Bruhat Bengaluru Mahanagara Palike (BBMP)

Comprehensive Bengaluru City Traffic Management Infrastructure Plan

Proposals for Vehicular Tunnel / Grade Separator / Road Widening In Selected Corridors.

Government of Karnataka

ALTINOK CONSULTING ENGINEERING INC.

Consultancy services for preparation of Comprehensive Bengaluru city road infrastructure plan to decongest traffic and to prepare comprehensive traffic management plan for proposal of vehicular tunnel / Grade separator / Road widening in selected corridors.

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Bruhat Bengaluru Mahanagara Palike

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PROJECT APPROVAL CERTIFICATE

This document has been prepared for the ***"Consultancy services for preparation of Comprehensive Bengaluru City road Infrastructure plan to decongest traffic and to prepare comprehensive Traffic Management Plan for proposal of Vehicular Tunnel / Grade separator / Road widening in selected corridors."*** **by Altinok Consulting Engineering Pvt.Ltd, New Delhi.**

The consultants have satisfactorily completed the consultancy services.

Consultants Altinok Consulting Engineering Pvt. Ltd New Delhi	AE Road Infra, BBMP	AEE Road Infra, BBMP	EE Road Infra, BBMP

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TABLE OF CONTENTS

C 05

Page 249-262

KANAKAPURA ROAD

Proposed Underpass at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road.

C 06

Page 3263-273

Anand Rao Flyover Extension.

Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road

C 07

Page 274-316

HOSUR ROAD

Extension of Existing Madiwala underpass till Traffic police station junction.

C 08

Page 3117-329

HOSUR ROAD

Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction - Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction.

C 09

Page 330-378

MYSURU ROAD

Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road

C 10

Page 379-390

HOSUR ROAD TO OLD MADRAS ROAD

Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala

C 11

Page 391-402

THANISANDRA MAIN ROAD

Proposed Elevated Corridor from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road

C 12

Page 403-418

MARAENAHALLI PIPE LINE ROAD

Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.

C 13

Page 419-428

HENNUR – BAGLUR MAIN ROAD

Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction.

Reference:

1. *CMP - 2020 for Bangalore*
2. *BBMP reports*
3. *BMRCL Data / Reports*
4. *RTO Data*
5. *Secondary data from various Traffic & Transportation Studies.*
6. *Highway Capacity Manual –HCM*
7. *IRC 99-2018*
8. *RC -106 -1990*

01.

Project Background

Introduction

Bengaluru, the largest city of Karnataka and the third most populous city in the country has an estimated population of over 10 million.
The city is also known as the "Silicon Valley of India" (or "IT capital of India") because of its role as the nation's leading IT exporter.
It also headquarters technological organisations like ISRO, NAL and HAL and is home to many educational and research institutions such as IISc, IIMB, IIITB, NIFT, NID-R&D Campus, NLSIU and NIMHANS.

Figure 1. Bengaluru city skyline

Figure 2. Bengaluru City Night view

As a growing metropolitan city, Bengaluru confronts problems with unplanned expansion of the city to accommodate the huge influx of the people every year leading to serpentine traffic jams on major corridors every day.
The resultant pressure on road spaces is very high, and traffic conditions are increasingly difficult.

Bengaluru Today

Demographics

The city of Bengaluru houses a population of over 10 million **(Figure 3)** with about 2 million migrant workers (4,378 people per square km), ranking it as the third most populous city in India. This accounts to a 46.48 % **(Figure 4)** jump in the population in the decadal population growth rate in India.

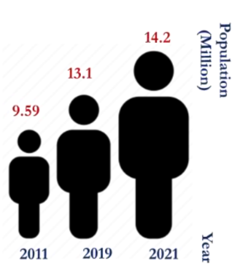


Figure 3. The Population of Bengaluru

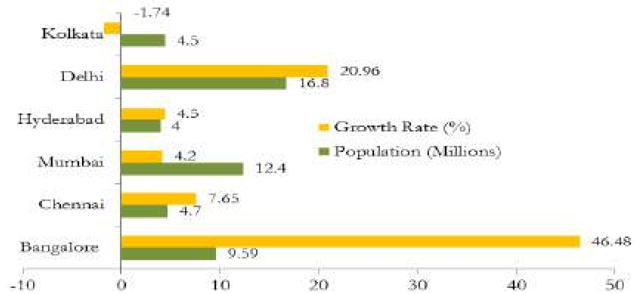


Figure 4. The rapid growth of Bengaluru against other major cities in India

Source: Directorate of Economics and Statistics/ Census 2011

Vehicular Registrations

According to the Bengaluru Traffic Police **(Figure 5)**, there is one vehicle for every two people on the roads of the city. This is the resultant of about 82,53,218 number of vehicles registered in Bengaluru (15,72,185 cars and 57,30,388 two wheelers.). It is estimated that by 2022, there would be more than one Crore vehicles seen on the road network of Bengaluru.

The increased number of vehicles on roads in Bengaluru has resulted in an average vehicular speed 10 - 15.5 Km (peak hour). Thus, Bengaluru has been ranked third behind Patna and Kolkata in the slowest moving traffic in the country. (Source: Ola Ease of Moving Report).

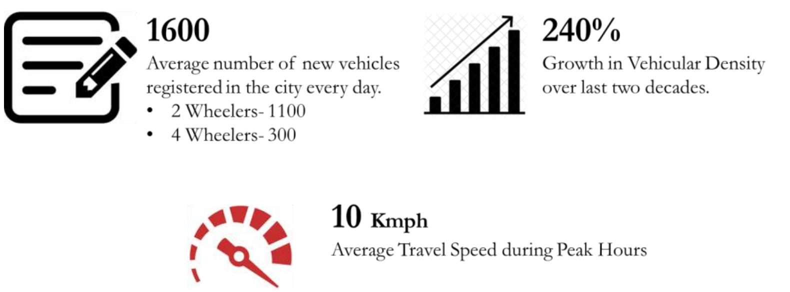


Figure 5. Vehicular Statistics of Bengaluru. (Source: Karnataka Transport Department)

Road Network

Bengaluru is endowed with a radial pattern of road network converging in the core area of the city. The total road network of the city is about 4000 km of which arterial/sub-arterial roads account for about 350 km. The road network in the central parts of the city has developed organically over the last few centuries and has inadequate right-of-way. There is also a ring road which cuts across the various radial roads.

The National Highways which pass through Bengaluru include:
- NH – 4 connecting Pune and Chennai
- NH – 7 connecting Varanasi and Kanyakumari
- NH – 209 connecting Dindigul / Pollachi

The following are the State Highways in Bengaluru:
- SH – 17 connecting Mysore and Gundlupet
- SH – 17E connecting T G Halli
- SH – 19 connecting Hindupur via Yelahanka & Doddaballapur
- SH – 86 connecting Mysore via Kanakapura

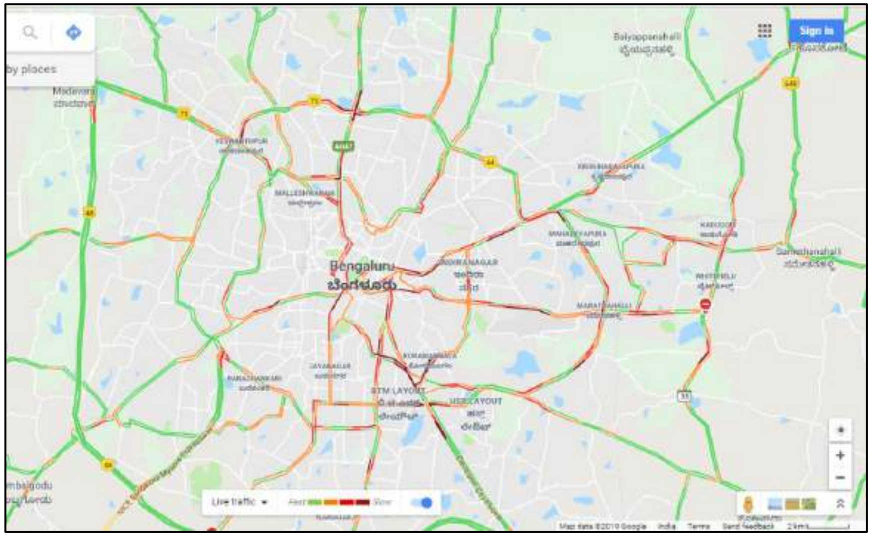


Figure 6. Typical Morning Peak Hour Traffic from Bengaluru Traffic Police Website

Some of the primary traffic bottlenecks in the city of Bengaluru happen at major, crucial junctions/ stretches in the core of the city. **Figure 6** above represents the typical peak hour traffic congestion on the road network as extracted from the Google maps traffic. It could be observed that the western part of the city is relatively lesser congested compared to the central zones.

Accident Statistics

The road accidents in the city of Bengaluru are as presented below in **Figure 7**. Despite road fatalities being reduced, the non-fatal accidents contribute to a significant number. The reasons include poor road condition, poor lighting, poor junction design, etc. The alarming reality is the vulnerable users who are victims in the accidents caused. This also relates to the high dependency of commuters on private transport over public transport.

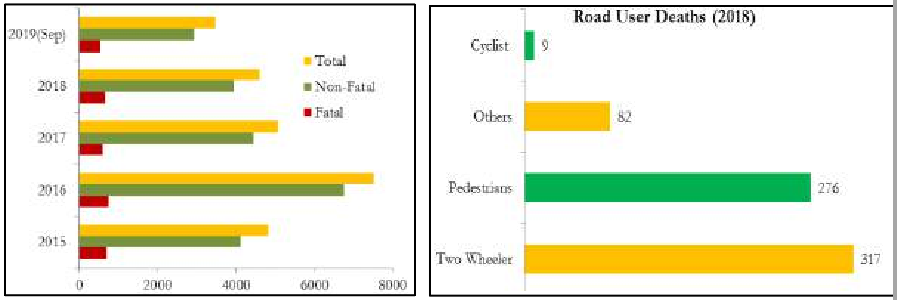


Figure 7. Accident Statistics of Bengaluru (Source: Bengaluru Traffic Police)

Public Transport

The two prominent public transport services in Bengaluru are the buses operated by Bangalore Metropolitan Transport Corporation (BMTC) and the metro, operated by Bangalore Metro Rail Corporation Limited (BMRCL).

The silent features of the two public transport systems are presented in the sections below:

Bangalore Metropolitan Transport Corporation (BMTC):

As Bengaluru's roads become more and more congested, the role of public transport becomes increasingly important. The public transport in the city has in the past seen rapid and dramatic improvement, with a comprehensive network of bus services providing high level of access to work, education, centres of retail and centres of recreation to meet the growing travel demand.

BMTC is the sole public bus transport provider for Bengaluru, serving urban, sub-urban and rural areas. This network was built with a vision of providing safe, reliable, quality service and choice option to the residents of the city over a period of 20 years, with a constant involvement and partnership between the urban local governments.

The service coverage of BMTC buses is as shown below in **Figure 8**:

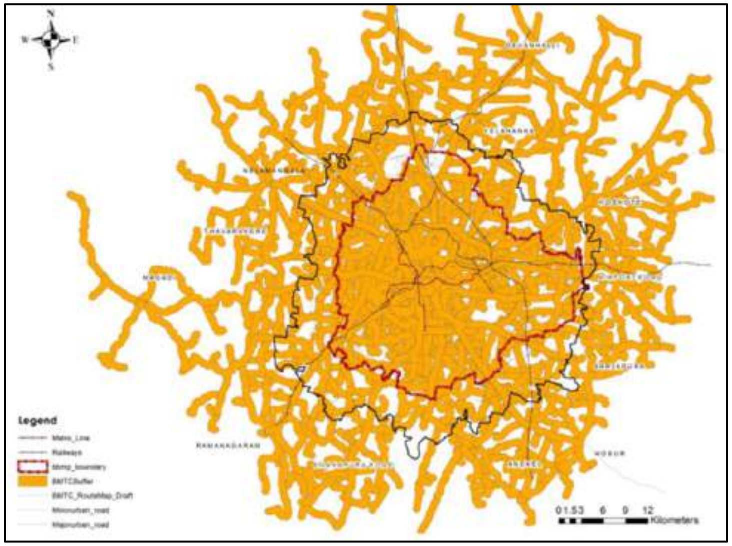


Figure 8. BMTC Service Coverage (Source: BMTC)

However, over the past few years, the performance of the public transport in the city has been reducing attributing to various reasons, which are both internal and external to PT operator. Over the years, the performance of fleet with reference to cancellation of service, effective kilometres, KMPL, etc. has been slowly declining.

Some of the notable points with respect to BMTC operations are listed below .

- BMTC has a fleet size of around 6,513 buses which are currently catering to about 35.8 Lakh passengers per day.
- The effective kilometre per day is 11.2 Lakhs with a cancellation rate of 11.9% recorded in year 2019-20.
- The average speed of the buses during peak hours is less than 10kmph on many major corridors

The share of public transport has been reduced from 35% to 27% over the years with increase in private vehicular trips.

Considering the future developments in the city, it is absolutely necessary that the spine of the city i.e. the public transport needs to be integrated with other modes of transport encouraging seamless travel with limited or no externalities with the active involvement of the local governments, if Bengaluru is to remain a successful and vibrant cosmopolitan that it is

Bangalore Metro Rail Corporation Limited (BMRCL)

Bangalore Metro Rail Corporation Limited (BMRCL) is a joint venture of Government of India and the Government of Karnataka. It is the city's most significant investment to-date in providing a lifeline for the city's constrained and congested roadways. The metro system is designed for a maximum train speed of 80 km/hr. but the trains are allowed to commercially run at a speed of not more than 67.50 km/hr.

The high capacity mass transit mode offers two trunk routes- Purple Line (Baiyyappanahalli - Mysore Road) and Green Line (Nagsandra - Yelechanahalli) in Phase I that is currently operational. A total of 42.3 km of metro services are operational. These services operate at a headway of 3-4 min with an estimated travel time of 30-45 min. The metro line alignment is as represented below in **Figure 9**:

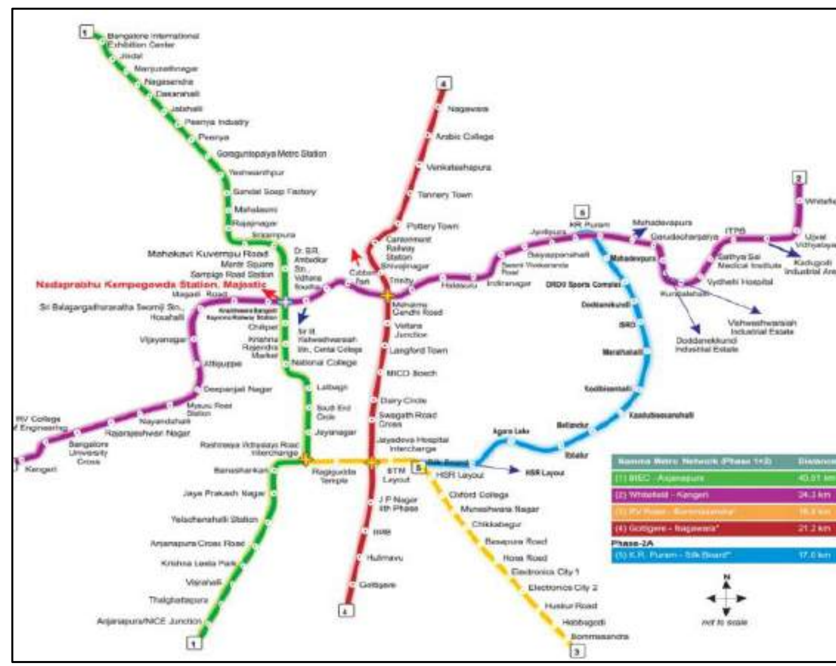


Figure 9. BMRCL Service Coverage (Operational + Proposed) (Source: BMRCL)

The Bruhat Bengaluru Mahanagara Palike (BBMP)

The Bruhat Bengaluru Mahanagara Palike (BBMP) is the governing body responsible for managing civic amenities and some infrastructural assets within the Greater Bengaluru metropolitan area. As India's fourth-largest Municipal Corporation, it oversees a population of 8.4 million across a 741 km² area. Over the past six decades, its jurisdiction has expanded more than tenfold.

BBMP's key responsibilities include ensuring the "orderly development of the city" through tasks like road development, zoning, building regulations, public health, hygiene, licensing, trade, and education. It also addresses issues related to quality of life, such as managing public spaces, parks, water bodies, and greenery.

BBMP functions as the third tier of government, below the Central and State governments. Additionally, other statutory authorities like the Bangalore Development Authority and BESCOM share some municipal duties.

Bengaluru has around 1,920 km of arterial and sub-arterial roads. The BBMP is tasked with the development and maintenance of these infrastructural assets, playing a key role in the city's improvement.

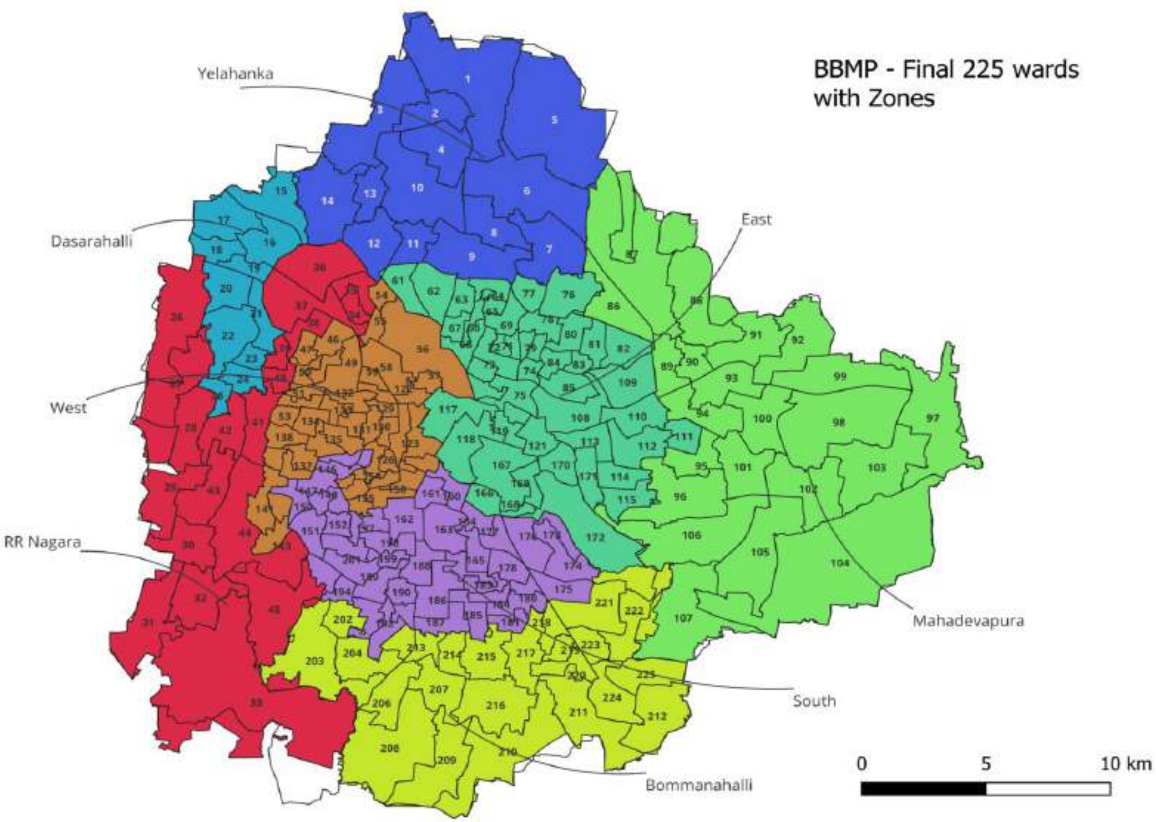


Figure 10. Ward Map of BBMP Bangalore

Bengaluru tops the list of India's most congested city, as revealed by the latest Traffic Quality Index, putting its notorious traffic woes in the spotlight. The TQI report, shows Bengaluru scoring alarmingly high in the "extreme congestion" category, ranging from 800 to 1,000.

According to the report, Mumbai follows closely behind with a score of 787, making it the second most congested city.
Delhi and Hyderabad are also on the list, with congestion scores of 747 and 718, respectively.

Project Initiation by BBMP

Bengaluru has struggled to balance the increasing population and vehicular growth with adequate infrastructure development. As a result, the city faces worsening traffic congestion, extended travel times, and low public transport usage. The aim of the current study is to propose long-term, sustainable solutions to improve traffic flow in Bengaluru. These interventions must be flexible and adaptable to the evolving travel patterns, fostering public engagement, and seeking innovative approaches to tackle emerging challenges. Public transport needs to move beyond conventional methods, offering diverse alternatives to private vehicle usage and integrating multiple modes of transport efficiently.

The city's traffic congestion stems from a combination of excessive vehicle numbers and insufficient infrastructure, aggravated by inadequate urban planning. The most effective solution is to alleviate traffic congestion through continuous infrastructure development projects such as elevated corridors, tunnels, underpasses, and flyovers. While the expansion of public transport via BMTC buses and Metro systems has been implemented, traffic congestion continues to rise. This growing issue has earned Bengaluru the title of the most congested city in terms of traffic. In response, the BBMP has taken this matter seriously and is preparing a comprehensive Traffic Management Plan. This plan aims to provide seamless, congestion-free mobility both within and across the city, aligning with the National Urban Transport Policy (NUTP) and addressing long-term solutions

Objectives of Study

The Bengaluru Comprehensive Traffic Management Plan is designed to enhance mobility, accessibility, convenience, and comfort for all road users, including public transport, private transport, commercial transport and non-motorized transport (NMT) users. The key objectives of the study include:

- Evaluating the current road infrastructure in the identified corridors, identifying areas for improvement, and ensuring seamless travel in terms of connectivity, safety, and convenience.
- Developing a plan to support the mobility of public transport users, pedestrians, and cyclists.
- Proposing actionable interventions and creating conceptual-level designs to improve mobility along the major corridors.
- Assessing the roads provided by BBMP to determine suitability for infrastructure solutions like elevated expressways or tunnels and underpasses.

Scope of Work

The development of the Bengaluru Comprehensive Traffic Management Plan includes the following key tasks: The study aims to propose strategies and plans that can be implemented long term solutions to achieve seamless traffic flow

The primary focus is on reducing travel times by addressing traffic conflicts at junctions and other bottleneck areas, with particular attention on improving the speeds of public buses, cars, and other transport modes.

The plans will prioritize enhancing road speeds, reducing congestion, and ensuring pedestrian safety while improving access to public transport , private vehicles and NMT.

The broad scope of work includes:

- Developing actionable solutions and strategies for corridor and area improvements.
- Proposing seamless travel solutions such as elevated corridors, tunnels, and underpasses.
- Creating conceptual designs for these interventions if necessary.
- Ensuring that proposed solutions are supported by traffic data, statistics, and model run analysis from the Transport Model.

Corridors to be studied as per Scope of Work

Table 1. Proposed Corridors as per RFP to take up the Travel Demand assessment

Sl. No	Corridor	Length
1	Bellary Road- Old madras road corridor :From Esteem Mall Junction to Mekri circle to Miller Road, Kensington Road, Murphy Road to Old Madras Road	14 kms
2	Bellary Road – From Mekri Circle to Chalukya Circle	7kms
3	Old Madras Road – From Trinity Circle to Hope farm via Budigere and K R puram	25 kms
4	Old Airport Road – From ASC junction to Yamalur Junction	18 kms
5	Sarjapura Road- From Hosur Road Junction to sarjapur	10 kms
6	Hosur Road –From Bellara Junction to Silkbord junction	6 kms
7	Bannergatta Road- from ORR junction to Bannerugatta Road BBMP limits	15 kms
8	Mysore Road-From Sirsi circle to NICE road	10 kms
9	Magadi Road-From Leprocy junction to NICE road	12 kms
10	Tumkur Road- From Yeshwanthpura junction to Tumkur road BBMP limits	10 kms
	Outer Ring Road	
11	Goragunte Palya to K R Puram	18
12	K R Puram to Silk Board	16
13	Silk Board to Mysore Road	12
	Total	190

Note: The corridors listed above are not finalized. Based on the feasibility report, additional corridors may be included, or some may be removed from the list.

Deliverables:

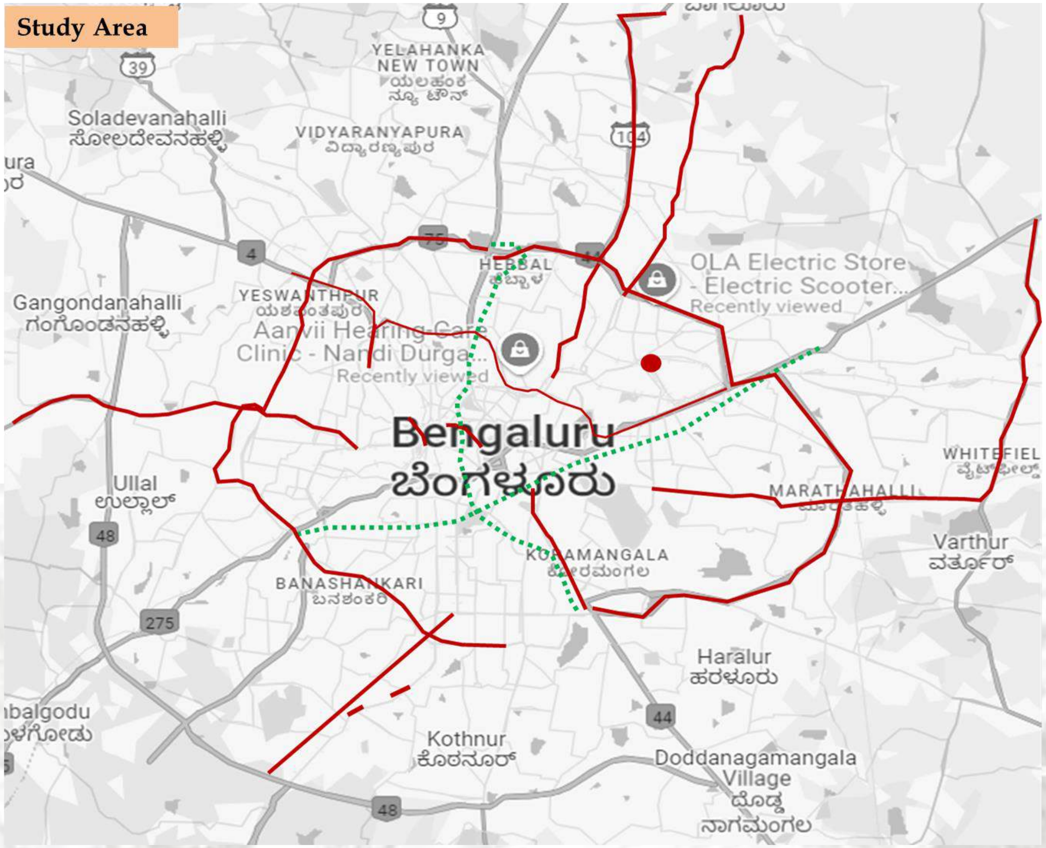
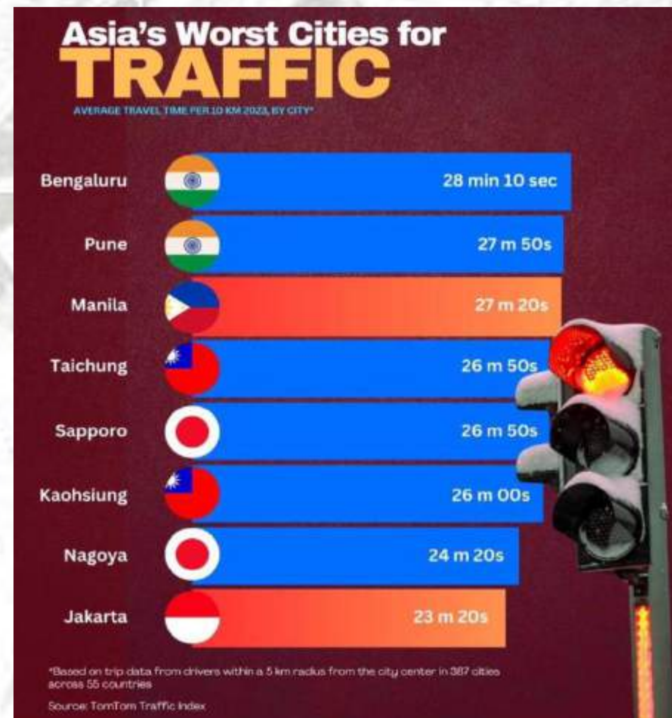


Figure 11. Map showing the Study Area

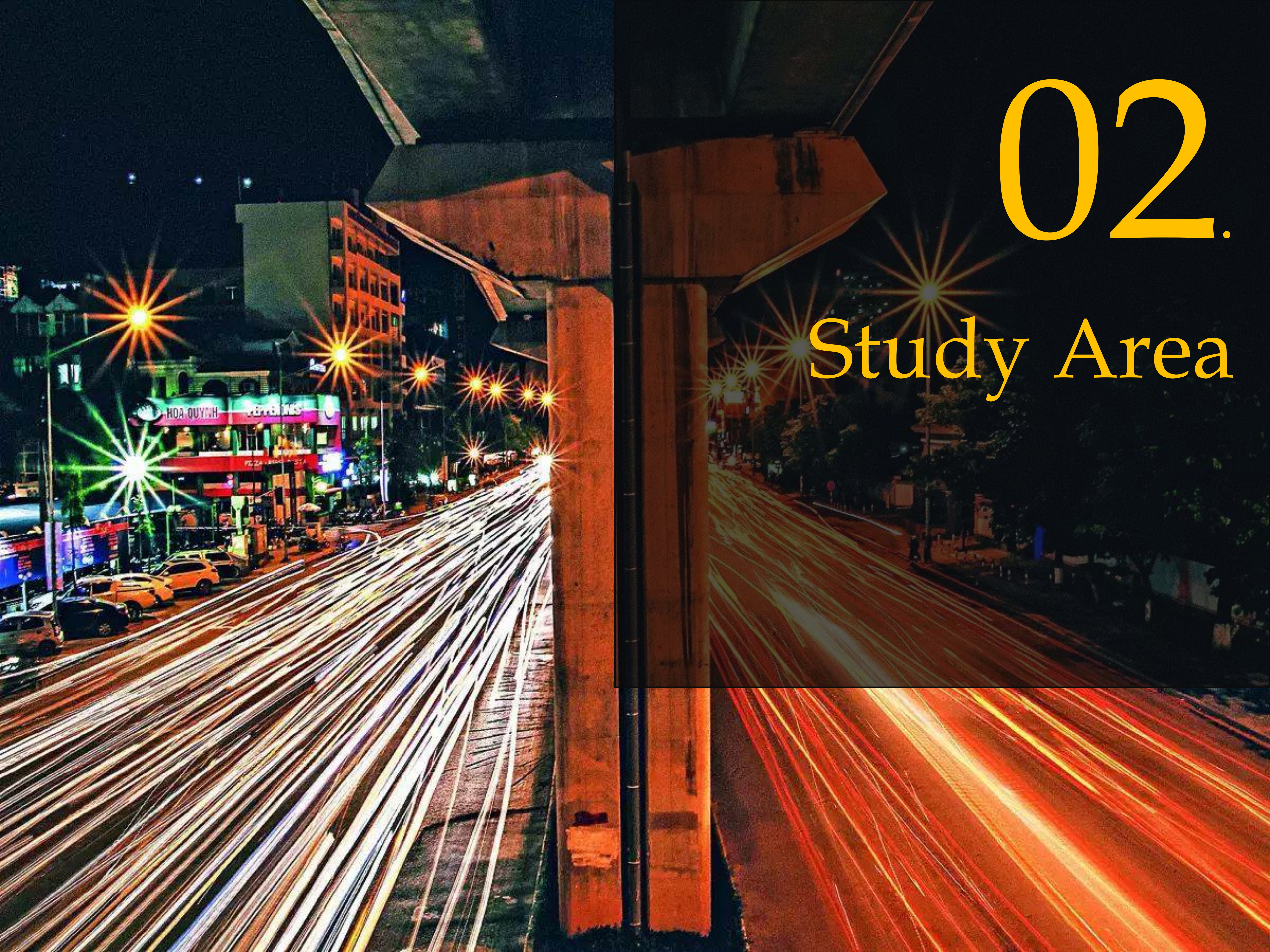
Task	Corridor Improvement Plan
Quantity	190 kms of corridors
Task 1	Baseline Scenario
Task 2	Primary Survey and Data Analysis
Task 4	Transport Demand Model Output
Task 5	Alignment Details / Conceptual Drawings

Deliverables:

•Feasibility study and technical assessments.
•Model out put report with respect to Transport Model.
•Route design and engineering blueprints.
• Block Cost estimates and budget plan.
•Environmental and stakeholder impact reports.
•Final conceptual proposal documents and presentation.



02. Study Area



Study Area

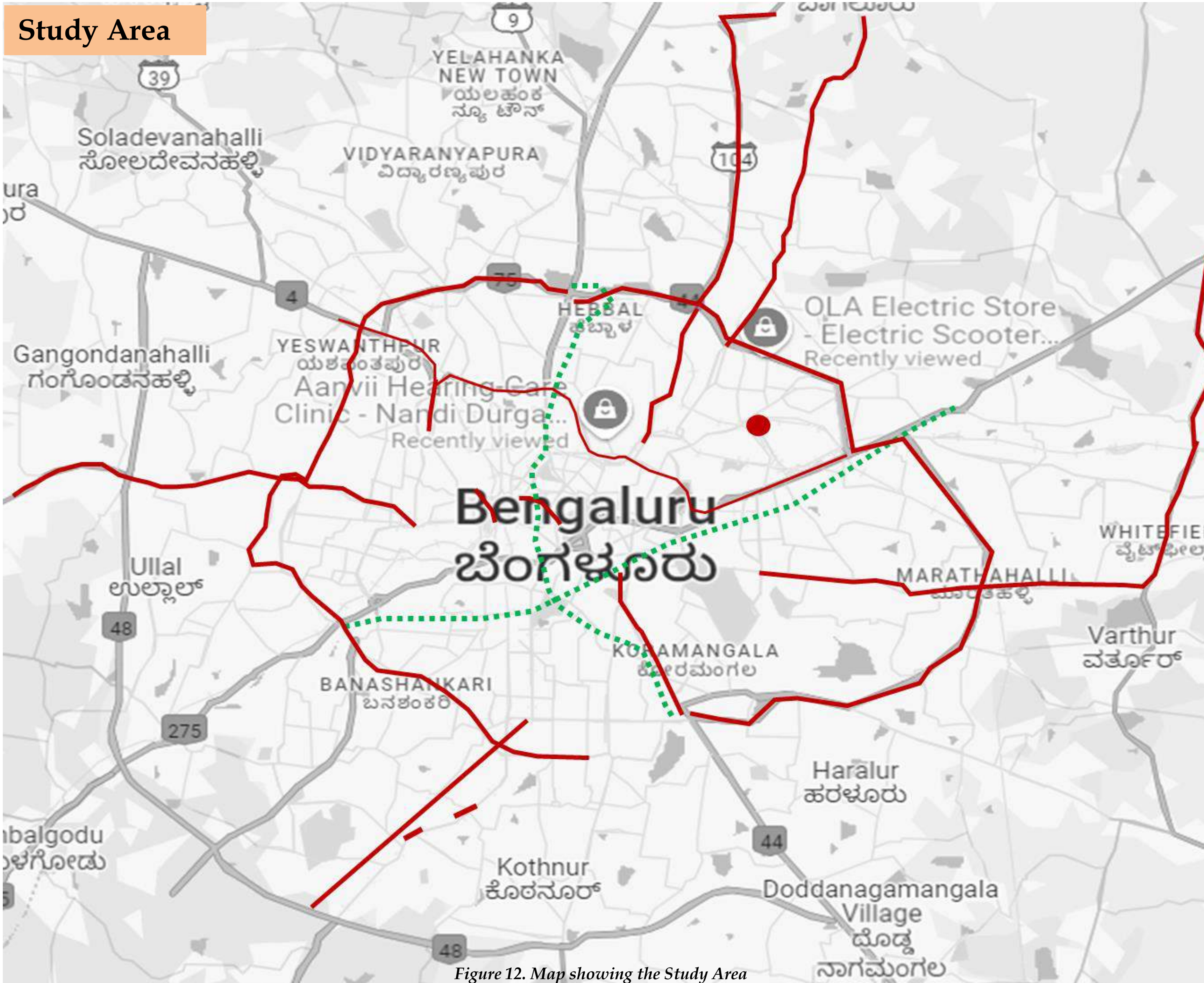


Figure 12. Map showing the Study Area

Proposed Study Area Profile

The overall aim of the project is to study and prepare a long term Seamless mobility plan for selected corridors within the city of Bengaluru as shown below in **Figure 10**.

Integrated Comprehensive Traffic Management Plan

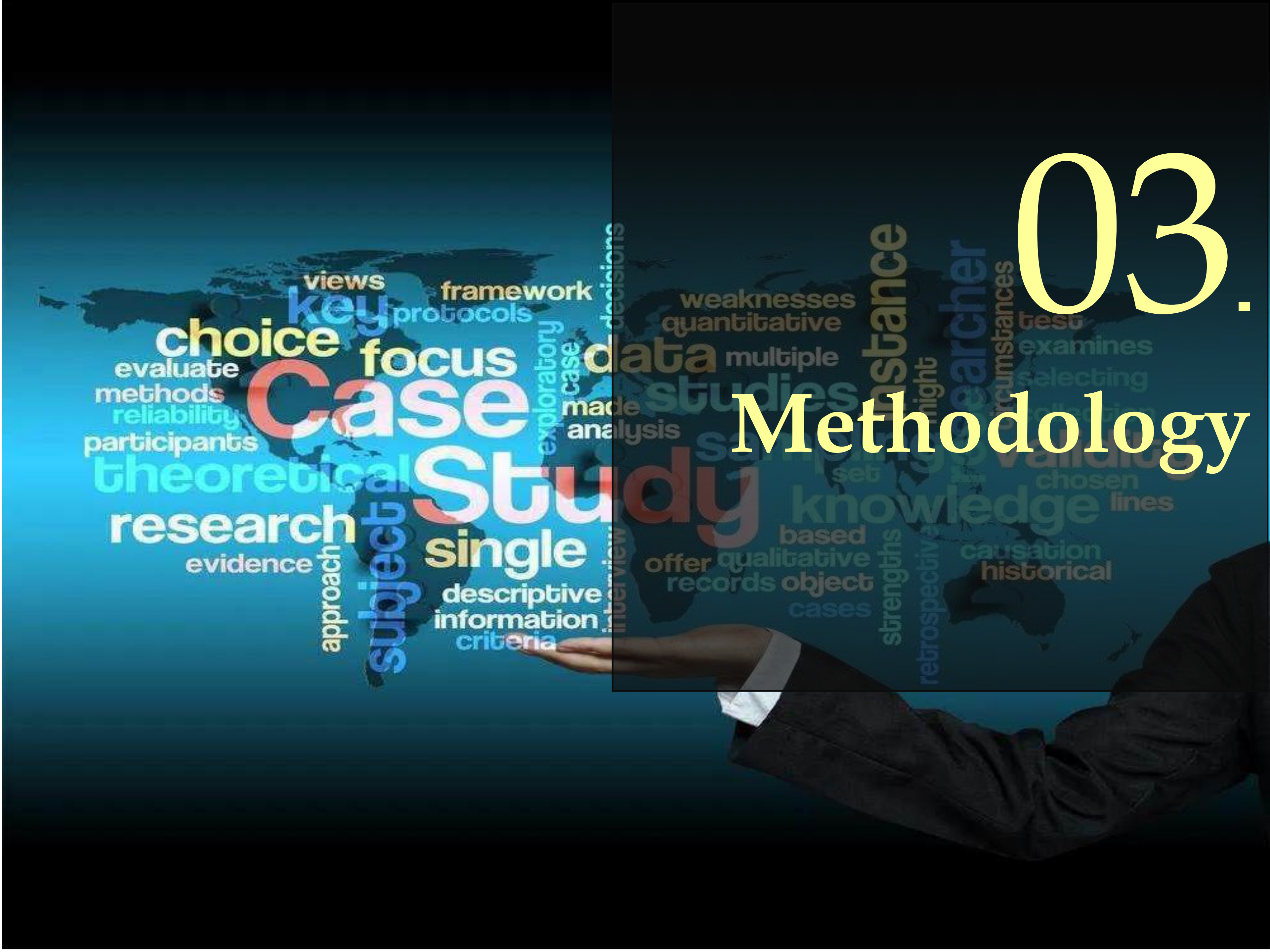
Twenty Three (23) Long term projects where identified on the corridors mentioned in the below Table no 2 & 3. these include important arterials that carry significant traffic and mass transit services along the RoW like buses and metro

Table 2: Proposed Corridors in the Study Area after the site reconnaissance Surveys

Sl. No	Corridor	Length kms
1	Split Flyover at MEI Junction	0.5
2	Yeshwanthpura (Mathikere cross) -IISC-Mekri circle-Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram.	27
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	2.7
4	Proposed flyover / Underpass at Konankuntae Cross for Through Traffic from Kanakapura to Banashankari	0.9
5	Proposed Flyover at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road	0.8
6	Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road	1.7
7	Extension of Existing Madiwala underpass till Traffic police station junction	0.5
8	Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction -Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	7.4
9	Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road	3.5
10	Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala	10
11	Proposed Elevated Corridor from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	15
12	Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.	**10.5**
13	Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction	15

Table 3: Proposed Corridors in the Study Area after the site reconnaissance Surveys

Sl. No`	Corridor	Length Kms
14	Proposed Elevated Corridor along Tannery road from Madava Mudiliyar road to Nagawara Junction.	5.5
15	Proposed Elevated Corridor from Yelahanka New town to Kempegowda International Airport Road	4
16	Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout).	4.5
DD1	Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.	13
DD2	Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station via Mohan Kumar Road.	2.2
T1	Proposed North – South Tunnel Corridor from Hebbal to Silk Board	18
T2	Proposed East- West Tunnel Corridor from K. R. Puram (I.T.I Colony) to Nayandahalli NICE intersection	28
	Total Length	**170.7**
	Total Length of Tunnels	**46**
	Total length of Elevated corridors/ Double Deckers/ Underpasses	**124.7**



03.

Methodology

Methodology

Approach

Increasing traffic volumes and the associated adverse impacts on congestion and air quality are key problems in Bengaluru and elsewhere in India and this situation is likely to deteriorate further.

The need, therefore is to find solutions that can meet people's desire to travel, by creating a long term Mobility plan that includes Elevated corridors, Tunnels and Underpasses and basic junction corrections if required.

'The Comprehensive approach to have a seamless traffic movement plan seeks to develop a most optimal transport road map keeping in view to decongest the traffic at all the major corridors and over passing the most congested junctions in the city by way of providing elevated corridors, Under passes and tunnels' This can be achieved by striving to improve the mobility of buses, private vehicles and commercial vehicles, thereby increasing their speeds on the road network of Bengaluru.

As a prerequisite, we would collect all relevant data very systematically to understand the present quantum of traffic and bottlenecks and challenges to the free movement of vehicles on the main corridors.

Solutions to transport improvement are not unique. A number of parallel strategies need to be considered. The road improvement, the public transport facilities improvement, parking management, traffic management, pedestrian movement and facilities, cycling facilities etc. must all be tackled in one go to achieve results that would meet the desired goal. Apart from this, we will also consider demand management strategies to reduce congestion on the road network.

While working on solutions, we will collect all earlier ideas and plans and review these proposals in the light of the present study aimed at the specific strategy under evaluation and come out with a list of possible and practical interventions.

Hence the outcome of the study will include Long term permanent solutions for seamless traffic movement within the city. Projects such as junction improvement plans, street improvement, parking improvement, circulation plans etc. can be taken up as per the Transport Demand Model.

The Stakeholders will be consulted at each stage of the project to make the outcome of the Study more beneficial to its users

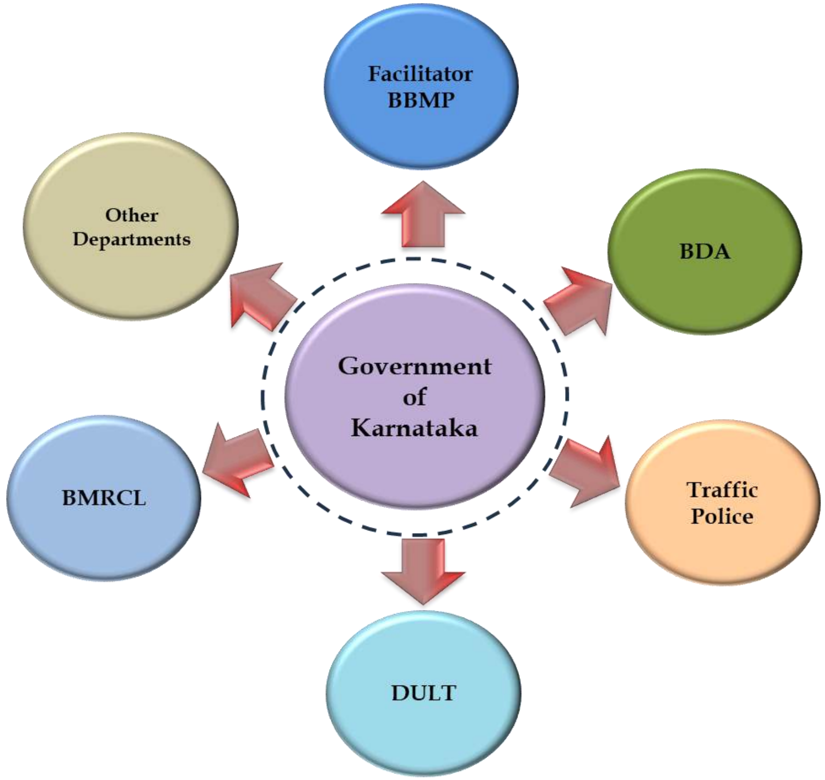


Figure 13. Map showing the Study Area

Methodology Adopted

The objective of the study is to improve the average speeds on the corridors by providing long term solutions . The corridors shall also provide enhanced safety for pedestrian movements at bus stands/stations, metro stations, and around major activity centres along the corridors. The study also focuses on long term seamless traffic movement for Bangalore city by proposing Integrated Elevated corridor, Underpasses and Tunnels. The proposed methodology is as illustrated below in **Figure 12.**

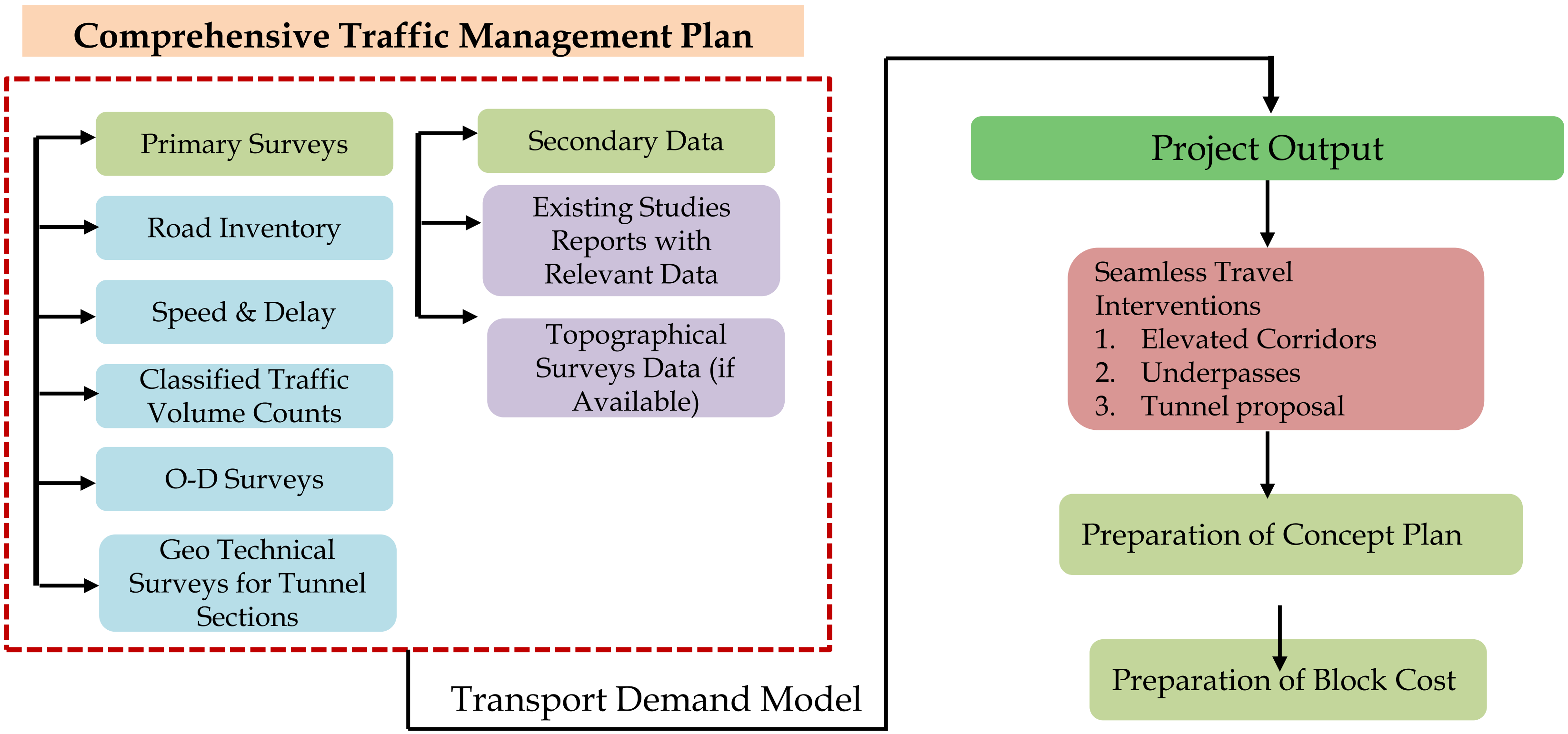


Figure 14. Pie Chart Showing the Traffic Management Plan details

Task 1: Baseline Scenario

The consultant shall establish the baseline for current corridor characteristics by means of Site Visits and Reconnaissance Survey. Apart from this the consultant has also undertake;

- Photo Documentation of the Corridors/Routes and Critical Area/Stretches
- Interactions with the Officials and Stakeholders to identify gaps and challenges
- Review of previous documents pertaining to the locations along the corridors/routes/stretches.
- The consultant has presented the major issues, opportunities and concerns observed and outline the broad strategies to guide the rest of the study.

Task 2: Primary Survey and Data Analysis

The consultant shall collect all relevant data by means of Surveys. The team will conduct the following surveys, as deemed necessary for the study;

- Road Network Inventory
- Junction Inventory – covering Geometric designs etc.
- Speed and Delay Surveys
- Classified Traffic Volume Counts at critical locations

Based on the data collected from the primary surveys and secondary sources, the team has done the data analysis for the following assessments

- Assessment of the Traffic Volumes as per IRC Guidelines or any other similar guidelines.
- Traffic Volume Assessment base year
- Establishment of level of service of individual corridors.
- Traffic Impact Assessment based on projections for 25 years.

The various assessments undertaken as part of this task has identified the critical gaps and challenges along the corridor, which will be used as inputs for formulating the strategies and interventions for the Corridor Improvement.

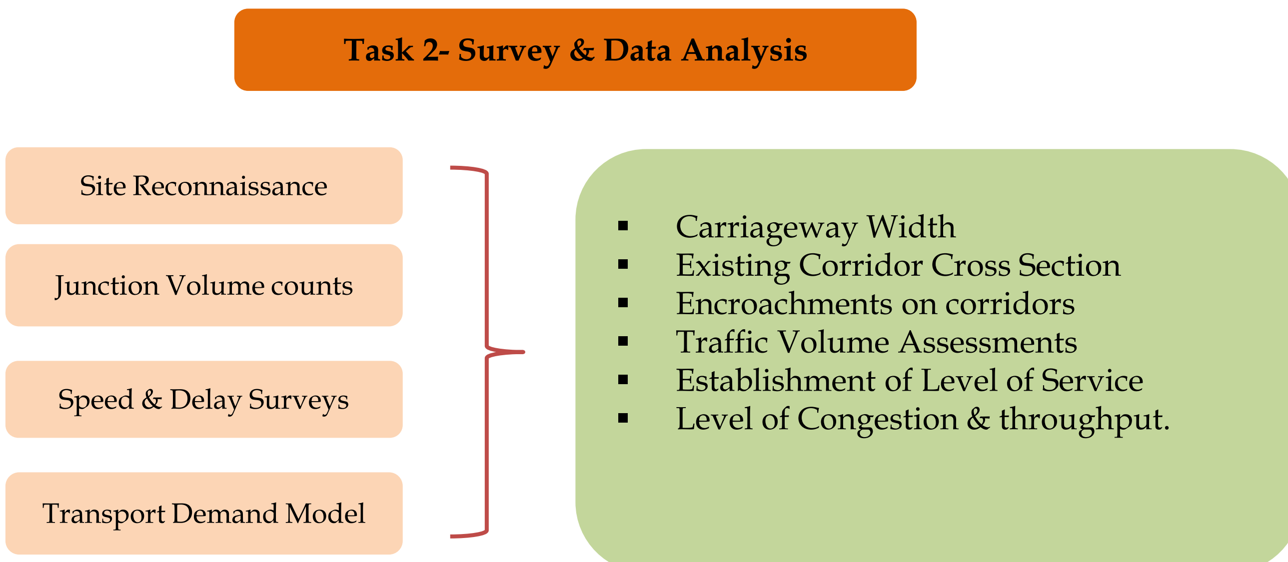


Figure 15. Task 2 – Survey and Data Analysis

Task 3: Corridor Improvement Solutions (Figure 14.)

Consultants have identified all the appropriate implementable Interventions for Corridor Improvements considering equitable Road Spaces for all Modes of Transport

- *Road Improvement Plan and Circulation Plans as deemed necessary; including*:
  - Road Markings and Signage
  - Junction Improvement
  - Turning movement controls
- *Parking Management Plan; including*
  - Parking restrictions or bans
- *Road Safety measures like*
  - Traffic engineering measures – Geometric Design Corrections
  - Traffic Calming Measures
  - Black Spot Corrections if any

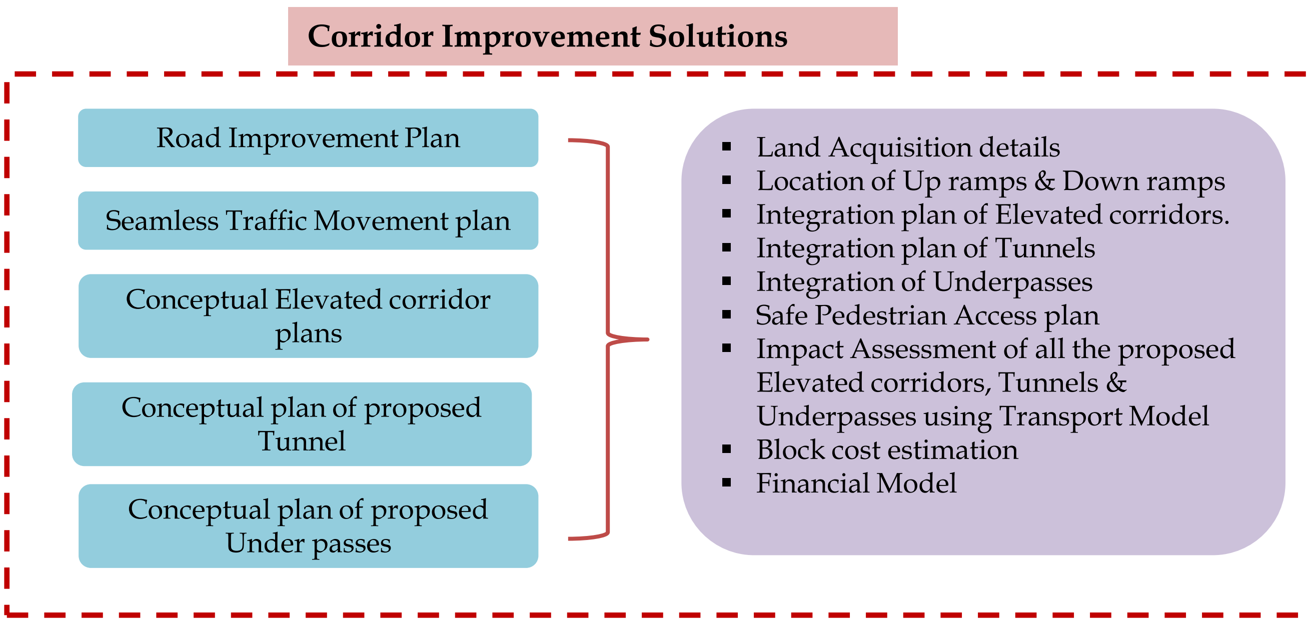


Figure 16. Task 3 Chart showing the Corridor Improvement Solutions approach

Task 4: Conceptual Drawings

All the critical proposals has been discussed with the stakeholders and conceptual drawings have been prepared by the Consultant.

04. Primary Surveys

Primary Surveys

In any transport planning exercise, data collection is the cornerstone and the very foundation on which rests the super structure of planning. The data is used to analyse the existing transport and traffic situation in the study area. The activity is undertaken to understand traffic and travel characteristics along the corridor and highlight corridor specific problems.

The following surveys have been carried out for the Comprehensive Traffic Management Plan.

Road Inventory Surveys

A full-scale inventory survey was undertaken to create a road network database. Inventories of the following facilities were carried out as part of the task.

- Road Network
- Effective Road width
- Quality of riding surface
- Adjoining Land use and available Access control
- Intersection Facilities
- Pedestrian Facilities
- Parking Facilities
- Traffic Control/management Measures like one –ways

Accordingly, road inventory survey was done for the entire corridor.

Intersection Turning Volume

Survey Location: Critical junctions and mid-block points along the corridor.

Objective: Surveys were conducted at the identified critical intersections. The data will help in realizing the seriousness of problem at the intersection, critical movements, etc.

Conduct: Video graphic counts were carried out along the corridor. Volume counts were carried out on a typical working day for 6 hours covering both morning and evening peak periods.

Data Entry and Analysis: The traffic data collected from the field were scrutinized and processed. The Passenger Car Unit (PCU) values recommended by Indian Roads Congress (IRC) are used in the traffic volume analysis.

Key Outputs:

- Peak Hour Volume at critical junctions (Veh./Hr. and PCU/Hr)
- Traffic by Vehicle type and hourly distribution of Traffic
- Identification of critical locations for pedestrian/Non-motorized vehicles movement Pedestrian Risk Zones
- Finalization of potential sites for safe pedestrian crossing facilities
- Identification of needs of NMT users and their opinion on exclusive NMT track
- Identification of traffic related issues at the junction

Speed and Delay Survey

Objective: The principle objective of the survey is to find out the running speed, journey 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: There are several methods available for conducting this type of survey. Few of the methods are; moving observer method, registration number plate method and Elevated observer method. Floating car method is widely used in India. The enumerators record the distance and time of travel between two junctions and stopping time of the vehicle along the road stretches, at intersections and the reasons for the same.

Key outputs:

- Travel and journey speeds along the corridors.
- Delays along each of the selected corridors by type/reason
- Intersection delay

Traffic Signal Phasing

Survey Location: Traffic Signal details in terms of phasing were collected during peak and off peak hours.

Objective: The principal objective of the study is to assess the operational efficiency of the signal along with checking of availability of pedestrian signal.

Conduct: Conduct the survey for both peak and off peak hours. The survey would estimate the number of phases along with the signal phasing time. Information on if the signal is under surveillance, signal being manual or automated shall also be collected.

Key Outputs:
- Signal operational efficiency.
- Delay
- Pedestrian only phase.

Origin & Destination Surveys

Objective: The principle objective of the survey is to find out the running speed, journey 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: There are several methods available for conducting this type of survey. Few of the methods are; moving observer method, registration number plate method and Elevated observer method. Floating car method is widely used in India. The enumerators record the distance and time of travel between two junctions and stopping time of the vehicle along the road stretches, at intersections and the reasons for the same.

Key outputs:

- Travel and journey speeds along the corridors.
- Delays along each of the selected corridors by type/reason
- Intersection delay

Household Surveys

Survey Location: Traffic Signal details in terms of phasing were collected during peak and off peak hours.

Objective: The principal objective of the study is to assess the operational efficiency of the signal along with checking of availability of pedestrian signal.

Conduct: Conduct the survey for both peak and off peak hours. The survey would estimate the number of phases along with the signal phasing time. Information on if the signal is under surveillance, signal being manual or automated shall also be collected.

Key Outputs:
- Signal operational efficiency.
- Delay
- Pedestrian only phase.

05. Travel Demand Model

Approach to Modelling for Proposed Elevated Corridors, Tunnels & Underpasses

Genesis of the model

•A transportation model was initially created as part of the 2015 Revision of the Master Plan.
•In 2019, the model was updated with fresh primary data during the development of the Comprehensive Mobility Plan (CMP).
•Further updates were made in 2023, incorporating new traffic volume counts and origin-destination (OD) surveys, specifically to project demand for Metro Line 3A.
•This study employs the updated model to forecast traffic on planned elevated corridors in Bangalore.

Salient features of the Transportation Model

- The road network was developed in GIS with high accuracy, covering over 3,000 kilometers of major roads.
- Link attributes, such as the number of lanes, capacity, and type, are included in the coding of the model's 15,500 links.
- Speed-flow curves have been calibrated for eight different carriageway configurations.
- The model uses a detailed zone system with 534 zones. All BMTC bus routes have been considered in the model with also consideration of the fare structure for the Volvo and ordinary routes.
- The Metro being developed through various phases over the years to follow has also been carefully considered in the forecast network.
- The metro line phase-I and Phase-II has been considered in the base year 2031 and all other proposed metro lines have been coded and run for the years 2041 and 2051.
- All the proposed Elevated Corridors and Tunnel alignment is also coded into the model.

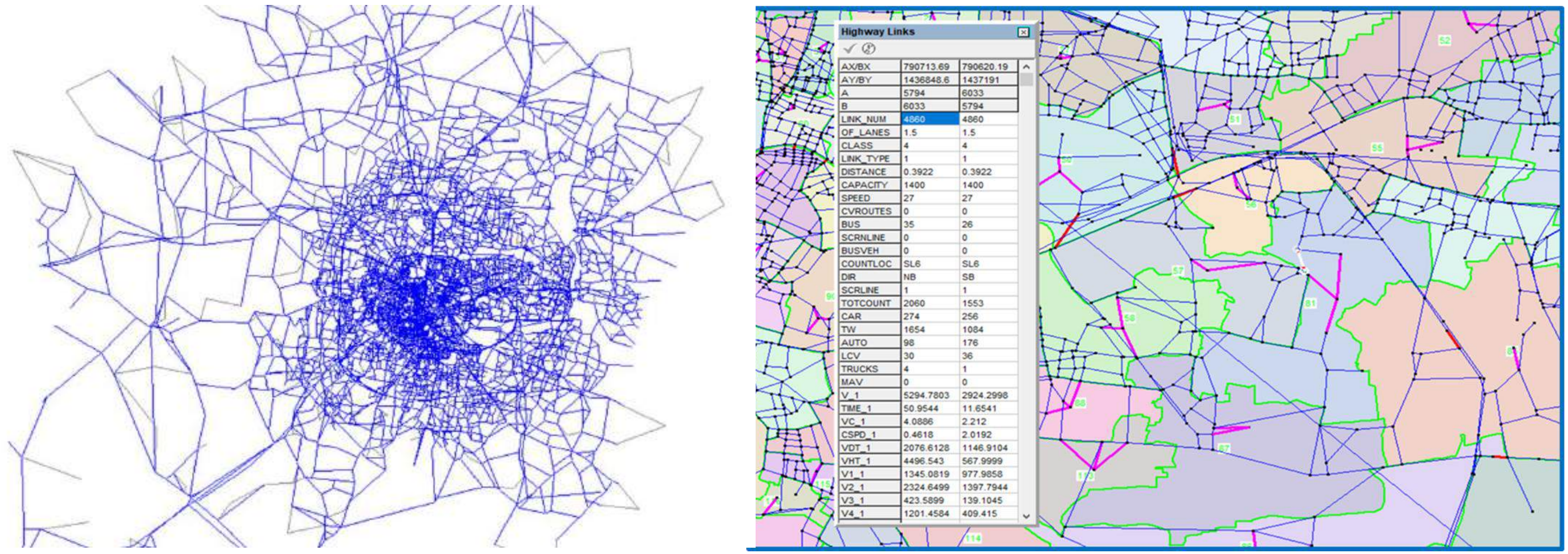


Figure 17. Road Network of Bangalore City coded in Cube Software

Transport Demand Model

- .

Cube (Modeling Software)

- State-of-Art Software
- Highway & Public Transit Modeling
- Doubly Constrained Gravity Model

Transportation System

- 15000 Links
- 6000 Bus Routes
- 534 Zones
- Metro (all phases)

Travel Demand (Mode-wise O-D)

- Public Transit
- Car
- Two Wheeler
- Auto Rickshaw

Model Runs:

- Yr 2024 base (validated & calibrated)
- Yr 2031,2041,2051 and 2061

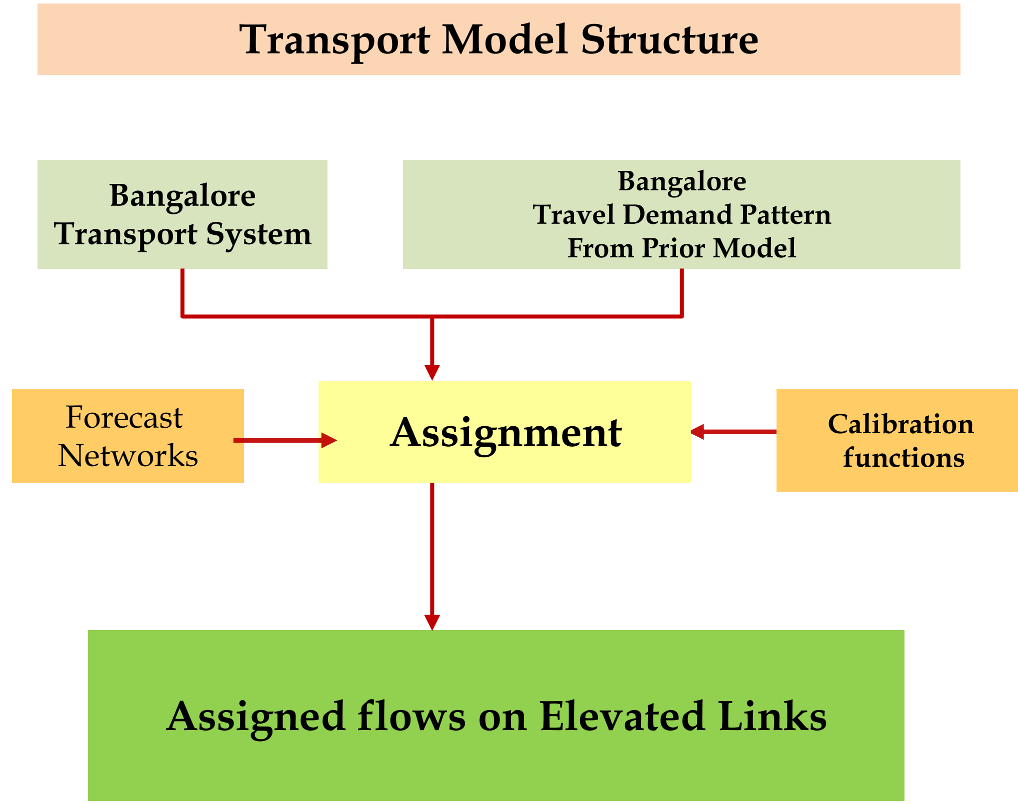


Figure 18 Flow Chart Showing Transport Model Structure

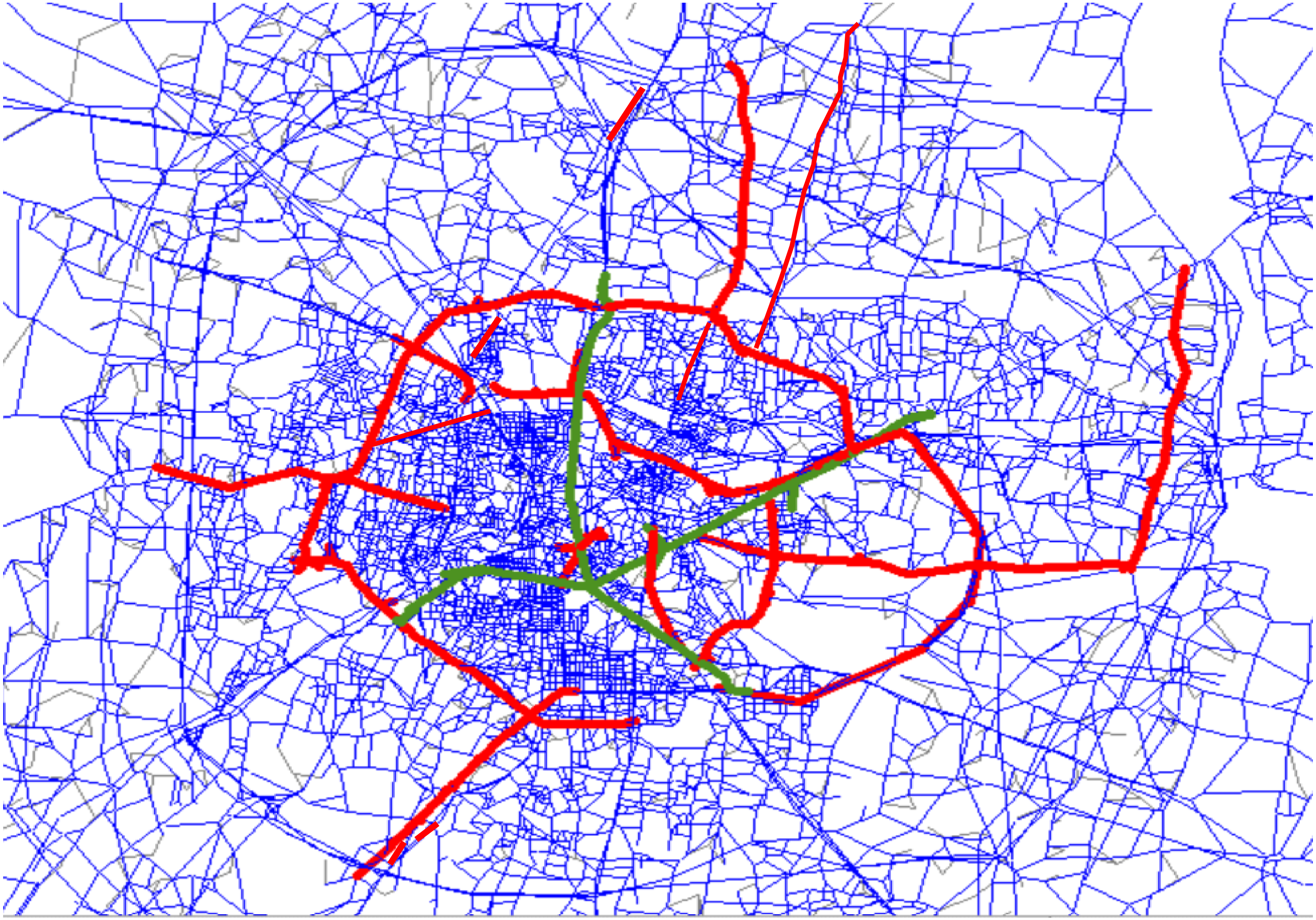
List of proposed Elevated Corridors, Tunnels and Underpasses

Table 4: List of Corridors coded in the Transport Model of Bangalore

Sl. No	Corridor	Length kms
1	Split Flyover at MEI Junction	0.5
2	Yeshwanthpura (Mathikere cross) -IISC-Mekri circle-Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram.	27
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	2.7
4	Proposed flyover / Underpass at Konankuntae Cross for Through Traffic from Kanakapura to Banashankari	0.9
5	Proposed Flyover at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road	0.8
6	Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road	1.7
7	Extension of Existing Madiwala underpass till Traffic police station junction	0.5
8	Elevated Corridor from Hosur Road from Shoolay circle –Vellara junction -Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	7.4
9	Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road	3.5
10	Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala	10
11	Proposed Elevated Corridor from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	15
12	Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.	**10.5**
13	Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction	15

Sl. No`	Corridor	Length Kms
14	Proposed Elevated Corridor along Tannery road from Madava Mudiliyar road to Nagawara Junction.	5.5
15	Proposed Elevated Corridor from Yelahanka New town to Kempegowda International Airport Road	4
16	Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout).	4.5
DD1	Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.	13
DD2	Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station via Mohan Kumar Road.	2.2
T1	Proposed North – South Tunnel Corridor from Hebbal to Silk Board	18
T2	Proposed East- West Tunnel Corridor from K. R. Puram (I.T.I Colony) to Nayandahalli NICE intersection	28
	Total Length	170.7
	Total Length of Tunnels	46
	Total length of Elevated corridors/ Double Deckers/ Underpasses	124.7

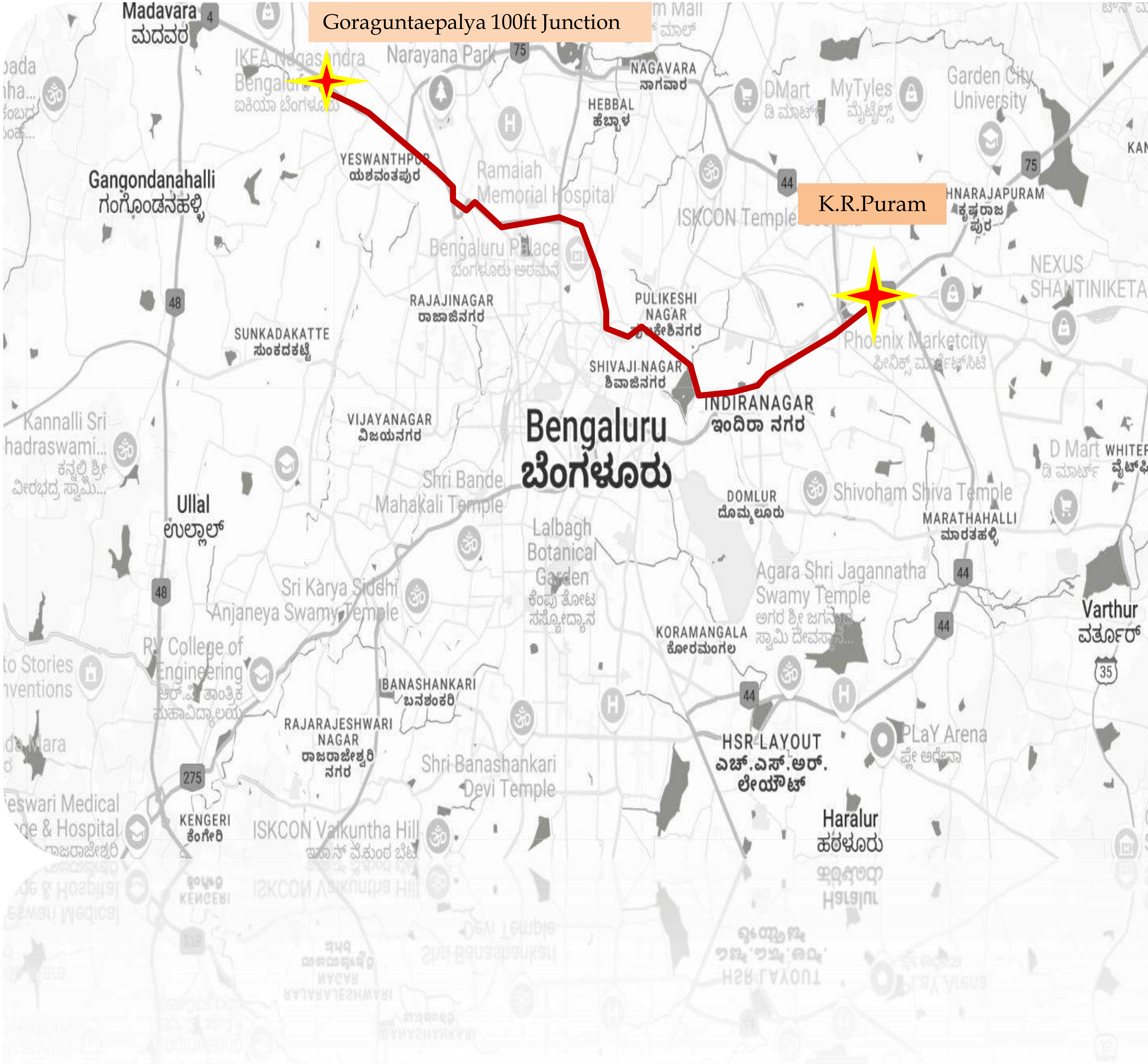
Bangalore road network map



Proposed Elevated Corridors Proposed Tunnels Existing Road Network

Figure 19 Image showing the Elevated corridors and tunnels mark on the existing road network of Bangalore

06. Strategic Traffic Augmentation for High-Impact Roads



CORRIDOR I

Tumakuru road – Old Madras road

Proposed Elevated Corridor form Tumakuru Road to Old Madras Road from Goraguntaepalya – Yeshwanthpura-IISC-Mekri circle-Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram

Corridor 1: Goraguntepalya – Yeshwanthapura- IISC- Mekhri circle - Jaymahal road- St.John Church road - Ulsoor lake-Old madaras road-K Rpuram

This corridor serves as a major radial road from Tumkur Road and is one of the oldest national highways, connecting the city to Chennai. The total development of the corridor spans 23 kilometers, starting from Goraguntepalya Junction and extending to K.R. Puram. It passes through Yeshwanthpur, Mekhri Circle, and Jayamahal Road, reaches Ulsoor Lake via St. John's Church Road, and then connects to Old Madras Road at Baiyappanahalli, finally ending at K.R. Puram as shown in the **Figure 20** below. However the consultant has made efforts to include certain portion of the corridors beyond its defined corridor limits to justify certain improvements that may enhance the current project objectives .

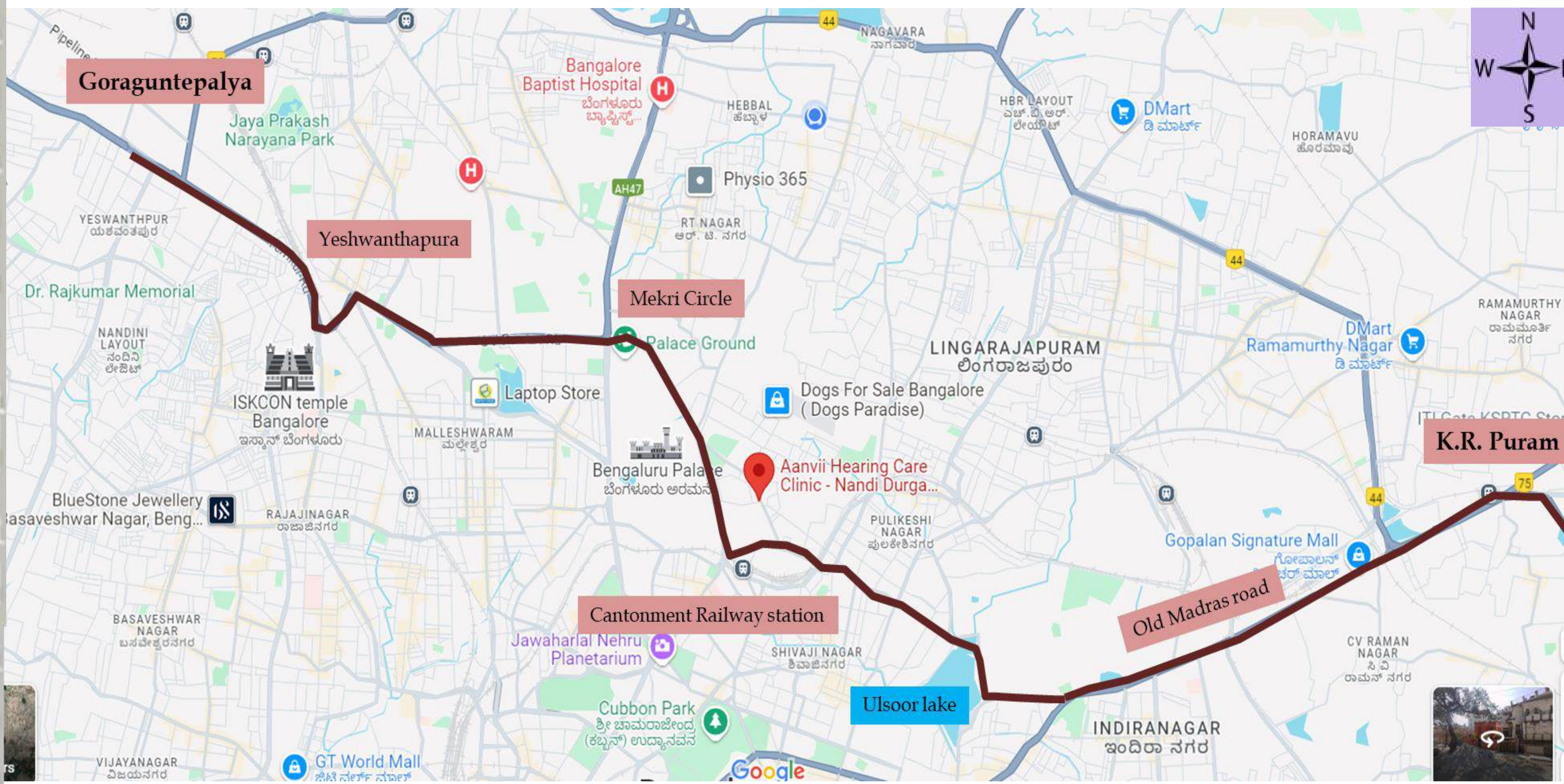


Figure 20 showing the Corridor Alignment Plan from Goraguntaepalya to K.R.Puram

Corridor 1 Section B: Yeshwanthapura (Mathikere Cross) to Halasuru lake Old Madras road

The corridor from Tumakuru road to Old Madras road is explained in section wise, section B is shown from Yeshwanthpuru to Old Madras road near Halasur Lake as shown in the **Figure 22** below.

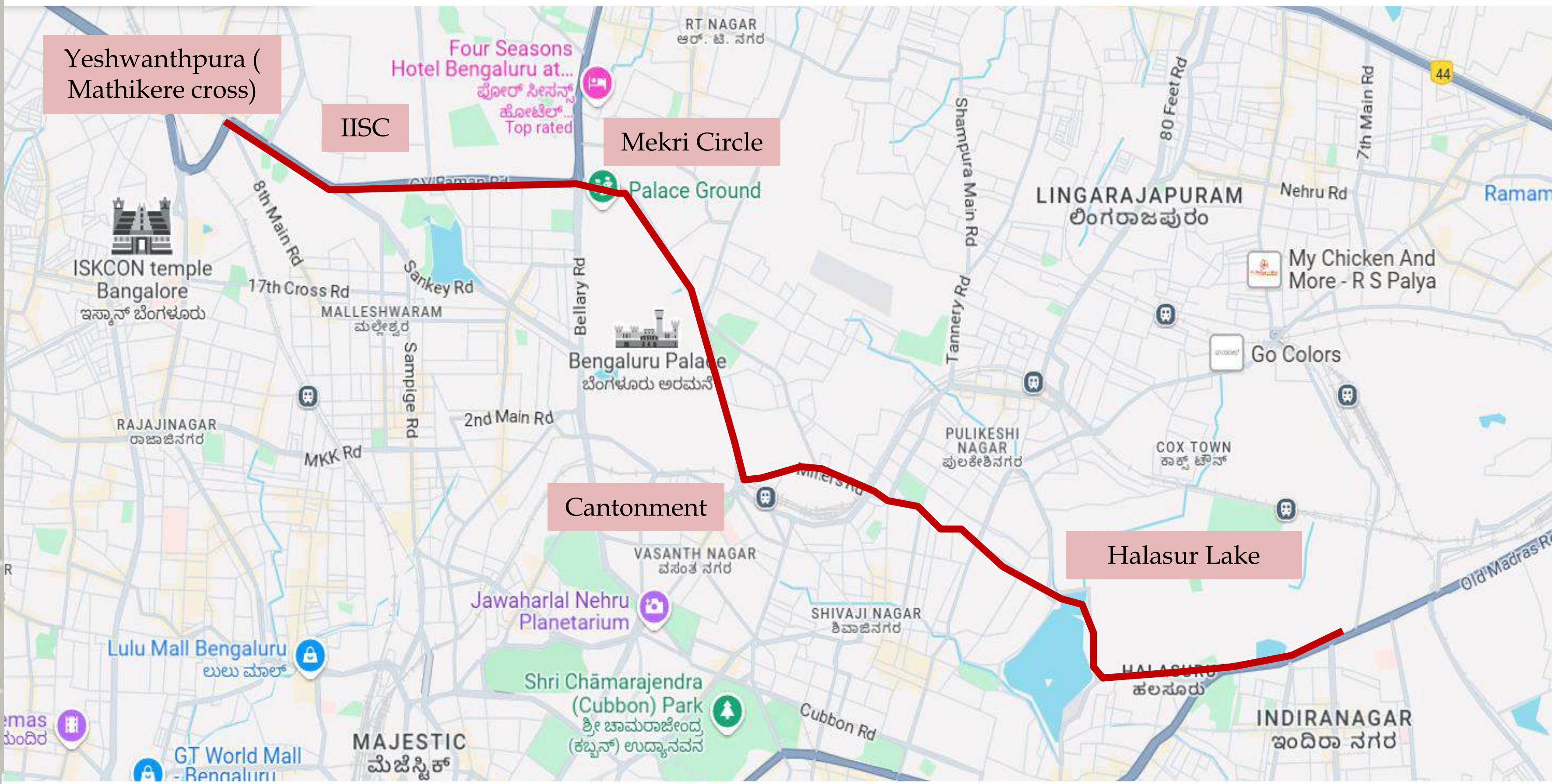


Figure 21 showing the Corridor Alignment Plan from Yeshwanthpur to Old Madras road near Halasur Lake

Corridor 1 Section C: Ulsoor lake Old Madras road to K.R.Puram (Extension road considered till Anil Kumble Circle via M.G Road)

The corridor from Tumakuru road to Old Madras road is explained in section wise, section C is shown from Halasuru to K.R.Puram as shown in the **Figure 23** below.

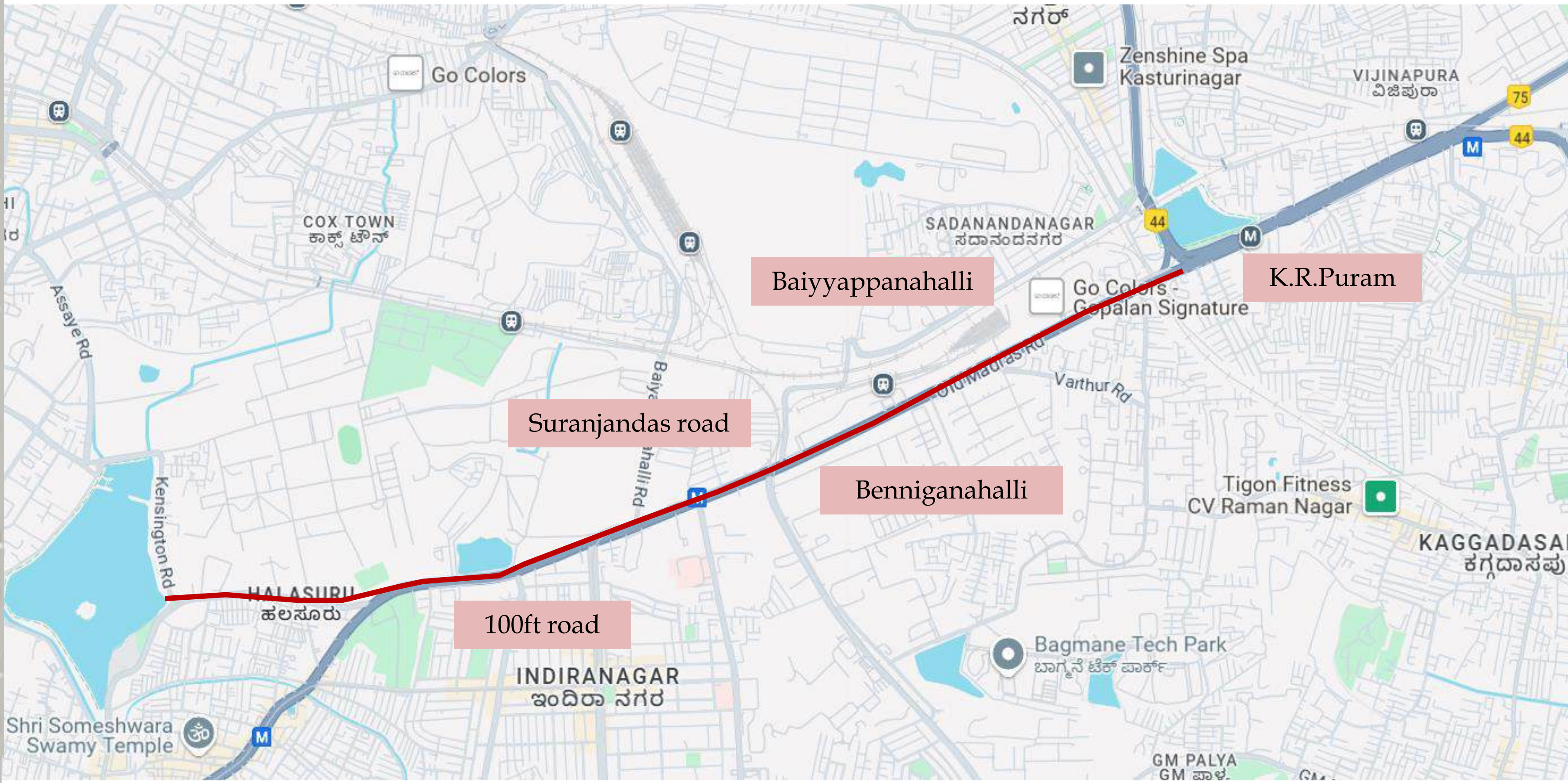


Figure 22 showing the Corridor Alignment Plan from Ulsoor lake Old Madras road to K.R.Puram

CORRIDOR CHARACTERISTICS

CORRIDOR I: TUMKUR ROAD - (Mysore Sandal Soap Factory to NICE Interchange / Bangalore International Exhibition Centre)

The first corridor to be undertaken for the corridor improvement study is the Tumkur Road Corridor, which is National Highway 73 . The study location starts from Mysore Sandal Soap Factory at Yeshwanthpur and ends at NICE interchange near Bangalore International Exhibition Centre

Corridor – I :Yeswanthapur(Mysore Sandal Soap Factory) to Nice (Bangalore International Exhibition Centre)

Figure 23. Tumkur Road Corridor

The corridor starts from Mysore sandal soap factory and the Yeshwanthpur TTMC and ends at NICE interchange or the BIEC as shown in **Figure 24**. It is one of the busiest radial roads on the North-western side of the city leading towards Mumbai.
Some of the main features of the corridor are:

- This is a six-lane divided road with service roads on either sides.
- Length of the study corridor is 11 Km.
- The road surface is varying from bituminous to concrete.
- There are five number of critical signalized junctions along the corridor.
- Metro Rail runs on the entire corridor.

Landmarks, Attraction & Production Centers

The corridor attracts many work trips due to the Industries located along the stretch, besides Markets, Malls, Hotels etc. Since the road network around Tumkur Road is well established, a majority of industrial areas are located very close to this corridor.
The corridor attracts many trip generation points such as those mentioned below and shown in **Figure 25**.

- The biggest wholesale market of agricultural produce in the city, the Yeshwanthpur APMC Yard (**Figure 26**) - This market generates maximum trips in terms of retailers and wholesalers. The vehicular density in terms of trucks, LCVs, luggage autos is very high.
- The second busiest railway station after the Majestic railways station is the Yeshwanthpur Railway station that is located on Tumkur Road.
- Mysore sandal soap factory is located along the corridor.
- Peenya industrial areas are located along the corridor near Jalahalli, which generate maximum trips.

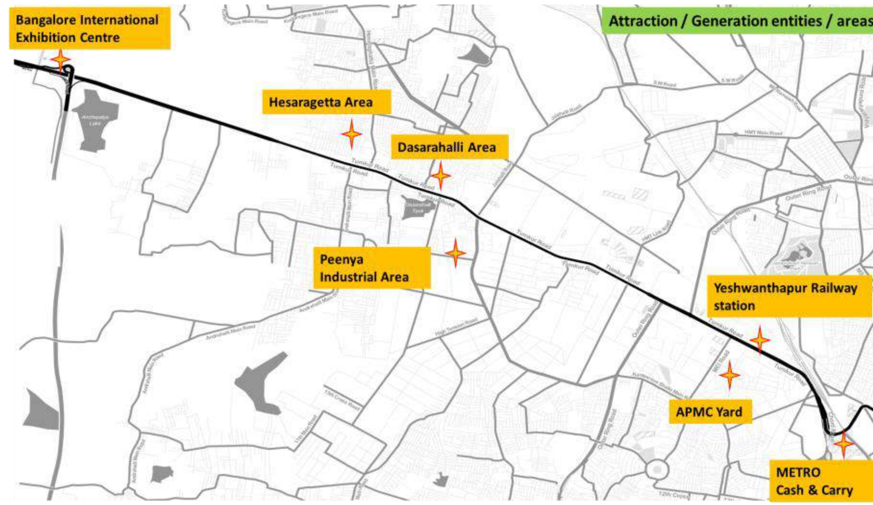


Figure 24. Attraction/ Generation Entities/ Areas

Figure 25. APMC Yard

Figure 26. APMC Yard

ALTINOK CONSULTING ENGINEERING INC.

The other major landmarks are mentioned in **Table 4** and shown in **Figure 27**:

Table 5. Other important Landmarks

• **Mysore Sandal Soap**	• **PVR**
• **Metro Cash & Carry**	• **Golden Grand Apartments**
• **Yeshwanthpur TTMC**	• **RNS Motors**
• **Yeshwanthpur Railway Station**	• **Peenya Industrial Area**
• **Yeshwanthpur APMC**	• **Pearle Biscuit Factory**
• **Taj Vivanta**	• **Bangalore International Exhibition Centre**
• **Peoples Tree Hospital**	• **Dasarahalli Market**

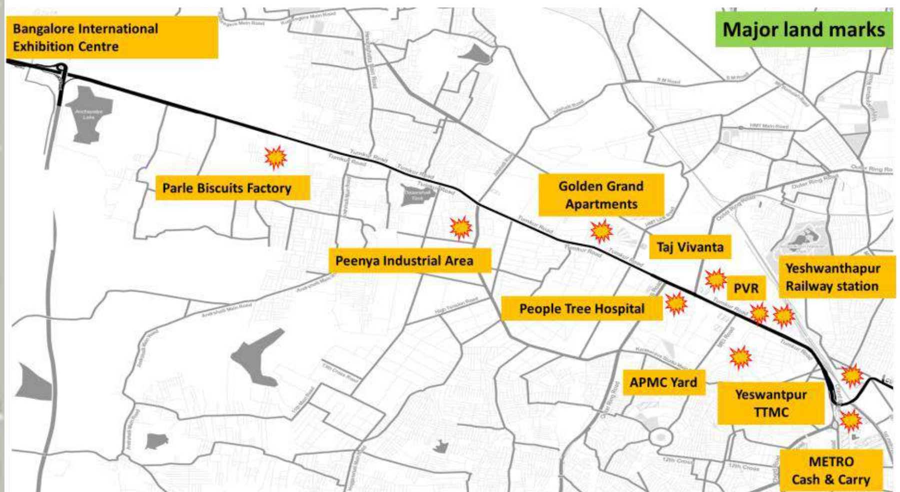


Figure 27. Major Landmarks

Metro Stations along the Corridor

The Green Line Metro runs along the corridor. There are eight Metro stations located along the corridor, which are operational, starting from Mysore Sandal Soap factory to Nice interchange

Metro stations along the corridor are as follows (Figure 28):

- Sandal Soap Factory Metro Station.
- Yeshwanthpur Metro Station.
- Goraguntepalya Metro Station.
- Peenya Metro Station.
- Peenya Industry Metro Station.
- Jalahalli Metro Station.
- Dasarahalli Metro Station.
- Nagasandra Metro Station

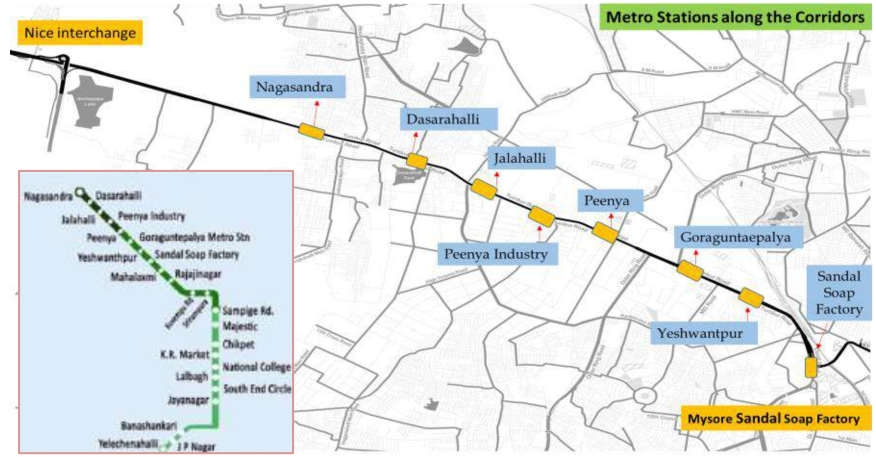


Figure 28. Metro stations along the corridor

Major Bus Stops along the Corridor

There are seventeen bus stops located on each side of the corridor, starting from Mysore Sandal Soap factory to NICE interchange.

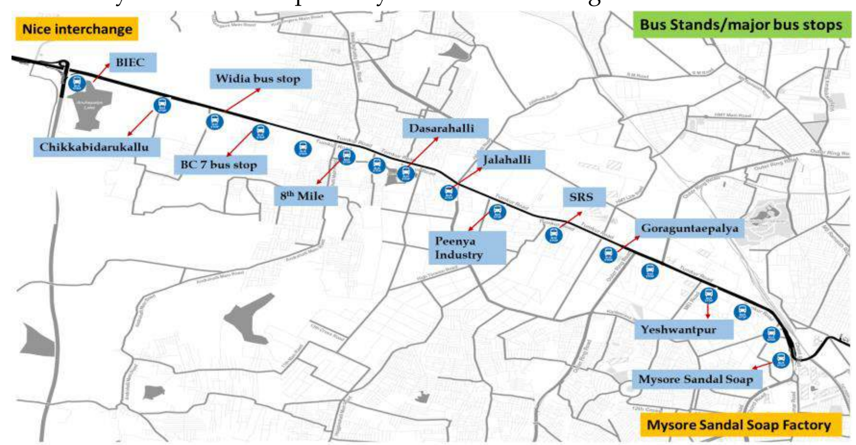


Figure 29. Major Bus stands/ Bus stops

Bus bays are not designed along the corridor, which is one of the major reasons for traffic congestions along the corridor. All the Bus Stop locations are as shown above in **Figure 29**.

Corridor Characteristics

The entire corridor is a 6 lane divided two way with service road on either side, except on a small stretch where the road widths are narrow on the RHS side near the Yeshwanthpur railway station.

Existing Footpaths/Pedestrian Facilities

It is observed that the existing footpath condition all along the corridor is very poor and at some locations there are no footpaths available. The pedestrian facilities are in complete neglect. There is only one pedestrian crossing skywalk near the Yeshwanthpur railway station connecting to other end of the road.

It is also observed that after the 100 feet road intersection, none of the metro stations has got pedestrian accessibility from the Left hand side to the metro station (**Figure 30 & Figure 31**)


@ Yeshwanthpur Railway station opposite to Govardhan Theatre


@ Yeshwanthapur Railway station


@ Nagasandra Metro station


@ Jalahalli Junction


@ Jalahalli Metro station


Near Nagasandra Metro, station LHS side

Figure 30 Absence of Pedestrian accessibility to Metro Stations from LHS

Near Dasarahalli Metro Station


At Grade Crossing along the Corridor

Near PVR

Near Nagasandra Metro station

Figure 31. Absence of Pedestrian accessibility to Metro Stations from LHS

Figure 32. Absence of Pedestrian accessibility to Metro Stations from LHS

Major Junctions

Along the 11 Km of stretch, there are 5 major critical intersections where maximum merging and diverging of the traffic takes place. List of Major intersections are as mentioned below (and shown in **Figure 33**)

- Goraguntepalya intersection – 3 arm Signalized intersection.
- 100 feet ORR intersection – 3 arm Signalized intersection.
- SRS junction – 3 arm Signalized intersection.
- Jalahalli cross junction – 4 arm Signalized intersection.
- NICE interchange – Bangalore international exhibition centre - Mid block un-signallized intersection

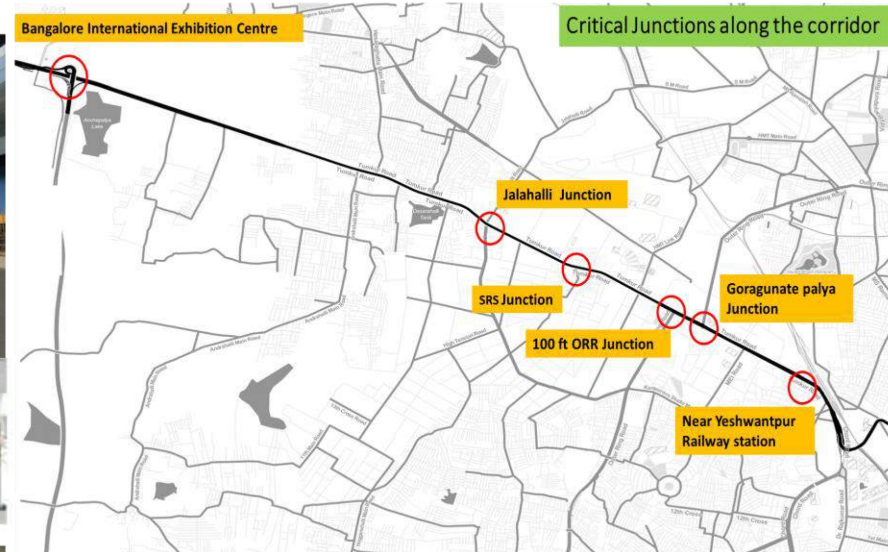


Figure 33. Critical Junctions along the Corridor

Signage/ Markings/ Signals

Bengaluru has the finest signage program called the "B-Trac Project" by Bangalore Traffic police. However, it is observed that this project is not executed correctly. The corridor lacks the right signboards at the right positions, the sign boards do not have good foundations and most of the sign boards are either damaged or not relevant to the site. It is also observed that the size of the sign boards are not as per IRC standards.

Road safety aspects are also ignored along the corridor to a larger extent which is of major concern. Some of the safety issues are:

- Pedestrian crossings are completely neglected.
- Adequate pedestrian skywalks not constructed.
- Bus bays are not built for safe commuter access.
- Unscientific medians have resulted in accidents.
- Median end treatments have not been done.
- Crash beam barriers are not installed at level differences.
- Non-engineered materials are used to close the vents on the bridges.
- Road markings not done.
- Road safety furniture are missing all along the corridor.
- Road surface at certain points is very bad resulting in two wheeler skidding, leading to sever accidents.
- Sharp Curves are not treated properly.
- Old culverts are not removed from the service roads which are very dangerous.
- Absence of access control below the metro pillars leading to accidents.
- On-street markets leading to encroachments in turn creating a safety hazard.
- School zones along the corridor not treated.
- Speed calming methods are not adequately implemented.

Vendor Zone

It is observed that for stretch of about 500 meters from the Dasarahalli metro station on the RHS there is presence of on-street vegetable market below the metro pillars **(Figure 34).** During peak hours, the road users park their vehicles (cars /two wheelers) on the main carriageway of the service road to shop from these vendors which causes traffic jams and congestions. The entire vendor zone shall need to be redeveloped in an engineered manner.

Figure 34. Vendor Zone

Land Use Along the Corridor

It is observed that majority of the land use pattern along the corridor is the industrial type and the rest amounts for public and semi public places with commercial activities. It is also observed that most of the existing residential land use are been used for commercial purposes (Same is shown in **Figure 35**).

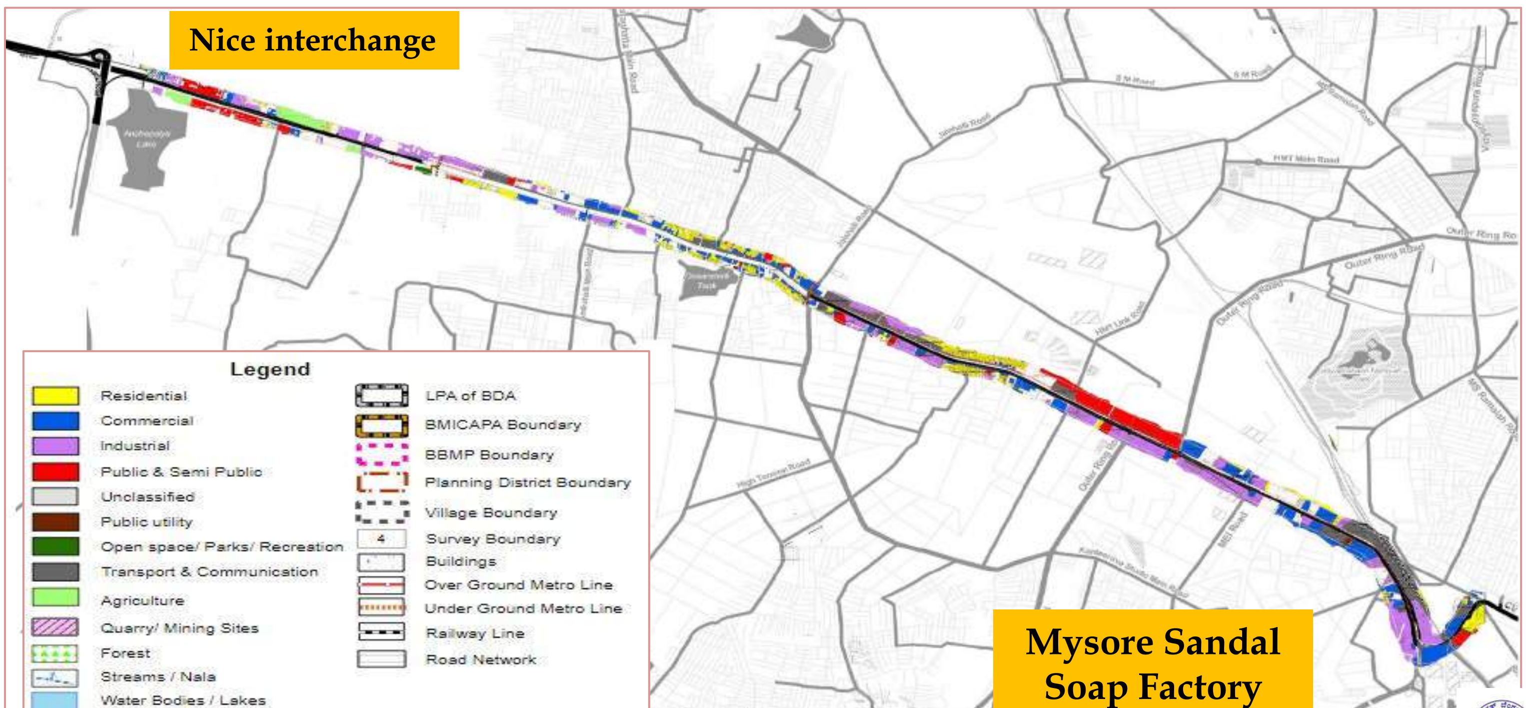


Figure 35. Landuse along the Corridor

PART B
SURVEY ANALYSIS

Traffic Survey Details

In order to assess the existing traffic and transport characteristic of the corridor and to decide on the type of traffic management measures needed, the surveys mentioned in chapter 4 were carried out. The survey particulars are as presented below in **Table 6.**

Table 6. Traffic Survey Details

SL.NO	TYPE OF SURVEY	QUANTITY
1	Turning Volume Count	5 Intersections
2	Mid-block Count	2 Locations
3	Pedestrian Count Survey	5 Intersections
4	Speed And Delay (Bus & Car)	11 Km
5	Road Network Inventory	11 Km
6	Traffic Signal Phasing	5 intersections

Traffic Volume Counts

Traffic volume count survey was conducted at 2 Mid-block locations and for the remaining stretches, traffic volumes were extracted from the turning volume counts conducted at junctions along the corridor (**Figure 36**). The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. The PCUs corresponding to Urban Roads as per Indo Highway Capacity Manual 2012-2017 (Chapter 5) were used and the direction-wise Peak Hour Traffic Volumes are as presented in **Table 7.**

Table 7. Traffic Volume Counts

Sl. No	Road Name	Morning Peak Hour	Morning Peak Hour Volume				Evening Peak Hour	Evening Peak Hour Volume			
			Towards Yeshwanthpur		Towards Nagasandra			Towards Yeshwanthpur		Towards Nagasandra	
			Vehicles	PCUs	Vehicles	PCUs		Vehicles	PCUs	Vehicles	PCUs
1	Yeshwanthpur TTMC	11.00-12.00	3936	3210	3061	3089	19.30-20.30	4065	3636	3871	3224
2	Yeshwanthpur Skywalk	9.30-10.30	3177	3268	3895	4414	18.00-19.00	3281	3349	3582	4117
3	Tumkur Road (Between Gorguntepalya-SRS)	9.15-10.15	3482	4429	7286	10204	17.45-18.45	4257	5255	6460	8533
4	Tumkur Road (Between SRS-Jalahalli Junction)	9.45-10.45	4253	3541	2698	2495	17.30-18.30	4471	3703	2513	2399
5	Tumkur Road (Between Jalahalli junction-Hesarghatta Junction)	10.45-11.45	2296	2835	1838	2009	19.30-20.30	3169	3632	2433	2615
6	Tumkur Road (Between Hesarghatta Junction-Nagasandra)	10.45-11.45	2296	2835	1838	2009	19.30-20.30	3169	3632	2433	2615

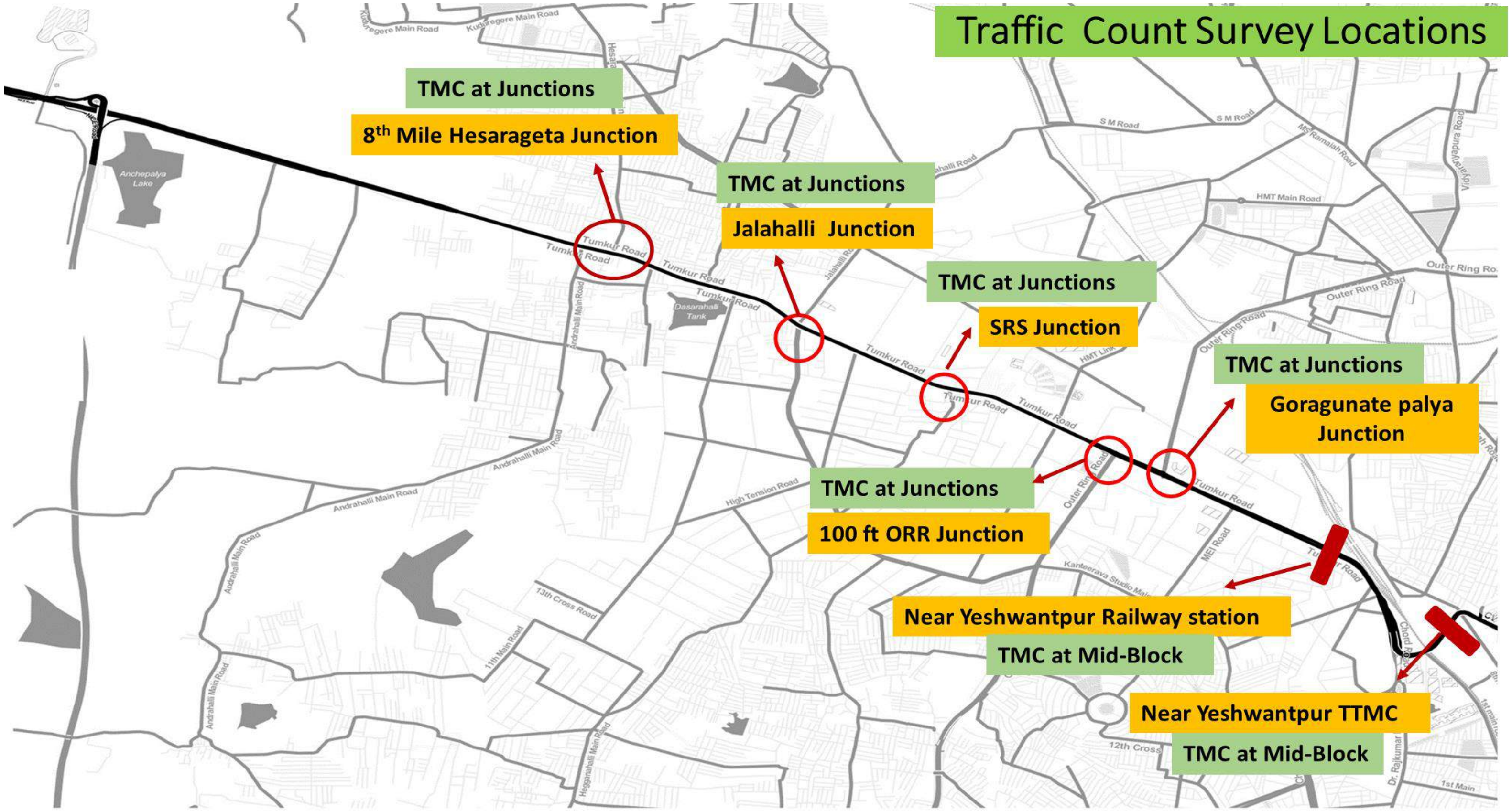


Figure 36. Tumkur Road Corridor Traffic Count Survey Locations

Among the 6 Mid-Block locations traffic volume between Gorguntepalya and SRS Junction is found to be highest with 10857 PCUs during morning peak hour and 11290 PCUs during evening peak hour followed by Yeshwanthpur Skywalk with traffic volume of 9544 PCUs during morning peak and 9489 PCUs during evening peak hour.

Volume to Capacity Ratio (V/C) and Level of Service

Volume to Capacity Ratio (V/C Ratio) is defined as the ratio of peak hour traffic flow rate to capacity and Level of Service (LOS) is defined as the a qualitative measure, describing operational conditions within a traffic stream and their perception by the drivers/passengers.

Universally, LOS is lettering scheme ranging from A to F. LOS 'A' represents highest quality of service whereas LOS 'F' represents heavily congested flow where traffic demand exceeds capacity. The service measures used for defining LOS are density and volume-to-capacity ratio.

For computation of V/C Ratio the capacity values have been adopted based on the road geometrics by applying adjustment factors ***(as per Indo Highway Capacity Manual 2012-2017)*** conforming to the site conditions.

Adjustment Factors

Several factors would have impact on traffic movement and on capacity as compared to the base section. The factors considered for assessment of influence on capacity include on-street parking manoeuvres; entry and exit of vehicles from access road and bus pull in and pull out manoeuvers in bus bays as well as access points.

The level of friction is categorized as low, medium and severe based on the extent of resistance or speed reduction to the flow as compared to base sections. The capacity of the urban road section is computed using the equation:

$$C = C_o * F_{OP} * F_{BS} * F_{AC}$$

Where,

C= Actual Capacity (PCU/hr)

C_o = Base Capacity for Ideal Condition (PCU/hr)

F_{OP} = Adjustment Factor for On-street Parking

F_{BS} = Adjustment Factor for Bus Stops

F_{AC} = Adjustment Factor for Access Point

It was observed that due to kerb side bus stops the effective road available for movement of other vehicles in the traffic stream reduces resulting in the capacity reduction at the following locations:

1. Near Yeshwanthpur Skywalk
2. Between Gorguntepalya-SRS
3. Between SRS-Jalahalli Junction
4. Between Jalahalli Junction-Hesarghatta Junction

As the level of friction due to kerb side bus stops is high (frequency of buses>30) the adjustment factor of 0.6 is considered to compute the actual capacity.

The ratio of peak hour traffic flow rate to capacity (V/C Ratio) and the Level of Service (LOS) of the road sections along Tumkur Road Corridor are presented in **Table 8**

It can be observed that amount of traffic approaching near Yeshwanthpur Skywalk and between Gorguntepalya and SRS Junction exceeds beyond its capacity resulting in considerable delay and queuing.

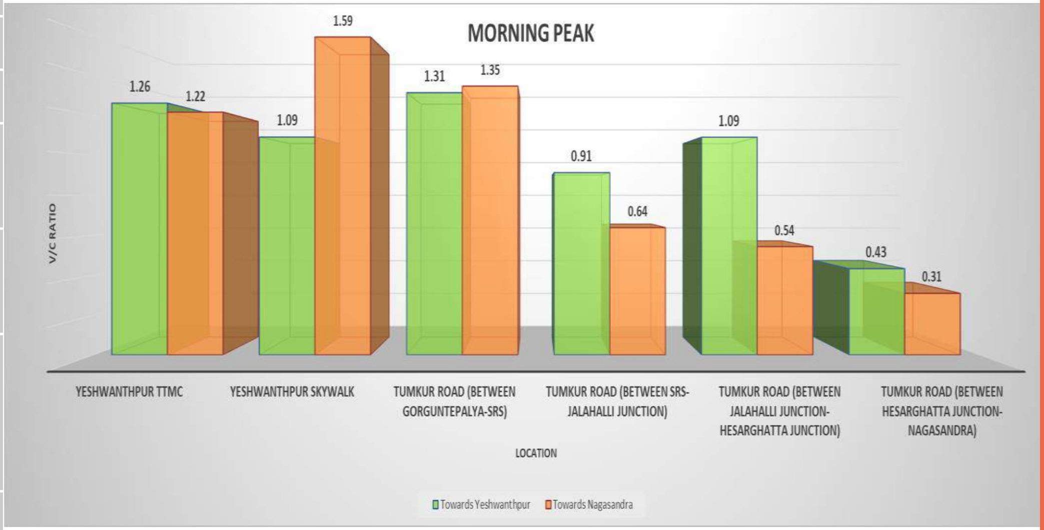
The volume to capacity ratio at both the locations exceeds 1.0 and the Level of Service is found to be 'F' which indicates heavily congested flow where traffic demand exceeds capacity

Table 8. Traffic Volume to Capacity ratio and Level of Service

Sl. No.	Road Name	Typology of Road	Capacity*		Morning Peak: Morning Peak Hour Volume (PCUs)		Morning Peak: V/C Ratio		Morning Peak: Level of Service*		Evening Peak: Evening Peak Hour Volume (PCUs)		Evening Peak: V/C Ratio		Evening Peak: Level of Service*	
			Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra
1	Yeshwanthpur TTMC	2+2 Lanes	2700	2700	3407	3285	1.26	1.22	LOS F	LOS F	3808	3362	1.41	1.25	LOS F	LOS F
2	Yeshwanthpur Skywalk	4+2 Lanes	3360	2800	3668	4461	1.09	1.59	LOS F	LOS F	3725	4163	1.11	1.49	LOS F	LOS F
3	Tumkur Road (Between Gorguntepalya-SRS)	4+4 Lanes	4080	4080	5362	5496	1.31	1.35	LOS F	LOS F	5219	6071	1.28	1.49	LOS F	LOS F
4	Tumkur Road (Between SRS-Jalahalli Junction)	4+4 Lanes	4080	4080	3728	2601	0.91	0.64	LOS E	LOS C	3897	2502	0.96	0.61	LOS E	LOS C
5	Tumkur Road (Between Jalahalli junction-Hesarghatta Junction)	4+4 Lanes	4080	4080	4451	2214	1.09	0.54	LOS F	LOS C	4843	2847	1.19	0.7	LOS F	LOS C
6	Tumkur Road (Between Hesarghatta Junction-Nagasandra)	4+4 Lanes	6800	6800	2938	2097	0.43	0.31	LOS B	LOS B	3752	2713	0.55	0.4	LOS C	LOS B

Table 9. Traffic Volume to Capacity ratio and Level of Service

LOCATION	MORNING PEAK		EVENING PEAK	
	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra
Yeshwanthpur TTMC	1.26	1.22	1.41	1.25
Yeshwanthpur Skywalk	1.09	1.59	1.11	1.49
Tumkur Road (Between Gorguntepalya-SRS)	1.31	1.35	1.28	1.49
Tumkur Road (Between SRS-Jalahalli Junction)	0.91	0.64	0.96	0.61
Tumkur Road (Between Jalahalli junction-Hesarghatta Junction)	1.09	0.54	1.19	0.70
Tumkur Road (Between Hesarghatta Junction-Nagasandra)	0.43	0.31	0.55	0.40



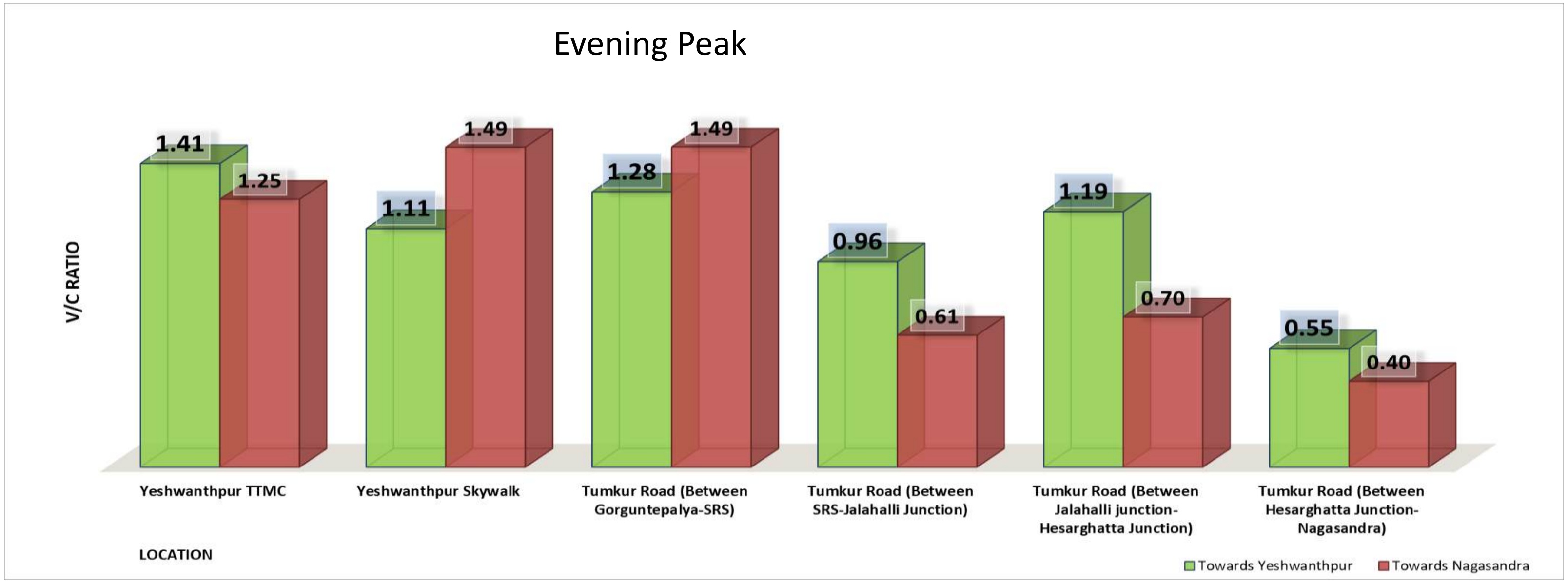


Figure 37. Volume to Capacity Ratios along Tumkur Road Corridor

Traffic Volume at Junctions

The traffic volumes at intersections help in assessing the traffic volumes at mid-block locations of the arms of the intersection which together with journey speed and road inventory data aid in evaluating the Level of Service (LOS) of Urban Arterials and further, the traffic volumes at mid-block also established the need for safe pedestrian crossing facility taking into account the pedestrian crossing volumes.

Traffic volume counts were conducted at 5 major intersections along the study corridor to assess the existing traffic level. The locations were duly identified based on reconnaissance for conduct of turning traffic volume count surveys. The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. he PCUs corresponding to Signalized Intersections as per Indo Highway Capacity Manual 2012-2017 (Chapter 6) was used and the Peak Hour Junction Volumes are as presented below.

Among the 5 turning volume count surveyed locations 100ft Ring Road Junction is noted with highest peak hour volume (9571 PCUs during morning peak and 9645 PCUs during evening peak) followed by Gorguntepalya Junction near Taj Vivanta with 8229 PCUs during morning peak and 8829 during evening peak as presented below in **Table 10**

Table 10. Peak Hour Traffic Volumes

Sl. No.	Junction Name	Morning Peak Hour Volume		Morning Peak Hour	Evening Peak Hour Volume		Evening Peak Hour
		Vehicles	PCUs		Vehicles	PCUs	
1	Gorgunte Palya Junction-Near Taj Vivanta	10192	8229	10.00-11.00	11197	8829	18.15-19.15
2	100 Ft Ring Road Junction	13150	9571	9.15-10.15	13086	9645	17.30-18.30
3	SRS Junction	9213	6141	9.45-10.45	9243	6175	17.30-18.30
4	Jalahalli Junction	8434	6500	10.45-11.45	10201	7982	19.45-20.45
5	Hesarghatta Main Road Junction	7012	5507	10.30-11.30	8645	6776	19.30-20.30

Speed and Delay

Speed & delay survey provides a link wise estimate of journey time, running time and delay. Speed and Delay Survey was carried out for Bus and Car separately during morning and evening peak hours. In case of Car Speed and Delay Survey, floating car technique has been utilized for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the cumulative time at specified timing points to ensure obtaining the average link travel time of the road network.

The overall travel speed generally referred to as journey speed is the effective speed between two points and is computed as the distance divided by the total time taken by the vehicle to complete the journey including delays incurred en-route.

The speed maintained by the vehicle over the stretch while in motion is the running speed obtained through dividing the distance by the duration of time while the vehicle is in motion and thus excludes that part of time wherein the vehicle suffers delay. The journey speed and the variation between running speed and journey speed is the indicator of level of service and a measure of congestion. The survey data analysis also highlights the causes of delay that occur at various locations such as stopped delay or operational delay.

The direction-wise abstract of analysis along Tumkur Road Corridor by the name of road, length surveyed, overall travel time, journey speed and running speed are furnished below in **Table 11** & graphically represented in **Figure 38**:

Table 11. Bus Speed and Delay- Towards Tumkur (Morning Peak)

Sl.No.	From Node	To Node	Length(in Kms)	Delay	Journey Time	Running Time	Journey Speed	Running Speed	Reasons for Delay
1	TTMC - Yeshwanthpur	MEI Junction	1.8	37.0	487	450	13	14	Unauthorized bus stoppage on the Main Carriageway
2	MEI Junction	Goraguntepalya Junction	0.7	10	148	138	17	18	Traffic Flow Delay
3	Goraguntepalya Junction	100 Ft Junction	0.5	107	169	62	11	29	Narrow Road , presence of bus stop and hospital along with Criss Crossing Traffic towards Mysore
4	100 Ft Junction	SRS Junction	1.0	43.0	170	127	21	28	Unauthorized bus stoppage by BMTC, KSRTC & Private buses at the junction
5	SRS Junction	peenya 1st StageJunction	1.0	25	142	117	25	31	Narrow road width at the junction
6	peenya 1st StageJunction	Jalahalli Cross Junction	0.5	10	68	58	26	31	Traffic Flow Delay
7	Jalahalli Cross Junction	Dasarahalli Junction	1	34	138	104	26	35	Unauthorized bus stoppage by BMTC, KSRTC & Private buses at the junction
8	Dasarahalli Junction	8th Mile Junction	1	25	143	118	25	31	Due to Service road traffic entering the main carriageway
9	8th Mile Junction	Madavara bus stop	3.5	125	532	407	24	31	Bus Stoppage time and traffic flow delay
AVERAGE							21	28	

Table 12. Bus Speed and Delay- Towards Yeshwanthapur (Morning Peak)

Sl.No.	From Node	To Node	Length(in Kms)	Delay	Journey Time	Running Time	Journey Speed	Running Speed	Reasons for Delay
1	Madavara bus stop	8th Mile Junction	3.5	73.0	803	730	16	17	Metro construction
2	8th Mile Junction	Dasarahalli Junction	1.0	3	256	253	14	14	
3	Dasarahalli Junction	jlahalli Cross Junction	1.0	58	154	96	23	38	Manual Signal Delay
4	Jalahalli Cross Junction	Peenya 1st Stage Junction	0.5	66	127	61	14	30	Unauthorized stoppage of buses
5	Peenya 1st Stage Junction	SRS Junction	1.0	39	182	143	20	25	Traffic flow delay
6	SRS Junction	100 Ft Junction	1.0		131	131	27	27	
7	100 FT Junction	Goraguntepalya Junction	0.5	44	127	83	14	22	Criss crossing of vehicles and signal delay
8	Goraguntepalya Junction	MEI Junction	0.7		159	159	16	16	
9	MEI Junction	Sandal Soap Factory Junction	1.8		456	456	14	14	
AVERAGE							18	23	

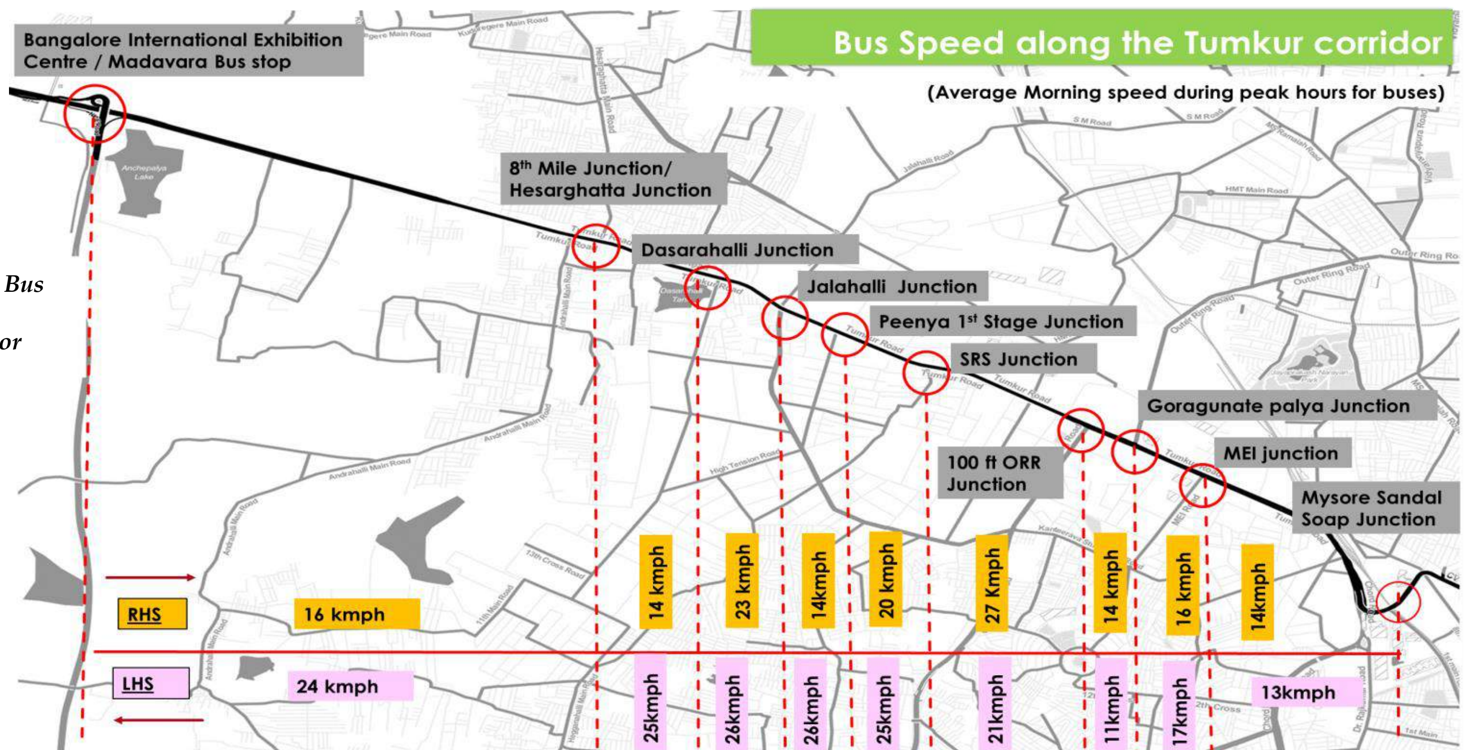


Figure 38. Average Morning Bus Speeds along the Tumkur Corridor

Table 13. Bus Speed and Delay- Towards Tumkur (Evening Peak)

Sl.No.	From Node	To Node	Length(in Kms)	Delay	Journey Time	Running Time	Journey Speed	Running Speed	Reasons for Delay
1	TTMC - Yeshwanthpur	MEI Junction	1.8	117.0	444	327	15	20	Unauthorized bus stoppage, crisscrossing of vehicles
2	MEI Junction	Goraguntepalya Junction	0.7	37	172	135	15	19	Bus stoppage delay
3	Goraguntepalya Junction	100 Ft Junction	0.5	115	266	151	7	12	Unauthorized bus stoppage, crisscrossing of vehicles moving towards Mysore road
4	100 Ft Junction	SRS Junction	1.0	152.0	369	217	10	17	Unauthorized bus stoppage by BMTC, KSRTC & Private buses at the junction
5	SRS Junction	Peenya 1st StageJunction	1.0	76	241	165	15	22	Delay due to road repair construction trucks
6	Peenya 1st StageJunction	Jalahalli Cross Junction	0.5	82	143	61	13	30	Manual Signal Delay
7	Jalahalli Cross Junction	Dasarahalli Junction	1	263	414	151	9	24	Unauthorized bus stoppage at the junction
8	Dasarahalli Junction	8th Mile Junction	1	106	253	147	14	24	Traffic Flow delay and bus stoppage delay
9	8th Mile Junction	Madavara bus stop	3.5	56	540	484	23	26	Traffic Flow delay
AVERAGE							13	21	

Table 14. Bus Speed and Delay- Towards Yeshwanthpur (Evening Peak)

Sl.No.	From Node	To Node	Length(in Kms)	Delay	Journey Time	Running Time	Journey Speed	Running Speed	Reasons for Delay
1	Madavara bus stop	8th Mile Junction	3.5	132	632	500	20	25	Metro construction
2	8th Mile Junction	Dasarahalli Junction	1.0	80	206	126	17	29	Due to Vegetable Market
3	Dasarahalli Junction	Jalahalli Cross Junction	1.0	143	220	77	16	47	Manual Signal Delay
4	Jalahalli Cross Junction	Peenya 1st Stage Junction	0.5	56.0	133	77	14	23	Unauthorized stoppage of buses
5	Peenya 1st Stage Junction	SRS Junction	1.0	24	147	123	24	29	Traffic flow delay
6	SRS Junction	100 FT Junction	1.0	14	167	153	22	24	Traffic flow delay
7	100 Ft Junction	Goraguntepalya Junction	0.5	16	105	89	17	20	Criss crossing of vehicles and signal delay
8	Goraguntepalya Junction	MEI Junction	0.7	16	187	171	13	15	Traffic flow delay
9	MEI Junction	TTMC - Yeshwanthpur	1.8	33	403	370	16	18	Traffic flow delay
AVERAGE							18	25	

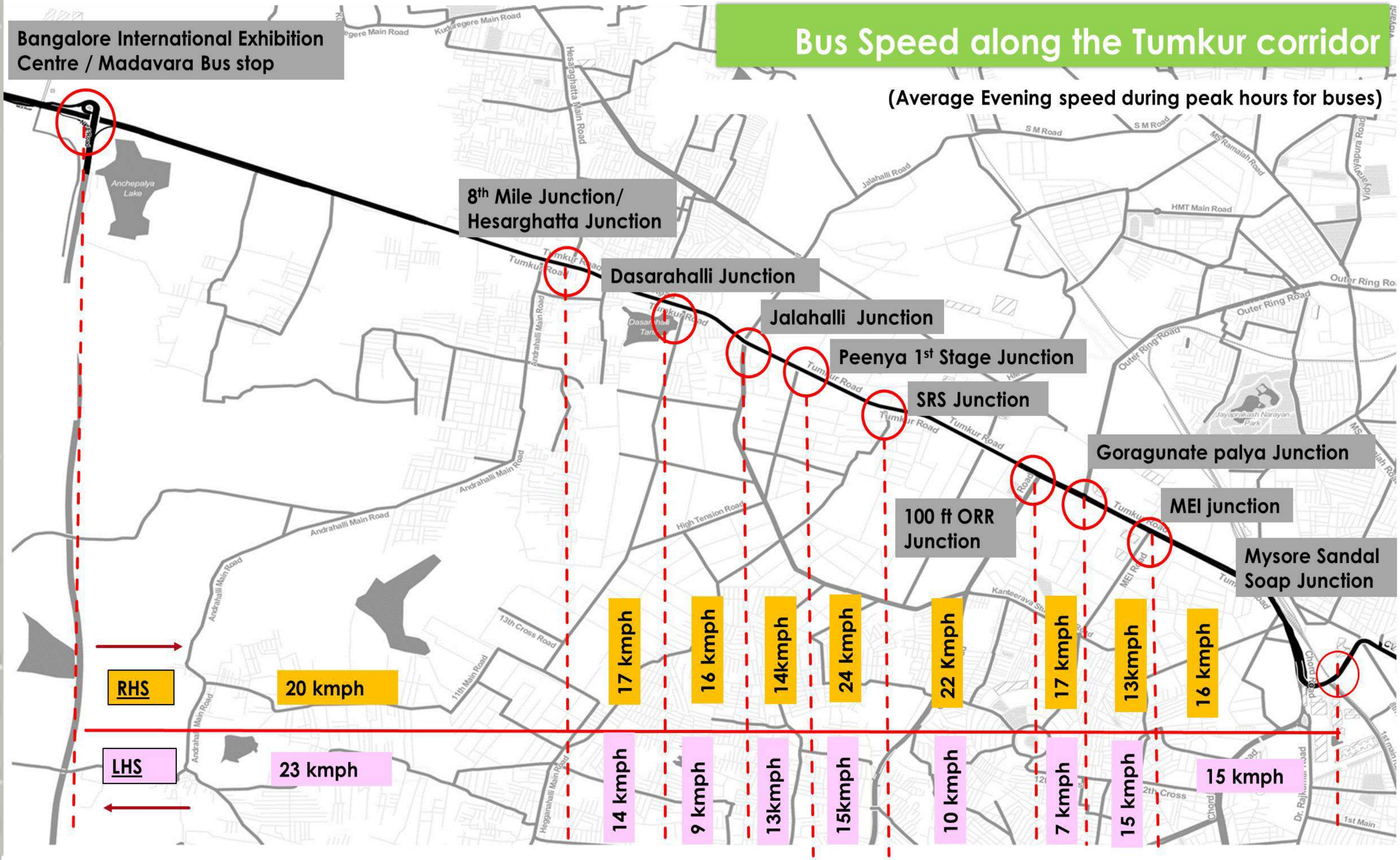


Figure 39. Average Evening Bus Speeds along the Tumkur Corridor

It was observed that the lower journey speeds are mainly due to traffic congestion, unauthorised bus stoppage at the junction and the delays are mostly occurring at junctions. The Average Bus Journey Speed is approximately 21 Kmph during morning peak hour towards Tumkur and 18 kmph towards Yeshwanthpur. Similarly, during evening peak hour average speed of the bus towards Tumkur is 13 kmph and towards Yeshwanthpur is 18 kmph as shown in **(Figure 28)**.

Car Speed and Delay

It was observed that the lower journey speeds are mainly due to traffic congestion and the delays are mostly occurring at junctions. The Average car Journey Speed is approximately 31 Kmph during morning peak hour and 30kmph during evening peak hour. The Average Journey speeds are shown in **Tables 14-15** & graphically represented in **Figure 40-41**.

