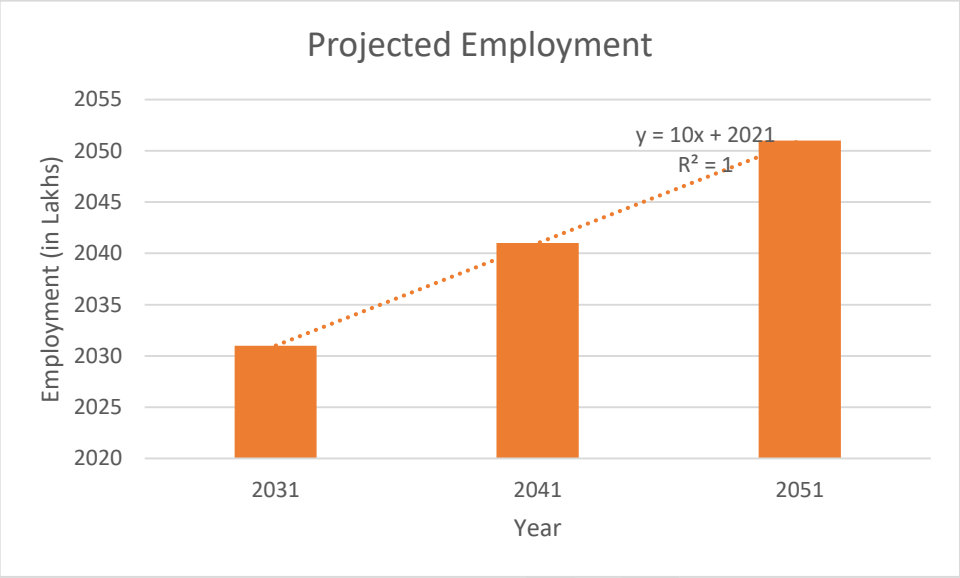


Figure 106 Projected Employment (in Lakhs) (Source: Draft Master Plan for Kochi 2040 & UMTC Estimates)

Table 64 Projected Employment (in Lakhs) (Source: Draft Master Plan for Kochi 2040 & UMTC Estimates)

	2031	2041	2051
STUDY AREA	14.68	18.15	24.76

Based on the land use transitions the projected population and employment has been distributed across the traffic analysis zones in the city.

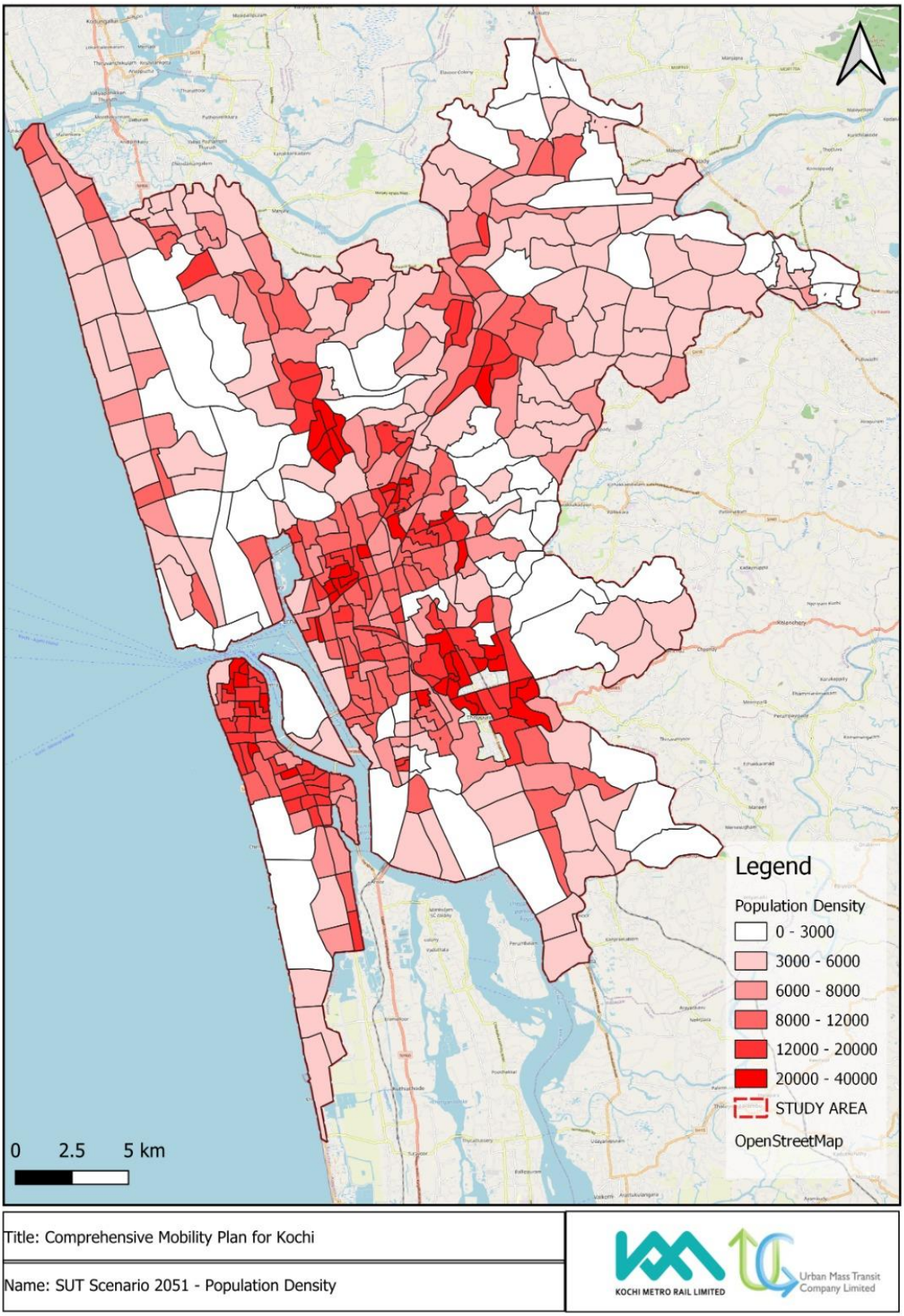


Figure 107 Projected Population Distribution – 2051 SUT

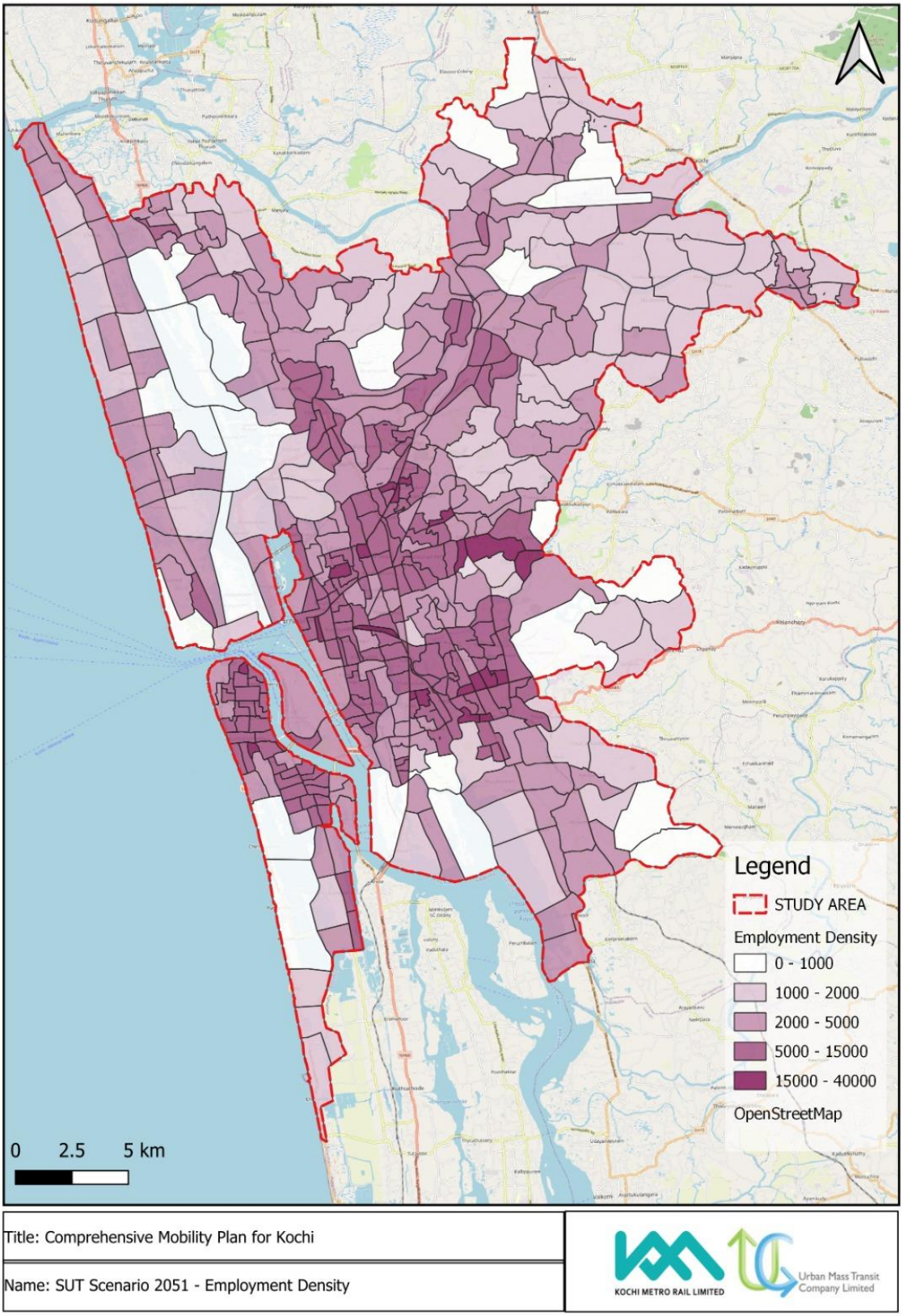


Figure 108 Projected Employment Distribution – 2051 SUT

7.3.3 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 - 348 km of the network is recommended for strengthening the ring and radial pattern.
- Upgradation of existing road network capacities – 330 km of the major corridors are recommended for capacity upgradations.
- Development of new links - 4 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 Mass Transit System – 27.1 km
- City Bus Rationalization and Augmentation – 31 overlapping routes are recommended for rationalization & 55 feeder routes for metro.
- 2 corridors of 65 km are recommended as high bus demand routes, 4 out of 9 Terminals are suggested for Sub-Urban Services, while 5 Terminals for city services and remaining 12 mini stations are recommended for decentralization of city and sub-urban operations.
- Inland Water Ways – 3 additional inland waterway corridors have been recommended.
- Development of PT Terminals – Development of 7 Multi-modal integration nodes with 3 city bus terminal and 2 suburban terminal improvements have been recommended.

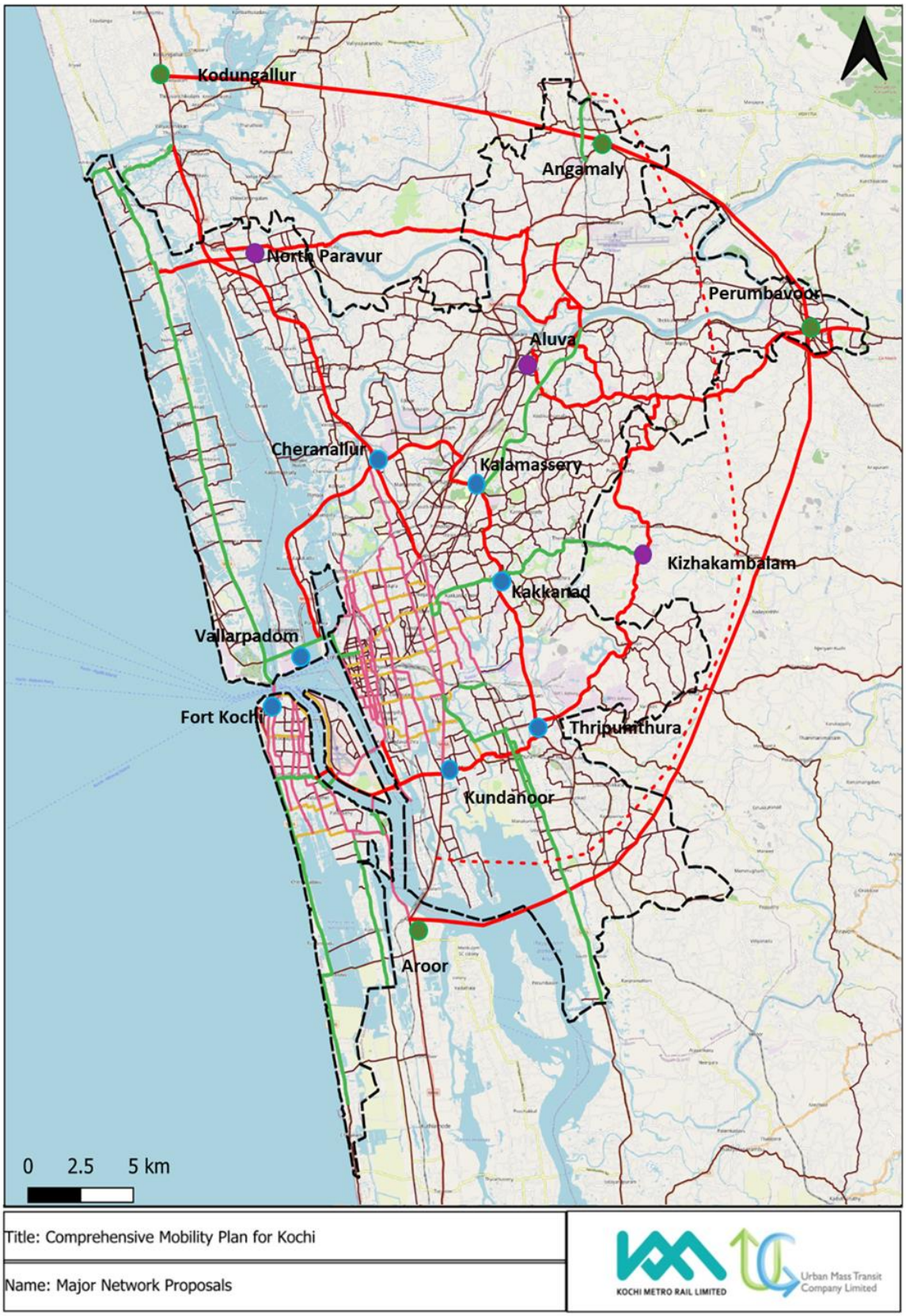


Figure 109 Proposed Road Network Transitions

Figure 110 Proposed Public Transport Network Transitions

7.3.4 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 household 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.

Table 65 Fuel Mix for SUT 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%

7.3.5 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 64% by 2051 (share of trips excluding walk) considering the proposals are being implemented in phased manner.

Table 66 *Mode Share for Horizon Years – Excluding NMT trips.*

Mode	2023	2031	2041	2051
Car	45%	25%	24%	23%
TW	14%	12%	11%	10%
Auto	10%	5%	4%	3%
PT	31%	58%	61%	64%
Total	100%	100%	100%	100%

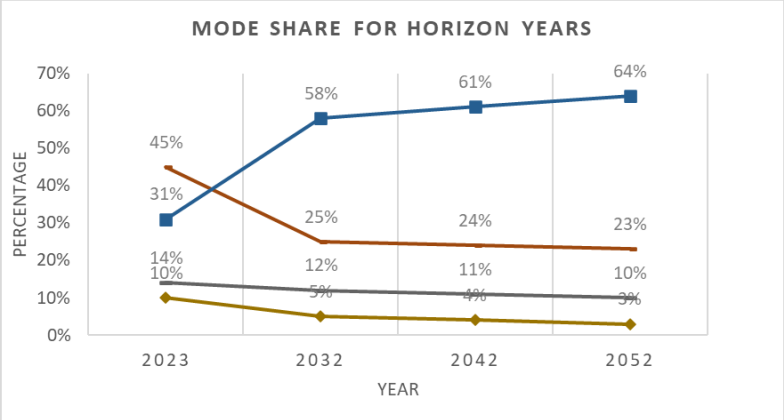
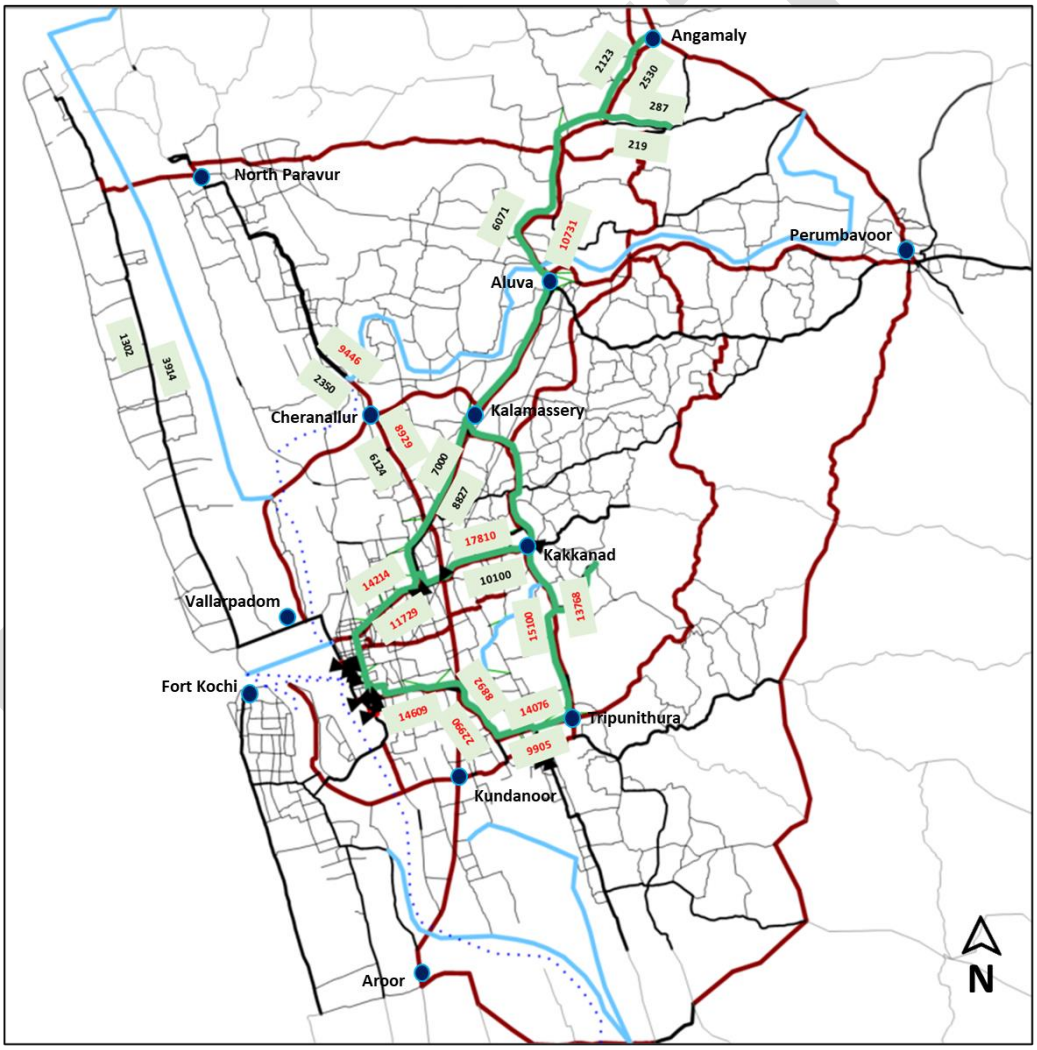


Figure 111: Mode Share for Horizon Years – Excluding NMT trips.



Title: Comprehensive Mobility Plan for Kochi	KOCHI METRO RAIL LIMITED / Urban Mass Transit Company Limited
Title: PHPDT along the major corridors – 2051 SUT Scenario	

Figure 112 PHPDT along the major corridors - SUT 2051 scenario

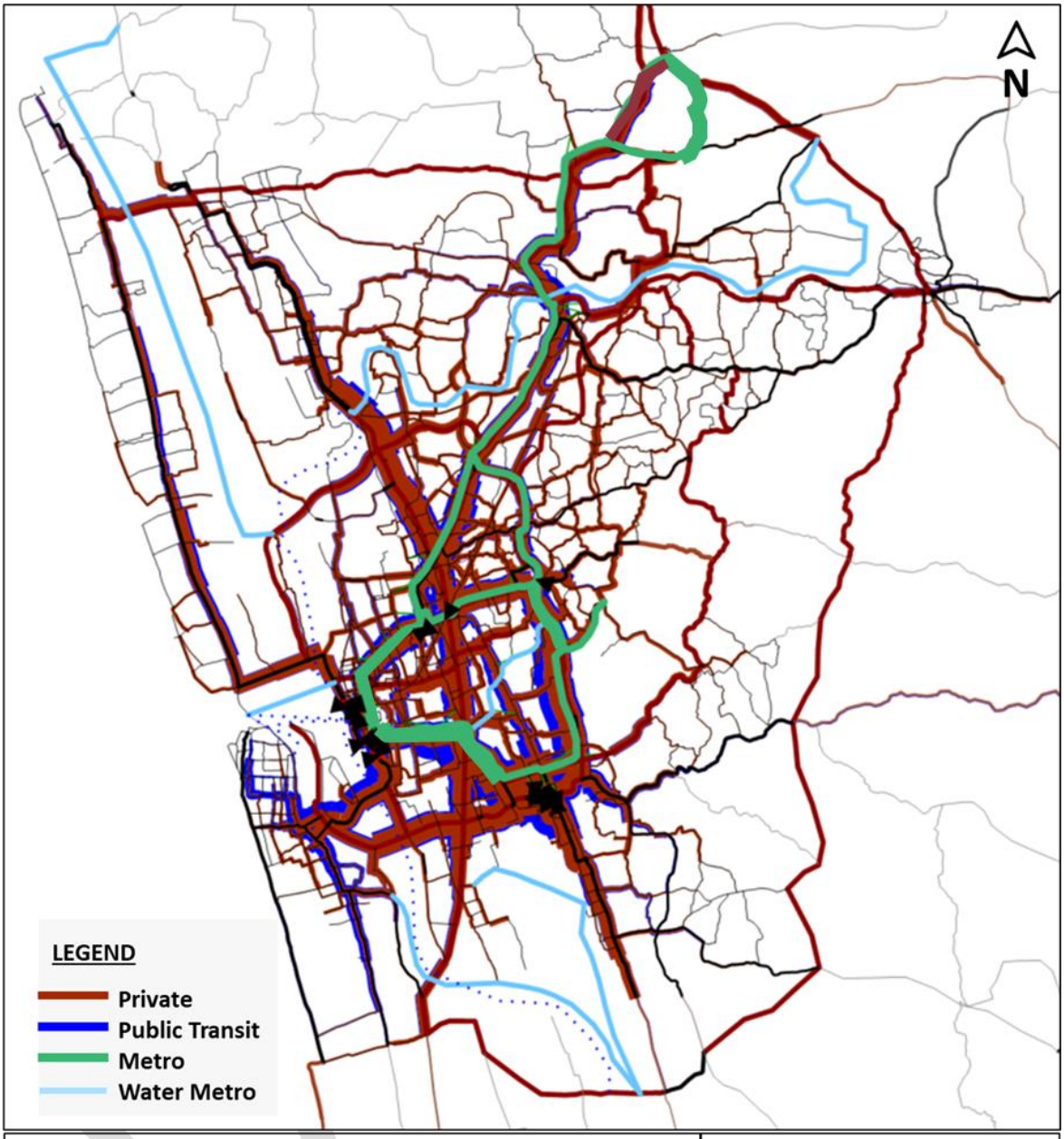


Figure 113: Diagram representing Passenger flow for all Motorised Modes Users –SUT-2051

The details of the SUT Scenario outcomes are presented in the impact assessment chapter.

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

08

SUSTAINABLE URBAN MOBILITY MEASURES

8 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 below.

Figure 114 Principles of Sustainable Urban Transportation

In line with these principles, the mobility goals for Kochi 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 115 Sustainable Mobility 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.

8.1 LAND USE AND TRANSPORT PLAN

A transport network of the 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 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/ cyclable neighbourhoods

8.1.1 MULTI NODAL URBAN 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.

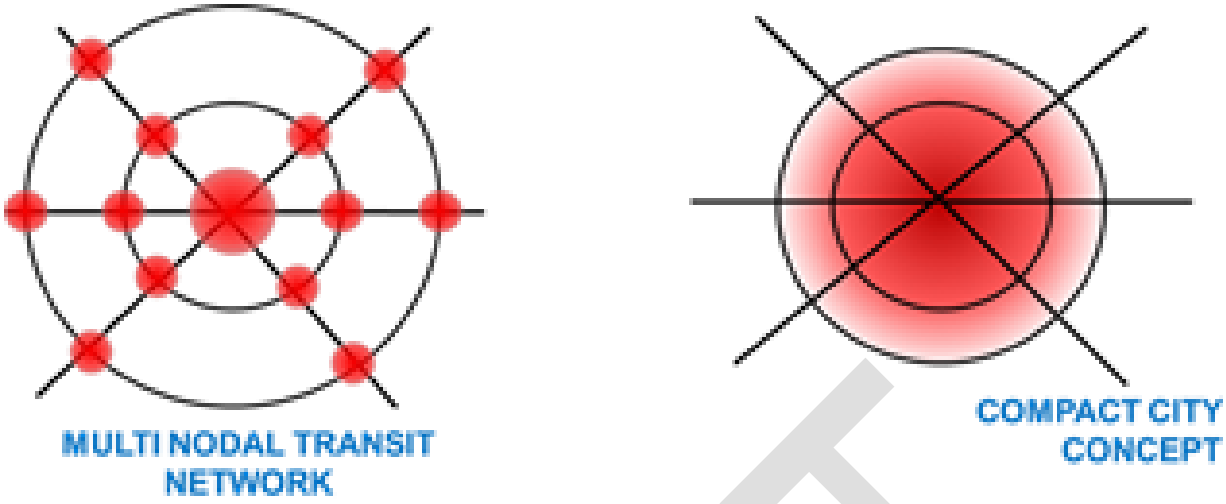


Figure 116 Urban Form Development Concepts

The structure of the study area resembles a compact node in the core Kochi Corporation area with growth centres emerging around it such as Aluva, Angamaly, Thripunithura, Kakkanad, North Paravoor, Vallarpadom, Kalamasserry, etc. Thus, a multi-nodal development concept is recommended for Kochi in ring radial structure.

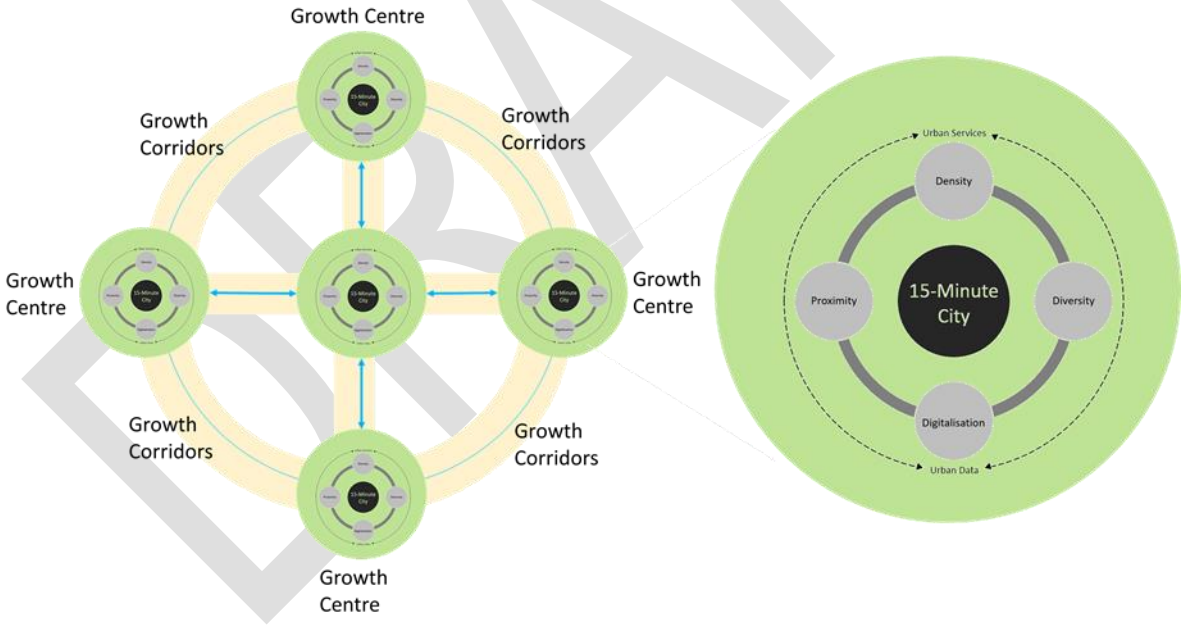


Figure 117 Multi-Nodal Urban Form Development Concept for Kochi

Multi-Nodal development structure recommended Kochi 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.

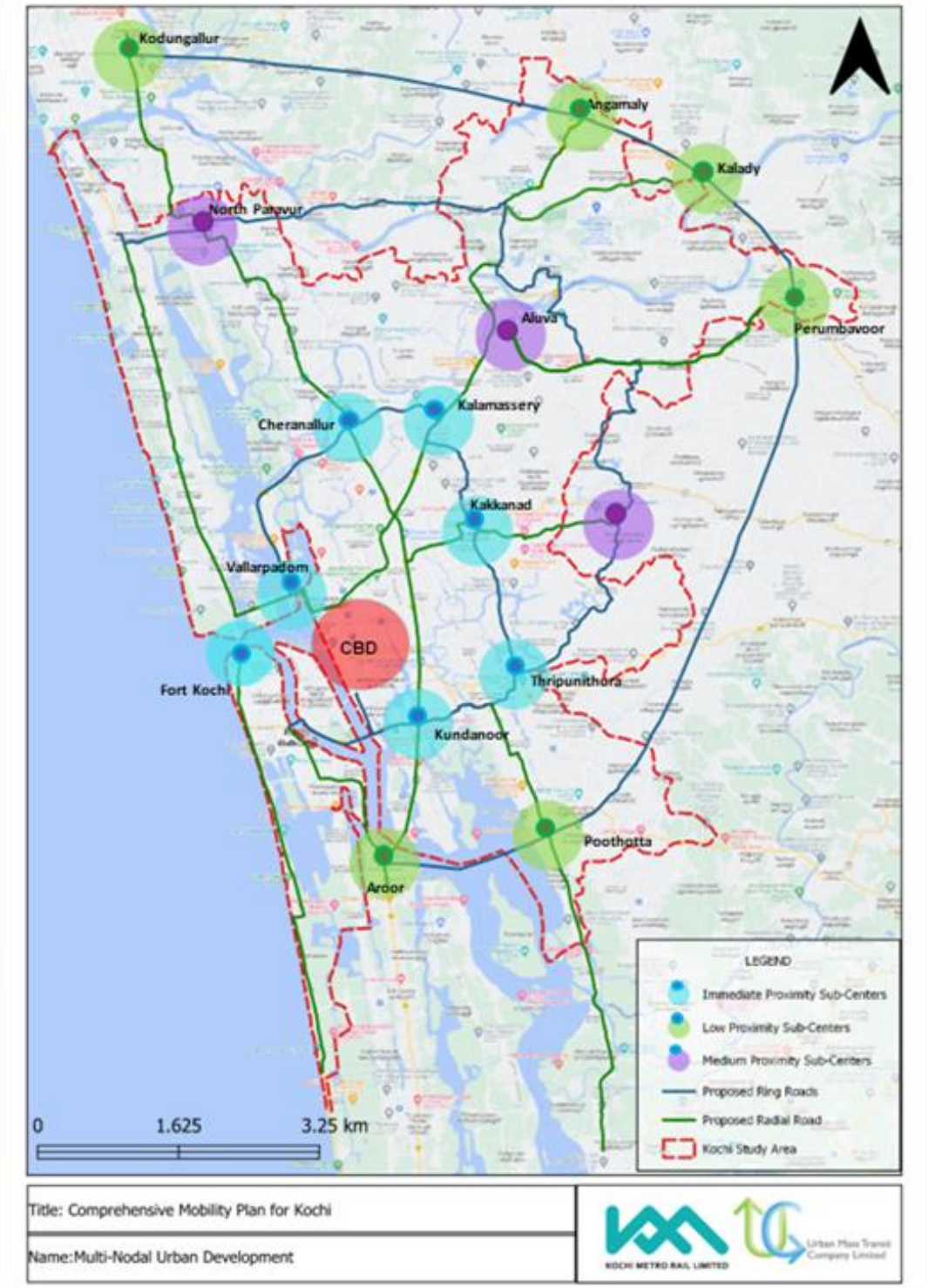


Figure 118 Multi-Nodal Urban Form Development for Kochi

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 67 Proximity of Core and Sub-Centres

SUB- CENTRES	AREA NAMES	DESCRIPTION
Immediate Proximity Sub-Centers	Vallarpadom, Cheranallur, Kalamasserry. Kakkanad, Thripunithura, Kundannur	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 apart from IT Parks and Port and ICT Terminal. 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	North Paravoor, Aluva, Kizhakkambalam	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, Tourism centres, industries, and residential clusters. These are a mix of employment generations nodes and residential nodes. They 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	Kodungallur, Angamaly, Kalady, Perumbavoor, Poothotta, Aroor	These are the important satellite towns of the city. However, owing the growth pattern towards the north, Angamaly 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.

8.1.2 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)

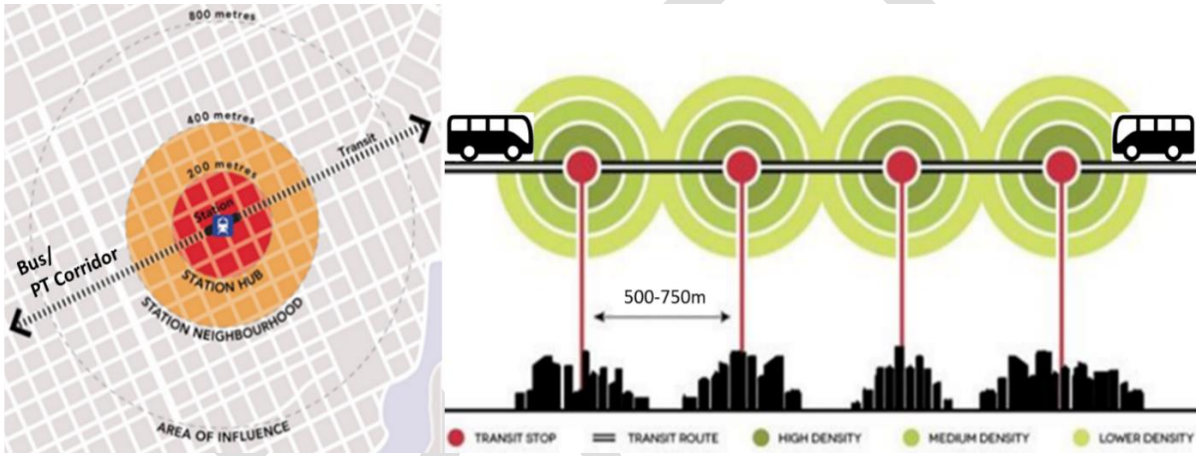


Figure 119 Concept of Public Transit Oriented Urban Land Use Development[5]

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.
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,

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

parks and Plazas as community gathering spaces to enable social interaction, quality facilities for transit users.

Figure 120 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.

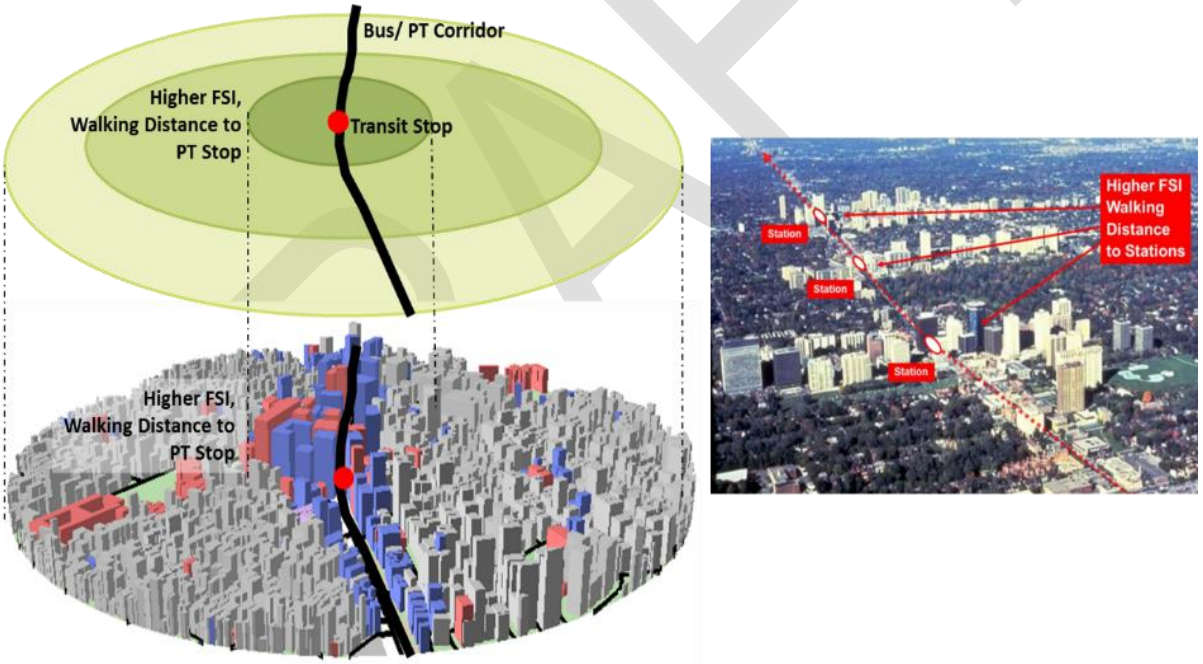


Figure 121 Building Height and Scale Along the Mobility Corridors

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) **PUBLIC SPACES**: This would include pedestrian-friendly streets including adoption of traffic calming measures, parks and Plazas as community gathering spaces to enable social interaction, quality facilities for transit users.
11) **PARKING**: Parking structures/shared parking lots are two ways to reduce the amount of space occupied by parking facilities.

Kochi has a 27.31 km metro corridor connecting Aluva to SN Junction. The extension to Thripunithura Terminal is in final stages while the extension works to Infopark Phase II has already started. Considering the developments planned soon there is immense scope for the corridor to branch out. Development in a controlled manner along metro benefiting the people living in the city and outskirts can be envisaged through TOD.

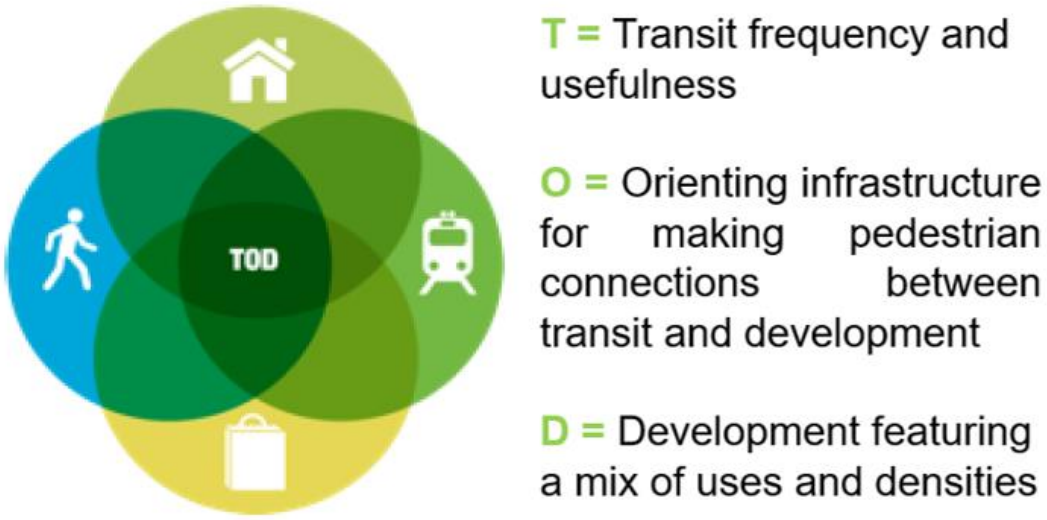


Figure 122 Concept of TOD – Work, Residence, Transit in Proximity[6]

Kochi has several land parcels which are interspersed in an organic manner without easy access to infrastructure. Land pooling and land reconstitution can help in organising the spaces and plots benefiting a much larger population.

The salient features of these Growth and TOD Corridors are as follows,

- The TOD and Growth corridors are proposed to have 1 km and 500m wide mixed-use development band.

[6] Source: www.completecommunitiesde.org

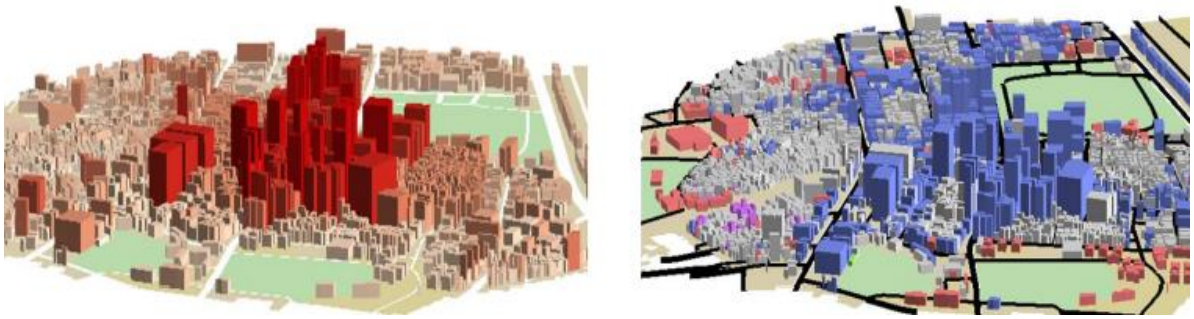


Figure 123 Representation of High Density (Left) And Mixed-Use Zones (Right) Around the Transit Zones

- This provides 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.

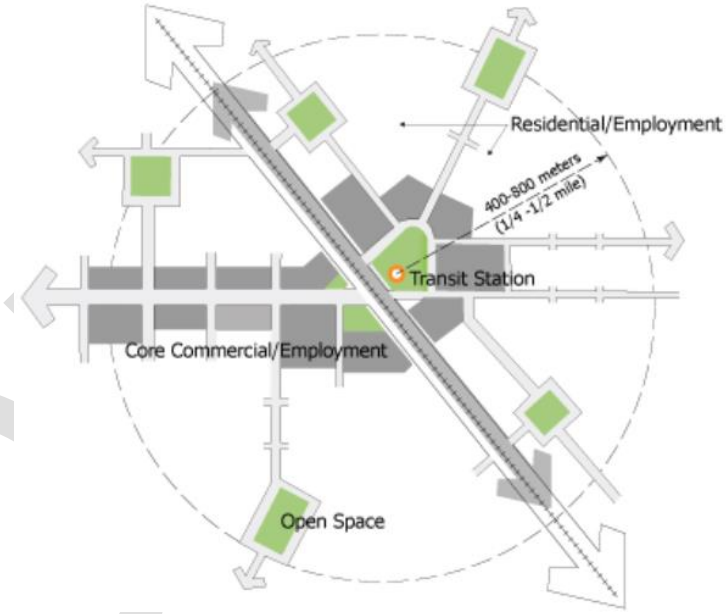
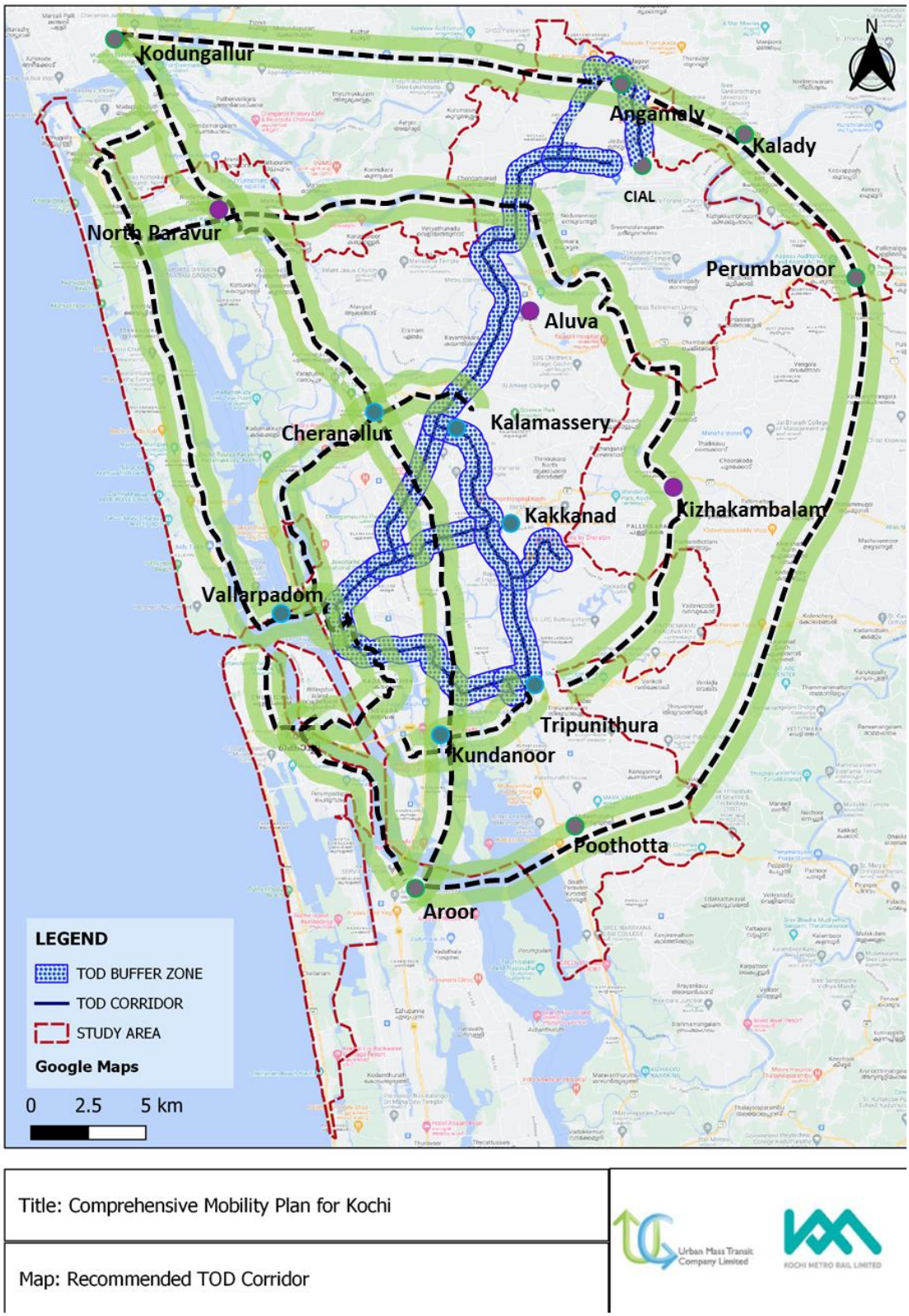


Figure 124 Walkable Core Transit Area (500m) Around A Transit Station[7]

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

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



Title: Comprehensive Mobility Plan for Kochi

Map: Recommended TOD Corridor

Figure 125 Recommended TOD Corridor

8.2 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. 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.

8.2.1 NETWORK STRUCTURE – RING RADIAL PATTERN

Kochi city clearly explains a radial network development like any other port city. In Kochi, these major radials are either state/national highways, and are important mobility corridors. In addition, there is a possibility to develop semi rings which bind these radial roads together providing a semi ring radial pattern for the road network.

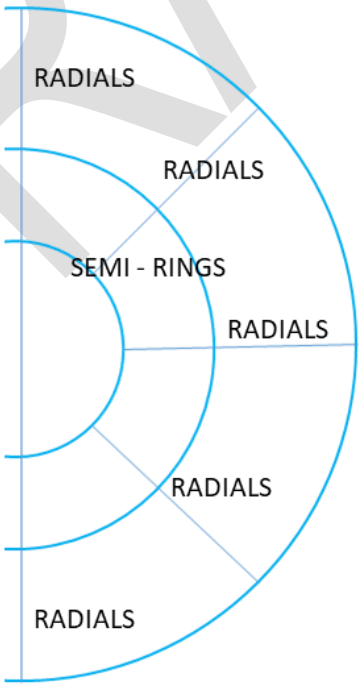


Figure 126 Conceptual Representation of Recommended Semi-Radial Network

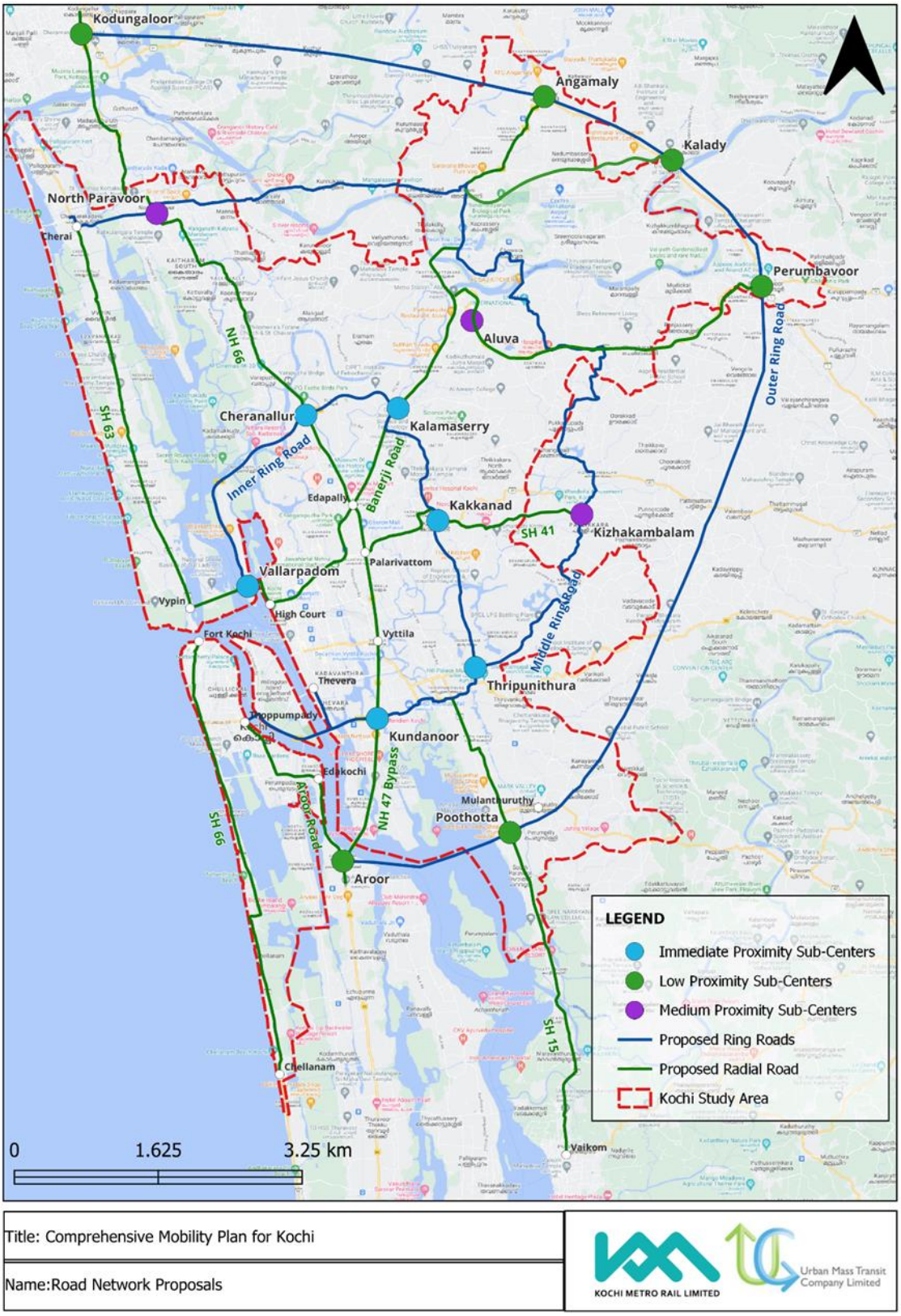


Figure 127 Recommended Semi-Radial Network

Ring Radial Roads area recommended for developing a clear network pattern in the study area is as follows.