Direction: Yeshwanthpur to Nice Interchange (11 KMs)- Morning Peak - CARS

Table 15. Average Morning Peak Speed & Delay Details - Cars

Sl.No.	From Node	To Node	Distance (km)	Delay (Sec)	Journey Time (sec)	Running Time (sec)	Journey Speed (kmph)	Running Speed (kmph)	Delay Cause
1	Yeshwanthpur TTMC	Yeshwanthpur Skywalk	0.8	53	196	143	15	20	Unauthorized bus stoppage, crisscrossing of vehicles
2	Yeshwanthpur Skywalk	MEI Junction	1.2	50	258	208	17	21	Criss-Crossing of vehicles at the service road openings and Pedestrian crossings at PVR
3	MEIJunction	Goragunate palya Junctio	0.6	20	120	100	18	22	Traffic Jam at the Junction
4	Goragunate palya Junctio	100ft ORR Junction	0.5	58	132	74	14	24	Unauthorized bus stoppage, crisscrossing of vehicles moving towards Mysore road
5	100ft ORR Junction	SRS Junction	1	33	116	83	31	43	Narrow road width at the Junction
6	SRS Junction	Peenya 1st Stage Junction	1	10	105	95	34	38	Road construction trucks blocking the road
7	Peenya 1st Stage Junction	Jalahalli intersection	0.5	15	48	33	38	55	Buses stopping randomly near the junction
8	Jalahalli intersection	Pillar 471	0.8	33	107	74	27	39	Manual Signal Controll
9	Pillar 471	8th Mile	0.6	28	76	48	28	45	Traffic flow delay
10	8th Mile	Nice Interchange	4	57	337	280	43	51	Toll Queue
AVERAGE							26	36	

Direction: Nice Interchange to Yeshwanthpur-Morning Peak-CARS

Table 16 Average Morning Peak Speed & Delay Details - Cars

Sl.no	From Node	To Node	Distance (km)	Delay (Sec)	Journey Time (sec)	Running Time (sec)	Journey Speed (kmph)	Running Speed (kmph)	Delay Cause
1	Nice Interchange	8th Mile	4	37	446	409	32	35	Metro Construction
2	8th Mile	Pillar 471	0.6	40	97	57	22	38	On street Market
3	Pillar 471	Jalahalli intersection	0.8	45	91	46	32	63	On street Market
4	Jalahalli intersection	Peenya 1st Stage Junction	0.5	15	56	41	32	44	Traffic Flow Delay
5	Peenya 1st Stage Junction	SRS Junction	1	37	97	60	37	60	Traffic Flow Delay
6	SRS Junction	100ft ORR Junction	1	40	110	70	33	51	Merging and Diverging of Vehicles
7	100ft ORR Junction	Goraguntepalya Junction	0.5	87	143	56	13	32	Merging and Diverging of Vehicles
8	Goraguntepalya Junction	MEI Junction	0.6	17	115	98	19	22	Traffic Flow Delay
9	MEI Junction	Yeshwanthpur Skywalk	1.2	78	267	189	16	23	Pedestrian crossing and Narrow road near the skywalk
10	Yeshwanthpur Skywalk	Yeshwanthpur TTMC	0.8	57	198	141	15	20	Traffic Flow Delay
AVERAGE							24	39	

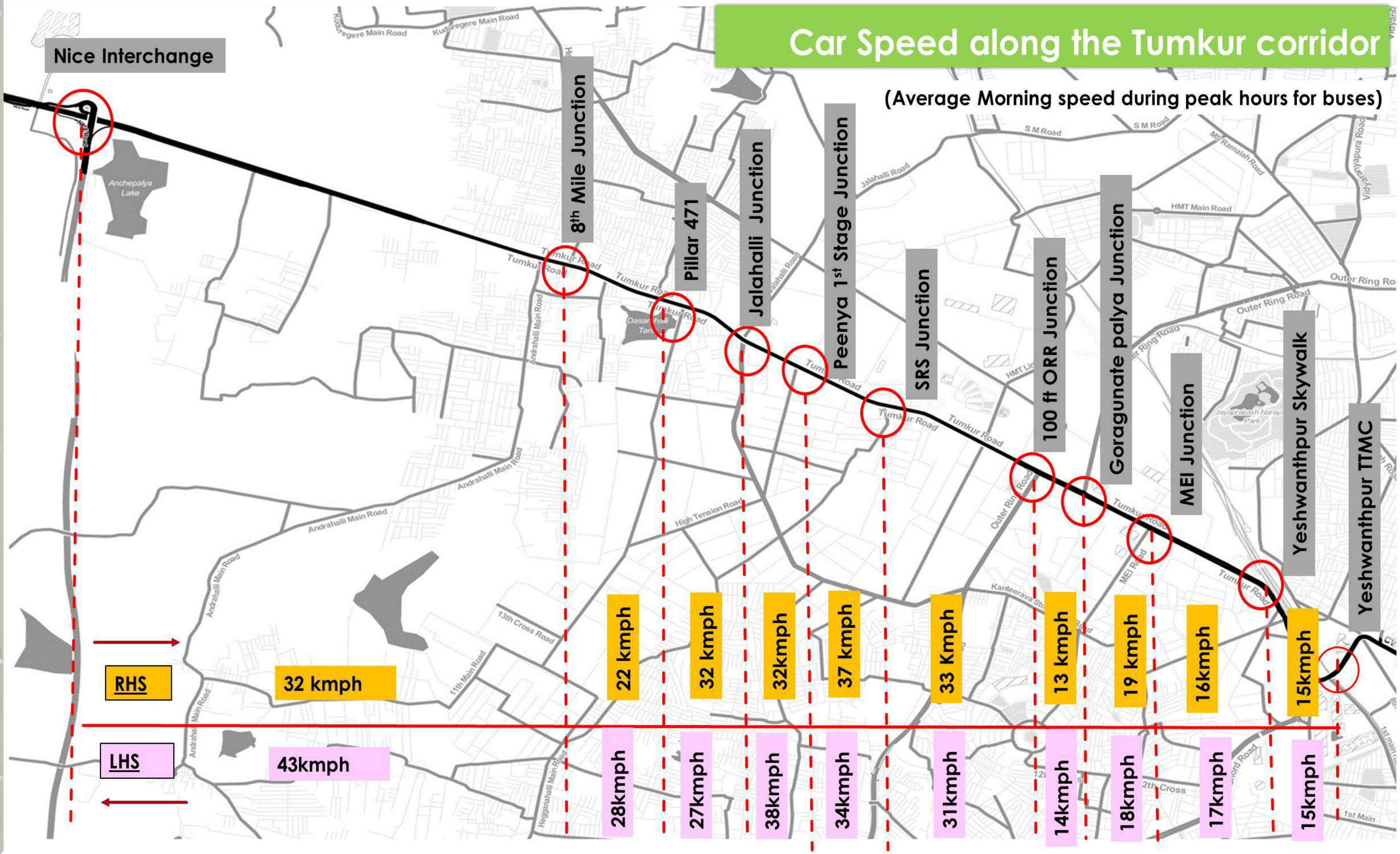


Figure 40. Average Morning Car Speeds along the Tumkur Corridor

Table 17. Average Evening Peak Speed & Delay Details - Cars

Direction: Yeshwanthpur to Nice Interchange (11 KMs)- Evening Peak- CARS

Sl.No.	From Node	To Node	Distance (km)	Delay (Sec)	Journey Time (sec)	Running Time (sec)	Journey speed (kmph)	Running speed (kmph)	Journey Speed (kmph)
1	Yeshwanthpur TTMC	Yeshwanthpur Skywalk	0.8	80	197	117	15	25	Traffic congestion
2	Yeshwanthpur Skywalk	MEI Junction	1.2	63	287	224	15	19	-
3	MEIJunction	Taj Vivanta	0.6	21	128	107	17	20	Traffic
4	Taj Vivanta	100ft ORR Junction	0.5	51	120	69	15	26	Traffic
5	100ft ORR Junction	SRS Junction	1	41	134	93	27	39	-
6	SRS Junction	Peenya junction Pillar 442	1	16	112	96	32	38	-
7	Peenya junction Pillar 442	Jalahalli intersection	0.5	10	65	55	28	33	-
8	Jalahalli intersection	Pillar 471	0.8	33	143	110	20	26	-
9	Pillar 471	8th Mile	0.6	41	88	47	25	46	-
10	8th Mile	Nice Interchange	4	22	312	290	46	50	Toll Queue
AVERAGE							24	32	

Table 18. Average Evening Peak Speed & Delay Details - Cars

Direction: Nice Interchange to Yeshwanthpur- Evening Peak- CARS

Sl.no	From Node	To Node	Distance (km)	Delay (Sec)	Journey Time (sec)	Running Time (sec)	Journey speed (kmph)	Running speed (kmph)	Delay Cause
	Nice Interchange	8th Mile	4	53	458	405	31	36	Metro Construction
2	8th Mile	Pillar 471	0.6	67	137	70	16	31	On street Market
3	Pillar 471	Jalahalli intersection	0.8	53	111	58	26	50	On street Market
4	Jalahalli intersection	Peenya junction Pillar 442	0.5	23	68	45	26	40	Traffic Flow Delay
5	Peenya junction Pillar 442	SRS Junction	1	27	103	76	35	47	Traffic Flow Delay
6	SRS Junction	100ft ORR Junction	1	67	176	109	20	33	Merging and Diverging of Vehicles
7	100ft ORR Junction	Goragunate palya Junction	0.5	56	113	57	16	32	Merging and Diverging of Vehicles
8	Goragunate palya Junction	MEI Junction	0.6	10	107	97	20	22	Traffic Flow Delay
9	MEIJunction	Yeshwanthpur Skywalk	1.2	80	232	152	19	28	Pedestrian crossing and Narrow road near the skywalk
9	Yeshwanthpur Skywalk	Yeshwanthpur TTMC	0.8	23	174	151	17	19	Traffic Flow Delay
AVERAGE							22	34	

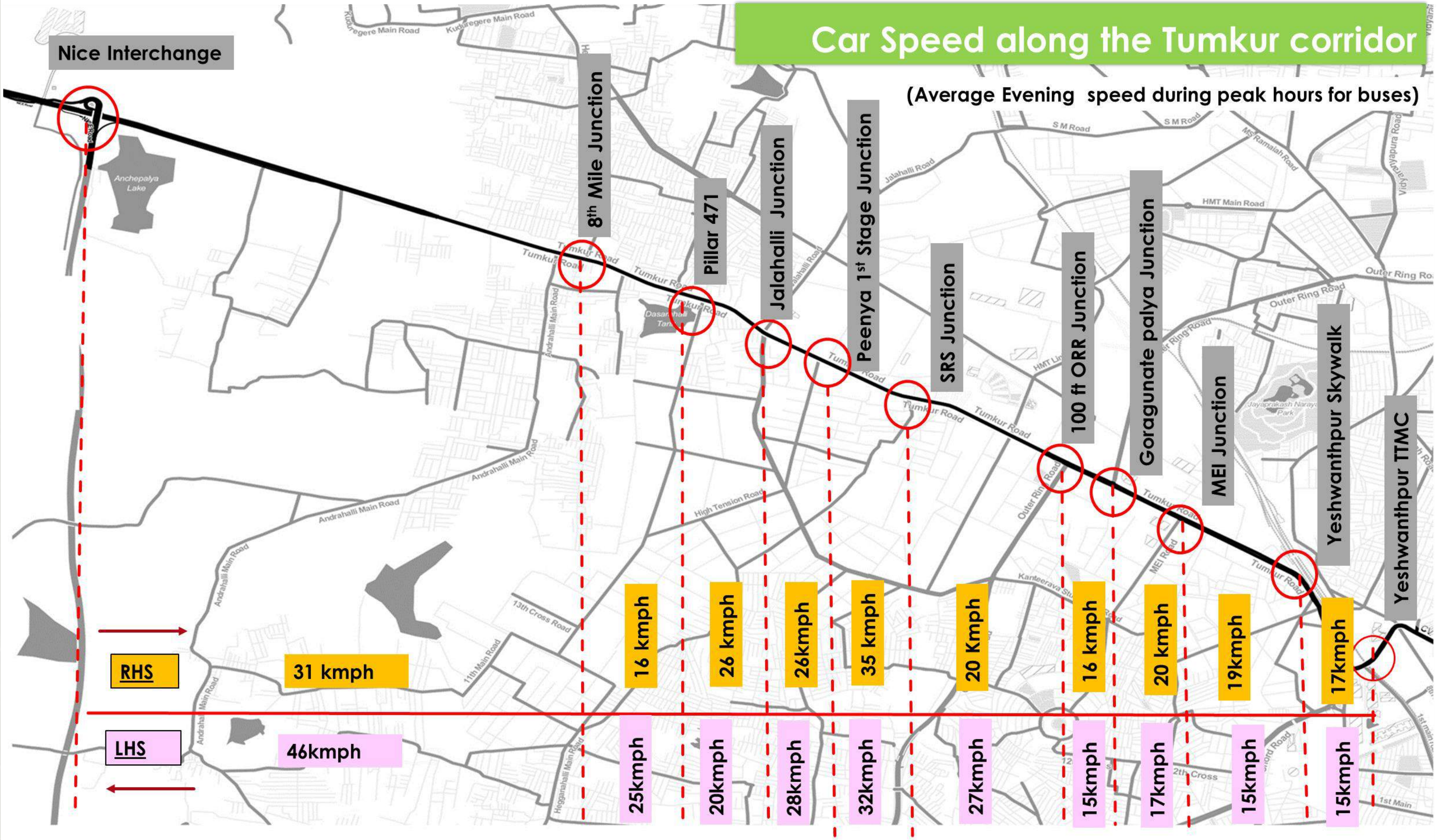


Figure 41. Average Evening Car Speeds along the Tumkur Corridor

Road Inventory Details

Table 19. Road Inventory Details

Link No	Name of Road	Name of Starting Point	Name of Ending Point	Carriageway Width			Service Lane Width	
				LHS Width	Median	RHS Width	LHS	RHS
1	Tumkur Road	Sandal SoapFactory Junction	Govardhan Bus stop FOB	9.4	8.4	8.8	8.3	8.0
2	Tumkur Road	Govardhan Bus stop FOB	Khader Road(Govardhan Theatre)	16.0	2.5	9.3	0.0	0.0
3	Tumkur Road	Khader Road(Govardhan Theatre)	Yeshwanthpur Railway Station	10.2	2.8	10.2	8.8	0.0
4	Tumkur Road	Yeshwanthpur Railway Station	MEI Signal	7.8	2.8	12.0	12.0	9.7
5	Tumkur Road	MEI Signal	Gorugunte palya Junction	10.8	3.8	15.7	9.2	0.0
6	Tumkur Road	Gorugunte palya Junction	CMTI Junction	23.5	2.8	20.8	0.0	0.0
7	Tumkur Road	CMTI Junction	SRS Junction	15.6	0.6	16.7	7.0	8.4
8	Tumkur Road	SRS Junction	Peenya 1st Stage Junction	8.5	4.0	8.5	5.8	5.8
9	Tumkur Road	Peenya 1st Stage Junction	Jalahalli Cross Junction	8.2	4.0	8.5	5.8	5.8

Figure 42. Road Inventory Yeshwanthpur TTMC

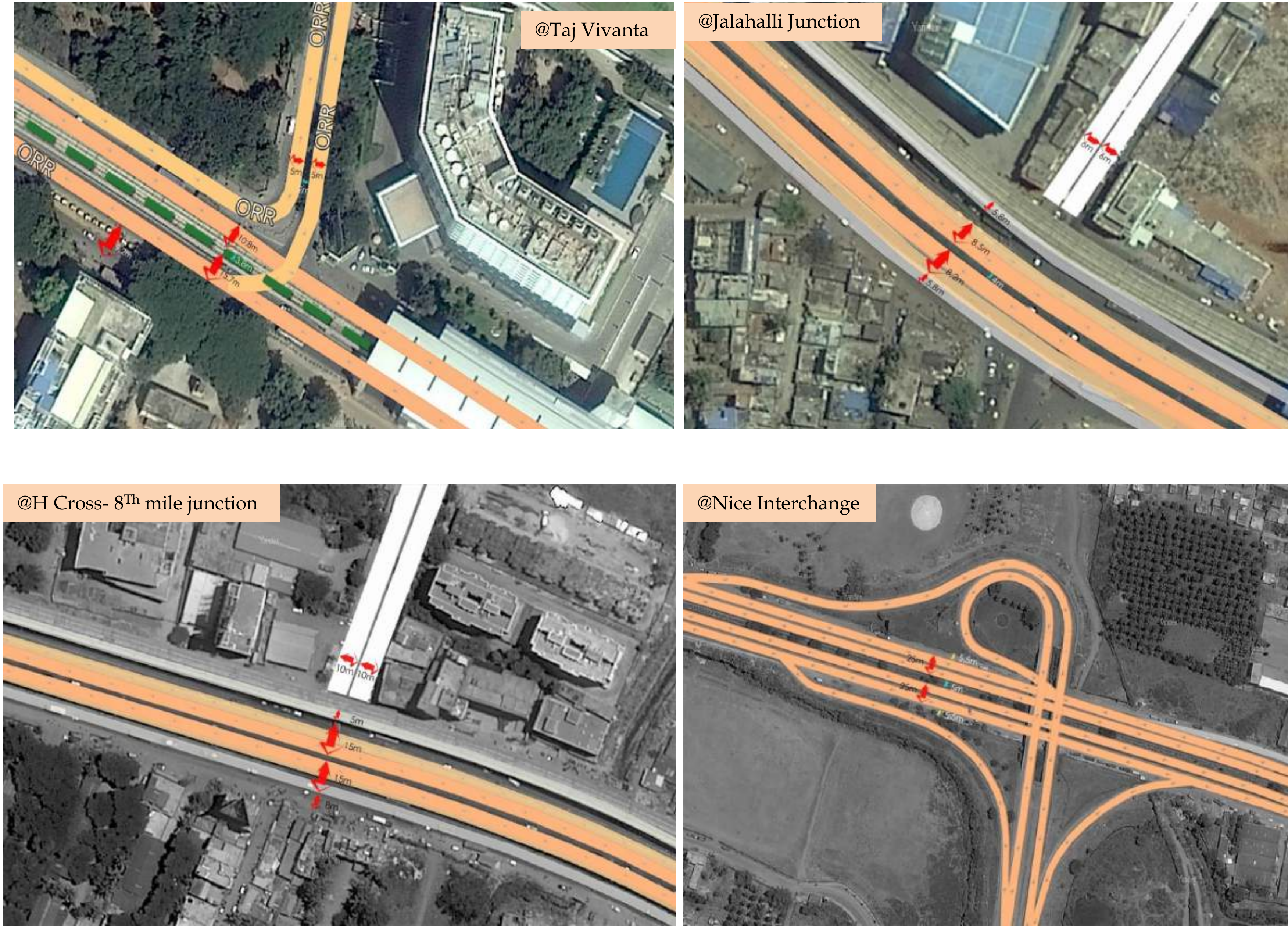


Figure 43. Road Inventory along the corridor

Turning Radius at Yeshwanthpur Flyover

As per the standards and general conditions required to construct the flyovers, it is suggested that large radii right-turn curves are more dangerous than left curves, in particular, during lane-changing manoeuvres. However, sharper curves are more dangerous in both left and right curves.

"The angularity of the curve may be as high as 70 degrees while the maximum curvature recommended is only 45 degrees. The steep curve creates a powerful centrifugal force on speeding vehicles, throwing them off the flyover," Already two ministerial government vehicles have been toppled at this stretch of the flyover and two trucks were thrown off the flyover killing two people in the recent months all this is due to poor engineering design.

The other reason is due to higher speeds and negligence driving. Since the flyover has a sharp curve, driving at speeds more than 50 kmph might be fatal.

The height of the existing parapet wall on the flyover is very less indicating poor geometric designs. Higher speeds are observed on the flyover, and since the height of the central median is just 8 inches, the vehicles tend to cross over to the opposite lanes while manoeuvring the sharp curve.

Tapering edges at the bottom of the parapet wall on the flyover, act as the platform to take-off, resulting the vehicles to throw them off the flyover. The issues are highlighted in **Figure 44-45**

Figure 44. Turning Radius at Yeshwanthpur Flyover

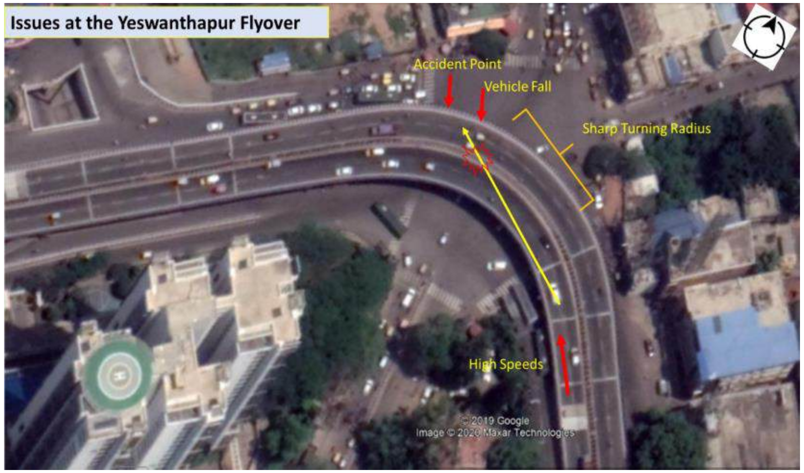
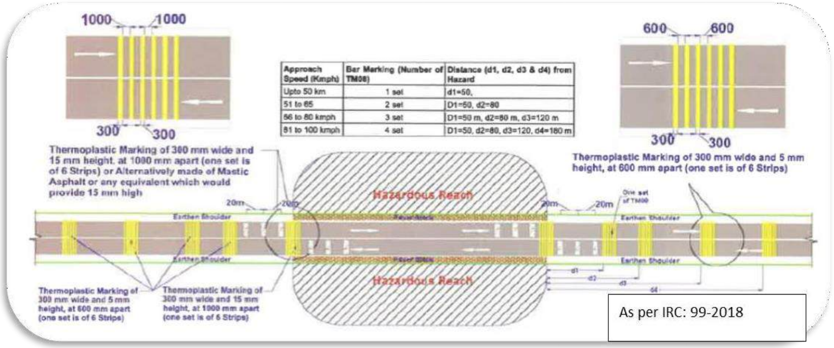


Figure 45. Issues at Yeshwanthpur Flyover

Recommendations:

- ✓ Traffic calming measures need to be implemented to control the over speeding of vehicles on the flyover which is one of the major reasons for accidents. Hence, traffic calming measures as per IRC 99-2018 are recommended. The IRC recommends applying 15 mm thick thermoplastic paints in a series of six strips (one set will have six strips). Based on the speeds on the corridors, the thermoplastic rumble sets are decided. e.g. if the speed is 50kmph then one set of rumble strip is required and similarly, two sets for 51-65 kmph, three sets for up to 80 kmph and above 80kmph four sets of thermoplastic paints need to be applied. (**Figure 46**)



Approach Speed (Kmph)	Bar Marking (Number of TM08)	Distance (d1, d2, d3 & d4) from Hazard
Upto 50 km	1 set	d1=50,
51 to 65	2 set	D1=50, d2=80
66 to 80 kmph	3 set	D1=50 m, d2=80 m, d3=120 m
81 to 100 kmph	4 set	D1=50, d2=80, d3=120, d4=180 m

Figure 46. Traffic calming measures

✓ Height of the parapet walls on the flyover needs to be increased to a minimum of 6 feet, which will help in stopping the vehicles that are thrown off the flyover. This will help in reducing fatal accidents. If the vehicles fall below, then the chances of fatalities will increase as the at-grade junction is one of the busiest junctions in the city. Similarly, the height of the central median needs to be raised to safeguard the vehicles that tend to cross over due to over speeding. **(Figure 47**)

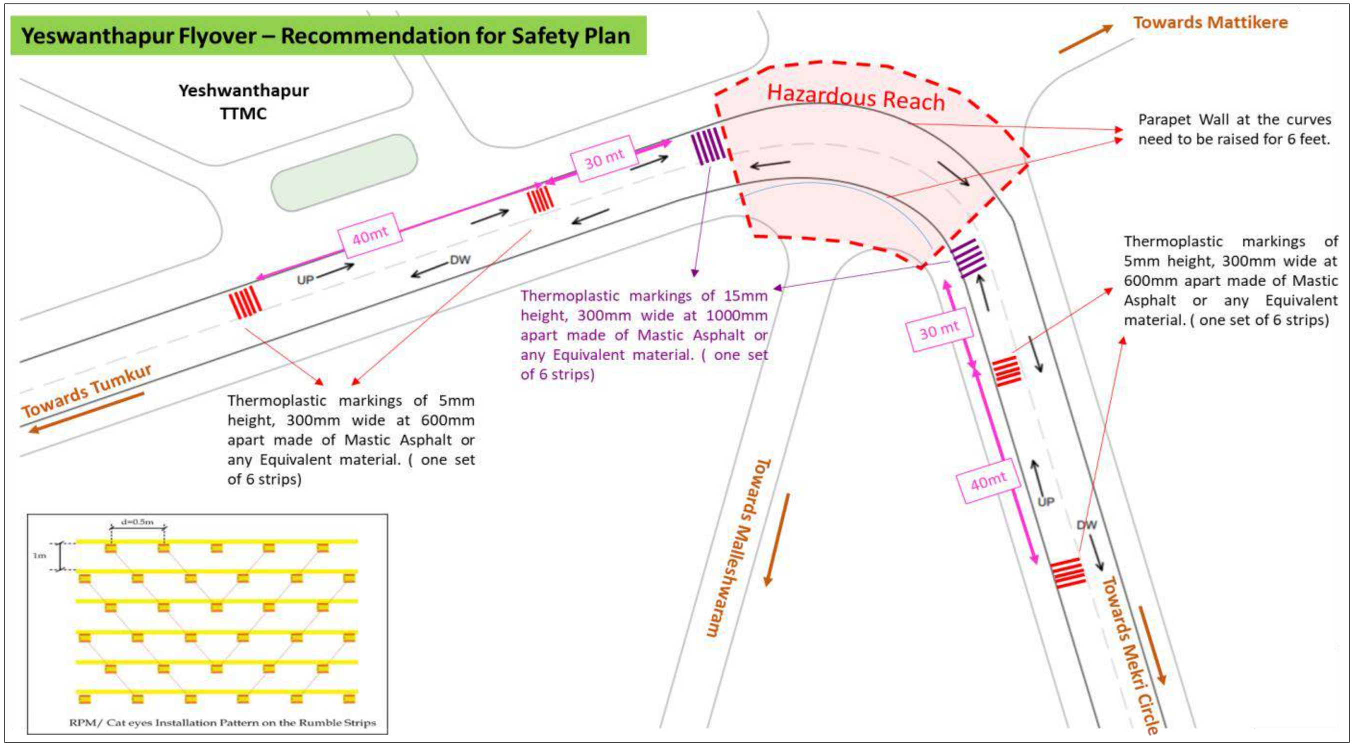


Figure 47. Recommendations at Yeshwanthpur Flyover

Benefits:

- Over-speeding of the vehicles will be controlled on the flyover, which will help in reducing accidents.
- Due to the increased height of parapet walls, toppling of the vehicles from the flyover can be prevented.
- Increasing the height of the median will help in restricting vehicle cross overs due to over speeding.

Traffic Congestion at Down Ramp of Yeshwanthpur Flyover opposite to TTMC

Traffic congestion at the Yeshwanthpur flyover is impediment imposed by vehicles on each other, i.e. the vehicles coming from the flyover and the vehicles coming at grade. The vehicular volume here is equal to or more than the capacity of the road stretch.

The traffic volume at this location can be defined as the difference between the roadway system design capacity and the actual operating capacity, and as simply put, a situation where demand for road space exceeds supply. The situation indicates the inability of the current system to accommodate the existing traffic situation at the down ramp of the flyover.

As per the observed traffic flow pattern, two lanes of traffic is coming from the Yeshwanthpur flyover and the other two lanes from at grade - one from TTMC and the other one from Malleswaram, meeting at the railway bridge. It is observed that the road width at this stretch reduces from 21 meters to 7 meters in a span of just 20 meters.

Due to the limited transition length, merging and diverging becomes difficult and with narrow bridge ahead, things have worsened, leading to serious traffic congestions during the peak hours.

It is observed that at certain periods during the peak hours, the traffic speed is less than 5km /hr, which is almost, stand still and is the major reason for concern. The details of the situation are explained in **Figure 48.**

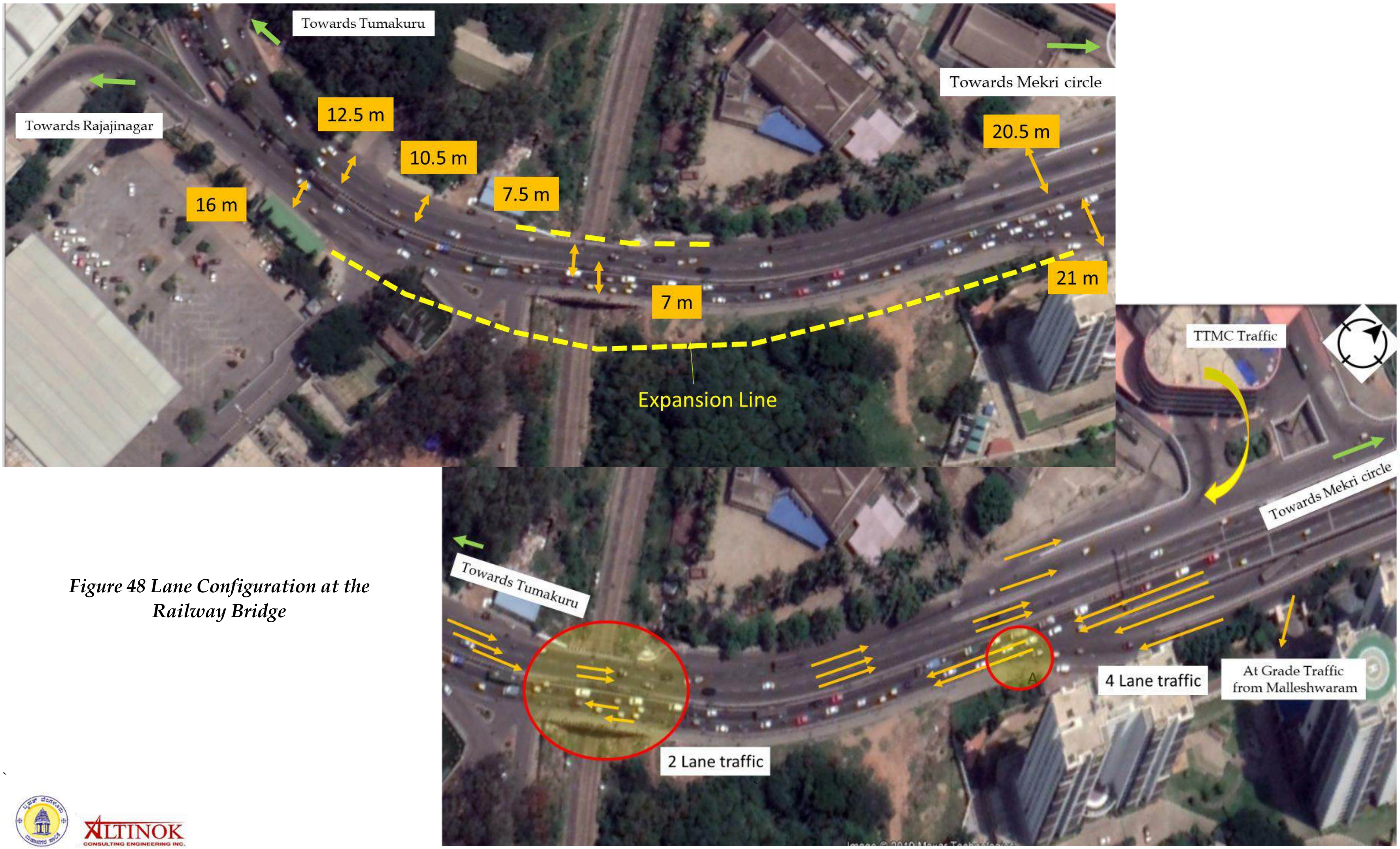


Figure 48 Lane Configuration at the Railway Bridge

- ✓ It is observed that there is an open land available on the LHS, as indicated in **Figure 49-50**, with the expansion line; the un-utilized open space available on the LHS be used for expanding the carriageway width from the existing two lanes to four lanes.

Figure 49 Road inventory on the Railway Bridge

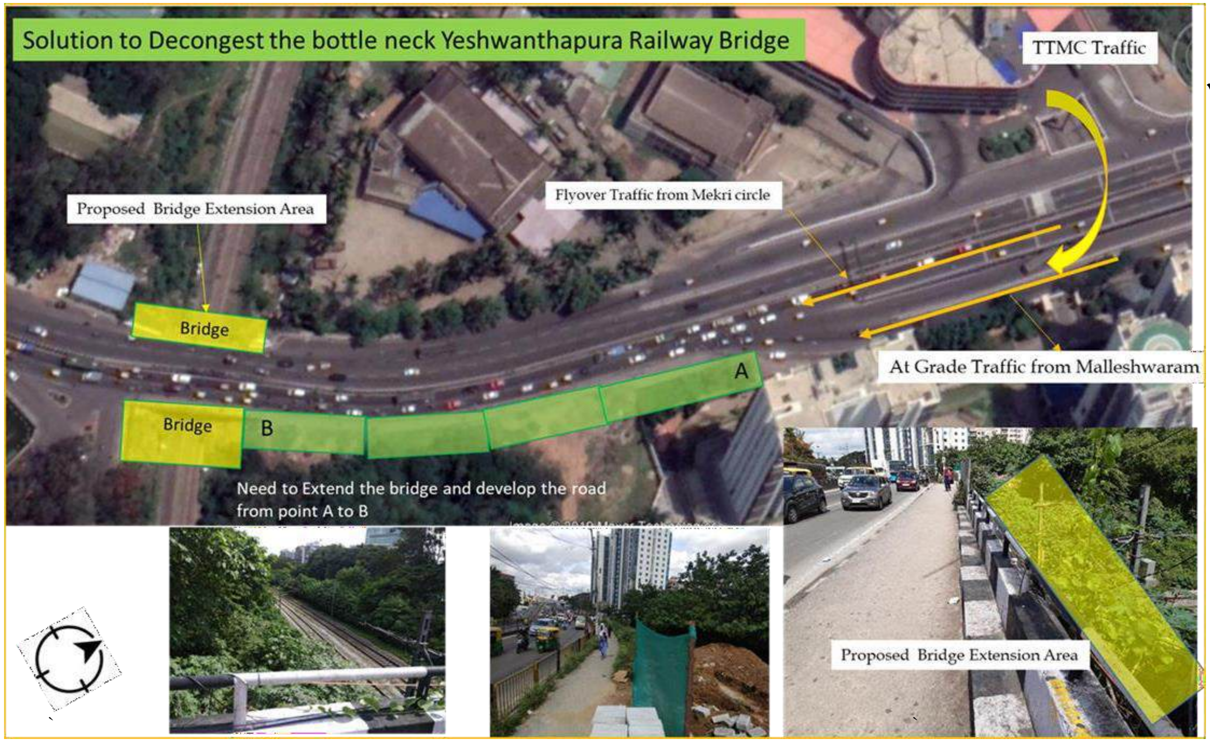


Figure 50. Conceptual Drawing of Junction near Yeshwanthpur TTMC

- ✓ The expansion of the carriageway widths requires the expansion of the railway bridge, i.e. the construction of additional deck/slab for the bridge.

- ✓ The next recommendation is to do the geometric design corrections on the minor junction located very next to the railway bridge as the impact of upgrading the carriageway from a two-lane road to four-lane will be seen on the existing minor junction. Hence, the entire junction needs to be redesigned. The conceptual junction improvement plan is as shown in **Figure 51-52**.

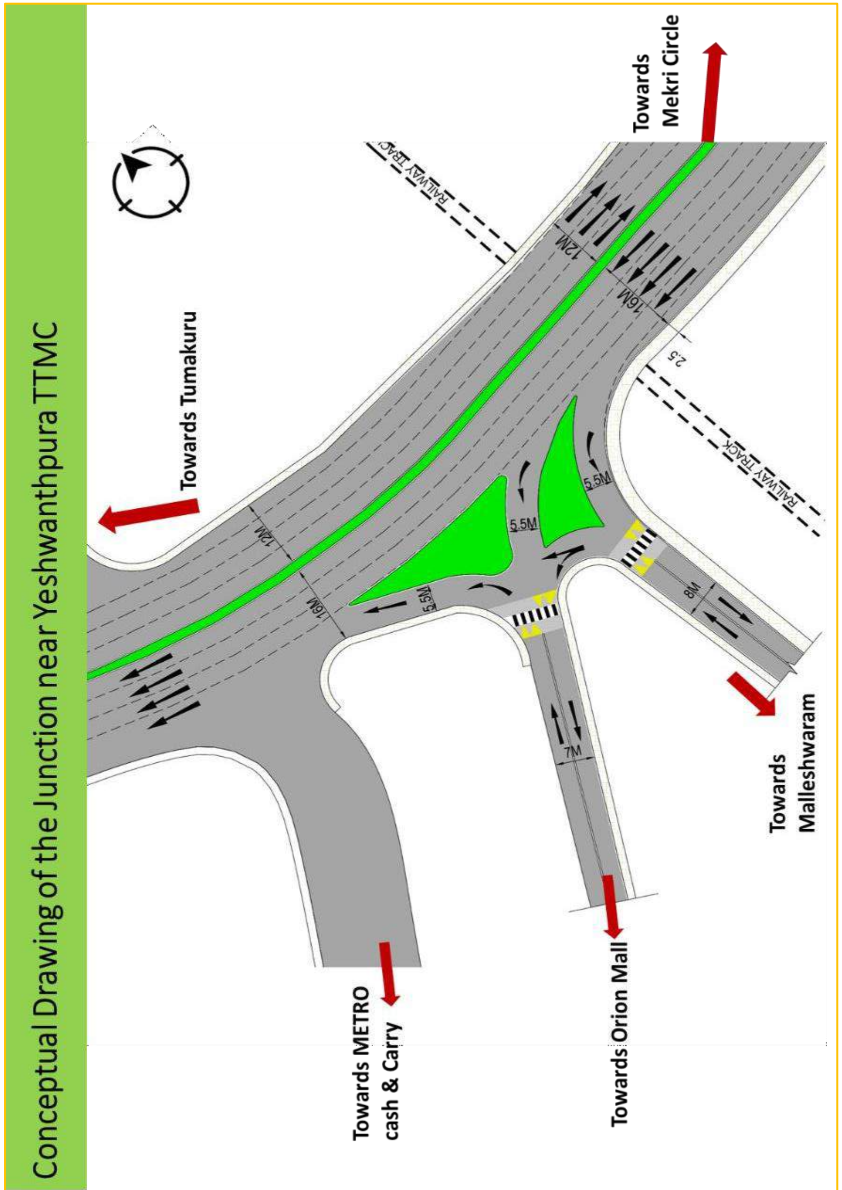


Figure 51. Conceptual Drawing of junction near Yeshwanthpur TTMC

Benefits:

✓The junction is to be re-designed with two central channels with 5.5 meters wide slip roads that will allow traffic taking a free left turn from Mekri Circle / Yeshwanthpur to Railway Parallel Road that leads to Malleswaram. The other channel will allow the traffic to move towards Orion Mall and will allow free left turning from Orion mall to Tumkur side.

- The Recommendations mentioned above once implemented will result in increasing the speeds of buses and other vehicles and will decrease the congestion and delays.
- It will allow safe transition length for merging and diverging of vehicles, which travel towards Tumkur and Rajajinagar.
- The travel time on this stretch will increase and simultaneously this will

  directly reflect on the junctions located before and after this stretch.
- It will reduce the Queue lengths of the buses below the flyover ramp coming from TTMC and will help in increasing the trip timings.
- The stresses of road users along this road stretch, especially during the

  peak hour traffic congestions will get reduced and it helps in safe driving.

Road Safety Issue

a) Level Difference on the Sharp curve opposite to Mysore sandal soap factory.

The level difference in the road network is a serious issue, which needs to be addressed immediately on priority. Here at this location, the steep slope is located on the sharp curve, which makes it even more dangerous, as shown in the location map (**Figure 52**).

The level difference is more than 7.8 meters on the Left-Hand side of the road, opposite to Mysore sandal soap factory and moving towards Tumkur. Apart from this, the spot is located on a very sharp curve with a turning radius of almost 90 degrees, which makes vehicle manoeuvring a challenging job. If a vehicle is driving at high speeds and fails to negotiate the sharp curve, might result in a fatal accident, wherein the vehicle may fall over from level one to at grade. As shown in the **Figure 53 & 54.**

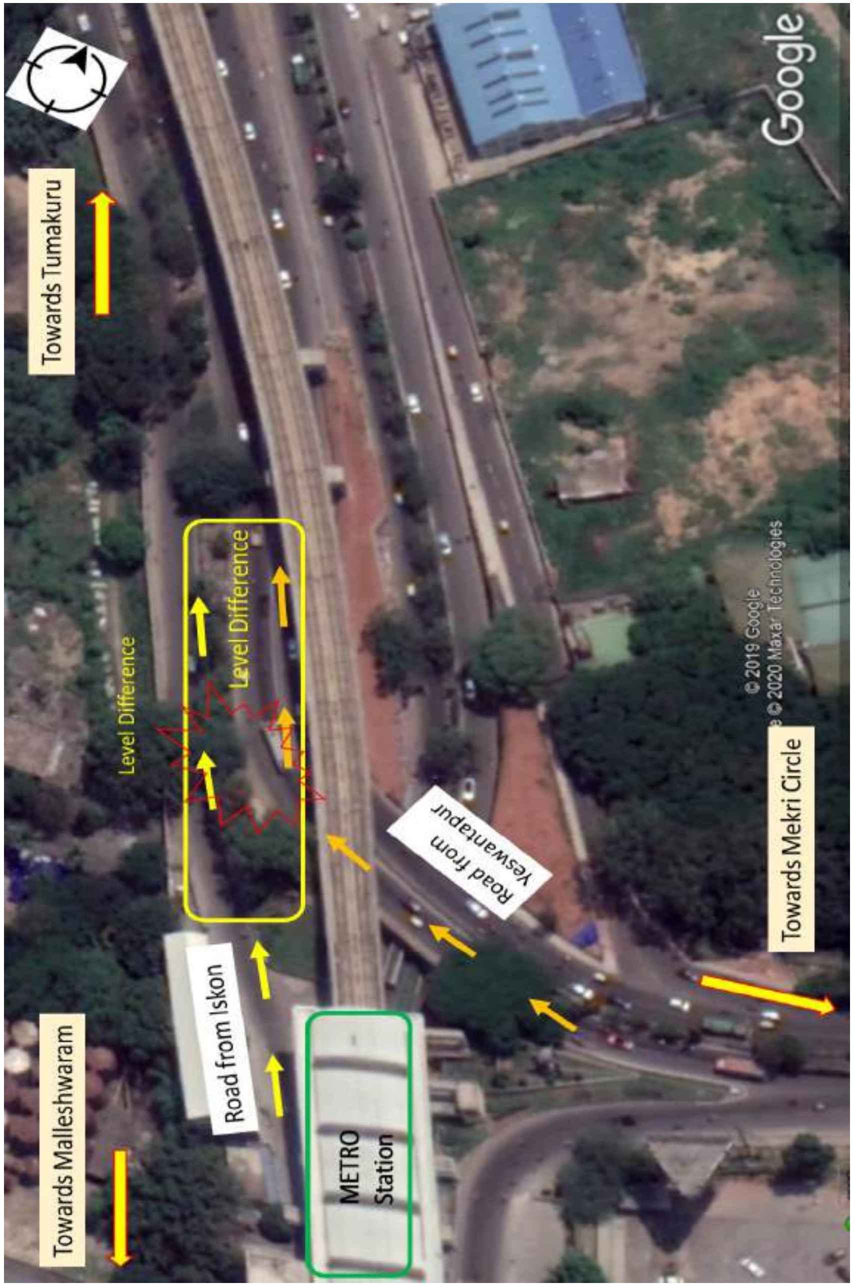


Figure 52. Road Safety Issue opposite Mysore Sandal Soap Factory

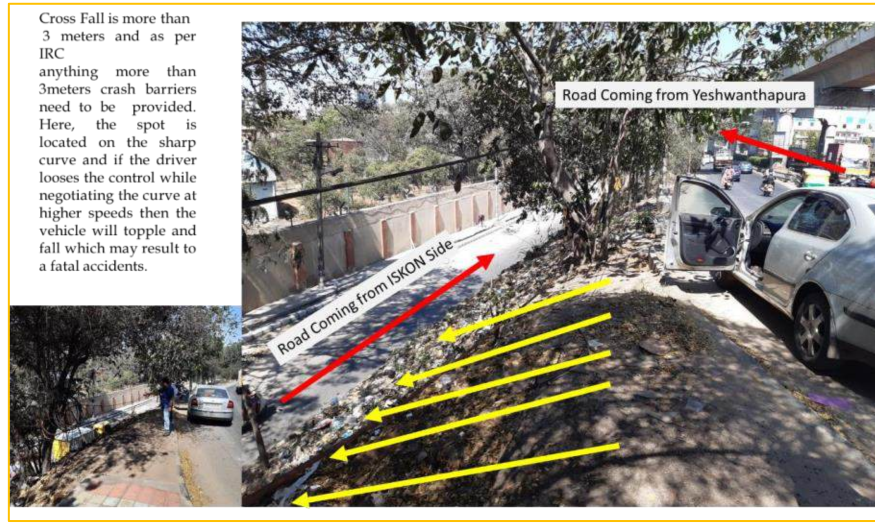


Figure 53. Road Safety Issue opposite Mysore Sandal Soap Factory

Figure 54. Measurement of Steep Slope at Mysore Sandal Soap Factory

and the footpath are almost at the same level and the slope starts immediately after the footpath making it a serious accidental hazardous location.

Recommendation

- ✓ First and the foremost thing which is recommended on priority is the installation/fixing of rigid crash beam barriers at the edge of the shoulders to avoid vehicle toppling.
- ✓ Once the Crash beam barrier (Figure 55) is installed, the face of the beam should be fixed with chevron reflective stickers to guide the road users.

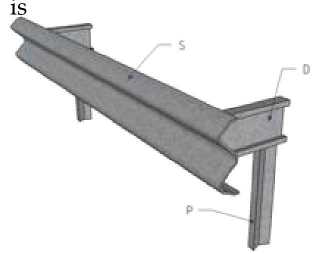


Figure 55.Rigid Crash beam Barriers

- ✓ Traffic calming measures need to be implemented to control over speeding on the sharp curve which is one of the major reasons for accidents, hence traffic calming measures a per IRC 99-2018 is recommended

b) Unscientific Vent Closure at the existing ROB.

The existing RoB near the Yeshwanthpur TTMC is at different levels. The old bridge is located on the RHS and the newly constructed bridge is at LHS. Due to this level difference, a vent is created between the two bridges. Instead of closing this vent in an engineering way, the concerned authority has done a temporary arrangement by using dangerous materials. Now, this closure has become another situation, which is even more dangerous.

The material used to close the vent is the 'I' section girder which is dangerously projected out and during the night and rainy season it is not visible to the road users which will result in fatal accidents. The barricading in done in an unscientific manner and is done only to close half the vent, the other half is still open which needs to be treated. (**Figure 56**)

Recommendation

- ✓ The existing temporary barricade needs to be removed immediately.
- ✓ The vent should be closed by a brick wall or concrete retaining wall.

Benefits:

- ➢ The Recommendations mentioned above once implemented will result in controlling over speeds.
- ➢ Will help in restricting vehicle toppling from one level to another.
- ➢ Will reduce accidents and increase safety.
- ➢ Closing the vent will help in two-wheeler safety.

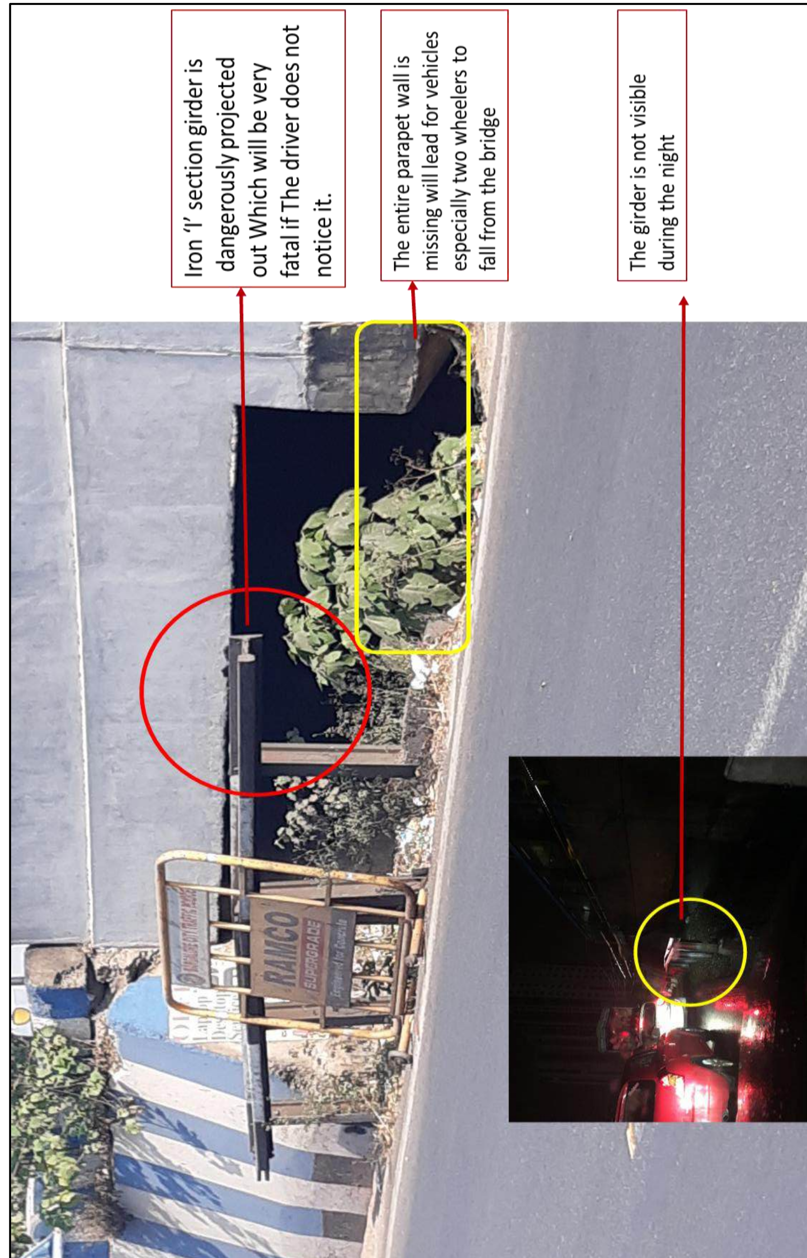


Figure 56. Vent Closure Issues near Yeshwanthpur TTMC

Unauthorized Bus Stoppage

Tumakuru corridor is growing fast leading to an increased demand for public transport services and facilities. This has subsequently led to challenges to provide suiTable bus stops and terminals. The Municipalities are keen to provide good public transport but have failed in providing the needed space. There is also a lack of knowledge in this problem area.

The BMTC has grown significantly over the last two decades years. While BMTC buses provide a useful service, their on-street operations are causing serious disruption to the local traffic network and risks to public safety. In certain stretches along the Tumkuru corridor, the proliferation of these buses has led to an increase in traffic and sidewalk congestion; a higher concentration of on-street bus parking, double parking or blocking of travel lanes; and the creation of traffic and safety concerns for drivers, travellers, pedestrians and residents.

The location under discussion is at the down ramp of the ROB going towards Tumkur and is right in front of ESSAR petrol pump and below the pedestrian, a skywalk that connects the Yeshwanthpur railway station. Unauthorized bus parking to alight and board the commuters on the centre of the main carriageway has created traffic chaos during the peak hours, particularly at the time when the inter-city trains arrive in.

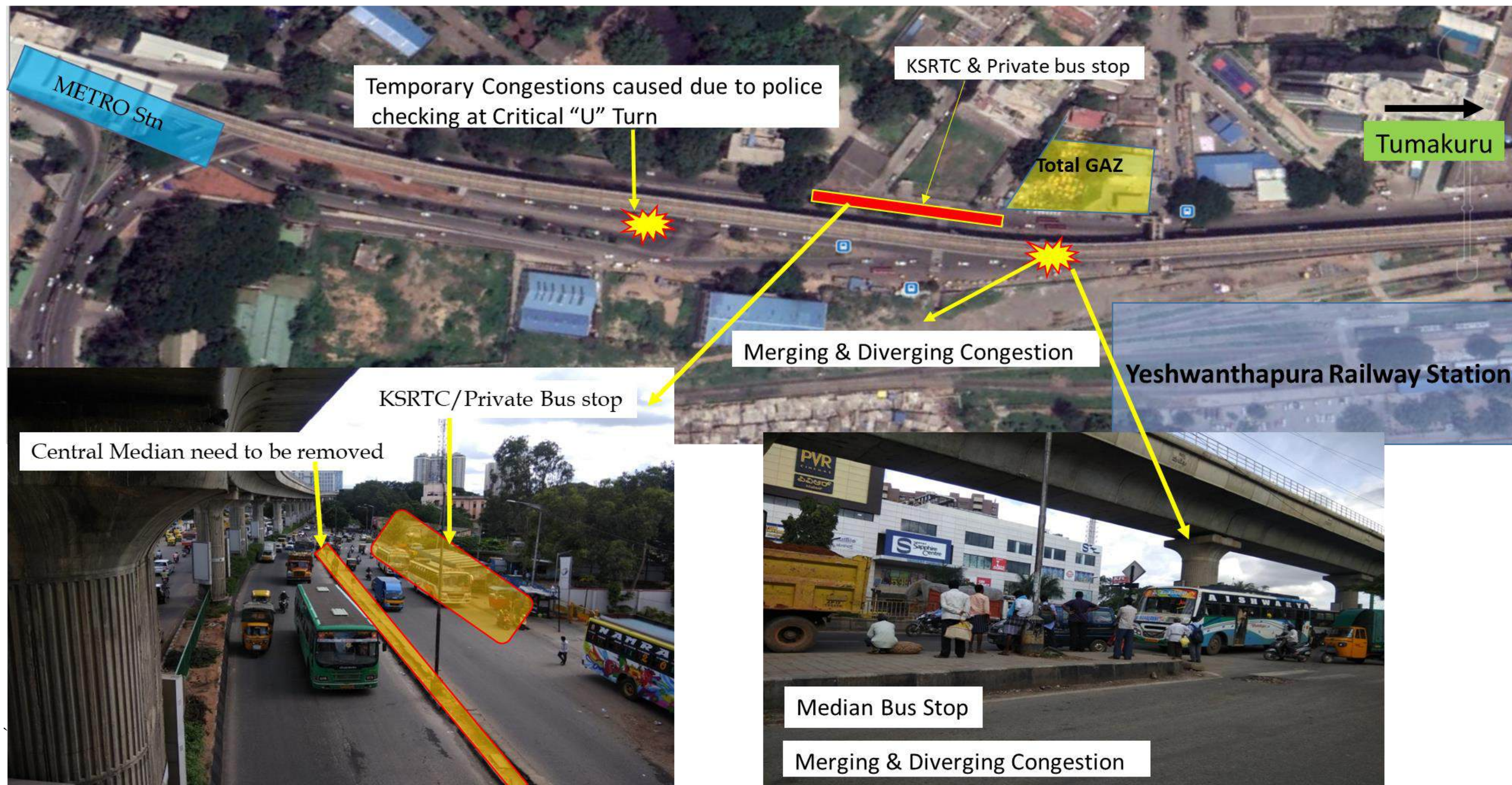


Figure 57 Existing Site Scenario near Yeshwanthapura Railway Station.

It is observed that, whenever the train arrives during the day, the commuters use the pedestrian skywalk and cross over to the other side of the road. On reaching the other side rather than moving towards the existing bus stop, which is located just 30 meters from the skywalk, the commuters prefer to stand at the entrance of the staircase or stand on the central median to take the city service buses. To add on this, the BMTC buses rather than stopping on the designated bus stop, park their buses on the main carriageway at multiple places in a span of 100 meters creating huge traffic jams, which is shown in the **Figures 57 & 58**.

The other major issue at this point is the merging and diverging of the vehicles. The traffic coming from the down ramp of the ROB from Yeshwanthpur side and the traffic coming at grade from Rajajinagar meets at a point where criss-cross of vehicles takes place and due to the lack of road sense among the drivers, accidents and traffic congestions are common at this stretch of Tumkur Road.

An improper geometric design of the roadway is the issue at this location i.e. the unscientific median opening near to the down ramp is resulting in traffic congestions.

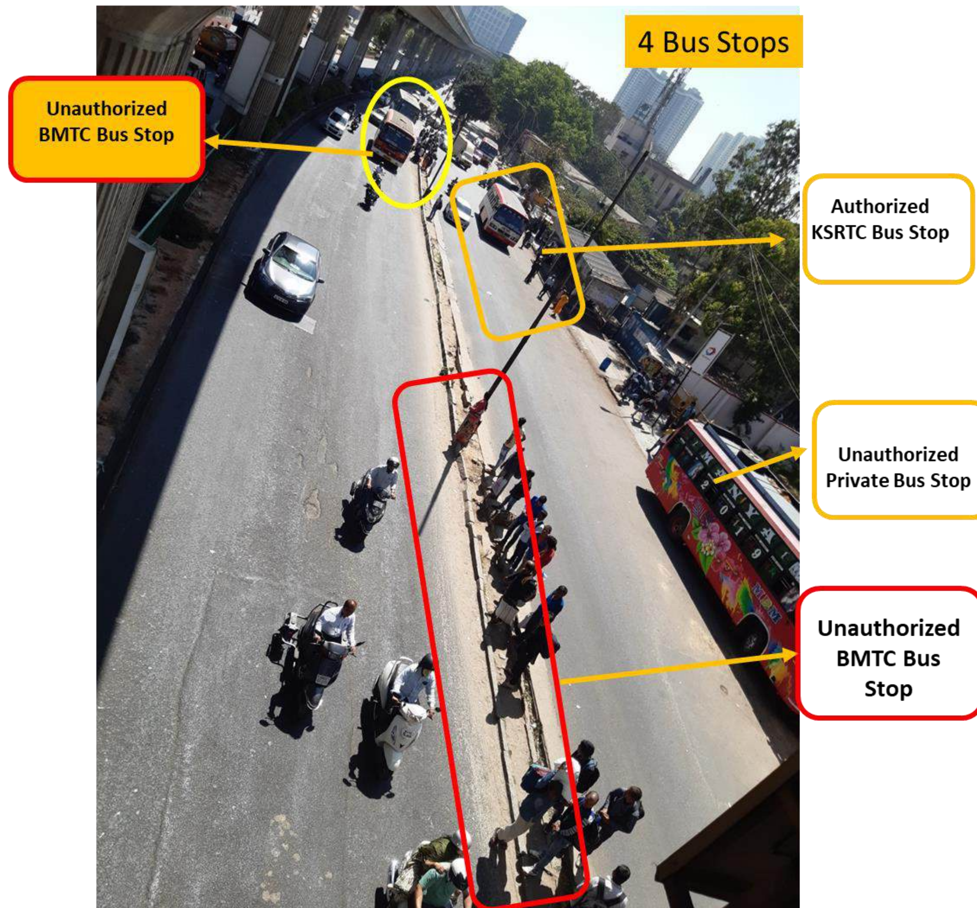
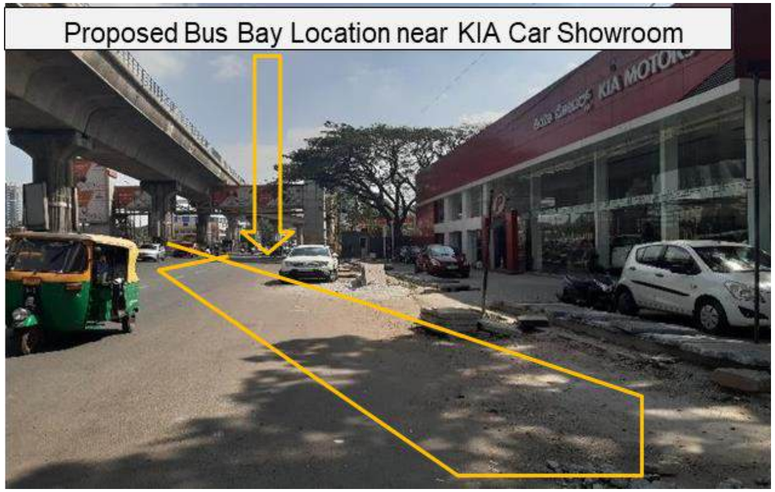


Figure 58. Issues of Unauthorised Bus Stoppage

Recommendation

- ✓ The existing median opening at the down ramp needs to be closed to avoid unscientific crisscrossing which is leading to traffic congestions and accidents. (**Figure 57**)
- ✓ The median needs to be extended until the existing bus stop and thereafter the entire median needs to be removed to avoid unauthorized bus stoppage on the central lane and this will force the commuters to walk to the authorized bus stop to take the bus.
- ✓ Currently, there is no dedicated bus stop for BMTC buses at this location. A new bus stop is proposed near the KIA car showroom which is just 20 meters away from the existing skywalk. Sufficient carriageway width is available to accommodate one lane for the buses. The existing width available at this proposed location on the LHS is 20 meters, which is sufficient to have controlled bus bay. (**Figure 59**)



- ✓ Above all, strict enforcement by BMTC is required; BMTC has to train its drivers and conductors to make sure that buses stop only at the authorized bus stops and not to pick the commuters near the skywalk of from the middle of the road.

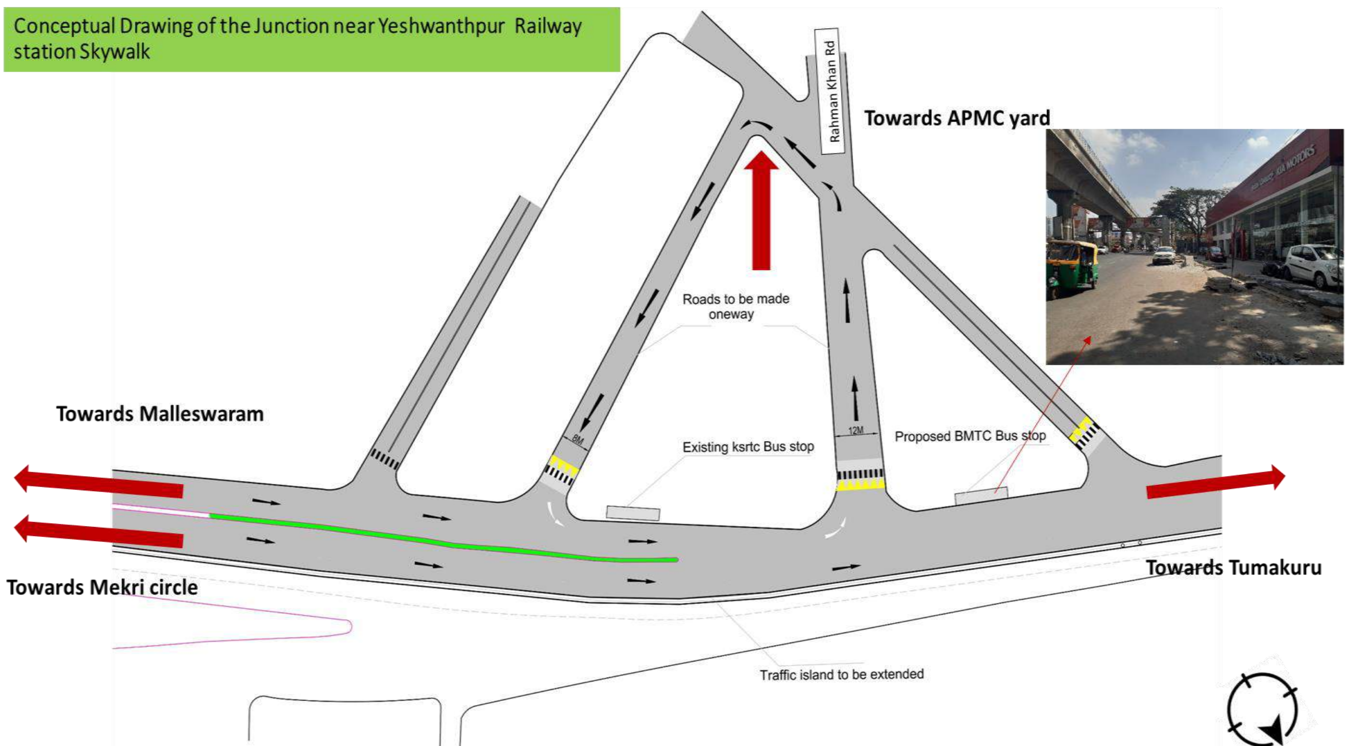


Figure 59. Conceptual Drawing of Junction near Yeshwanthpur Railway Station Skywalk

Benefits:

- The Recommendations mentioned above once implemented will result in increasing the speeds of buses and other vehicles and will decrease the congestion and delays.
- Will eliminate the delays caused due to crisscrossing at the down ramp.
- The travel time on this stretch will increase due to the shifting of the bus stop.
- By creating bus bays the BMTC buses will function systematically and by removing the central median, BMTC buses will not stop in the middle of the road to pick the commuters thus eliminating traffic jams.
- Extension of the central median and by implementing the Traffic Management Plan, the traffic circulation will be smooth around the area.

At-grade Pedestrian crossing Issue

Pedestrians, in general, face a common obstacle at several locations along the Highway. Crossing the road is one of the major problems. Due to the sheer increase in the number of vehicles and the speeds at which they operate, pedestrians face a severe challenge while crossing the highway in the absence of any safe pedestrian crossing facility. A similar situation can be seen right in front of PVR cinemas. Vehicular speeds at this location are very high during off-peak hours and late-night hours.

However, during the day the traffic density is very high making it difficult for the pedestrian to cross the road.

It is also observed that during the peak hours, more than two hundred pedestrians cross the road not only due to the cinema theatres but also due to the presence of bus stops on either side of the road at this location. Any pedestrian-vehicle conflict would be fatal because of the speeds of the vehicles travelling on this stretch of the roadway (during off-peak periods).

Figure 60. Pedestrian Skywalk Proposal

Recommendation

- ✓ As a short-term improvement, a Pelican signal for pedestrian should be installed for safe pedestrian crossing from either side.
- ✓ A Pedestrian skywalk is proposed at this location as a long term improvement strategy (**Figure 61-62**)

Figure 61. Pedestrian Skywalk Proposal Location

Benefits:

- ➢ Installation of Pelican signal will help in safe pedestrian crossing at grade and will make the vehicles to stop while the pedestrians are crossing the road.
- ➢ The long-term proposal for constructing a pedestrian skywalk will help in safe pedestrian movement and will avoid any pedestrian-vehicle conflicts.

Left Turning Issue at Taj Vivanta Hotel

This is one of the critical intersections along the corridor, which carries the Outer Ring Road traffic, and the National Highway traffic. The major issue here is the left turn from Tumkur side towards Hebbal due to reduced carriageway width and absence of bus bays.

The major issues noted at this junction leading for severe traffic congestions include (**Figure 63-64**):

- Left turning vehicles from Peenya/ Tumkuru moving towards Hebbal on the outer ring road result in congestion due to narrow turning radius.
- Due to the reduced carriageway and limited scope of road widening of the presence of army land on the left-hand side, things have become more problematic.
- One of the major issues at this location is enforcement. The bus stop is located at 70 meters from the junction but buses stop at the turning, making it difficult for other vehicles to move, thus resulting in long queues.

Figure 62. Issues at Taj Vivanta Hotel Junction

Recommendations:

- ✓ The entire junction needs to be redesigned as per engineering standards /guidelines.

- ✓ If the abutting defence land can be acquired for creating an additional lane for the bus bay, then most of the problem is solved and congestion can be eased out. (**Figure 63**)
- ✓ Traffic signal optimization with new signal phase timings is recommended along with the other proposals mentioned above.
- ✓ Enforcement by BMTC and Traffic Police is the primary requirement, to ensure that BMTC buses do not stop at the turning, which is creating traffic chaos.
- ✓ Educating the commuters and pedestrians need to be done to get discipline among all the road users. This is important because the commuters do not follow the road rules and hence need to educate them.

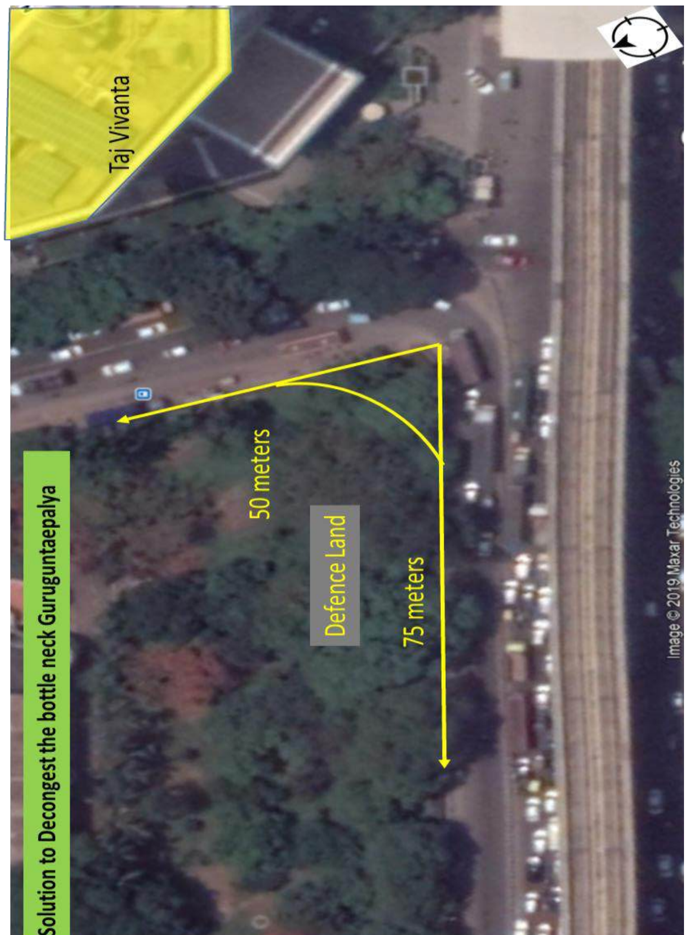


Figure 63. Solution to Decongest the bottleneck of Gorguntepalya

Conceptual plans for all the above recommendations are shown in the following **Figure 64**.

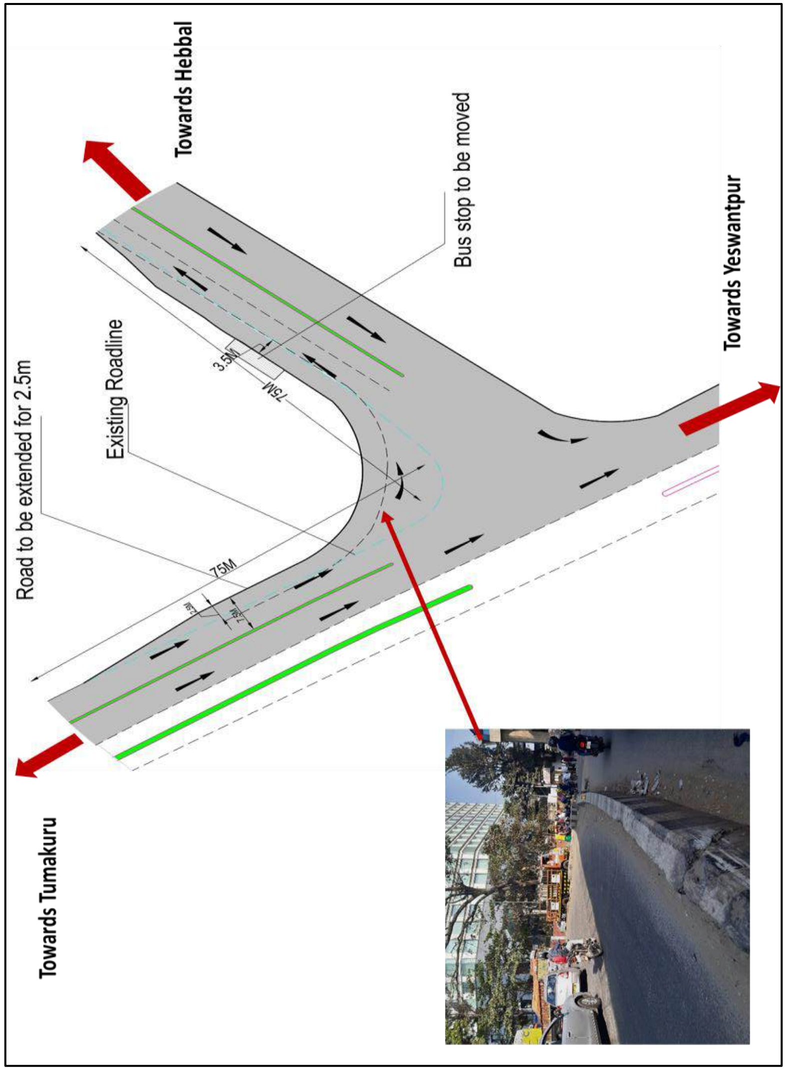


Figure 64. Conceptual Drawing of the Junction for Left Turning near Taj Vivanta

Benefits:

- ➢ By acquiring part of defense land at the turning, as shown in the conceptual plan, a separate bus lane can be developed which will make the buses move in the dedicated lane and the other traffic can move without any hindrance.

100 Ft ring road Bus stop Issue

The bus stop is the first point of contact between the passenger and the bus service. To improve the quality of bus service, the bus stop should be recognized as a crucial element. Bus stop layout should enable safe and smooth flow of bus and passengers.

At this junction, it is observed that congestion is occurring at the junction due to buses, which are decelerating, stopping and accelerating on the carriageway and accidents occur due to lack of facilities for safe passenger movements at bus stops.

Even though the bus bay is located about 50 meters away from the junction towards Tumkur, the BMTC buss, the KSRTC buses and the Private buses tend to stop at the junction itself, instead of stopping at the designated bus bay . This is creating congestion and blocking the traffic near the junction.

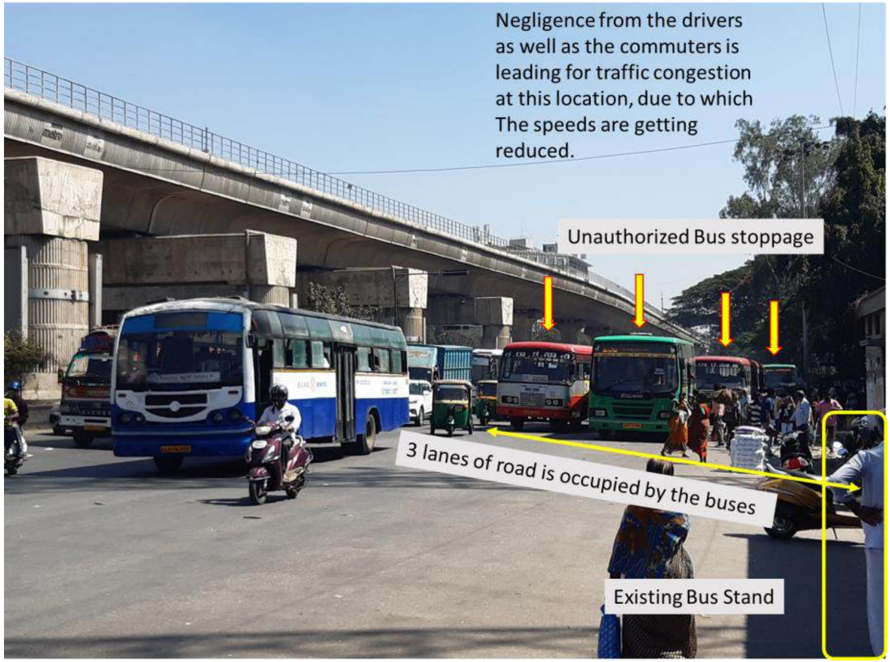


Figure 65 Bus Stop Issue at 100ft Ring Road

The buses are stopping parallel to each other, thus taking away almost three lanes during the peak hours. Once the buses stop, long traffic queues are seen behind the buses, which completely obstruct the intersection flow, thereby resulting in junction delays. (**Figure 65**

Figure 66. 100ft Ring Road Junction Location

Recommendations:

- ✓ Since people are reluctant to walk till the authorized bus bays/bus stop located 50meters away from the junction, there is a need to do a minor geometric correction at the junction to force the people towards the bus stop.
- ✓ Part of the junction needs to be redesigned by creating a bulb at the corner of ORR and NH going towards Tumkur as shown in the Figure. This will help in forcing the buses to enter the authorized bus stop rather than stopping at the junction.
- ✓ Once the Bulb is created the entire footpath needs to be installed with railings so that commuters don't come on the carriageway.
- ✓ Enforcement by BMTC and Traffic Police is the primary requirement to ensure that BMTC buses and other interstate buses don't stop at the turning.

Figure 67 Shows the conceptual drawing of the Junction considering all the recommendations mentioned above.

Benefits:

- ➢ The buses will be forced to stop at the authorized bus stops.
- ➢ Commuters will have no option but to move towards the designated bus stop as the railings will guide the pathway towards the bus stop.
- ➢ Long vehicular queue lengths will be eliminated.
- ➢ Vehicular speeds will increase and delays will be reduced.
- ➢ Above all, the safety of commuters and pedestrians will be achieved

Conceptual Drawing of the Junction at 100 ft Outer Ring road

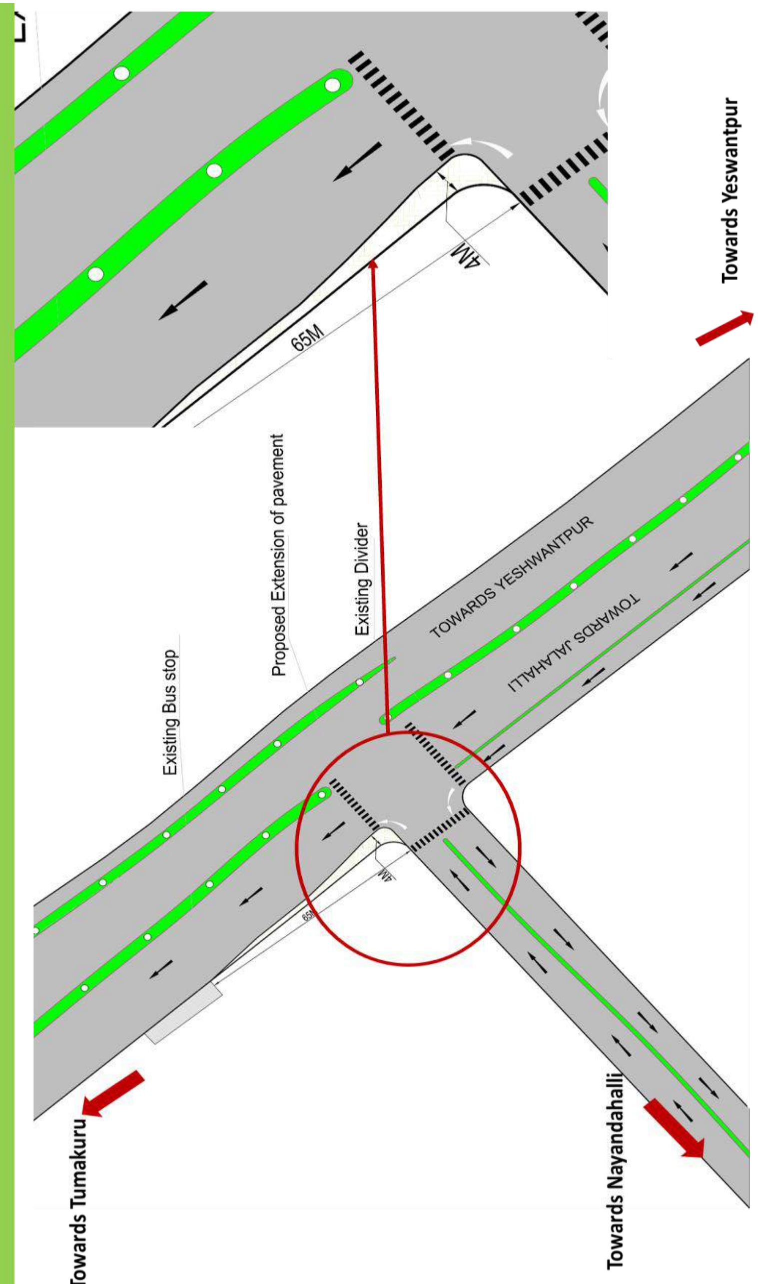


Figure 67. Conceptual Drawing of the Junction at 100ft Outer Ring Road

Multiple Access through Metro Pillars - Peenya Station

This is a good example of negligence engineering by the concerned authorities. It is a major road safety issue due to multiple access provided on the RHS in between the metro pillars (**Figure 68-69**). The vehicles coming from HMT main road can enter any of the openings provided between the metro pillars to reach the NH, resulting in accidents and congestion during the peak hours. These multiple accesses need to be controlled in an engineering way and organised access need to be designed.

Unscientific / dangerous Multiiple access through the Metro Pillars near Peenya Metro Station

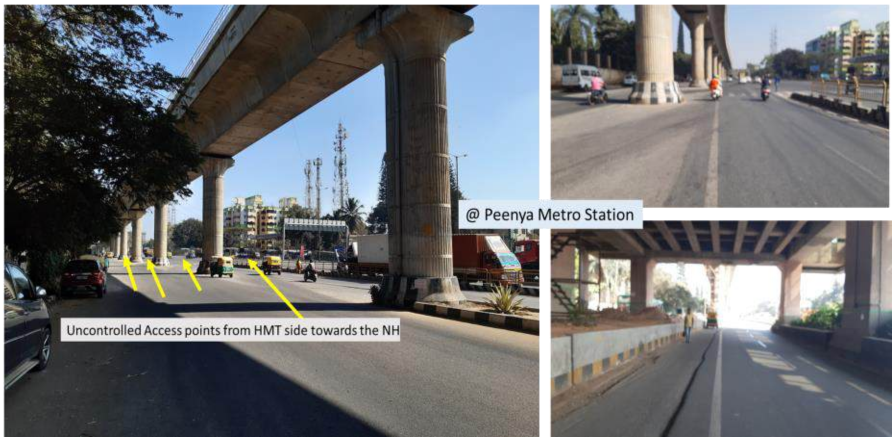


Figure 68. Multiple access points at Peenya Metro station

Detailed observation at this location shows:

- Metro pillars starting from number 401 to 394 are currently opened for access from either side below the metro line, resulting in multiple crisscrossing of vehicles that are very unsafe and results in accidents.
- Three types of Traffic flow patterns are observed at this location - one from the Expressway, the other is the at-grade traffic from Jalahalli side on NH and the last one is the feeder road traffic coming from HMT main road.
- It is measured that the speeds are different on these three different corridors, which is the main reason for accidents during merging and diverging.
- Speeds of the vehicles, which are merging and diverging through these pillars, are more than 60 kmph and in the absence of speed calming measures, the accident rate is increasing at this location.

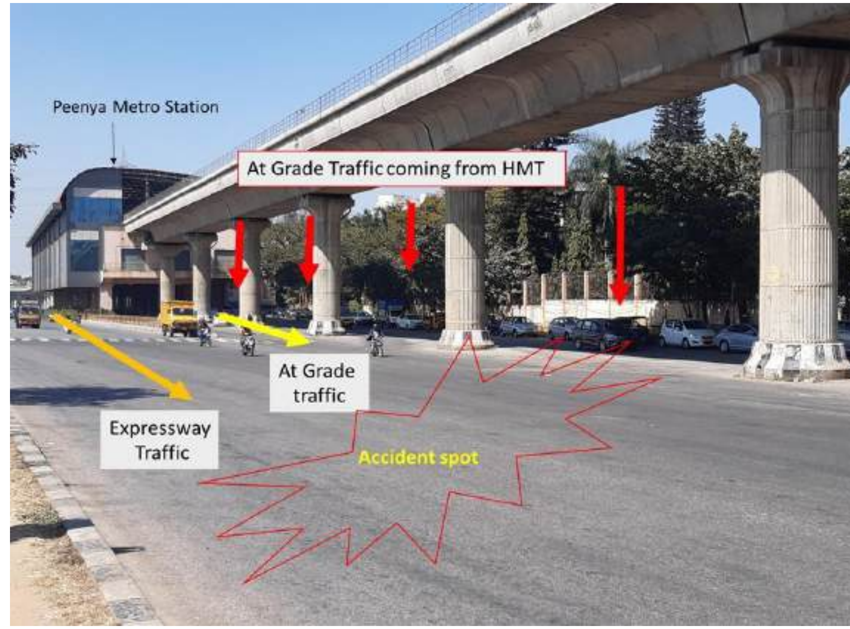


Figure 69. Issues at Peenya Metro Station

Recommendations:

- Access control management is the need of the hour. Access for the vehicles coming from HMT roadside should be given only from pillar number 400 to 398.
- Access should be closed from pillar number 398 to 395 using precast medians.
- Access should be opened from pillar number 395 onwards for the traffic coming from Tumkur side moving towards Yeshwanthpur.
- To control vehicular speeds on all the three roads,

  1.Raised speed breakers should be provided on the service road to control the speeds of vehicles coming from HMT main road.

  2.Thermoplastic 15 mm thick rumble strips should be provided for the road coming from Peenya metro station and for the expressway as per IRC: 99- 2018.

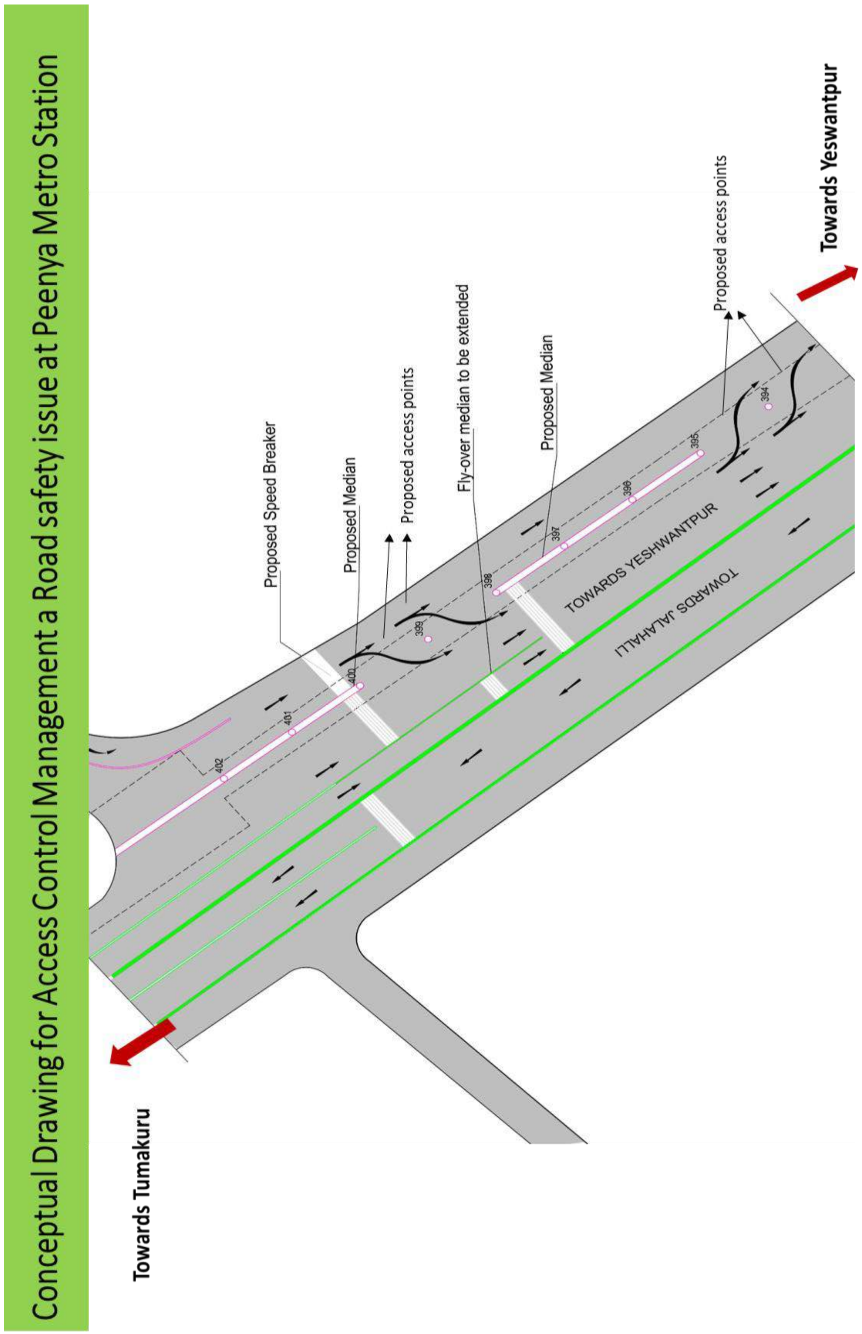


Figure 70. Conceptual Drawing For Access Control Management at Peenya Metro Station

Benefits:

- Safe and controlled access will be achieved.
- Accidents happening due to merging and diverging will be constrained.

SRS Junction – Bottleneck on LHS

It is observed that the road width on the existing service lane on the LHS reduces abruptly, which results in traffic congestion due to the presence of an abutting building. The traffic is choked up at the junction. The detailed observations are as given below (**Figure 71**):

Figure 71. SRS Junction.

- Lane width of the service road reduces from 14 meters to 5 meters in a pan of 10 meters at the junction, thereby increasing the delays at the junction.
- The main carriageway and the service road are divided with railings, which is another reason for the delay at the junction. The vehicles coming on the service road cannot merge on the main carriageway due to these railings and thus vehicles start queuing up leading to severe congestion for a length of about 70 meters.

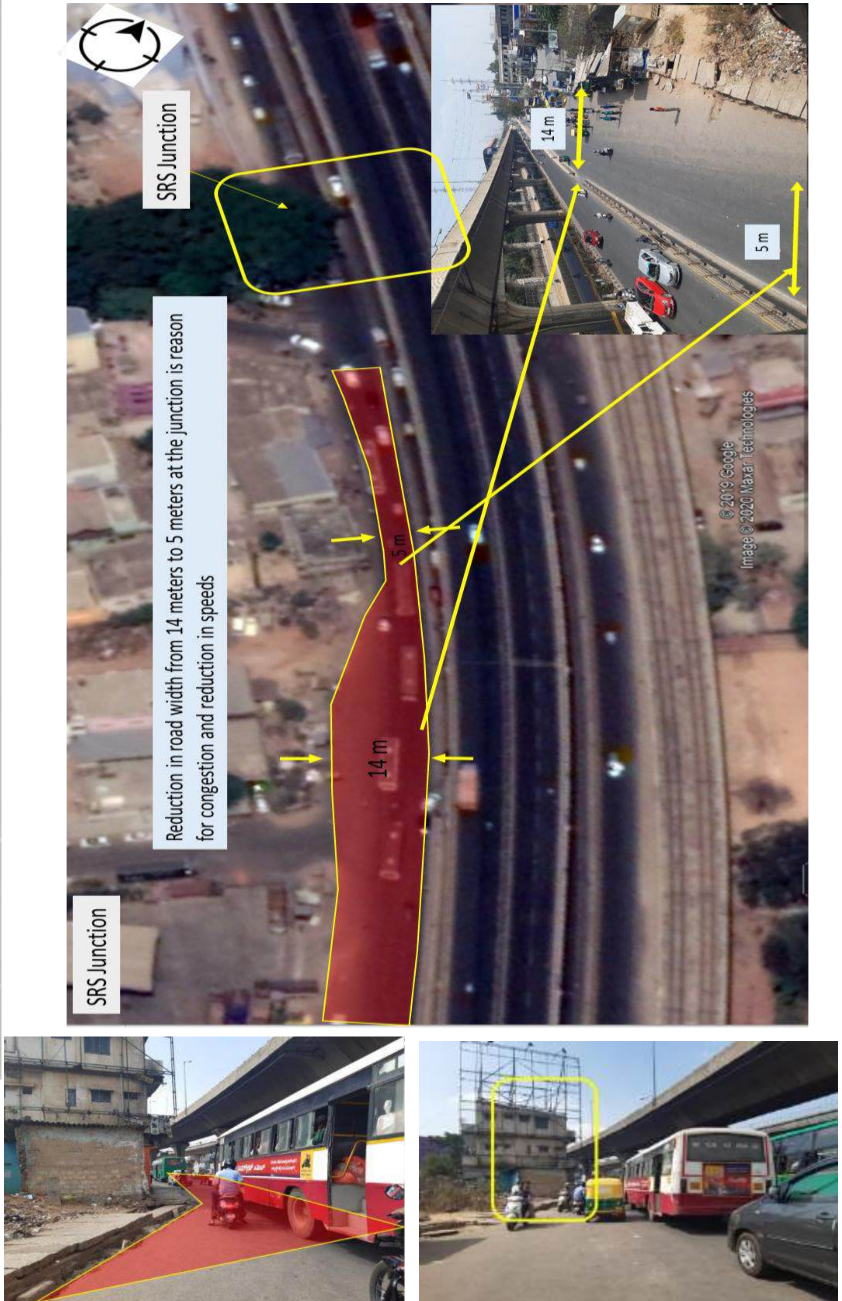


Figure 72. Issues at SRS Junction.

Recommendations:

✓ With the limited scope of land acquisition at the junction, it is proposed that the central median/ railings between the service road and the main should be removed for the length of 80 meters; this will improve the speeds on the corridor.

✓ By opening the mouth of the junction, the congestions will be reduced drastically.

✓ Once the below recommendations are done (**Figure 73**), signal optimization needs to be done with new signal phase timings.

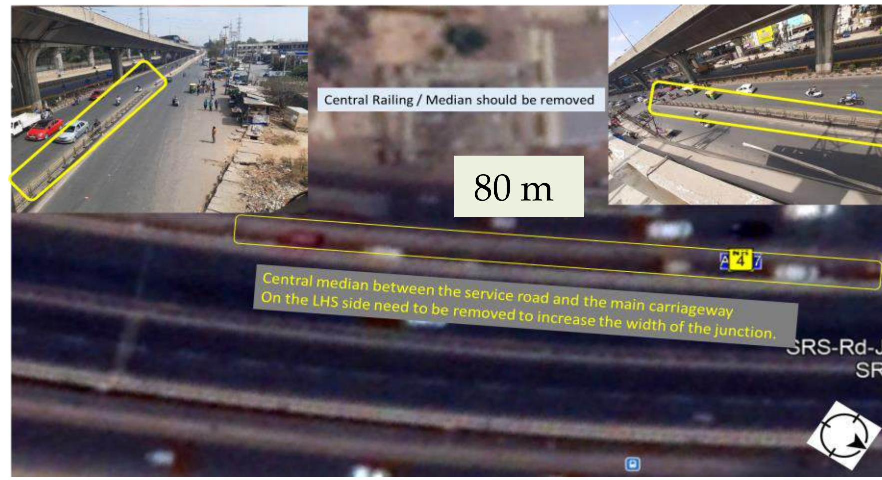


Figure 73. Recommendations for Issues at SRS Junction.

Benefits:

➢ Once the signal optimization is done, signal delays will be reduced drastically.
➢ By opening the mouth of the junction congestions will also get reduced.

Jalahalli Junction – Congestion due to bus stop location

Bus stop layout should enable safe and smooth flow of bus and passengers. At this junction, a bus bay is constructed before the junction to have safe access but negligence from both the commuters and the BMTC buses have resulted in a chaotic situation at the junction.

At Jalahalli junction, it is observed that congestion is occurring due to BMTC and KSRTC buses along with private buses, which are decelerating, stopping and accelerating on the main carriageway as well as on the service road. The service road here is very narrow with a width of 5 meters and the commuters occupy almost 2 metres of the road by standing on the road and occupying the road space.

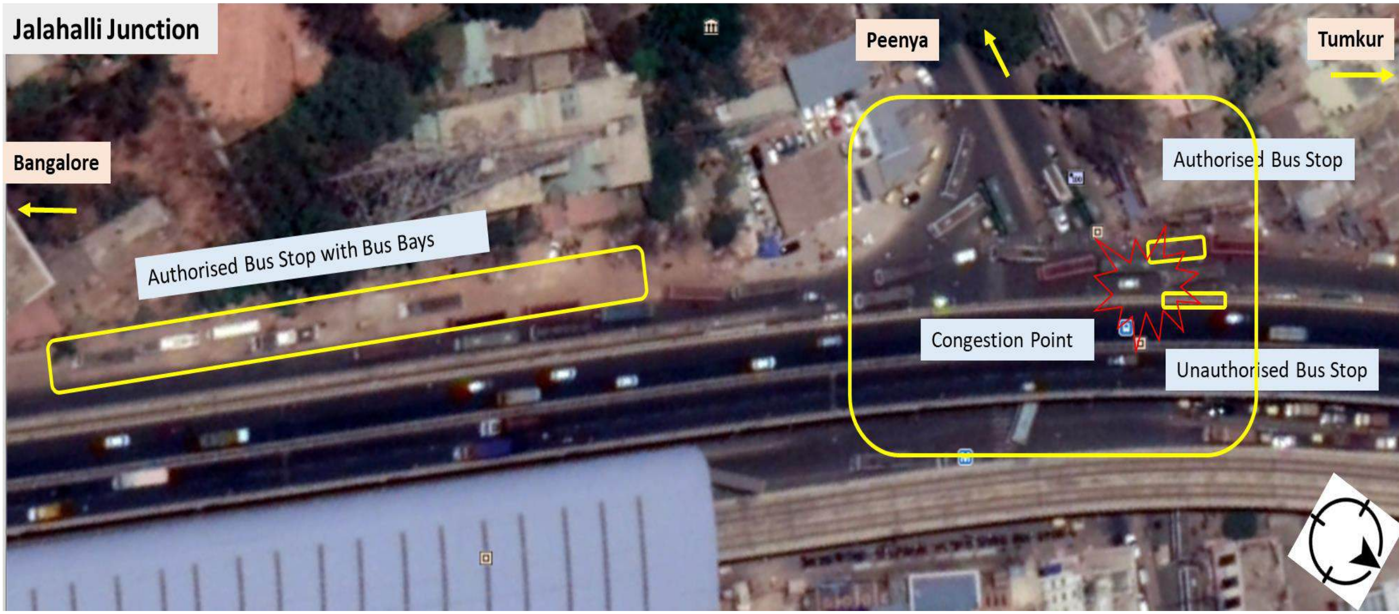


Figure 74. Issues at Jalahalli Junction.

The service road is separated from the main carriageway by railings. Due to acute entry, the buses tend to pile up at the junction and the spill over is observed on the main carriageway. The commuters stop randomly on the service road, at the junction and at the main carriageway making the things even problematic. This situation at Jalahalli junction makes it one of the congested intersections on the study corridor. (**Figure 74-75)**

Figure 75. Issues at Jalahalli Junction.

Recommendations:

- ✓ The railings in-between the service road and the main carriageway need to be removed for a distance of 100 meters, after the junction so that the buses can easily enter the service road.
- ✓ Once the railings are removed, the unauthorised bus stop created on the main carriageway will be eliminated.
- ✓ Existing bus bays should be made to use by enforcement through BMTC and Traffic Police for better functioning.

Recommendations:

- ✓ Since sufficient space is available below the metro alignment, proper space management is required, creating market space for the vendors. This will create more space to accommodate vendors, pedestrians and avoid unauthorized on-street parking which is resulting in traffic congestion. (**Figure 76**)
- ✓ Pedestrian walkways with proper parking facility need to be designed to achieve safe access at vendor zone below the metro pillars.
- ✓ Overall, a well-planned vendor zone with all the facilities needs to be designed and developed to the safe tone of the oldest market of the city. (**Figure 76 & 77**)

Figure 76. Proposed Vendor Zone from Dasarahalli to Jalahalli.

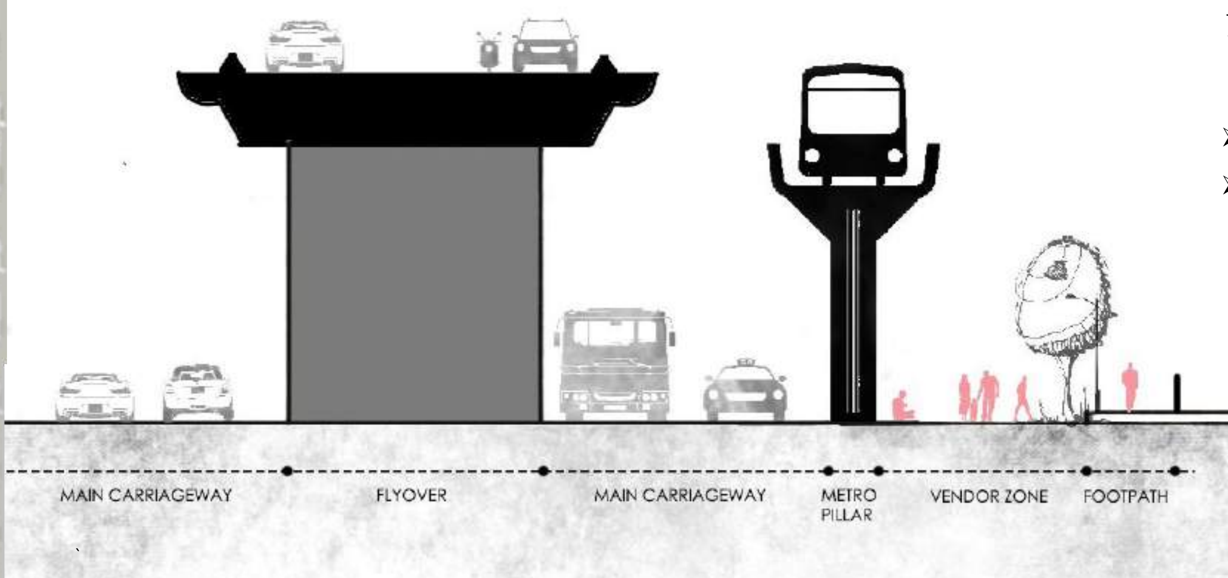


Figure 77. Proposed Vendor Zone Cross section.

Benefits:

- ➢ Congestion free service road.
- ➢ Architecturally well-planned Vendor zone can be developed.

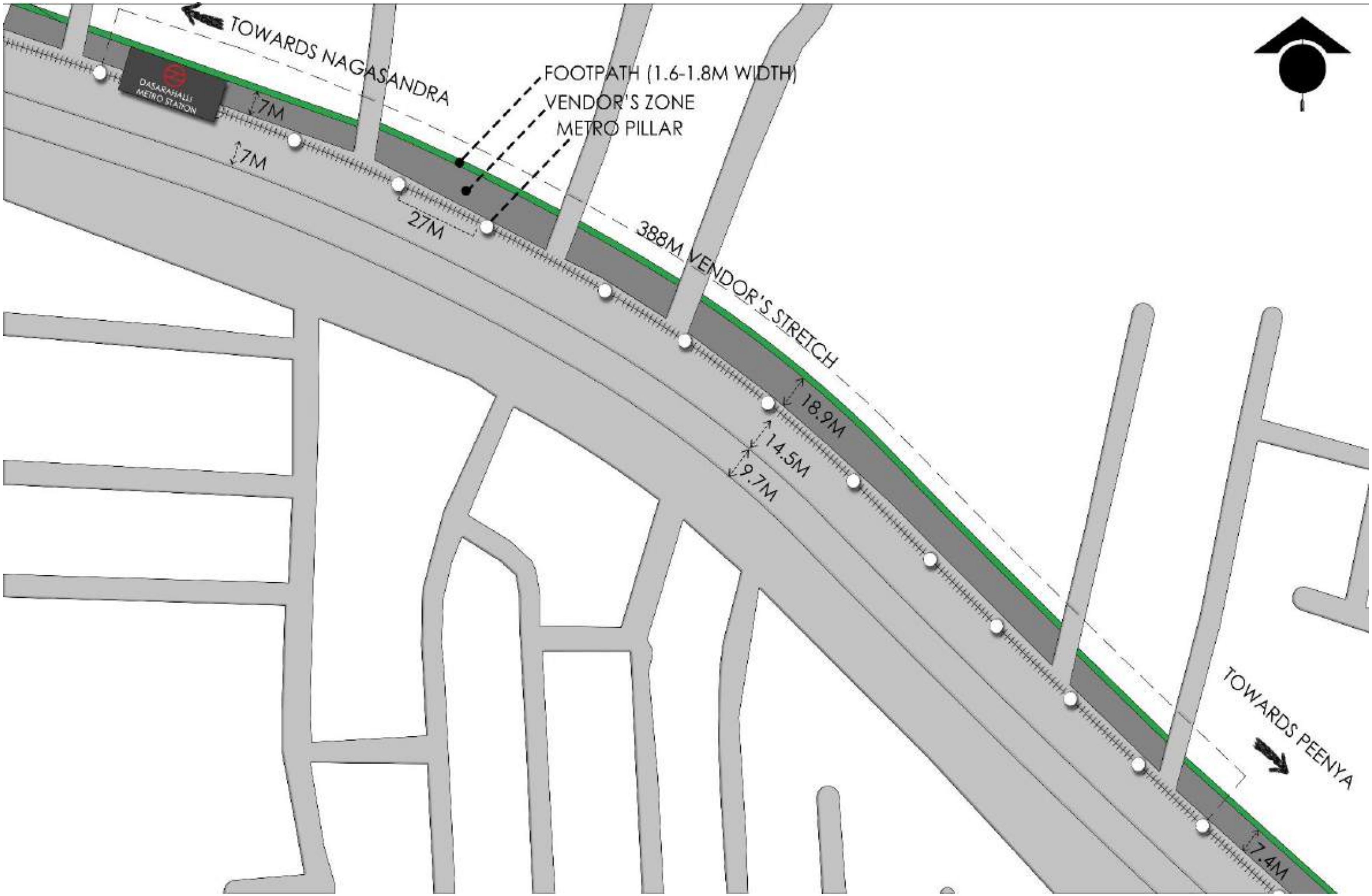


Figure 78. Proposed Vendor Zone from Dasarahalli to Jalahalli.

Issue of Pedestrian Access to Metro Stations Along the Corridor

It is observed that pedestrian safety along the corridor is completely neglected due to which safety of pedestrians at many locations is compromised and many fatal accidents have occurred.

Because none of the metro stations from Peenya to Nagasandra have accessibility for pedestrians from the RHS, as all the metro stations are on the LHS.

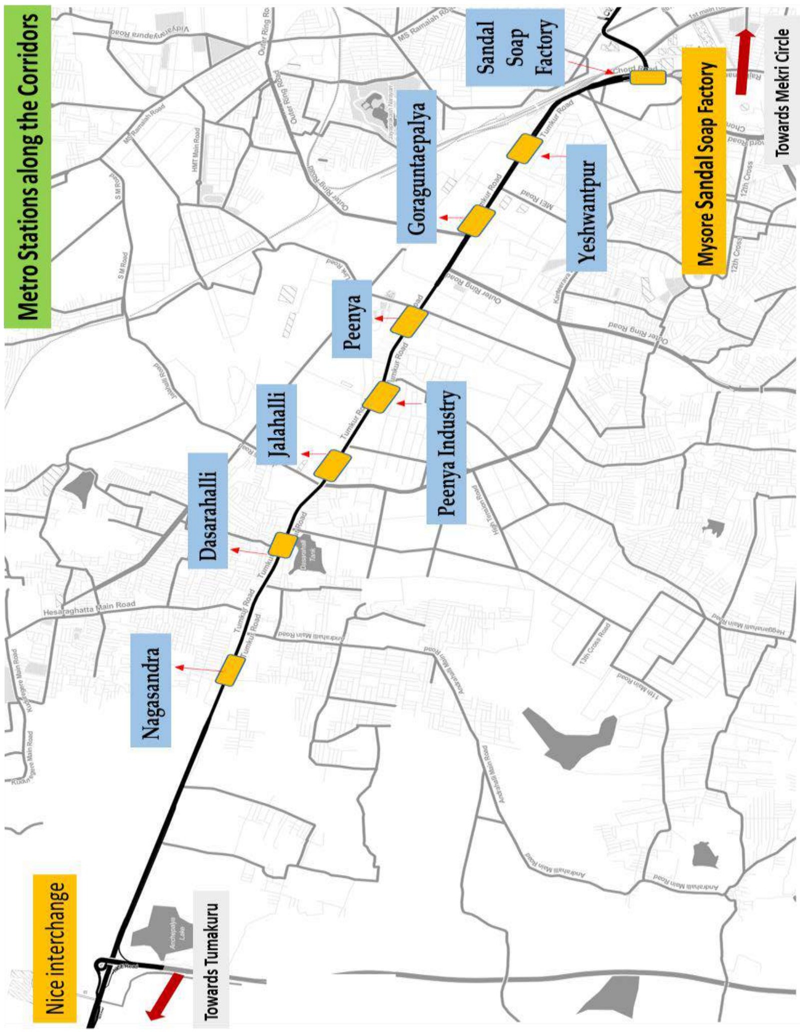


Figure 79. Proposed Pedestrian Skywalks at Metro Stations along the corridor

Recommendations:

It is recommended to construct five pedestrian skywalk facilities to the following metro stations to make sure the commuters can access the metro station safely (**Figure 79**).

1. Peenya Metro station
2. Peenya Industrial Area
3. Jalahalli Metro Station.
4. Dasarahalli Metro station.
5. Nagasandra Metro Station

Figure 80 Proposed Pedestrian Skywalks at Metro Stations along the corridor

Benefits:

- Pedestrians/commuters can access the metro stations safely.
- Metro can generate more ridership.
- Pedestrian – Vehicle crashes can be controlled.

Key Map Issues along Section A of Corridor 1

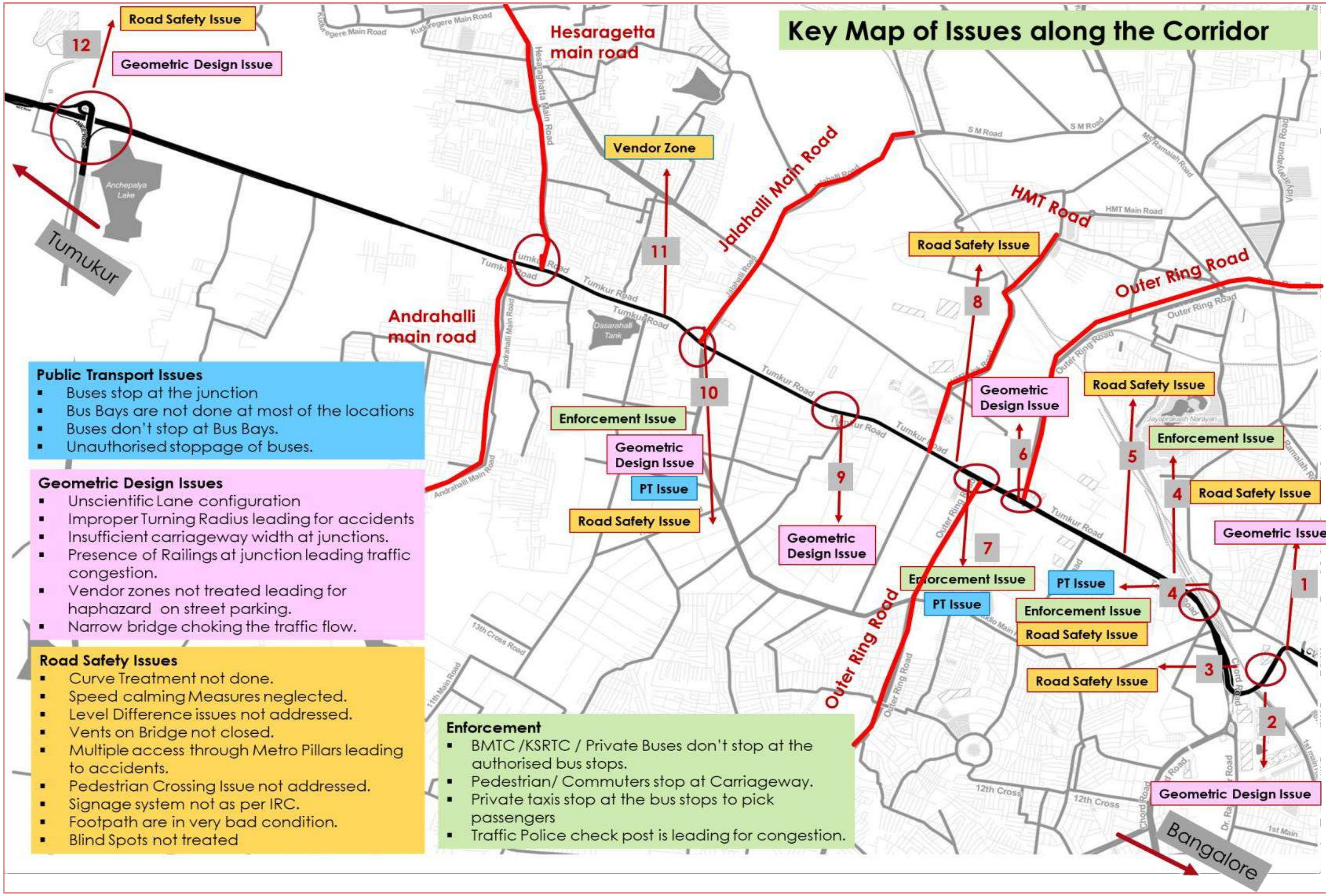


Figure 81. Map showing issues along the corridor.

Corridor 1 Section C: Old Madras Road: From Queens Road Junction to Lowry School Junction

The sixth corridor to be undertaken for the corridor improvement study is the Old Madras Road Corridor, which starts from Queens's Road junction near Mahatma Gandhi Circle to Lowry school Junction near K.R.Puram Bridge. As shown in **Figure 82**

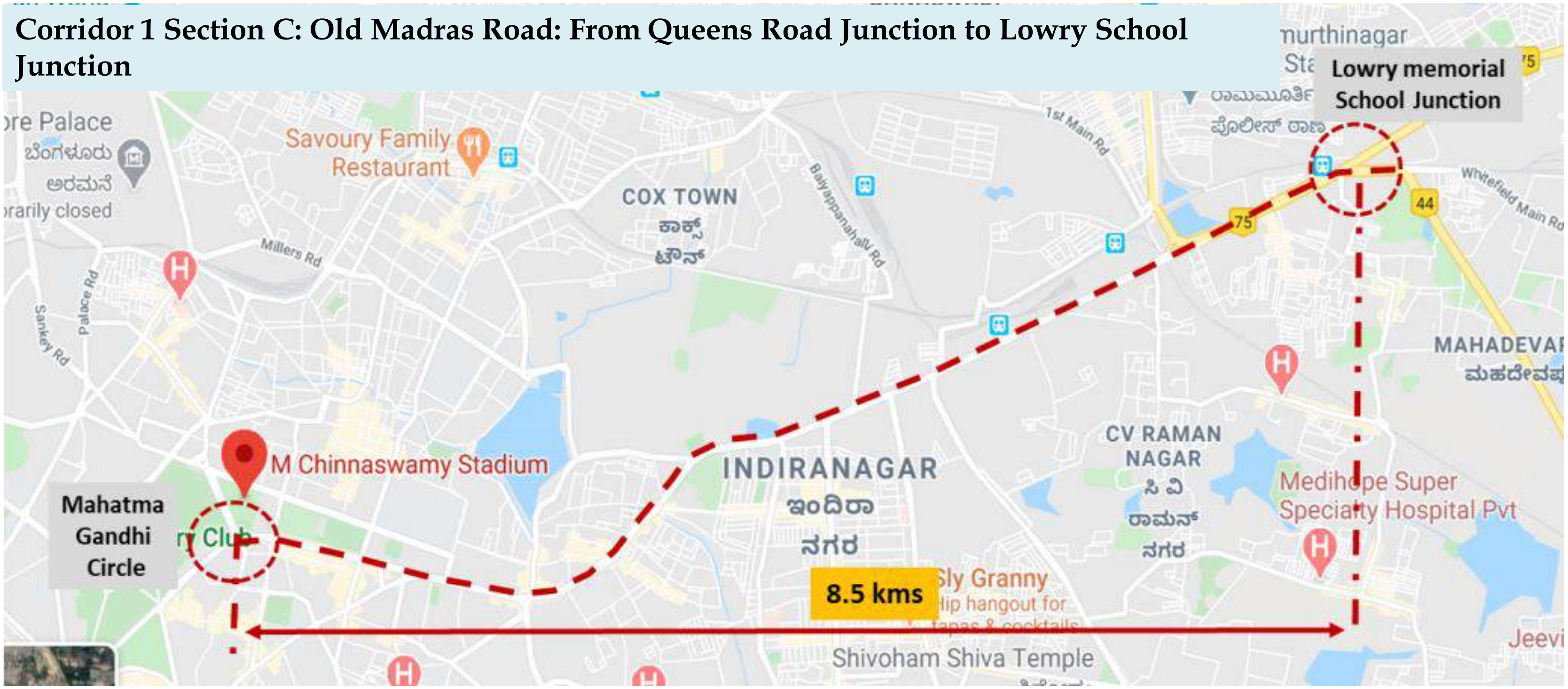


Figure 82 Old Madras Road

It is one of the busiest corridors in the city. It is the major lifeline, which connects central and the east parts of the city. Starting from the core central areas like M.G Road, Lavelle road, Cubbon park in the center to Baiyappanahalli, K.R Puram in the east.
Some of the main features of the corridor are:

•This corridor starts as a Sub Arterial road from M.G Road until Murphy road and ends as Arterial road, ,from Murphy road till K.R. Puram. The lane widths vary from 4 lanes to 6 lanes divided two way.

•Length of the study corridor is 8.5 km.

•The road surface is varying from bituminous.

•There are thirteen signalized junctions along the corridor.

•Metro Rail runs along the corridor from Anil Kumar Circle to Baiyappanahalli. At the same time stretch from Lowry junction to Tin Factory Metro is under construction.

Landmarks, Attraction & Production Centers

The corridor attracts many work trips due to the presence of commercial establishments, Government Office, Hotels, Movie theatres, Malls, Parks etc. **Figure 83**

The corridor houses many major attraction points such as:

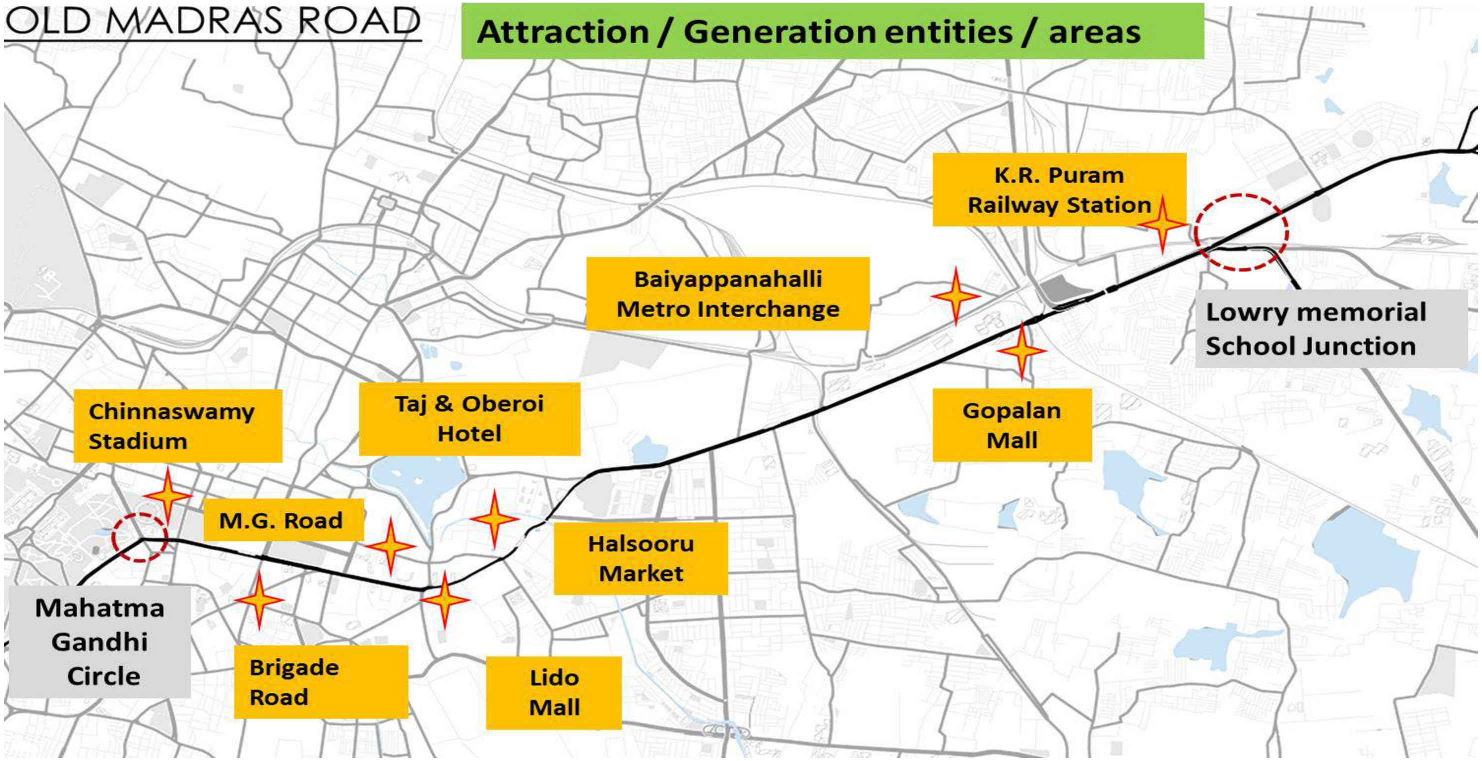


Figure 83. Attraction/ Generation Entities/ Areas

- One of the biggest and famous shopping streets of the city, i.e. M.G Road and the Brigade road are is located on this corridor.
- One of the oldest and biggest parks i.e. Cubbon Park is located along the corridor.
- The corridor also houses heritage and important structures like St Mark's Cathedral, LIC Building, Utility Building, Hard Rock Café, Holy Trinity Church etc.
- Prominent government institutions like LIC, Cauvery Emporium, Civil Courts, KUIDFC etc. are on the corridor.
- The corridor also has the famous Chinnaswamy Cricket Stadium, which attracts lot of trips during the matches.
- The corridor and the areas adjacent to the study corridor houses various have Star Hotels like Taj, Oberoi, Conrad, The Park, The Chancery etc.

The landmarks mentioned above attract huge trips on both weekdays as well as on weekends.

LIC Building on M.G. Road

Hard Rock Cafe on M.G. Road

Figure 84. Attraction/ Generation Entities/ Areas photographs

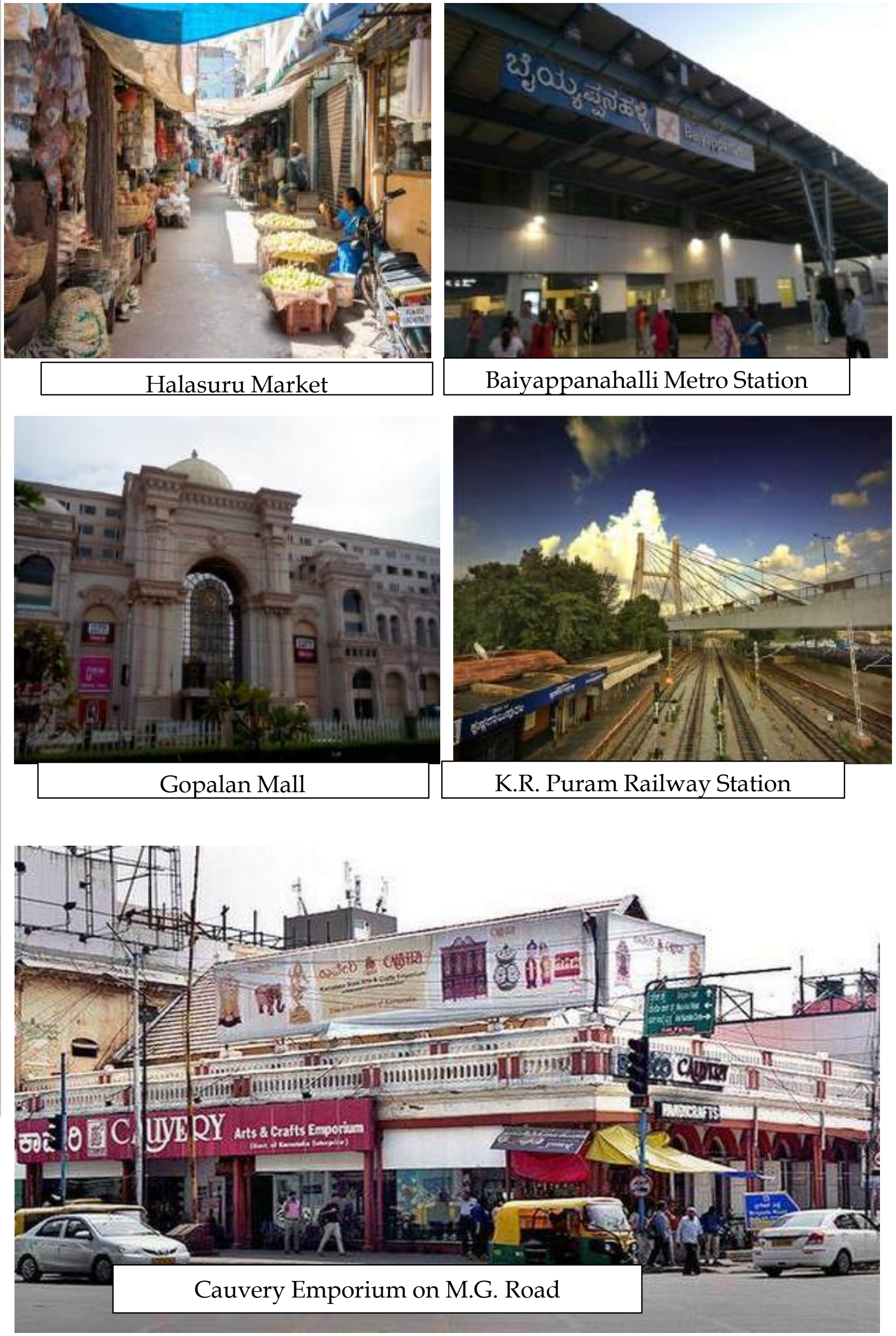


Figure 85. Attraction/ Generation Entities/ Areas photographs

Figure 86. Attraction/ Generation Entities/ Areas photographs

Major Bus Stops along the Corridor

There are seventeen bus stops located along the corridor. Dedicated bus bays are designed near Baiyappanahalli metro station and Tin Factory and at the remaining bus stops, there are no bus bays. The absence of bus bays results in buses stopping on the carriageway itself. Thus resulting in traffic congestions. All the Bus Stop locations are as shown in the **Figure 85-87**

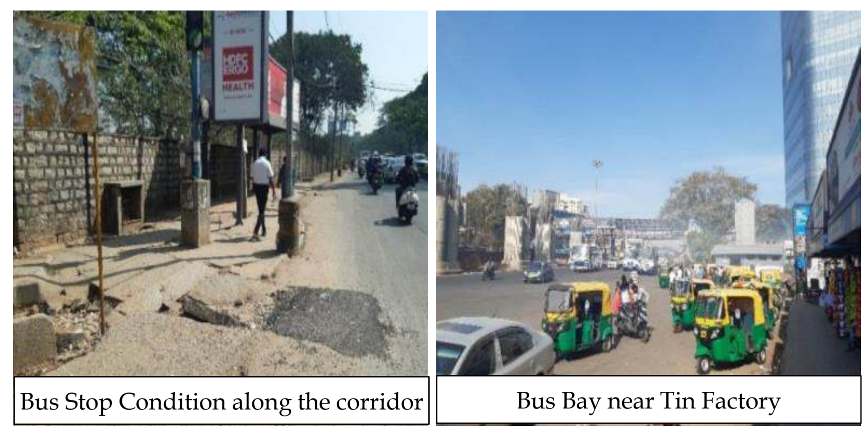


Figure 87. Bus Stop Condition

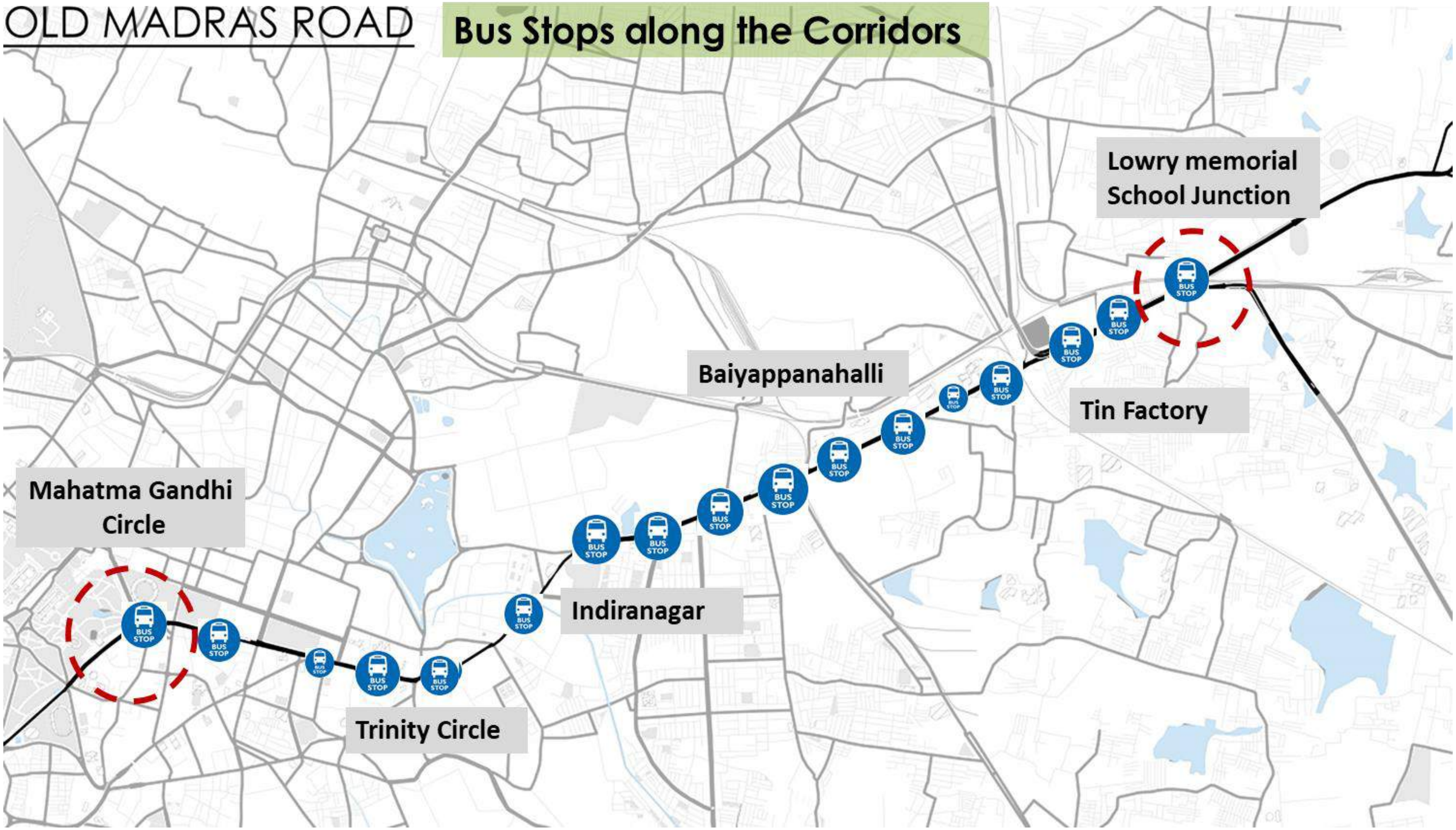


Figure 88. Bus Stops Along Corridor

Corridor Characteristics

The entire corridor is a varying from 4 Lane to 6 lane two way divided with footpath on either side. The entire corridor surface is bituminous and the condition of the road surface is good.
It is also observe that for a small stretch from Halasuru Police station to Old madras road near Bharath Petrol Bunk the footpath condition is not good. As shown in **Figures 89.**


@ Vivekananda Metro Station


@ Halasuru Police Station


@ Baiyappanahalli


@ Vivekananda Metro Station


@ Tin factory Interchange


@ K.R.Puram Hanging Bridge


@ Baiyapanahalli Metro Station


@ Halasuru

Figure 90 Corridor Characteristics


M.G. Road


@ Trinity Metro Station

5 Existing Footpaths/Pedestrian Facilities

It is observed that on certain stretches of road, footpath condition is good but on majority of the locations, the condition of the footpath is poor. The pedestrian facilities along the corridor are largely neglected. There is are only It is observed that on certain stretches of road, footpath condition is good but on majority of the locations, the condition of the footpath is poor. The pedestrian facilities along the corridor are largely neglected. There are only two pedestrian skywalks along entire corridor. Footpaths are encroached upon near the Halasuru Market area two pedestrian skywalks along entire corridor.
Refer **Figure 91**


Near K.R. Puram Skywalk


Near Vivekananda Metro Station


At grade Pedestrian Crossing near Benniganahalli

Figure 91. Existing footpaths/pedestrian facilities

Swamy Vivekananda Road

Near KUIFDC

Near Halasuru Metro station

Near Mayo Hall

Near Indiranagar Bus Depot

Near old Madras road, Indiranagar Police Station

Figure 92. Existing footpaths/pedestrian facilities

6 Major Junctions

There are nine major intersections where maximum merging and diverging of the traffic takes place. The major intersections are as shown in **Figure 93** and mentioned below:

1. Mahatma Gandhi Circle- 4 arm Signalized intersection.
2. Anil Kumar Circle– 4 arm Signalized intersection.
3. Electronic B. Bus stop Circle – 3 arm Signalized intersection.
4. Trinity Circle- 4 arm Signalized intersection.
5. Halasuru Police Station Circle- 4 arm Signalized intersection
6. Indiranagar Double Road Junction – 3 arm Signalized intersection.
7. Suranjandas Road Junction -3 arm signalized intersection.
8. Benniganahalli Junction – 3 arm signalized intersection.
9. K.R. Puram Junction - 3 arm signalized intersection.

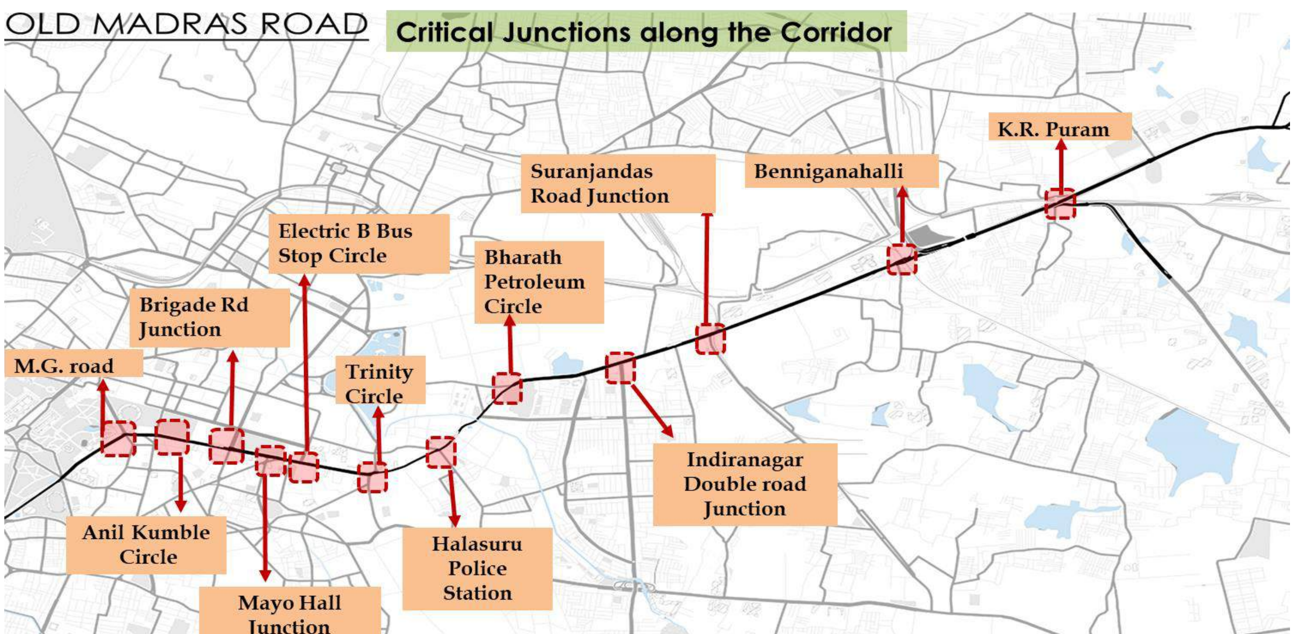


Figure 93. Critical junctions along old madras road

7 Signage/ Markings/ Signals

The corridor lacks right signboards at the right locations; the signboards do not have good foundation and most of the signboards are either damaged or not relevant to the site. Sign boards are installed on the shoulders which is very dangerous for the road users. Road safety aspects are also ignored along the corridor largely, which is of major concern. Some of the safety issues are shown in **Figure 330:**

Signboard fixed on shoulders

Poor Foundation

Sign Board not as per IRC near Trinity Circle

Damaged Road Surface near Baiyappanahalli

Median End Treatment not done

Water Valve is projected out dangerously

Signboard Installed on Shoulder and fallen due to Poor foundation

Pedestrians Jumping the central Median to cross the road

Irrelevant Sign Board in the middle of the road

Figure 94. Signage/ marking/signals

• Pedestrian crossings are completely neglected at certain stretches of the corridor. Especially near Benniganahalli RoB where people are seen jumping the central median and crossing the road, which is resulting in pedestrian vehicle conflicts. There is no pedestrian crossing facility available at this location thereby compromising on the pedestrian safety. **Figure 95**

Figure 95. Pedestrian crossing

- Pedestrian crossing facility is provided at two only two locations -, one of the locations is the very critical i.e. at K.R Puram bridge and is serving the its purpose of, which is reducing the pedestrian vehicle conflicts and reducing the pedestrian fatalities.
- Expect Except at two locations, none of the bus stops have the bus bays designed along the corridor, thus the commuter safety is compromised. Absence of bus bays is adding up to buses stopping on the carriageway leading to congestion during the peak hours.
- Road markings are missing for the entire corridor stretch. Especially, on old Madras road, Swami Vivekananda Road. In the absence of road markings, traffic discipline cannot be attained.
- Road safety furniture like cat eyes, solar blinkers are missing all along the corridor, which are required for safe access during night.
- Road surface at certain points is very bad resulting in two-wheeler skidding, which might be fatal, especially at near Baiyappanahalli, Halasuru Metro station.
- Footpaths are in very bad condition, which need to be rectified on priority; especially on Swami Vivekananda Road, the granite slabs damaged. **Figure 96**

Figure 96. Damaged road

Figure 97 Damaged footpaths slabs

8 Land Use along the Corridor

It is observed that majority of the land use pattern along the corridor is commercial and defence land. It is also observed that most of the existing residential land uses have been used for commercial purposes as shown in **Figure 98.**

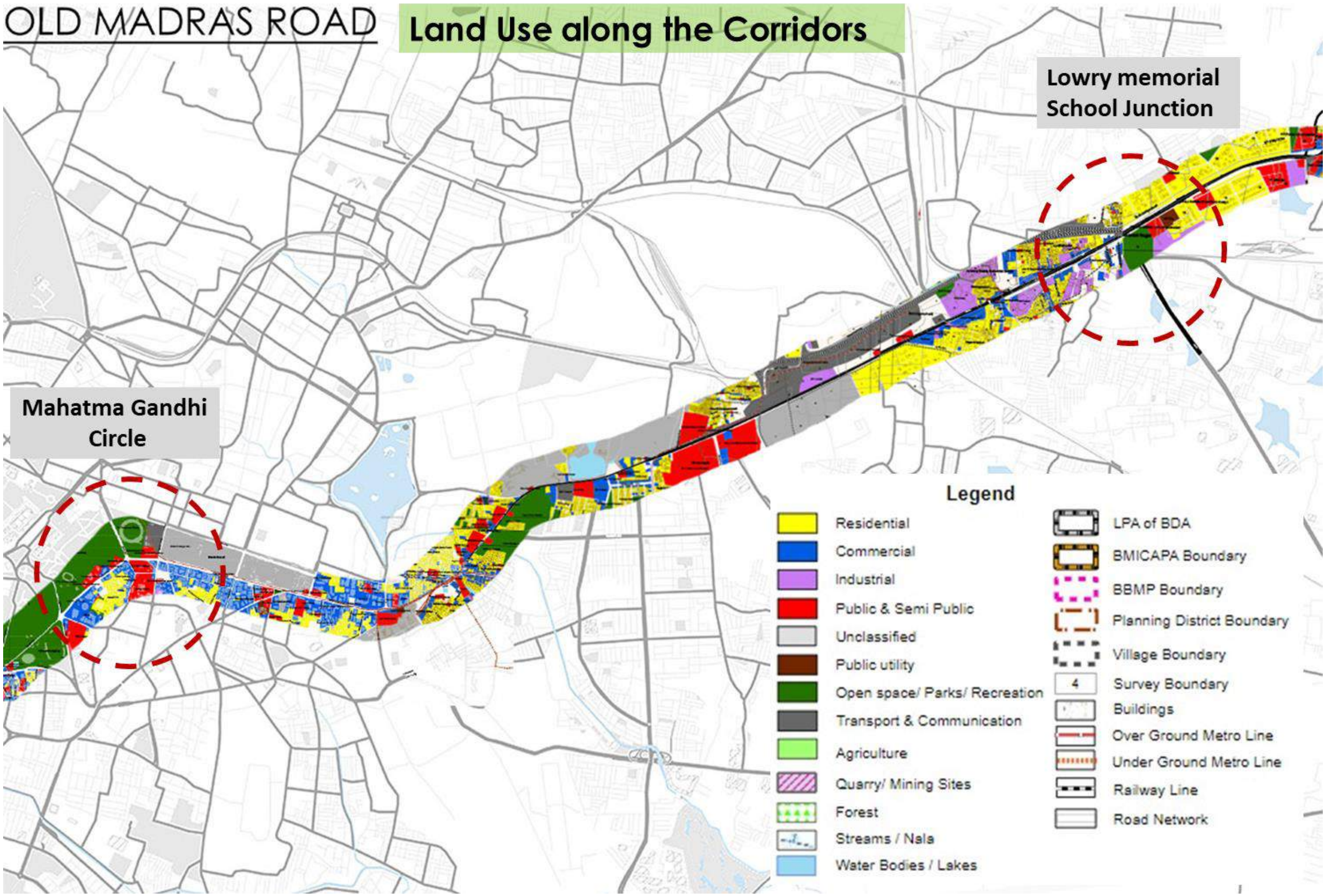


Figure 98. Land use along old madras road

Traffic Survey Details

In order to assess the existing traffic and transport characteristic of the corridor and to decide on the type of traffic management measures needed, traffic surveys were carried out. The survey particulars are as presented in the following paragraphs **Figure 99** and **Table 20**

Table 20. Study Corridors For Traffic Surveys

Sl.No	Type of Survey	Quantity
1	Turning Volume Count	8 Intersections
2	Mid-block Count	1 Location
3	Pedestrian Count Survey	8 Intersections
4	Speed And Delay (Bus & Car)	8.5Km
5	Road Network Inventory	8.5 Km
6	Traffic Signal Phasing	7 intersections

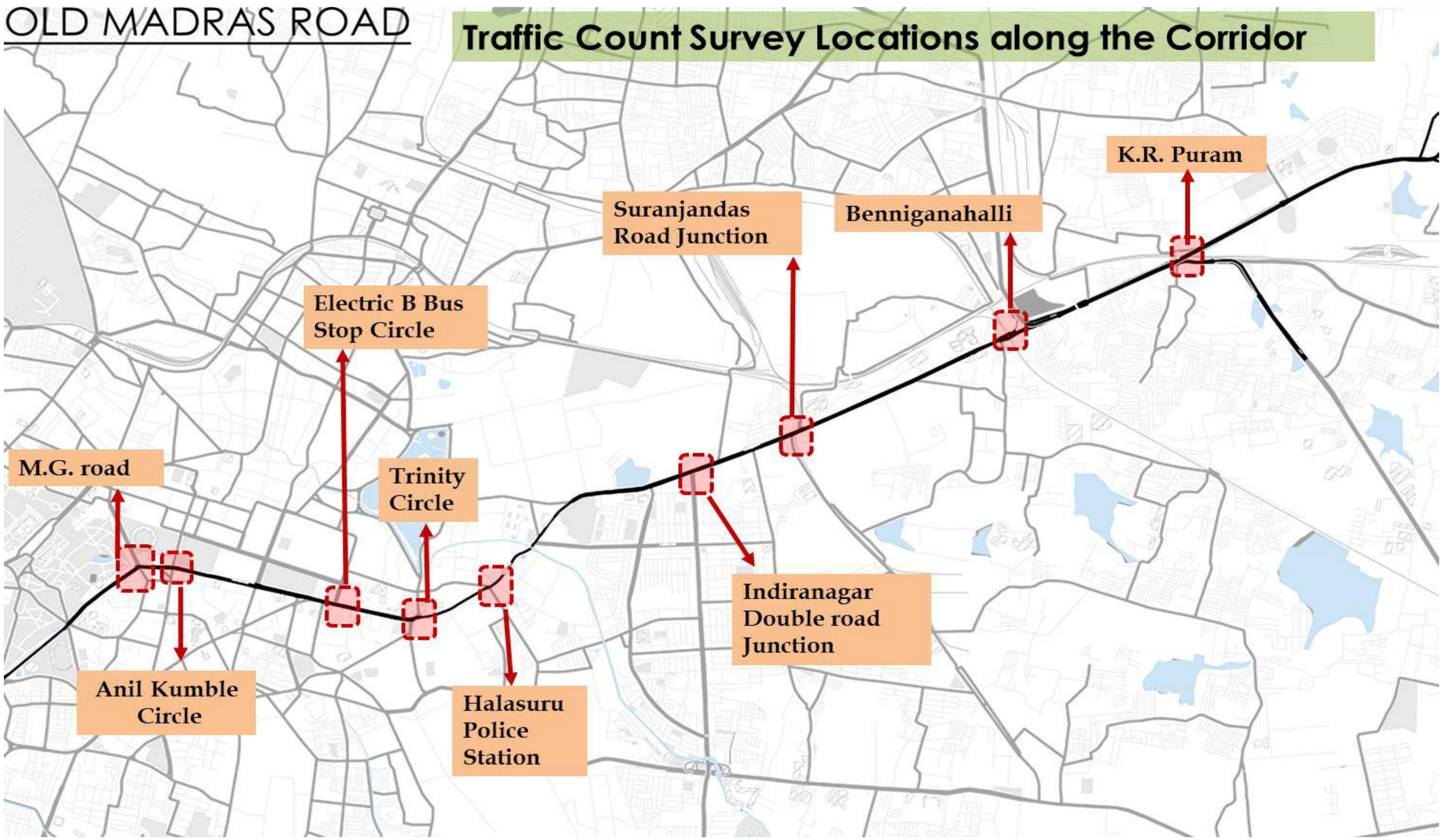


Figure 99. Traffic survey locations

Traffic Volume Counts

Traffic volume count survey was conducted at one Mid-block location and for the remaining stretches traffic volumes were extracted from the turning volume counts conducted along the corridor. The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. The PCUs corresponding to urban roads as per Highway Capacity Manual were used and the Peak Hour Traffic Volumes are as presented in **Table 21**.

Table 21. Traffic volume count

Sl. No	Road Name	Morning Peak Hour	Morning Peak Hour Volume				Evening Peak Hour	Evening Peak Hour Volume			
			Towards K.R Puram		Towards M.G Road			Towards K.R Puram		Towards M.G Road	
			Vehicles	PCUs	Vehicles	PCUs		Vehicles	PCUs	Vehicles	PCUs
1	Between Mahatma Gandhi Park Junction and Anil Kumble Circle	10.15-11.15	2958	1998.08	5807	4272.69	19.30-20.30	2932	1978.62	5814	4206.64
2	Between Anil Kumble Circle and Kamraj Road Junction	11.00-12.00	3351	3445.73	6307	5686.42	19.00-20.00	3191	3497.22	6261	6193.46
3	Between Kamraj Road Junction and Dikenson Road Junction	10.45-11.15	3234	2117.68	5137	3661.55	18.45-19.45	3234	2117.68	5137	3661.55
4	Between Dikenson Road Junction and Trinity Circle	11.00-12.00	5614	4313.3	4715	3896.74	18.30-19.30	5934	4354.73	4607	3744.35
5	Between Trinity Circle and Halasuru Junction	11.00-12.00	4118	3144.52	5078	3768.61	18.30-19.30	4891	3262.83	5185	3887.77
6	Between Halasuru Junction and CMH Road Junction	10.00-11.00	4311	2410.15	3205	2114	19.30-20.30	4266	2453.06	3215	2125.54
7	Between CMH Road Junction and Murphy Road Junction	11.00-12.00	1624	1281.12	1827	1238.02	19.30-20.30	1654	1226.22	1890	1225.56
8	Between Murphy Road Junction and Indiranagar Double Road Junction	11.00-12.00	3841	3177.42	3718	2535.38	19.30-20.30	3863	3086.31	3806	2478.01
9	Between Indiranagar Double Road Junction and Binnamangala Junction	9.15-10.15	4730	3241.87	5817	4599.22	18.15-19.15	4618	3186.53	5693	4304.6
10	Between Binnamangala Junction and Suranjandas Road Junction	9.15-10.15	4248	3317.58	4382	3645.37	18.15-19.15	4174	3215.58	4265	3398.23
11	Between Suranjandas Road Junction and Varthur Road Junction	10.15-11.15	4131	3726.29	4091	3529.36	19.30-20.30	4308	3802.55	4107	3563.31
12	Between Varthur Road Junction and Tin Factory	9.15-10.15	3016	4836.01	6062	7564.58	17.30-18.30	2778	4153.45	5849	7733.36

Among the 12 Mid-Block locations, traffic volume between Dickenson road junction and Trinity Circle is found to be the highest with 5614 PCUs during Morning peak hour and 5934 PCUs during evening peak for the same location.

Volume to Capacity Ratio (V/C) and Level of Service

Volume to Capacity Ratio (V/C Ratio) is defined as the ratio of peak hour traffic flow rate to capacity and Level of Service (LOS) is defined as the a qualitative measure, describing operational conditions within a traffic stream and their perception by the drivers/passengers.

Universally, LOS is lettering scheme ranging from A to F. LOS 'A' represents highest quality of service whereas LOS 'F' represents heavily congested flow where traffic demand exceeds capacity. The service measures used for defining LOS are density and volume-to-capacity ratio.

For computation of V/C Ratio the capacity values have been adopted based on the road geometrics by applying adjustment factors ***(as per Indo Highway Capacity Manual 2012-2017)*** conforming to the site conditions.

Adjustment Factors

Several factors would have impact on traffic movement and on capacity as compared to the base section. The factors considered for assessment of influence on capacity include on-street parking manoeuvres; entry and exit of vehicles from access road and bus pull in and pull out manoeuvers in bus bays as well as access points.

The level of friction is categorized as low, medium and severe based on the extent of resistance or speed reduction to the flow as compared to base sections. The capacity of the urban road section is computed using the equation:

$$\mathbf{C = C_o * F_{OP} * F_{BS} * F_{AC}}$$

Where,

C= Actual Capacity (PCU/hr)

C_o = Base Capacity for Ideal Condition (PCU/hr)

F_{OP} = Adjustment Factor for On-street Parking

F_{BS} = Adjustment Factor for Bus Stops

F_{AC} = Adjustment Factor for Access Point

It was observed that due to kerb side bus stops the effective road available for movement of other vehicles in the traffic stream reduces resulting in the capacity reduction

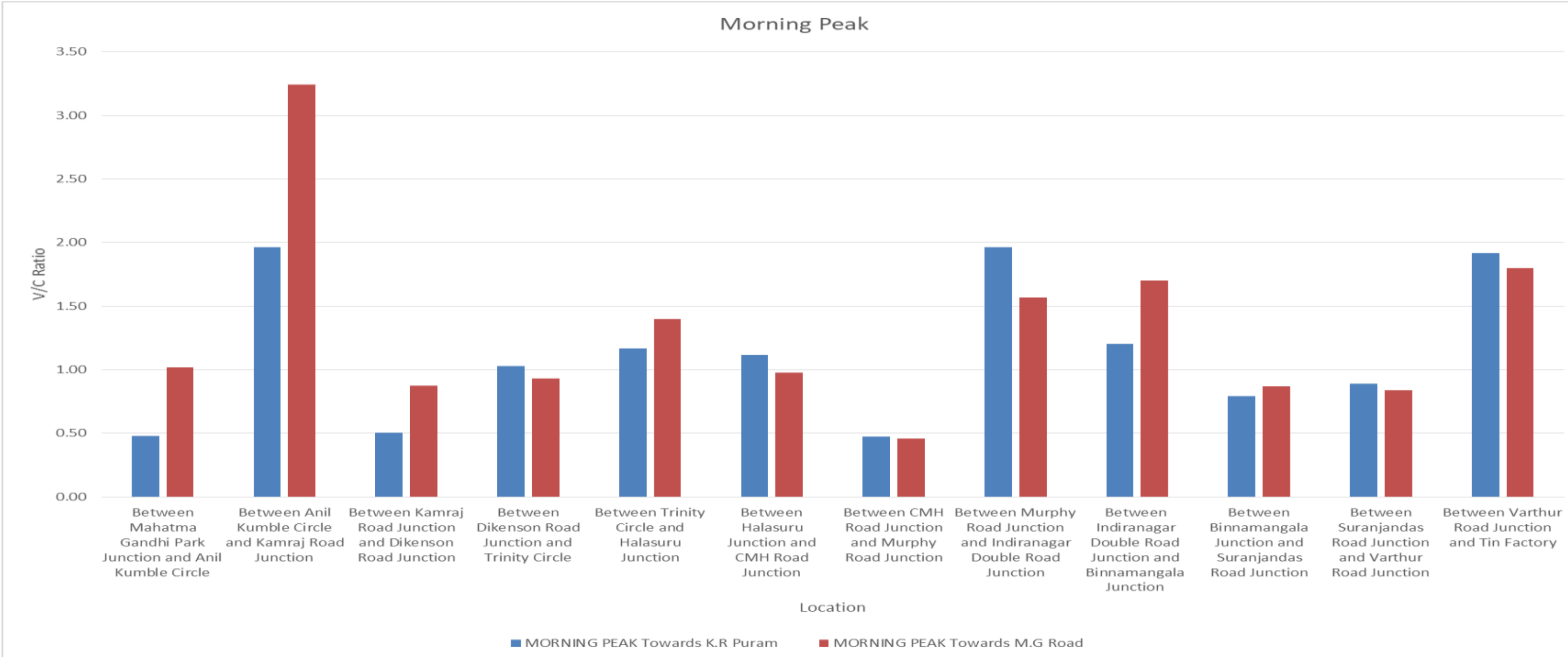
As the level of friction due to kerb side bus stops is high (frequency of buses>30) the adjustment factor of 0.6 is considered to compute the actual capacity.

It was also observed that due to on-street parking between Anil Kumble Circle and Brigade Road Junction there is considerable reduction in road capacity and the stream speed of traffic flow. As the percentage of intensity in terms of parking segment length occupied is around 50%, the adjustment factor of 0.65 is considered to compute the actual capacity for this stretch.

The ratio of peak hour traffic flow rate to capacity (V/C Ratio) and the Level of Service (LOS) of the road sections along Old Madras Road Corridor are presented in **Table 22**

Table 22. Volume to Capacity Ratio and Level of Service

Sl. No.	Road Name	Typology of Road	Capacity*		Morning Peak						Evening Peak					
					Morning Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*		Evening Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*	
			Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road
1	Between Mahatma Gandhi Park Junction and Anil Kumble Circle	6 Lanes	4200	4200	1998.08	4272.69	0.5	1.0	LOS C	LOS F	1979	4207	0.5	1.0	LOS C	LOS F
2	Between Anil Kumble Circle and Kamraj Road Junction	4 Lane	1755	1755	3445.73	5686.42	2.0	3.2	LOS F	LOS F	3497.22	6193.46	2.0	3.5	LOS F	LOS F
3	Between Kamraj Road Junction and Dikenson Road Junction	6 Lane	4200	4200	2118	3662	0.5	0.9	LOS C	LOS E	2118	3662	0.5	0.9	LOS C	LOS E
4	Between Dikenson Road Junction and Trinity Circle	6 Lane	4200	4200	4313.3	3896.74	1.0	0.9	LOS F	LOS E	4354.73	3744.35	1.0	0.9	LOS F	LOS E
5	Between Trinity Circle and Halasuru Junction	4 Lane	2700	2700	3144.52	3768.61	1.2	1.4	LOS F	LOS F	3262.83	3887.77	1.2	1.4	LOS F	LOS F
6	Between Halasuru Junction and CMH Road Junction	3 lane	2160	2160	2410.15	2114	1.1	1.0	LOS F	LOS E	2453.06	2125.54	1.1	1.0	LOS F	LOS E
7	Between CMH Road Junction and Murphy Road Junction	4 Lane	2700	2700	1281.12	1238.02	0.5	0.5	LOS C	LOS C	1226.22	1225.56	0.5	0.5	LOS C	LOS C
8	Between Murphy Road Junction and Indiranagar Double Road Junction	4 Lane	1620	1620	3177.42	2535.38	2.0	1.6	LOS F	LOS F	3086.31	2478.01	1.9	1.5	LOS F	LOS F
9	Between Indiranagar Double Road Junction and Binnamangala Junction	4 Lane	2700	2700	3241.87	4599.22	1.2	1.7	LOS F	LOS F	3186.53	4304.6	1.2	1.6	LOS F	LOS F
10	Between Binnamangala Junction and Suranjandas Road Junction	6 Lane	4200	4200	3317.58	3645.37	0.8	0.9	LOS D	LOS E	3215.58	3398.23	0.8	0.8	LOS D	LOS D
11	Between Suranjandas Road Junction and Varthur Road Junction	6 Lane	4200	4200	3726.29	3529.36	0.9	0.8	LOS E	LOS D	3802.55	3563.31	0.9	0.8	LOS E	LOS D
12	Between Varthur Road Junction and Tin Factory	6 Lane	2520	4200	4836.01	7564.58	1.9	1.8	LOS F	LOS F	4153.45	7733.36	1.6	1.8	LOS F	LOS F



Volume to Capacity Ratio (V/C) ***along Old Madras Road Corridor***

It can be observed that the traffic approaching at all the locations (except between CMH Road Junction and Murphy Road Junction) exceeds beyond the road capacity resulting in considerable delay and queuing. **Figure 100.**

The volume to capacity ratio at most of the stretches of roads exceeds 1.0 and the Level of Service is found to Vary between 'E' and 'F' which indicates heavily congested flow where traffic demand exceeds capacity.

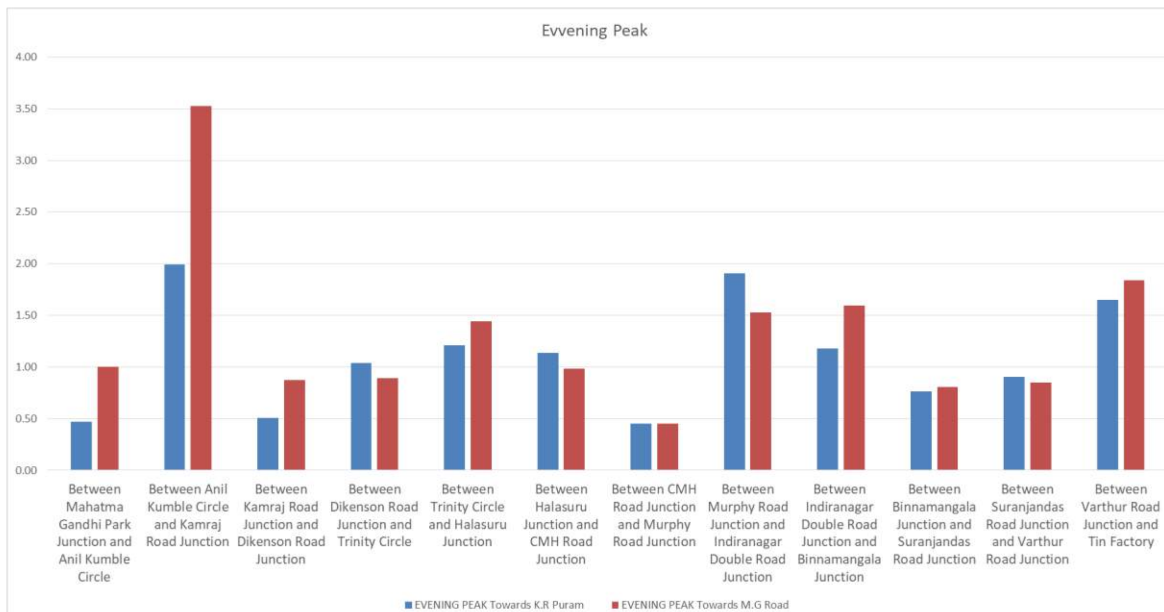


Figure 100 Volume to Capacity Ratios for Morning and Evening Peaks

Traffic Volume at Junctions

The traffic volumes at intersections help in assessing the traffic volumes at mid-block locations of the arms of the intersection which together with journey speed and road inventory data aid in evaluating the Level of Service (LOS) of Urban Arterials and further, the traffic volumes at mid-block also establishes the need for safe pedestrian crossing facility taking into account the pedestrian crossing volumes.

The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. **Table 23**

Table 23. Peak hour traffic volumes

Sl. No.	Junction Name	Morning Peak Hour Volume		Morning Peak Hour	Evening Peak Hour Volume		Evening Peak Hour
		Vehicles	PCUs		Vehicles	PCUs	
1	Mahatma Gandhi Park Junction	14247	10452	10.15-11.15	14231	9454	19.30-20.30
2	Anil Kumble Circle	14782	10927	11.00-12.00	14552	11042	19.00-20.00
3	MG Road-Dikenson Road Junction	12939	8667	10.45-11.45	14297	9946	18.45-19.45
4	Trinity Circle	16025	11024	11.00-12.00	16935	11359	18.30-19.30
5	Halasuru Junction	9814	5908	10.00-11.00	9820	5952	19.30-20.30
6	SV Road-Murphy Road Junction	7793	5363	11.00-12.00	7914	5430	19.30-20.30
7	Binmangala Junction	11068	7334	9.15-10.15	10839	7168	18.15-19.15
8	Varthur Road Junction	9399	6785	10.15-11.15	9596	6875	19.30-20.30

Speed and Delay

Speed & delay survey provides a link wise estimate of journey time, running time and delay. Speed and Delay Survey was carried out for Bus and Car separately during morning and evening peak hours. In case of Car Speed and Delay Survey, floating car technique has been utilized for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the cumulative time at specified timing points to ensure obtaining the average link travel time of the road network.

The overall travel speed generally referred to as journey speed is the effective speed between two points and is computed as the distance divided by the total time taken by the vehicle to complete the journey including delays incurred en-route.
The direction-wise abstract on analysis along Old Madras Road Corridor are furnished in **Table 24** to **Table 27**. The average bus journey speed for both morning and evening peak hour is shown in **Figure 101-102**

Table 24. Bus Speed and Delay- Towards KR Puram (Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (sec)	Journey Time (Sec)	Running TimE (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Shivaji Nagar	Bowring Hospital Junction	0.19	0	42	42	16	16	
2	One Way	Bowring Hospital Junction	Cubbon Road Junction	0.34	15	103	88	12	14	
3	Two Way	Cubbon Road Junction	Kamaraj Road Junction	0.61	65	159	94	14	23	Narrow roads and traffic flow delays
4	Two Way	Kamaraj Road Junction	Dickenson Road Junction	0.67	83	212	129	11	19	Signal Delays
5	Two Way	Dickenson Road Junction	Murphy Road x S.V Road Junction	2.53	65	497	432	18	21	Signal Delays
6	Two Way	Murphy Road x S.V Road Junction	Binnamangala Junction	1.04	0	256	256	15	15	
7	Two Way	Binnamangala Junction	Suranjandas Road Junction	0.87	84	242	158	13	20	Traffic flow delay & Pedestrai crossings
8	Two Way	Suranjandas Road Junction	Varthur Road Junction	1.08	87	319	232	12	17	Traffic flow delay & Pedestrai crossings
9	Two Way	Varthur Road Junction	Lowry School Junction	2.85	229	849	620	12	17	Unsuthorized stoppage of buses at flyover & Narrow road, congestion at K.R.Puram bridge
AVERAGE								14	18	

Table 25 Bus Speed and Delay- Towards KR Puram (Morning) Peak

	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Lowry Memorial School Junction	Varthur Road Junction	2.85	618	1032	414	10	25	Metro construction works, Merging traffic from K.R.Puram
2	Two Way	Varthur Road Junction	Suranjandas Road Junction	1.08	200	321	121	12	32	Narrow railway bridge, unorganized bus stoppage, traffic flow delay
3	Two Way	Suranjandas Das Road Junction	Binnamangala Junction	0.87	71	240	169	13	19	Signal Delay and Traffic flow delay
4	Two Way	Binnamangala Junction	Murphy Road x S.V Road Junction	1.04	47	252	205	15	18	Signal Delay and Traffic flow delay
5	Two Way	Murphy Road x S.V Road Junction	Halasuru Police Station Junction	0.99	116	340	224	10	16	Narrow roads, unscientific junction geometrics, Signal Delay and Traffic flow delay
6	Two Way	Halasuru Police Station Circle	Trinity Circle	0.64	160	235	75	10	31	Narrow road & Signal Delay
7	Two Way	Trinity Circle	Ulsoor Road Junction	0.23	0	47	47	18	18	
8	Two Way	Ulsoor Road Junction	Dickenson Road Junction	0.61	102	243	141	9	16	Signal Delay and Traffic flow delay
9	Two Way	Dickenson Road Junction	Cubbon Road Junction	0.67	90	205	115	12	21	Signal Delay and Traffic flow delay
10	Two Way	Cubbon Road Junction	Kamaraj Road Junction	0.66	33	179	146	13	16	Traffic flow delay
11	Two Way	Kamaraj Road Junction	Central Street Junction	0.72	98	175	77	15	34	Signal Delay and Traffic flow delay
12	One Way	Central Street Junction	Shivaji Nagar Bus stand	0.41	0	75	75	20	20	
AVERAGE								13	22	

Table 26 Bus Speed and Delay- Towards KR Puram (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Shivaji Nagar	Bowring Hospital Junction	0.19	0	47	47	15	15	
2	One Way	Bowring Hospital Junction	Cubbon Road Junction	0.34	54	254	200	5	6	Traffic flow delay & Pedestrai crossings
3	Two Way	Cubbon Road Junction	Kamaraj Road Junction	0.61	144	185	41	12	54	Narrow roads and traffic flow delays
4	Two Way	Kamaraj Road Junction	Dickenson Road Junction	0.67	97	245	148	10	16	Signal Delays & Traffic flow delays
5	Two Way	Dickenson Road Junction	Murphy Road x S.V Road Junction	2.53	126	494	368	18	25	Signal Delays & Traffic flow delays
6	Two Way	Murphy Road x S.V Road Junction	Binnamangala Junction	1.04	105	263	158	14	24	Signal Delays & Traffic flow delays
7	Two Way	Binnamangala Junction	Suranjandas Road Junction	0.87	192	412	220	8	14	Traffic flow delay & Pedestrai crossings
8	Two Way	Suranjandas Road Junction	Varthur Road Junction	1.08	73	288	215	14	18	Traffic flow delay & Pedestrai crossings
9	Two Way	Varthur Road Junction	Lowry School Junction	2.85	353	839	486	12	21	Unsuthorized stoppage of buses at flyover & Narrow road, congestion at K.R.Puram bridge
AVERAGE								12	21	

Table 27 Bus Speed and Delay- Towards MG Road (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Lowry Memorial School Junction	Varthur Road Junction	2.85	681	1490	809	7	13	Metro construction works, Merging traffic from K.R.Puram
2	Two Way	Varthur Road Junction	Suranjandas Road Junction	1.08	308	493	185	8	21	Narrow railway bridge, unorganized bus stoppage, traffic flow delay
3	Two Way	Suranjandas Das Road Junction	Binnamangala Junction	0.87	99	245	146	13	21	Signal Delay and Traffic flow delay
4	Two Way	Binnamangala Junction	Murphy Road x S.V Road Junction	1.04	29	247	218	15	17	Signal Delay and Traffic flow delay
5	Two Way	Murphy Road x S.V Road Junction	Halasuru Police Station Junction	0.99	354	697	343	5	10	Narrow roads, unscientific junction geometrics, Signal Delay and Traffic flow delay
6	Two Way	Halasuru Police Station Circle	Trinity Circle	0.64	51	149	98	15	24	Narrow road & Signal Delay
7	Two Way	Trinity Circle	Ulsoor Road Junction	0.23	0	128	128	6	6	
8	Two Way	Ulsoor Road Junction	Dickenson Road Junction	0.61	0	140	140	16	16	
9	Two Way	Dickenson Road Junction	Cubbon Road Junction	0.67	38	241	203	10	12	Signal Delay and Traffic flow delay
10	Two Way	Cubbon Road Junction	Kamaraj Road Junction	0.66	29	179	150	13	16	Traffic flow delay
11	Two Way	Kamaraj Road Junction	Central Street Junction	0.72	85	182	97	14	27	Signal Delay and Traffic flow delay
12	One Way	Central Street Junction	Shivaji Nagar Bus stand	0.41	36	176	140	8	11	
AVERAGE								11	16	

It was observed that the lower journey speeds are mainly due to traffic congestion and the delays are mostly occurring at junctions. The Average Bus Journey Speed is approximately 13 Kmph during morning peak hour and 11 kmph during evening peak hour.

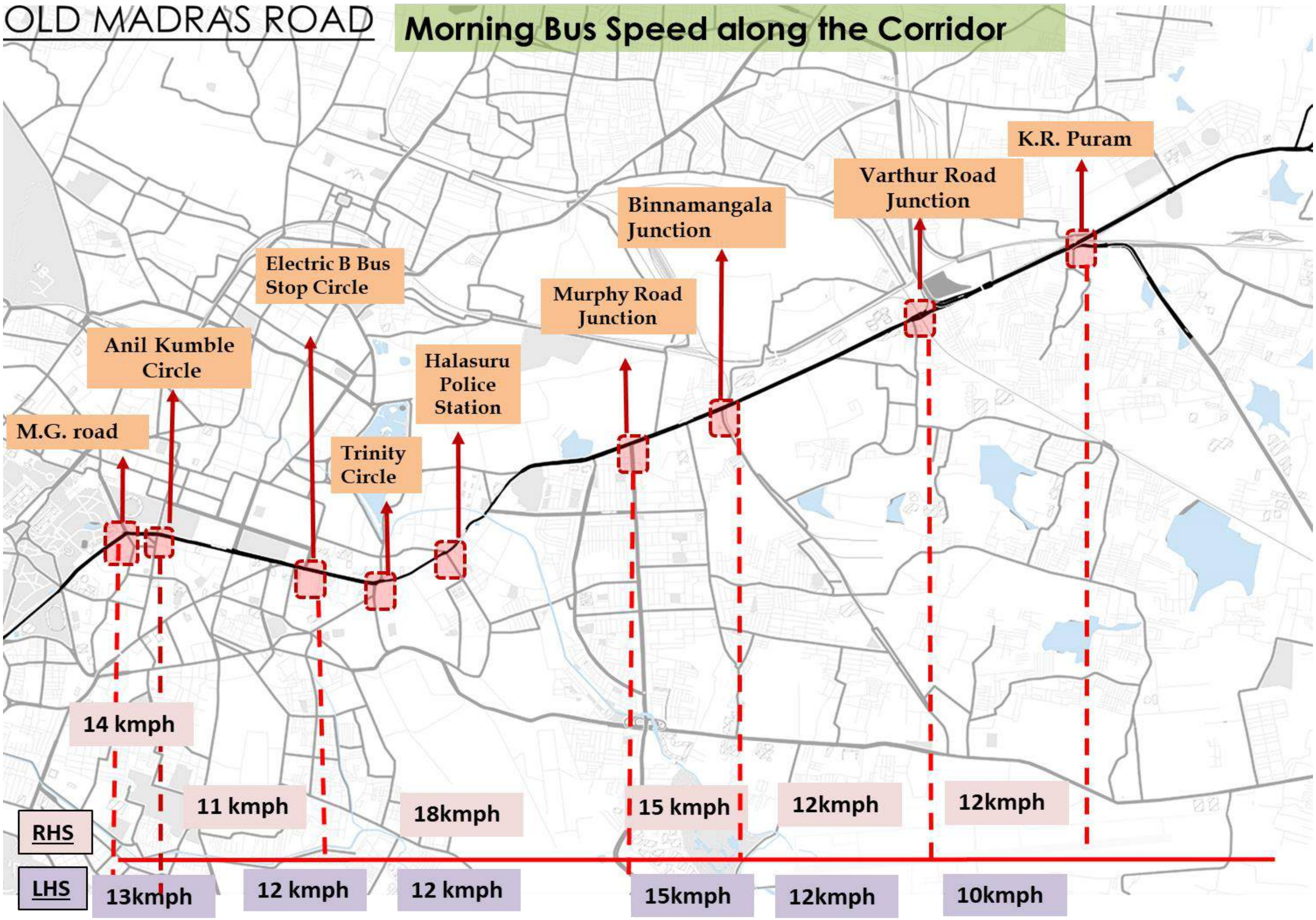


Figure 101. Average Bus Speed and Delay (Morning Peak)

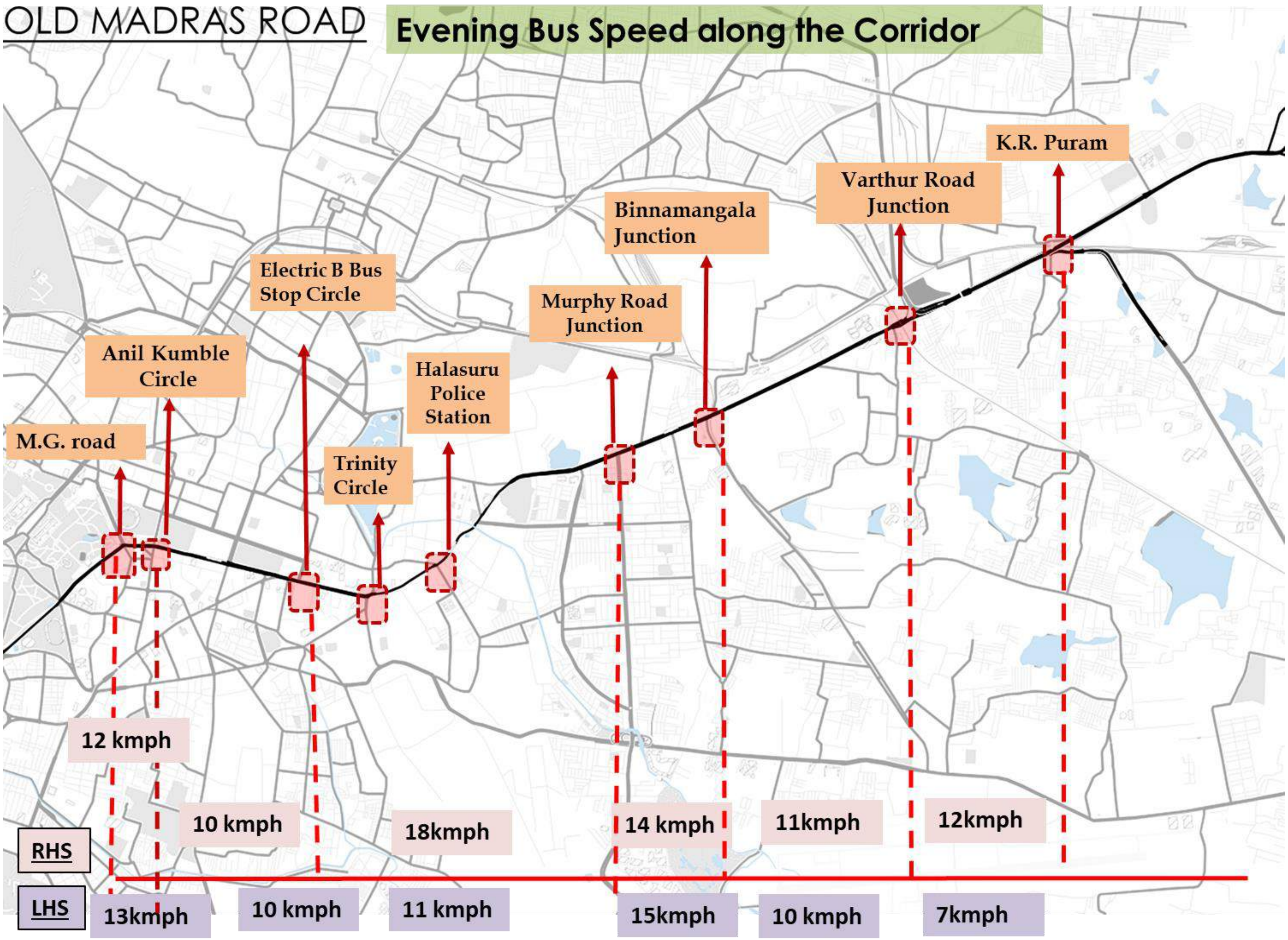


Figure 102. Average Bus Speed and Delay (Evening Peak)

Car Speed and Delay

The Average Car Journey speeds are shown below in **Table 28-31.**

Table 28 Car Speed & Deal Details – Towards KR Puram (Morning Peak)

Sl.No	Carriageway Category	From Node	To Node	Length in km	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for the Dealy
1	Two Way	Cubbon Road Junction	Kamaraj Road Junction	0.61	59	143	84	15	26	Signal Delay& Traffic flow delay
2	Two Way	Kamaraj Road Junction	Dickenson Road Junction	0.65	78	176	98	13	24	Signal Delay& Traffic flow delay
3	Two Way	Dickenson Road Junction	Murphy Road x S.V Road Junction	2.53	111	587	476	16	19	Signal Delay& Traffic flow delay, Narrow roads
4	Two Way	Murphy Road x S.V Road Junction	Binnamangala Junction	1.04	43	261	218	14	17	Signal Delay& Traffic flow delay
5	Two Way	Binnamangala Junction	Suranjandas Road Junction	0.87	71	209	138	15	23	Signal Delay& Traffic flow delay
6	Two Way	Suranjandas Road Junction	Varthur Road Junction	1.08	94	234	140	17	28	Signal Delay& Traffic flow delay
7	Two Way	Varthur Road Junction	Lowry School Junction	2.85	193	668	475	15	22	Unsuthorized stoppage of buses at flyover & Narrow road, congestion at K.R.Puram bridge
AVERAGE								15	23	

The Average Car Journey Speed is approximately 15 Kmph during morning peak hour towards K.R.Puram.

Table 29 Car Speed & Deal Details – Towards KR Puram (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length in Km	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for the Dealy
1	Two Way	Lowry School Junction	Varthur Road Junction	2.85	168	687	519	15	20	Metro construction works, Merging traffic from K.R.Puram
2	Two Way	Varthur Road Junction	Suranjandas Road Junction	1.08	78	269	191	14	20	Narrow railway bridge, unorganized bus stoppage, traffic flow delay
3	Two Way	Suranjandas Road Junction	Binnamangala Junction	0.87	56	203	147	15	21	Signal Delay and Traffic flow delay
4	Two Way	Binnamangala Junction	Murphy Road x S.V Road Junction	1.04	67	243	176	15	21	Signal Delay and Traffic flow delay
5	Two Way	Murphy Road x S.V Road Junction	Dickenson Road Junction	2.53	98	527	429	17	21	Narrow roads, unscientific junction geometrics, Signal Delay and Traffic flow delay
6	Two Way	Dickenson Road Junction	Kamaraj Road Junction	0.65	71	152	81	15	29	Signal Delay and Traffic flow delay
7	Two Way	Kamaraj Road Junction	Cubbon Road Junction	0.61	81	144	63	15	35	Signal Delay and Traffic flow delay
AVERAGE								15	24	

The Average Car Journey Speed is approximately 15 Kmph during evening peak hour towards K.R.Puram

Table 30 Car Speed & Deal Details – Towards M.G. Road (Morning Peak)

	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for the Dealy
1	Two Way	Cubbon Road Junction	Kamaraj Road Junction	0.61	72	146	74	15	30	Signal Delay& Traffic flow delay
2	Two Way	Kamaraj Road Junction	Dickenson Road Junction	0.65	88	185	97	13	24	Signal Delay& Traffic flow delay
3	Two Way	Dickenson Road Junction	Murphy Road x S.V Road Junction	2.53	121	587	466	16	20	Signal Delay& Traffic flow delay, Narrow roads
4	Two Way	Murphy Road x S.V Road Junction	Binnamangala Junction	1.04	65	249	184	15	20	Signal Delay& Traffic flow delay
5	Two Way	Binnamangala Junction	Suranjandas Road Junction	0.87	95	200	105	16	30	Signal Delay& Traffic flow delay
6	Two Way	Suranjandas Road Junction	Varthur Road Junction	1.08	103	236	133	16	29	Signal Delay& Traffic flow delay
7	Two Way	Varthur Road Junction	Lowry School Junction	2.85	218	759	541	14	19	Unsuthorized stoppage of buses at flyover & Narrow road, congestion at K.R.Puram bridge
AVERAGE								15	25	

The Average Car Journey Speed is approximately 15 Kmph during morning peak hour. towards ***M.G. Road***

Table 31 Car Speed & Deal Details – Towards KR Puram (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for the Delay
1	Two Way	Lowry School Junction	Varthur Road Junction	2.85	174	684	510	15	20	Metro construction works, Merging traffic from K.R.Puram
2	Two Way	Varthur Road Junction	Suranjandas Road Junction	1.08	94	259	165	15	24	Narrow railway bridge, unorganized bus stoppage, traffic flow delay
3	Two Way	Suranjandas Road Junction	Binnamangala Junction	0.87	73	226	153	14	20	Signal Delay and Traffic flow delay
4	Two Way	Binnamangala Junction	Murphy Road x S.V Road Junction	1.04	82	243	161	15	23	Signal Delay and Traffic flow delay
5	Two Way	Murphy Road x S.V Road Junction	Dickenson Road Junction	2.53	119	613	494	15	18	Narrow roads, unscientific junction geometrics, Signal Delay and Traffic flow delay
6	Two Way	Dickenson Road Junction	Kamaraj Road Junction	0.65	83	169	86	14	27	Signal Delay and Traffic flow delay
7	Two Way	Kamaraj Road Junction	Cubbon Road Junction	0.61	93	163	70	13	31	Signal Delay and Traffic flow delay
AVERAGE								14	23	

The Average Car Journey Speed is approximately 14 Kmph during evening peak hour towards M.G.Road.

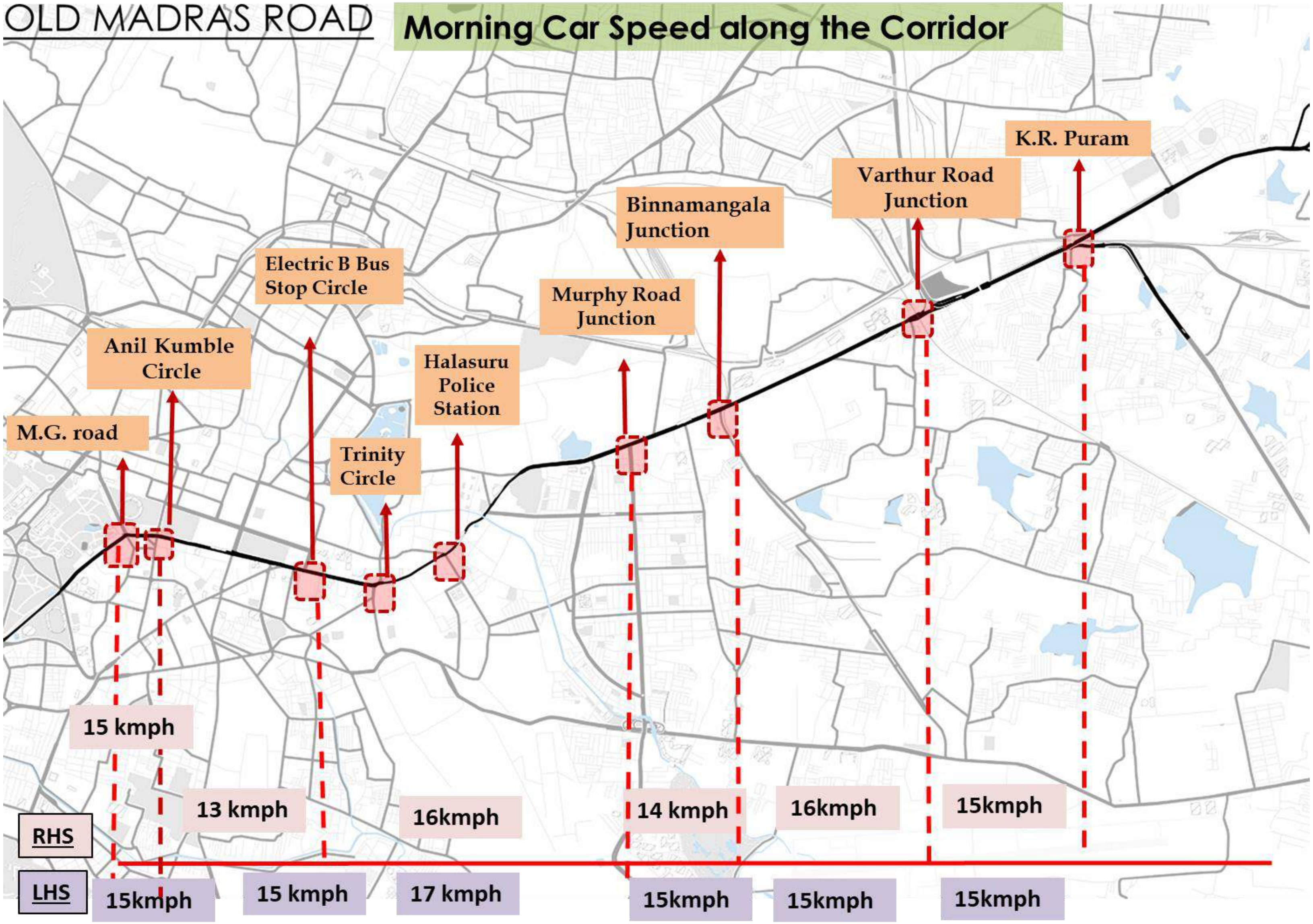


Figure 103 Average Car Speed (Morning Peak)

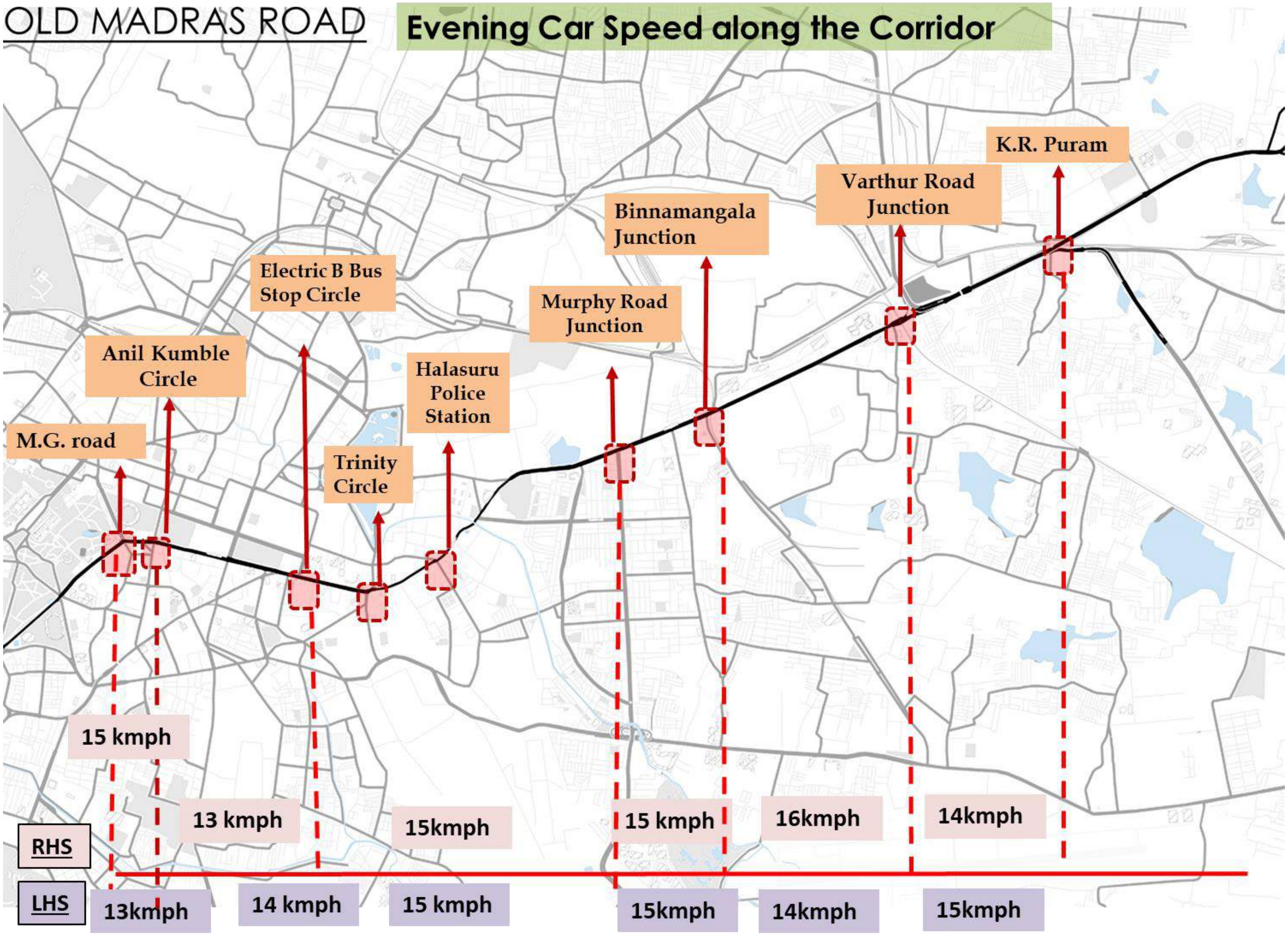


Figure 104. Average Car Speed (Evening Peak)

Pedestrian Counts

Pedestrian Count Survey was carried out to estimate the quantum of pedestrian movements across important locations with predominant pedestrian activity at major junctions for which the turning volume counts were done in the study area. This in turn would help in assessing the need for various facilities such as pedestrian subway, foot over bridge, Zebra crossings etc. on priority basis in the short and medium time frame for safe pedestrian movement.

Pedestrians crossings at 8 major junctions along Old Madras Road Corridor were recorded for a period of 6 hours from 9.00 AM to 12.00 PM and 5.30 PM to 8.30 PM. Summary of pedestrian counts with peak hour pedestrian characteristics are shown below. **Figure 105** and **Table 132.**

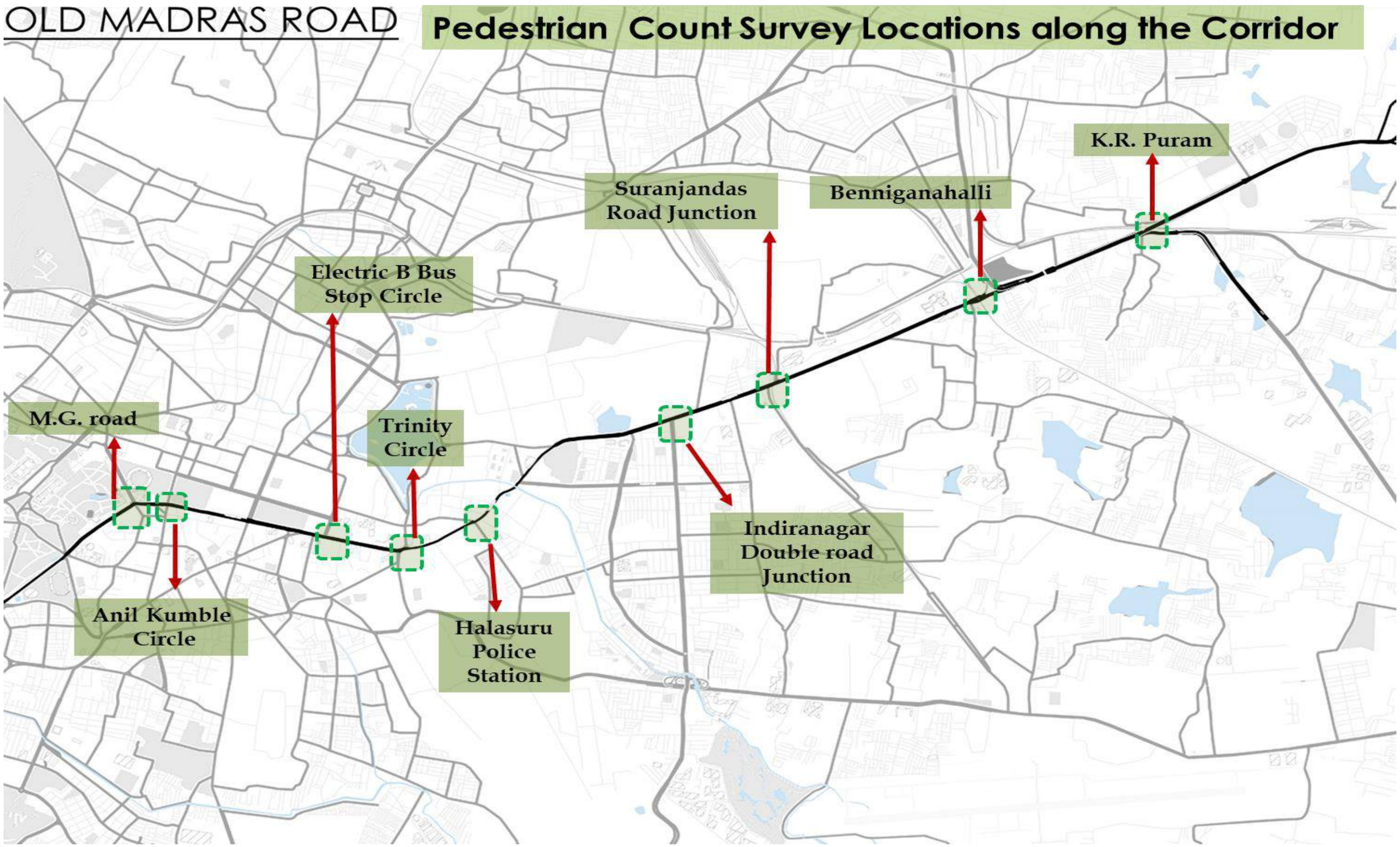


Figure 105 Pedestrian Count Survey Locations

Table 32 Summary of Pedestrian Volume Counts

Sl. No.	Junction Name	Crossing The Road		Along The Road/Footpath		TOTAL	Morn Peak Hour Vol.	Morn Peak Hour Time	Evn. Peak Hour Vol.	Evn. Peak Hour Time
		Dir 1	Dir 2	LHS	RHS					
1	Mahatma Gandhi Park Junction	3299	3676	5440	8952	21367	3474	10.00 - 11.00	4346	19.30 - 20.30
2	Anil Kumble Circle	2130	2475	2724	2408	9737	1919	10.00 - 11.00	1451	19.30 - 20.30
3	MG Road-Dickenson Road Junction	3180	3199	7012	8453	21844	3687	10.00 - 11.00	3651	18.30 - 19.30
4	Trinity Circle	3855	4036	13146	3952	24989	4211	10.00 - 11.00	4208	19.30 - 20.30
5	Halasuru Junction	4814	5172	9480	5201	24667	4195	9.00 - 10.00	4114	18.30 - 19.30
6	SV Road-Murphy Road Junction	813	1119	8007	0	9939	1674	10.00 - 11.00	1690	18.30 - 19.30
7	Binnamangala Junction	1833	2454	4851	4568	13706	2274	11.00 - 12.00	2333	18.30 - 19.30
8	Varthur Road Junction	3347	3239	9800	2190	18576	3128	10.00 - 11.00	3098	17.30 - 18.30

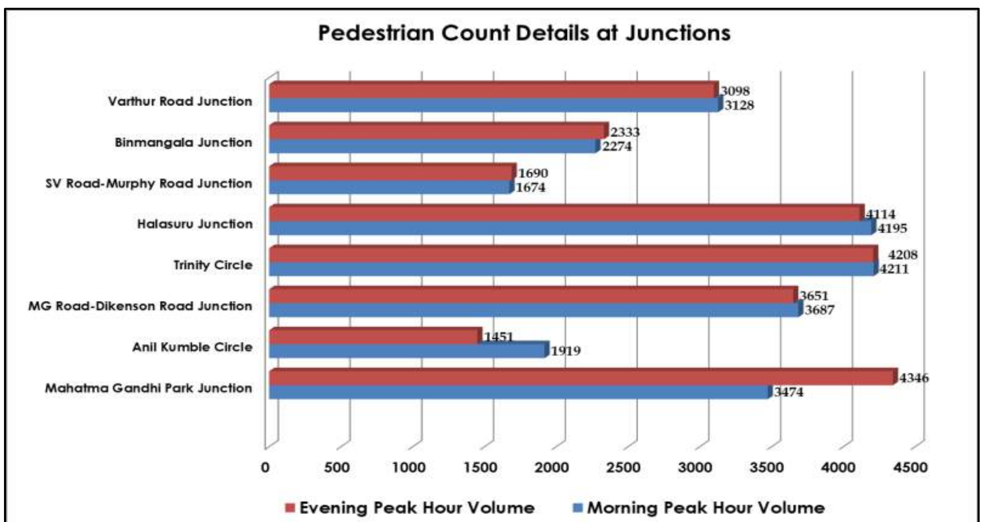


Figure 106. Peak Hour Pedestrian Count Details

Observations

- Pedestrian crossings at junctions along the study corridor ranged from 24989 to 9737 for 6 hours duration.
- Among all the locations in the study area, heavy pedestrian crossing was observed at Trinity Circle (24989) followed by Halasuru Junction (24667).
- Maximum pedestrian crossings were observed between 10.00 AM and 11.00 AM in the morning and between 18.30 PM and 19.30 PM in the evening at majority of locations.

Road Inventory Details

The roadway inventory details in terms of lane widths are shown in the table below in **Table 33:**

Table 33 Road Inventory Details

Link No	Name of Road	Name of Starting Point	Name of Ending Point	Carriageway Width in meters		
				LHS Width	Median	RHS Width
1	Old Madras Road	Queens Circle	Anil Kumble Circle	10.5	1	14.5
2	Old Madras Road	Anil Kumble Circle	Brigade Road junction	8	0.5	10.5
3	Old Madras Road	Brigade Road junction	Dicken Son road intersection	8.25	2.5	8.25
4	Old Madras Road	Dicken Son road intersection	Trinity Circle	8.25	2.5	8.25
5	Old Madras Road	Trinity Circle	Chinmaya Mission Hospital Junction	Total Carriageway Width is varying from 15 meters to 23 meters with central metro median.		
6	Old Madras Road	Chinmaya Mission Hospital Junction	Murphy Road Junction	12 meters undivided		
7	Old Madras Road	Murphy Road Junction	Indiranagar Double road	9	0.5	8.5
8	Old Madras Road	Indiranagar Double road	SuranjanDas road intersection	10.5	1	10.5
9	Old Madras Road	SuranjanDas road intersection	Bennigenahalli	11.5	1	11.5
10	Old Madras Road	Bennigenahalli	K.R.Puram	Total Carriageway Width is varying from 24 meters to 46 meters with central metro median.		

Road Inventory Details

Figure 107 Road Inventory Survey Details

Road Inventory Details

Figure 108 Road Inventory Survey Details

Road Inventory Details

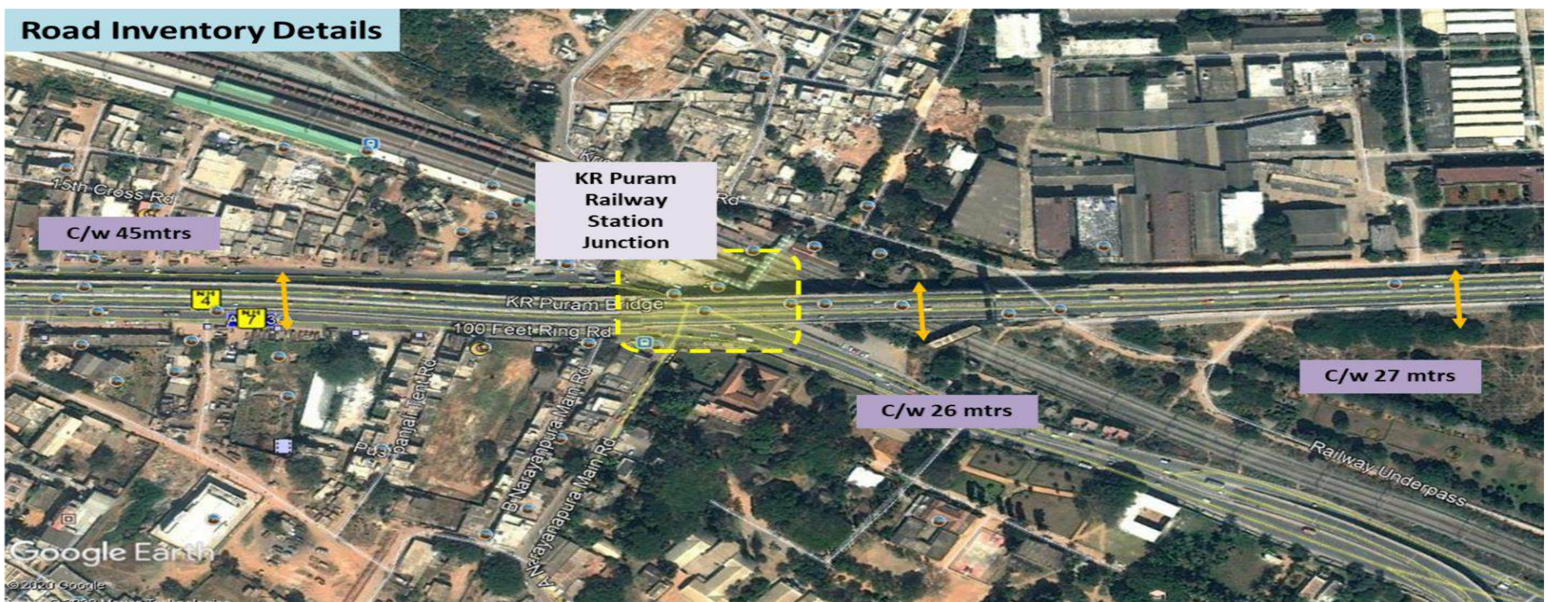


Figure 109. Road Inventory Survey Details

2. Traffic Congestion at K.R. Puram Hanging Bridge

The bridge was built with the intention to ease traffic between Baiyappanahalli and K R Puram. The bridge is now a bottleneck for commuters travelling to Whitefield and nearby areas. Lack of a link to the adjoining areas of Whitefield and Mahadevpura, is creating more congestion. This congestion problem doubles up, as a parking lot for the nearby KR Puram railway station is located below the bridge and in the absence of safe pedestrian crossing, the things are getting out of control. To make matters worse, BMTC, KSRTC and some private buses stop at the entrance of the up ramp of the hanging bridge and below the K.R.Puram Bridge.

The traffic gridlock under the bridge near the K R Puram railway station has gained a notorious reputation. The three-lane Old Madras Road narrows to a traffic gridlock during peak hours on a 500-metre stretch between Tin Factory and K R Puram railway station, causing traffic pile-ups that stretch for over kilometers and sometimes even more especially during festive seasons. The problem is exacerbated during peak hours.

This is a combined junction where two major arterial corridors (White Field to Hebbal Ring road and Baiyappanahalli to Hoskote) cross each other with a small transition length as shown in the Figure. These is one of the major and important gateway junctions for the traffic coming from Chennai and Whitefield area

There are major issues observed at K.R. Puram Bridge which are explained in detail in the following sections

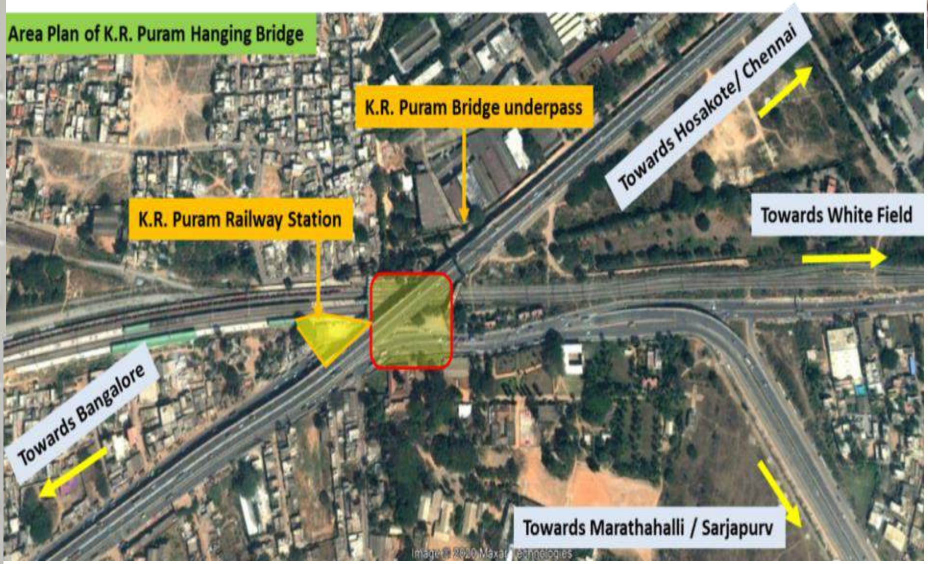


Figure 110. Plan of K.R. Puram Hanging Bridge

a) Bus stoppage at the up ramp of the bridge

The most critical and worst situation to start with that results in traffic congestion at this area is the stoppage of interstate buses, especially the private bus operators who stop their buses at the entrance of the bridge, which results in server traffic jams. The congestion is occurring due to the crisscrossing or merging and diverging of vehicles, which takes place at this location as shown in the **Figure 111.**

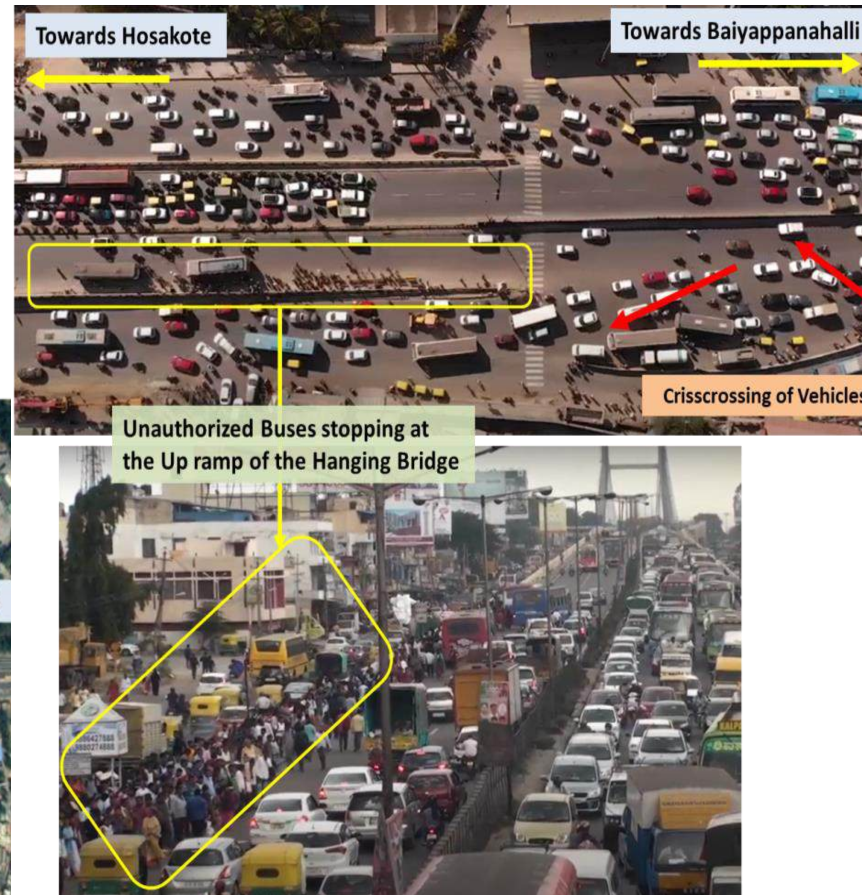


Figure 111 Plan of K.R. Puram Hanging Bridge

Narrow Carriageway width near Halasuru Metro Station causing Congestion

It is observed that the carriageway width reduces drastically from 15 meters to 5 meters and further to less than 5 meters at a particular stretch near Halasuru Metro station. Another issue is the bus stop, which is located at the point where the road width gets reduced. Even though there is a bus bay at the location, the buses do not stop at the bus bay resulting in serious traffic jams during the peak hours. **Figure 112.**

Figure 112. Identification of issues

a. Recommendations

✓ Road widening needs to be carried out on the RHS side to clear the traffic congestion. Land should be acquired for a length of 50 meters in length and 6 meters in width as shown in the **Figure 113.**

Figure 113 Solutions For the Identified Issues

✓ Bus stop needs to be shifted and enforcement need to be done so that the buses stop only at the bus bay. **Figure 114**

Figure 114. Solutions For the Identified Issues

Benefits:

➢ Once the land is acquired and road is widened, traffic congestions will be reduced.

KEY MAP OF ALL ISSUES ALONG THE CORRIDOR

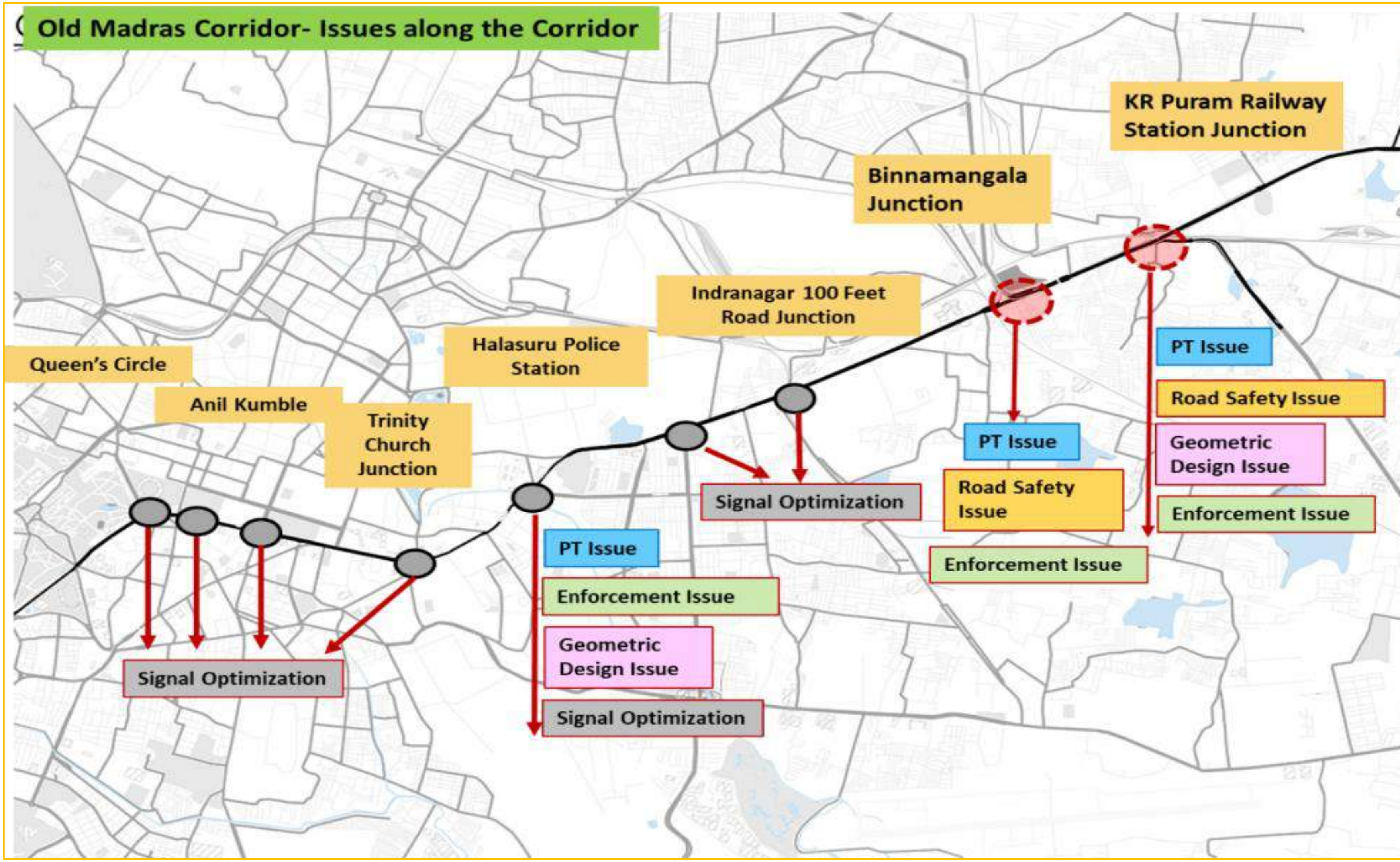


Figure 115.Issue along the corridor

•The comparison between existing operational scenario and the operational scenario after implementing the interventions discussed in the previous chapter along Tumkur Road Corridor is tabulated in Table24. From Table 24 it can be seen that with the implementation of the interventions, there will be considerable reduction in Volume to Capacity Ratio (V/C Ratio), enhanced Level of Service and increased Journey Speeds along Tumkur Road Corridor.

With all the above introversions, the speeds on the corridor can be improvised and the average vehicular speeds can be increased form 15kmph to 25 kmph between Yeshwanthpur Skywalk and Goraguntae Palya and Yeshwanthapur to SRS junction and from SRS junction to NICE interchange the speeds can be improvised up to 40 kmph. (**Figure 101**).

A summary of the existing travel parameters versus the improved parameters after the recommended interventions is given in comparison statement **Table 34 & 35.**

Sl. No.	Road Name	EXISTING											
		Capacity		Morning Peak Hour Volume (PCUs)		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Bus Journey Speed (Kmph)-Morning Peak		Car Journey Speed (Kmph)-Morning Peak	
		Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra
1	Between Yeshwanthpur TTMC and Yeshwanthpur Skywalk	2700	2700	3407	3285	1.26	1.22	LOS F	LOS F	15	13	17	22
2	Yeshwanthpur Skywalk and Gorguntepalya	3360	2800	3668	4461	1.09	1.59	LOS F	LOS F	15	17	17	22
3	Between Gorguntepalya and SRS Junction	4080	4080	5362	5496	1.31	1.35	LOS F	LOS F	21	16	23	21
4	Between SRS and Jalahalli Juction	4080	4080	3728	2601	0.91	0.64	LOS E	LOS C	17	25	36	35
5	Between Jalahalli Junction and Hesarghatta Junction	4080	4080	4451	2214	1.09	0.54	LOS F	LOS C	19	25	27	22
6	Between Hesarghatta Junction and Nagasandra	6800	6800	2938	2097	0.43	0.31	LOS B	LOS B	16	24	43	46

Table 34. Comparison Statement

WITH IMPROVEMENTS							
Capacity		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Anticipated Speed (Kmph) as per HCM-Morning Peak	
Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra
2700	2700	1.26	1.22	LOS F	LOS F	15	15
5600	2800	0.65	1.59	LOS C	LOS F	30	15
6800	6800	0.79	0.81	LOS D	LOS D	25	25
6800	6800	0.55	0.38	LOS C	LOS B	30	40
6800	6800	0.65	0.33	LOS C	LOS B	30	40
6800	6800	0.43	0.31	LOS B	LOS B	40	40

Table 35. Comparison Statement

Sl. No.	Road Name	EXISTING											
		Capacity		Evening Peak Hour Volume (PCUs)		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Bus Journey Speed (Kmph)-Evening Peak		Car Journey Speed (Kmph)-Evening Peak	
		Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra
1	Between Yeshwanthpur TTMC and Yeshwanthpur Skywalk	2700	2700	3808	3362	1.41	1.25	LOS F	LOS F	14	15	19	17
2	Yeshwanthpur Skywalk and Gorguntepalya	3360	2800	3725	4163	1.11	1.49	LOS F	LOS F	14	15	19	17
3	Between Gorguntepalya and SRS Junction	4080	4080	5219	6071	1.28	1.49	LOS F	LOS F	20	9	18	23
4	Between SRS and Jalahalli Juction	4080	4080	3897	2502	0.96	0.61	LOS E	LOS C	24	15	35	32
5	Between Jalahalli Juction and Hesarghatta Junction	4080	4080	4843	2847	1.19	0.70	LOS F	LOS C	16	12	26	22
6	Between Hesarghatta Junction and Nagasandra	6800	6800	3752	2713	0.55	0.40	LOS C	LOS B	20	23	44	46

WITH IMPROVEMENTS							
Capacity		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Anticipated Speed (Kmph) as per HCM-Evening Peak	
Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra	Towards Yeshwanthpur	Towards Nagasandra
2700	2700	1.41	1.25	LOS F	LOS F	15	15
5600	2800	0.67	1.49	LOS C	LOS F	30	15
6800	6800	0.77	0.89	LOS D	LOS D	25	25
6800	6800	0.57	0.37	LOS C	LOS B	30	40
6800	6800	0.71	0.42	LOS C	LOS B	30	40
6800	6800	0.55	0.40	LOS C	LOS B	30	40

The comparison between existing operational scenario and the operational scenario after implementing the interventions discussed in the previous chapter along Old Madras Road Corridor is tabulated in **Table 143.** From **Table 36** it can be seen that with the implementation of the interventions, there will be considerable reduction in Volume to Capacity Ratio (V/C Ratio) Old Madras Road Corridor.

A summary of the existing travel parameters versus the improved parameters after the recommended interventions is given in comparison statement **Table 36.**

Table 36. Total Summary of the existing and proposed Scenario with all the proposed interventions with Morning Peak

Sl. No.	Typology of Road	Road Name	EXISTING											
			Capacity		Morning Peak Hour Volume (PCUs)		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Bus Journey Speed (Kmph)-Morning Peak		Car Journey Speed (Kmph)-Morning Peak	
			Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road
1	6 Lane	Between Mahatma Gandhi Park Junction and Anil Kumble Circle	4200	4200	1998	4273	0.48	1.02	LOS C	LOS F	14	13	15	15
2	4 Lane	Between Anil Kumble Circle and Kamraj Road Junction	1755	1755	3446	5686	1.96	3.24	LOS F	LOS F	11	12	13	13
3	6 Lane	Between Kamraj Road Junction and Dikenson Road Junction	4200	4200	2118	3662	0.5	0.87	LOS C	LOS E	11	12	13	13
4	6 Lane	Between Dikenson Road Junction and Trinity Circle	4200	4200	4313	3897	1.03	0.93	LOS F	LOS E	11	9	16	16
5	4 Lane	Between Trinity Circle and Halasuru Junction	2700	2700	3145	3769	1.16	1.4	LOS F	LOS F	18	18	16	16
6	2 Lane	Between Halasuru Junction and CMH Road Junction	2160	2160	2410	2114	1.12	0.98	LOS F	LOS E	18	10	16	16
7	4 Lane	Between CMH Road Junction and Murphy Road Junction	2700	2700	1281	1238	0.47	0.46	LOS C	LOS C	18	10	14	15
8	4 Lane	Between Murphy Road Junction and Indiranagar Double Road Junction	1620	1620	3177	2535	1.96	1.57	LOS F	LOS F	15	15	14	15
9	4 Lane	Between Indiranagar Double Road Junction and Binnamangala Junction	2700	2700	3242	4599	1.2	1.7	LOS F	LOS F	13	15	15	16
10	6 Lane	Between Binnamangala Junction and Suranjandas Road Junction	4200	4200	3318	3645	0.79	0.87	LOS D	LOS E	13	13	15	16
11	6 Lane	Between Suranjandas Road Junction and Varthur Road Junction	4200	4200	3726	3529	0.89	0.84	LOS E	LOS D	12	13	17	16
12	6 Lane	Between Varthur Road Junction and Tin Factory	2520	4200	4836	7565	1.92	1.8	LOS F	LOS F	12	12	15	14

Table 37. Total Summary of the existing and proposed Scenario with all the proposed interventions with Morning Peak

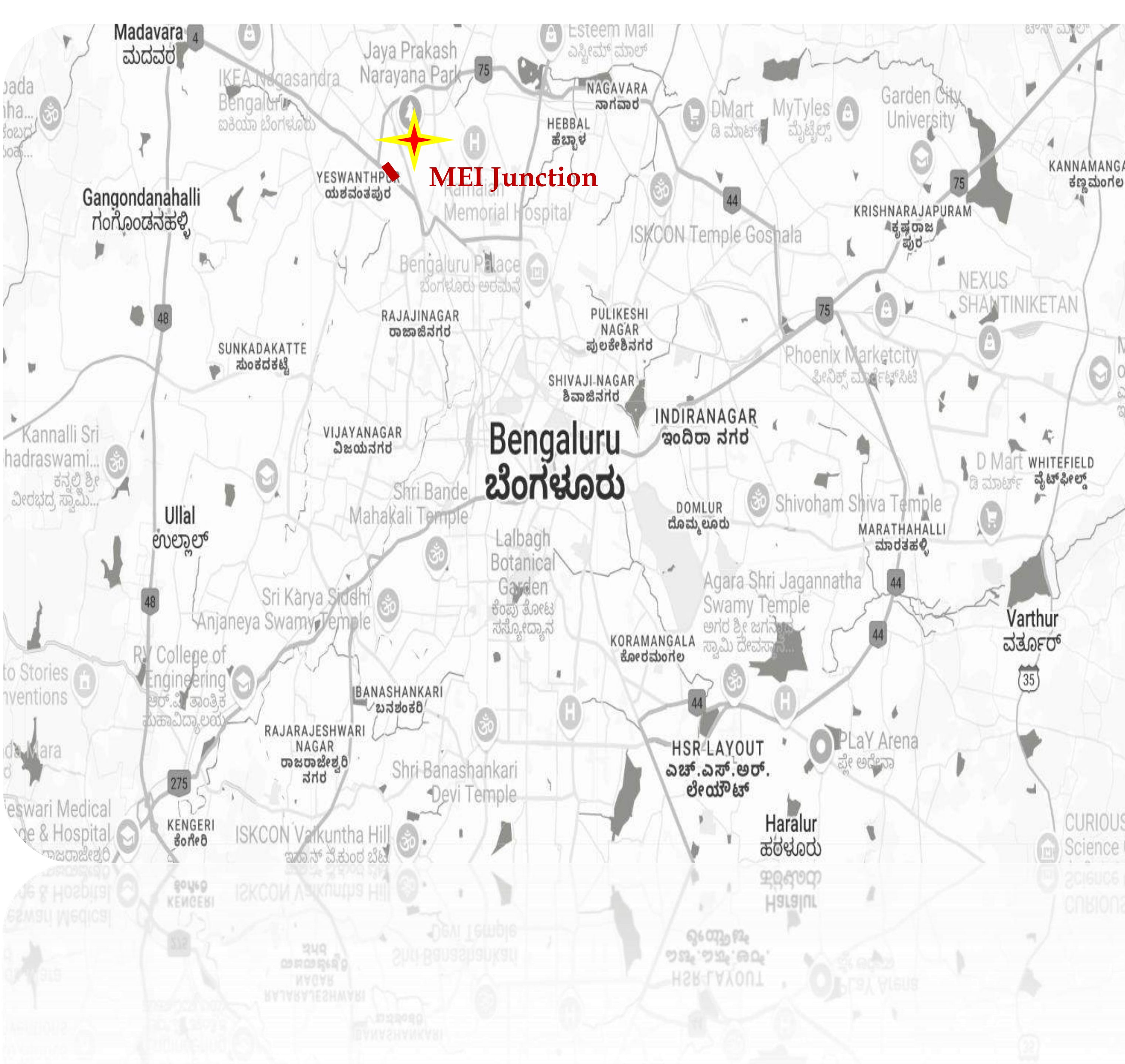
Sl. No.	Typology of Road	Road Name	WITH IMPROVEMENTS							
			Capacity		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Anticipated Speed (Kmph) as per HCM-Morning Peak	
			Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road
1	6 Lane	Between Mahatma Gandhi Park Junction and Anil Kumble Circle	4200	4200	0.4757	1.0174	LOS C	LOS F	30	15
2	4 Lane	Between Anil Kumble Circle and Kamraj Road Junction	2700	2700	1.2763	2.1059	LOS F	LOS F	15	15
3	6 Lane	Between Kamraj Road Junction and Dikenson Road Junction	4200	4200	0.5043	0.8719	LOS C	LOS E	30	25
4	6 Lane	Between Dikenson Road Junction and Trinity Circle	4200	4200	1.0269	0.9279	LOS F	LOS E	15	25
5	4 Lane	Between Trinity Circle and Halasuru Junction	2700	2700	1.1648	1.3959	LOS F	LOS F	15	15
6	2 Lane	Between Halasuru Junction and CMH Road Junction	2400	2400	1.0042	0.8808	LOS F	LOS E	15	25
7	4 Lane	Between CMH Road Junction and Murphy Road Junction	2700	2700	0.4744	0.4585	LOS C	LOS C	30	30
8	4 Lane	Between Murphy Road Junction and Indiranagar Double Road Junction	2700	2700	1.1767	0.9389	LOS F	LOS E	15	25
9	4 Lane	Between Indiranagar Double Road Junction and Binnamangala Junction	2700	2700	1.2007	1.7033	LOS F	LOS F	15	15
10	6 Lane	Between Binnamangala Junction and Suranjandas Road Junction	4200	4200	0.79	0.8679	LOS D	LOS E	25	25
11	6 Lane	Between Suranjandas Road Junction and Varthur Road Junction	4200	4200	0.8871	0.8402	LOS E	LOS D	25	25
12	6 Lane	Between Varthur Road Junction and Tin Factory	4200	4200	1.1514	1.8012	LOS F	LOS F	15	15

Table 38. Total Summary of the existing and proposed Scenario with all the proposed interventions with Evening Peak

Sl. No.	Typology of Road	Road Name	EXISTING											
			Capacity		Evening Peak Hour Volume (PCUs)		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Bus Journey Speed (Kmph)-Evening Peak		Car Journey Speed (Kmph)-Evening Peak	
			Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road
1	6 Lane	Between Mahatma Gandhi Park Junction and Anil Kumble Circle	4200	4200	1979	4207	0.47	1	LOS C	LOS F	12	15	15	15
2	4 Lane	Between Anil Kumble Circle and Kamraj Road Junction	1755	1755	3497	6193	1.99	3.53	LOS F	LOS F	12	13	15	15
3	6 Lane	Between Kamraj Road Junction and Dikenson Road Junction	4200	4200	2118	3662	0.5	0.87	LOS C	LOS E	10	13	13	15
4	6 Lane	Between Dikenson Road Junction and Trinity Circle	4200	4200	4355	3744	1.04	0.89	LOS F	LOS E	10	16	16	17
5	4 Lane	Between Trinity Circle and Halasuru Junction	2700	2700	3263	3888	1.21	1.44	LOS F	LOS F	10	15	16	17
6	2 Lane	Between Halasuru Junction and CMH Road Junction	2160	2160	2453	2126	1.14	0.98	LOS F	LOS E	18	5	16	17
7	4 Lane	Between CMH Road Junction and Murphy Road Junction	2700	2700	1226	1226	0.45	0.45	LOS C	LOS C	18	5	14	15
8	4 Lane	Between Murphy Road Junction and Indiranagar Double Road Junction	1620	1620	3086	2478	1.91	1.53	LOS F	LOS F	14	15	14	15
9	4 Lane	Between Indiranagar Double Road Junction and Binnamangala Junction	2700	2700	3187	4305	1.18	1.59	LOS F	LOS F	14	15	14	15
10	6 Lane	Between Binnamangala Junction and Suranjandas Road Junction	4200	4200	3216	3398	0.77	0.81	LOS D	LOS D	8	13	15	15
11	6 Lane	Between Suranjandas Road Junction and Varthur Road Junction	4200	4200	3803	3563	0.91	0.85	LOS E	LOS D	14	8	17	14
12	6 Lane	Between Varthur Road Junction and Tin Factory	2520	4200	4153	7733	1.65	1.84	LOS F	LOS F	12	7	15	15

Table 39 . Total Summary of the existing and proposed Scenario with all the proposed interventions with Evening Peak

Sl. No.	Typology of Road	Road Name	WITH IMPROVEMENTS							
			Capacity		V/C Ratio-Evening Peak		Level of Service- Evening Peak		Anticipated Speed (Kmph) as per HCM- Evening Peak	
			Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road	Towards K.R Puram	Towards M.G Road
1	6 Lane	Between Mahatma Gandhi Park Junction and Anil Kumble Circle	4200	4200	0.47	1.00	LOS C	LOS F	30	15
2	4 Lane	Between Anil Kumble Circle and Kamraj Road Junction	2700	2700	1.30	2.29	LOS F	LOS F	15	15
3	6 Lane	Between Kamraj Road Junction and Dikenson Road Junction	4200	4200	0.50	0.87	LOS C	LOS E	30	25
4	6 Lane	Between Dikenson Road Junction and Trinity Circle	4200	4200	1.04	0.89	LOS F	LOS E	15	25
5	4 Lane	Between Trinity Circle and Halasuru Junction	2700	2700	1.21	1.44	LOS F	LOS F	15	15
6	2 Lane	Between Halasuru Junction and CMH Road Junction	2400	2400	1.02	0.89	LOS F	LOS E	15	25
7	4 Lane	Between CMH Road Junction and Murphy Road Junction	2700	2700	0.45	0.45	LOS C	LOS C	30	30
8	4 Lane	Between Murphy Road Junction and Indiranagar Double Road Junction	2700	2700	1.14	0.92	LOS F	LOS E	15	25
9	4 Lane	Between Indiranagar Double Road Junction and Binnamangala Junction	2700	2700	1.18	1.59	LOS F	LOS F	15	15
10	6 Lane	Between Binnamangala Junction and Suranjandas Road Junction	4200	4200	0.77	0.81	LOS D	LOS D	25	25
11	6 Lane	Between Suranjandas Road Junction and Varthur Road Junction	4200	4200	0.91	0.85	LOS E	LOS D	25	25
12	6 Lane	Between Varthur Road Junction and Tin Factory	4200	4200	0.99	1.84	LOS E	LOS F	25	15



CORRIDOR

1

Tumakuru road- MEI Junction

Proposed Split Flyover at MEI Intersection along Tumakuru road

Proposed Split Flyover at MEI Junction on Tumakuru road

Given the significant traffic congestion at the MEI Junction, particularly with high volumes of traffic moving between Tumakuru and Bengaluru, immediate attention is required. To alleviate this congestion, a Split flyover is having been proposed to facilitate smoother flow for through traffic."

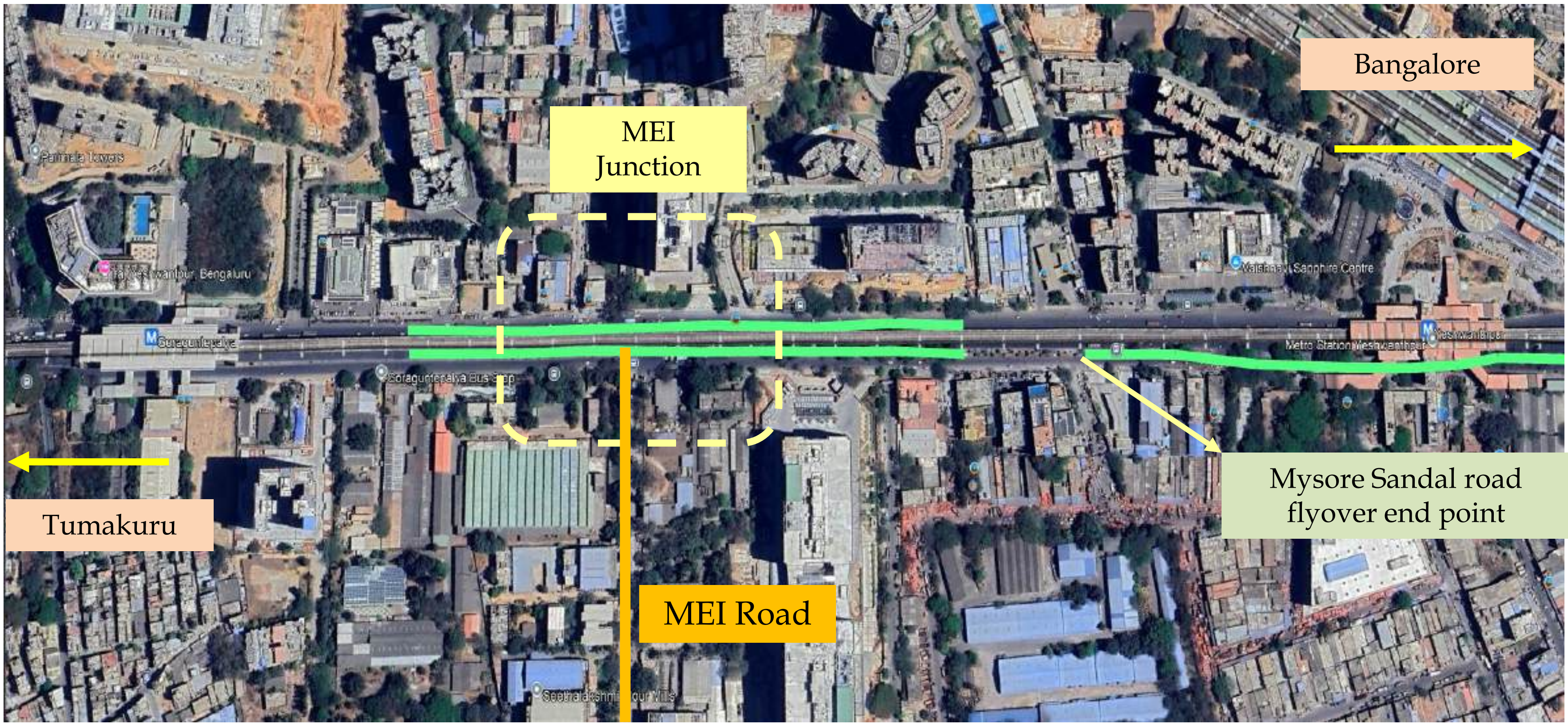


Figure 116. Proposed split flyover at MEI junction – Tumakuru road

Proposed Split Flyover at MEI intersection

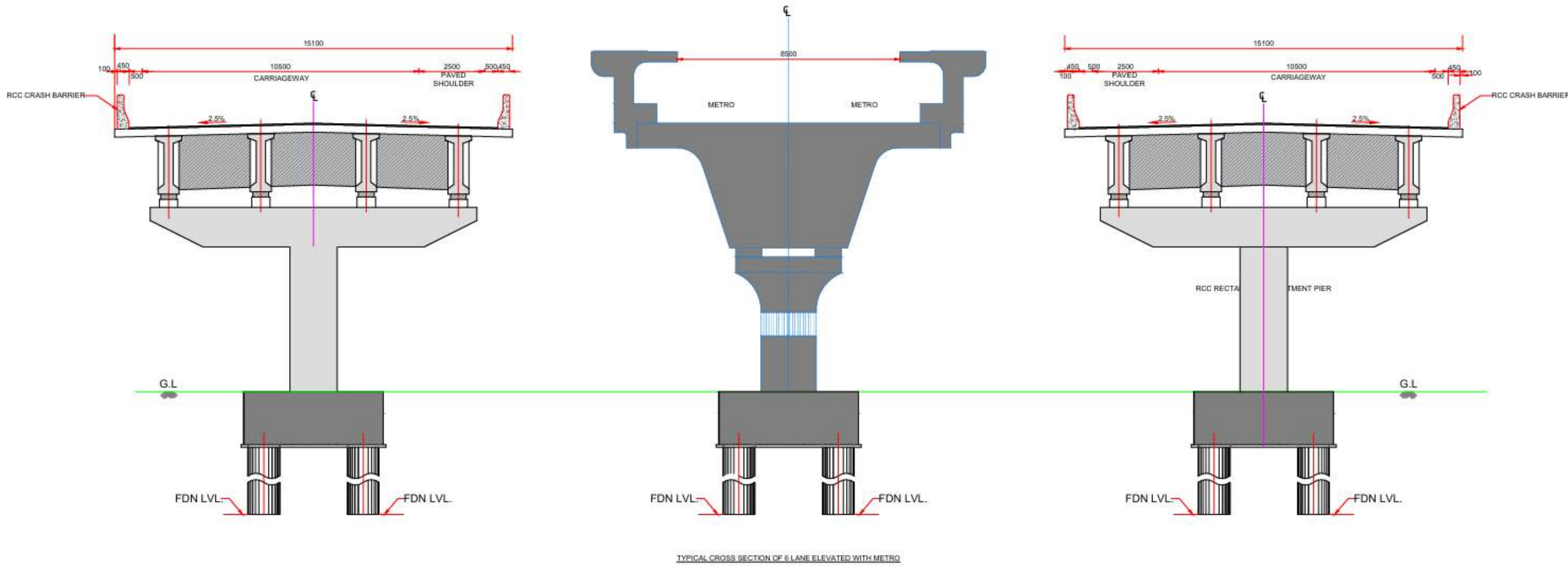
Due to the heavy traffic congestion at the MEI Junction, especially with substantial traffic volumes moving between Tumakuru and Bengaluru, immediate intervention is essential. To reduce this congestion, a plan for a split flyover on either sides of the METRO has been proposed to streamline through traffic. A two-lane single side split flyover is suggested on the Tumakuru road as shown in the figure. This configuration accounts for spatial limitations caused by the presence of Metro pillars in the middle.

Figure 117. Proposed Split flyover at MEI junction on Tumakuru road

Proposed Split flyover at MEI junction on Tumakuru road

Figure 118. Site photos at MEI junction on Tumakuru road

Proposed Typical Cross section for four lane split flyover at MEI junction on Tumakuru road



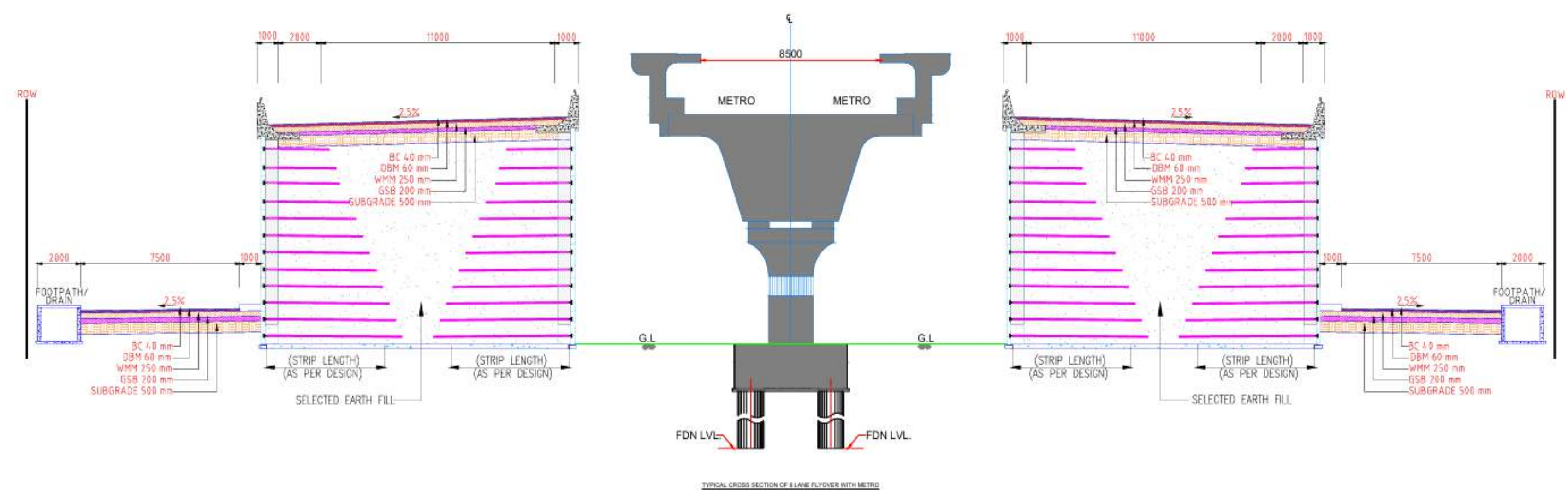
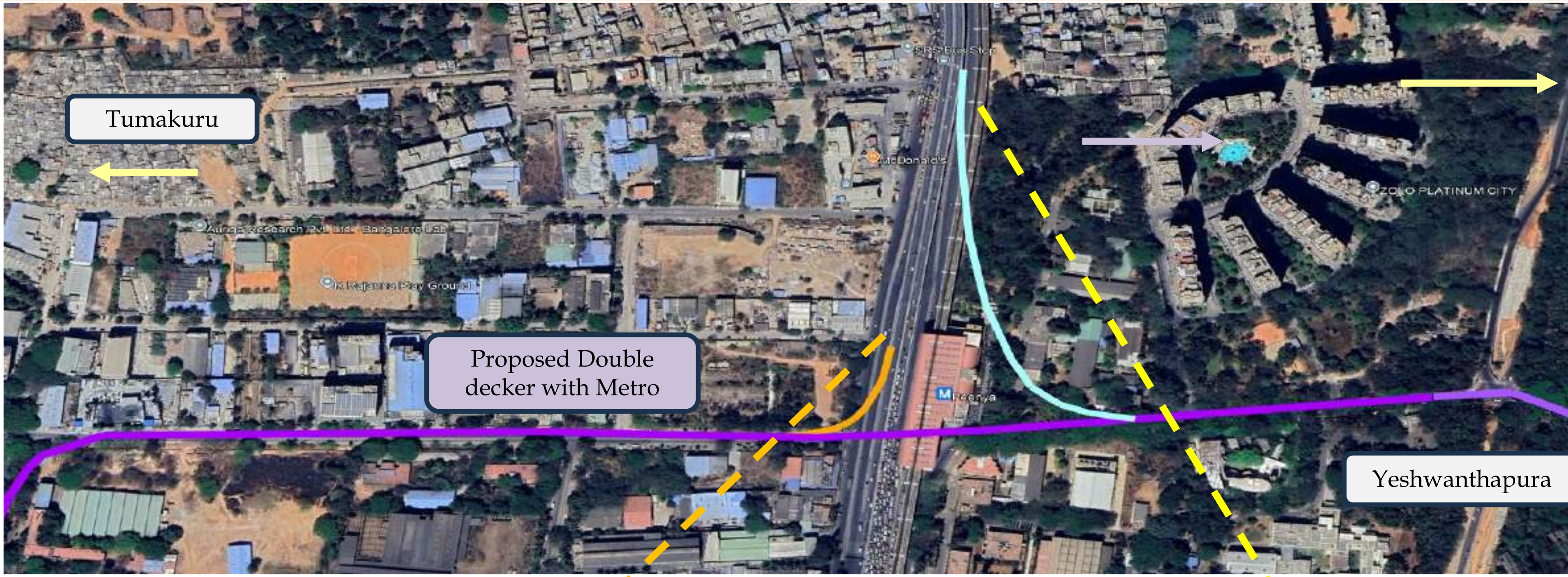


Figure 119. **Proposed cross section for 46lane Vehicle underpass at Madiwala**

Details of the integrated plan on Tumakuru road at Peenya metro station with existing NH elevated corridor and the proposed Double Decker.



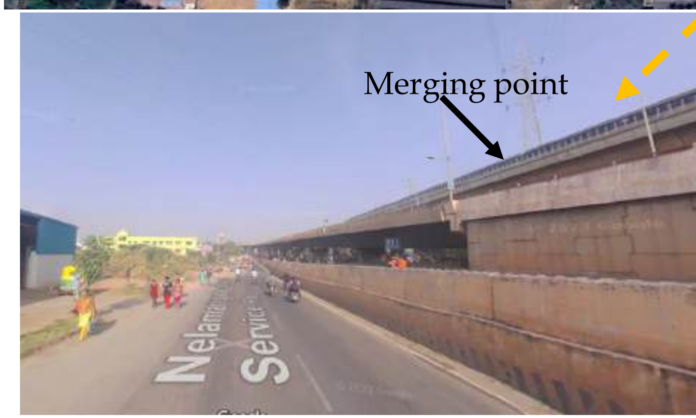


Figure 120. Proposed Elevated corridor section wise details

At this location, a slightly complex down ramp is proposed, which needs to integrate with the existing NH flyover on the left hand side towards Tumakuru from Nayandahalli side.

At this location, a Up ramp is proposed to merge with the existing NH flyover on the left-hand side towards Hebbal on the double decker.

Details of the Proposed integrated plan of Double decker and NH on Tumkur road at 100Ft Goraguntaepalya Junction

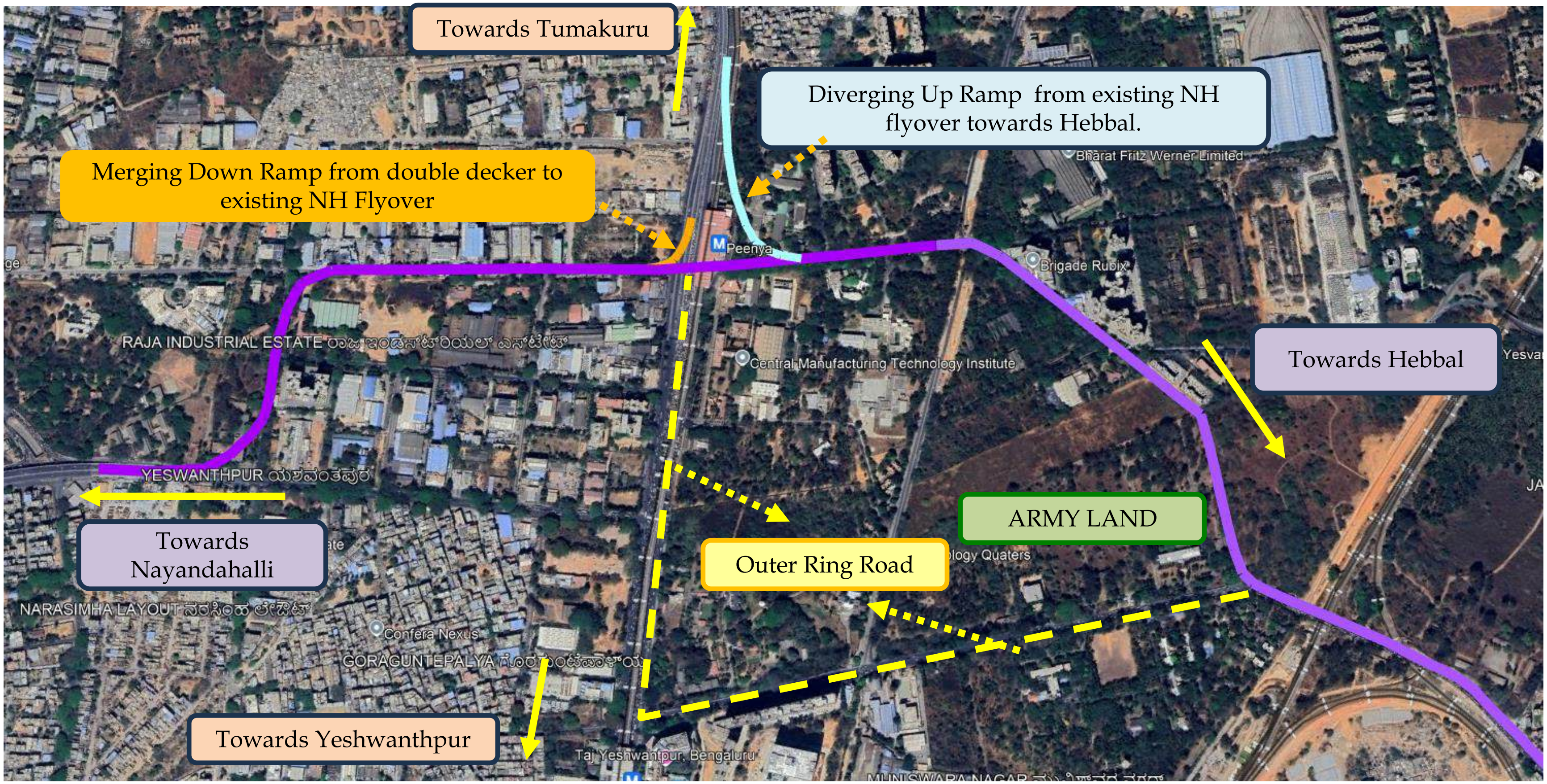
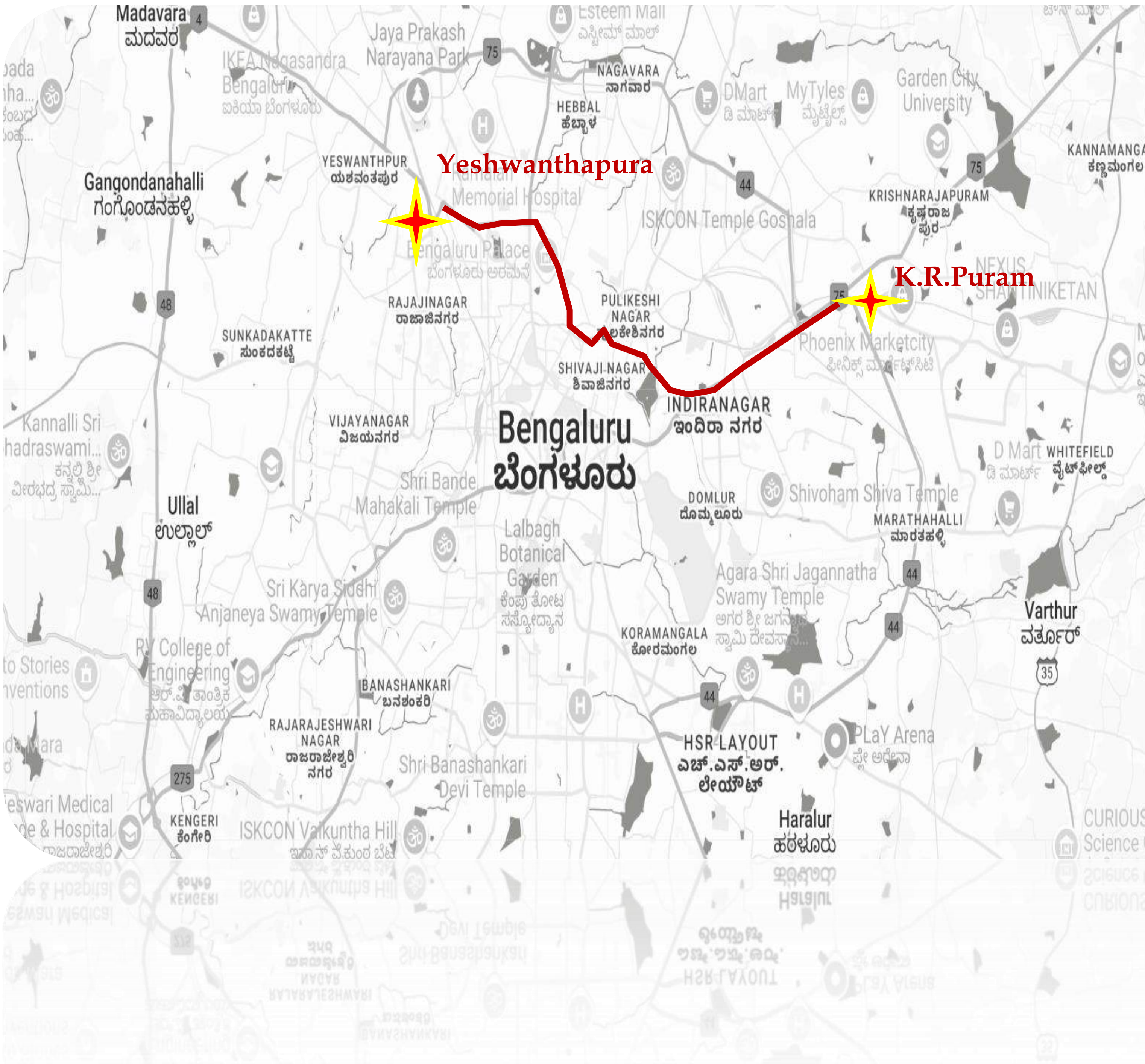


Figure 121. Proposed integration plan of Double decker with existing NH elevated road

This plan features both an "up ramp" and a "down ramp" for the existing NH elevated corridor, which is part of the proposed Double Decker project. These ramps will provide direct traffic access from Nayandahalli to the Tumakuru side, as well as from Tumakuru to Hebbal and onward to the airport.



CORRIDOR 02

Tumakuru road – Old Madras road

Mathikere Cross - IISC-Mekri circle- Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram

Corridor 1 Section B: Yeshwanthapura to Halasuru lake Old Madras road

Continuing from Section A, the elevated corridor begins after the Yeshwanthpur flyover, passes in front of IISc, and turns left towards Mekhri Circle via C.V. Raman Road. It then follows Jayamahal Road, reaching the Cantonment Railway Station, where it turns left onto Millers Road. The corridor continues along St. John's Road, passing Halasuru Lake, and connects to Old Madras Road near Indiranagar. This stretch provides seamless travel from Yeshwanthpur to Old Madras Road, bypassing twelve minor and major junctions, offering significant relief to commuters. It then extends to K.R. Puram, which is detailed in Section C of the corridor."

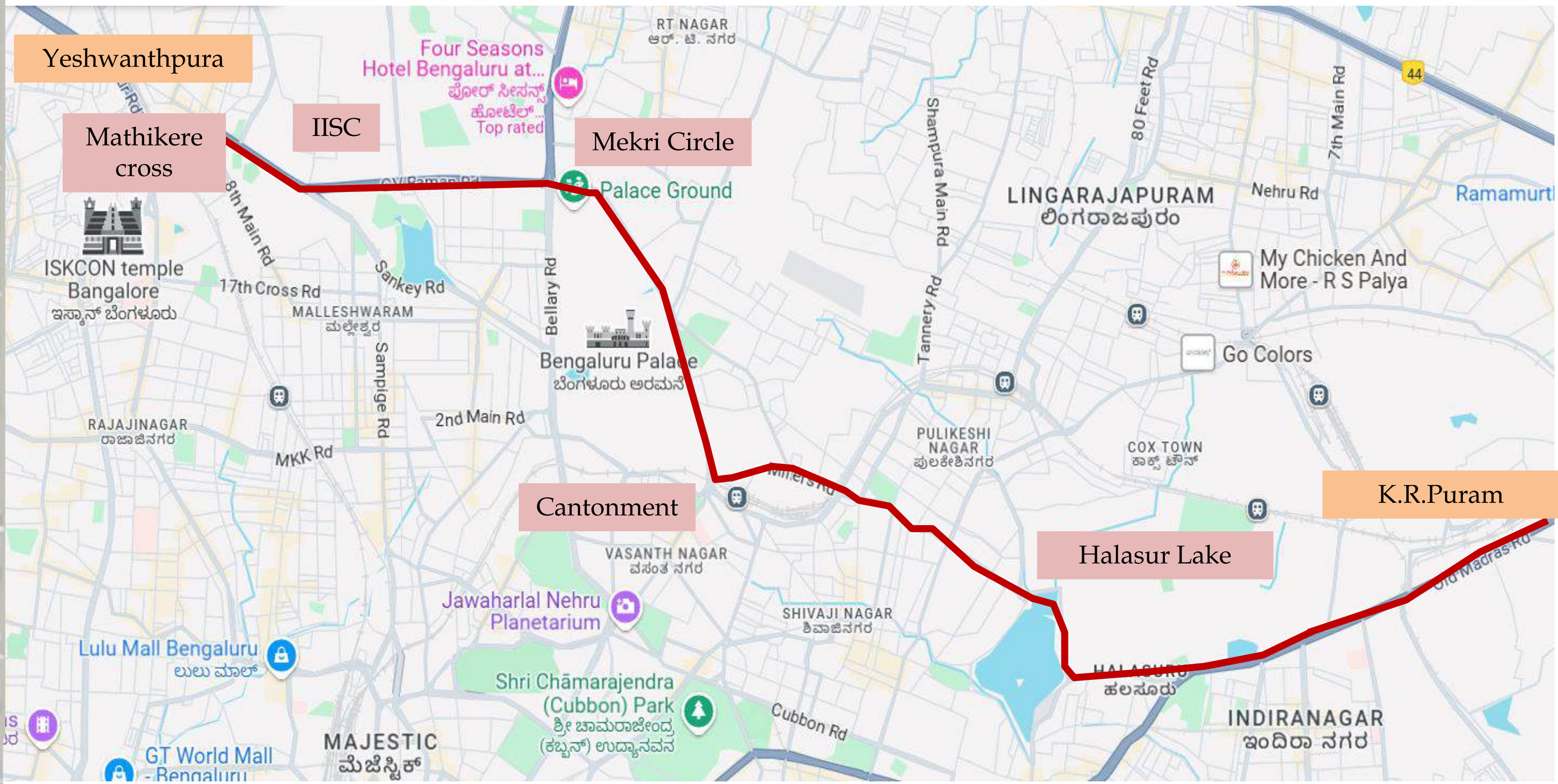


Figure 122 Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road

Proposed Elevated corridor from Yeshwanthapura junction to Old Madras road- Alignment details

At this location, the elevated corridor passes in front of IISC

At this location , the proposed corridor takes left at C.N.Rao junction

At this location, the proposed elevated corridor starts and ends .

Figure 123. Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road Site inspection photos

Proposed Elevated corridor from Yeshwanthapura junction to Old Madras road

Proposed elevated corridor passes over the Mekri Circle

Proposed elevated corridor passes over the Mekri Circle

Proposed elevated corridor passes through CV Raman road

Figure 124. Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road Site inspection photos

Proposed Elevated corridor from Yeshwanthapura junction to Old Madras road

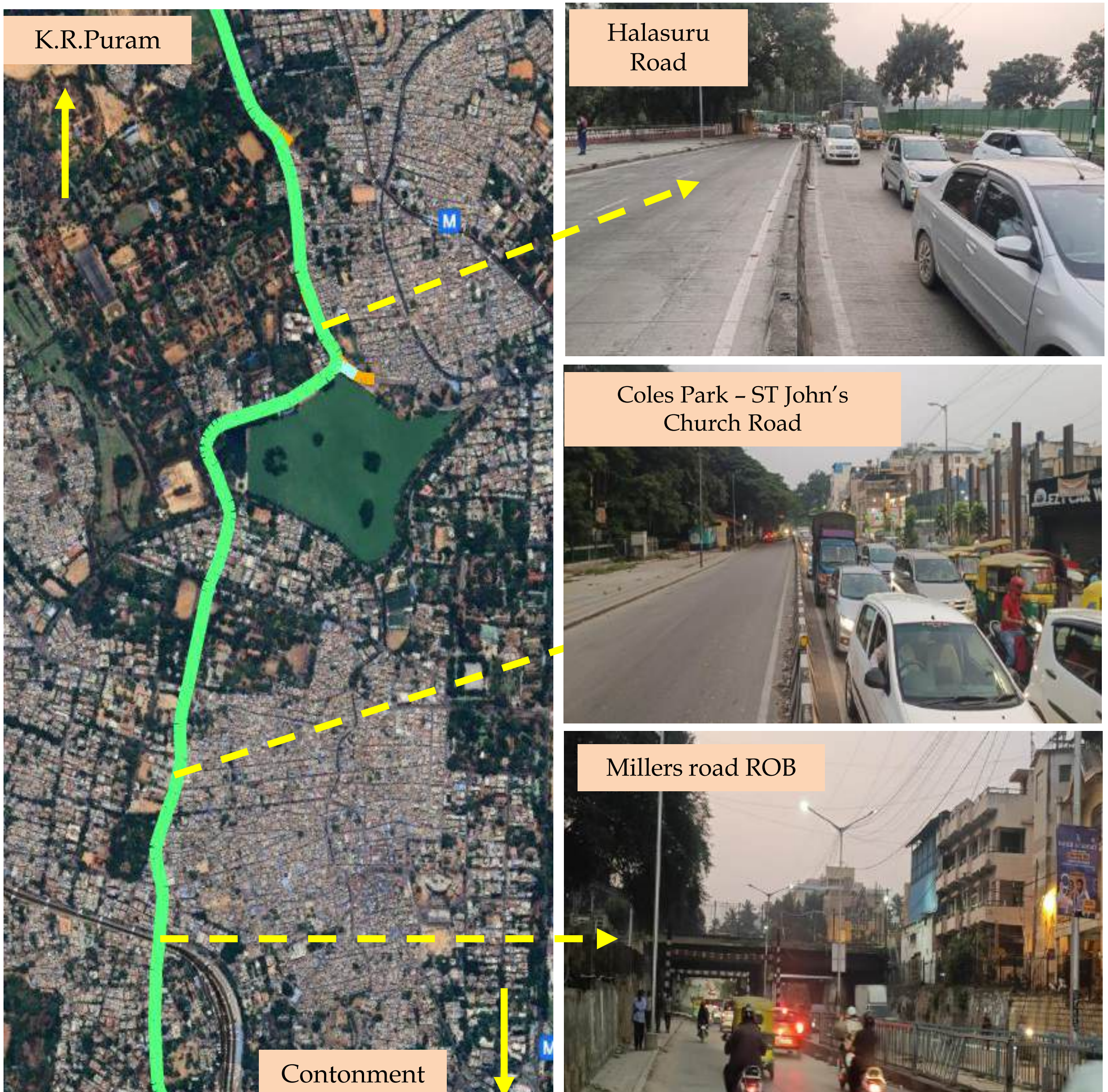
A proposed elevated corridor runs along Jayamahal Road, turning right just before the Cantonment Railway Station underpass.

A proposed elevated corridor runs along Jayamahal Road,.

A proposed elevated corridor runs along Jayamahal Road, crosses the CL junction..

Figure 125. Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road Site inspection photos

Proposed Elevated corridor from Yeshwanthapura junction to Old Madras road Site Reconnaissance Photos



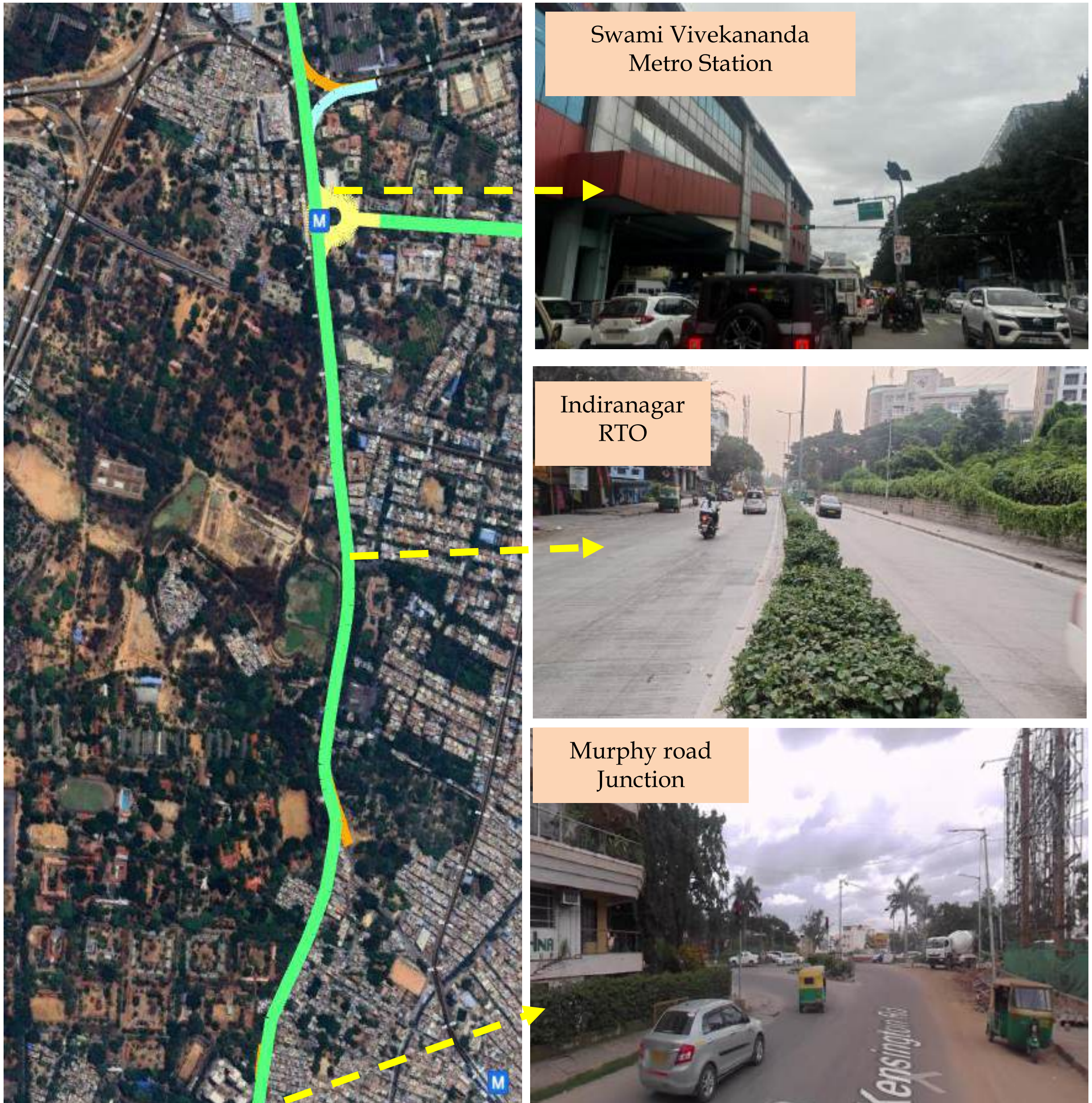
A proposed elevated corridor along Old Madras after taking the left from Ulsoor lake.

A proposed elevated corridor crosses the AKS junction and a down ramp is proposed at Coles park.

A proposed elevated corridor runs along the Millers road and crosses over the RoB.

Figure 126. Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road Site inspection photos

Proposed Elevated corridor from Yeshwanthapura junction to Old Madras road Site Reconnaissance Photos



An elevated rotary is proposed at the Swami Vivekananda Metro Station, where another elevated corridor from Silk Board intersects

An elevated rotary is proposed at the Swami Vivekananda Metro Station, where another elevated corridor from Silk Board intersects

Proposed elevated corridor turns left to reach old Madras road.

Figure 127 Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road Site inspection photos

Proposed Elevated corridor from Yeshwanthapura junction to Old Madras road

Proposed elevated corridor moves along the Old Madras road

Proposed elevated corridor moves along the Old Madras road and terminates at K.R.Puram where three elevated corridors meet at the interchange.

Figure 128. Proposed Elevated corridor from Yeshwanthapura to Halasur lake on Old Madras road Site inspection photos

Corridor 1 Section C: Ulsoor lake Old Madras road to K.R.Puram (Extension road considered till Anil Kumble Circle via M.G Road)

Continuing from Section B, the elevated corridor starts at the Halasuru Lake Junction on Old Madras Road and extends to the K.R. Puram interchange. This stretch bypasses seven critical minor and major junctions that experience significant congestion. Additionally, this section intersects with another elevated corridor, which begins at Silk Board and connects to Old Madras Road near Swami Vivekananda Metro Station on 80 Feet Road. An elevated rotary is proposed at this intersection to efficiently manage traffic flow.

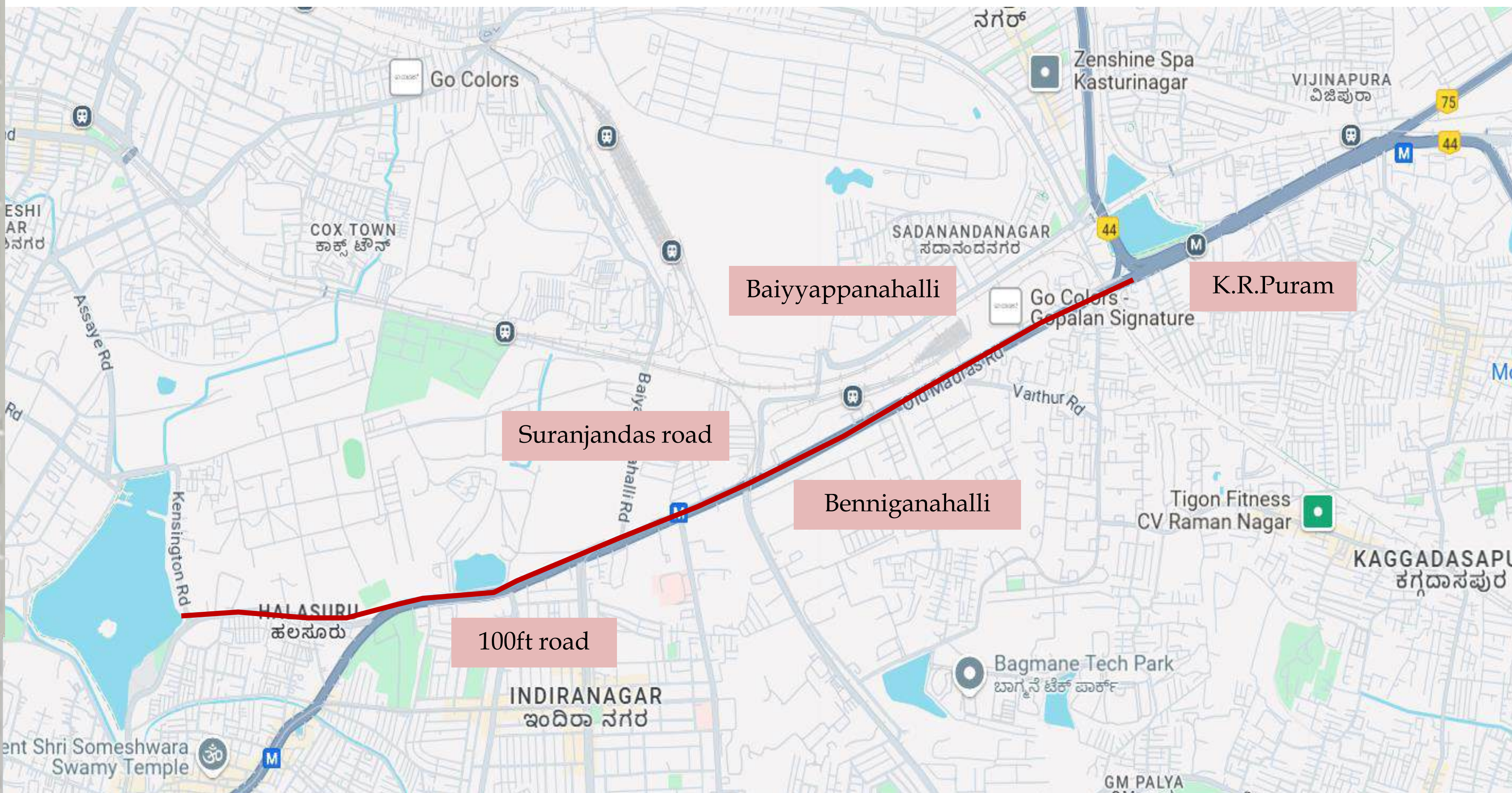


Figure 129. Proposed Elevated corridor from Halasur lake on Old Madras road to K. R. Puram - Alignment Details section C

Proposed Elevated Rotary at the intersecting point of two Elevated corridors near Swami Vivekananda Metro Station

A **three-arm elevated rotary** is a circular traffic interchange located at an elevated level, typically above ground, designed to manage traffic from three connecting roads or highways. It functions similarly to a roundabout but is elevated, often built above an existing road network to manage traffic flow efficiently.

Here's how it works:

1.Three Arms: This rotary connects three different roads or routes that converge at one point. The traffic from each arm enters the circular rotary and can exit onto any of the other two connecting roads, ensuring continuous movement without the need for traditional intersections or stoplights.

2.Elevated Structure: The rotary is constructed above ground, allowing it to handle traffic flows from multiple directions while avoiding the interference of ground-level traffic. It is especially useful in busy urban areas or where there are multiple crossing points.

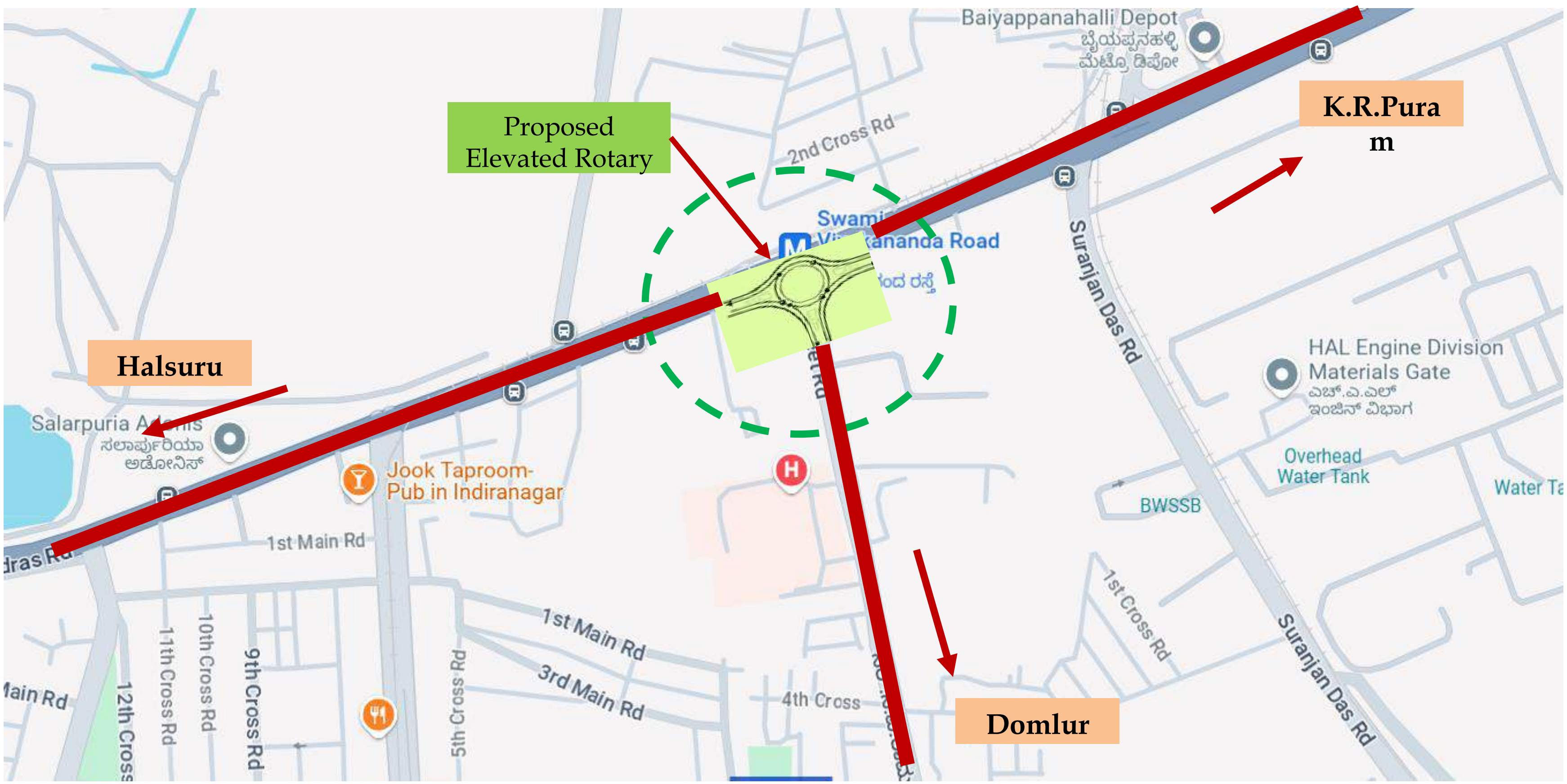


Figure 130. Proposed Elevated Rotary at the intersecting point of two Elevated corridors near Swami Vivekananda Metro Station

Proposed Elevated Rotary at the intersecting point of two Elevated corridors near Swami Vivekananda Metro Station

Figure 131. Site Photos of the Proposed Elevated Rotary at the intersecting point of two Elevated corridors near Swami Vivekananda Metro Station

Proposed Elevated Rotary & Loop System at K.R.Puram Interchange

K.R. Puram interchange is a crucial junction where multiple major roads converge, including the Outer Ring Road from Hebbal, the Hoskote National Highway, the Outer Ring Road from Silk Board, and Old Madras Road from Yeshwanthpur. Given the complexity of traffic from these multiple directions, various flyovers and bridges have already been proposed. Additionally, the integration of the Metro rail system further complicates the junction, making it one of the most intricate in Bangalore. As a result, a comprehensive solution is required to address the traffic challenges. Two options have been proposed for this location:

1. A Loop System
2. An Elevated Rotary

Figure 132. Site **Proposed Elevated Rotary & Loop System at K.R.Puram Interchange**

Proposed Elevated Rotary at K.R.Puram Interchange

To integrate the three elevated corridors converging at this point from Hebbal, Silk Board, and Yeshwanthpur, a second-level elevated rotary is proposed, with the Metro operating at level one. This rotary will also be connected to the existing flyover, enabling seamless traffic flow from all directions, as illustrated in the figure below

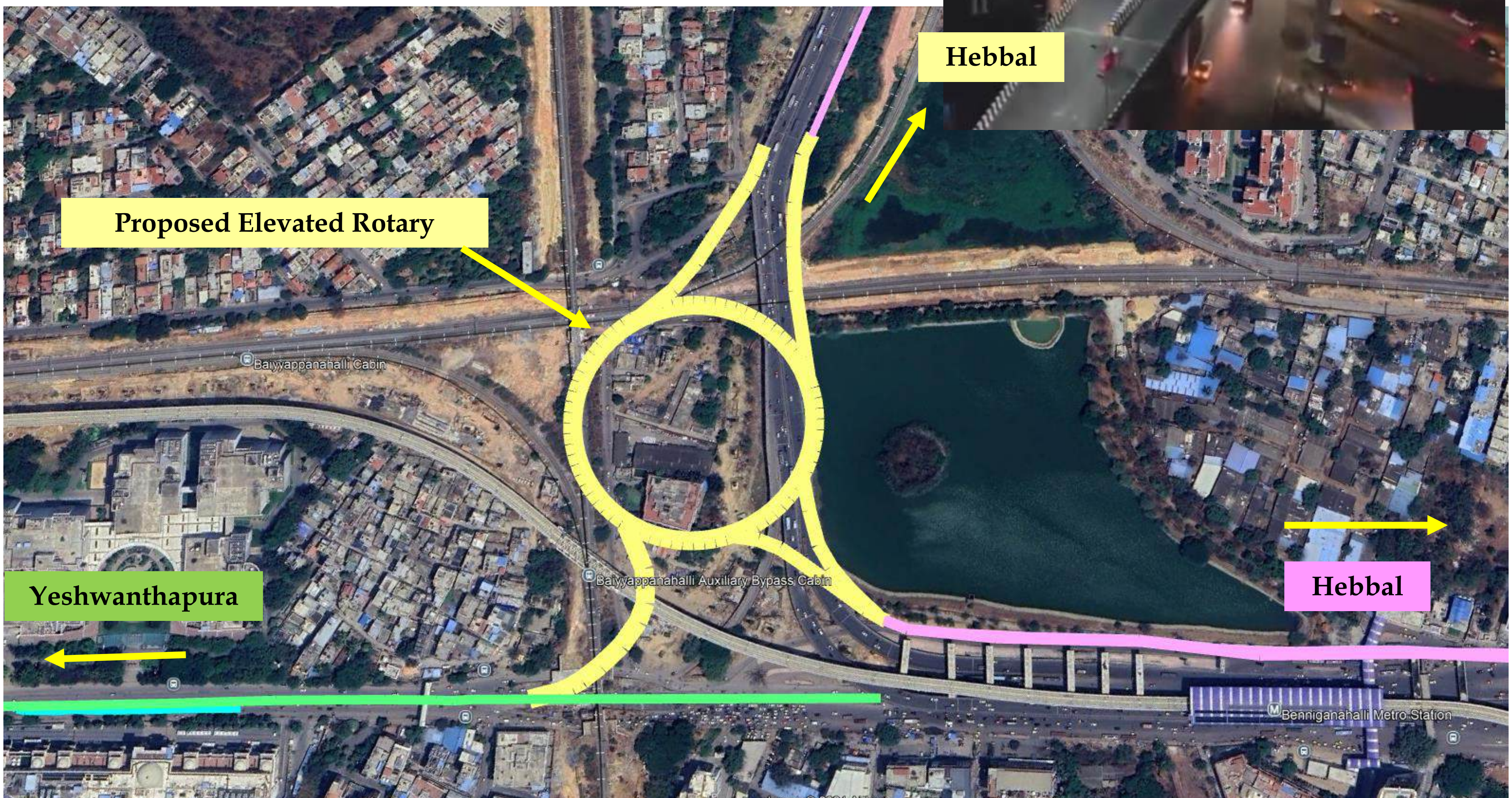


Figure 133. **Proposed Elevated Rotary at K.R.Puram Interchange**

Site photos of Proposed Elevated Rotary at K.R.Puram Interchange

Figure 134. Site Photos of the Proposed Elevated Rotary at K.R. Puram

Proposed Elevated Loop system for integrating with all the elevated corridors

To integrate the three elevated corridors converging at this point from Hebbal, Silk Board, and Yeshwanthpur, a second-level elevated rotary is proposed, with the Metro operating at level one. This rotary will also be connected to the existing flyover, enabling seamless traffic flow from all directions, as illustrated in the figure 145 below

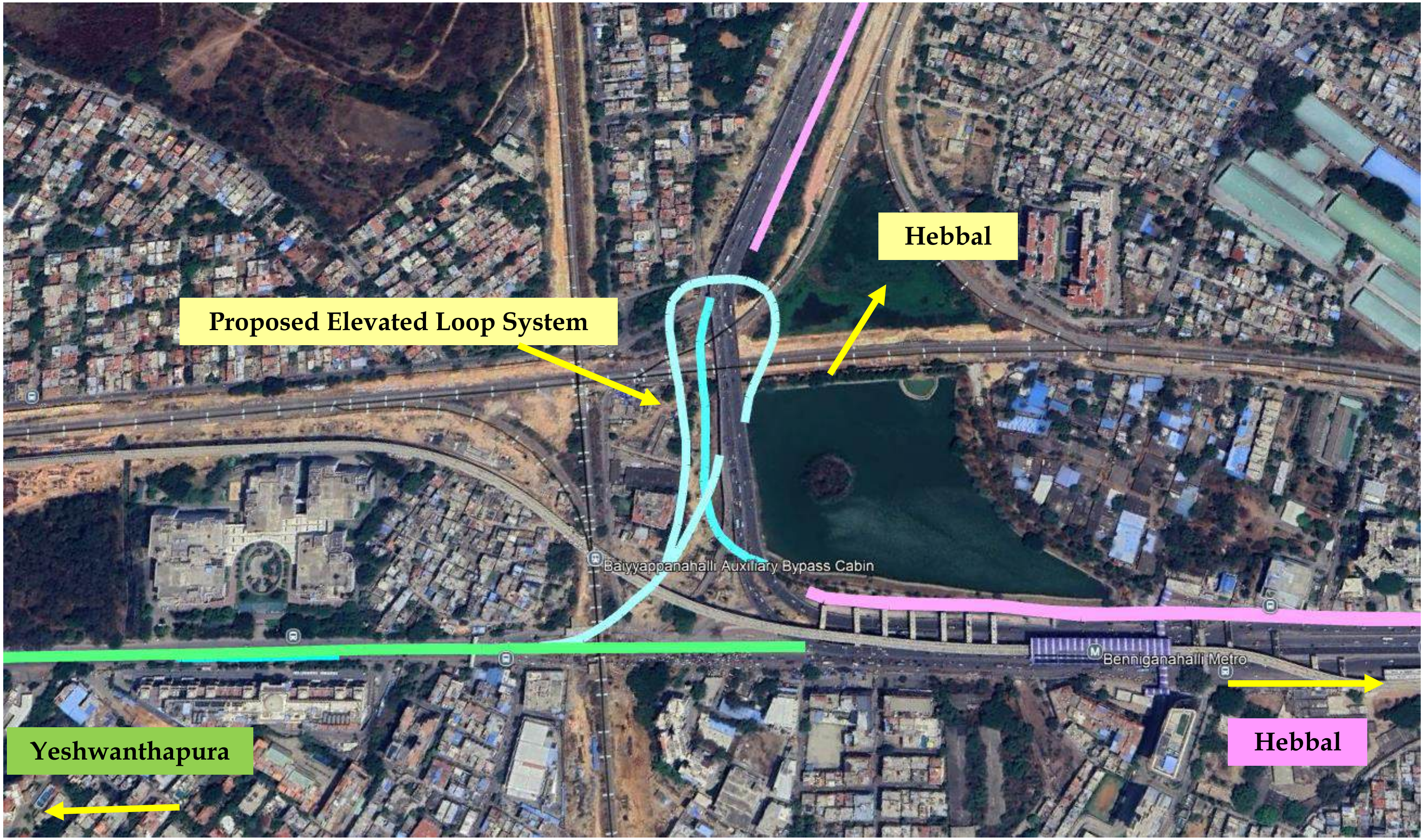


Figure 135. **Proposed Elevated Rotary at K.R.Puram Interchange**

Proposed Typical Cross section for the 4 lane divided Elevated corridor from Yeshwanthapura to K.R.Puram on Old Madras road

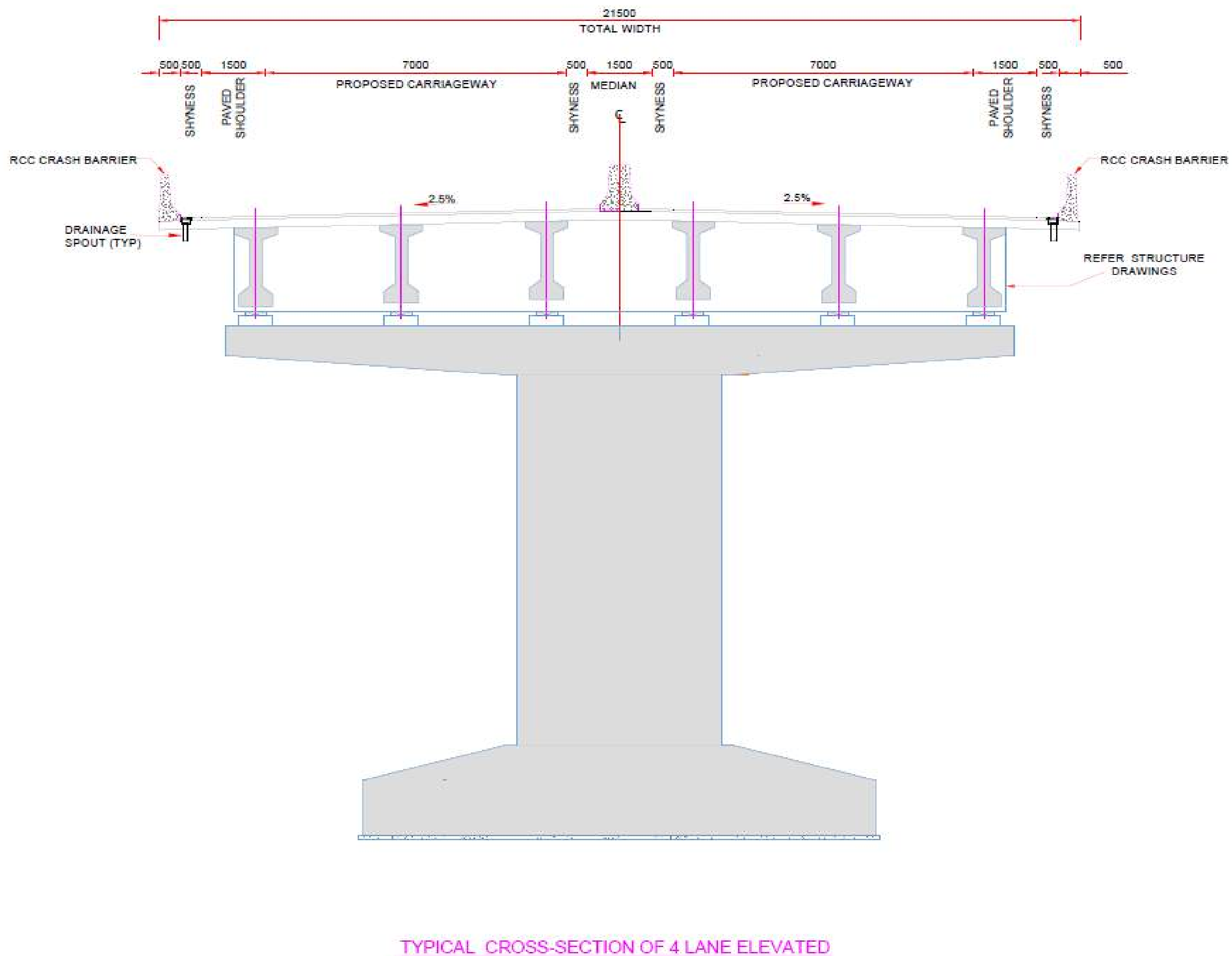


Figure 136. **Proposed cross section for 4 lane Elevated corridor from Yeshwanthapura to K.R.Puram on Old Madras Road**

Proposed Typical Cross section for the 6 lane divided Elevated corridor from Yeshwanthapura to K.R.Puram on Old Madras road

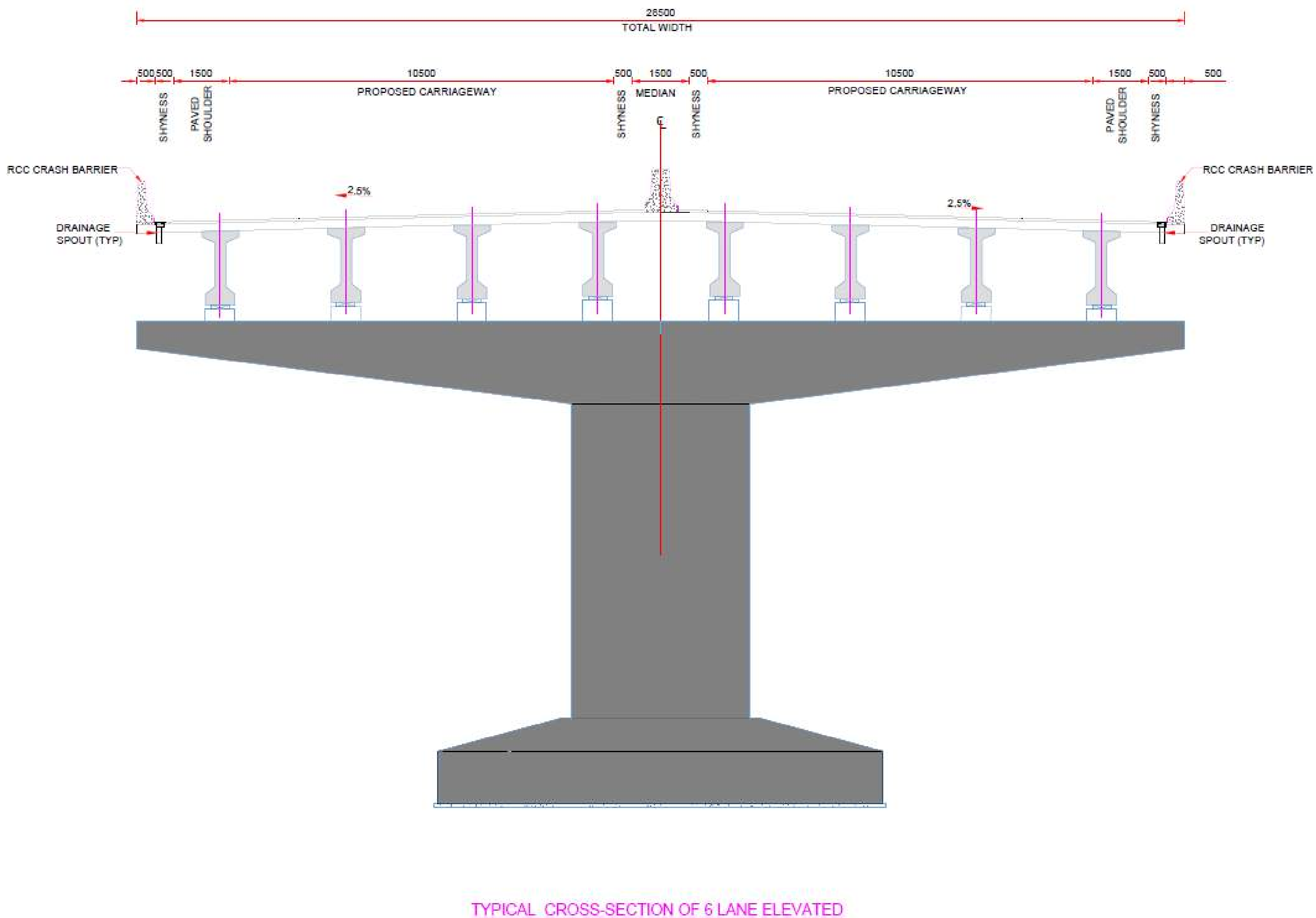


Figure 137. **Proposed cross section for 6 lane Elevated corridor from Yeshwanthapura to K.R.Puram on Old Madras Road**

CORRIDOR 03

J.C Road

Proposed Integrated Elevation from Hudson Circle to Minerva Circle (Minerva Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)

CORRIDOR IV: JC ROAD / LAL BAGH MAIN ROAD (one way loop)

Starting from Hudson Circle to Lal Bagh West Gate; Minerva Circle to Hudson Circle via Town Hall

The fourth corridor to be undertaken for the corridor improvement study is the J.C Road/ Lal Bagh Road Corridor (**Figure 196**), which starts from Hudson Circle near BBMP office to Lal Bagh West Gate, then reaching Town Hall and Hudson Circle back via Minerva circle.

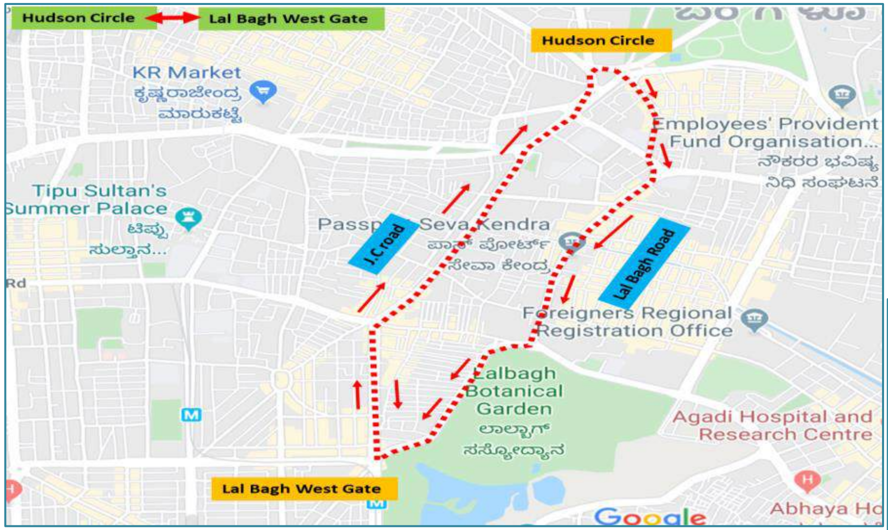


Figure 138 JC Road Corridor

It is one of the busiest corridors in the center of the city. It is the major life line which connects north and south parts of the city.

Some of the main features of the corridor are:

- This is a six-lane divided road with varying lanes from 2 lanes to 6 lanes.
- Length of the study corridor is 5.5 km and is a sub Arterial road.
- The road surface is varying from bituminous to concrete.
- There are thirteen signalized junctions along the corridor.
- Metro Rail runs on the edge of the corridor at Lal Bagh West Gate

Landmarks, Attraction & Production Centers

The corridor attracts many work trips due to the presence of Government Office, small-scale industries, wholesale markets, Hotels,Botanical Park etc.(**Figure 203**) .
The corridor houses many major attraction points such as::

•The biggest car accessories market is located on the corridor, along with wholesale markets for aluminium, plastic, mats; net etc. along J.C.Road. The vehicular density in terms of trucks, LCVs, luggage autos is more along J.C road.

•One of the oldest and biggest botanical gardens of Karnataka is located along the corridor.

• The corridor also houses heritage and important structures like Town hall, Ravindra Kalakshetra, BBMP Office, Shivaji Statue, Unity Building, LIC Building, Canara Bank etc.

•Prominent government institutions like Bruhat Bangalore Mahanagara Palike- BBMP, Pass Port Office, and Government College of Pharmacy etc. are on the corridor.

•The famous cancer hospital – HCG is located on this corridor.

•The area adjacent to J.C Nagar i.e. Sudama Nagar houses various small scale industries like garments, manufacturing units of tools, chairs etc.

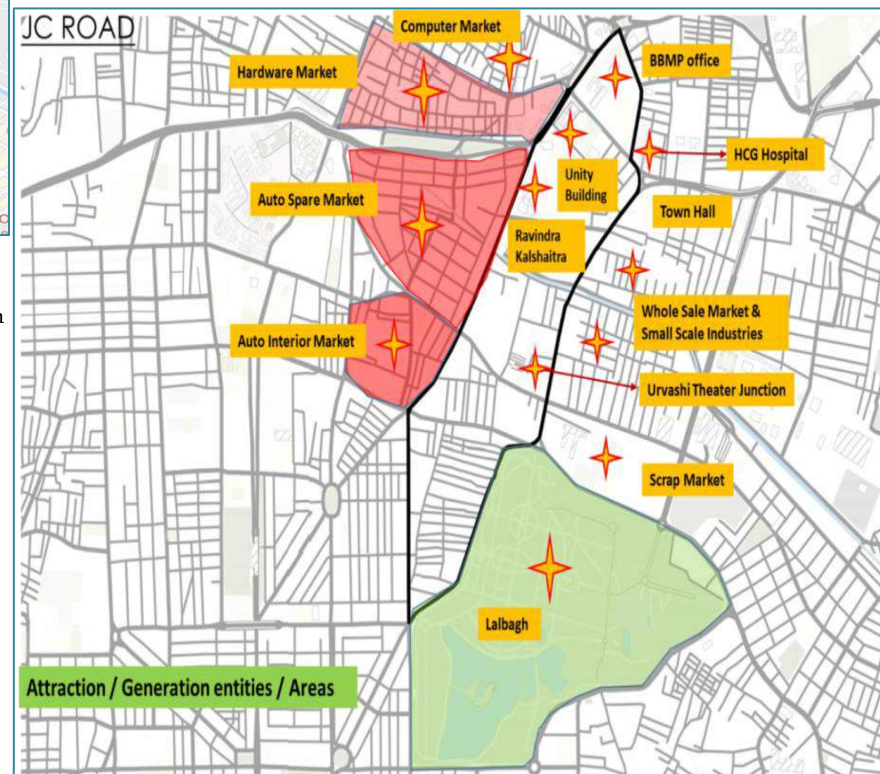


Figure 139. Attraction/ Generation Entities/ Areas

CORRIDOR IV: JC ROAD / LAL BAGH MAIN ROAD (one way loop) Starting from Hudson Circle to Lal Bagh West Gate; Minerva Circle to Hudson Circle via Town Hall

The fourth corridor to be undertaken for the corridor improvement study is the J.C Road/ Lal Bagh Road Corridor (Figure 198), which starts from Hudson Circle near BBMP office to Lal Bagh West Gate, then reaching Town Hall and Hudson Circle back via Minerva circle as shown below in **Figure 204**

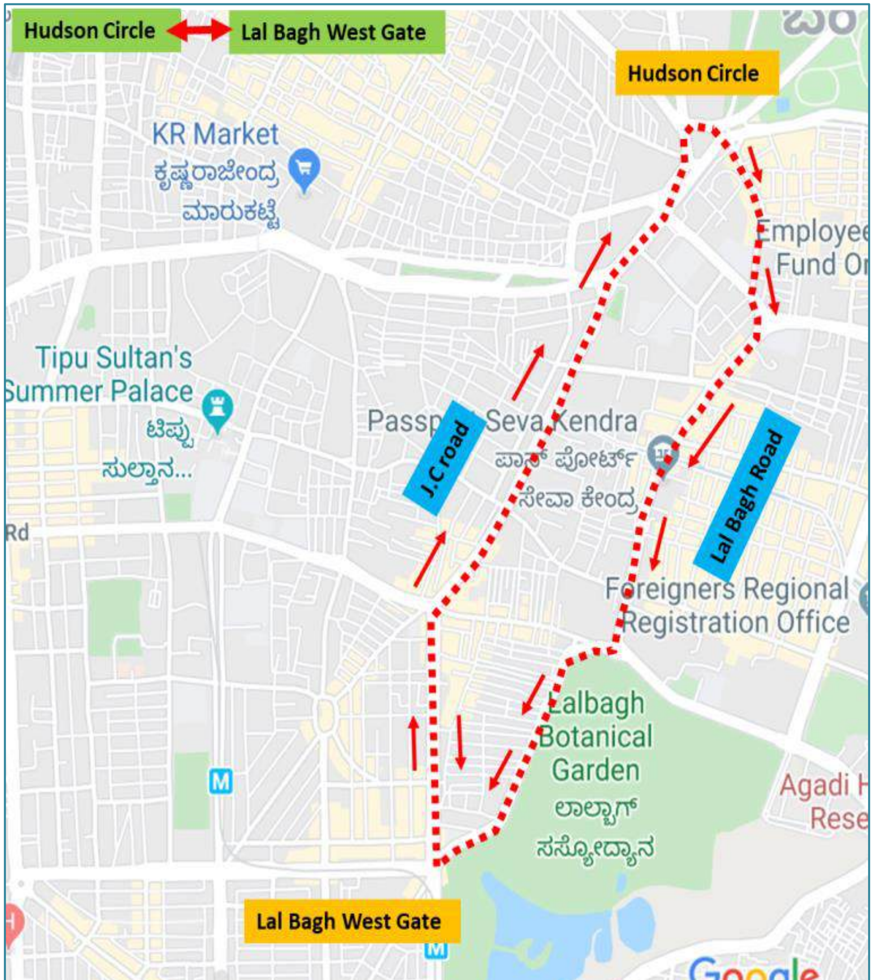


Figure 140 JC Road Corridor

It is one of the busiest corridors in the center of the city. It is the major life line which connects north and south parts of the city.