Table 68 Recommended Semi-Radial Network

SN	NAME OF THE CORRIDOR	LENGTH (KM)	TYPOLOGY	PHASE
1	SH 63 High Court-Vypin-Cherai	22.9	Radial Road	PHASE II
2	NH 66 (Old NH 17) Edapally-Paravur	28.6	Radial Road	IN PROGRESS
3	SH 41 (Palarivattom- Kakkanad-Kizhakkambalam)	12.0	Radial Road	PHASE I
4	SH 15 (Thripunithura-Vaikom)	22.6	Radial Road	PHASE II
5	NH 47 Bypass (Edapally-Vyttila) NH 47(Vyttila-Aroor)	16.7	Radial Road	PHASE II
6	Aroor Road (Thoppumpady-Edakochi-Aroor)	9.8	Radial Road	PHASE II
7	SH 66 (Fort Kochi- Chellanam)	20.9	Radial Road	PHASE II
8	Inner Ring Road - Goshree Bridge at Vallarpadom to Thevara via Seaport Airport Road via Thripunithura	39.6	Ring Road	PHASE II
9	Middle Ring Road – Cherai-Paravoor-Aluva-Thripunithura-Kundannur-Thevara	70.4	Ring Road	PHASE II
10	Outer Ring Road – Kodungallur-Angamaly-Perumbavoor-Mulamthuruthy-Aroor	71.2	Ring Road	PHASE III
11	SH 16 (Aluva - Kuruppumpady)	23.55	Radial Road	PHASE II
12	Airport-Mattoor Road	9.41	Radial Road	PHASE I

About 348 km of the network is recommended for developing a clear network pattern in the study area.

8.2.2 NETWORK STRUCTURE – GRID IRON PATTERN (INTERNAL ROAD)

The interior networks largely fall under grid iron pattern. During the primary survey it was observed that 77% of the road network have lane configuration of 2 lanes or less. To strengthen the interior networks of the Ring-Radial pattern, the upgradation of lane capacities and new links in the horizon year in the study area are tabulated below. These are broadly divided as North-South and East-West Corridors covering 200 km and 130 km route length.

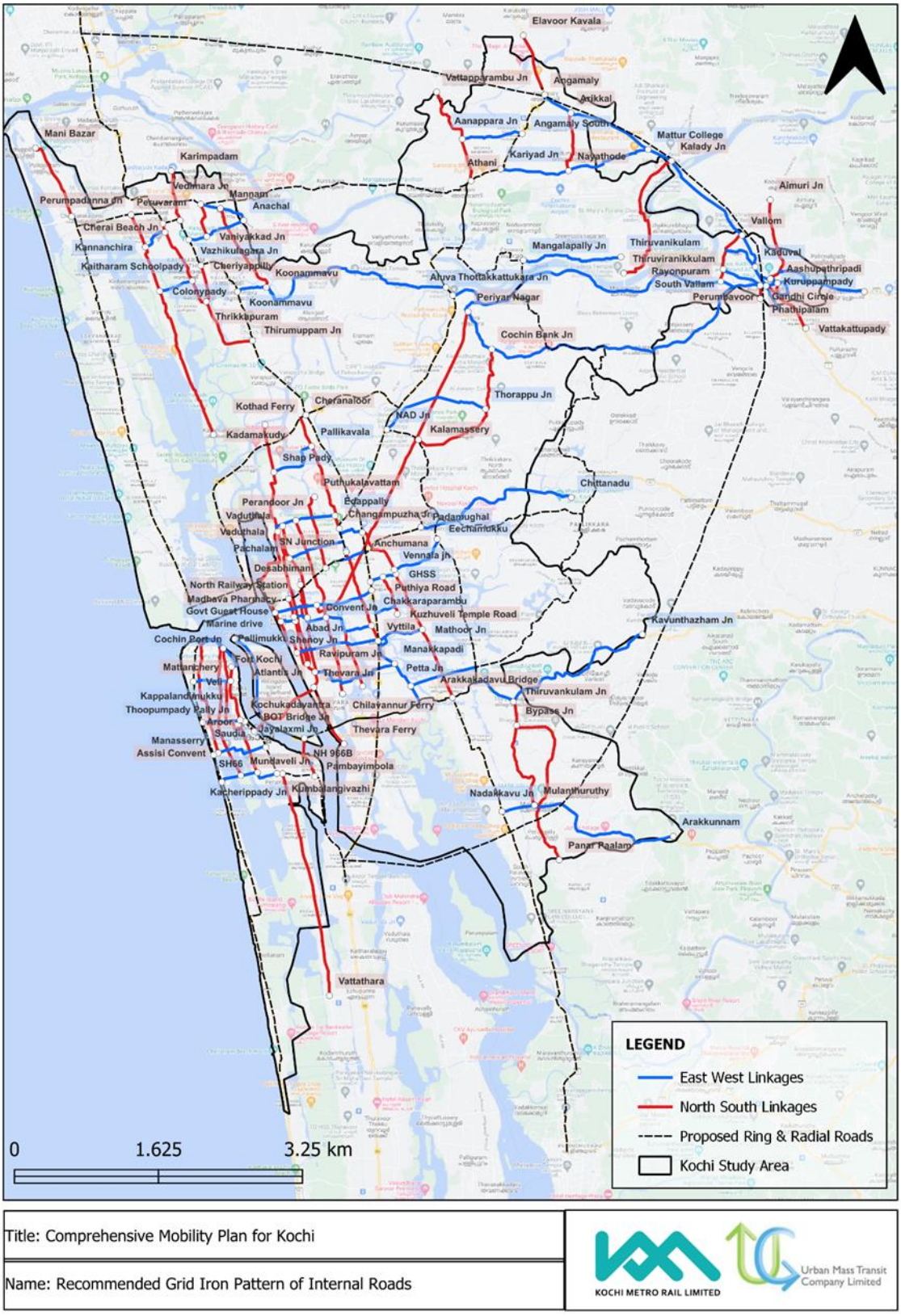


Figure 128 Recommended Grid Iron Pattern of Internal Roads

Table 69 Recommended Corridors in the Study Area

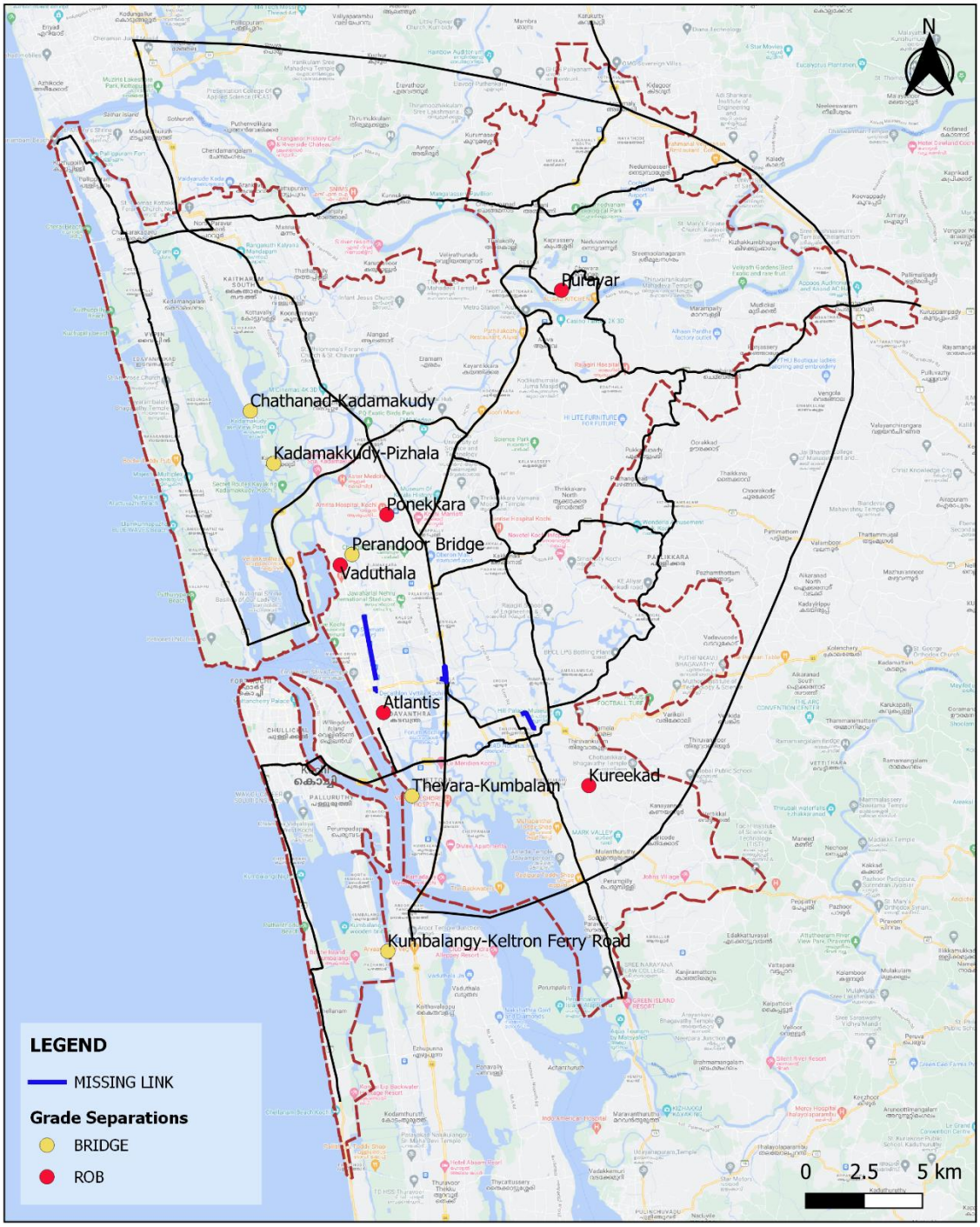
SN	NAME OF THE CORRIDOR	DIRECTION	PHASE
1	Ravipuram to Vaduthala	North-South	Phase I
2	BOT Bridge Jn to Madhava Pharmacy	North-South	Phase I
3	Thevara Ferry to Thevara Jn	North-South	Phase I
4	Ravipuram Jn to Kothad Ferry	North-South	Phase I
5	Atlantis Jn to Vaduthala	North-South	Phase I
6	Chilavannur Ferry to Kumaranasan Jn	North-South	Phase I
7	Deshabhimani to Puthukalavattam	North-South	Phase I
8	Vyttila to SN Jn	North-South	Phase I
9	Changampuzha Jn to Cheranallur	North-South	Phase I
10	Arakkakadavu Bridge to Anchumana	North-South	Phase I
11	Assisi Convent to Fort Kochi	North-South	Phase I
12	Mundamveli Jn to Fort Kochi	North-South	Phase I
13	Kalathara Rd to Fort Kochi	North-South	Phase I
14	Vattathara to Kumbalangi Vazhi	North-South	Phase I
15	Aroor to Mattancherry	North-South	Phase I
16	Pambayimoola to NH 966B	North-South	Phase I
17	New Bus Terminal at Karrikamurri to North Railway Station	North-South	Phase I
18	Kuzhuveli Temple Rd to Puthiya Road	North-South	Phase I
19	Peruvaram to Karimpadam	North-South	Phase I
20	Vaniyakkad Jn to Vedimara Jn	North-South	Phase I
21	Thirumuppam Jn to Thekey Naluvazhi	North-South	Phase I
22	Panar Paalam to Bypass Jn	North-South	Phase I
23	Kadamakkudy to Perumpadanna Jn	North-South	Phase I
24	Mulanthuruthy to Thiruvankulam Jn	North-South	Phase I
25	Thrikkapuram to Cheriyappilly	North-South	Phase I

SN	NAME OF THE CORRIDOR	DIRECTION	PHASE
26	Pathipalam to Gandhi Circle	North-South	Phase I
27	Rayonpuram to Vallom	North-South	Phase I
28	Vattakattupady to Perumbavoor	North-South	Phase I
29	Perumbavoor Bus Stand to Aashupathripadi	North-South	Phase I
30	Bhajanamadom to Aimuri Jn	North-South	Phase I
31	Thiruvairanikulam to Kalady Jn	North-South	Phase I
32	Nayathode to Arikkal	North-South	Phase I
33	Athani to Vattapparambu Jn	North-South	Phase I
34	Koonammavu to Mannam	North-South	Phase I
35	Kochukadavantra to Perandoor Jn	North-South	Phase I
36	Kathrikadavu to Periyar Nagar	North-South	Phase I
37	Kalamasserry to Cochin Bank Junction	North-South	Phase I
38	Atlantis Jn to Manakkapadi	East-West	Phase I
39	Pallimukku to Vyttila	East-West	Phase I
40	Govt Guest House on Park Avenue Road to Shenoy Jn	East-West	Phase I
41	Abad Jn to Convent Jn	East-West	Phase I
42	Vyttila Jn to Corporation Boundary	East-West	Phase I
43	Marine drive on Shanmugam road to Padma Jn	East-West	Phase I
44	Padma Jn to Chakkaraparambu	East-West	Phase I
45	Puthiya road Bypass to GHSS	East-West	Phase I
46	Vennala jn to Eechamukku	East-West	Phase I
47	Pachalam to Anchumana	East-West	Phase I
48	Vaduthala on Chittoor Road to Edapally on NH bypass	East-West	Phase I
49	SH66 to Kacherippady Jn	East-West	Phase I
50	Cochin Port Jn to Kavunthazham Jn	East-West	Phase I
51	Manasserry on Saudia-Chellanam Road to Jayalaxmi Jn	East-West	Phase I

SN	NAME OF THE CORRIDOR	DIRECTION	PHASE
52	Kappalandimukku to Veli	East-West	Phase I
53	Fort Kochi to Mattancherry	East-West	Phase I
54	Ponnurunni Challikavattom Road	East-West	Phase I
55	Link Road 2	East-West	Phase I
56	Nadakkavu Jn to Arakkunnam	East-West	Phase I
57	Vedimara Jn to Anachal	East-West	Phase I
58	Vazhikulangara Jn to Anachal	East-West	Phase I
59	Shap Pady to Pallikavala	East-West	Phase I
60	Aanappara Jn to Angamaly South	East-West	Phase I
61	NAD Jn to Thorappu Jn	East-West	Phase I
62	Kariyad Jn to Mattur College	East-West	Phase I
63	Mangalapally Jn to Thiruvankulam	East-West	Phase I
64	Vyttila Jn to Mathoor Jn	East-West	Phase I
65	Koonammavu to Thottakkattukara Jn	East-West	Phase I
66	Colonypady to Kaitharam Schoolpady	East-West	Phase I
67	Kannanchira to Thonniyakavu	East-West	Phase I
68	Vallom to Kaduval	East-West	Phase I
69	South Vallam to Gandhi Circle	East-West	Phase I
70	Oushadhi Jn to Aashupathripadi	East-West	Phase I
71	Perumbavoor Bus Stand to Marakkar Road	East-West	Phase I
72	Pooppani to Children's Park	East-West	Phase I
73	Pump Jn to Palakkatuthazham Jn	East-West	Phase I

8.2.3 DEVELOPMENT OF MISSING LINKS/NEW LINKS

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,



Title: Comprehensive Mobility Plan for Kochi	
Map: Grade Seperators & Missing Links	

Figure 129 Recommended Missing Links & Grade Separators

Table 70 Recommended New Links

SN	NAME OF THE CORRIDOR	PROPOSED WIDTH	PHASE
1.	Road from Manikathu X Rd to Sahodaran Ayyapan Road.	12 M	PHASE I
2.	Link Road I - from Krishnapuram Rd. to Krishnapuram Rd.	15 M	PHASE I
3.	Corridor Connecting North & South Railway Station	9 M	PHASE I
4.	Thripunithura Railway Station Link Road	18 M	PHASE I

8.2.4 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 10 crossing which includes 5 railway crossings and 5 bridges. The locations are presented below.

Table 71 Recommended Upgradation of Grade Separators

SN	NAME OF THE CORRIDOR	TYPOLOGY	PHASE
1	Atlantis ROB	ROB	PHASE I
2	Vaduthala ROB	ROB	PHASE I
3	Ponekkara ROB	ROB	PHASE II
4	Kureekad ROB	ROB	PHASE I
5	Periyar ROB	ROB	PHASE II
6	Bridge over Perandoor Canal	Bridge	PHASE I
7	Kadamakkudy Chathanad Bridge	Bridge	PHASE II
8	Kadamakkudy - Pizhala Bridge	Bridge	PHASE I
9	Thevara - Kumbalam Bridge	Bridge	PHASE II
10	Kumbalangy - Keltron Ferry Road Bridge	Bridge	PHASE I

8.3 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 paratransit, appropriate Mass Rapid Transit (MRT) 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. 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:

- Integration of the existing Public Transit Modes for seamless travel experience
- Feasibility of additional Mass Transit corridors
- Inland Water Ways

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 130 Available Hierarchy of Public Transit Systems

8.3.1 MASS TRANSIT SYSTEMS

A Mass Transit System is designed to move large numbers of people at one time. Mass Rapid Transit system usually runs in special guideways which will lead to lower travel time, and decreased congestion.

The selection of suitable mass transit system is based on the Passengers per Hour per Direction (PPHPD) and feasibility of implementation, along with other parameters as mentioned below.

SELECTION CRITERIA[8]

A. Effectiveness of mode in meeting demand
B. Cost
C. Right of way availability
D. Environmental Impact
E. Journey Time
F. Safety
G. Comfort
H. Flexibility
I. Reliability
J. Fare
K. Technical Sophistication
L. Implementation Complexities
M. Image

The guidelines for selection of mass rapid transit choice for the city is given as specified by working group on Urban Transport for 12th Five Year Plan of India.

Table 72 Selection Criteria of Mass Rapid Transit

MODE CHOICE	DESIRABLE PHPDT	POPULATION (MILLION)	AVERAGE TRIP LENGTH (KM)
Metro Rail (Light, Medium, Heavy)	>15000 for at least 5 km continuous length	>=2	>7-8
LRT Elevated	>15000	>1.5	>7-8
LRT primarily at grade	<=10000	>1	>7-8
Monorail	<=10000	>1	About 5-6
Bus Based Systems (BRTS)	>=4000 and up to 15000	>1	>5
Organized City Bus Service as per urban bus specifications		>1 lac, 50,000 in case of hilly towns	>2 to 3

The major mobility corridors in the study area along with existing and under construction MRTS corridors are listed below:

Table 73 Major Mobility Corridors (UMTC)

SN	NAME OF THE CORRIDOR	LENGTH (KM)	REMARK
1	Aluva To SN Junction	27.3	Existing MRTS
2	SN Junction to Thripunithura	1.8	Phase 1B - Under Construction MRTS

[8] *UNDP Reference Guide, Vol 2: Public Transport – 2013, MoUD, GoI*

SN	NAME OF THE CORRIDOR	LENGTH (KM)	REMARK
3	JLN Stadium to Infopark	11.3	Phase 2 - Under Construction MRTS
4	High Court – Fort Kochi	14	Mobility Corridors
5	Paravoor To Aroor	35	Mobility Corridors
6	Kalamasserry - Thripunithura Via Kakkanad	14.1	Mobility Corridors
7	Aluva to Angamaly	13	Mobility Corridors
8	Petta to Thoppumpady via Kundannur	8.5	Mobility Corridors
9	High Court to Munambam	30	Mobility Corridors
10	Thripunithura to Poothotta	14	Mobility Corridors
11	Vallarpadam to Kalamasserry	16	Mobility Corridors

The assessment resulted in the identification of potential corridors for the development of higher capacity mass transit system. Mass Transit System designed to move large numbers of people on special guideways will lower travel time and mitigate congestion. Preliminary assessments indicate roughly 27.1 km of MRTS corridors with a base year PPHPD above or close to 5000. Considering the demand on the major mobility corridors the most suitable high-capacity mass transit modes can be explored. The suitable corridor shall be identified based on PPHPD, and a detailed study must be carried out to assess the feasibility of these corridors. Aluva-Angamaly corridor is an extension of the existing Metro corridor. This mobility corridor being in close proximity to Cochin International Airport (CIAL), it is recommended to provide connectivity to CIAL. The feasible connectivity options may be explored while undertaking the Alternative Analysis Report or Feasibility Study of the corridor.

Table 74 Suggested MRTS System with Phasing

SN	NAME OF THE CORRIDOR	LENGTH (KM)	SYSTEM	PHASE
1.	Paravoor To Aroor	35	BUS BASED	PHASE II
2.	Kalamasserry - Thripunithura Via Kakkanad	14.1	RAIL BASED	PHASE II
3.	Aluva to Angamaly	13	RAIL BASED	PHASE I
4.	High Court to Munambam	30	BUS BASED	PHASE III

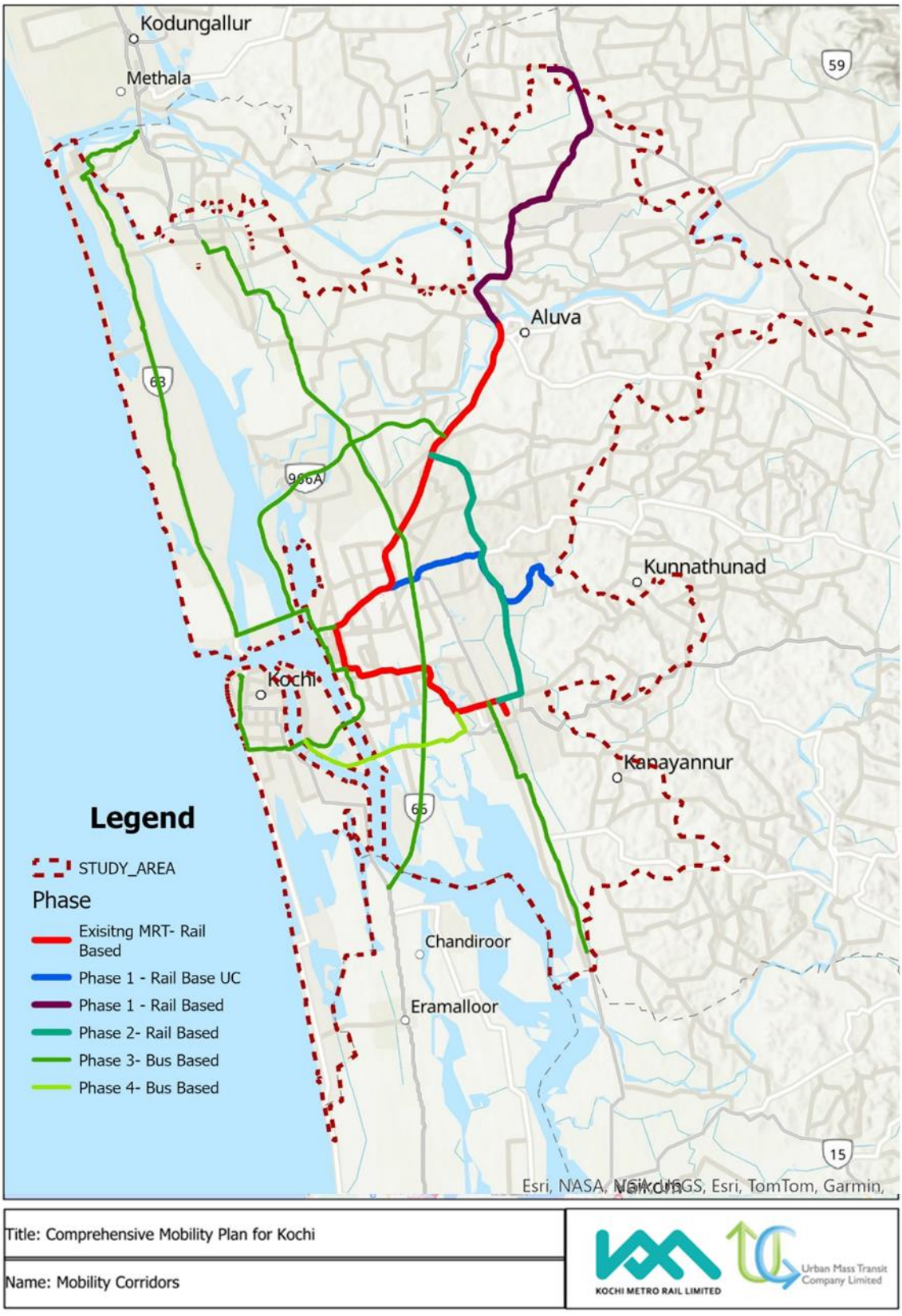


Figure 131 Potential Mobility Corridors

Table 75 Demand on recommended MRT Corridors & PHPDT for 2051

SN	NAME OF THE CORRIDOR	LENGTH (KM)	SYSTEM	PHPDT (2051)
1	Aluva To Thripunithura	28.2	EXISTING RAIL BASED	22990
3	JLN Stadium to Infopark	11.3	UNDER CONSTRUCTION RAIL BASED	17810
4	Kalamasserry - Thripunithura Via Kakkanad	14.1	RAIL BASED	15100
5	Aluva to Angamaly	13	RAIL BASED	10931
6	Paravoor To Aroor	35	BUS BASED	9446
7	High Court to Munambam	30	BUS BASED	3914

8.3.2 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 Mass Transit Systems. 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.

Further, a route-to-route overlap analysis has been carried out for bus services in Kochi is observed that about 22% of the routes have above 60% average route overlap with the proposed trunk routes or MRTS corridors. 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.

It is recommended to rationalise 31 routes (13 KSRTC Routes & 18 Private Bus Routes) which are observed to be overlapping with the current and proposed Mass Transit Corridors by re-outing to alternative corridors.

Table 76 Route Rationalization Proposals

RATIONALIZATION OF ROUTES	2027
Total No. of Routes for Curtailed/Modified	31

The details of the routes are as follows,

Table 77 Recommended Private Bus routes for Rationalization.

SN	NAME OF CORRIDOR	OVERLAP WITH	RECOMMENDATION	PHASE
1	Ernakulam Boat Jetty-Angamaly	Existing MRTS	Re-route overlap	Phase I
2	Perumbavoor-Ernakulam Boat Jetty	Existing MRTS	Re-route overlap	Phase I
3	Aluva-Kakkanad	Existing MRTS	Re-route overlap	Phase I
4	Kalamasserry-Aluva	Existing MRTS	Re-route overlap	Phase I
5	Aluva-Thripunithura	Existing MRTS	Re-route overlap	Phase I
6	Angamaly-Thoppumpady	Existing MRTS	Re-route overlap	Phase I
7	Angamaly-Eloor	Existing MRTS	Re-route overlap	Phase I
8	Perumbavoor-Ernakulam South	Existing MRTS	Re-route overlap	Phase I
9	Infopark-Aluva	Existing MRTS	Re-route overlap	Phase I
10	Aluva Pvt. BS-Chittoor Ferry	City Bus Service	Re-route overlap	Phase I
11	Cherukara-Kaloor Pvt. BS	City Bus Service	Re-route overlap	Phase I
12	Eloor Depot-Thripunithura	City Bus Service	Re-route overlap	Phase I
13	Eramalloor-North Paravoor	City Bus Service	Re-route overlap	Phase I
14	High Court Jn.-Puzhakkaredath	City Bus Service	Re-route overlap	Phase I
15	Kadannoth Jn.-Thevara Jn	Existing MRTS	Re-route overlap	Phase I
16	Kaloor Pvt. BS-Koothattukulam	City Bus Service	Re-route overlap	Phase I
17	Kaloor Pvt. BS-Moothakunnam	City Bus Service	Re-route overlap	Phase I
18	Kaloor Pvt. BS-Piravom	City Bus Service	Re-route overlap	Phase I
19	Kaloor Pvt. BS-Thalayolaparambu	City Bus Service	Re-route overlap	Phase I
20	Malavana Ferry-North Paravur	City Bus Service	Re-route overlap	Phase I
21	North Paravur-Kadathu Kadavu	City Bus Service	Re-route overlap	Phase I
22	Pizhalakadavu-Malavana Ferry	City Bus Service	Re-route overlap	Phase I
23	Ponkunnam BS-Kaloor Pvt. Bs	City Bus Service	Re-route overlap	Phase I
24	Puthukalavattam -Thripunithura	City Bus Service	Re-route overlap	Phase I
25	South Chittoor-Thripunithura	City Bus Service	Re-route overlap	Phase I
26	Thevara Jn-Puthuvankunnu	Existing MRTS	Re-route overlap	Phase I
27	Thripunithura-Irumpanam C	Proposed MRTS	Re-route overlap	Phase I
28	Aluva-Angamaly	Proposed MRTS	Re-route overlap	Phase II
29	Angamaly-Thripunithura	Proposed MRTS	Re-route overlap	Phase II
30	Piravom-Angamaly	Proposed MRTS	Re-route overlap	Phase II

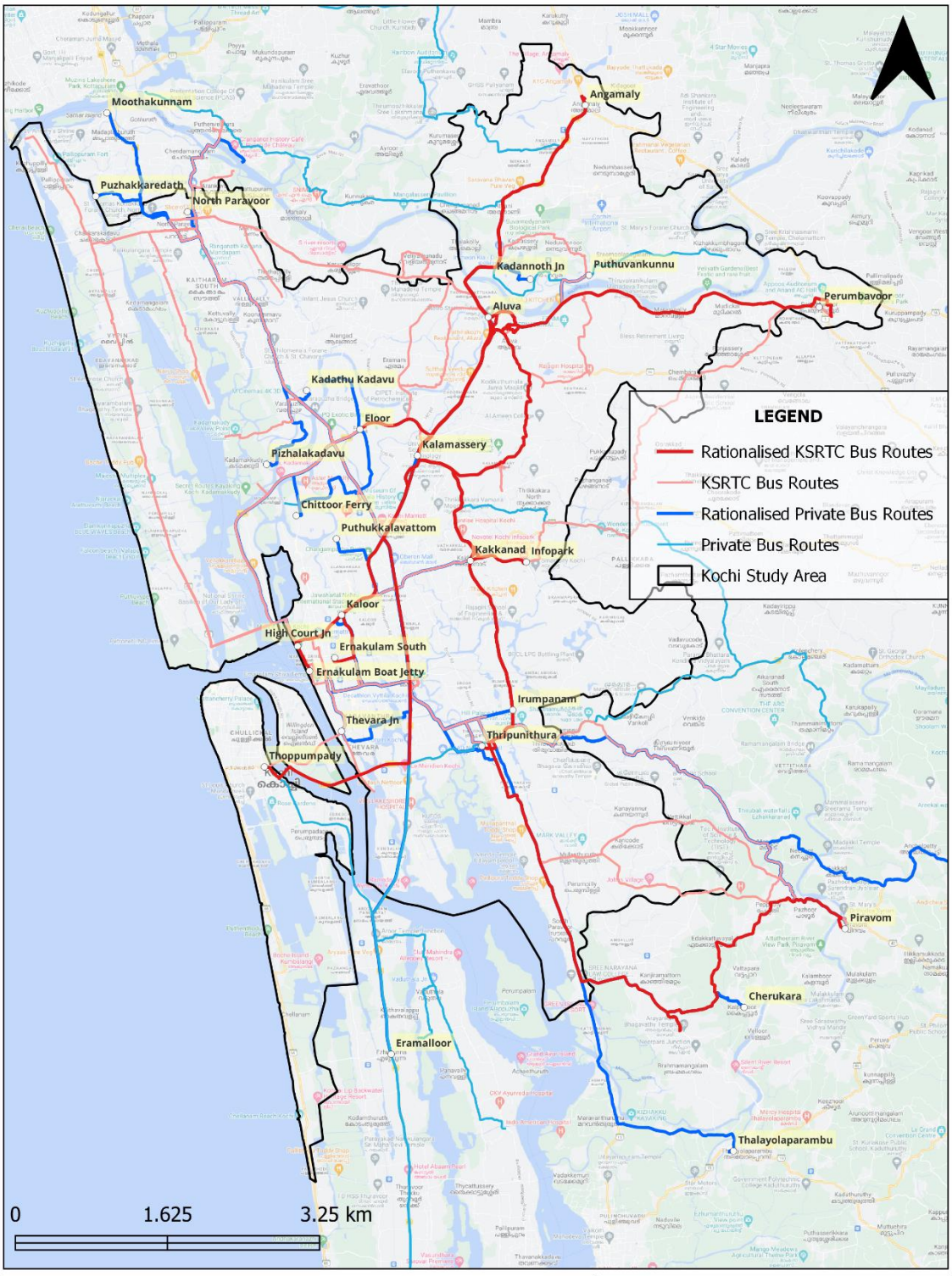


Figure 132 Rationalised Bus Routes

8.3.3 NEW CITY BUS ROUTES

Apart from the bus route rationalization it is suggested to enhance the feeder services along the existing and proposed metro corridor in a phased manner. Circular services are proposed connecting the metro stations to the nearest residential and activity centres.

Table 78 Proposed Feeder Services

SN	ROUTE NAME	PHASE
1	Thottakkattukara Jn - East Kadungalloor - Elookkara - Uliyannoor Rd - NH 544	PHASE I
2	Aluva Jn - Pump Jn - Mahilalayam Jn - Mangalapally Jn - Desom Jn - NH 544	PHASE III
3	SN Junction - NH 85 - Irumpanam Junction - Seaport Airport Road - Irumpanam Eroor Road	PHASE II
4	NH 85 - SH 15 - Statue Junction - Vadakkekotta Junction	PHASE II
5	NH 85 - SH 15 - Mini Bypass Thripunithura Road - NH 85	PHASE I
6	SH 15 - NH 85 - Kundannur - NH 66 - Chambakkara Kannadikadu Road	PHASE I
7	SH 15 - Chambakkara Kannadikadu Road - NH 66 - Church Road	PHASE I
8	Vyttila - SH 15 - Church Road - Janatha Road - Janatha Junction - SH 15	PHASE I
9	Janatha Jn - Tank Bund Rd - Amalabhavan Rd - Kadavanthra - SH 15	PHASE I
10	Kadavanthra Jn - Kallupalam Jn - Chakkola Jn - Thevara Jn - Pallimukku Jn - SH 15	PHASE I
11	South Metro - Pallimukku - Foreshore Road - TDM Hall - South Metro	PHASE I
12	Maharaja College Metro - Chittoor Road - TDM Hall - Park Ave - KPCC Junction - Metro Station	PHASE I
13	Maharajas College Metro - KPCC Junction - Market Road - Shanmugham Road - Banerjee Road - MG Road	PHASE I
14	Vyttila - Mathoor - NH 85 - SH 15	PHASE I
15	Vyttila - Mathoor - Puthiya Road - NH 66	PHASE I
16	SH 15 - Kaloor Kadavanthra Road - Thammanam Junction - Chakkaraparambu - NH 66 - Vyttila	PHASE I

SN	ROUTE NAME	PHASE
17	Ernakulam South - Kadavanthra Jn - Kumaranasan Jn - Mahatma Gandhi Rd	PHASE I
18	Changampuzha Park - Madam Jn - Perandoor Jn - Pottakuzhi - Mamangalam Jn	PHASE I
19	Town Hall Metro - Golden Jubilee Road - SRM Road - High Court - Banerjee Road	PHASE I
20	Banerjee Road - Golden Jubilee Road - SRM Road - Pottakuzhy Road - Perandoor Road	PHASE I
21	Mamangalam Jn - Pottakuzhi - Kaloor Jn - Palarivattom Jn	PHASE I
22	Banerji Road - Mahakavi Vailoppilli Road - Thammanam Junction - Kaloor Junction	PHASE I
23	Palarivattom Jn - Civil Line Rd - NH 66 - Anchumana Temple Rd - Mamangalam Jn	PHASE II
24	Pipeline Jn - Kakkanad - Seaport Airport Rd - Thrikkakara Temple Jn - Parutheli Jn - Edapally	PHASE II
25	VP Marakkar Rd - Vattekunnam Rd - NH 66 - Edapally - NH 544	PHASE I
26	Edapally - NH 66 - Juwan Cross Rd - Ponekkara - Changampuzha Park - Edapally	PHASE I
27	Kalamasserry Town Hall - VP Marakkar Rd - NH 544	PHASE I
28	Toll Jn - Parutheli Jn - Thrikkakara Temple Jn - Kinder Hospital - NH 544	PHASE I
29	Kalamasserry - Eloor - Manjummel - TVS Road - NH 544	PHASE I
30	TVS Road - Manjummel - Kunnumpuram Jn - Indiraji Bridge Rd - VP Marakkar Rd - Kalamasserry Town Hall	PHASE I
31	Companypady Jn - Pathalam Jn - Aanavathil Jn - Kalamasserry - NH 544	PHASE I
32	Companypady Jn - Pathalam Jn - Muppathadam Jn - Elookkara - Uliyannoor Rd - NH 544	PHASE I
33	Kinder Hospital - Thrikkakara Temple Jn - Seaport Airport Rd - HMT Rd - Kalamasserry - NH 544	PHASE I
34	Kalamasserry Metro - HMT Road - HMT School - Pipeline Road - NAD Road	PHASE I
35	Pulinchodu - Hospital Jn - Pump Jn - Aluva Jn - NH 5444	PHASE I
36	Seaport Airport Road - Infopark Expy - Infopark Road - SH 41	PHASE II
37	Seaport Airport Road - Thuthiyoor Road - Palachuvadu - Padamugal - SH 41	PHASE II

SN	ROUTE NAME	PHASE
38	Seaport Airport Road	PHASE II
39	Infopark Road - Smart City Road - LuLu IT Tower - MariApps - Smart City Substation	PHASE II
40	Paravoor Jn - UC Kaniyankunnu Jn - East Kadungalloor Jn - Thottakkattukara Jn - NH 544	PHASE III
41	Desom Jn - Chowara - Neduvannoor - Kaprassery - Desom	PHASE III
42	Chengamanadu - Kaprassery - Neduvannoor - Akaparambu - Athani - NH 544	PHASE III
43	Athani Jn - Chengamanadu - Panchayat Road - NH 544	PHASE III
44	Athani - Akaparambu - Nedumbassery - NH 544	PHASE III
45	Angamaly - Angamaly South - Aanappara Jn - Mallussery - Peechanikkad - SH 19	PHASE III
46	Angamaly South - Aanappara Jn - Athani Jn - Nh 544	PHASE III
47	Akaparambu - Nedumbassery - AJ Nagar - Angamaly - NH 544	PHASE III
48	Pulinchodu Metro - Nazareth Road - Manthrakkal Road - Pipeline Road - Kombara - NAD Road - SH 16	PHASE I
49	Irumpanam Junction - Chithrapuzha Road - Makalliyam Junction	PHASE III
50	Irumpanam Junction - Hill Palace Road - NH 85	PHASE III
51	SH 41 - Athani - Kollamkudimugal Road - Manathu Road - Kakkanad Jct Road	PHASE III
52	Seaport Airport Road - Manathu Road - Navodaya North - Edapally Pukkattupady Road	PHASE III
53	Seaport Airport Road - Edapally Pukkattupady Road - Kangarappady Medical College Road - HMT Road	PHASE III
54	Thripunithura - Hill Palace Rd - Karingachira Jn - Irumpanam Jn - SN Jn - East Fort Gate -	PHASE II
55	Infopark Metro - Cognizant - Member Padi Junction - Infopark Road	PHASE II

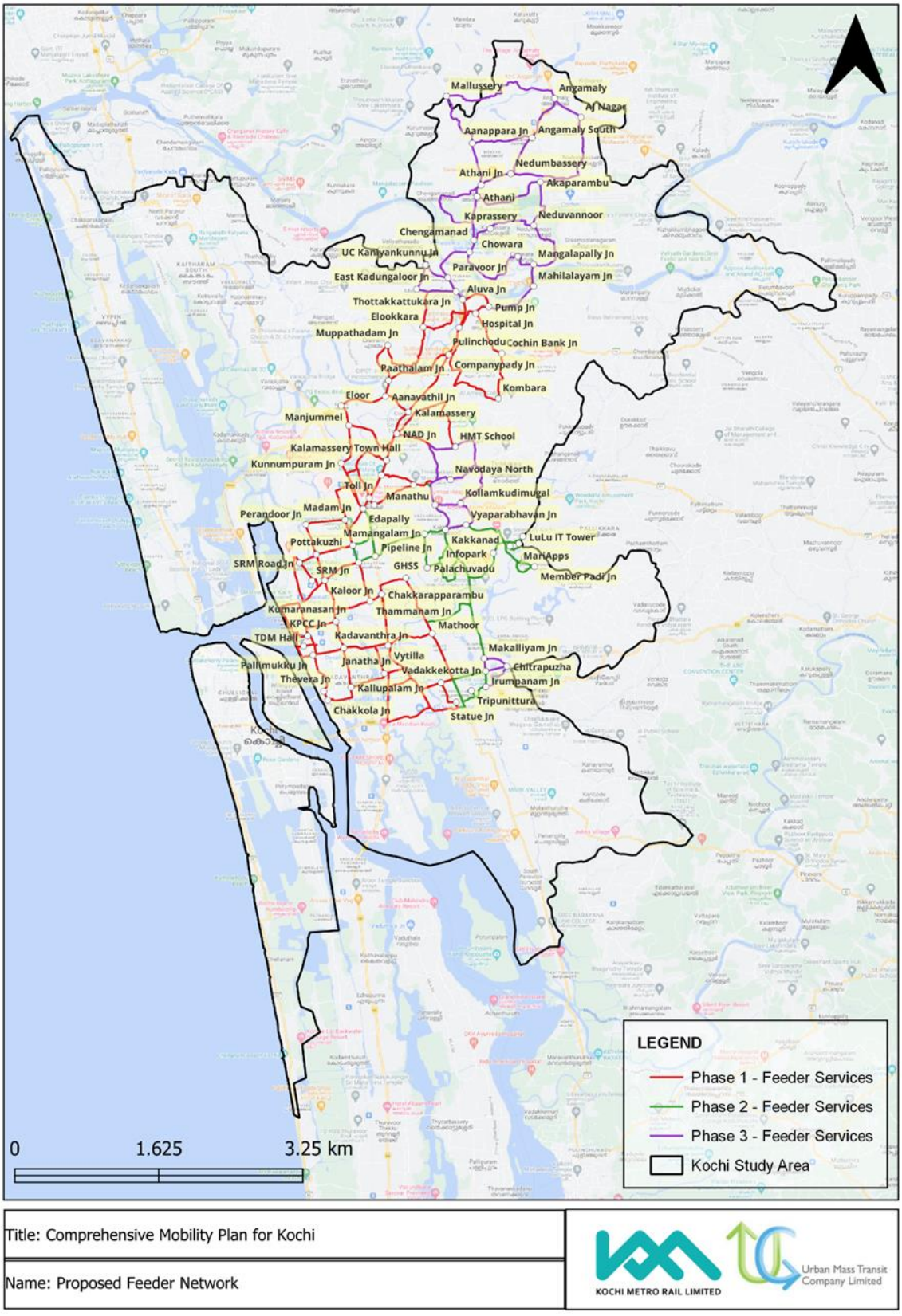


Figure 133 Proposed Feeder Network

8.3.4 BUS FLEET AUGMENTATION

Based on the route rationalization plan, new routes 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 MoHUA norms and demand is presented in the Table below:

Table 79 Fleet Requirement Over the Years

YEAR	POPULATION (in Lakhs)	EXISTING FLEET	RECOMMENDED FLEET	SCRAPPED BUSES	ADDITIONAL FLEET REQUIRED
2023	23.63	1027	1182		
2027	26.61		1331	133	437
2031	30.08		1504	150	190
2041	35.95		1798	180	324
2051	47.62		2381	238	641

8.3.5 INLAND WATER TRANSPORT

Inland Waterways are recommended on 3 routes in the study area and the details of the same are as presented below. This is apart from the 15 routes under implementation by KMRL.

Table 80 Water Metro Routes under Implementation

SN	ROUTE NAME	ROUTE	HEADWAY (MIN)	
			2025	2035
1	High Court - Fort Kochi	High Court - Vypeen - Fort Kochi	7	5
2	Vyttila - Infopark	Vyttila - Eroor - Kakkanad - Infopark	10	10
3	High Court - Mattancherry	High Court - Willingdon Island (Ferry side) - Mattancherry	9	5
4	Ernakulam - Moolampilly	Ernakulam - High Court - Bolgatty - Thanthoninthuruth - Ponnarimangalam - Mulavukad Hospital - Mulavukad Panchayat - Mulavukad North - Korumkotta - S Chittoor - Moolampilly	8	5
5	High Court - Kumbalam	High Court - Ernakulam - Thevara - Nettoor - Kumbalam	7	5

SN	ROUTE NAME	ROUTE	HEADWAY (MIN)	
			2025	2035
6	Fort Kochi - Mattancherry	Fort Kochi - Willingdon Island (Ferry side) - Mattancherry	28	15
7	Ernakulam - Vypeen	Ernakulam - Embarkation - Fort Kochi - Vypeen	8	5
8	Edakochi - Vyttila	Edakochi - Kumbalam - Nettoor - Thykoodam - Vyttila	10	10
9	Edakochi - Vypeen	Edakochi - Thoppumpady - Mattancherry - Willingdon Island (Ferry Side) - Fort Kochi - Vypeen	8	8
10	Moolampilly - Cheranallur	Moolampilly - South Chittoor - Pizhala - Chennur - Kothad - Cheranallur	30	20
11	Cheranallur - Varappuzha	Cheranallur - Eloor - Varappuzha	30	20
12	Moolampilly - Njarackal	Moolampilly – S Chittoor - Pizhala - Paliyamthuruth - Kadamakkudy - Njarackal	30	30
13	Moolampilly - Thundathumkadavu	Moolampilly - S Chittoor - Pizhala - Cheriyamthuruth - Thundathumkadavu	30	30
14	Njarackal - High Court	Njarackal - Elamkunnapuzha - Mulavukad Viewpoint - High Court	20	20
15	Pizhala - Amrita Hospital	Pizhala - Aster Medicity - Amrita Hospital	30	30

Table 81 Potential Water ways

SN	ROUTES	PHASE
1	Edakochi – Aroor – Panangad – South Paravur	PHASE III
2	Kadamakkudy – Kottapuram	PHASE III
3	Varappuzha to CIAL/ Kalady	PHASE III

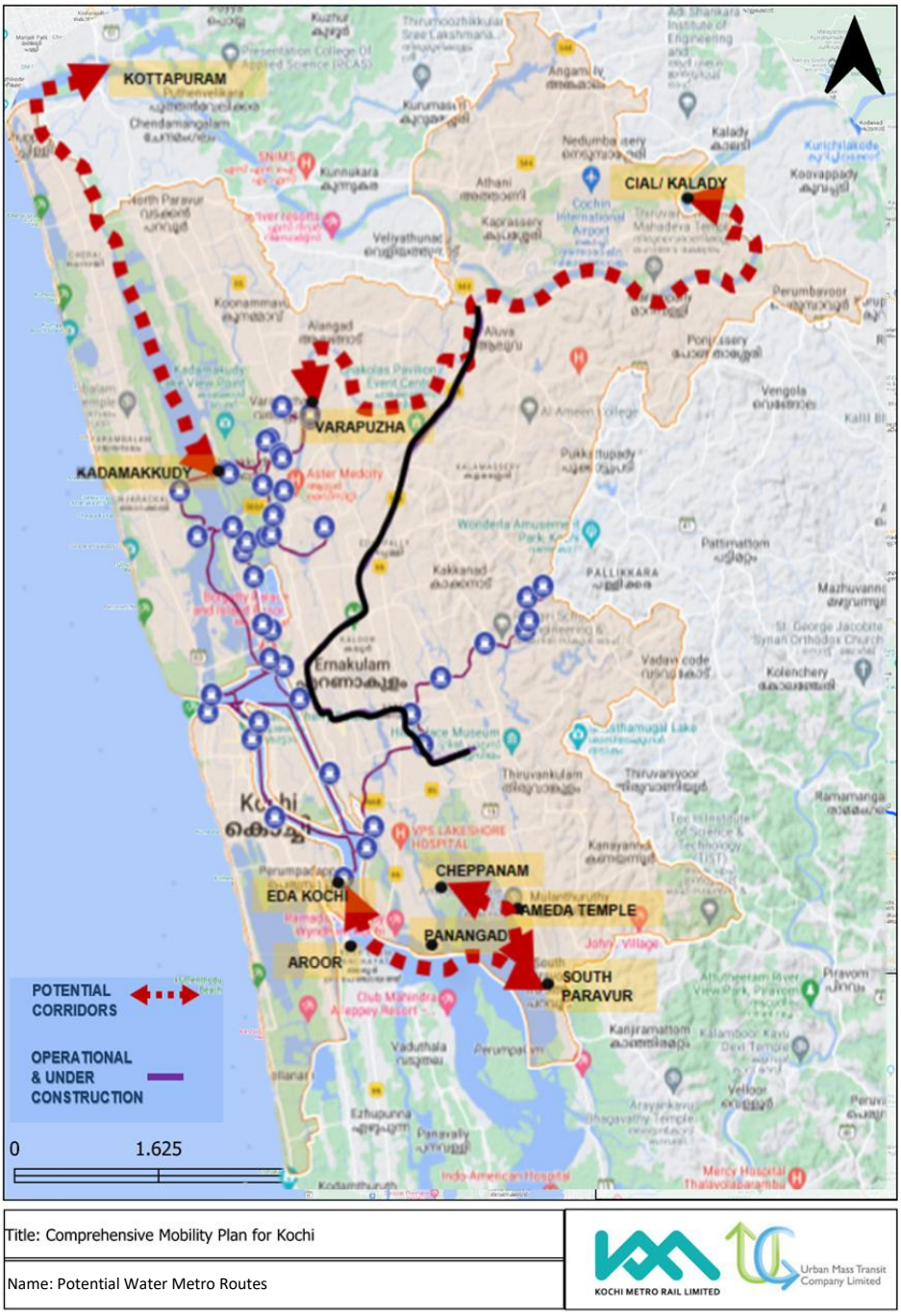


Figure 134 Potential Corridors Water Transport

8.3.6 PUBLIC TRANSPORT TERMINALS

It is also recommended for the de-centralization of sub-urban services for the city centre and terminate services at the peripheral terminals. This is recommended for KSRTC and City services, creating a Hub and Spoke model between major hubs and minor hubs for city and

suburban services. The proposed typology of the stations is suggested in the table below along with status of the stations.