Some of the main features of the corridor are:

- This is a six-lane divided road with varying lanes from 2 lanes to 6 lanes.
- Length of the study corridor is 5.5 km and is a sub Arterial road.
- The road surface is varying from bituminous to concrete.
- There are thirteen signalized junctions along the corridor.
- Metro Rail runs on the edge of the corridor at Lal Bagh West Gate

Landmarks, Attraction & Production Centers

The corridor attracts many work trips due to the presence of Government Office, small-scale industries, wholesale markets, Hotels,Botanical Park etc.(**Figure 205-206**) .
The corridor houses many major attraction points such as::

Figure 141 Landmarks, Attraction and Production Centres


LIC Building

Unity Building


Ravindra Kalakhethra


Town Hall

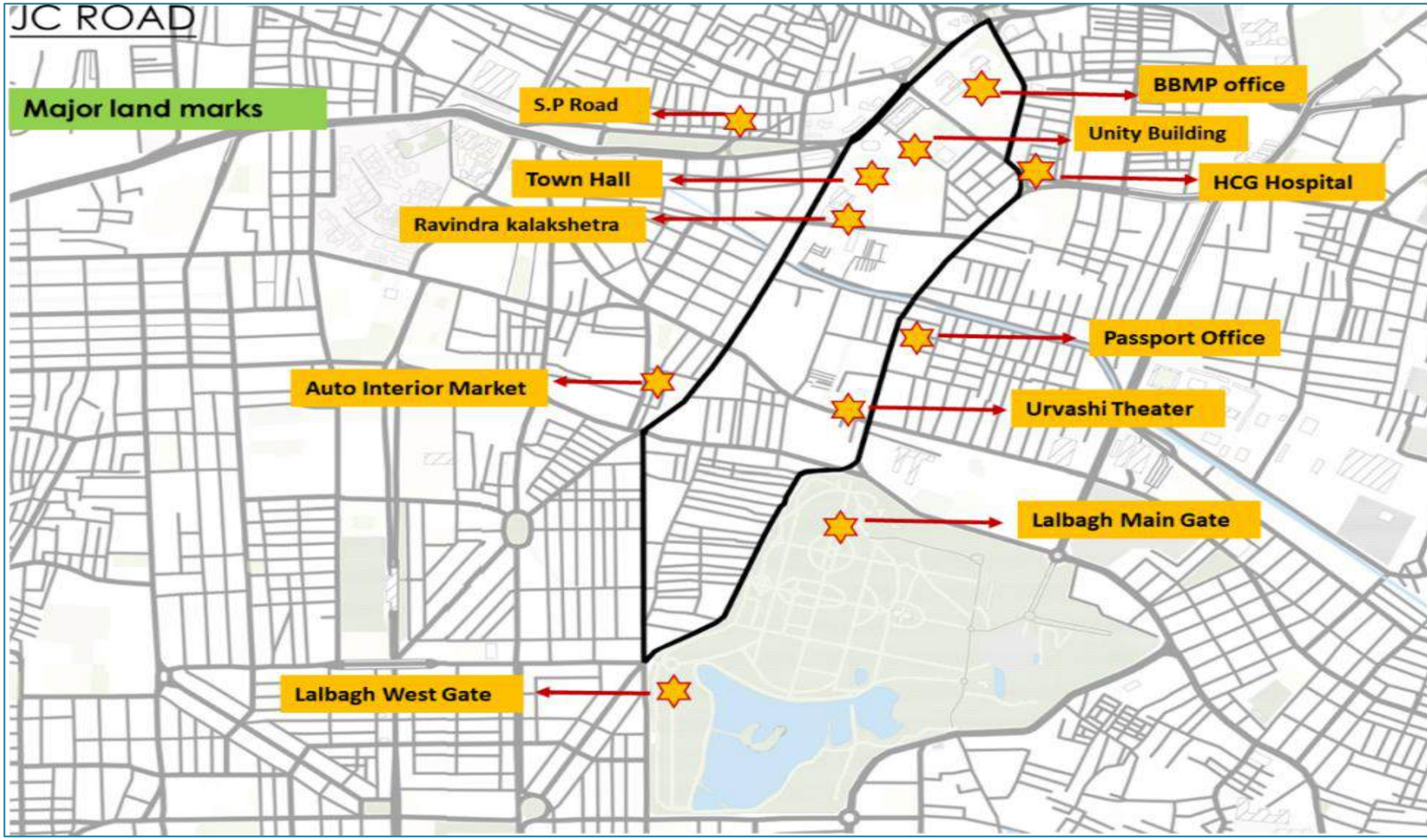


Figure 142. Attraction and Trip Generation

The land marks mentioned above attract huge trips 0n both weekdays as well as on weekends. The corridor does not have metro alignment but one of the metro stations is located near Lal Bagh West Gate.

Major Bus Stops and Metro Stations along the Corridor

There are nine bus stops located along the corridor. There is a dedicated bus bay on Kalinga Road and for the remaining bus stops there are no bus bays. The absence of bus bays results in buses stopping on the carriageway itself. All the Bus Stop locations are as shown in the **Figure 207**.

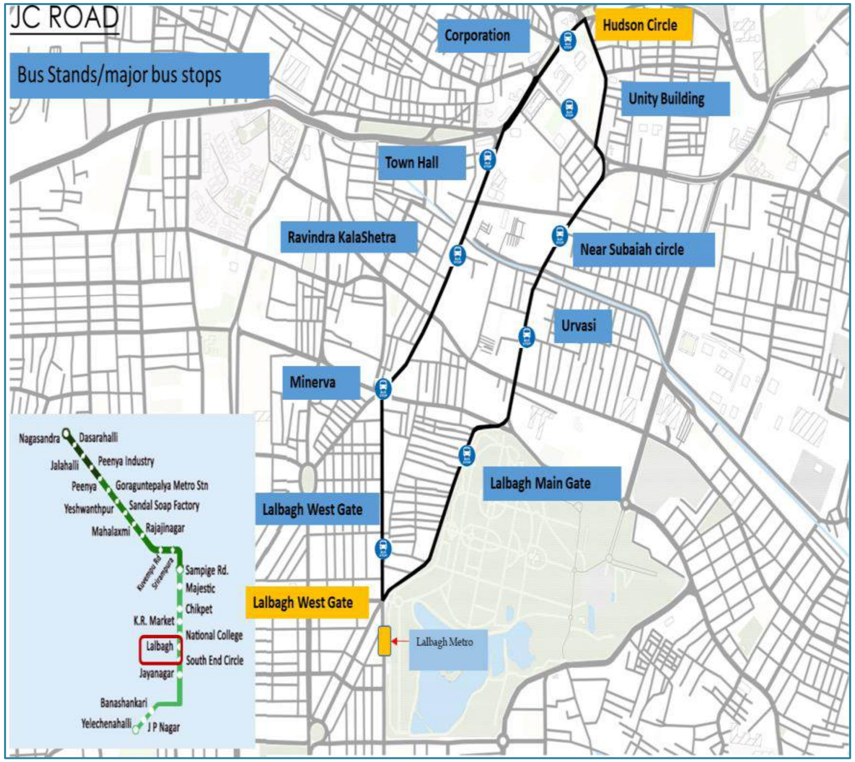


Figure 143. Bus Stops And Metro Station Along The Corridor

Corridor Characteristics

Figure 144. Road Along The Corridor

The entire corridor is a varying from 3 Lane to 6 lane one way with footpath on either side, except on a small stretch on J.C road near pass port office, where the road width is narrow, resulting in peak hour traffic congestion. Besides, on Devanga Hostel Road, one stretch of roadway is reduced to just two-lane (**Figure 208**)

Existing Footpaths/Pedestrian Facilities

It is observed that on certain stretches of road, footpath condition is good but on majority of the locations, the condition of the footpath is poor. The pedestrian facilities along the corridor are largely neglected. There is only one pedestrian skywalk along entire corridor. Footpaths are encroached upon near the Auto Market (**Figure 209)**

Figure 145 Existing Footpath Along The Corridor

Figure 146 Existing Footpath Along The Corridor

Major Junctions

There are seven major intersections where maximum merging and diverging of the traffic takes place. The major intersections are:

1. Hudson Circle- 4 arm Signalized intersection(**Figure 211**).
2. Subbaiah Circe– 3 arm Signalized intersection.
3. Urvashi Circle – 4 arm Signalized intersection.
4. Lal Bagh Main Gate circle- 3 arm Signalized intersection.
5. Lal Bagh West Gate circle- 5 arm Signalized intersection
6. Minerva Circle – 5 arm Signalized intersection.
7. Town Hall intersection -3 arm signalized intersection.

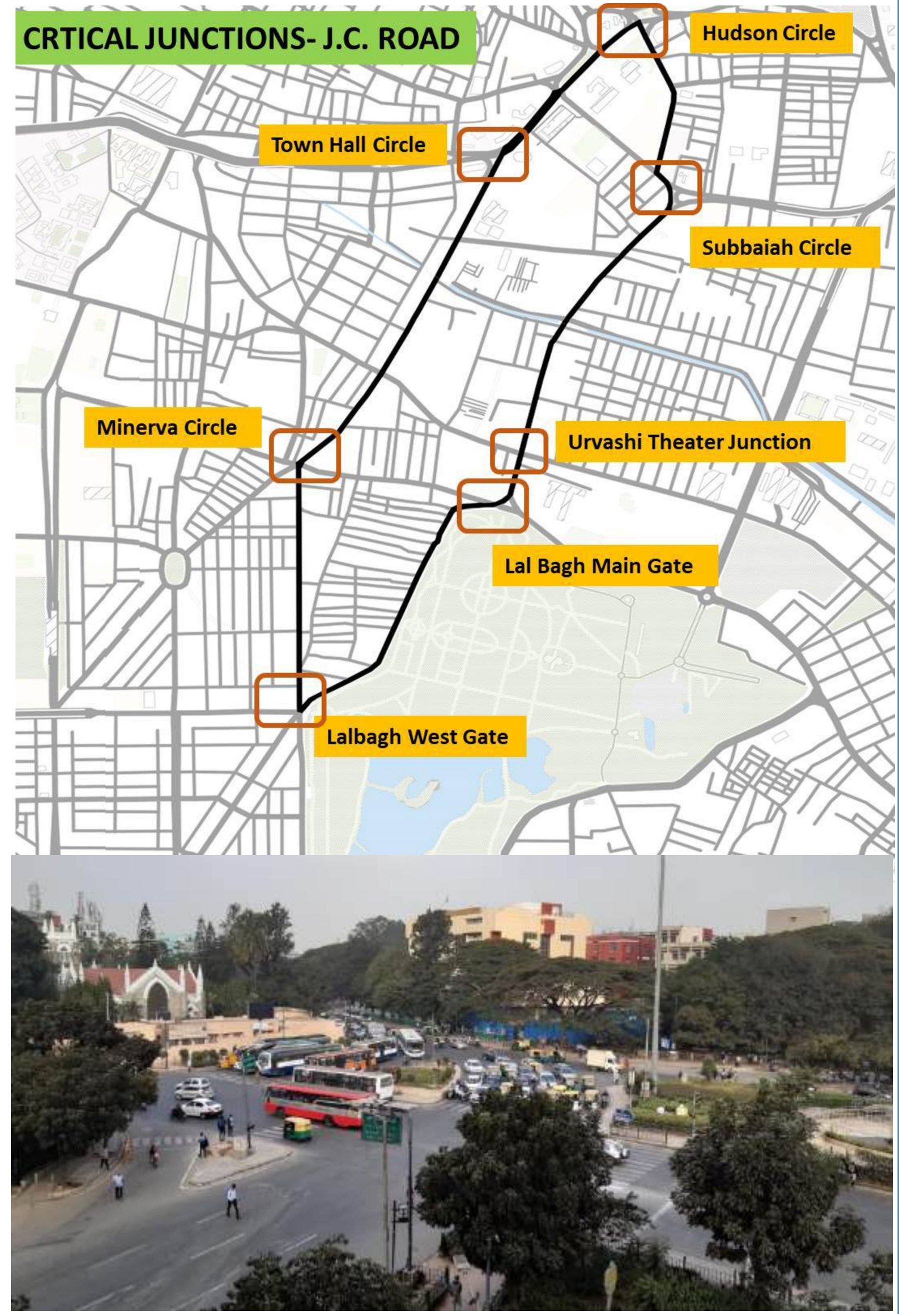


Figure 147. Critical Junctions Along The Corridor

Signage / Marking / Signals

The corridor lacks right signboards at the right locations; the signboards do not have good foundation and most of the signboards are either damaged or not relevant to the site. The signboards are installed on the shoulders rather than on the footpath, thus neglecting the safety of the road users.**(Figure 212)**

Figure 148Dislocation of Signboards Along The Corridor

Road safety aspects are also ignored along the corridor to a larger extent which is of major concern. Some of the safety issues are:

•Pedestrian crossings are completely neglected along Lal Bagh Road on the road stretch from Subbiah Circle until the Lal Bagh Main Gate.
The roadway is a one way and there are only two intersections in between, and the speeds are high. Due to high vehicular speed, it has become difficult for the pedestrians to cross the roadway and facilities like skywalks or high raised pedestrian crossings are missing along the corridor. Similarly, on the J.C Road, there is no pedestrian crossing facility available at any mid blocks thereby compromising on the pedestrian safety.

•None of the bus stops have the Bus bays designed along the corridor, thus the commuter safety is compromised. Absence of bus bays is adding up to buses stopping on the carriageway leading to congestion during the peak hours.

Road markings are missing for the entire corridor stretch .especially, on J.C Road, which is a newly laid road. In the absence of road markings, traffic discipline cannot be attained. Road safety furniture like cat eyes, solar blinkers are missing all along the corridor, which are required for safe access during night. (**Figure 149)**

Figure 149.Condition of Road Surface & Road Marking Along The Corridor

Road surface at certain points is very bad resulting in two-wheeler skidding, leading to fatal accidents, especially at Subbiah Circle, near passport office and near Urvashi Theater. Footpaths are in very bad condition, which need to be rectified on priority; especially on Devanga Samaja Road, the granite slabs damaged. The electrical cables from the old electric poles are left open, compromising on pedestrian safety. (**Figure 150**)

Figure 150.Condition of Footpath Along The Corridor

Land Use Along The Corridor

It is observed that majority of the land use pattern along the corridor is commercial and the rest are for public and parks. It is also observed that most of the existing residential land uses have been used for commercial purposes. (**Figure 151)**

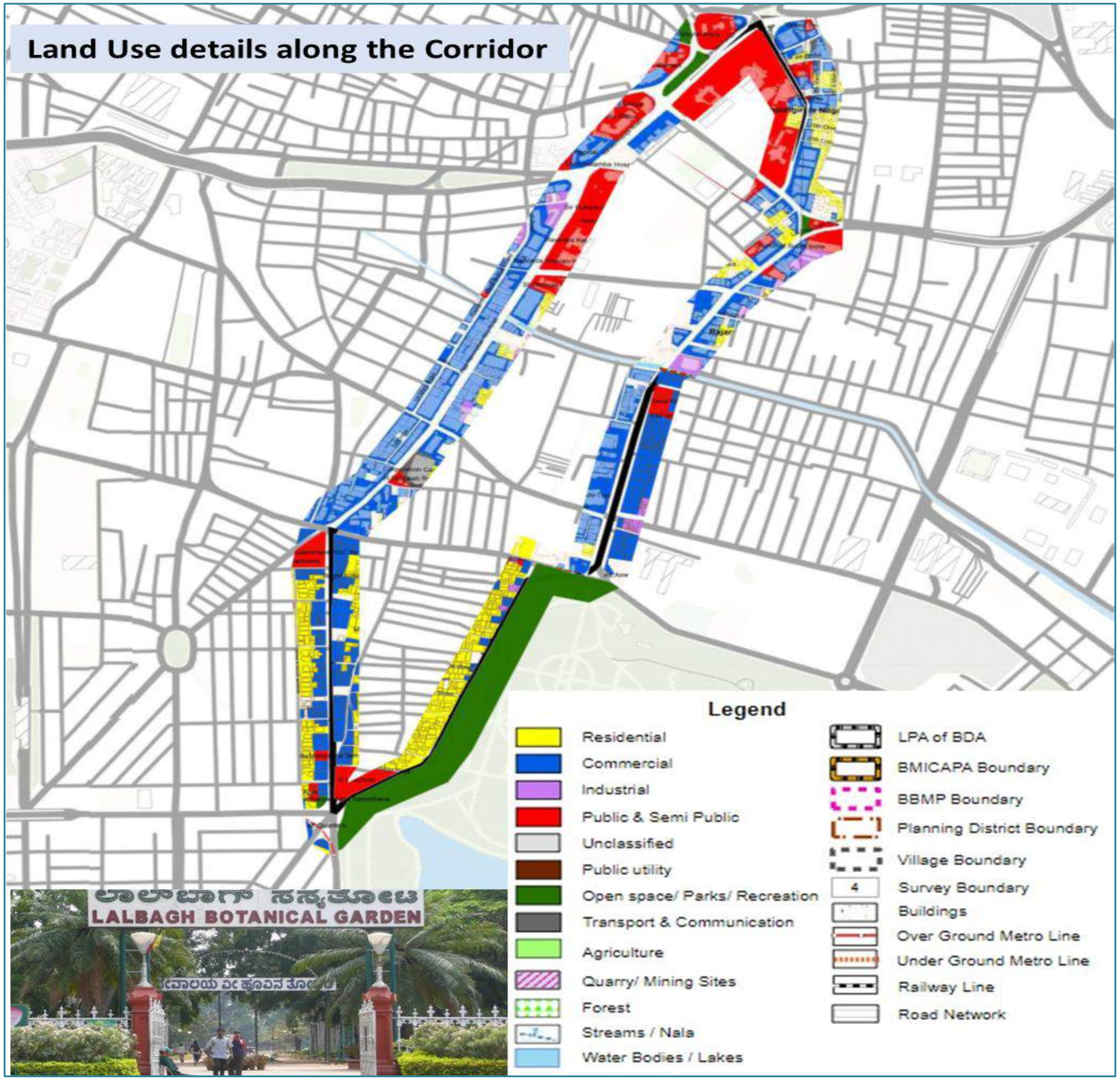


Figure 151. Land use Details Along The Corridor

PART B
SURVEY ANALYSIS

Traffic Survey Details

In order to assess the existing traffic and transport characteristic of the corridor (**Table 40)** and to decide on the type of traffic management measures needed, traffic surveys were carried out.(**Figure 152**)

The survey particulars are as presented in the following paragraphs:

Table 40: Study Corridors For Traffic Surveys

Sl. No	Type of Survey	Quantity
1	Turning Volume Count	7 Intersections
2	Pedestrian Count Survey	7 Intersections
3	Speed And Delay (Bus & Car)	5.5 Km
4	Road Network Inventory	5.5 Km
5	Traffic Signal Phasing	7

Traffic Volume Counts

Traffic volumes were extracted from the turning volume counts conducted along the corridor. The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. The PCUs corresponding to urban roads as per IRC: 106-1990 were used and the Peak Hour Traffic Volumes are as presented **Table 59**.

Figure 152. Traffic Volume Count Locations Along The Corridor

One Way Stretch

Table 41:Traffic Volume Count Survey Conducted Along The Corridor

Sl. No.	Road Name	Morning Peak Hour	Morning Peak Hour Volume		Evening Peak Hour	Evening Peak Hour Volume	
			Vehicles	PCUs		Vehicles	PCUs
1	Devanga Samaja Road	11.00-12.00	4344	3851	19.15-20.15	4466	3953
2	Lalbagh Main Road-Between Subbiah Circle and Urvashi Theatre Junction	10.15-11.15	4138	3352	19.00-20.00	4187	3418
3	Lalbagh Main Road-Between Urvashi Theatre Junction and Lal Bagh Main Gate	10.15-11.15	4575	3927	19.00-20.00	4627	3757
4	Kumbigal Road -Between Lalbagh Main Gate Junction and Lalbagh West Gate Junction	10.00-11.00	5304	4041	19.15-20.15	5416	4141
5	JC Road-Between Minerva Circle and JC Road Junction	9.15-10.15	11011	9324	19.30-20.30	9499	8198
6	JC Road-Between JC Road Junction and Town Hall Junction	9.00-10.00	6549	5199	17.30-18.30	6251	4831
7	Mysore Road-Between N.R Square and Police Square	10.45-11.45	7144	6944	19.30-20.30	7226	7087

Two Way Stretch

Sl. No.	Road Name	Morning Peak Hour	Morning Peak Hour Volume				Evening Peak Hour	Evening Peak Hour Volume			
1	Rasthriya Vidhyalaya Road-Between Lalbagh West Gate Junction and Minerva Junction	10.00-11.00	Towards Minerva Circle		Towards Lalbagh		19.15-20.15	Towards Minerva Circle	Towards Lalbagh		
			Vehicles	PCUs	Vehicles	PCUs		Vehicles	PCUs	Vehicles	PCUs
			4664	3533	665	435		4605	3456	638	449
2	Mysore Road-Between Town Hall Junction and N.R Square	10.15-11.15	Towards Hudson Circle		Towards Town Hall		19.15-20.15	Towards Hudson Circle	Towards Town Hall		
			Vehicles	PCUs	Vehicles	PCUs		Vehicles	PCUs	Vehicles	PCUs
			5426	5373	2787	3082		5352	5384	2745	3034

Among the 9 Mid-Block locations, traffic volume along JC Road (Between Minerva Circle and JC Road Junction) is found to be highest with 9324 PCUs during morning peak hour and 8198 PCUs during evening peak hour.

Volume to Capacity Ratio (V/C) and Level of Service

Volume to Capacity Ratio (V/C Ratio) is defined as the ratio of peak hour traffic flow rate to capacity and Level of Service (LOS) is defined as the a qualitative measure, describing operational conditions within a traffic stream and their perception by the drivers/passengers.
Universally, LOS is lettering scheme ranging from A to F. LOS 'A' represents highest quality of service whereas LOS 'F' represents heavily congested flow where traffic demand exceeds capacity. The service measures used for defining LOS are density and volume-to-capacity ratio.
For computation of V/C Ratio the capacity values have been adopted based on the road geometrics by applying adjustment factors ***(as per Indo Highway Capacity Manual 2012-2017)*** conforming to the site conditions.
The ratio of peak hour traffic flow rate to capacity (V/C Ratio) and the Level of Service (LOS) of the road sections along JC Road/Lal Bagh Corridor are presented below.(**Table 42**)

Table 42:Traffic Volume to Capacity Ratio Conducted Along The Corridor

Sl. No.	Road Name	Typology of Road	Capacity	Morning Peak Hour Volume (PCUs)	V/C Ratio	Level of Service	Evening Peak Hour Volume (PCUs)	V/C Ratio	Level of Service
1	Devanga Samaja Road	3 Lanes	3600	3851	1.07	LOS F	3953	1.10	LOS F
2	Lalbagh Main Road-Between Subbiah Circle and Urvashi Theatre Junction	4 Lane	5400	3352	0.62	LOS C	3418	0.63	LOS C
3	Lalbagh Main Road-Between Urvashi Theatre Junction and Lal Bagh Main Gate	4 Lane	5400	3927	0.73	LOS C	3757	0.70	LOS C
4	Kumbigal Road - Between Lalbagh Main Gate Junction and Lalbagh West Gate Junction	3 Lanes	3600	4041	1.12	LOS F	4141	1.15	LOS F
5	JC Road-Between Minerva Circle and JC Road Junction	4 Lane	5400	9324	1.73	LOS F	8198	1.52	LOS F
6	JC Road-Between JC Road Junction and Town Hall Junction	4 Lane	5400	5199	0.96	LOS E	4831	0.89	LOS E
7	Mysore Road-Between N.R Square and Police Square	4 Lane	5400	6944	1.29	LOS F	7087	1.31	LOS F

Table 43:Traffic Volume to Capacity Ratio Conducted Along The Corridor

Road Name	Typology of Road	Capacity*		Morning Peak						Evening Peak					
				Morning Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*		Evening Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*	
Rasthriya Vidhyalaya Road- Between Lalbagh West Gate Junction and Minerva Junction	4 Lane	Towards Minerva Circle	Towards Lalbagh	Towards Minerva Circle	Towards Lalbagh	Towards Minerva Circle	Towards Lalbagh	Towards Minerva Circle	Towards Lalbagh	Towards Minerva Circle	Towards Lalbagh	Towards Minerva Circle	Towards Lalbagh	Towards Minerva Circle	Towards Lalbagh
		2700	2700	3533	435	1.31	0.16	LOS F	LOS A	3456	449	1.28	0.17	LOS F	LOS A
Mysore Road- Between Town Hall Junction and N.R Square	4 Lane	Towards Hudson Circle	Towards Town Hall	Towards Hudson Circle	Towards Town Hall	Towards Hudson Circle	Towards Town Hall	Towards Hudson Circle	Towards Town Hall	Towards Hudson Circle	Towards Town Hall	Towards Hudson Circle	Towards Town Hall	Towards Hudson Circle	Towards Town Hall
		2700	2700	5373	3082	1.99	1.14	LOS B	LOS C	5384	3034	1.99	1.12	LOS F	LOS F

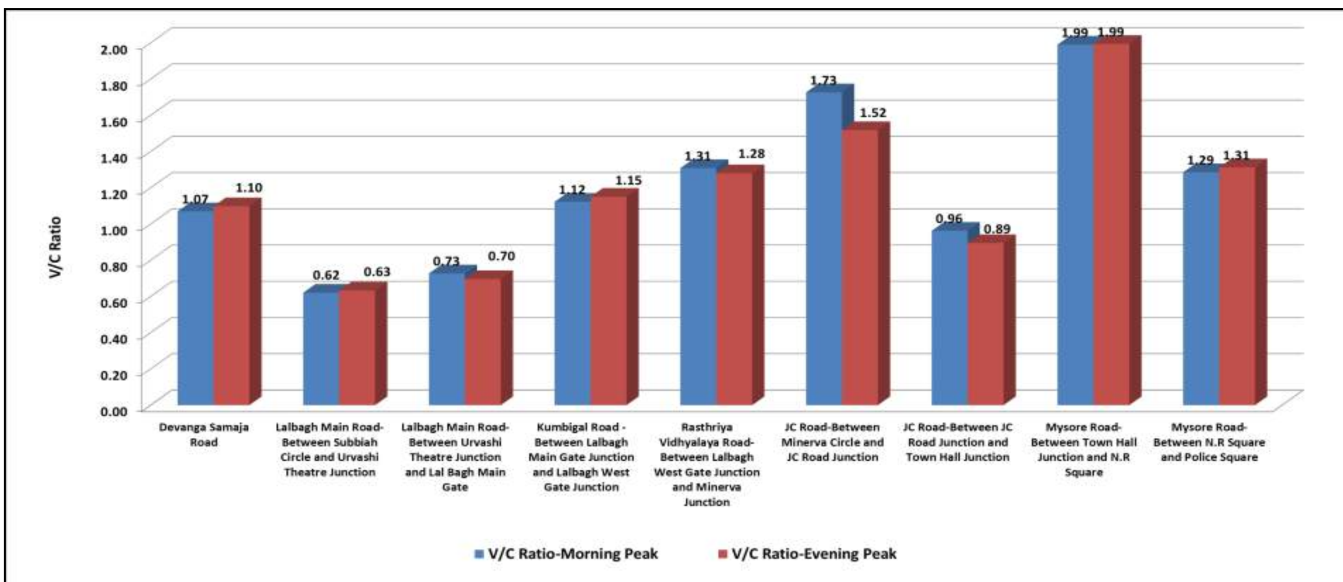


Figure 153. Volume to Capacity Ratios along JC Road/ LalBagh Road Corridor

It can be observed that amount of traffic at all the locations (except along Lalbagh Main Road-between Subbiah Circle and Lalbagh Main Gate Junction) exceeds beyond its capacity resulting in considerable delay and queuing. **Figure 216**
The volume to capacity ratio at most of the locations exceeds 1.0 and the Level of Service is found to be 'F' which indicates heavily congested flow where traffic demand exceeds capacity.

Traffic Volume at Junctions

The traffic volumes at intersections help in assessing the traffic volumes at mid-block locations of the arms of the intersection which together with journey speed and road inventory data aid in evaluating the Level of Service (LOS) of Urban Arterials and further, the traffic volumes at mid-block also establishes the need for safe pedestrian crossing facility taking into account the pedestrian crossing volumes. Passenger Car Units (PCUs) by adopting equivalent PCUs.

Among the 7 turning volume count surveyed locations, Hudson Circle is noted to be carrying the highest peak hour volume (9270 PCUs during morning peak and 9419 PCUs during evening peak) followed by Lalbagh West Gate Junction with 8804 PCUs during morning peak and 8859 during evening peak Traffic volume counts were conducted at 7 major intersections along the study corridor to assess the existing traffic level. The locations were duly identified based on reconnaissance for conduct of turning traffic volume count surveys. The vehicles counted were converted to Peak Hour Traffic Volumes are as shown below (**Figure** 154)(**Table 44**)

Table 44: Traffic Volume at Junctions Conducted Along The Corridor

Sl. No.	Junction Name	Morning Peak Hour Volume		Morning Peak Hour	Evening Peak Hour Volume		Evening Peak Hour
		Vehicles	PCUs		Vehicles	PCUs	
1	Hudson Circle	12572	9270	11.00-12.00	12697	9419	19.15-20.15
2	Urvashi Theatre Junction	7449	4935	10.15-11.15	7515	5050	19.00-20.00
3	Lalbagh West Gate Junction	13055	8804	10.00-11.00	13141	8859	19.15-20.15
4	Minerva Circle	12320	8383	9.15-10.15	10793	7649	19.30-20.30
5	Town Hall Junction	12272	8590	9.00-10.00	11593	8012	17.30-18.30
6	Corporation Circle-Near Unity Building	10416	7717	10.15-11.15	10285	7639	19.15-20.15
7	Corporation Circle-Near Old LIC Building	10406	7492	10.45-11.45	10517	7594	19.30-20.30

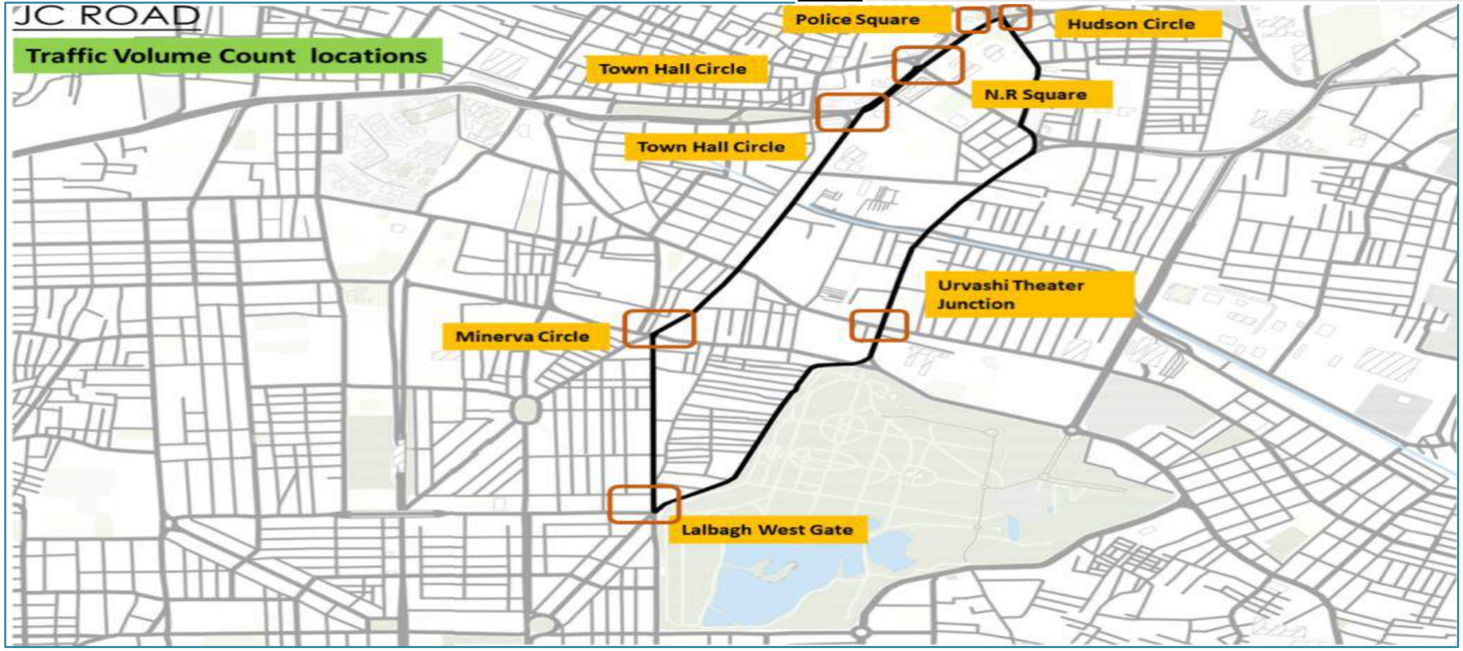


Figure 154. Traffic Volume Count locations Along The Corridor

Speed and Delay

Speed & delay survey provides a link wise estimate of journey time, running time and delay. Speed and Delay Survey was carried out for Bus and Car separately during morning and evening peak hours. In case of Car Speed and Delay Survey, floating car technique has been utilized for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the cumulative time at specified timing points to ensure obtaining the average link travel time of the road network.

The overall travel speed generally referred to as journey speed is the effective speed between two points and is computed as the distance divided by the total time taken by the vehicle to complete the journey including delays incurred en-route.

The speed maintained by the vehicle over the stretch while in motion is the running speed obtained through dividing the distance by the duration of time while the vehicle is in motion and thus excludes that part of time wherein the vehicle suffers delay. The journey speed and the variation between running speed and journey speed is the indicator of level of service and a measure of congestion. The survey data analysis also highlights the causes of delay that occurs at various locations such as stopped delay or operational delay.

The direction-wise abstract on analysis along Hudson Circle Corridor furnishing the name of road, length surveyed, journey speed and running speed is furnished below **(Figure 155)**(**Table 45-46**)

Table 45:Bus Speed and Delay- Towards Lalbagh West Gate (Morning Peak)

Carriageway Category	From Node	To Node	Length(in Km)	Journey Speed (Kmph)	Running Speed (Kmph)
One Way	Hudson Circle	Kalinga Rao Road Junction	0.30	6	13
One Way	Kalinga Rao Road Junction	Subbaiah Circle	0.43	6	15
One Way	Subbaiah Circle	Urvashi Theatre Junction	0.96	20	25
One Way	Urvashi Theatre Junction	Lalbagh Signal Junction	0.19	17	21
One Way	Lalbagh Signal Junction	Lalbagh West Gate Junction	1.31	33	39
AVERAGE				**17**	**23**

Table 46:Bus Speed and Delay- Towards Hudson Circle (Morning Peak)

Carriageway Category	From Node	To Node	Length (in Km)	Journey Speed (Kmph)	Running Speed (Kmph)
One Way	Lal Bagh West Gate Junction Signal	JC Road Junction	0.79	19	24
One Way	JC Road Junction	Siddhaiah Road Junction	0.36	18	23
One Way	Siddhaiah Road Junction	Town Hall Junction	0.75	13	20
One Way	Canara Bank Road	Hudson Circle	0.30	4	9
AVERAGE				**14**	**19**

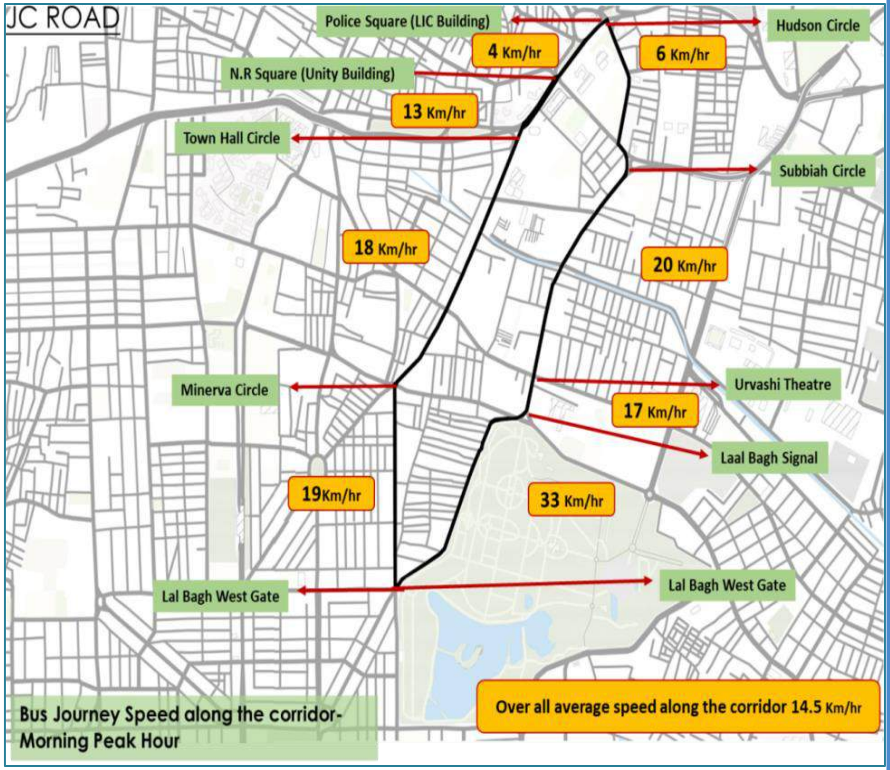


Figure 155. Bus Speed and Delay- Towards Lalbagh West Gate (Morning Peak)

Table 47:Bus Speed and Delay- Towards Lalbagh West Gate (Evening

Carriageway Category	From Node	To Node	Length(in Km)	Journey Speed (Kmph)	Running Speed(Kmph)
One Way	Hudson Circle Junction	Kalinga Road Junction	0.30	4	10
One Way	Kalinga Road Junction	Subbiah Circle Junction	0.43	10	19
One Way	Subbiah Circle Junction	Urvashi Theatre Junction	0.96	11	16
One Way	Urvashi Theatre Junction	Lal Bagh West Gate Junction	1.50	15	22
AVERAGE				10	17

Table 48: Bus Speed and Delay- Towards Hudson Circle (Evening **Peak**)

Carriageway Category	From Node	To Node	Length(in Km)	Journey Speed (Kmph)	Running Speed(Kmph)
One Way	Lal Bagh West Gate Junction	Minerva Junction	0.79	12	17
One Way	Minerva Junction	Town Hall Junction	1.10	16	32
One Way	Town Hall Junction	Kalinga Road Junction	0.26	7	11
One Way	Kalinga Road Junction	Hudson Church Junction	0.30	13	18
AVERAGE				12	20

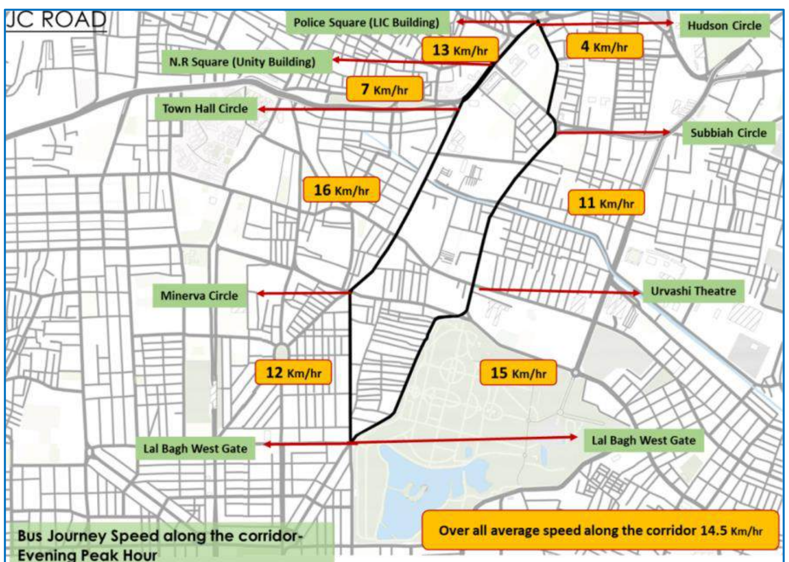


Figure 156:Bus Speed and Delay- Towards Hudson Circle (Evening Peak)

It was observed that the lower journey speeds are mainly due to traffic congestion and the delays are mostly occurring at junctions. The Average Bus Journey Speed is approximately 14.5 Kmph during morning peak hour and 11kmph during evening peak hour.(**Figure 156**)

Car Speed and Delay

Table 49: Average Morning Peak Speed & Delay Details - Cars

Carriageway Category	From Node	To Node	Length(in Km)	Journey Speed (Kmph)	Running Speed (Kmph)
One Way	Hudson Circle	Subbaiah Circle	0.48	22	30
One Way	Subbaiah Circle	Dr Nanjappa Junction	0.38	22	39
One Way	Dr Nanjappa Junction	Urvashi Theatre Junction	0.69	35	49
One Way	Urvashi Theatre Junction	Lalbagh Main Gate Signal Junction	0.20	40	55
One Way	Lalbagh Main Gate Signal Junction	Lalbagh West gate Signal	0.90	36	50
One Way	Lalbagh West gate Signal	Minerva Circle	0.70	16	27
One Way	Minerva Circle	J.C. Road Junction	0.40	6	9
One Way	J.C. Road Junction	Ravindra Kala Shetra Junction	0.50	8	12
One Way	Ravindra Kala Shetra Junction	Town Hall Junction	0.50	6	10
One Way	Town Hall Junction	Unity Building Junction	0.30	10	17
One Way	N.R Square (Unity Building)	Halsooru Police Station	0.30	15	28
One Way	Police Square	Corporation Circle	0.20	10	28
AVERAGE				19	29

It was observed that the lower journey speeds are mainly due to traffic congestion and the delays are mostly occurring at junctions. The Average car Journey Speed is approximately 19 Kmph during morning peak hour and 16kmph during evening peak hour.(**Figure 220-221**) **Table 50.**

The Average Journey speeds are shown below:

Table 50 :Average Evening Peak Speed & Delay Details - Cars

Carriageway Category	From Node	To Node	Length(in Km)	Journey Speed (Kmph)	Running Speed(Kmph)
One Way	Hudson Circle	Subbaiah Circle	0.48	15	24
One Way	Subbaiah Circle	Dr Nanjappa Junction	0.38	14	26
One Way	Dr Nanjappa Junction	Urvashi Theatre Jn	0.69	30	48
One Way	Urvashi Theatre Jn	Lalbagh Main Gate Signal Jn	0.20	20	30
One Way	Lalbagh Main Gate Signal Jn	Lalbagh West gate Signal	0.90	26	75
One Way	Lalbagh West gate Signal	Minerva Circle	0.70	20	36
One Way	Minerva Circle	J.C. Road Junction	0.40	5	6
One Way	J.C. Road Junction	Ravindra Kala Shetra Junction	0.50	8	8
One Way	Ravindra Kala Shetra Junction	Town Hall Junction	0.50	7	12
One Way	Town Hall Junction	Unity Building Junction	0.30	15	28
One Way	N.R Square (Unity Building)	Halsooru Police Station	0.30	15	30
One Way	Police Square	Corporation Circle	0.20	7	19
AVERAGE				**16**	**29**

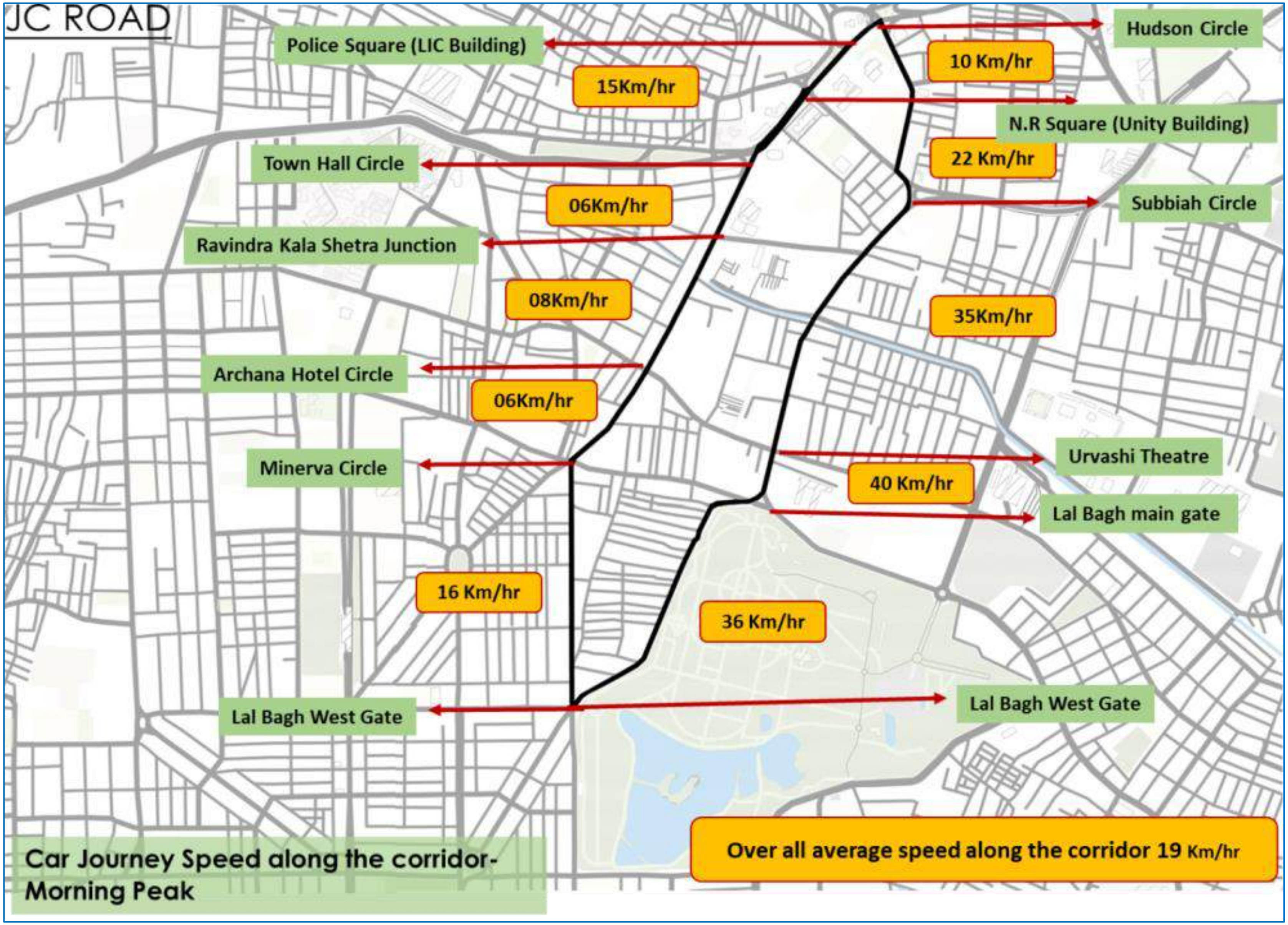


Figure 157.Car Speed Towards Hudson Circle (Morning Peak)

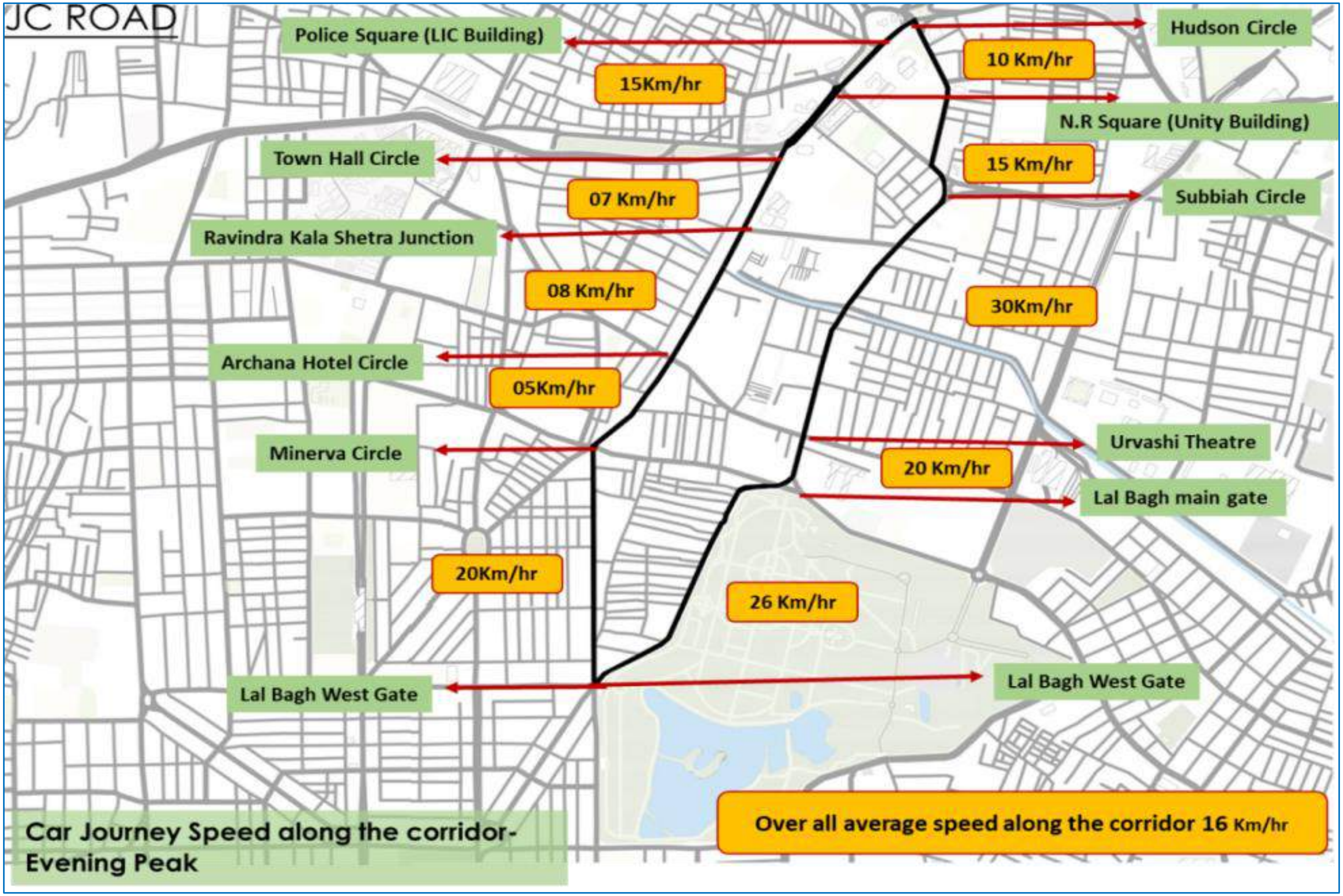


Figure 158 .Car Speeds Towards Hudson Circle (Evening Peak)

Pedestrian Counts

Pedestrian Count Survey was carried out to estimate the quantum of pedestrian movements across important locations with predominant pedestrian activity at major junctions for which the turning volume counts were done in the study area. This in turn would help in assessing the need for various facilities such as pedestrian subway, foot over bridge, Zebra crossings etc. on priority basis in the short and medium time frame for safe pedestrian movement. (**Figure 159**)

Pedestrians crossings at 7 major junctions along Hudson Circle Corridor were recorded for a period of 6 hours from 9.00 AM to 12.00 PM and 5.30 PM to 8.30 PM. Summary of pedestrian counts with peak hour pedestrian characteristics are shown below.(**Table 51**)

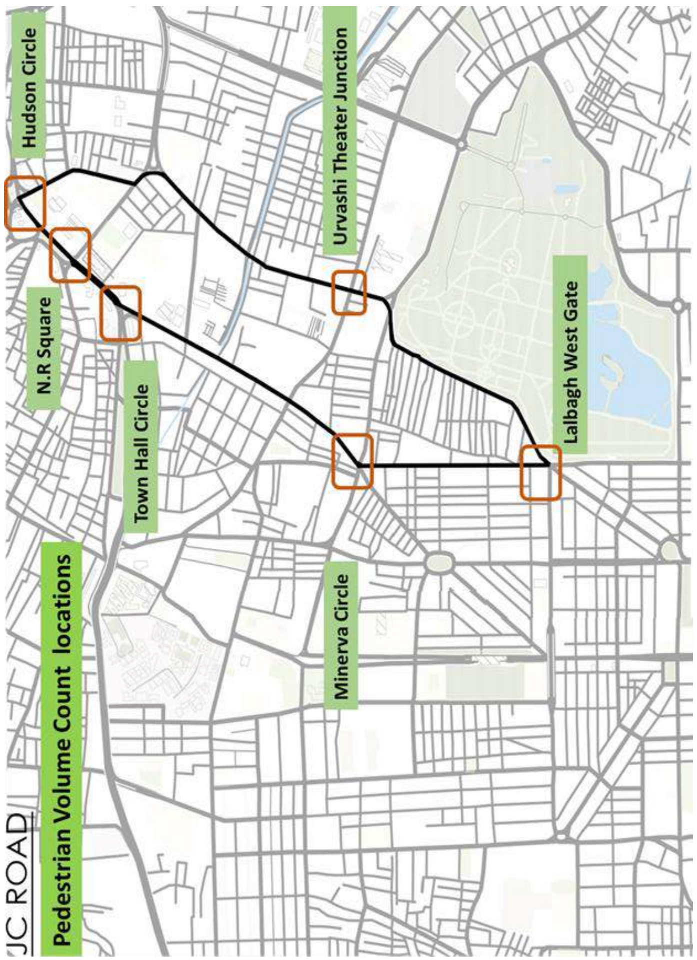


Figure 159 .Pedestrian Volume Count Locations Along The Corridor

Table 51: .Pedestrian Volume Count Surveyed Along The Corridor

Sl. No.	Junction Name	Crossing The Road		Along The Road/Footpath		TOTAL	Morn Peak Hour Vol.	Morn Peak Hour Time	Evn. Peak Hour Vol.	Evn. Peak Hour Time
		Dir 1	Dir 2	LHS	RHS					
1	Hudson Circle	3224	4673	7936	4139	19972	3380	9.00 - 10.00	3315	18.30 - 19.30
2	Urvashi Theatre Junction	3657	4283	7420	9429	24789	4182	9.00 - 10.00	4134	18.30 - 19.30
3	Lalbagh West Gate Junction	4911	6028	8176	3661	22776	3836	10.00 - 11.00	3824	19.30 - 20.30
4	Minerva Circle	2599	2721	6498	2539	14357	2423	11.00 - 12.00	2391	18.30 - 19.30
5	Town Hall Junction	4238	4457	6872	6793	22360	3753	10.00 - 11.00	3748	18.30 - 19.30
6	N.R Square(Unity Building)	5486	4991	6896	3694	21067	3541	10.00 - 11.00	3540	19.30 - 20.30
7	Police square	4066	3639	10226	6156	24087	4088	11.00 - 12.00	4007	19.30 - 20.30

Observations

•Pedestrian crossings at junctions in the study area ranged from 14357 to 24789 for 6 hours duration.

•Among all the locations in the study area, heavy pedestrian crossing was observed at Urvashi Theatre Junction (24789) followed by Police Square-Near Old LIC Building (24087).

•Maximum pedestrian crossings were observed between 10.00 AM and 11.00 AM in the morning and between 18.30 PM and 19.30 PM in the evening at majority of locations.

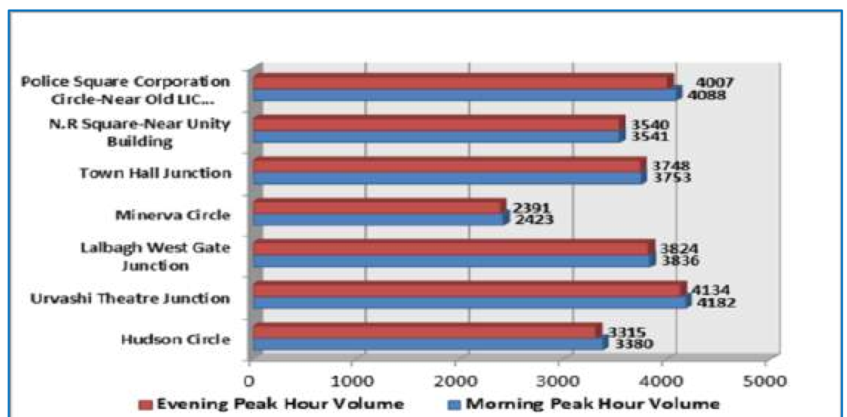


Figure 160.Pedestrian Volume Count

Road Inventory Survey Details

The roadway inventory details in terms of lane widths are shown in the Table below (**Table 52**)

Table 52:The Road Inventory Survey Details

Link No	Name of Road	Name of Starting Point	Name of Ending Point	Carriageway Width			Road type
				LHS Width	Median	RHS Width	
1	Devanga Samaja Road	Hudson Circle	Devanga Samaja Junction	17.3	One way		Bituminous
2			Near Juice Center	10.7	One way		Bituminous
3			HCG Hospital	8.6	One way		Bituminous
4	Lal Bagh Road	Near Dr Nanjappa Circle	Before signal	20.6	One way		Bituminous
5			After Signal	25.5	One way		Bituminous
6		Near Drain		19	One way		Bituminous
7		Near Passport office		11	One way		Bituminous
8		Near Urvashi theatre		15	One way		Bituminous
9		Before lal bagh main gate junction		14	One way		Bituminous
10	Lal Bagh main gate to west gate	Near temple turning		11.4	One way		Bituminous
11	Rashtriya Vidyalaya road	West gate	Minerva	18	Divided two way		Bituminous
12		Near Akshaya hotel		13	Divided two way		Bituminous
13	J.C road	Minerva circle	Town hall	17	One way		
14		Near Bharath Talkies junction	Before junction	20	One way		Bituminous
15			After junction	17	One way		Bituminous
16		Near Shivaji Talkies		16.5	One way		Bituminous
17		Near Ravindra Kalashetra		17	One way		Bituminous
18		Near Canara Bank		21	Two way		Bituminous
19	Mysore Road	Near Halasooru Police station		14.6	One way		Bituminous
20		Near Police corner junction		24	One way		Bituminous
21		Hudson circle	Oppt to hop com	17.6	One way		Bituminous
22		Hudson circle opt to BBMP office		24	One way		Bituminous

Figure 161:The Road Inventory Survey for Lal Bagh Road

Figure 162 :The Road Inventory Survey for Jayachamaraja wodayar road

Figure 163:The Road Inventory Survey for Jayachamaraja wodayar road

PART C
ISSUE IDENTIFICATION AND SOLUTIONS

ISSUE IDENTIFICATION AND SOLUTIONS

Congestion due to Narrow Road Width

The narrow road stretch from Hudson Circle to Subbiah Circle is causing a lot of inconvenience to the people besides causing frequent traffic jams. The road stretch along the corridor is below par. Though the traffic has increased manifolds over the years, the road remains to be same. The road users on this stretch and the residents living along this stretch of road way rue the congestion, especially during the peak hours.

As per the surveys, it is observed that maximum traffic congestion is from Hudson Circle to Subbiah Circle on Devanga Samaja Road. Even though the road is one way, the carriageway width reduces from 17.3 meters to 8.6 meters, which is one of the main reasons for congestion. Apart from the narrow road width, unauthorized on street parking by trucks, luggage autos and taxis is observed that is causing traffic congestion. Presence of HCG Hospital abutting the road is adding to the traffic jams. (**Figure 164**)

Figure 164 . Identification of issues from Hudson Circle to Subbaiah Circle

Figure 165 . Identification of issues on Devanga Samaja Road

a. Recommendations

•Unauthorized on street parking needs to be prohibited; this will help in achieving one extra lane and help in smooth traffic flow.

•Footpaths need to be developed along the stretch.

•The corner of the HCG hospital needs to be acquire for at least two meters from the footpath to have free movement towards Lal Bagh for the traffic coming from Hudson circle.

•The road surface needs to be rectified at Subbiah Circle due to which the speeds have being reduced.

• Once the above recommendations are carried out, signal optimization needs to be done with new signal phase timings.

(**Figure 229**)

Figure 166 . Solutions For the Identified Issues

b. Benefits:

➢Delays occurring due to unauthorized on street parking will get reduced.
➢Congestion due to bad road surface at Subbiah Circle will be eliminated once the road surface is rectified.
➢The signal optimization will further reduce the delays.

Traffic Circulation Issue

In order to have proper and smooth traffic-circulation in the area, a minor traffic management plan is proposed. The local area has two feeder roads meeting at Subbiah circle ;both the roads are one ways reaching towards the circle as shown in the Figure.

As evident from the picture, the traffic coming from 1st Mission Cross Road conflicts with the left turning traffic at Subbiah Circle and then crosses the through traffic to move the traffic chaos are observed.(**Figure 167-168)**

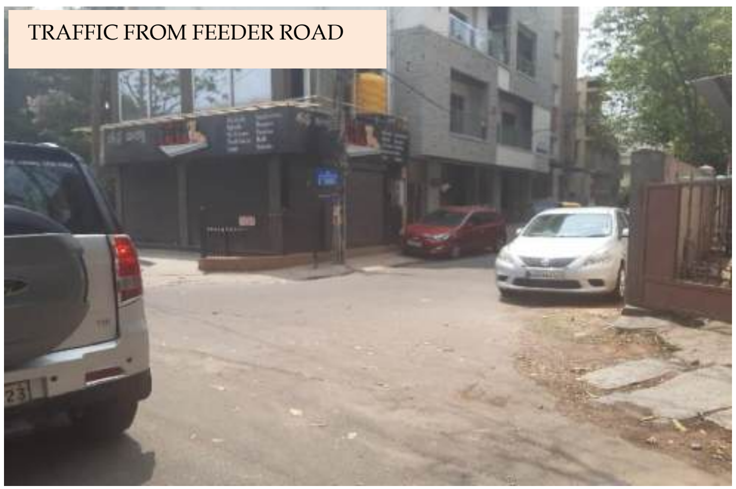


Figure 167 Identification of traffic circulation issues in Subbaiah circle

a. Recommendations

➢It is proposed to reverse the traffic directional flow of 1st mission cross road, so that rather than having two entries on the small stretch, the entire flow can be diverted on the road which is connecting the junction.

➢Once the traffic flow pattern is changed, signal optimization need to be done with new signal phase timings. (**Figure 168**)

Figure 168 . Identification of traffic circulation issues in Subbaiah circle

Figure 169 .Solution for the Identified issues in Subbaiah circle

b. Benefits:

➢By reversing the traffic flow, signal delays will be reduced drastically at Subbiah Circle.
➢The signal optimization will further reduce the delays.
Re-laid of road surface will improve the traffic speeds.

Road Safety Issue

Looking at the road profile of the corridor, once Subbaiah Circle is crossed, the stretch on Lal Bagh road changes to 6 lane undivided one-way .In between this road stretch from Siddiah Circle to Urvashi Theater, there is one location where a small feeder road cuts across the main road next to the drain. Since this crossing is without any signal or any manual controls, frequent accidents occur at this location, as the speeds on Lal Bagh Road are much higher when compare to feeder road. Hence, speed calming methods need to be adopted on all feeder roads as well as on the main road (**Figure 170**).

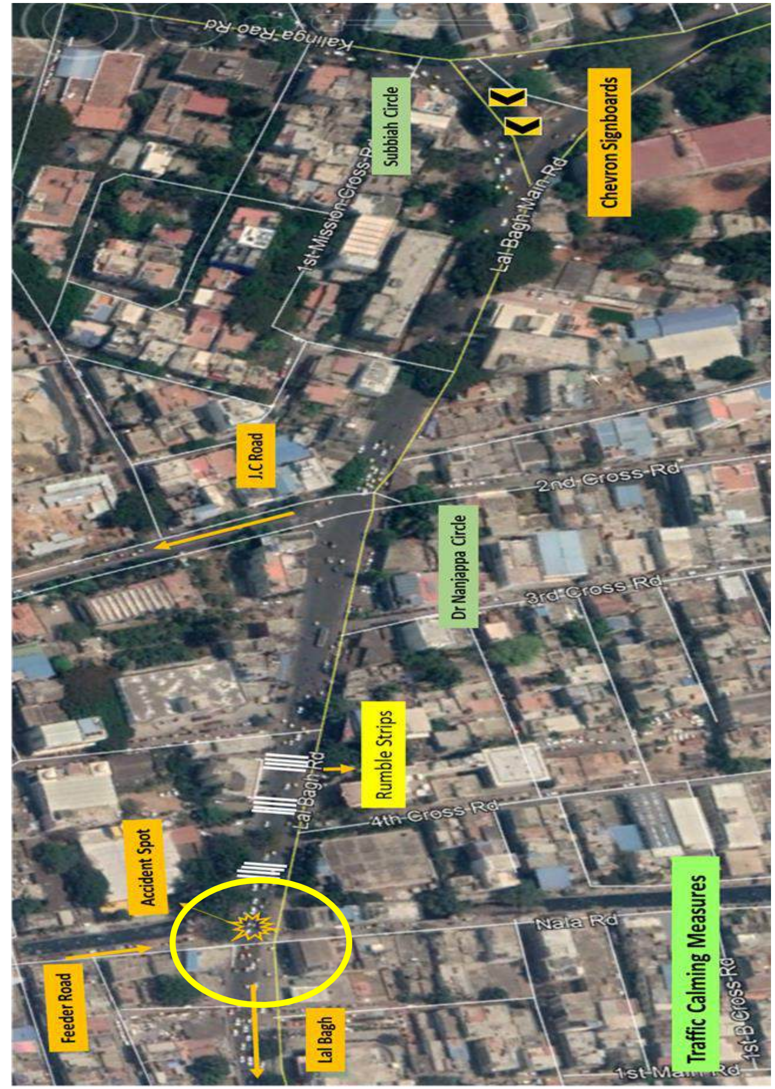


Figure 170.Identification of Road Safety Issues –Subbaiah Circle

a. Recommendations

Speed breakers need to be constructed on the both the sides of the feeder roads to control direct access of the vehicles onto the main road.
Traffic calming measures need to be implemented to control the over speeding of vehicles on Lal Bagh road, near the drain, which is one of the reasons for accidents . Hence, traffic-calming measures as per IRC 99-2018 are recommended.

The IRC recommends applying 15 mm thick thermoplastic paints in a series of six strips (one set will have six strips). Based on the speeds on the corridors, the thermoplastic rumble sets are decided.eg if the speed is 50kmph then one set of rumble strip is required and similarly, two sets for 51-65 kmph, three sets for up to 80 kmph and above 80kmph four sets of thermoplastic paints need to be applied. The location is as shown in the **Figure 171**.

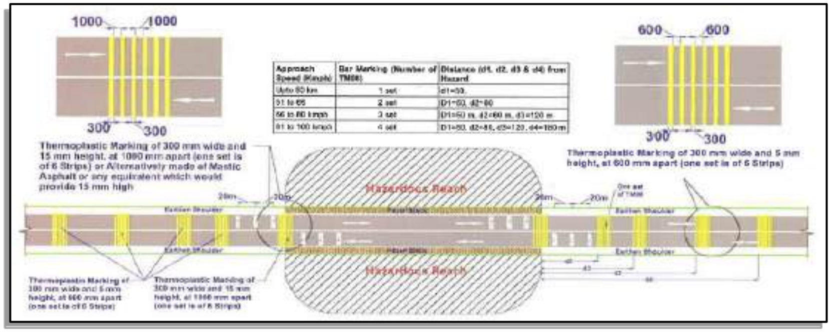


Figure 171.Solutions for identified issues

b. Benefits:

Safe vehicle crossings from feeder roads will be achieved.

Black Spot of Minerva Circle

A Black Spot (accident prone location) has been identified along the corridor. As per the accident data collected from Kalasipalyam Traffic Police, it was noticed that at Minerva circle, five accidents have occurred in the last couple of years, out of which one was a fatal other four involved serious injuries as presented in **Table 72& Figure 172**

Table 72 .Accident Record At V.V Puram

V.V. Puram Traffic Police Station Limits		
Accident Record at Minerva Circle		
Year	No of Grevious Injuries	No of Fatalities
2017	3	1
2018	2	0

Figure 173.Accident Record At V.V Puram

A Road Safety Audit has been done and , it has been noted that the accidents are occurring due to wrong signal phase timings at Miverva Junction. The signal phase timings for the traffic coming from Lal Bagh West Gate on R.V. Road and from V.V. Puram have the same green signal phase. Traffic from both the roads enter J.C Road at the same time, at an acute angle, almost making it a 'Y' shaped entry. This is resulting in vehicle conflict paths and hence, accidents happen quite regularly at this junction as shown in **Figure 172**

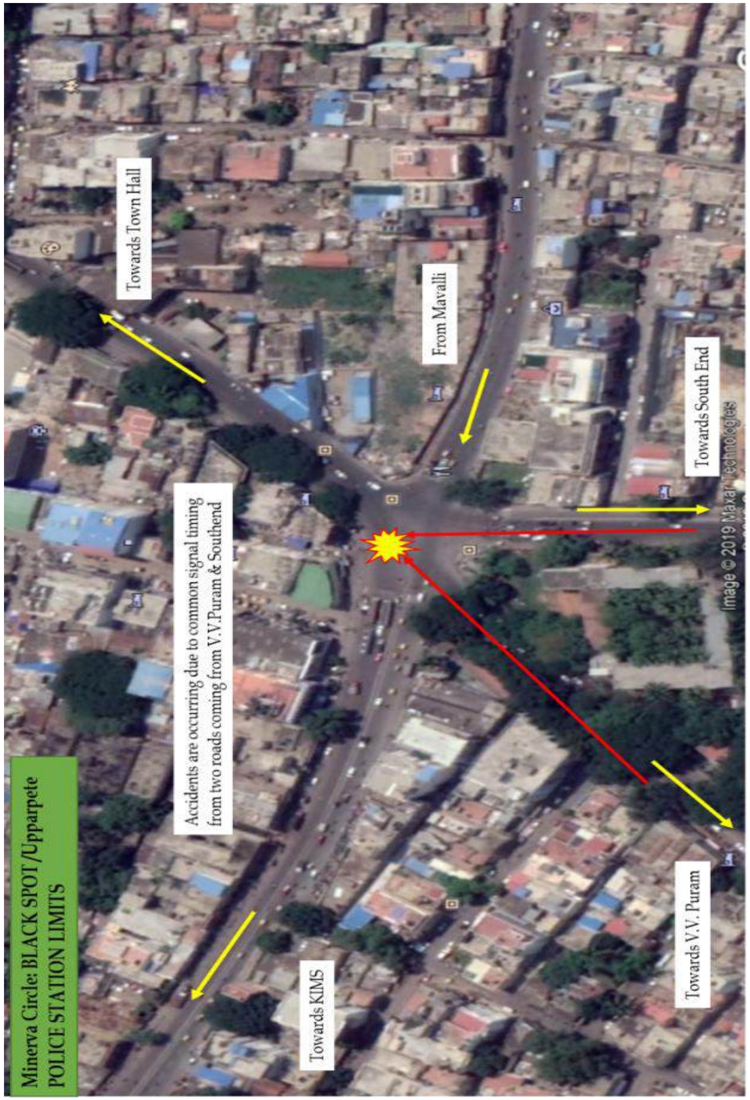


Figure 172.Identification of Black Spot at Minerva Circle

Figure 174 .Identification of Black Spot at Minerva Circle

a. Recommendations

➢First step is to optimize the entire signal and make two separate phase times for traffic coming from R.V.Road and V.V.Puram Road.
➢The junction needs to be treated with proper signage boards to road safety furniture.
➢Road safety furniture such as cat eyes, AFP sheeting, solar blinkers etc. need to be installed.(**Figure 174**)

b. Benefits:

Once the signal optimization is done, accident rate will come down along with reduction in signal delays.

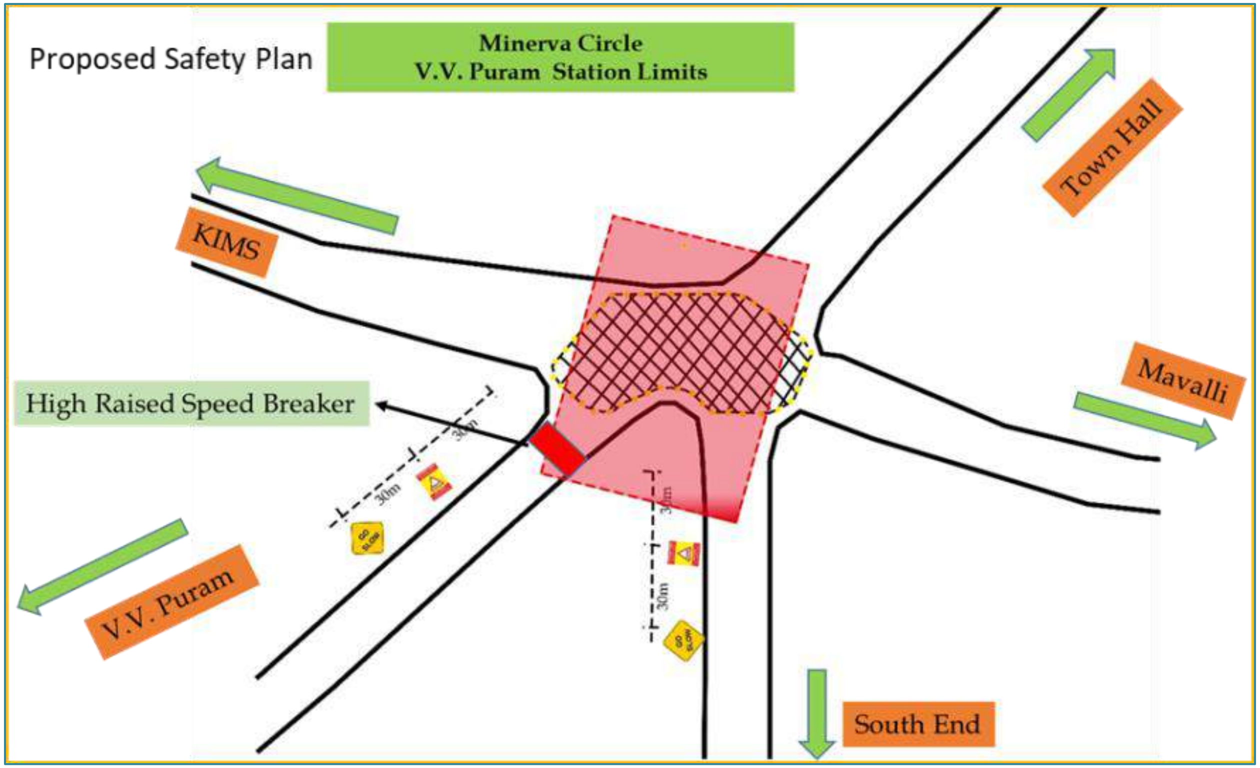


Figure 175. Proposed Safety Plan for Minerva Circle

Key Map of all the issues along the corridor

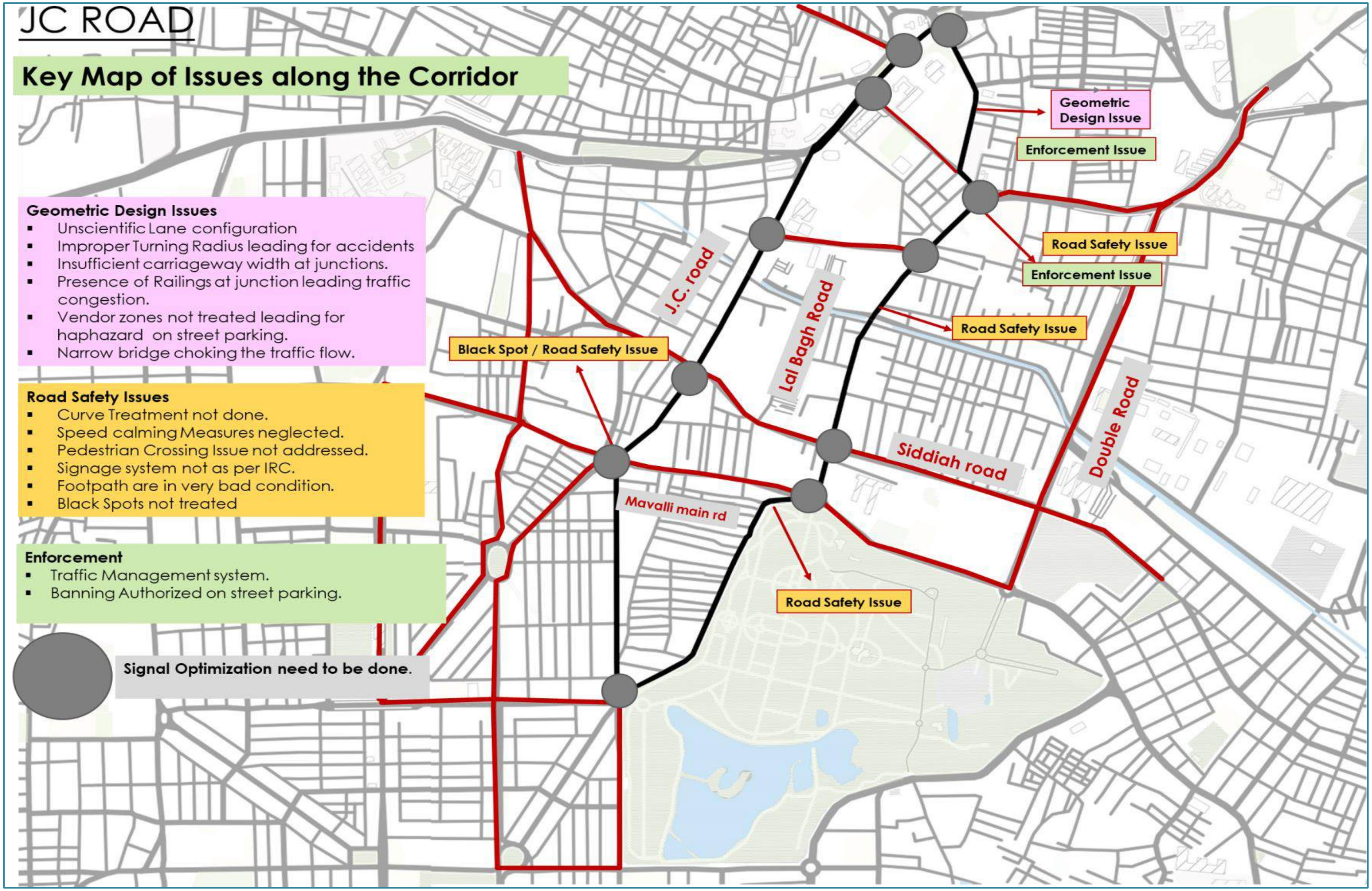


Figure 176. Key Map of Issues along the Corridor

PART D
SUMMARY AND IMPACT OF MEASURES

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle with Elevated rotary at Hudson circle – Option 1

The one-way loop from J.C. Road to Lal Bagh Road, passing through Minerva Circle, Town Hall Circle, N.R. Square, Halasoor Police Station Junction, Police Square, Hudson Circle, Devanga Hostel Circle, H.B. Bakery Circle, Urvashi Circle, and Lal Bagh Circle, is one of the busiest routes in the Central Business District (CBD). This loop plays a vital role in connecting southbound traffic to central and eastern areas. However, the current one-way traffic system has reached its saturation point, prompting the need for a long-term solution. To address this, an elevated corridor is proposed from Minerva Circle to Hudson Circle, connecting to an elevated rotary at Hudson Circle, which would significantly reduce congestion by bypassing seven major intersections in the CBD. Additionally, the existing Sirsi Circle flyover will link to the new loop from K.R. Market to Town Hall Junction, where it will merge with the proposed elevated corridor. Details are illustrated in the accompanying figure.177

Figure 177. Proposed Elevated Corridor from Minerva circle to Hudson Circle

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle with Elevated rotary at Hudson circle – Option 1

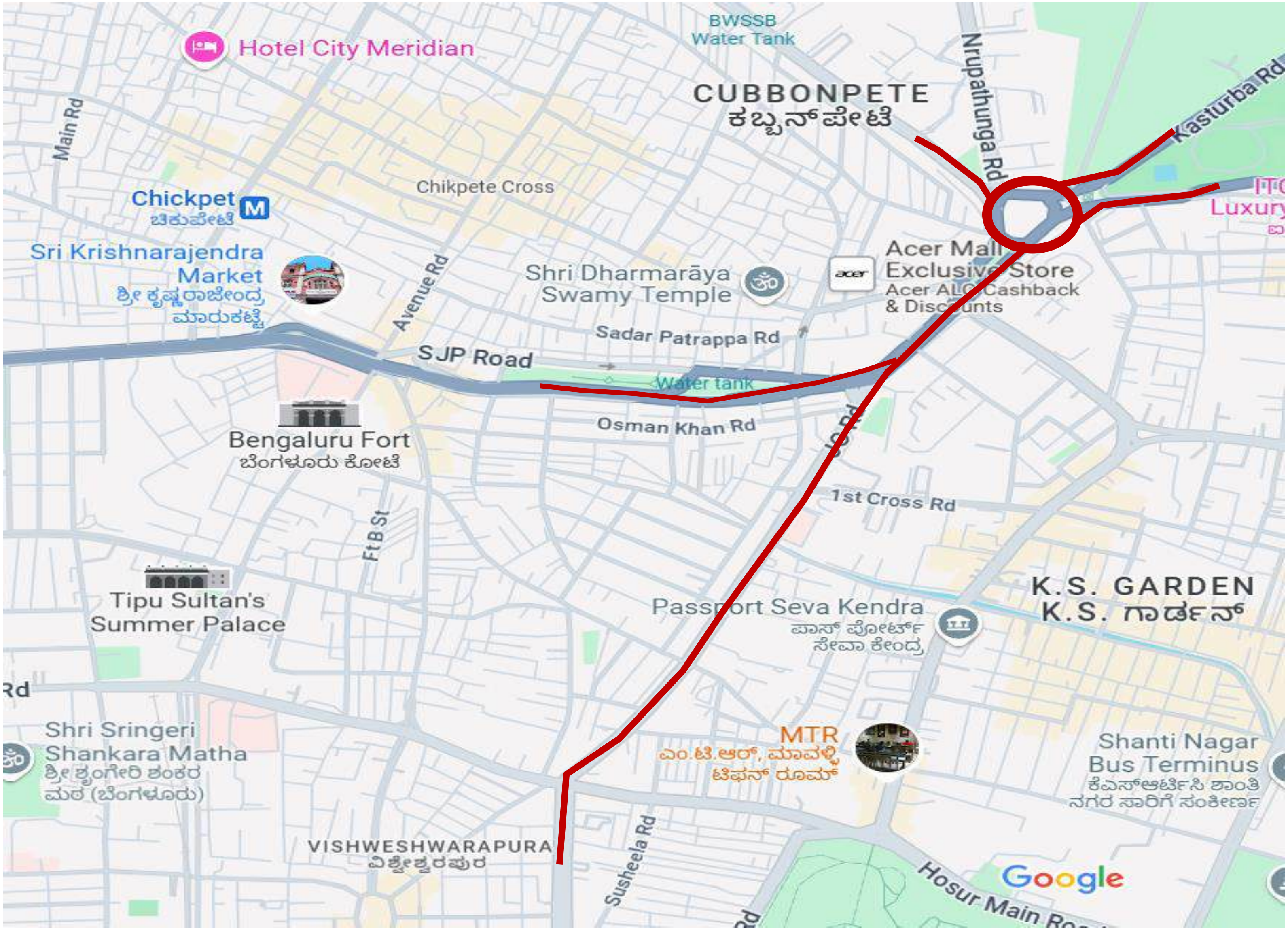


Figure 178 Proposed Elevated Corridor from Minerva circle to Hudson Circle

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle without Elevated Rotary- Option 2

The one-way loop from J.C. Road to Lal Bagh Road, passing through Minerva Circle, Town Hall Circle, N.R. Square, Halasoor Police Station Junction, Police Square, Hudson Circle, Devanga Hostel Circle, H.B. Bakery Circle, Urvashi Circle, and Lal Bagh Circle, is one of the busiest routes in the Central Business District (CBD). This loop plays a vital role in connecting southbound traffic to central and eastern areas. However, the current one-way traffic system has reached its saturation point, prompting the need for a long-term solution. To address this, an elevated corridor is proposed from Minerva Circle to Hudson Circle, connecting to an elevated rotary at Hudson Circle, which would significantly reduce congestion by bypassing seven major intersections in the CBD. Additionally, the existing Sirsi Circle flyover will link to the new loop from K.R. Market to Town Hall Junction, where it will merge with the proposed elevated corridor. Details are illustrated in the accompanying figure 179.

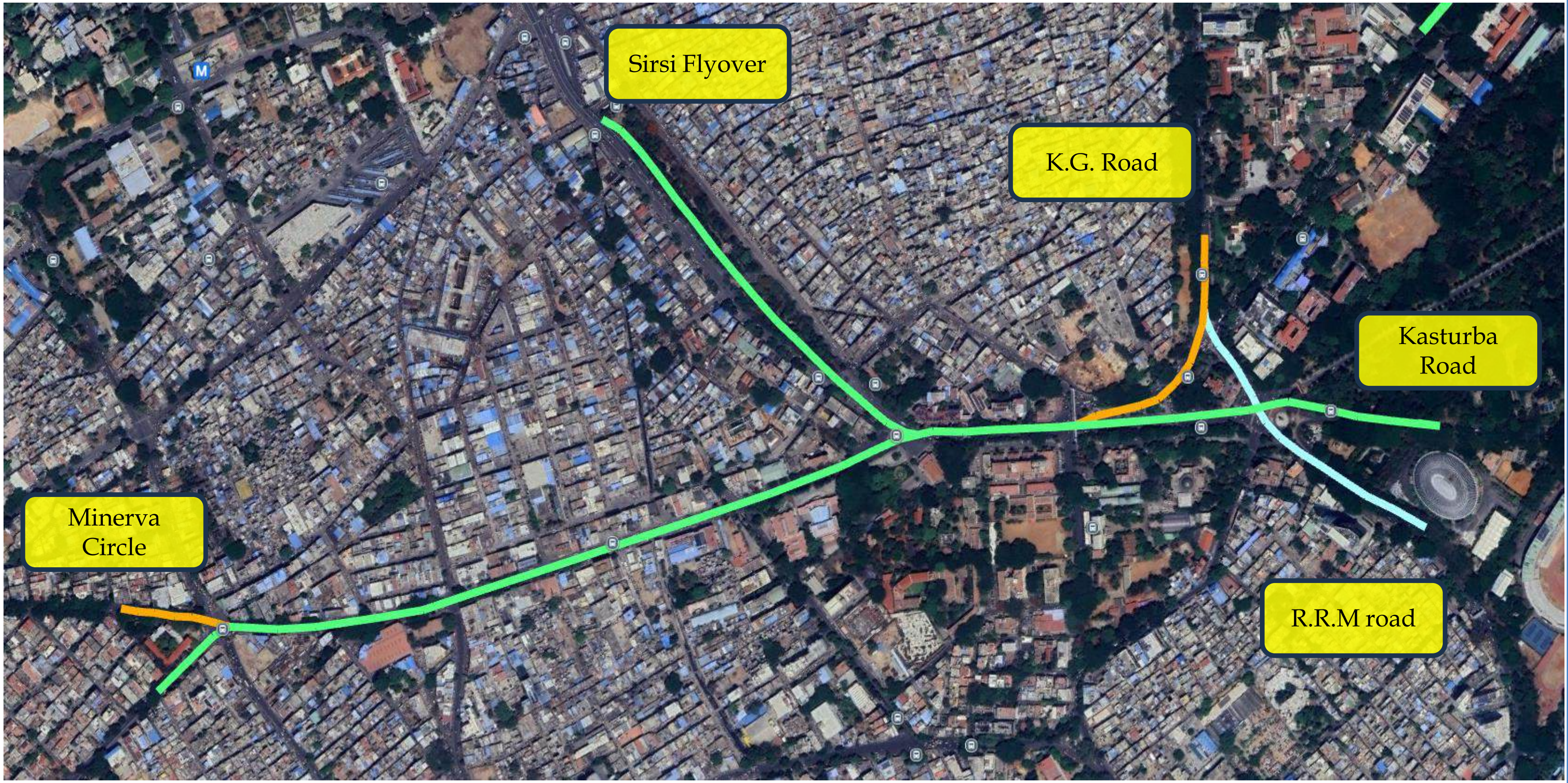


Figure 179. Proposed Elevated Corridor from Minerva circle to Hudson Circle

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle without Elevated Rotary- Option 2

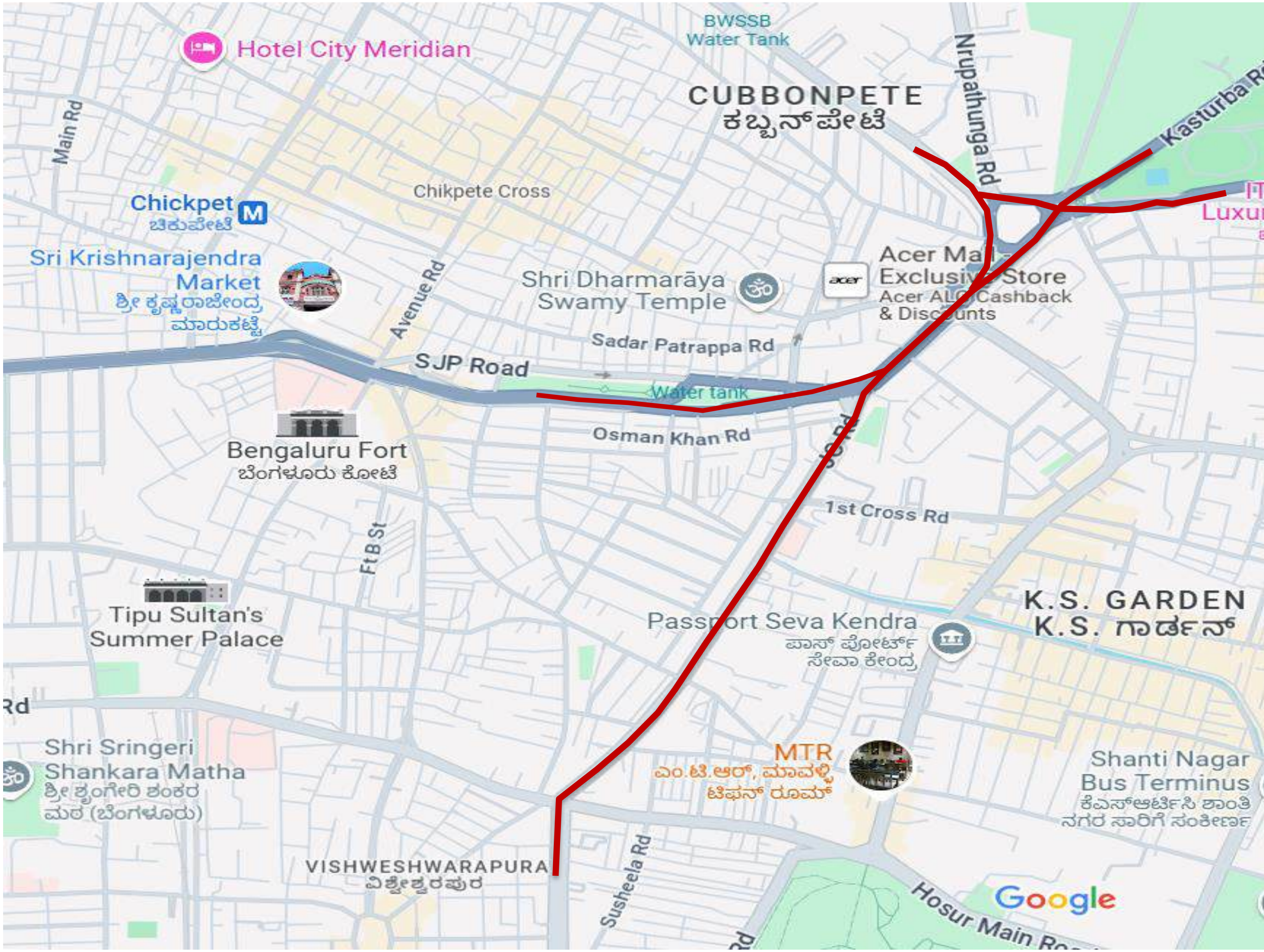


Figure 180. Proposed Elevated Corridor from Minerva circle to Hudson Circle

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle

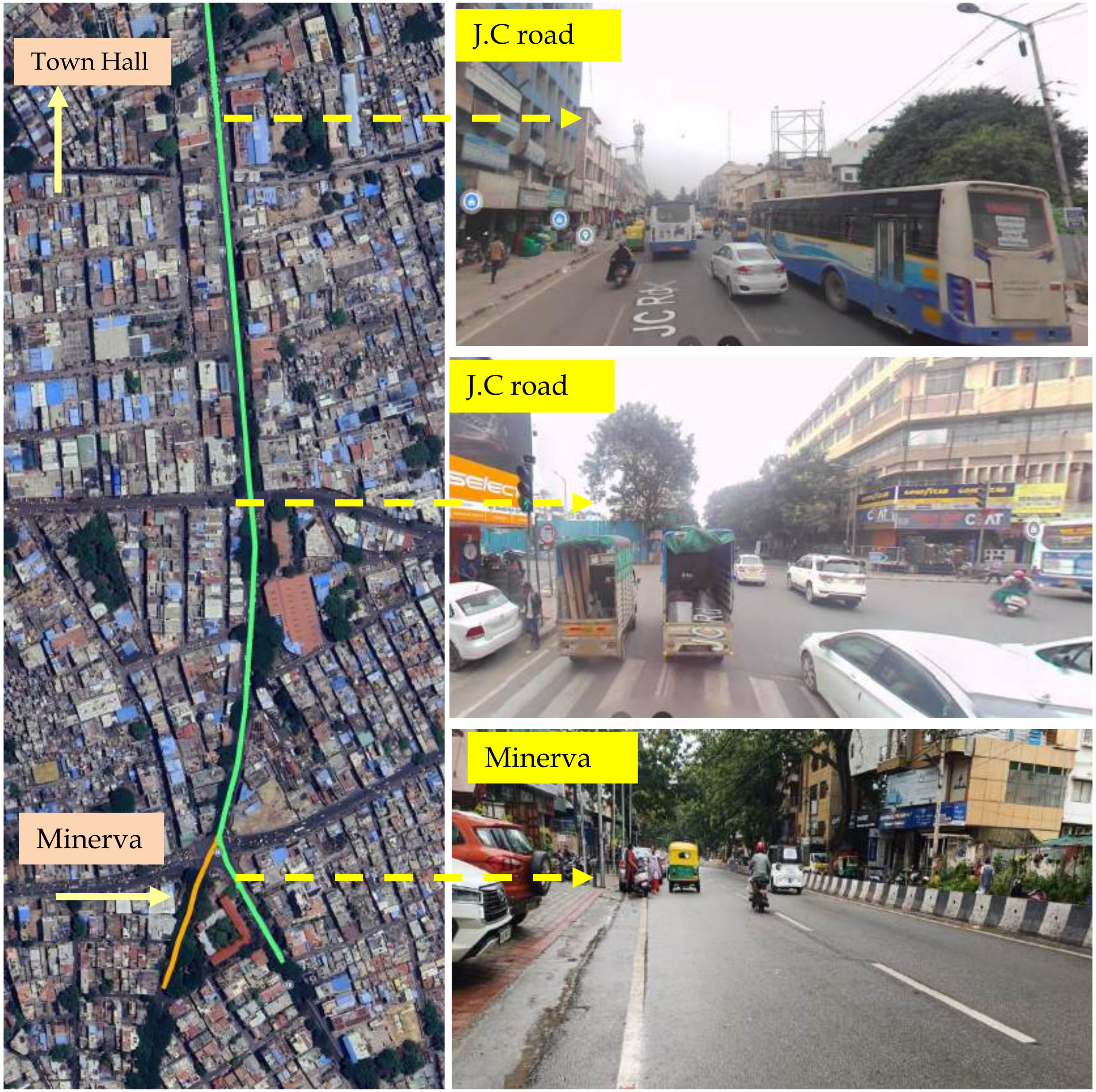
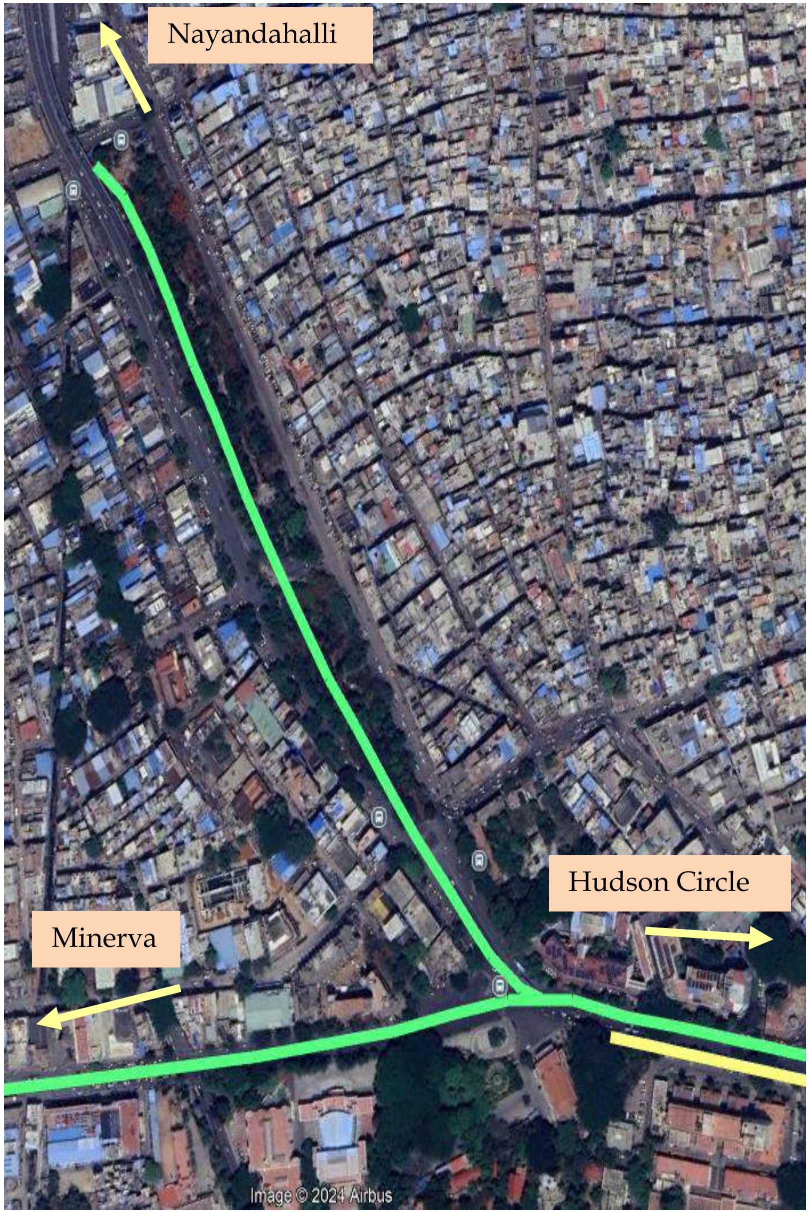


Figure 181. Proposed Elevated Corridor from Minerva circle to Hudson Circle

The proposed elevated corridor starts from R.V road just before the Minerva junction near the government school. Another ramp is proposed from the V.V. Puram side. Both the ramps merges at Minerva junction and proceeds on the J.C road as a one way elevated corridor. This stretch by passes three major junctions i.e. Minerva junction, J.C road Junction and the 1st cross J.C road junction moving ahead to Town hall junction.

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle

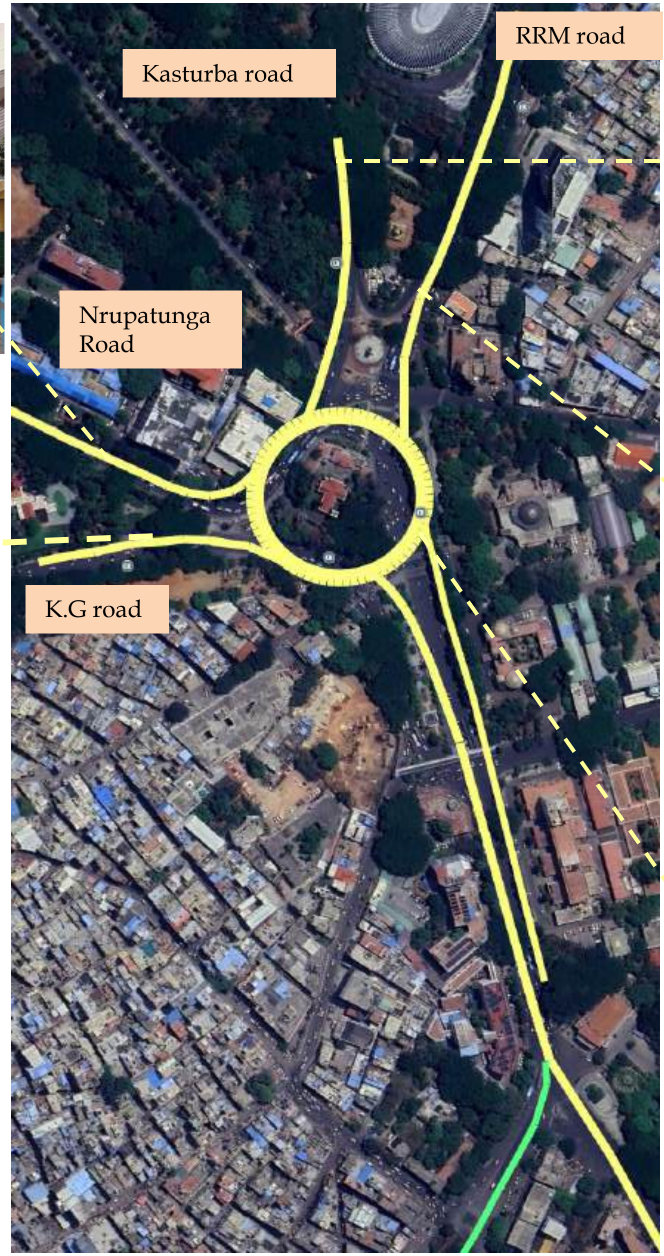


The proposed elevated corridor includes an additional loop from the existing Sirsi flyover, connected near Jamia Masjid to accommodate traffic from the Nayandahalli side heading toward Hudson Circle. This loop merges at the Town Hall junction with the elevated corridor running from Minerva to Hudson Circle.

Figure 182. Proposed Elevated Corridor from Minerva circle to Hudson Circle

Proposed integrated Elevated corridor from Minerva Circle to Hudson Circle with Elevated rotary at Hudson circle – Option 1

The proposed elevated corridor features an elevated rotary encircling Hudson Church at Hudson Circle, providing access to all connecting roads. This design aims to facilitate seamless travel, though traffic speeds are expected to be moderate.



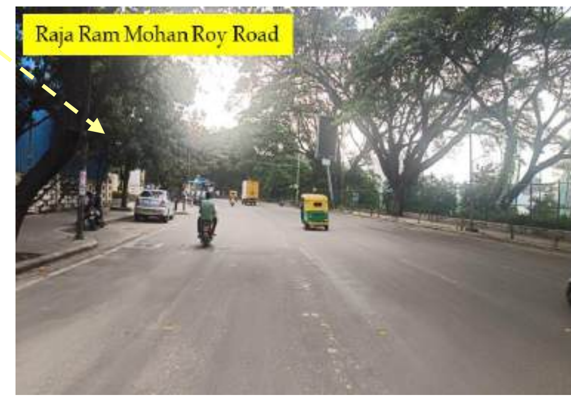


Figure 183. Proposed Elevated Corridor from Minerva circle to Hudson Circle

Proposed Typical Cross section for the 4 lane Undivided Elevated corridor

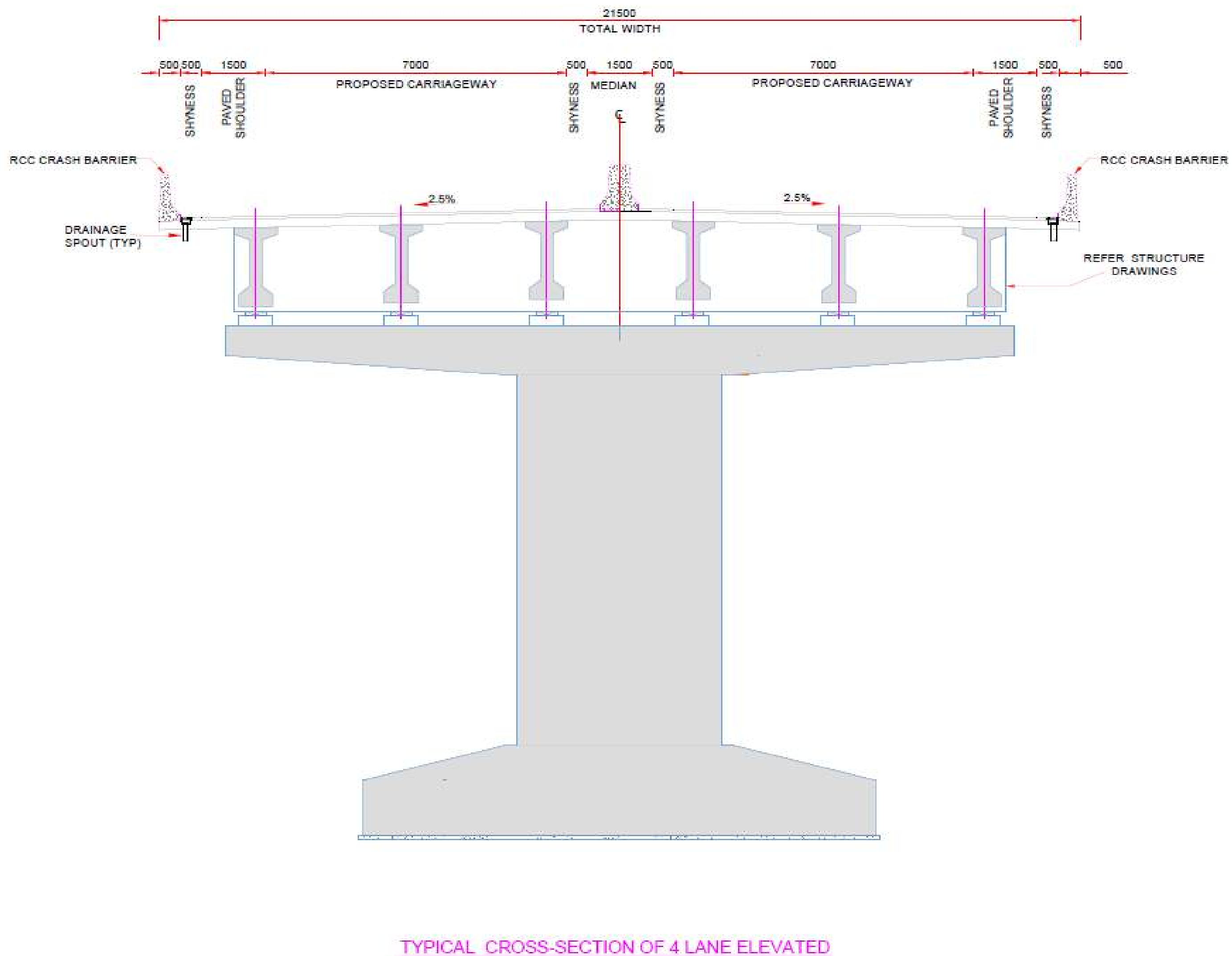


Figure 184. **Proposed cross section for 4 lane undivided Elevated corridor for J.C road**

CORRIDOR 04

Kanakapura Road-Konankuntae Cross

Proposed Split Flyover / Underpass at Konankuntae Cross for Through Traffic from Kanakapura to Banashankari

Existing Site Location

Figure 185. Existing Site for the Proposed Falcon City Phase-II

Approach of the Site Area

Major corridors which will have the impact of the new development are as listed below.

1. Kanakapura Road
2. Vasanthapura Main road
3. Anjanapura main road
4. Tippasandra main road

Site Observations

The above listed corridors proposed for impact assessment are prominent corridors which carry high density traffic within the study area These corridors feed to the major traffic near the proposed development and have high potential for business development. The commercialisation along these sections has increased the demand for road space for vehicles with poor or no concerns to the need of vulnerable users like pedestrians . The increased traffic volume on these streets have reduced the speeds and increased the traffic congestions.

Some of the common observations based on the site reconnaissance are:

- Unusable/ dilapidated footpaths
- Insufficient carriageway capacity within the urban centers to cater to ever increasing vehicle numbers
- Unequal distribution of road space
- Unscientific and unsafe design of junctions and road curves
- Neglected NMT Users
- Manual Signal Operations.
- Insufficient turning radius for 'U' Turns.
- Unscientific Medain Openings
- Too many traffic movements allowed at junctions.

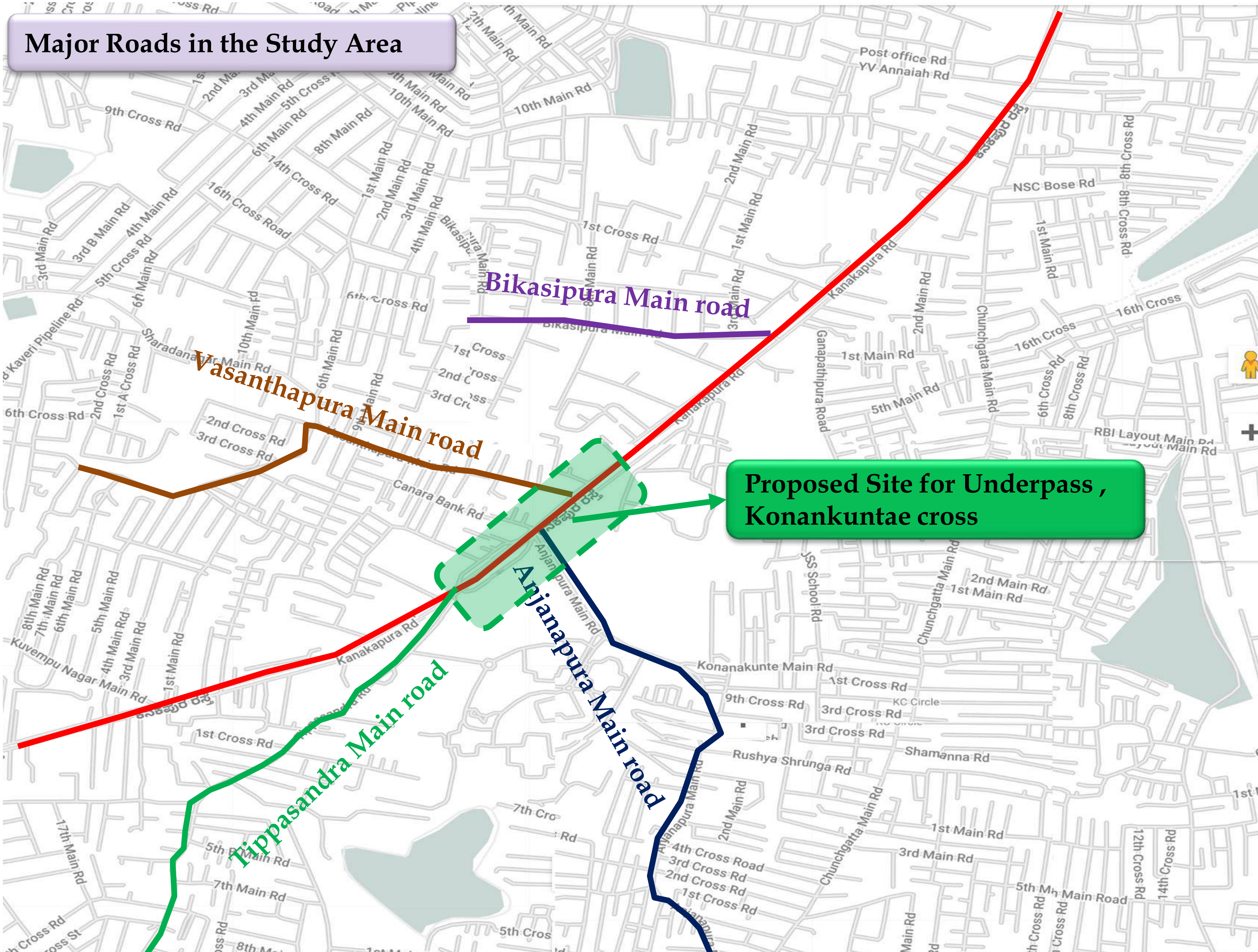


Figure 186 Major roads in the vicinity of Konankuntae cross junction

Areas Surrounding the Project Site

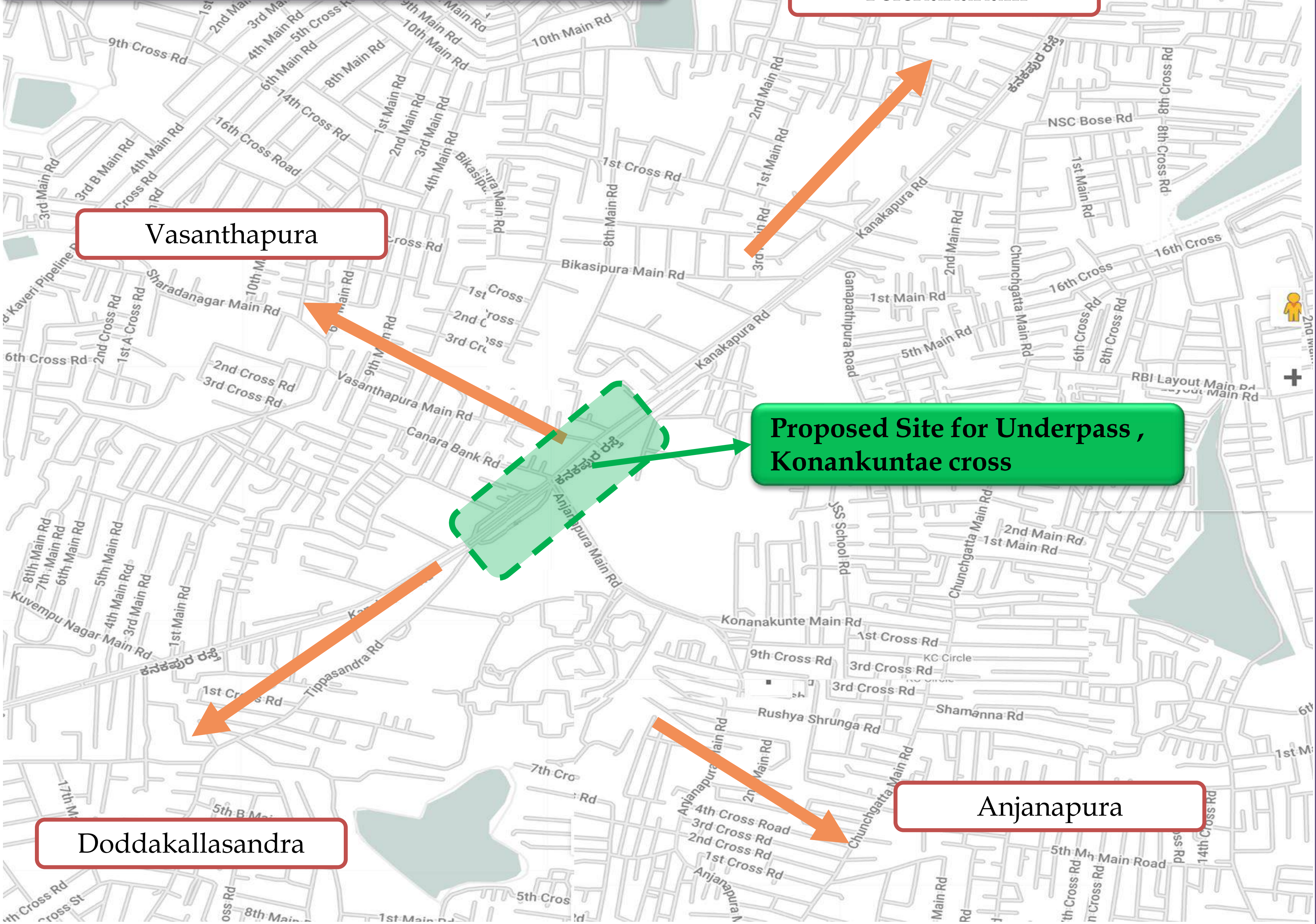


Figure 187 Major roads in the vicinity of Konankuntae cross junction

Traffic Circulation Pattern in the Study Area

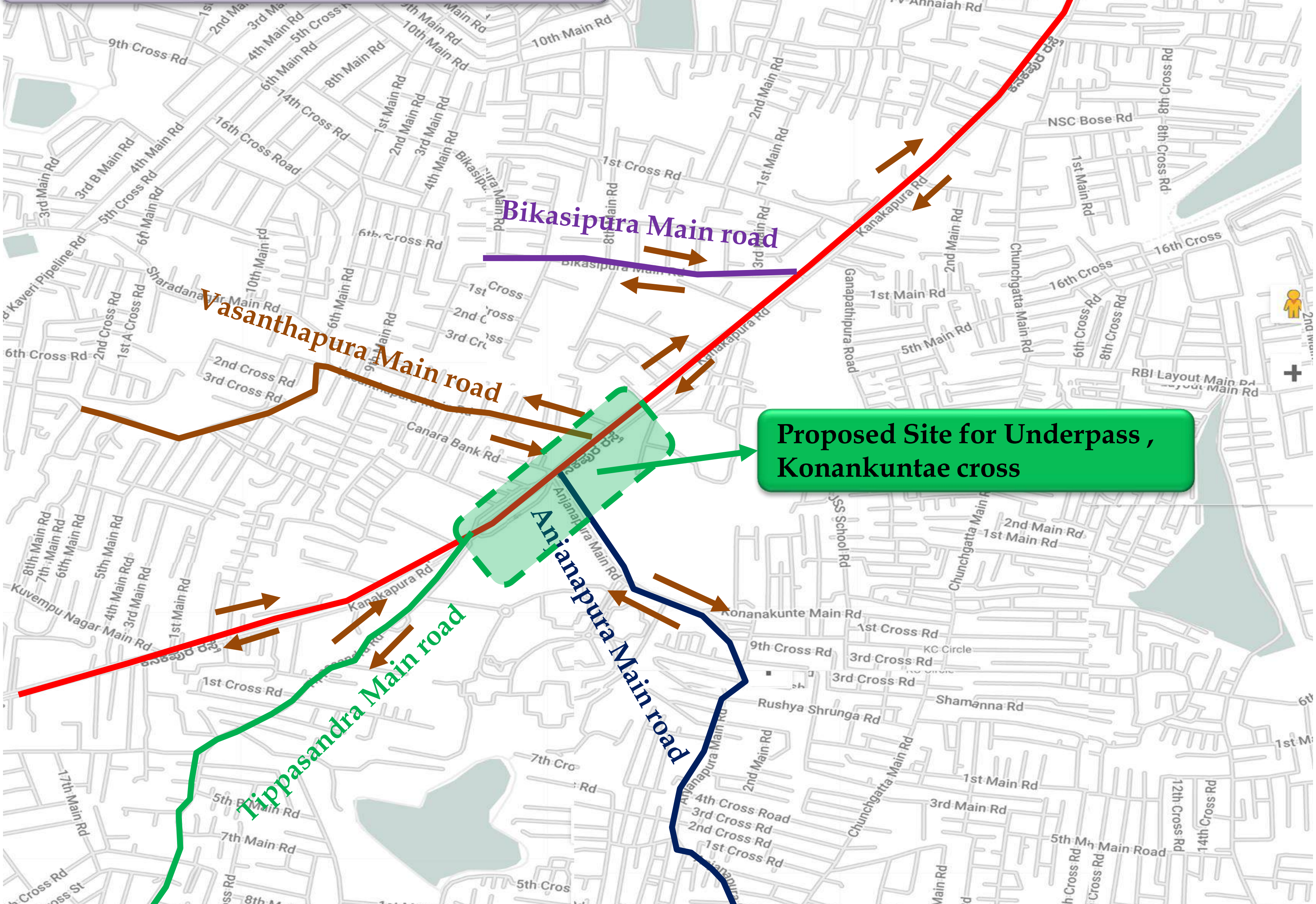


Figure 188. Traffic circulation pattern in the vicinity of Konankuntae cross junction

Base Map of Hot Spots in the Study Area

As per the site reconnaissance survey conducted with in the vicinity of the study area certain hot spots were noted wherein the traffic congestions where happening and required immediate attention to address the issues as shown in the **Figure 189** below. Further the issue / hot spots are explained in detailed.

01	Vasanthapura Junction Issue
02	Signal Optimization & Geometric Issue at Konankuntae cross junction

04	Criss- crossing ,Merging & Diverging Issue near mall
03	Entry to Mall at the Konankuntae Junc

Figure 189 Task 3 – Base map showing Hot Spots in the Study Area

Hot Spot 1 : Vasanthapura Junction Issue

Vasanthapura junction is a three arm unsignalized intersection located on Kanakapura road as shown in **Figure 190**, which is controlled manually by traffic police. This is a minor intersection located just 115 meters away from the Konankuntae cross junction. Since this is a manual control or unsignalized intersection vehicle queueing is observed as soon as the signal is left from Konankuntae junction and Vanathapura main road being a two way road it is difficult to manage the traffic flow at the junction leading to traffic congestion and delays.

Apart from the junction geometric issues strict enforcement is required at this junction in terms of on street parking, signalization and pedestrian crossings.

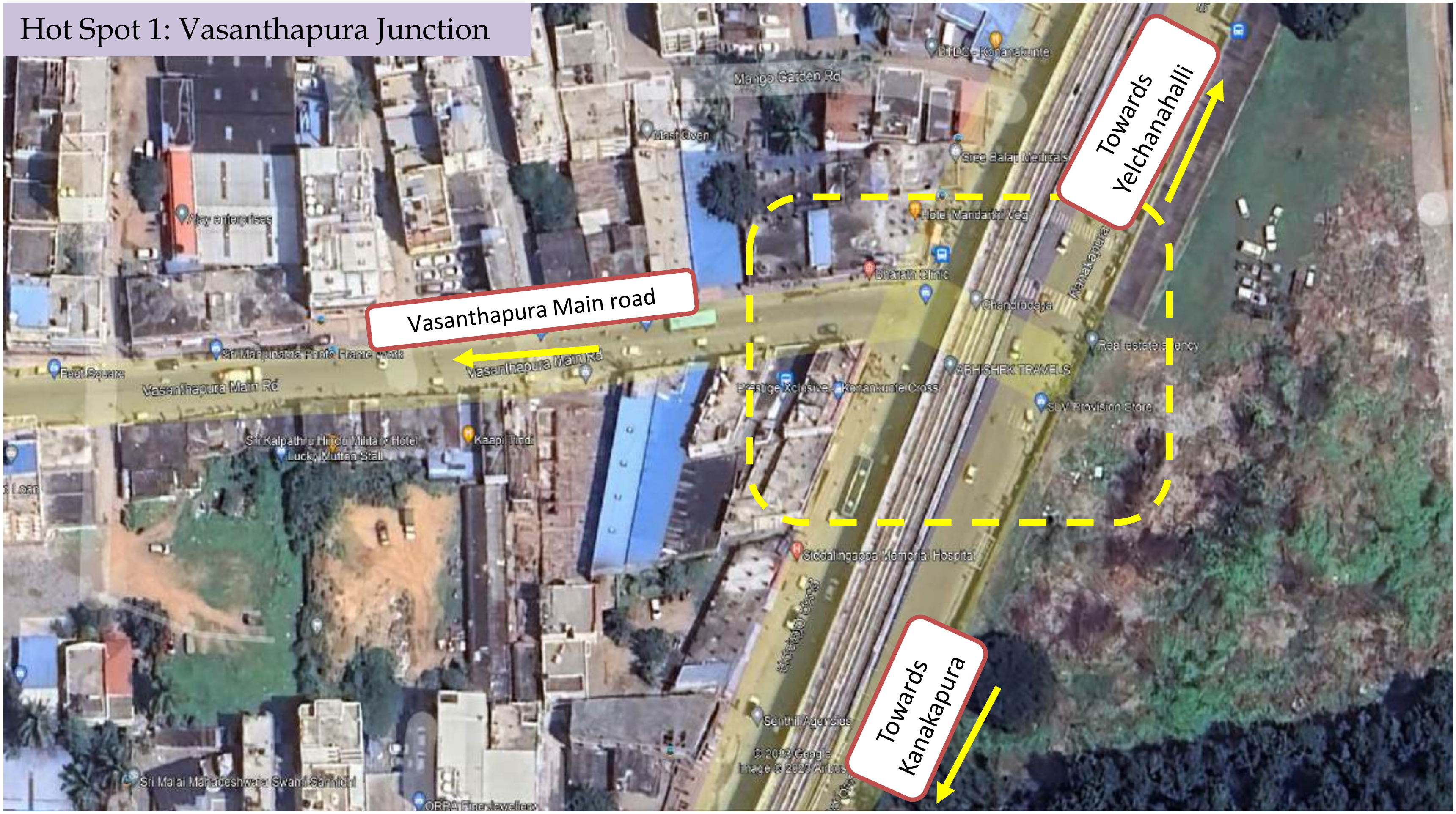


Figure 190. Task 3 – Map showing Hot Spot 1 – Vasanthapura Junction

Vasanthapura Junction

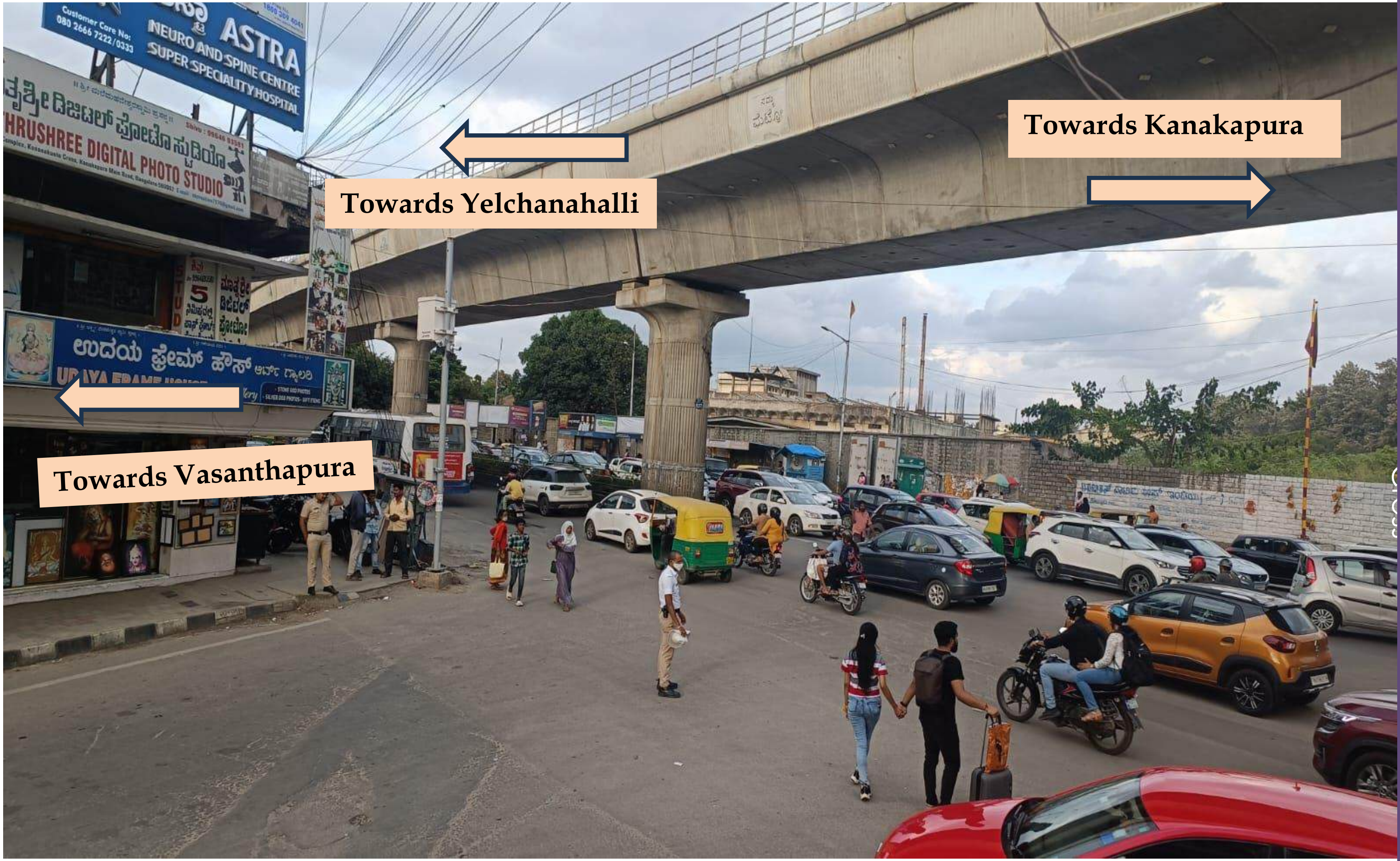


Figure 191 View of Vasanthapura Junction on Kanakapura Road

Hot Spot 2 : Konankuntae Junction Issue

Konankuntae cross junction is a three arm major signalized intersection, located on Kanakapura road as shown in **Figure 192,** which is controlled by traffic police during the peak hours by operating manually. The junction is not designed scientifically and in a engineering way, in the presence of Metro rail and its station at the junction , road widths are varying and from 30 meters to 33 meters at the mouth of the junction . Another major road connects at this junction which leads to Anjanapura. This is also a two way road which is very narrow and is leading to major traffic congestions and vehicle queues.
Apart from the junction improvements, signal optimization need to be done to have smooth traffic flow along with strict enforcement towards unauthorized auto parking , bus stopping at the junction and taxi pick ups and drops for the mall.

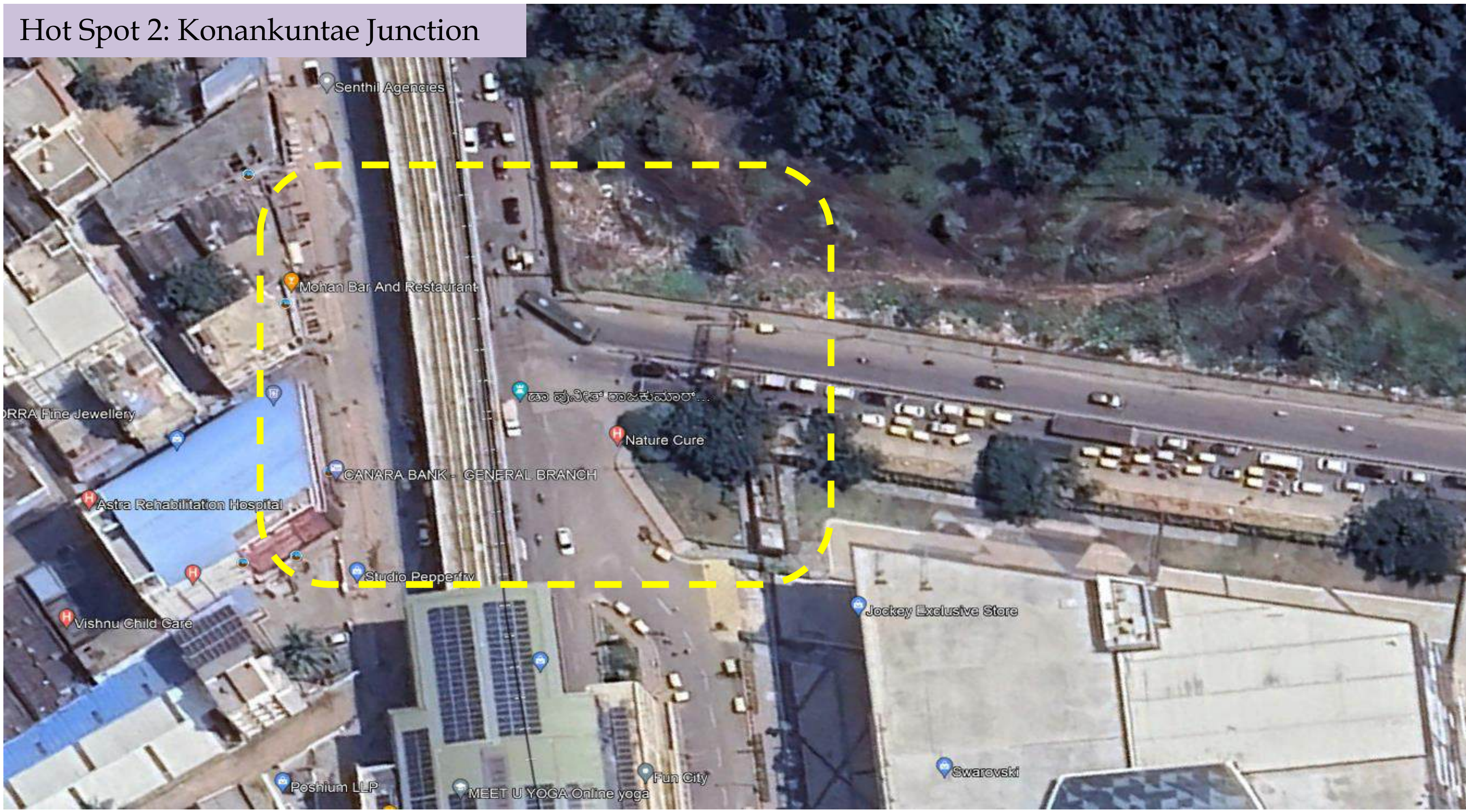


Figure 192 Map Showing Hot Spot 2- Konankuntae cross Junction on Kanakapura Road

Hot Spot 2: Konankuntae Junction

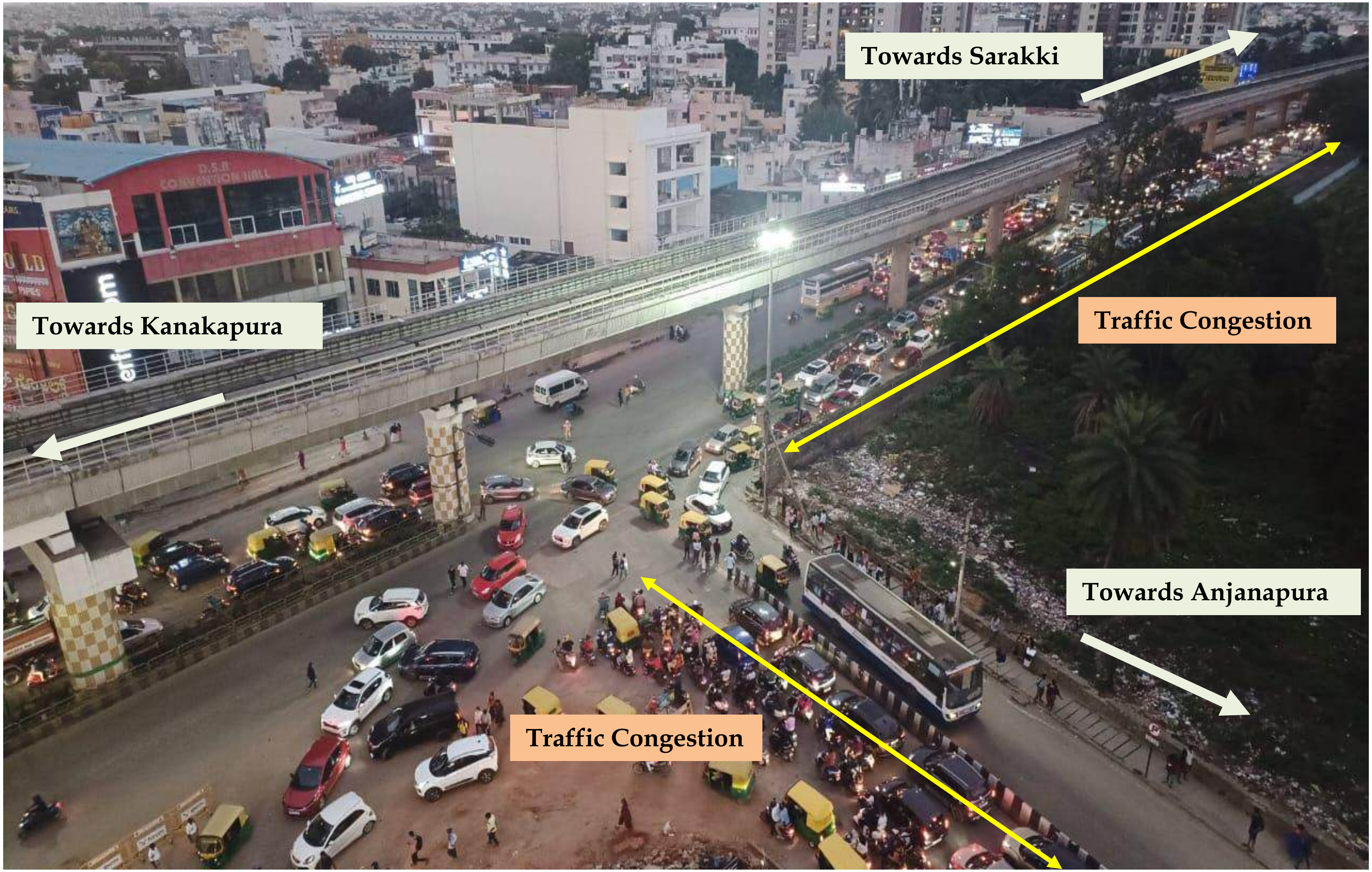


Figure 193. View of Konankuntae cross Junction on Kanakapura Road

Hot Spot 3 : Entry to Mall at Konankuntae Junction Issue

This issue here is that the entry to the mall is located right at the junction as shown in **Figure 194**. This is causing traffic congestions specially during weekends. Vehicles coming from Banashankari side, Anjanapura side ,Vanathapura side and also from Kanakapura road need to enter at this point leading to traffic Queues and junction delays. Apart from the vehicle delays , in the absence of proper pedestrian facility at the junction pedestrian vehicle conflicts can be seen at this junction.

Hot Spot Location 3 : Entry to Mall at Konankuntae cross Junction

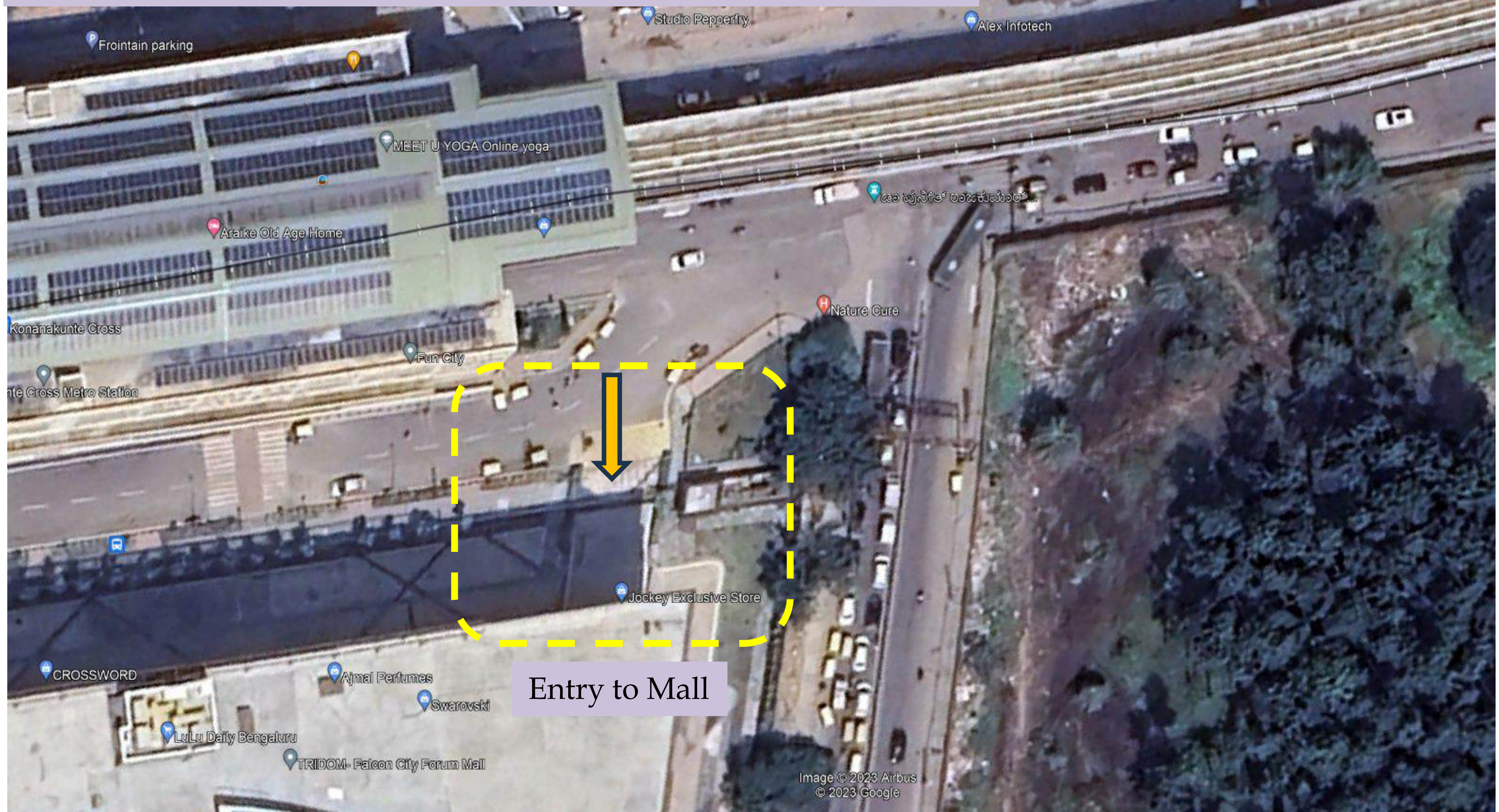


Figure 194. Map showing Hot spot 3 - Entry to Forum Mall at Konankuntae cross junction on Kanakapura Road

Hot Spot 3 : Entry to Mall at Konankuntae Junction Issue

Figure 195 Picture showing Hot spot 3 - Entry to Forum Mall at Konankuntae cross junction on Kanakapura Road

Hot Spot 4 : Criss- crossing ,Merging & Diverging Issue near mall

This is critical junction wherein we can see about 14 types of traffic movements can be seen which is more than anormal 4 arm intersection, the reason being a critical median opening at Kanakapura road and the residential area access on Tippasandra main road and mall. Different types of traffic movements are shown in the **Figure 196** and in the absence of proper channelization and geometric designs this junction has become more cumbersome leading to traffic congestions.

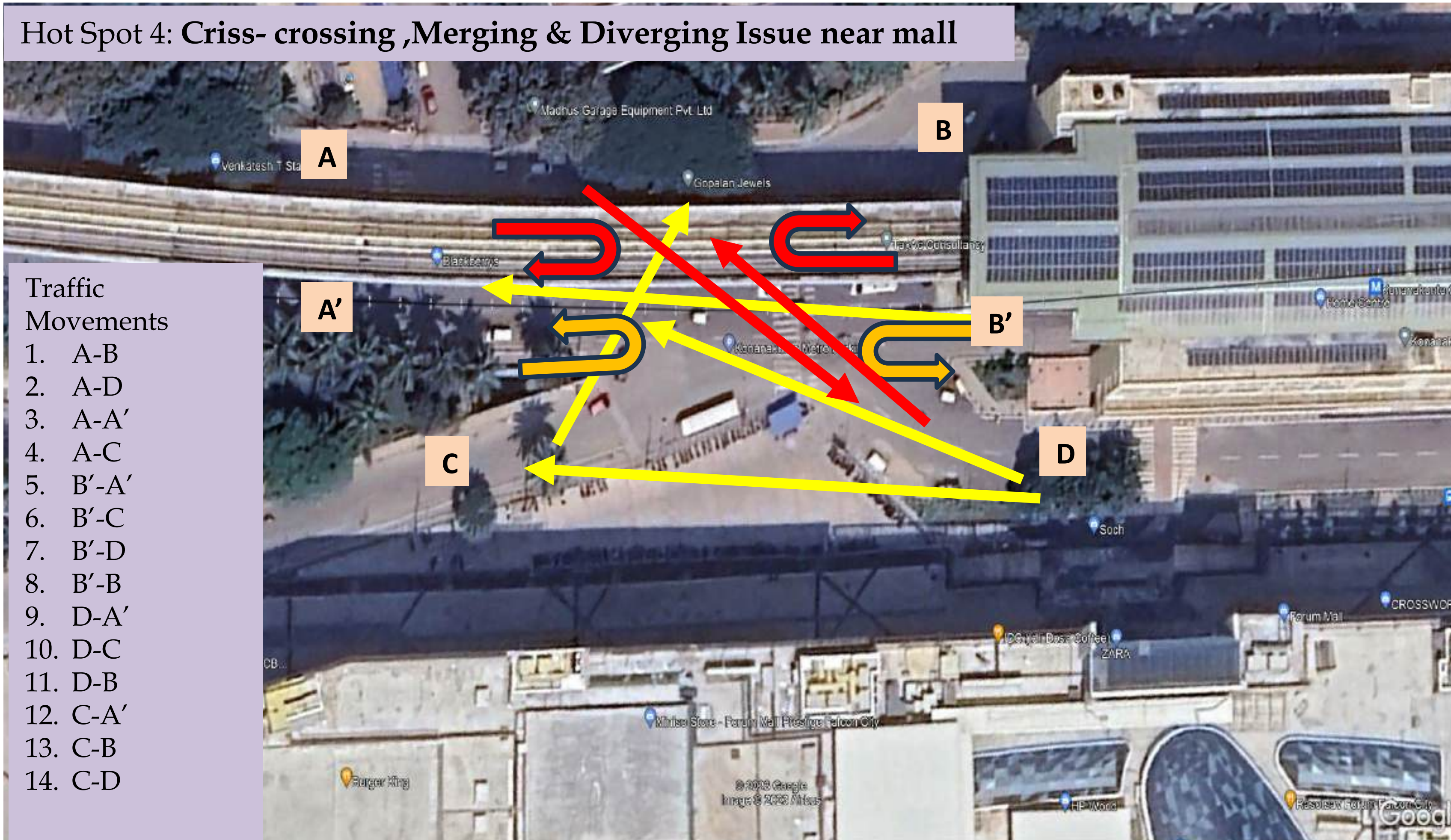


Figure 196. Map showing Hot spot 4- Criss-crossing, merging & Diversion issue near Forum Mall on Kanakapura Main road

Road Inventory Survey- Existing Site Condition

Footpath adjacent to the project site

Entrance to the project site

Bus Stop adjacent to the project site

Entrance to the project site

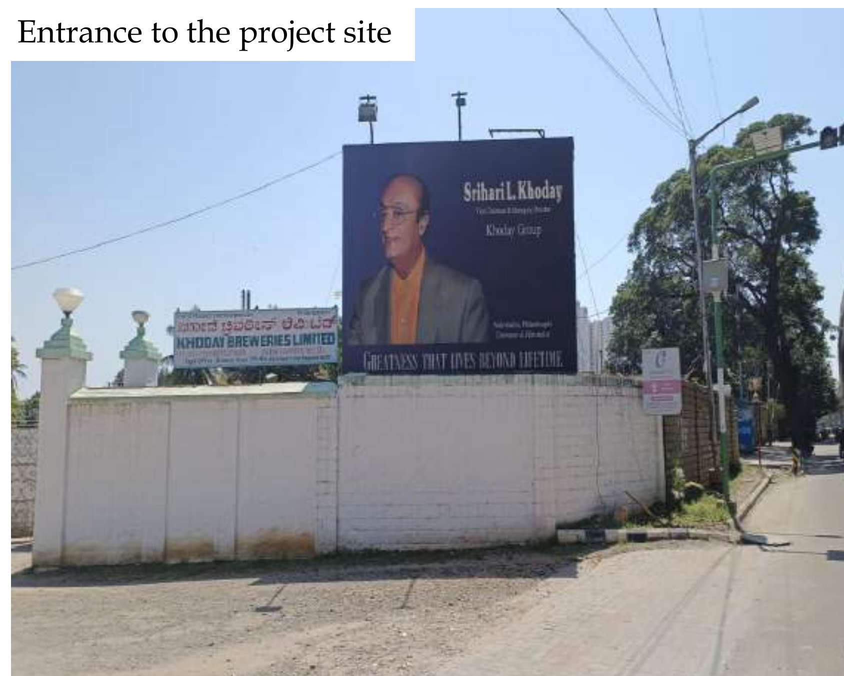
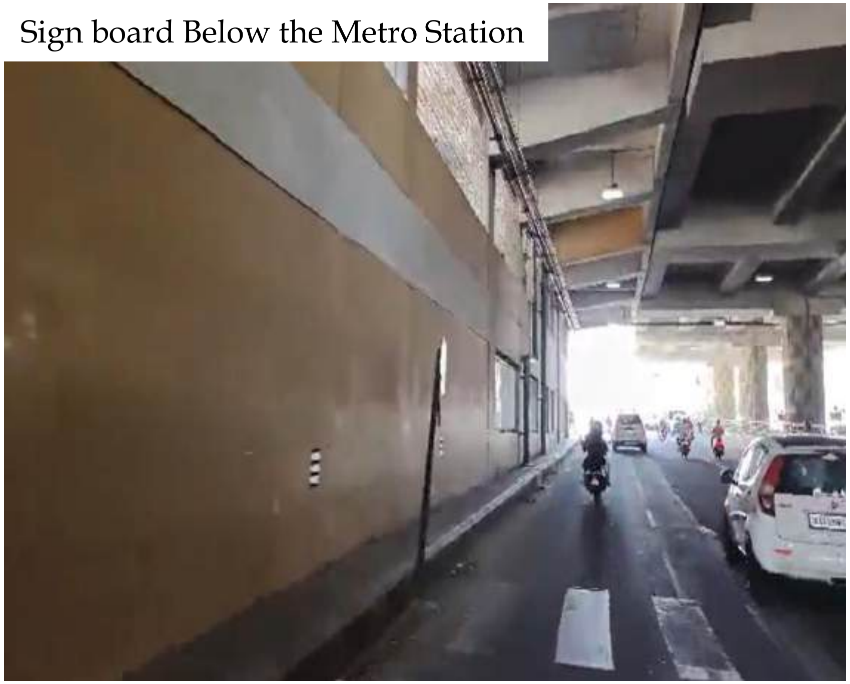


Figure 197. Pictures Showing the Existing Road inventory in the vicinity of the project site

Road Inventory Survey- Existing Site Condition

Tree on the main Carriageway

Sign board Below the Metro Station



Gantry Signboard on the Carriageway

Debris on the Footpath

Figure 198: Pictures Showing the Existing Road inventory in the vicinity of the project site

Road Inventory Survey- Existing Site Condition

Two Wheeler Parking on Footpath- Kanakapura Road

Electrical Junction boxes on footpath

Vasanthapura Main road

On street Parking at Vasanthapura Main road

Figure 199. Pictures Showing the Existing Road inventory in the vicinity of the project site

Topographical Surveys- Vasanthapura Junction

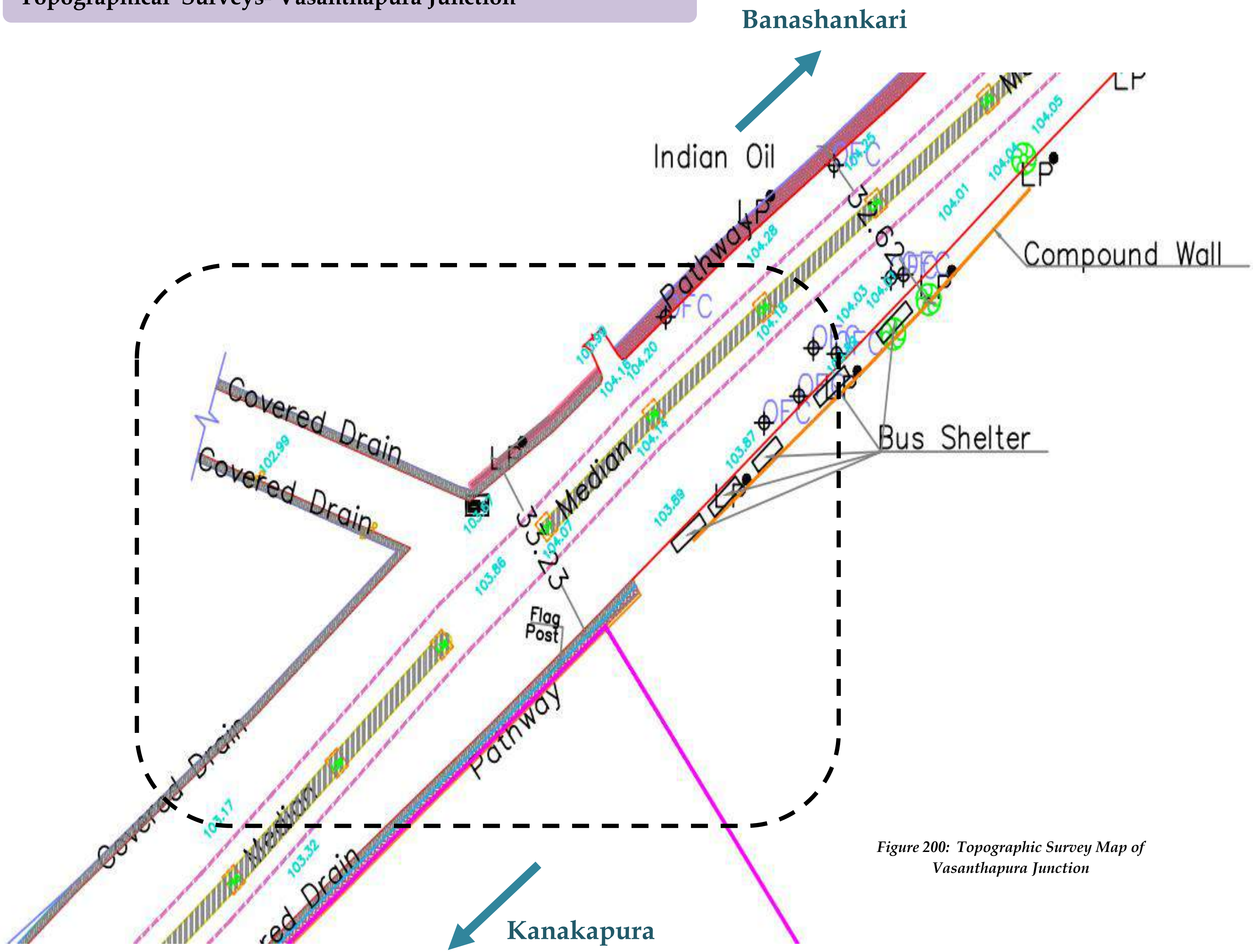
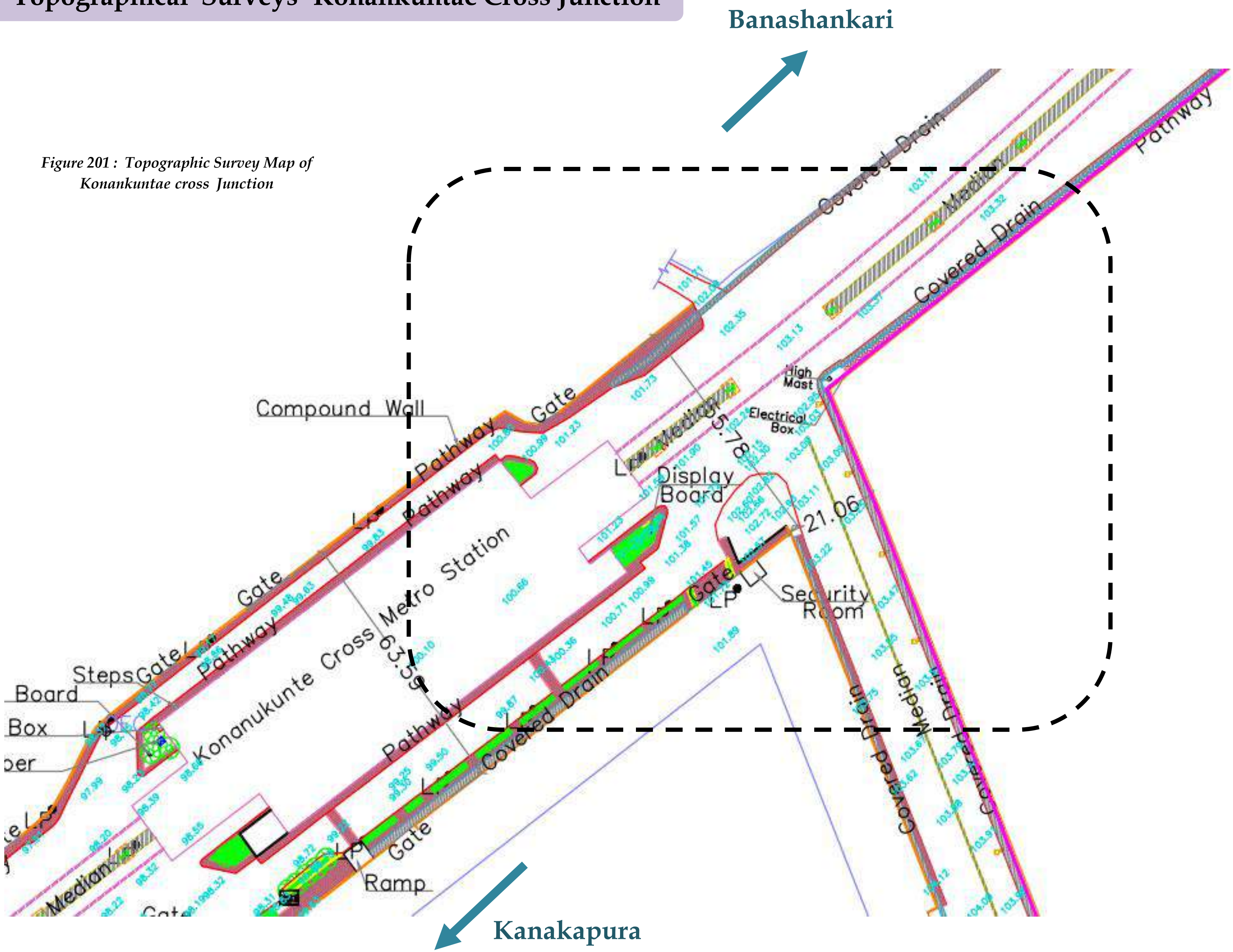


Figure 200: Topographic Survey Map of Vasanthapura Junction

Topographical Surveys- Konankuntae Cross Junction

Figure 201 : Topographic Survey Map of Konankuntae cross Junction



Topographical Surveys- Tippasandra Junction

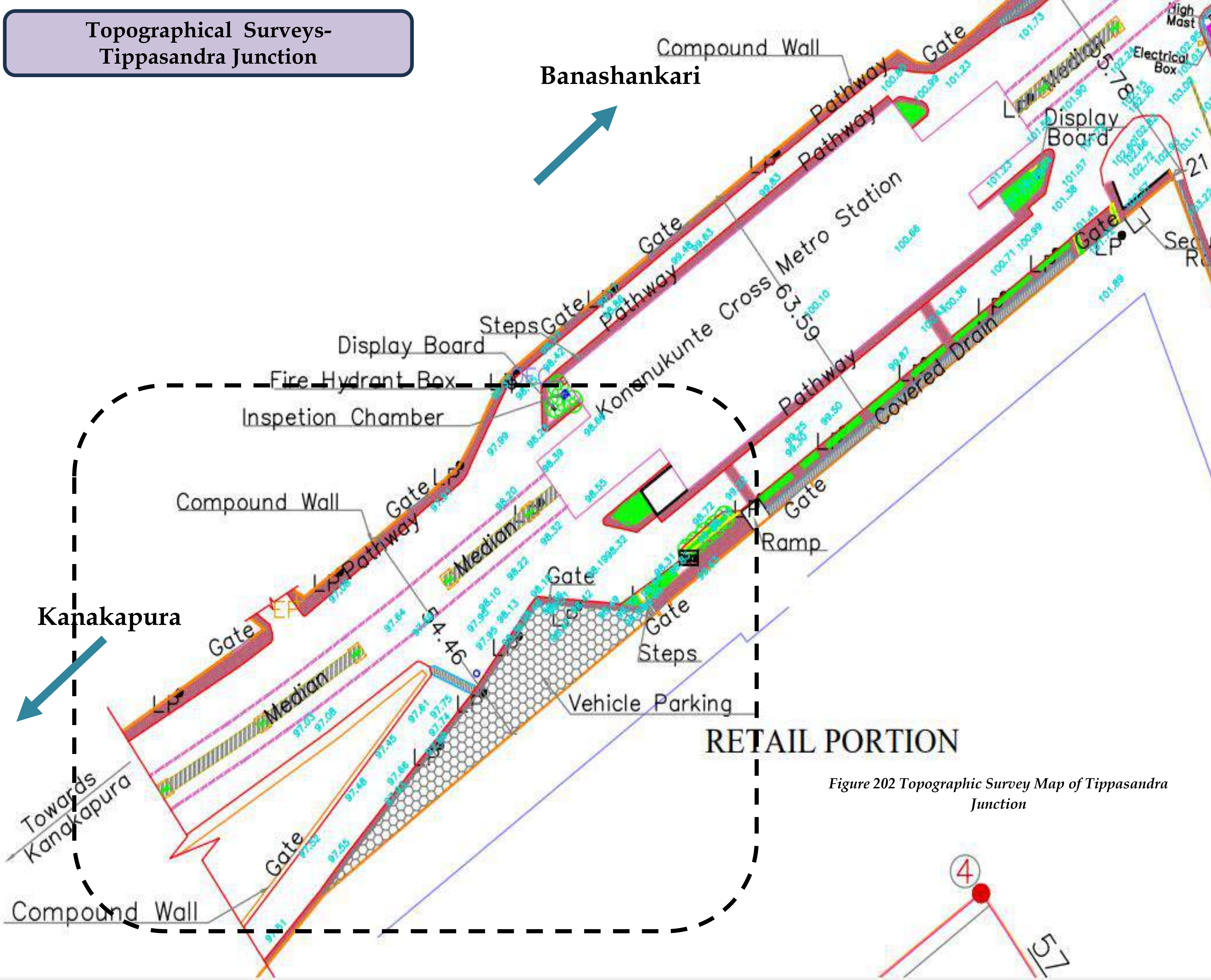


Figure 202 Topographic Survey Map of Tippasandra Junction

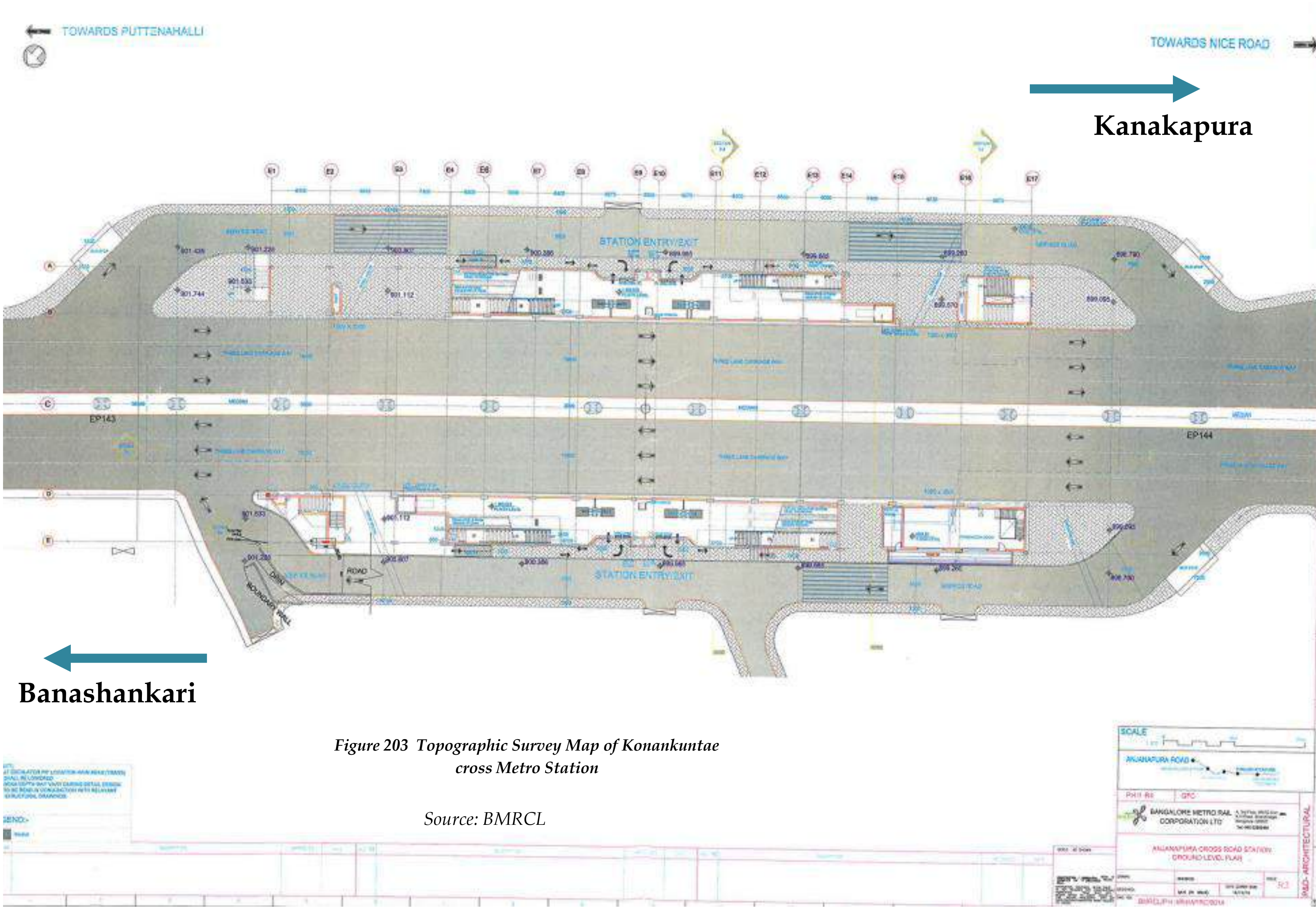


Figure 203 Topographic Survey Map of Konankuntae cross Metro Station

Source: BMRCL

Secondary Data : Metro Drawings

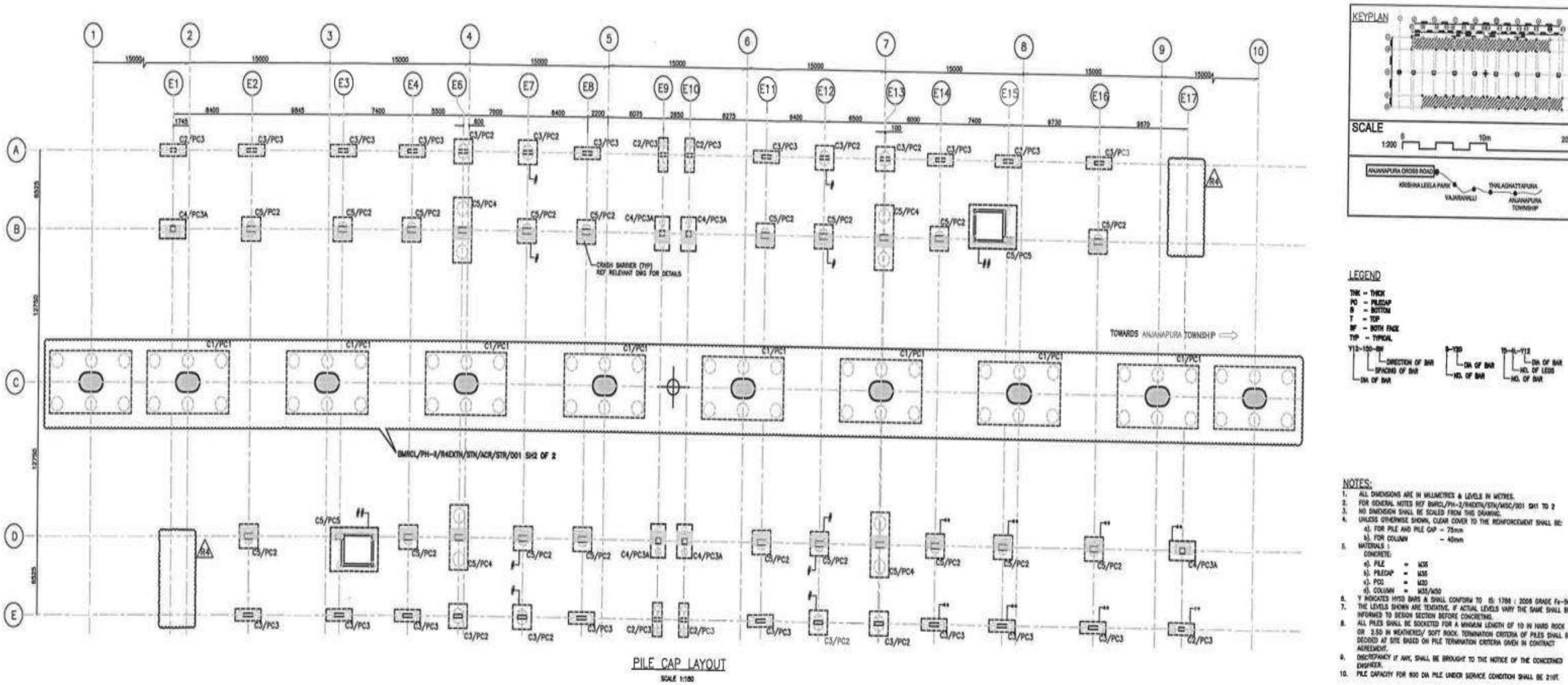


Figure 204. Foundation Details of Metro Pillars along Kanakapura road near Konankuntae cross junction

Source: BMRCL

Secondary Data : Metro Foundation Drawings

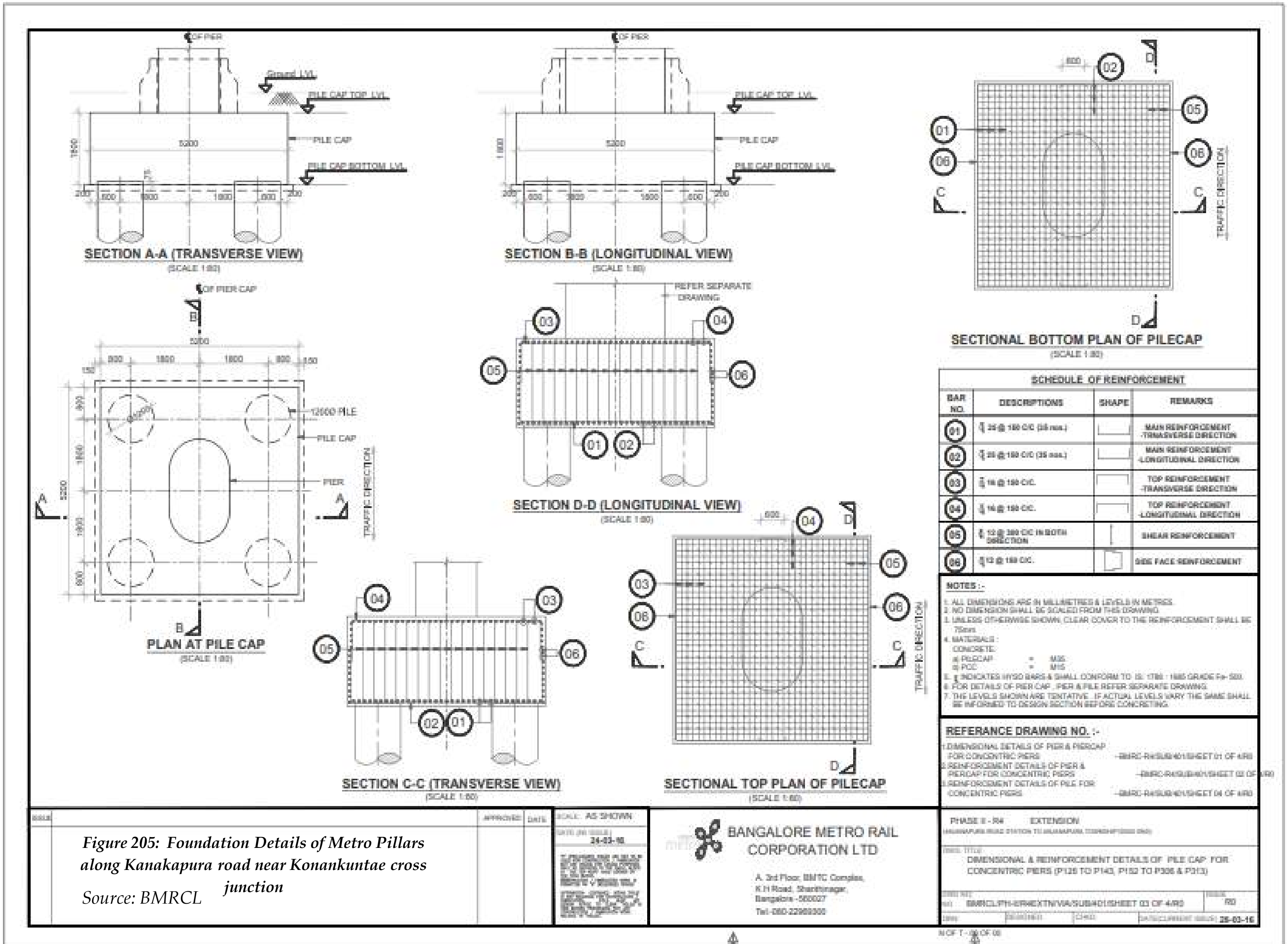


Figure 205: Foundation Details of Metro Pillars along Kanakapura road near Konankuntae cross junction

Source: BMRCL

Secondary Data : Metro Foundation Drawings

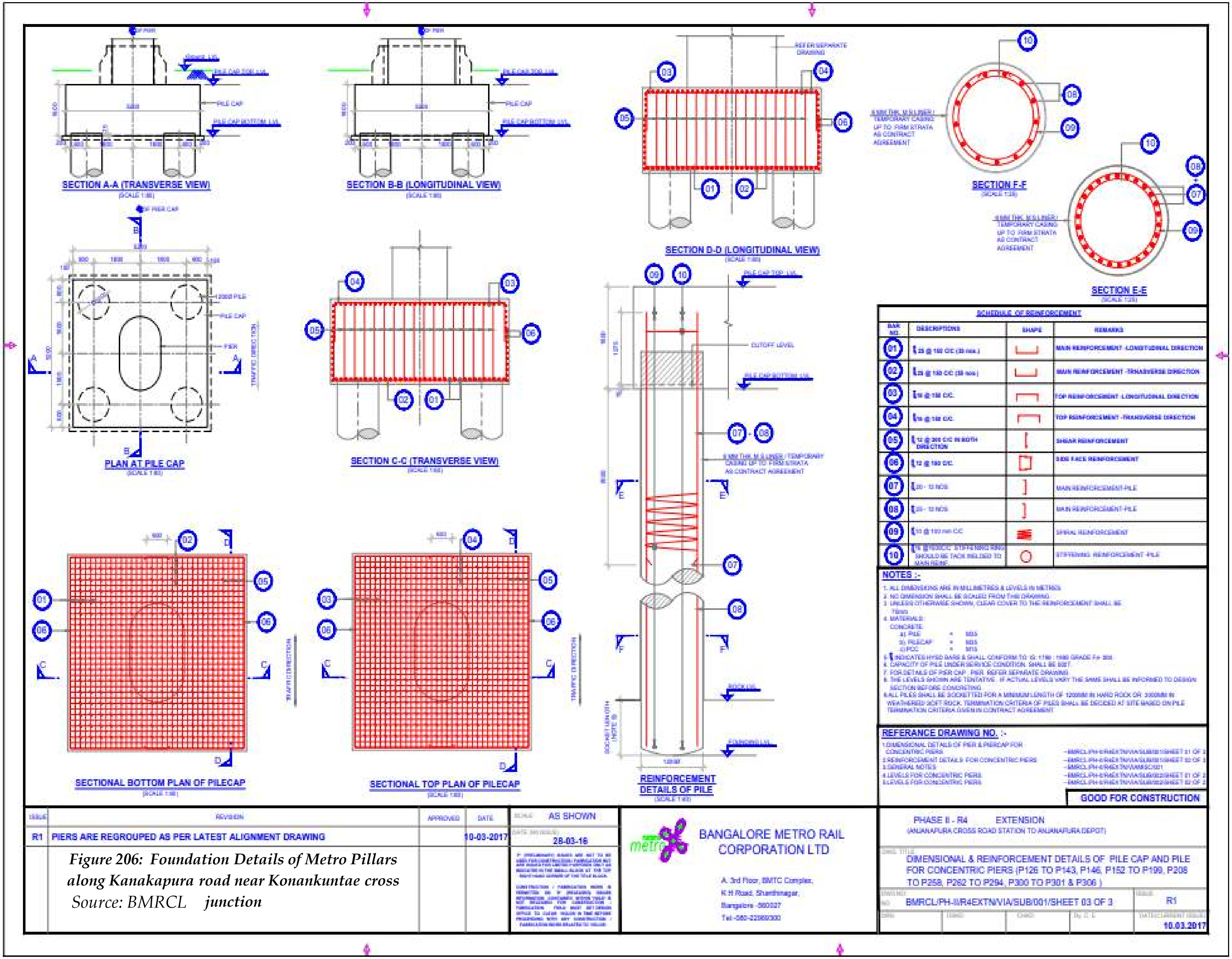
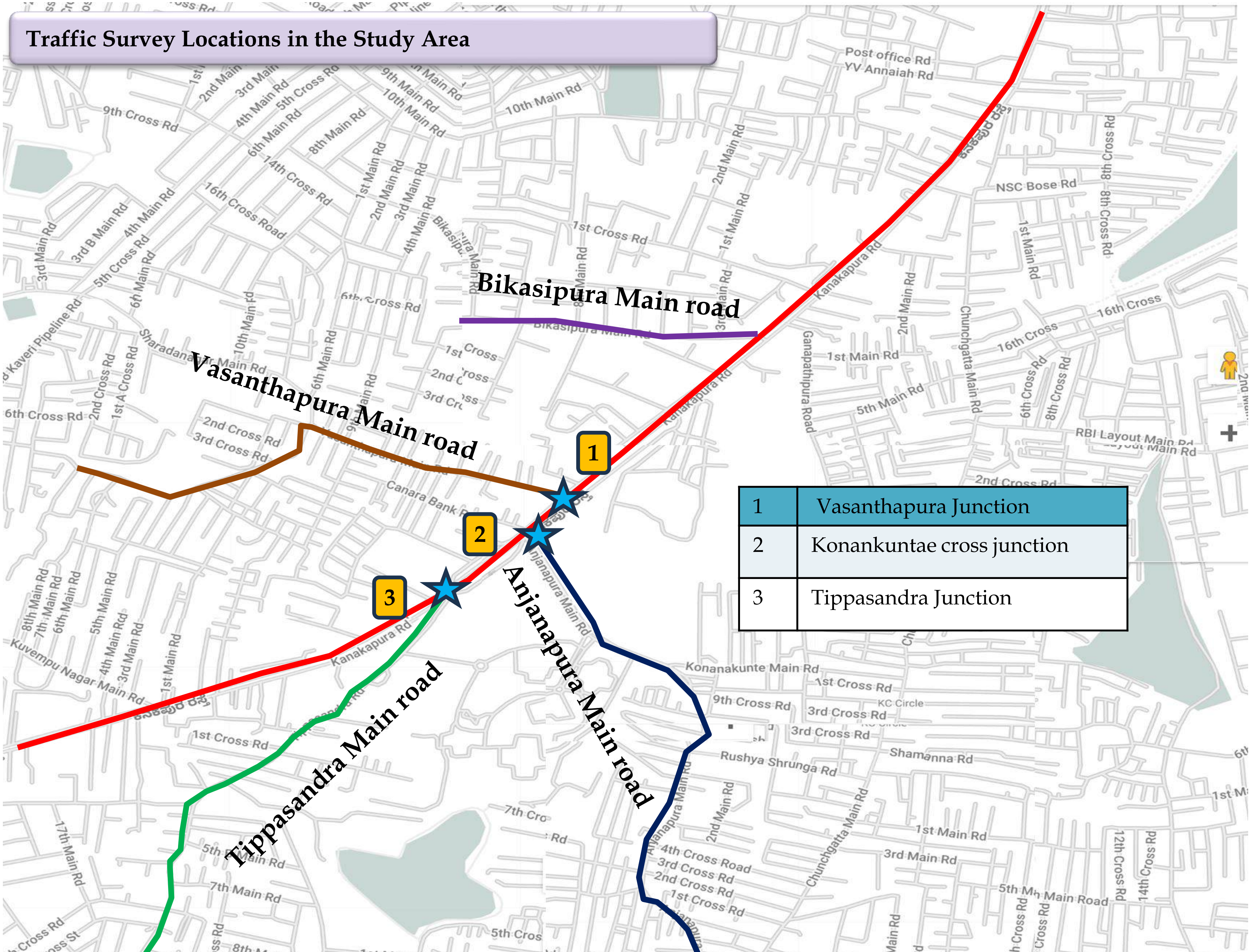


Figure 206: Foundation Details of Metro Pillars along Kanakapura road near Konankuntae cross junction

Source: BMRCL

Traffic Survey Locations in the Study Area



1	Vasanthapura Junction
2	Konankuntae cross junction
3	Tippasandra Junction

Figure 207: Map Showing the Traffic Survey Locations in the Study Area

Videographic Volume count surveys using CCTV Cameras at all the Critical Locations

Peak Hour Video graphic traffic counts were conducted at all the four locations, out of which three locations i.e. Location 1 , 2 and 3 traffic counts were done for three days (One weekday and two weekends) but at location 4 peak hour count was done for one day during weekday. Cameras were installed at the junctions and recording was done as shown in the **Figure 208.**

1	Vasanthapura Junction
2	Konankuntae cross junction

3	Tippasandra Junction

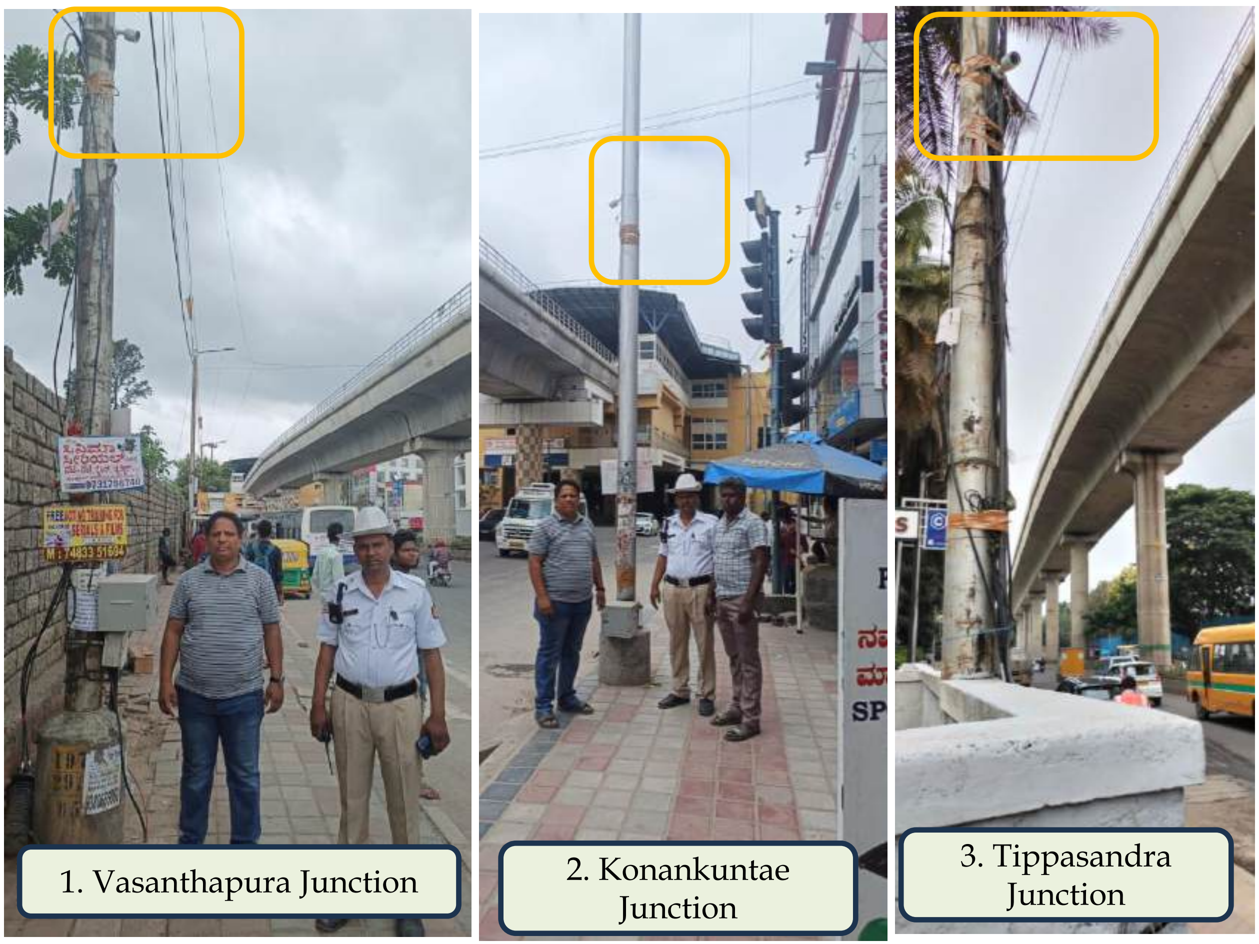


Figure 208: Pictures Showing the Cameras installed to conduct video Traffic counts at all the Locations in the Study Area

Video Graphic Volume count Locations using CCTV Camera at all the Critical Locations

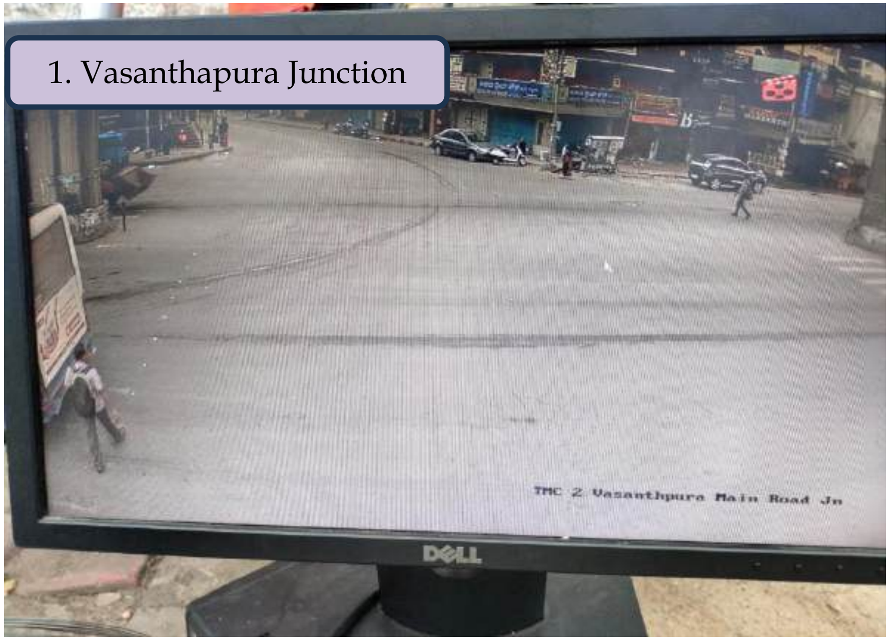


Figure 209. Pictures Showing the video recordings at Traffic Survey Locations in the Study Area

Spot Speeds Survey roads in the Study Area

Spot Speeds surveys were conducted at four locations as shown in the **Figure 210**, The spot speeds were taken at around 4:00 PM in a weekday, to assess the spot speeds on the adjoining roads of the proposed development. When we compare the spot speeds with speed and delay we can see that speeds get reduced when it reaches the junction and increase as soon as you move away from the junction on Kanakapura road. Hence when the entry & exit is designed on this road will add up to the traffic increasing the congestion level and reducing the speeds, hence need to have a long term proposal to mitigate this issue.

1	**Yelachenahalli-Konankuntae Jn**
2	**Anjanapura-Konankuntae Jn**
3	**Doddakalsandra-Konankuntae Jn**
4	**Vasanthapura-Bannerghatta Road**

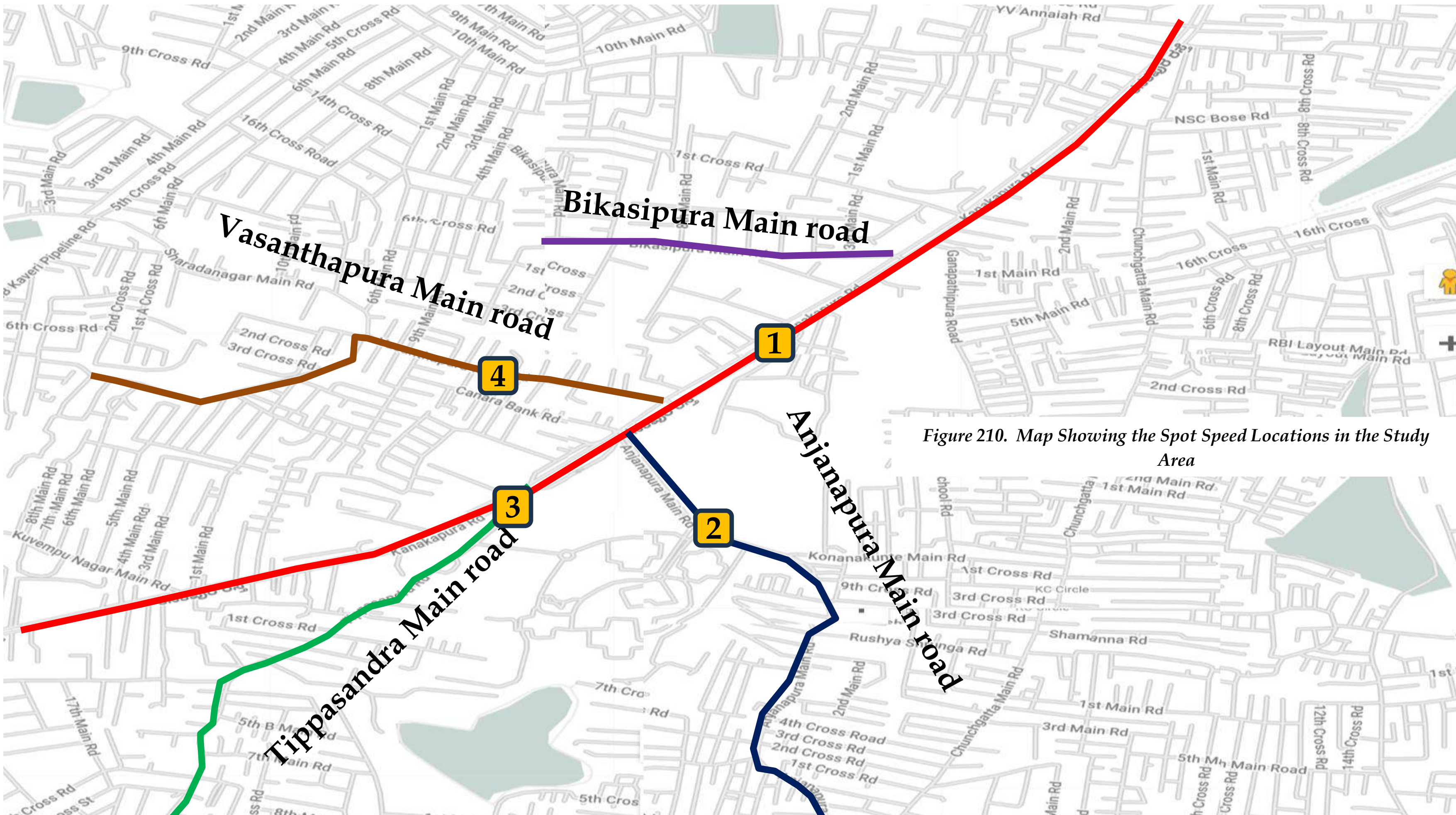


Figure 210. Map Showing the Spot Speed Locations in the Study Area

Table 53 : Traffic Flow at Intersections (PCUs)

Sl. No.	Junction Name	Total Flow (PCUs)	Morning Peak Hour Volume (PCUs)			Evening Peak Hour Volume (PCUs)		
			Peak Time	Peak Hr. Flow (PCUs)	Peak Hour Share	Peak Time	Peak Hr. Flow (PCUs)	Peak Hour Share
1	Forum Mall Junction	97791	9:15-10:15	8341	8.50%	18:15-19:15	8920	9.10%
2	Konankunte Cross Junction	111003	8:45-9:45	10970	9.90%	18:00-19:00	9778	8.80%
3	Vasanthpura Junction	137223	8:45-9:45	12797	9.30%	18:00-19:00	11863	8.60%
4	Adayar Ananda Bhavan, Raghuvanahalli Junction	70837	8:45-9:45	6139	8.67%	18:15-19:15	6483	9.15%

From **Table 53** it can be inferred that the following intersections carry more than 10,000 PCUs during the peak hour.

- Konankuntae Cross Junction
- Vasanthapura Junction

The movement wise traffic flow diagrams have been shown in **Figures.**

Volume to Capacity Ratio (V/C) and Level of Service

Volume to Capacity Ratio (V/C Ratio) is defined as the ratio of peak hour traffic flow rate to capacity and Level of Service (LOS) is defined as the a qualitative measure, describing operational conditions within a traffic stream and their perception by the drivers/passengers.

Universally, LOS is lettering scheme ranging from A to F. LOS 'A' represents highest quality of service whereas LOS 'F' represents heavily congested flow where traffic demand exceeds capacity. The service measures used for defining LOS are density and volume-to-capacity ratio.

For computation of V/C Ratio the capacity values have been adopted based on the road geometrics ***(as per Indo Highway Capacity Manual 2012-2017)*** conforming to the site conditions as shown in **Table 54**.

Table 54 Existing V/C and Level of Service for Roadway Segments

V/C	LOS	Performance
0.0 -0.2	A	Excellent
0.2-0.4	B	Above Average
0.4-0.6	C	Average
0.6-0.8	D	Below Average
0.8-1.0	E	Poor
1.0-1.2	F	Very Poor

The ratio of peak hour traffic flow rate to capacity (V/C Ratio) and the Level of Service (LOS) of the road sections along Kanakapura Road Corridor are presented pictorially in Figure 211.

Table 55. Traffic Volume to Capacity ratio and Level of Service

Sl. No.	Road Name	EXISTING												
		Towards Banashankari							Towards Kanakapura					
		Capacity	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak
1	Between Vasanthapura Junction and Bikasipura Main Road	2700	6192	2.29	LOS F	4776	1.77	LOS F	4005	1.48	LOS F	4658	1.73	LOS F
2	Between Konankunte Junction and Vasanthpura Junction	2700	4859	1.8	LOS F	4133	1.53	LOS F	4410	1.63	LOS F	4134	1.53	LOS F
3	Between Forum Mall Junction and Konankuntae Junction	2700	4614	1.71	LOS F	4410	1.63	LOS F	3125	1.16	LOS F	3672	1.36	LOS F
4	Between Forum Mall Junction and Doddakalsandra Junction	2700	3633	1.35	LOS F	3267	1.21	LOS F	2319	0.86	LOS E	2910	1.08	LOS F
5	Between Doddakalsandra Junction and 80 Feet Junction	2700	3051	1.13	LOS F	3267	1.21	LOS F	1980	0.73	LOS C	2910	1.08	LOS F

It can be observed that amount of traffic approaching at all the locations (except Between Konankuntae Junction and Vasanthapura Junction towards Banashankari) exceeds beyond its capacity resulting in considerable delay and queuing.

The volume to capacity ratio at most of the locations exceeds 1.0 and the Level of Service is found to be ‘F’ which indicates heavily congested flow where traffic demand exceeds capacity

Traffic Analysis Results- PCU-V/C Ratio & LOS: Week Day Monday Morning Peak

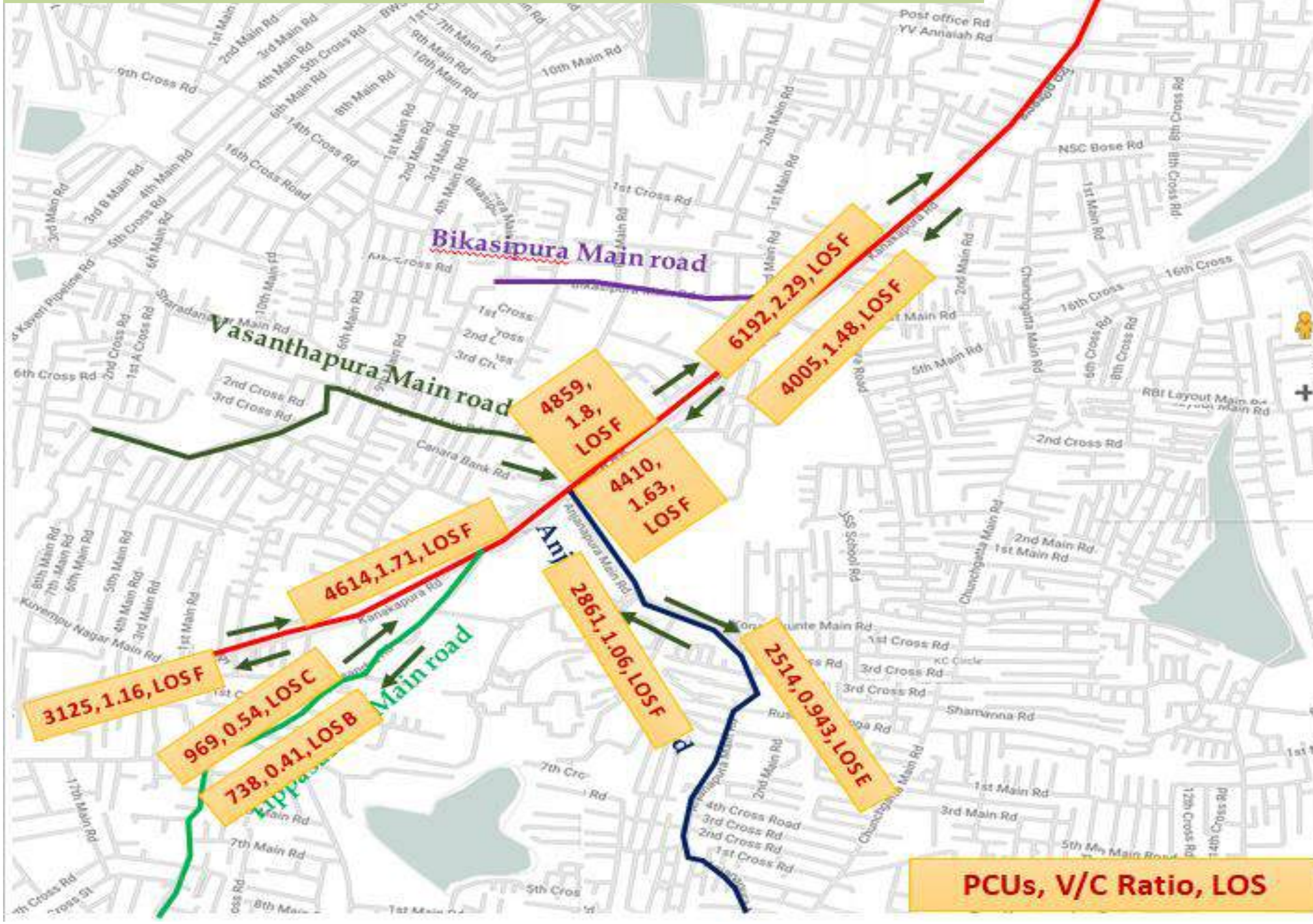


Figure 211: Mid-block Traffic (PCUs) during Morning Peak (Weekday-Monday)

Traffic Analysis Results- PCU-V/C Ratio & LOS: Week Day Monday Evening Peak

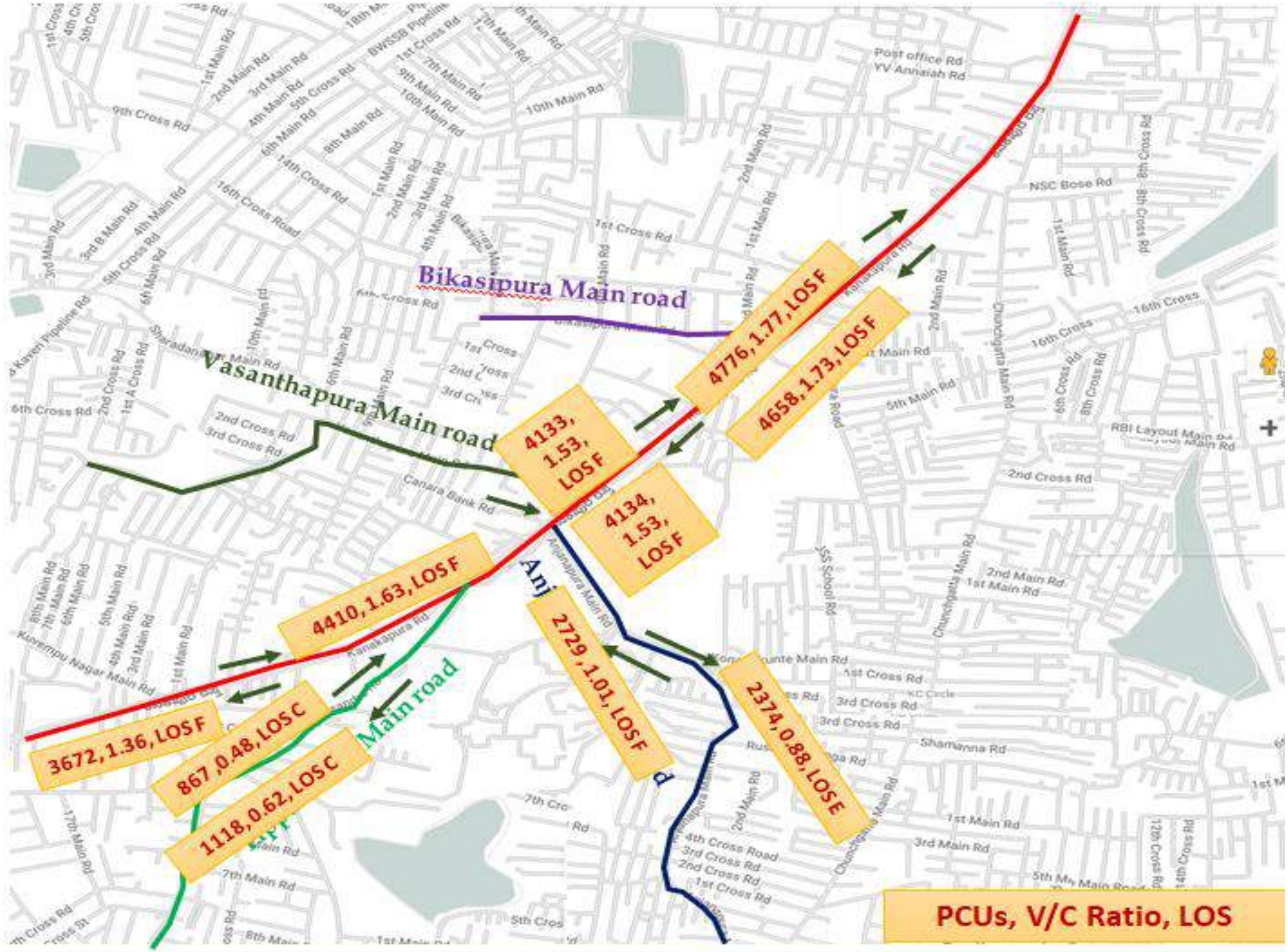


Figure 212 : Mid-block Traffic (PCUs) during Evening Peak (Weekday-Monday)

Spot Speeds Survey roads in the Study Area

Spot Speeds surveys were conducted at four locations as shown in the **Figure 213**, The spot speeds were taken at around 4:00 PM in a weekday, to assess the spot speeds on the adjoining roads of the proposed development. When we compare the spot speeds with speed and delay we can see that speeds get reduced when it reaches the junction and increase as soon as you move away from the junction on Kanakapura road. Hence when the entry & exit is designed on this road will add up to the traffic increasing the congestion level and reducing the speeds, hence need to have a long term proposal to mitigate this issue.

1	**Yelachenahalli-Konankuntae Jn**
2	**Anjanapura-Konankuntae Jn**
3	**Doddakalsandra-Konankuntae Jn**
4	**Vasanthapura-Bannerghatta Road**

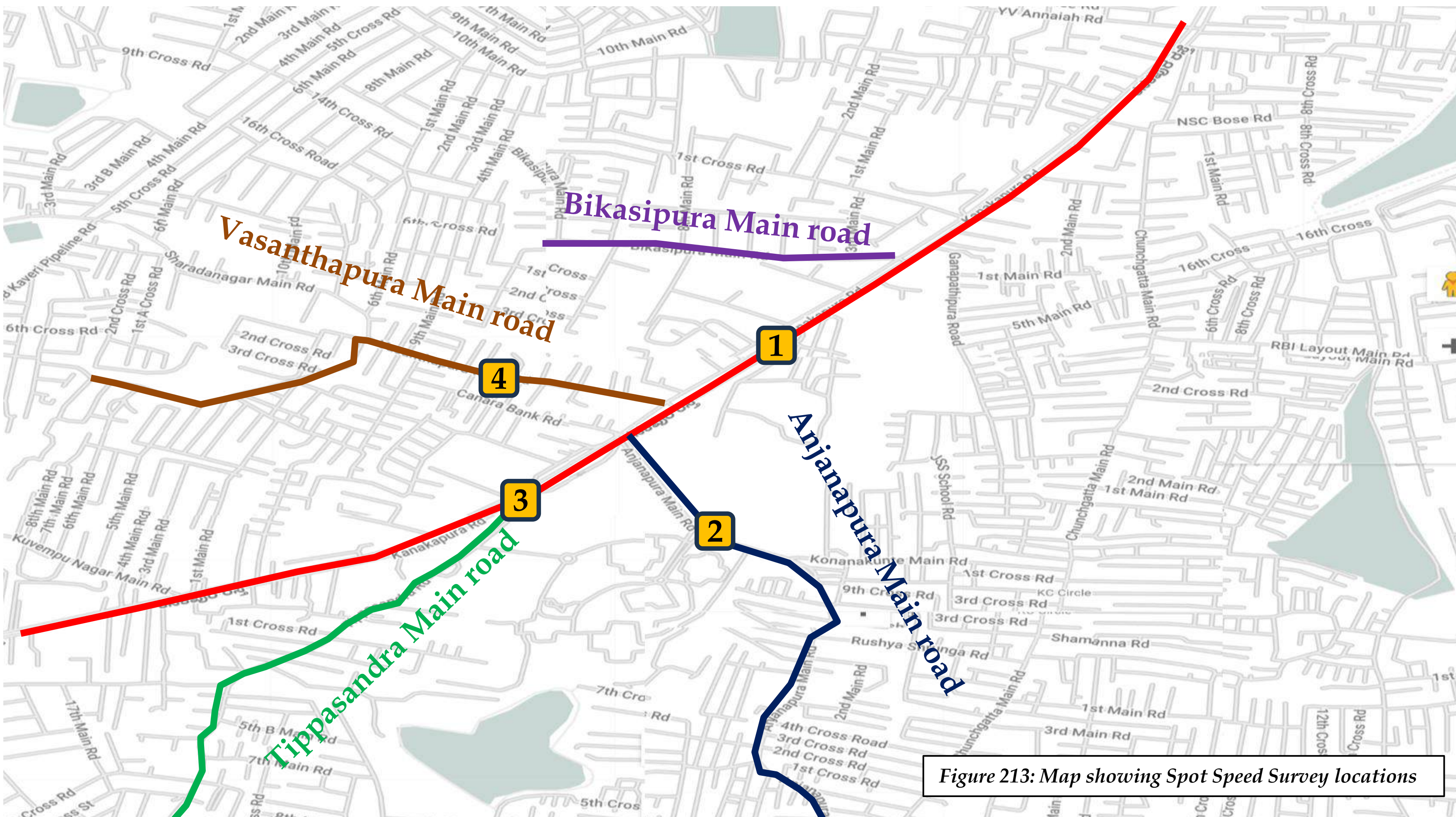


Figure 213: Map showing Spot Speed Survey locations

Spot Speed Data

Name of the location			Yelchanahalli- Konankuntae Jn		
Slno.	Cars	Two Wheelars	Buses	LCV's	Auto
1	38	43	26	21	31
2	52	52	24	18	26
3	42	38	32	24	24
4	36	34	34	36	18
5	32	46	28	26	30
6	26	40	26	34	28
7	34	38	38	22	26
8	29	26	20	19	32
9	35	45	18	29	22
10	26	54	24	31	25
Total	350	416	270	260	262
Average	**35**	**41.6**	**27**	**26**	**26.2**

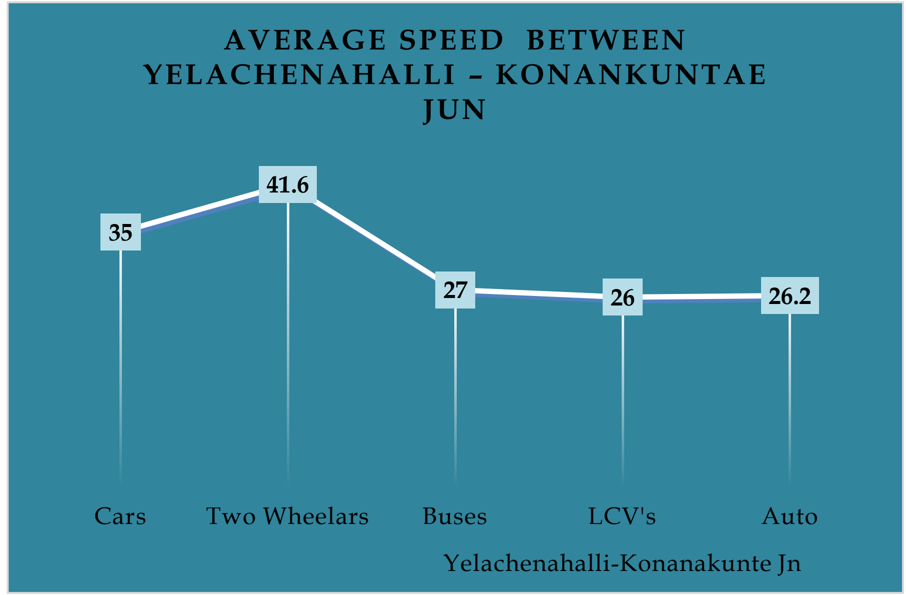


Figure 214: Spot Speed Details between Yelchanahalli & Konankuntae cross

Name of the location			Anjanapura-Konankuntae Jn		
Slno.	Cars	Two Wheelars	Buses	LCV's	Auto
1	32	30	18	22	28
2	28	36	22	18	32
3	26	24	19	24	26
4	30	34	24	20	20
5	28	29	20	17	16
6	26	38	26	28	24
7	20	18	21	25	21
8	32	26	14	22	28
9	18	22	19	14	16
10	20	29	22	20	19
Total	260	286	205	210	230
Average	**26**	**28.6**	**20.5**	**21**	**23**

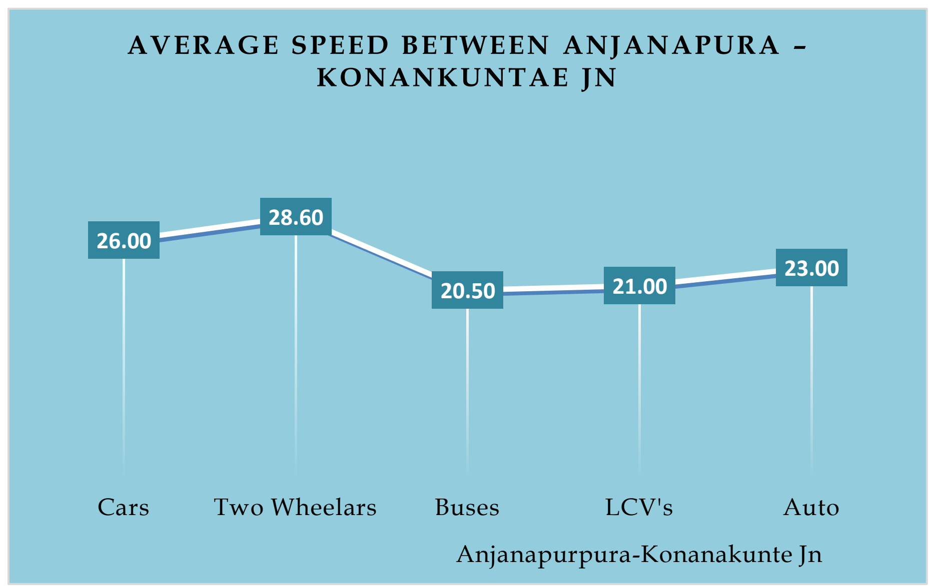


Figure 215: Spot Speed Details between Anjanapura & Konankuntae cross

Spot Speed Data

Name of the location			Doddakalsandra-Konankuntae Jn		
Slno.	Cars	Two Wheelars	Buses	LCV's	Auto
1	48	48	39	38	38
2	46	42	43	46	32
3	40	46	36	44	36
4	44	33	41	32	30
5	36	56	46	48	44
6	52	44	39	52	48
7	48	50	32	41	42
8	44	40	51	36	36
9	54	32	46	44	40
10	42	46	44	41	42
Total	454	437	417	422	388
Average	**45.4**	**43.7**	**41.7**	**42.2**	**38.8**

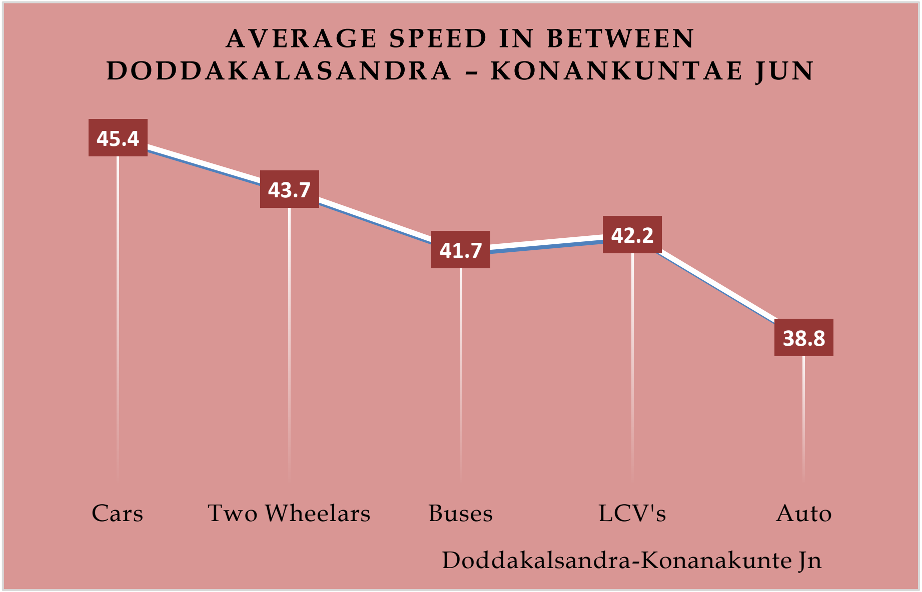


Figure 216: Spot Speed Details between Doddakalasandra & Konankuntae cross

Name of the location			Vasanthapura-Bannerghatta Road		
Slno.	Cars	Two Wheelars	Buses	LCV's	Auto
1	32	28	22	21	26
2	24	34	28	26	24
3	26	36	26	22	32
4	20	28	18	24	28
5	28	32	16	28	34
6	18	41	24	18	31
7	24	23	22	16	26
8	28	18	18	28	38
9	34	32	19	30	21
10	28	38	21	25	26
Total	262	310	214	238	286
Average	**26.2**	**31**	**21.4**	**23.8**	**28.6**

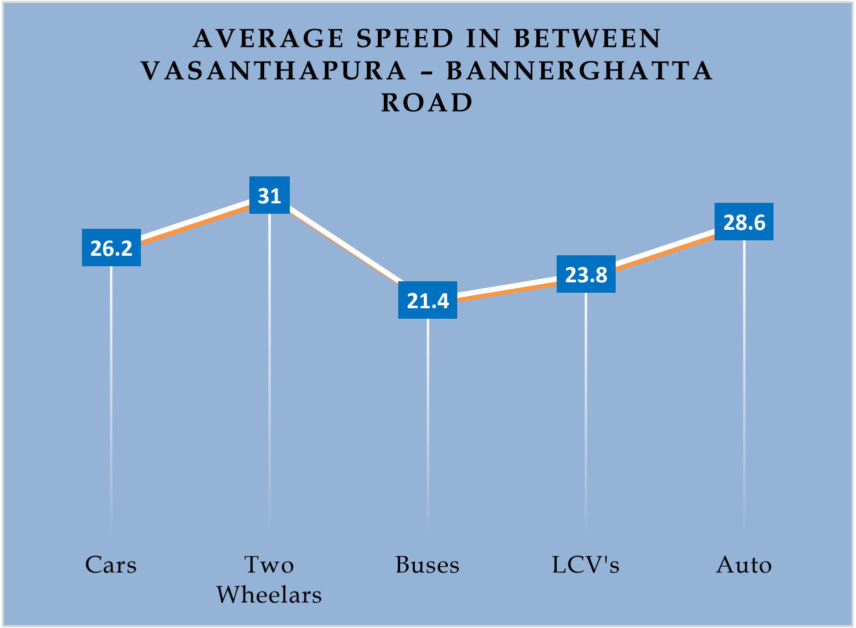


Figure 217: Spot Speed Details between Vasanthapura & Bannerghatta road

Speed and Delay

Speed & delay survey provides a link wise estimate of journey time, running time and delay. Speed and Delay Survey was carried out Car during morning and evening peak hours. Floating car technique has been utilized for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the cumulative time at specified timing points to ensure obtaining the average link travel time of the road network.

The overall travel speed generally referred to as journey speed is the effective speed between two points and is computed as the distance divided by the total time taken by the vehicle to complete the journey including delays incurred en-route.

The speed maintained by the vehicle over the stretch while in motion is the running speed obtained through dividing the distance by the duration of time while the vehicle is in motion and thus excludes that part of time wherein the vehicle suffers delay. The journey speed and the variation between running speed and journey speed is the indicator of level of service and a measure of congestion. The survey data analysis also highlights the causes of delay that occur at various locations such as stopped delay or operational delay.

The direction-wise abstract of analysis along the study area by the name of road, length surveyed, overall travel time, journey speed and running speed are furnished below in **Table 56.**

Table 56. Car Speed and Delay-Morning Peak

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)
1	Two Way	Vasanthpura Junction	Konankunte Cross	0.11	35	69	34	6	12
2	Two Way	Konankunte Cross	Forum Mall Junction	0.19	25	74	49	9	14
3	Two Way	Konankunte Cross	Kairuchi Junction	0.45	15	82	67	20	24

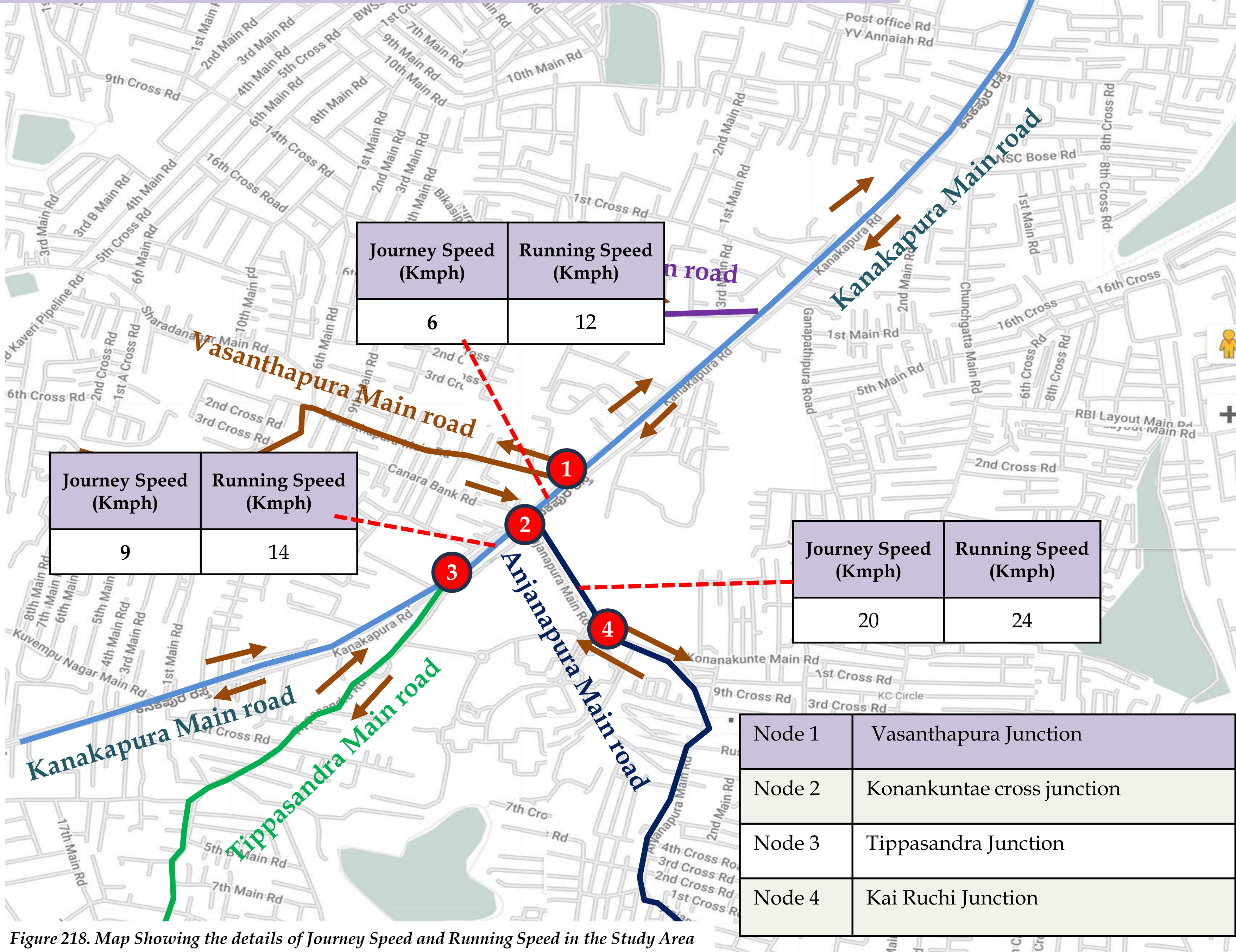
Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)
1	Two Way	Kairuchi Junction	Konankunte Cross	0.45	89	157	68	10	24
2	Two Way	Forum Mall Junction	Konankunte Cross	0.19	32	81	49	8	14
3	Two Way	Konankunte Cross	Vasanthpura Junction	0.11	15	82	67	5	6

Table 57 Car Speed and Delay-Evening Peak

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)
1	Two Way	Vasanthpura Junction	Konankuntae Cross	0.11	41	73	32	5	12
2	Two Way	Konankunte Cross	Forum Mall Junction	0.19	30	82	52	8	13
3	Two Way	Konankunte Cross	Kairuchi Junction	0.45	21	93	72	17	23

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)
1	Two Way	Kairuchi Junction	Konankunte Cross	0.45	96	176	80	9	20
2	Two Way	Forum Mall Junction	Konankuntae Cross	0.19	35	88	53	8	13
3	Two Way	Konankunte Cross	Vasanthapura Junction	0.11	20	85	65	5	6

Overall Speeds of cars on the adjacent roads of the proposed project site



Journey Speed (Kmph)	Running Speed (Kmph)
6	12

Journey Speed (Kmph)	Running Speed (Kmph)
9	14

Journey Speed (Kmph)	Running Speed (Kmph)
20	24

Node 1	Vasanthapura Junction
Node 2	Konankuntae cross junction
Node 3	Tippasandra Junction
Node 4	Kai Ruchi Junction

Figure 218. Map Showing the details of Journey Speed and Running Speed in the Study Area

Mitigation Measures

In order to have the transportation system in the project vicinity operate at satisfactory levels of service several improvements are recommended. The roadway improvements are categorized under short term, medium term and long term. Installation of short-term and medium term improvements alone will not in itself make the transportation system operate at desired level of service. For full operational efficiency short term, medium term and long term improvements are essential. With the installation of these improvements the transportation system within the project vicinity will operate at satisfactory level of service.

Proposed Underpass along Kanakapura Road

From the traffic analysis it is evident that Kanakapura Road between Vasanthapura Junction and Doddakalsandra Junction is the most congested stretch in the project vicinity with a volume-capacity ratio exceeding 1 and a journey speed below 10 kmph during peak hours.

Existing roads are inadequate to serve the traffic along Kanakapura Road. Any traffic from adjacent roads and developments to these roads will choke the existing roadway circulation in the neighborhood. Hence consultants have proposed a grade separator (Tunnel / Underpass) to relieve the congestion on Kanakapura Road.

The comparison between existing operational scenario and the operational scenario after construction of the tunnel is tabulated in Table 58. From Table 20 it can be seen that with the construction of tunnel, there will be considerable reduction in Volume to Capacity Ratio (V/C Ratio), enhanced Level of Service and increased Journey Speeds along Kanakapura Road Corridor.

Table 58 Level of service with Underpass Proposal-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed (Kmph)	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed (Kmph)
1	Between Konankunte Junction and Vasanthpura Junction	2700	4410	1.63	LOS F	4134	1.53	LOS F	10	1887	0.7	LOS C	1813	0.67	LOS C	30
2	Between Konankunte Junction and Forum Mall Junction	2700	3125	1.16	LOS F	3672	1.36	LOS F	10	549	0.20	LOS B	815	0.30	LOS B	40

Table 59 Level of service with Underpass Proposal-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	4859	1.80	LOS F	4133	1.53	LOS F	15	1344	0.50	LOS C	1430	0.53	LOS C	30
2	Between Konankunte Junction and Forum Mall Junction	2700	4614	1.71	LOS F	4410	1.63	LOS F	15	1025	0.38	LOS B	921	0.34	LOS B	40

From the above table it is evident that with this proposed underpass, the traffic (At grade) between Vasanthapura Junction and Doddakalsandra Junction will drastically reduce relieving congestion along this stretch.

Future Operating Conditions

The future peak hour traffic volumes for the future years 2031, 2041 and the year 2051 conditions were forecasted using RTO growth rates. The growth rate obtained from the RTO data were used to forecast the future year traffic volumes at the study roadway segments.

The LOS conditions for the horizon year scenarios (With and Without Improvements) for the years 2031, 2041 and 2051 are presented in the following tables

Table 60. Traffic forecast for the year 2031-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							**Towards Kanakapura (At Grade)**						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	5558	2.06	LOS F	5187	1.92	LOS F	10	2352	0.87	LOS E	2257	0.84	LOS D	30
2	Between Konankunte Junction and Forum Mall Junction	2700	3979	1.47	LOS F	4666	1.73	LOS F	10	685	0.25	LOS B	1027	0.38	LOS B	40

Table 61. Traffic forecast for the year 2031-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	6109	2.26	LOS F	5118	1.90	LOS F	10	1670	0.62	LOS C	1747	0.65	LOS C	30
2	Between Konankunte Junction and Forum Mall Junction	2700	5835	2.16	LOS F	5559	2.06	LOS F	10	1293	0.48	LOS C	1159	0.43	LOS B	40

Table 62. Traffic forecast for the year 2041-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	7885	2.9	LOS F	7323	2.7	LOS F	10	3284	1.22	LOS F	3153	1.17	LOS F	15
2	Between Konankunte Junction and Forum Mall Junction	2700	5721	2.1	LOS F	6706	2.5	LOS F	10	960	0.36	LOS B	1464	0.54	LOS C	30

Table 63. Traffic forecast for the year 2041-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	8651	3.2	LOS F	7113	2.6	LOS F	10	2332	0.86	LOS E	2332	0.86	LOS E	25
2	Between Konankunte Junction and Forum Mall Junction	2700	8347	3.1	LOS F	7906	2.9	LOS F	10	1845	0.68	LOS C	1648	0.61	LOS C	30

Table 64. Traffic forecast for the year 2051-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	11401	4.2	LOS F	10555	3.9	LOS F	10	4670	1.73	LOS F	4501	1.67	LOS F	15
2	Between Konankunte Junction and Forum Mall Junction	2700	8373	3.1	LOS F	9833	3.6	LOS F	10	1377	0.51	LOS C	2134	0.79	LOS D	30

Table 65.Traffic forecast for the year 2051-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Konankunte Junction and Vasanthpura Junction	2700	12506	4.6	LOS F	10127	3.8	LOS F	10	3337	1.24	LOS F	3358	1.24	LOS F	15
2	Between Konankunte Junction and Forum Mall Junction	2700	12210	4.5	LOS F	11489	4.3	LOS F	10	2696	1.00	LOS E	2396	0.89	LOS E	15

From the above traffic forecasting findings for the proposed underpass indicates that its construction could significantly alleviate congestion, increase travel speeds and enhance safety along Kanakapura Road Corridor.

Hot Spot 2 : Konankuntae Junction Issue

Konankuntae cross junction is a three arm major signalized intersection, located on Kanakapura road as shown in **Figure 219,** which is controlled by traffic police during the peak hours by operating manually. The junction is not designed scientifically and in a engineering way, in the presence of Metro rail and its station at the junction , road widths are varying and from 30 meters to 33 meters at the mouth of the junction . Another major road connects at this junction which leads to Anjanapura. This is also a two way road which is very narrow and is leading to major traffic congestions and vehicle queues.

Apart from the junction improvements, signal optimization need to be done to have smooth traffic flow along with strict enforcement towards unauthorized auto parking , bus stopping at the junction and taxi pick ups and drops for the mall.

Hot Spot 2: Konankuntae Junction

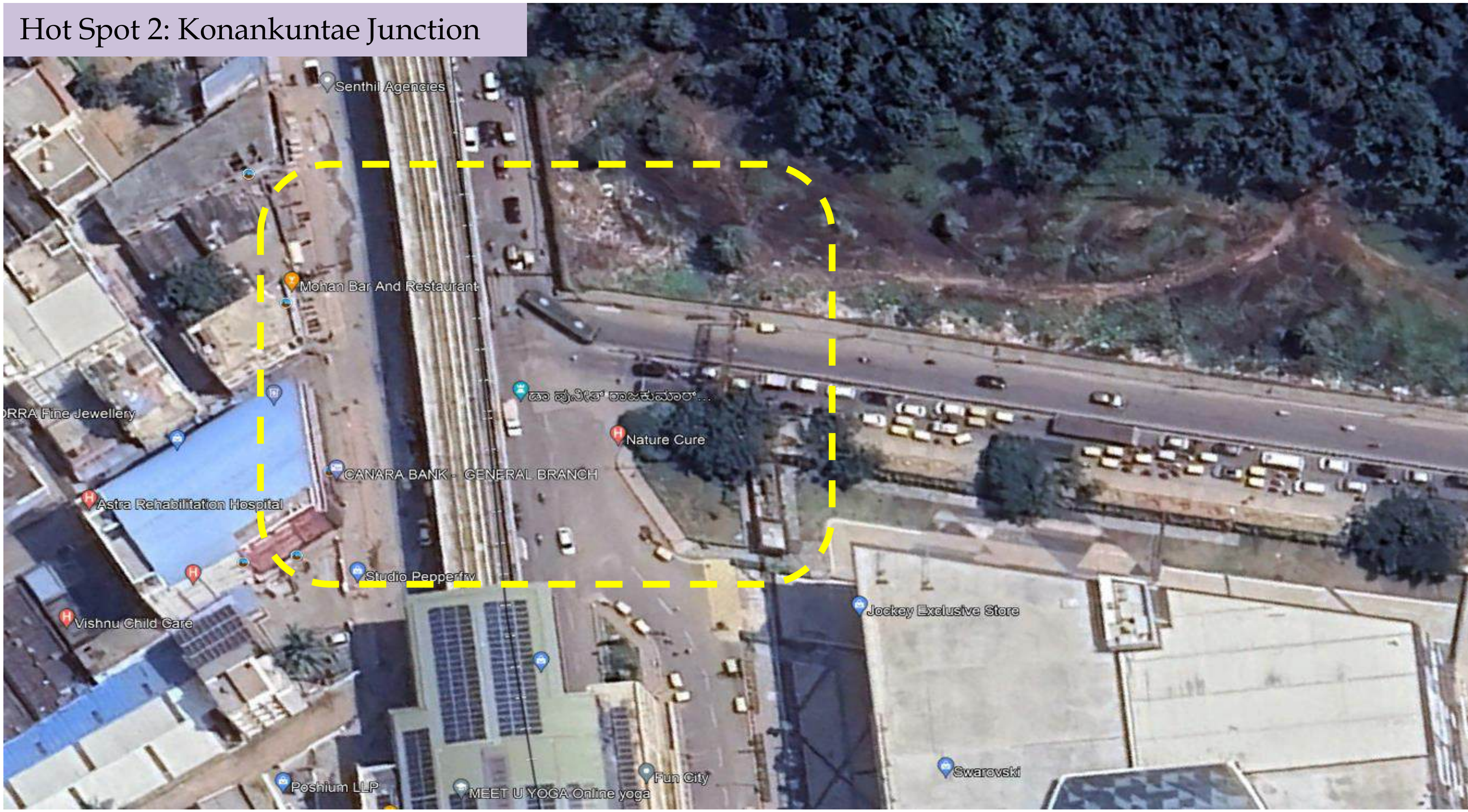


Figure 219 Map Showing Hot Spot 2- Konankuntae cross Junction on Kanakapura Road

Proposed Underpass at Konankuntae cross, Kanakapura Road, Bangalore

Figure 220: Picture Showing the proposed Underpass Alignment

Proposed Underpass Alignment

As per the traffic surveys analysis and forecasting it can be inferred that the current Level of service has already reached to ‘F’ and will continue to get worst in the coming years and with the upcoming development. To overcome the congestion issues both the options of flyover and a underpass is proposed on either sides of the junction for about 500 meters on the LHS and RHS side i.e. from Banashankari to Kanakapura side and vice-versa as shown in the **Figure 221** below. The LOS of at grade roadway segment would significantly improve by achieving **LOS C** from **LOS B.** Also will have seamless travel giving relief for three major junctions and congestion points for the traffic moving towards Kanakapura and Bangalore side.

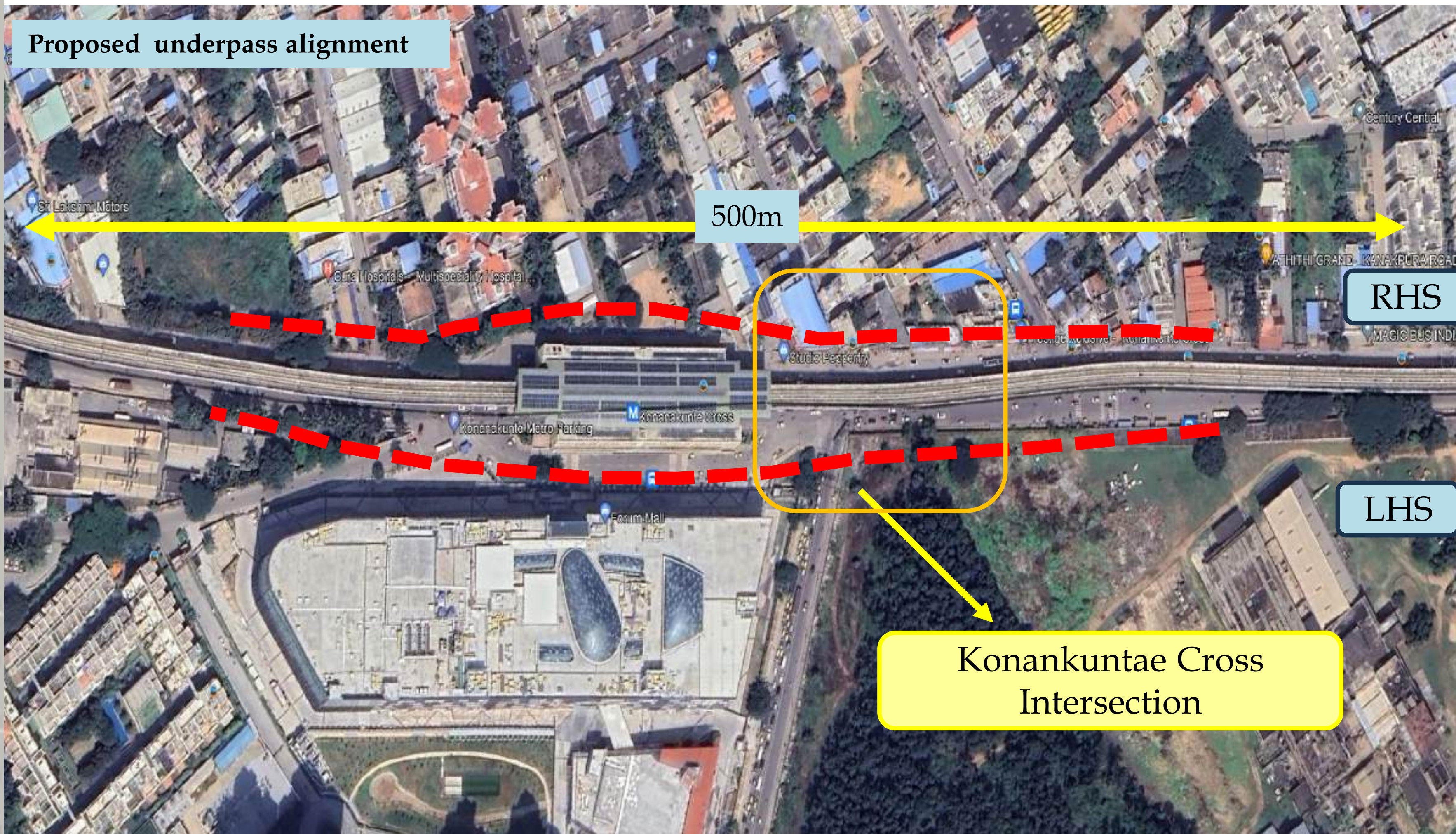


Figure 221: Map Showing the proposed flyover / Underpass Alignment

Option 2: Proposed Split flyover at Konankuntae cross

As an alternative, a split flyover is proposed along the same alignment to accommodate traffic flow between Banashankari and Kanakapura in both directions. The alignment for the split flyover and the underpass remains consistent, allowing for a decision to be made based on economic feasibility.

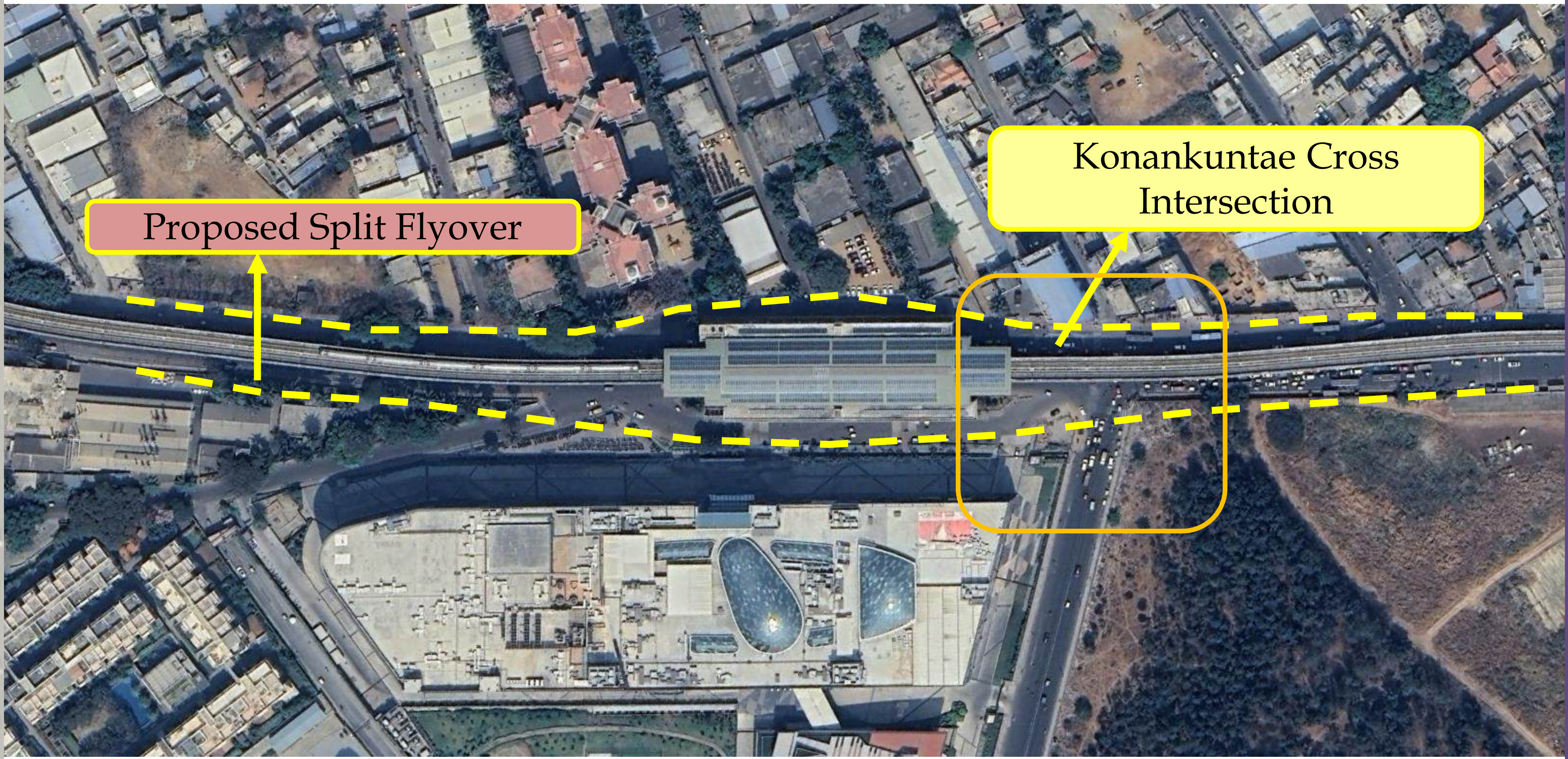


Figure 222: Map Showing the proposed flyover Alignment

Proposed Underpass Alignment on LHS side of Kanakapura Road

The proposed tunnel is aligned in between the existing Forum mall and the Konankuntae Metro Station the land belongs to Prestige group and the reason that it cannot be aligned below the metro station due to the foundation issues of metro pillars and station. Hence the alignment is designed as shown in the **Figure 223** and also it is in line with the proposed project site. The underpass will have concrete slab at all the three junctions and the at grade traffic circulation will remain the same after construction of Underpass and will decrease the travel time and increase the speed.

Figure 223: Picture Showing the proposed Underpass Alignment between Forum Mall and the Konankuntae Metro Station

Proposed Underpass Alignment on LHS side of Kanakapura Road

The proposed tunnel is aligned in between the existing Konankuntae Metro Station and the private properties and the reason that it cannot be aligned below the metro station due to the foundation issues of metro pillars and station. Hence the alignment is designed as shown in the **Figure 224** and also it is in line with the proposed project site. The underpass will have concrete slab at all the three junctions and the at grade traffic circulation will remain the same after construction of Underpass and will decrease the travel time and increase the speed.

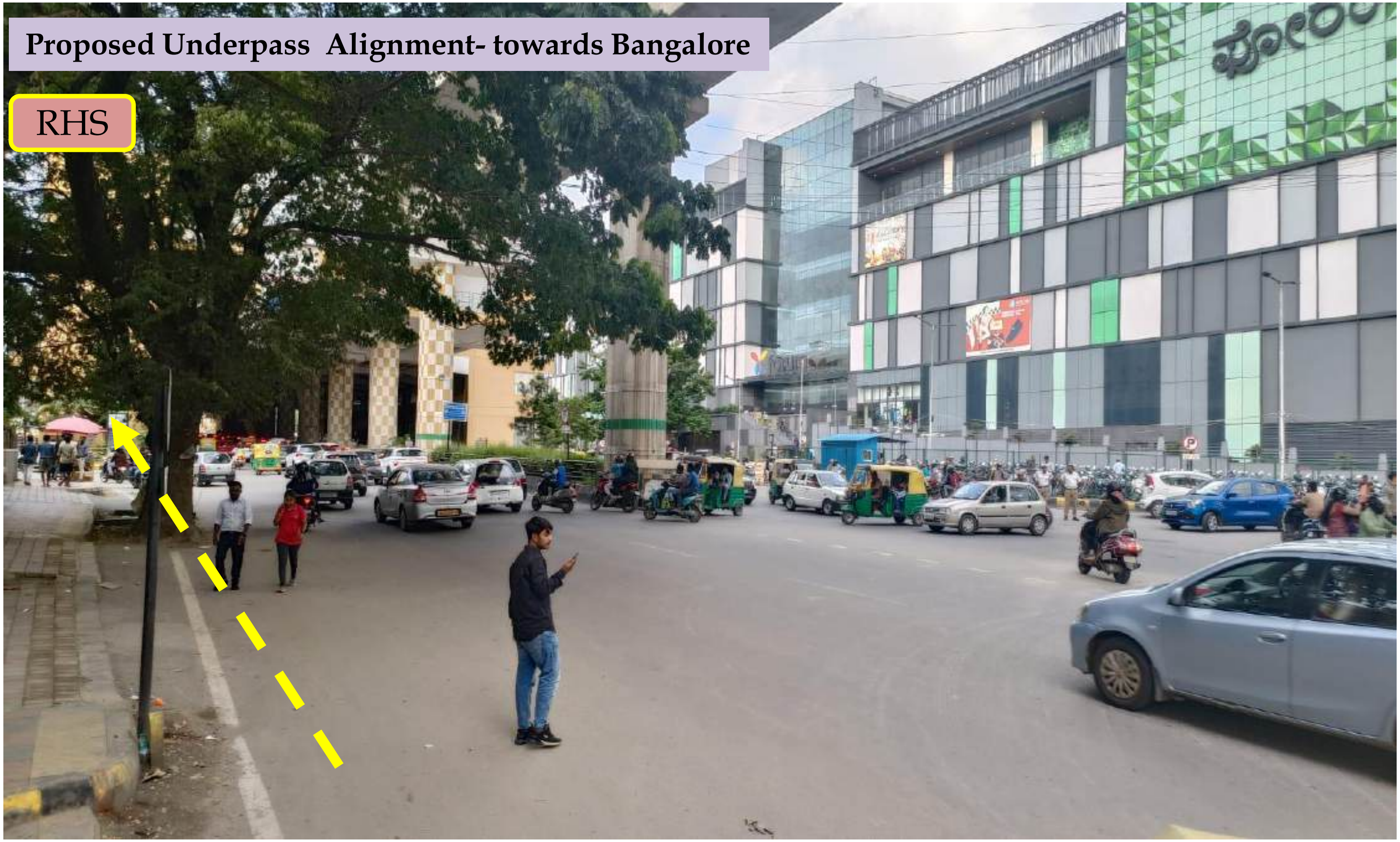
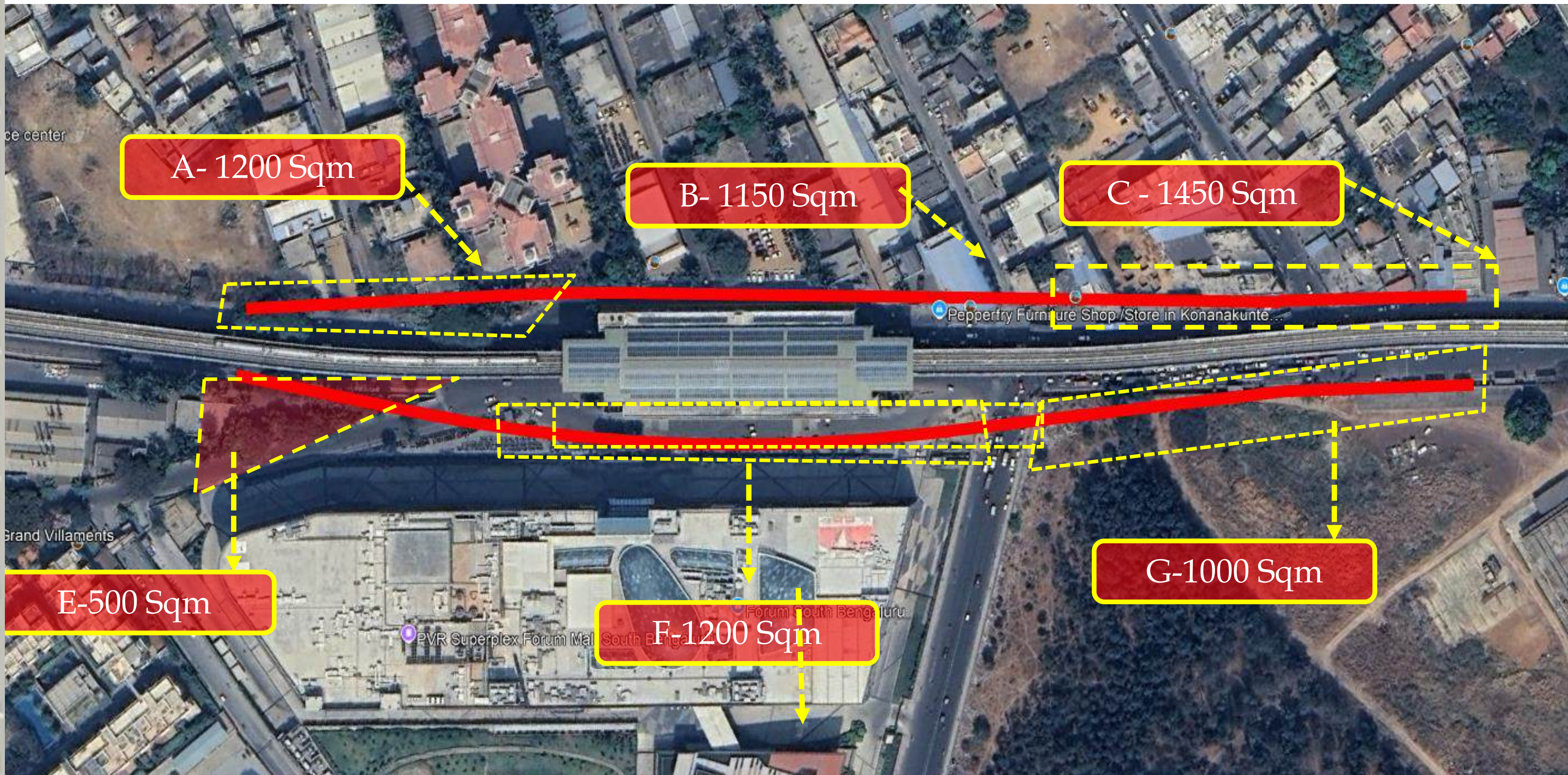


Figure 224: Picture Showing the proposed Tunnel Alignment between Forum Mall and the Konankuntae Metro Station

Land Acquisition details for the proposed Underpass at Konankuntae cross



Sl No	Zone	Area in Sqm	Remarks
1	A	1200	Private Property
2	B	1150	Private Property
3	C	1450	Private Property
Total Area		**3800**	**RHS**

Sl No	Zone	Area in Sqm	Remarks
1	D	500	Private Property
2	E	1200	Private Property
3	F	1000	Private Property
Total Area		**2700**	**LHS**

Figure 225. Land Acquisition Details

Total Land Acquisition required is 6500 Sqm

Cross Section of the Existing Kanakapura Road

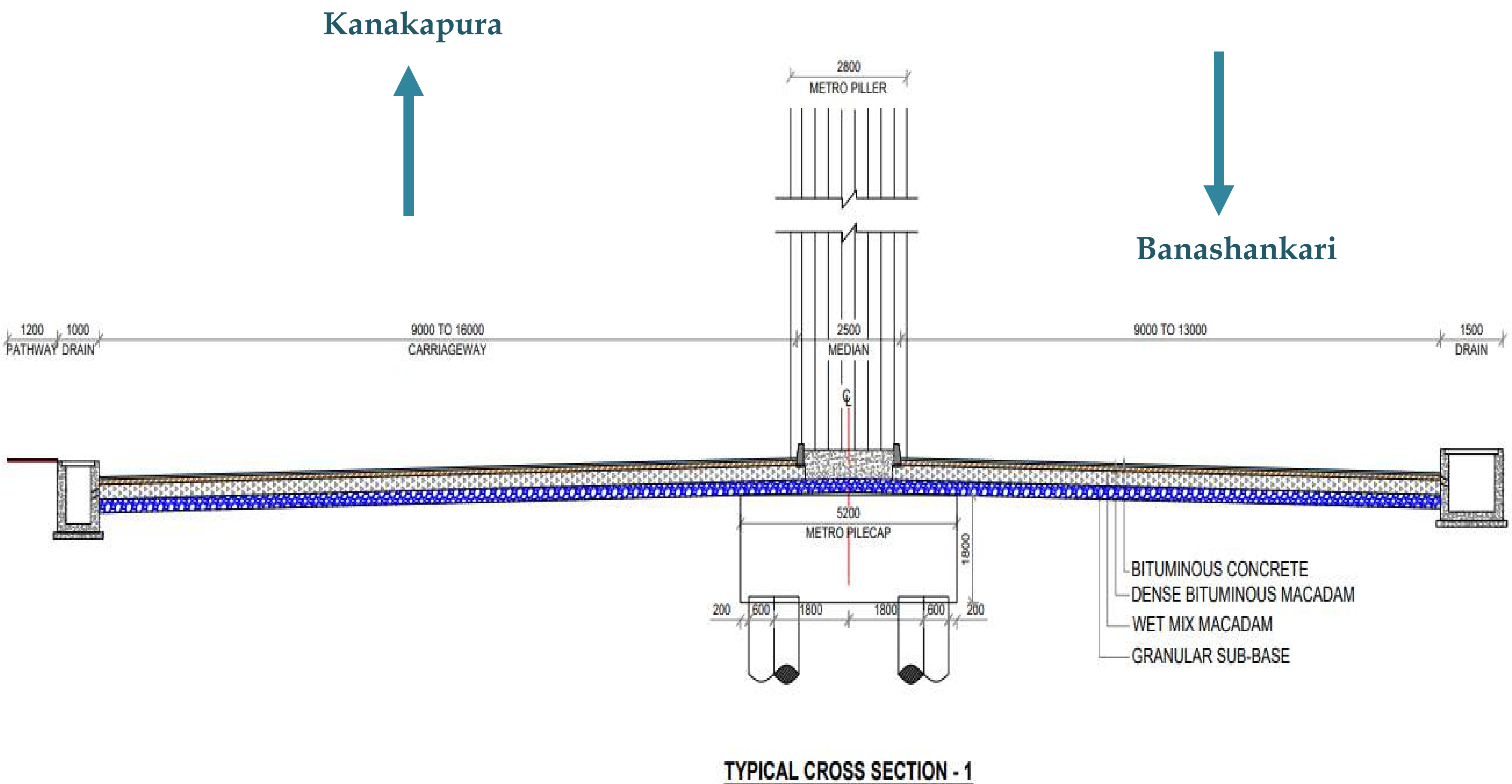


Figure 226: Cross section plan of the existing Kanakapura main road

Conceptual plan for Cross Section of the Existing Kanakapura Road with the proposed Underpass

As mentioned in the report tunnel is proposed from Vasanthapura junction to Tippasandra junction, the proposed width of the tunnel is 7 meters i.e. two lane one way with one sided drain as shown in the **Figure 227** below.

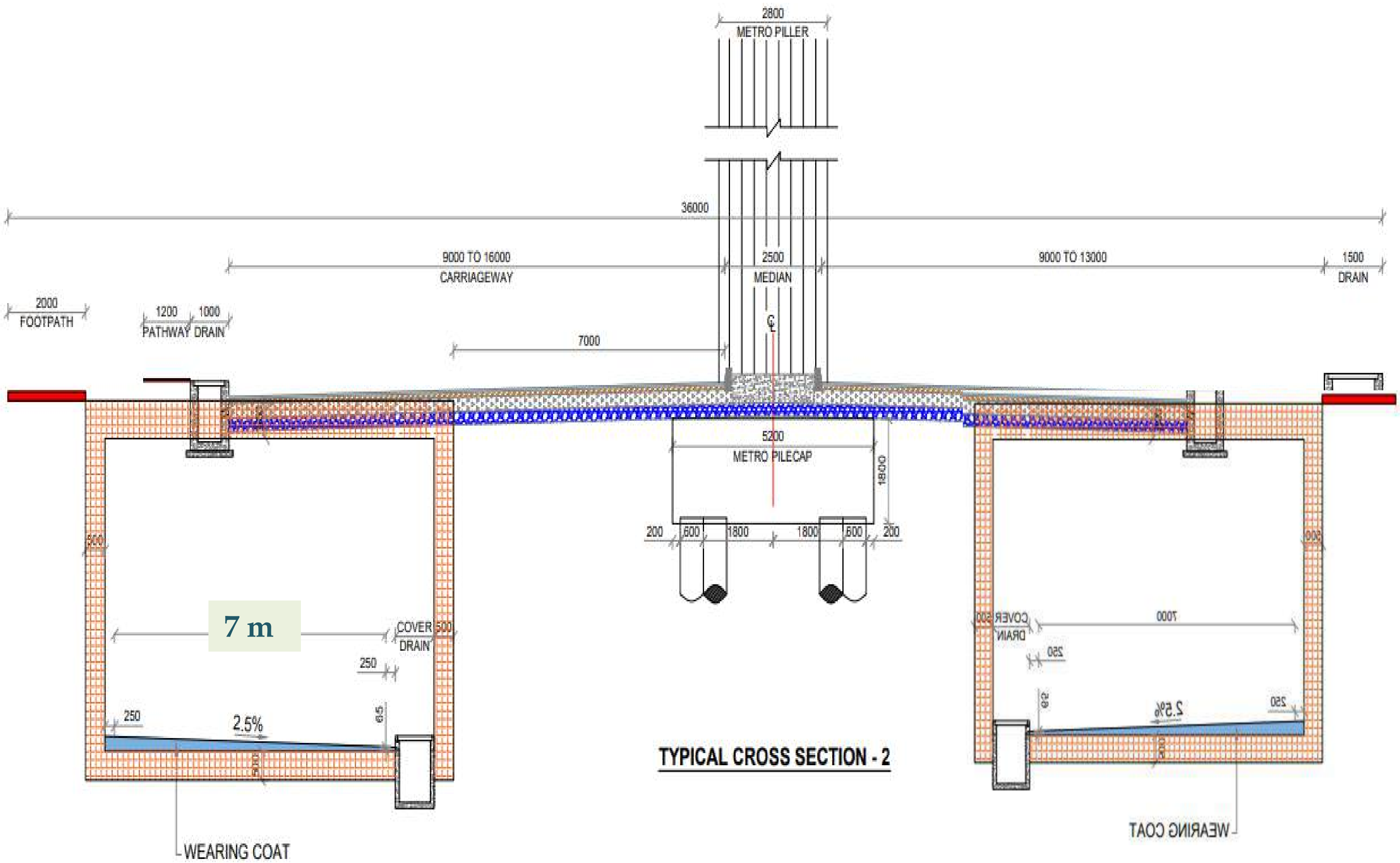


Figure 227: Conceptual cross section plan of the proposed Tunnel

Proposed Typical Cross section for the 4 lane divided Elevated corridor

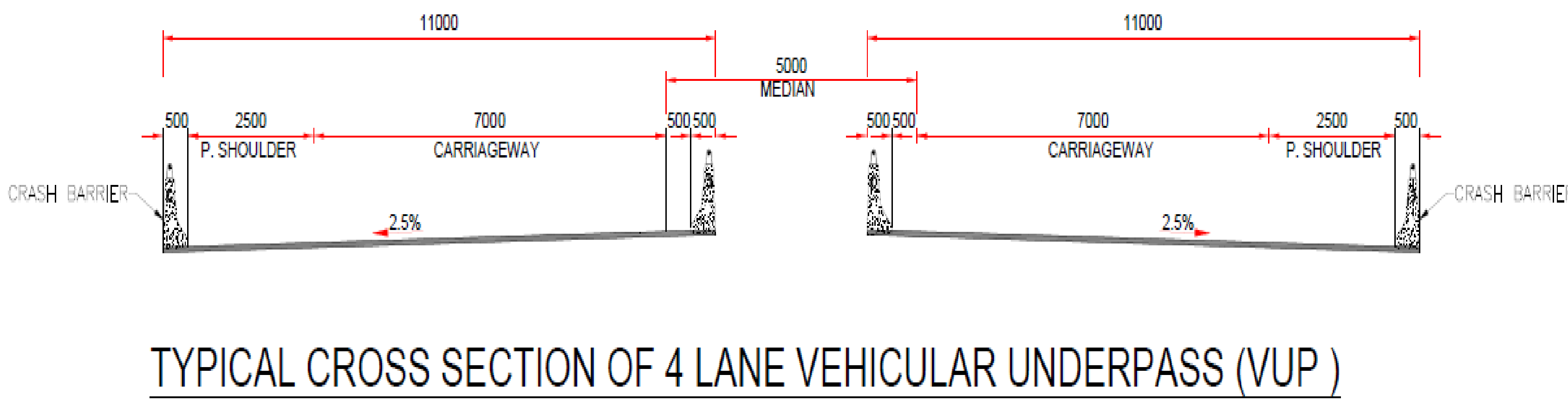


Figure 228. **Proposed cross section for 4 lane Vehicle underpass at Konankuntae cross**

Conceptual plan for Cross Section of the Existing Kanakapura Road with the proposed Flyover

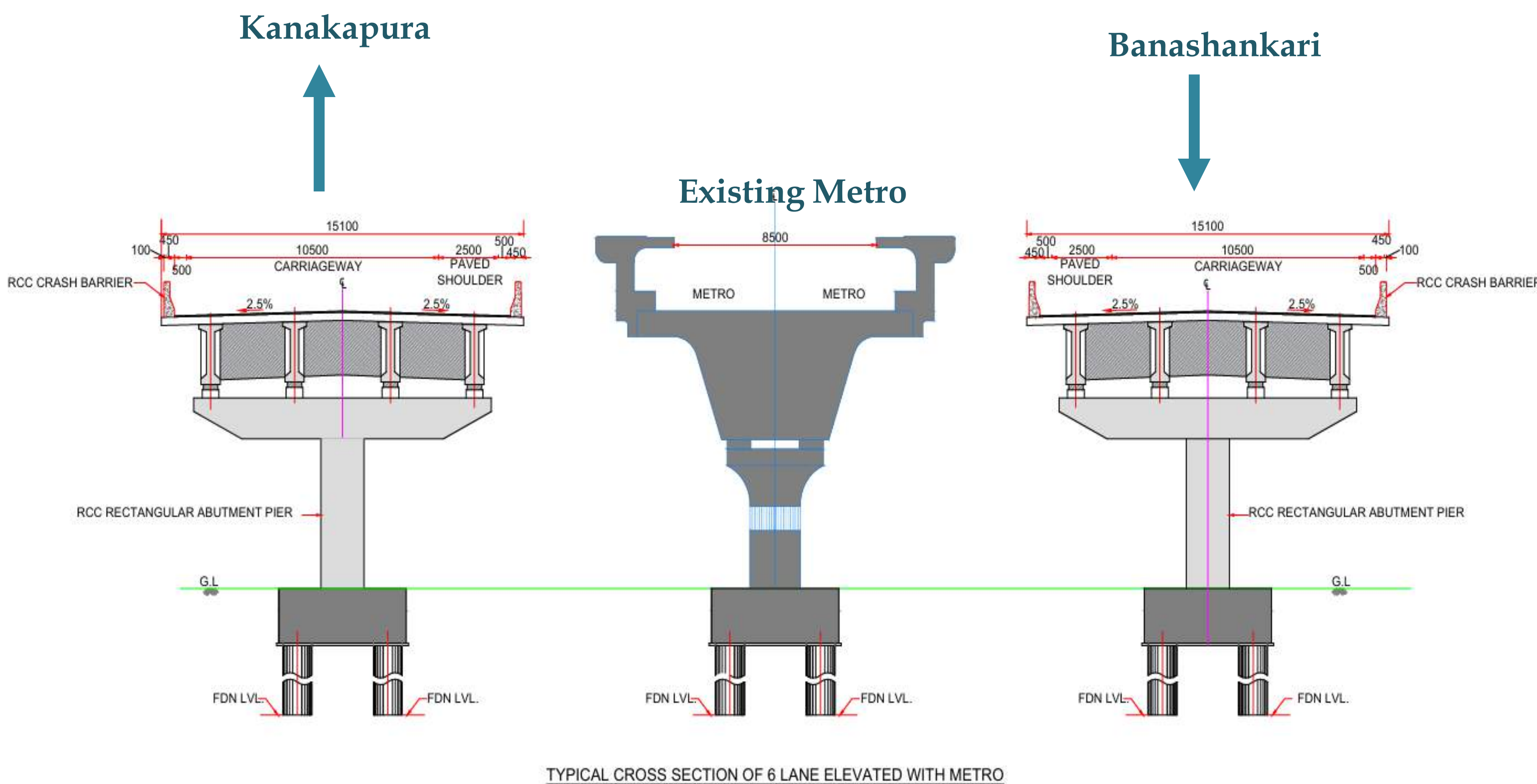


Figure 229: Conceptual cross section plan of the proposed Tunnel

Traffic Movement at Tippasandra Junction below the Metro Station Once the flyover /Tunnel is constructed.

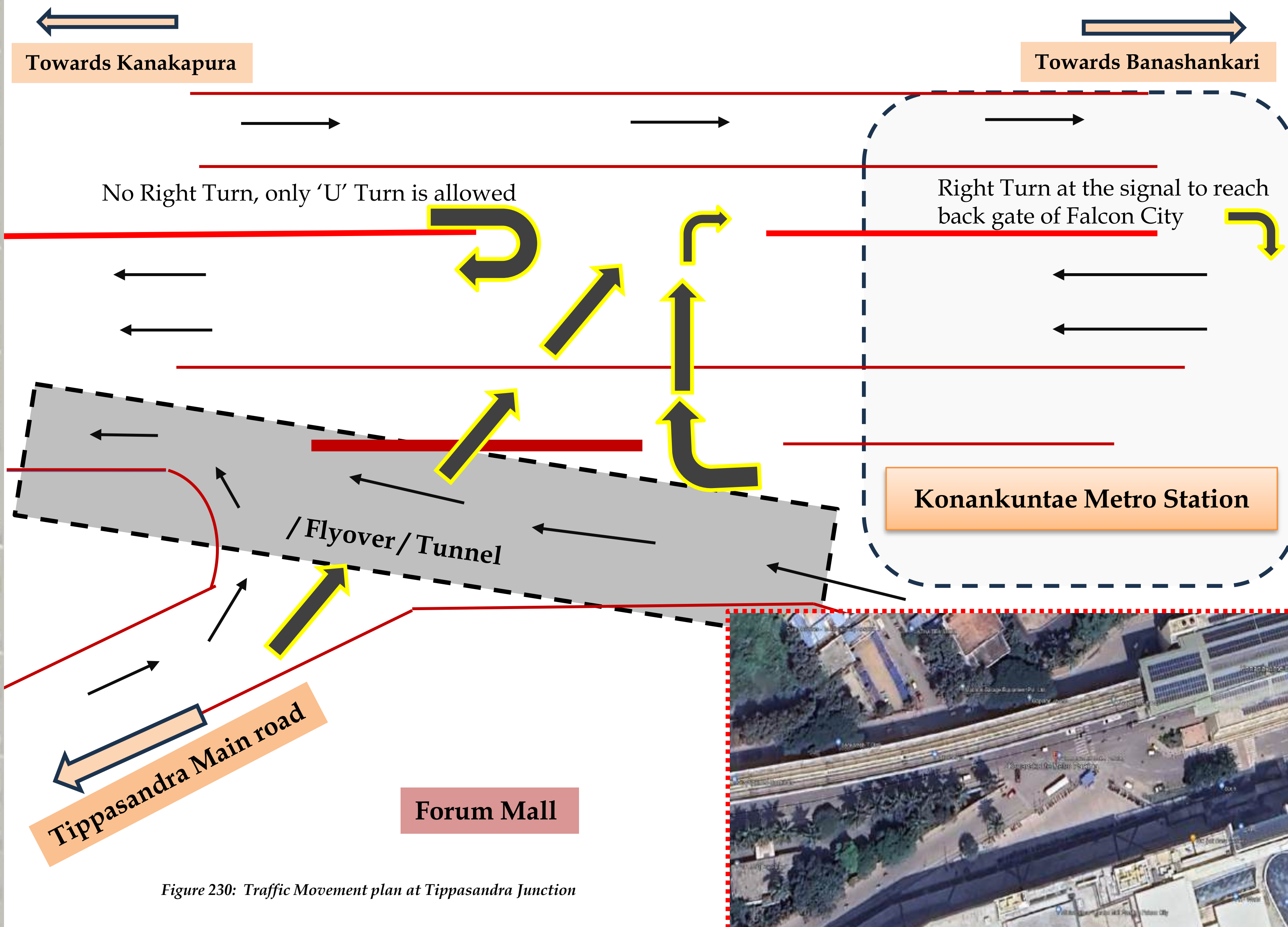


Figure 230: Traffic Movement plan at Tippasandra Junction

Proposed Bus Bays

Once the tunnel is completed the at grade traffic management need to be designed. One of the key point is to designate dedicated bus stop with bus bay. Hence the bus bay is proposed on the corner of the Konankuntae cross junction as shown in the **Figure 231** as it can be planned on top of the tunnel without hindering the at grade traffic.

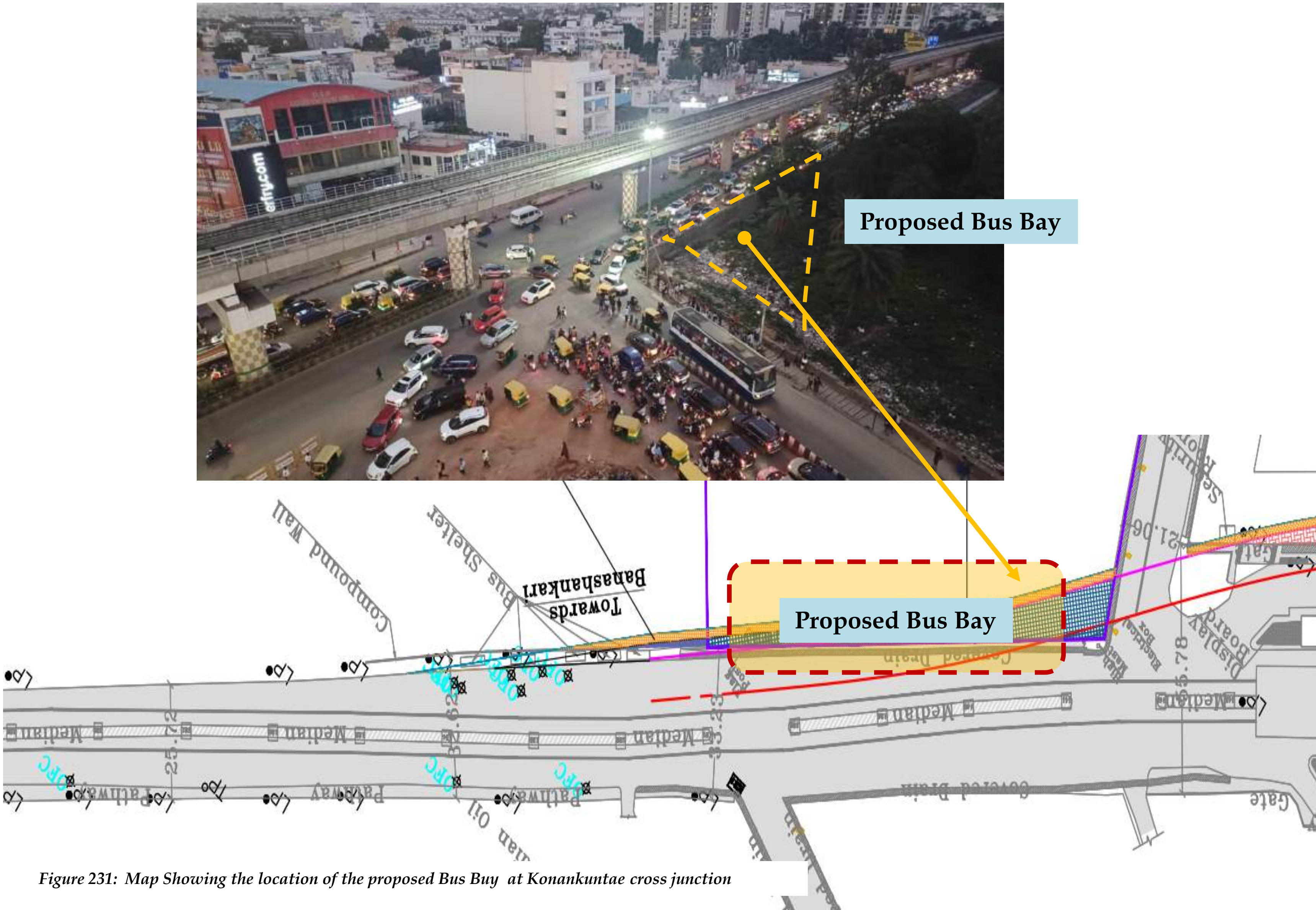


Figure 231: Map Showing the location of the proposed Bus Buy at Konankuntae cross junction

Proposed Pedestrian Skywalk

It was seen that during the morning peak hours more than 1200 pedestrian cross at the junction and during the evening peak hours it is about 1000 pedestrian crossing at the junction. Hence safety is of major concern and in order to have safe pedestrian access across the junction pedestrian skywalk is proposed as shown in the **Figure 232.**

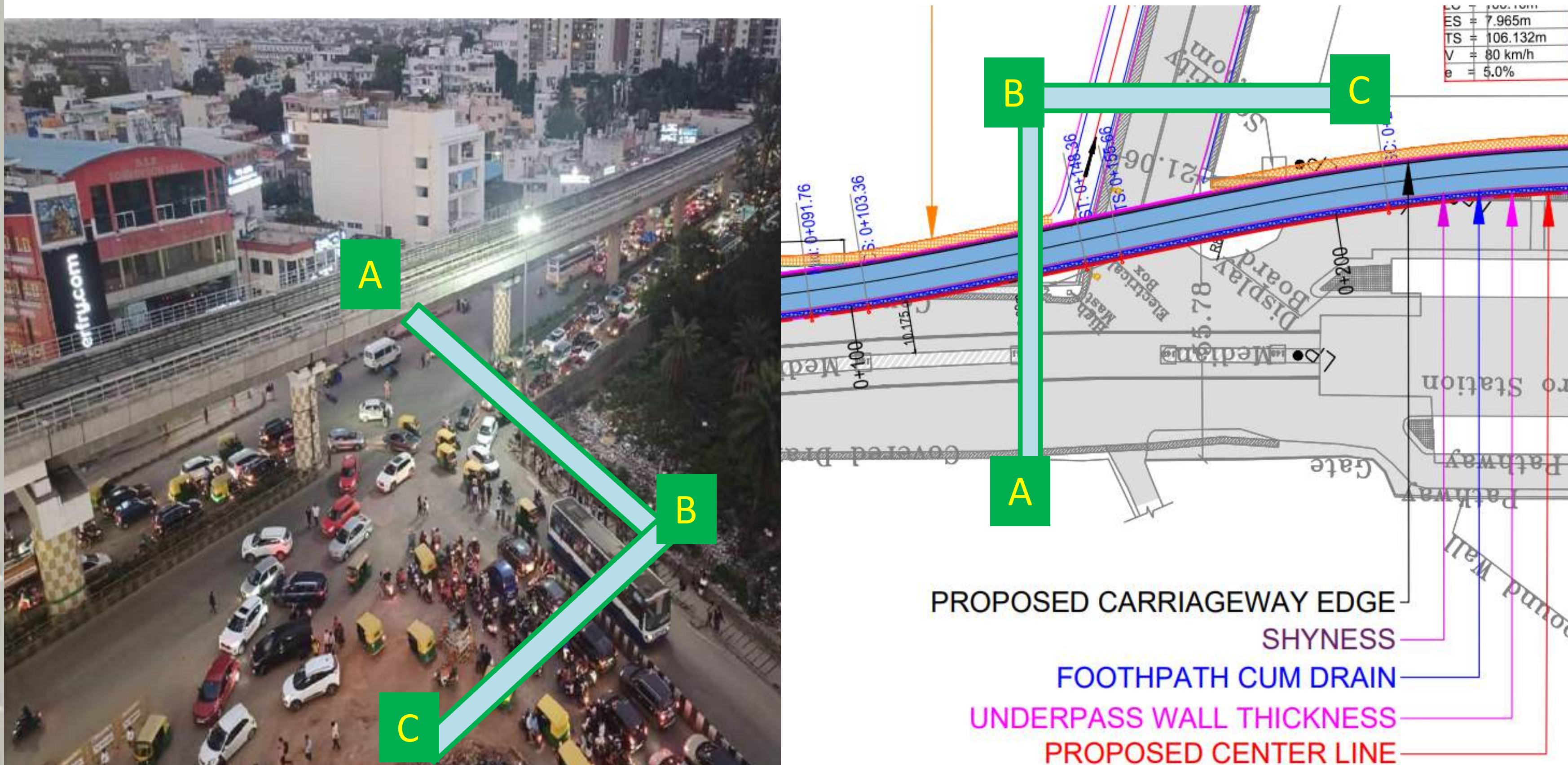


Figure 232: Map Showing the location of the proposed Pedestrian Skywalk at Konankuntae cross junction

Proposed Skywalk Plan – Access from Metro Station to Mall and the proposed site

As shown in **Figure 233,** Pedestrian skywalk is proposed connection Kanakapura road on the RHS i.e. at point 'A' to LHS at point 'B' and the same skywalk is connecting the Forum mall across Anjanapura main road. Access is provided at both sides of Anjanapura main road and Kanakapura main road.

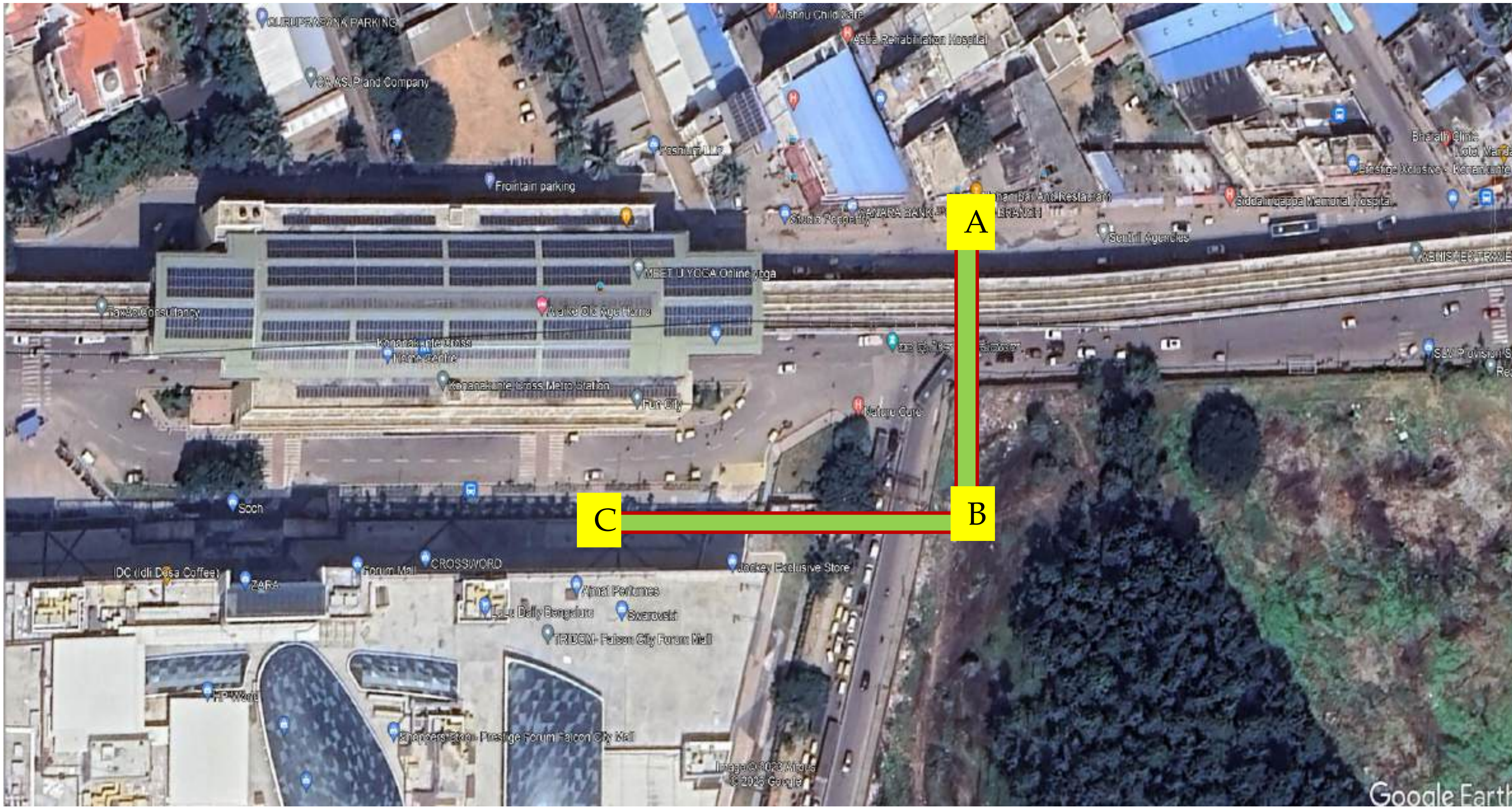


Figure 233: Map Showing the location of the proposed Pedestrian Skywalk at Konankuntae cross junction

Summary and Conclusions

The following are concluded based on the traffic analysis:

- The roadway system in the project vicinity is grossly inadequate to handle the project traffic.

- All the major intersections along Kanakapura road such as Forum Mall Junction, Konankuntae Junction, Vasanthapura junction are expected to operate at level of service “F” with very large traffic delays with or without the project build out. Over a period of time these delays translate to higher fuel consumption, excess travel time, and a higher accident potential.

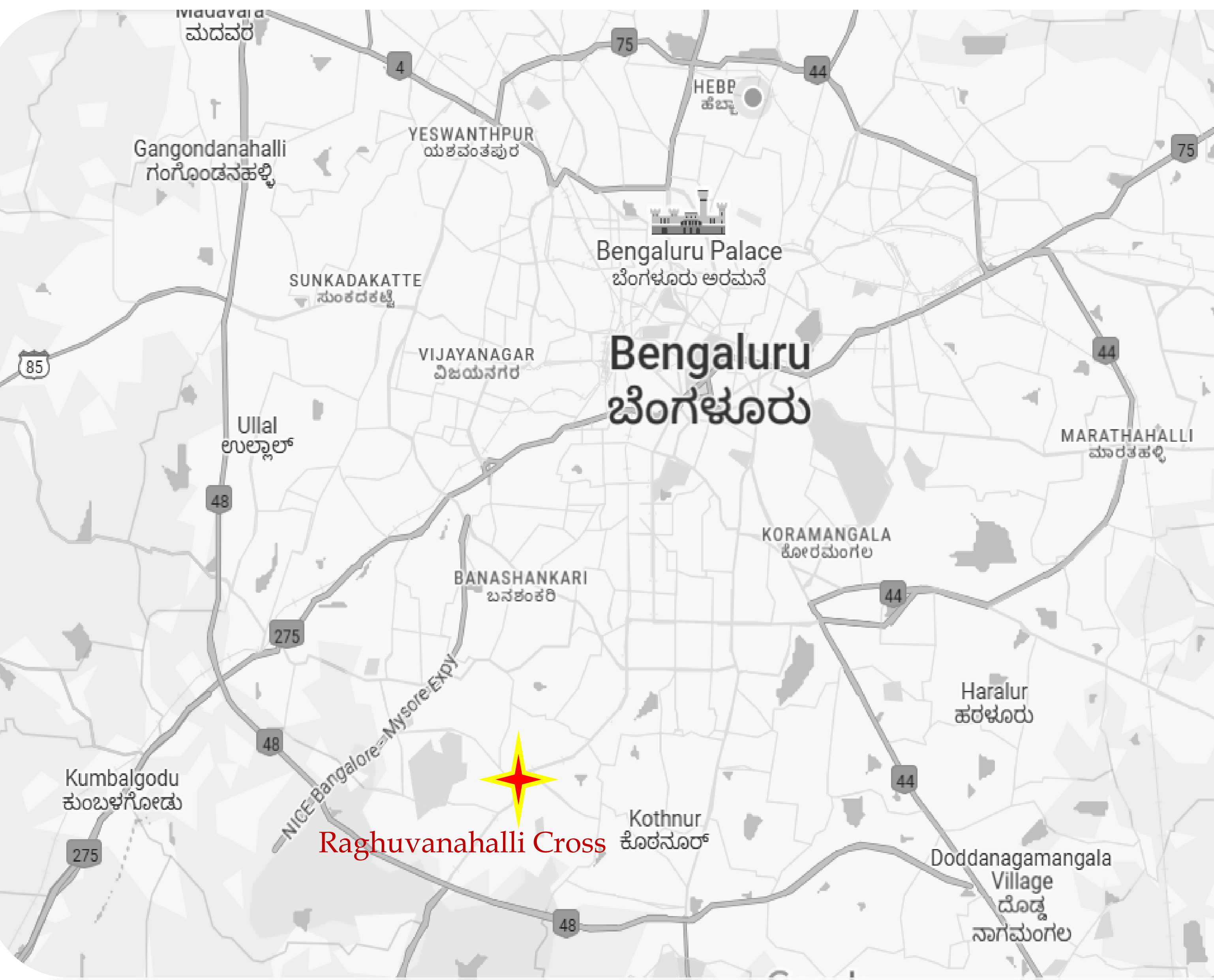
- Two lane 7 meter tunnel is proposed on the LHS & RHS side along Kanakapura road between Vasanthapura Junction and Forum Mall Junction which covers three major junction which are in series, and will help reduce congestion by providing seamless travel giving relief to these three major junctions and congestion points for the traffic moving towards Kanakapura side. However several additional improvements need to be done at the junctions and also other access routes that need to be developed to provide sufficient capacity for project traffic.

- Additional one lane of road is proposed on the LHS along Anjanapura main road to cater the traffic demand.

- On the RHS side there is little scope to propose the tunnel due to the unavailability of land and lot of land acquisition will be required covering all the commercial and residential properties which might do into the legal issues delaying the project

- Bus Bay is proposed on the corner of the Konankuntae cross above the proposed tunnel. This will help in organizing the bus stop and to achieve safe access to all the road users.

- Pedestrian Skywalk walk is proposed at the junction connecting all the major developments and to have safe pedestrian access to all the sides of the junction.



CORRIDOR 05

Kanakapura Road-Raghuvanahalli Cross

Proposed Split Flyover at Adayar Ananda Bhavan Raghuvanahalli Cross Kanakapura

Existing Site Location

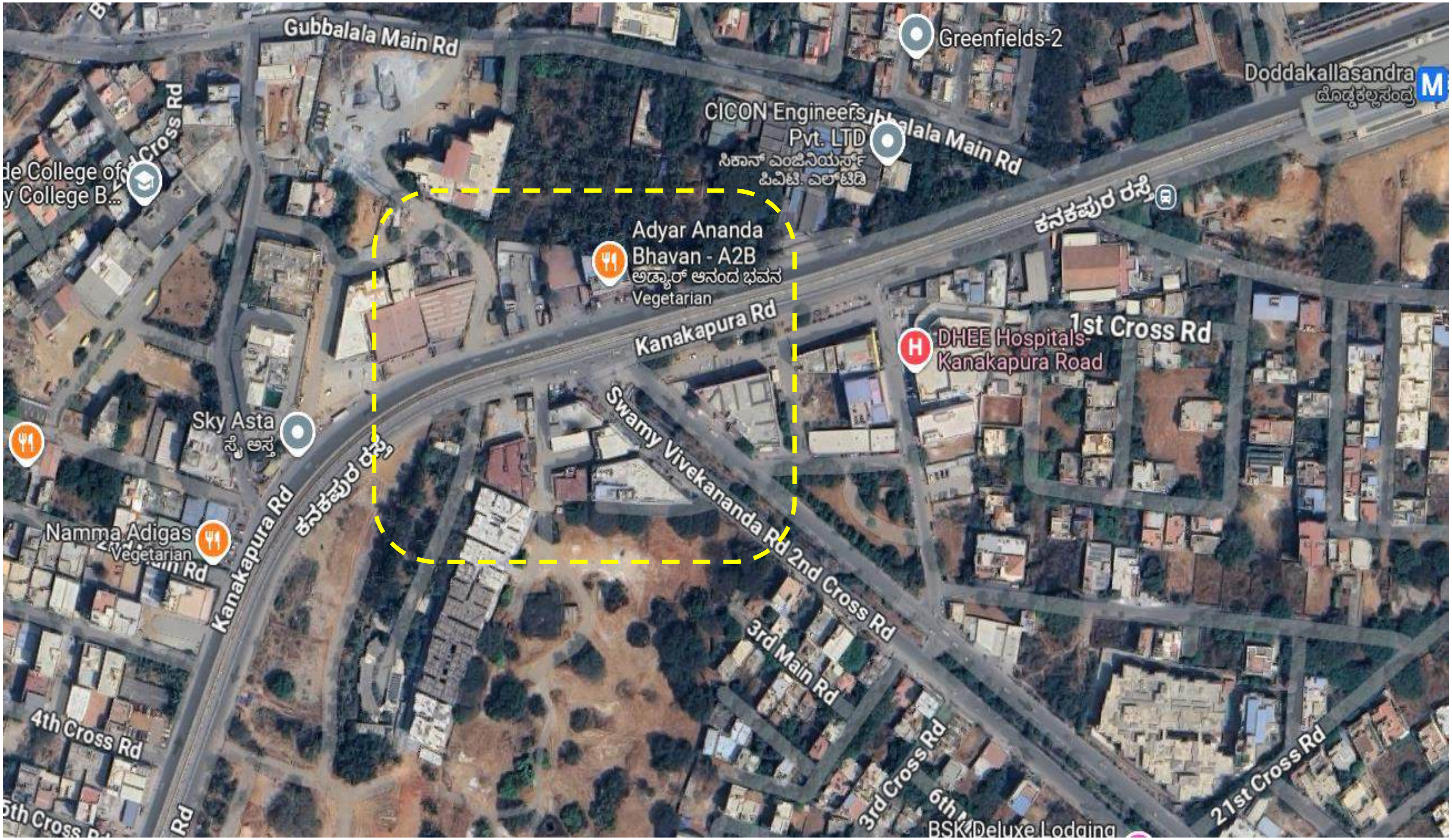


Figure 234. Existing Site for the Proposed Under pass at Adayar Ananda Bhavan, Raghuvanahalli Junction

Existing Site Location : Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road Bangalore

Adayar Ananda Bhavan at the Raghuvanahalli junction is situated on Kanakapura Road, Bangalore. This location features a three-arm intersection where Kanakapura Road meets Swamy Vivekananda Road. Kanakapura Road serves as the through road, while Swamy Vivekananda Road connects the surrounding residential areas to Kanakapura Road.

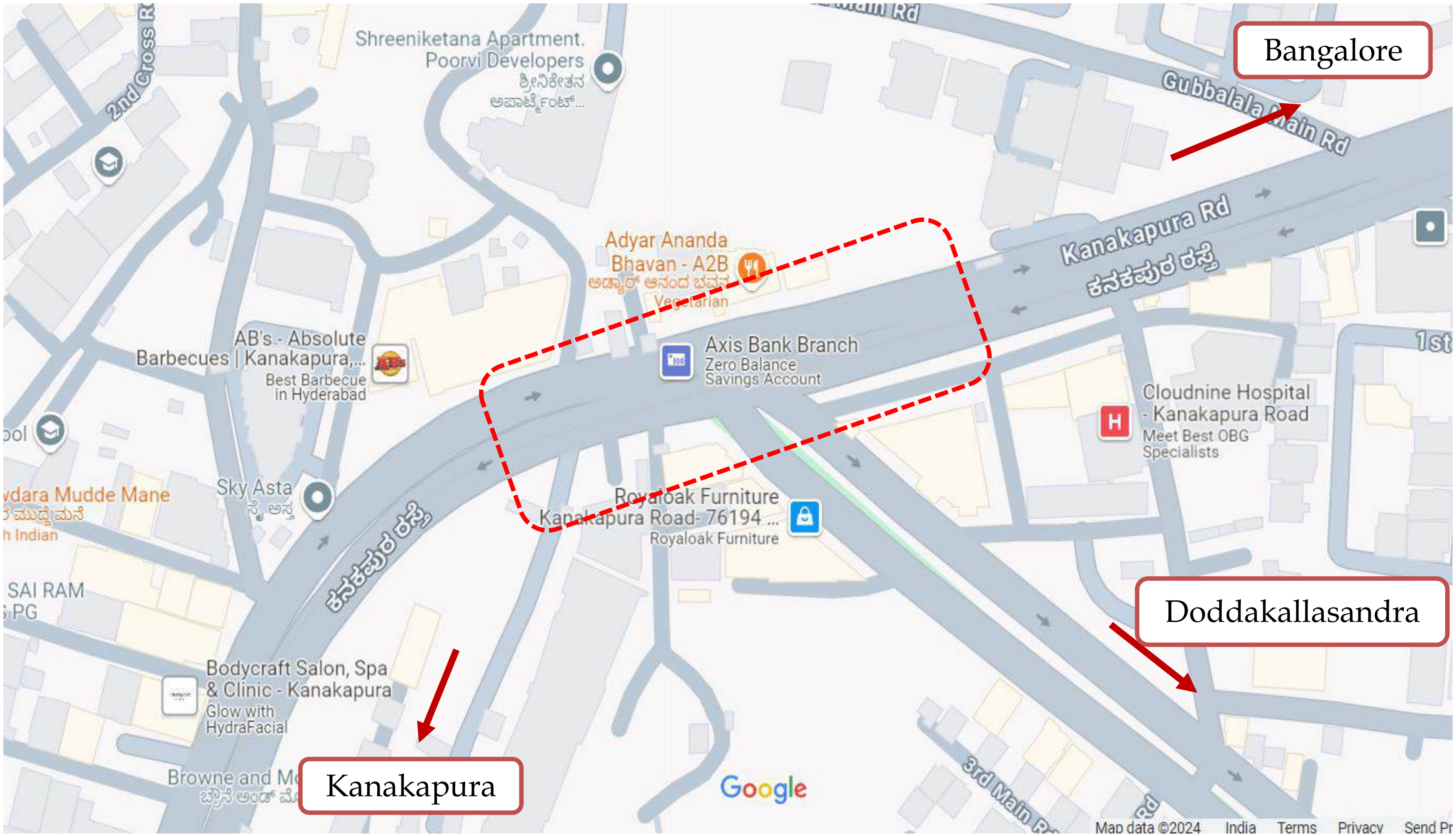


Figure 235. Existing Site for the Proposed Under pass at Adayar Ananda Bhavan, Raghuvanahalli Junction

Approach of the Site Area

Major corridors which will have the impact of the new development are as listed below.

1. Kanakapura Road
2. Swamy Vivekananda road 2nd cross road

Site Observations

The above listed corridors proposed for impact assessment are prominent corridors which carry high density traffic within the study area These corridors feed to the major traffic near the proposed development and have high potential for business development. The commercialisation along these sections has increased the demand for road space for vehicles with poor or no concerns to the need of vulnerable users like pedestrians . The increased traffic volume on these streets have reduced the speeds and increased the traffic congestions.

Some of the common observations based on the site reconnaissance are:

- Unusable/ dilapidated footpaths
- Insufficient carriageway capacity within the urban centers to cater to ever increasing vehicle numbers
- Unequal distribution of road space
- Unscientific and unsafe design of junctions and road curves
- Neglected NMT Users
- Manual Signal Operations.
- Insufficient turning radius for 'U' Turns.
- Too many traffic movements allowed at junctions.

Areas Surrounding the Project Site

This is a key intersection connecting important areas such as Gubbalala, Shara Layout, Raghavendra Layout, Bagegowda Layout, and Doddakallasandra. Traffic congestion is commonly observed at this junction. Since it serves as a major connecting point for traffic coming from the Kanakapura side towards Bangalore and vice-versa, measures need to be implemented to alleviate the congestion at the junction.