Table 82 Typology of the Public Bus Terminals

SN	NAME	STATUS	TYPOLOGY	TYPE	PHASE
26.	Aluva KSRTC Stand	Existing	Terminal - City	Major	
27.	Angamaly KSRTC Stand	Existing	Terminal - Sub Urban (North)	Major	
28.	Chilavannoor	Proposed	Station	Minor	Phase II
29.	CIAL	Proposed	Station	Minor	Phase II
30.	Edakochi	Proposed	Station	Minor	Phase II
31.	Ernakulam Boat Jetty	Existing	Station	Minor	
32.	Fort Kochi	Existing	Station	Minor	
33.	High Court	Proposed	Terminal - City	Major	Phase II
34.	Kaloor Private Bus Stand	Existing	Station	Minor	
35.	Karikkamuri KSRTC Terminal	Proposed	Terminal - City	Major	Phase II
36.	Konthuruthy	Proposed	Station	Minor	Phase II
37.	Kumbalam	Proposed	Terminal -Sub Urban (South)	Major	Phase II
38.	Mattancherry	Existing	Station	Minor	
39.	North Paravur Bus Stand	Existing	Terminal	Major	
40.	Perumbavoor KSRTC Terminal	Existing	Terminal - Sub Urban (North-East)	Major	
41.	Perumbavoor Pvt. Bus Stand	Existing	Terminal - City	Major	
42.	Perumpadappu	Proposed	Station	Minor	Phase II
43.	Puthukalavattam	Proposed	Station	Minor	Phase II
44.	Thevara Ferry	Proposed	Station	Minor	Phase II
45.	Thrikkakara Pvt. Bus Stand	Existing	Station	Major	
46.	Thripunithura Pvt. Stand	Existing	Terminal – Sub Urban (South-East)	Minor	
47.	Thripunithura Bus Terminal	Proposed	Terminal – City	Major	Phase II
48.	Vaduthala	Proposed	Station	Minor	Phase II
49.	Vyttila Mobility Hub	Existing	Terminal - Sub Urban (East)	Major	
50.	Vyttila Mobility Hub	**Extension**	Terminal - City	Major	Phase II

Title: Comprehensive Mobility Plan for Kochi	
Map:Bus Terminals	

Figure 135 Typology for Bus Stations

8.3.7 MULTI-MODAL MOBILITY 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 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 has 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 Hubs and integration of modes are also recommended for easing out the transfers across various transit modes. The details are as presented below,

Table 83 Multi-modal mobility Hubs

SN	NAME	TYPOLOGY	CONNECTIVITY	CATEGORY	PHASE
18.	Aluva	Multi Modal	Bus (City & Regional) + Metro	Major	Phase II
19.	Angamaly	Multi Modal	Metro + Bus	Major	Phase II
20.	CIAL	Multi Modal	Metro + Air + Bus	Major	Phase II
21.	High Court	Multi Modal	Water + Bus + Metro (Through Walkway)	Major	Phase II
22.	Thripunithura	Multi Modal	Metro + Rail + Bus	Major	Phase II
23.	Vyttila	Multi Modal	Metro + Water + Bus (City & Regional)	Major	Phase II (Extension)
24.	Smart City	Multi Modal	Metro + Bus + Water	Major	Phase II
25.	Cheranallur	Interchange	Water + Bus	Minor	Phase II
26.	Chittethukara	Interchange	Metro + Water + Bus	Minor	Phase II
27.	Ernakulam Jetty	Interchange	Water + Bus	Minor	Phase II
28.	Ernakulam South	Interchange	Metro + Rail + Bus	Minor	Phase II
29.	Ernakulam Town	Interchange	Metro + Rail + Bus	Minor	Phase II
30.	Fort Kochi	Interchange	Water + Bus (City) + Ro-Ro	Minor	Phase II
31.	Kaloor	Interchange	Bus (City) + Metro	Minor	Phase II
32.	Mattancherry	Interchange	Water + Bus	Minor	Phase II
33.	Thevara	Interchange	Water + Bus	Minor	Phase II
34.	Vypin	Interchange	Water + Bus	Minor	Phase II

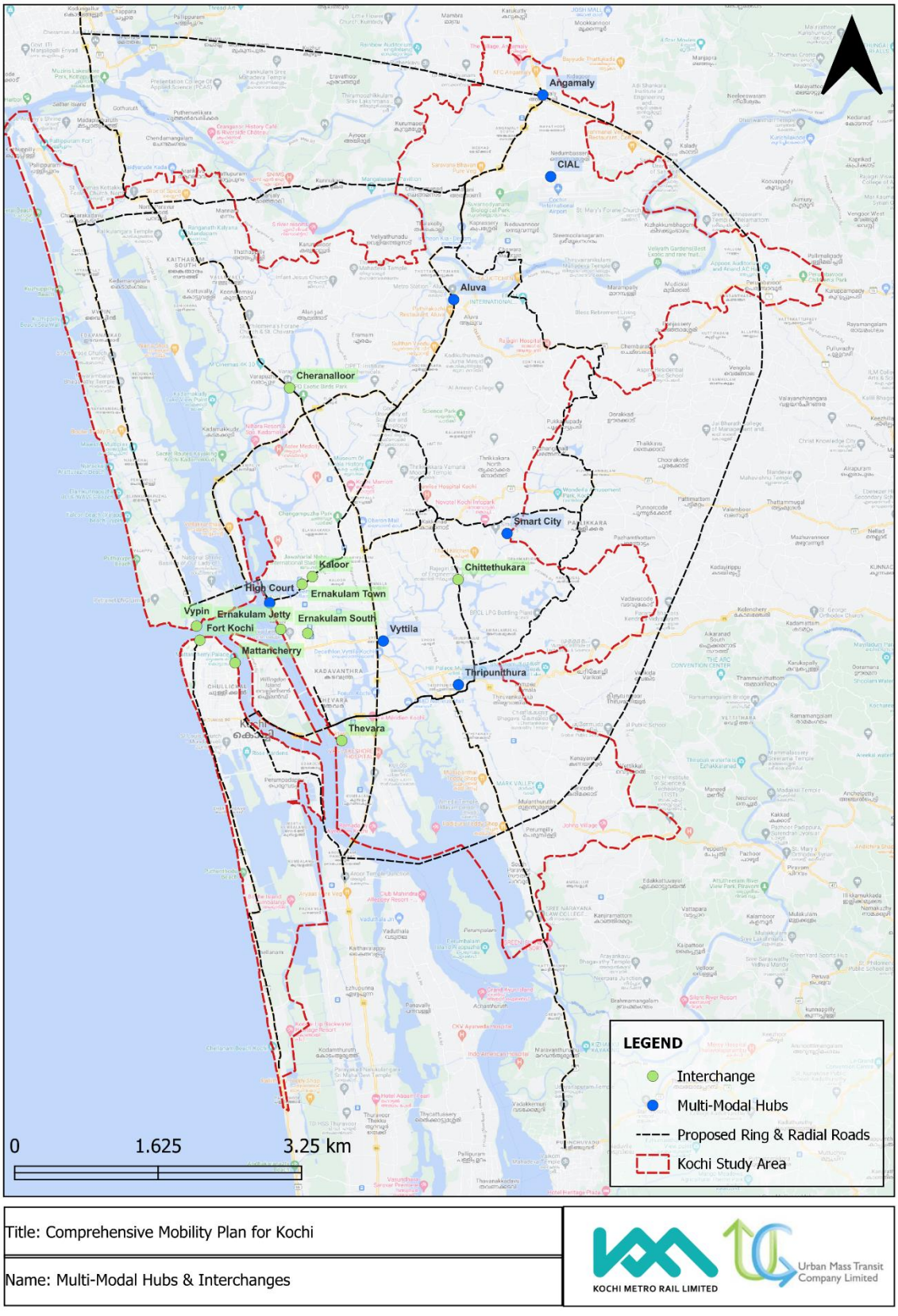


Figure 136 Connectivity - Hubs & Interchanges

8.4 INTERMEDIATE PUBLIC TRANSPORT STRATEGY

IPT modes of transport, such as auto-rickshaws and shared auto-rickshaws serve the mobility needs of 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.

Currently, 105 e-autos are acting as feeder services in the study area, 75 e-autos being owned by KMRL and 30 by Ernakulam Jilla Auto Rickshaw Drivers Cooperative Society (EJADCS). These autos act as feeders to Kochi Metro, while 15 charging points are provided by KMRL across 5 locations viz., Aluva, Kalamasserry, Kaloor, Edapally and Vyttila. In addition, 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 coordination with RTA and Traffic Police Departments. The infrastructure facilities shall include,

8.4.1 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 137 Proposed Halt and Go Stops

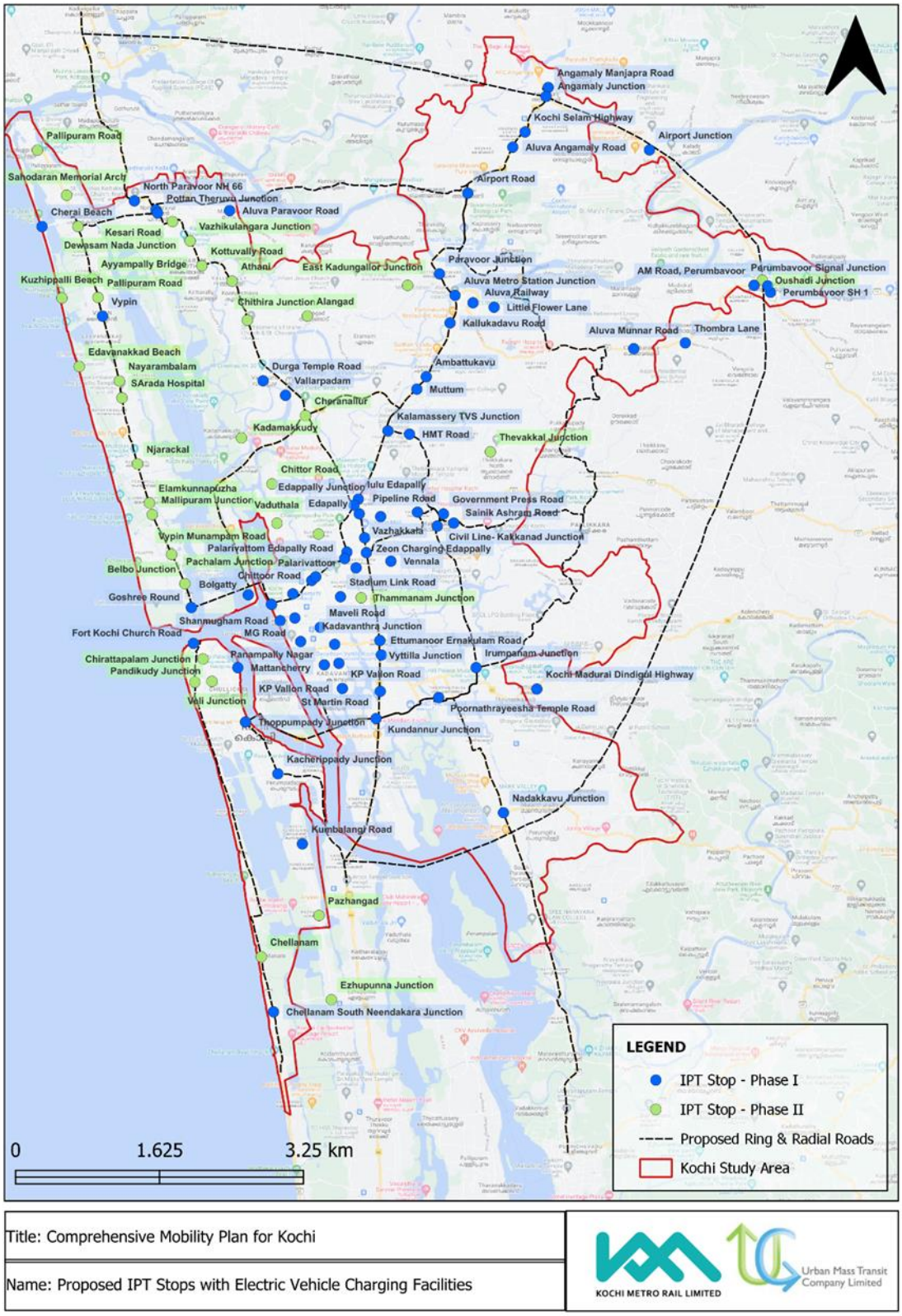


Figure 138 Proposed Halt and Go Stops with Electric Vehicle charging facilities.

Table 84 Proposed Halt and Go Stops with Electric Vehicle charging facilities for Three-seater auto rickshaw.

S N	NAME	NO. OF CHARGING SLOTS	PHASE
1	HMT Road	3	PHASE I
2	Vazhakkala	3	PHASE I
3	Sainik Ashram Road	3	PHASE I
4	Pipeline Road	5	PHASE I
5	Palarivattom	8	PHASE I
6	Pipeline Road	8	PHASE I
7	Stadium Link Road	8	PHASE I
8	Vennala	3	PHASE I
9	Ettumanur Ernakulam Road	5	PHASE I
10	KP Vallon Road	3	PHASE I
11	Government Press Road	3	PHASE I
12	Edapally	5	PHASE I
13	Zeon Charging Edapally	3	PHASE I
14	Palarivattom Edapally Road	8	PHASE I
15	Chittoor Road	5	PHASE I
16	MG Road	5	PHASE I
17	Panampally Nagar	8	PHASE I
18	Banerjee Road	5	PHASE I
19	Maveli Road	3	PHASE I
20	Poornathrayeesa Temple Road	3	PHASE I
21	St Martin Road	3	PHASE I
22	KP Vallon Road	3	PHASE I
23	Kochi Madurai Dindigul Highway	3	PHASE I
24	Kumbalangi Road	5	PHASE I
25	Bolgatty	5	PHASE I
26	Shanmugham Road	5	PHASE I
27	lulu Edapally	8	PHASE I
28	Aluva Munnar Road	3	PHASE I
29	Perumbavoor SH 1	8	PHASE I
30	Kallukadavu Road	3	PHASE I
31	Muttom	3	PHASE I
32	North Paravoor NH 66	3	PHASE I
33	NH 66 Paravoothara	3	PHASE I
34	Aluva Paravoor Road	3	PHASE I
35	Durga Temple Road	5	PHASE I
36	Ambattukavu	5	PHASE I
37	Little Flower Lane	5	PHASE I
38	Aluva Angamaly Road	5	PHASE I

S N	NAME	NO. OF CHARGING SLOTS	PHASE
39	Angamaly Manjapra Road	5	PHASE I
40	Thombra Lane	5	PHASE I
41	Kochi Selam Highway	3	PHASE I
42	Thevakkal Junction	3	PHASE II
43	Pallipuram Road	5	PHASE II
44	Sahodaran Memorial Arch	5	PHASE II
45	Cherai Beach	5	PHASE I
46	Oushadhi Junction	3	PHASE II
47	Kundannur Junction	5	PHASE I
48	Vyttila Junction	10	PHASE I
49	AM Road	5	PHASE I
50	Edapally Junction	10	PHASE I
51	Palarivattom Junction	5	PHASE I
52	High Court Signal Junction	8	PHASE I
53	Goshree Round	8	PHASE I
54	Kadavanthra Junction	13	PHASE I
55	Kacherippady Junction	8	PHASE I
56	Chellanam South Neendakara Junction	8	PHASE I
57	Jose Junction	8	PHASE I
58	Thoppumpady Junction	5	PHASE I
59	Pottan Theruvu Junction	8	PHASE I
60	Angamaly Junction	8	PHASE I
61	Aluva Metro Station Junction	5	PHASE I
62	Perumbavoor Signal Junction	8	PHASE I
63	Kaloor Junction	10	PHASE I
64	Irumpanam Junction	3	PHASE I
65	Civil Line- Kakkanad Junction	8	PHASE I
66	Kalamasserry TVS Junction	3	PHASE I
67	Airport Road	5	PHASE I
68	Airport Junction	8	PHASE I
69	Nadakkavu Junction	3	PHASE I
70	Cheranallur	8	PHASE II
71	Athani	3	PHASE II
72	Kesari Road	8	PHASE II
73	Vazhikulangara Junction	3	PHASE II
74	Kottuvally Road	8	PHASE II
75	Pallipuram Road	8	PHASE II
76	Ayyampally Bridge	3	PHASE II
77	Dewasam Nada Junction	3	PHASE II
78	Kuzhuppilly Beach	3	PHASE II
79	Vypin	3	PHASE I

S N	NAME	NO. OF CHARGING SLOTS	PHASE
80	Edavanakkad Beach	3	PHASE II
81	Nayarambalam	5	PHASE II
82	Sarada Hospital	3	PHASE II
83	Njarackal	5	PHASE II
84	Elamkunnapuzha	3	PHASE II
85	Mallipuram Junction	3	PHASE II
86	Vypin Munambam Road	3	PHASE II
87	Belbo Junction	3	PHASE II
88	Pachalam Junction	5	PHASE II
89	Vaduthala	3	PHASE II
90	Chittoor Road	5	PHASE II
91	Kadamakkudy	3	PHASE II
92	Vallarpadam	5	PHASE I
93	Chithira Junction	5	PHASE II
94	Alangad	3	PHASE II
95	Paravoor Junction	3	PHASE I
96	Fort Kochi Church Road	3	PHASE I
97	Chirattapalam Junction	3	PHASE II
98	Veli Junction	3	PHASE II
99	Pandikudy Junction	5	PHASE II
100	Mattancherry Ferry	5	PHASE I
101	Aluva Railway	10	PHASE I
102	East Kadungallur Junction	3	PHASE II
103	Pazhangad	3	PHASE II
104	Ezhupunna Junction	3	PHASE II
105	Chellanam	3	PHASE II
106	Keerthi Nagar Junction	3	PHASE II

8.4.1.1 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. Apart from these, the CMP proposes 106 new charging stations to establish a good coverage for Electric vehicle charging facilities. These are presented below.

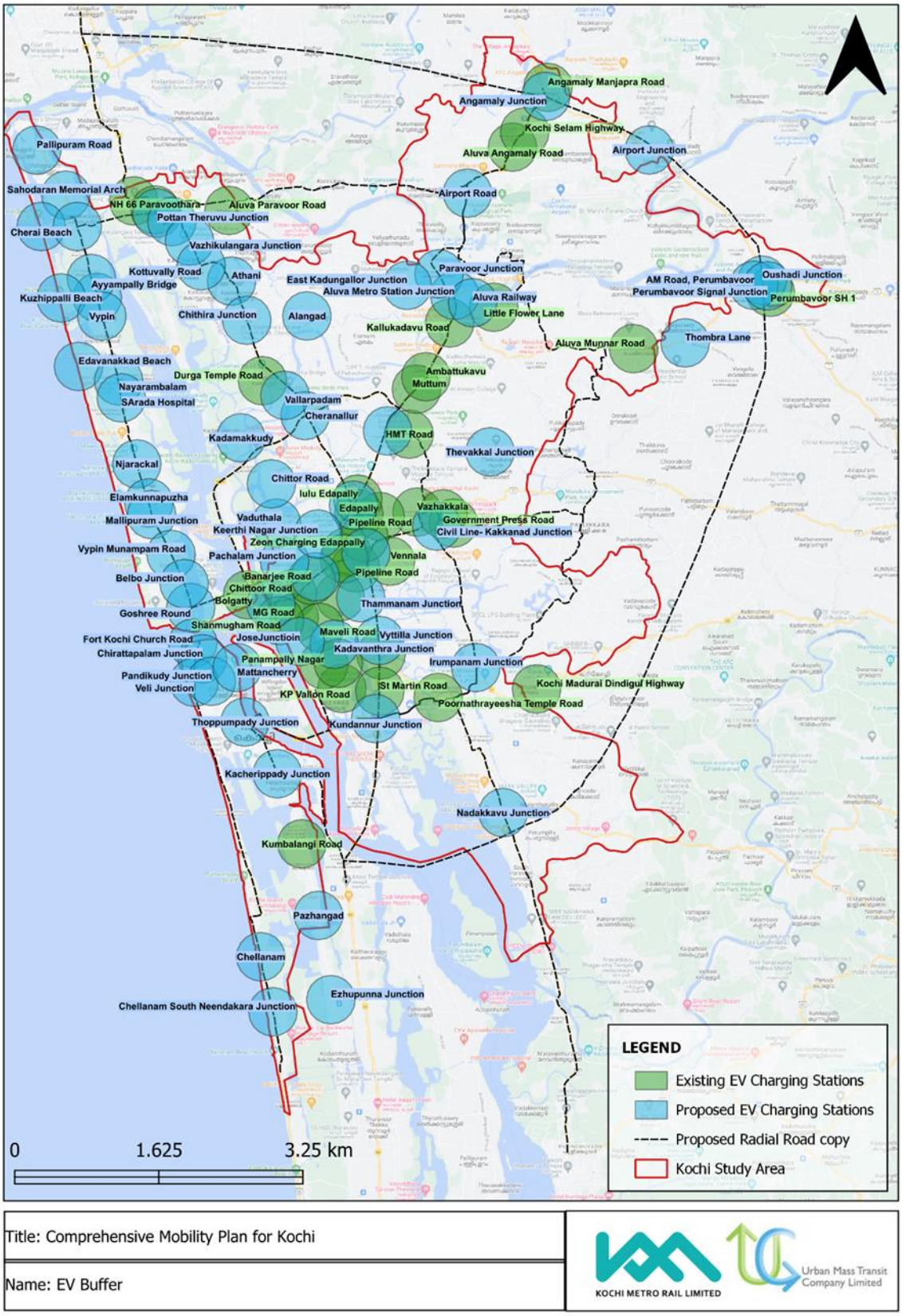


Figure 139 Charging Stations and the area covered.

8.5 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.

8.5.1 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 492 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 4.6 Km of pedestrian priority streets where pedestrian, NMT and public transport only allowed during the peak periods. The streets identified are the major corridors at Fort Kochi area and core city with high commercial and recreational 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 Kochi core city by the development agency.

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

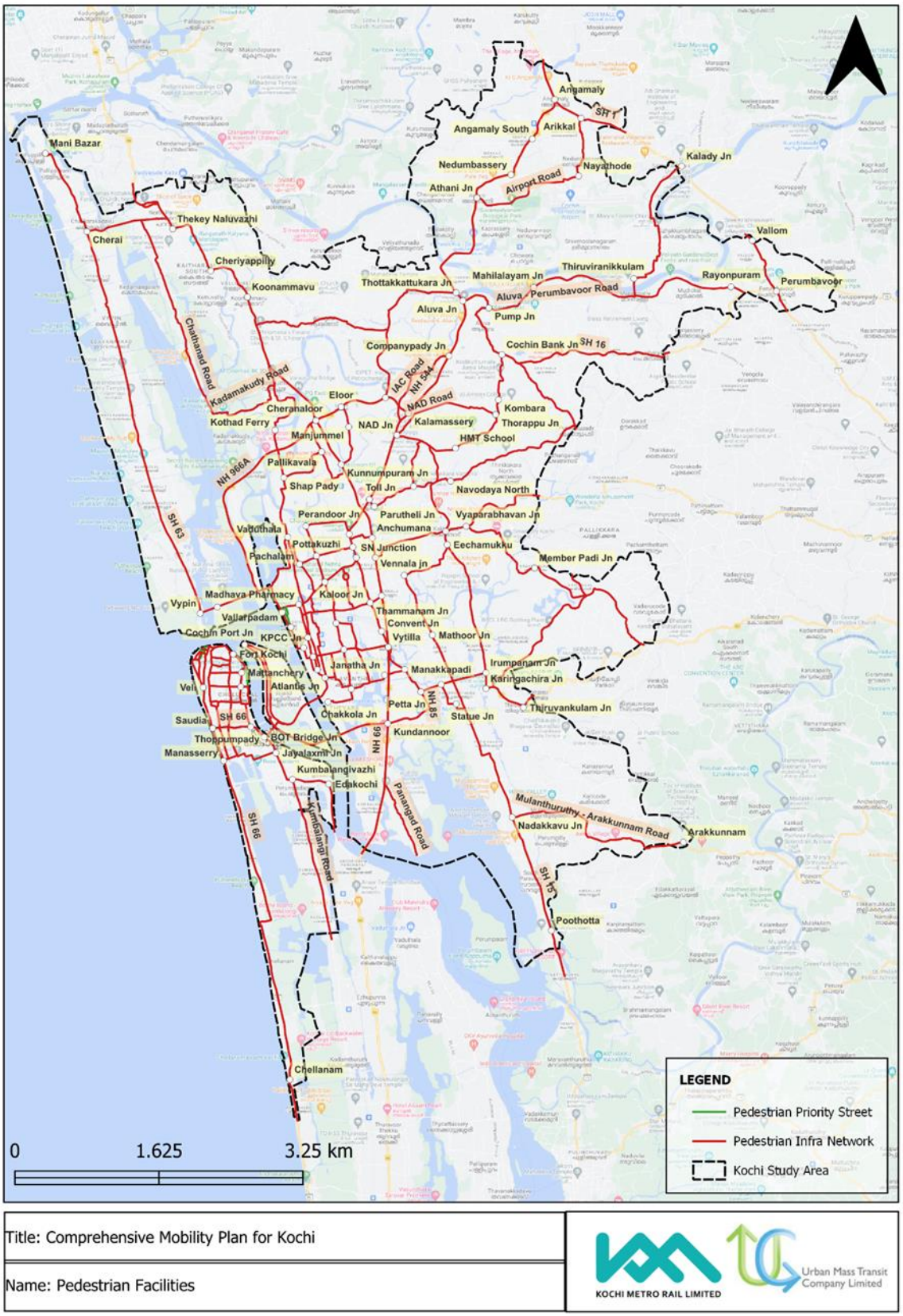


Figure 140 Proposed Pedestrian Network

Table 85 Corridors with Proposed Footpath

SN	Name	Length (Km)	Min. Footpath Width (M)
103	AG Milne Road	0.84	3
104	Airport Road	8.36	2
105	AK Xavier Road	0.46	2
106	Aluva - Perumbavoor Road	13.02	2
107	Aluva - Pukkattupady Road	4.25	2
108	Amalabhavan Road	0.94	2
109	Amaravati Road	1.84	2
110	Andamkulam - Kochangadi Road	0.94	2
111	Anjumana Road	1.14	2
112	Aroor - Thoppumpady Road	6.36	2
113	Aryad Athipozhi Road	1.48	2
114	Banerji Road	6.72	2.5
115	Bastian Street	0.26	2
116	Bazaar Road	1.89	2
117	Bellar Road	0.29	2
118	Bishop Kureethara Road	1.24	2
119	Bristow Road	3.69	3
120	Chathanad Road	9.76	2
121	Cheralai Road	1.42	2
122	Cheranallur Road	1.39	2
123	Chilavannur Road	1.66	2
124	Chithrapuzha - Karimughal Road	7.69	2
125	Chithrapuzha - Ponjassery Road	1.18	2
126	Chullickal Road	0.44	2
127	Church Road	0.76	2

SN	Name	Length (Km)	Min. Footpath Width (M)
128	Edapally - Thrikkakara Road	3.43	2
129	Edayaar - Kadungalloor Road	8.01	2
130	Elanjikkal Lane	0.37	2
131	Fathima Church Road	1.14	2
132	Goshree Road	3.41	2
133	Hill Palace Road	3.36	2
134	Hospital Road	0.67	2.5
135	IAC Road	4.43	2
136	Indira Gandhi Road	3.98	3
137	Infopark Road	7.59	2
138	Janatha Road	0.27	2
139	Kadamakkudy Road	3.93	2
140	Kalabhavan Road	0.76	2.5
141	Kalamasserry - Thorappu Road	5.71	2
142	Karippalam Road	0.84	2
143	KB Jacob Road	1.93	2
144	Kizhavana Road	0.47	2
145	KJ Herschel Road	3.59	2
146	Kochery Road	0.48	2
147	Kumaranasan Road	0.69	2
148	Kumbalangi Road	7.50	2
149	Mahakavi Vailoppilli Road	4.15	2
150	Mahatma Gandhi Road	5.45	3
151	Manikathu Road	1.08	2
152	Manjummel Road	2.99	2
153	Manthra Road	1.75	2

SN	Name	Length (Km)	Min. Footpath Width (M)
154	Meisthirippady - Eramam Road	6.52	2
155	Mohammad Abdul Rahman Road	1.01	2
156	Moulana Azad Road	2.98	2
157	Mulanthuruthy - Arakkunnam Road	9.05	2
158	Mundamveli Road	1.36	2
159	NAD Road	8.26	2
160	Nazareth Road	0.71	2
161	NH 544	25.01	2.5
162	NH 66	37.63	2
163	NH 85	9.53	2
164	NH 966 B	5.90	3
165	NH 966A	15.02	2
166	Old NH 47	2.57	3
167	Panampally Nagar Avenue	1.21	2
168	Panangad Road	3.67	2
169	Park Avenue	0.31	2.5
170	Pattarupadam Road	2.81	2
171	Pottakuzhi - Mamangalam Road	1.73	2
172	Pottakuzhy Road	0.86	2
173	Poysha Road	1.89	2
174	Pullupalam Road	0.86	2
175	Puthenpally - Chennur Road	4.49	2
176	Ravipuram - Kothad Road	11.63	2
177	Republic Road	3.72	2
178	S Chittoor Road	2.56	2
179	S Moolankuzhi Road	0.51	2

SN	Name	Length (Km)	Min. Footpath Width (M)
180	Sahodaran Ayyappan Road	3.49	2.5
181	Santo Gopalan Road	1.38	2
182	Seaport - Airport Road	11.35	2
183	SH 1	7.68	2
184	SH 15	19.30	2.5
185	SH 16	12.81	2
186	SH 41	8.88	2
187	SH 63	22.59	2
188	SH 66	22.24	2
189	Shanmugham Road	7.72	2
190	Shihab Thangal Road	0.51	2
191	SRM Road	2.52	2
192	St. Francis Church Road	0.40	2
193	Stadium Link Road	2.53	2
194	Statue Road	0.45	2
195	Swami Vivekananda Road	2.28	2.5
196	Tank Bund Road	1.11	2
197	Thammanam - Pullepady Road	3.89	2
198	Thevara - Edapally Road	11.87	2
199	Thuthiyoor - Eroor Road	8.25	2
200	Tower Road	0.28	2
201	Town Hall Road	0.64	2
202	Thrikkakara - Pukkattupady Road	7.35	2
203	University Road	2.30	2
204	Vadakkumbhagom - Marampally Road	7.74	2

Table 86 Proposed Pedestrian Priority Streets

SN	NAME	LENGTH (KM)
1	Veli Road	0.90
2	Basin Road	0.45
3	Broadway	0.89
4	Burger Street	0.18
5	Jew Town Road	0.86
6	Princess Street	0.29
7	Quiros Street	0.34
8	River Road	0.51
9	Rose Street	0.18

8.5.2 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.

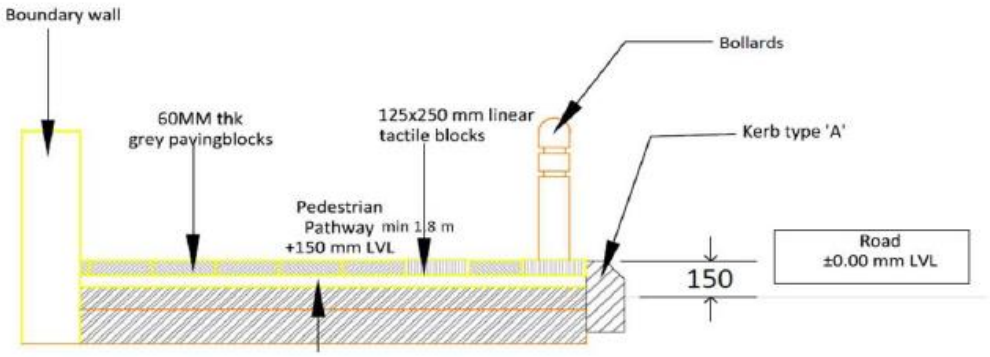


Figure 141 Detailed Cross-Section of Footpath

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

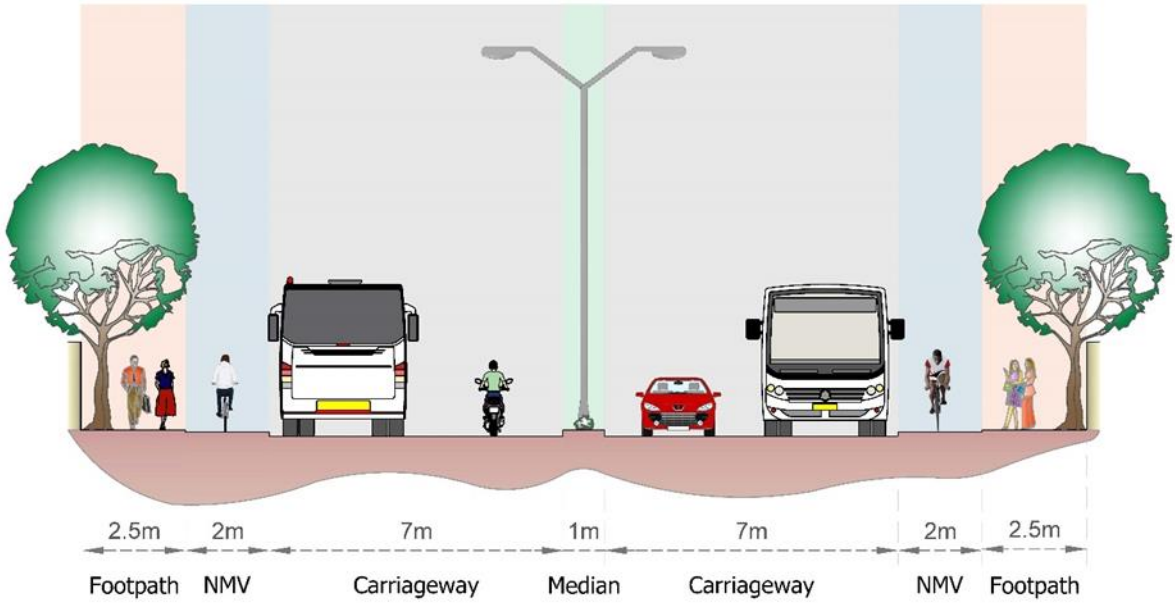


Figure 142 Typical Cross Section of 24m Wide Road with NMT

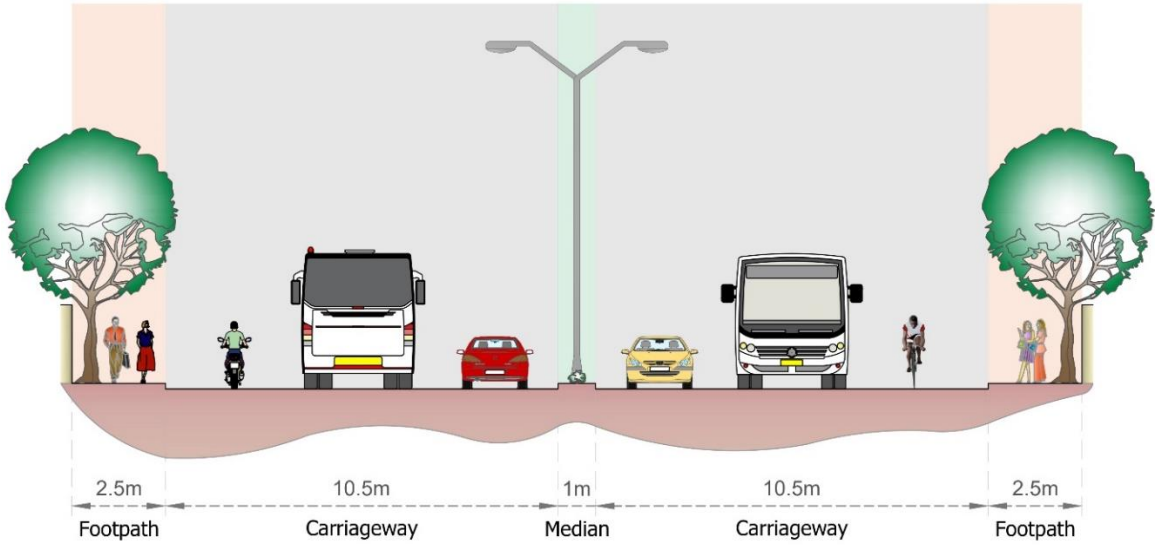


Figure 143 Typical Cross Section of 27m Wide Road with Footpath

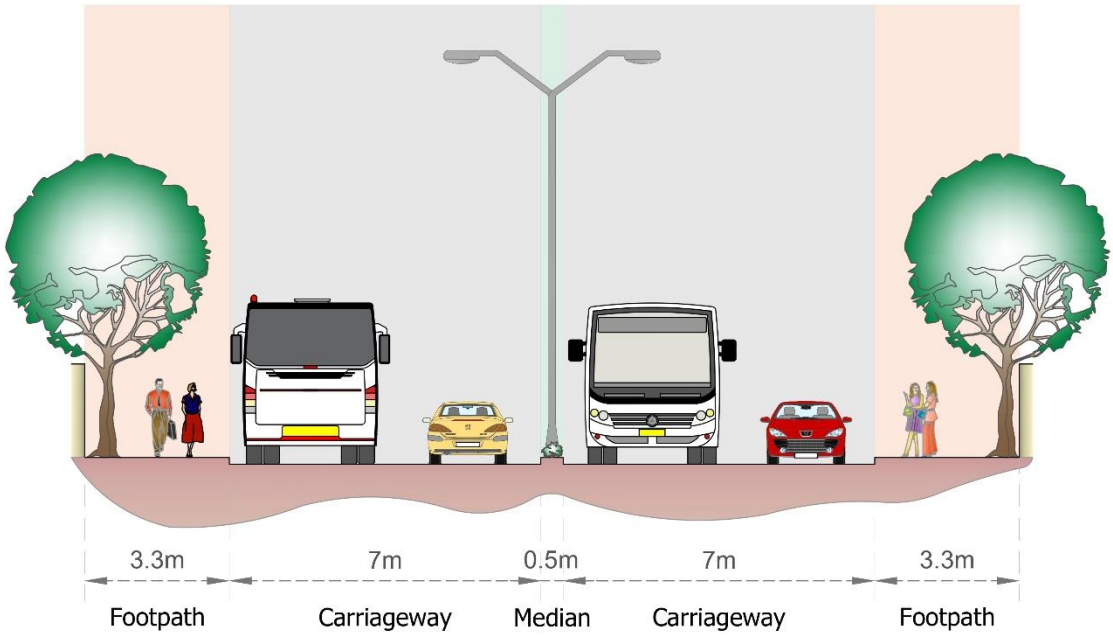


Figure 144 Typical Cross Section of 21m Wide Road with Footpath

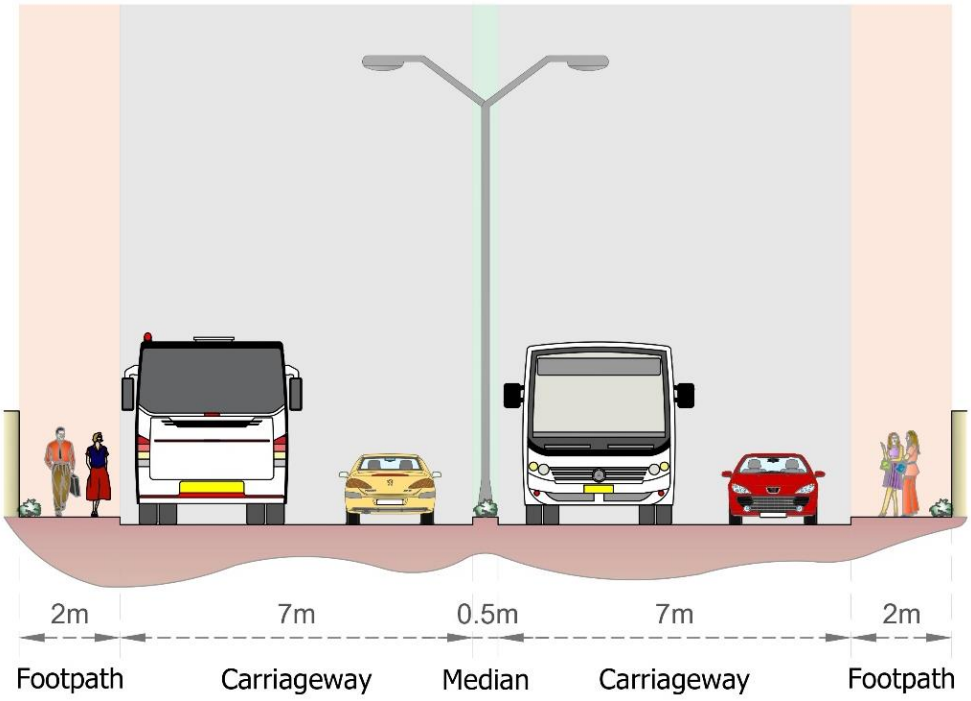


Figure 145 Typical Cross Section of 18.5m Wide Road with Footpath

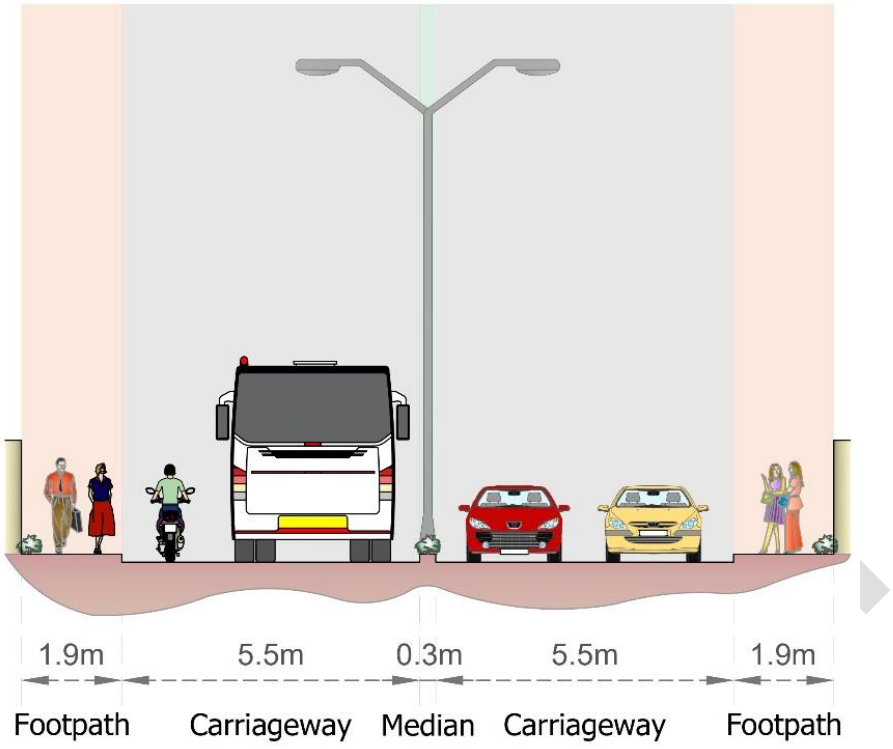


Figure 146 Typical Cross Section of 15m Wide Road with Footpath

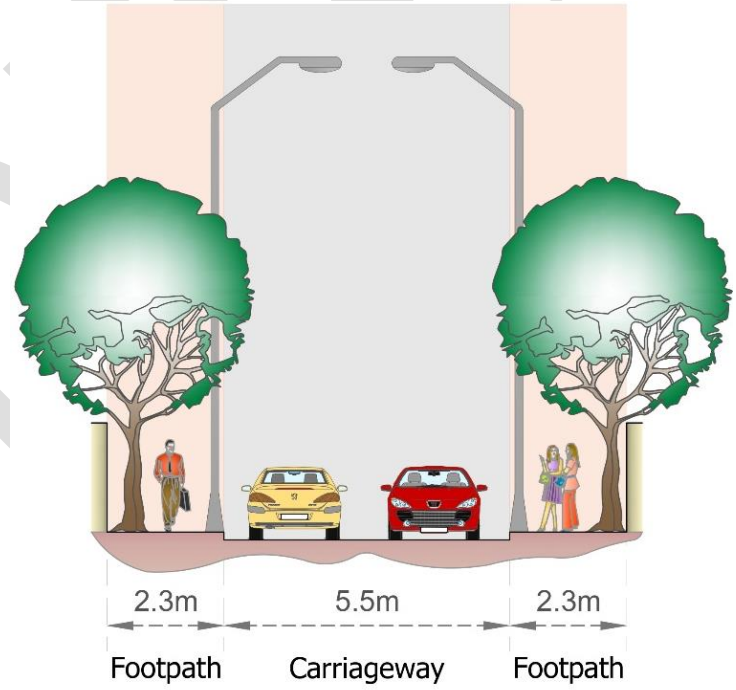


Figure 147 Typical Cross Section of 10m Wide Road with Footpath

8.5.3 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 Kochi 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 Kochi 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 287 Km of shared and dedicated bicycle network. As per the MoHUA guidelines, 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 for roads having width 18m & more and 12m to 18m respectively, based on site assessment.

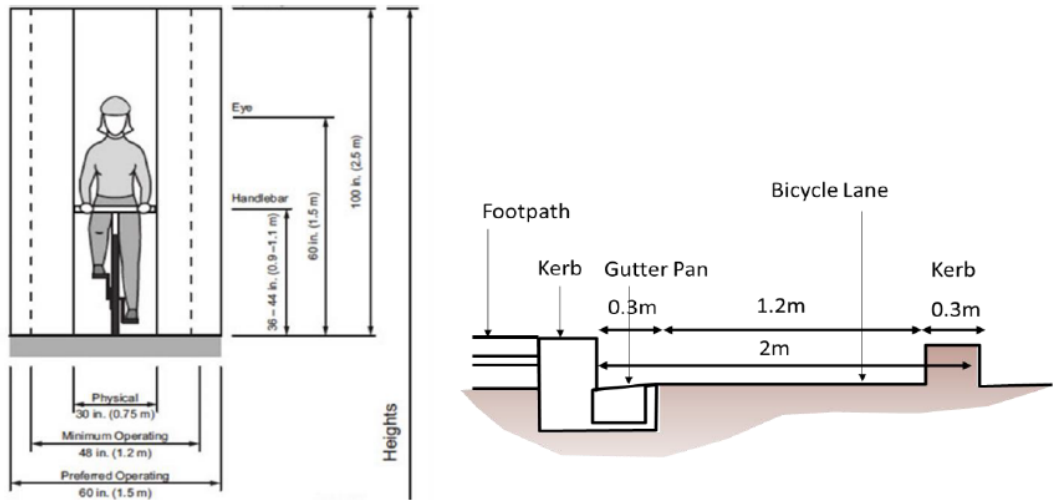


Figure 148 Proposed Bicycle Operating Widths

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 Kochi. Non-Motorized Vehicles (NMV) lanes can generally be classified into four main categories and are listed below. In case of Kochi, Non-Motorized Vehicles (NMV) lane typologies 1, 2 and 4 are suggested.

Table 87 Types of NMV Lanes

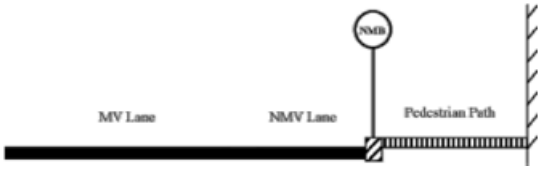
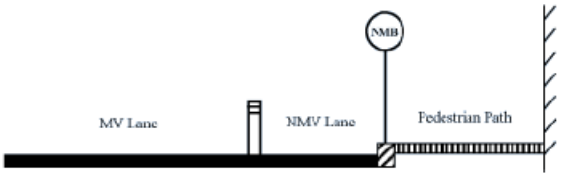
SN	Type of NMV Lane	Cross Section
1	NMV lanes shared with MVs and designated by signs	
2	NMV lanes designated by lane markings (e.g., striping) and within the highway right-of-way	
3	NMV-exclusive lanes physically separated from MVs by barriers (e.g., concrete blocks, steel railing, raised curb) and within the highway right-of-way	
4	NMV-exclusive lanes within an independent right-of-way (often referred to as NMV paths)	

Table 88 Proposed Corridors for Bicycle Infrastructure

SN	NAME	LENGTH	TYPOLOGY
1	AG Milne Road	0.84	1
2	AK Xavier Road	0.46	1
3	Amalabhavan Road	0.94	1
4	Amaravati Road	1.84	1
5	Andamkulam - Kochangadi Road	0.94	1
6	Anjumana Road	1.14	1
7	Aroor - Thoppumpady Road	6.36	1
8	Aryad Athipozhi Road	1.48	1
9	Banerji Road	6.72	2
10	Basin Road	0.45	4
11	Bastian Street	0.26	1
12	Bazaar Road	1.89	1
13	Bellar Road	0.29	1
14	Bishop Kureethara Road	1.24	1
15	Bristow Road	3.69	1
16	Broadway	0.89	4
17	Burger Street	0.18	4
18	Cheralai Road	1.42	1
19	Cheranallur Road	1.39	1
20	Chilavannur Road	1.66	1
21	Chullickal Road	0.44	1
22	Church Road	0.76	1
23	Elanjikkal Lane	0.37	1
24	Fathima Church Road	1.14	1
25	Goshree Road	3.41	2
26	Hospital Road	0.67	1
27	Indira Gandhi Road	3.98	1
28	Janatha Road	0.27	1

SN	NAME	LENGTH	TYPOLOGY
29	Jew Town Road	0.86	4
30	Kalabhavan Road	0.76	1
31	Karippalam Road	0.84	1
32	KB Jacob Road	1.93	1
33	Kizhavana Road	0.47	1
34	KJ Herschel Road	3.59	1
35	Kochery Road	0.48	1
36	Kumaranasan Road	0.69	1
37	Kumbalangi Road	7.50	1
38	Mahakavi Vailoppilli Road	4.15	1
39	Mahatma Gandhi Road	5.45	2
40	Manikathu Road	1.08	1
41	Manthra Road	1.75	1
42	Mohammad Abdul Rahman Road	1.01	1
43	Moulana Azad Road	2.98	1
44	Mundamveli Road	1.36	1
45	Nazareth Road	0.71	1
46	NH 544	25.01	1
47	NH 66	37.63	2
48	NH 85	9.53	2
49	NH 966 B	5.90	2
50	NH 966A	15.02	2
51	Old NH 47	2.57	2
52	Panampally Nagar Avenue	1.21	2
53	Park Avenue	0.31	2
54	Pattarupadam Road	2.81	1
55	Pottakuzhi - Mamangalam Road	1.73	1
56	Pottakuzhy Road	0.86	1
57	Poysha Road	1.89	1

SN	NAME	LENGTH	TYPOLOGY
58	Princess Street	0.29	4
59	Pullupalam Road	0.86	1
60	Quiros Street	0.34	4
61	Ravipuram - Kothad Road	11.63	1
62	River Road	0.51	4
63	Rose Street	0.18	4
64	S Chittoor Road	2.56	1
65	S Moolankuzhi Road	0.51	1
66	Sahodaran Ayyappan Road	3.49	1
67	Santo Gopalan Road	1.38	1
68	SH 15	19.30	1
69	SH 63	22.59	1
70	Shanmugham Road	7.72	2
71	Shihab Thangal Road	0.51	2
72	SRM Road	2.52	1
73	St. Francis Church Road	0.40	1
74	Stadium Link Road	2.53	2
75	Statue Road	0.45	1
76	Swami Vivekananda Road	2.28	1
77	Tank Bund Road	1.11	1
78	Thammanam - Pullepady Road	3.89	1
79	Thevara - Edapally Road	11.87	1
80	Tower Road	0.28	1
81	Town Hall Road	0.64	1
82	Veli Road	0.90	1
83	SH 66	2.63	1

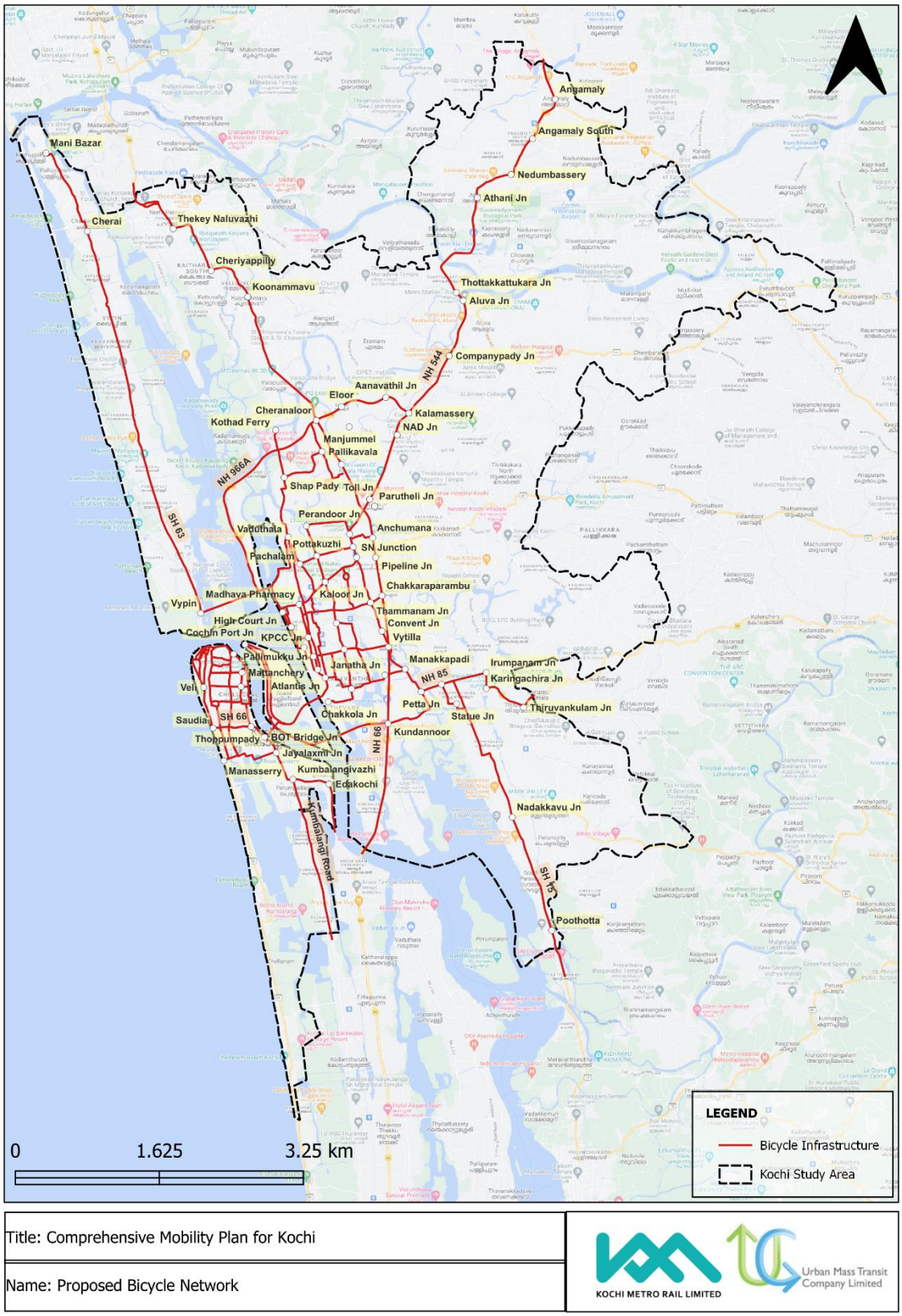


Figure 149 Proposed Bicycle Network for Improvement

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

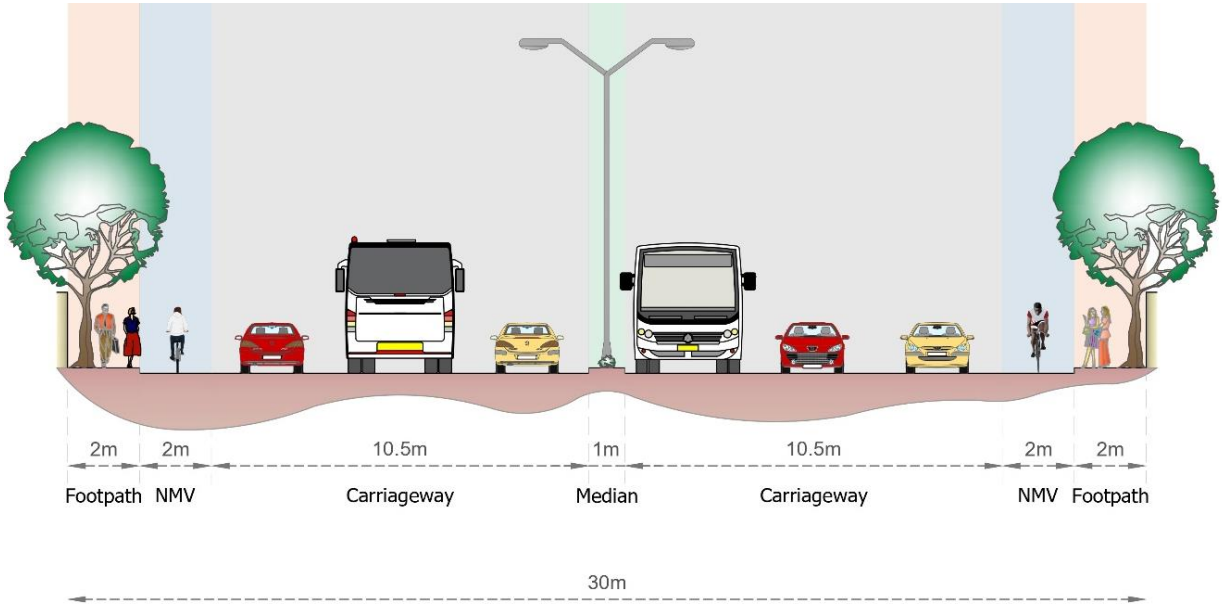


Figure 150 Typical Cross Section of 30m Wide Road with Bicycle Tracks

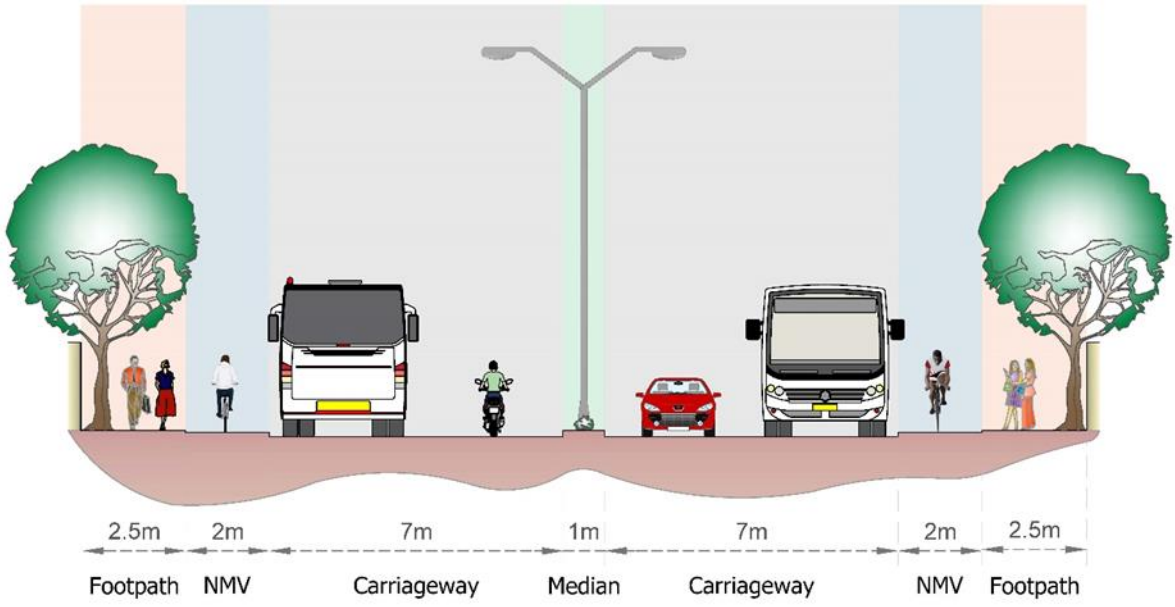


Figure 151 Typical Cross Section of 24m Wide Road with Bicycle Tracks

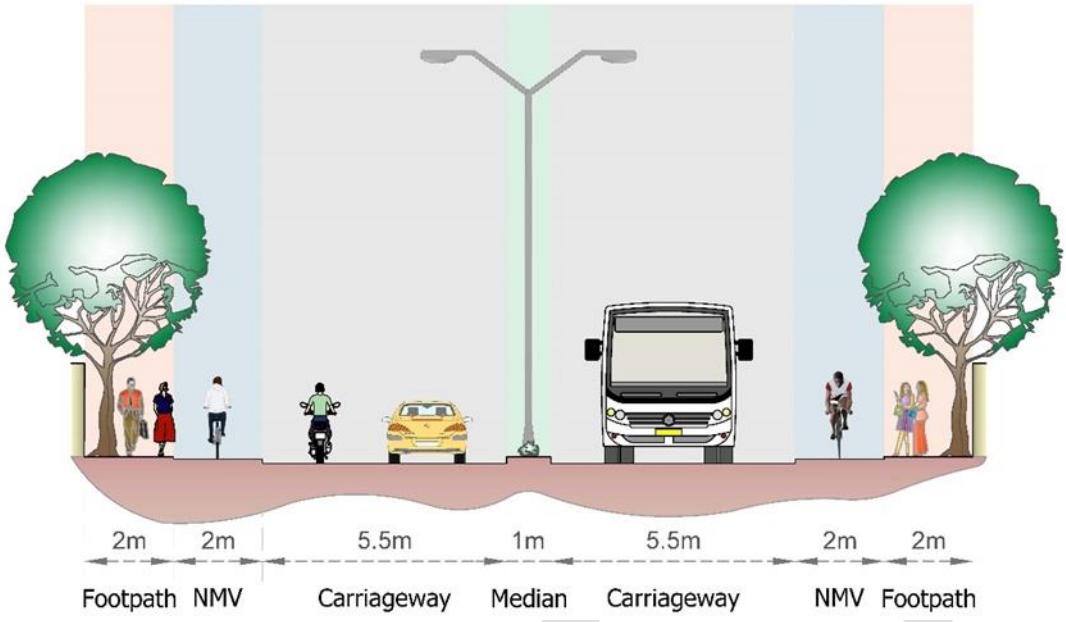


Figure 152 Typical Cross Section of 20m Wide Road with Bicycle Tracks

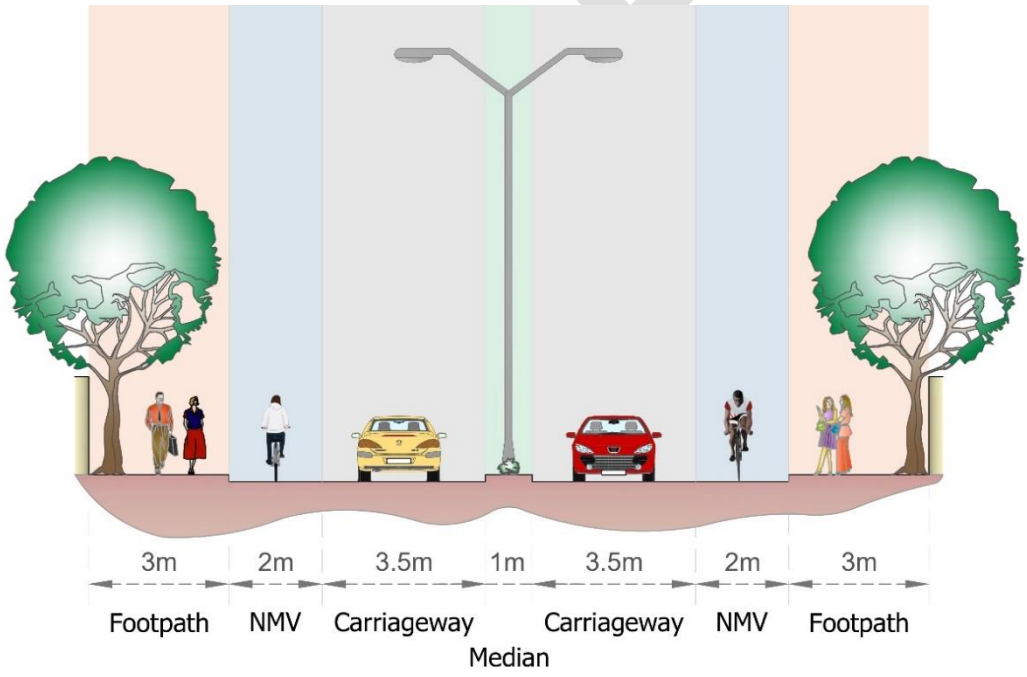


Figure 153 Typical Cross Section of 18m Wide Road with Bicycle Tracks

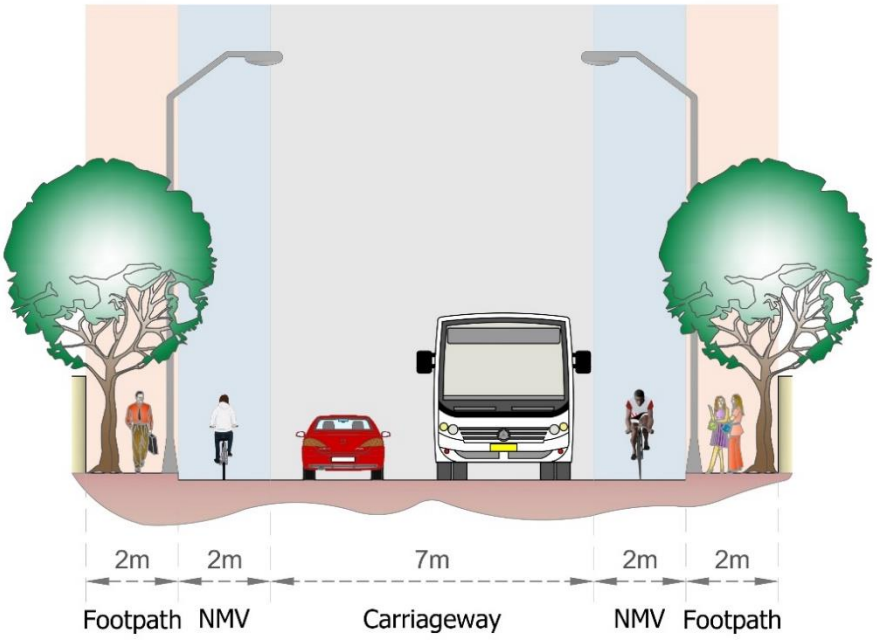


Figure 154 Typical Cross Section of 15m Wide Road with Bicycle Tracks

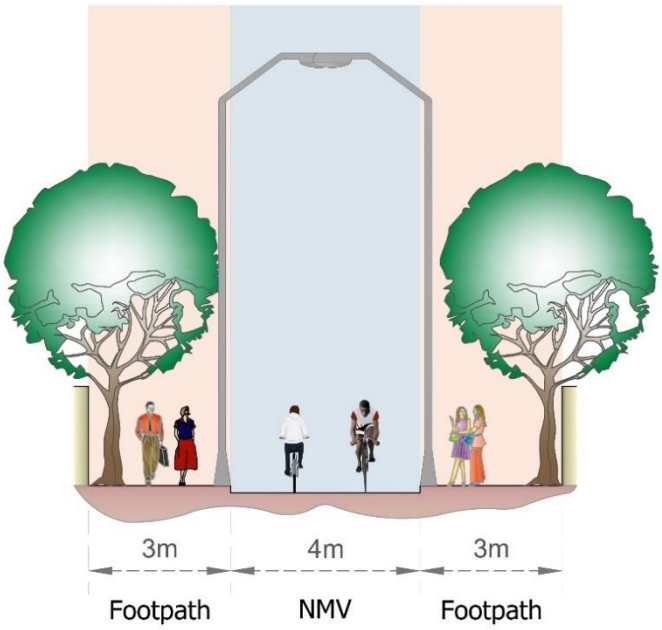


Figure 155 Typical Cross Section of 10m Wide NMT Priority Corridor

8.5.4 DEVELOPMENT OF RECREATIONAL BICYCLE CIRCUIT

To encourage the bicycle culture and induce it in the lifestyle of people in the city, it is proposed to develop bicycle circuit. This will help to promote healthy lifestyle and create a bicycling culture

in the city. Thus, to attract more people into the same, two bicycle circuits have been proposed under recreational bicycle circuit with a total length of 22 Km.

The recreational bicycle circuits are proposed at the areas with most attractions in the city, Fort Kochi area and Marine Drive. These two circuits connect some of the most visited places in the city viz., Fort Kochi Beach, Jawahar Park, Mattancherry Palace, Kerala Folklore Museum, Mangalavanam Bird Sanctuary, Queens Way Mangroves, Antique Museum Kochi, etc.

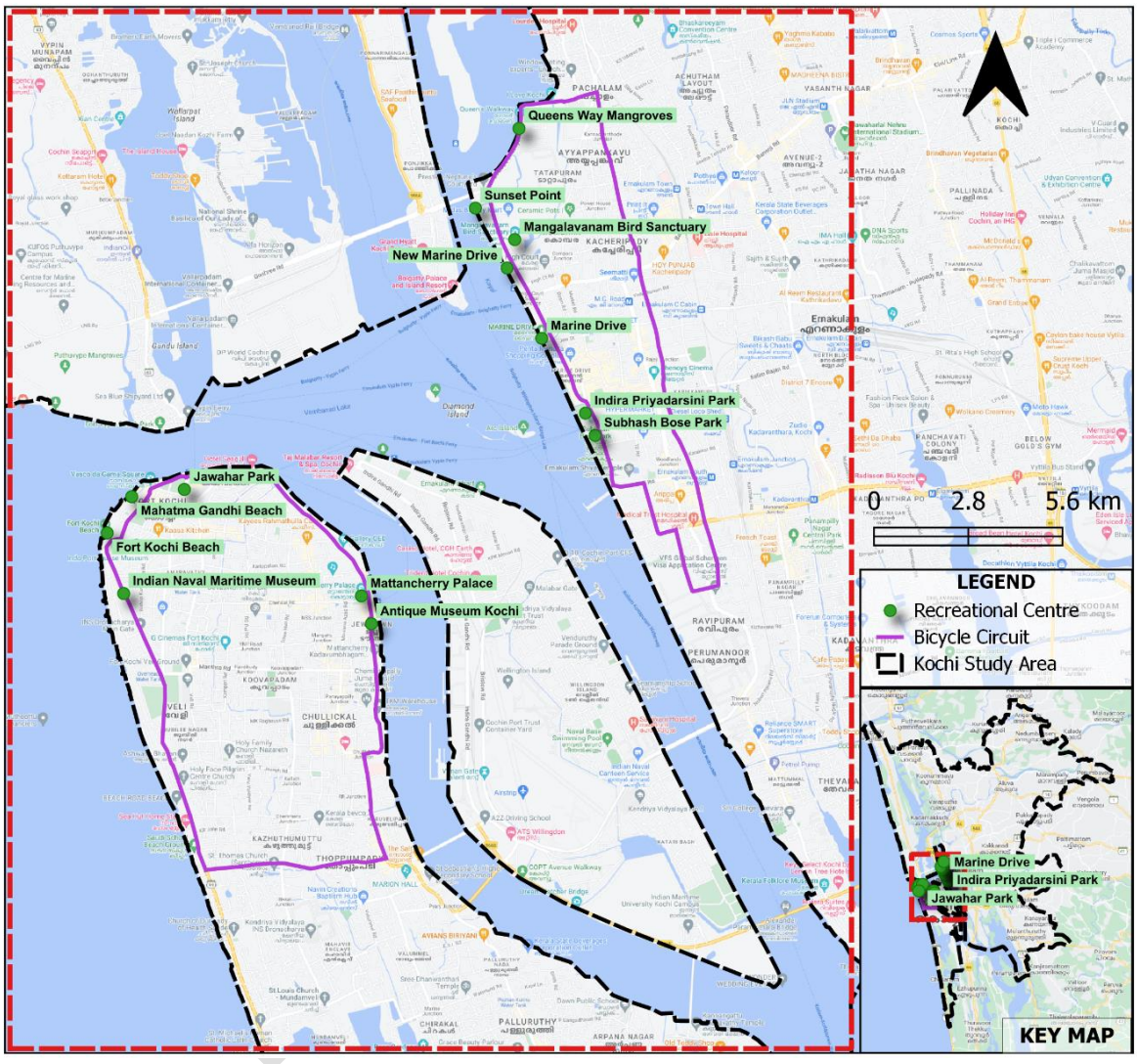


Figure 156 Proposed Recreational Bicycle Circuit

Similar bicycle friendly plans are proposed to be developed connecting heritage spots in Mattancherry, Wellington Island, North Paravur, Marine Drive along backwaters and beaches of Kadamakkudy, Vypin, Kuzhuppilly, Njarackal, Cherai, Munambam, Chellanam, Kumbalangi, Panangad etc.

Bicycle infrastructure improvements is recommended along the circuit as mentioned in the above network improvement proposal to facilitate cyclists to enjoy a traffic-free heritage ride (Similar to the initiatives at Shihab Thangal Road, Panampally Nagar, Kochi).

Figure 157 NMT Shihab Thangal Road, Panampally Nagar, Kochi as a Pilot Project by KMRL (Source: KMRL, Twitter)

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 recreational 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 Marine Drive, Queens Way, 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.

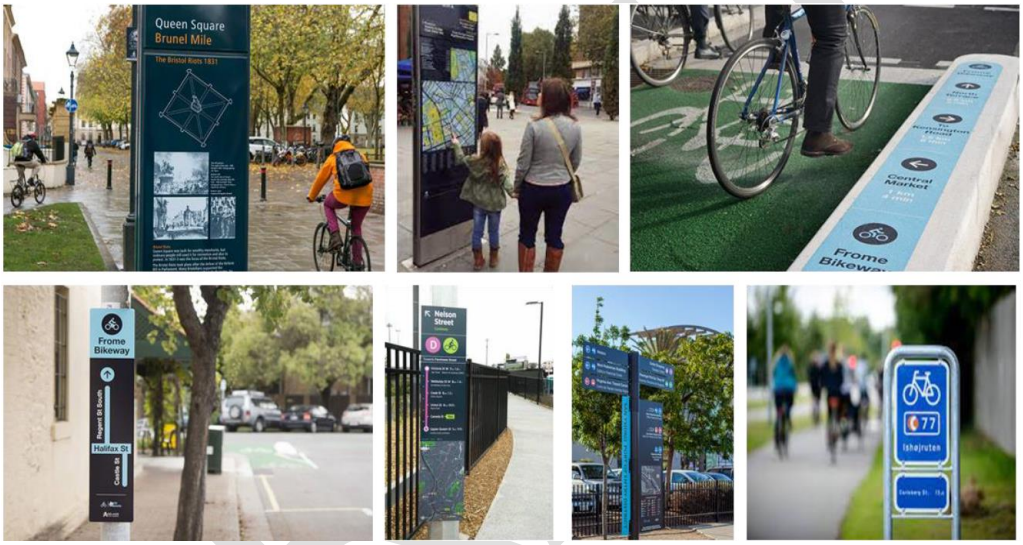


Figure 158 Representation of Wayfinding and Map Kiosk used in Various Cities Across the World[9]

Figure 159 Representation of Wayfinding and Signage Boards Heights[10]

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

[10] Image Source: Wayfinding Sign Project

8.5.5 SAFE ROUTES TO SCHOOL

Kochi city has more than 800 educational institutions with close 8 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. Most of these trips are under 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 Kochi 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 programs 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.

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 89 Pilot Areas Identified for SRTS Kochi

SN	NAME
1	Thevara
2	Fort Kochi
3	Thripunithura
4	Nayarambalam
5	North Paravur
6	Mattancherry

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

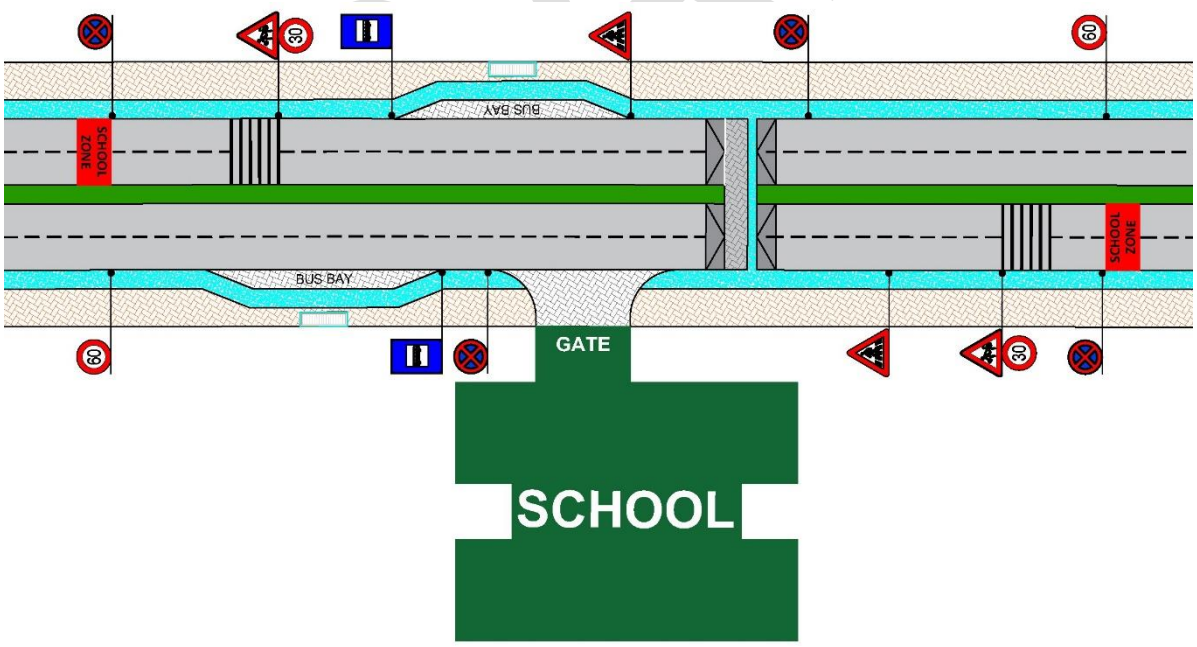


Figure 160 Conceptual Plan for RoW Design in School Zone (Source: UMTC)

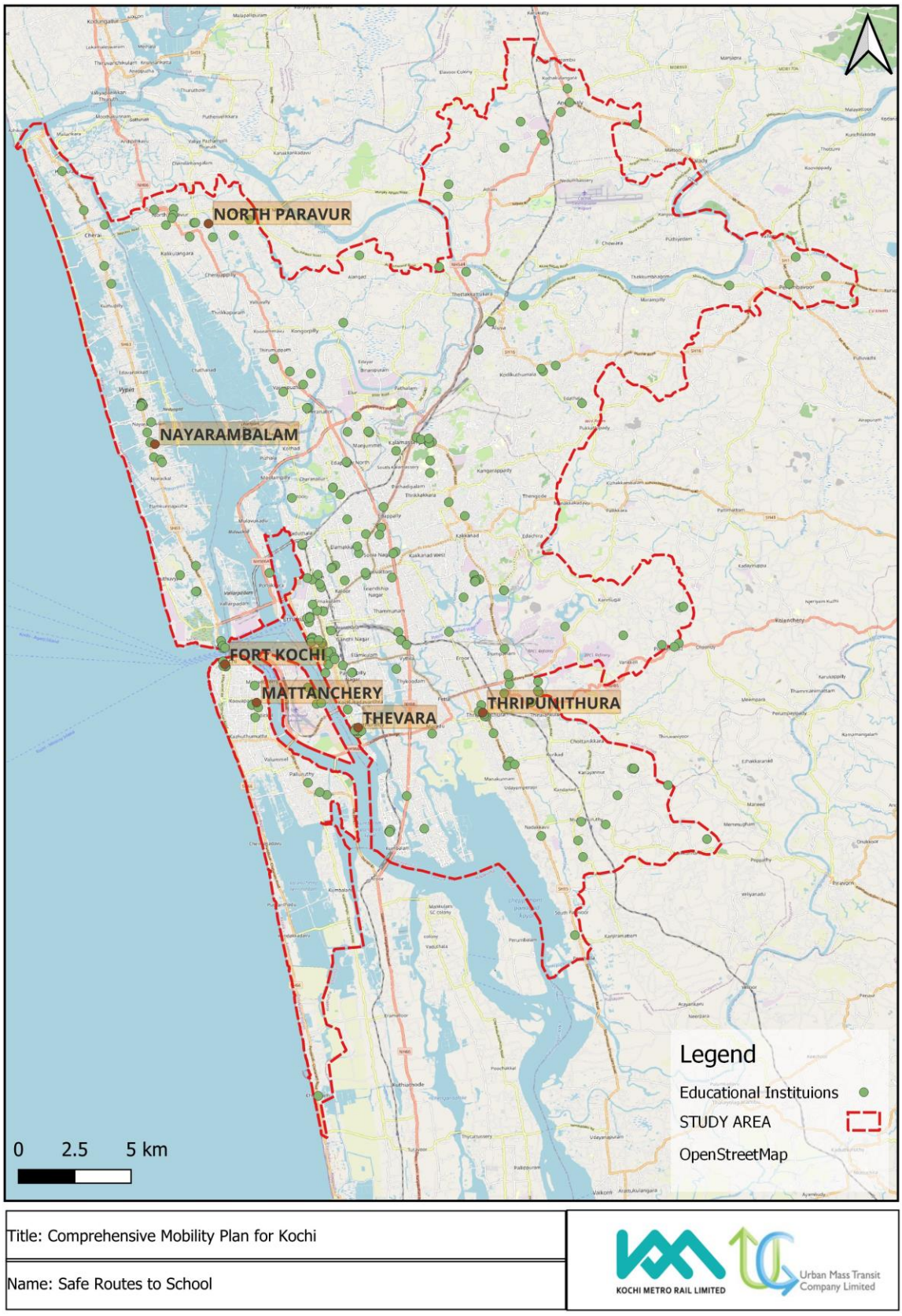


Figure 161 Proposed Pilot Areas for SRTS Kochi

8.5.6 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 River Road, Broadway, Basin Road, Town Road, Heritage Roads, etc.

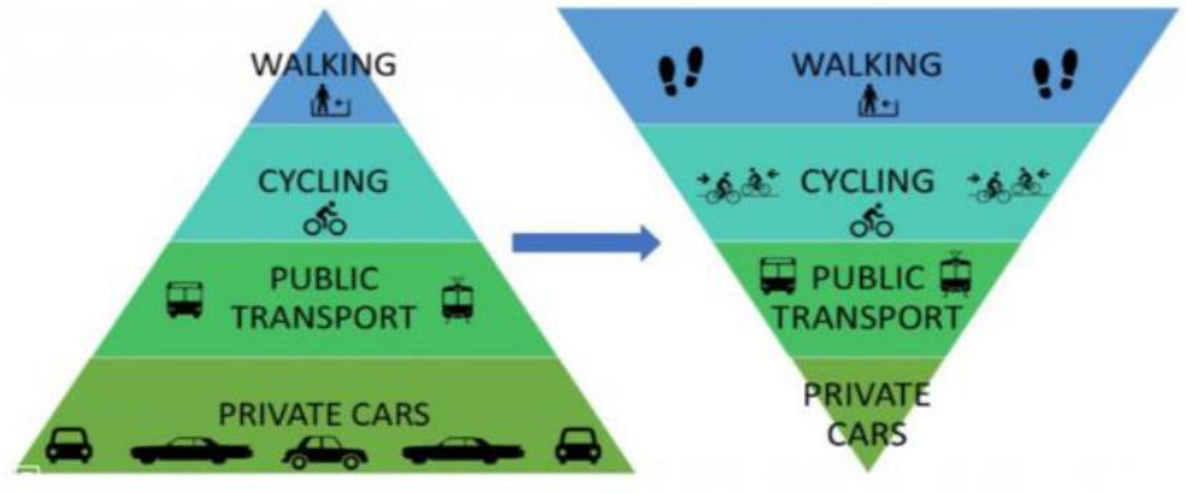


Figure 162 Mode Priority in NMT Streets

Figure 163 Representation of before and After of NMT Streets

NMT priority street for Kochi 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.

At Fort Kochi, it is recommended to develop about 4.6 Km as NMT priority streets where pedestrian, bicyclist movement along with public transport is only allowed during the peak periods. The streets identified are the major corridors at Fort Kochi area and core city with high commercial and recreational activity and having a higher pedestrian footfall.

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.
- Prohibit parking and vehicular traffic excluding public transport to ensure that clear paths remain unobstructed during the peak periods of the day, i.e., are morning 11am to 1pm and evening 4pm to 7pm.
- 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 164 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.

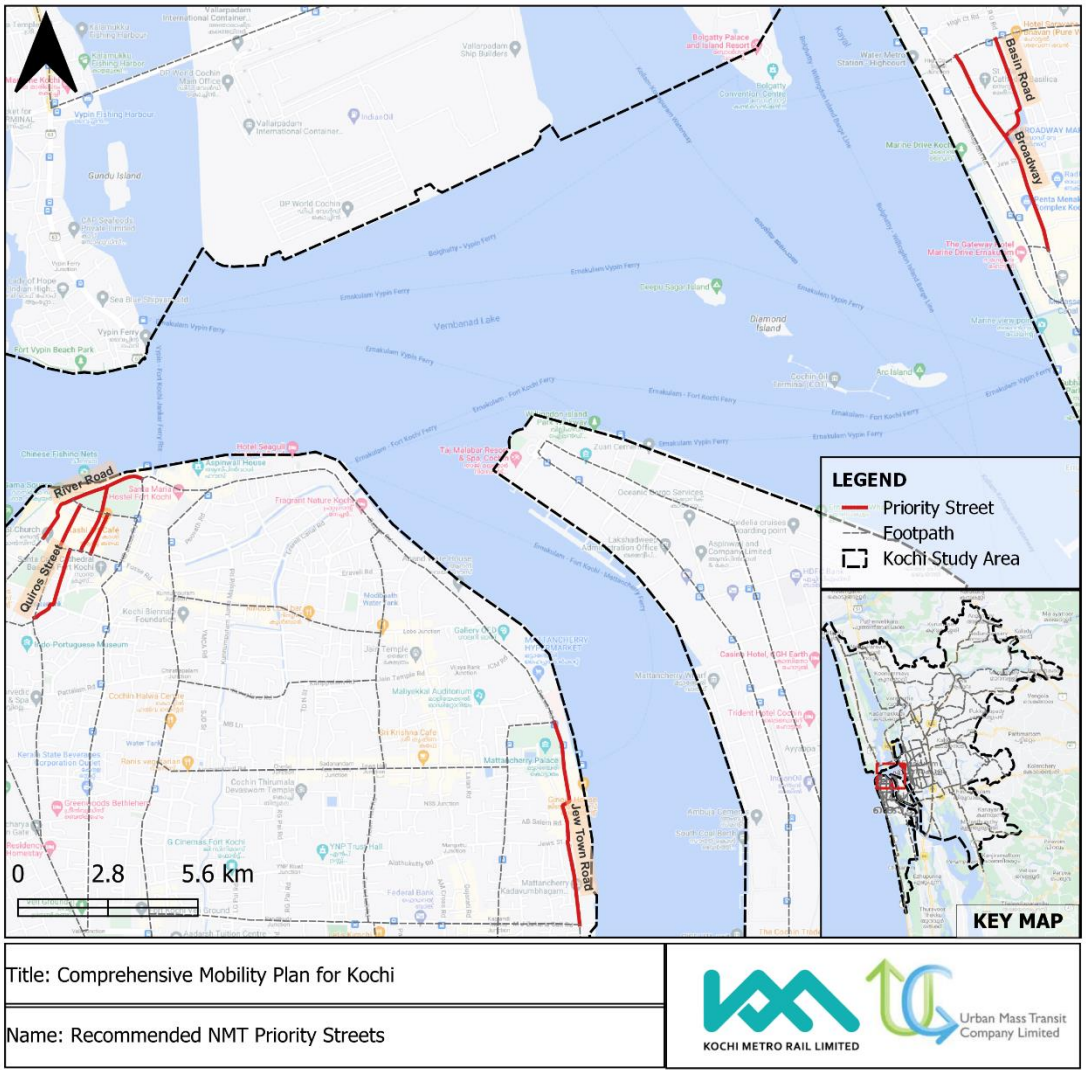


Figure 165 Recommended NMT Priority Streets

Table 90 Recommended NMT Priority Streets

SN	NAME	LENGTH (KM)
1	Veli Road	0.90
2	Basin Road	0.45
3	Broadway	0.89
4	Burger Street	0.18
5	Jew Town Road	0.86
6	Princess Street	0.29
7	Quiros Street	0.34
8	River Road	0.51
9	Rose Street	0.18

8.5.7 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. Apart from the PBS systems deployed at the Metro Stations and neighbourhood areas, it is suggested to augment the facilities to other parts of the city connecting the crucial nodes and trip generating and attraction nodes. Additionally, it is suggested to provide priority parking spaces to safely lock and park their own cycles used for commute at major transit points, attraction zones etc. Proposed locations are tabulated along below.

Table 91 Proposed PBS Locations

SN	LOCATION	PBS TYPE	CYCLES PER STATION	PHASING
1	Vendurthy Bridge	Low	10	PHASE I
2	Vendurthy Church	Low	10	PHASE I
3	Naval Base Parade Ground	Low	10	PHASE I
4	Thevara Ferry Road	Low	10	PHASE I
5	Nayk Block	Low	10	PHASE I
6	Vidyut Block	Low	10	PHASE I
7	Shastri Nagar	Low	10	PHASE I
8	Central Ave	Low	10	PHASE I
9	Passport Office	Low	10	PHASE I
10	Goshree Chathiyath Road	Low	10	PHASE I
11	Karukappilly	Low	10	PHASE I
12	Palarivattom Metro	Low	10	PHASE I
13	JNL Metro	Low	10	PHASE I
14	Kaloor	Low	10	PHASE I
15	Town Hall Metro	Low	10	PHASE I
16	Banerji Rd	Low	10	PHASE I
17	High Court	Low	10	PHASE I
18	MG Road	Low	10	PHASE I

SN	LOCATION	PBS TYPE	CYCLES PER STATION	PHASING
19	Ernakulam Jetty	Low	10	PHASE I
20	Hospital Road	Low	10	PHASE I
21	Foreshore Road	Low	10	PHASE I
22	Maharajas College	Low	10	PHASE I
23	Ernakulam Junction	Low	10	PHASE I
24	Fathima Church Road	Low	10	PHASE I
25	Elamkulam	Low	10	PHASE I
26	Gandhi Nagar Road	Low	10	PHASE I
27	Kadavanthra Metro	Low	10	PHASE I
28	Elamkulam	Low	10	PHASE I
29	Vyttila Hub	Low	10	PHASE I
30	Thaikoodam	Low	10	PHASE I
31	Petta Metro	Low	10	PHASE I
32	Vadakkekotta Metro	Low	10	PHASE I
33	Pokkaali Park	Low	10	PHASE I
34	Panampally Nagar Central Park	Low	10	PHASE I
35	Veli	Low	10	PHASE I
36	Veli Ground	Low	10	PHASE I
37	Bishop Kureethara Road	Low	10	PHASE I
38	Naval Museum	Low	10	PHASE I
39	Tower road	Low	10	PHASE I
40	Vypin	Low	10	PHASE I
41	Thoppumpady Jn	Low	10	PHASE I
42	North Paravoor	Medium	15	PHASE I
43	FACT Junction	Medium	15	PHASE I
44	Aluva Metro	Medium	15	PHASE I
45	Aluva Manappuram	Medium	15	PHASE I

SN	LOCATION	PBS TYPE	CYCLES PER STATION	PHASING
46	Govt Boy's School Thripunithura	Medium	15	PHASE I
47	Thevara	Medium	15	PHASE I
48	Thammanam	Medium	15	PHASE I
49	Perandoor Junction	Medium	15	PHASE I
50	Pallipuram	Medium	15	PHASE I
51	Kuzhuppilly	Medium	15	PHASE I
52	Kumbalangi	High	25	PHASE I
53	Kandakadavu	Medium	15	PHASE I
54	Perumpadappu	Medium	15	PHASE I
55	Edakochi	Medium	15	PHASE I
56	Kumbalam	Medium	15	PHASE I
57	Njarackal	Medium	15	PHASE I
58	School Muttam	Medium	15	PHASE I
59	Vallarpadam Panambukad Road	Medium	15	PHASE I
60	Mulavukadu	Medium	15	PHASE I
61	Mundamveli	Medium	15	PHASE I
62	Karuvelappadi	Medium	15	PHASE I
63	Mattancherry	Medium	15	PHASE I
64	CUSAT	High	25	PHASE I
65	Thrikkakara	High	25	PHASE I

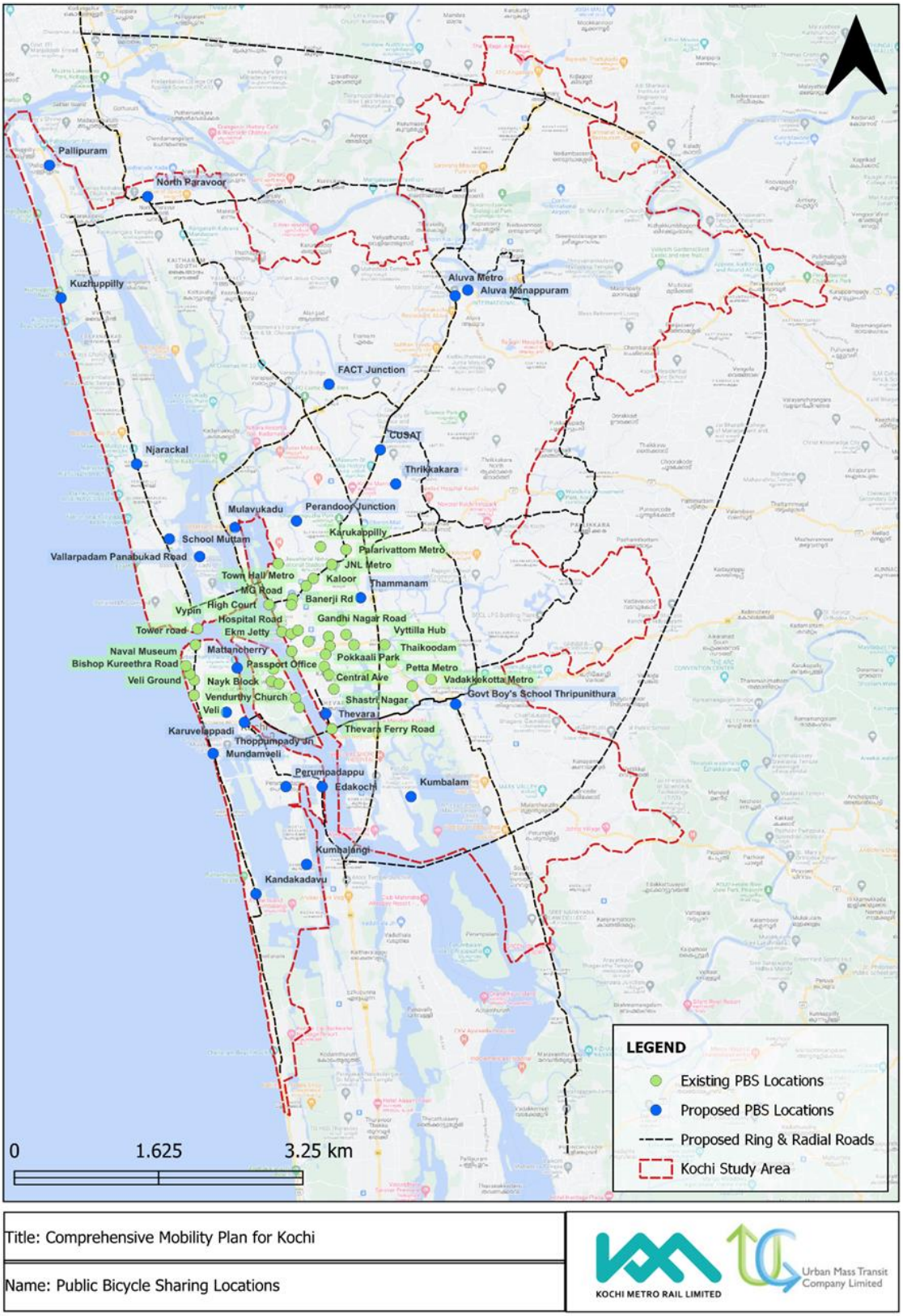


Figure 166 Proposed PBS Locations

8.5.8 NON-MOTORISED TRANSPORT OUT-REACH PROGRAM

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 167 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.

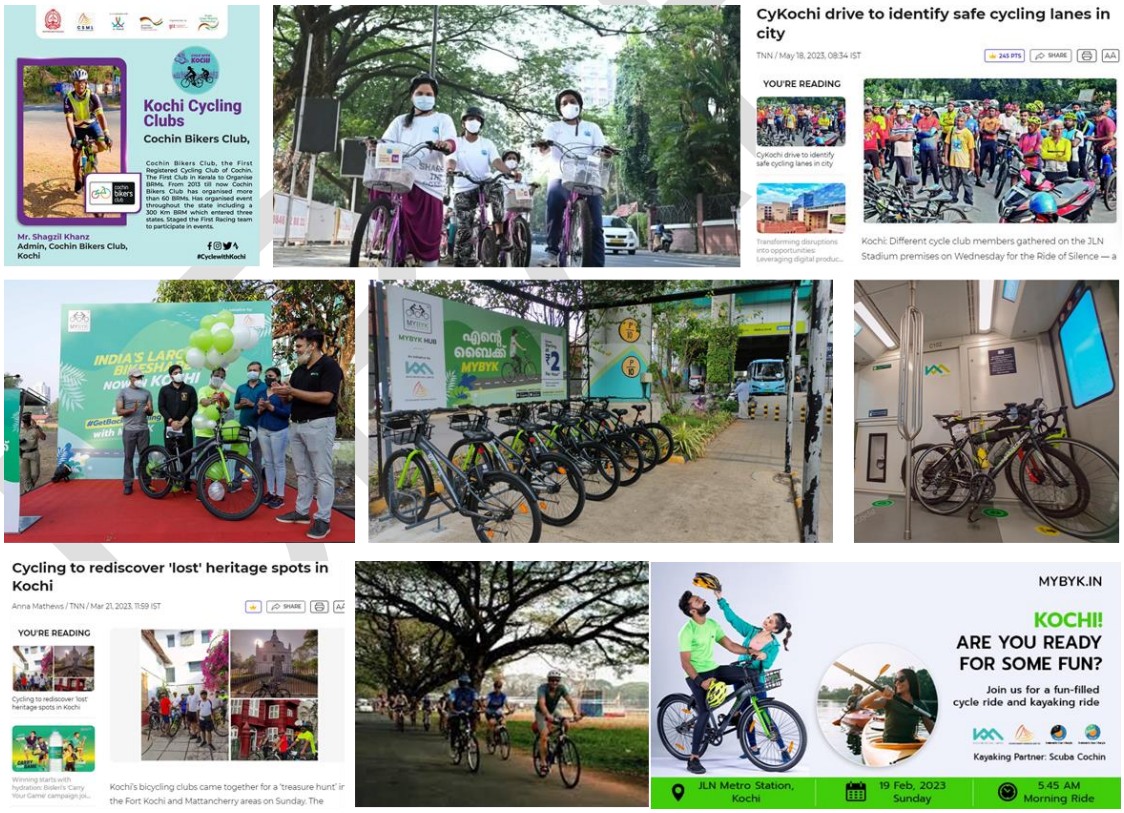


Figure 168 Bicycle Users and Outreach Programs in Kochi

Kochi has good number of cycle enthusiasts, across all income groups, those who take up cycling for a hobby or exercise to daily commutes. Kochi also witnesses campaigns and outreach programs being conducted in association with KMC, KMRL, CSML, NGOs as well as Cycling Clubs. Nonetheless, it is pertinent to mention that these outreach programs have helped to review the cycling culture. Further the need of the hour is that the civic authorities' team up to provide safe commute by providing continuous and dedicated cycle tracks.

8.5.1 TRAFFIC PARKS

Traffic Training Parks or Traffic Parks are places where children can learn about traffic rules, signage, and road safety. They are also known as transportation parks, traffic gardens, or safety villages.

These facilities are designed to teach children, about road safety and traffic rules in a controlled and interactive environment. Typically equipped with miniature streets, road signs, traffic signals, and various vehicles such as bicycles, pedal cars, and sometimes even small electric cars. Traffic parks serve as educational tools where individuals, especially young children, can learn about road safety, traffic regulations, and responsible behaviour as both pedestrians and drivers. They provide a practical and hands-on approach to teaching these concepts. Participants can practice and apply what they have learned in a safe and controlled environment. They can experience different traffic situations and learn how to navigate them safely. This interactive approach helps them develop a better understanding of the responsibilities associated with each role and promotes empathy for other road users.

Figure 169 Traffic Training Parks - Hyderabad (Left), Chennai (Right) (Source: Various-Online)

Miniature traffic cities in these parks often replicate real-world traffic scenarios, including intersections, crosswalks, roundabouts, and parking areas. This allows individuals to understand and practice how to interact with various traffic elements. Traffic parks typically include a variety of road signs and signals. Participants can learn to recognize and understand the meaning of these signs and signals through hands-on experience.

In addition to learning rules and regulations, participants can acquire practical safety skills, such as proper use of crosswalks, wearing helmets while cycling, and looking out for oncoming traffic. Traffic parks often serve as community resources for safety education. Local schools, traffic safety organizations, and law enforcement agencies may collaborate to offer educational programs and events at these facilities. By teaching road safety at a young age and reinforcing these lessons throughout life, traffic parks contribute to reducing accidents and injuries on real roads. They help create safer, more responsible road users.

Some traffic parks incorporate elements that promote sustainable transportation, such as bicycle lanes and pedestrian-friendly features, encouraging eco-friendly modes of transport from an early age. Parents and caregivers often accompany their children to traffic parks, allowing them to reinforce the lessons learned and model safe behaviour. Similar parks are functional at Marine Drive and Vyttila as well as in other cities viz., Chennai, Bengaluru, Hyderabad, Noida etc.

Certain area in the premises can also be earmarked and utilized for conducting Driving Test Centres during stipulated hours facilitating. It is recommended to encourage Traffic Parks in coordination with the RTO offices in the study area. Such parks would assist in instilling road safety awareness and skills in individuals, particularly children, who are vulnerable road users. They play a crucial role in promoting responsible and safe behaviour on the road and contribute to overall traffic safety within communities and assist in promotion of sustainable transportation.

8.6 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

8.6.1 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 and 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.

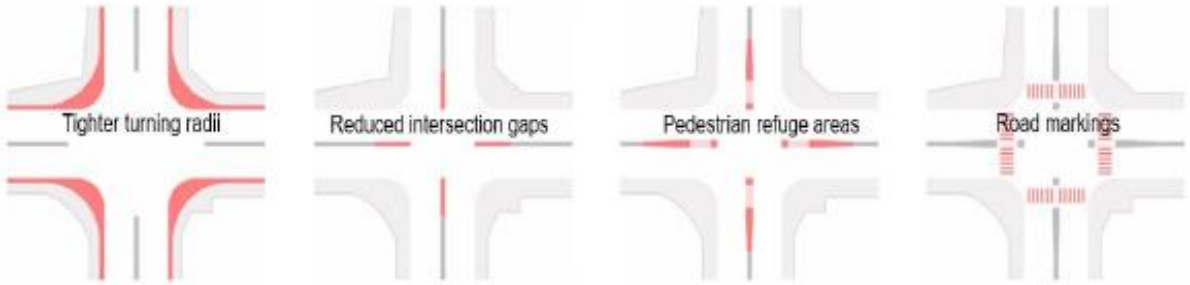


Figure 170 *Typical Junction Improvement Measures*

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 92 *Identified Junctions for Improvement*

SN	NAME	PHASE
1	Angamaly Jn.	PHASE II
2	Aluva Metro Station Jn.	PHASE I
3	Athani Jn., Aluva	PHASE II
4	Athani Jn., Kakkanad	PHASE II
5	Atlantis Jn.	PHASE I
6	BOT Bridge	PHASE I
7	CIFT Jn.	PHASE I
8	Companypady	PHASE II
9	CPT Jn.	PHASE I
10	Desom	PHASE II
11	Edapally	PHASE I
12	Elamkulam	PHASE I
13	GCDA Jn.	PHASE I
14	Goshree Jn.	PHASE I
15	High Court Jn.	PHASE I
16	Hill Palace	PHASE II
17	HMT Jn. 2	PHASE II
18	Hospital Jn.	PHASE I
19	IMG Jn.	PHASE II
20	Infopark Gate Jn.	PHASE II
21	Irumpanam Jn.	PHASE II
22	Jose Jn.	PHASE I
23	Judges Avenue Jn.	PHASE II
24	Kacherippady Jn.	PHASE I
25	Kadavanthra Jn.	PHASE I
26	Kakkanad Jn.	PHASE II
27	Kalamasserry TVS Jn.	PHASE II
28	Kaloor Jn.	PHASE I
29	Kannankulangara	PHASE II
30	Karingachira	PHASE II
31	Kathrikadavu	PHASE I

SN	NAME	PHASE
32	Kundannur Jn.	PHASE II
33	Kumaranasan	PHASE I
34	Kunnumpuram	PHASE I
35	Madavana Jn.	PHASE II
36	Madhava Pharmacy	PHASE I
37	Mavelipuram Signal Jn.	PHASE II
38	Mini Bypass Jn., Maradu	PHASE I
39	Nettoor Jn.	PHASE II
40	Pachalam Jn.	PHASE I
41	Palarivattom Bypass Jn.	PHASE I
42	Palarivattom Circle	PHASE I
43	Paramara Jn.	PHASE I
44	Paravoor Jn.	PHASE II
45	Parippu	PHASE I
46	Pettah Jn.	PHASE I
47	Perumbavoor Jn.	PHASE II
48	Potten Theruv Jn.	PHASE I
49	PT Jacob Jn.	PHASE I
50	Pump Jn., Aluva	PHASE II
51	Puthiyakvu	PHASE II
52	Pyary Jn.	PHASE I
53	Ravipuram Jn.	PHASE I
54	Samskara Jn.	PHASE I
55	SN Jn.	PHASE I
56	Subhash Chandra Bose Jn.	PHASE I
57	Thammanam	PHASE I
58	Thevara Jn.	PHASE I
59	Thiruvankulam	PHASE II
60	Thoppumpady	PHASE I
61	Vallathol Jn.	PHASE II
62	Vyttila Jn.	PHASE I

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 crossed or close to the 10000 PCU mark during peak hours. The crucial junction being Aluva, Vyttila, Edapally, Palarivattom Bypass junctions. Considering the recent construction of flyovers in these locations, additional flyovers are not recommended at these junctions.

Hence improvements to these junctions need to be considered for signalization/ roundabouts or grade separators. The type of junction must be suited to the road type, the environment and capacity, to maintain good readability both 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.