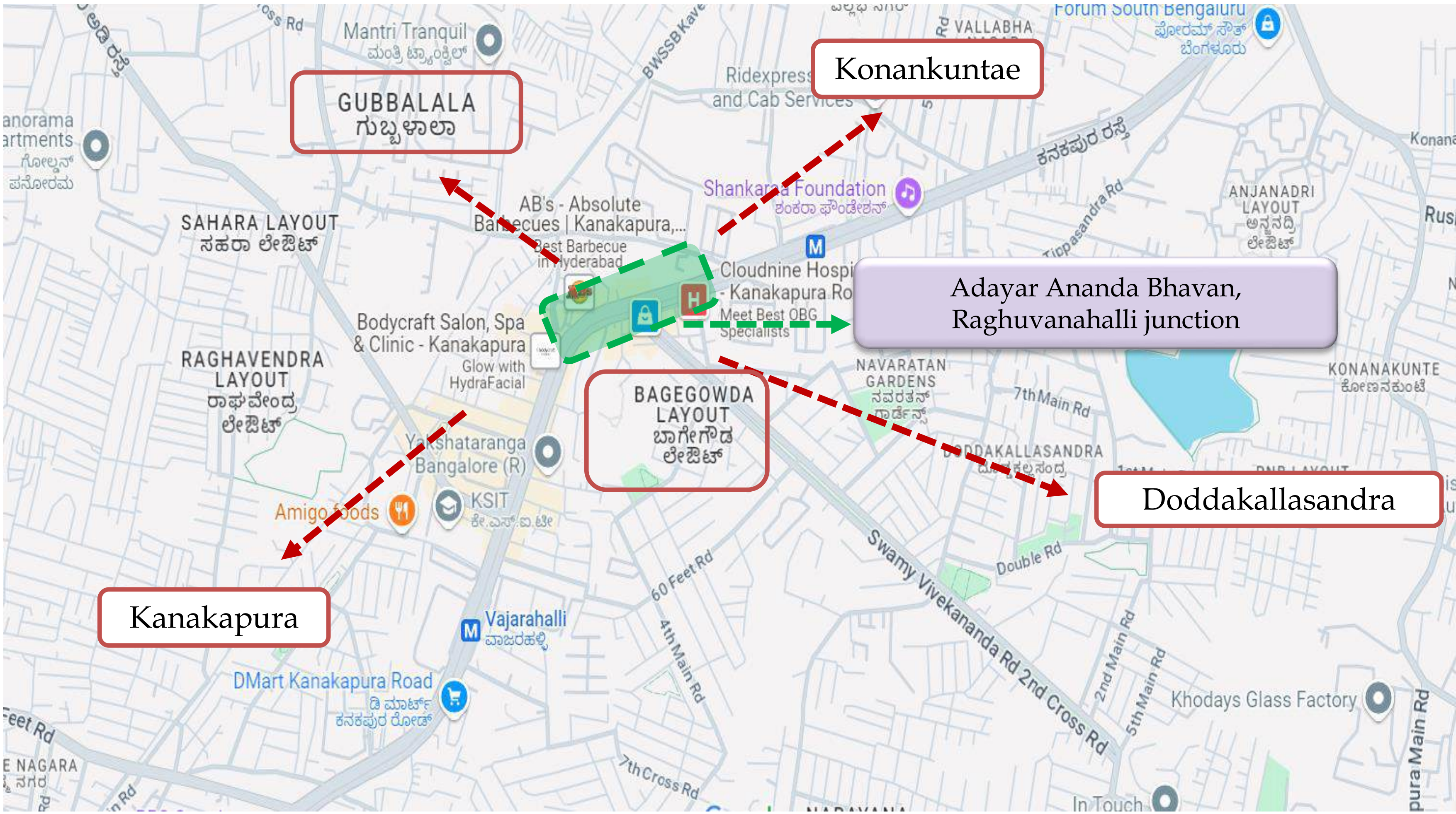


Figure 236. **Areas Surrounding the Project Site**

On Site Inspection Photos

Figure 237. **Site inspection Photos**

On Site Inspection Photos

Figure 238. **Site inspection Photos**

Proposed Underpass at Adayar Ananda Bhavan, Raghuvanahalli Junction

The comparison between existing operational scenario and the operational scenario after construction of the underpass is tabulated in Table 66 From Table 67 it can be seen that with the construction of tunnel, there will be considerable reduction in Volume to Capacity Ratio (V/C Ratio), enhanced Level of Service and increased Journey Speeds along Kanakapura Road Corridor.

Table 66 Level of service with tunnel proposal-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	2319	0.86	LOS E	2910	1.08	LOS F	15	412	0.15	LOS B	661	0.24	LOS B	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	1980	0.73	LOS C	2352	0.87	LOS E	25	73	0.03	LOS A	103	0.04	LOS A	50

Table 67. Level of service with tunnel proposal-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service-Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	3633	1.35	LOS F	3267	1.21	LOS F	15	695	0.26	LOS B	536	0.20	LOS B	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	3051	1.13	LOS F	2934	1.09	LOS F	15	113	0.04	LOS A	203	0.08	LOS A	50

From the above table it is evident that with this proposed underpass, the traffic (At grade) at Adayar Ananda Bhavan, Raghuvanahalli Junction will drastically reduce relieving congestion along this stretch.

Future Operating Conditions

The future peak hour traffic volumes for the future years 2031, 2041 and the year 2051 conditions were forecasted using RTO growth rates. The growth rate obtained from the RTO data were used to forecast the future year traffic volumes at the study roadway segments.

The LOS conditions for the horizon year scenarios (With and Without Improvements) for the years 2031, 2041 and 2051 are presented in the following tables

Table 68. Traffic forecast for the year 2031-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	2947	1.09	LOS F	3694	1.37	LOS F	10	519	0.19	LOS B	835	0.31	LOS B	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	2520	0.93	LOS E	2992	1.11	LOS F	10	92	0.03	LOS A	264	0.10	LOS A	50

Table 69.Traffic forecast for the year 2031-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	4630	1.71	LOS F	4140	1.53	LOS F	10	898	0.33	LOS B	687	0.25	LOS B	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	3876	1.44	LOS F	3716	1.38	LOS F	10	144	0.05	LOS A	264	0.10	LOS A	50

Table 70.Traffic forecast for the year 2041-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	4231	1.57	LOS F	5302	1.96	LOS F	10	737	0.27	LOS B	1193	0.44	LOS B	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	3625	1.34	LOS F	4305	1.59	LOS F	10	131	0.05	LOS A	197	0.07	LOS A	50

Table 71.Traffic forecast for the year 2041-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	6682	2.47	LOS F	5924	2.19	LOS F	10	1316	0.49	LOS C	996	0.37	LOS B	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	5574	2.06	LOS F	5319	1.97	LOS F	10	208	0.08	LOS A	391	0.14	LOS A	50

Table 72.Traffic forecast for the year 2051-Towards Kanakapura

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Kanakapura							Towards Kanakapura (At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	6189	2.29	LOS F	7762	2.87	LOS F	10	1068	0.40	LOS B	1743	0.65	LOS C	30
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	5313	1.97	LOS F	6317	2.34	LOS F	10	192	0.07	LOS A	298	0.11	LOS A	40

Table 73.Traffic forecast for the year 2051-Towards Banashankari

Sl. No.	Road Name	Capacity	EXISTING							WITH IMPROVEMENTS						
			Towards Banashankari							Towards Banashankari(At Grade)						
			Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service - Evening Peak	Travel Speed	Morning Peak Hour Volume (PCUs)	V/C Ratio-Morning Peak	Level of Service - Morning Peak	Evening Peak Hour Volume (PCUs)	V/C Ratio-Evening Peak	Level of Service-Evening Peak	Travel Speed
1	Between Forum Mall Junction and Doddakalsandra Junction	2700	9845	3.65	LOS F	8646	3.20	LOS F	10	1963	0.73	LOS C	1466	0.54	LOS C	40
2	Between Doddakalsandra Junction and 80 Feet Junction	2700	8186	3.03	LOS F	7770	2.88	LOS F	10	304	0.11	LOS A	590	0.22	LOS B	50

From the above traffic forecasting findings for the proposed underpass indicates that its construction could significantly alleviate congestion increase travel speeds and enhance safety along Kanakapura Road Corridor.

Proposed Split Flyover Alignment

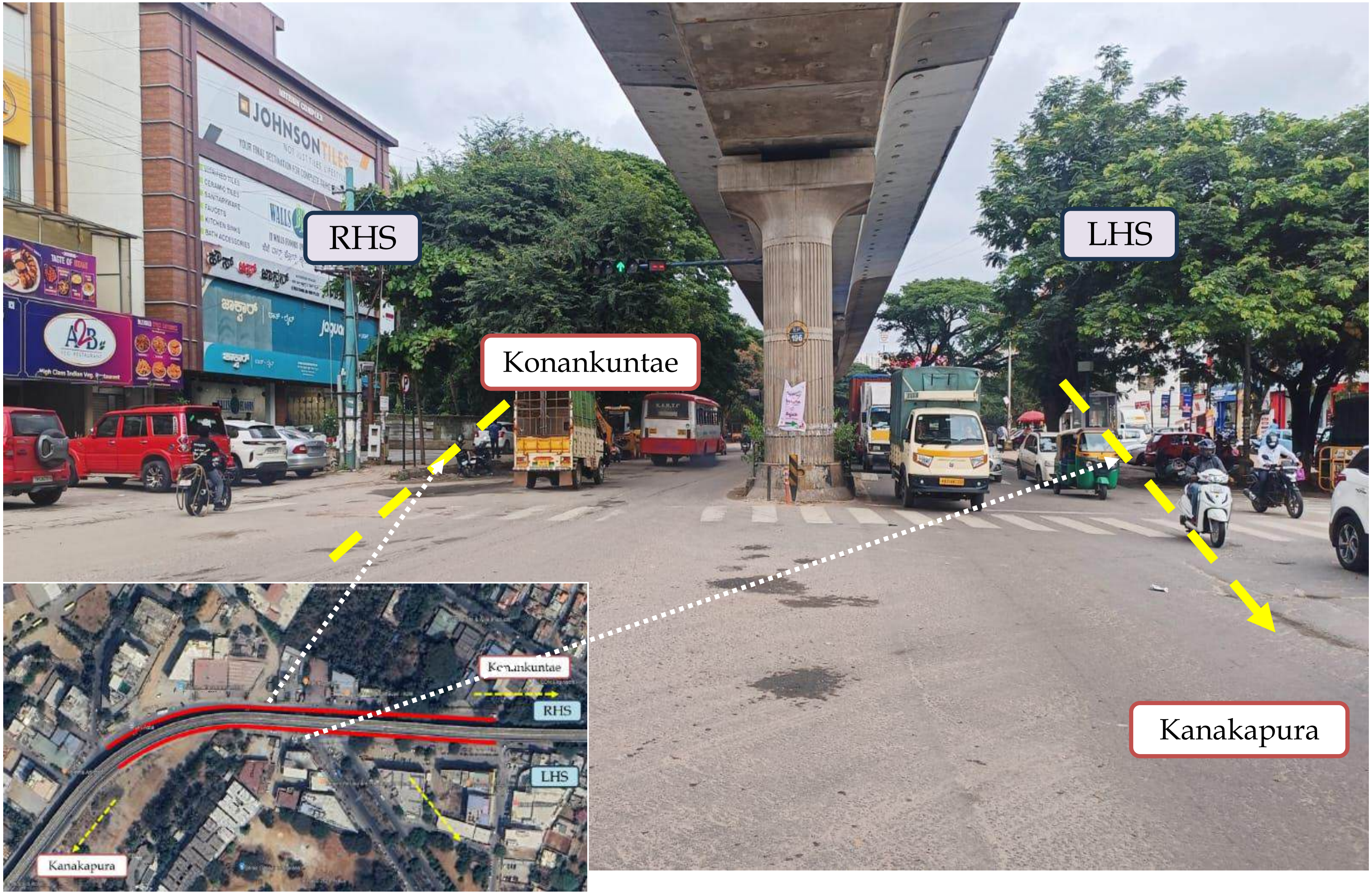


Figure 239. **Proposed Underpass Alignment**

Proposed Split Flyover Alignment

As per the traffic surveys analysis and forecasting it can be inferred that the current Level of service has already reached to 'F' and will continue to get worst in the coming years and with the upcoming development. To overcome the congestion issues a Split flyover is proposed on either sides of the junction for about 350 meters on the LHS and RHS side i.e. from Banashankari to Kanakapura side and vice-versa as shown in the **Figure 240** below. The LOS of at grade roadway segment would significantly improve by achieving **LOS C** from **LOS B.** Also will have seamless travel giving relief for three major junctions and congestion points for the traffic moving towards Kanakapura and Bangalore side.

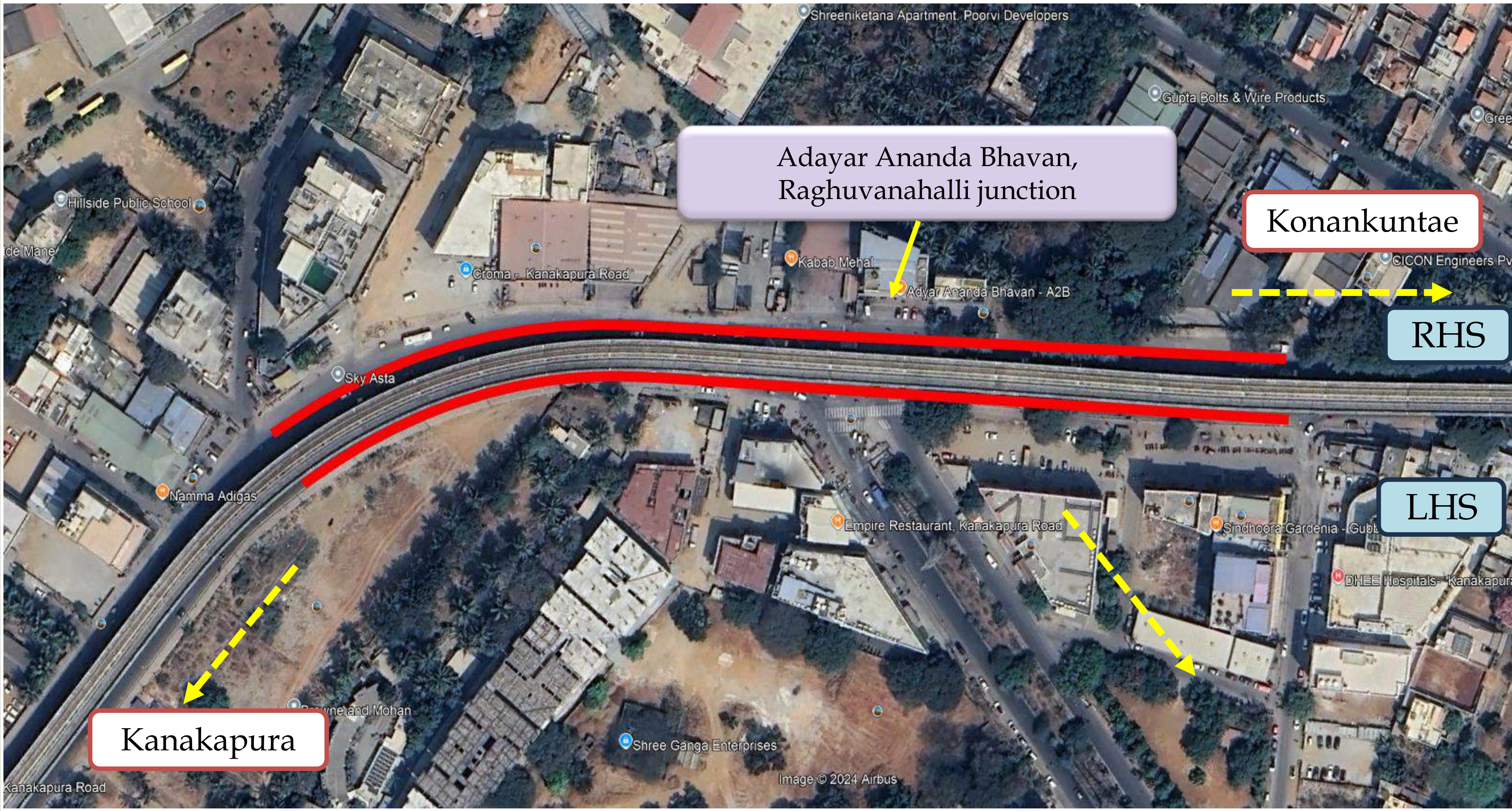


Figure 240. **Proposed Split Flyover Alignment**

Proposed cross section for 4 lane Split flyover at Raghuvanahalli Cross, Kanakapura road

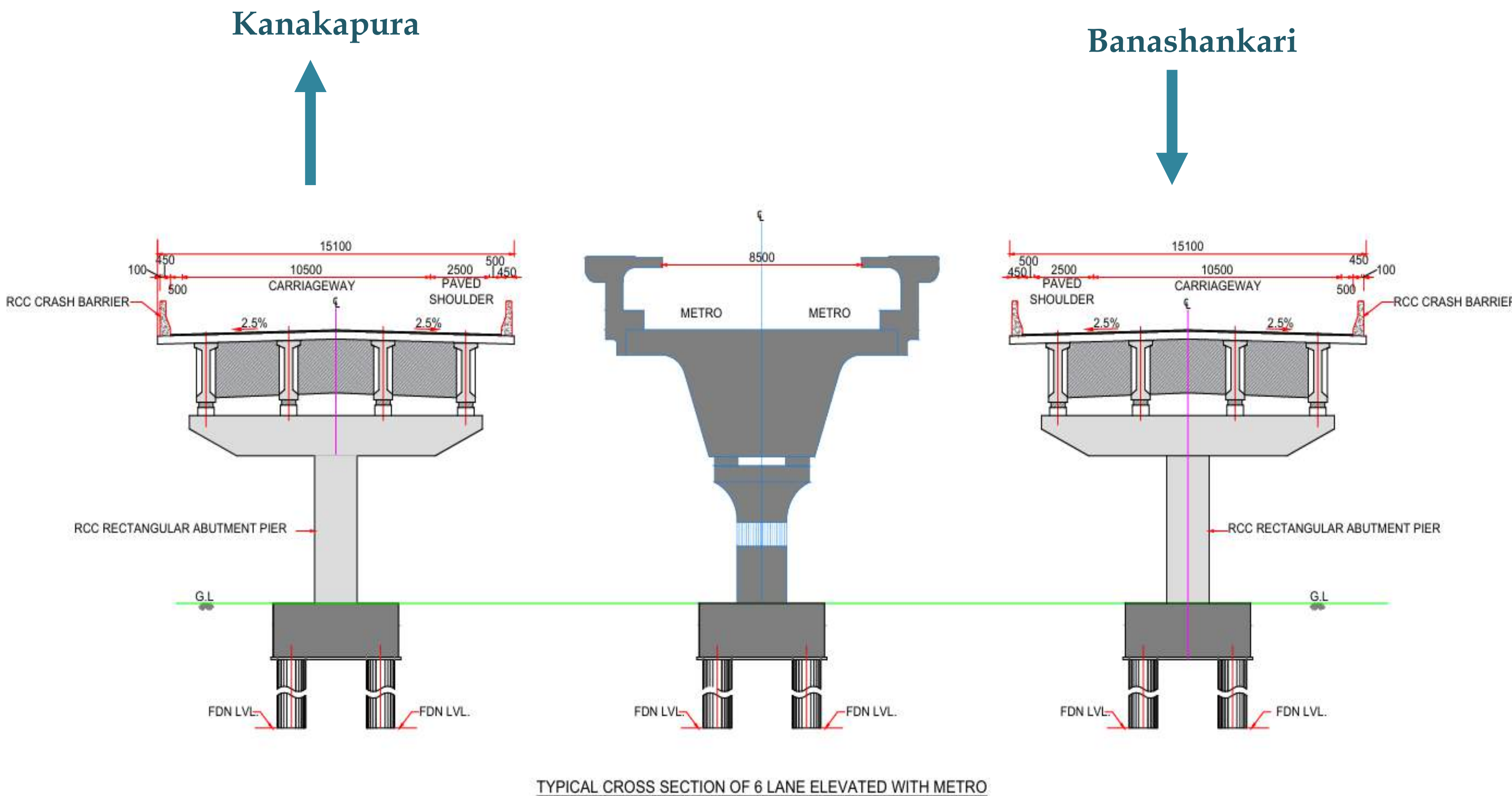
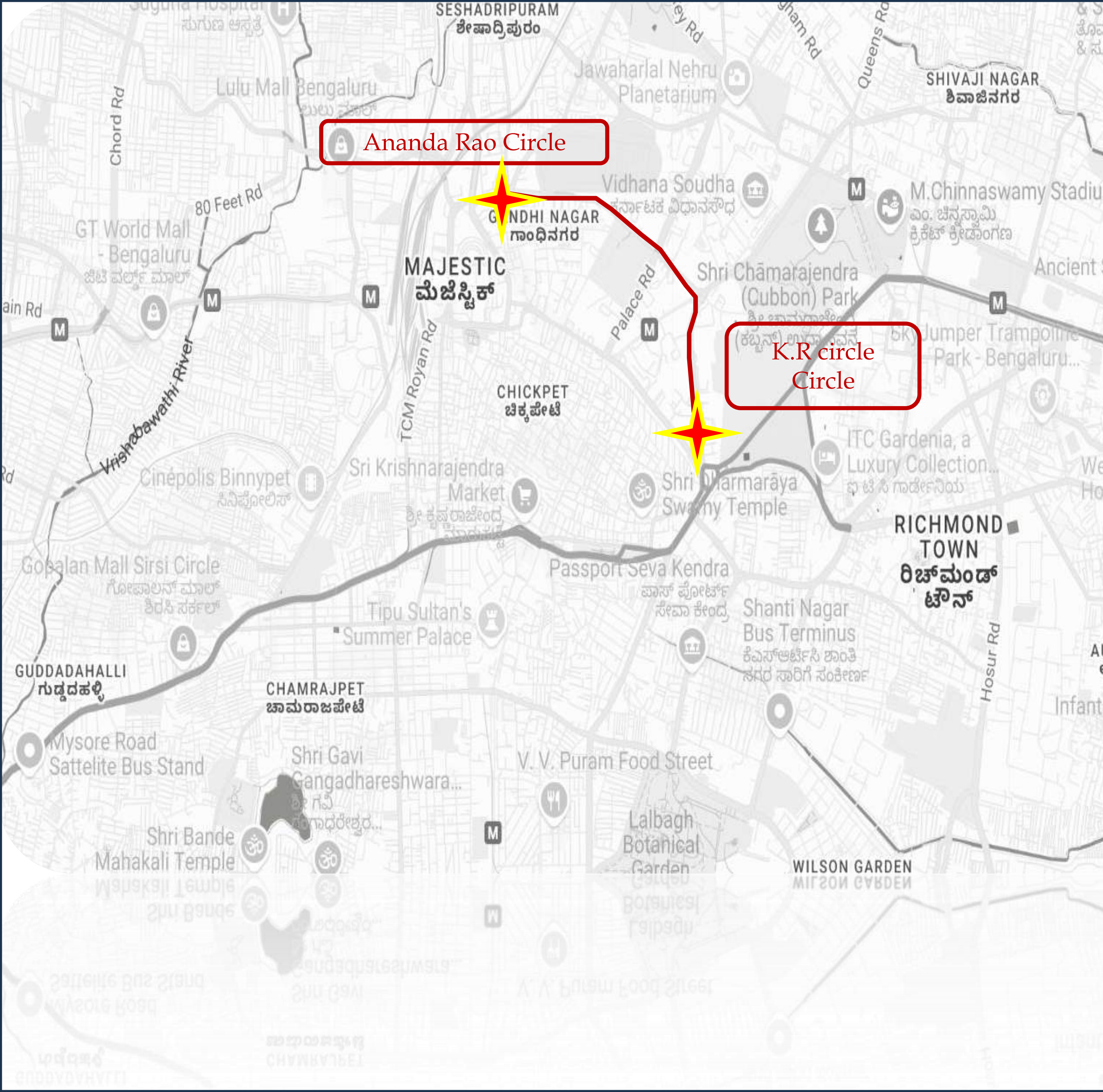


Figure241. Proposed cross section for 4 lane Split flyover at Raghuvanahalli Cross Kanakapura road



CORRIDOR 06

Anand Rao Circle Flyover- Seshadri Road

Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road

Proposed Extension of Anand Rao Circle Flyover to Nrupatunga road – Alignment details

The traffic scenario between Anand Rao Circle and K.R. Circle in Bangalore can be challenging, especially during peak hours. This stretch, which spans approximately 2.5 kilometers, is part of a vital route connecting different parts of the city. Here are some key points about the traffic conditions along this route:

1.Heavy Congestion: Being in a central area with major commercial and governmental establishments, the road between Anand Rao Circle and K.R. Circle is prone to heavy congestion. It's one of the busiest stretches in Bangalore, particularly during rush hours in the morning (8–11 a.m.) and evening (5–8 p.m.).

2.Bus and Auto Traffic: The area around Anand Rao Circle serves as a major hub for buses, and there is a lot of BMTC (Bangalore Metropolitan Transport Corporation) and KSRTC (Karnataka State Road Transport Corporation) bus traffic. This can lead to frequent stops and starts, slowing down overall flow.

3.Signal and Intersection Delays: There are multiple signals and intersections along this stretch, including crucial points like the intersection near Maharani College and Freedom Park. Vehicles often have to wait at signals, which leads to bottlenecks, especially at these junctions.

4.One-Way and Flyover Limitations: The flyover at Anand Rao Circle helps manage some traffic, but limited exits and one-way systems force vehicles to reroute, adding to congestion. Traffic management can sometimes make things slower as vehicles try to merge or change lanes near flyover entry and exit points.

1.Pedestrian Movement: The road sees a high volume of pedestrian traffic due to nearby colleges, offices, and government buildings. This adds to the delays, as vehicles slow down near crossings or zebra lines to accommodate pedestrians.

Proposed Extension of Anand Rao Circle Flyover to Nrupatunga road – Alignment details

Extending the Anand Rao Circle flyover all the way to K.R. Circle could help decongest the traffic between these points, but there are both advantages and potential drawbacks to consider. Here's an analysis of how such an extension might impact traffic flow:

Benefits of Extending the Flyover

1.Reduced Signal Stops and Improved Flow: The extension would allow vehicles to bypass K. R. Circle which is one of the most congested signal in the CBD area and intersection that cause bottleneck. This uninterrupted flow could reduce overall travel time, especially during peak hours.

2.Segregation of Long-Distance Traffic: Extending the flyover could separate through traffic from local traffic. Vehicles traveling beyond the K.R. Circle area wouldn't need to mix with those making local stops, reducing congestion at surface levels.

3.Faster Bus and Public Transport Movement: Since Anand Rao Circle is a hub for BMTC and KSRTC buses, giving buses a more direct route might streamline their schedules and make public transport more efficient.

4.Reduction in Pedestrian-Vehicle Conflicts: The elevated structure could also reduce conflicts between pedestrians and vehicles, as fewer cars would be on the ground level, making it safer and more accessible for those on foot.

Proposed Extension of Anand Rao Circle Flyover to Nrupatunga road – Alignment details

An elevated flyover has already been constructed at Anand Rao Circle on Seshadri Road to address traffic demands. However, with the increase in traffic, Seshadri Road requires further upgrades, as vehicles coming from Anand Rao Circle are experiencing congestion at K.R. Circle, resulting in lengthy traffic queues. To accommodate the current traffic flow, a new elevated corridor is proposed along Seshadri Road. This corridor will connect Anand Rao Circle, pass over K.R. Circle, and conclude at Nrupatunga Road, spanning a total length of 1.5 kilometers. This new elevated route is designed to bypass K.R. Circle, ensuring a smoother journey towards Hudson Circle.

Figure 242. proposed extension plan of Anand Rao Flyover

Proposed Extension of Anand Rao Circle Flyover to Nrupatunga road – Alignment details

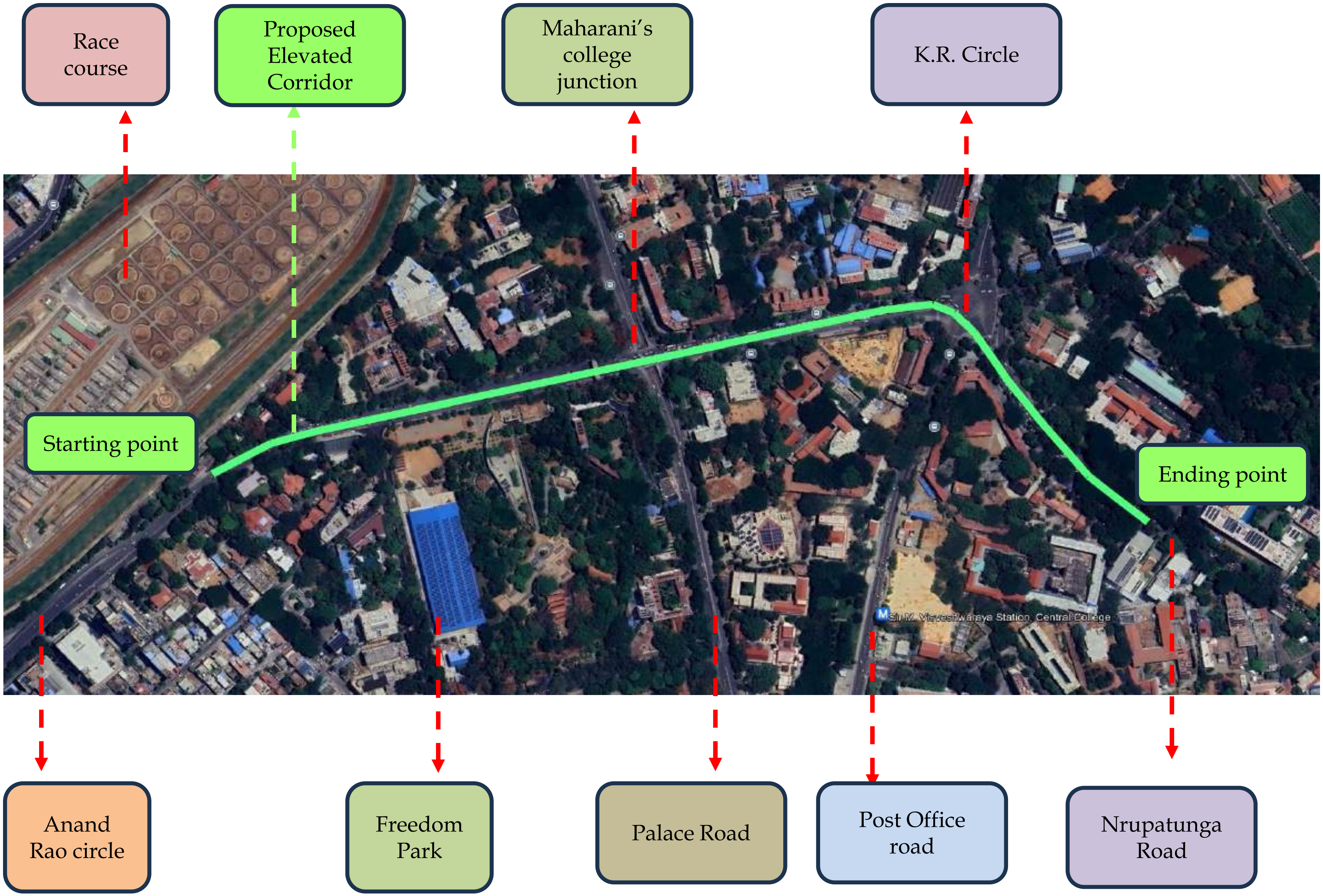


Figure 243. proposed Extension plan of Anand Rao Flyover

Figure 244. proposed extension plan phptps of Anand Rao Flyover

Alignment Reconnaissance

Figure 245. proposed extension plan phptps of Anand Rao Flyover

Road Inventory Data

Based on the road inventory details, the width of the carriageway remains relatively consistent along most of the stretch. It maintains a steady width of approximately 24 meters, providing uniform space for vehicular movement. However, there are slight variations at specific points where the road widens. Notably, near the down ramp of the existing flyover at Anand Rao Circle, the carriageway width increases to 32 meters. This expansion likely accommodates merging traffic from the flyover, ensuring smoother vehicular flow in this high-traffic zone. Similarly, as the road approaches K.R. Circle, the width slightly reduces to around 30 meters. These localized changes in carriageway width help manage traffic dynamics in critical sections, particularly where congestion and vehicle density tend to peak.

Figure 246. Road inventory data from Anand Rao Flyover to K.R. Circle

Road Inventory Data

The traffic flow from Anand Rao Circle to K.R. Circle showcases significant fluctuations in vehicle speeds due to varying road conditions and signal timings. Starting at Anand Rao Circle, the average car speed is approximately 35 kmph, allowing for relatively smooth movement. However, this pace is abruptly reduced to around 17 kmph near Freedom Park, primarily due to the delay caused by the signal in that area. Following this, the speeds pick up slightly, reaching an average of 28 kmph as vehicles move towards Maharani College. Despite this brief improvement, the traffic flow deteriorates significantly as cars approach K.R. Circle, with speeds dropping sharply to as low as 10-12 kmph. This drastic reduction is likely due to congestion and bottlenecks commonly experienced in this critical junction, making it a major choke point along this stretch.

Figure 247.Average Peak Hour car speed from Anand Rao Flyover to K.R. Circle

Proposed cross 4 lane undivided Elevated corridor from Anand Rao circle to K,R. Circle

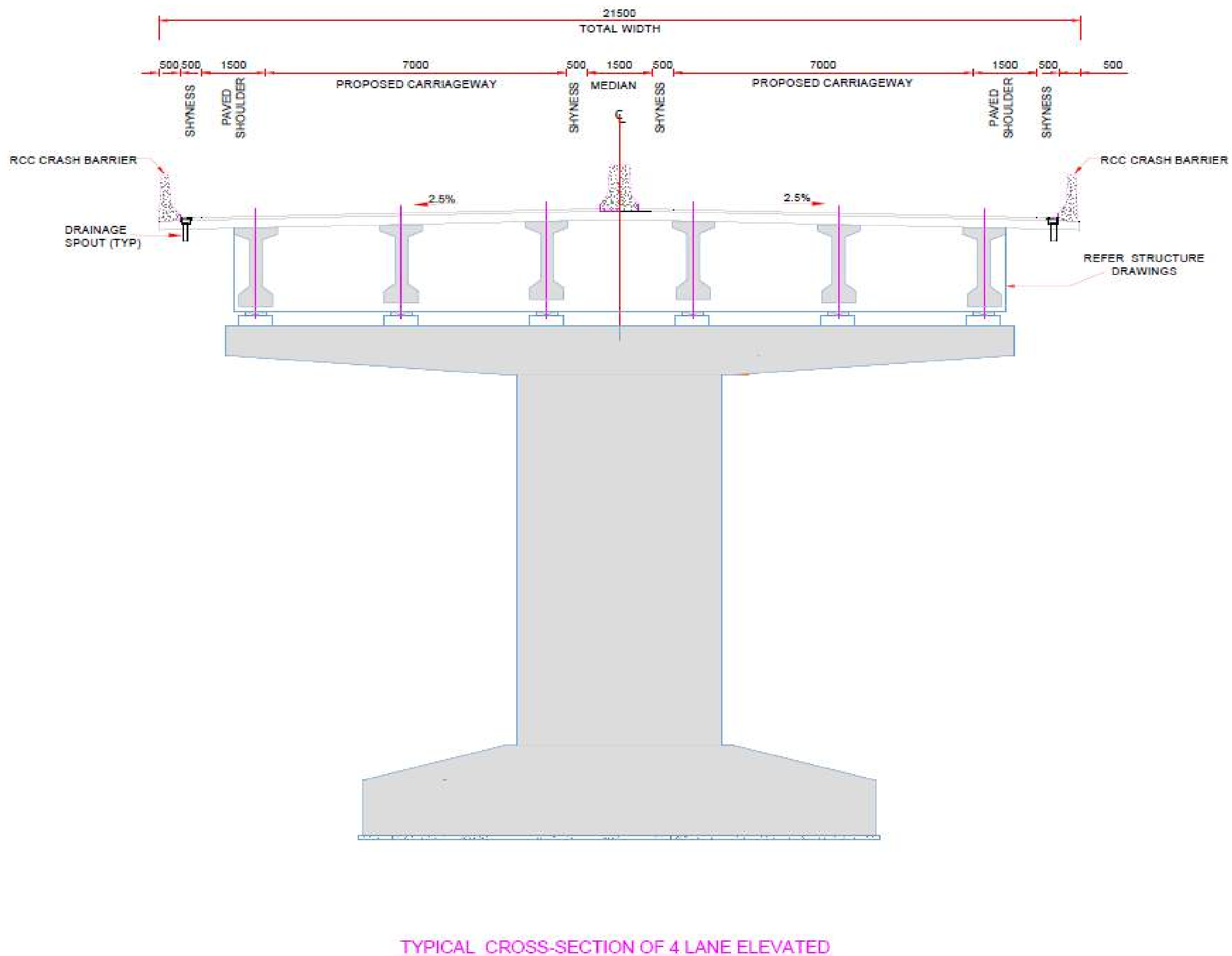


Figure 248. **Proposed cross section for the Elevated corridor**

Proposed cross 6 lane undivided Elevated corridor from Anand Rao circle to K,R. Circle

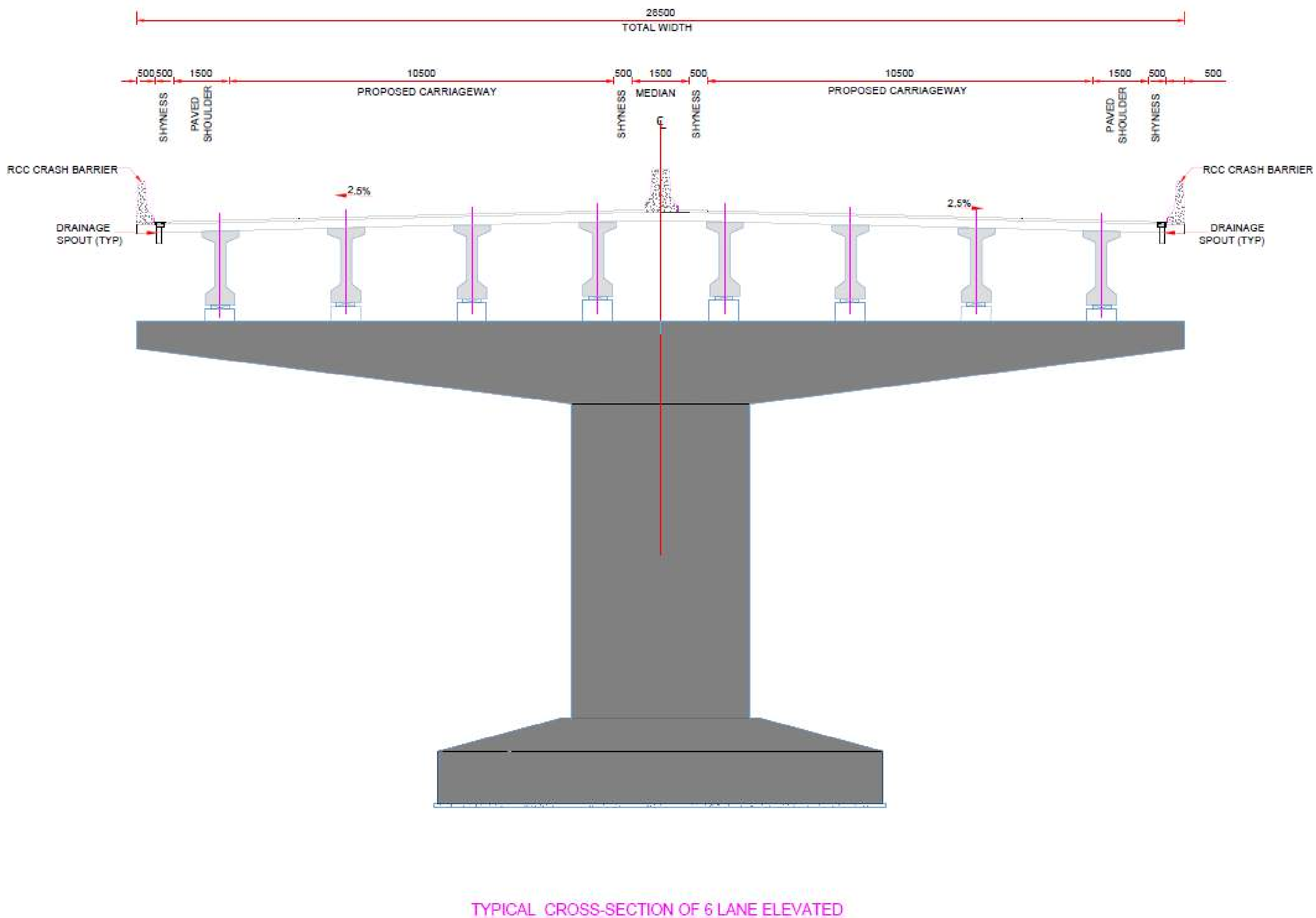


Figure 249. Proposed cross section for Elevated corridor from Anand Rao circle to K,R. Circle

CORRIDOR

07

Hosur Road

Proposed Elevated Corridor Shoolay circle -Anaepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction

CORRIDOR V:HOSUR ROAD - Starting From Brigade Road Junction To Begur Junction And From Begur Junction To Museum Road Junction.

Hosur Road Corridor, which starts from Brigade Road junction on Residency road and ends at Begur Junction on the LHS and on the RHS, it starts from Begur Junction and ends at Museum Road Junction on Residency road. **Figure 312.**

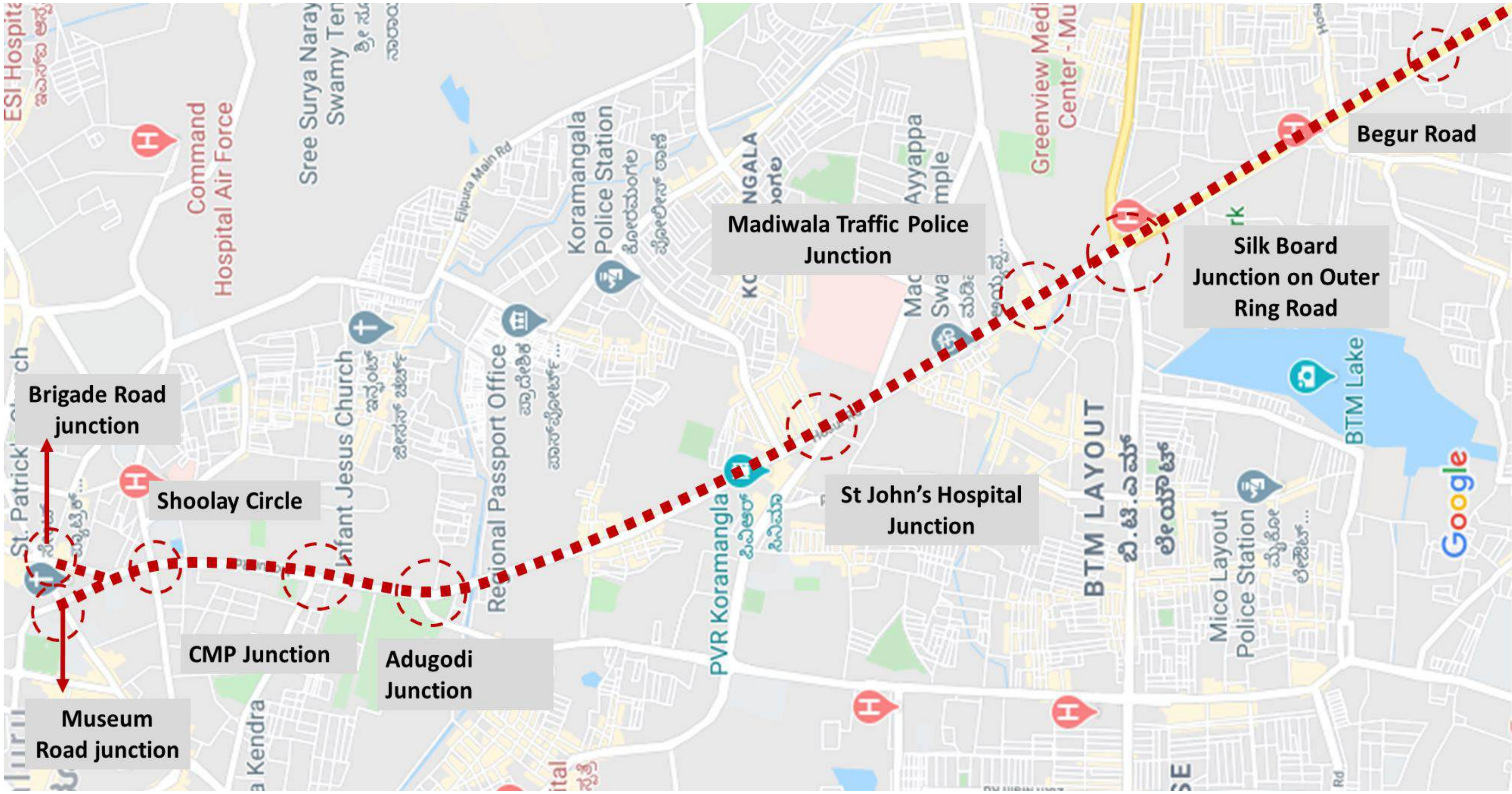


Figure 250. Hosur Road Corridor

It is one of the busiest corridors, which starts from center of the city and goes towards the southeastern side towards Chennai.

Some of the main features of the corridor are:

•Length of the study corridor is 8.6 km and is an Arterial road.
•The road surface is varying from bituminous to concrete.
•Lane widths vary from three lane divided to six lane divided two way.
•There are thirteen signalized junctions along the corridor.
•Metro rail is under construction from Silk Board Junction to Begur Junction.

Landmarks, Attraction & Production Centers

The corridor mainly attracts many work trips due to the presence of Software companies. This corridor is considered as software corridor, which leads to Bangalore's Electronic city, the other trips are recreations trips as the corridor has Forum Mall and other eateries and hotels. The parallel corridor has many granite factories and stockyards, but the major traffic flow takes place through this corridor. The corridor also has army training institutes and schools .and shown in **Figure 313.**

The corridor houses many major attraction points such as:

- •The corridor starts from Brigade road, which is considered as the shopping street of Bangalore.
- •One of the oldest Markets - the Johnson's Market is located on this corridor, which is a heritage market.
- •Shopping malls like EVA, Forum Mall, and Market Square are located on the corridor.
- •Prominent government institutions are located on the corridor such as Silk Board, National Dairy Research Institute, Robert Bosch, Geological Survey of India etc.
- • The famous St John's Hospital is located on this corridor.

Show Silk Board on map **Figure 251**

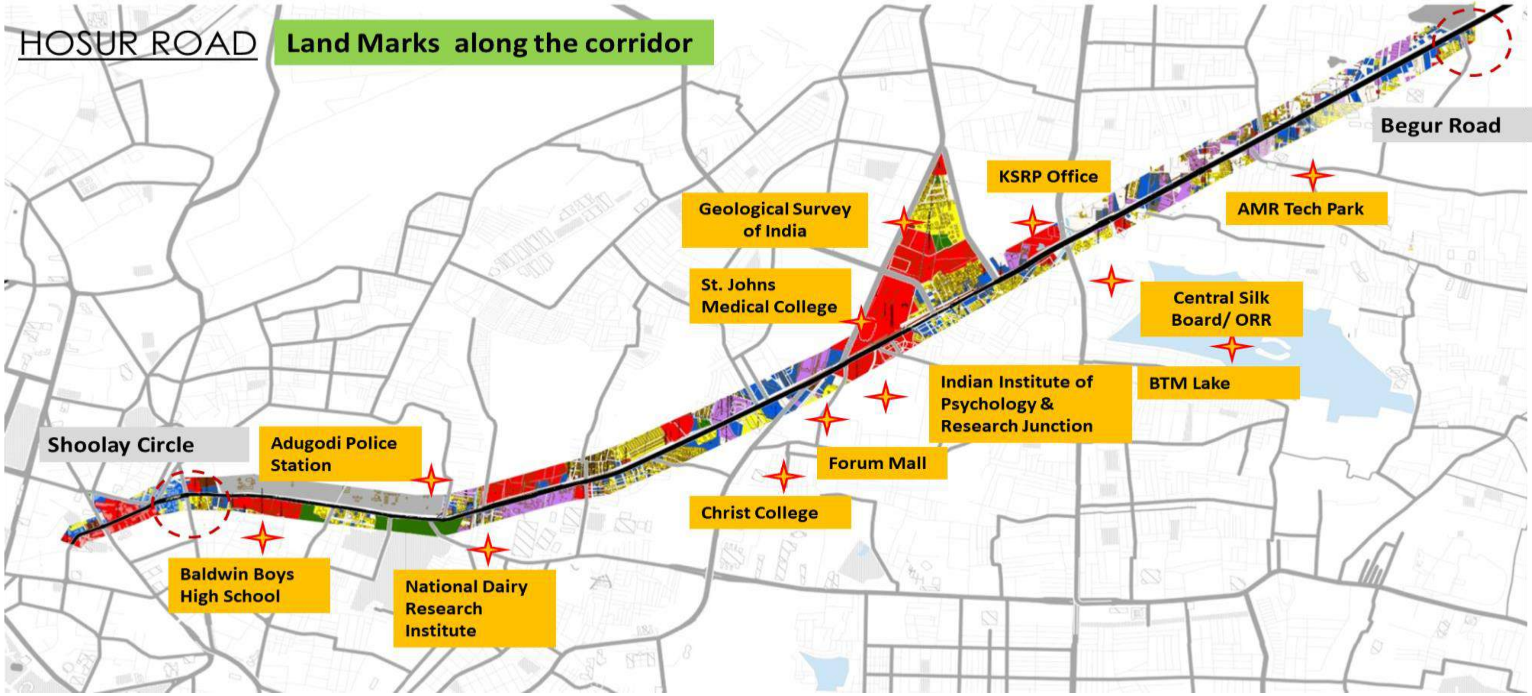


Figure 251 Attraction/ Generation Entities/ Areas

Figure 252 Landmarks,Attraction and production centres

Major Bus Stops along the Corridor

There are eighteen bus stops located along the corridor. There are dedicated bus bays near Forum Mall, near Begur, and near Baldwin Methodist College. For the remaining bus stops, there are no bus bays .The absence of bus bays results in buses stopping on the carriageway itself leading to traffic congestion. All the Bus Stop locations are as shown in the **Figure 253.**

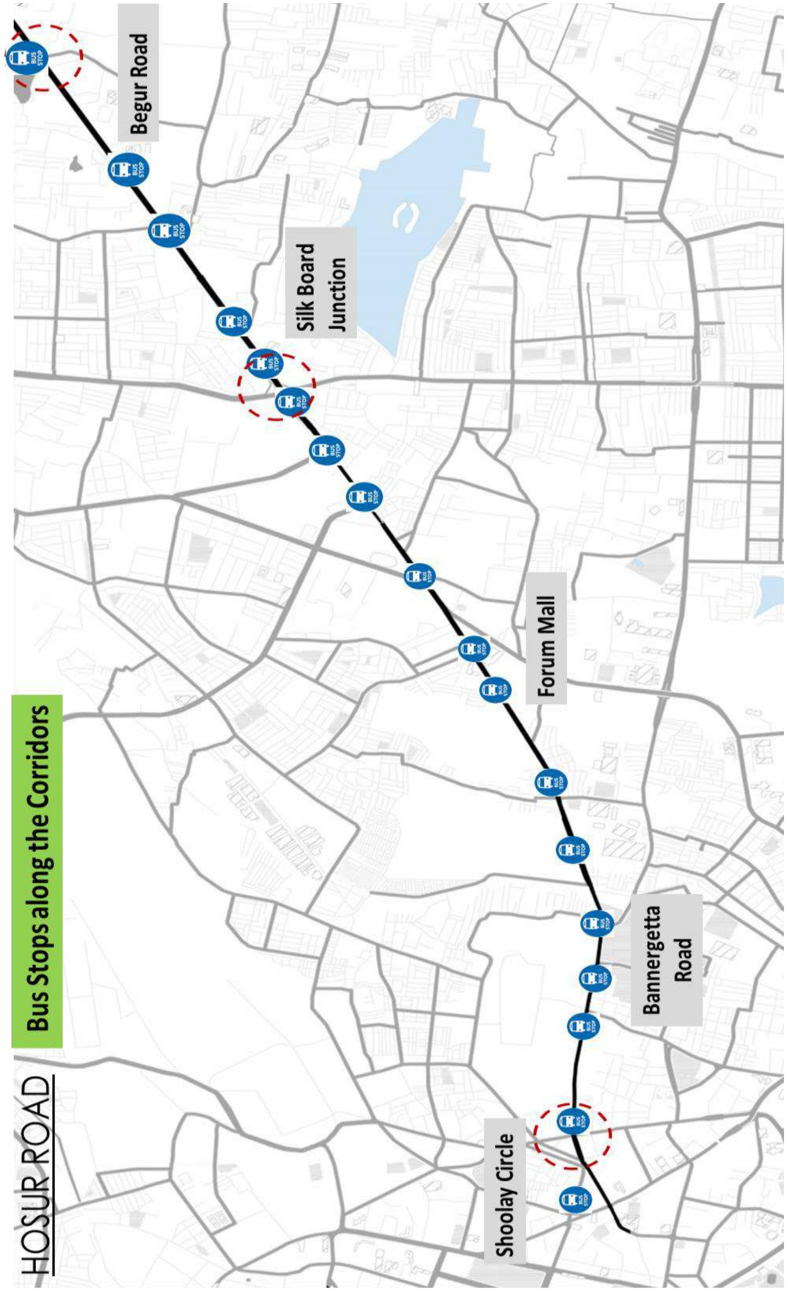


Figure 253 Major Bus Stands/Bus stops

Corridor Characteristics

The entire corridor is a varying from 3 Lane to 6 lane two way with footpath on either side. A small part of the road stretch is the one way from Brigade Road junction to Shooley Circle on the LHS and from Shooley circle to Museum Road intersection. entire corridor is a varying from 3 Lane to 6 lane two way with footpath on either side. A small part of the road stretch is the one way from Brigade Road junction to Shooley Circle on the LHS and from Shooley circle to Museum Road intersection. **Figure 254.**

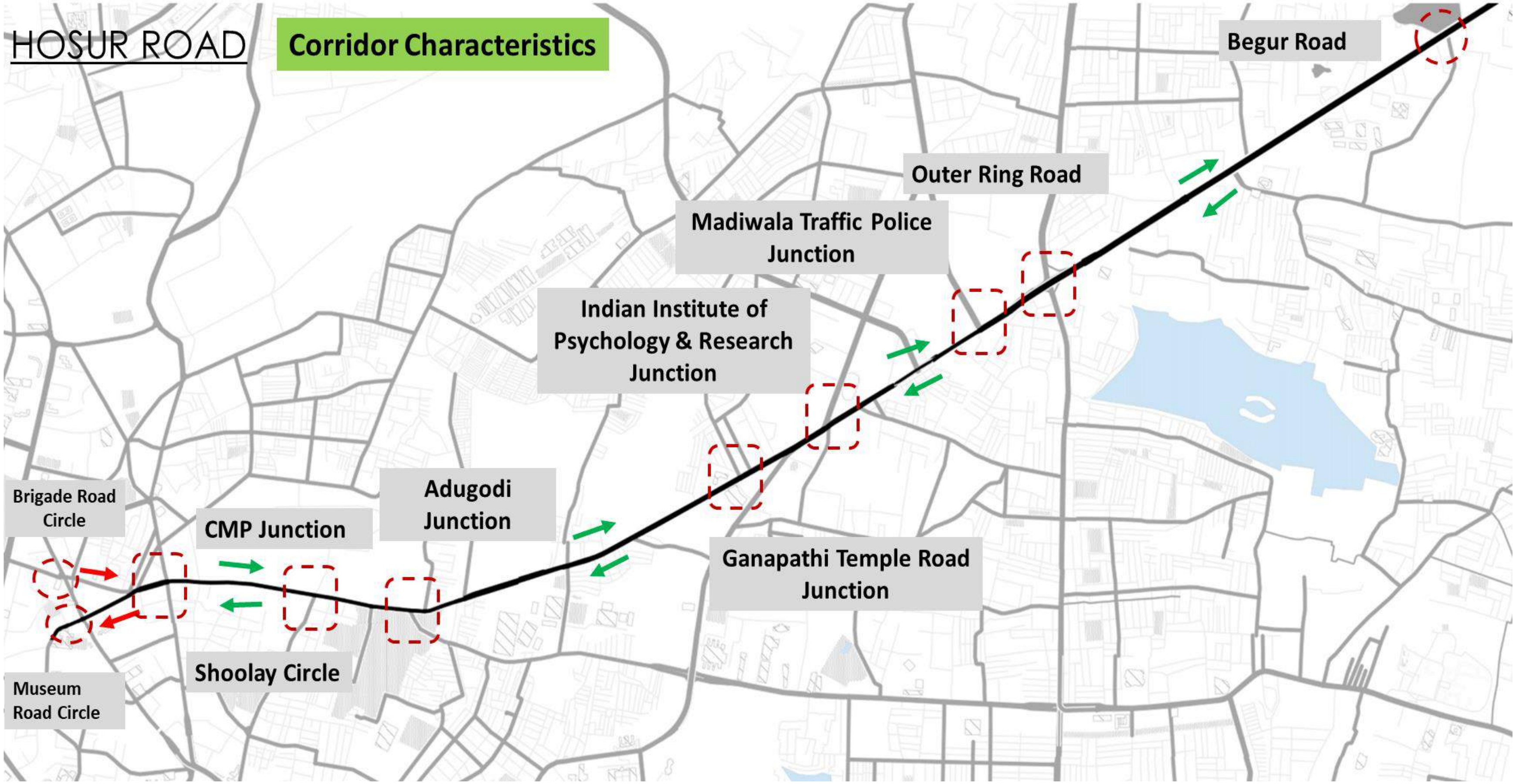
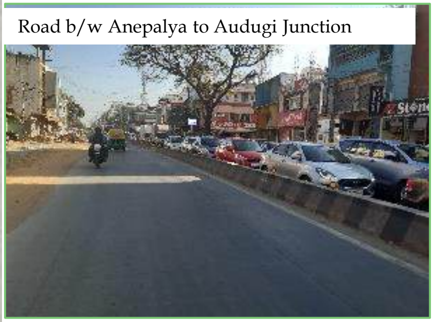


Figure 254. Major Junctions along the corridor


Road b/w Anepalya to Audugi Junction


Road near Forum Mall


Road near Madiwala Check Post


Road near Silk Board Flyover


Road @ Up ramp of Silk Board

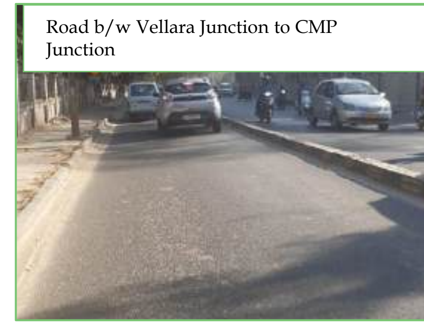

Traffic at Silk Board


Road near Begur Junction Skywalk


Road near Begur Junction Skywalk

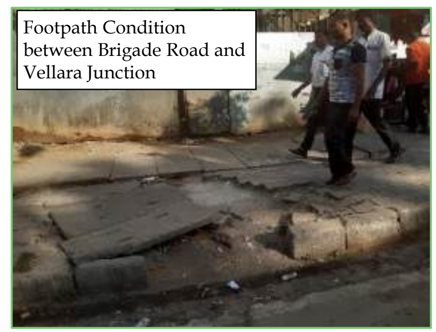
Figure 255. Major Junctions along the corridor


Road b/w Vellara Junction to Museum Road Junction


Road b/w Vellara Junction to CMP Junction

Existing Footpaths/Pedestrian Facilities

It is observed that on certain stretches of road, footpath condition is good but on majority of the locations, the condition of the footpath is poor. The pedestrian facilities along the corridor is taken care well. There are four pedestrian skywalks along entire corridor. **Figure 318**


Footpath Condition between Brigade Road and Vellara Junction


Footpath Condition at Anepalya


Debris Dumped on Footpath near Vellara Junction


Debris Dumped on Footpath near Silk Board Junction

Figure 256. Existing footpaths/Pedestrian facilities

Figure 257. Absence of Pedestrian accessibility to Metro Stations from LHS

Major Junctions

There are eleven major intersections where maximum merging and diverging of the traffic takes place. The major intersections are ***(figure-320)***:

•Brigade Road Junction- 4 arm Signalized intersection.
•Museum Road Junction– 4arm Signalized intersection.
•Shooley Circle –3 arm Signalized intersection.
•Vellara Junction- 4 arm Signalized intersection.
•CMP circle- 3arm Signalized intersection
•Adugodi Circle – 4arm Signalized intersection.
•Forum Mall Circle -3 arm signalized intersection.
•Madiwala Check Post Circle- 3 arm signalized intersection.
•St John's Hospital Junction - 4 arm Signalized intersection.
•Central Silk Board Junction on Outer Ring Road 4 arm Signalized intersection.
•Begur Junction-3 arm signalized intersection.

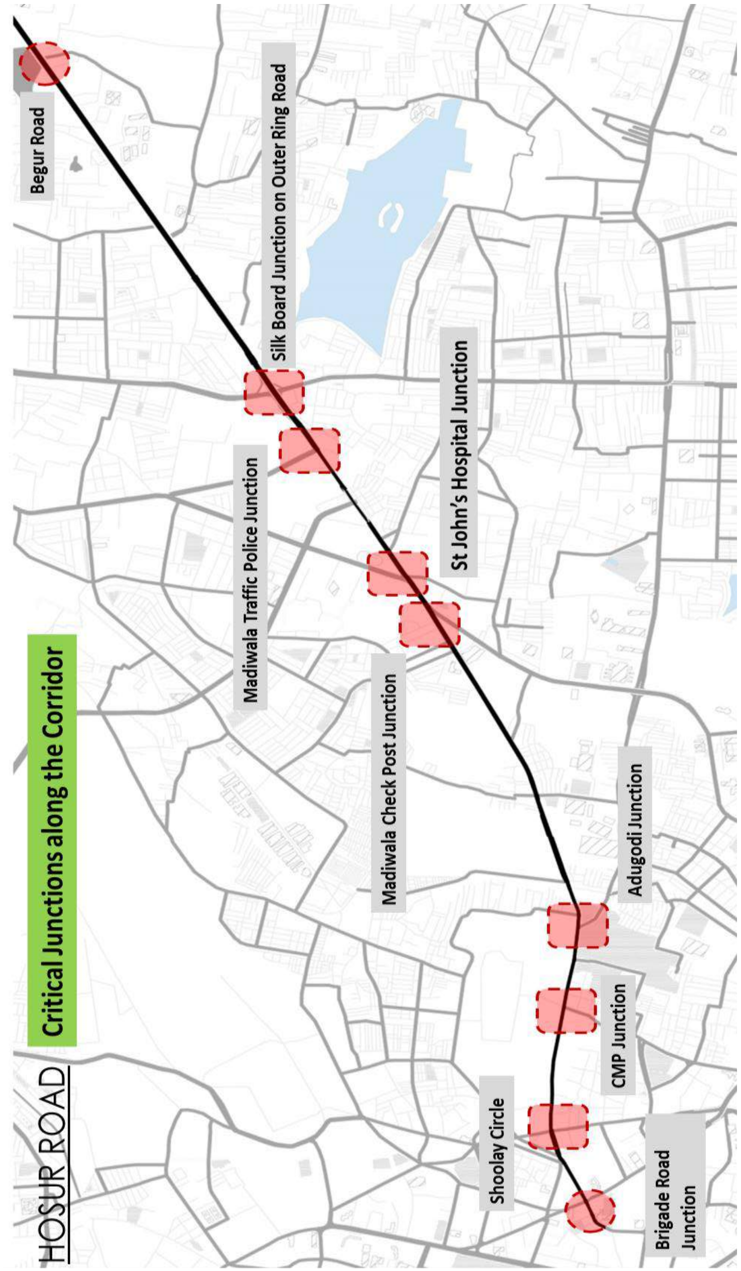


Figure 258. Critical Junctions along the Corridor

Signage/ Markings/ Signals

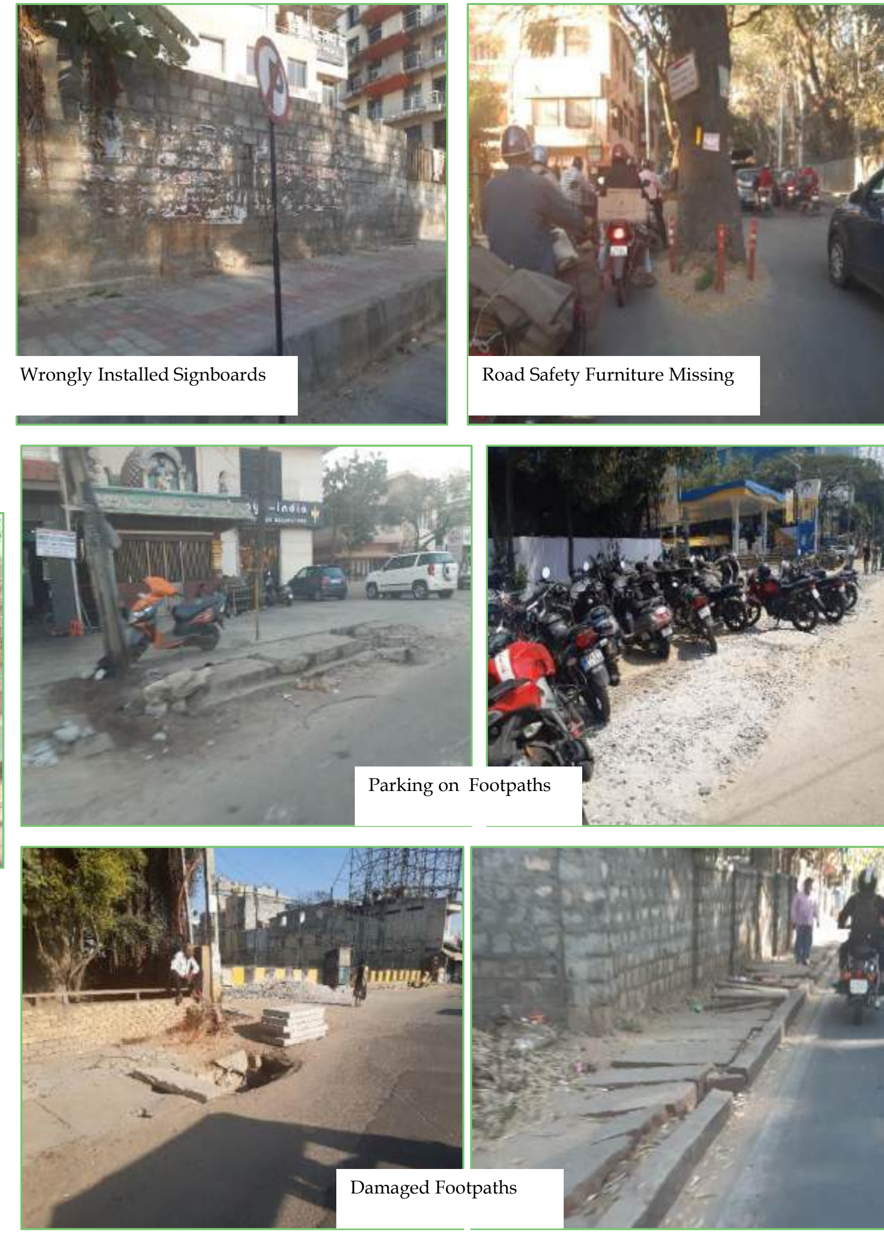
The corridor lacks right signboards at the right locations; the signboards do not have good foundation and most of the signboards are either damaged or not relevant to the site. Road safety aspects are also ignored along the corridor largely which is of major concern. Some of the safety issues are:

•Road safety furniture like cat eyes, solar blinkers are missing all along the corridor, which are required for safe access during night.
•Road surface at certain points is very bad resulting in two-wheeler skidding, leading to fatal accidents, especially at Madiwala Police Station and near Adugodi.
•Footpaths are in very bad condition, which need to be rectified on priority; especially on near CMP junction, the granite slabs damaged and near Madiwala Check post junction where the slabs are completely broken. **Figure 259-260**

Unscientific and Damaged Sign Boards near Madiwala check Post Junction

Sign board condition along the Corridor

Figure 259 Conditions of signage/signals along the corridor



Wrongly Installed Signboards

Road Safety Furniture Missing

Parking on Footpaths

Damaged Footpaths

Figure 260. Signage/markings/signals condition along the corridor

Land Use Along the Corridor

It is observed that majority of the land use pattern along the corridor is Commercial, Defence land, Hospitals and some part of Industry. It is also observed that most of the existing residential land uses have been used for commercial purposes. (shown in **Figure 261**).

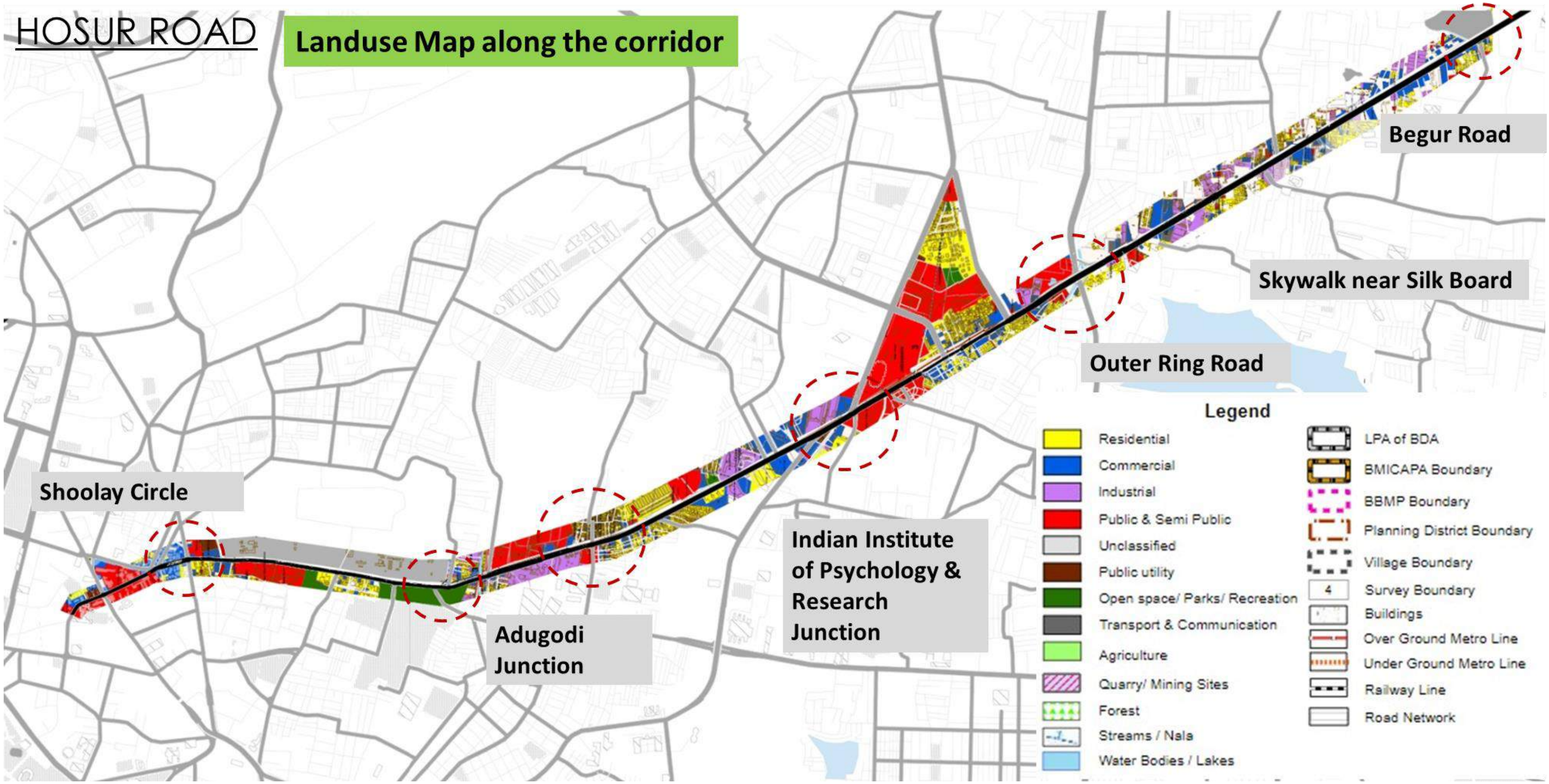


Figure 261. Land use along the corridor

PART B
SURVEY ANALYSIS

Traffic Survey Details

In order to assess the existing traffic and transport characteristic of the corridor and to decide on the type of traffic management measures needed, traffic surveys were carried out. The survey particulars are as presented below in **Table 74.**

Table 74. Traffic Survey Details

Sl.No	Type of Survey	Quantity
1	Turning Volume Count	7 Intersections
2	Mid-block Count	1 Location
3	Pedestrian Count Survey	7 Intersections
4	Speed And Delay (Bus & Car)	8.6 Km
5	Road Network Inventory	8.6 Km
6	Traffic Signal Phasing	7 intersections

Traffic Volume Counts

Traffic volume count survey was conducted at 2 Mid-block locations and for the remaining stretches, traffic volumes were extracted from the turning volume counts conducted at junctions along the corridor (**Figure 269**). The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. The PCUs corresponding to urban roads as per IRC: 106-1990 were used and the Peak Hour Traffic Volumes are as presented below in **Table 75**.

Table 75. Traffic Volume Counts

Sl. No	Road Name	Morning Peak Hour	Morning Peak Hour Volume				Evening Peak Hour	Evening Peak Hour Volume			
			Towards Begur road		Towards M.G Road			Towards Begur road		Towards M.G Road	
			Vehicles	PCUs	Vehicles	PCUs		Vehicles	PCUs	Vehicles	PCUs
1	Between Vellara Junction and Toll Gate Bus Stop	10.15-11.15	3197	2095	1886	1562	19.15-20.15	3333	2095	1836	1514
2	Between Toll Gate Bus Stop and Adugodi Junction	10.30-11.30	4224	3195	3568	2837	19.00-20.00	4244	3241	3535	2860
3	Between Adugodi Junction and Ganapathi Temple Road Junction	10.30-11.30	5185	3968	4876	3810	19.00-20.00	5196	4030	4829	3841
4	Between Ganapathi Temple Road Junction and Madivala Check Post	11.00-12.00	4731	3426	4900	3861	19.15-20.15	4719	3528	5026	3853
5	Between Madivala Check Post and St John's Hospital Junction	11.00-12.00	7600	6327	4900	3911	19.15-20.15	7591	6418	5026	3904
6	Between St John's Hospital Junction and Madivala Traffic Police Station Junction	9.45-10.45	5167	4131	8410	6981	19.15-20.15	5054	3909	10035	7141
7	Between Madivala Traffic Police Station Junction and Silk Board Junction	9.45-10.45	5167	4131	6421	5332	19.15-20.15	5054	3909	6393	5161
8	Between Silk Board and NH Skywalk	9.00-10.00	7214	6233	4485	3828	18.30-19.30	7032	5888	4231	3770
9	Between NH Skywalk and Begur Road Junction	9.15-10.15	3749	3106	4463	4666	17.30-18.30	3676	2913	4588	4742

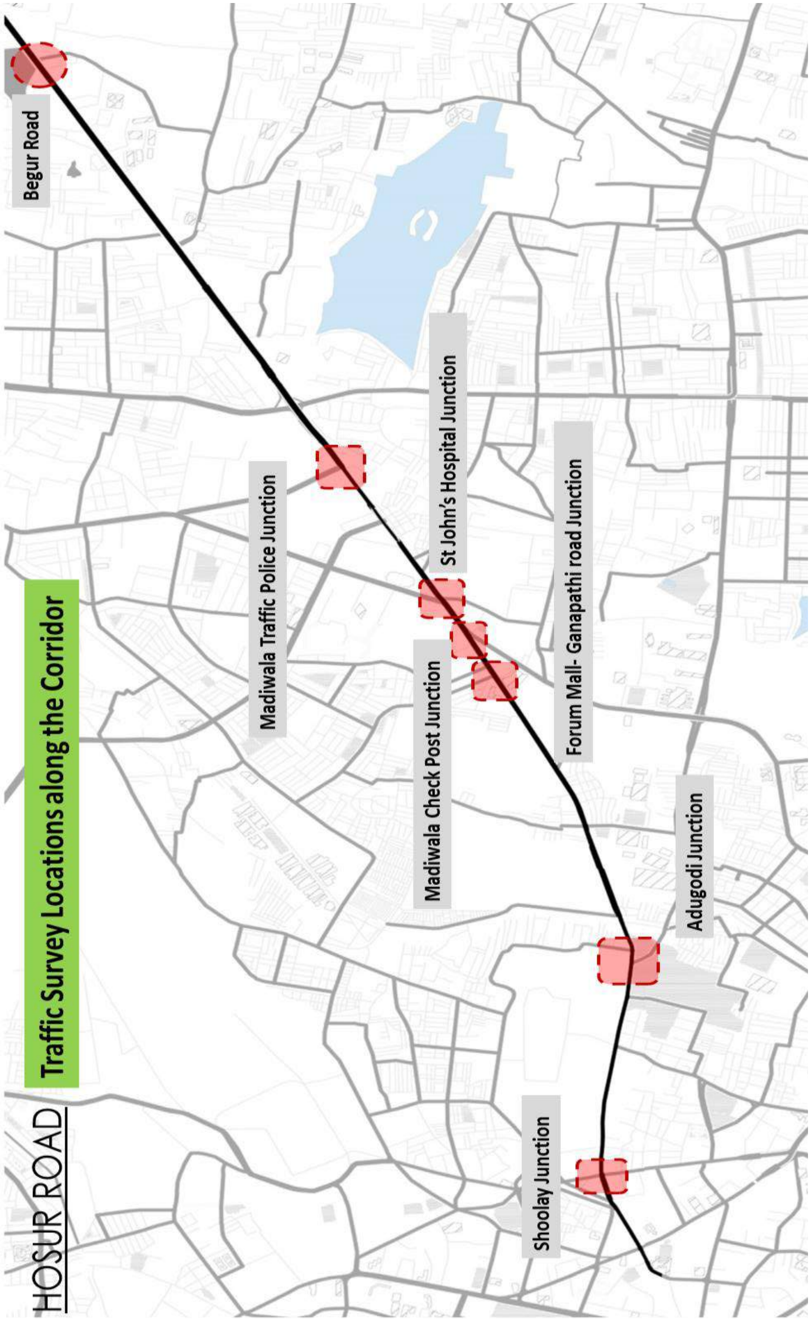


Figure 262. Tumkur Road Corridor Traffic Count Survey Locations

Among the 9 Mid-Block locations, traffic volume between Madivala Check Post and St John's Hospital Junction is found to be the highest with 13554 PCUs during morning peak hour and 13664 PCUs during evening peak hour followed by Hosur Road stretch between Silk Board and NH Skywalk with a traffic volume of 12016 PCUs during morning peak and 11498 PCUs during evening peak hour.

Volume to Capacity Ratio (V/C) and Level of Service

Volume to Capacity Ratio (V/C Ratio) is defined as the ratio of peak hour traffic flow rate to capacity and Level of Service (LOS) is defined as the a qualitative measure, describing operational conditions within a traffic stream and their perception by the drivers/passengers.

Universally, LOS is lettering scheme ranging from A to F. LOS 'A' represents highest quality of service whereas LOS 'F' represents heavily congested flow where traffic demand exceeds capacity. The service measures used for defining LOS are density and volume-to-capacity ratio.

For computation of V/C Ratio the capacity values have been adopted based on the road geometrics by applying adjustment factors ***(as per Indo Highway Capacity Manual 2012-2017)*** conforming to the site conditions.

Adjustment Factors

Several factors would have impact on traffic movement and on capacity as compared to the base section. The factors considered for assessment of influence on capacity include on-street parking manoeuvres; entry and exit of vehicles from access road and bus pull in and pull out manoeuvers in bus bays as well as access points.

The level of friction is categorized as low, medium and severe based on the extent of resistance or speed reduction to the flow as compared to base sections. The capacity of the urban road section is computed using the equation:

$$C = C_o * F_{OP} * F_{BS} * F_{AC}$$

Where,

C= Actual Capacity (PCU/hr)

C_o = Base Capacity for Ideal Condition (PCU/hr)

F_{OP} = Adjustment Factor for On-street Parking

F_{BS} = Adjustment Factor for Bus Stops

F_{AC} = Adjustment Factor for Access Point

As the level of friction due to kerb side bus stops is high (frequency of buses>30) the adjustment factor of 0.6 is considered to compute the actual capacity. The ratio of peak hour traffic flow rate to capacity (V/C Ratio) and the Level of Service (LOS) of the road sections along Hosur Road Corridor are presented in **Table 76** and **Figure 270-271**.

Table 76. Traffic Volume to Capacity ratio and Level of Service

Road Name	Typology of Road	Capacity*		Morning Peak						Evening Peak					
				Morning Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*		Evening Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*	
		Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road
KH Road Junction	4 lane	2700	2700	2095	1562	0.78	0.58	LOS D	LOS C	2095	1514	0.78	0.56	LOS D	LOS C
Between Toll Gate Bus Stop and Adugodi Junction	4 lane	2700	2700	3195	2837	1.18	1.05	LOS F	LOS F	3241	2860	1.2	1.06	LOS F	LOS F
Between Adugodi Junction and Ganapathi Temple Road Junction	6 lane	4200	2520	3968	3810	0.94	1.51	LOS E	LOS F	4030	3841	0.96	1.52	LOS E	LOS F
Between Ganapathi Temple Road Junction and Madivala Check Post	4 lane	2700	2700	3426	3861	1.27	1.43	LOS F	LOS F	3528	3853	1.31	1.43	LOS F	LOS F
Between Madivala Check Post and St John's Hospital Junction	6 lane	4200	4200	6327	3911	1.51	0.93	LOS F	LOS E	6418	3904	1.53	0.93	LOS F	LOS E
Between St John's Hospital Junction and Madivala Traffic Police Station Junction	6 lane	2520	2520	4131	6981	1.64	2.77	LOS F	LOS F	3909	7141	1.55	2.83	LOS F	LOS F
Between Madivala Traffic Police Station Junction and Silk Board Junction	6 lane	2520	2520	4131	5332	1.64	2.12	LOS F	LOS F	3909	5161	1.55	2.05	LOS F	LOS F
Between Silk Board and NH Skywalk	8 Lanes	4080	4080	6233	3828	1.53	0.94	LOS F	LOS E	5888	3770	1.44	0.92	LOS F	LOS E
Between NH Skywalk and Begur Road Junction	8 Lanes	4080	4080	3106	4666	0.76	1.14	LOS D	LOS F	2913	4742	0.71	1.16	LOS C	LOS F

It can be observed that the traffic approaching at all the locations (except between Vellara Junction and Toll Gate Bus Stop) exceeds beyond the road capacity resulting in considerable delay and queuing.
`

The volume to capacity ratio at most of the locations exceeds 1.0 and the Level of Service is found to be 'F' which indicates heavily congested flow where traffic demand exceeds capacity.

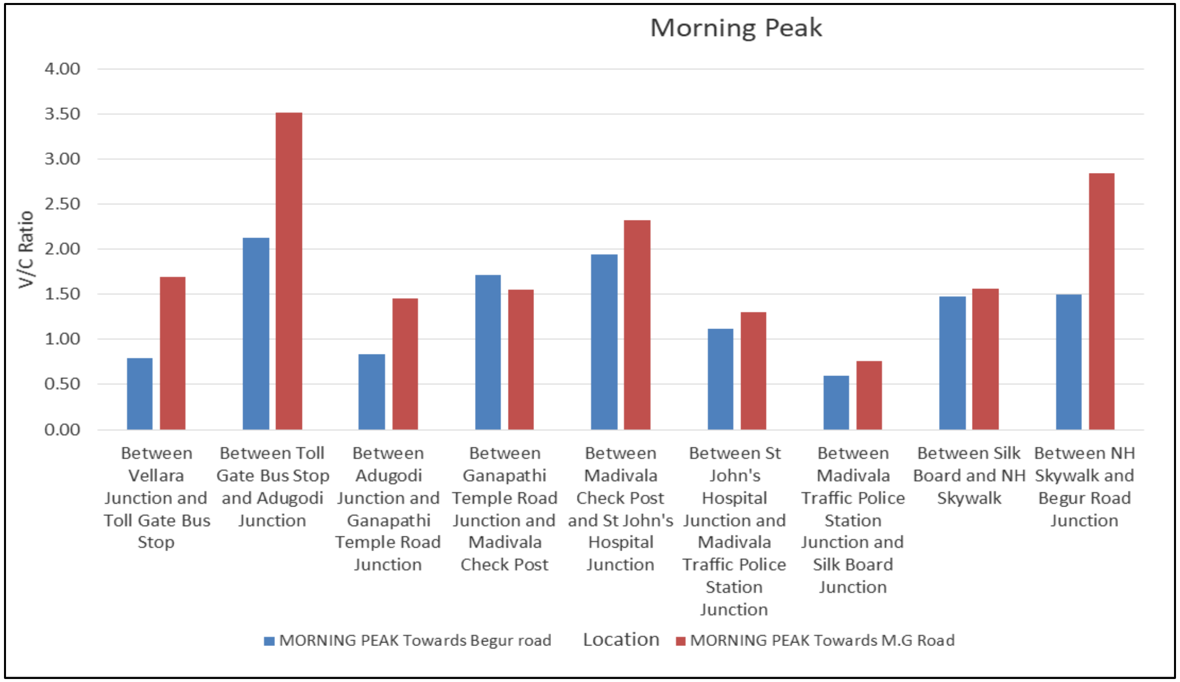


Figure 263. V/C ratios for Morning Peak

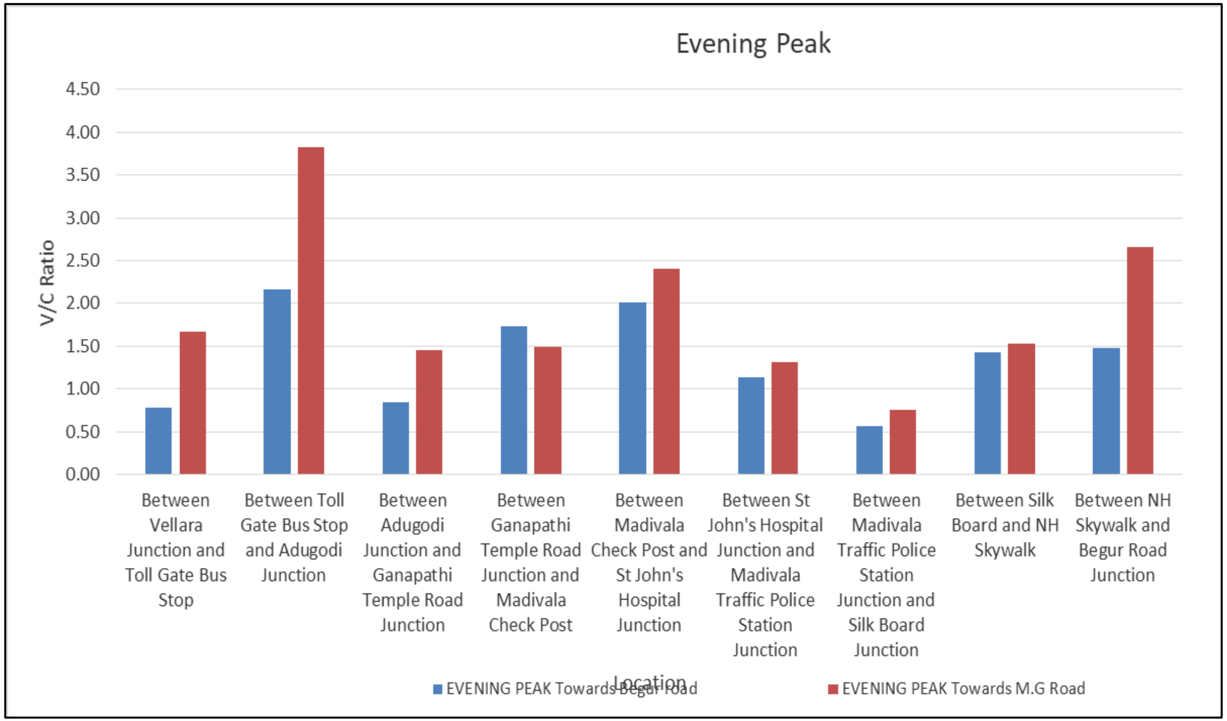


Figure 264. V/C ratios for Evening Peak

Traffic Volume at Junctions

The traffic volumes at intersections help in assessing the traffic volumes at mid-block locations of the arms of the intersection which together with journey speed and road inventory data aid in evaluating the Level of Service (LOS) of Urban Arterials and further, the traffic volumes at mid-block also establishes the need for safe pedestrian crossing facility taking into account the pedestrian crossing volumes.

Among the 7 turning volume count surveyed locations, Madivala Traffic Police Junctions found to be having the highest peak hour volume (9360 PCUs during morning peak and 9873 PCUs during evening peak) followed by Audugodi Junction with 6785 PCUs during morning peak and 8729 PCUs during evening peak.

Peak Hour Traffic Volumes are as shown below in **Table 77.**

Table 77. Traffic Volume Counts at all the junctions along the corridor

Sl. No.	Junction Name	Morning Peak Hour Volume		Morning Peak Hour	Evening Peak Hour Volume		Evening Peak Hour
		Vehicles	PCUs		Vehicles	PCUs	
1	Vellara Junction	8015	5270.7	10.15-11.15	8049	5223.8	19.15-20.15
2	Adugodi Junction	13081	8685.1	10.30-11.30	13091	8729.2	19.00-20.00
3	Forum Mall Junction (Ganapathi Temple Road Junction)	11272	7568.5	10.45-11.45	11393	7660.5	19.30-20.30
4	Madivala Check Post Junction	12500	8502	11.00-12.00	12617	8563.1	19.15-20.15
5	St.John's Hospital Junction	9276	6612.6	9.00-10.00	9289	6435.9	17.45-18.45
6	Madivala Traffic Police Junction	13577	9360.3	9.45-10.45	15089	9873.4	17.30-18.30
7	Begur Road Junction	11308	8186.3	9.45-10.45	11322	8109	17.30-18.30

Speed and Delay

Speed & delay survey provides a link wise estimate of journey time, running time and delay. Speed and Delay Survey was carried out for Bus and Car separately during morning and evening peak hours. In case of Car Speed and Delay Survey, floating car technique has been utilized for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the cumulative time at specified timing points to ensure obtaining the average link travel time of the road network.
The overall travel speed generally referred to as journey speed is the effective speed between two points and is computed as the distance divided by the total time taken by the vehicle to complete the journey including delays incurred en-route.

The direction-wise abstract on analysis along Hosur Road Corridor furnishing the name of road, length surveyed, journey speed and running speed is furnished below from **table 98-100.**

Table 78. Bus Speed and Delay- Towards Begur (Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	One Way	Mayo Hall Junction (M.G.Road)	Vellara Junction	1.3	154	452	298	10	16	Signal delay and narrow carriageway width
2	Two Way	Vellara Junction	CMP Junction	0.91	115	304	189	11	17	Metro Work under construction
3	Two Way	CMP Junction	Bannerghatta Road Junction	0.6	47	130	83	17	26	Traffic Flow Delay
4	Two Way	Bannerghatta Road Junction	Ganapathi Temple Road Junction	2.18	279	705	426	11	18	Narrow road, traffic signal delay & Traffic flow delay
5	Two Way	Ganapathi Temple Road Junction	St. Johns Hospital Junction	0.61	0	129	129	17	17	Signal Delay ad Traffic Flow Delay
6	One Way	St. Johns Hospital Junction	Krupanidhi College Junction	1.61	303	710	407	8	14	Construction works, Siganl Delays and Traffic flow delays
7	One Way	Krupanidhi College Junction	Madiwala Traffic Police Station Junction	0.99	17	147	130	24	27	Traffic lfow delay
8	Two Way	Madiwala Traffic Police Station Junction	Silk Board Junction	0.52	8	95	87	20	22	On street parking, bad roads and traffic flow delays, Merging and diverging delays
9	Two Way	Silk Board Junction	Begur Main Road Junction	1.31	190	391	201	12	23	Merging and Diverging delays, bus stoppage and traffic flow delays
AVERAGE								**14**	**20**	

Table 79 Bus Speed and Delay- Towards MG Road (Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Begur Main Road Junction	Silk Board Junction	1.31	114	505	391	9	12	Metro under construction
2	Two Way	Silk Board Junction	Madiwala Traffic Police Station Junction	0.52	55	152	97	12	19	Merging and Diverging Delays, bus stoppage at down ramp
3	One Way	Madiwala Traffic Police Station Junction	St. John's Hospital Junction	1.1	83	273	190	15	21	Hevay traffic, Traffic flow delay
4	Two Way	St. John's Hospital Junction	Ganapathi Temple Road Junction	0.61	192	370	178	6	12	White topping works, On street parking by autos near forum mall, signal delay
5	Two Way	Ganapathi Temple Road Junction	Bannerghatta Road Junction	2.18	142	457	315	17	25	White topping works , traffic flow delays and signal delay
6	Two Way	Bannerghatta Road Junction	CMP Junction	0.6	179	313	134	7	16	Narrow road width, signal delay and traffic flow delay
7	Two Way	CMP Junction	Vellara Junction	0.91	232	410	178	8	18	Metro under construction
8	Two Way	Vellara Junction	Brigade Road Junction	0.26	0	45	45	21	21	
9	One Way	Brigade Road Junction	Residency Road Junction	0.3	56	120	64	9	17	Signal delay and traffic flow delay
AVERAGE								**12**	**18**	

Table 80. Bus Speed and Delay- Towards Begur(Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	One Way	Mayo Hall Junction (M.G.Road)	Vellara Junction	1.3	115	392	277	12	17	Signal delay and narrow carriageway width
2	Two Way	Vellara Junction	CMP Junction	0.91	48	158	110	21	30	Metro Work under construction
3	Two Way	CMP Junction	Bannerghatta Road Junction	0.6	11	96	85	23	25	Traffic Flow Delay
4	Two Way	Bannerghatta Road Junction	Ganapathi Temple Road Junction	2.18	318	606	288	13	27	Narrow road, traffic signal delay & Traffic flow delay
5	Two Way	Ganapathi Temple Road Junction	St. John's Hospital Junction	0.61	0	175	175	13	13	Signal Delay ad Traffic Flow Delay
6	One Way	St. John's Hospital Junction	Krupanidhi College Junction	1.61	191	597	406	10	14	Construction works, Siganl Delays and Traffic flow delays
7	One Way	Krupanidhi College Junction	Madiwala Traffic Police Station Junction	0.99	33	225	192	16	19	Traffic lfow delay
8	Two Way	Madiwala Traffic Police Station Junction	Silk Board Junction	0.52	0	138	138	14	14	
9	Two Way	Silk Board Junction	Begur Main Road Junction	1.31	237	598	361	8	13	Merging and Diverging delays, bus stoppage and traffic flow delays
AVERAGE								14	19	

Table 81. Bus Speed and Delay- Towards MG Road(Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Begur Main Road Junction	Silk Board Junction	1.31	21	312	291	15	16	Metro under construction
2	Two Way	Silk Board Junction	Madiwala Traffic Police Station Junction	0.52	26	149	123	13	15	Merging and Diverging Delays, bus stoppage at down ramp
3	One Way	Madiwala Traffic Police Station Junction	St. Johns Hospital Junction	1.1	52	218	166	18	24	Hevay traffic, Traffic flow delay
4	Two Way	St. Johns Hospital Junction	Ganapathi Temple Road Junction	0.61	102	218	116	10	19	White topping works, On street parking by autos near forum mall, signal delay
5	Two Way	Ganapathi Temple Road Junction	Bannerghatta Road Junction	2.18	43	327	284	24	28	White topping works , traffic flow delays and signal delay
6	Two Way	Bannerghatta Road Junction	CMP Junction	0.6	118	281	163	8	13	Narrow road width, signal delay and traffic flow delay
7	Two Way	CMP Junction	Vellara Junction	0.91	648	921	273	4	12	Metro under construction, Signal Delay
8	Two Way	Vellara Junction	Brigade Road Junction	0.26	36	85	49	11	19	Traffic flow delay
9	One Way	Brigade Road Junction	Residency Road Junction	0.3	92	104	12	10	90	Signal delay and traffic flow delay
							AVERAGE	13	25	

It was observed that the lower journey speeds are mainly due to traffic congestion and the delays are mostly occurring at junctions. The Average Bus Journey Speed is approximately 13 Kmph during morning peak hour and 14 kmph during evening peak hour as shown in **Figure 265.**

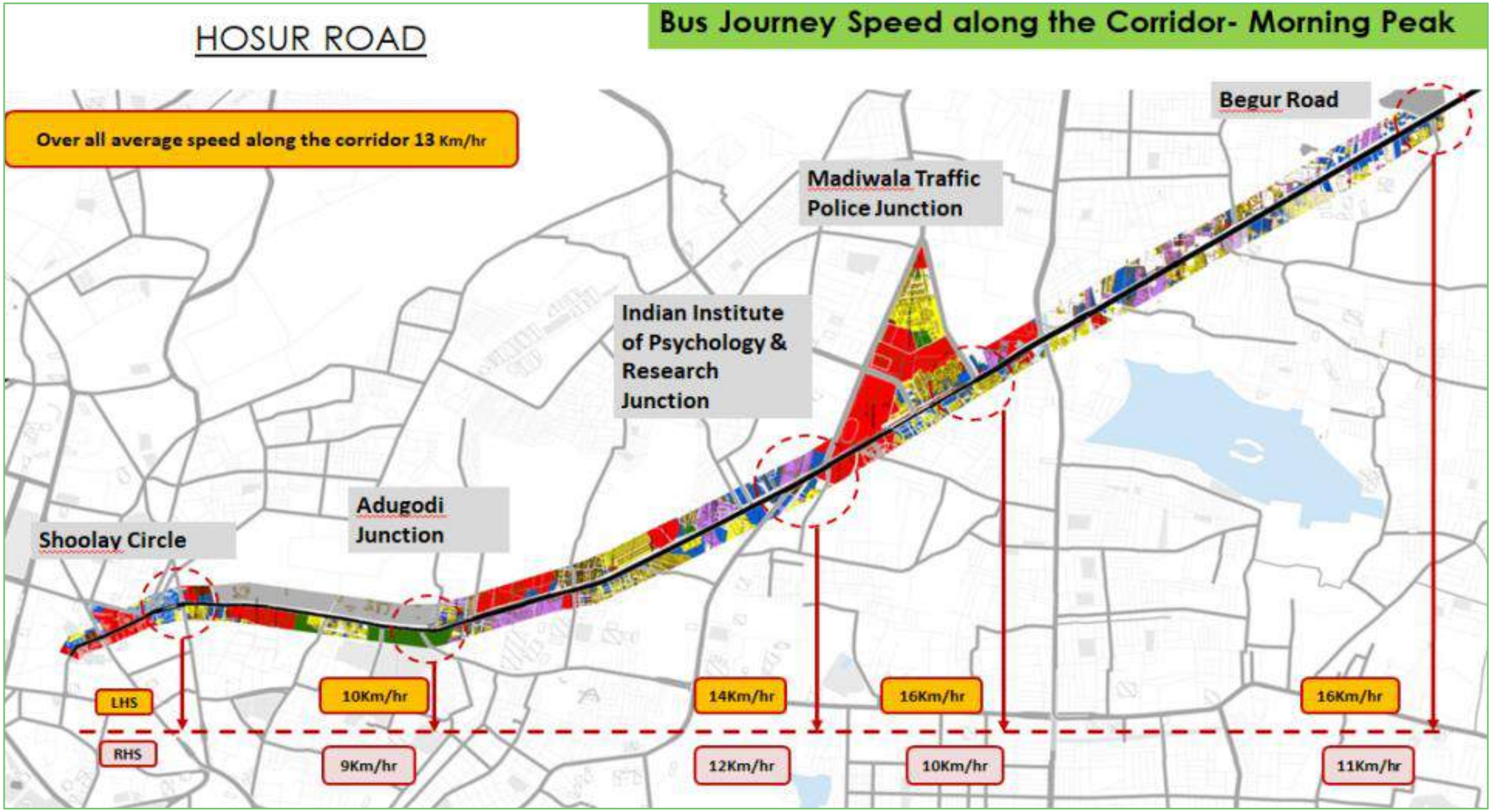


Figure 265:Average Bus Speed and Delay (Morning Peak)

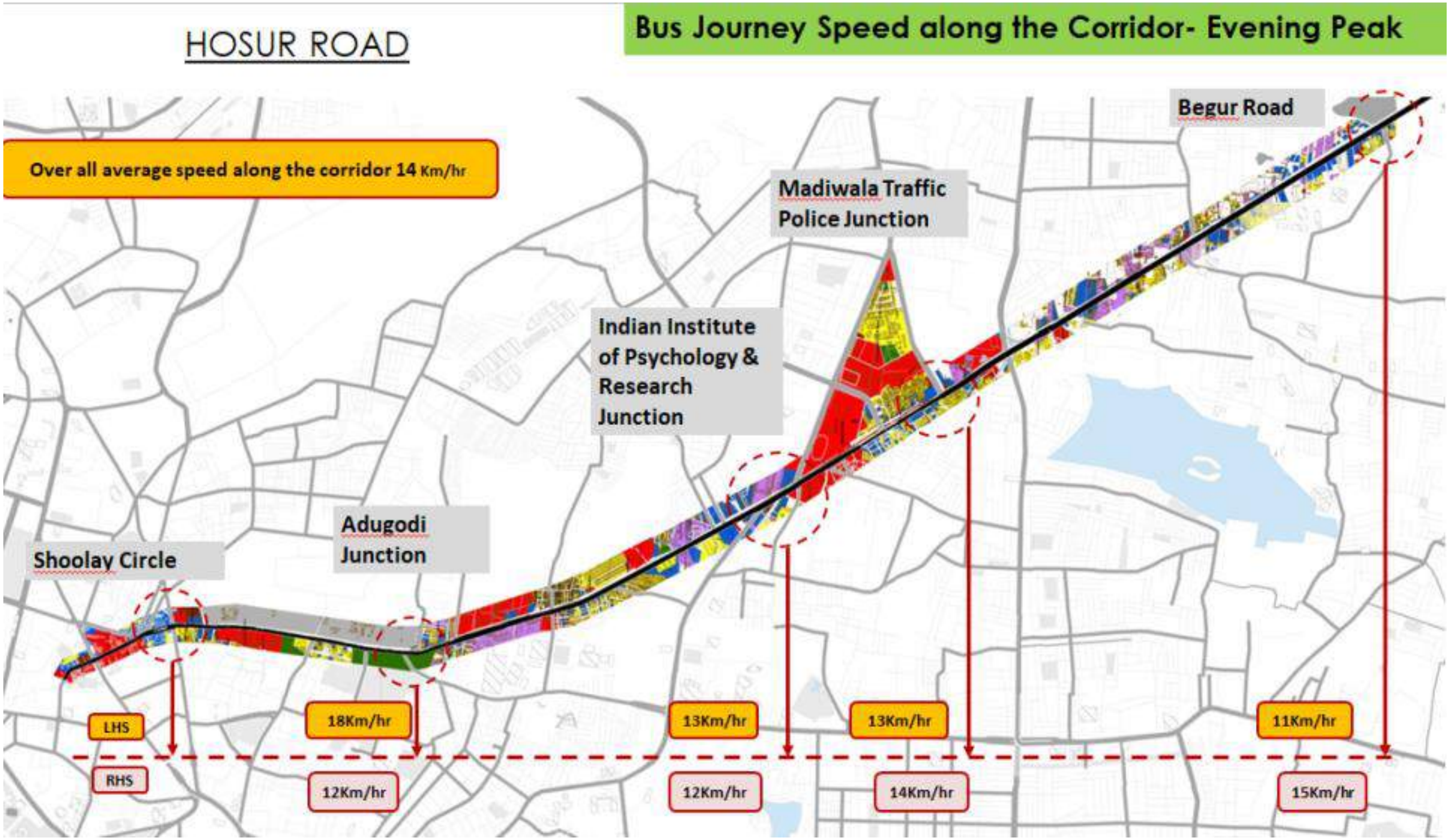


Figure 266:Average Bus Speed and Delay (Evening Peak)

Car speed and delay

Table 82. Car Speed and Delay- Towards Begur(Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	One Way	Brigade road	Shooley Circle	0.5	16	90	74	20	24	Traffic flow delay
2	Two Way	Shoolay Circle	Vellara Junction	0.3	13	35	22	31	49	Traffic flow delay
3	Two Way	Vellara Junction	CMP junction	1	65	142	77	25	47	Metro works under construction
4	Two Way	CMP junction	Anepalya Junction	0.75	31	98	67	28	40	Narrow roads
5	Two Way	Anepalya Junction	Adugodi Junction	1	156	245	89	15	40	Bottleneck , white topping works
6	Two Way	Adugodi Junction	Forum Mall junction	1.25	50	176	126	26	36	White topping works , signal dealys and traffic flow delay
7	Two Way	Forum Mall junction	St Johns hospital junction	0.75	65	135	70	20	39	Signal delays and traffic flow delays
8	Two Way	St Johns hospital junction	Silk Board	1.5	67	245	178	22	30	Signal delays and traffic flow delays
9	Two Way	Silk Board	Begur Junction	1.55	43	185	142	30	39	Signal delays and traffic flow delays
AVERAGE								24	38	

Car speed and delay

Table 83. Car Speed and Delay- Towards MG Road(Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Begur Junction	Silk Board	1.55	33	179	146	31	18	Merging and diverging at flyover
2	Two Way	Silk Board	St Johns hospital junction	1.5	76	204	128	26	28	Merging and diverging at flyover and bus stop at the down ramp
3	Two Way	St Johns hospital junction	Forum Mall junction	0.75	39	147	108	18	42	Signal delay and traffic flow delay
4	Two Way	Forum Mall junction	Adugodi Junction	1.25	50	161	111	28	24	White topping works, signal delays
5	Two Way	Adugodi Junction	Anepalya Junction	1	57	195	138	18	39	White topping works , narrow road
6	Two Way	Anepalya Junction	CMP junction	0.75	21	110	89	25	63	Signal delay and traffic flow delay
7	Two Way	CMP junction	Vellara Junction	1	75	156	81	23	56	Metro work construction
8	Two Way	Vellara Junction	Museum road junction	0.7	27	91	64	28	42	
AVERAGE								**25**	**36**	

Car speed and delay

Table 84. Car Speed and Delay- Towards Begur (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	One Way	Brigade road	Shooley Circle	0.5	23	91	68	20	26	Traffic flow delay
2	Two Way	Shooley Circle	Vellara Junction	0.3	20	58	38	19	28	Traffic flow delay
3	Two Way	Vellara Junction	CMP junction	1	79	153	74	24	49	Metro works under construction
4	Two Way	CMP junction	Anepalya Junction	0.75	43	114	71	24	38	Narrow roads
5	Two Way	Anepalya Junction	Adugodi Junction	1	178	259	81	14	44	Bottleneck , white topping works
6	Two Way	Adugodi Junction	Forum Mall junction	1.25	62	196	134	23	34	White topping works , signal dealys and traffic flow delay
7	Two Way	Forum Mall junction	St Johns hospital junction	0.75	74	156	82	17	33	Signal delays and traffic flow delays
8	Two Way	St Johns hospital junction	Silk Board	1.5	82	285	203	19	27	Signal delays and traffic flow delays
9	Two Way	Silk Board	Begur Junction	1.55	59	203	144	27	39	Signal delays and traffic flow delays
AVERAGE								**21**	**35**	

Car speed and delay

Table 85. Car Speed and Delay- Towards Begur (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Resons for the Delay
1	Two Way	Begur Junction	Silk Board	1.55	52	193	141	29	19	Merging and diverging at flyover
2	Two Way	Silk Board	St Johns hospital junction	1.5	97	229	132	24	27	Merging and diverging at flyover and bus stop at the down ramp
3	Two Way	St Johns hospital junction	Forum Mall junction	0.75	23	123	100	22	45	Signal delay and traffic flow delay
4	Two Way	Forum Mall junction	Adugodi Junction	1.25	78	185	107	24	25	White topping works, signal delays
5	Two Way	Adugodi Junction	Anepalya Junction	1	52	193	141	19	38	White topping works , narrow road
6	Two Way	Anepalya Junction	CMP junction	0.75	36	139	103	19	26	Signal delay and traffic flow delay
7	Two Way	CMP junction	Vellara Junction	1	63	163	100	22	45	Metro work construction
8	Two Way	Vellara Junction	Museum road junction	0.7	37	103	66	24	41	Signal delay and traffic flow delay
AVERAGE								**23**	**30**	

The Average Car Journey Speed is approximately 24Kmph during morning peak hour and 22 Kmph during evening peak hour.

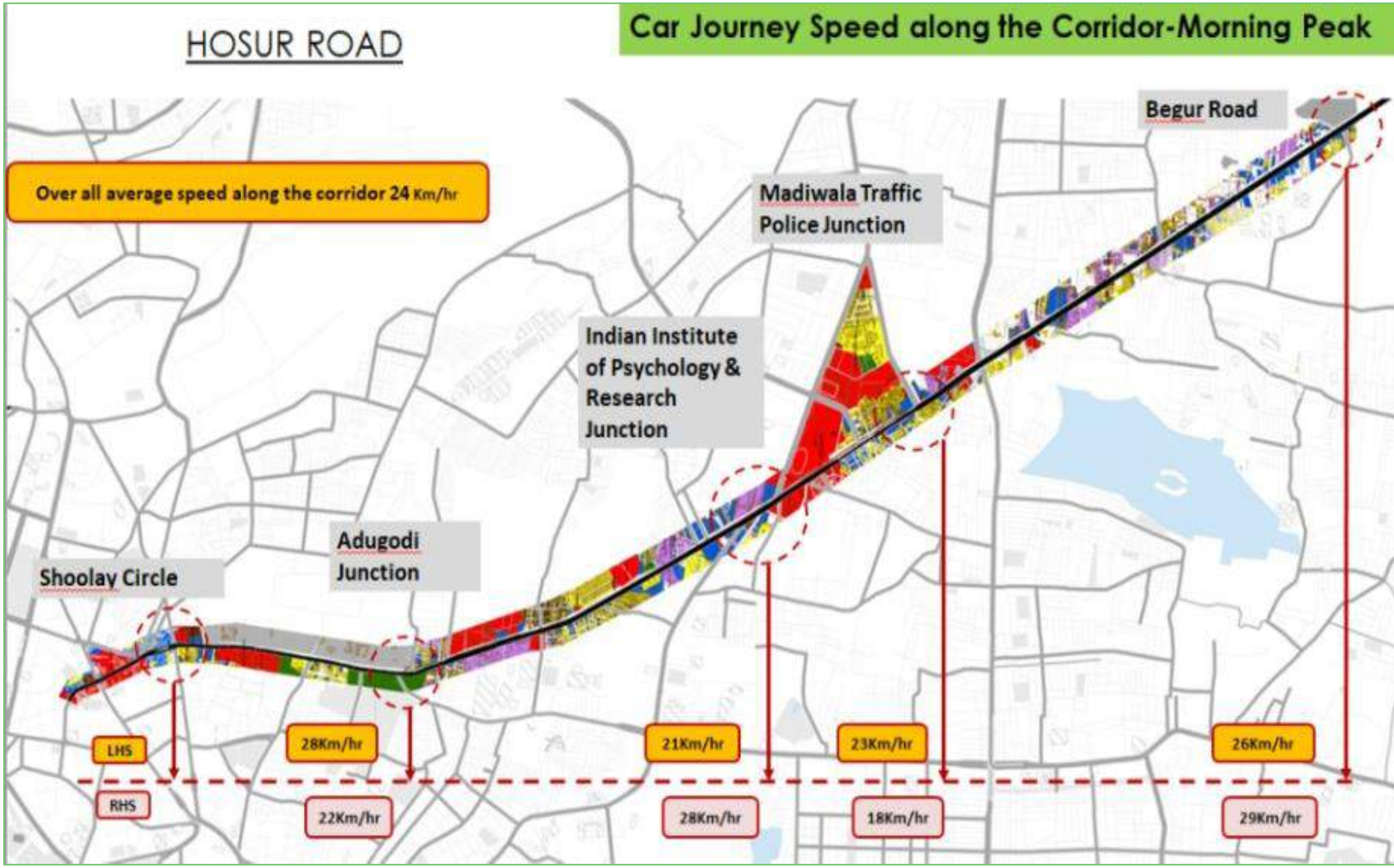


Figure 267 :Average Car Speed and Delay (Morning Peak)

The Average Car Journey Speed is approximately 22Kmph during morning peak hour and 22 Kmph during evening peak hour.

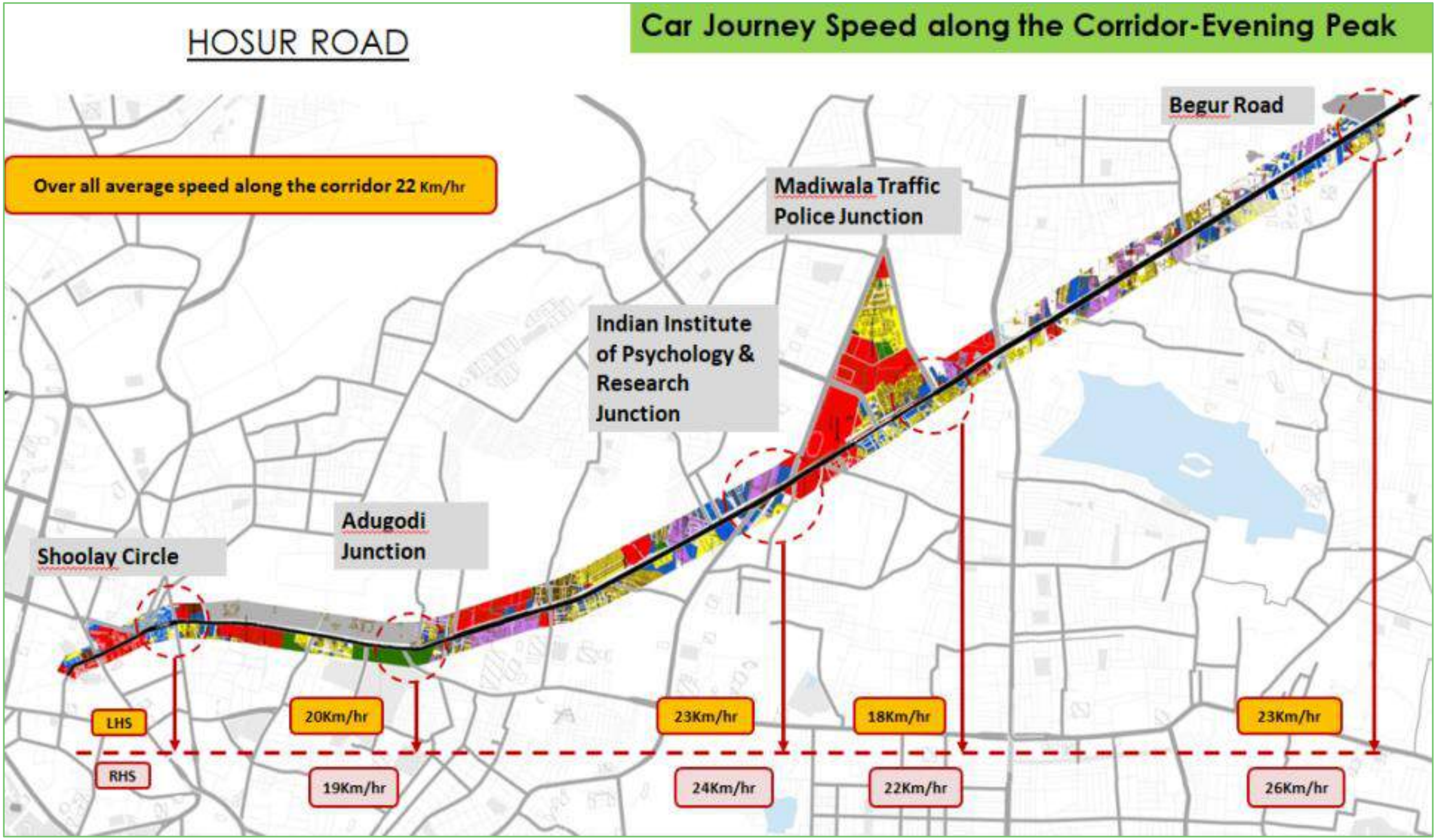


Figure 268:Average Car Speed and Delay (Evening Peak)

Road Inventory Details

The road network inventory has been carried out to identify the characteristics of the road network along Hosur Road Corridor. The characteristics of the road network include the width of the roadway, divided or undivided, existence of on street parking, any traffic management system like one way etc. Features of various road stretches are presented in **Table 86.**

Table 86 Road Network Inventory Details

Link No	Name of Road	Location	Carriageway Width			Road type
			LHS Width	Median	RHS Width	
1	Hosur Road	Shoolay Circle towards Residency Road	11	0.5	11	Bituminous
2		Shoolay Circle Towards John Son Market	10	0.5	10.5	Bituminous
3		Shoolay Circle Towards Richmond circle	15	One way	-	Bituminous
4		Shoolay Circle Towards D'Souza circle	15	One way	-	Bituminous
5		Near Baldwin Methodist College	7	0.5	11.5	Bituminous
6		Near CMP Junction	5	0.5	5	Bituminous
7		Near Anepalya	10.3	0.5	8.6	8.6
8		Near St John's Hospital Skywalk	36	One way		Concrete
9		Near Market Square	21	One way		Bituminous
10		Near Madiwala Police Station	14	1	14	Bituminous
12		NH after Silk Board Junction including service road	20	2.5	20	Bituminous

Figure 269. Road Inventory

Figure 270. Road Inventory

Figure 271. Road Inventory

Figure 272. Road Inventory

1. Congestion due to Narrow Road Width near Shooley Junction

The site which is under construction for Metro Station on the narrow road stretch from Shooley Junction to Johnson Market is causing a lot of inconvenience to the people besides causing frequent traffic jams. ***Figure 273.***

The road stretch along the corridor is below par. Though the traffic has increased manifolds over the years, the road remains to be the same. The road users on this stretch and the residents living along this stretch of roadway are greatly inconvenienced due to the congestion, especially during the peak hours.

Figure 273. Issues near Shooley junction

Recommendations:

✓Since the site is under construction, it is considered as temporary condition, but to handle the current situation the signal timings of the Johnson market intersection need to be optimized and extra phase for the through traffic need to be provided.

✓Usually it is seen that at the road side construction site, the debris is dumped on the footpath and pedestrians are forced to walk on the carriageway thus resulting in conflicts with vehicles. Therefore, all the debris from the footpaths need to be removed for safe Pedestrian access.

Benefits:

Congestion due to construction activity can be reduced by signal optimization. Pedestrian- Vehicular conflicts can be reduced by improving footpath and removing the construction debris from the footpath.

Congestion due to Narrow Road width from Johnson Market junction to Hotel Mint Propus.

The narrow road stretch from Johnson Market to Baldwin Methodist College School is causing a lot of inconvenience to the people besides causing frequent traffic jams especially during the time when the college is let off in the evening. The road stretch along the corridor is below par. Though the traffic has increased manifolds over the years, the road remains to be the same.

The road users on this stretch and the residents living along this stretch of roadway are adversely affected by the congestion,

especially during the peak hours.

From the surveys, it is observed that maximum traffic congestion is from Johnson Market till the Hotel Mint Propus. The carriage way width here reduces from 21 meters to 10.5 meters thus choking the entire road, which is one of the main reasons for congestion. **Figure 274.**

Figure 274. Issues near Johnson market junction

Recommendations:

✓The solution is to widen up this stretch of road to ease out the traffic congestion. This is a very critical spot on the entire corridor where the road width is 21 meter on one side and 10.5 meters on the other side. The entire land on the LHS belongs to defence/ army, which needs to be acquired. Minimum land required is 11meters in width as the RHS has crematoriums, Colleges, residential land use and worship places.
✓Total land required from the defence area is 950 meters in length and 11 meters in width, which is approximately 10,000 sq meters of land as shown in the ***Figure 275***
✓Footpath need to be developed along the corridor especially near the Baldwin Methodist College and the Johnson Market area where the pedestrian activity is maximum.
✓Once the road widening is done, Signal Optimization need to be done for all the signals along the corridor.

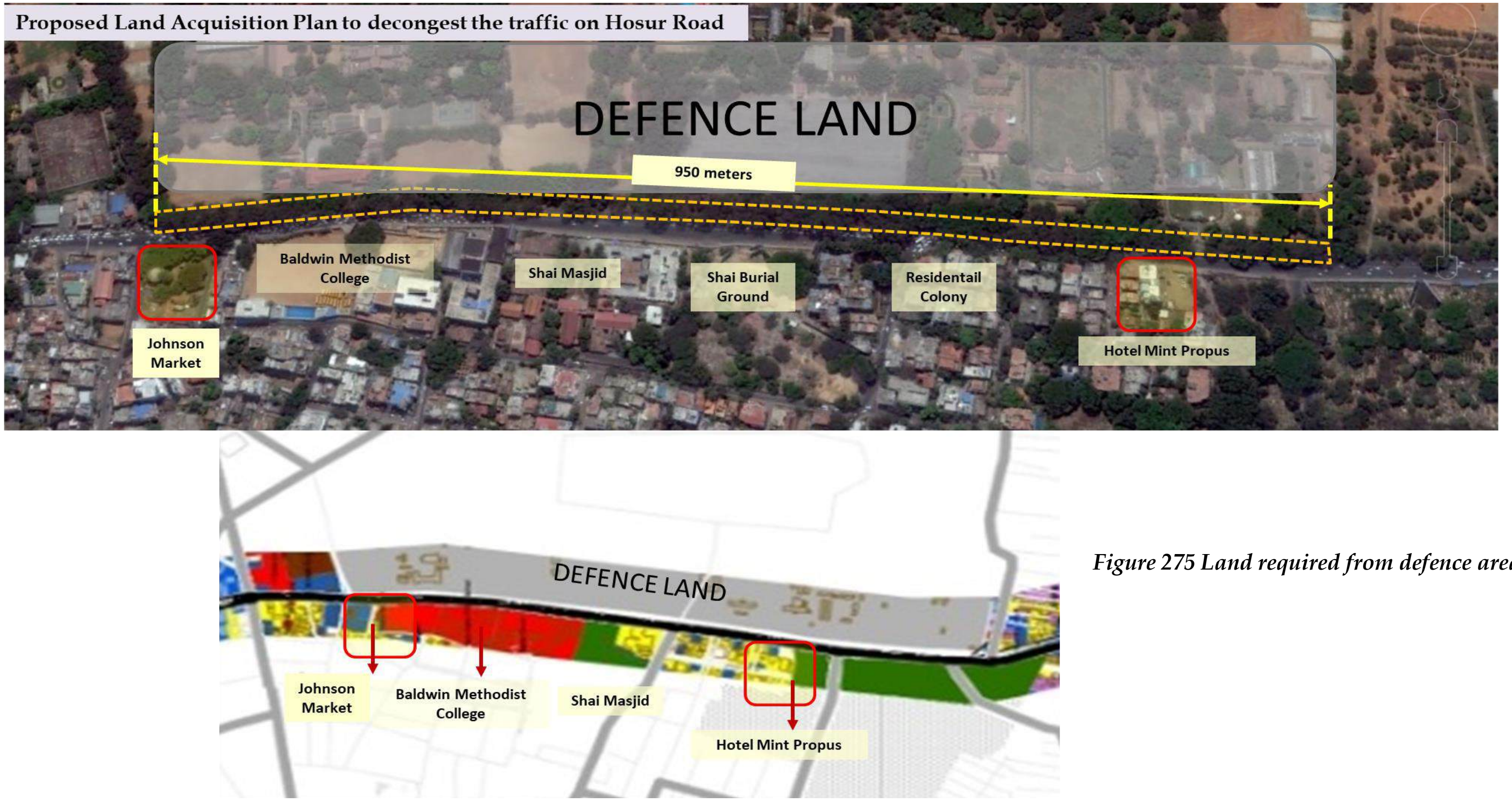


Figure 275 Land required from defence area

Benefits:

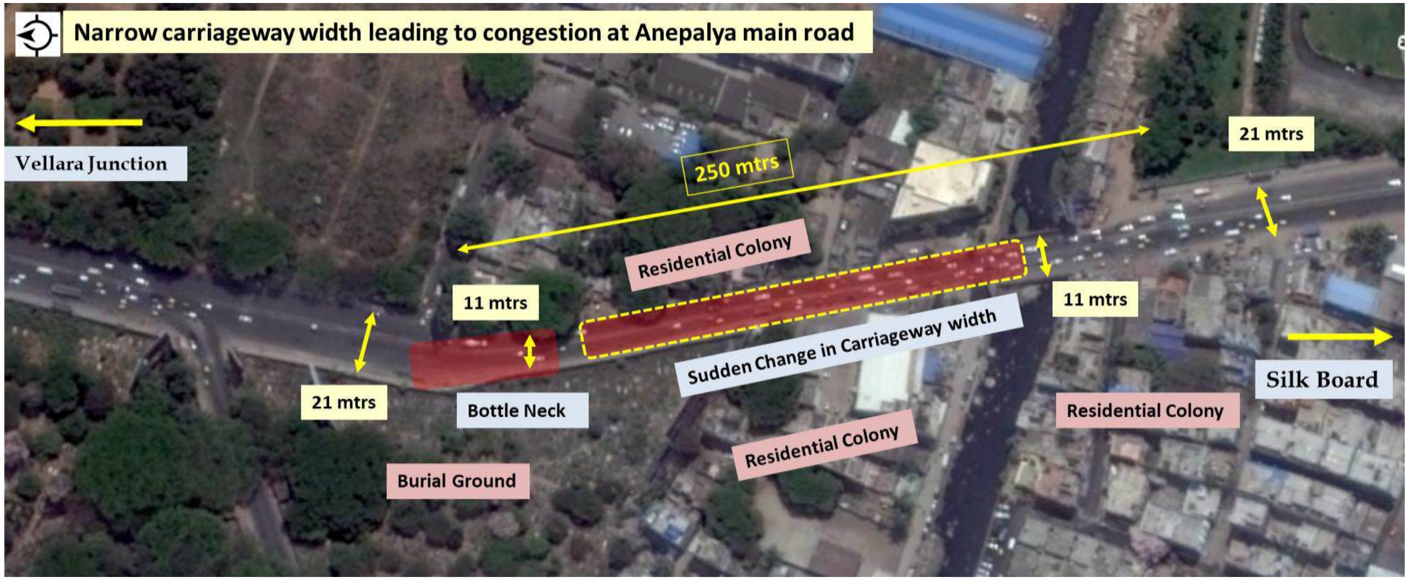
`

➢Congestion due narrow road /bottleneck can be reduced, as symmetry`along the road widths will be achieved all along the corridor .i.e. 21meters.
➢Signal optimization will help in setting right signal phase timings based on the traffic flow.

Congestion due to sudden reduction in road width at Anepalya Road

Sudden change in road widths is resulting in traffic congestion near Anepalya Main road diversion. The road width reduces from 21 meters to 11 meters for a length of 250 meters till the bridge on the drain. Once the bridge is crossed, the road width widens to 21 meters. The narrow road stretch from Anepalya main road to Bridge/ Drain is causing a lot of inconvenience to the people besides causing frequent traffic jams especially during the peak hours.

The road stretch along the corridor is below par. Though the traffic has increased manifolds over the years, the road width remains to be the same. The presence of burial ground on the RHS and residential colony at LHS has limited the scope for road widening. ***Figure 276.***



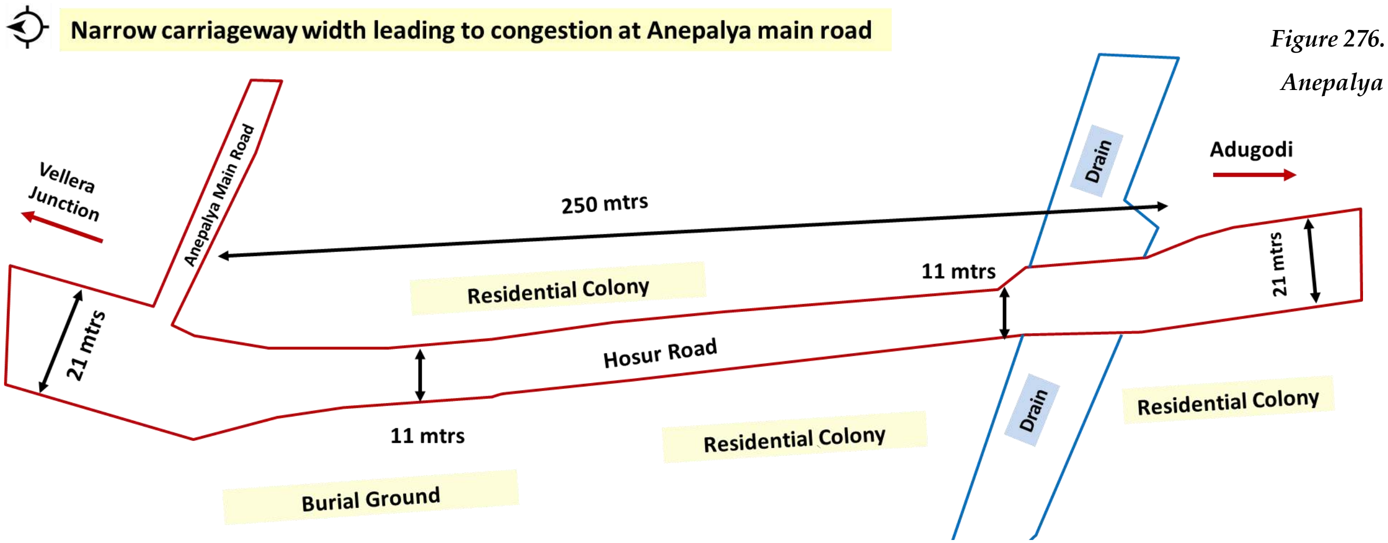


Figure 276. Issues near Anepalya main road

Figure 277 Issues near Anepalya main road

Recommendations:

✓The solution is to widen up this stretch of road to ease out the traffic congestion. This is one of the critical spots on the corridor ,where the road width is 21 meter on one side and 10.5 meters on the other side.

✓The entire land use on the LHS is residential, and a small portion of it needs to be acquired . Minimum land required on LHS varies from 5.5 meter to 11meters in width. The place where residential land use is on either side, the land should be acquired for 10.5 meters from the centre line on both the sides and the place were burial ground is there the land should be acquired on the LHS for 10.5 meters.

✓Approximate land required for acquisition is 2,500 Square meters.

✓Footpath need to be developed along this stretch and the debris and garbage need to be removed from the footpaths.

Benefits:

➢Congestion due narrow road /bottleneck can be reduced, as symmetry along the road widths will be achieved all along the corridor .i.e. 21meters.

4. Road Safety Issue at the Pedestrian Skywalk Bus Bay between Silk Board and the Begur Junction

As per the site condition, there exists a bus bay and a pedestrian skywalk at the mid-block of Silk Board Junction and the Begur Junction. However, the issue here is the enforcement. The Interstate and the intra state buses - both KSRTC, BMTC and private buses do not stop at the bus bay and instead park the buses parallel to each other on the main carriageway. This is resulting in traffic congestions, queuing and accidents ***figure303***.

Figure 278 Issues Between silk board and the Begur junction

Recommendations:

✓Existing bus bay should be made to use by enforcement through BMTC and Traffic Police for better functioning.

Benefits:

✓Congestion and queuing occurring due to haphazard bus stopping can be eliminated and maximum road safety can be achieved.

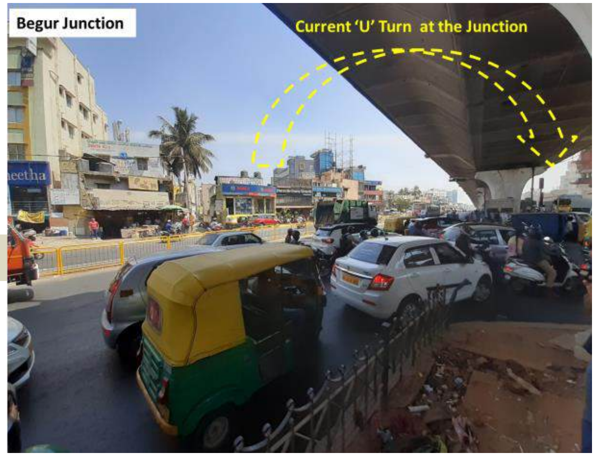
Congestion due to 'U 'Turn at Begur Junction.

It is observed that the current situation at Begur junction is getting out of control and regular traffic jams are occurring due to the buses and other vehicles, which are taking 'U' turn at the junction .i.e. vehicles coming from Silk Board side and taking 'U' turn towards Silk Board, are causing traffic congestions regularly.

Recommendations:

✓To overcome the issue of 'U' turn at the junction which is resulting in traffic congestions and sometimes accidents, a separate lane of 5.5 meters can be created below the flyover about 30 meters before the junction.

✓Once the 'U' turn is created, signal optimization need to be done for getting right signal phasing. *figure 279-280*



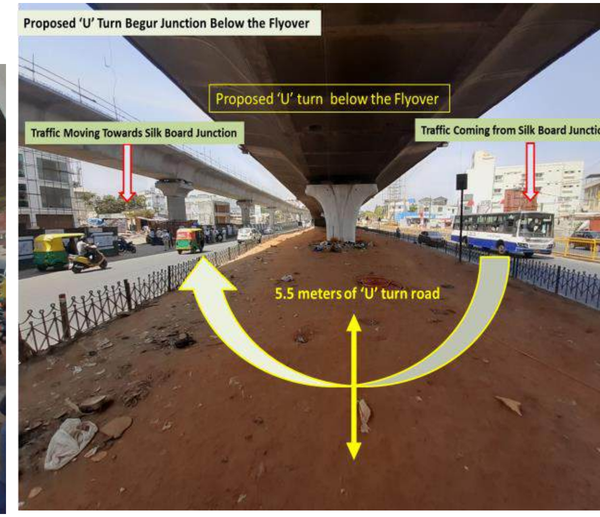


Figure 279. Proposal to over come the issues

Figure 280. Proposal to over come the issues

Benefits:

- Congestion occurring due to 'U-turn at the junction will get eliminated thus reducing unwanted traffic congestions occurring at the junction.

PART D
SUMMARY AND IMPACT OF MEASURESS

The comparison between existing operational scenario and the operational scenario after implementing the interventions discussed in the previous chapter along Hosur Road Corridor is tabulated**.** As discussed in Chapter 6 (Survey Analysis) due to kerb side bus stops the effective road available for movement of other vehicles in the traffic stream reduces resulting in the capacity reduction at few locations along the study corridor. From **Table 87** it can be seen that with the implementation of the interventions there will be considerable reduction in Volume to Capacity Ratio (V/C Ratio), enhanced Level of Service and increased Journey Speed along Hosur Road Corridor.

Table 87 Comparison chart between existing scenario and proposed scenario- Morning Peak

Sl. No.	Typology of Road	Road Name	EXISTING											
			Capacity		Morning Peak Hour Volume (PCUs)		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Bus Journey Speed (Kmph)-Morning Peak		Car Journey Speed (Kmph)-Morning Peak	
			Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road
1	4 lane	Between Vellara Junction and Toll Gate Bus Stop	2700	2700	2095	1562	0.78	0.58	LOS D	LOS C	11	8	15	16
2	4 lane	Between Toll Gate Bus Stop and Adugodi Junction	2700	2700	3195	2837	1.18	1.05	LOS F	LOS F	17	7	17	17
3	6 lane	Between Adugodi Junction and Ganapathi Temple Road Junction	4200	2520	3968	3810	0.94	1.51	LOS E	LOS F	11	17	16	14
4	4 lane	Between Ganapathi Temple Road Junction and Madivala Check Post	2700	2700	3426	3861	1.27	1.43	LOS F	LOS F	17	6	17	18
5	6 lane	Between Madivala Check Post and St John's Hospital Junction	4200	4200	6327	3911	1.51	0.93	LOS F	LOS E	17	15	17	18
6	6 lane	Between St John's Hospital Junction and Madivala Traffic Police Station Junction	2520	2520	4131	6981	1.64	2.77	LOS F	LOS F	8	15	15	17
7	6 lane	Between Madivala Traffic Police Station Junction and Silk Board Junction	2520	2520	4131	5332	1.64	2.12	LOS F	LOS F	15	12	15	17
8	8 Lanes	Between Silk Board and NH Skywalk	4080	4080	6233.38	3828.06	1.53	0.94	LOS F	LOS E	12	9	18	16
9	8 Lanes	Between NH Skywalk and Begur Road Junction	4080	4080	3105.94	4665.82	0.76	1.14	LOS D	LOS F	12	9	18	16

Table 88. Comparison chart between existing scenario and proposed scenario

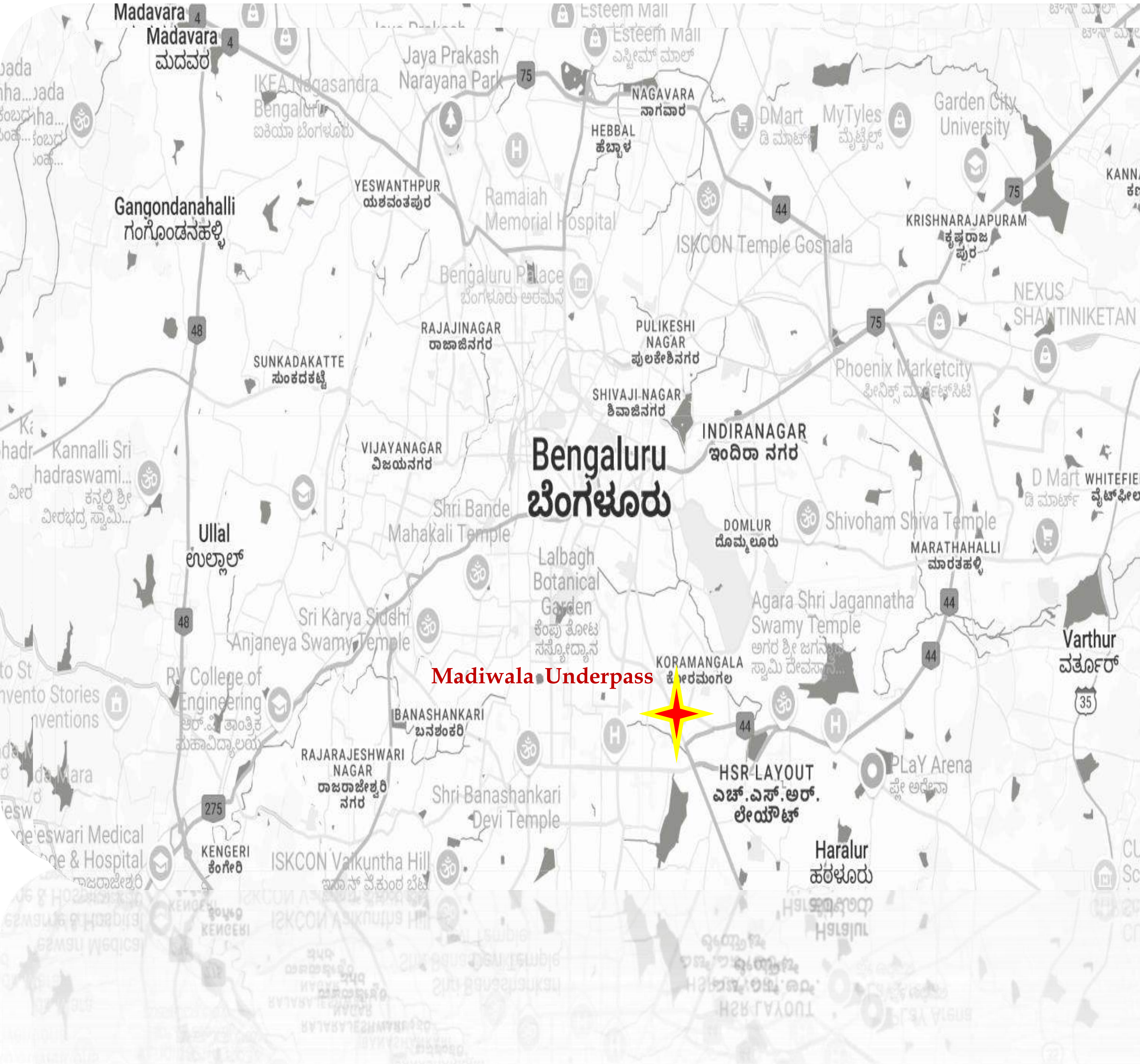
Sl. No.	Typology of Road	Road Name	WITH IMPROVEMENTS							
			Capacity		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Anticipated Speed (Kmph) as per HCM-Morning Peak	
			Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road
1	4 lane	Between Vellara Junction and Toll Gate Bus Stop	2700	2700	0.78	0.58	LOS D	LOS C	25	30
2	4 lane	Between Toll Gate Bus Stop and Adugodi Junction	2700	2700	1.18	1.05	LOS F	LOS F	15	15
3	6 lane	Between Adugodi Junction and Ganapathi Temple Road Junction	4200	4200	0.94	0.91	LOS E	LOS E	25	25
4	4 lane	Between Ganapathi Temple Road Junction and Madivala Check Post	2700	2700	1.27	1.43	LOS F	LOS F	15	15
5	6 lane	Between Madivala Check Post and St John's Hospital Junction	2700	2700	2.34	1.45	LOS F	LOS F	15	15
6	6 lane	Between St John's Hospital Junction and Madivala Traffic Police Station Junction	4200	4200	0.98	1.66	LOS E	LOS F	25	15
7	6 lane	Between Madivala Traffic Police Station Junction and Silk Board Junction	4200	4200	0.98	1.27	LOS E	LOS F	25	15
8	8 Lanes	Between Silk Board and NH Skywalk	6800	6800	0.92	0.56	LOS E	LOS C	30	30
9	8 Lanes	Between NH Skywalk and Begur Road Junction	6800	6800	0.46	0.69	LOS C	LOS C	30	30

Table 89. Comparison chart between existing scenario and proposed scenario – Evening Peak

Sl. No.	Typology of Road	Road Name	EXISTING											
			Capacity		Evening Peak Hour Volume (PCUs)		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Bus Journey Speed (Kmph)-Evening Peak		Car Journey Speed (Kmph)-Evening Peak	
			Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road
1	4 lane	Between Vellara Junction and Toll Gate Bus Stop	2700	2700	2095	1514	0.78	0.56	LOS D	LOS C	13	4	13	17
2	4 lane	Between Toll Gate Bus Stop and Adugodi Junction	2700	2700	3241	2860	1.20	1.06	LOS F	LOS F	12	8	17	16
3	6 lane	Between Adugodi Junction and Ganapathi Temple Road Junction	4200	2520	4030	3841	0.96	1.52	LOS E	LOS F	13	15	16	18
4	4 lane	Between Ganapathi Temple Road Junction and Madivala Check Post	2700	2700	3528	3853	1.31	1.43	LOS F	LOS F	13	10	15	18
5	6 lane	Between Madivala Check Post and St John's Hospital Junction	4200	4200	6418	3904	1.53	0.93	LOS F	LOS E	13	10	15	17
6	6 lane	Between St John's Hospital Junction and Madivala Traffic Police Station Junction	2520	2520	3909	7141	1.55	2.83	LOS F	LOS F	10	15	13	17
7	6 lane	Between Madivala Traffic Police Station Junction and Silk Board Junction	2520	2520	3909	5161	1.55	2.05	LOS F	LOS F	14	13	16	16
8	8 Lanes	Between Silk Board and NH Skywalk	4080	4080	5888	3770	1.44	0.92	LOS F	LOS E	8	15	18	18
9	8 Lanes	Between NH Skywalk and Begur Road Junction	4080	4080	2913	4742	0.71	1.16	LOS C	LOS F	8	15	18	18

Table 90. Comparison chart between existing scenario and proposed scenario

Sl. No.	Typology of Road	Road Name	WITH IMPROVEMENTS							
			Capacity		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Anticipated Speed (Kmph) as per HCM-Evening Peak	
			Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road	Towards Begur road	Towards M.G Road
1	4 lane	Between Vellara Junction and Toll Gate Bus Stop	2700	2700	0.78	0.56	LOS D	LOS C	25	30
2	4 lane	Between Toll Gate Bus Stop and Adugodi Junction	2700	2700	1.20	1.06	LOS F	LOS F	15	15
3	6 lane	Between Adugodi Junction and Ganapathi Temple Road Junction	4200	4200	0.96	0.91	LOS E	LOS E	25	25
4	4 lane	Between Ganapathi Temple Road Junction and Madivala Check Post	2700	2700	1.31	1.43	LOS F	LOS F	15	15
5	6 lane	Between Madivala Check Post and St John's Hospital Junction	2700	2700	2.38	1.45	LOS F	LOS F	15	15
6	6 lane	Between St John's Hospital Junction and Madivala Traffic Police Station Junction	4200	4200	0.93	1.70	LOS E	LOS F	25	15
7	6 lane	Between Madivala Traffic Police Station Junction and Silk Board Junction	4200	4200	0.93	1.23	LOS E	LOS F	25	15
8	8 Lanes	Between Silk Board and NH Skywalk	6800	6800	0.87	0.55	LOS E	LOS C	25	30
9	8 Lanes	Between NH Skywalk and Begur Road Junction	6800	6800	0.43	0.70	LOS B	LOS C	40	30



CORRIDOR

08

Hosur Road- Extension of Madiwala Underpass

Extension of Existing Madiwala underpass till Traffic police station junction

Madiwala Underpass Extension

he Madiwala underpass, constructed in 2010 to alleviate traffic congestion at Madiwala junction, has successfully served its purpose over the years. However, the current traffic situation has significantly worsened, with the underpass now overburdened due to the increasing volume of vehicles. The primary cause of this issue is the nearby three-arm intersection, located just 200 meters away. Traffic from Silk Board turning right at this intersection exacerbates the congestion on Hosur Road, where traffic jams often extend for nearly 1 km, resulting in a 45-minute commute from Madiwala check post to Silk Board.

To address these challenges, there are plans to construct a North-South Tunnel from Hebbal to Silk Board, with one of its entry and exit points on Hosur Road near Madiwala. Additionally, the elevated corridors from Anepalya to Silk Board and from Silk Board to Old Madras Road are also set to be built in the area. Given these developments, it is crucial to design Hosur Road for maximum accessibility and smooth traffic flow. At the same time, the surface-level traffic must remain undisturbed and congestion-free.

In response to this, a proposal has been made to extend the existing Madiwala underpass up to the Madiwala Police Station Junction, using an open-cut-and-cover system. This approach would allow full right-of-way (ROW) for surface traffic from Madiwala to the police station junction, greatly benefiting traffic flow on the ground level. The proposal, as depicted in the accompanying images, outlines how this extension can help mitigate current traffic bottlenecks.