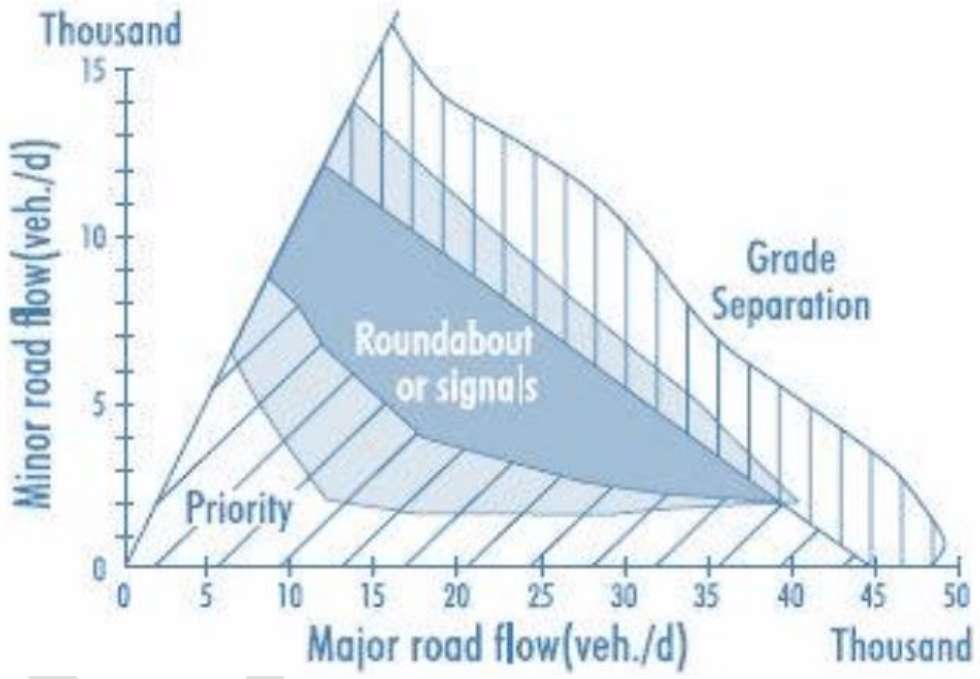


Figure 171 Junction Typology Based on Traffic Flows (IHT)

Table 93 Improvements Proposed at Identified Junctions

SN	NAME	TYPOLOGY
1	Angamaly Jn.	Design
2	Aluva Metro Station Jn.	Design & Signal
3	Athani Jn., Aluva	Design & Signal
4	Athani Jn., Kakkanad	Design

SN	NAME	TYPOLOGY
5	Atlantis Jn.	Design & Signal
6	BOT Bridge	Design
7	CIFT Jn.	Design & Signal
8	Companypady	Design & Signal

SN	NAME	TYPOLOGY
9	CPT Jn.	Design
10	Desom	Design & Signal
11	Edapally	Signal
12	Elamkulam	Design & Signal
13	GCDA Jn.	Design & Signal
14	Goshree Jn.	Signal
15	High Court Jn.	Signalized
16	Hill Palace	Design & Signal
17	HMT Jn. 2	Design & Signal
18	Hospital Jn.	Design
19	IMG Jn.	Design & Signal
20	Infopark Gate Jn.	Design
21	Irumpanam Jn.	Design & Signal
22	Jose Jn.	Design
23	Judges Avenue Jn.	Design
24	Kacherippady Jn.	Design
25	Kadavanthra Jn.	Design & Signal
26	Kakkanad Jn.	Design & Signal
27	Kalamasserry TVS Jn.	Design & Signal
28	Kaloor Jn.	Design & Signal
29	Kannankulangara	Design
30	Karingachira	Design & Signal
31	Kathrikadavu	Design & Signal
32	Kundannur Jn.	Design & Signal
33	Kumaranasan	Design & Signal
34	Kunnumpuram	Design & Signal
35	Madavana Jn.	Design & Signal
36	Madhava Pharmacy	Signal

SN	NAME	TYPOLOGY
37	Mavelipuram Signal Jn.	Design & Signal
38	Mini Bypass Jn., Maradu	Design & Signal
39	Nettoor Jn.	Design & Signal
40	Pachalam Jn.	Design
41	Palarivattom Bypass Jn.	Design & Signal
42	Palarivattom Circle	Design & Signal
43	Paramara Jn.	Design & Signal
44	Paravoor Jn.	Design
45	Parippu	Design
46	Pettah Jn.	Design & Signal
47	Perumbavoor Jn.	Design
48	Potten Theruv Jn.	Design & Signal
49	PT Jacob Jn.	Design & Signal
50	Pump Jn., Aluva	Design & Signal
51	Puthiyakvu	Design
52	Pyary Jn.	Design & Signal
53	Ravipuram Jn.	Design
54	Samskara Jn.	Design
55	SN Jn.	Design & Signal
56	Subhash Chandra Bose Jn.	Design & Signal
57	Thammanam	Design & Signal
58	Thevara Jn.	Design & Signal
59	Thiruvankulam	Design & Signal
60	Thoppumpady	Design & Signal
61	Vallathol Jn.	Design & Signal
62	Vyttila Jn.	Design & Signal

Figure 172 Identified Junctions for Improvement

8.6.2 PAVEMENT MARKINGS AND SIGNAGES

Even though road signs and markings are provided on major road stretches of Kochi, 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 173 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.

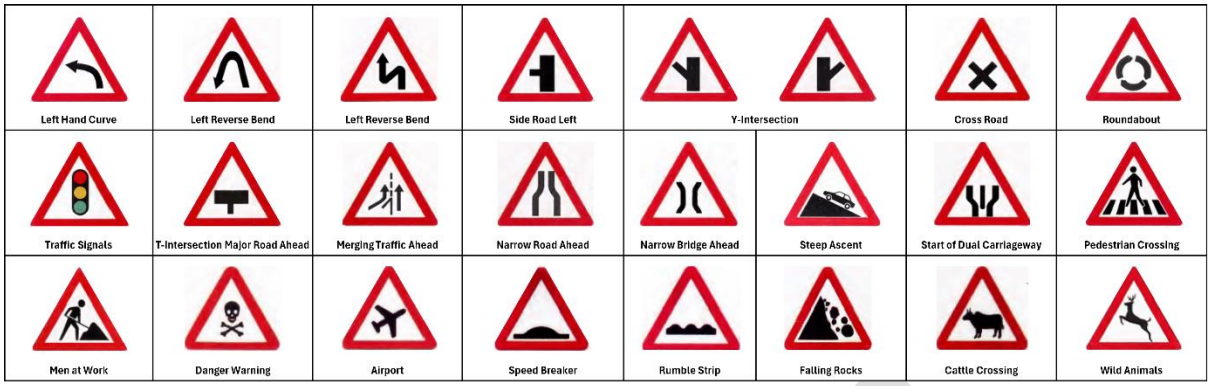


Figure 174 Warning or Cautionary Signs

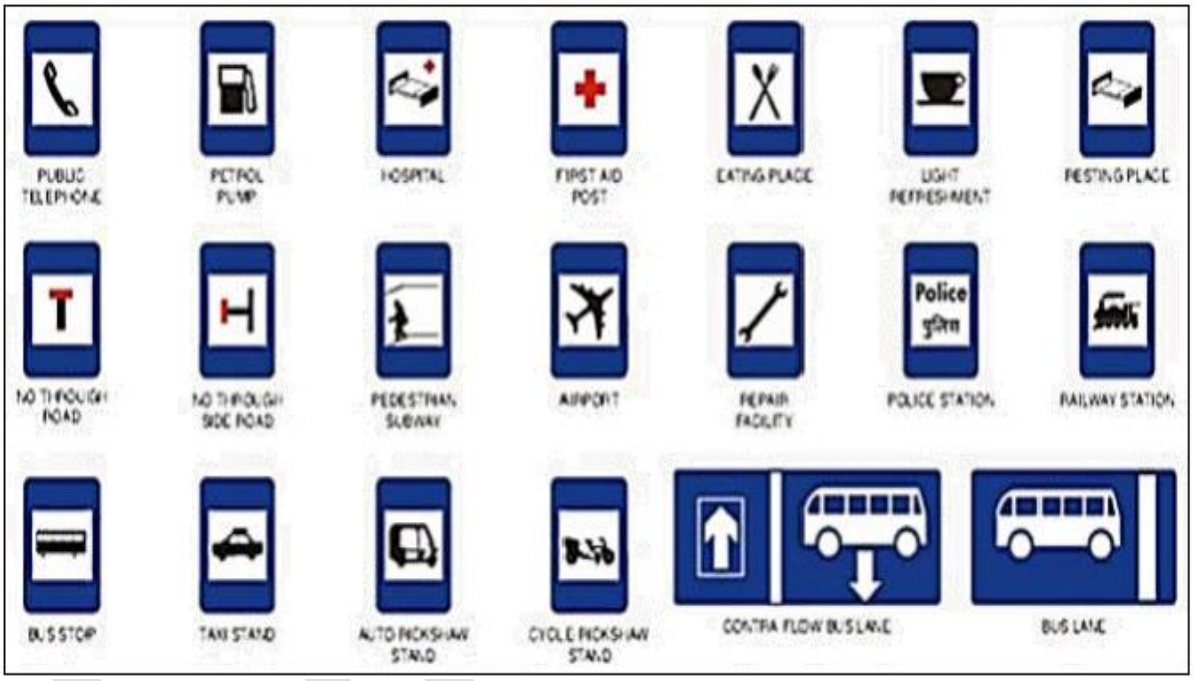


Figure 175 Informatory Signs

8.6.3 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 must 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.

8.6.3.1 VYTTILA JUNCTION AND VYTTILA MOBILITY HUB

Vyttila Junction is a major node and serves as a focal point in the transport network of Kochi city. Over the past two decades, with the rapid growth of the city towards the eastern and northeastern direction, the junction which was once part of the NH Bypass has transformed into an integral part of the city. It is surrounded by commercial establishments, shopping centres, multi-storeyed residential units, restaurants, and offices, which contribute to its vibrant and bustling atmosphere. One of the busiest intersections in the city, it connects several major viz., NH 66, Sahodaran Ayyappan (SA) Road and SH 15. Apart from these, roads viz., Mahakavi Vailoppilli road is a crucial link to Palarivattom via Thammanam and Vyttila- Mathoor road to the residential suburb of Eroor.

The prominence of the place lead to the development of the Vyttila Mobility Hub in the near vicinity by the GoK to improve and integrate the public transportation infrastructure as well as to ease traffic congestion in the CBD. It was envisioned as an integrated transportation hub that would provide seamless connectivity between different modes of transport, including buses, ferry, upcoming metro, and private vehicles. The hub operational since 2011, has gained prominence with the Metro Station and the Water Metro Terminal enhancing the overall public transport connectivity.

Another recent development in the vicinity is the construction of the 6-lane flyover on NH 66 to facilitate the through traffic on NH and enhance the traffic processing capacity of the junction. As per the primary surveys, the six-lane flyover caters to 40% of the total traffic at the junction. Also 67% of the junction comprises of east – west and north- south movement. The junction has good amount of pedestrian activity as well. It is observed that during morning peak it handles 5150 pedestrians along and across the junction. Indicating high volume of pedestrian activity, whereas

it needs mention that the location lacks any kind of sidewalk while the crossing facility is not pedestrian friendly. Existing major road networks and nodes are shown below.

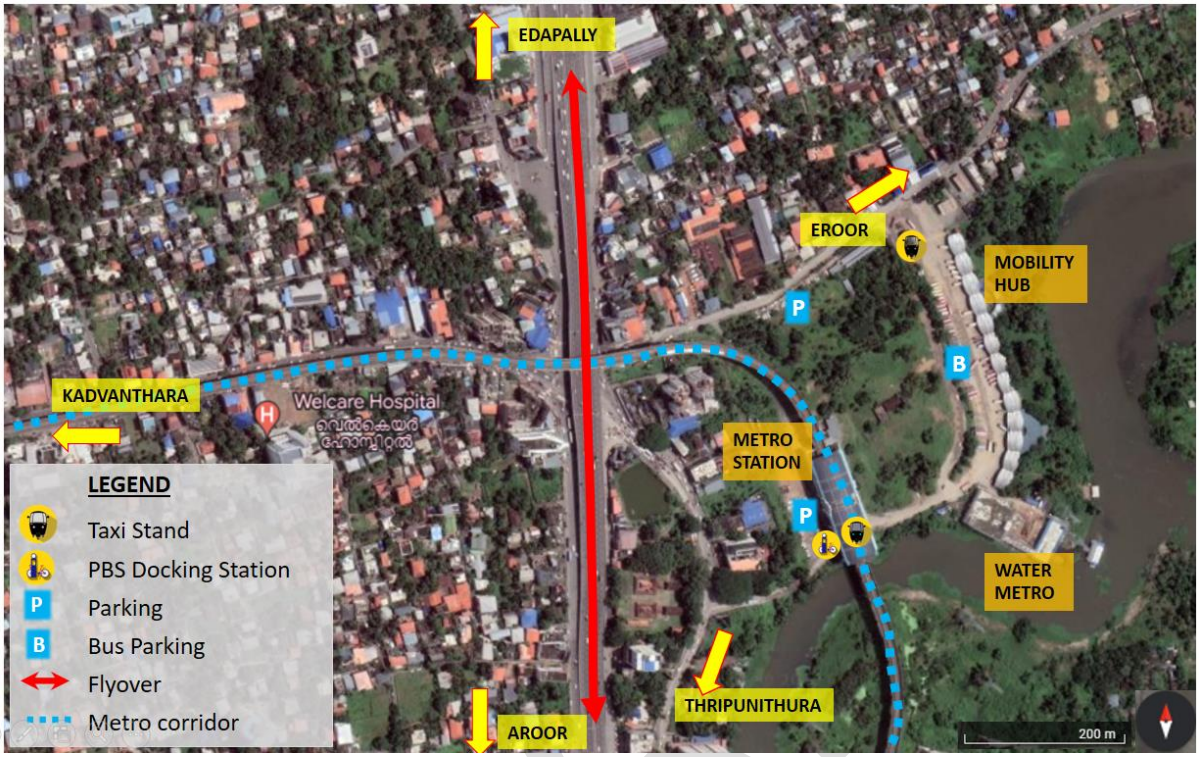


Figure 176 Satellite Imagery of Vyttila Junction and Vyttila Mobility Hub along with major roads and development.

Existing situation at Vyttila Junction:

However, despite the intended benefits of the flyover, the junction design at the ground level which includes a roundabout has increased the traffic congestion and as on date is closed partially during operations. The junction at ground level experiences heavy congestion during peak and non-peak hours reducing the capacity of the junction. Additionally, inadequate pedestrian facilities due to improper design of refuge islands as well as absence of sidewalks pose threat to pedestrians. This makes it difficult for NMT users to navigate the area safely. Haphazard parking and vehicles spilling onto the main roads, further contributes to the problem. Evaluation of the existing situation at the Vyttila Mobility Hub, point out to the following major concerns:

1.Scattered infrastructure development in the land parcel has come up as a challenge to the seamless integration among the various modes. The coordination between buses, metro, water metro, auto-rickshaws, and other modes of transport could be improved to ensure smoother intermodal transfers and enhance overall efficiency. Segregation of the inter-city and intra-city services would further lead to smoother transfers.

2. Non-existent pedestrian and NMT infrastructure: The safety of pedestrians navigating the Vyttila Mobility Hub remains a concern. Insufficient pedestrian infrastructure, including sidewalks and crosswalks, makes it challenging for pedestrians to move safely through the area, especially given the high volume of vehicular traffic and speed of the buses. The area lacks proper streetlights during night, adding to the safety concerns.

3.Limited facilities and amenities: Though essential facilities and amenities are available, considering the quantum of people utilizing the facility, amenities such as clean and accessible public restrooms, waiting areas, parking facilities, way finding signs and passenger information kiosks needs immediate upgradation. These are expected to transform the overall public transport user experience and attract more users.

Suggested immediate improvement measures at Vyttila Junction and Mobility Hub are:

10. Review the feasibility of widening the underpass near the ROB along with the development of service roads to channelize the traffic from SA Road through the underpass along with the traffic from the Thammanam direction.
11. Pedestrian infrastructure development along the sidewalks and at grade crossing facilities with user friendly refuge islands as well as lane markings at the junction.
12. Opening the bottle neck at the entry point of Vyttila-Mathoor road by providing a flare to facilitate the left turning movement and channelizing the traffic from Eroor direction and restrict two-way traffic at the entry point. Diversion of traffic from Eroor through hub to SH-15 as shown in the figure below.
13. Skywalk connecting the Metro Station to the Water Metro Terminal.
14. Well-lit pedestrian network to channelize the pedestrian movement in and around the hub with crossing facilities, refuge islands as well as lane markings as appropriate.
15. Provision for MLCP to accommodate the parking demand at the Hub and Metro Station
16. Segregation of city and mofussil bus services as shown in the figure.
17. Urban place making to improve the aesthetics of the area.
18. Passenger information system, way finding signage and information kiosks at strategic points.

Figure 177 Conceptual Plan of suggested improvement measures at Vyttila Junction and Vyttila Mobility Hub

Figure 178 Traffic Diversion for vehicular traffic at Eroor

To mitigate the congestion at Vyttila, the draft Master Plan has recommended a detailed town planning scheme for the area, including the feasibility of a flyover in the east west direction. Along with the above-mentioned measures, implementation of traffic signal optimization strategies,

infrastructure improvements and traffic management strategies are required after evaluating the detailed plan to effectively address the congestion and ensure smooth traffic flow at the junction. The goal is to create a more efficient and user-friendly transportation hub while ensuring the smooth flow of traffic and enhancing the overall travel experience for commuters.

8.6.3.2 TRIPUNITHURA MULTIMODAL CONNECTIVITY

Thripunithura Railway Station located on the Ernakulam – Kottayam rail route caters to the residential community in the vicinity and is the nearest railway node for travellers from the eastern part of Ernakulam and Idukki district, which has no rail connectivity. Passenger services provide connectivity to within the state while Express trains provide regional connectivity to Chennai, Bengaluru, Kanyakumari etc. The extension of the metro corridor from SN Junction to Thripunithura Railway Station is expected to finish shortly. This has opened possibility of a critical road connection to the Railway Station, which otherwise had a narrow access from the southern end and smaller streets, (shown in red in the figure below). It is suggested to also extend city bus services to the vicinity by providing a Minibus Station, to reduce the dependency on private vehicles & enhance intermodal connectivity. Preparation of detailed integration plan of various services in consultation with the Thripunithura Municipality, KMRL and GCDA is recommended.

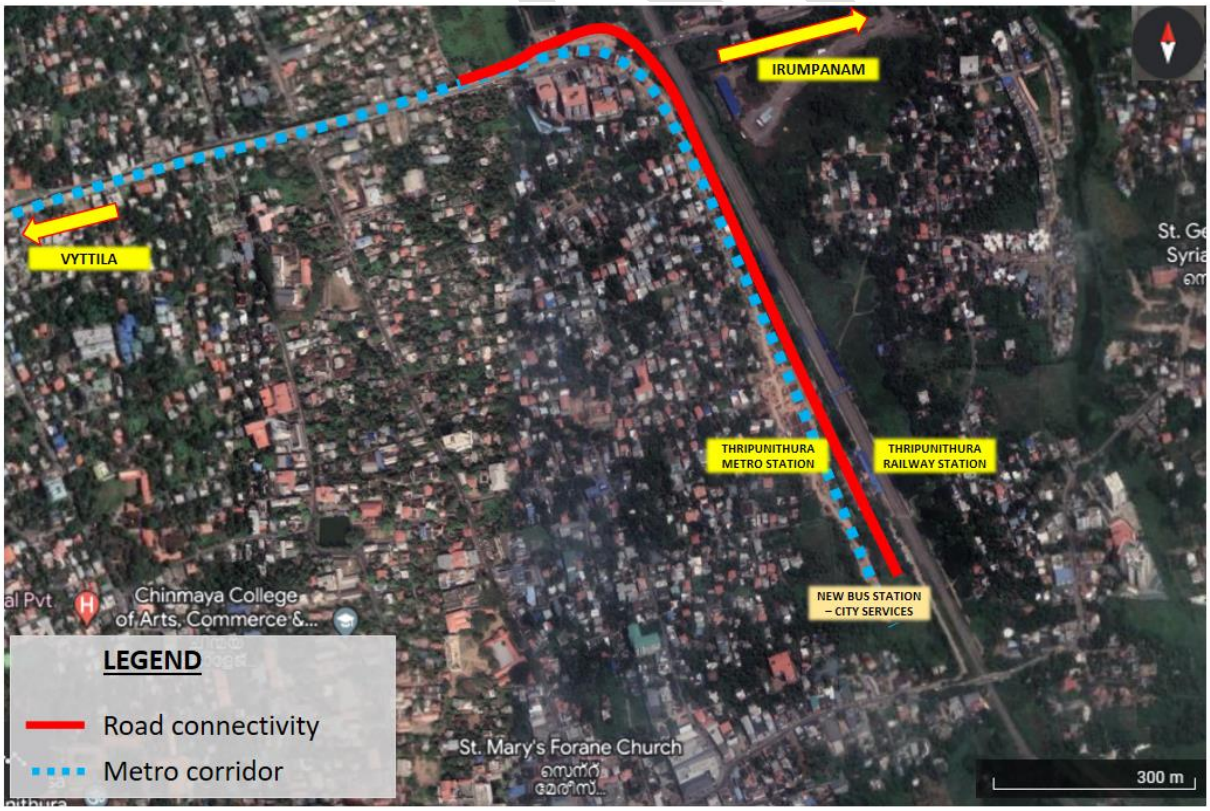


Figure 179 Proposals at Thripunithura Railway Station Area

8.6.3.3 SKYWALK AT ERNAKULAM SOUTH RAILWAY STATION

The CBD area in Kochi has two major railway stations viz., Ernakulam South and Ernakulam North Railway Station. These being in the city centre has thick urban developments in the vicinity leading to space constraints for widening of the RoW. The existing metro corridor from Aluva to SN Junction has Ernakulam South metro station falling within the 300 m radii of the railway stations.

This transfer which ideally is a mere distance of 250 m becomes lengthier in terms of time and distance considering the egress from metro, walk to the metro exist point and further across the street to the railway station. Further the connectivity to the station at the ground level has considerable conflict points due to the vehicular movements, on-street parking, as well as luggage movements etc.

Preparation of detailed station improvement plan is recommended for the railway station to ensure dedicated NMT facilities, channelized vehicular movements and organized parking facilities. To reduce the travel time and distance as well as to provide seamless integration it is suggested to provide skywalk connectivity form the concourse level of the metro station to the railway premises as conceptually shown in the figure.

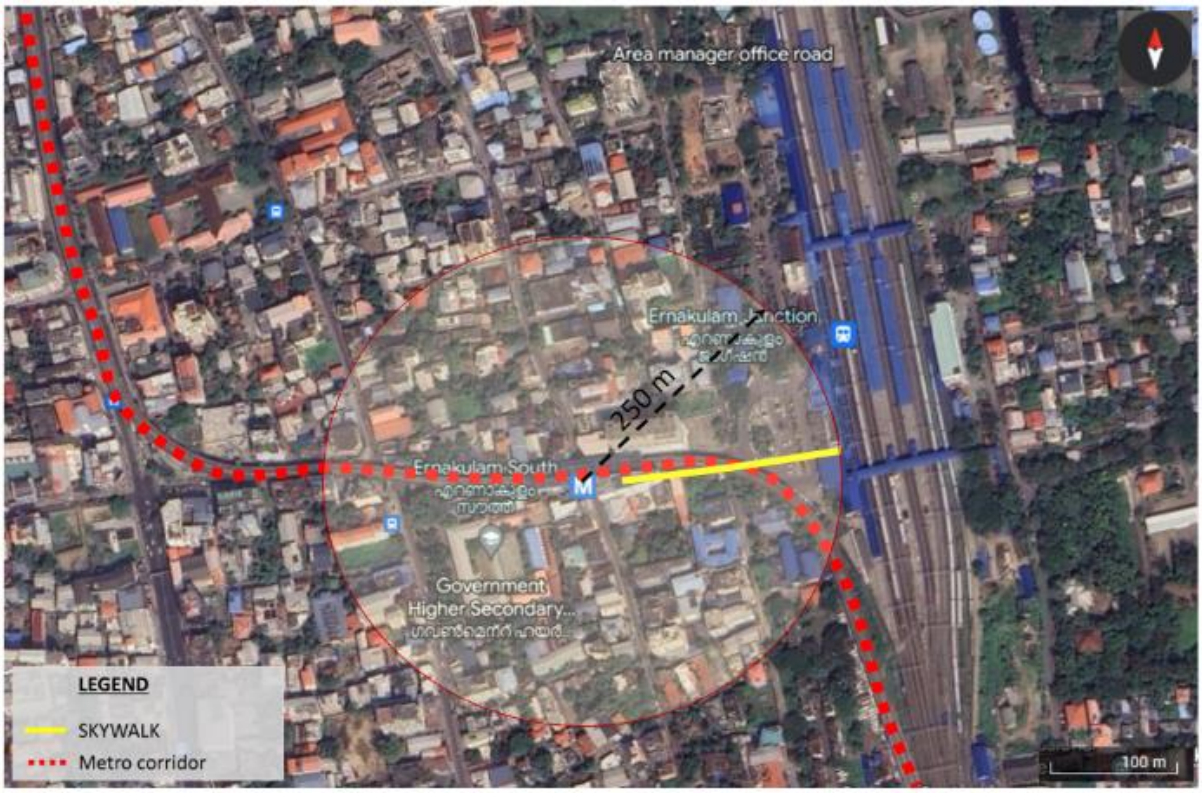


Figure 180 Skywalk Proposal for Ernakulam South Railway station from Metro Station

Skywalks and FoBs with facilities viz., escalators, lifts, lighting shall be provided at these locations. Similar skywalks are implemented in Mumbai, Hyderabad, Bengaluru etc.

Figure 181 Skywalk connecting Raidurg Metro Station to Mindspace, Hyderabad

Figure 182 FOB at Punjagutta Central with Escalators, Lifts and Stairs, Hyderabad

8.7 PARKING MANAGEMENT STRATEGY

Like 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 Shanmugham Road, Broadway, High Court vicinity, Edapally Junction, and along major corridors 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 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.

8.7.1 DESIGNATED ON-STREET PARKING SPACES

Designated On-Street Parking is recommended on the following locations with optimum lengths for 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 94 *Proposed On-street Parking Spaces Capacities*

SN	LOCATION	EFFECTIVE LENGTH (M)	PARKING BAYS								
			LHS			RHS			TOTAL		
			2W	4W	CYCLE	2W	4W	CYCLE	2W	4W	CYCLE
1	Aluva Bypass	300	60	20	20	0	0	0	60	20	20
2	Banerji Road	300	30	10	10	30	10	10	60	20	20
3	Changampuzha Park	500	0	0	0	0	0	0	0	0	0
4	Edapally	500	50	15	10	50	15	10	100	30	20
5	Jose Jn	100	10	3	5	10	2	5	20	5	10
6	Kaloor - Kadavanthra Road	200	14	10	6	14	10	6	28	20	12
7	Perumbavoor Old Muvattupuzha Road	500	50	20	10	50	20	10	100	40	20
8	Rajaji Road	200	5	15	5	5	15	5	10	30	10
9	Shanmugham Road	600	100	5	5	100	5	5	200	10	10
10	TD Road	400	110	20	10	0	0	0	110	20	10
11	Subhash Park	300	20	45	10	0	0	0	20	45	10

8.7.2 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.

Table 95 *Proposed ECS for Off-street Parking Spaces Capacities*

Location	Area (m^2)	ECS	Composition				Bays				Type
			2W	4W	Bus	Cycle	2W	4W	Bus	Cycle	
Aluva Railway Station	2272	145	60%	30%	0%	10%	87	44	0	15	Surface
Ernakulam South Bus Stand	1000	64	70%	20%	0%	10%	45	13	0	6	Surface
Ernakulam South Railway Station	2048	130	70%	25%	0%	5%	91	33	0	7	Surface
Marine Drive Pay & Park	3000	300	35%	45%	15%	5%	105	135	45	15	Convert to MLCP
Mattancherry Dutch Palace	440	28	0%	60%	30%	10%	0	17	8	3	Surface
Thripunithura Railway Station	3050	195	90%	5%	0%	5%	176	10	0	10	Convert to MLCP
Vyttila Hub - 1	2000	300	40%	40%	10%	10%	120	120	30	30	Convert to MLCP
Vyttila Hub - 2	2000	300	40%	40%	10%	10%	120	120	30	30	Convert to MLCP

8.7.3 CONCEPT - PARKING POLICY

8.7.3.1 PARKING PRICING

Parking pricing and time limits are important parking management mechanisms 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.

8.7.3.2 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.

8.7.3.3 TIME-OF-THE DAY / OCCUPANCY BASED PRICING

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

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

- Marine Drive/ Broadway on street parking facility
- High Court area
- Infopark Area core area
- Edapally Junction
- Aluva core area

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:

- Parking underneath Aluva, Maradu flyovers
- Parking near Edapally flyover
- Kaloor (near JLN Stadium)
- Infopark area

8.7.3.4 DISTANCE FROM TRANSIT

High parking charges should be levied on parking in places that are well-connected with transit facilities. This should be done to discourage private vehicle use. The On-Street Parking locations around the following locations are suggested to have higher parking price,

- Ernakulam North Railway Station
- Ernakulam South Railway Station
- Vyttila Mobility Hub
- Major Railway Stations

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

Table 96 *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 97 *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 98 *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.

8.7.3.5 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 Kochi, 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.

8.7.3.6 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.

8.7.3.7 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.

8.7.3.8 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 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.

8.7.3.9 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 99 *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:

- Panampally Nagar
- Kadavanthra
- Thrikkakara
- Edapally

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 100 *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.

8.8 TECHNOLOGICAL TRANSITIONS

8.8.1 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[11].

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

[11] Source: Bus Karo 2.0

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 183 PIS System

8.8.2 MOBILITY AS A SERVICE (MAAS)

MaaS, is a concept that aims to promote collaboration between the public and private transport operators towards creating a platform where all mobility needs of an individual are met on one platform providing an option to plan and pay for their travel. It provides a form to integrate various transportation modes into a single platform, simplifying trip planning, booking, and payment processes. MAAS is crucial for a city which must address the increasing demand for sustainable and efficient transportation solutions, especially in places where issues like traffic congestion and pollution are on the rise. It can be operated by public transit agencies, private companies, or a combination of both and accessed through mobile apps, websites, or physical kiosks.

The key components of Mobility as a Service (MaaS) include:

5. Trip Planning: MaaS systems provide users with real-time information about different transportation options, such as schedules, fares, and routes, enabling them to plan their trips in advance.
6. Booking: MaaS systems allow users to book and pay for transportation services through a single digital platform, making the process more convenient and seamless.
7. Payment: MaaS systems support various payment methods, such as credit cards, digital wallets, or mobile payments, depending on the user's preference and the service provider's policy.
8. Customer Support: MaaS systems offer customer support services, such as feedback, complaints, and assistance, to ensure a high level of user satisfaction.

The role of the government in fostering MaaS development is significant, with the National Urban Transport Policy (NUTP 2006) mentioning the establishment of Unified Metropolitan Transport Authority (UMTA) in cities with a population of over one million. MaaS promotes collaboration between public and private transport operators, enhancing the usage of public transportation through real-time passenger information and smart ticketing.

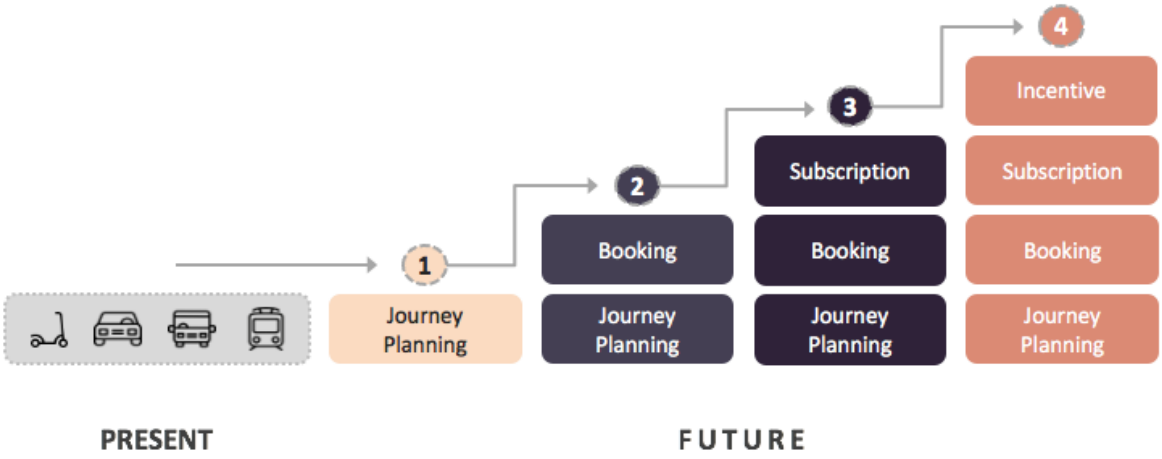


Figure 184 Stages of MaaS

The need for MaaS in Indian cities is significant due to their urbanization and complex transportation structures, with various transportation modes and operators both public and private. Kochi is among the pioneer cities in India that has understood the importance and made efforts to provide a multimodal transport solution involving cycling, walking, and public transport considering the cities urbanization trends. Collaborations between different transport modes are necessary for promoting end-to-end connectivity and encouraging a shift from private to shared transportation. These efforts include introduction of Kochi One Card and mobile application apart from bringing 800 plus private buses operational in the city under 7 cluster-based bus operating companies for integrated bus operations as well as installation of GPS in private bus services. To assure feeder services and ensure last-mile connectivity, aggregating 15000 auto-rickshaws under one single umbrella 'Ernakulam District Auto Rickshaw Drivers Co-Operative Society'. Introduction of Chalo mobile app for bus transit planning and ticketing. Setting up of Kochi Open Mobility Network (KOMN) becoming pioneers in India to integrate, plan, and regulate the various commute modes. KOMN enabled by open specifications of Beckn strives integration of urban transport modes which is an inclusive and interoperable. Yatri mobile application for rental cab services works on this protocol. ONDC (Open Network for Digital Commerce), an initiative undertaken by the Government of India aims to promote open networks for all aspects of the exchange of goods and services over digital or electronic networks.

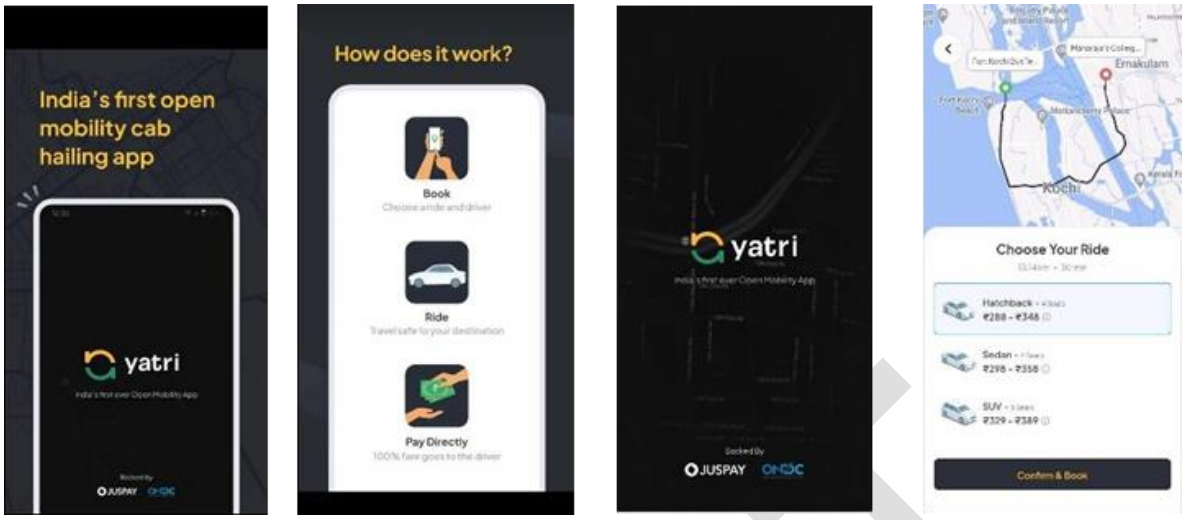


Figure 185 Yatri Mobile Application – Cab Hailing Interface

Other mobile application which is available for Public Transport Users to plan their journey and ticket booking are Kochi1 mobile application by KMRL and Axis Bank. Initially developed for metro commute, this application has evolved to include bus timings, water metro services, booking QR tickets, recharging Kochi1 Card, journey planning etc.

Similarly, Chalo mobile application is another journey planner and ticketing platform that allows the bus commuters to plan their journey and track the availability of the buses. Chalo application is functional in 20 plus Indian cities for live bus tracking and ticketing at select cities.

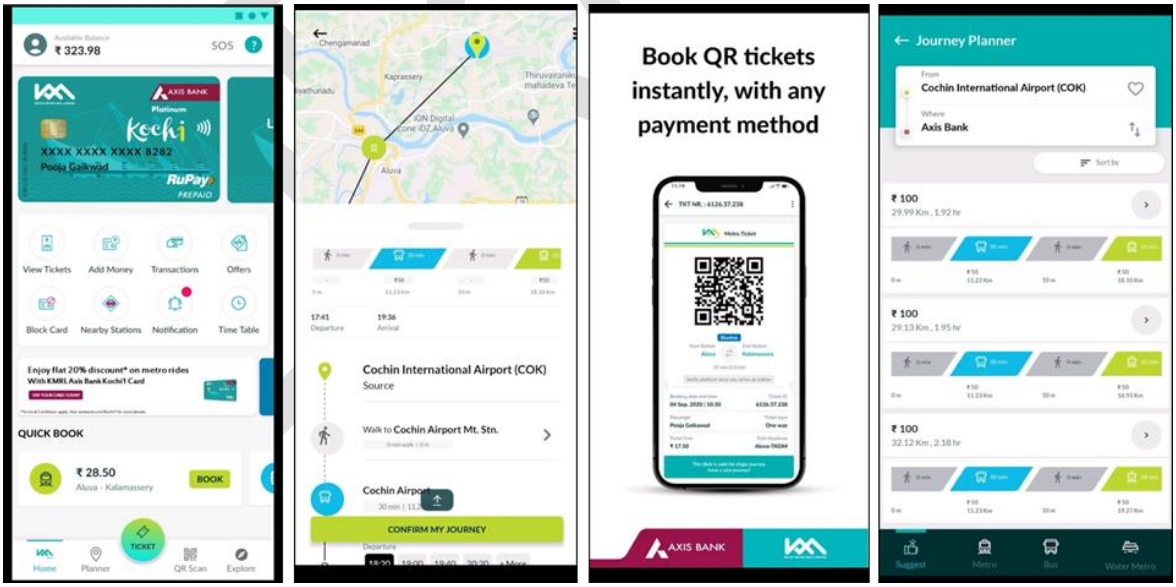


Figure 186 Kochi1 Mobile Application – Journey Planning and Ticketing

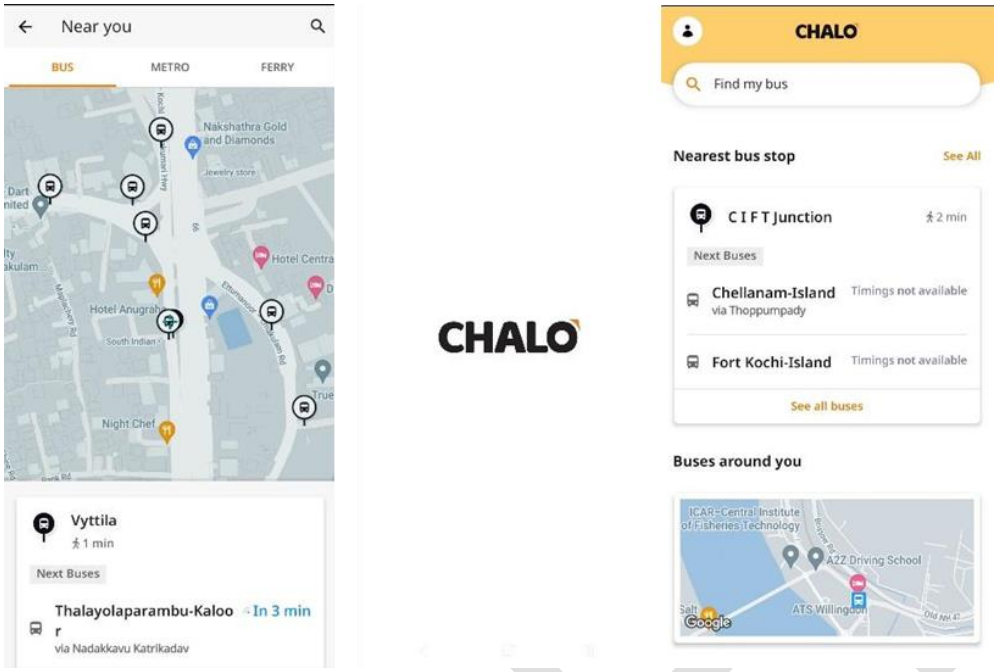


Figure 187 Chalo Mobile Application - for Live Bus Tracking and Mobile Ticketing

Though multiple facilities are available, initiatives to ensure integration of various features of the MaaS platform, such as mobility and non-mobility modes using technology and innovation for functional platforms, and offering flexible fare structures, including digital payment options are needed to provide a seamless travel experience for commuters in Kochi. Data sharing and privacy are vital for personalized travel experiences, and clear rules are essential for managing data and information flow in the ecosystem.

Such MaaS platforms through data analytics in due course shall facilitate efficient capacity utilization, and influence commuters' travel behaviour because of the enhanced travel experience. The current digitalization wave globally is driving the momentum of MaaS adoption, benefitting passengers with seamless experiences, reducing car usage, and promoting sustainable transportation.

For Kochi, it is recommended to have a detailed assessment of the extent of available technology interventions and gap identification be carried out to develop and integrate the various services under a single umbrella under the aegis of KMTA/ KMRL/ PPP.

8.8.3 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.

8.8.4 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, several 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 188 Electric Vehicles

Electric Feeder Services (e-buses) are operational along three routes by KMRL. It is suggested to expand the services and promote utilization of e-buses. Whereas E-rickshaws are highly recommended in the city. As a part of the CSML and Kochi Corporation initiative, E-Rickshaws are currently operational in the city. It is recommended that these e-auto be allowed to ply in the core are to provide connectivity during the restricted vehicle hours to provide connectivity.

8.8.5 SMART 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.

Figure 189 CSML Smart Bus Shelters at Abraham Madamakal Road, Kochi (Source: Various)

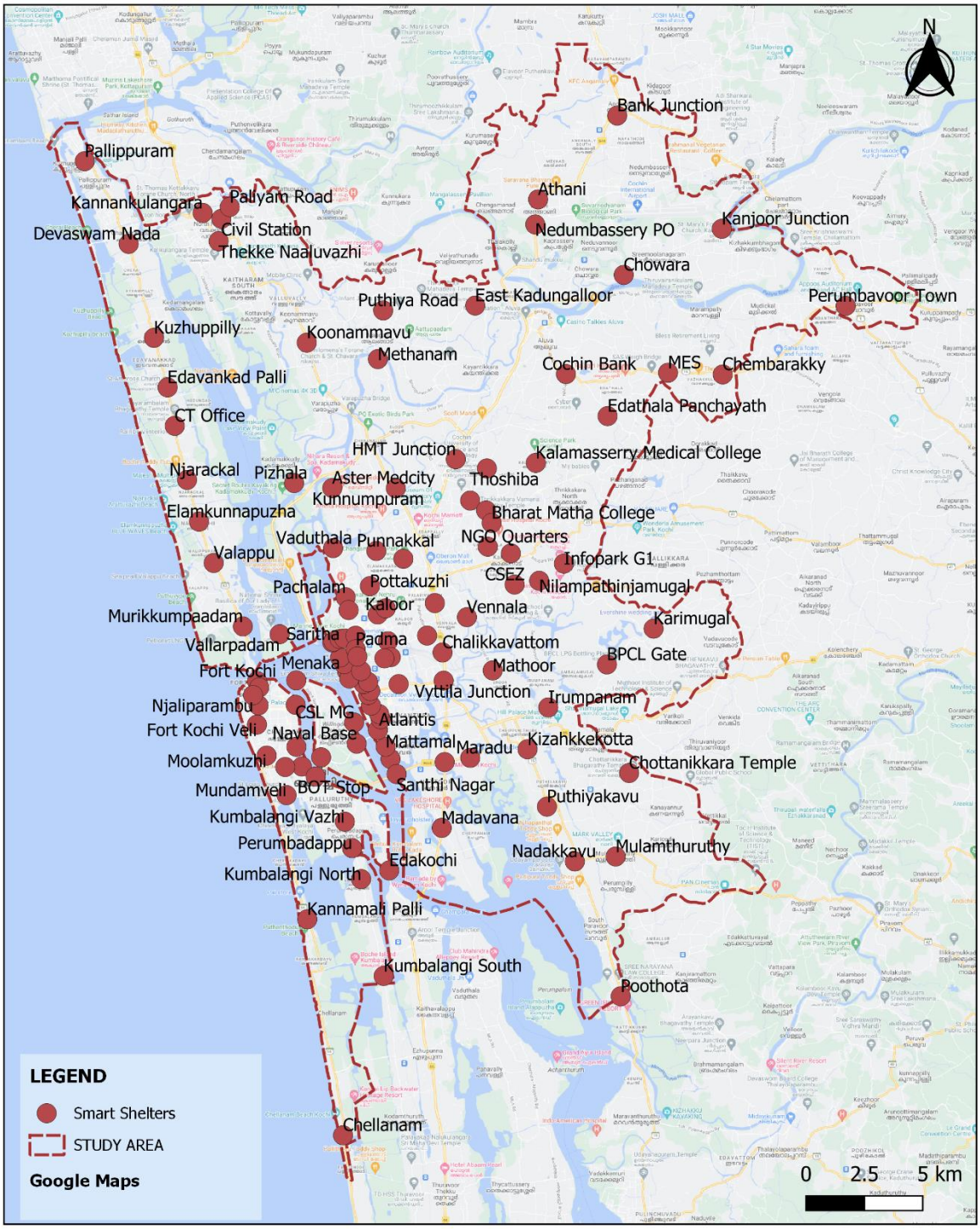
CSML has initiated implementation of smart bus shelters to benefit the city commuters, two such shelters are implemented on Abraham Madamakkal (AM) Road. These shelters are equipped with solar power, SOS alert switches, charging points, wastebins, and CCTV surveillance for increased safety. A suggested list of bus shelters for implementation is provided below. On a pilot basis, 122 bus shelters are listed, and this will be further augmented to include all the bus shelters in the study area.

Table 101 Proposed Bus Stops for Smart Bus Shelters on Pilot Basis

SN	Location	SN	Location
1	Karuvelappadi	27	HMT Junction
2	CIFT	28	Methanam
3	Perumpadappu	29	Kunnumpuram
4	Fort Kochi Veli	30	Punnakkal
5	Kumbalangi Vazhi	31	Judgemukku
6	Mattancherry Govt. Hospital	32	CUSAT University Ground
7	BOT Stop	33	Toshiba
8	Taluk Hospital Fort Kochi	34	CSEZ
9	Kumbalangi North	35	Nilampathinjamugal
10	Fort Kochi	36	NGO Quarters
11	Kokers	37	Kakkanad Civil Station
12	Njaliparambu	38	Mulamthuruthy
13	Mundamveli	39	Nadakkavu
14	Moolankuzhi	40	Mathoor
15	Kazhuthumuttu	41	Vennala
16	Naval Base	42	Pallippuram
17	Thoppumpady	43	Devaswam Nada
18	Wellington Island	44	Kuzhuppilly
19	Chembarakky	45	Edavanakkad Palli
20	MES	46	Thekke Naluvazhi
21	Cochin Bank	47	Paliyam Road
22	Edakochi	48	Kannankulangara
23	Chellanam	49	Civil Station
24	Bank Junction	50	Vaduthala
25	Kanjoor Junction	51	Aster Medicity
26	Kalamasserry Medical College	52	Pizhala

SN	Location
53	Koonammavu
54	Ayyappankavu
57	Pottakuzhi
58	Changampuzha Park
59	Vyttila Junction
60	Mathrubhoomi
61	Kaloor
62	Gandhi Nagar
63	Kumaranasan Junction
64	Kizakkekotta
65	Irumpanam
66	Murikkumpaadam
67	Vallarpadam
68	Shenoys
69	Thammanam
70	CT Office
71	Njarackal
72	Elamkunnapuzha
73	Valappu
74	High Court
75	Menaka
76	St, Teresa's College
77	Subhash Park
78	Kacherippady
79	St. Alberts
80	Saritha
81	High Court - Banerji Road
82	Kadavanthra Junction
83	Kundannur Junction
84	Maharajas
85	Padma
86	Ernakulam Medical Centre
87	Maradu
88	Challikavattom

SN	Location
89	Kathrikadavu
90	Santhi Nagar
91	SH College
92	CSL MG
93	CSL
94	Thevara
95	Mattamal
96	Valanjambalam
97	Medical Trust Hospital
98	Ravipuram
99	Atlantis
100	Ernakulam Boat Jetty
101	Hospital Junction
102	Ernakulam South
103	Jose Junction
104	Madavana
105	Chottanikkara Temple
106	Puthiyakavu
107	Poothotta
108	Chowara
109	Nedumbassery PO
110	Athani
111	Kumbalangi South
112	Perumbavoor Town
113	East Kadungalloor
114	Puthiya Road
115	Edathala Panchayat
116	Infopark G1
117	Kannamaly Palli
118	Kavunthazham
119	BPCL Gate
120	Karimughal
121	Pachalam
122	Bharat Matha College



Title: Comprehensive Mobility Plan for Kochi	
Map: Smart Bus Shelters	

Figure 190 Proposed Locations for Smart Bus Shelters

8.8.6 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 analysed 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 considers 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 analysed 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.

Based on the recommendations of the Kochi CMP 2017, CSML has implemented ATCS in Kochi Corporation limits under two segments Enforcement, and Traffic Management. The project Intelligent Traffic Management System (ITMS) covers 35 junctions wherein enforcement cameras to detect violation detection as well as signal systems with flow detection and optimization of signal controls are implemented. Other capabilities of the project ITMS incident management and information dissemination. As per the data collected from Kochi City Traffic police, these facilities are operational at 17 junctions in the city.

Table 102 Junctions covered under ITMS Project

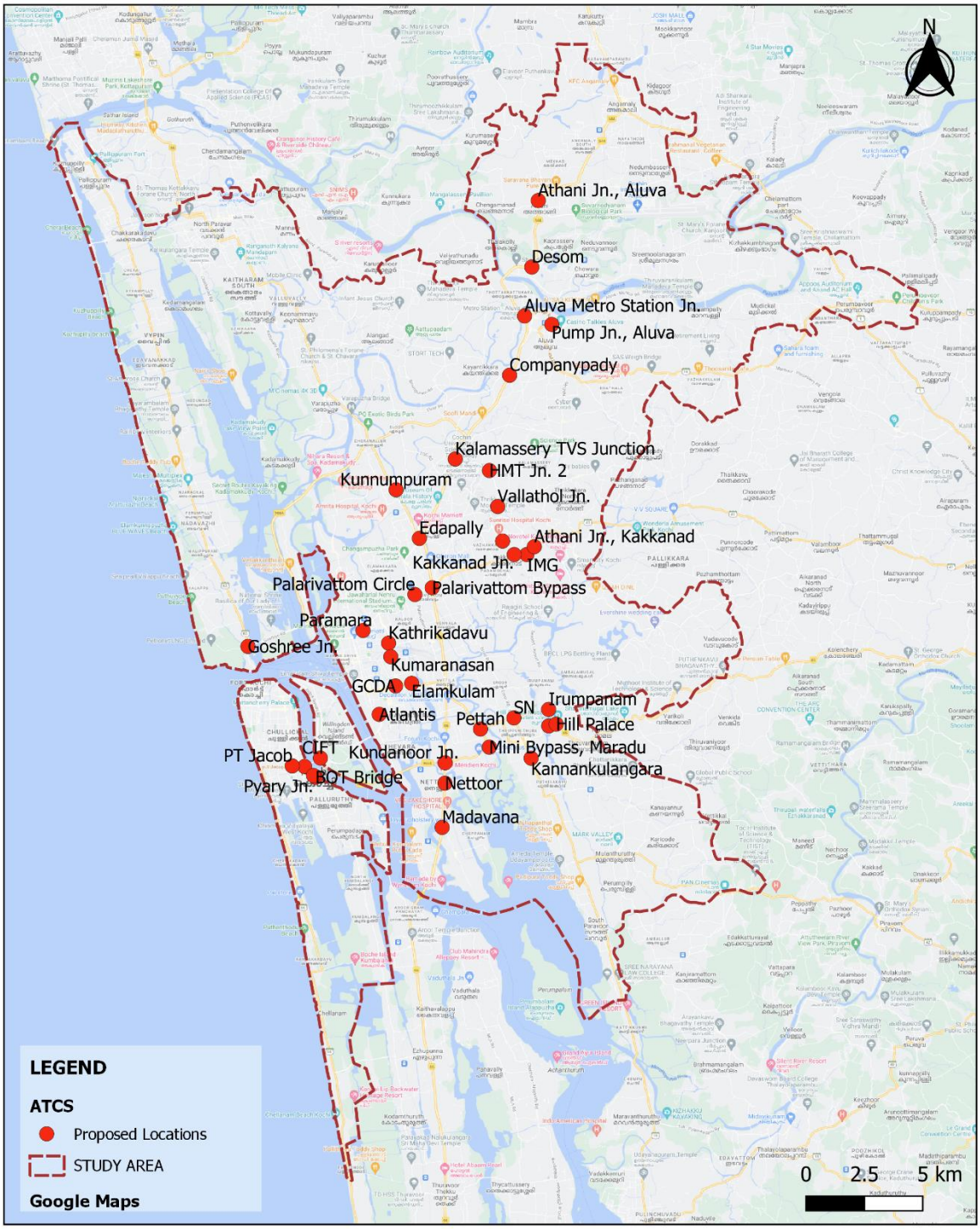
SN	JUNCTIONS
1	DCC Junction
2	Jose Junction
3	Pallimukku
4	Manorama Junction
5	Judges Avenue Junction
6	Madhava Pharmacy Junction
7	Kaloor Junction
8	Thevara Junction
9	Kadavanthra Junction
10	Subhash Chandra Bose Junction
11	Thevara Ferry Junction
12	Palarivattom – SN Junction
13	CPO Junction
14	Police Club Junction
15	Rajaji Junction
16	Subhash Chandra Bose Junction
17	Hospital Junction

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 103 Proposed Intersection for ATCS

SN	JUNCTION	PHASE
1.	Aluva Metro Station Jn.	PHASE I
2.	Athani Jn., Aluva	PHASE II
3.	Athani Jn., Kakkanad	PHASE II
4.	Atlantis Jn.	PHASE I
5.	BOT Bridge	PHASE I
6.	CIFT Jn.	PHASE I
7.	Companypady	PHASE II
8.	Desom	PHASE II
9.	Edapally	PHASE I
10.	Elamkulam	PHASE I
11.	GCDA Jn.	PHASE I
12.	Goshree Jn.	PHASE I
13.	Hill Palace	PHASE II
14.	HMT Jn. 2	PHASE II
15.	IMG Jn.	PHASE II
16.	Irumpanam Jn.	PHASE II
17.	Kakkanad Jn.	PHASE II
18.	Kalamasserry TVS Jn.	PHASE II
19.	Kannankulangara	PHASE II
20.	Karingachira	PHASE II
21.	Kathrikadavu	PHASE I
22.	Kundannur Jn.	PHASE I
23.	Kumaranasan	PHASE I
24.	Kunnumpuram	PHASE I
25.	Madavana Jn.	PHASE II
26.	Mavelipuram Signal Jn.	PHASE II
27.	Mini Bypass Jn., Maradu	PHASE I
28.	Nettoor Jn.	PHASE II
29.	Palarivattom Bypass Jn.	PHASE I
30.	Palarivattom Circle	PHASE I
31.	Paramara Jn.	PHASE I
32.	Pettah Jn.	PHASE I
33.	PT Jacob Jn.	PHASE I
34.	Pump Jn., Aluva	PHASE II
35.	Pyary Jn.	PHASE I
36.	SN Jn.	PHASE I
37.	Thoppumpady	PHASE I
38.	Vallathol Jn.	PHASE II

Considering the extent of interventions is limited to certain select junctions and within Corporation Area, to maximize the benefits and ensure enhanced mobility, it is recommended to have a detailed assessment of the extent of available technology and infrastructure implemented, its capacity as well as scalability. Identify the gaps in the system and develop an ATCS system for the entire study area, implementation thereof along with corridor and junction improvements as appropriate.



Title: Comprehensive Mobility Plan for Kochi	
Map: ATCS Proposals	

Figure 191 ATCS Proposals in the Study Area

8.9 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.

Kochi being centrally located with the presence of International Transhipment Terminal at Vallarpadom and Cochin Port operations, witnesses' significant goods movement, through international waters apart from the road and rail-based freight. The city, a confluence of 5 NHs has two spurs NH 966A and 966B developed which connects the International Transhipment Terminal and Cochin Port to NH66, at Cheranallur in the North and Kundannur in the South as well as NH 544 at Kalamasserry.

The recent boom in digital transactions and online delivery services, urban freight has piqued up considerably apart from the existing regional freight. 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. It is recommended to arrest the regional freight at the suburbs as well as ensure the through freights bypass it through middle and outer ring roads.

Table 104 *Proposed Freight Terminals with Capacity*

NAME	CAPACITY	AREA REQUIRED (SQ. M.)	RECOMMENDED TERMINAL TYPE
Angamaly	400	120000	Major
CIAL	500	-	Hub
Cheranallur	400	120000	Major
Edapally	200	60000	Major
Ernakulam Boat Jetty	50	15000	Minor
Irumpanam	400	120000	Major
Kalamasserry	400	120000	Major
Kumbalam	400	120000	Major
Kundannur	200	60000	Minor
Mamala	200	60000	Minor
North Paravur	400	120000	Major
Perumbavoor	500	140000	Major
Thykoodam	200	60000	Minor
Vallarpadam	500	140000	Hub
Wellington Island	500	140000	Hub

Owing to the urban growth and densification of the city towards eastern and north-eastern as well as southern directions beyond Kalamasserry, Cheranallur and Kundannur in the recent decades, it is recommended to prepare a detailed freight management strategy for the city to develop a long-term freight management plan.

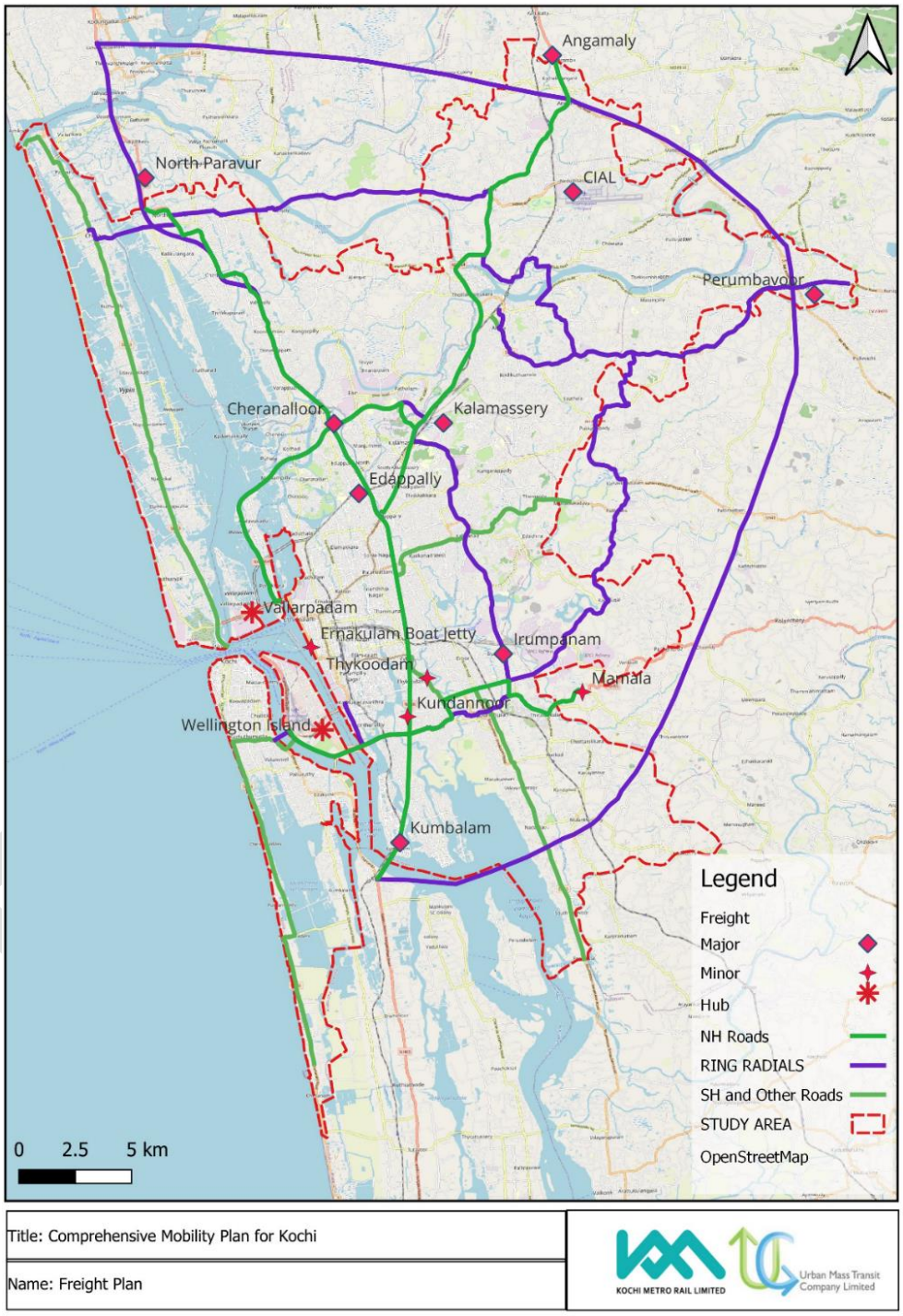


Figure 192 Proposed Freight Plan

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

09

PROJECT IMPACT ASSESSMENT


COCHIN SHIPYARD

9 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.

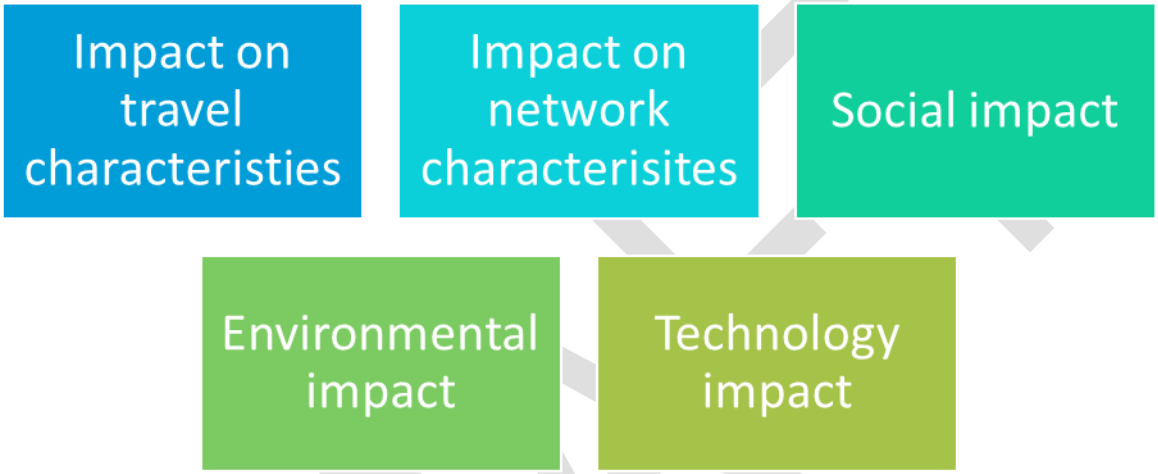


Figure 193 Parameters for Impact Assessment

9.1 IMPACT ON TRAVEL CHARACTERISTICS

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 Kochi.

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

Table 105 Impact Assessment for Travel Characteristics.

SN	INDICATOR TYPE	DESCRIPTION	BASE YEAR (2023)	BAU (2051)	SUT (2051)
Impact on Network Characteristics					
1	**Modal Share (%)-Motorized Modes (i.e., excluding NMT)**				
	Private Modes	% of trips made by private motorized modes (two-wheelers, car)	59%	61%	33%
	Public Modes	% of trips made by public transport modes	31%	33%	64%
	IPT Modes	% of trips made by intermediate public transport modes (auto-rickshaws, shared auto-rickshaws)	10%	6%	3%
2	**Trip Length (Km)**				
	Trip Length (PvT Modes)	Average Trip Length of the Two-wheeler, Car, and Auto users in the study area	10.6	11.2	10.9
	Trip Length (PT Modes)	Average Trip Length of the Public Transport users in the study area	8.61	10.4	13.6
3	**Travel Time (Minutes)**				
	Travel Time (PvT Modes)	Average Travel Time of the Two-wheeler, Car, and Auto users in the study area	27.3	33.4	27.4
	Travel Time (PT Modes)	Average Travel Time of the Public Transport users in the study area	33.9	55	34
4	**Accessibility to Public Transport (Population in lakh)**				
	Access to PT	Population having access to PT	11	15	22

9.2 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 observed to improve in intensity as well as the coverage due to introduction of new routes and improved frequency of PT transit systems. The impact on the congestion levels is assessed the same has been presented in the following table on the major mobility corridors.

Table 106 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	Aluva-Edapally – NH 544	10.8 km	1.49	1.10	1.00
2	Kaloor Kadavanthra Road	3.3 km	0.60	1.04	0.98
3	Aluva Munnar Road (SH-16)	13 km	1.14	1.98	0.99
4	SH 41 (Chithrapuzha Ponjassery Rd)	9 km	1.14	1.99	1.01
5	SH63	23 km	1.12	1.94	0.54
6	Seaport-Airport Road	11.6 km	1.76	1.87	1.01
7	Aroor Thoppumpady	8.2 km	1.45	1.57	0.98
8	Banerji Road	4 km	0.90	1.62	0.95
9	Chittoor Road	5.5 km	1.43	2.37	1.01
10	ICT Road	17.8 km	0.70	1.31	0.97
11	Civil Line Road	4.4 km	0.95	1.65	0.91
12	MG Road	4.6 km	1.30	1.83	0.94
13	SA Road	3.5 km	1.09	1.90	0.97
14	Shanmugham Road	1.1 km	0.70	1.22	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 107 Impact Assessment for Network Characteristics

SN	INDICATOR TYPE	DESCRIPTION	BASE YEAR (2023)	BAU (2051)	SUT (2051)
1 Infrastructure and Landuse					
1	**Infrastructure Quality**				
	Average Speed (Kmph) (PvT)	Average speed of private modes	23.3	20.11	25
	Average Speed (Kmph) (PT)	Average speed of public transport modes (Bus, Metro & Ferry)	15.25	11.34	21
2	**Safety**				
	Quality of footpath infrastructure	% of city covered with Footpaths (Arterial and Sub-Arterial)	7%	29%	100%

9.3 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 108 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
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 109 Social Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU SCENARIO (2051)	SUT SCENARIO (2051)
Walkability (Arterial & Sub-Arterial)	7%	29%	100%
Cyclability (Arterial & Sub-Arterial)	0%	10%	>50%
Public Transport Accessibility	60%	72%	80%
Average distance to nearest stop from house of a PT user	0.7	0.7	0.6
Percent of public transport vehicles that provide disability access (by public transport mode)	<1 %	<10%	50%
Percent public transport stations / bus stops that provide disability access	<1%	<10%	50%
Percent length of public footpaths (km) that provide disability access	<1%	<10%	75%

9.4 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 *110*.

Table 110 *Impacts of Proposed Project Implementation*

	PROJECT	SUBCOMPONENTS	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	SUBCOMPONENTS	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 Kochi, 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 111 Environmental Impacts of Proposed Projects

NAME OF THE IMPACT	BASE YEAR (2023)	BAU (2051)	SUT (2051)
GHG Emissions (Tonnes/day)	36.53	72.93	49.59
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.

9.4.1 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 Kochi.

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 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.

9.4.2 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

9.4.2.1 ENVIRONMENTAL MITIGATION MEASURES

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.

9.4.2.2 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 112 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 laning &/or 2 laning of road could increase the number of accidents.	Safe pedestrian pathway shall be included.
CONSTRUCTION STAGE	
Construction of the road to 4 laning/2 laning 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 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.

ADVERSE IMPACT	MITIGATION MEASURES
Operation of construction equipment and delivery trucks generates air & noise pollution.	Stationary construction equipment will be kept at least 500m away from residential areas.
	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

9.4.2.3 Generic Environmental Mitigation Measures

Table 113 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 Maharashtra 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	KMC	PIA
2	Local Traffic Arrangements	Temporary traffic arrangements during construction within ROW must be planned. This plan shall be periodically reviewed with respect to site conditions	MoRTH:112	During site clearance and Construction	Contractor	KMC
3	Pedestrian Safety	Special considerations shall be given in the local traffic management to the pedestrian safety especially at congested locations.	MoRTH:112.2	At Congested locations	Contractor	KMC
		Adequate provisions to segregate through the local traffic.				

S. NO.	ADVERSE IMPACT	MITIGATION MEASURES	CROSS REFERENCE TO DOCUMENTS	TIME FRAME	RESPONSIBILITY	
					IMPLEME-NTATION	SUPER VISION
		Guard railing all along the urban section.				
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	KMC
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	KMC
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	KMC
7	Noise Level	NOC from concerned State Pollution Control Board shall be obtained.	MoRTH 111	Before start of the project road	Contractor	KMC

S. NO.	ADVERSE IMPACT	MITIGATION MEASURES	CROSS REFERENCE TO DOCUMENTS	TIME FRAME	RESPONSIBILITY	
					IMPLEME-NTATION	SUPER VISION
		Noise screening by trees plantation scheme proposed as noise barriers.				
		Adequacy of measures shall be checked to control noise pollution.				
8	Relocation of utility lines/community utilities	Affected utilities shall be relocated with prior approval of the concerned agencies.	MoRTH 110	Before start of the project road	Contractor	KMC
		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.				
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

9.4.2.4 INSTITUTIONAL STRENGTHENING

The implementation of an environmentally sound transport strategy involves several 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.

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.

Kochi Corporation is the apex organization and being the regional funding authority must 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 114 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 analyse environmental information generated by organizations like KSPCB (Kerala State Pollution Control Board), etc.	Enhance the capabilities of the KMC by outsourcing whenever required. Training coordinated by KMC with support of EMCB Consultants on: • Environmental assessment • Appreciation of Environmental impacts and EMPs procedure and responsibilities for EMP implementation, monitoring & reporting etc.

9.4.2.5 ROLE OF IMPLEMENTING AUTHORITIES IN CONSTRUCTION PHASE MITIGATION

Implementing Organizations for Construction Stage Mitigation:

The project implementing authorities like KMC 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 daytime 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 KMC /PWD specified sites.

9.4.2.6 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 115 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.

9.4.2.7 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 KMC 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 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.)

9.5 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.

9.5.1 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 Kochi, 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 116 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%

9.5.2 ITS TRANSITION

The efforts to add information technology to transport infrastructure and vehicles 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

9.5.2.1 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 117 Availability of Traffic Surveillance

PARAMETER	DESCRIPTION	BASE YEAR (2023)	SUT (2051)	BAU (2051)
Availability of Traffic Surveillance – CCTV	Share of Stations with CCTV on Terminals, Stations, and Signalized Intersections	58.33%	**100%**	**80%**

9.5.2.2 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 118 Passenger Information System

PARAMETER	DESCRIPTION	BASE YEAR (2023)	SUT (2051)	BAU (2051)
Passenger Information System (PIS) for Public Transport	Share of Terminals, Stations having PIS	54.10%	**100%**	**50%**

9.5.2.3 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 119: Global Positioning System

PARAMETER	DESCRIPTION	BASE YEAR (2023)	SUT (2051)	BAU (2051)
Global Positioning System / GPRS	Share of Public Transport Vehicles and IPT with on-board GPS/GPRS which are connected to common control center	8.2%	**100%**	**80%**

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

10

IMPLEMENTATION PLAN

10 IMPLEMENTATION PLAN

10.1 PHASING AND PRIORTIZATION OF PROJECTS

"Prioritization" as an activity, identifies all individual projects that need to be executed 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 (2027-2031-2041), and Phase III indicates long term measures (2051)

10.1.1 PROPOSAL 1: PUBLIC TRANSPORT SYSTEM

Table 120: 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 Mass Transit System	Critical	High	Phase I, II, III
Development of Inland Water Transportation	Critical	High	Phase I, II, III
Public Terminals	Critical	Medium	Phase II
Intermediate Public Transport	Critical	High	Phase I, II

10.1.2 PROPOSAL 2: NON-MOTORISED TRANSPORT FACILITY IMPROVEMENT

Table 121: Phasing and Prioritization of Pedestrian Facility Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Footpath	Critical	High	Phase I

Table 122: Phasing and Prioritization of Bicycling Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Segregated Cycle Tracks	Critical	High	Phase I
Public Bick Sharing Schemes	Critical	High	Phase I

10.1.3 PROPOSAL 3: FREIGHT MANAGEMENT PLAN

Table 123: Phasing and Freight Management Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Freight Terminals	Critical	Medium	Phase I, II, III

10.1.4 PROPOSAL 4: PARKING MANAGEMENT PLAN

Table 124: 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

10.1.5 PROPOSAL 5: INTELLIGENT TRANSPORTATION SYSTEMS

Table 125: 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 I, II, III

10.1.6 PROPOSAL 6: ROAD NETWORK PLAN

Table 126: Phasing and Prioritization of Road Network Proposals

PROPOSED SCHEMES	CATEGORY	PRIORITY BASED ON SCORING	PHASING
Upgradation of Links	Critical	High	Phase I
Development Ring Roads	Desirable	Medium	Phase II, III
New / Missing Links	Desirable	Medium	Phase I
ROBs/RUB/Canal Crossings	Desirable	Medium	Phase I, II

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 review 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 Kochi are presented below.

10.1.7 SHORT TERM PROPOSALS

Table 127: List of Short-Term Proposals

SN	PROPOSALS
10.	City Bus, MRTS, Water Transport
11.	Intermediate Public Transport
12.	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras
13.	Footpath, Cycle Tracks, PBS
14.	Freight Terminals
15.	On-street & Off-street Parking, MLCP
16.	Upgradation of Links
17.	New / Missing Links, Radials
18.	ROBs/RUB/Canal Crossings

10.1.8 MEDIUM TERM PROPOSALS

Table 128: List of Medium-Term Proposals

SN	PROPOSALS
1.	City Bus, MRTS, Water Transport
2.	Public Transport Terminals
3.	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras
4.	Intermediate Public Transport
5.	Freight Terminals
6.	Off-street Parking, MLCP
7.	Ring Roads
8.	ROBs/RUB/Canal Crossings

10.1.9 LONG TERM PROPOSALS

Table 129: List of Medium-Term Proposals

SN	PROJECTS
1.	City Bus, MRTS, Water Transport
2.	Freight Terminals
3.	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras
4.	Ring Roads

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 is required for validating the feasibility of each project.

10.2 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 to the district scheduled rates for year 2023.

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 **6356.40** 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 **7746.68** crores and **5567.29** crores for long term measures.

Table 130: Estimated Project Costs

SN	PROJECTS	TOTAL COST (IN CRORES)	PHASING RS (IN CRORES)		
			2023-2027	2027-2041	2041-2051
1	Improvement of Road Network	2595.01	1409.65	917.89	267.47
2	Improvement of Non-Motorised Transport Facilities	493.34	493.34	0.00	0.00
3	Improvement of Public Transport System	14037.48	4125.24	6030.91	3881.33
4	Improvement of Freight Transportation System	2046.53	0.00	708.18	1338.35
5	Intelligent Transportation System Facilities	489.50	324.19	85.17	80.14
6	Improvement of Parking Facilities	8.51	3.99	4.52	0.00
Overall CMP Proposals		**19670.36**	**6356.40**	**7746.68**	**5567.29**

Table 131: 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.	677.79	380.14	226.45	71.20	2.770	1991.58	1052.93	671.18	267.47
2	New Links	Km.	5.00	5.00	0.00	0.00	3.693	18.47	18.47	0.00	0.00
3	Flyover upgradation (2-Lane)	No.	0.00	0.00	0.00	0.00	42.841	0.00	0.00	0.00	0.00
4	ROB/ Canal Crossing Upgradation (2-Lane)	No.	5.00	3.00	2.00	0.00	51.409	264.25	154.23	110.02	0.00
5	River Bridge	No.	5.00	3.00	2.00	0.00	42.841	220.21	128.52	91.68	0.00
6	Flyover (4-Lanes)	No.	0.00	0.00	0.00	0.00	59.977	0.00	0.00	0.00	0.00
7	Underpass	No.	0.00	0.00	0.00	0.00	42.841	0.00	0.00	0.00	0.00
8	Junction Improvements	No.	62.00	37.00	25.00	0.00	1.500	100.50	55.50	45.00	0.00
Total Project Cost								**2595.01**	**1409.65**	**917.89**	**267.47**
Improvement of Non-Motorised Transport Facilities											
1	Footpath	Km.	286.57	286.57	0.00	0.00	1.625	465.68	465.68	0.00	0.00
2	NMT Only Lanes	Km.	4.60	4.60	0.00	0.00	2.556	11.76	11.76	0.00	0.00
3	Shared Cycle Tracks	Km.	184.36	184.36	0.00	0.00	0.026	4.77	4.77	0.00	0.00
4	Dedicated Cycle Tracks	Km.	3.70	102.21	0.00	0.00	0.052	5.28	5.28	0.00	0.00
5	Public Bike Sharing Stations	No.	65.00	65.00	0.00	0.00	0.018	1.20	1.20	0.00	0.00
6	Public Bike Sharing Cycles	No.	800.00	800.00	0.00	0.00	0.007	5.32	5.32	0.00	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
Total Project Cost								**494.00**	**494.00**	**0.00**	**0.00**
Improvement of Public Transport System											
1	Bus Fleet Augmentation	No.	1592.00	437.00	514.00	641.00	1.808	3356.62	790.18	994.52	1571.93
2	Improvement of Bus Terminals / Multi Modal Mobility Hubs	No.	12.00	0.00	12.00	0.00	1.950	25.04	0.00	25.04	0.00
3	New Public Transportation Station	No.	18.00	0.00	18.00	0.00	1.773	34.14	0.00	34.14	0.00
4	In Land Water Ways System	Km	78.00	0.00	0.00	78.00	10.467	1107.29	0.00	0.00	1107.29
5	MRT System (Metro)	Km	27.10	13.00	14.10	0.00	256.543	7205.74	3335.06	3870.68	0.00
6	BRTS System	Km	65.00	0.00	35.00	30.00	29.545	2308.65	0.00	1106.54	1202.11
Total Project Cost								**14037.48**	**4125.24**	**6030.91**	**3881.33**
Improvement of Freight Transportation System											
1	Proposed New Truck Terminals	Sq. m	1395000.00	0.00	560000.00	835000.00	0.001	2046.53	0.00	708.18	1338.35
Total Project Cost								**2046.53**	**0.00**	**708.18**	**1338.35**
Technological and Intelligent Transportation System Facilities											
1	New Signal Installations	No.	44.00	27.00	17.00	0.00	0.295	13.35	7.98	5.37	0.00
2	Adaptive Traffic Control System	No.	38.00	21.00	17.00	0.00	0.886	34.74	18.61	16.12	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
3	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	Km.	450.00	250.00	100.00	100.00	0.591	291.10	147.73	63.23	80.14
4	Smart Bus Shelters	No.	2800.00	300.00	1250.00	1250.00	0.133	148.91	148.91	0	0
5	Electric Charging Stations - 2w and 3w	No.	525.00	384.00	141.00	0.00	0.003	1.40	0.96	0.44	0.00
Total Project Cost								**489.50**	**324.19**	**85.17**	**80.14**
Improvement of Parking Facilities											
1	On street Parking	Km.	4.00	4.00	0.00	0.00	0.554	2.22	2.22	0.00	0.00
2	Off street Parking (MLCP)	No.	4.00	0.00	4.00	0.00	1.108	4.52	0.00	4.52	0.00
2	Off street Parking (Surface))	No.	4.00	4.00	0.00	0.00	0.443	1.77	1.77	0.00	0.00
Total Project Cost								**8.51**	**3.99**	**4.52**	**0.00**
Overall Comprehensive Traffic and Transportation Plan Proposals											
Total Project Cost								**19670.36**	**6356.40**	**7746.68**	**5567.29**

10.3 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 does not make the system self-sustainable. At the same time, providing safe, comfortable, speedy, and affordable public urban transport to all must 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 must 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.

10.3.1 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 several 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, 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.

10.3.2 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.

10.3.2.1 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 centres and other tourism infrastructure projects

10.3.2.2 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:

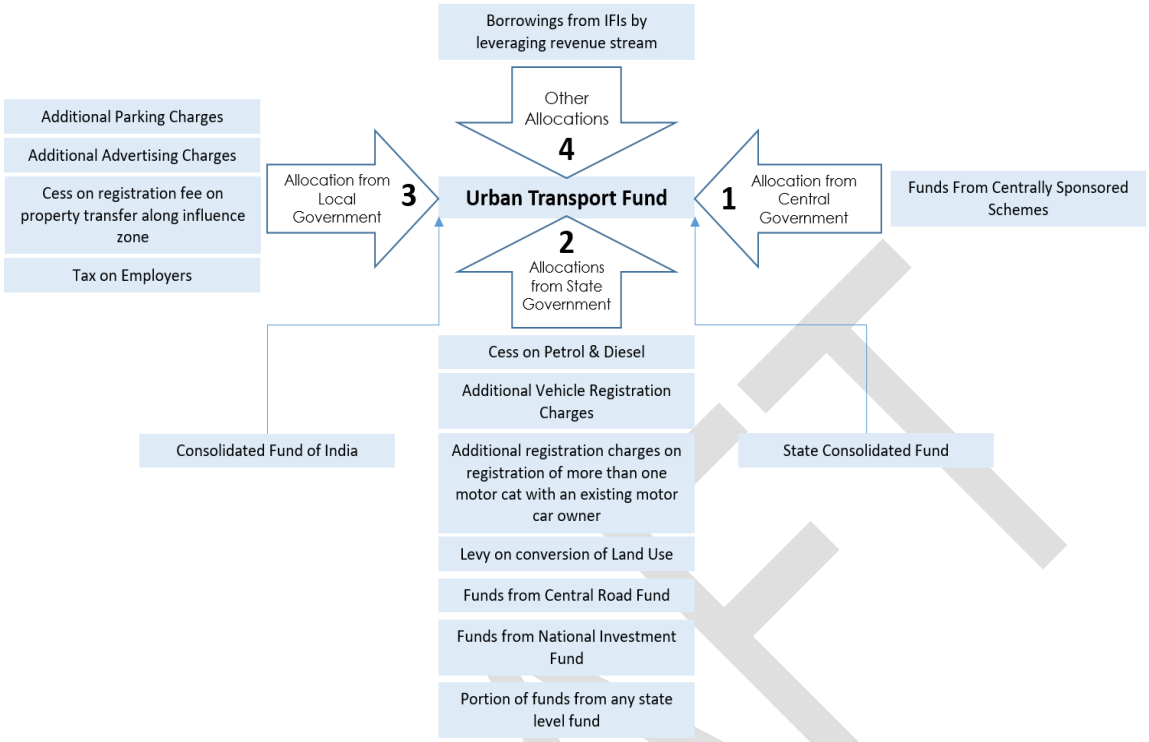


Figure 194 Sources of Funds for Urban Transport Fund

10.3.2.2.1 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.

10.3.2.2.2 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 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 seek to capitalize on the use of their land.

10.3.2.2.3 LAND VALUE TAX

Once an area is well connected by public transport and is accessible to the commercial area and 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.

10.3.2.2.4 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.

10.4 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 132: Details of Implementation Agency

SN	PROJECTS	AGENCIES RESPONSIBLE	IMPLEMENTATION OPERATION	
			CONSTRUCTION	OPERATION/MAINTAIN
Improvement of Road Network				
1	Upgradation of Existing Roads	PWD/NHAI/KMC	PWD/ NHAI / Private	PWD / NHAI / Private
2	New Links	PWD/NHAI/KMC	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/KMC	PWD/ NHAI / Private	PWD / NHAI / Private
5	Flyover (4-Lanes)/ Bridges/ Underpasses	PWD / KMC / State Govt. / NHAI	State Govt. / KMC	PWD / NHAI / Private
6	Junction Improvements	PWD / KMC / State Govt. / NHAI	State Govt. / KMC	PWD / NHAIs
Improvement of Non-Motorised Transport Facilities				
1	Footpath	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
2	NMT Only Lanes	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
3	Shared Cycle Tracks	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
4	Dedicated Cycle Tracks	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL	KMC / Smart City / PWD/ KMRL/ Traffic Police
5	Public Bike Sharing Stations	KMC / Smart City / KMRL / Private	KMC / Smart City / KMRL / Private	KMC / Smart City /KMRL / Private
6	Public Bike Sharing Cycles	KMC / Smart City / KMRL / Private	KMC / Smart City / KMRL / Private	KMC / Smart City / KMRL / Private
7	Public Education and Awareness program	KMC / Smart City / KMRL / Private / NGOs /State Govt.	KMC / Smart City / KMRL / NGOs	KMC / Smart City / KMRL / 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/KMC / Smart City	KSRTC/KMC / Smart City / Private	KSRTC/KMC / Smart City / Private
3	New Public Transportation Station	KSRTC/ KMRL /KMC / Smart City	KSRTC/ KMRL/ KMC / Smart City / Private	KSRTC/ KMRL/ KMC / Smart City / Private
4	In Land Water Ways System	KMRL /KMC / Smart City	KMRL /KMC / Smart City	KMRL /KMC / Smart City
5	MRT System (BRT/LRT/MRT)	KMRL	KMRL	KMRL
Improvement of Freight Transportation System				
1	Proposed New Truck Terminals	State Govt. / KMC	State Govt. / Private	Private
Technological and Intelligent Transportation System Facilities				
1	New Signal Installations	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police
2	Adaptive Traffic Control System	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police
3	Smart City Bus Shelters	KSRTC/ KMC/ Smart City / Traffic Police	KSRTC/ KMC/ Smart City / Traffic Police / Private	KSRTC/ KMC/ Smart City / Traffic Police / Private
4	ITS control Centre, PIS, GPS, Mobile phone Applications and Surveillance Cameras)	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police
5	Electric Charging Stations - 2w and 3w	KMC / Smart City / KSEB / Private	KMC / Smart City / KSEB / Private	KMC / Smart City / KSEB / Private
Improvement of Parking Facilities				
1	On street Parking	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police / Private	KMC/ Smart City / Traffic Police / Private
2	Off street Parking (MLCP)	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police / Private	KMC/ Smart City / Traffic Police / Private
3	Off street Parking (Surface))	KMC/ Smart City / Traffic Police	KMC/ Smart City / Traffic Police / Private	KMC/ Smart City / Traffic Police / Private

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

11

INSTITUTIONAL FRAMEWORK

11 INSTITUTIONAL FRAMEWORK

11.1 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 Kochi.

- Kochi Municipal Corporation (KMC)
- Greater Cochin Development Authority (GCDA)
- Goshree Islands Development Authority (GIDA)
- Kochi Metro Rail Limited (KMRL)
- Kochi Metropolitan Transport Authority (KMTA)
- Cochin Smart Mission Limited (CSML)
- 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)
- CIAL, Kochi

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.

Kochi Metropolitan Transport Authority was setup for the city on 1st November 2020, under the Kerala Metropolitan Transport Authority Act, 2019. KMRL played a pivotal role in setting up KMTA. The initiatives and activities taken up by the Urban Transport wing of KMRL to promote integration and seamless travel experience across various modes of transport in Kochi are:

1. Assist GoK in formulation of the Kerala Metropolitan Transport Authority Bill, 2019 as per the NUTP policy 2006.
2. Bring more than 800 private buses operational in the city under 7 cluster-based bus operating companies for integrated bus operations as well as installation of GPS in private bus services.
3. Introduction of journey planner mobile application 'Chalo' in 2018.
4. Efforts to promote the adoption of Kochi1 card across various class of public transport users.
5. To assure feeder services and ensure last-mile connectivity, facilitated in aggregating 15000 auto-rickshaws under one single umbrella 'Ernakulam District Auto Rickshaw Drivers Co-Operative Society'.
6. Other efforts include fare integration in association with CEPT, measures to enhance metro ridership in association with CPPR, bus route rationalization plan for Greater Kochi Region, etc.

The noteworthy initiatives taken up by KMTA within months of operation include setting up of Kochi Open Mobility Network (KOMN) becoming pioneers in India to integrate, plan, and regulate the various commute modes. KOMN enabled by open specifications of Beckn strives integration of urban transport modes which is an inclusive and interoperable.

The activities of KMTA are limited due to a shortage of staff. With a view to coordinate all urban transport activities in the city, it is recommended that KMTA be revived at the city level that acts as a planning and coordinating body for all matters related to urban transport in the city. This would enable planned development of urban transport infrastructure considering the duties and powers vested in Kochi MTA by the KMTA Act 2019.

It is also recommended to consider at least the 732 km area consisting of GCDA and GIDA as the Urban Mobility Area for Kochi apart from the prescribed Kochi Municipal Corporation limits as per the KMTA Act 2019, considering the urban growth of the city.

11.2 INSTITUTIONAL SETUP

It is recommended that the city level UMTA be revived with appropriate professionals so that it's functioning falls in line with that of the KMTA act and commands greater authority.

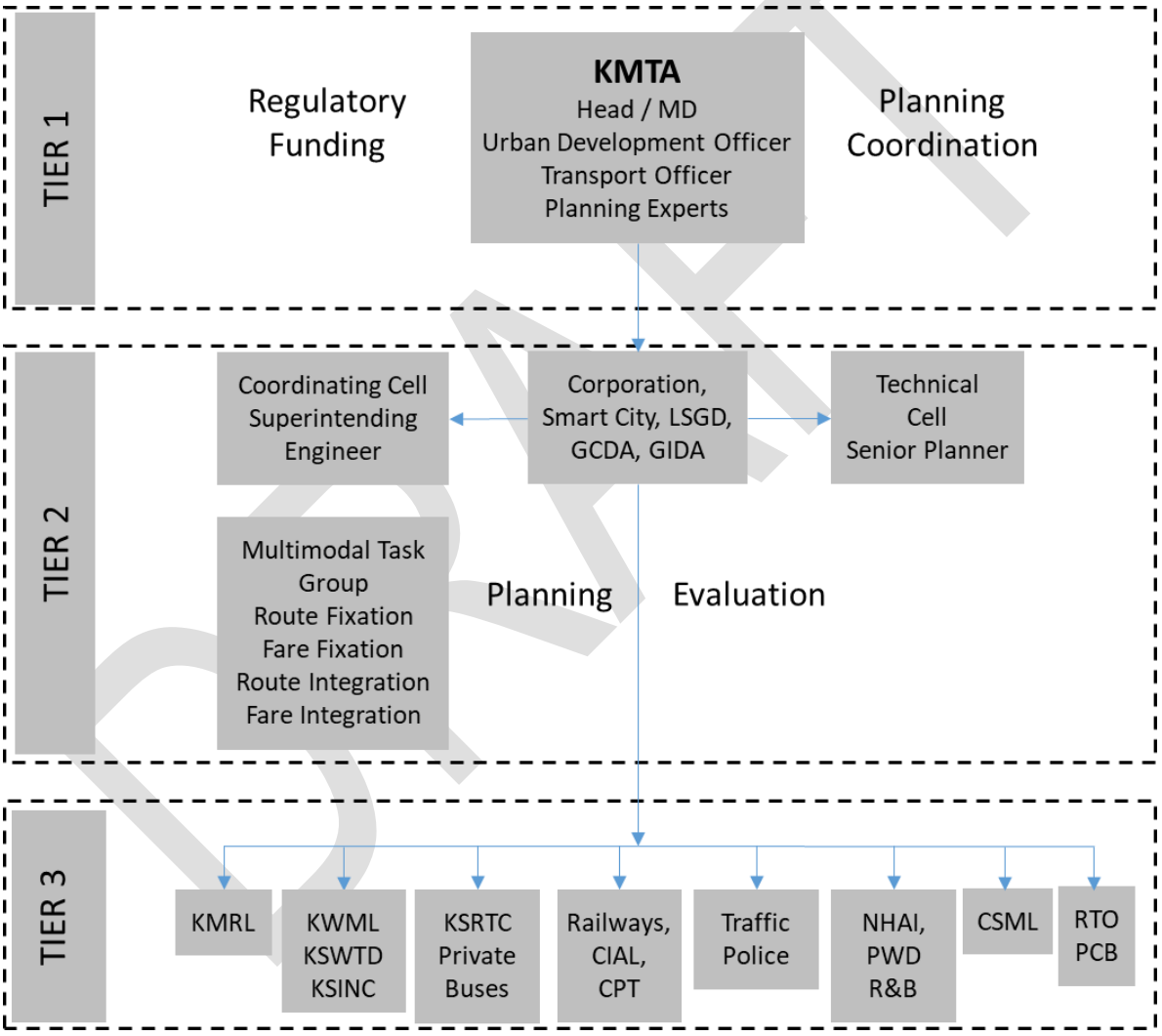


Figure 195 Recommended Structure for UMTA Setup

11.3 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.

11.4 LEGAL BACKING OF UMTA

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.

11.5 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. 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.

KOCHI METRO RAIL LIMITED

Urban Mass Transit Company Limited

ANNEXURE


COCHIN SHIPYARD
COCHIN SHIPYARD

ANNEXURES

ANNEXURE 1: TAZ WISE DETAILS OF STUDY AREA

The study area of comprising of Kochi Municipal Corporation, 9 Municipalities and 29 Panchayats spread across an area of 732 sq. km. is divided into 439 Traffic Analysis Zones (TAZ) is presented in Table below.

TAZ_NO	BOUNDARY	LOCATION NAME
1	Kochi Municipal Corporation	Fort Kochi
2	Kochi Municipal Corporation	Fort Kochi
3	Kochi Municipal Corporation	Calvathy
4	Kochi Municipal Corporation	Eeravely
5	Kochi Municipal Corporation	Karippalam
6	Kochi Municipal Corporation	Mattancherry
7	Kochi Municipal Corporation	Mattancherry
8	Kochi Municipal Corporation	Kochangadi
9	Kochi Municipal Corporation	Cheralai
10	Kochi Municipal Corporation	Panayappilly
11	Kochi Municipal Corporation	Panayappilly
12	Kochi Municipal Corporation	Chakkamadam
13	Kochi Municipal Corporation	Karuvelappadi
14	Kochi Municipal Corporation	Thoppumpady
15	Kochi Municipal Corporation	Thoppumpady
16	Kochi Municipal Corporation	Tharebhagom
17	Kochi Municipal Corporation	Tharebhagom
18	Kochi Municipal Corporation	Kadebhagom
19	Kochi Municipal Corporation	Kadebhagom
20	Kochi Municipal Corporation	Thazhappu
21	Kochi Municipal Corporation	Thazhappu
22	Kochi Municipal Corporation	Edakochi North
23	Kochi Municipal Corporation	Edakochi North
24	Kochi Municipal Corporation	Edakochi South
25	Kochi Municipal Corporation	Perumpadappu
26	Kochi Municipal Corporation	Perumpadappu
27	Kochi Municipal Corporation	Konam
28	Kochi Municipal Corporation	Konam
29	Kochi Municipal Corporation	Kacherippady
30	Kochi Municipal Corporation	Kacherippady

TAZ_NO	BOUNDARY	LOCATION NAME
31	Kochi Municipal Corporation	Nambyapuram
32	Kochi Municipal Corporation	Pullardesom
33	Kochi Municipal Corporation	Pullardesom
34	Kochi Municipal Corporation	Mundamveli
35	Kochi Municipal Corporation	Mundamveli
36	Kochi Municipal Corporation	Manasserry
37	Kochi Municipal Corporation	Moolankuzhi
38	Kochi Municipal Corporation	Chullickal
39	Kochi Municipal Corporation	Nazareth
40	Kochi Municipal Corporation	Fort Kochi Veli
41	Kochi Municipal Corporation	Amaravathy
42	Kochi Municipal Corporation	Amaravathy
43	Kochi Municipal Corporation	W. Island South
44	Kochi Municipal Corporation	W. Island North
45	Kochi Municipal Corporation	W. Island North
46	Kochi Municipal Corporation	Vaduthala East
47	Kochi Municipal Corporation	Vaduthala East
48	Kochi Municipal Corporation	Vaduthala West
49	Kochi Municipal Corporation	Elamakkara North
50	Kochi Municipal Corporation	Puthukalavattam
51	Kochi Municipal Corporation	Puthukalavattam
52	Kochi Municipal Corporation	Ponekkara
53	Kochi Municipal Corporation	Kunnumpuram
54	Kochi Municipal Corporation	Edapally
55	Kochi Municipal Corporation	Edapally
56	Kochi Municipal Corporation	Devankulangara
57	Kochi Municipal Corporation	Devankulangara
58	Kochi Municipal Corporation	Karukappilly
59	Kochi Municipal Corporation	Karukappilly
60	Kochi Municipal Corporation	Mamangalam
61	Kochi Municipal Corporation	Mamangalam
62	Kochi Municipal Corporation	Padivattam
63	Kochi Municipal Corporation	Padivattam
64	Kochi Municipal Corporation	Vennala
65	Kochi Municipal Corporation	Vennala
66	Kochi Municipal Corporation	Palarivattom
67	Kochi Municipal Corporation	Palarivattom
68	Kochi Municipal Corporation	Karanakodam
69	Kochi Municipal Corporation	Karanakodam
70	Kochi Municipal Corporation	Thammanam

TAZ_NO	BOUNDARY	LOCATION NAME
71	Kochi Municipal Corporation	Thammanam
72	Kochi Municipal Corporation	Thammanam
73	Kochi Municipal Corporation	Chakkaraparambu
74	Kochi Municipal Corporation	Chakkaraparambu
75	Kochi Municipal Corporation	Challikavattom
76	Kochi Municipal Corporation	Ponnurunni East
77	Kochi Municipal Corporation	Ponnurunni East
78	Kochi Municipal Corporation	Vyttila
79	Kochi Municipal Corporation	Vyttila
80	Kochi Municipal Corporation	Chambakkara
81	Kochi Municipal Corporation	Poonithura
82	Kochi Municipal Corporation	Vyttila Janatha
83	Kochi Municipal Corporation	Vyttila Janatha
84	Kochi Municipal Corporation	Ponnurunni
85	Kochi Municipal Corporation	Ponnurunni
86	Kochi Municipal Corporation	Elamkulam
87	Kochi Municipal Corporation	Elamkulam
88	Kochi Municipal Corporation	Girinagar
89	Kochi Municipal Corporation	Girinagar
90	Kochi Municipal Corporation	Panampally Nagar
91	Kochi Municipal Corporation	Kadavanthra
92	Kochi Municipal Corporation	Kadavanthra
93	Kochi Municipal Corporation	Konthuruthy
94	Kochi Municipal Corporation	Konthuruthy
95	Kochi Municipal Corporation	Thevara
96	Kochi Municipal Corporation	Perumanoor
97	Kochi Municipal Corporation	Perumanoor
98	Kochi Municipal Corporation	Ravipuram
99	Kochi Municipal Corporation	Ernakulam South
100	Kochi Municipal Corporation	Ernakulam South
101	Kochi Municipal Corporation	Gandhinagar
102	Kochi Municipal Corporation	Gandhinagar
103	Kochi Municipal Corporation	Gandhinagar
104	Kochi Municipal Corporation	Kathrikadavu
105	Kochi Municipal Corporation	Kathrikadavu
106	Kochi Municipal Corporation	Kaloor South
107	Kochi Municipal Corporation	Kaloor South
108	Kochi Municipal Corporation	Kaloor South
109	Kochi Municipal Corporation	Ernakulam Central
110	Kochi Municipal Corporation	Ernakulam Central

TAZ_NO	BOUNDARY	LOCATION NAME
111	Kochi Municipal Corporation	Ernakulam North
112	Kochi Municipal Corporation	Ernakulam North
113	Kochi Municipal Corporation	Ayyappankavu
114	Kochi Municipal Corporation	Ayyappankavu
115	Kochi Municipal Corporation	Thrikkanarvattom
116	Kochi Municipal Corporation	Thrikkanarvattom
117	Kochi Municipal Corporation	Kaloor North
118	Kochi Municipal Corporation	Kaloor North
119	Kochi Municipal Corporation	Elamakkara South
120	Kochi Municipal Corporation	Elamakkara South
121	Kochi Municipal Corporation	Pottakuzhi
122	Kochi Municipal Corporation	Pachalam
123	Kochi Municipal Corporation	Pachalam
124	Kochi Municipal Corporation	Thattazham
125	Aluva Municipality	Mangalapuzha
126	Aluva Municipality	Manappuram
127	Aluva Municipality	Kadathu Kadavu
128	Aluva Municipality	Pulinchodu
129	Aluva Municipality	Snehalayam
130	Angamaly Municipality	Peechanikkad
131	Angamaly Municipality	Chambanoor
132	Angamaly Municipality	Mangattukara
133	Angamaly Municipality	Maniyankulam
134	Angamaly Municipality	Kothakulangara
135	Angamaly Municipality	Pliyekkara
136	Angamaly Municipality	Valavazhi
137	Angamaly Municipality	Chetthikode
138	Eloor Municipality	Eloor North
139	Eloor Municipality	Ambedkar Ward
140	Eloor Municipality	Pathalam
141	Eloor Municipality	Parackal
142	Eloor Municipality	Manjummel
143	Eloor Municipality	F A C T Township
144	Eloor Municipality	Muttar
145	Kalamasserry Municipality	Chakyadam
146	Kalamasserry Municipality	Industrial Estate
147	Kalamasserry Municipality	Rajagiri
148	Kalamasserry Municipality	Sundaragiri
149	Kalamasserry Municipality	North Kalamasserry
150	Kalamasserry Municipality	Municipality

TAZ_NO	BOUNDARY	LOCATION NAME
151	Kalamasserry Municipality	Museum
152	Kalamasserry Municipality	Koonamthai
153	Kalamasserry Municipality	Vattekkunnam
154	Kalamasserry Municipality	Parutheli
155	Kalamasserry Municipality	Puthuppallypram
156	Kalamasserry Municipality	Changampuzha Nagar
157	Kalamasserry Municipality	Town Hall
158	Kalamasserry Municipality	St. Joseph
159	Kalamasserry Municipality	H M T Junction
160	Kalamasserry Municipality	Rockwell
161	Kalamasserry Municipality	H M T Estate
162	Kalamasserry Municipality	Medical College
163	Kalamasserry Municipality	Thevakkal
164	Kalamasserry Municipality	Puliyampuram
165	Kalamasserry Municipality	University Colony
166	Kalamasserry Municipality	C U S A T University
167	Kalamasserry Municipality	Library
168	Kalamasserry Municipality	Unichira
169	Maradu Municipality	Nettoor North
170	Maradu Municipality	Kundannur North
171	Maradu Municipality	J B School
172	Maradu Municipality	Kannadikadu East
173	Maradu Municipality	Sankar Nagar
174	Maradu Municipality	Neravathu
175	Maradu Municipality	Maradu North
176	Maradu Municipality	Kairali Nagar
177	Maradu Municipality	Pandavathu
178	Maradu Municipality	Mannaparambu
179	Maradu Municipality	Kundannur Junction
180	Maradu Municipality	Santhivanom
181	Maradu Municipality	Valanthakadu
182	Maradu Municipality	Nettoor South
183	Maradu Municipality	Peringattu Parambu
184	Maradu Municipality	Purakeli
185	Maradu Municipality	Svups
186	Maradu Municipality	North Pattupurackal
187	Maradu Municipality	Ambalakadavu
188	Paravur Municipality	Mattummal Neendoor
189	Paravur Municipality	Kannankulangara
190	Paravur Municipality	Pallamthuruth

TAZ_NO	BOUNDARY	LOCATION NAME
191	Paravur Municipality	Paravoothara
192	Paravur Municipality	Nanthikulangara
193	Paravur Municipality	Vazhikulangara
194	Paravur Municipality	Peruvaram
195	Paravur Municipality	Samooham School
196	Paravur Municipality	Kedamangalam
197	Perumbavoor Municipality	Thrikkaparambu
198	Perumbavoor Municipality	Chakkarakattu
199	Perumbavoor Municipality	Sasthamangalam
200	Perumbavoor Municipality	Thuruthiparambu
201	Perumbavoor Municipality	Karattupallikkara
202	Perumbavoor Municipality	Konnankudy
203	Perumbavoor Municipality	Neelamkulangara
204	Perumbavoor Municipality	Naganchery Mana
205	Perumbavoor Municipality	Pankulam
206	Perumbavoor Municipality	Kaduval
207	Thrikkakara Municipality	Marottichuvadu
208	Thrikkakara Municipality	Thoppil
209	Thrikkakara Municipality	Thrikkakara
210	Thrikkakara Municipality	Maleppally
211	Thrikkakara Municipality	Kunneparambu
212	Thrikkakara Municipality	Desiyakavala
213	Thrikkakara Municipality	Cherumuttapuzhakkara
214	Thrikkakara Municipality	Kennedi Mukku
215	Thrikkakara Municipality	Snehanilayam
216	Thrikkakara Municipality	Kambiveli
217	Thrikkakara Municipality	Padamugal
218	Thrikkakara Municipality	T V Centre
219	Thrikkakara Municipality	Thuthiyoor
220	Thrikkakara Municipality	Palachuvadu
221	Thrikkakara Municipality	Athani
222	Thrikkakara Municipality	Vallyattumugal
223	Thrikkakara Municipality	Kollamkudimugal
224	Thrikkakara Municipality	Maleppally
225	Thrikkakara Municipality	Mavelipuram
226	Thrikkakara Municipality	Kakkanad Health Centre
227	Thrikkakara Municipality	Nilampathinjamugal
228	Thrikkakara Municipality	Chittethukara
229	Thrikkakara Municipality	Chittethukara
230	Thrikkakara Municipality	Kakkanad