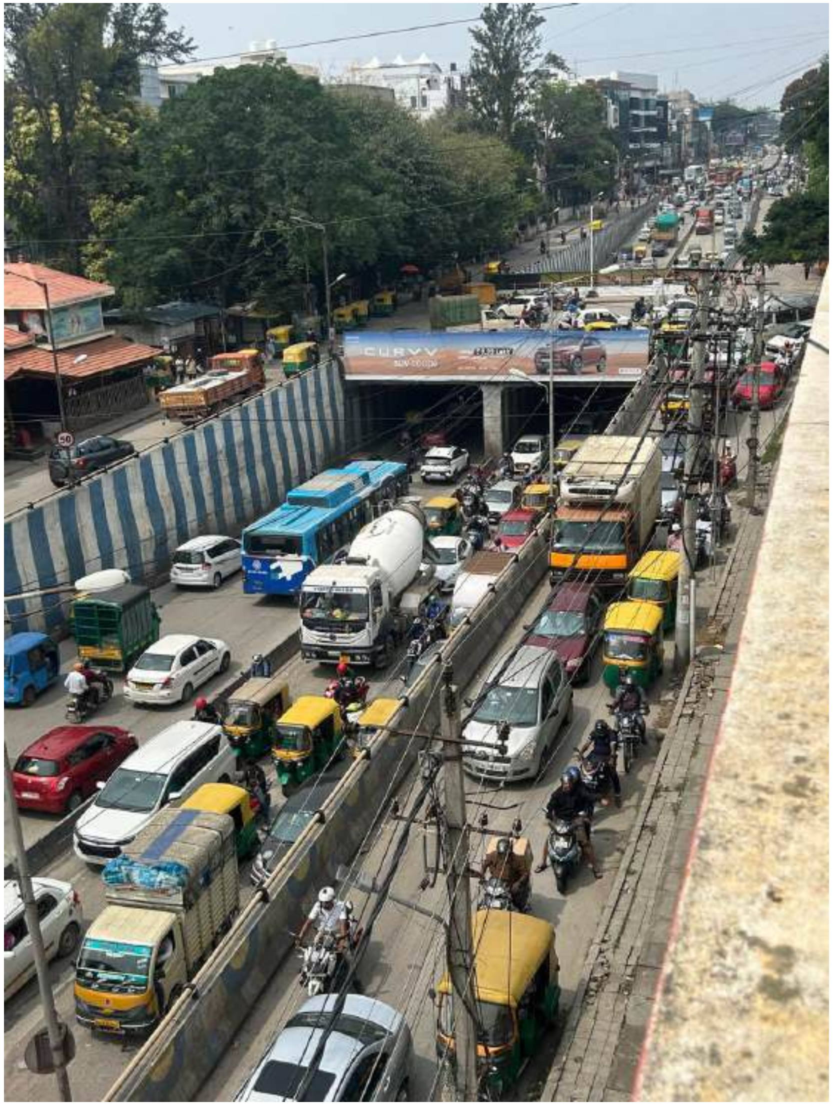


Figure 281 Madiwala underpass

Decongestion Plan from Madiwala Check post to Silk board

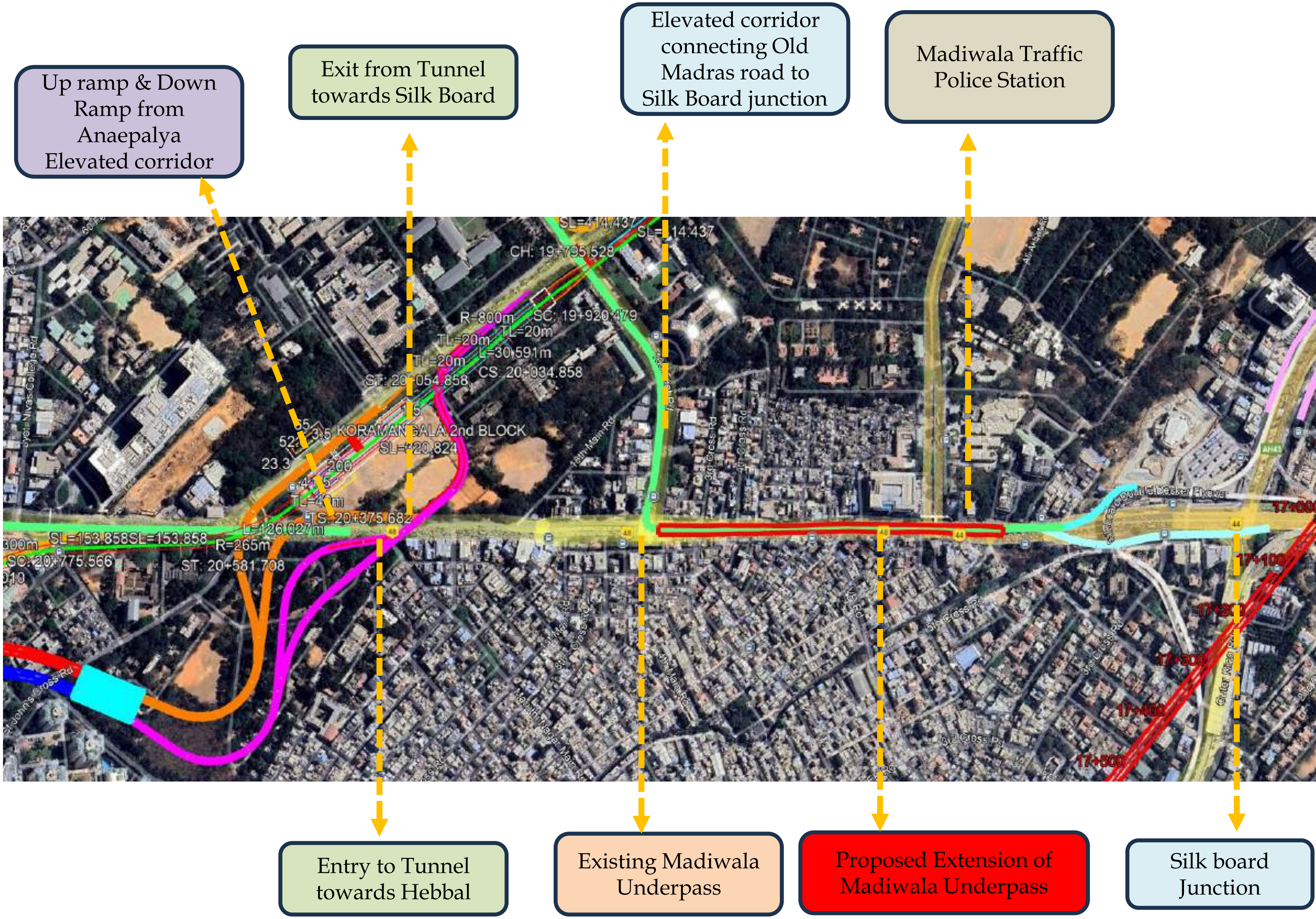


Figure 282. **Decongestion Plan from Madiwala Check post to Silk board**

Traffic Congestion Scenario from Madiwala Check post to Silk Board

t any time of day, traffic congestion is consistently observed at Madiwala, primarily due to the right-turning traffic coming from Silk Board. Previously, this right turn was restricted, allowing traffic to flow straight through, but this resulted in increased congestion at Madiwala check post and Sarjapur Road. To alleviate the density, the right turn was permitted; however, this has led to heavy traffic buildup extending back to Madiwala check post, especially during peak hours.A permanent solution is now needed to ensure seamless traffic flow. It is proposed that the existing underpass be extended beyond the Madiwala Traffic Police Station junction, with an up ramp introduced 100 meters before Silk Board. This modification would accommodate traffic heading towards HSR and BTM Layout at grade, while ensuring uninterrupted access to Hosur Road and Electronic City.

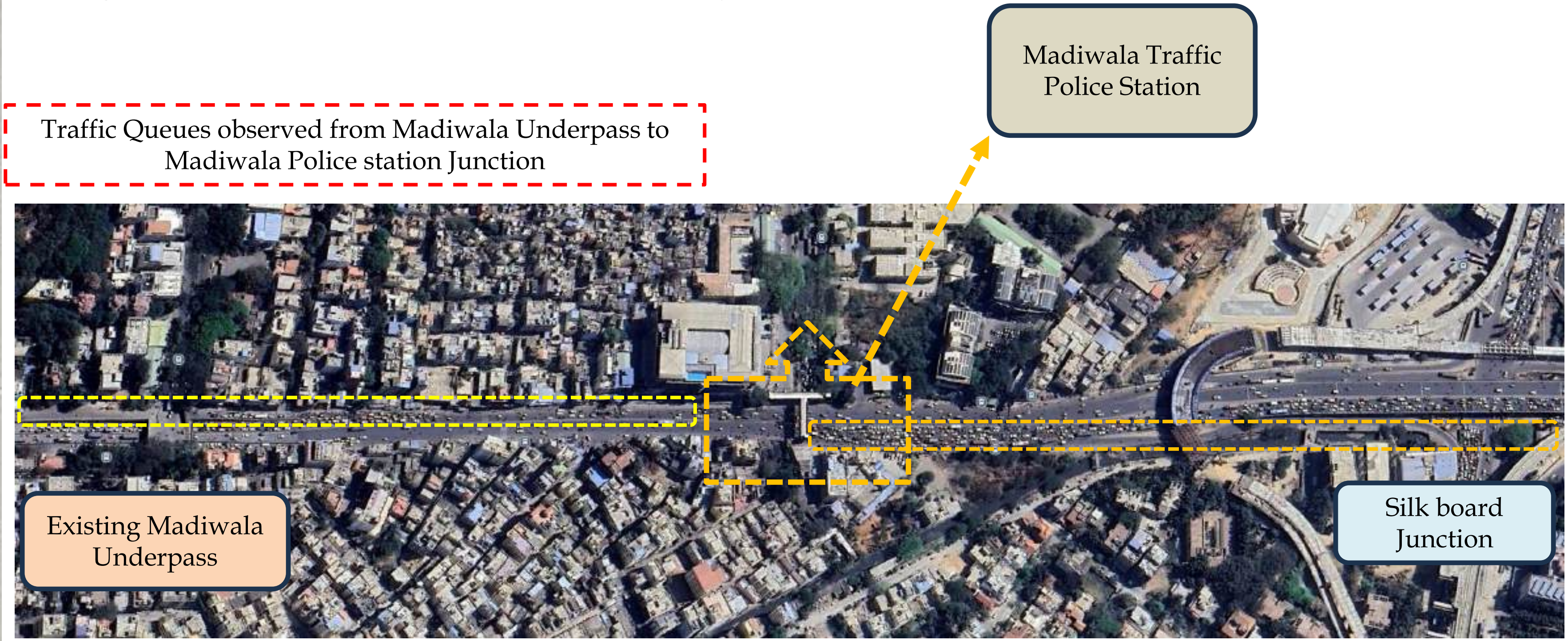


Figure 283.. **Traffic Scenario at Madiwala**

Proposed Extension of Underpass with Cut & Cover Method

At any time of day, traffic congestion is consistently observed at Madiwala, primarily due to the right-turning traffic coming from Silk Board. Previously, this right turn was restricted, allowing traffic to flow straight through, but this resulted in increased congestion at Madiwala check post and Sarjapur Road. To alleviate the density, the right turn was permitted; however, this has led to heavy traffic buildup extending back to Madiwala check post, especially during peak hours.A permanent solution is now needed to ensure seamless traffic flow. It is proposed that the existing underpass be extended beyond the Madiwala Traffic Police Station junction, with an up ramp introduced 100 meters before Silk Board. This modification would accommodate traffic heading towards HSR and BTM Layout at grade, while ensuring uninterrupted access to Hosur Road and Electronic City.

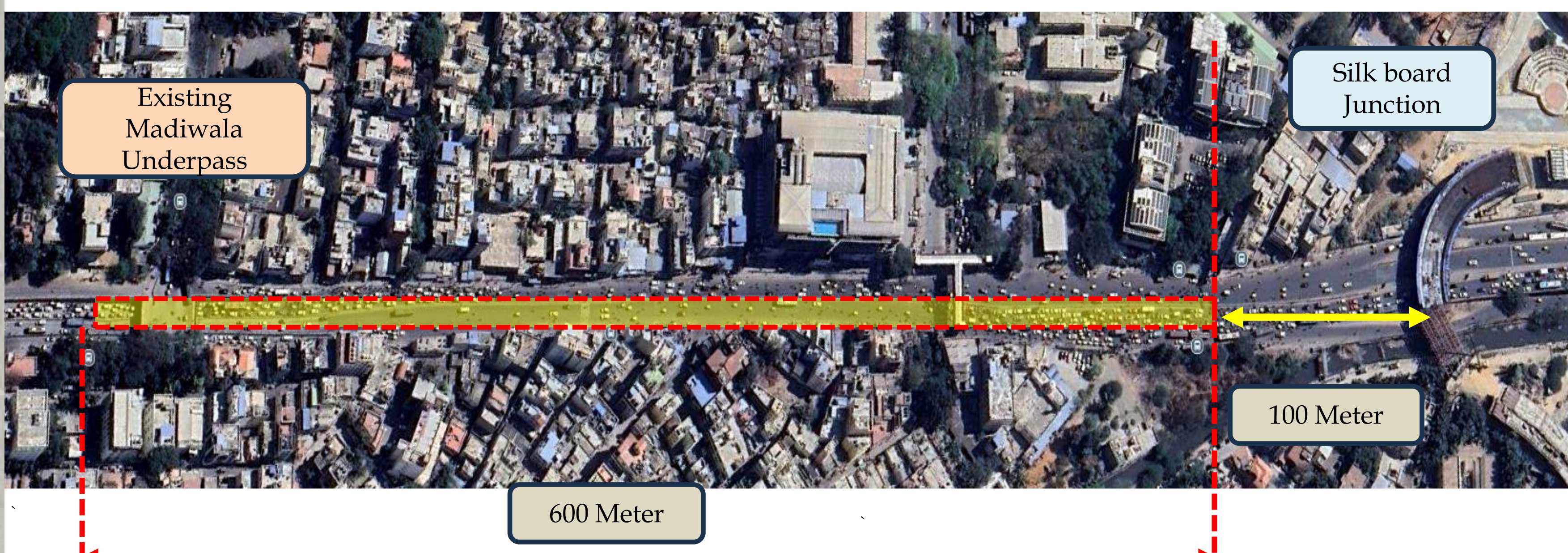


Figure 284. **Proposed Madiwala Extension plan to decongest the traffic**

Proposed Typical Cross section for the 4 lane divided Vehicular Under pass

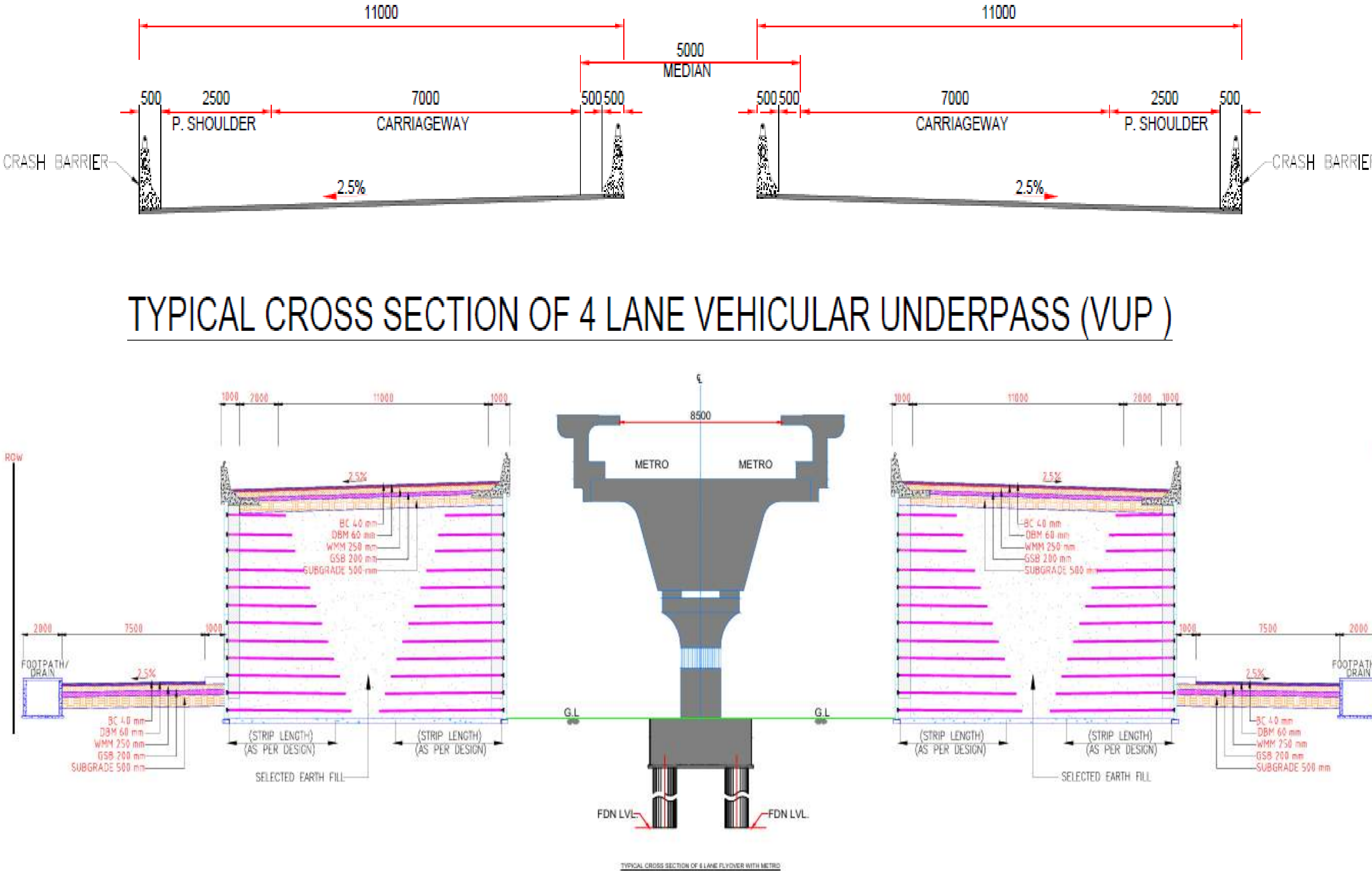
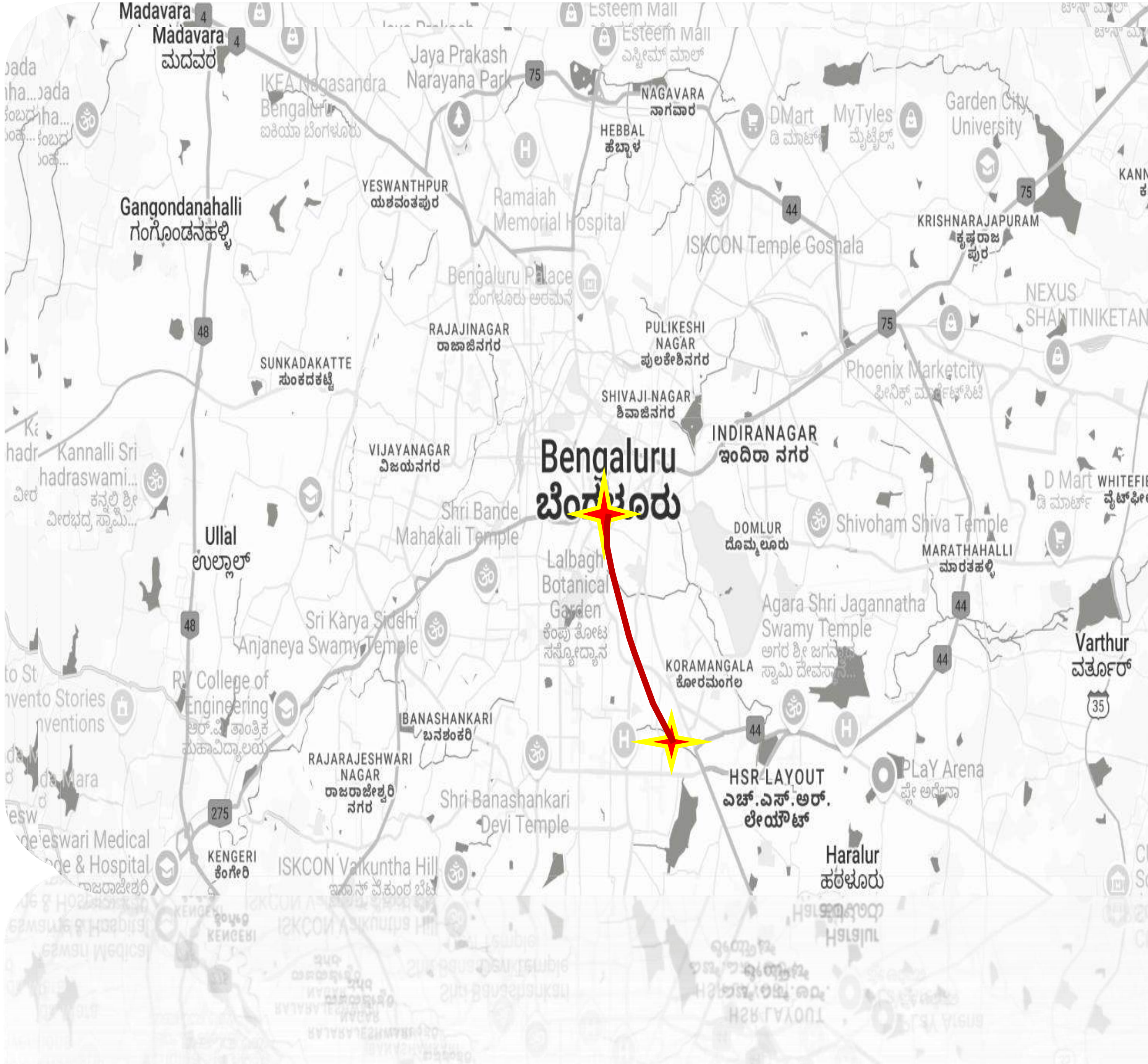


Figure 285. **Proposed cross section for 4 lane Vehicle underpass at Madiwala**



CORRIDOR

08

Hosur Road

Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction - Anepalya Junction- Adugodi Junction- Forum junction- St.John Chruch junction-Madiwala junction-Silk board Junction

Proposed Elevated Corridor from Shoolay Circle to Madiwala Check post

Hosur Road is a major radial road serving interstate traffic, but it is also one of the most congested routes in Bengaluru. Key junctions along this road, including Vellar, Anepalya, Adugodi, Forum Mall, and Madiwala junctions, face severe traffic bottlenecks, particularly during peak hours. The average speed of vehicles is less than 15 km/h due to narrow stretches and ongoing metro construction, which further worsens traffic jams.

To alleviate this congestion, an elevated corridor has been proposed from Shoolay Circle to Madiwala Check Post. This will bypass seven minor and major junctions, significantly improving travel speeds and reducing travel times. With other major infrastructure projects planned near Silk Board, such as tunnel roads, underpasses, and elevated roads connecting to Old Madras Road, this elevated corridor will be a key solution for traffic flowing from central Bengaluru toward Silk Board.

The plan includes an up ramp after Brigade Road with a down ramp at Museum Road. Another up ramp and down ramp are planned near Anepalya and Adugodi junctions."

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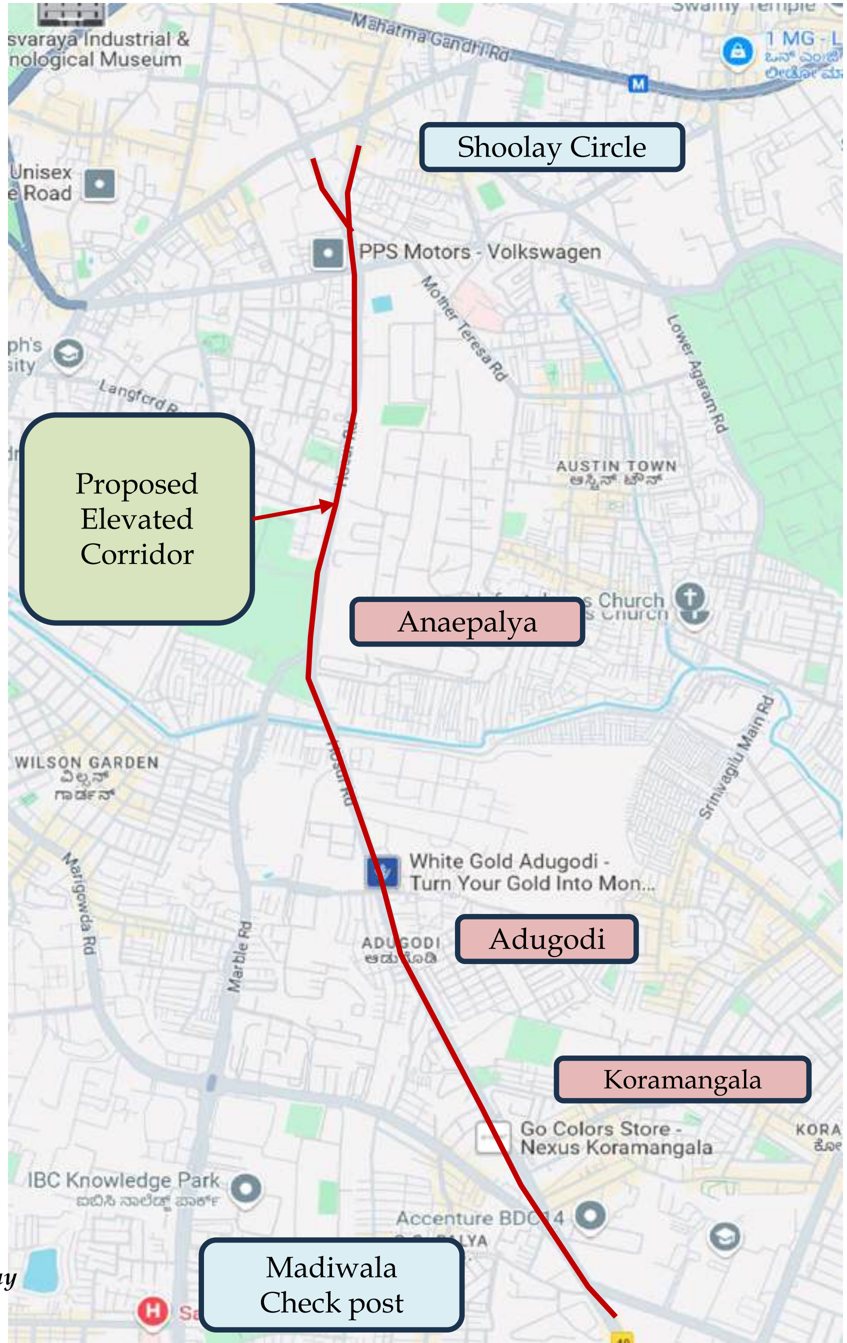


Figure 286 Plan of proposed elevated corridor from Shoolay circle to Madiwala Check post

Proposed Elevated Corridor from Shoolay Circle to Madiwala Check post location of Ramps

The proposed corridor passes one of the busiest Vellara junction.

The proposed corridor ends just past the shoolay circle on the museum road. Its a a one-way ramp heading towards Residency road.

The proposed corridor begins just past the Opera House Junction at the end of Brigade Road, featuring a one-way ramp heading toward Silk Board..

Figure 287. **Site Inspection photos of proposed Elevated corridor on Hosur road**

Proposed Elevated Corridor from Shoolay Circle to Madiwala Check post location of Ramps

The proposed corridor passes the narrow stretch of Anepalya area.

The proposed corridor passes the narrow stretch of Anepalya area. Near Johnson market.

The proposed corridor passes the narrow stretch of Anepalya area. Near Johnson market where underground Metro is designed/

Figure 288. **Site Inspection photos of proposed Elevated corridor on Hosur road**

Proposed Elevated Corridor from Shoolay Circle to Madiwala Check post location of Ramps

The proposed corridor passes the Madiwala check post junction and terminates before Madiwala underpass.

The proposed corridor passes on the Hosur road near police quarters.

Additional Up ramp and a down ramp is proposed near Adugodi junction.

Figure 289. **Site Inspection photos of proposed Elevated corridor on Hosur road**

Proposed cross 4 lane undivided Elevated corridor from Shoolay Circle to Silk board on Hosur road

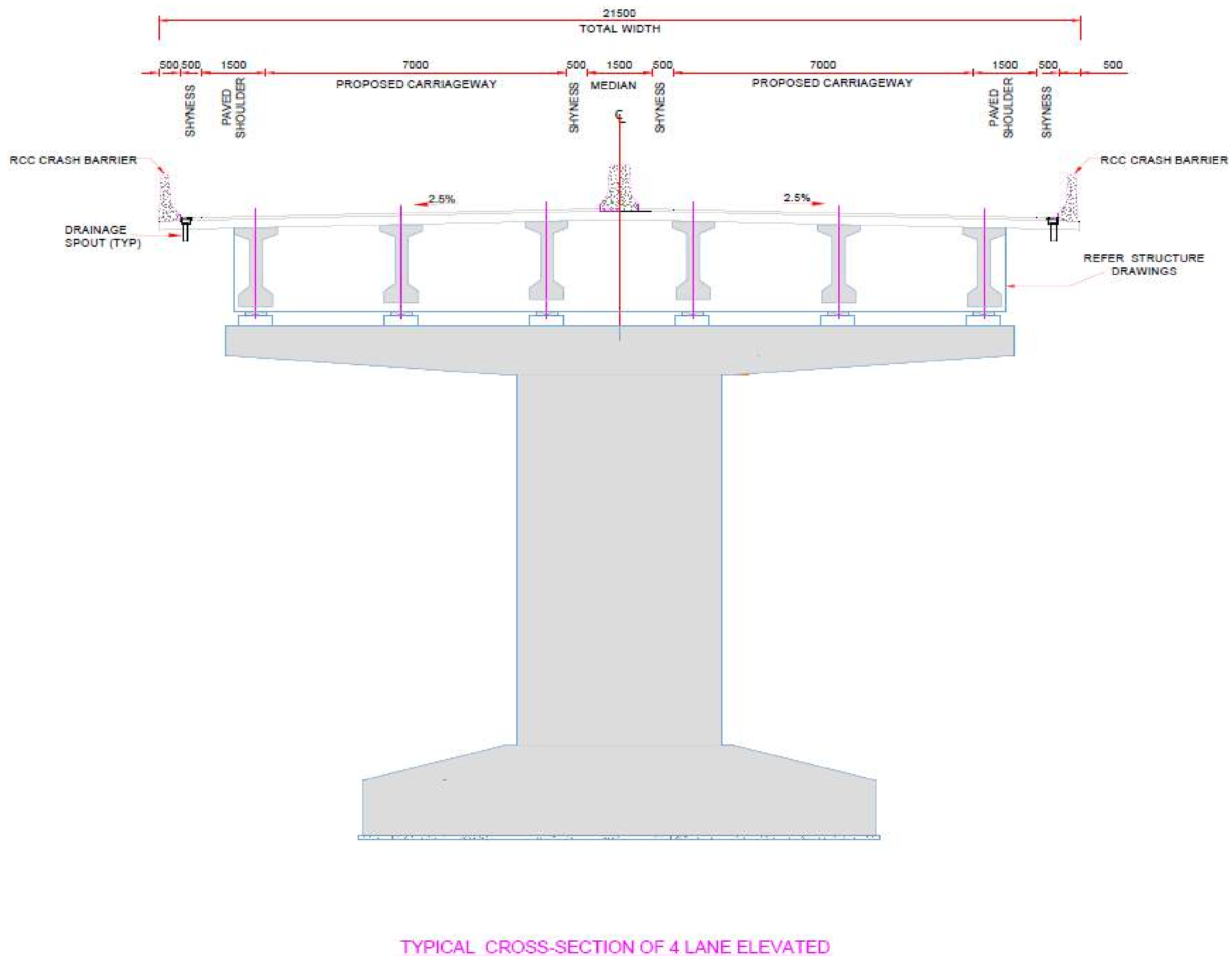


Figure 290. **Proposed cross section for the Elevated corridor from Shoolay Circle to Silk board on Hosur road**

Proposed cross 6 lane undivided Elevated corridor from Shoolay Circle to Silk board on Hosur road

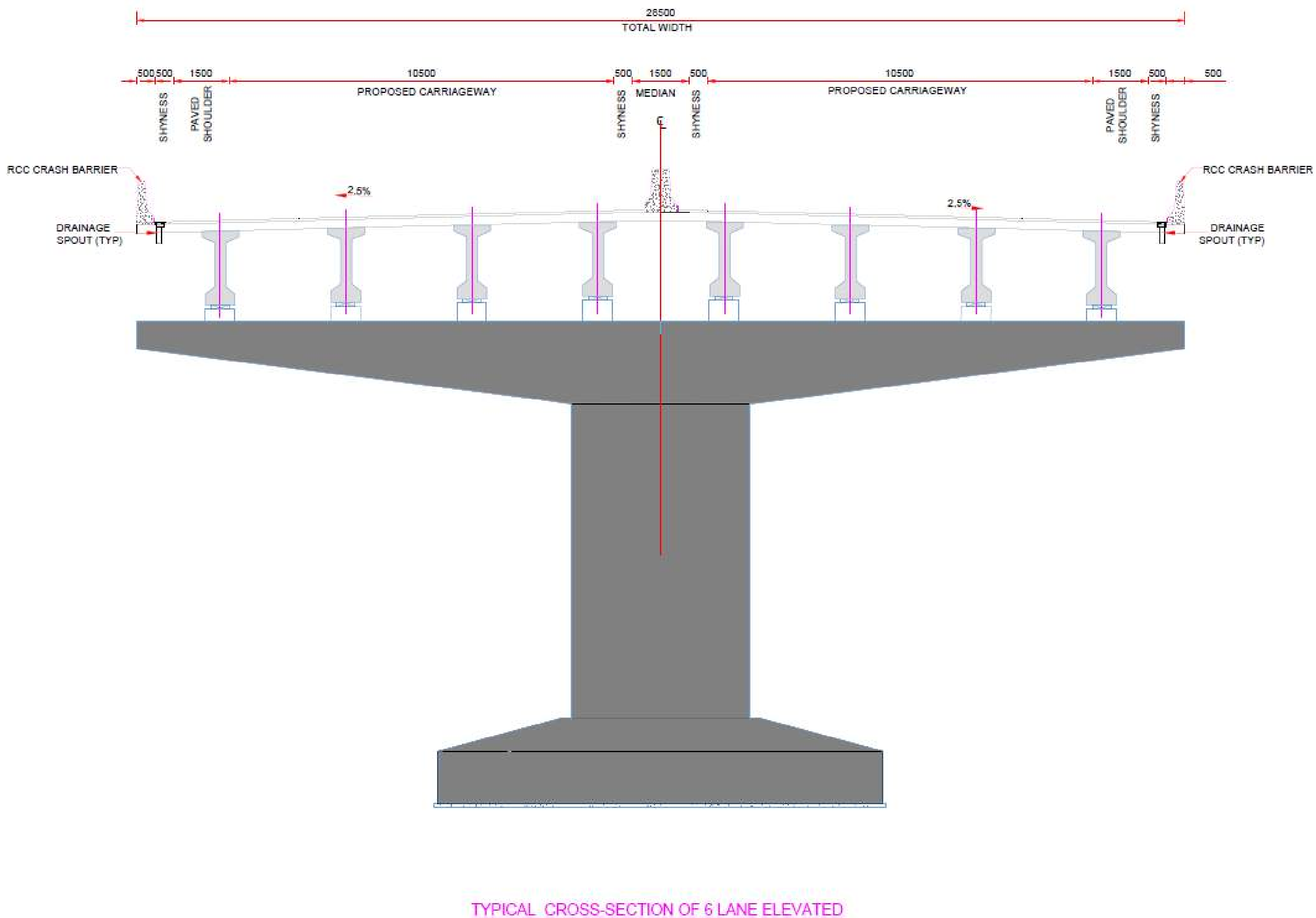
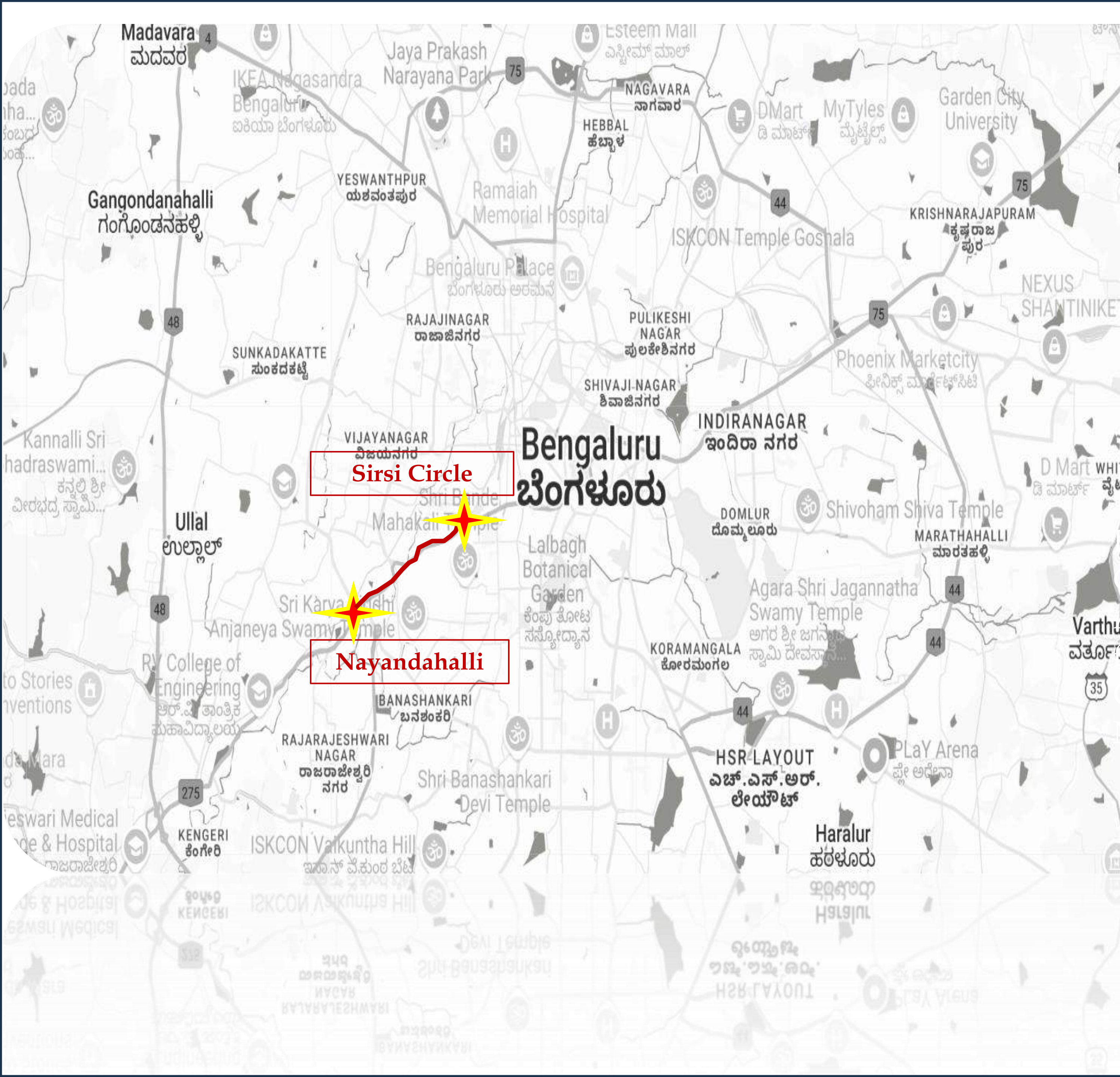


Figure 291. **Proposed cross section for Elevated corridor from Shoolay Circle to Silk board on Hosur road**



CORRIDOR

09

Mysuru Road

Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road

Corridor VII : Mysore Road Corridor (Hudson Circle to Nayandahalli Interchange)

The seventh corridor to be undertaken for the corridor improvement study is the Mysore Road Corridor. The corridor starts from Hudson Circle and ends at Nayandahalli Circle (on Outer Ring Road), traversing via K.R. Market. **Figure 292.**

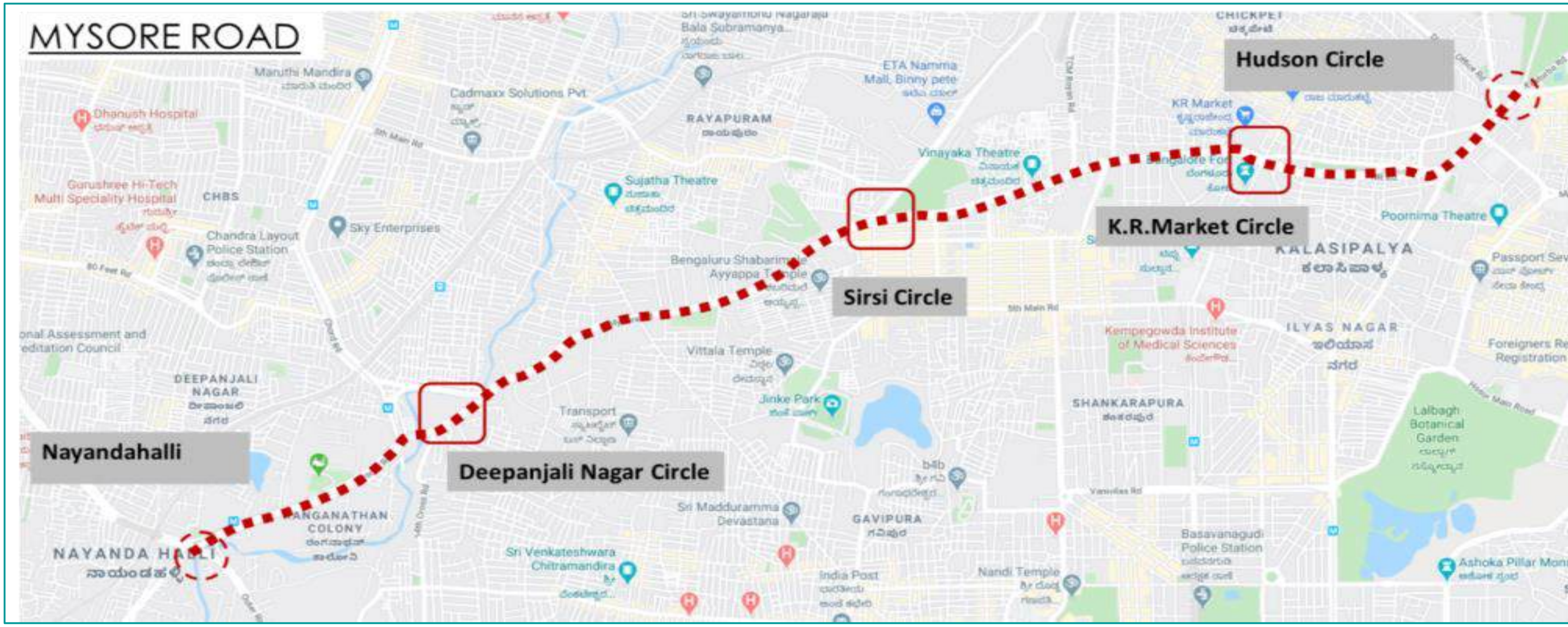


Figure 292. Mysore Road Corridor

The corridor starts from Hudson Circle and ends at Nayandahalli Circle (on Outer Ring Road). It is one of the busiest radial roads on the South – Western side of the city leading towards Mysore.

Some of the main features of the corridor are:

•The lane configuration on this corridor is varying from four lane divided to six lane divided two way.
•Length of the study corridor is 7km.
•The road surface is varying from bituminous to concrete.
•There are nine major signalized junctions along the corridor.
•Metro Rail run on this corridor operates from Deepanjali nagar to Nayandahalli interchange.

Landmarks, Attraction & Production Centers

The corridor attracts many work trips due to the presence of commercial activities, small-scale industries, wholesale steel and hardware market, wholesale timber market, wholesale agricultural market and wholesale grain market. Since the road network around the corridor is well established and being the gate way entry for the traffic coming from Mysore and vice-versa the trip attraction rate on the corridor is higher. shown in **Figure 394**

The salient features of the corridor are:

- The corridor starts from one of the biggest wholesale markets for agricultural products, which attracts large number of business trips.
- The corridor also has one of the city's biggest markets for computer products, electronics, agricultural equipment, machine and tools, that includes hardware, aluminum and steel.
- The corridor has one of the oldest and largest Government hospitals in Bangalore -Victoria Hospital that was established in the year 1901.
- The Corridor has prominent land mark heritage buildings like BBMP office, LIC Building, Unity Building, Town Hall, K.R. Market etc.

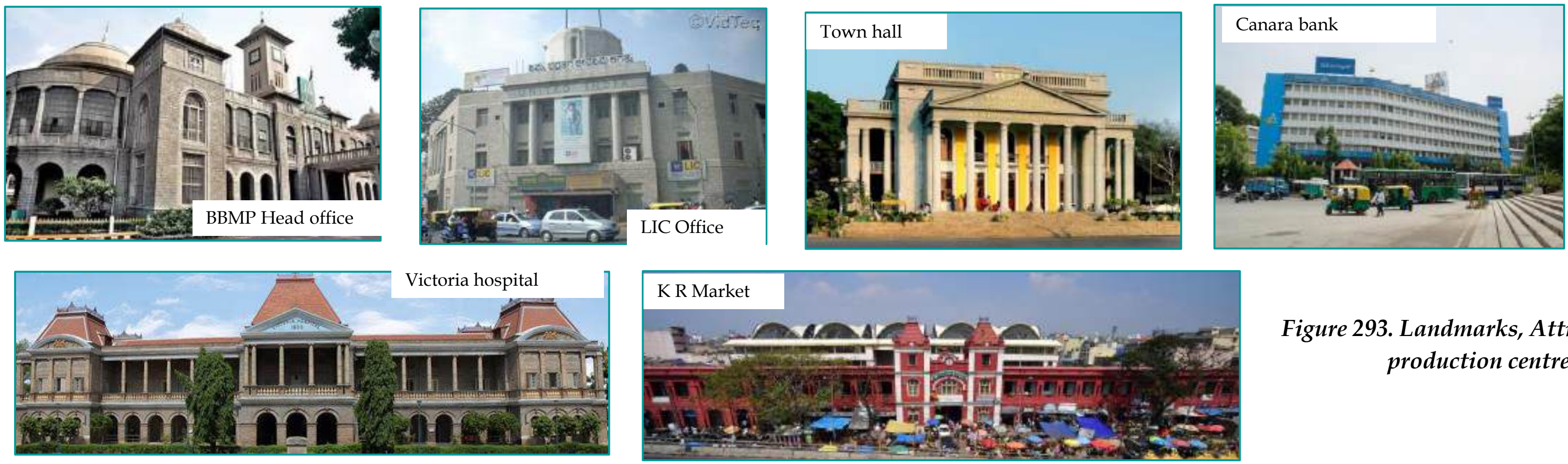


Figure 293. Landmarks, Attraction and production centres

Major Bus Stops along the Corridor

There are twenty-one bus stops located on each side of the corridor, starting from Hudson Circle to Nayandahalli Junction.. Bus bays are not designed for any of the bus stops along the corridor. This has resulted in the buses getting stopped on the carriageway, leading to traffic jams and congestions. All the Bus Stop locations are as shown in the **Figure 294.**

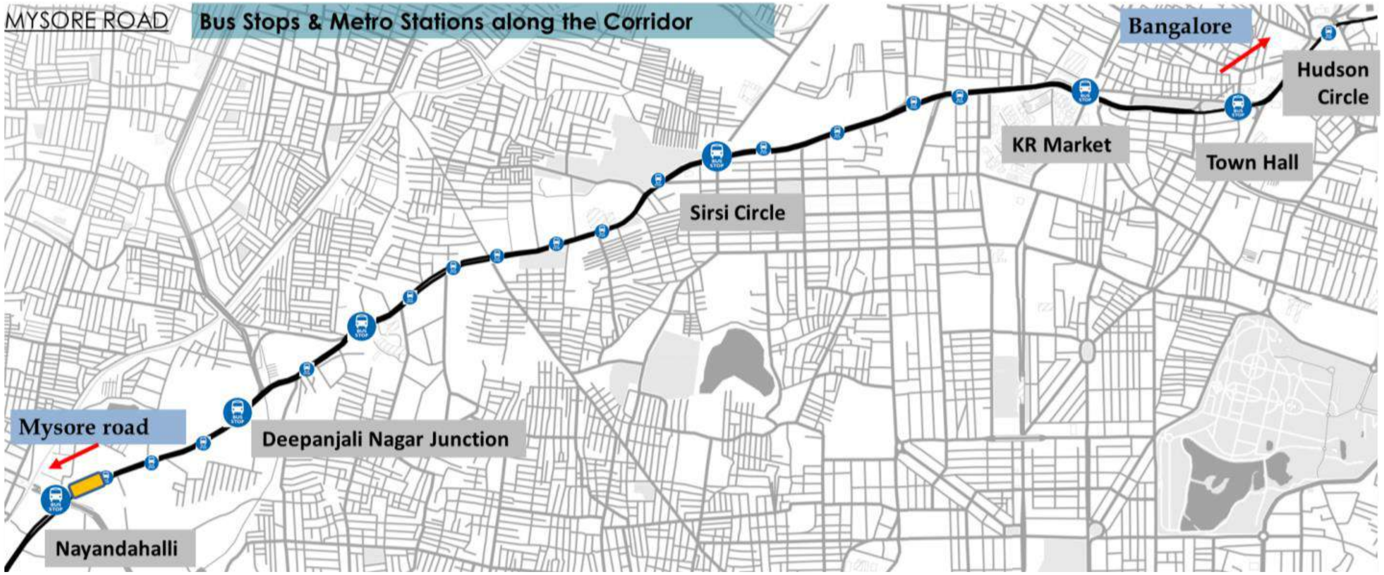


Figure 294. Major Bus Stands/Bus stops

Corridor Characteristics

Entire corridor from Hudson Circle to Nayandahalli junction varies from four lane divided two way to six lane divided two-way carriageway with footpaths on either side. Bangalore's first longest elevated flyover was built on this corridor starting from Silver Jubilee Park on Narasimha Raja Road near K.R.Market to SirsiCircle, which is a four lane two way, divided flyover with the length of 2.65 km **Figure 295.**

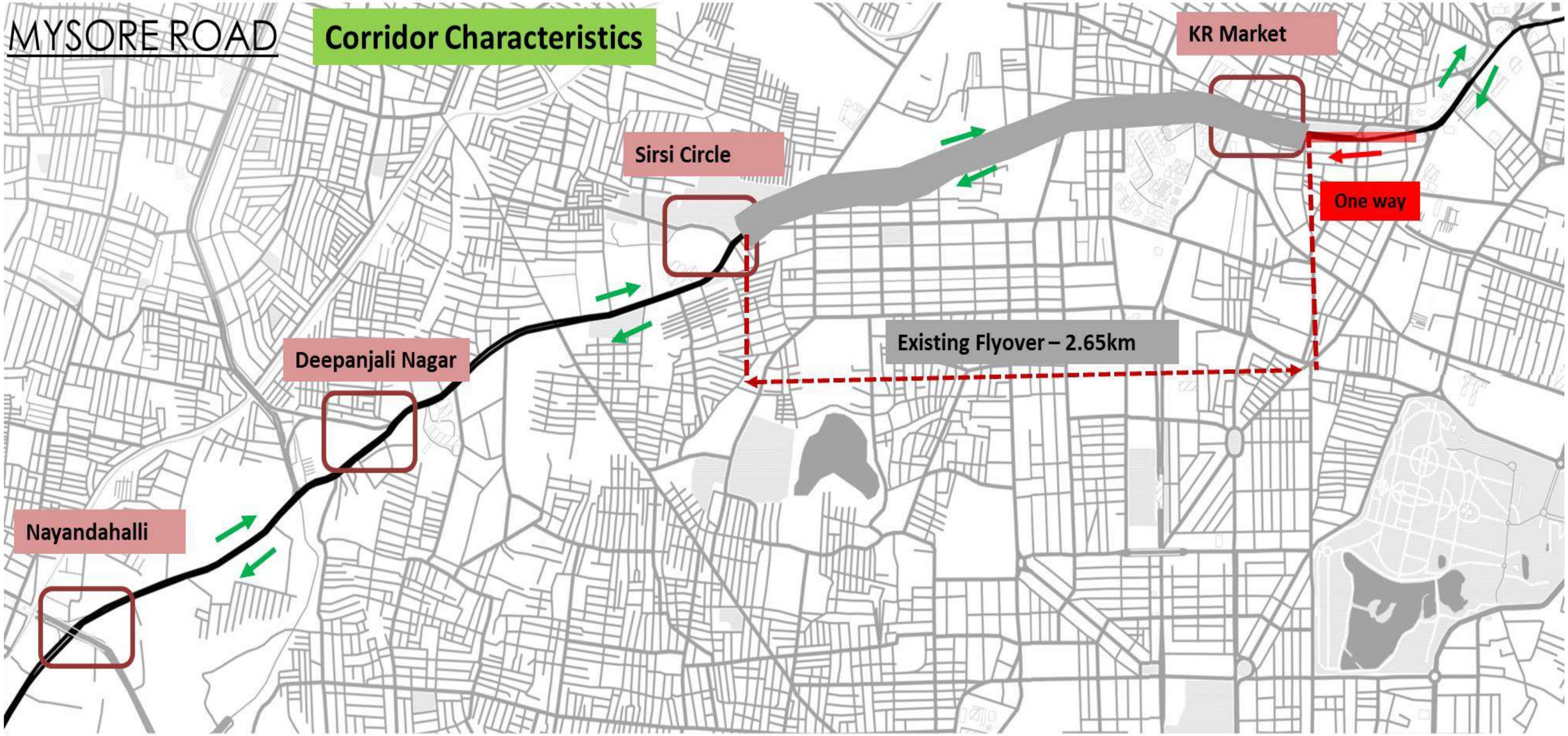


Figure 295. Major Junctions along the corridor

Existing Footpaths/Pedestrian Facilities

It is observed that the existing footpath condition along the corridor is varying from poor to excellent at certain stretches; the quality is good;, whereas, footpaths are absent at many stretches..There are five pedestrian skywalks along the corridor - one near Gopalan Mall; the other near Valmiki Nagar bus stop, the third at Nayandahalli Metro station and the fourth one near N.R. Square. The fifth skywalk is under progress near Deepanjali Nagar shown in **Figure 296.**


Two wheeler parking on footpath near K.R.Market


Debris & Garbage dumped in the central median below the flyover near Chamrajpet


Footpath condition near vegetable market


Drainage debris on footpath & Carriageway near Tipu Nagar


Skywalk under construction near Deepanjali Nagar


Skywalk @ Nayandahalli


Skywalk @ N.R.Square


Skywalk @ Valmiki Nagar Bus Stop


Skywalk @ Gopalan Mall

Figure 296. Existing footpaths conditions

Major Junctions

Along the7 km stretch, there are nine major intersections. List of major intersections is as mentioned below and shown in **Figure 297** :

•Police Square – 3 arm Signalized intersection.	•TCM Royan Circle- 4-arm Signalized intersection.
•Hudson Circle – 3 arm Signalized intersection.	•Sirsi Circle- 5arm Signalized intersection.
•N.R. Square – 4 arm Signalized intersection.	•Deepanjali Nagar intersection - 3 arm un signalized intersection one-way movements.
•Town Hall Circle - 3arm Signalized Skew intersection.	Nayandahalli interchange on Outer Ring Road
•K.R Market Intersection – 4 arm Signalized intersection.	

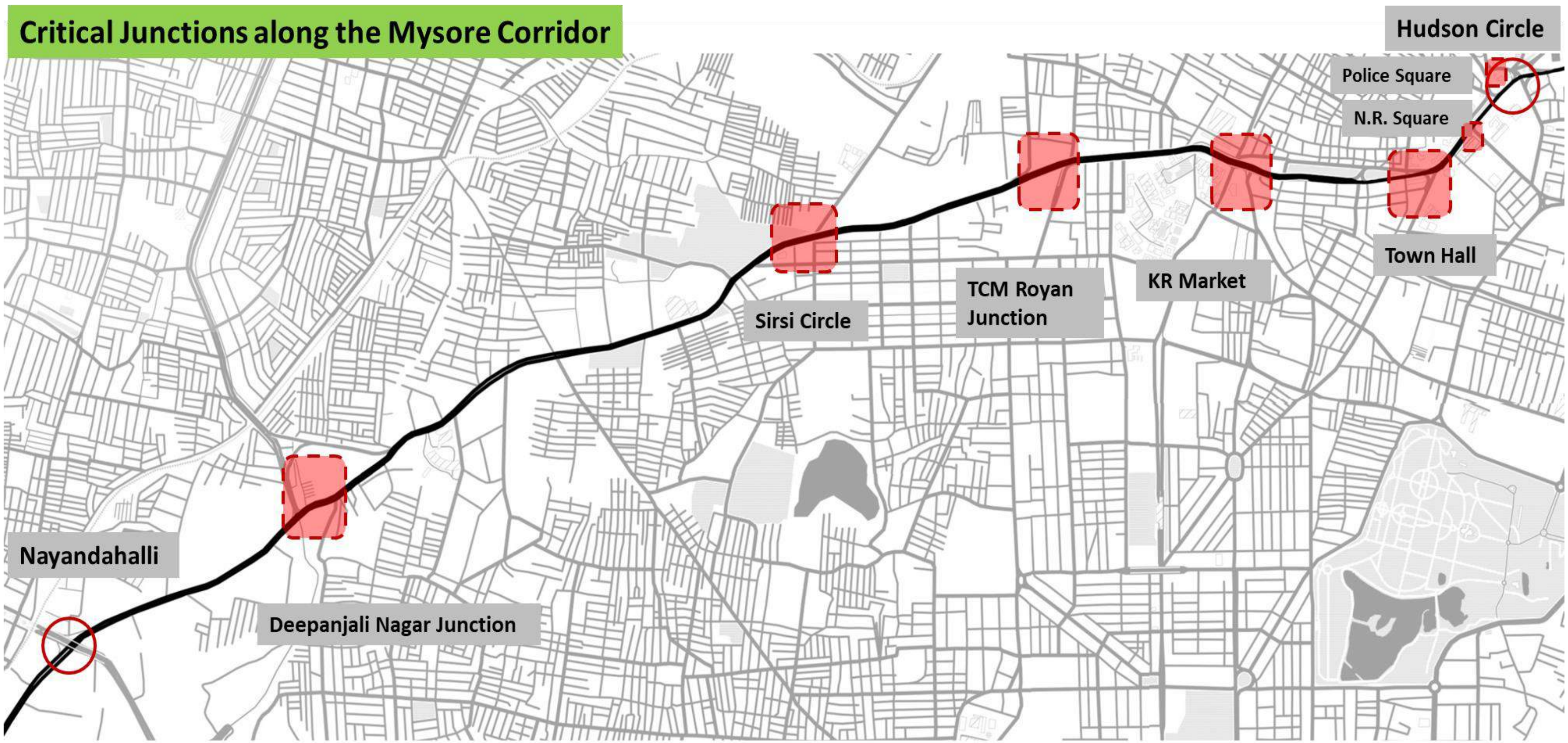


Figure 297.Critical Junction along the Corridor

Signage/ Markings/ Signals

The corridor lacks right signboards at the right locations; the signboards do not have good foundation and most of the signboards are either damaged or not relevant to the site. The signboards are installed on the shoulders rather than on the footpath, thus neglecting the safety of the road users. Road safety aspects are also ignored along the corridor to a larger extent which is of major concern. Some of the safety issues are:

•At-grade, pedestrian crossings are completely neglected, especially near K.R.Market Circle, near Jamia Masjid Circle, between Town Hall and the Sirsi flyover up ramp, near Mysore Satellite Station etc. which are the locations with high pedestrian movements. Due to the high vehicular speeds, pedestrians find it difficult to cross the roadway and facilities like skywalks or high raised pedestrian crossings are not provided along the corridor.
•Road safety furniture like cat eyes, solar blinkers etc. are missing all along the corridor, which are required for the safe access during night.
•Road surface from Jamia Masjid to T.C. Royan Circle is very bad resulting in frequent skidding of two-wheelers and other accidents **Figure 298.**
•Footpaths are in very bad condition, and need to be rectified on priority especially in-between Town Hall and the Sirsi Circle on either sides.

Figure 298 Safety issues near K.R Market circle

Land Use Along the Corridor

It is observed that majority of the land use pattern along the corridor is the commercial and Mixed land use type and the rest amounts for industrial and residential activities. **Figure 299.**

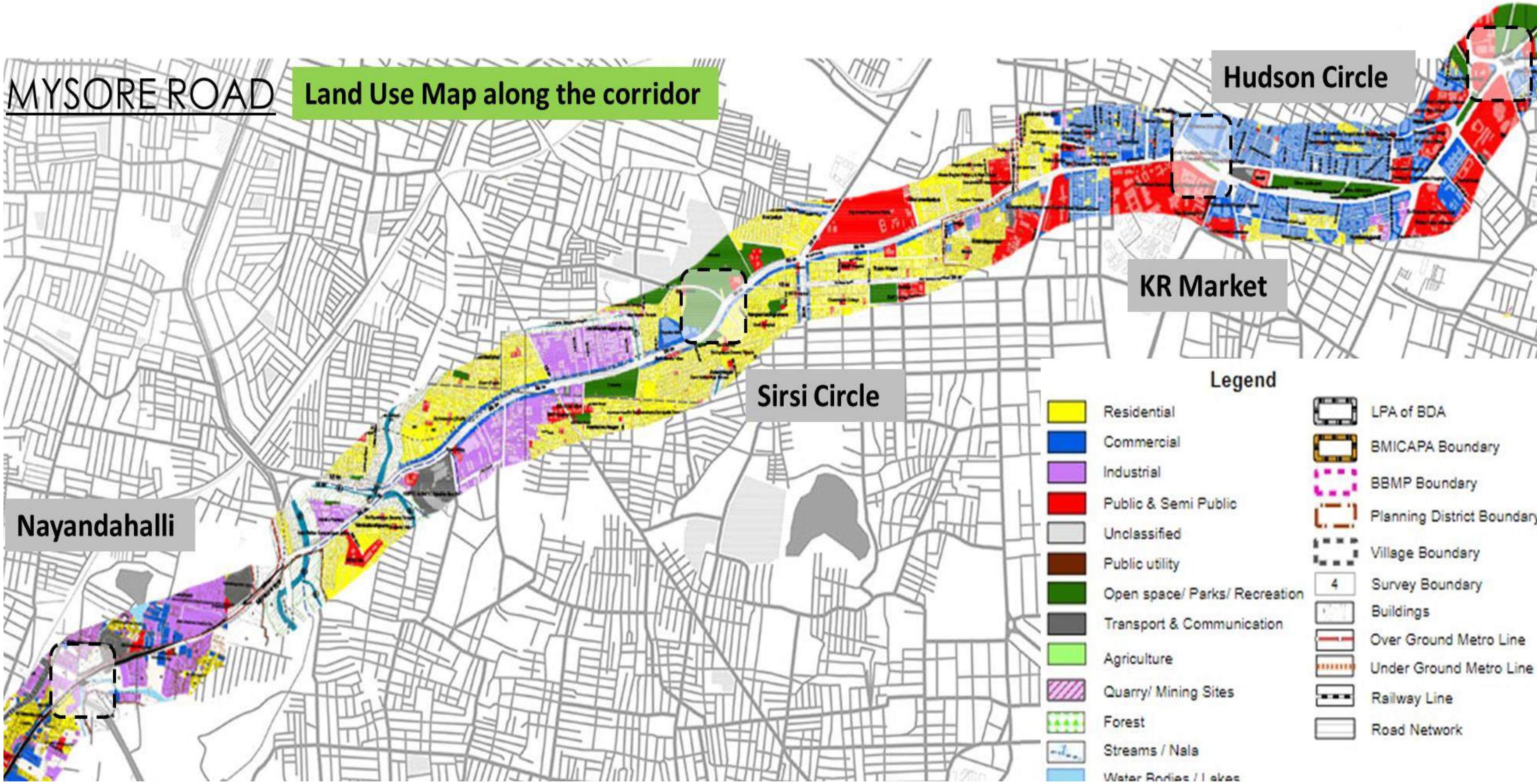


Figure 299. Land use along the corridor

PART B
SURVEY ANALYSIS

Traffic Survey Details

In order to assess the existing traffic and transport characteristic of the corridor and to decide on the type of traffic management measures needed, traffic surveys were carried out. The survey particulars are as presented in the following paragraphs:. The survey particulars are as presented below in **Table 90.**

Table 90. Traffic Survey Details

Sl.No	Type of Survey	Quantity
1	Turning Volume Count	7Intersections
2	Mid-block Count	1Location
3	Pedestrian Count Survey	7Intersections
4	Speed And Delay (Bus & Car)	7.5Km
5	Road Network Inventory	7.5Km
6	Traffic Signal Phasing	7 intersections

Traffic Volume Counts

Traffic volume count survey was conducted at one Mid-block location and for the remaining stretches, traffic volumes were extracted from the turning volume counts conducted along the corridor. The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs. The PCUs corresponding to urban roads as per IRC: 106-1990 were used and the Peak Hour Traffic Volumes are as presented below: **Table 91.**

Table 91 Traffic Volume Counts

Sl. No	Road Name	Morning Peak Hour	Morning Peak Hour Volume				Evening Peak Hour	Evening Peak Hour Volume			
			Towards Mysore Road		Towards Hudson Circle			Towards Mysore Road		Towards Hudson Circle	
			Vehicles	PCUs	Vehicles	PCUs		Vehicles	PCUs	Vehicles	PCUs
1	Between Hudson Circle and Corporation Circle	11.00-12.00	5472	6678	ONE WAY		19.15-20.15	5433	6911	ONE WAY	
2	Between Corporation Circle and Town Hall	10.15-11.15	2787	3082	5426	5373	19.15-20.15	2745	3034	5352	5384
3	Between Town Hall and KR Market	9.00-10.00	5251	4850	3033	2438	17.30-18.30	5203	4745	2673	2167
4	Between KR Market and TCM Royan Road Junction	11.00-12.00	2830	3083	2689	2484	18.30-19.30	3099	3722	2553	2463
5	Between TCM Royan Road Junction and Sirsi Circle	9.30-10.30	3088	2762	4370	4844	18.00-19.00	3114	2639	4301	4871
6	Between Sirsi Circle and Old Guddahalli Road Junction	10.15-11.15	1878	2056	4253	3812	19.30-20.30	2089	2240	4226	3667
7	Between Old Guttahalli Junction and Deepanjali Nagar Junction	10.15-11.15	1878	2082	3915	3687	18.15-19.15	2089	2267	3886	3541
8	Between Deepanjali Nagar Junction and Nayandhalli	11.00-12.00	4166	4009	5039	4940	19.15-20.15	4237	4208	4991	4828

Among the 8 Mid-Block locations, traffic volume between Corporation Circle and Town Hall is found to be the highest with 10249 PCUs during morning peak hour and 10212 PCUs during evening peak hour, followed by Mysore Road stretch between Deepanjali Nagar Junction and Nayandahalli with a traffic volume of 10184PCUs during morning peak and 10221 PCUs during evening peak hour.

Volume to Capacity Ratio (V/C) and Level of Service

Volume to Capacity Ratio (V/C Ratio) is defined as the ratio of peak hour traffic flow rate to capacity and Level of Service (LOS) is defined as the a qualitative measure, describing operational conditions within a traffic stream and their perception by the drivers/passengers.

Universally, LOS is lettering scheme ranging from A to F. LOS 'A' represents highest quality of service whereas LOS 'F' represents heavily congested flow where traffic demand exceeds capacity. The service measures used for defining LOS are density and volume-to-capacity ratio.

For computation of V/C Ratio the capacity values have been adopted based on the road geometrics by applying adjustment factors ***(as per Indo Highway Capacity Manual 2012-2017)*** conforming to the site conditions.

Adjustment Factors

Several factors would have impact on traffic movement and on capacity as compared to the base section. The factors considered for assessment of influence on capacity include on-street parking manoeuvres; entry and exit of vehicles from access road and bus pull in and pull out manoeuvers in bus bays as well as access points.

The level of friction is categorized as low, medium and severe based on the extent of resistance or speed reduction to the flow as compared to base sections. The capacity of the urban road section is computed using the equation:

$$C = C_o * F_{OP} * F_{BS} * F_{AC}$$

Where,

C= Actual Capacity (PCU/hr)

C_o = Base Capacity for Ideal Condition (PCU/hr)

F_{OP} = Adjustment Factor for On-street Parking

F_{BS} = Adjustment Factor for Bus Stops

F_{AC} = Adjustment Factor for Access Point

It was observed that due to kerb side bus stops, the effective road widths available for movement of other vehicles in the traffic stream reduce resulting in the capacity reduction at the following locations:

1. Between Hudson Circle and Corporation Circle
2. Between Town Hall and KR Market
3. Between TCM Royan Road Junction and Sirsi Circle
4. Between Old Guddadahalli Junction and Deepanjali Nagar Junction
5. Between Deepanjali Nagar Junction and Nayandahalli

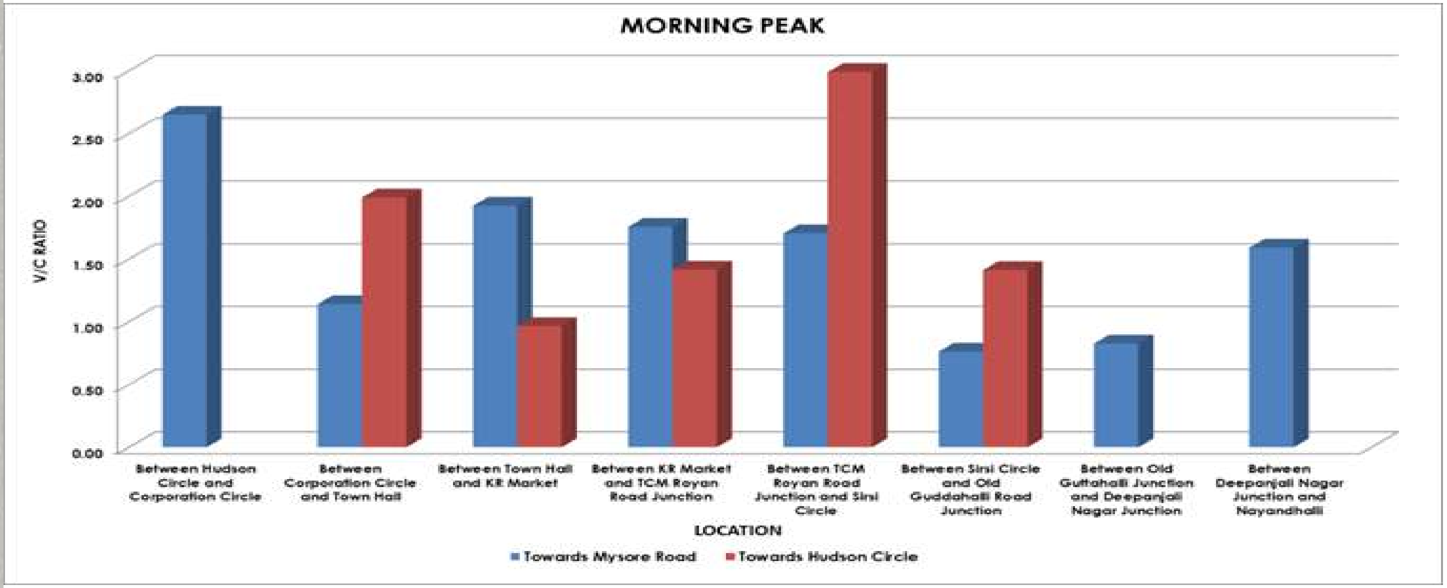
As the level of friction due to kerb side bus stops is high (frequency of buses>30) the adjustment factor of 0.6 is considered to compute the actual capacity.

It was also observed that due to on-street parking between KR Market and TCM Royan Road Junction there is considerable reduction in road capacity and in the stream speed of traffic flow. As the percentage of intensity in terms of parking segment length occupied is around 50%, the adjustment factor of 0.65 is considered to compute the actual capacity for this stretch.

The ratio of peak hour traffic flow rate to capacity (V/C Ratio) and the Level of Service (LOS) of the road sections along Mysore Road Corridor are presented below. **Table 119 and Figure 384**

Table 92. Traffic Volume to Capacity ratio and Level of Service

Sl. No.	Road Name	Typology of Road	Capacity*		Morning Peak						Evening Peak					
					Morning Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*		Evening Peak Hour Volume (PCUs)		V/C Ratio		Level of Service*	
			Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle
1	Between Hudson Circle and Corporation Circle	6 lane	2520		6678	ONE WAY	2.65	ONE WAY	LOS F	ONE WAY	6911	ONE WAY	2.74	ONE WAY	LOS F	ONE WAY
2	Between Corporation Circle and Town Hall	4 lane	2700	2700	3082	5373	1.14	1.99	LOS F	LOS F	3034	5384	1.12	1.99	LOS F	LOS F
3	Between Town Hall and KR Market	6 lane	2520	2520	4850	2438	1.92	0.97	LOS F	LOS E	4745	2167	1.88	0.86	LOS F	LOS F
4	Between KR Market and TCM Royan Road Junction	4 lane	1755	1755	3083	2484	1.76	1.42	LOS F	LOS F	3722	2463	2.12	1.40	LOS E	LOS C
5	Between TCM Royan Road Junction and Sirsi Circle	4 lane	1620	1620	2762	4844	1.70	2.99	LOS F	LOS F	2639	4871	1.63	3.01	LOS F	LOS C
6	Between Sirsi Circle and Old Guddahalli Road Junction	4 lane	2700	2700	2056	3812	0.76	1.41	LOS D	LOS F	2240	3667	0.83	1.36	LOS D	LOS B
7	Between Old Guttahalli Junction and Deepanjali Nagar Junction	6 lane	2520	2520	2082	3687	0.83	1.46	LOS D	LOS F	2267	3541	0.90	1.41	LOS E	LOS B
8	Between Deepanjali Nagar Junction and Nayandhalli	6 lane	2520	2520	4009	4940	1.59	1.96	LOS F	LOS F	4208	4828	1.67	1.92	LOS F	LOS F



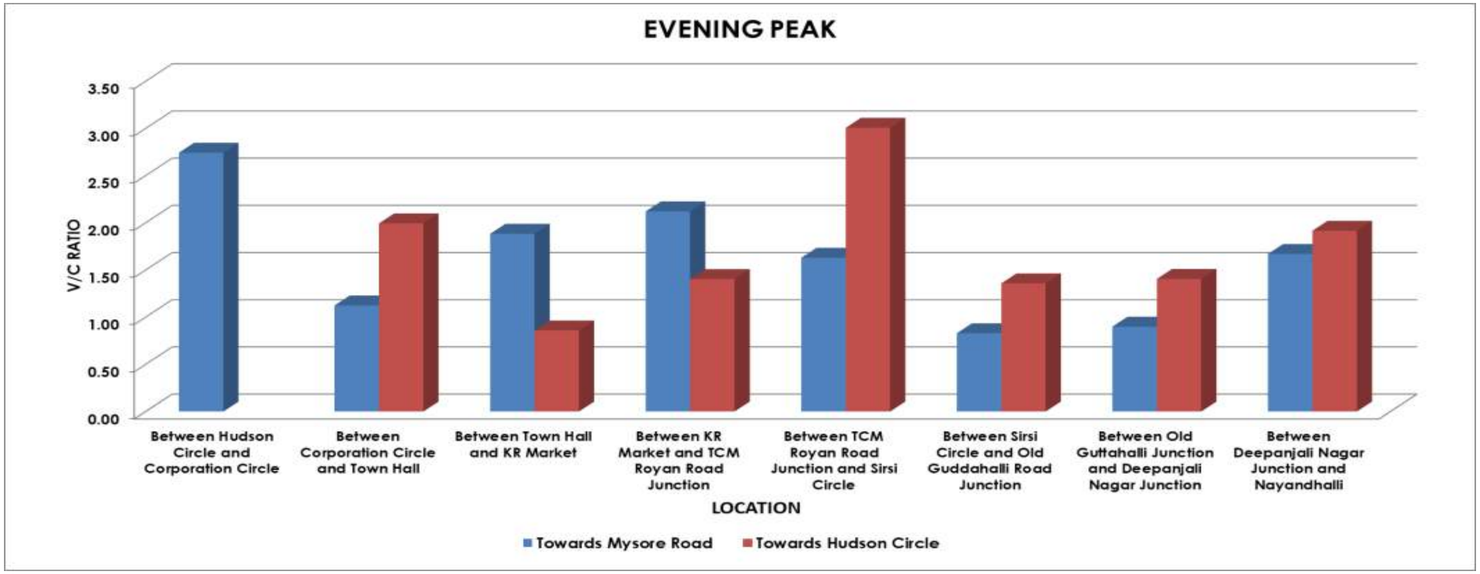


Figure 300 . Volume to Capacity Ratios along Tumkur Road Corridor both Morning & Evening

It can be observed that the traffic approaching at all the locations exceeds beyond the road capacity resulting in considerable delay and queuing.

The volume to capacity ratio at all the locations exceeds 1.0 and the Level of Service is found to be 'F' which indicates heavily congested flow where traffic demand exceeds capacity.

Traffic Volume at Junctions

The traffic volumes at intersections help in assessing the traffic volumes at mid-block locations of the arms of the intersection which together with journey speed and road inventory data aid in evaluating the Level of Service (LOS) of Urban Arterials and further, the traffic volumes at mid-block also establishes the need for safe pedestrian crossing facility taking into account the pedestrian crossing volumes **Table 93.**

The vehicles counted were converted to Passenger Car Units (PCUs) by adopting equivalent PCUs.

Table 93. Traffic Volume at Junctions

Sl. No.	Junction Name	Morning Peak Hour Volume		Morning Peak Hour	Evening Peak Hour Volume		Evening Peak Hour
		Vehicles	PCUs		Vehicles	PCUs	
1	Hudson Circle	12572	9270	11.00-12.00	12697	9419	19.15-20.15
2	Corporation Circle-Near Unity Building	10416	7717	10.15-11.15	10285	7639	19.15-20.15
3	Town Hall Junction	12272	8590	9.00-10.00	11593	8012	17.30-18.30
4	KR Market	10057	6664	11.00-12.00	10132	6961	18.30-19.30
5	TCM Royan Road Junction	6652	4746	9.00-10.00	7082	5034	18.15-19.15
6	Sirsi Circle	13433	9939	9.30-10.30	13365	9880	18.00-19.00
7	Old Guddadahalli Road Junction	6702	4846	10.15-11.15	6920	4911	19.30-20.30

Among the 7 turning volume count surveyed locations, Sirsi Circle is found to be having the highest peak hour volume (9939 PCUs during morning peak and 9880 PCUs during evening peak) followed by Hudson Circle with 9270 PCUs during morning peak and 9419 PCUs during evening peak.

Speed and Delay

Speed & delay survey provides a link wise estimate of journey time, running time and delay. Speed and Delay Survey was carried out for Bus and Car separately during morning and evening peak hours. In case of Car Speed and Delay Survey, floating car technique has been utilized for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the cumulative time at specified timing points to ensure obtaining the average link travel time of the road network.

The overall travel speed generally referred to as journey speed is the effective speed between two points and is computed as the distance divided by the total time taken by the vehicle to complete the journey including delays incurred en-route.

The direction-wise abstract on analysis along Hosur Road Corridor furnishing the name of road, length surveyed, journey speed and running speed is furnished below. **Table 94.**

Table 94. Bus Speed and Delay- Towards Nayandahalli (Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Hudson Circle	Kalinga Rao Road Junction	0.42	210	297	87	5	17	Merging & Diverging of traffic, signal delays, pedestrain crossings
2	Two Way	Kalinga Rao Road Junction	Town Hall Junction	0.25	25	98	73	9	12	Narrow roadn& Signal delay
3	Two Way	Town Hall Junction	K.R.Market Junction	0.93	100	260	160	13	21	on street parking y LCVs traffic divering and merging issue
4	Two Way	K.R.Market Junction	Royan Circle	1.19	80	295	215	15	20	Signal delay & tarffic flow delay
5	Two Way	Royan Circle	Sirsi Circle (Alur Venkata Rao Road)	1.02	267	521	254	7	14	Narrow roads, hapazard on street parking, truck movements, Jay walkers, hawkers, Potholes, debris on road etc
6	Two Way	Sirsi Circle (Alur Venkata Rao Road)	Bapuji Nagar Junction	2.15	141	528	387	15	20	White topping work under progress
7	Two Way	Bapuji Nagar Junction	Deepanjali Nagar Junction	0.52	0	189	189	10	10	
8	Two Way	Deepanjali Nagar Junction	ORR Underpass	1.17	34	318	284	13	15	Traffic flow delays
AVERAGE								11	16	

Table 95. Bus Speed and Delay- Towards Begur (Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Ring Road Underpass	Deepanjali Nagar Junction	1.13	22	321	299	13	14	Traffic flow delays
2	Two Way	Deepanjali Nagar Junction	Bapuji Nagar Junction	0.78	27	220	193	13	15	Traffic flow delays
3	Two Way	Bapuji Nagar Junction	Sirsi Circle Junction	2.18	422	891	469	9	17	Traffic diversion, white topping work underprogress
4	Two Way	Sirsi Circle Junction	Vinayaka Theatre Junction	1.02	0	255	255	14	14	
5	Two Way	Vinayaka Theatre Junction	Church Circle Junction	0.2	0	50	50	14	14	
6	Two Way	Church Circle Junction	K.R.Market Junction	0.75	182	219	37	12	73	Narrow roads, hapazard on street parking, truck movements, Jay walkers, hawkers, Potholes, debris on road etc
7	Two Way	K.R.Market Junction	Town Hall Junction	0.91	80	251	171	13	19	Signal delay and pedestrain crossings at K.R. Maket circle
8	Two Way	Town Hall Junction	Kalinga Rao Road Junction	0.25	29	76	47	12	19	Traffic flow delays
9	Two Way	Kalinga Rao Road Junction	Hudson Circle	0.26	37	133	96	7	10	Signal delay & Traffic flow delay
AVERAGE								**12**	**22**	

Table 96. Bus Speed and Delay- Towards Nayandahalli(Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Hudson Circle	Kalinga Rao Road Junction	0.42	51	124	73	12	21	Merging & Diverging of traffic, signal delays, pedestrain crossings
2	Two Way	Kalinga Rao Road Junction	Town Hall Junction	0.25	48	113	65	8	14	Narrow roadn& Signal delay
3	Two Way	Town Hall Junction	K.R.Market Junction	0.93	66	255	189	13	18	on street parking of LCVs , traffic divering and merging issue
4	Two Way	K.R.Market Junction	Vinayaka Theatre Junction	0.96	0	289	289	12	12	
5	Two Way	Vinayaka Theatre Junction	Sirsi Circle Junction	1.03	0	290	290	13	13	
6	Two Way	Sirsi Circle Junction	Bapuji Nagar Junction	2.18	115	582	467	13	17	White topping work under progress
7	Two Way	Bapuji Nagar Junction	Deepanjali Nagar Junction	0.52	0	157	157	12	12	
8	Two Way	Deepanjali Nagar Junction	ORR Underpass	1.17	220	497	277	8	15	Vehicle break down, Traffic flow delays
AVERAGE								**11**	**15**	

Table 97. Bus Speed and Delay- Towards Hudson Circle(Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Ring Road Underpass	Deepanjali Nagar Junction	1.13	16	328	312	12	13	Traffic flow delays
2	Two Way	Deepanjali Nagar Junction	Bapuji Nagar Junction	0.78	12	211	199	13	14	Traffic flow delays
3	Two Way	Bapuji Nagar Junction	Sirsi Circle Junction	2.18	75	514	439	15	18	Traffic diversion, white topping work underprogress
4	Two Way	Sirsi Circle Junction	Vinayaka Theatre Junction	1.02	0	280	280	13	13	
5	Two Way	Vinayaka Theatre Junction	K.R.Market Junction	0.95	43	226	183	15	19	Traffic flow delays
6	Two Way	K.R.Market Junction	Kalinga Rao Road Junction	1.16	320	498	178	8	23	Narrow roads, hapazard on street parking, truck movements, Jay walkers, hawkers, Potholes, debris on road etc
7	Two Way	Kalinga Rao Road Junction	Hudson Circle	0.26	69	139	70	7	13	Signal delay and pedestrain crossings at k>r. Maket circle
AVERAGE								**12**	**16**	

It was observed that the lower journey speeds are mainly due to traffic congestion and the delays are mostly occurring at junctions. The Average Bus Journey Speed is approximately 11Kmph during both morning peak hour and evening peak hour. **Figure 385-386.**

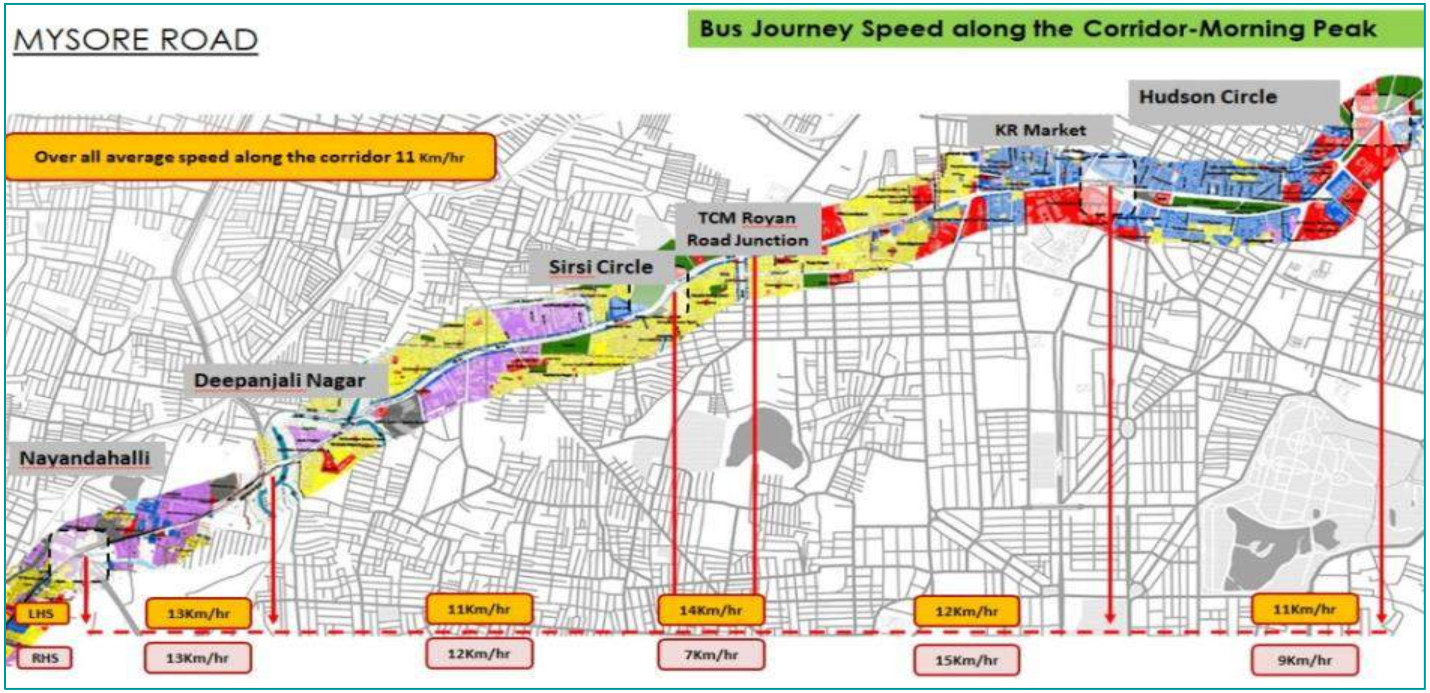


Figure 301. Average Bus Speed and Delay (Morning Peak)

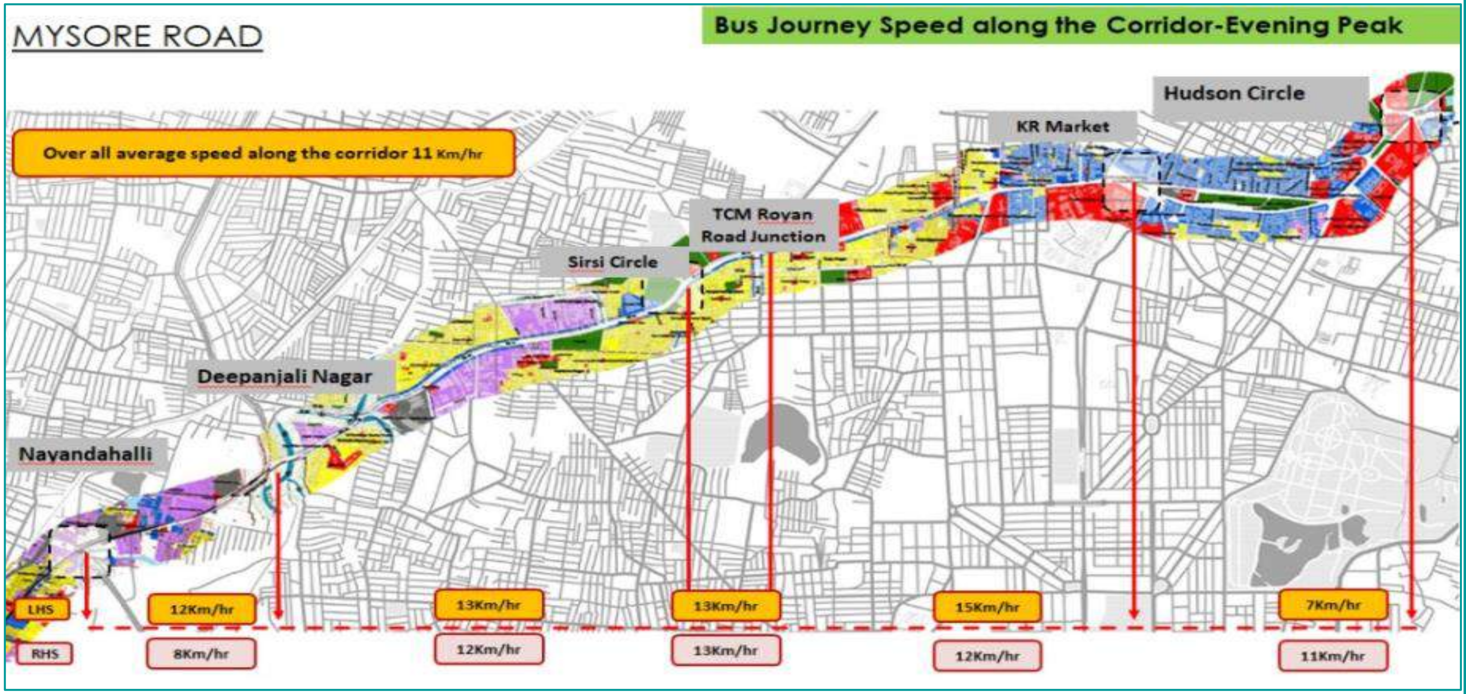


Figure 302. Average Bus Speed and Delay (Evening Peak)

Car speed and delay

The Average Car Journey speeds are shown below **Table 98-99**:

Sl.No.	Carriageway Category	From Node	To Node	Length (in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	One way	Hudson Circle	Kalinga Rao Road Junction	0.42	89	156	67	10	23	Signal Delay and Traffic flow delays
2	Two Way	Kalinga Rao Road Junction	Town Hall Junction	0.25	35	87	52	10	17	Traffic flow delays
3	Two Way	Town Hall Junction	K.R.Market Junction	0.93	89	221	132	15	25	On street Parking and traffic flow delays
4	Two Way	K.R.Market Junction	Royan Circle	1.19	112	276	164	16	26	Hawkers on road , Pedestrain crossings and signal delay
5	Two Way	Royan Circle	Sirsi Circle (Alur Venkata Rao Road)	1.02	76	241	165	15	22	Bad roads, debris on roads, on street parking
6	Two Way	Sirsi Circle (Alur Venkata Rao Road)	Bapuji Nagar Junction	2.15	99	503	404	15	19	White topping works
7	Two Way	Bapuji Nagar Junction	Deepanjali Nagar Junction	0.52	33	126	93	15	20	Signal delay and traffic flow delays
8	Two Way	Deepanjali Nagar Junction	ORR Underpass	1.17	85	289	204	15	21	Traffic flow delays
AVERAGE								14	22	

Table 98. Car Speed & Deal Details – Towards Nayandahalli(Morning Peak)

Table 99. Car Speed & Deal Details –Towards Hudson Circle(Morning Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Ring Road Underpass	Deepanjali Nagar Junction	1.13	56	265	209	15	19	Signal delay and traffic flow delays
2	Two Way	Deepanjali Nagar Junction	Bapuji Nagar Junction	0.78	32	203	171	14	16	Traffic flow delays
3	Two Way	Bapuji Nagar Junction	Sirsi Circle Junction	2.18	109	543	434	14	18	Traffic diversion, white topping work underprogress
4	Two Way	Sirsi Circle Junction	Royan Circle	1.02	88	263	175	14	21	Bad roads, debris on roads, on street parking
5	Two Way	Royan Circle	K.R.Market Junction	1.19	37	298	261	14	16	Traffic flow delays
6	Two Way	K.R.Market Junction	Town Hall Junction	0.75	102	178	76	15	36	Signal delay and pedestrain crossings at K.R. Maket circle
7	One Way	Town Hall Junction	Hudson Circle	0.91	98	251	153	13	21	On street parking by LCVs and cars
AVERAGE								14	21	

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	One way	Hudson Circle	Kalinga Rao Road Junction	0.42	95	143	48	11	32	Signal Delay and Traffic flow delays
2	Two Way	Kalinga Rao Road Junction	Town Hall Junction	0.25	29	85	56	11	16	Traffic flow delays
3	Two Way	Town Hall Junction	K.R.Market Junction	0.93	97	249	152	13	22	On street Parking and traffic flow delays
4	Two Way	K.R.Market Junction	Royan Circle	1.19	109	303	194	14	22	Hawkers on road , Pedestrain crossings and signal delay
5	Two Way	Royan Circle	Sirsi Circle (Alur Venkata Rao Road)	1.02	83	256	173	14	21	Bad roads, debris on roads, on street parking
6	Two Way	Sirsi Circle (Alur Venkata Rao Road)	Bapuji Nagar Junction	2.15	104	521	417	15	19	White topping works
7	Two Way	Bapuji Nagar Junction	Deepanjali Nagar Junction	0.52	41	139	98	13	19	Signal delay and traffic flow delays
8	Two Way	Deepanjali Nagar Junction	ORR Underpass	1.17	96	304	208	14	20	Traffic flow delays
AVERAGE								13	21	

Table 100. Car Speed & Deal Details – Towards Nayandahalli (Evening Peak)

Sl.No.	Carriageway Category	From Node	To Node	Length(in Km)	Delay (Sec)	Journey Time (Sec)	Running Time (Sec)	Journey Speed (Kmph)	Running Speed (Kmph)	Reasons for Delay
1	Two Way	Ring Road Underpass	Deepanjali Nagar Jn	1.13	69	281	212	14	19	Signal delay and traffic flow delays
2	Two Way	Deepanjali Nagar Jn	Bapuji Nagar Jn	0.78	43	208	165	14	17	Traffic flow delays
3	Two Way	Bapuji Nagar Jn	Sirsi Circle Jn	2.18	117	543	426	14	18	Traffic diversion, white topping work underprogress
4	Two Way	Sirsi Circle Jn	Royan Circle	1.02	95	280	185	13	20	Bad roads, debris on roads, on street parking
5	Two Way	Royan Circle	K.R.Market Jn	1.19	58	302	244	14	18	Traffic flow delays
6	Two Way	K.R.Market Jn	Town Hall Jn	0.75	98	178	80	15	34	Signal delay and pedestrain crossings at K.R. Maket circle
7	One Way	Town Hall Jn	Hudson Circle	0.91	107	251	144	13	23	On street parking by LCVs and cars
AVERAGE								14	21	

Table 101. Car Speed & Deal Details –Towards Hudson Circle(Evening Peak)

The Average Car Journey Speed is approximately 14Kmph during morning peak hour and 13Kmphduring evening peak hour.

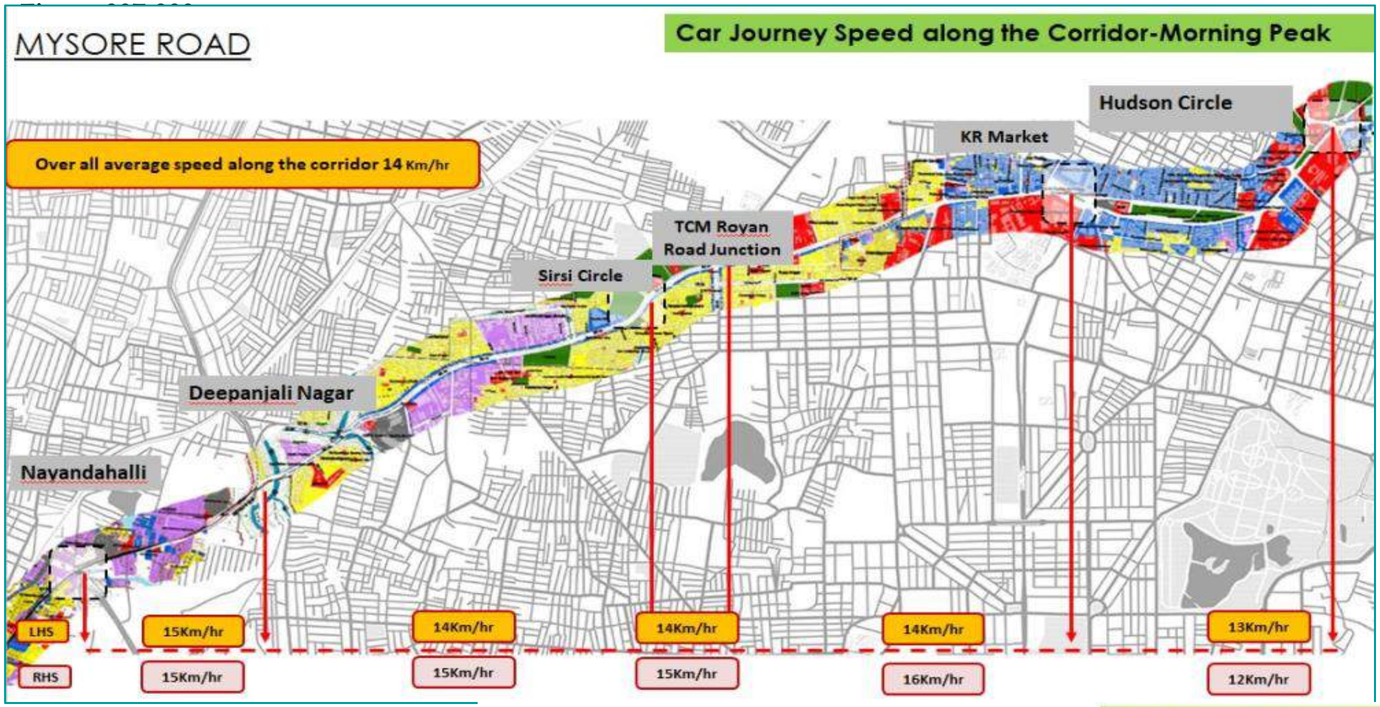


Figure 303. **Average Car Speed and Delay (Morning Peak)**

Figure 304. **Average Car Speed and Delay (Evening Peak)**

Road Inventory Details

Table 102. **Road Inventory Details along the Corridor**

Link No	Name of Road	Name of Starting Point	Name of Ending Point	Carriageway Width			Road type
				LHS Width	Median	RHS Width	
1	Mysore Road	Hudson Circle	N.R Square	24	One way		Bituminous
2		N.R Square	Town Hall	21	Two way		Bituminous
3		Town Hall	Start of S. P Road	36	One way		Bituminous
4		Start of S.P Road	K.R. Market	15	Two way		Bituminous
5		K.R Market	TCM Royan Circle	15	Two way		Bituminous
6		Sirsi Circle	Deepanjali nagar	42	Two way		Bituminous
7		Deepanjali nagar	Vijayanagar junction	21	One way		Bituminous
8		Vijayanagar junction	Nayandahalli	Varying from 21 to 36m	Two way		Bituminous

Road Inventory Details

Figure 305. Road Inventory along Mysore Road

Road Inventory Details

Figure 306 Road Inventory along Mysore Road

Road Inventory Details

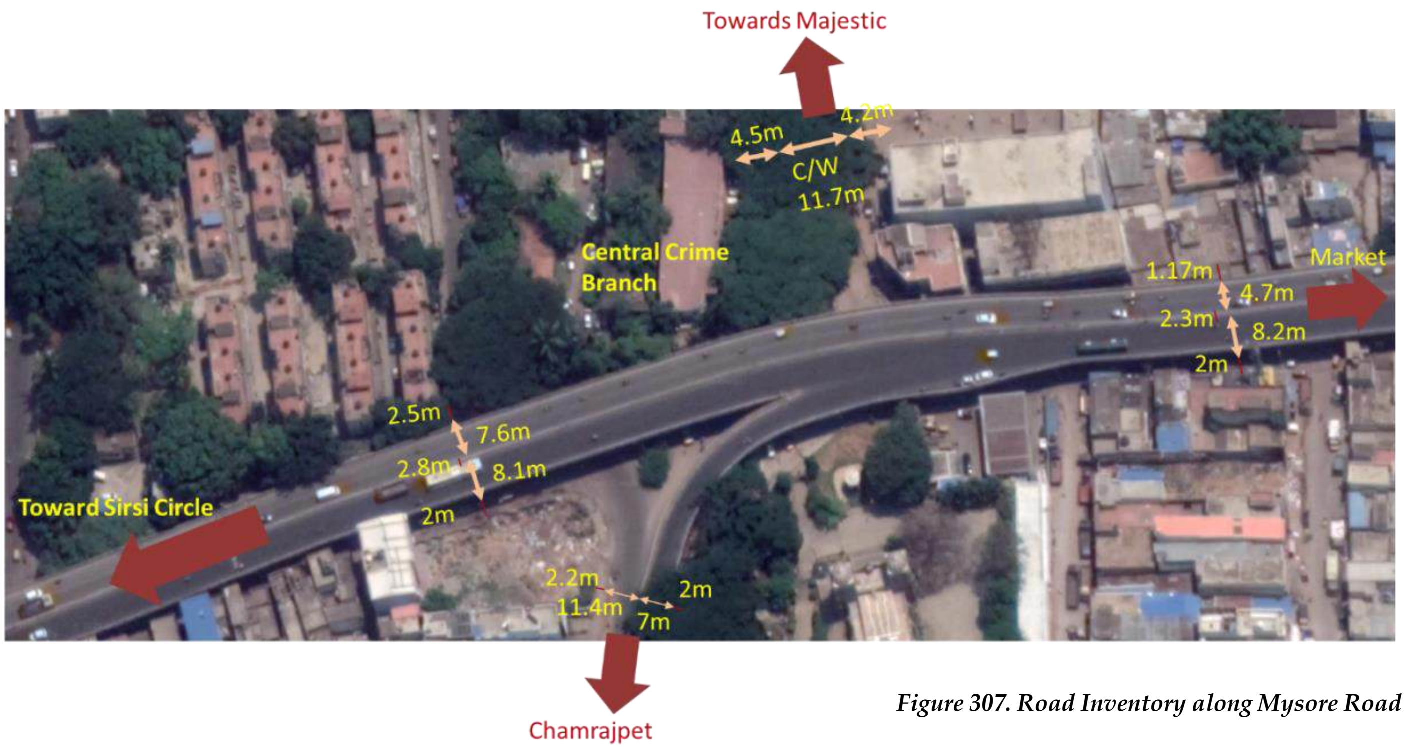


Figure 307. Road Inventory along Mysore Road

Road Inventory Details

Figure 308. Road Inventory along Mysore Road

PART C
ISSUE IDENTIFICATION AND SOLUTIONS

1.Un-scientific Geometric Design and Signal Design at K.R.Market

The area around K.R Market and surrounding has always been and remains a commercial hub, selling everything from salvaged automobile parts to wholesale vegetables, clothes, shoes and furniture. The land use by itself is a reason for the movement of a large number of people and goods. This is coupled with a dense old city fabric with winding narrow lanes, no visible road hierarchy or travel lanes, disorganized parking and a complete lack of pedestrian infrastructure. These have made the movement within the area with any mode of transport, a nightmare. Throw in heavy goods vehicles and the result is a complete chaos. The pedestrian is the one who faces the most hazard, as he / she has to weave in and out of this traffic while navigating other obstacles such as vendors and piles of garbage. **Figure 309.**

Figure 309: K.R.Market Junction

The KR Market junction is formed with the intersection of NR Road running east west with KR Road to the south and Avenue Road in north. This Junction was grade separated in 1990 in the east west direction in an effort to ease traffic flow conditions. The northern half of NR road is known as SJP Road. In addition, the junction has a pedestrian subway on the western side of the junction and this is poorly maintained and very rarely used due to its dilapidated status. An incomplete subway lies towards the eastern side rendering this junction to a nightmare for the pedestrians. A fixed time traffic signal operates as a control

for traffic at grade. However, traffic police personnel manually operate the signal for most part of the day.

Major mobility issues at this junction can be summarized as:
Disorganized movement of goods - loading, unloading and parking
Poor road and pedestrian infrastructure
Lack of organized parking
Poorly defined and chaotic city market bus terminus
Poor last mile connectivity to public transport
Extremely large Volume of Pedestrians using the intersection for cross movement
Lack of Pedestrian Facilities
Presence of bus terminals close by on the eastern side of Junction on the north and southern sides of NR Road (In a day, 600 buses, including city buses and outstation buses ply from the bus terminus located south east of the market, providing connectivity all over the city and outside; source-BSCL)
Unscientific Junction geometrics at grade
Irrational Signal Control System
Very high level of encroachment and street vending
Lack of strict enforcement and lack of civil sense

Recommendations:

✓Optimization of the signal as an immediate measure

✓Provision of segregated pedestrian right of way

✓Redesign of Intersection geometry as shown in **Figure 310.**

Proposed Junction Design at K.R.Market Circle/ Annapoorna Circle

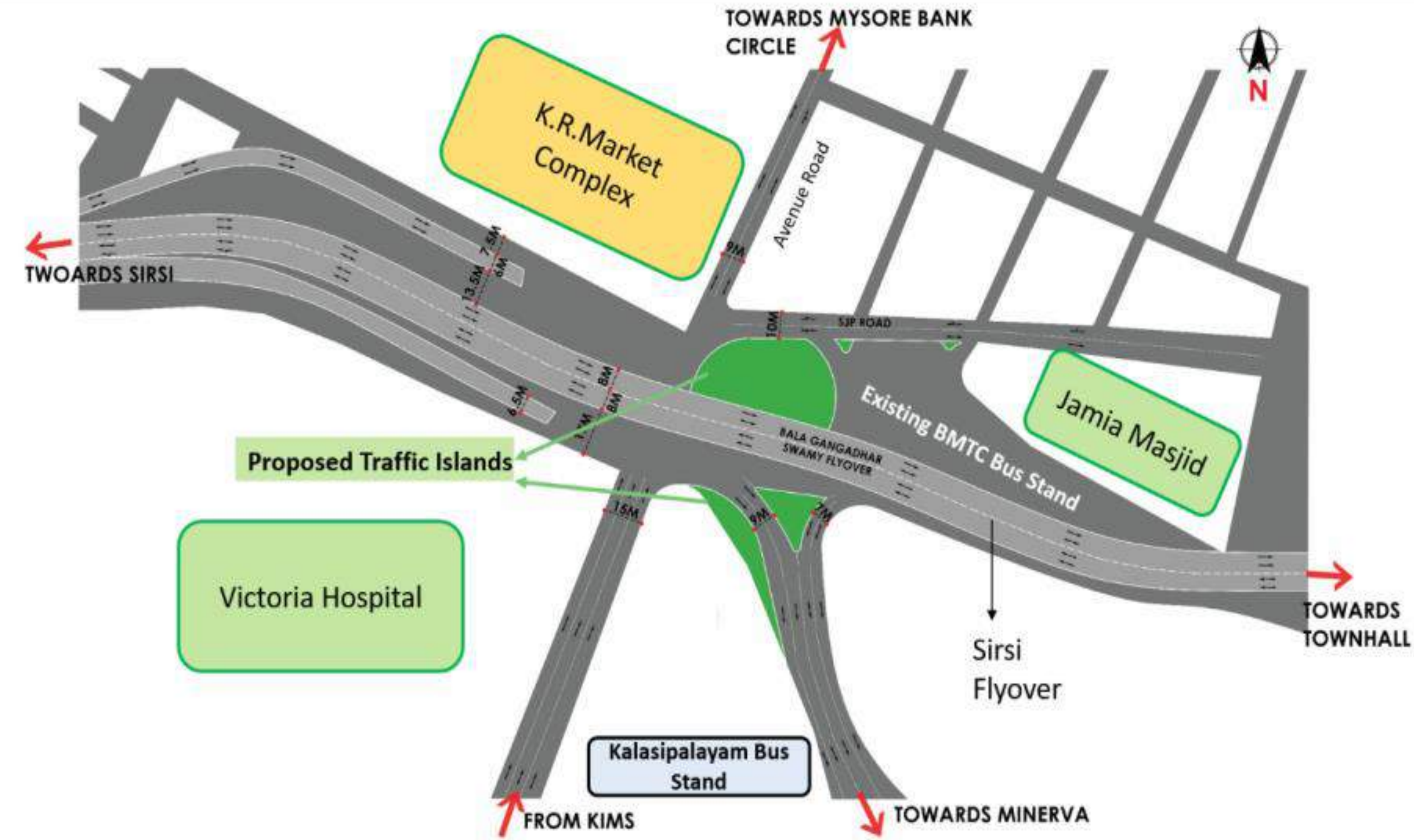


Figure 311: K.R.Market Junction Redesign of Intersection Geometry

Benefits:

➢Once the signal optimization is done along with proposed geometric corrections, junction delays will be reduced and congestions will come down.

2. Black Spot at K.R. Market Circle / Annapoorna Circle

This is a five-arm intersection. The major fatalities occurring are due conflicts between the Pedestrians and the BMTC buses. BMTC buses coming from Town Hall and moving towards Kalasipalyam take the left turn at the circle. While taking the left turn it is observed that pedestrian/ commuters stop at this turning to board the buses, resulting in fatal accidents. Due to pedestrian negligence and rash driving of BMTC drivers, ten accidents have occurred in past three years.

As evident from **Table 124** it can be inferred that total fatalities over the last 3 years is three (3). In addition the grievous injures are at seven (07) which again is a serious concern. The detailed observations and recommendations are mention below. **Figure 312**

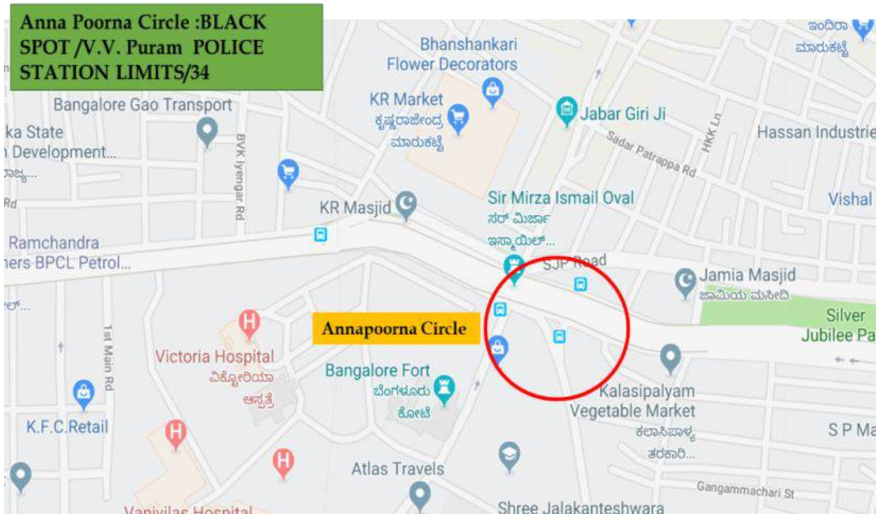


Figure 312. Black Spot at K.R.Market Circle

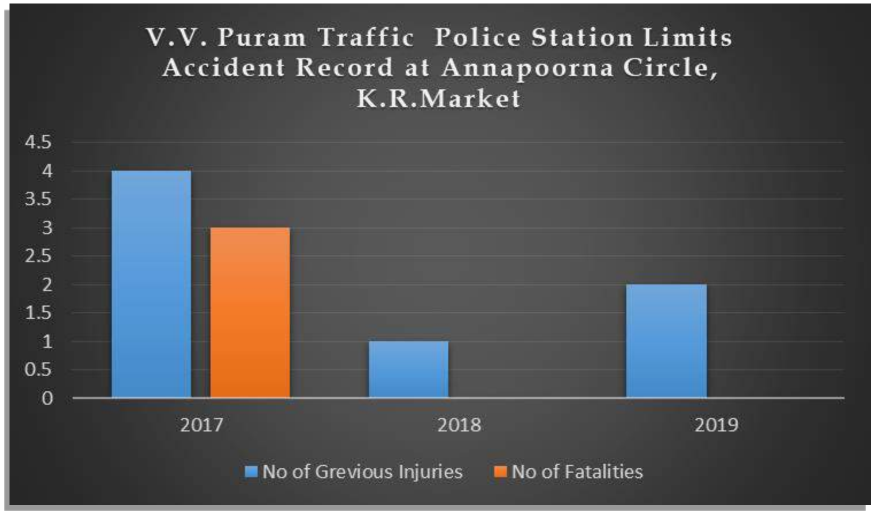


Figure 313. Accident Record at K.R.Market Circle

Table 124. Accident Record at K.R.Market Circle

V.V. Puram Traffic Police Station Limits		
Accident Record at Annapoorna Circle, K.R.Market		
Year	No of Grevious Injuries	No of Fatalities
2017	4	3
2018	1	0
2019	2	0

Observations:

•All the accidents involved at this location are between the BMTC buses and the pedestrians, reason being the negligence of pedestrians and rash driving by the BMTC buses while taking the left turn.
•Other reason is that on the free left turn, the buses stop to pick up the commuters there by hitting the commuters and pedestrians. **Figure 314**

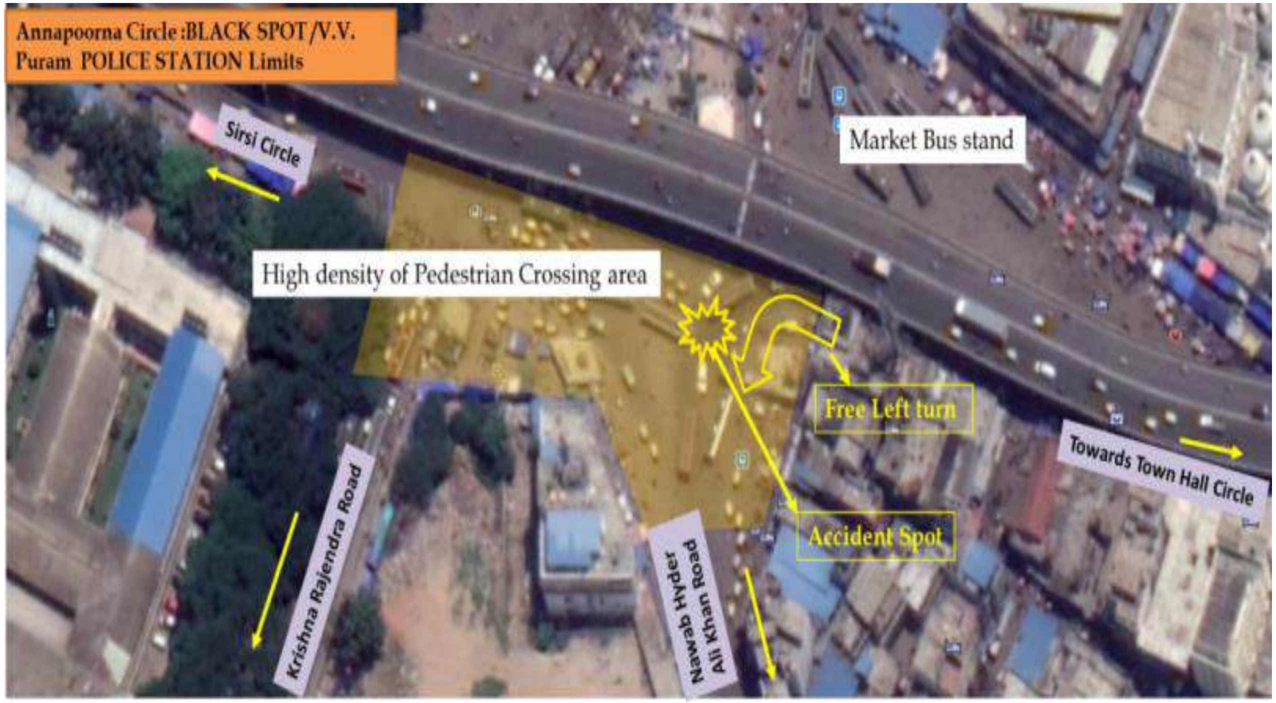


Figure 314 Black spots at Annapoorva Junction

Figure 315. Black spots at Annapoorva Junction

Recommendations:

•To reduce the speed of BMTC buses while turning left, a high raised speed breaker should be constructed on corner of the N.R Road just before the left turn.
•Sign board for “speed breaker and GO SLOW" need to be installed as per IRC standards before the high raised speed breaker.
•Bus stop at the turning need to be shifted further ahead by at least 20 meters.

Benefits:

•Pedestrian Safety will increase.
•Vehicle-Pedestrian crashes will be reduced.
•Rash driving from BMTC buses with be controlled.

3. Black Spot on Sirsi Flyover

Black spot is located on top of BGS /city market flyover/Sirsi flyover. All accidents occurring at the flyover are due to over speeding on the reverse curve. The reason for this is the sharp turning radius and lesser transition length in between the curves. Due to lesser transition length it is difficult to negotiate the vehicle at very high speeds, thus leading to fatal accidents. The central median is neither painted nor provided with any sort of road safety furniture to guide the road users about the approaching curve profile. This stretch of reverse curve needs to be addressed in the scientific manner and in the absence of proper signage system and road safety furniture, road users are unable to negotiate the curve safely. The detailed observations and recommendations are mention below . **Figure 316 and Table 103.**

Table 103. Accident Record at Sirsi FLyover

City Market Police Station Limits		
Accident Record on Mysore road flyover (From Market circle to Jamia Masjid): Black spot		
Year	Total Accidents	Total Fatalities
2016	2	3
2017	4	2
2018	5	1

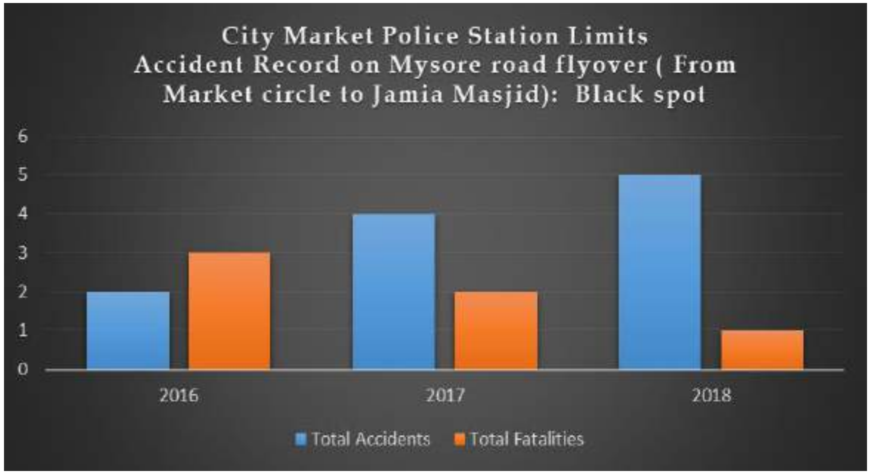


Figure 316. Accident Record On Mysore Road Flyover

Observations:

➢In the absence of speed calming measures, the vehicles are over speeding leading to fatal accidents. Observed journey speed during the off peak hours is more than 80km/hr on the flyover.

➢Presence of sharp reverse curve with shorter negotiation distance is another reason for fatal accidents; here the vehicles are unable to negotiate the transition length between the curves and there by losing the balance and resulting in accidents.

➢The median does not have any road safety furniture to guide the road users of the approaching curve profile.

➢Absence of cautionary signage system like chevron signs, speed limits is resulting in accidents.**Figure-317**

Table169. Accident Record at Sirsi Flyover

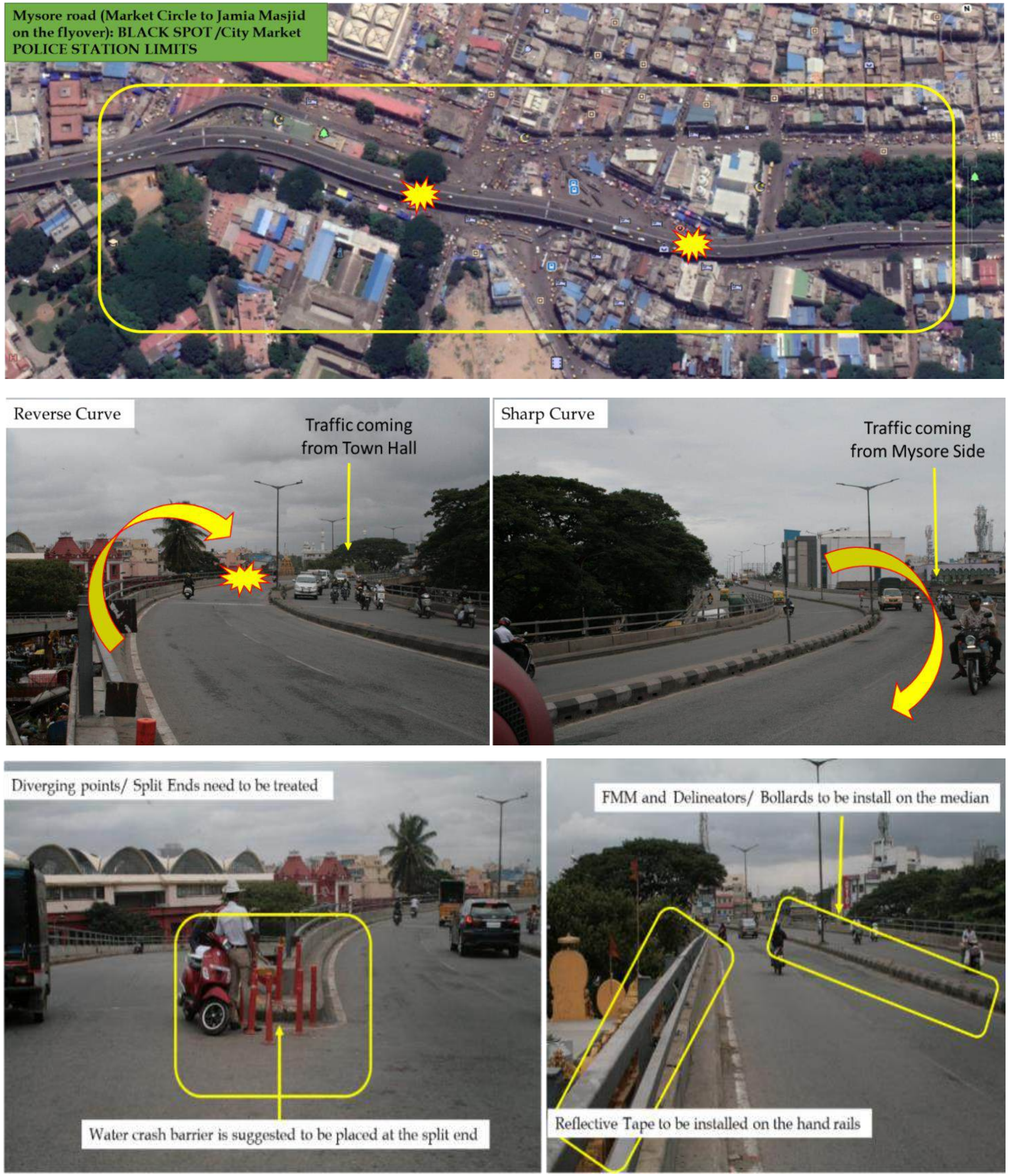


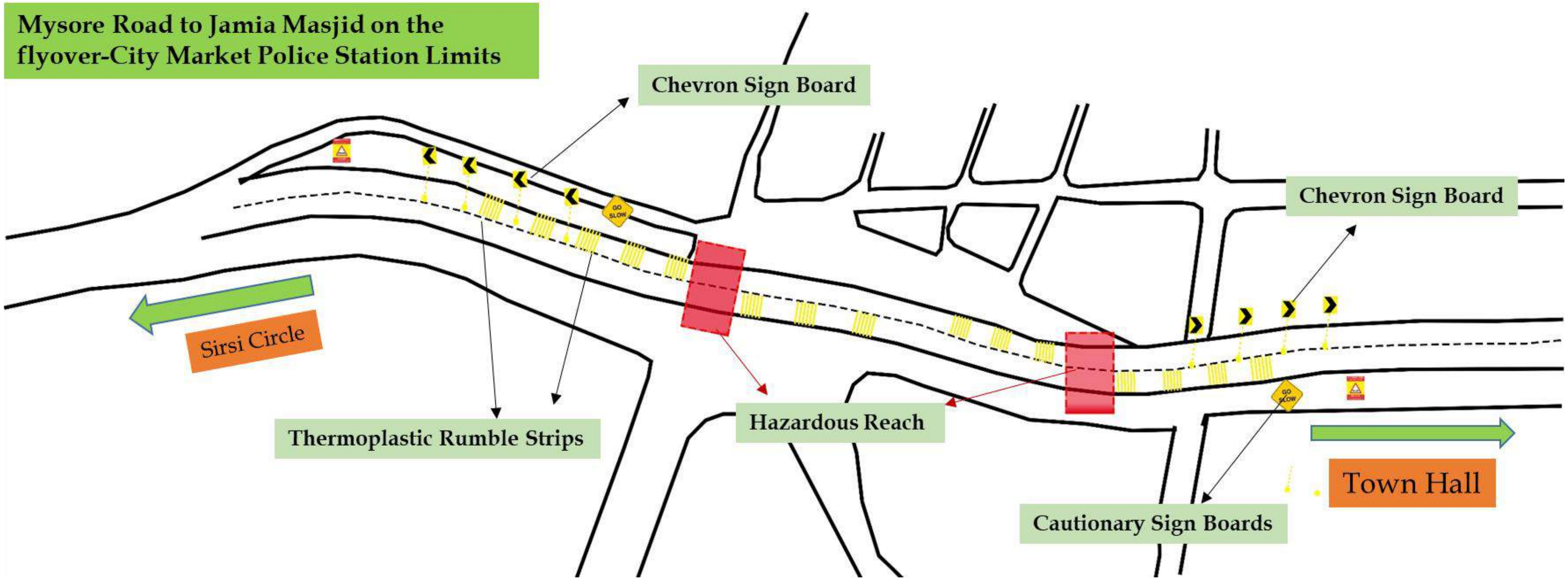
Figure 317. Corrected Black Spot

Recommendations:

➢Road Safety Furniture like Flexible median markers needs to be installed on the central median throughout the flyover along with delineators / Bollards to guide the road users.
➢The railing pipes provided on the parapet wall need to be installed with reflective tape to increase safety during the night throughout the flyover.
➢Flexible median markers need to be installed on the parapet wall for the reverse curve portion.

➢To reduce the speed on the main carriageway, thermoplastic rumble strips should be painted. The safety pattern is as recommended in IRC-99-2018, which says to treat any black spot location 120m ahead from the approaching accidental spot as shown in the figure, and need to be treated on either sides as a measure of traffic calming.
➢The Rumble strips should be in a set of five on each side with each set having six numbers of strips making it in total ten sets. One of the set located very next to the approaching point of the black spot should be at the height of 15mm and 300mm wide on either sides, while the other sets of four should be 5mm thick and 300mm wide on each side

•Cat eyes or RPMs should be install across the roads at the start of every rumble strip pattern in the zig-zag pattern at an interval of 0.5 meters apart, so that it has two impacts on the road users. Firstly, during the day, it gives a rumbling effect and during the night, it will reflect and shows the probable approaching hazard ahead.
•In order to negotiate the curve, Chevron signboards need to be installed on the parapet wall of the flyover, which will guide the road users to drive safely on the curve negotiate it carefully.
•It was also observed that the flyover has one up ramp and three down ramps, for which split ends need to be treated with solar cat eyes, bollards, cat eyes and if possible water crash barriers.
Figure 317.



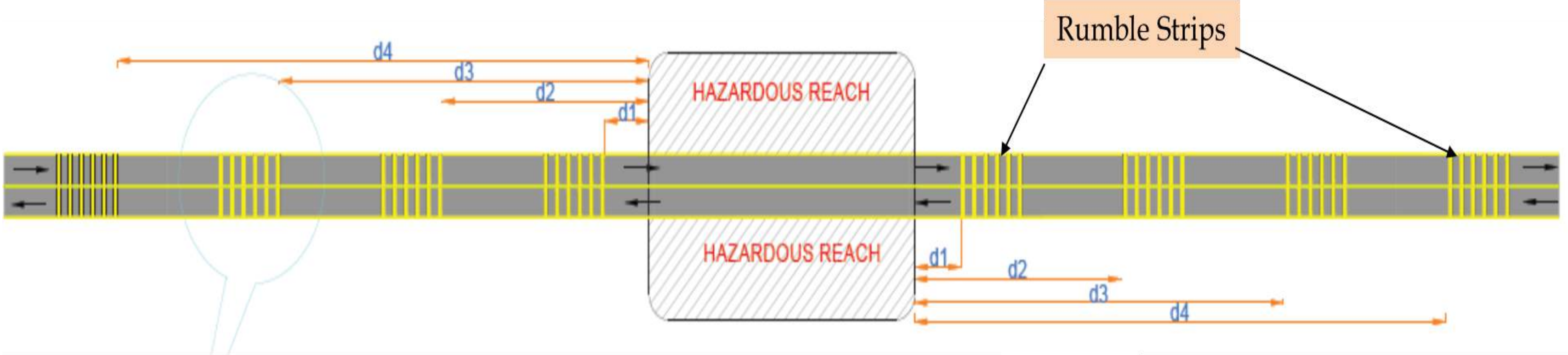


Figure 318. Corrected Black Spot from Mysore Road to Jamia Masjid

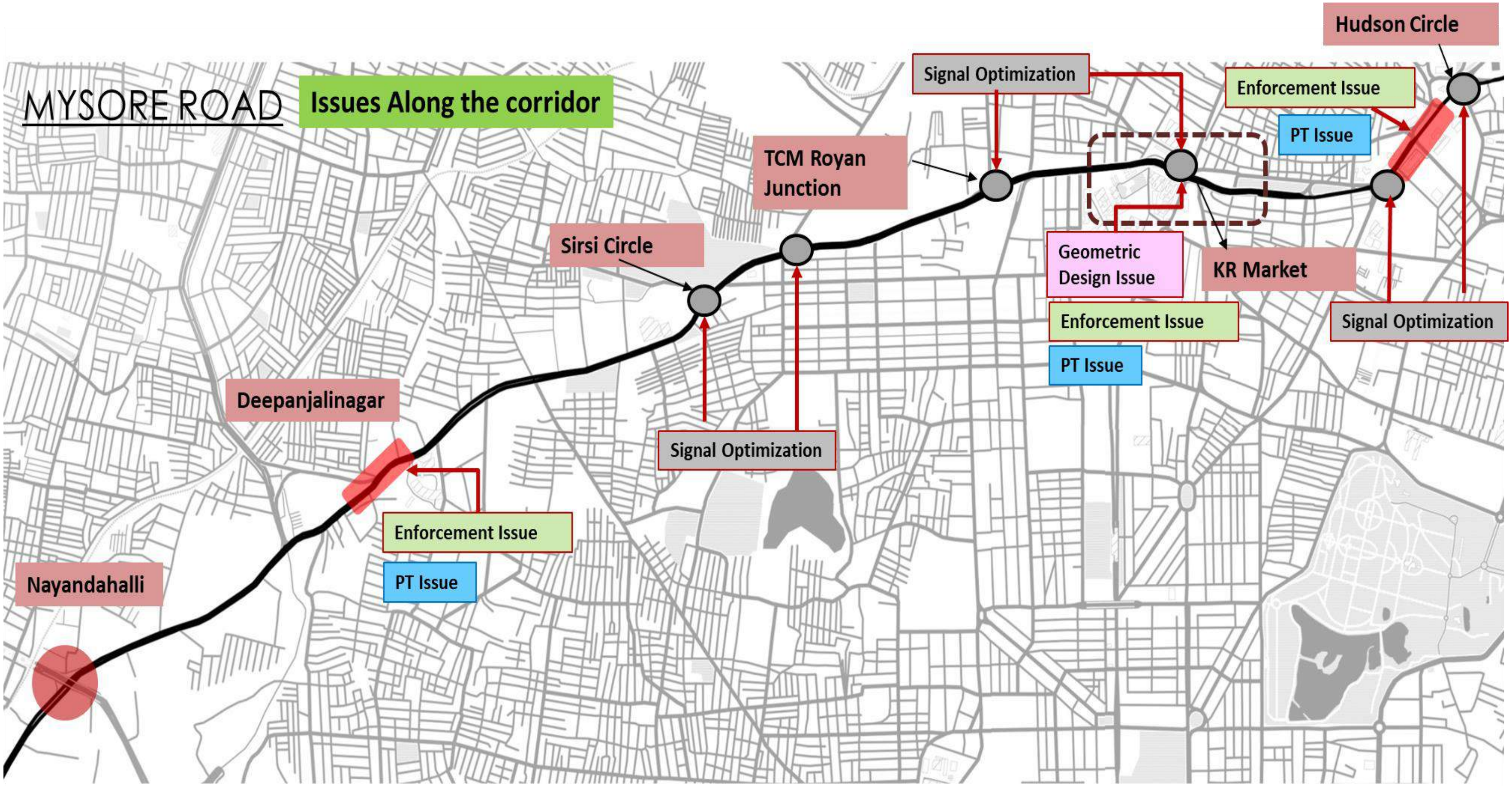


Figure 319. Key Map of all the Issues along the Corridor

PART D
SUMMARY AND IMPACT OF MEASURES

The comparison between existing operational scenario and the operational scenario after implementing the interventions discussed in the previous chapter along Mysore Road Corridor is tabulated in **Table 126**. From **Table 170** it can be seen that with the implementation of the interventions, there will be considerable reduction in Volume to Capacity Ratio (V/C Ratio) Old Madras Road Corridor.
A summary of the existing travel parameters versus the improved parameters after the recommended interventions is given in comparison statement **Table 104.**

Table 104. Comparison chart between existing scenario and proposed scenario

Sl. No.	Road Name	EXISTING											
		Capacity		Morning Peak Hour Volume (PCUs)		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Bus Journey Speed (Kmph)-Morning Peak		Car Journey Speed (Kmph)-Morning Peak	
		Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle
1	Between Hudson Circle and Corporation Circle	2520	ONE WAY	6678	ONE WAY	3	ONE WAY	LOS F	ONE WAY	12		10	
2	Between Corporation Circle and Town Hall	2700	2700	3082	5373	1	2	LOS F	LOS F	8	13	10	13
3	Between Town Hall and KR Market	2520	2520	4850	2438	2	1	LOS F	LOS E	13	12	15	15
4	Between KR Market and TCM Royan Road Junction	1755	1755	3083	2484	2	1	LOS F	LOS F	12	14	16	14
5	Between TCM Royan Road Junction and Sirsi Circle	1620	1620	2762	4844	2	3	LOS F	LOS F	13	14	15	14
6	Between Sirsi Circle and Old Guddahalli Road Junction	2700	2700	2056	3812	1	1	LOS D	LOS F	13	9	15	14
7	Between Old Guttahalli Junction and Deepanjali Nagar Junction	2520	2520	2082	3687	1	1	LOS D	LOS F	12	13	15	14
8	Between Deepanjali Nagar Junction and Nayandhalli	2520	2520	4009	4940	2	2	LOS F	LOS F	8	13	15	15

Table 105. Comparison chart between existing scenario and proposed scenario

Sl. No.	Road Name	WITH IMPROVEMENTS							
		Capacity		V/C Ratio-Morning Peak		Level of Service-Morning Peak		Anticipated Speed (Kmph) as per HCM-Morning Peak	
		Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle
1	Between Hudson Circle and Corporation Circle	4200		1.59		LOS F		15	
2	Between Corporation Circle and Town Hall	2700	2700	1.14	1.99	LOS F	LOS F	15	15
3	Between Town Hall and KR Market	4200	4200	1.15	0.58	LOS F	LOS C	15	30
4	Between KR Market and TCM Royan Road Junction	2700	2700	1.14	0.92	LOS F	LOS E	15	25
5	Between TCM Royan Road Junction and Sirsi Circle	2700	2700	1.02	1.79	LOS F	LOS F	15	15
6	Between Sirsi Circle and Old Guddahalli Road Junction	2700	2700	0.76	1.41	LOS D	LOS F	25	15
7	Between Old Guttahalli Junction and Deepanjali Nagar Junction	4200	4200	0.50	0.88	LOS C	LOS E	30	25
8	Between Deepanjali Nagar Junction and Nayandhalli	4200	4200	0.95	1.18	LOS E	LOS F	25	15

Table 106. Comparison chart between existing scenario and proposed scenario

Sl. No.	Road Name	EXISTING											
		Capacity		Evening Peak Hour Volume (PCUs)		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Bus Journey Speed (Kmph)- Evening Peak		Car Journey Speed (Kmph)- Evening Peak	
		Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle
1	Between Hudson Circle and Corporation Circle	2520	ONE WAY	6911	ONE WAY	2.74	ONE WAY	LOS F	ONE WAY	12		11	
2	Between Corporation Circle and Town Hall	2700	2700	3034	5384	1.12	1.99	LOS F	LOS F	8	8	11	13
3	Between Town Hall and KR Market	2520	2520	4745	2167	1.88	0.86	LOS F	LOS F	13	8	13	15
4	Between KR Market and TCM Royan Road Junction	1755	1755	3722	2463	2.12	1.40	LOS E	LOS C	12	15	14	14
5	Between TCM Royan Road Junction and Sirsi Circle	1620	1620	2639	4871	1.63	3.01	LOS F	LOS C	13	13	14	13
6	Between Sirsi Circle and Old Guddahalli Road Junction	2700	2700	2240	3667	0.83	1.36	LOS D	LOS B	13	15	15	14

Table 107. Comparison chart between existing scenario and proposed scenario

Sl. No.	Road Name	WITH IMPROVEMENTS							
		Capacity		V/C Ratio-Evening Peak		Level of Service-Evening Peak		Anticipated Speed (Kmph) as per HCM-Evening Peak	
		Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle	Towards Mysore Road	Towards Hudson Circle
1	Between Hudson Circle and Corporation Circle	4200	ONE WAY	1.65	ONE WAY	LOS F	ONE WAY	15	ONE WAY
2	Between Corporation Circle and Town Hall	2700	2700	1.12	1.99	LOS F	LOS F	15	15
3	Between Town Hall and KR Market	4200	4200	1.13	0.52	LOS F	LOS C	15	30
4	Between KR Market and TCM Royan Road Junction	2700	2700	1.38	0.91	LOS F	LOS E	15	25
5	Between TCM Royan Road Junction and Sirsi Circle	2700	2700	0.98	1.80	LOS E	LOS F	25	15
6	Between Sirsi Circle and Old Guddahalli Road Junction	2700	2700	0.83	1.36	LOS D	LOS F	25	15
7	Between Old Guttahalli Junction and Deepanjali Nagar Junction	4200	4200	0.54	0.84	LOS C	LOS D	30	25
8	Between Deepanjali Nagar Junction and Nayandhalli	4200	4200	1.00	1.15	LOS F	LOS F	15	15

Elevated Corridor from Sirsi Circle to Nayandahalli

Based on the traffic analysis, it has been identified that the stretch between Sirsi Circle and Nayandahalli Junction requires improvements to ensure smoother traffic flow. To address this, an elevated corridor is proposed, extending from the existing Sirsi Flyover to Nayandahalli. The design includes an elevated rotary at the Deepanjalinagar Junction along Mysore Road, as depicted in the detailed figure 320

This elevated corridor will feature a direct connecting loop from the existing Sirsi Flyover towards K.R. Market, coming from Nayandahalli, along with an upward ramp and a downward ramp before the Sirsi Flyover begins. Additionally, a downward ramp is provided near Deepanjalinagar Junction to facilitate traffic heading towards Vijayanagar via West of Chord Road. The elevated rotary will be constructed at the first level to enable seamless traffic movement from all four directions.

Corridor 21: Elevated corridor from Sirsi circle to Nayandahalli

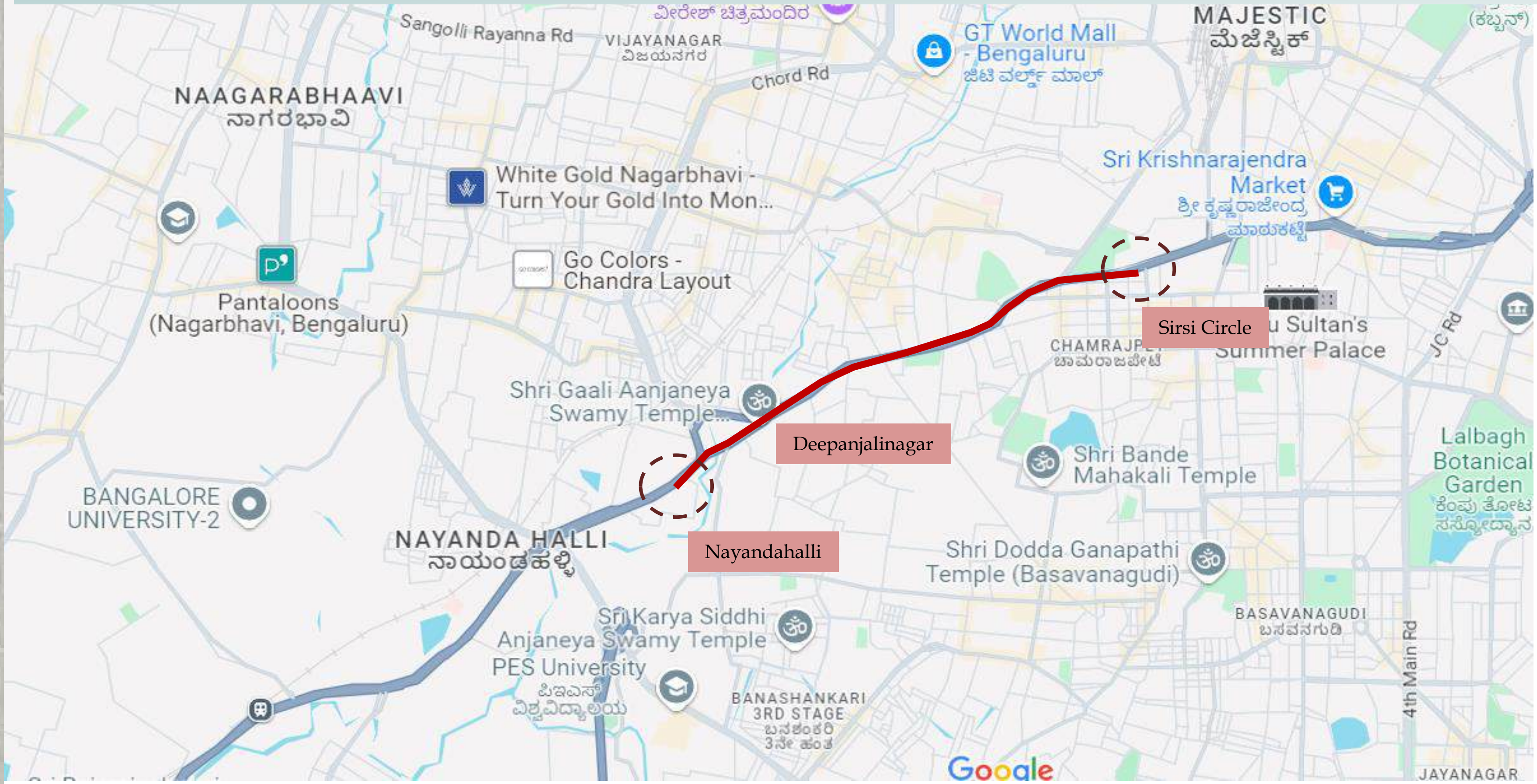


Figure 320 Proposed Elevated Corridor from Sirsi circle to Nayandahalli on Mysore road

Elevated Rotary

An **elevated rotary** (also known as an elevated roundabout or flyover roundabout) is a type of circular intersection where a roundabout structure is raised above ground level, often used to manage traffic at congested intersections or freeway interchanges. Elevated rotaries aim to allow traffic to flow without stopping, reducing congestion by removing traffic signals or intersections on the ground level below.

Advantages of Elevated Rotary

1.Improved Traffic Flow: Elevated rotaries allow continuous traffic movement, reducing stops, delays, and congestion.
2.Enhanced Safety: Fewer conflict points compared to traditional intersections reduce the likelihood of accidents.
3.Efficient Land Use: By building vertically, elevated rotaries make efficient use of space, especially in urban or densely populated areas.
4.Reduced Pollution and Fuel Consumption: Smoother traffic flow means fewer idling vehicles, leading to lower emissions and fuel use.
5.Aesthetic Value: Well-designed elevated structures can add architectural appeal to urban settings.

Disadvantages of Elevated Rotary

1.High Construction Costs: Building elevated structures is expensive due to the materials, labor, and engineering complexity.
2.Maintenance Challenges: Elevated rotaries require regular maintenance and inspections to ensure structural integrity, adding to long-term costs.
3.Complex Navigation: Drivers unfamiliar with elevated rotaries may find them challenging to navigate, increasing the chance of confusion and accidents.
4.Visual and Noise Impact: Elevated structures may obstruct views, reduce natural light, and generate more noise, affecting the quality of life for nearby residents.
5.Accessibility Issues: For pedestrians and cyclists, elevated rotaries may be less accessible or safe, requiring additional infrastructure like ramps or underpasses.

Summary

While elevated rotaries improve traffic flow and safety, they come with high costs and certain environmental and social impacts. They are best suited for heavily congested intersections where the benefits outweigh the costs.

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Elevated corridor from Sirsi circle to Nayandahalli

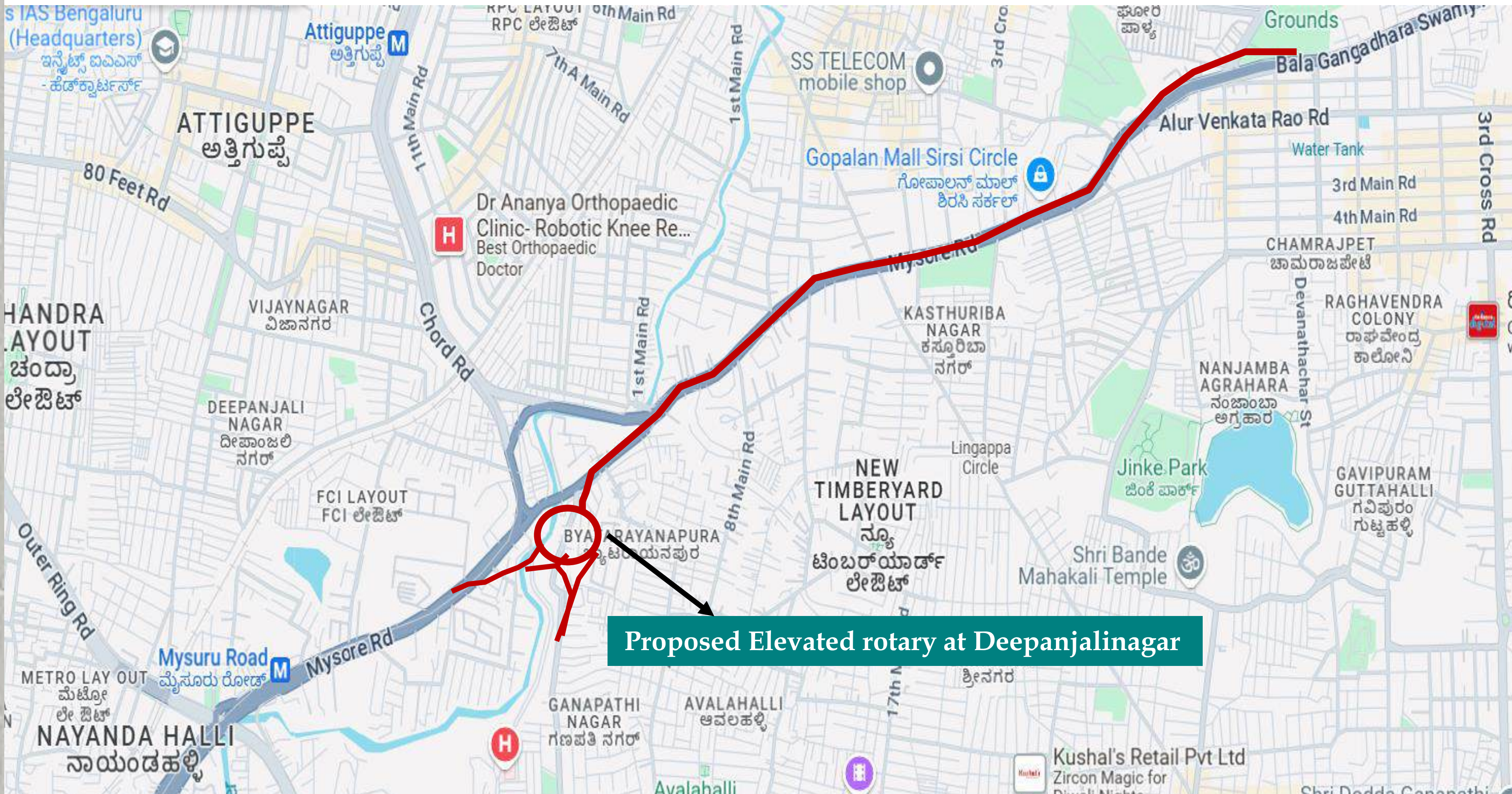


Figure 321. Proposed Elevated Corridor from Sirsi circle to Nayandahalli on Mysore road

Proposed Elevated Rotary at Deepanjali Nagar along Mysore road

An elevated rotary is proposed at the West of Chord Mysore Road junction to manage traffic flow in all four directions. Given the presence of an existing elevated Metro line, the rotary will be ideal for addressing the traffic challenges in the area. This design will enable seamless movement of vehicles towards Nayandahalli, West of Chord Road, Sirsi Circle, and the NICE corridor."