TAZ_NO	BOUNDARY	LOCATION NAME
231	Thrikkakara Municipality	Thengode
232	Thrikkakara Municipality	Edachira
233	Thrikkakara Municipality	Vazhakkala
234	Thripunithura Municipality	Attaprayil
235	Thripunithura Municipality	Puthankulangara
236	Thripunithura Municipality	Post Office
237	Thripunithura Municipality	Traco
238	Thripunithura Municipality	I O C
239	Thripunithura Municipality	Puliyannoor
240	Thripunithura Municipality	Vadake Veimeedi
241	Thripunithura Municipality	Elumana
242	Thripunithura Municipality	Iyirettil
243	Thripunithura Municipality	Makaliyam
244	Thripunithura Municipality	Ilamanathope
245	Thripunithura Municipality	Hillpalace
246	Thripunithura Municipality	Kyomtha
247	Thripunithura Municipality	Karingachira
248	Thripunithura Municipality	Chathari
249	Thripunithura Municipality	Pallipparambukavu
250	Thripunithura Municipality	Chakkamkulangara
251	Thripunithura Municipality	Thevarakkavu
252	Thripunithura Municipality	Nannappilly
253	Thripunithura Municipality	Thondoor
254	Thripunithura Municipality	Thamaramkulangara
255	Thripunithura Municipality	Pereekkad
256	Thripunithura Municipality	Mathoor
257	Thripunithura Municipality	Thiruvankulam
258	Thripunithura Municipality	Changaputha
259	Thripunithura Municipality	Mekkara
260	Thripunithura Municipality	Choorakad
261	Thripunithura Municipality	Puthiyakavu
262	Thripunithura Municipality	Valiyathara
263	Thripunithura Municipality	Pavamkulangara
264	Thripunithura Municipality	Thoppil
265	Thripunithura Municipality	Kannankulangara
266	Thripunithura Municipality	Statue
267	Thripunithura Municipality	Market
268	Thripunithura Municipality	Ambalam Ward
269	Thripunithura Municipality	Chakkuparambu
270	Pallipuram Panchayat	Munambam

TAZ_NO	BOUNDARY	LOCATION NAME
271	Pallipuram Panchayat	Pallippuram
272	Pallipuram Panchayat	Cherai Beach
273	Pallipuram Panchayat	Kadathu
274	Pallipuram Panchayat	Pallippuram Fort
275	Pallipuram Panchayat	Chakkarakadavu
276	Pallipuram Panchayat	Cherai
277	Kuzhuppilly Panchayat	Kuzhuppilly Beach
278	Kuzhuppilly Panchayat	Ayyampilly
279	Edavanakkad Panchayat	Edavanakkad
280	Edavanakkad Panchayat	Vypin
281	Edavanakkad Panchayat	Edavanakkad
282	Edavanakkad Panchayat	Vypin
283	Kottuvally Panchayat	Mannam
284	Kottuvally Panchayat	Thathappilly
285	Kottuvally Panchayat	Aiswarya Nagar Road
286	Kottuvally Panchayat	Vaniyakkadu
287	Kottuvally Panchayat	Ezhikkara
288	Kottuvally Panchayat	Kaitharam South
289	Kottuvally Panchayat	Koonammavu
290	Kottuvally Panchayat	Chemmayam
291	Ezhikkara Panchayat	Kalluchira
292	Ezhikkara Panchayat	Kedamangalam
293	Ezhikkara Panchayat	Chathanad
294	Nayarambalam Panchayat	Mayamayooram
295	Nayarambalam Panchayat	Nayarambalam
296	Nayarambalam Panchayat	Nedungad
297	Nayarambalam Panchayat	Nayarambalam
298	Alangad Panchayat	Panayikulam
299	Alangad Panchayat	Alangad
300	Alangad Panchayat	Kongorppilly
301	Alangad Panchayat	Neerickode
302	Alangad Panchayat	Malikampeedika
303	Alangad Panchayat	Kochirika
304	Alangad Panchayat	Olanad
305	Varappuzha Panchayat	Varappuzha
306	Varappuzha Panchayat	Edampaadam
307	Varappuzha Panchayat	Thundathum Kadavu
308	Varappuzha Panchayat	Puthenpally
309	Varappuzha Panchayat	Muttinakam
310	Varappuzha Panchayat	Arattu Kadavu

TAZ_NO	BOUNDARY	LOCATION NAME
311	Charanallur Panchayat	Cheranallur
312	Charanallur Panchayat	Cheranallur
313	Charanallur Panchayat	Soth Nada
314	Charanallur Panchayat	Mathrupalli
315	Charanallur Panchayat	Cheranallur
316	Charanallur Panchayat	Cheranallur
317	Kadamakkudy Panchayat	Kadamakkudy
318	Kadamakkudy Panchayat	South Chittoor
319	Kadamakkudy Panchayat	Aster Medicity
320	Kadamakkudy Panchayat	Kothad
321	Mulavikad Panchayat	Mulavukad Vadakkumbhagam
322	Mulavikad Panchayat	Ponjikkara
323	Mulavikad Panchayat	Mulavukad
324	Mulavikad Panchayat	Vallarpadam
325	Kadungallur Panchayat	Uliyanoor
326	Kadungallur Panchayat	Kunjunnikkara
327	Kadungallur Panchayat	Binanipuram
328	Kadungallur Panchayat	Kayantikkara
329	Kadungallur Panchayat	Elookkara
330	Kadungallur Panchayat	Kadungalloor
331	Kadungallur Panchayat	Elapadam
332	Kadungallur Panchayat	Eramam
333	Choornikkara Panchayat	Ambattukavu
334	Choornikkara Panchayat	Kunnathery Thikavu
335	Choornikkara Panchayat	Pallikkunnu
336	Choornikkara Panchayat	Manakkapady
337	Choornikkara Panchayat	Kunnathery
338	Choornikkara Panchayat	Muttom
339	Edathala Panchayat	Edathala
340	Edathala Panchayat	New Gcda Colony
341	Edathala Panchayat	Edathala
342	Edathala Panchayat	N A D
343	Edathala Panchayat	Kuzivelippady
344	Edathala Panchayat	Mochamkulam
345	Edathala Panchayat	Mochamkulam
346	Edathala Panchayat	Nochima
347	Keezhmadu Panchayat	Erumathala West
348	Keezhmadu Panchayat	Edayapuram
349	Keezhmadu Panchayat	Kuttamassery
350	Keezhmadu Panchayat	Chalakkal

TAZ_NO	BOUNDARY	LOCATION NAME
351	Keezhmadu Panchayat	Chakkankulangara
352	Keezhmadu Panchayat	Keezhumadu
353	Keezhmadu Panchayat	Kulakkad
354	Chengamanadu Panchayat	Chengamanadu
355	Chengamanadu Panchayat	Thalakolly
356	Chengamanadu Panchayat	Kunnumpuram
357	Chengamanadu Panchayat	Parambayam
358	Chengamanadu Panchayat	Neduvannoor
359	Chengamanadu Panchayat	Gandhipuram
360	Chengamanadu Panchayat	Desom
361	Nedumbasserry Panchayat	Mekkad
362	Nedumbasserry Panchayat	Poickattussery
363	Nedumbasserry Panchayat	C K Colony
364	Nedumbasserry Panchayat	Athani
365	Nedumbasserry Panchayat	Vaappalassery
366	Nedumbasserry Panchayat	Kariyad
367	Nedumbasserry Panchayat	Akaparambu
368	Nedumbasserry Panchayat	Athani
369	Sreemoolanagaram Panchayat	Chowara
370	Sreemoolanagaram Panchayat	Sreemoolanagaram
371	Sreemoolanagaram Panchayat	Thekkumbhagom
372	Sreemoolanagaram Panchayat	Thiruvairanikulam
373	Sreemoolanagaram Panchayat	Edanad
374	Kanjoor Panchayat	Chengal
375	Kanjoor Panchayat	Kizhakkumbhagom
376	Kanjoor Panchayat	Parappuram
377	Kanjoor Panchayat	Kanjoor
378	Vazhakulam Panchayat	Mudickal
379	Vazhakulam Panchayat	Mudickal
380	Vazhakulam Panchayat	Vazhakulam
381	Vazhakulam Panchayat	Vazhakulam
382	Vazhakulam Panchayat	Marampally
383	Vazhakulam Panchayat	Chembarakky
384	Vazhakulam Panchayat	Chembarakky
385	Kumbalangy Panchayat	North Kumbalangi
386	Kumbalangy Panchayat	North Kumbalangi
387	Kumbalangy Panchayat	Panambukad Colony
388	Kumbalangy Panchayat	Kumbalangi
389	Kumbalangy Panchayat	Pazhangad
390	Kumbalangy Panchayat	Pazhangad

TAZ_NO	BOUNDARY	LOCATION NAME
391	Elamkunnapuzha Panchayat	Elamkunnapuzha
392	Elamkunnapuzha Panchayat	Elamkunnapuzha
393	Elamkunnapuzha Panchayat	Puthuvype
394	Elamkunnapuzha Panchayat	Ochanthuruth
395	Elamkunnapuzha Panchayat	Valappu
396	Elamkunnapuzha Panchayat	Murikkumpaadam
397	Elamkunnapuzha Panchayat	Puthuvype LNG Terminal
398	Njarackal Panchayat	Njarackal
399	Njarackal Panchayat	Njarackal
400	Njarackal Panchayat	Njarackal
401	Njarackal Panchayat	Valiyavattom
402	Njarackal Panchayat	Vatassery Mana
403	Vadavukode Puthencruz Panchayat	Ambalamugal
404	Vadavukode Puthencruz Panchayat	Kaninadu
405	Vadavukode Puthencruz Panchayat	Ambalamedu
406	Vadavukode Puthencruz Panchayat	Vadavukode
407	Vadavukode Puthencruz Panchayat	Varikoli
408	Vadavukode Puthencruz Panchayat	Brahmapuram
409	Udayamperoor Panchayat	Pavangkulangara
410	Udayamperoor Panchayat	Kandanad
411	Udayamperoor Panchayat	Udayamperoor
412	Udayamperoor Panchayat	Nadakkaavu
413	Udayamperoor Panchayat	South Paravoor
414	Udayamperoor Panchayat	South Paravoor
415	Udayamperoor Panchayat	Chakulam
416	Udayamperoor Panchayat	Poothotta
417	Kumbalam Panchayat	Kumbalam
418	Kumbalam Panchayat	Madavana
419	Kumbalam Panchayat	Chathamma
420	Kumbalam Panchayat	Panangad
421	Kumbalam Panchayat	Panangad
422	Chellanam Panchayat	Mundamveli
423	Chellanam Panchayat	Rameshwaram
424	Chellanam Panchayat	Cheriyakadavu
425	Chellanam Panchayat	Kannamaly
426	Chellanam Panchayat	Chellanam
427	Chellanam Panchayat	Neendakara Bridge
428	Chellanam Panchayat	Pallithode
429	Mulamthuruthy Panchayat	Mulanthuruthy
430	Mulamthuruthy Panchayat	Karicode

TAZ_NO	BOUNDARY	LOCATION NAME
431	Mulamthuruthy Panchayat	Perumpilly
432	Mulamthuruthy Panchayat	Karicode
433	Mulamthuruthy Panchayat	Thuppampadi
434	Mulamthuruthy Panchayat	Arakkunnam
435	Chottanikkara Panchayat	Jai Nagar
436	Chottanikkara Panchayat	Chottanikkara
437	Chottanikkara Panchayat	Kanayannur
438	Chottanikkara Panchayat	Eruveli
439	Airport	C I A L

ANNEXURE 2: PRIMARY SURVEYS METHODOLOGY

Based on the preliminary field visits and the scope of the study the following surveys have been identified for the Kochi.

LIST OF PRIMARY TRAFFIC & TRANSPORTATION SURVEYS

The study mandate requires 21 types of primary surveys to capture the travel and transportation characteristics in the city. The list of surveys to be conducted is as presented below in Table 133.

Table 133 List of Surveys To be Conducted.

SN	PARTICULARS OF SURVEY	HOURS	UNIT	QUANTITY
1	Classified Volume count at cordon locations	24	Location	12
2	Classified Volume counts surveys at Screen Line locations and vehicle occupancy	24	Location	12
3	Classified Volume counts surveys at Mid-Block locations and vehicle occupancy	16	Location	7
4	Classified Turning Volume Counts at Junctions	16	Location	25
5	RSI at Screen Line location (10% sample size of daily vehicle volumes)	24	Location	12
6	RSI at Cordon locations (10% sample size of daily vehicle volumes)	24	Location	10
7	Passenger Terminal Counts	16	Location	17
8	Passenger Terminal Origin and Destination Surveys (10 % sample of the daily passenger count)	16	Location	17
9	Public Transport (PT) Stop Waiting, Boarding and Alighting (B/A) survey – Bus/ Metro/ Ferry	16	Location	22
10	Public Transport (PT) Stop Passenger Origin and Destination Surveys (10 % sample size of the daily B/A) at PT stops – Bus/ Metro/ Ferry	16	Location	22
11	Stated Preference Surveys for PT, IPT, Private Users (2W and Car) and NMT (cycle and walk) users along major activity centres	-	Sample	500
12	Pedestrian Volume Counts at critical junctions	16	Location	20
13	Speed and Delay Study at peak and off-peak hours	-	Km	250
14	IPT Operator Survey (Taxi/auto)	-	Sample	150

SN	PARTICULARS OF SURVEY	HOURS	UNIT	QUANTITY
15	Parking Survey-On Street with inventory	12	km	10
16	Parking Survey-Off Street with inventory	12	location	12
17	Household Interview with opinion survey	-	Sample	5000
18	Road Network Inventory with lux levels	-	Km	250
19	Vehicles Survey at Petrol Pump	-	Sample	200
20	Establishment and Workplace survey	-	Sample	250
21	Goods Operator Survey	-	Sample	150

CLASSIFIED TRAFFIC VOLUME COUNTS (CVC) 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 of the Survey:

- Video traffic counts will be carried out on typical working day at all locations listed.
- At each identified location both **directional classified volume counts will be carried out by vehicle type for a period of 24 hours**.
- The data will be collected, compiled, and submitted as per the templates.

Location: The survey will be conducted at **twelve (12) outer cordon points**. (*Refer **Error! Reference source not found.**)*

Table 134 List of Outer Cordon Locations

Code	Place/Road	Landmark	Direction
OC 1	NH 66	Paravur Bridge	North
OC 2	NH 544	Angamaly Bridge	North
OC 3	Aluva Munnar Road	Sub RTO Perumbavoor	East
OC 4	SH 1 MC Road	Sree Bhavani Wood Industries	East
OC 5	SH 41 Kakkanad Pallikkara Road	Manakakkadavu Bridge	East
OC 6	Kochi Madurai Tondi Point	Thrippakkudath Sree Dharma Sastha Temple	East
OC 7	Arakkunnam	Honda Service & Spares	East
OC 8	Ettumanur Ernakulam Road	Poothotta Bridge	South
OC 9	NH 66	Aroor Kumbalam Railway Bridge	South
OC 10	SH 66	St Xavier's Roman Catholic Church	South

Figure 196 Outer Cordon Survey Locations

CLASSIFIED TRAFFIC VOLUME COUNTS (CVC) AND VEHICLE OCUPANCY AT SCREEN LINE LOCATIONS

Objective: The survey aims to assess and 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 traffic counts will be carried out on typical working day at all locations listed.
- At each identified location both **directional classified volume counts will be 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 need to be captured.
- The data will be collected, compiled, and submitted as per the templates.

Location: The survey will be conducted at **twelve (12) screen lines points** along the north-south and east-west screen lines. *(Refer **Error! Reference source not found.**)*

Table 135 List of Screen line Locations

Code	Landmark	Place/Road
SL 1	Varappuzha Bridge	NH 66
SL 2	NH- Desom ROB	NH 544
SL 3	Selam Kochi Highway ROB	Angamaly
SL 4	Marampally Bridge	PHC Vazhakulam
SL 5	Edapally ROB	Edapally Railway Over Bridge
SL 6	Banerji Road ROB	Banerjee Road/ North Railway Over Bridge
SL 7	Chambakkara Bridge	SH 15
SL 8	Venduruthy	NH 544
SL 9	Mamala Bridge	Kochi Madurai Tondi Point Road
SL 10	Seaport- Airport Bridge	Kakkanad Water Metro
SL 11	Aroor Edakochi Bridge (Towards Thoppumpady)	Aroor Thoppumpady Road
SL 12	Mulamthuruthy ROB	Mulanthuruthy Level Cross

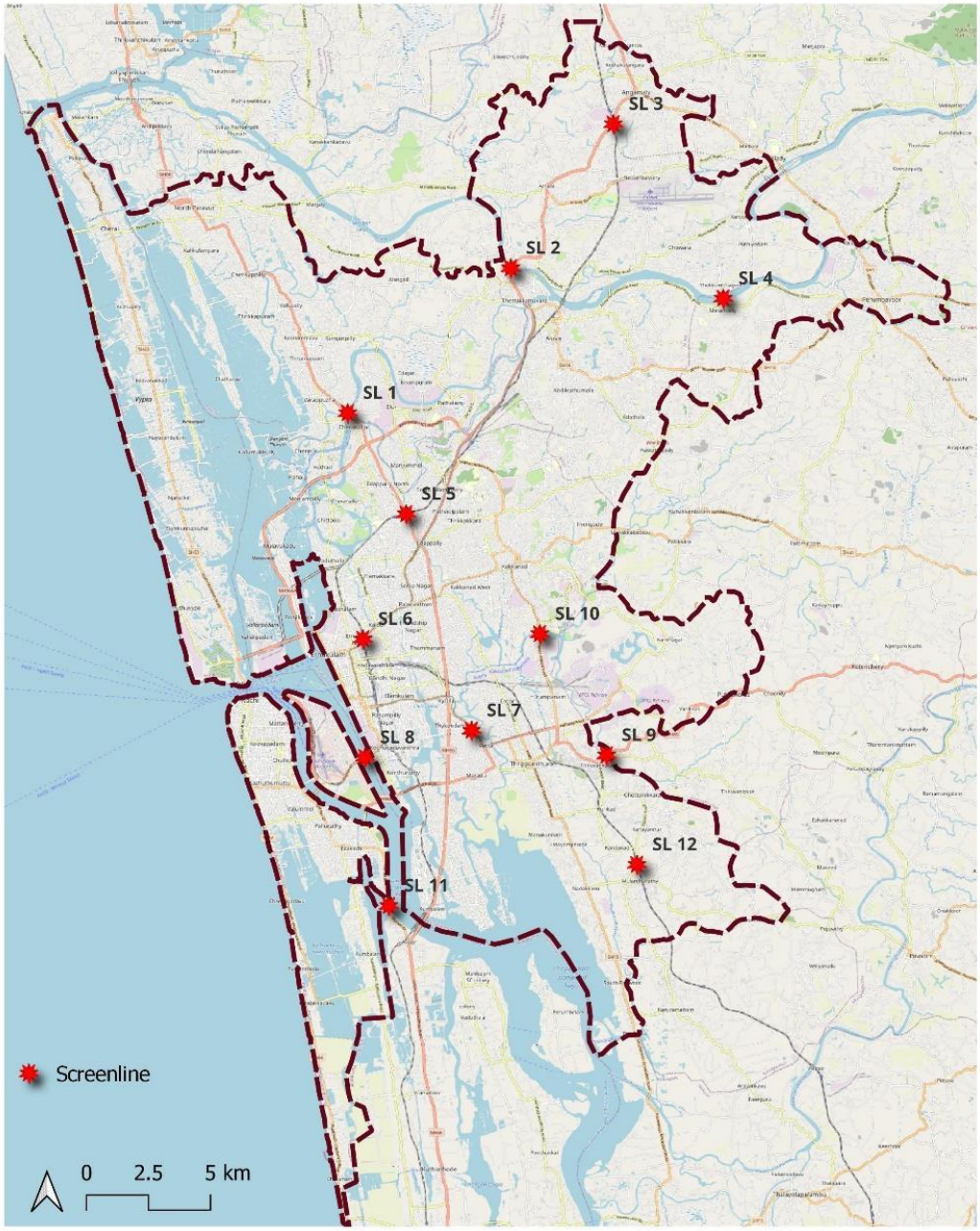


Figure 197 Screen line Survey Locations

CLASSIFIED TRAFFIC VOLUME COUNTS (CVC) AND VEHICLE OCUPANCY AT MID-BLOCK LOCATIONS

Objective: The survey aims to assess and 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 traffic counts will be carried out on typical working day at all locations listed.
- At each identified location both **directional classified volume counts will be carried out by vehicle type for a period of 16 hours**.
- Passenger occupancy by vehicle type. i.e., cars, jeeps, vans, buses, trucks, MAVs, LCV's tractors, motorized two wheelers and so on need to be captured.
- The data will be collected, compiled, and submitted as per the templates provided by UMTC.

Location: The survey will be conducted at **seven (7) mid-block points**. *(Refer **Error! Reference source not found.**)*

Table 136 List of Mid-Block Locations

Code	Road	Landmark
MB 1	Beach Road	Pazhangad Beach
MB 2	NH 544 Salem Kochi Highway	City Fuels- Indian Oil Petrol Pump
MB 3	Chittoor Road	AWHO Eamprakash Vihar
MB 4	SH 16 Aluva- Munnar Road	St Joseph Province
MB 5	Seaport- Airport Road	Vismaya Furniture Kakkanad
MB 6	Ettumanur Ernakulam Road	Lotus Kochupurakkal Gardens
MB 7	Chithrapuzha – Ponjassery Road	Ponjassery

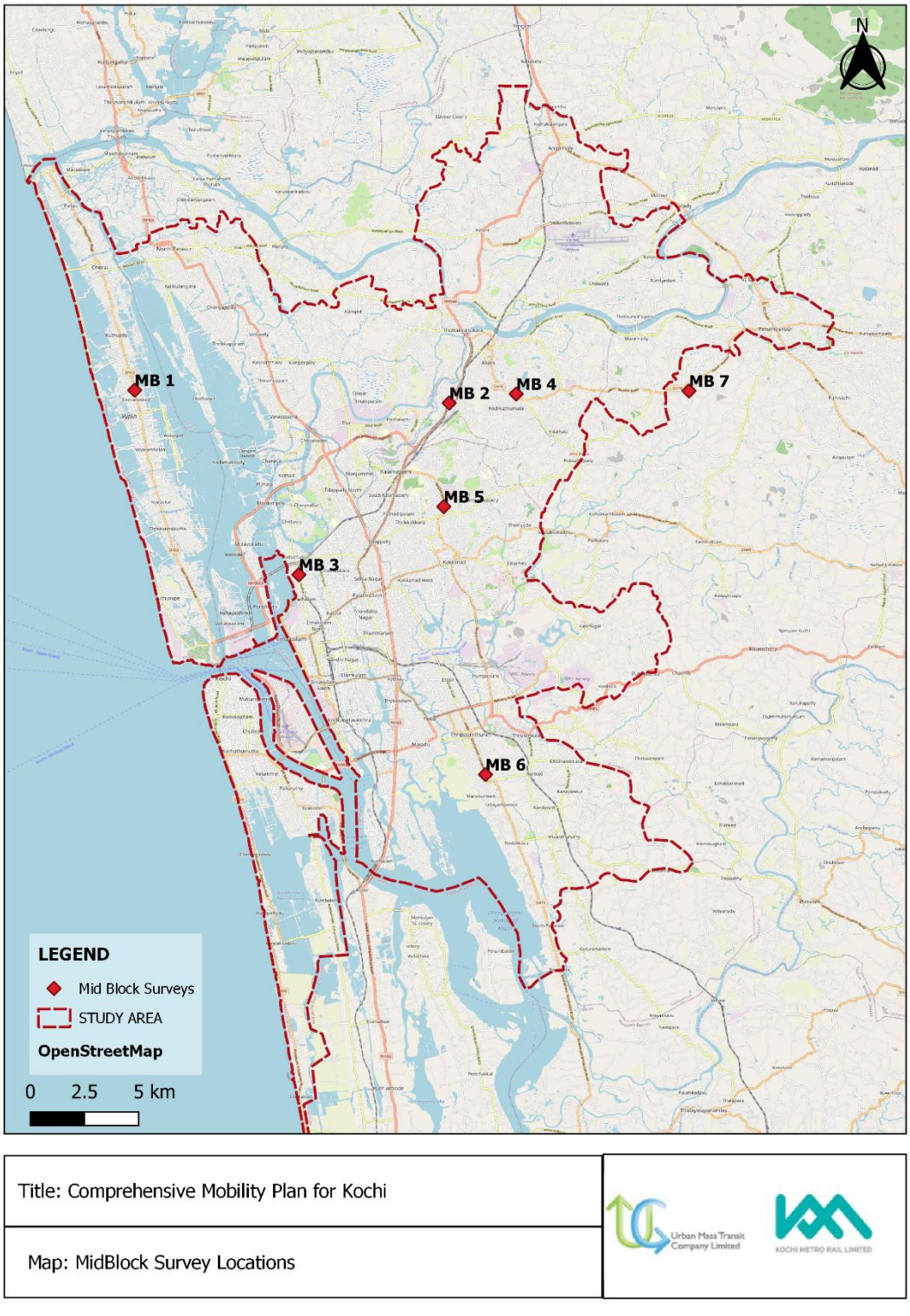


Figure 198 Mid-Block Survey Locations

CLASSIFIED TURNING MOVEMENT COUNTS AT INTERSECTIONS

Objectives: The survey aims 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.

Conduct of the Survey:

- Video traffic counts will be carried out on typical working day at all locations listed.
- At each identified location/ intersection, for **all arms both directional counts will be carried out by vehicle type**. I.e., cars, jeeps, vans, buses, trucks, MAVs, LCV's tractors, motorized two wheelers and slow-moving vehicles **for a period of 16 hours**.
- The data will be collected, compiled, and submitted as per the templates.

Locations: The survey will be conducted at **twenty-five (25) critical intersections**. *(Refer **Error! Reference source not found.**)*

Table 137 List of Intersections

Code	Place/ Junction	Road/ Landmark
TMC 1	Pottan Theruvu Junction	NH 66 X Republic Road
TMC 2	Angamaly Junction	Selam Kochi Highway X MC Road
TMC 3	Airport Junction	NH 544 X Airport Road
TMC 4	Perumbavoor Signal Junction	SH 1 MC road X SH 16 Aluva Munnar Road
TMC 5	Aluva Metro Station Junction	Selam Kochi Highway X Aluva Bypass
TMC 6	Cheranallur Junction	NH 66 X NH 966A
TMC 7	Kalamasserry TVS Junction	Selam Kochi Highway X HMT Road
TMC 8	Edapally Junction	NH 66 X Palarivattom Edapally Road
TMC 9	Civil Line- Kakkanad Junction	Kakkanad Jn X Ernakulam Thekkady Rd
TMC 10	Palarivattom Junction	NH 66 X Civil Line Rd

TMC 11	Irumpanam Junction	Kochi Madurai Tondi Rd X Airport Seaport Road
TMC 12	Kaloor Junction	Banerjee Road X Kaloor Kadavanthra Road
TMC 13	High Court Signal Junction	Banerjee Road X Shanmugham Road
TMC 14	Goshree Round	Goshree Road X SH 63
TMC 15	Jose Junction	MG Road X Swami Chinmayananda Road
TMC 16	Kadavanthra Junction	SA Road X Kaloor Kadavanthra Road
TMC 17	Vyttila Junction	NH 66 X SA Road
TMC 18	Karimughal Junction	Alappuzha Ponjassery Road X Chithrapuzha Ponjassery Road
TMC 19	Cochin Port	NH 966B X Old NH 47
TMC 20	Maradu	NH 66 X NH 966B
TMC 21	Kacherippady Junction	Aroor Thoppumpady Road X MLA Road
TMC 22	Nadakkavu Junction	SH 15 X Nadakkavu Mulanthuruthy Road
TMC 23	Chellanam South Neendakara Junction	NH 66 X Chellanam Ezhupunna Road
TMC 24	Airport Road	MC Road X Airport (Mattoor)Road
TMC 25	Thoppumpady Junction	PT Jacob Road X Old Thoppumpady Bridge

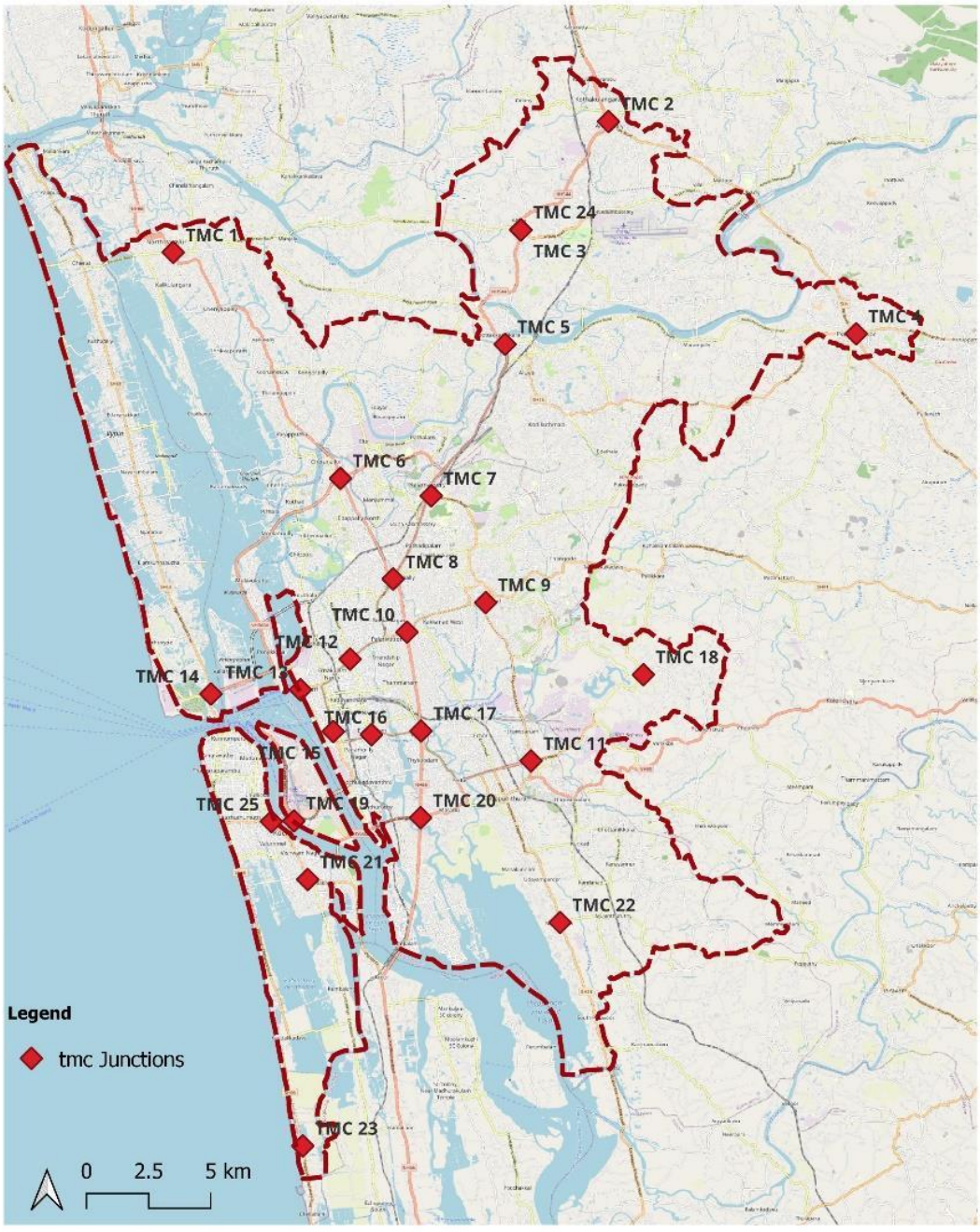


Figure 199 TMC Survey Locations

ROADSIDE (ORIGIN – DESTINATION) SURVEY - SCREEN LINE

Objective: The survey aims to assess and validate the traffic and passenger flows at identified locations mode wise and in evaluating the travel characteristics and mode wise travel pattern.

Conduct of the Survey:

- The survey will be 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. needs to be carried out.**
- The data will be collected and compiled and submitted as per the templates provided by UMTC.

Location: The survey will be conducted at **twelve (12) screen lines points** along the north-south and east-west screen lines, similar to the CVC locations at screen lines. *(Refer **Error! Reference source not found.** &* Table 135*)*.

ROADSIDE (ORIGIN – DESTINATION) SURVEY) - OUTER CORDON

Objective: The survey aims to assess the floating population, interaction of the surrounding regions with the study area and in assessing the travel characteristics and mode wise travel pattern.

Conduct of the Survey:

- The survey will be 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. needs to be carried out.**
- The data will be collected, compiled, and submitted as per the templates provided by UMTC.

Location: The survey will be conducted at **ten (10) outer cordon points** along the north-south and east-west screen lines, similar to the CVC locations at Outer cordon locations *(Refer* Table 134 *&* Figure 196*)*

PASSENGER TERMINAL COUNTS SURVEY

Objective: The survey aims to evaluate the percentage of people using Bus/Rail/Air/Water transport and under the volumes and demands at these transit nodes.

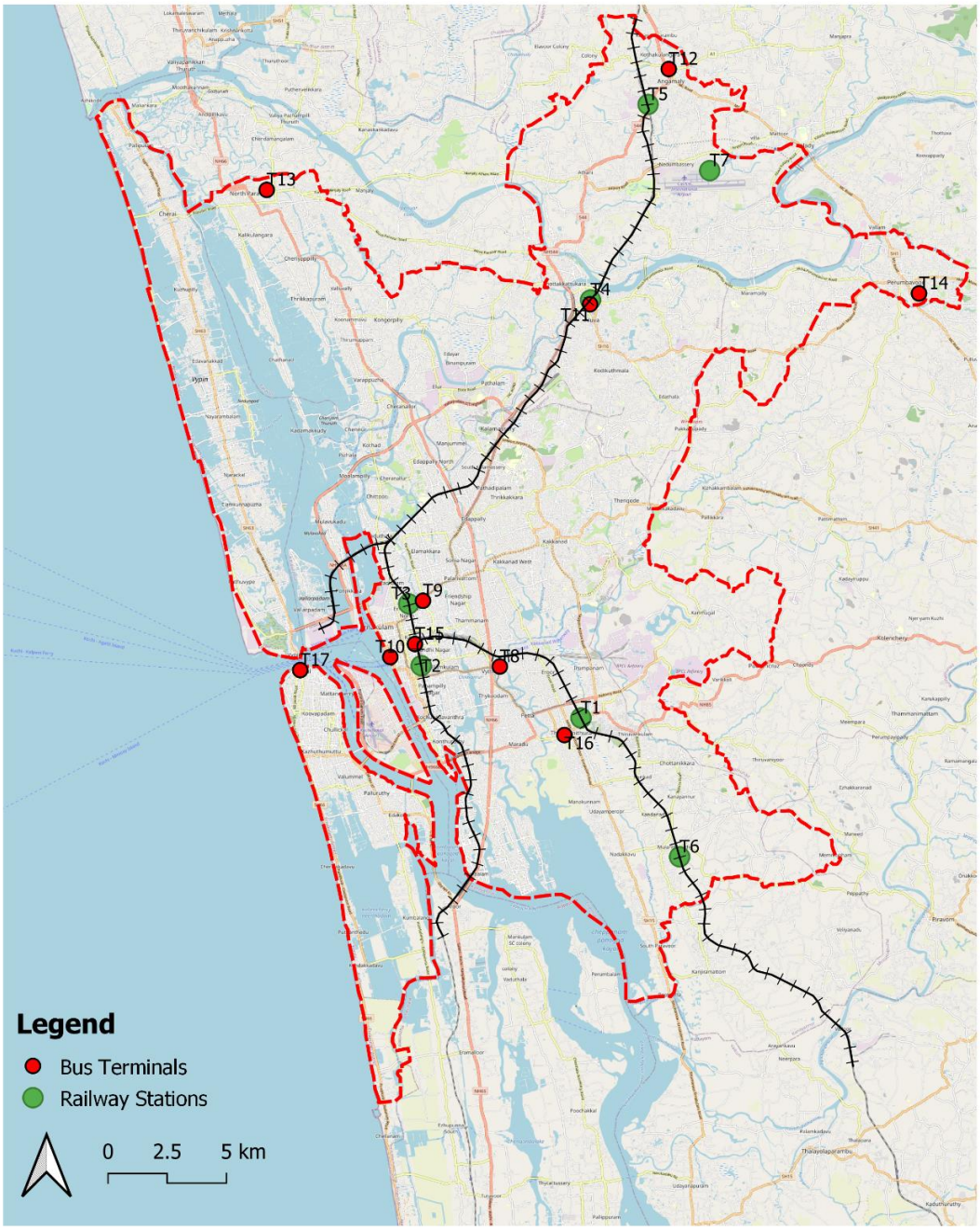
Conduct of the Survey:

- The survey will be conducted for a period of **16 hours at Bus/ Rail/ Air/ Water Terminals**.
- **Manual counts of passengers** entering and exiting the terminal will be captured at all entry and exit locations of the identified locations.
- The data will be collected, compiled, and submitted as per the templates.

Locations: The surveys will be conducted at all the **seventeen (17) public transit terminals**. *(Refer* Figure 200 *)*

Table 138 List of Terminal Locations

Type	Code	Place/Road
Railway Station	T1	Thripunithura
Railway Station	T2	Ernakulam Junction
Railway Station	T3	Ernakulam Town
Railway Station	T4	Aluva
Railway Station	T5	Angamaly
Railway Station	T6	Mulanthuruthy
Cochin International Airport	T7	Cochin International Airport
Bus Terminal	T8	Vyttila Mobility Hub
Bus Terminal	T9	Kaloor Bus Stand
Bus Terminal	T10	Ernakulam Jetty
Bus Terminal	T11	Aluva KSRTC
Bus Terminal	T12	Angamaly KSRTC
Bus Terminal	T13	North Paravoor Private Bus Stand
Bus Terminal	T14	Perumbavoor KSRTC Bus Stand
Bus Terminal	T15	KSRTC Ernakulam
Bus Terminal	T16	Thripunithura Private Bus Stand
Bus Terminal	T17	Fort Kochi Ferry & Bus Stand



Title: Comprehensive Mobility Plan for Kochi	
Map: Terminal Survey Locations	

Figure 200 Terminal Survey Locations

PASSENGER TERMINAL ORIGIN AND DESTINATION SURVEYS

Objective: The survey aims to evaluate the travel and trip characteristics of the passengers using Bus/Rail/Air/Water transport and to capture the floating population and their impact on the travel demand in the study area.

Conduct of the Survey:

- The survey will be conducted for a period of **16 hours at Bus/ Rail/ Air/ Water Terminals**.
- **Manual interviews of passengers** entering and exiting the terminal will be captured at all entry and exit locations of the identified locations.
- Data pertaining to travel and traffic characteristics of the intercity & intra city travellers are captured along with trip characteristics, and details to estimate the PT passengers the existing demand and need for additional supply to be captured.
- The data will be collected, compiled, and submitted as per the templates.
- Samples collected need to be at least 10 % of the daily passenger count at passenger terminals.

Locations: The surveys will be conducted at all the **seventeen (17) public transit terminals**. like the passenger terminal count survey locations *(Refer* Figure 200 *& Table 138)*.

PUBLIC TRANSPORT STOP WAITING, BOARDING AND ALIGHTING SURVEY

Objective: The survey aims to capture the quantum of people using Public Transport for their daily travel in the city and to identify and validate the existing PT demand at identified locations.

Conduct of the Survey:

- The survey will be conducted for a period of **16 hours at Public Transport Stops (Bus/ Metro/ Ferry, etc.)**.
- **Manual counts of passengers** of boarding and alighting the public transport services at the identified locations.
- The data will be collected, compiled, and submitted as per the templates.

Locations: The survey will be conducted in **twenty-two (22) public transportation stops**. *(Refer* Figure 201*)*

Table 139 List of Boarding & Alighting Survey Locations

Code	Place/Road
BS 1	Thoppumpady Bus Stop/BOT
BS 2	Vyttila
BS 3	Angamaly
BS 4	Edapally
BS 5	Thevara Junction
BS 6	Ernakulam Boat Jetty
BS 7	Ernakulam town
BS 8	High Court
BS 9	Palarivattom
BS 10	North Kalamasserry Junction
BS 11	Pulinchodu Junction
BS 12	Kadavanthra Junction
BS 13	Civil Station Kakkanad
BS 14	Cherai Junction
BS 15	Kundannur Junction
BS 16	Edayaar
BS 17	Varappuzha
BS 18	Vadakkekotta
BS 19	Aroor
BS 20	Mattanchrry
BS 21	Penta Menaka
BS 22	Vypin

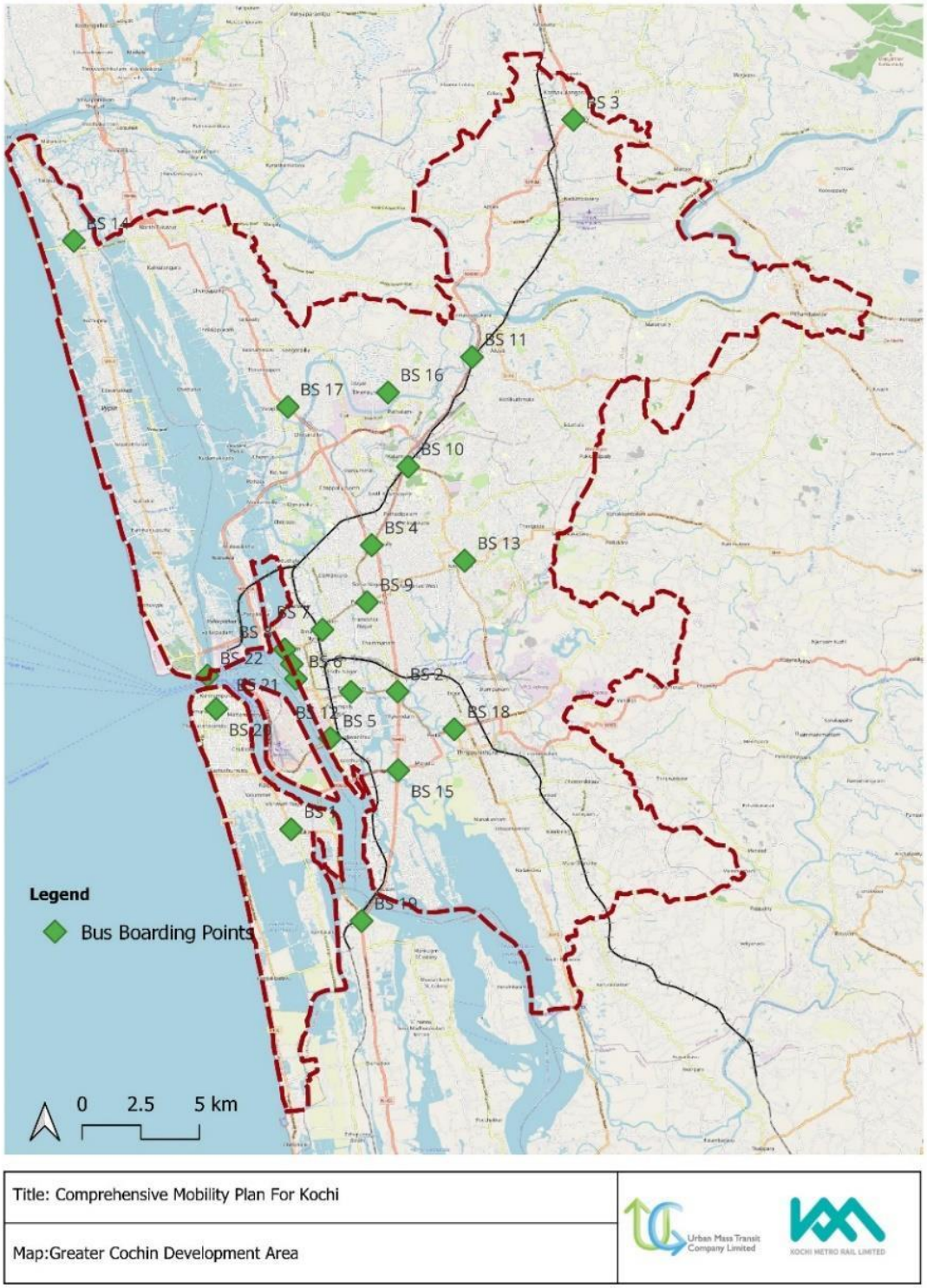


Figure 201 Boarding & Alighting Survey Locations

PUBLIC TRANSPORT STOP 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 of the Survey:

- The survey will be conducted for a period of **16 hours at Public Transport Stops (Bus/ Metro/ Ferry, etc.)**.
- **Manual interviews of passengers** boarding and alighting the public transport services at the identified locations.
- 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 to be captured.
- The data will be collected, compiled, and submitted as per the templates.
- Samples collected need to be at least 10% of the daily passenger count at PT stops.

Locations: The survey will be conducted in **twenty-two (22) public transportation stop locations** are similar to the PT Stop waiting, boarding & alighting survey (*(Refer* Figure 201).

STATED PREFERENCE SURVEYS FOR PT, IPT, PRIVATE USERS (2W AND CAR) AND NMT (CYCLE AND WALK) USERS

Objective: The survey aims to evaluate the preferences of commuters towards improved transportation systems and travel conditions and to identify their travel characteristics

Conduct of the Survey:

- **Manual interviews of PT, IPT, Private users (2w and car) and NMT (cycle and walk) users** are to be captured with an equal representation of all modes while sampling.
- Data pertaining to travel and **traffic characteristics are captured along with trip characteristics** and the preferences of commuters towards improved transportation systems and travel conditions.
- The data will be collected, compiled, and submitted as per the templates.

Locations: The survey will be conducted at 37 workplaces and major activity centres in the city, through roadside interviews *(Refer Figure 209 &* Table 145*).*

Samples: The survey aims to collect **Five hundred (500) clean samples** to be collected across all modes of travel.

PEDESTRIAN VOLUME COUNTS AT CRITICAL JUNCTIONS

Objective: The objective of the survey is to quantify the extent of pedestrian movement in order to design facilities for such movement.

Conduct of the Survey:

- The survey will be conducted using video/manual counts for a **period of 16 hours** on important locations where heavy pedestrian movement and critical junction in the city.
- **The survey will capture both along and across movements of pedestrians at all the arms of the intersection.**

Locations: The survey will be conducted at **twenty (20) critical intersections.** *(Refer Figure 202)*

Table 140 List of Pedestrian Volume Counts Locations

Code	Place/Road
Ped 1	Cheranallur Jn
Ped 2	Angamaly Jn
Ped 3	Aluva Metro Station Jn
Ped 4	Palarivattom Jn
Ped 5	Karimughal Junction
Ped 6	Penta Menaka
Ped 7	Subhash Park
Ped 8	Edapally Jn
Ped 9	NAD Jn
Ped 10	Kakkanad Jn
Ped 11	Maradu Junction
Ped 12	Kacherippady Jn
Ped 13	Vyttila Jn
Ped 14	Perumbavoor Signal Jn
Ped 15	Irumpanam Jn
Ped 16	Kaloor
Ped 17	High Court Jn
Ped 18	North Paravoor- Pottan Theruvu Jn
Ped 19	Thopumpady Jn (Pyary)
Ped 20	Aluva Railway Station- Bus Stand Link

Title: Comprehensive Mobility Plan for Kochi	
Map:Pedestrian Count Survey Locations	

Figure 202: Pedestrian Count Survey

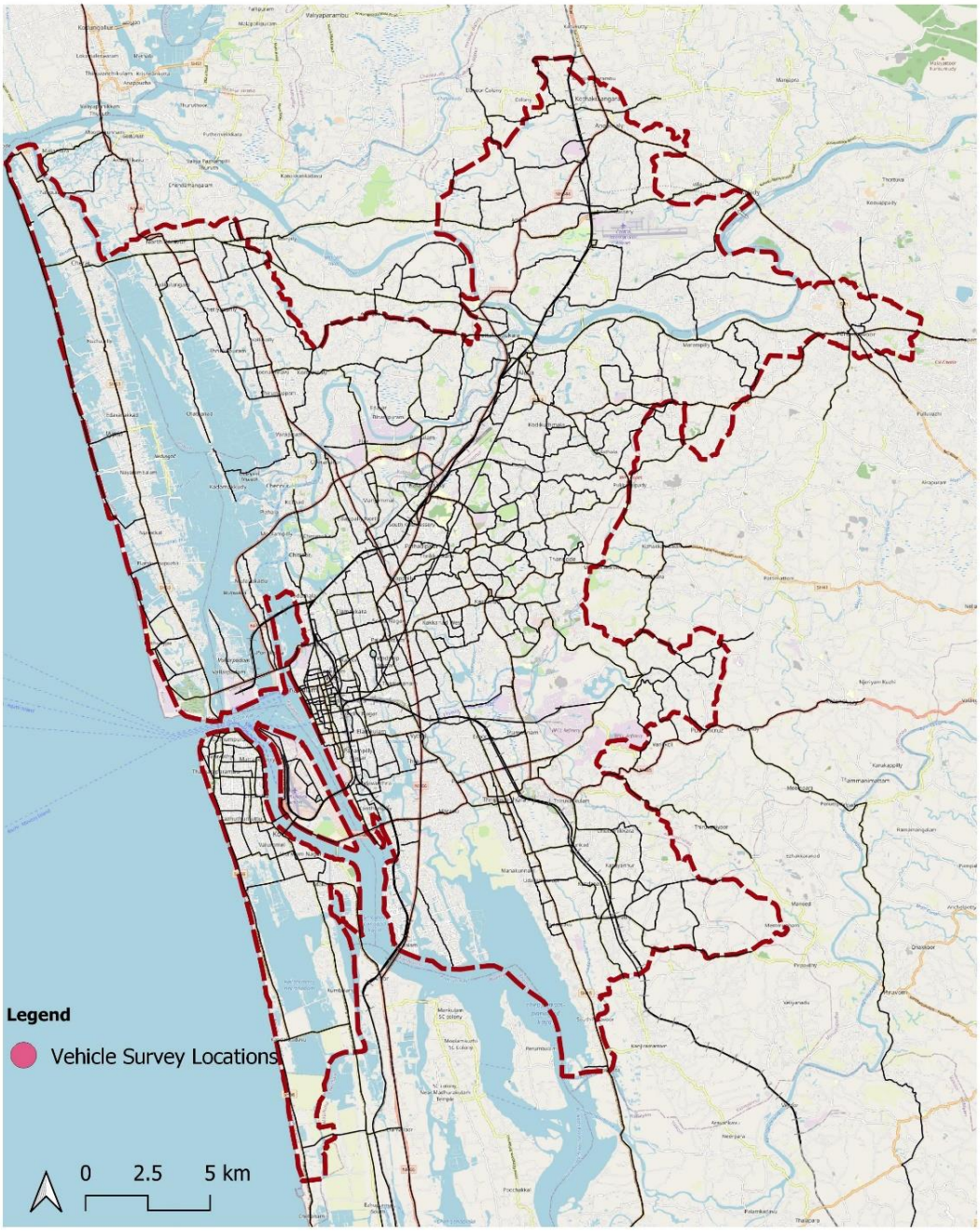
SPEED AND DELAY SURVEY AT PEAK AND OFF-PEAK HOURS

Objective: The 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 of the Survey:

- The survey should be conducted using GPS based method/ moving car method **during peak and off period in both directions on a typical working day**.
- Data such as speed and delay information on different road stretches and at intersections/level crossings in the study area are to be collected along with capturing the reason for delays along the identified stretches.
- The survey needs to be conducted using a car and bus for identified routes.
- The data will be submitted as per the templates.

Road Stretches: Road length of **approx. 250 km** similar to the road network inventory will be surveyed including 4 bus routes. *(Refer **Error! Reference source not found.**)*



Title: Comprehensive Mobility Plan For Kochi	
Map: Speed & Delay Survey Links	

Figure 203 Speed & Delay Survey Links

INTERMEDIATE PUBLIC TRANSPORT (IPT) OPERATOR SURVEY

Objective: The survey aims to evaluate the travel characteristics of Intermediate Public Transport in the study area.

Conduct of the Survey:

- The survey will be conducted through manual interviews capturing the operator trip details.
- The details pertaining to operations such as major routes, travel conditions, trip details, etc. will be captured.
- The samples should include equal representation of auto-rickshaws, shared auto-rickshaw operators, cabs, taxies, (all yellow plate IPT vehicles) etc.

Location: The survey will be conducted across the 10 locations which were observed to be the major IPT catchments nodes in the study area. *(Refer **Error! Reference source not found.**)*

Samples: A clean sample size **of One hundred and Fifty (150)** to be collected.

Table 141 List of locations for IPT Operator Survey

Code	Place/Road
IPT1	Angamaly Junction
IPT2	Fort Kochi IPT
IPT3	Aluva Railway Station
IPT4	High Court
IPT5	Palarivattom Junction
IPT6	Vyttila Hub - Auto Taxi Stand
IPT7	Kadavanthra
IPT8	Thammanam
IPT9	Edapally
IPT10	Kundannur Junction

Title: Comprehensive Mobility Plan for Kochi	
Map: IPT Operators Survey	

Figure 204 IPT Operators Survey

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 of the Survey:

- The survey will be conducted **for a period of 12 hours** on identified important commercial areas where parking is predominant.
- Number Method will be used capturing the vehicle type and registration number of parked vehicles **every 15 mins** and associated parking fees.\
- The data will be collected, compiled, and submitted as per the templates.

Locations: The survey will be conducted at along a total length of **ten (10) kilometres** with on-street parking activity. *(Refer Figure 205)*

Table 142 List of On Street Parking Locations

Code	Place/Road
ON 1	Edapally On-street Parking
ON 2	Aluva Bypass
ON 3	On Street Parking- TD Road
ON 4	Shanmugham Road
ON 5	Kaloor Kadavanthra Road On-street Parking
ON 6	Rajaji Road
ON 7	Banerjee Road On-street Parking
ON 8	Changampuzha Park- Edapally On-street Parking
ON 9	Perumbavoor Old Muvattupuzha Road
ON 10	Jose Jn On Street Parking
ON 11	Subhash Park

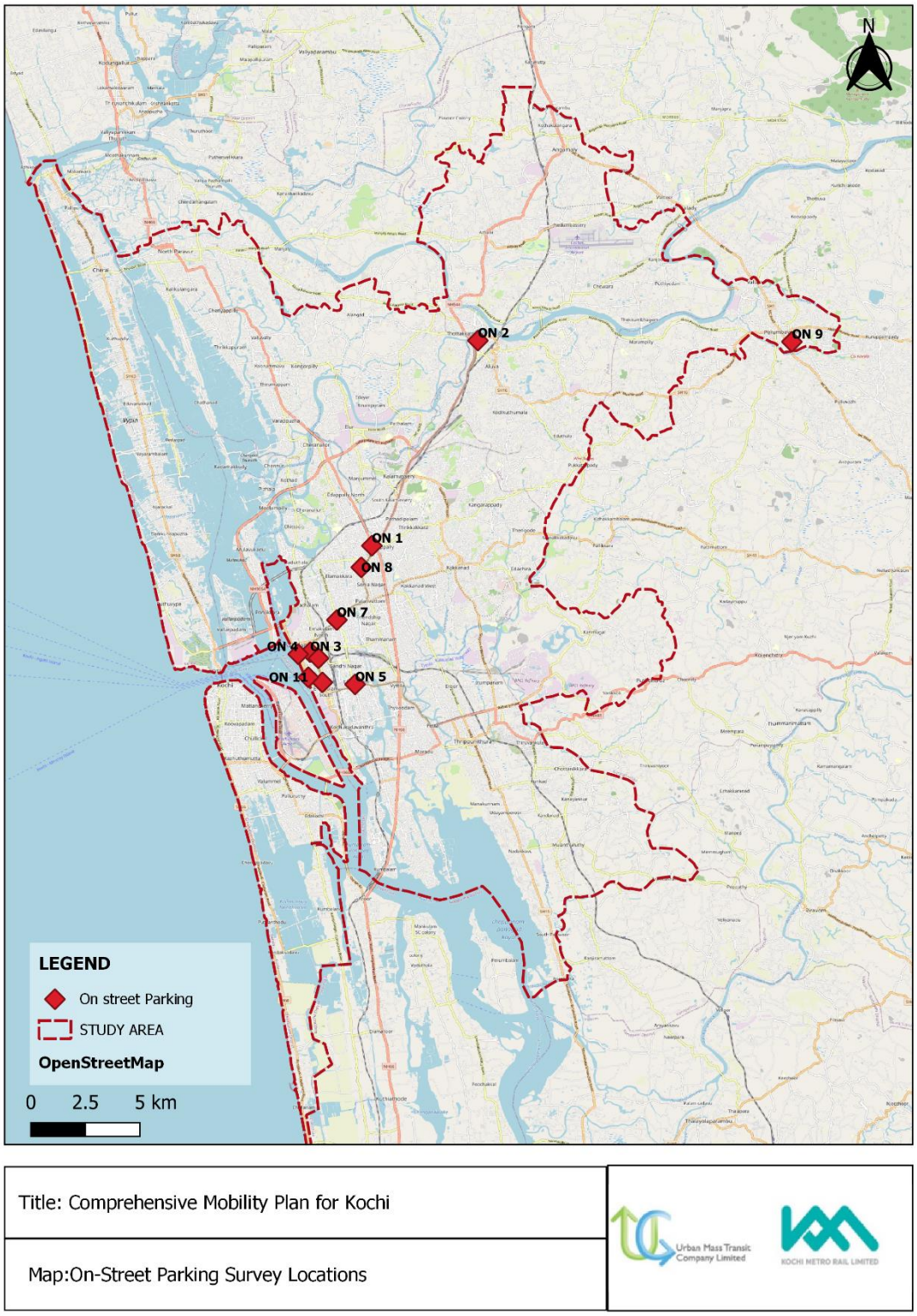


Figure 205 On Street Parking Survey Locations

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 of the Survey:

- The survey will be conducted **for a period of 12 hours** on identified important commercial areas where parking is predominant.
- Number Method will be used capturing the vehicle type and registration number of parked vehicles **every 15mins** and associated parking fees.
- The data will be collected, compiled, and submitted as per the templates.

Locations: The survey will be conducted at the **Ten (10) off street Parking l**ocations. *(Refer* Figure 206*).*

Table 143 List of Off-Street Parking Locations

Code	Place/ Road
OFF 1	Maradu Flyover
OFF 2	Marine Drive Pay & Park
OFF 3	Perumbavoor Private Stand
OFF 4	Ernakulam South Bus Stand Parking
OFF 5	Ernakulam South Railway Station
OFF 6	Aluva Railway Station
OFF 7	Thripunithura Railway Station
OFF 8	Mattancherry Dutch Palace
OFF 10	Vyttila Hub
OFF 11	Airport Vicinity

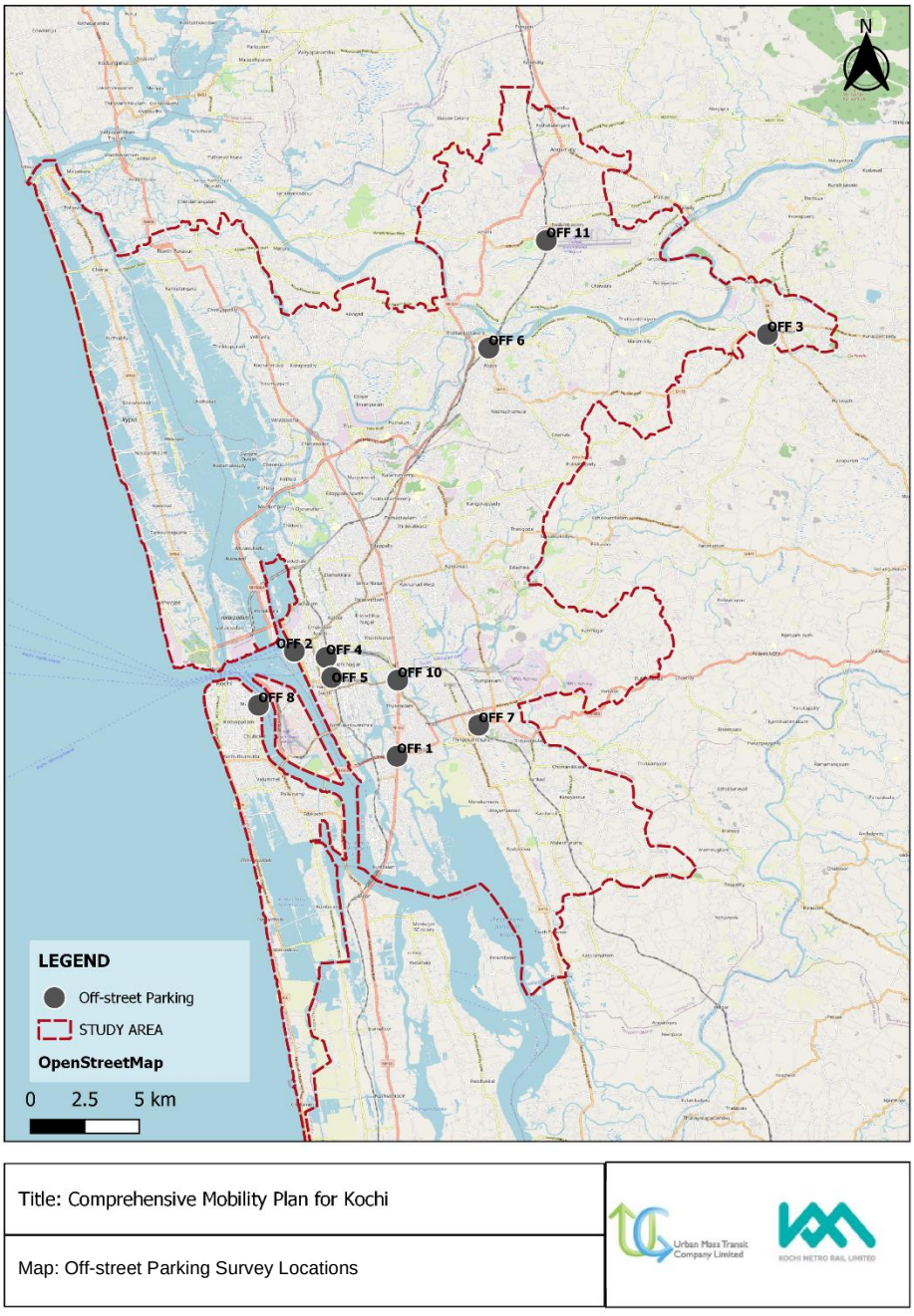


Figure 206 Off Street Parking Survey Locations

HOUSEHOLD INTERVIEW SURVEYS

Objective: The household survey aims to capture the data which is used for describing the travel patterns in the city and travel preferences of its residents.

Conduct of the Survey:

- 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 Socioeconomics, Household member characteristics, and travel diary of each individual member of the household will be captured.
- Sample size needs to be well distributed capturing all types of households (HIG, MIG and MIGs) and collected in all types of residential dwellings.
- The samples with filled data set would only be considered.
- The data will be collected, compiled, and submitted as per the templates.

Samples: A total cleaned sample set shall comprise of **5000 cleaned** and filled samples.

ROAD NETWORK INVENTORY WITH LUX READING

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 of the Survey:

- The survey will be 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.**
- Data pertaining to ROW, CW, Median, footpath, bicycle tracks, drainage, parking, shoulder, MUZs widths along with the quality and the condition of the surfacing will be captured.
- The data will be collected, compiled, and submitted as per the templates.

Road Stretches: Road length of approx. **two hundred and fifty (250) km** to be surveyed. *(Refer* Figure 207*)*

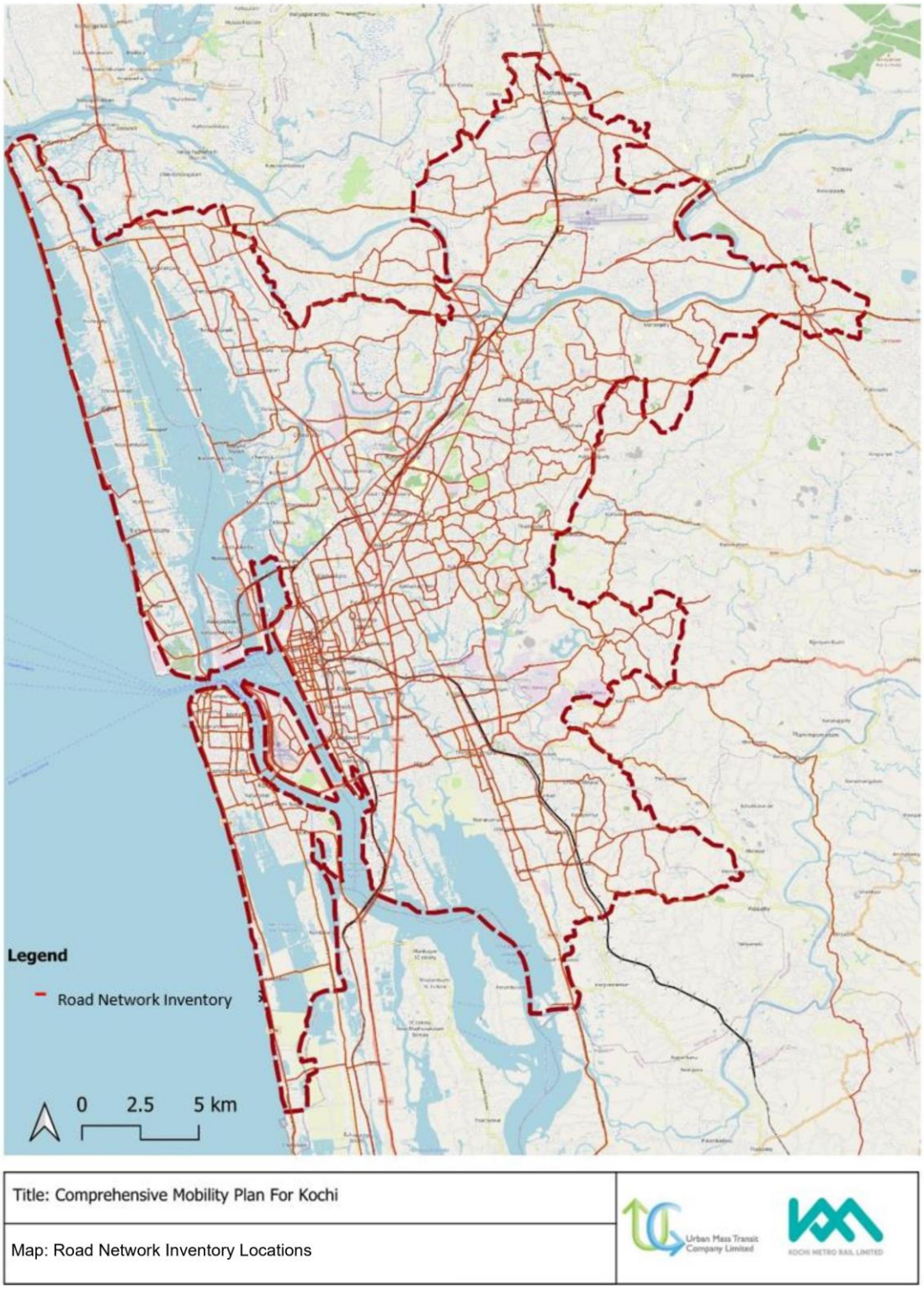


Figure 207 Road Network Inventory Locations

VEHICLE SURVEY AT PETROL PUMPS

Objective: The survey aims at updating the fuel usage and details on vehicle type, mileage etc.

Conduct of the Survey:

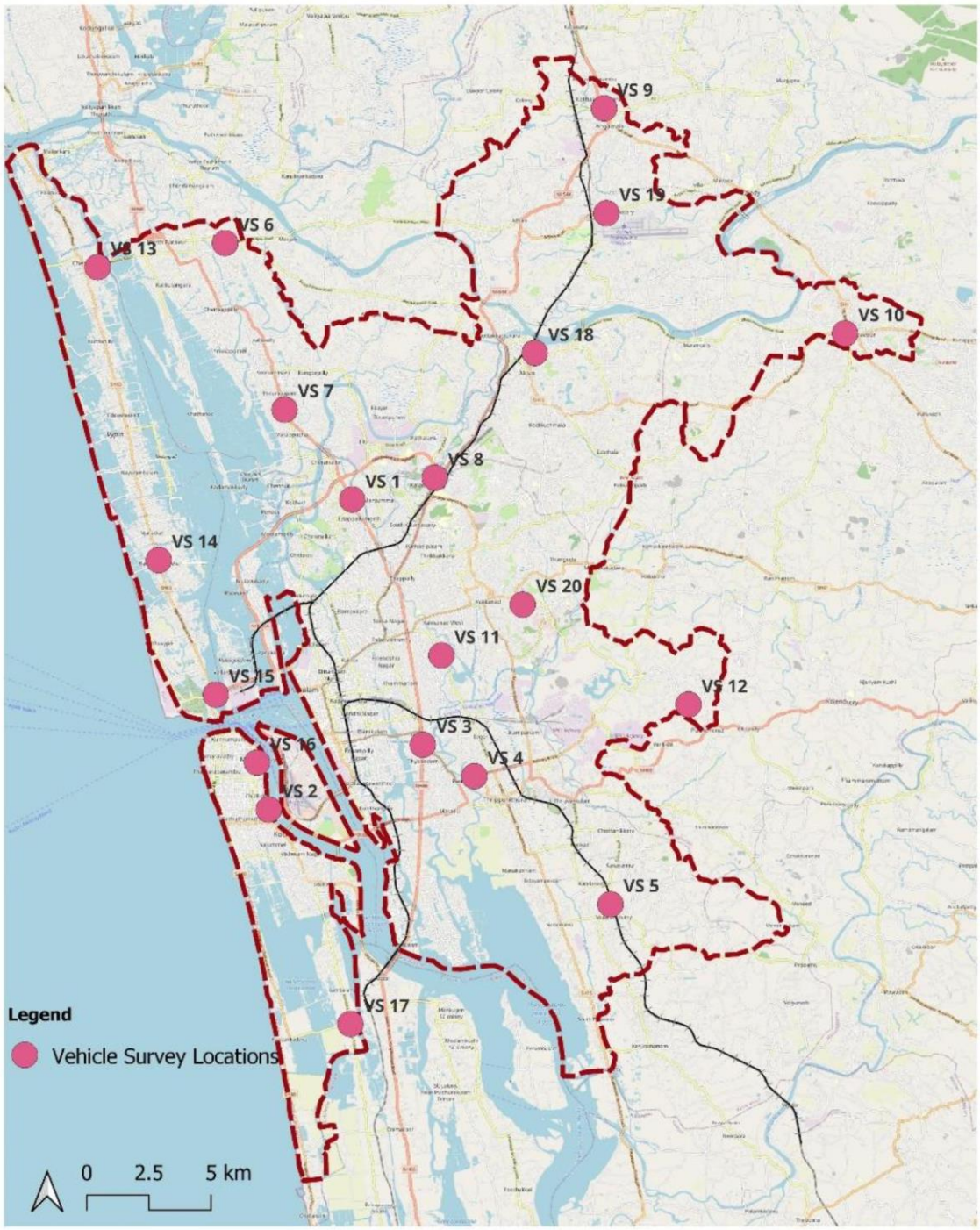
- The survey will be conducted at petrol pumps identified within the study area, capturing the details such as **type of fuel, make, model, year of manufacture, mileage, etc.**
- **The survey will be carried out through manual interviews.**
- The samples should represent an equal representation of all vehicle types includes passenger and good vehicles.
- The samples with a filled data set would only be considered.
- The data will be collected and compiled and submitted as per the templates.

Locations: The survey shall be conducted at 20 petrol pumps identified in the study area. *(Refer* Figure 208*).*

Samples: The survey should be done collecting at least **200 clean samples.**

Table 144 Vehicle Survey Locations

Code	Locations
VS 1	Edapally
VS 2	Thoppumpady
VS 3	Vyttila
VS 4	Thripunithura
VS 5	Mulanthuruthy
VS 6	Petrol Pump
VS 7	Varappuzha
VS 8	Kalamasserry
VS 9	Angamaly
VS 10	Perumbavoor
VS 11	Vennala
VS 12	Puthencruz
VS 13	Cherai
VS 14	Njarackal
VS 15	Vypin Boat Petrol Pump
VS 16	Mattancherry
VS 17	Kumbalangy
VS 18	Aluva
VS 19	Nedumbassery
VS 20	Infopark



Title: Comprehensive Mobility Plan For Kochi	
Map: Vehicle Survey Locations	

Figure 208 Vehicle Survey Locations

ESTABLISHMENT AND WORKPLACE SURVEYS

Objective: The survey aims to capture and evaluate the travel patterns to workplaces and to capture the floating populations trips in the city.

Conduct of the Survey:

- The workplace survey will be conducted to collect data regarding the travel costs (whole and distributed costs), trips characteristics and related socio-economic data.
- This survey should capture 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.
- The samples with a filled data set would only be considered.
- The data will be collected, compiled, and submitted as per the templates.

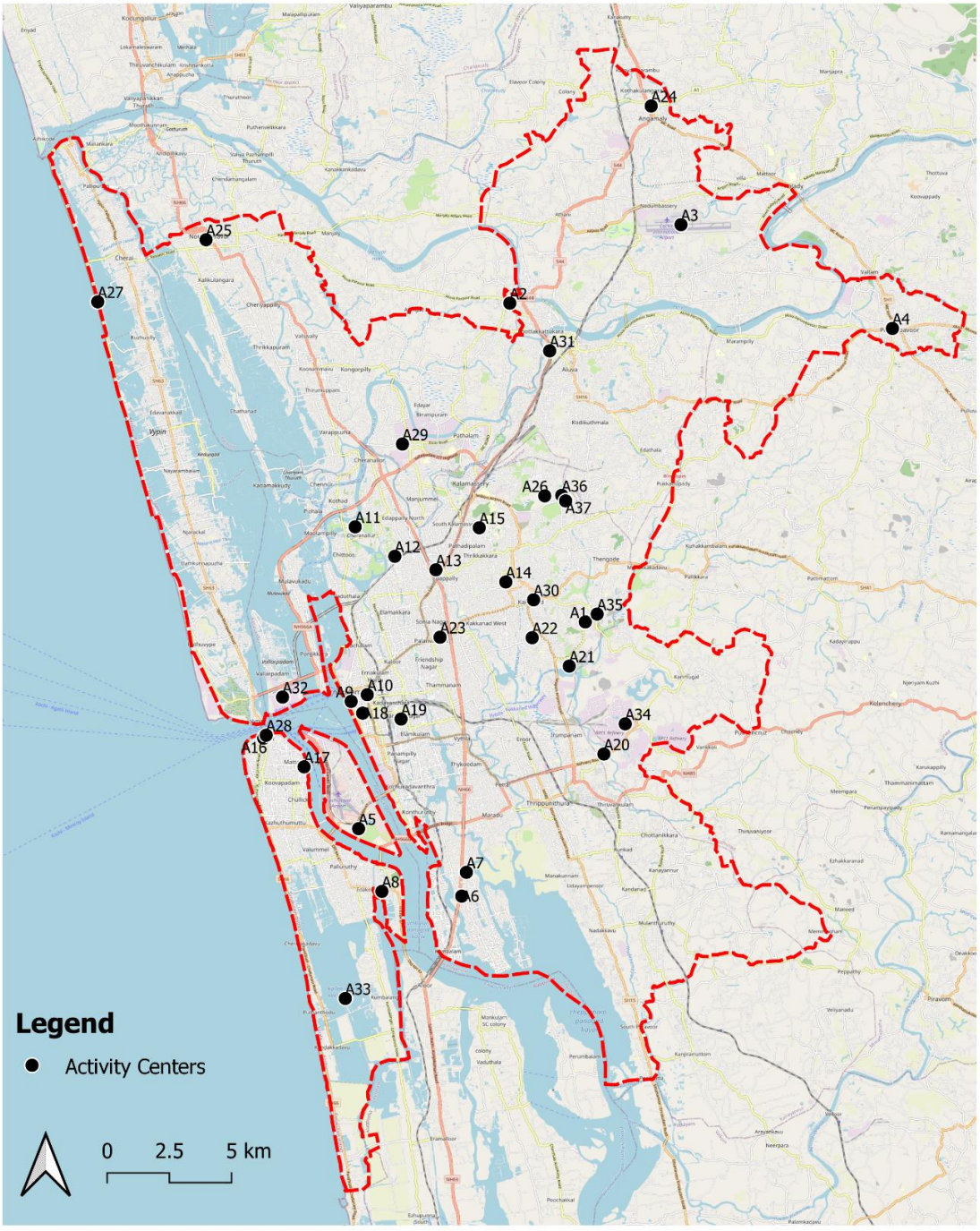
Locations: The survey will be conducted at workplaces and major activity centres in the city, through interviews at the identified **37 locations**. *(Refer Figure 209)*

Samples: About **250 cleaned samples** shall be collected.

Table 145 Major and Minor Activity Spots

Code	Place/Road
A1	Infopark Campus
A2	UC College Aluva
A3	CIAL
A4	Municipal Office Perumbavoor
A5	Logistics Company Willingdon Island
A6	Kerala Fisheries University
A7	Lakeshore Hospital
A8	Aquinas College Edakochi
A9	Broadway Market
A10	Textile Lane MG Road
A11	Aster Medicity
A12	Amrita Hospital Kochi
A13	Lulu Hyper Market Kochi
A14	Thrikkakara Govt Office
A15	Cusat University
A16	Club 18 Fort Kochi

Code	Place/Road
A17	Oriental Art Emporium Synagogue Lane
A18	Convent Road Textile Shops
A19	District Fire Office
A20	BPCL Refinery Thripunithura
A21	Rajagiri Educational Campus Kakkanad
A22	CSEZ
A23	BSNL Customer Service Centre
A24	Angamaly KSRTC Complex
A25	Government Girls High School N P
A26	GAIL India Kalamasserry
A27	Wave Roost Beach Resort Cherai
A28	Brunton Boatyard Resort CGH
A29	FACT Udyogamandal Division
A30	Civil Station, Kakkanad
A31	Aluva, Market
A32	Container Terminal
A33	Kumbalangy Resorts
A34	BPCL Area
A35	Smart City Kochi
A36	KINFRA Start Up
A37	Kalamasserry Govt. Medical College Ernakulam



Title: Comprehensive Mobility Plan for Kochi	
Map: Activity Centres	

Figure 209 Workplace Survey Locations

GOODS OPERATOR SURVEYS

Objective: The survey aims to evaluate the travel patterns of goods vehicles in the study area.

Conduct of the Survey:

- The surveys will be conducted at major good focal points through **manual interviews capturing the goods vehicle trip characteristics.**
- The samples with filled data set would only be considered.
- The data will be collected, compiled, and submitted as per the templates.

Locations: The survey will be conducted in the following 18 locations. *(Refer* Figure 210*).*

Samples: About **150 cleaned samples** shall be collected.

Table 146 Major Goods Focal Points

Code	Place/ Road
G1	**Goods Pay & Park**
G2	IOCL Parking 1
G3	SEZ
G4	Freight Station Vypin
G5	IOCL Parking 2
G6	BPCL Parking
G7	BPCL LPG Truck Parking
G8	NH 544
G9	Eroor Goods Parking
G10	Vallarpadam Goods Parking
G11	Vyttila
G12	Willingdon Island Parking Yard
G13	Salem Kochi Highway
G14	FACT Parking
G15	Aluva Market
G 16	Angamaly Rice Mill Parking
G 17	Thripunithura
G 18	Kalamasserry Lorry Parking

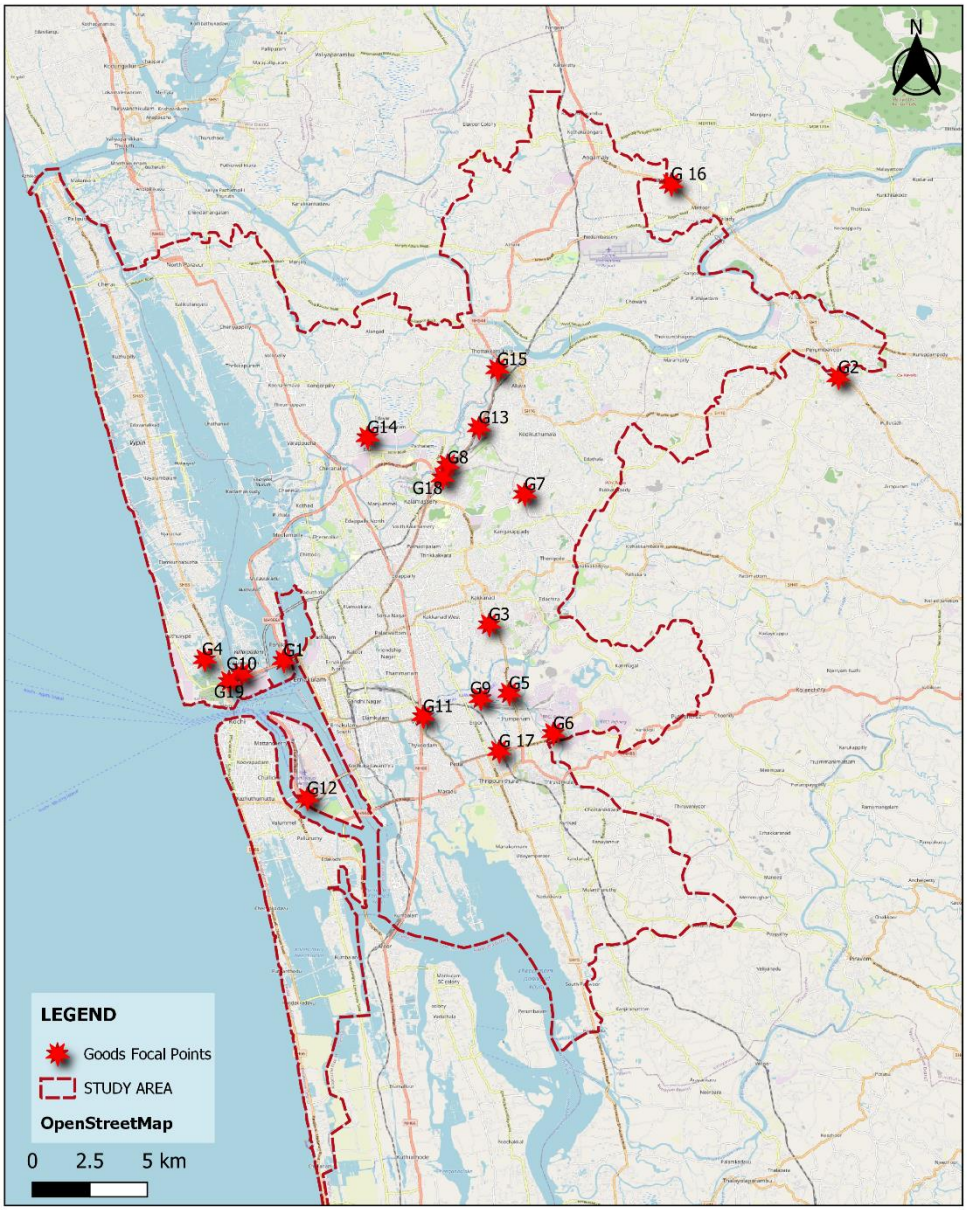


Figure 210 Goods Focal Point Survey Locations

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 Kochi. 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.

Table 147 Presence of Organized Public Transport

S. No.	Computation	Unit	Description	Data Source	Value
a.	Total buses	No.	Buses operating on road.	Metro + KSRTC + Private (2022)	1425
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.	Metro + KSRTC + Private (2022)	372
c.	Presence of Public Transport System in Urban Area	%	Calculate= [b / a] *100		26.11
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 3, indicating need for improvement in the public transportation system in the Study Area.

EXTENT OF SUPPLY / AVAILABILITY OF PUBLIC TRANSPORT SYSTEM

The computation of the extent of supply/availability of public transport system is shown below.

Table 148 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).	Metro + KSRTC + Private (2022)	1425
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	23.63
c.	PT Availability /1000 population	Ratio	Calculate= [a / b]		0.6
LOS					1
LOS1: >= 0.60, LOS2: 0.40 to 0.60, LOS3: 0.20 to 0.40, LOS4: Below 0.20					

Based on the above, the corresponding LoS for the indicator 'Extent of Supply/Availability of Public Transport System' is 1.

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.

Table 149 Service Coverage of Public Transport

S. No.	Computation	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)	8217
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)	732
c.	Service Cover	Ratio	Calculate= [a / b]		11.23
LOS					1
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 1 for 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.

Table 150 Average Waiting Time of Public Transport Users

S. No.	Computation	Unit	Data Source	Value
a.	Average Waiting time for Public Bus	Min	Primary Surveys at Bus Stops and Households- 2022	6
LOS				2
LOS1: <= 4, LOS2: 4 to 6, LOS3: 6 to 10, LOS4: Above 10				

Based on the above table, the corresponding LoS is 2 for the study area. Thus, indicating the need to improve 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.

Table 151 Level of Comfort in Public Transport Users

S. No.	Computation	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	61
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	40
c.	Passenger Comfort- Load Factor (Passengers Per Seat)		Calculate= [a / b]		1.53
LOS					2
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.

Table 152 Percentage of Fleet as Per Urban Bus Specifications

S. No.	Computation	Unit	Description	Data Source	Value
a.	Total number of buses in the city	No.	Total fleet	KSRTC + Private (2022)	1308
b.	Total number of buses as per urban bus Specifications in the city	No.	Fleet as per UBS	KSRTC + Private (2022)	158
c.	% of Fleet as per Urban Bus Specifications	%	Calculate= [b / a] * 100		12.08
LOS					4
LOS1: >= 75, LOS2: 50 to 75, LOS3: 25 to 50, LOS4: Below 25					

Based on above table, the corresponding LoS for this indicator is 4 for the study area. Thus, indicating deficiency in supply of fleet as per Urban Bus Specifications.

LEVEL OF SERVICE FOR PUBLIC TRANSPORT FACILITIES

Table 153 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**	**1**	**1**	**2**	**2**	**4**
TOTAL INDICATOR LOS VALUE:13 (OVERALL LOS -2)						
OVERALL: LOS1 <12, LOS2: 12-16, LOS3:17-20, LOS4 21-24						

Based on the above indicators, the overall score of the benchmark computes to 13 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 to enhance organized public transport, in the extent of supply of public transport, comfort and average waiting time, which define the reliability and efficiency of the system.

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.

Table 154 Signalized Intersection Delay

S. No.	Computation	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 arm is zero	Primary Survey 2022 (RNI)	11
b.	Total number of signalized intersections	No.	Identify the total number of signalized intersections surveyed in a city	Primary Survey 2022 (RNI)	25
c.	Signalized intersections Delay (%)	%	Calculate= [a / b] * 100		48
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 at 3.

STREET LIGHTING

The computation of the service level for street lighting is shown below.

Table 155 Street Lighting

S. No.	Computation	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)	1731
b.	Lux Level	%.	Cumulative frequency of LUX levels	Primary Survey 2022	4.3
c.	Street Lighting		Value		4.3
LOS					3
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 3. This indicates that area requires adequate visibility along the footpaths, 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.

Table 156 Percentage of City Covered by Footpaths

S. No.	Computation	Unit	Description	Data Source	Value
a.	Total length of road network	Km	Calculate the total length of road network	Primary Survey 2022 (RNI)	1731
b.	Total length of footpath of a city	Km	Total length of footpath of a city (footpath width >= 1.8m)	Primary Survey 2022 (RNI)	427
c.	Percentage of City Covered by Footpaths	%	Calculate= [b / a] * 100		24.67
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 the 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 the 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.

Table 157 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			

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.

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.

Table 158 Percentage of Network Covered by NMT Facilities

S. No.	Calculation	Unit	Description	Value
a.	Total length of road network	Km	Primary Survey 2022 (RNI)	249
b.	Total length of NMT network (minimum of 2.5 m width)	Km	Primary Survey 2022 (RNI)	16.7
c.	Percentage of network covered	%	Calculate= [b / a] * 100	7%
LOS				4
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 7% 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 the city has painted cycle tracks along few major arterials in the CBD (less than 5km), which are mostly encroached. Thus, accounting to a LoS value of 4.

NMT PARKING FACILITIES AT INTERCHANGES

The computation of the NMT parking facilities at interchange is shown below. The corresponding LoS value is 2, indicating low number of interchanges have NMT parking within 250 m around them.

Table 159 NMT Parking Facilities at Interchange

S. No	Calculation	Unit	Description	Value
a.	Total number of interchanges (major Bus, Terminals, and Railway stations)	No	Primary Survey 2022 (RNI)	19
b.	Total number of interchanges having Bicycle parking (within 250m radius)	No	Primary Survey 2022 (RNI)	10
c.	NMT parking facility at interchanges	%	Calculate= [b / a] * 100	52.63
LOS				
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25				

LEVEL OF SERVICE FOR NMT PARKING 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.

Table 160 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			

LEVEL OF USAGE OF ITS FACILITIES

This benchmark indicates the efforts to add information technology to transport infrastructure and vehicles 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.

Table 161 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	-	Traffic Police Department	63
b.	Total number of Bus stations on BRTS, Terminals, Metro Stations, and Signalized Intersections	No	-	Primary Survey 2022	108
c.	Availability of Traffic Surveillance – CCTV	%	Calculate = [b/a] * 100		58.33
LOS					**2**
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 LoS accounts to 4 indicating the need to improve PIS at terminals. But still has scope to improve the services, especially at the bus terminals. A significant investment is needed in PIS.

Table 162 Passenger Information System

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Total number of Terminals, Metro Stations having PIS	No	-	Primary Survey 2022	33
b.	Total number of Terminals, Metro Stations	No	-	Primary Survey 2022	61
c.	Passenger Information System (PIS) for Public Transport	%	Calculate = [b /a] * 100		54.10
LOS					**2**

LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25

GPS/GPRS SYSTEMS

The calculation of Global Positioning System (GPS/GPRS) is shown below.

Table 163 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	KMRL, KSRTC, RTO Primary Survey 2022	117
b.	Total public transport vehicles and IPT	No.	Calculate total no. of Public Transport Vehicles and IPT	KSRTC, RTO Primary Survey 2022	1425
c.	Global Positioning System / GPRS	%	Calculate= [a / b] * 100		8.2
LOS					**4**
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 4.

SIGNAL SYNCHRONIZATION

To improve the traffic flow along the road networks, the signals along the corridor are interconnected. The phasing of the signal at any specific intersection is 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 is shown below.

Table 164 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	17

b.	Total no. of signalized intersections	No.	Calculate Total no. of signalized intersections in the city	Traffic Police Department and Primary Surveys	47
c.	Signal Synchronization	%	Calculate= [a / b] * 100		36.17
LOS					3
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

Table 165 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	Metro, KSRTC, RTO Primary Survey 2022	1
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	Metro, KSRTC, RTO Primary Survey 2022	4
c.	Integrated Ticketing System	%	Calculate= [a / b] * 100		25
LOS					3
LOS1: >= 75, LOS2: 75 to 50, LOS3: 25 to 50, LOS4: Below 25					

LEVEL OF SERVICE FOR ITS FACILITIES

Table 166 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	2	4	3	3
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 14, 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.

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.

Table 167 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 area.

Table 168 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 the area face high congestion along the network and will require traffic management plans to improve travel times.

LEVEL OF SERVICE FOR TRAVEL SPEEDS

Table 169 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.

AVAILABILITY OF PARKING SPACES

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

Table 170 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	779

b.	Total available on-street parking spaces in ECS allotted for all vehicles	ECS	-	Primary Survey, 2022	5505
c.	Availability of paid parking spaces	%	Calculate= [a /b] * 100		14.15
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.

Table 171 Ratio of Maximum and Minimum Parking Fee

S.NO	CALCULATION VALUE	UNIT	DESCRIPTION	
a.	Maximum parking fee being charged per 2 hours in the city for public parking	INR	Primary Surveys, 2022	35
b.	Minimum parking fee being charged per 2 hours in the city for public parking	INR	Primary Surveys, 2022	20
c.	Ratio of paid parking fee		Calculate= [a /b]	1.75
LOS1: >4, LOS2: 3-4, LOS3: 1-2, LOS4: 1				

As there is 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.

Table 172 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.

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 FOR LAKH POPULATION

The calculation of fatality rate per lakh population is shown below.

Table 173 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.	DCRB, 2022 (City & Rural Police)	353
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	22.86

c.	Fatality rate per 1,00,000 population	Ratio	Calculate= [(a*100000) / b].		15.44
LOS					**4**
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 the area. This indicates poor safety in the area and actions are required to improve the same.

FATALITY RATE FOR PEDESTRIAN AND NMT

The calculation of fatality rate of pedestrian and NMT is shown below.

Table 174 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.)	DCRB, 2022 (City Police)	40
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	DCRB, 2022 (City Police)	156
c.	Fatality rate for pedestrian and NMT	%	Calculate = [(a / b)*100].		25.64
LOS					**2**
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 2.

LEVEL OF SERVICE FOR ROAD SAFETY

Based on the above indicators, the overall score of the Benchmark computes to 6. The overall LoS for the parameter "Road Safety" is 3. Road safety of all road users, esp., NMT and pedestrians are hence observed to be unsafe on the streets.

Table 175 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**	**2**
TOTAL INDICATOR LOS Value: 6 (OVERALL LOS 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.

Table 176 Pollution Levels

LOS	Description	Data Source	Value
1	Annual Mean Concentration of SO2	Pollution Control Board (PCB) zonal office	1.4
2	Annual Mean Concentration Range of Oxides of Nitrogen		17.51
3	Annual Mean Concentration of SPM		35.83
4	Annual Mean Concentration of RSPM		21.82

LEVEL OF SERVICE FOR POLLUTION LEVELS

Based on the above indicators, the overall score of the Benchmark computes to 4 with a LOS of 1. This indicates the city emission levels are under control. The standards are met with and to maintain the same, public transport usage should be enhanced while the growing dependency on private vehicles should be curbed.

Table 177 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	**1**	**1**	**1**	**1**
TOTAL INDICATOR LOS VALUE :4 (OVERALL LOS 1)				
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
4. Intensity of Development along Transit Corridor
5. Clear Pattern and completeness of the Network
6. Percentage of Area under Roads

POPULATION DENSITY (GROSS)

The calculation of Population Density is shown below.

Table 178 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	73200
b.	Population of current year or the year for which data is available.	No.		UMTC Estimates, 2022	23.63 lakhs
c.	Population density	Ratio	Population density= [b / a]		32.28

LOS	4
LOS1: >=175, LOS2: 150-175, LOS3: 125-150, LOS4: <125	

MIXED LAND USE ON MAJOR TRANSIT CORRIDORS / NETWORK

The percentage of mixed land use along the major corridors was calculated as less than 5% for the study area. The corresponding LoS value for the indicator 'Mixed Land Use Zoning' is 4. This indicates the need to strategize the planning regulations to improve mixed non- residential usage along the mobility corridor to improve the usage of public modes as envisaged.

Table 179 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 1.

Table 180 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	3(without additional fee) 4 (with additional fee)
LOS					**1**
LOS1: >=2, LOS2: 1.5-2, LOS3: 1.0-1.5, LOS4: <1					

INTENSITY OF DEVELOPMENT ALONG TRANSIT CORRIDOR

The calculation of intensity of development along transit corridors is shown below. The corresponding LOS value is 3. There are currently no development control guidelines promoting higher density development along mass transit corridors in the city.

Table 181 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	3
b.	FSI along transit corridors.	No.	As per Master plan/ Development plan as applicable to areas along transit corridors	LSGD	*4*
c.	Intensity of Development along Transit Corridors	Ratio	Calculate Ratio = [b/ a].	LSGD	*1.33*
LOS					**4**
LOS1: >=3, LOS2: 2-3, LOS3: 1.5-2, LOS4: <1.5					

CLEAR PATTERN AND COMPLETENESS OF THE NETWORK

This is a qualitative indicator and is based on the extent of clarity and completion of existing and proposed road network of the city. The city has somewhat clear pattern radial pattern with somewhat incomplete rings in the road network. The indicator's LoS range is given below. The corresponding LoS value for the 'Road Network Pattern and Completeness' is 2.

Table 182 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 2. This indicates that certain areas could require network augmentation.

Table 183 Percentage of Area under Roads

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Measure overall developed area	km. sq.	Measure developed area of a city	LSGD	732
b.	Measure overall area under road network.	km. sq.	Total area under roads	LSGD	*89.62*
c.	Percentage of area under road network	%	Calculate Ratio = [b / a] * 100.		*12.24*
LOS					**2**
LOS1: >=15, LOS2: 12-15, LOS3: 10-12, LOS4: <10					

PERCENTAGE NETWORK WITH EXCULSIVE ROW FOR TRANSIT (FOR >1 MILLION POPULATION)

The LoS value for the indicator 'Percentage Network with Exclusive RoW for Transit' is 3.

Table 184 Percentage of Network under exclusive RoW for Transit

S. No.	Calculation	Unit	Description	Data Source	Value
a.	Total major network (Arterial & Sub arterial only)	km.	-	LSGD	249
b.	Total network with exclusive ROW (for BRT/monorail/LRT/Metro)	km.	-	LSGD	*28*
c.	Percentage of area under road network	%	Calculate Ratio = [b / a] * 100.		*11.24*
LOS					**3**
LOS1: >=15, LOS2: 12-15, LOS3: 10-12, LOS4: <10					

LEVEL OF SERVICE FOR INTEGRATED LAND USE TRANSPORT SYSTEM

Based on the table below, the overall score of the Benchmark computes to 20. The Benchmark's LoS is at 3, indicating the need to develop a coherence between city structure and public transport system in the study area.

Table 185 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**	**1**	**4**	**2**	**2**	**3**
TOTAL INDICATOR LOS VALUE :20 (OVERALL LOS 3)							
OVERALL: LOS1: <=8, LOS2: 9-15, LOS3: 16-22, LOS4: 23-28							

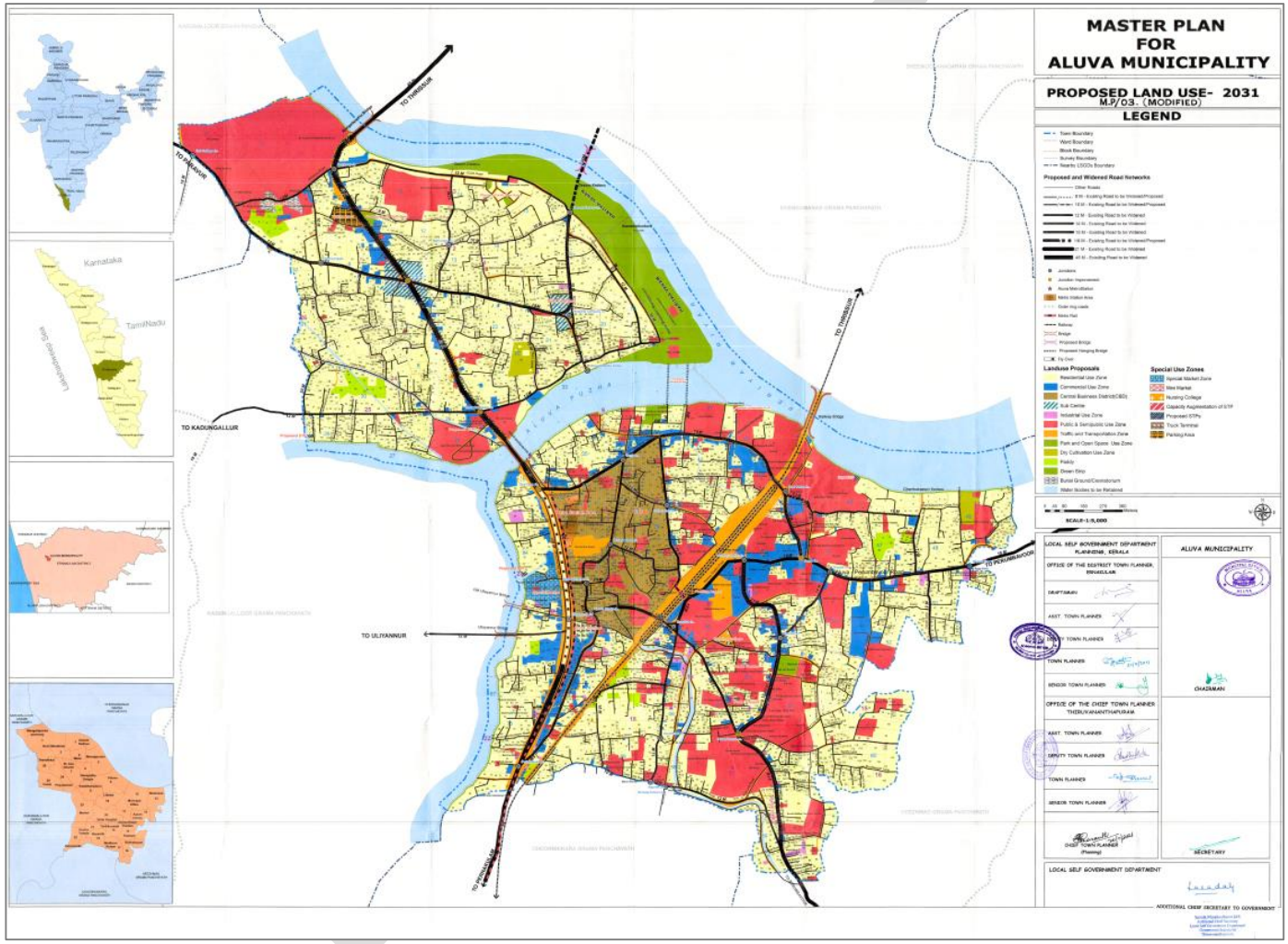
ANNEXURE 4: PUBLIC TRANSPORT FARE STRUCTURE

PUBLIC TRANSPORT FARE STRUCTURE						
Cost Per Km (Paisa)	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	
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	

PUBLIC TRANSPORT FARE STRUCTURE							
Cost Per Km (Paisa)		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)
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	

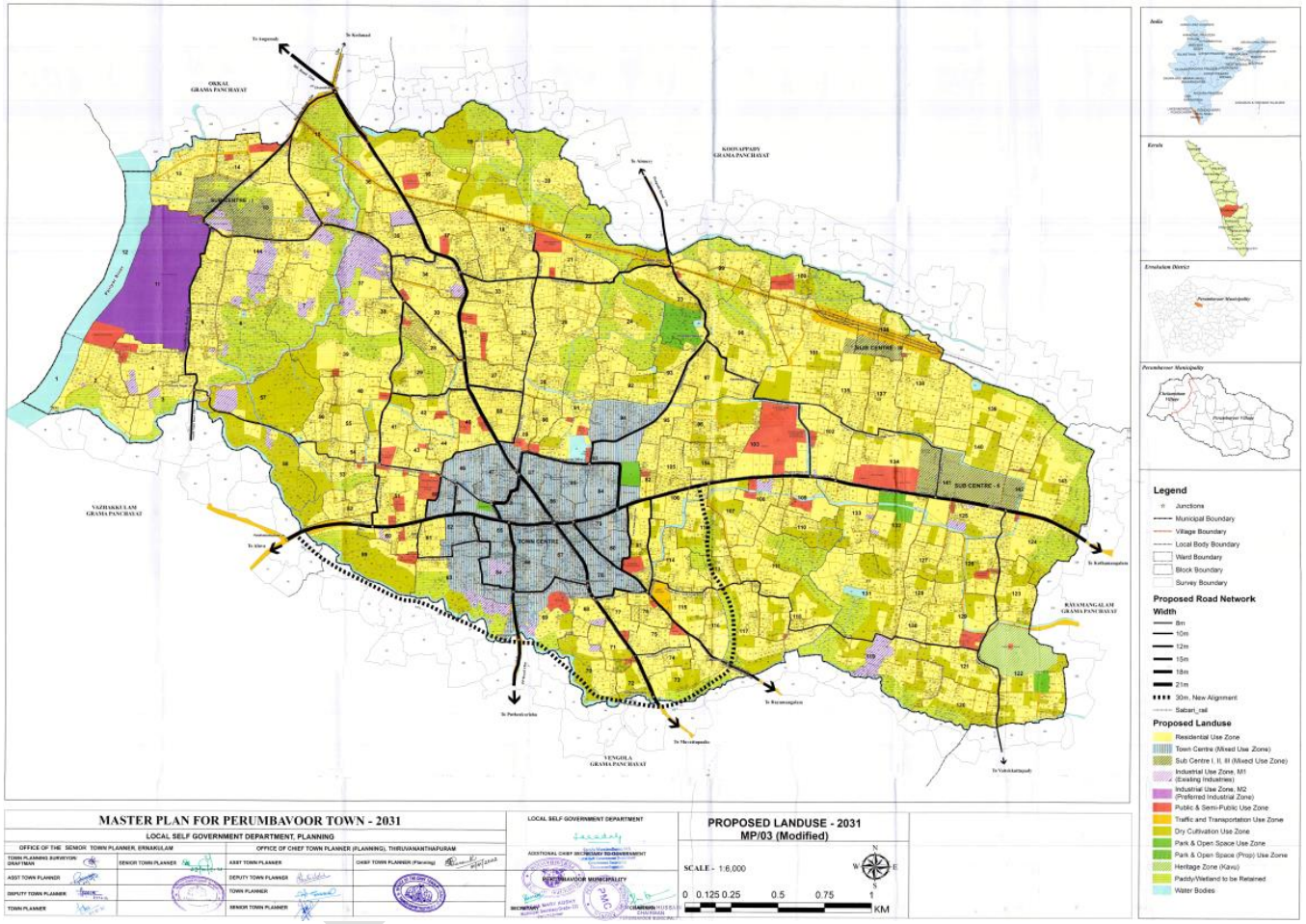
ANNEXURE 5: PROPOSED LANDUSE PLANS

ALUVA MUNICIPALITY (PROPOSED LANDUSE PLAN 2031)



NORTH PARAVUR MUNICIPALITY (PROPOSED LANDUSE PLAN 2031)

PERUMBAVOOR MUNICIPALITY (PROPOSED LANDUSE PLAN 2031)



ANGAMALY MUNICIPALITY (PROPOSED LANDUSE PLAN 2031)

GIDA LANDUSE PLAN (EXISTING) AND PROJECT PROPOSALS