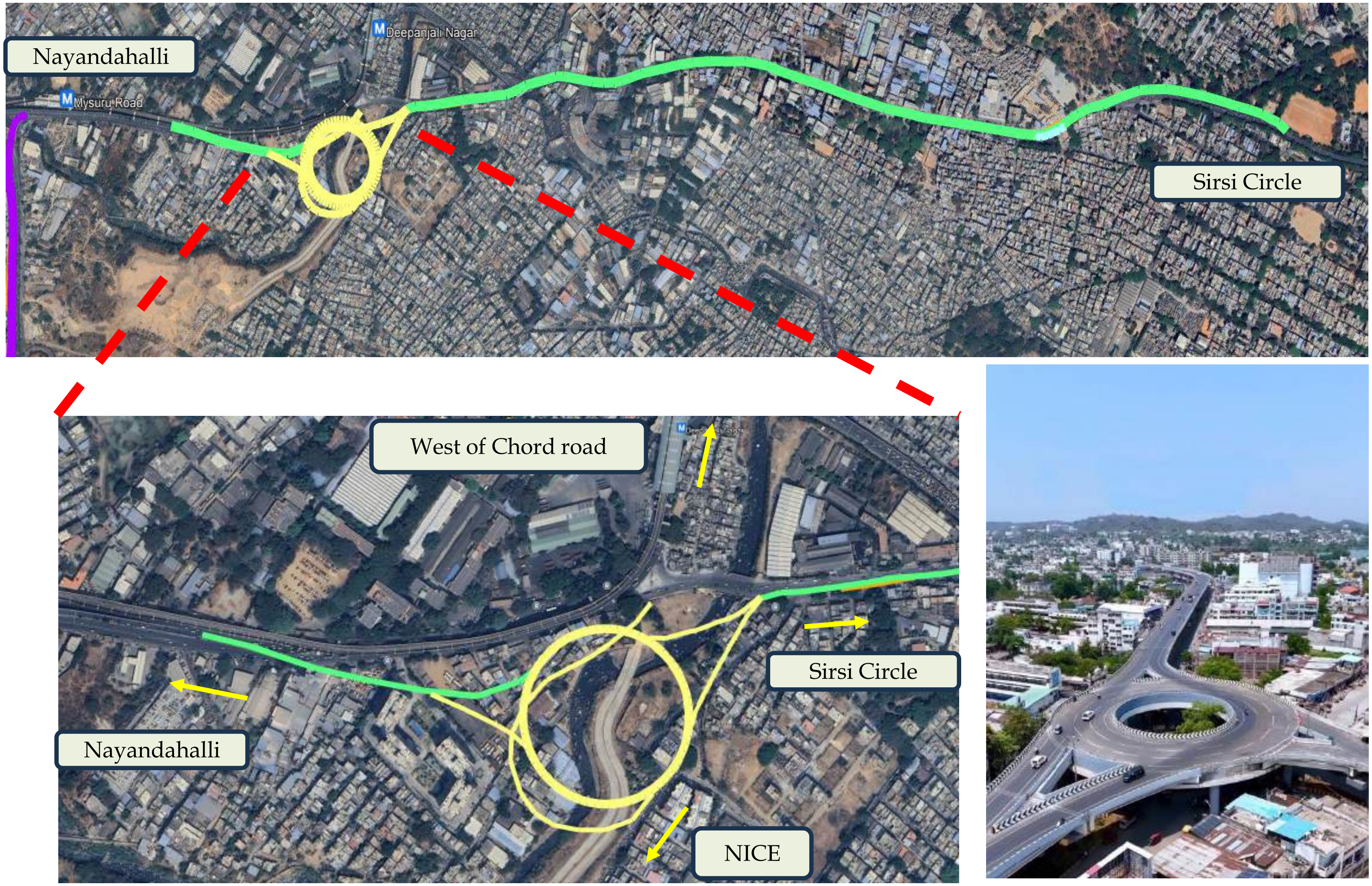
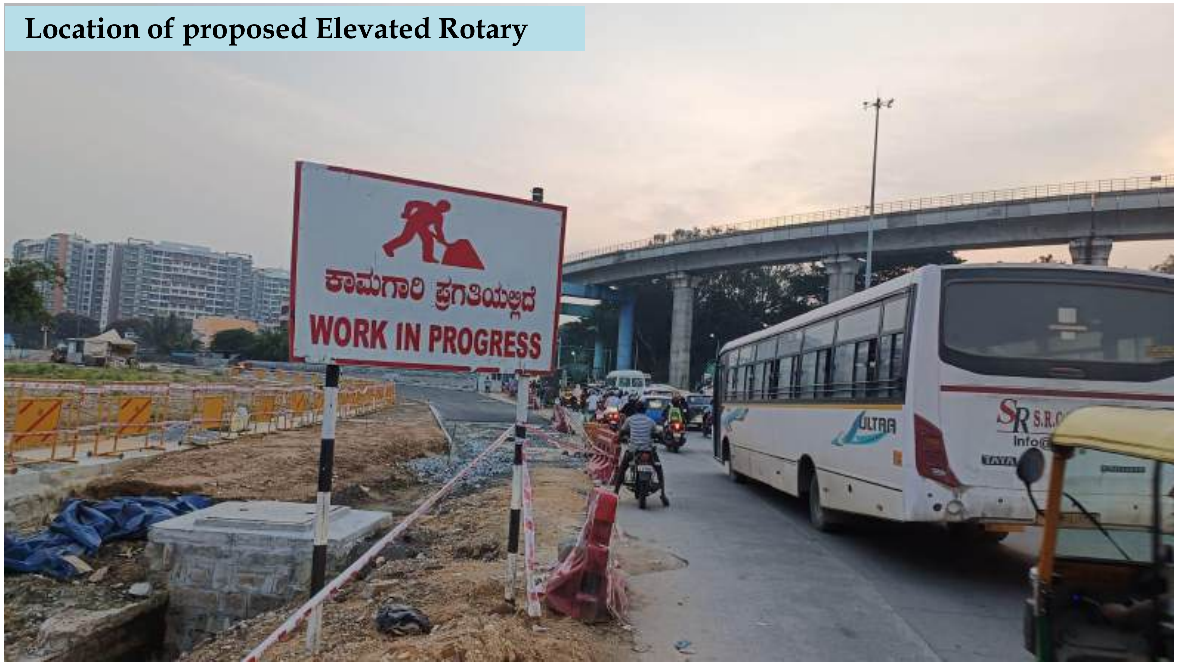


Figure 322. Proposed Elevated Rotary at Deepanjalii Nagar junction on Mysore road

Proposed Elevated Rotary at Deepanjali Nagar along Mysore road location of Ramps

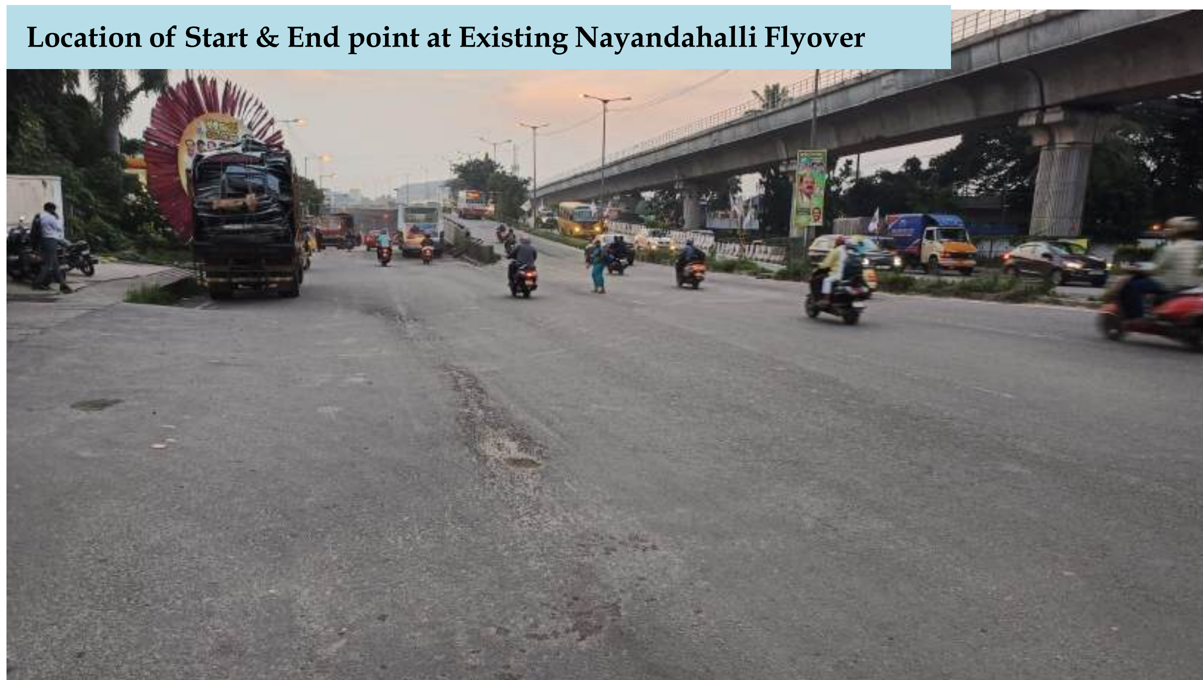
Figure 323. Site photos of the Proposed Elevated corridor from Sirsi circle to Nayandahalli on Mysuru

Location of proposed Elevated Rotary



At this point an elevated rotary is proposed which will integrate all the traffic from four sides and help in seamless traffic movement.

Location of Start & End point at Existing Nayandahalli Flyover



The proposed elevated corridor from Sirsi Flyover terminates at the existing Nayandahalli Flyover

Figure 324. Site photos of the Proposed Elevated corridor from Sirsi circle to Nayandahalli on Mysuru

Proposed cross 4 lane undivided Elevated corridor from Sirsi circle to Nayandahalli flyover

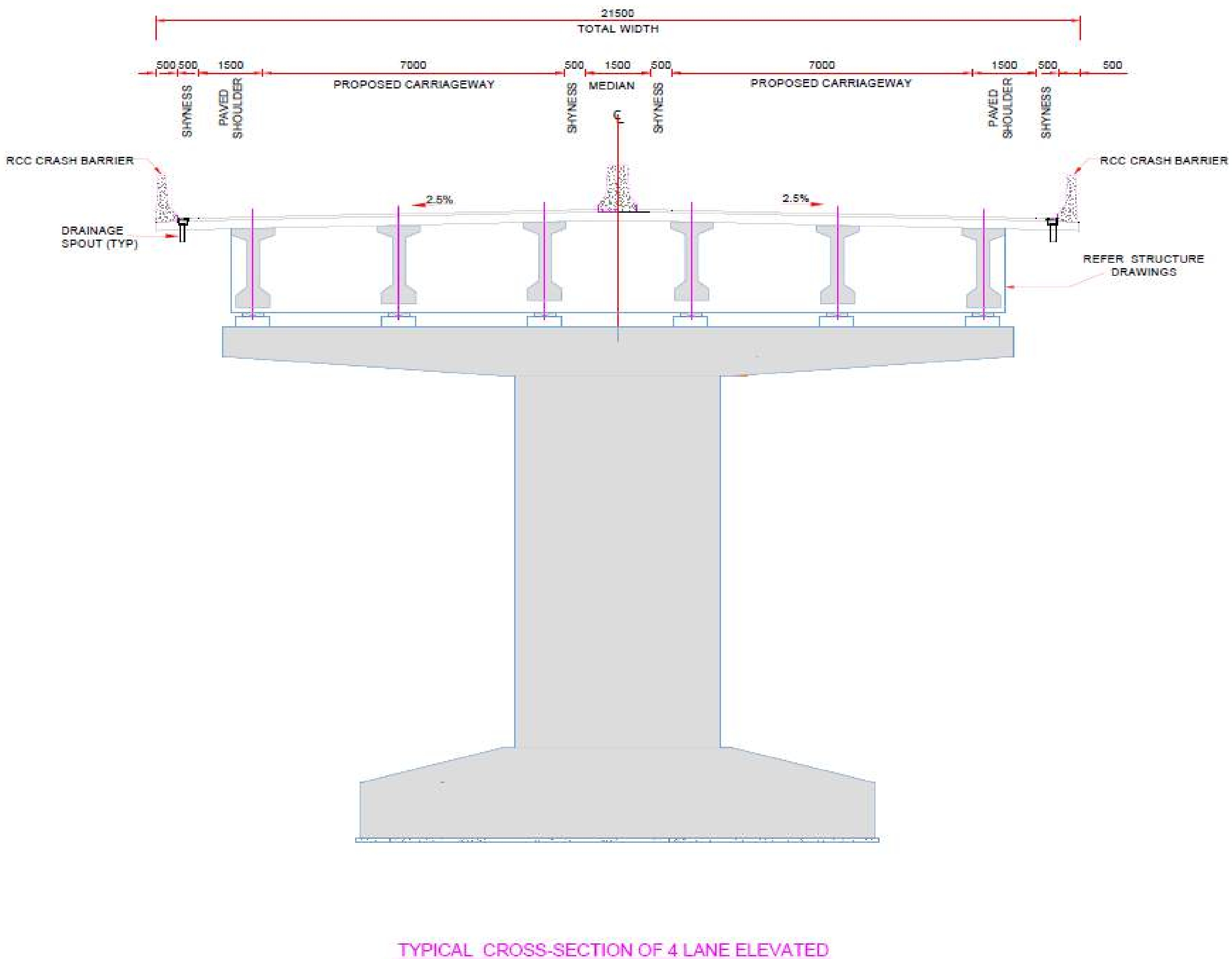


Figure 325. **Proposed cross section for the Elevated corridor from Sirsi circle to Nayandahalli flyover**

Proposed cross 6 lane undivided Elevated corridor from Shoolay Circle to Silk board on Hosur road

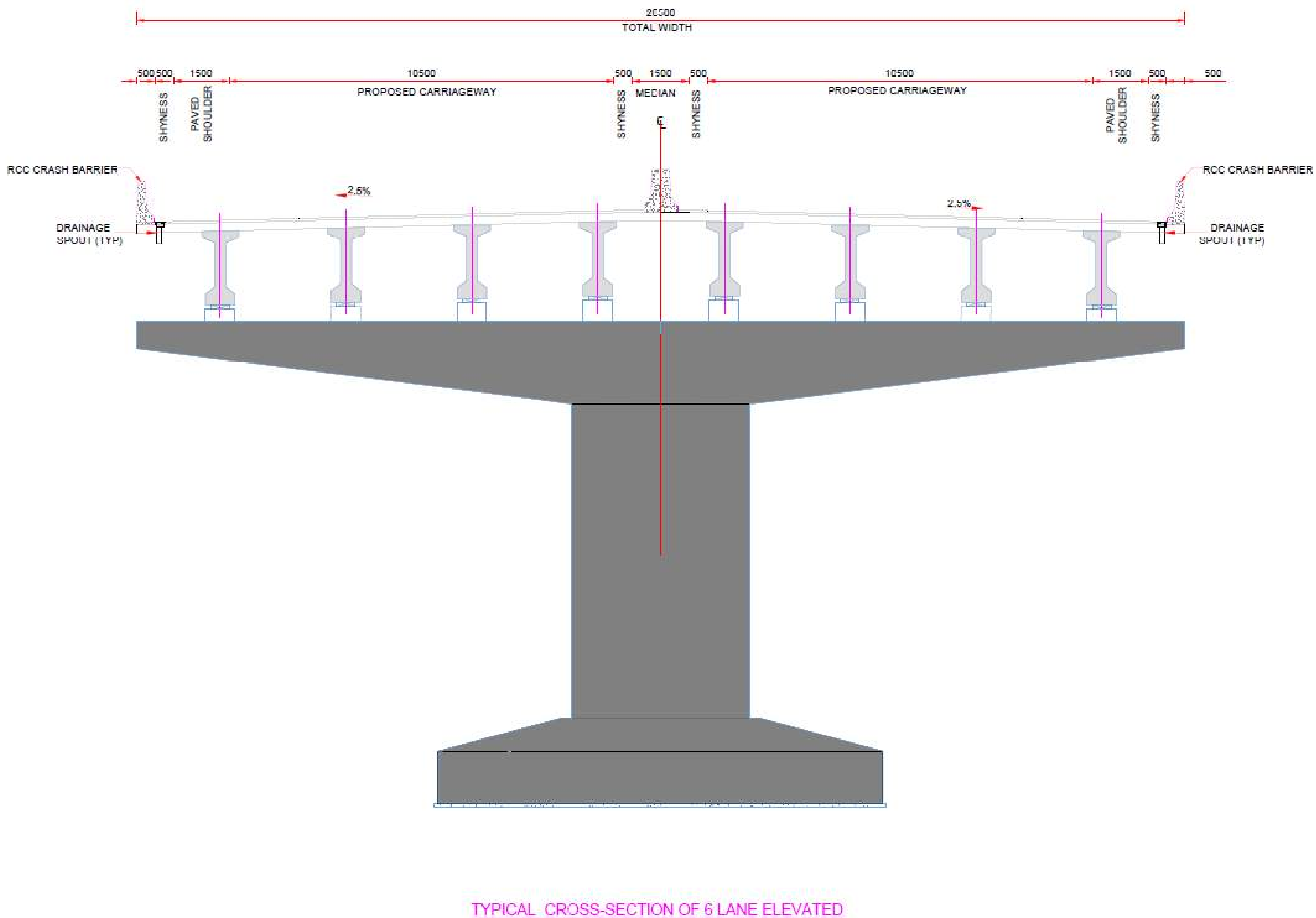
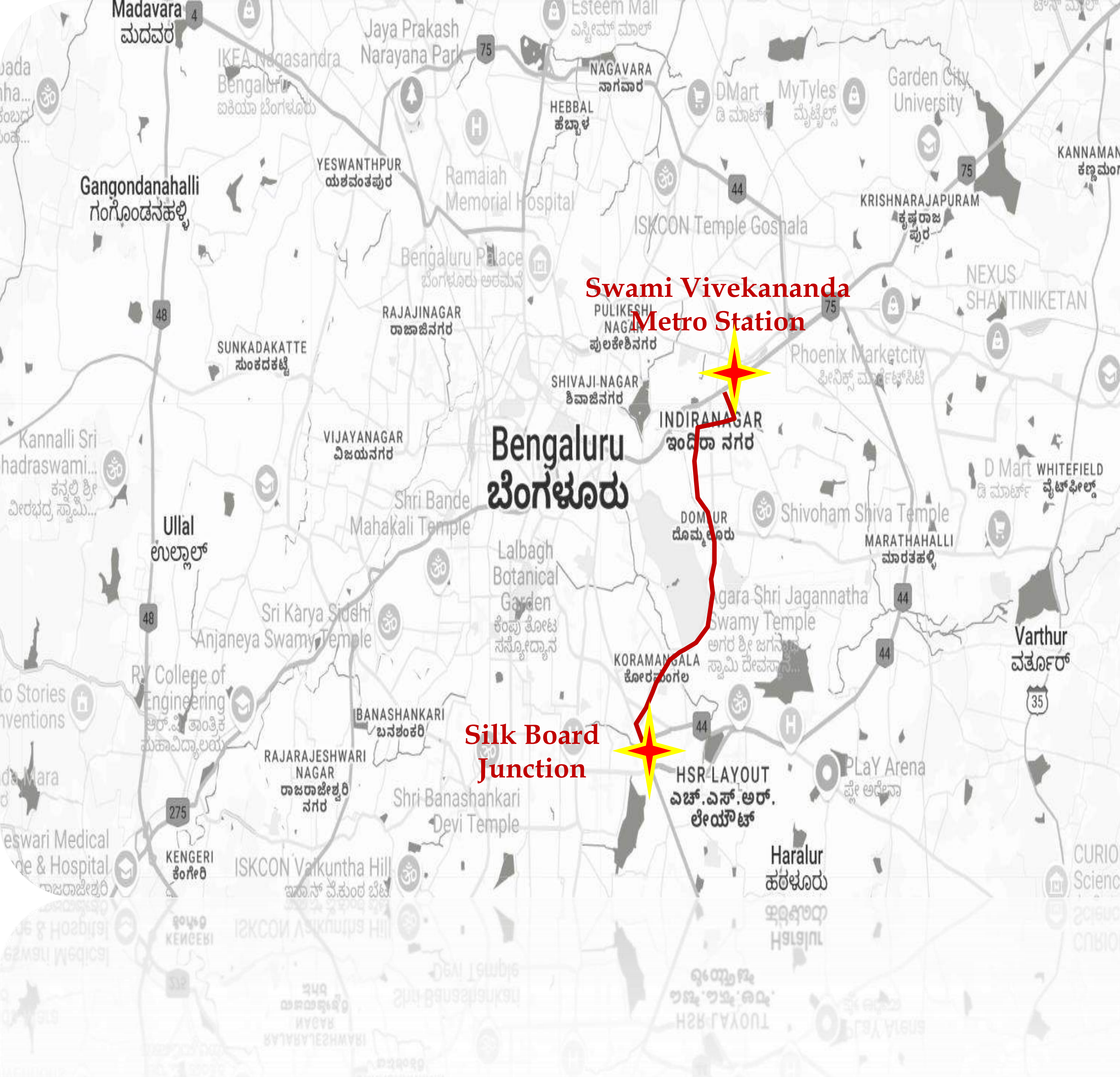


Figure 326. **Proposed cross section for Elevated corridor from Sirsi circle to Nayandahalli flyover**



CORRIDOR

10

Old Madras Road to Hosur Road

Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar- Domlur- Madiwala

Old Madras Road,Vivekananda Metro Station to Silk Board Junction via Indiranagar-Domlur- Madiwala

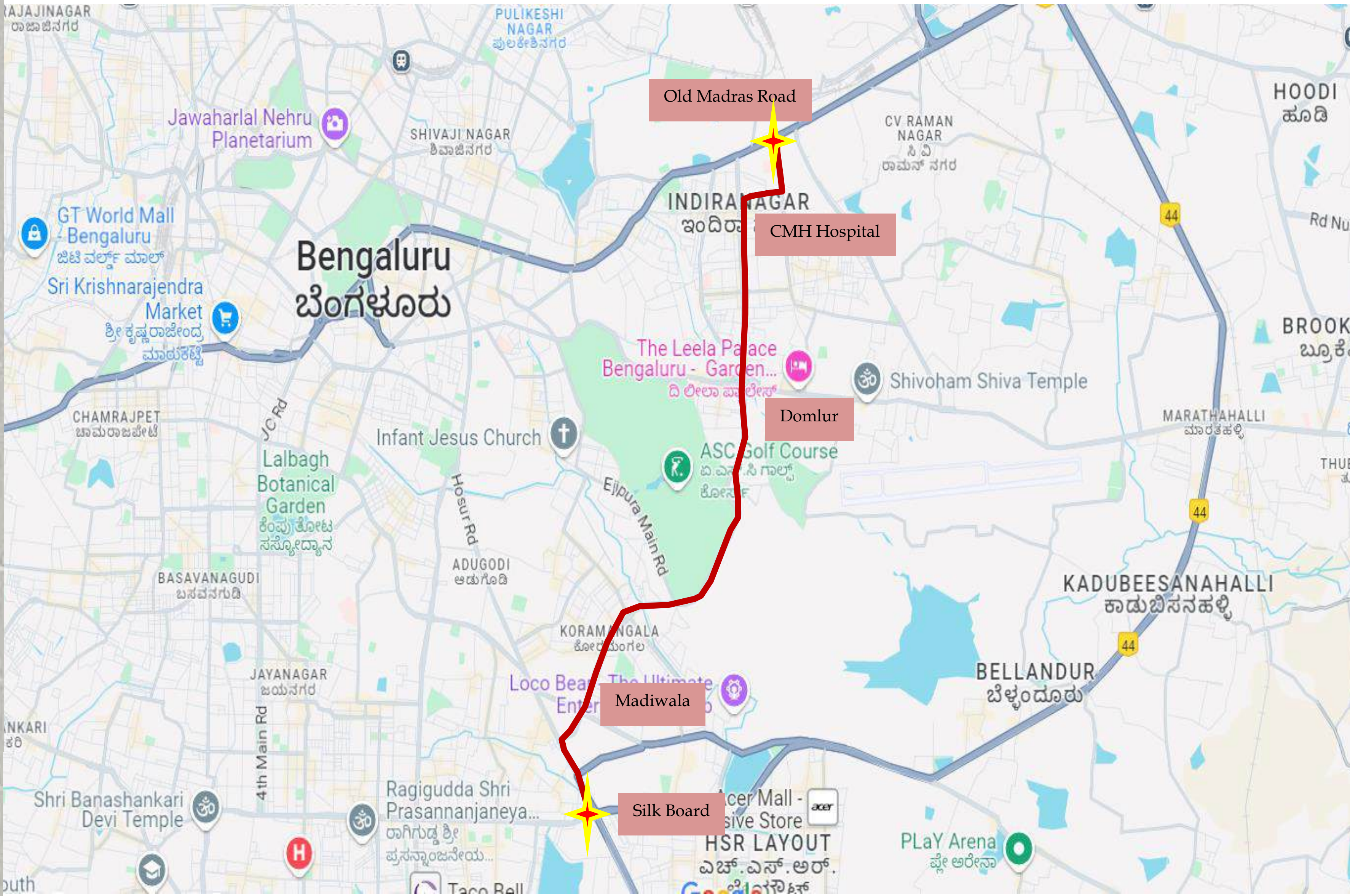
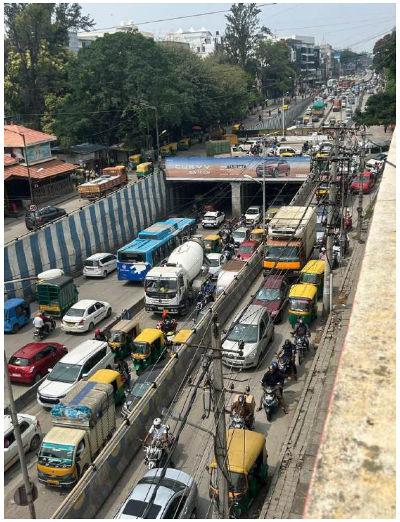


Figure 327.Proposed Elevated corridor from Old Madras road Swami Vivekananda Metro Station to Silk Board on Hosur Road

Proposed Elevated Corridor from Old Madras road to Silk board– Alignment details



The route from Madiwala to Old Madras Road via Domlur is a major traffic corridor in Bangalore that experiences significant congestion, especially during peak hours. This route connects South and East Bangalore, passing through key commercial and residential areas, including Madiwala, Koramangala, Domlur, and Indiranagar, before reaching Old Madras Road. Here's an analysis of the traffic conditions along this stretch and the factors contributing to congestion:

Key Causes of Congestion

1.High Volume of Commuter and Commercial Traffic: This route serves a large number of office-goers, especially since it connects major business hubs in Koramangala, Domlur, and Indiranagar. With many IT companies, commercial establishments, and retail outlets located along the way, this road is consistently busy throughout the day, with peak congestion during morning and evening commute hours.

2.Multiple Intersections and Signals: The route from Madiwala to Old Madras Road has numerous intersections and traffic signals that disrupt the flow. Key junctions, including St. John's Hospital junction, Sony World junction, EGL (Embassy Golf Links) entrance, and the Domlur flyover, create frequent stop-and-go situations, leading to prolonged delays during peak hours.

3.Narrow Roads and Lane Changes: In sections like Koramangala and Domlur, road widths are often insufficient to accommodate the high traffic volume, leading to frequent lane changes. The Domlur flyover has limited entry and exit lanes, which adds to the bottleneck as vehicles converge from different directions.

4.Pedestrian Crossings and Local Traffic: The route has several commercial areas and residential complexes, leading to frequent pedestrian crossings and local traffic entering and exiting side streets. This interaction between through-traffic and local traffic creates congestion, especially near malls, restaurants, and other popular spots in Koramangala and Indiranagar.

5.Mixed Traffic with Public Transport Stops: BMTC buses, autos, and cabs frequently stop to pick up and drop off passengers, adding to the slowdowns. The stops are often close to intersections or signal points, which can create bottlenecks, especially in busy areas like Sony World junction and near the Domlur flyover.

6.Ongoing Infrastructure Projects and Construction: Periodic roadwork, metro construction, and maintenance projects further reduce road space and create temporary diversions along this route, adding to the congestion.

Characteristics of Traffic Flow

•**Stop-and-Go Movement**: The combination of heavy traffic volume, signals, and pedestrian crossings leads to stop-and-go movement throughout this stretch, especially during peak hours. This pattern is evident near major intersections like Sony World junction and the Domlur flyover.

•**Peak Hour Delays**: Morning and evening rush hours see the highest congestion, with significant delays around 8–11 a.m. and 5–8 p.m. Travel time along this route can increase considerably, especially on Fridays or during rainy weather, which slows down traffic further.

•**Lane Merging at Flyover Exits**: The Domlur flyover is a major bottleneck, with vehicles merging from different directions (including Indiranagar, Koramangala, and Inner Ring Road). This leads to slower movement as vehicles attempt to merge into limited lanes.

Potential Solutions to Improve Traffic Flow

1.**Dedicated Bus Lanes and Improved Public Transport Options**: Creating dedicated bus lanes, where feasible, could improve the flow of public transport and reduce delays caused by buses stopping on main lanes. Additionally, encouraging greater use of metro services (once the metro line expands) could reduce road congestion.

2.**Improved Signal Coordination and Adaptive Traffic Signals**: Using adaptive traffic signals that adjust based on real-time traffic conditions could help manage congestion more effectively, especially at intersections like Sony World junction and the Domlur flyover.

3.**Additional Pedestrian Overpasses and Footpaths**: Constructing pedestrian overpasses or underpasses at high-traffic pedestrian points, particularly near Koramangala and Domlur, would improve pedestrian safety and reduce the need for vehicles to stop for crossings.

4.**Grade Separation at Key Junctions**: Grade separation at critical junctions like Sony World junction or constructing an elevated corridor or underpass in heavy traffic areas like Domlur could streamline vehicle movement and reduce the frequency of stops.

5.**Implementation of One-Way Systems Where Feasible**: Implementing one-way routes on some feeder roads, especially in Koramangala and Indiranagar, could reduce conflicts between vehicles entering and exiting main roads, improving the overall flow.

6.**Strict Enforcement of Parking Regulations**: Illegal parking along the route, especially in commercial areas, reduces available road space. Strict enforcement and designated parking zones could help free up space, particularly in Koramangala and Indiranagar.

7.**Expansion of Metro Connectivity**: Expediting the construction and expansion of the metro along this route would provide a viable alternative for commuters, reducing the number of private vehicles on the road and alleviating congestion in the long term.

Proposed Elevated Corridor from Old Madras road to Silk board– Alignment details

The traffic congestion between Madiwala and Old Madras Road via Domlur is largely due to heavy commuter and commercial traffic, varied vehicle types, pedestrian crossings, and limited road capacity. Long-term improvements like expanded metro connectivity and grade separation at key junctions could greatly ease these conditions. In the short term, measures such as dedicated bus lanes, coordinated signals, and enhanced pedestrian infrastructure could help streamline traffic flow.

Additionally, constructing an elevated corridor along this route could significantly reduce congestion. By functioning as an expressway for through-traffic, the elevated corridor would alleviate surface-level congestion, enabling vehicles to bypass busy intersections and avoid frequent stops, thus improving overall traffic movement and reducing delays on this key corridor.

Potential Benefits of an Elevated Corridor

1.Reduced Traffic Load at Surface Level: An elevated corridor would allow vehicles, especially those commuting between South Bangalore and East Bangalore, to bypass crowded areas like Koramangala, Sony World junction, and Domlur flyover. This would reduce the number of vehicles on surface roads, leaving them less congested for local traffic.

2.Improved Travel Time and Efficiency: An uninterrupted elevated corridor would provide a faster route with fewer stops, improving travel time for commuters. Vehicles could move more efficiently between Madiwala and Old Madras Road, especially during peak hours, as they would avoid intersections and signal stops.

3.Decreased Bottlenecks at Key Junctions: Major bottlenecks at Sony World junction, EGL, and the Domlur flyover could be eased, as through-traffic would be diverted above these intersections. This would prevent the merging and lane-changing issues that contribute to congestion at these points.

4.Enhanced Public Transport Movement: If the elevated corridor includes a dedicated lane for buses or allows BMTC buses to use it, it could speed up public transport, making bus commutes more reliable. This could encourage more people to use buses instead of private vehicles, reducing surface-level traffic further.

5.Reduced Pollution and Improved Air Quality: By reducing the amount of stop-and-go traffic at the surface level, an elevated corridor could help decrease idling time for vehicles, which in turn would lower emissions. Improved traffic flow leads to better fuel efficiency and less pollution in densely populated areas like Koramangala and Domlur.

6.Better Pedestrian Safety: Reduced congestion at the surface level means fewer interactions between vehicles and pedestrians, especially in busy areas where people frequently cross roads. This could enhance pedestrian safety and reduce traffic-related incidents.

Old Madras Road, Vivekananda Metro Station to Silk Board Junction via Indiranagar-Domlur- Madiwala

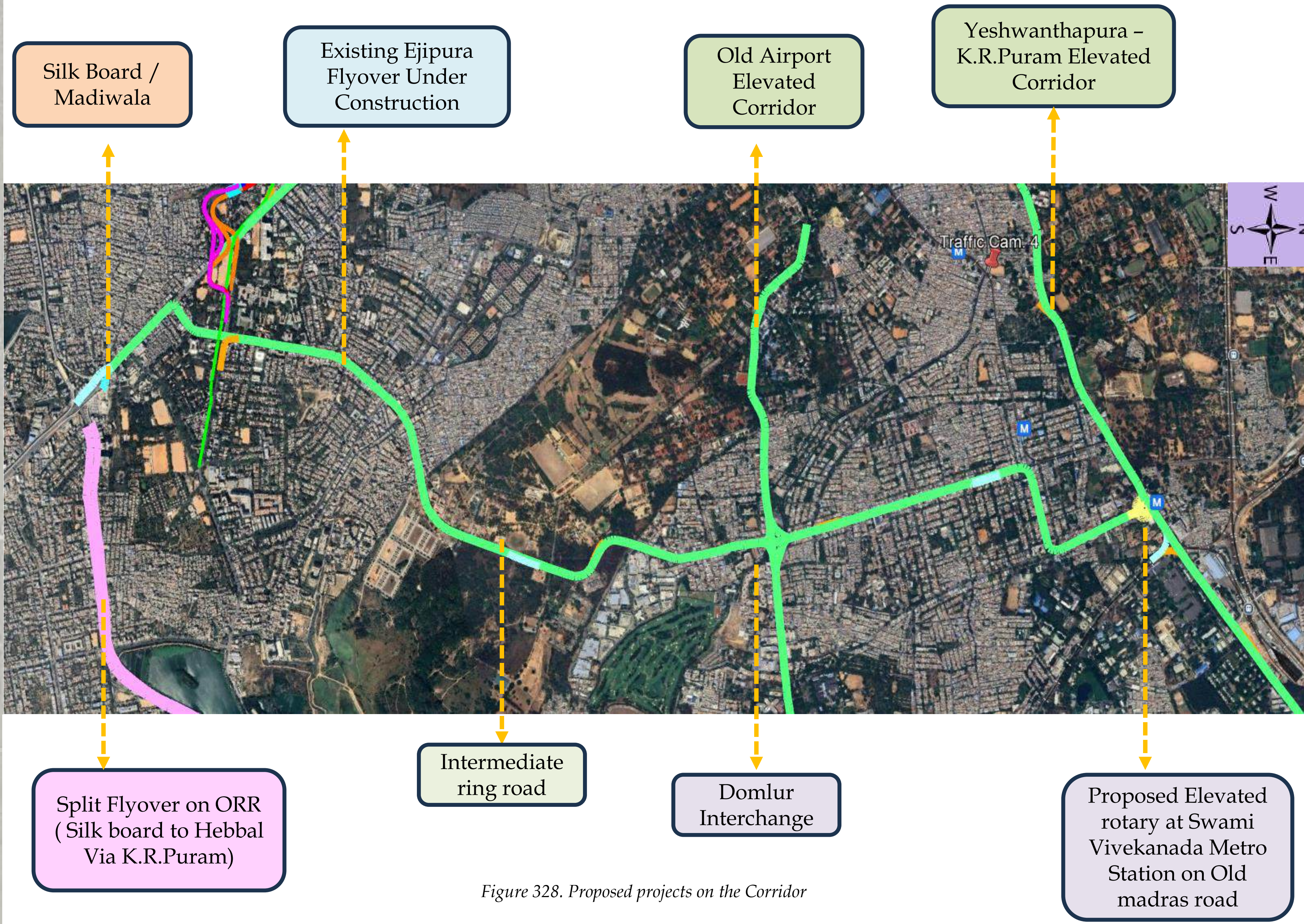


Figure 328. Proposed projects on the Corridor

Proposed Elevated Corridor from Old Madras road to Silk board– Alignment details

The proposed corridor will serve as a crucial link between Silk Board and Old Madras Road, traversing some of the city's most congested areas, including Madiwala, Ejipura, Koramangala, and Indiranagar. It is designed to connect with the ongoing Ejipura flyover project, continuing along the Intermediate Inner Ring Road, crossing the Domlur interchange, and taking a right near C.M.H. Hospital. Ultimately, the corridor will merge with the elevated route on Old Madras Road through an elevated rotary.

The elevated corridor begins at Silk Board, with ramps integrated into the existing loops of the Silk Board interchange

The elevated corridor makes its first right turn at the Madiwala underpass, continuing along 100 ft Road

The elevated corridor merges with the ongoing Ejipura flyover construction, extending past Sony World Junction and connecting with the Intermediate Inner Ring Road.

Figure 329. Proposed Project Corridor section wise details

Proposed Elevated Corridor from Old Madras road to Silk board– Alignment details

The elevated corridor connects with the existing interchange at Domlur, as well as the elevated corridor extending from Varthur to the ASC Center on Old Airport Road. This will be a significant interchange, where two elevated corridors intersect with the current infrastructure.

Figure 330. Proposed Project Corridor section wise details

Proposed Elevated Corridor from Old Madras road to Silk board– Alignment details

Yeshwanthapura – K.R.Puram Elevated Corridor

Existing Metro Line

Proposed Rotary near Swami Vivekanada Metro Station

Directly aligning the elevated corridor with Old Madras Road is unfeasible due to the existing metro line in the center of the road. Constructing the corridor on either side would require significant land acquisition, and merging onto Old Madras Road is complicated by the differing heights of the metro line and the Yeshwanthapur-Old Madras elevated corridor, which will be at levels 1 and 2. Therefore, the alignment is planned to turn right onto C.M.H. Road.

Upon reaching C.M. Hospital, the alignment turns right at Shri Krishna Temple, then merges with the proposed elevated rotary on Old Madras Road, marking the end of the corridor

Figure 331.Proposed Project Corridor section wise details

Proposed Elevated Corridor from Old Madras road to Silk board– Alignment details

A **three-arm elevated rotary** is a circular traffic interchange located at an elevated level, typically above ground, designed to manage traffic from three connecting roads or highways. It functions similarly to a roundabout but is elevated, often built above an existing road network to manage traffic flow efficiently.

Here's how it works:

1.Three Arms: This rotary connects three different roads or routes that converge at one point. The traffic from each arm enters the circular rotary and can exit onto any of the other two connecting roads, ensuring continuous movement without the need for traditional intersections or stoplights.

2.Elevated Structure: The rotary is constructed above ground, allowing it to handle traffic flows from multiple directions while avoiding the interference of ground-level traffic. It is especially useful in busy urban areas or where there are multiple crossing points.

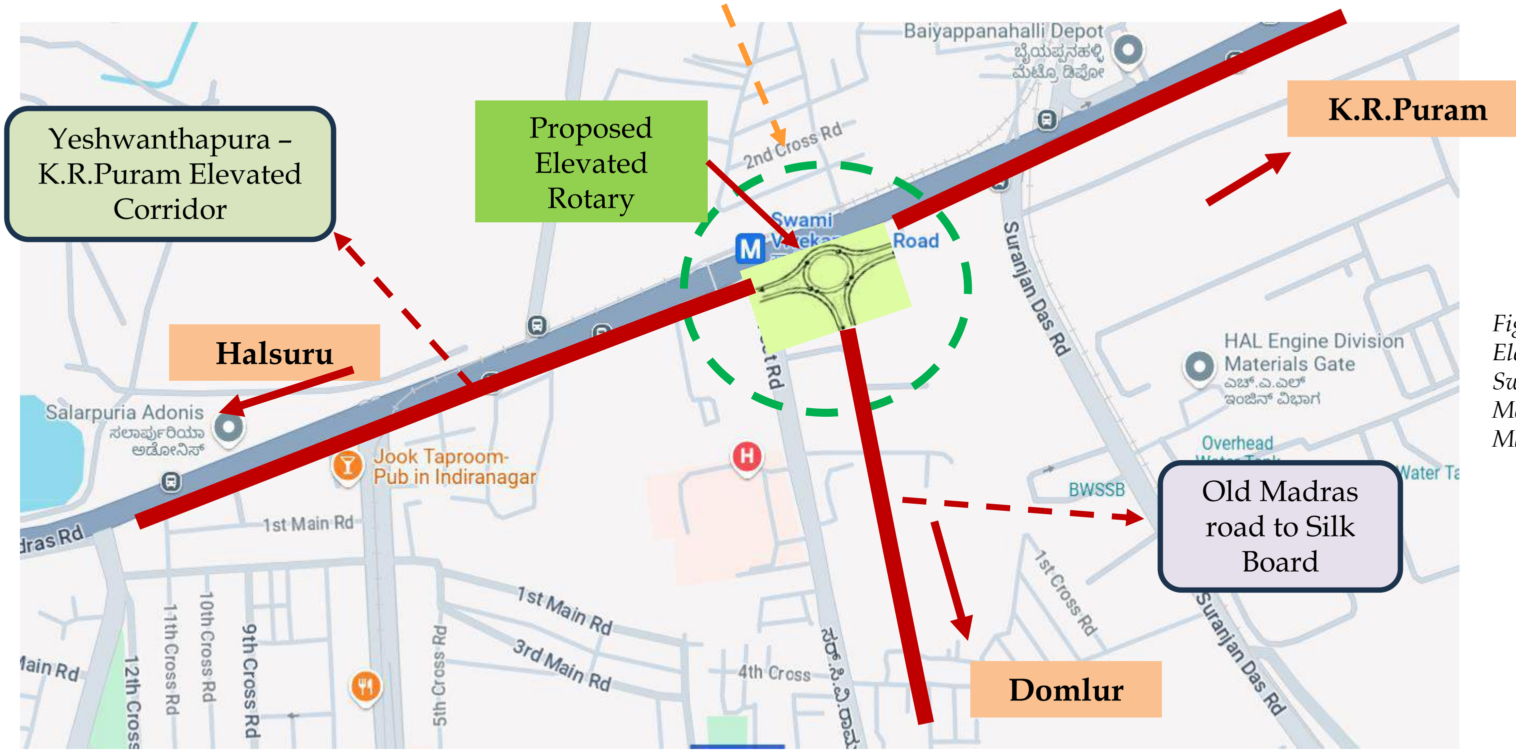


Figure 332..Proposed Elevated Rotary at Swami Vivekananda Metro Station On Old Madras Road

Proposed cross 4 lane undivided Elevated corridor from Sirsi circle to Nayandahalli flyover

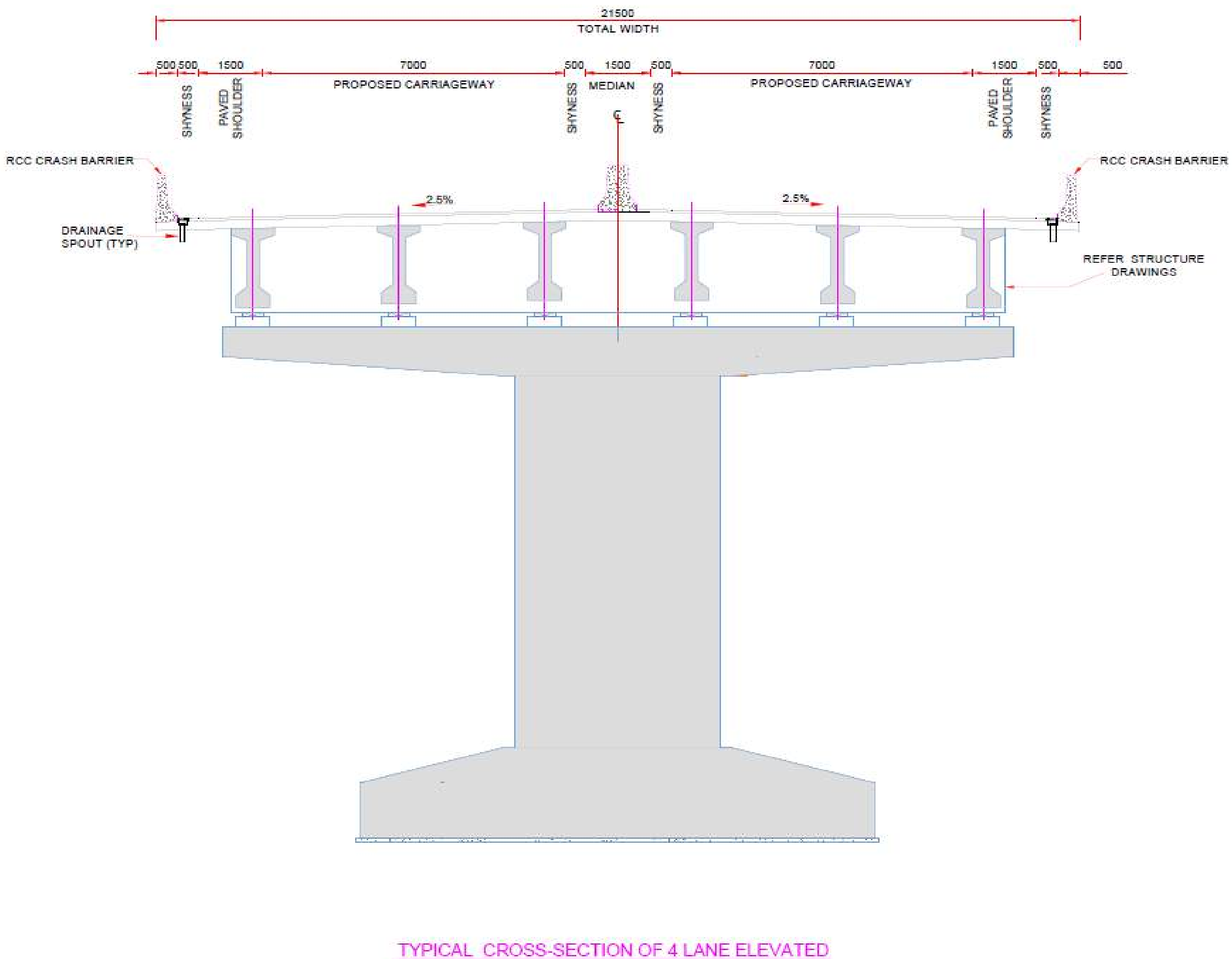


Figure 404. **Proposed cross section for the Elevated corridor from Sirsi circle to Nayandahalli flyover**

Proposed cross 6 lane undivided Elevated corridor from Shoolay Circle to Silk board on Hosur road

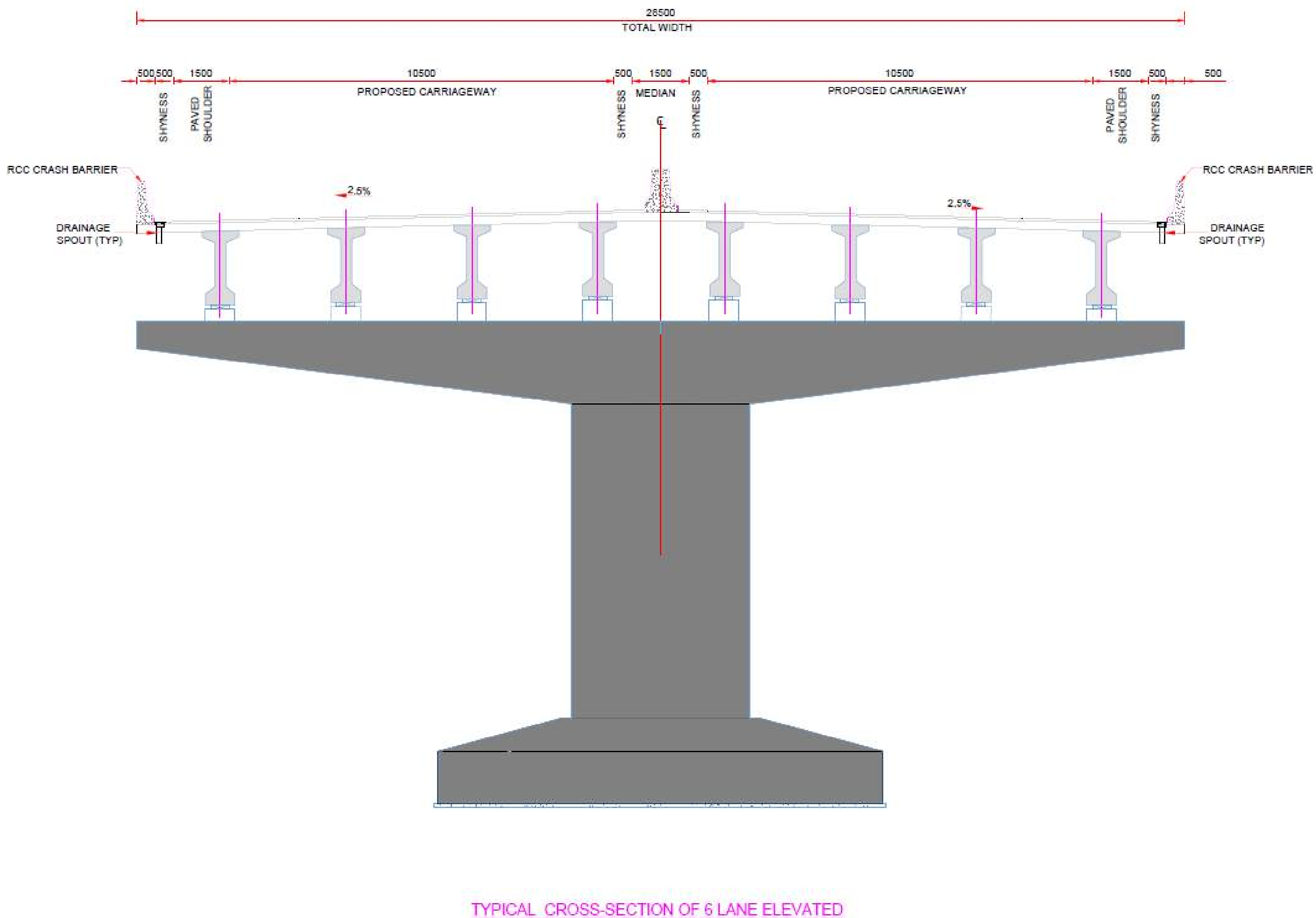
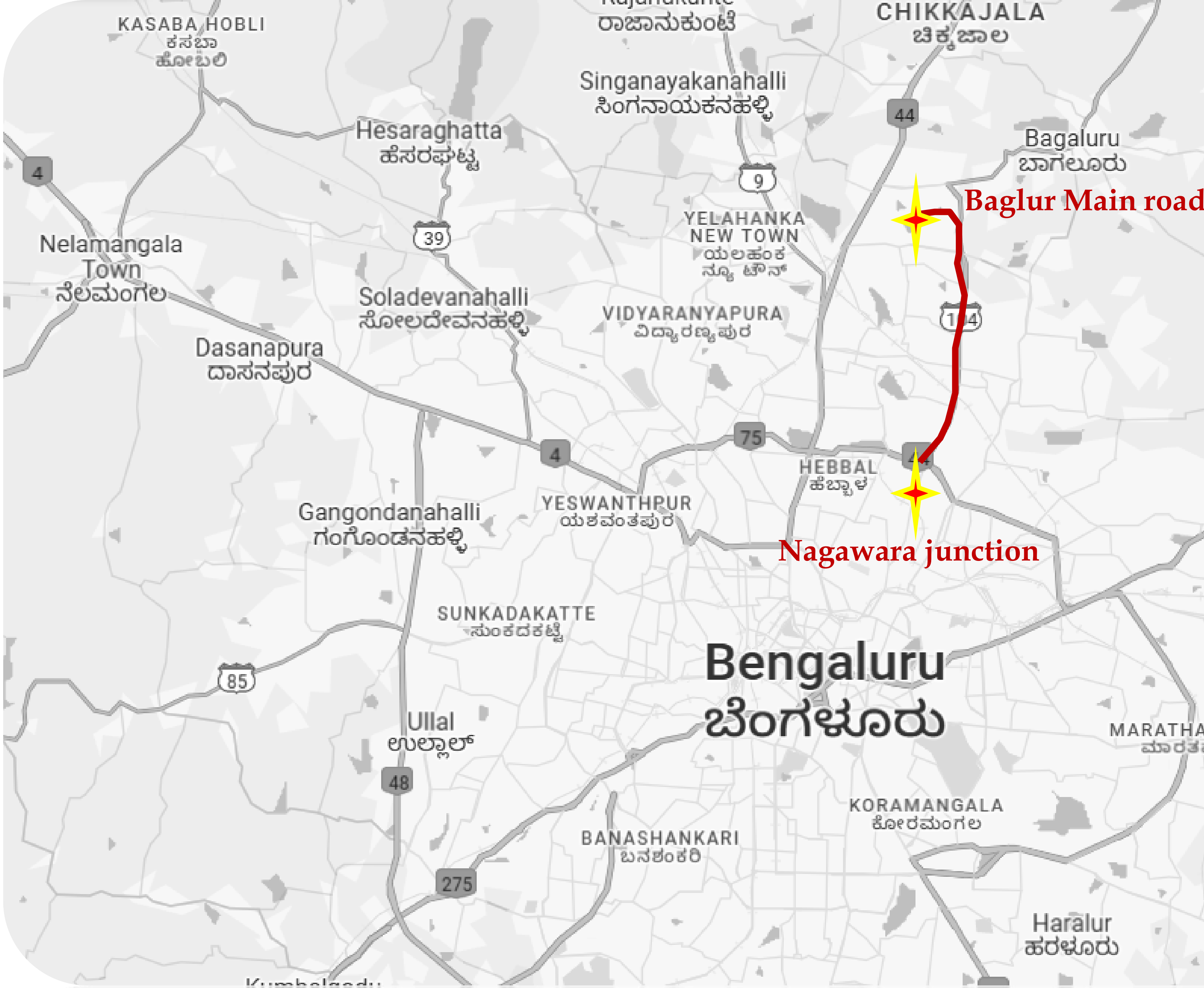


Figure 333. **Proposed cross section for Elevated corridor from Sirsi circle to Nayandahalli flyover**



CORRIDOR 11

Thanisandra Main Road

Proposed Elevated Corridor from Nagawara junction- Ramakrishna HedgedeNagar Junction- Sampigehalli- Tirumenahalli- Bellahalli junction- Bagalur main road

Integrated Elevated flyover from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road

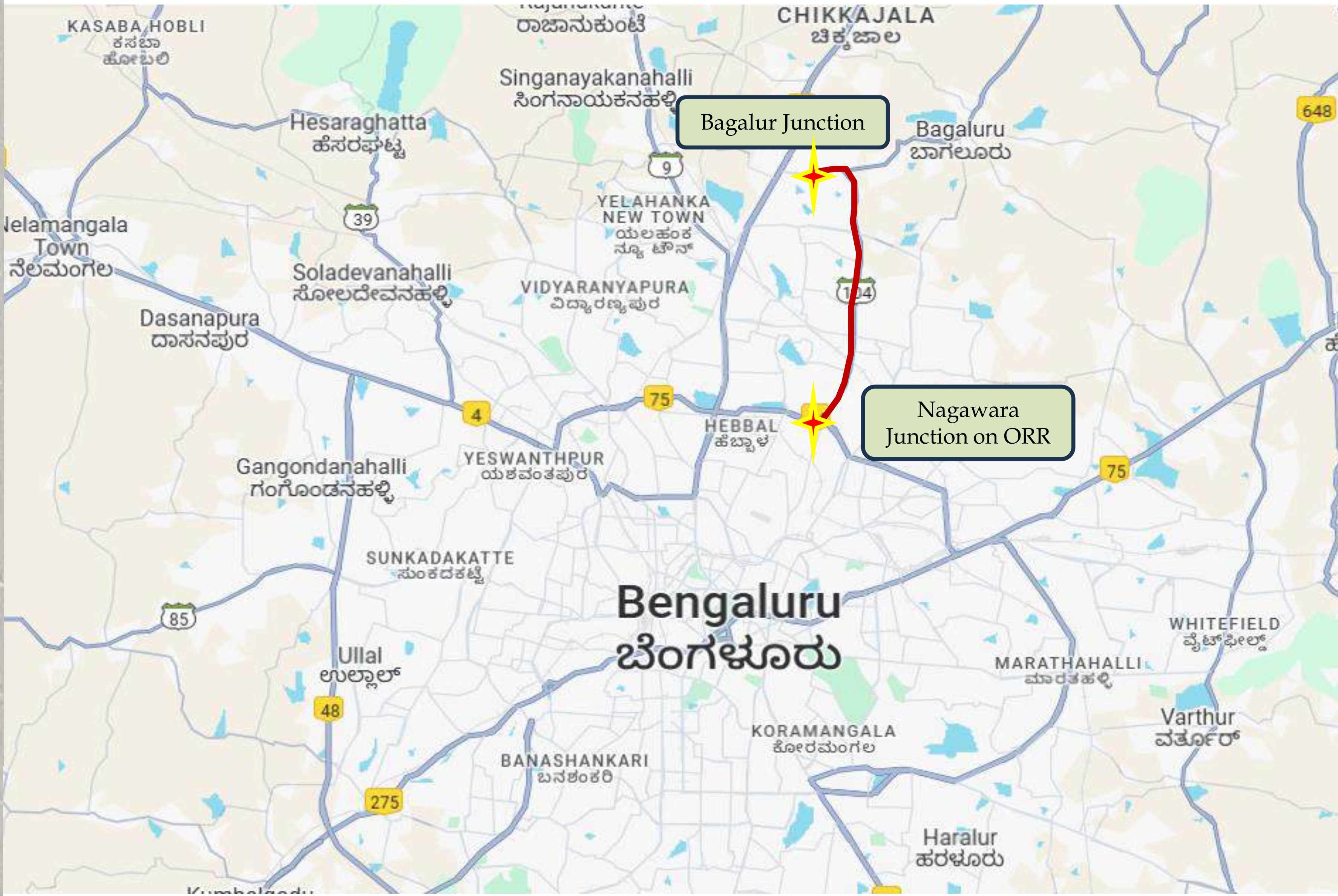


Figure 334.Proposed Elevated Corridor from Nagawara junction on ORR to Bagalur Main road

Integrated Elevated flyover from Nagawara junction-Ramakrishna Hedgede Nagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road.

The proposed corridor will provide a vital alternative route between the Outer Ring Road and Airport Road. Beginning at the Nagawara junction on the Outer Ring Road, it extends to Bagalur Main Road, bypassing heavily congested areas like Sarai Palya, Thannisandra, and Hedge Nagar. Over time, this area has seen significant development, with the growth of IT hubs such as Bharatiya City, residential complexes, and institutions like Reva University and KNS Institute of Technology. Additionally, facilities such as the Haj House and multiple convention centers have been established here. To accommodate traffic demand, a 10 km elevated corridor is planned, featuring several on- and off-ramps to facilitate smoother traffic flow and better connectivity for commuters along the route.

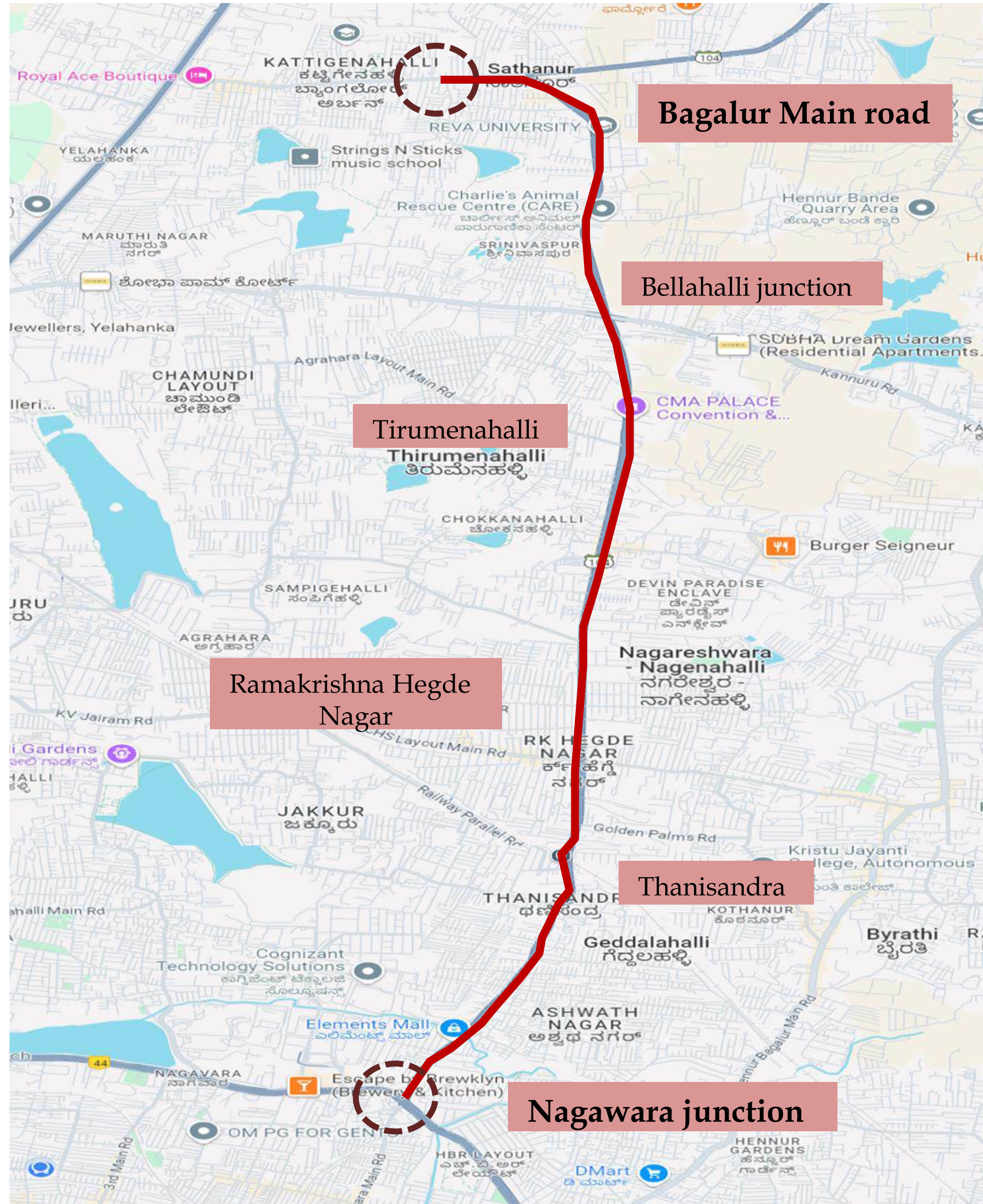


Figure 335..Proposed Elevated Corridor from Nagawara junction on ORR to Bagalur Main road

Proposed Elevated Corridor from Nagawara junction to Bagalur - Alignment details

The traffic scenario between **Nagawara** and **Bagalur Junction** is complex, as this stretch connects key residential, commercial, and industrial areas in North Bangalore. Here's an overview of the key issues, typical traffic conditions, and primary contributing factors along this route:

Key Areas and Traffic Flow:

1.Nagawara Junction:

1. **Nagawara** is a busy intersection in North Bangalore, connecting Manyata Tech Park, one of the largest IT hubs in the city, with surrounding residential and commercial areas.
2. This area sees heavy congestion, especially during peak hours, as thousands of IT employees commute to and from Manyata Tech Park.
3. **Outer Ring Road (ORR)** runs through Nagawara and is a critical route for commuters, connecting Hebbal in the west and KR Puram in the east. This road already has high vehicle density, especially from heavy vehicles, office-goers, and local traffic.

2.Thanisandra Main Road:

1. Thanisandra Main Road is a key route connecting Nagawara to Bagalur Junction, and it runs through several densely populated residential areas, including developments like Hegde Nagar and Thanisandra.
2. Due to rapid residential and commercial growth along Thanisandra Main Road, the volume of vehicles—particularly private cars, two-wheelers, and BMTC buses—has increased substantially.
3. The road is narrow in some sections, with frequent bottlenecks caused by local markets, bus stops, and intersections. The lack of adequate service roads and narrow lanes leads to congestion during peak hours.

3.Hegde Nagar and Kothanur:

1. As you move further along Thanisandra Main Road, Hegde Nagar and Kothanur are residential hubs with many apartment complexes, schools, and shopping areas, which contribute to local traffic.
2. These areas are also served by BMTC buses, and frequent bus stops slow down traffic as vehicles have to wait for passengers.
3. Traffic is often slower here, especially in the mornings and evenings, as residents and school buses join the flow.

4.Bagalur Junction:

1. Bagalur Junction is a strategic point, serving as a link between Thanisandra, Hennur Road, and the road towards the Kempegowda International Airport.
2. It attracts a mix of local traffic, airport-bound vehicles, and heavy trucks due to its industrial and commercial activity.
3. Merging and turning movements at this junction cause delays, particularly with the presence of heavy vehicles. The narrow roads around Bagalur Junction often create bottlenecks, leading to traffic buildup.

Major Traffic Challenges:

1.High Vehicle Volume:

1. The entire stretch from Nagawara to Bagalur sees a high volume of traffic, as it serves as a major connection between residential areas, Manyata Tech Park, and the airport route.
2. During peak hours, the concentration of IT employees commuting to Manyata Tech Park and back home adds significant pressure to the roads, especially at Nagawara Junction and on Thanisandra Main Road.

2.Narrow and Poorly Maintained Roads:

1. Thanisandra Main Road is not fully equipped to handle the high density of traffic it currently supports. In some sections, it is narrow, lacks proper markings, and has potholes, which slows down vehicles.
2. The lack of service roads in many parts means that local traffic, including autos, buses, and private vehicles, often share the same lanes, leading to congestion and slower travel times.

3.Frequent Intersections and U-Turns:

1. This route has multiple intersections, U-turns, and pedestrian crossings, especially around Hegde Nagar, Kothanur, and Bagalur Junction.
2. These frequent crossings create traffic interruptions, as vehicles often slow down to let pedestrians cross or to navigate turning vehicles.

4.Lack of Adequate Public Transport Infrastructure:

1. While BMTC buses operate along this route, the frequency may not fully meet the demand. Many people rely on private vehicles or ride-hailing services, increasing the vehicle count.
2. Insufficient bus stops and waiting areas also contribute to traffic slowing down, as passengers board and alight on the main road.

5.Heavy Vehicles:

1. Due to its proximity to industrial areas, Bagalur Junction sees many heavy vehicles, which impact traffic flow by occupying more road space and moving at slower speeds.
2. The lack of dedicated lanes for heavy vehicles on Thanisandra Main Road and at Bagalur Junction creates delays and bottlenecks, especially as trucks often have difficulty maneuvering in tight spaces.

Proposed Elevated Corridor from Nagawara junction to Bagalur - Alignment details

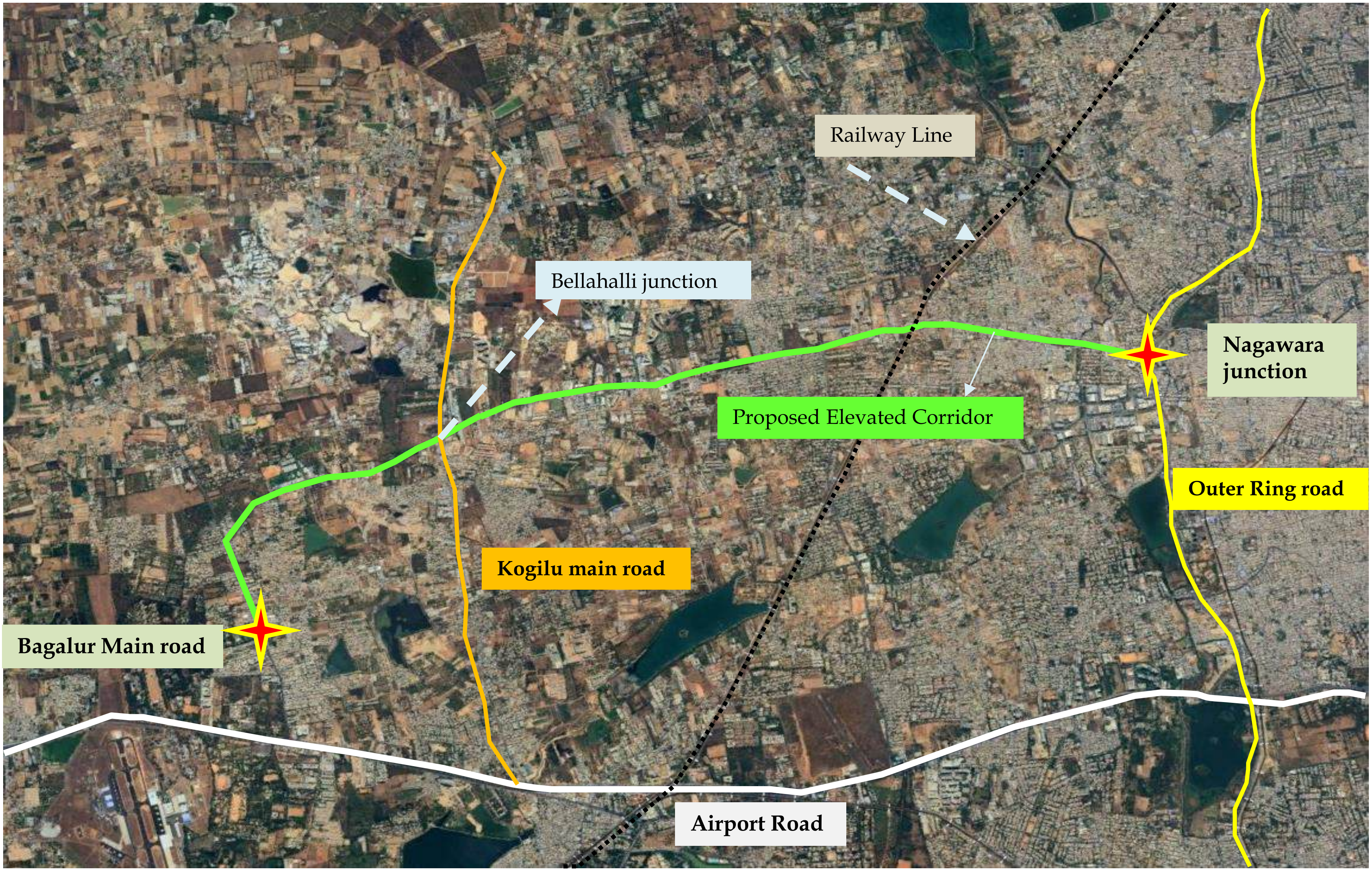


Figure 336.Proposed Elevated Corridor from Nagawara junction on ORR to Bagalur Main road

Proposed Elevated Corridor from Nagawara junction to Bagalur - Alignment details

The elevated corridor starts at Nagawara junction, featuring a split flyover and separate ramps connecting from the at-grade level near Elements Mall.

The elevated corridor veers right near the Thanisandra petrol station, with a down ramp provided just before the railway overbridge (ROB).

A down ramp is also provided just before the Hegde Nagar flyover.

Nagawara Junction

RoB- Thanisandra Main rd

Hegde Nagar Flyover

Figure 337 Proposed Project Corridor section wise details

Proposed Elevated Corridor from Nagawara junction to Bagalur - Alignment details

Down ramp is provided at Vibgyor School road & Up ramp near Police training center

Down ramp is provided before Bellahalli junction

Up ramp & Down ramp is provided before Bagalur junction and takes the right turn to terminate on Bagalur main road

Vibgyor School

Bellahalli Junction

Baglur Main road

Figure 338. Proposed Project Corridor section wise details

Proposed 6 lane divided Elevated corridor from Nagawara to Bagalur main road

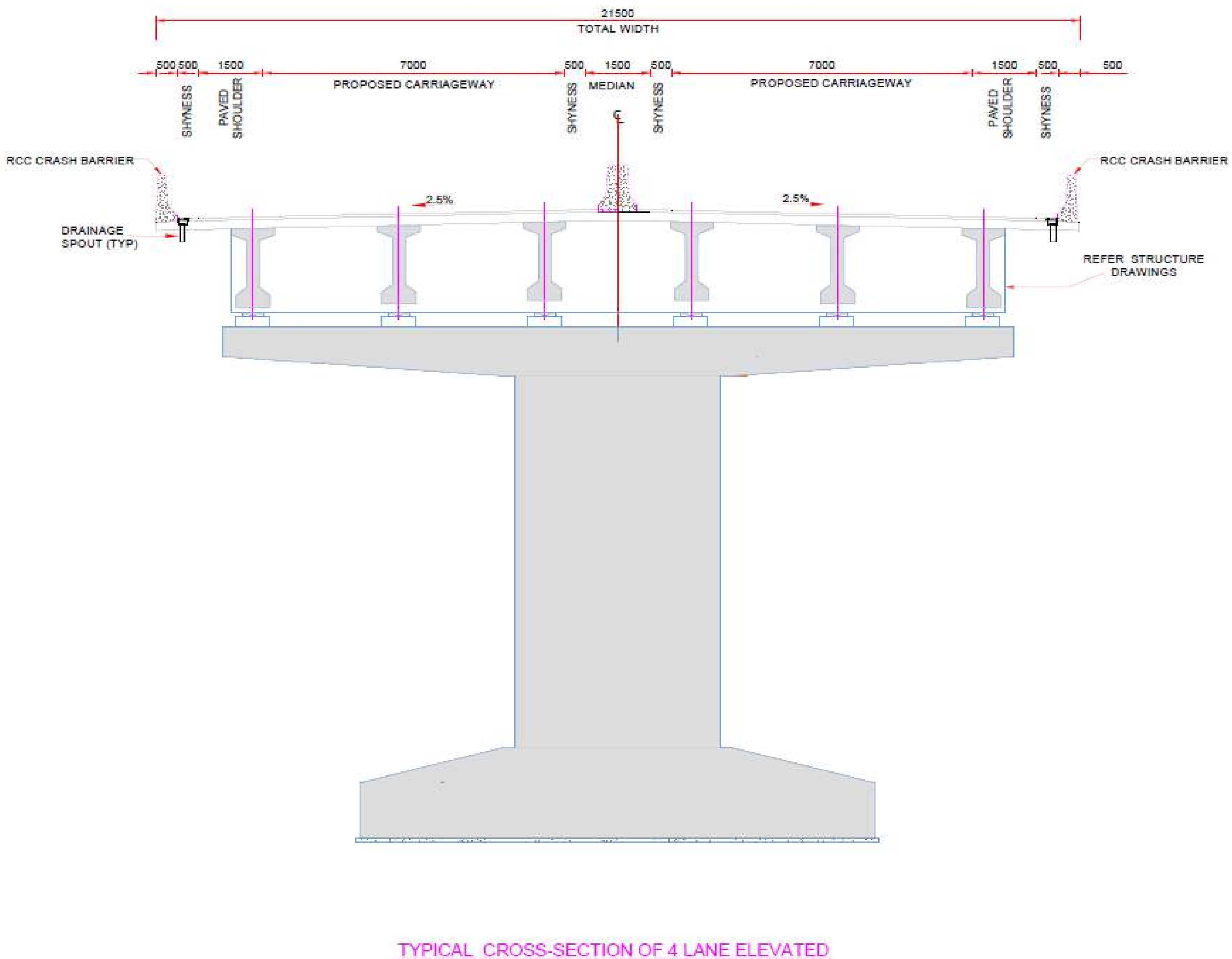


Figure 339. **Proposed cross section for the Elevated corridor from Nagawara junction to Baglur main road**

Proposed 6 lane divided Elevated corridor from Shoolay Circle to Silk board on Hosur road

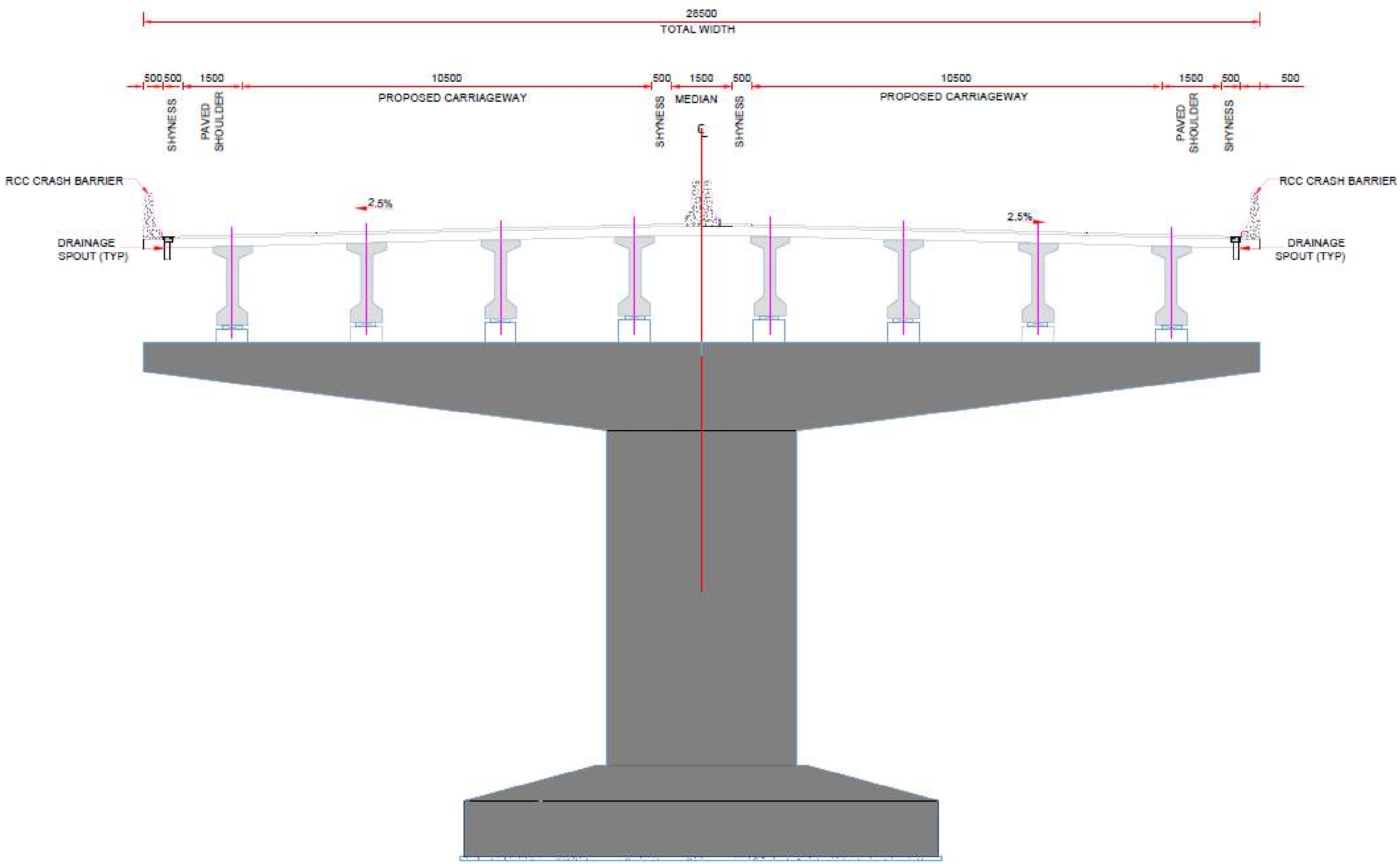


Figure 340. **Proposed cross section for the Elevated corridor from Nagawara junction to Baglur main road**

Proposed Elevated Corridor from Nagawara junction to Bagalur - Alignment details

An elevated corridor from **Nagawara** to **Bagalur Junction** could significantly help in reducing traffic congestion along this busy route. This corridor would provide a direct, uninterrupted path for vehicles traveling between these two points, which could greatly relieve the existing congestion on **Thanisandra Main Road** and surrounding areas. Here's how and why it would help:

Benefits of an Elevated Corridor from Nagawara to Bagalur Junction:

1.Bypassing Major Congestion Points:

1. The elevated corridor would bypass traffic-heavy intersections, such as **Nagawara Junction**, **Thanisandra**, and **Bagalur Junction**, reducing wait times and allowing for smoother, faster travel.
2. Many of the bottlenecks along Thanisandra Main Road are due to local traffic, pedestrians, and intersections. An elevated route would allow through-traffic to bypass these problem areas entirely.

2.Dedicated Route for Through-Traffic:

1. The elevated corridor would serve as a dedicated route for through-traffic, particularly for commuters traveling to and from **Manyata Tech Park**, nearby residential hubs, and the airport route.
2. This would help separate long-distance traffic from local traffic on the ground level, allowing both types of traffic to move more efficiently.

3.Reduction in Surface-Level Congestion:

1. Local and residential traffic would have more room on the surface roads without the added burden of through-traffic. This would result in reduced congestion on **Thanisandra Main Road**, making it easier for buses, local vehicles, and pedestrians to navigate.
2. With less congestion on the ground level, buses and other public transport options could operate more smoothly, potentially encouraging more people to use them.

4.Improved Access to Manyata Tech Park and Airport:

1. Manyata Tech Park is a major destination for commuters in the area, and an elevated corridor could provide faster, more reliable access for thousands of employees.
2. Additionally, an elevated route could benefit those traveling toward the **Kempegowda International Airport** by creating a more direct path, minimizing delays caused by local traffic and intersections.

5.Faster Travel Times and Reduced Commute Stress:

1. By providing a faster and more direct route, the elevated corridor would reduce travel times between Nagawara and Bagalur, leading to less stress for commuters and potentially boosting productivity for those working in nearby tech parks.
2. Faster travel times would also make the area more attractive for residential and commercial development, as connectivity improves.

Key Considerations for the Elevated Corridor's Success:

1.Strategic Placement of Entry and Exit Ramps:
1. To ensure maximum effectiveness, entry and exit points would need to be strategically placed at key locations, like **Nagawara**, **Thanisandra**, **Hegde Nagar**, and **Bagalur Junction**.
2. Proper ramp placement would allow seamless access to the elevated corridor, without creating new congestion points at entry/exit ramps.

2.Integration with Public Transport:
1. The elevated corridor should be well-integrated with BMTC bus routes and other forms of public transport to encourage more people to opt for public transit.
2. Proper connections to the metro, if extended toward Nagawara, would also help decongest surface roads.

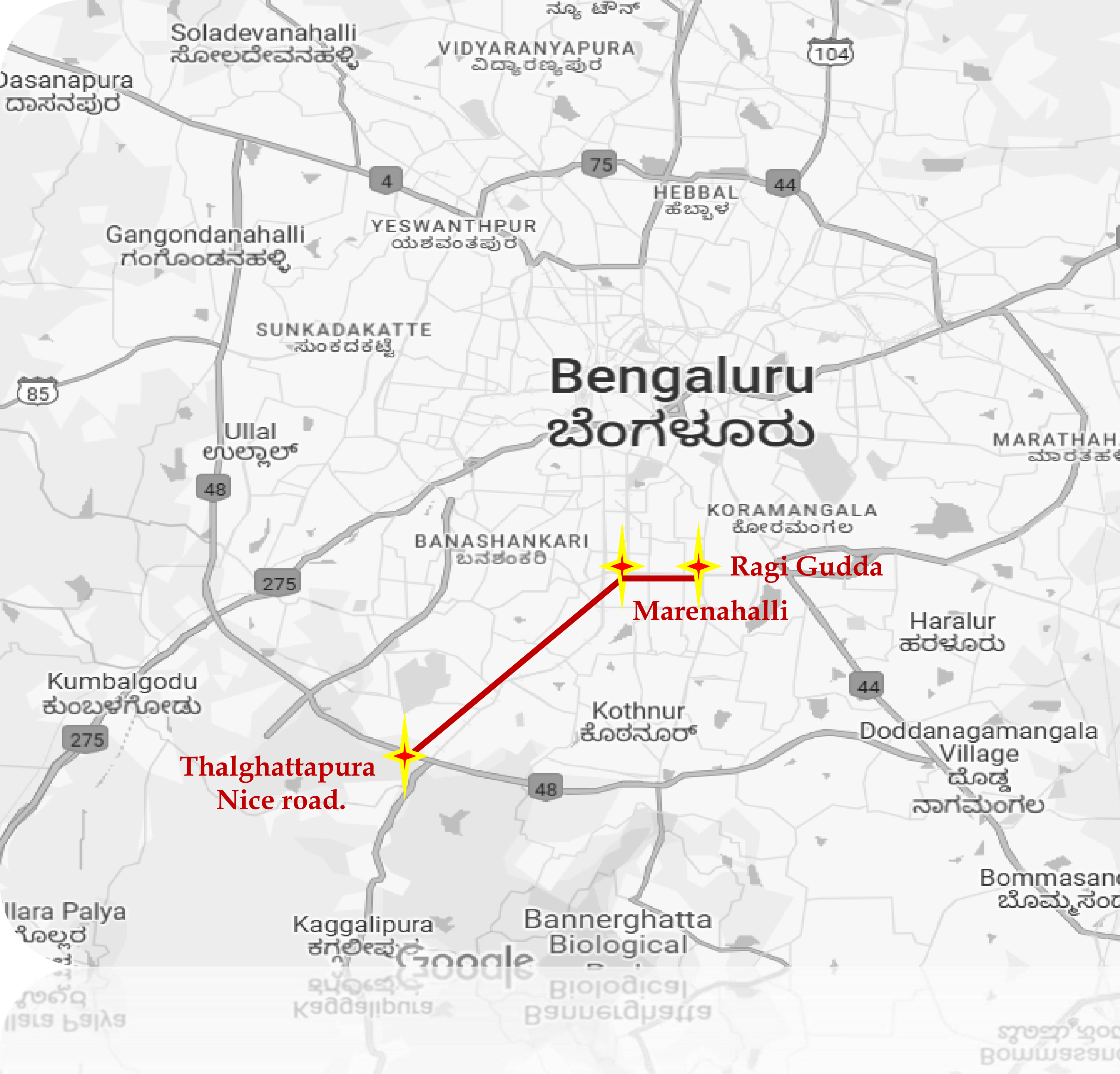
3.Managing Heavy Vehicles and Commercial Traffic:
1. If designed with dedicated lanes or restrictions for heavy vehicles, the elevated corridor could better manage the flow of trucks, particularly near **Bagalur Junction** and other industrial areas.
2. Restrictions on surface roads for heavy vehicles, during peak hours, could also further reduce congestion.

4.Minimizing Disruptions During Construction:
1. Constructing an elevated corridor on an already
2. oute would require well-planned traffic management strategies to prevent construction from causing major disruptions.
3. Phased construction and alternative routes would be necessary to keep traffic flowing smoothly during the project.

5.Supportive Infrastructure on Surface Roads:
1. While the elevated corridor would alleviate congestion for through-traffic, surface-level improvements, like better pedestrian crossings, signal management, and road widening at key points, would still be necessary to support local traffic.
2. Proper lane markings, signage, and intersection upgrades on Thanisandra Main Road would enhance the impact of the elevated corridor on overall traffic flow.

Overall Impact:

An elevated corridor from Nagawara to Bagalur Junction would likely be a highly effective solution for decongesting this route. It would create a faster, more reliable path for commuters and through-traffic, ease the burden on Thanisandra Main Road, and improve the efficiency of public transport. By reducing congestion, this corridor would also improve air quality and road safety in the area, benefiting both commuters and local residents.
In summary, with careful planning and strategic implementation, an elevated corridor between Nagawara and Bagalur Junction could be a transformative infrastructure project, providing long-term relief from traffic congestion and supporting the area's continued growth and development.



CORRIDOR 12

Marenahalli Pipe Line Road

Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.

Elevated Corridor from Marenahalli main road connecting Kanakapura main road-Thalghattapura Nice road

The proposed corridor will offer an essential alternative route from Bangalore to Kanakapura Road. Starting from Jayanagar 4th main road on Pipeline road, it runs diagonally toward Kanakapura Road, ending at the NICE junction near Thalaghattapura. Spanning approximately 10 kilometers, this corridor will benefit commuters from areas like Thurahalli, Kumaraswamy Layout, Lingadeeranahalli, and ISKCON.

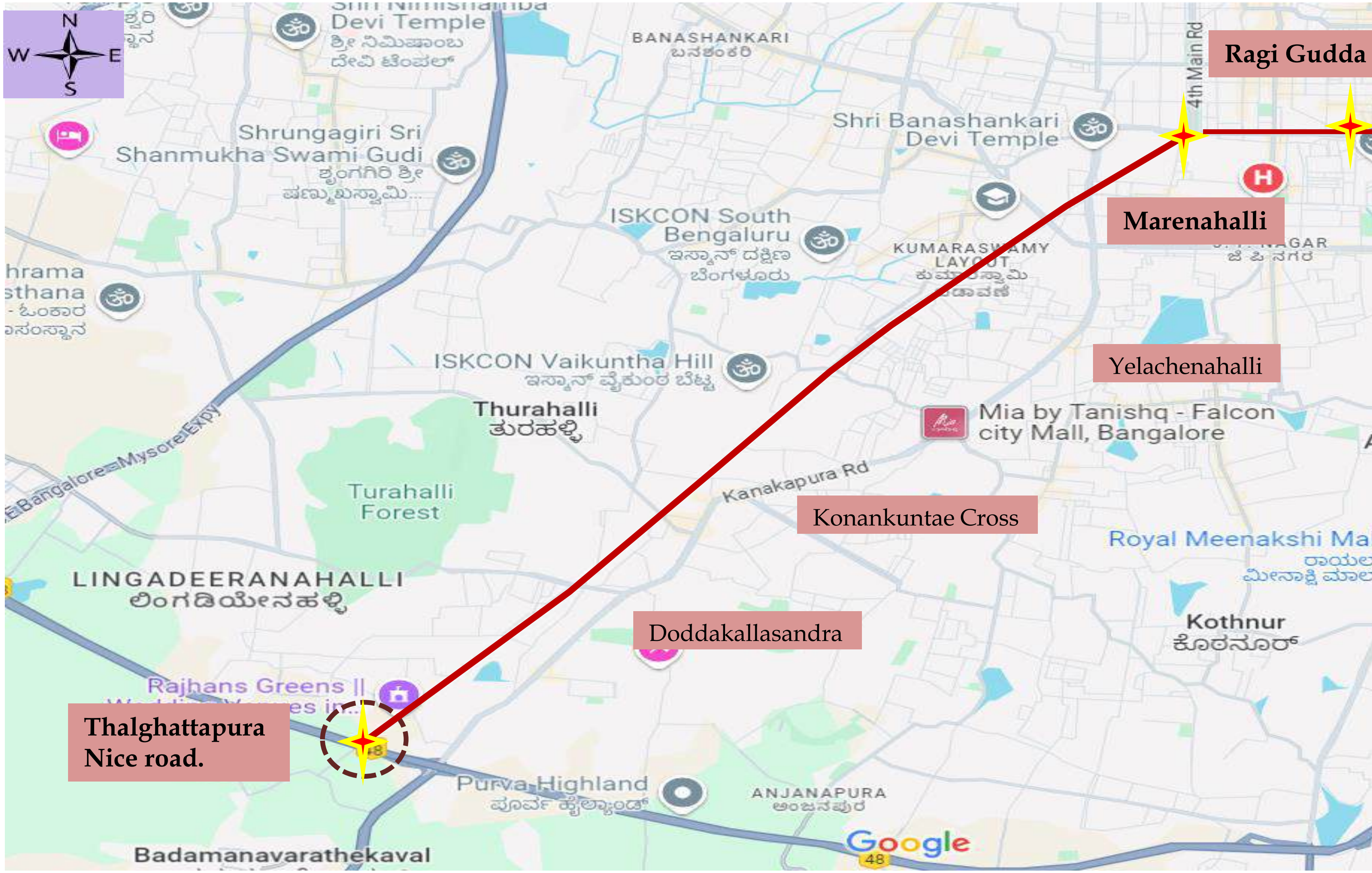


Figure 341.Proposed Elevated Corridor from Marenahalli Piple Line road to Nice Road Thalghattapura

Proposed Elevated Corridor from Ragi Gudda junction to 7th main road- Alignment details

In addition to the main elevated corridor extending from Marenahalli to Thalaghattapura NICE Road, a proposal has been made to extend the existing double-decker Metro line from Ragi Gudda Junction to 7th Main on Marenahalli Road. This extension aims to ease traffic at two major intersections where significant congestion frequently occurs, as illustrated in the figure 414.

Figure 342.Proposed Elevated Corridor from Marenahalli Pipe Line road to Nice Road Thalghattapura

Proposed Elevated Corridor from Ragigudda junction to 7th main road- Alignment details

Construction of Flyover from Ragi Gudda Metro Station to 7th Main Road integrating Double Decker Flyover Traffic near Raghavendra Swamy Mutt at J.P. Nagar in BBMP South Zone Limit.

The traffic scenario from Ragigudda (near Jayanagar) to 7th Main in Bangalore can vary quite a bit depending on the time of day and ongoing roadwork or events.

1.Morning (8–10 AM): This route typically sees moderate to heavy traffic, especially around the Jayadeva Flyover and Bannerghatta Road, as people are commuting to work. The smaller lanes in Jayanagar, like 7th Main, can get congested due to school traffic and local commercial activity.

2.Afternoon (12–3 PM): The traffic is usually lighter compared to the morning and evening peaks, though construction or lane restrictions might cause slight delays near major intersections.

3.Evening (5–8 PM): Traffic is generally heavy again due to the evening commute, especially along main stretches like Bannerghatta Road and near Jayadeva Hospital. 7th Main can also get crowded as people shop and dine out in Jayanagar.

4.Late Evening (after 8 PM): Traffic is lighter, though popular restaurants and shops in Jayanagar contribute to some crowding around 7th Main until closing hours.

Proposed Elevated Corridor from Ragigudda junction to 7th main road- Alignment details

An elevated corridor from Ragigudda to 7th Cross could significantly help with decongestion, especially during peak hours. Elevated corridors help by providing a dedicated, uninterrupted pathway that bypasses ground-level traffic and intersections, reducing travel time and easing congestion on the main roads below.

Here's how it could specifically improve the flow:

1.Bypassing Key Bottlenecks: This area sees congestion around the Jayadeva Flyover, 9th Block, and Bannerghatta Road intersections. An elevated route would allow vehicles to bypass these congested spots entirely, especially benefiting those commuting long distances who don't need to stop along the way.

2.Reduced Local Traffic Impact: By diverting through-traffic to the elevated corridor, the local streets below, like 7th Main and smaller roads in Jayanagar, could see reduced congestion, making it easier for residents and businesses to move about.

3.Improved Public Transport Efficiency: If buses and other public transport vehicles use the elevated corridor, it could enhance the reliability of transit times, reducing the overall pressure on the local roads.

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

The existing Double decker is extended from Ragi Gudda junction to 7th main road this will bypass Three intersections the detail alignment is as shown in the figure below

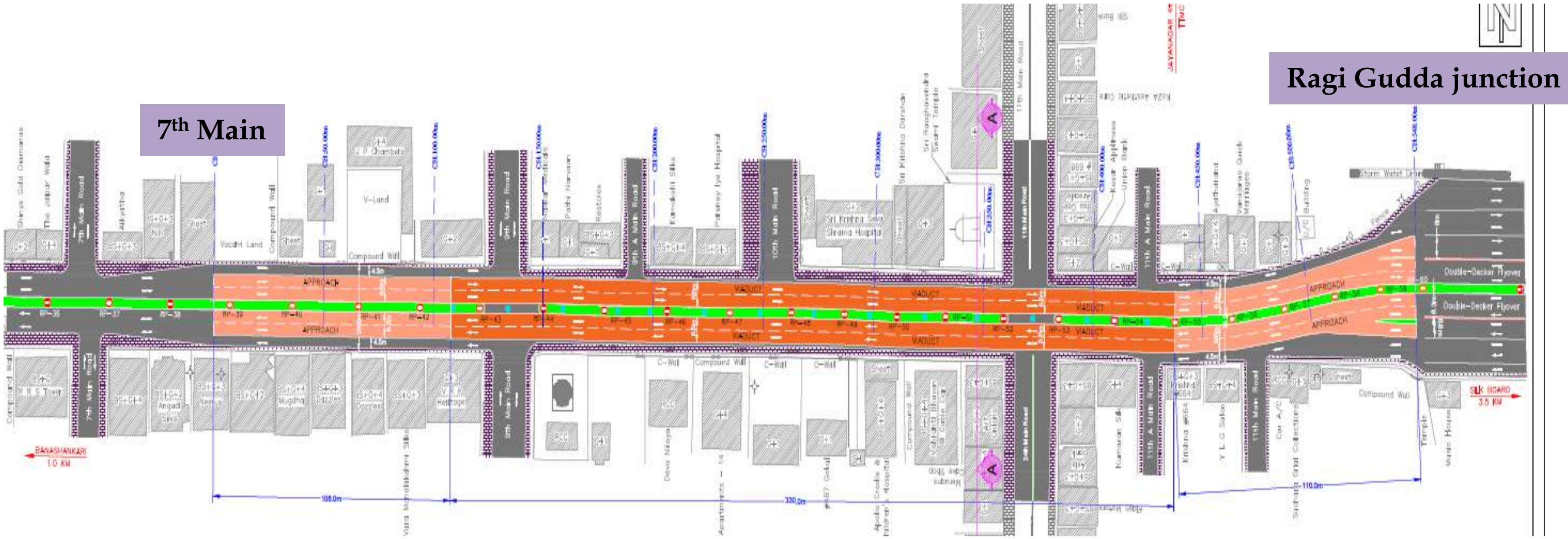


Figure 343.Alignment details of the proposed flyover from ragu Gudda to 7th Main on Marenahalli road

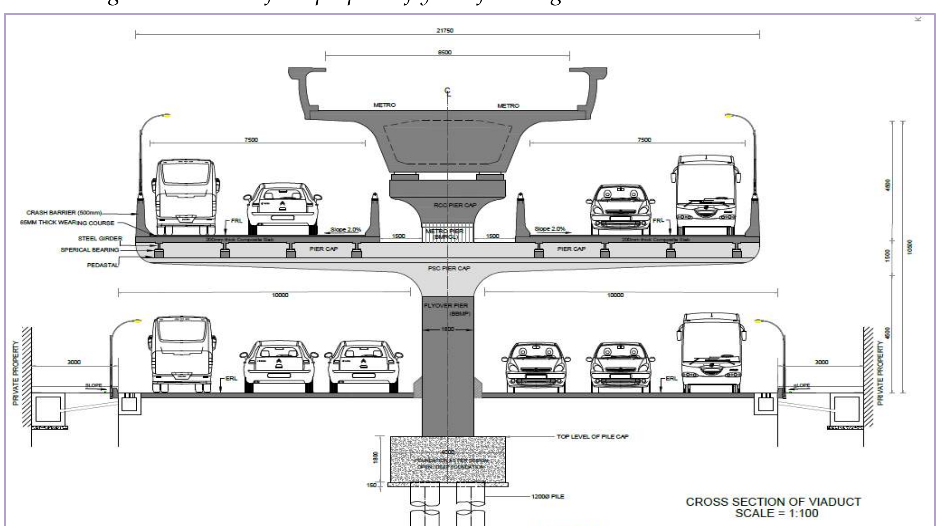


Figure 344. Typical cross section of the proposed flyover

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

The traffic scenario between **Marenahalli** and **Thalaghattapura NICE (Nandi Infrastructure Corridor Enterprises) Junction** is challenging due to the mix of residential, commercial, and industrial traffic, as well as the impact of heavy vehicles using the NICE Ring Road. Here's a breakdown of the current traffic conditions and key issues along this stretch:

Key Areas and Traffic Flow:

1.Marenahalli Junction:

1. Located near Kanakapura Road, Marenahalli Junction is a busy area that connects several residential neighborhoods to main roads, especially Kanakapura Road.
2. The area experiences heavy traffic during peak hours due to local residents, buses, and vehicles heading towards commercial areas.
3. The intersection is particularly congested due to limited road width, high vehicle volumes, and lack of alternative routes for local traffic.

2.Kanakapura Road (NH-209):

1. Kanakapura Road is one of the main arterial roads in South Bangalore and serves as a key connection between central parts of Bangalore and the southern outskirts.
2. This stretch of Kanakapura Road is a mixture of dense residential areas, educational institutions, and commercial establishments, which lead to significant traffic volumes, especially during morning and evening peak hours.
3. The road frequently faces congestion, particularly near intersections, bus stops, and pedestrian crossings, slowing down overall traffic flow.

3.Thalaghattapura NICE Junction:

1. The NICE Junction at Thalaghattapura is a critical point where Kanakapura Road intersects with the NICE Ring Road.
2. The NICE Road serves as a bypass around Bangalore, attracting a high volume of heavy trucks and commercial vehicles, which adds to congestion at this junction.
3. During peak hours, vehicles from Kanakapura Road merge with the traffic on NICE Road, causing delays. The limited space and merging of vehicles from multiple directions result in bottlenecks, especially for those accessing NICE Road from Kanakapura Road.

4.NICE Road Traffic:

1. The NICE Ring Road is a high-speed expressway connecting several key points around Bangalore, attracting heavy vehicle traffic, including trucks, due to its convenience as a bypass route.
2. The section around Thalaghattapura is frequently used by vehicles heading toward Mysore Road, Bannerghatta Road, and Tumkur Road.
3. NICE Road users entering or exiting at Thalaghattapura often encounter slow-moving traffic, especially during peak hours when merging can be difficult due to the high volume of vehicles.

Main Issues Contributing to Traffic Congestion:

1.High Traffic Volume:

1. Kanakapura Road and Marenahalli see a steady flow of vehicles, including private cars, two-wheelers, BMTC buses, and auto-rickshaws. The high density of vehicles contributes to congestion, especially as the road approaches the NICE Junction.
2. NICE Road also carries a large volume of heavy trucks, which reduces the pace of traffic flow and causes congestion at entry and exit points like Thalaghattapura.

2.Narrow Roads and Limited Infrastructure:

1. Kanakapura Road in some sections is still relatively narrow and not fully equipped to handle the current volume of vehicles. The lack of service roads, adequate lane width, and proper pedestrian crossings leads to slow traffic movement.
2. The narrow lanes at Marenahalli Junction and on stretches approaching Thalaghattapura further exacerbate congestion, especially during peak hours.

3.Merging Traffic at NICE Junction:

1. The NICE Junction at Thalaghattapura is a key point where traffic from NICE Road and Kanakapura Road converges, leading to frequent bottlenecks.
2. The merging of vehicles from NICE Road onto Kanakapura Road (and vice versa) is often chaotic, as vehicles must slow down significantly to navigate this area.

4.Peak Hour Pressure:

1. During morning and evening rush hours, traffic volumes increase significantly, as many commuters use Kanakapura Road to travel to and from the city. Traffic slows down substantially during these hours, with vehicles moving at a crawl at key intersections like Marenahalli.
2. The pressure of office commuters, school buses, and local vehicles adds to the congestion.

5.Pedestrian and Local Traffic:

1. Kanakapura Road has a high volume of pedestrian traffic, with many people crossing the road at various points to access local markets, schools, and other amenities. Vehicles often slow down for pedestrians, which affects traffic flow.
2. The lack of pedestrian infrastructure, such as foot overbridges or underpasses, means that pedestrian crossings are frequent and often unsafe, further slowing down vehicular traffic.

Marenahalli Pipe Line Road

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

An elevated corridor along Pipeline Road could help relieve traffic congestion between **Marenahalli** and **Thalaghattapura NICE Junction**. This corridor would effectively create a new, high-capacity route for through-traffic, helping to ease the burden on Kanakapura Road and surrounding roads. Here's a breakdown of how it would help and the potential benefits and considerations:

Benefits of an Elevated Corridor on Pipeline Road:

1.Bypassing Major Bottlenecks:

1. Pipeline Road currently serves as an alternative route, but it gets congested due to its narrow lanes and intersections with local roads. An elevated corridor would bypass these bottlenecks, allowing for faster, uninterrupted travel from Marenahalli to Thalaghattapura.
2. The elevated corridor would especially help bypass congested points at busy intersections and junctions along Kanakapura Road, particularly at Marenahalli and Thalaghattapura NICE Junction.

2.Diverting Through-Traffic from Local Roads:

1. By providing a dedicated elevated route, the corridor could divert through-traffic, especially vehicles that do not need to stop along Kanakapura Road or Pipeline Road, away from surface roads.
2. This would reduce congestion on both Kanakapura Road and Pipeline Road, allowing surface roads to handle local traffic more efficiently.

3.Reducing Pressure on Kanakapura Road:

1. Kanakapura Road is heavily used, especially during peak hours, as it connects Bangalore city with the southern outskirts. An elevated corridor on Pipeline Road would provide an alternative for vehicles looking to reach NICE Road and areas beyond.
2. By creating an alternative route, the elevated corridor would reduce the volume of vehicles using Kanakapura Road, which in turn would reduce delays, improve travel time, and create a safer environment for pedestrians and local vehicles on the ground level.

4.Faster Access to NICE Road:

1. For vehicles needing to access NICE Road, the elevated corridor would provide a faster, more direct connection. This could help reduce traffic at the Thalaghattapura NICE Junction, where merging traffic often leads to congestion.
2. With direct ramps or access points to NICE Road, vehicles can bypass the busy intersections and avoid merging delays, leading to smoother traffic flow on both NICE Road and the surface roads below.

5.Supporting Future Growth:

1. The areas around Marenahalli, Kanakapura Road, and Thalaghattapura are experiencing rapid residential and commercial development. An elevated corridor would help support the increased traffic demand from this growth, providing additional capacity and reducing pressure on existing infrastructure.
2. A new elevated route would also improve connectivity to nearby neighborhoods and business hubs, helping distribute traffic load more effectively across the area.

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

Considerations for the Elevated Corridor's Effectiveness:

1.Strategic Access Ramps:

1. The elevated corridor would need carefully planned access ramps at key points to ensure smooth entry and exit, particularly near Marenahalli, important intersections along Pipeline Road, and Thalaghattapura NICE Junction.
2. Proper ramp placement is crucial; if not well-designed, ramps can create new congestion points or shift traffic issues to different areas.

2.Integration with Existing Road Infrastructure:

1. The corridor should be well-integrated with Kanakapura Road, NICE Road, and surrounding local roads. Proper signage, lane markings, and traffic signals would be necessary to guide vehicles seamlessly onto the elevated route and prevent confusion at entry/exit points.
2. Effective coordination with ongoing infrastructure projects, such as metro expansions or road widening, would be important to avoid construction conflicts and ensure smooth traffic flow.

3.Impact on Local Roads During Construction:

1. Constructing an elevated corridor along Pipeline Road may temporarily impact traffic flow and increase congestion in surrounding areas. This would require phased construction and traffic management strategies to minimize disruption.
2. Coordinated efforts with local authorities and clear communication with the public regarding construction schedules and alternative routes would help mitigate short-term traffic issues.

4.Managing Traffic on Surface Roads Post-Completion:

1. While the elevated corridor would alleviate through-traffic, ground-level roads like Pipeline Road and Kanakapura Road would still need improvements to manage local traffic effectively.
2. Enhanced traffic management at intersections, improved pedestrian infrastructure, and potentially restricting certain types of vehicles (e.g., heavy trucks) from surface roads during peak hours would help maximize the benefits of the elevated corridor.

5.Long-Term Traffic Planning:

1. While the elevated corridor would provide relief, additional planning may be needed to accommodate future traffic growth. Coordinating with other infrastructure projects, like expanding public transport (e.g., metro, BMTC services), and adding service roads would further support long-term traffic management in the area.

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

The elevated corridor begins at Marenahalli Main Road, where two metro corridors intersect near Jayanagar 4th Main Road. The proposed corridor will be built along the existing pipeline route.

The proposed elevated corridor crosses over both Kanakapura Main Road and the metro line.

Figure 345.Proposed Elevated corridor section wise details

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

The proposed elevated corridor crosses over the double decker and crossing the outer ring road

The proposed elevated corridor crosses Vasanthapura main road

Figure 346..Proposed Elevated corridor section wise details

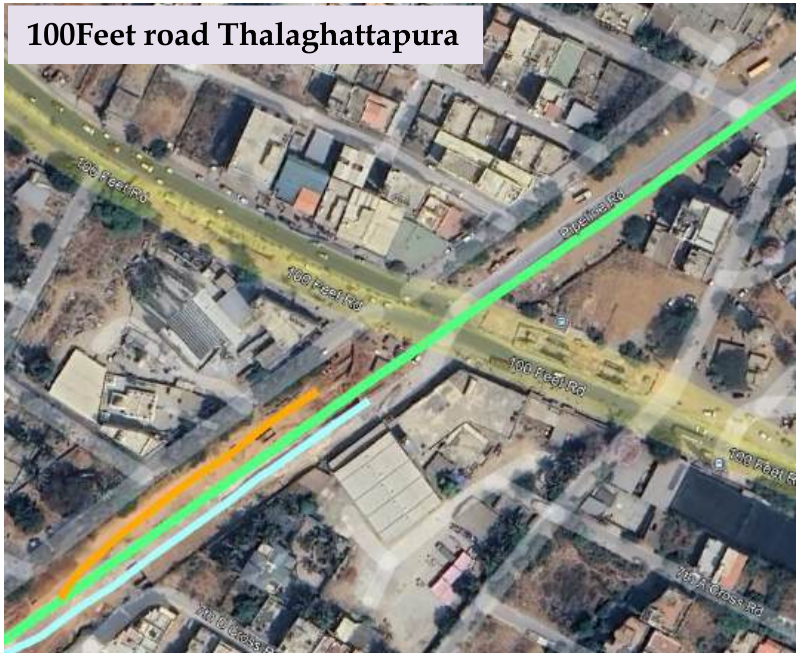
Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details

The proposed elevated corridor crosses Gubbala main road

The proposed elevated corridor crosses the 80 feet road

Figure 347. Proposed Elevated corridor section wise details

Proposed Elevated Corridor from Marenahalli main road to Thalghattapura Nice road - Alignment details



The proposed elevated corridor crosses 100 ft road at Thalghattapura.

The proposed elevated corridor crosses NICE road and gets terminated

Figure 348.Proposed Elevated corridor section wise details

Proposed 4 lane divided Elevated corridor from from Marenahalli main road to Thalghattapura Nice road

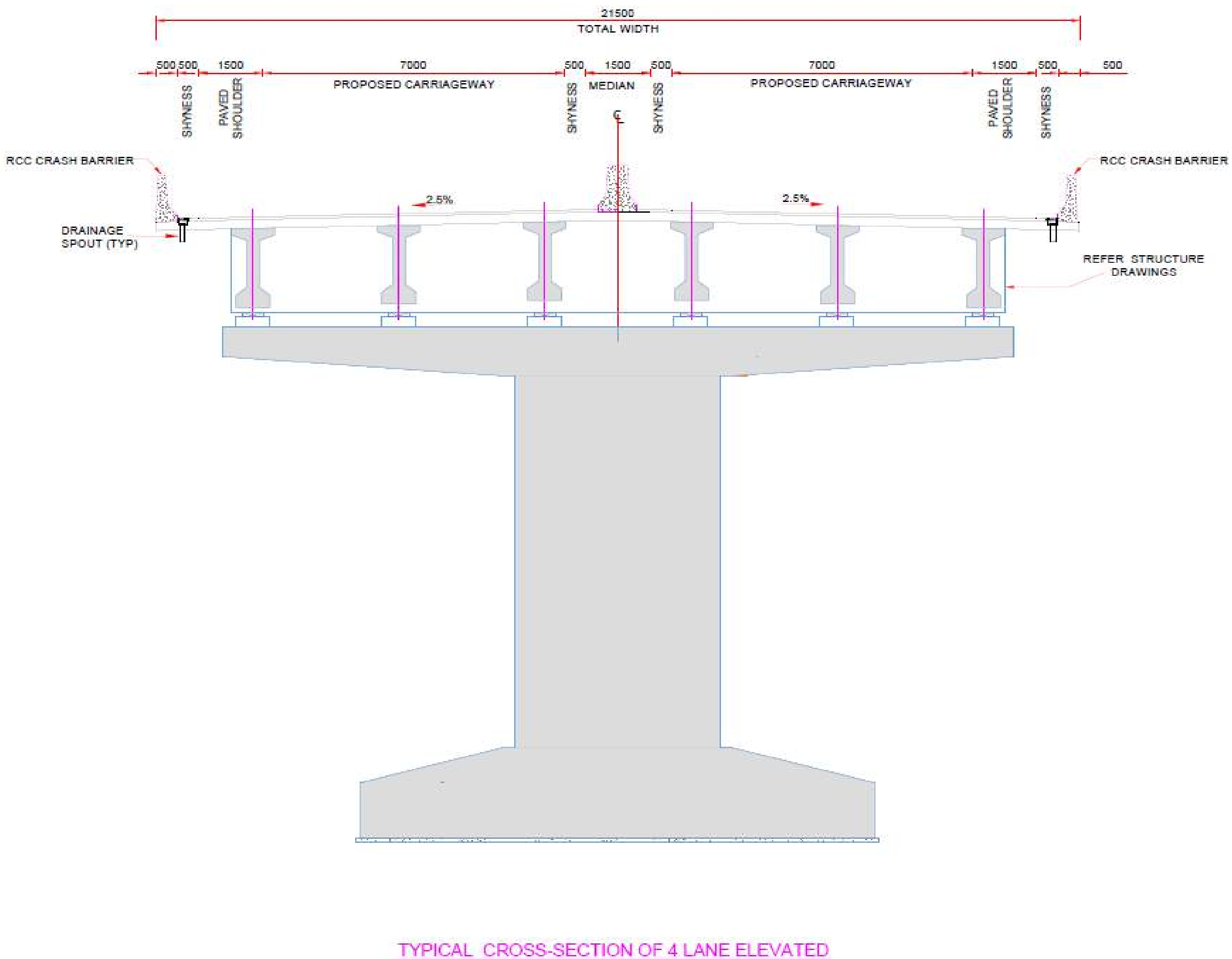


Figure 349. **Proposed cross section for the Elevated corridor from Marenahalli main road to Thalghattapura Nice road**

Proposed 6 lane divided Elevated corridor from from Marenahalli main road to Thalghattapura Nice road

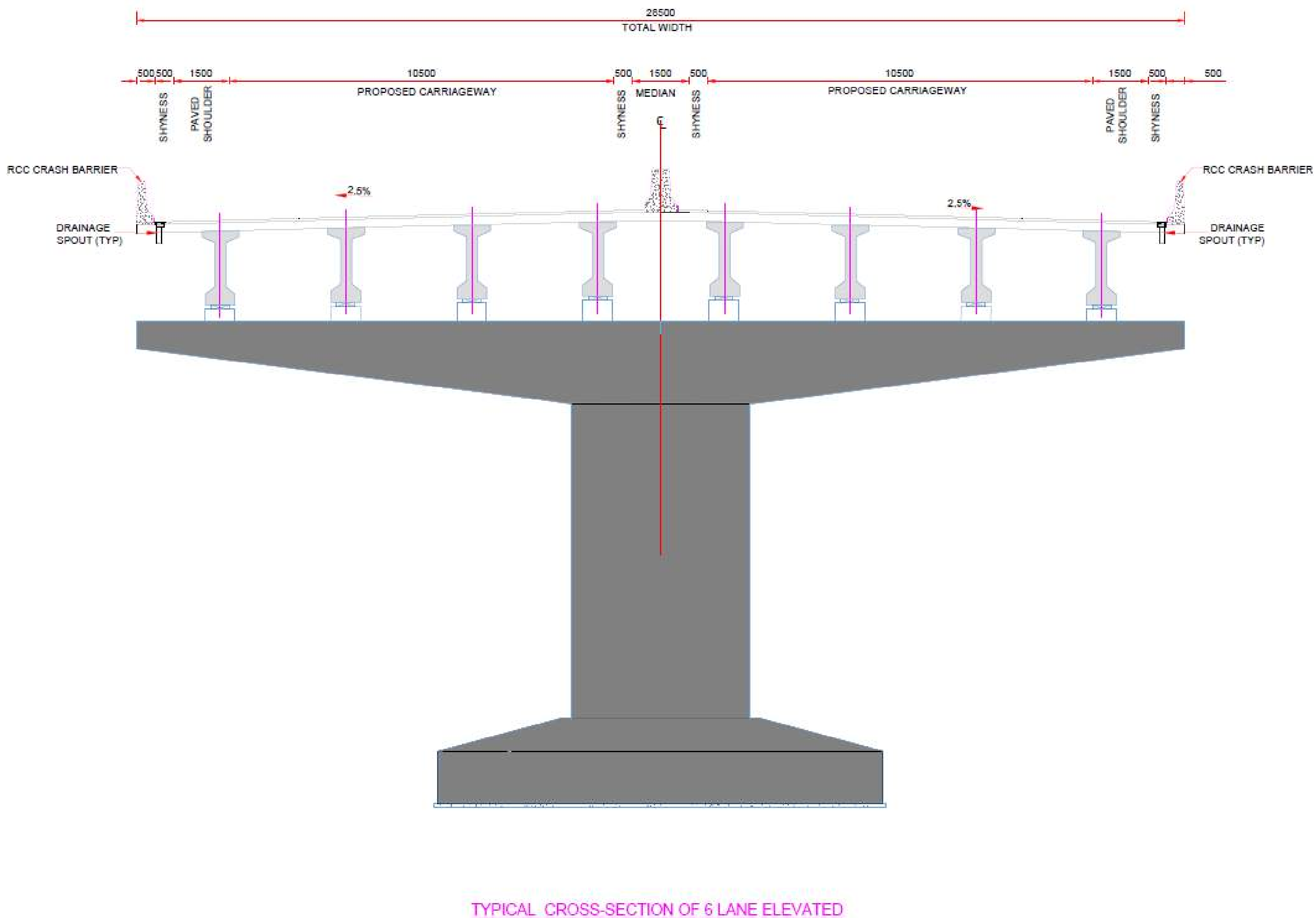
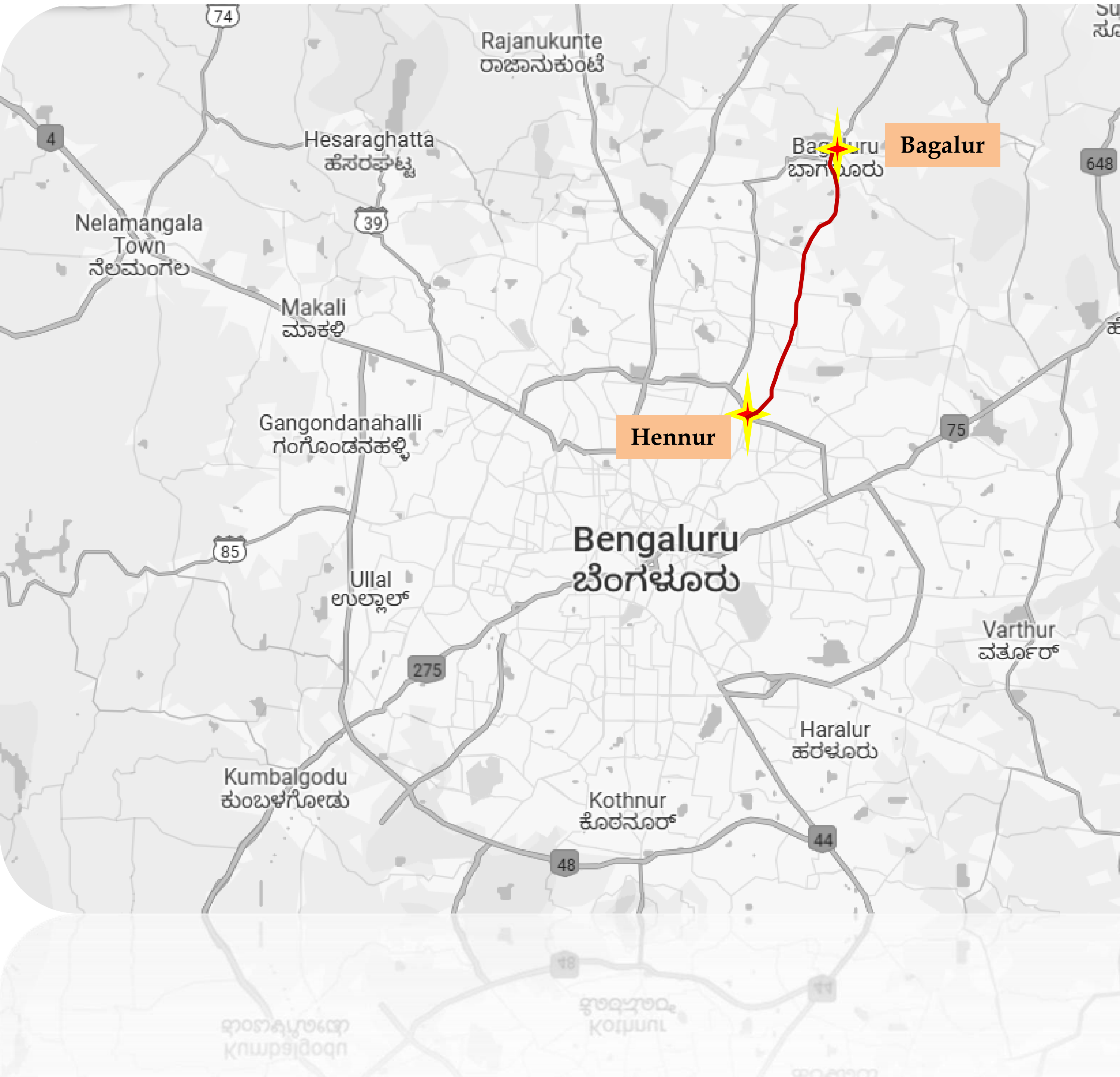


Figure 350. **Proposed cross section for the Elevated corridor from   Marenahalli main road to Thalghattapura Nice road**



CORRIDOR 13

Hennur-Bagalur Main Road

Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur Bagalur main road junction to Bagalur Junction

Proposed Elevated Corridor from Hennur to Bagalur - Alignment details

The proposed corridor will provide a vital alternative route between the Outer Ring Road and Airport Road. Beginning at the Hennur junction on the Outer Ring Road, it extends to Bagalur, bypassing heavily congested areas like Byrathi,Kothanur,Chikkagubbi,Hennur etc. Along with this it crossess one primary drain bridge and a RoB which are the bottle necks.. Over time, this area has seen significant development, with the growth of IT hubs such as y, residential complexes, and institutions.. To accommodate traffic demand, a 15 km elevated corridor is planned, featuring several on- and off-ramps to facilitate smoother traffic flow and better connectivity for commuters along the route.

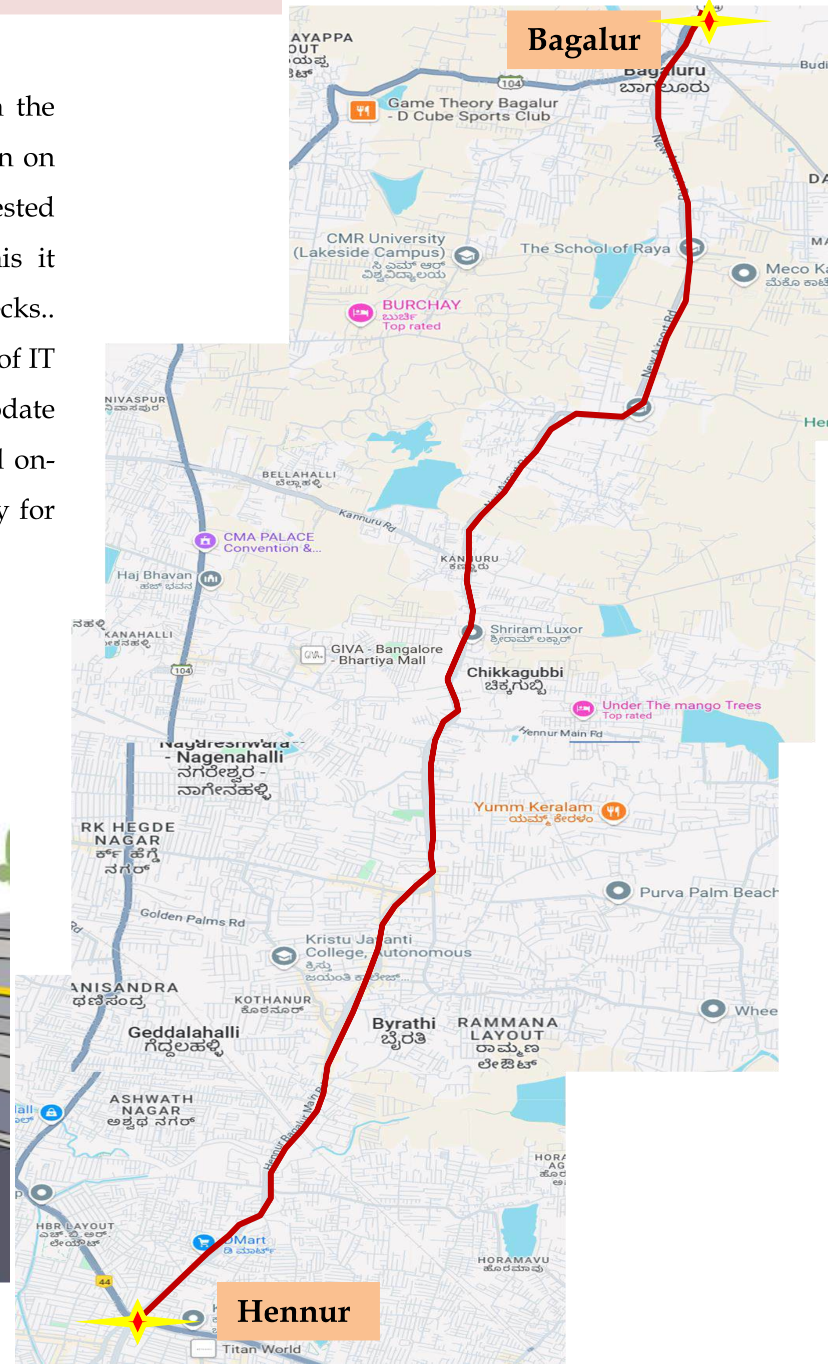


Figure 351.Alignment of the proposed Elevated corridor from Hennur to Bagalur

Proposed Elevated Corridor from Hennur to Bagalur - Alignment details

The traffic scenario between Hennur and Bagalur is relatively less congested compared to central Bangalore routes like Silk Board to Hebbal. However, this stretch is becoming busier due to rapid development, with increasing residential, commercial, and industrial projects, especially as it connects parts of North Bangalore and emerging suburban areas. Here's a breakdown of the traffic conditions along this route:

1.Hennur Road: Hennur Road (or Hennur Main Road) begins near Outer Ring Road (ORR) and extends northward. The initial stretch near ORR can experience moderate traffic during peak hours, primarily due to local commuters, nearby residential complexes, and schools. The development of IT parks and residential areas along Hennur Road has contributed to increased traffic, though it is still more manageable compared to other main roads in Bangalore.

2.Hennur-Bagalur Cross: This intersection is one of the key points along this route and can have moderate congestion, especially during rush hours. The traffic here is influenced by both local commuter vehicles and goods vehicles heading to various industries and warehouses in the northern suburbs. However, since it's less developed compared to central junctions in Bangalore, traffic usually flows smoothly outside peak hours.

3.Hennur-Bagalur Road: The stretch from Hennur to Bagalur goes through semi-urban areas and farmland, making it less congested in comparison to city roads. It serves as a connection between various residential projects and is used by vehicles traveling towards Kempegowda International Airport from eastern parts of the city. Though relatively free-flowing, there is increasing traffic due to construction projects and new residential layouts. Heavy vehicles, including trucks supplying construction materials, use this route, leading to occasional slowdowns.

4.Bagalur Road: As you approach Bagalur, traffic becomes lighter. Bagalur itself is still developing, with a mixture of residential areas and open spaces, and lacks the kind of dense infrastructure that causes bottlenecks in central Bangalore. However, ongoing development and roadwork can create some temporary disruptions.

Challenges:

•**Infrastructure Development**: With ongoing construction and new residential developments, this area may see worsening congestion over time if infrastructure does not keep pace with growth.

•**Heavy Vehicle Movement**: Increasing movement of goods vehicles, especially construction trucks, can create slowdowns and affect road quality.

•**Road Conditions**: Some stretches of Hennur-Bagalur Road may have uneven surfaces or need repairs, causing occasional delays and affecting vehicle flow.

Proposed Elevated Corridor from Hennur to Bagalur - Alignment details

An elevated corridor from Hennur to Bagalur could indeed help alleviate traffic congestion on this route, especially given the increasing development in North Bangalore. However, the effectiveness of such a project would depend on several factors, including the design, integration with existing infrastructure, and management of traffic flow in surrounding areas. Here's a breakdown of how an elevated corridor could impact traffic and potential considerations:

Potential Benefits:

1.Bypassing Local Traffic: An elevated corridor would allow through-traffic, especially vehicles headed toward the airport or other northern suburbs, to bypass local traffic on the ground. This separation of local and through-traffic could reduce bottlenecks on the main road, allowing faster travel for both local commuters and those heading beyond Bagalur.

2.Reducing Heavy Vehicle Interference: Many construction and goods vehicles use the Hennur-Bagalur road, often slowing down regular traffic. An elevated corridor would provide an alternative route, keeping heavy vehicles off the main surface road, thereby reducing congestion for local and light-vehicle traffic.

3.Improving Connectivity: An elevated corridor could significantly reduce travel times between Hennur, Bagalur, and further toward the airport or Bellary Road. This could make the route more attractive for daily commuters and reduce the load on other major roads like Bellary Road (NH-44), which connects the airport to central Bangalore.

4.Facilitating Future Development: With North Bangalore's rapid growth, this elevated corridor could support new residential and commercial projects without further straining existing road infrastructure. This may also help attract more businesses, leading to well-managed development in the region.

Proposed Elevated Corridor from Hennur to Bagalur - Alignment details

Challenges and Considerations:

1.Intersections and Ramps: To maximize effectiveness, the corridor would need strategically placed entry and exit ramps at key locations (e.g., near residential or commercial hubs along the Hennur-Bagalur route). Poorly planned ramps could lead to congestion at entry and exit points, especially during peak hours.

2.Connecting to Outer Ring Road (ORR): Since Hennur connects with the ORR, proper integration is essential. If the elevated corridor lacks efficient connections to ORR or major intersections, traffic could still back up at these points, diminishing the corridor's overall effectiveness.

3.Capacity Planning: North Bangalore's development is accelerating, and an elevated corridor designed with current traffic volumes in mind could quickly become insufficient. It would need to be built with a vision for future traffic demand to ensure it remains effective over the next decade.

4.Construction Disruption: During the construction phase, the elevated corridor project could temporarily worsen traffic congestion on the Hennur-Bagalur road. Detailed planning and phased construction could mitigate this, but it would still require careful traffic management to minimize the impact on commuters.

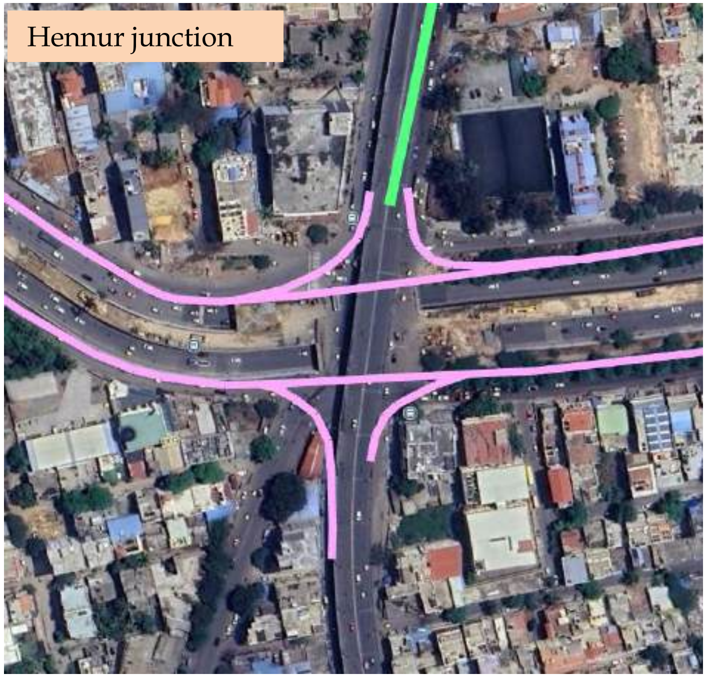
5.Last-Mile Connectivity: For commuters whose destinations are not directly on the corridor, last-mile connectivity options such as feeder roads, bus services, or metro links would still be necessary. Without these, commuters may face congestion at the start or end of their journey despite the elevated corridor.

Long-Term Outlook

In combination with other infrastructure improvements, like expanded public transportation (such as metro extensions) and improved road quality, an elevated corridor could have a significant positive impact on traffic congestion along this route. However, it is likely only part of the solution. For long-term effectiveness, a comprehensive approach that includes better ground-level road management, public transportation options, and integration with surrounding infrastructure will be necessary.

Ultimately, while an elevated corridor from Hennur to Bagalur could relieve congestion, it would be most effective as part of a broader plan to enhance connectivity across North Bangalore.

Proposed Elevated Corridor from Hennur to Bagalur - Alignment details



Hennur junction

RoB & drain on Hennur road

Elevated corridor starts from Hennur junction
It merges with the Split elevated corridor on Outer ring road.

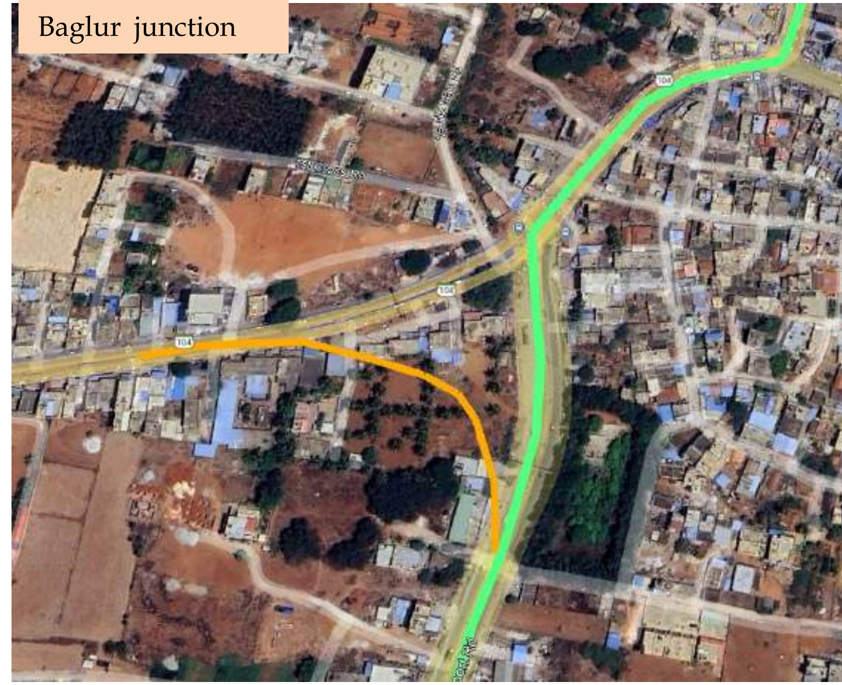
RoB on Hennur road

Corridor cross Primary drain and a RoB along the route

Hennur junction

Drain on Hennur road

Figure 352.Proposed Elevated corridor section wise details



Elevated corridor takes right at Narayanpura Junction to continue on Hebbal-Bagalur main road

Elevated corridor reaches Bagalur junction and terminates after crossing the village limits.

Figure 353.Proposed Elevated corridor section wise details

Proposed 4 lane divided Elevated corridor from Hennur junction to Baglur Main road

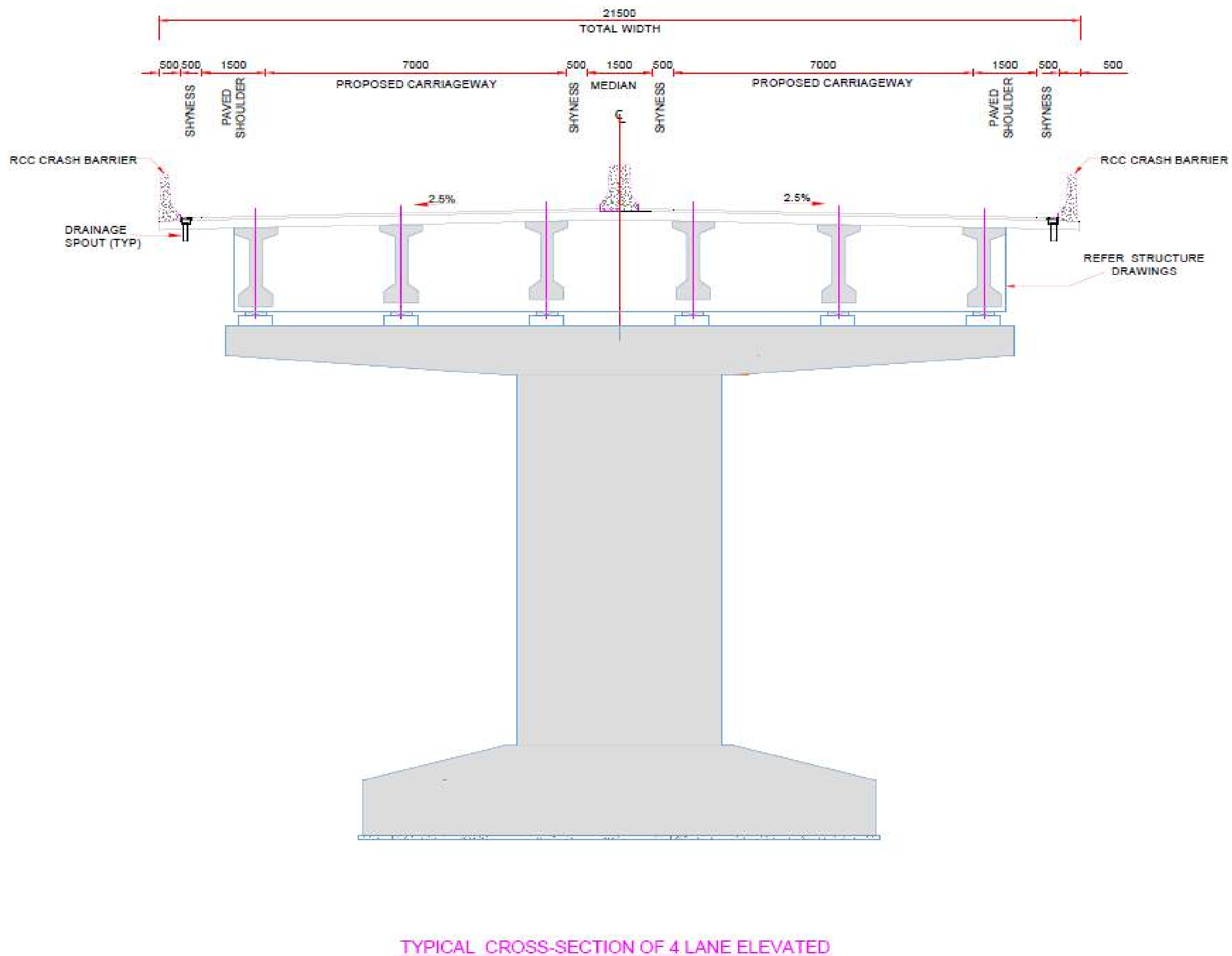


Figure 354. **Proposed cross section for the Elevated corridor from Hennur to Baglur Main road**

Proposed 6 lane divided Elevated corridor from Hennur junction to Baglur main road

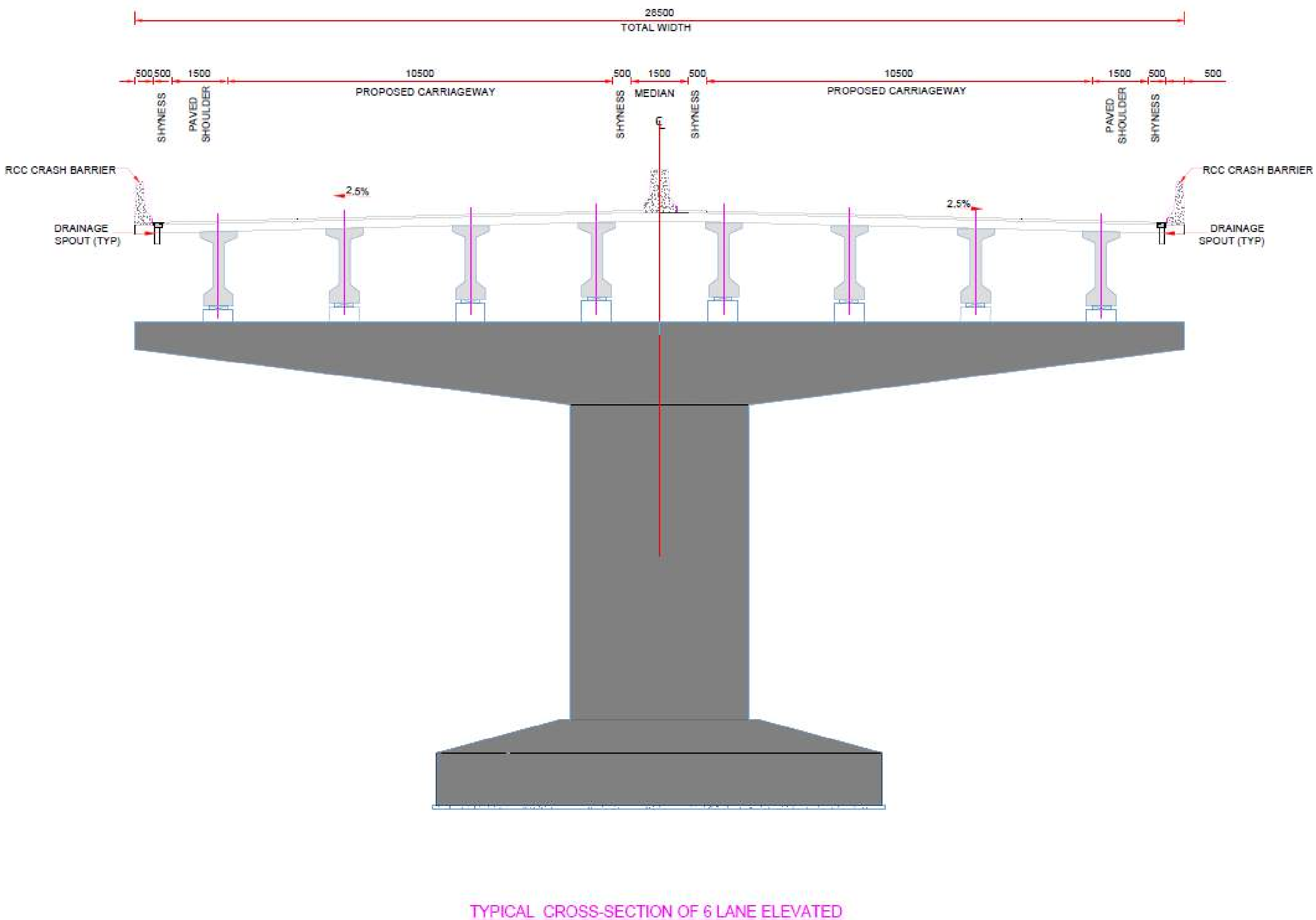
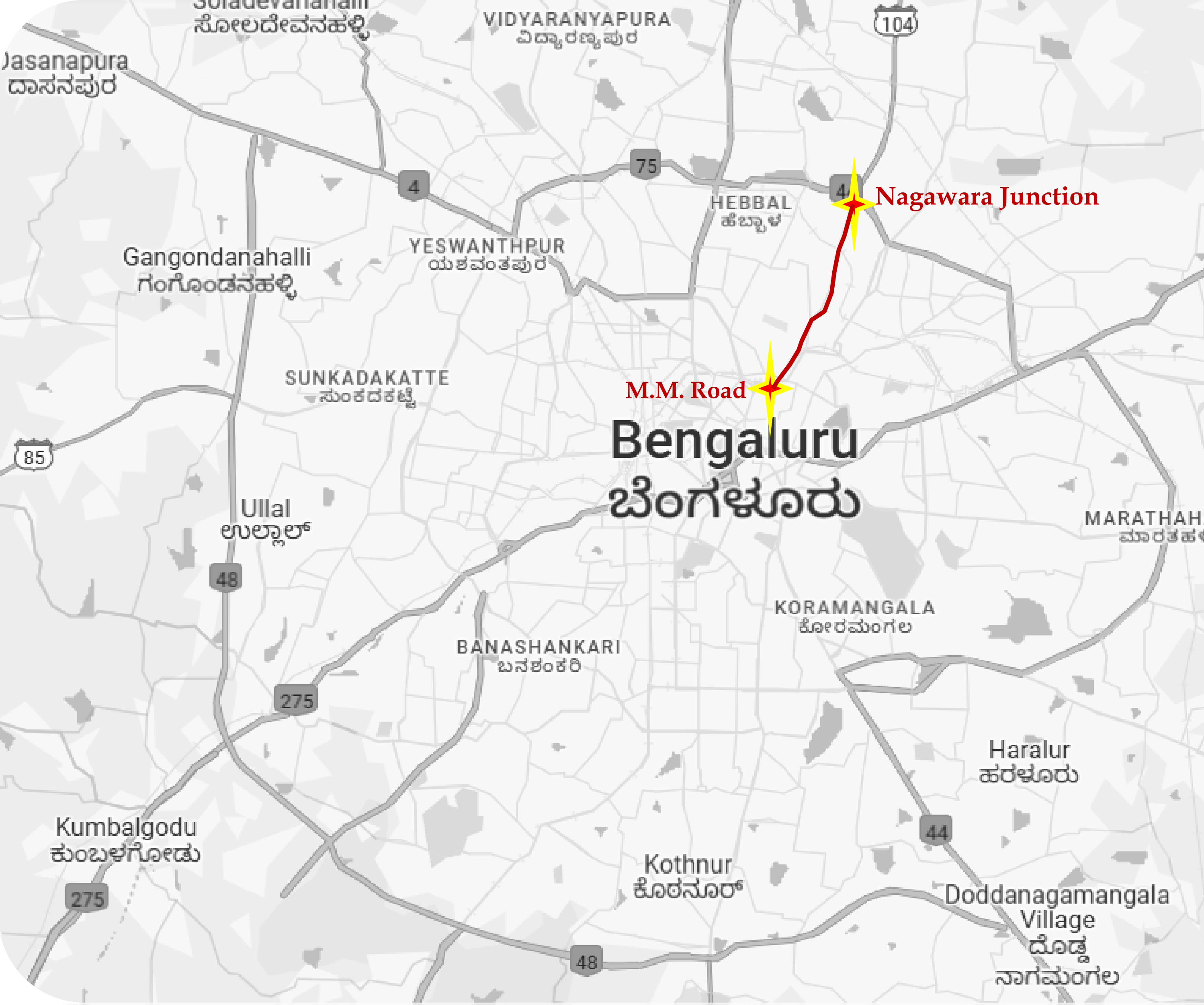


Figure 355. **Proposed cross section for the Elevated corridor from Hennur junction to Baglur main road**



CORRIDOR

14

TANNERY ROAD

Proposed Elevated corridor from Madava Mudiliyar road to Nagawara Junction

The traffic situation on **Tannery Road up to Nagawara Junction** is a chronic issue due to several factors, including high population density, narrow roads, encroachments, and increasing vehicular volume. Below is a detailed breakdown:

1. Road Infrastructure

- **Narrow Roads**: Tannery Road is notoriously narrow, often insufficient to handle the volume of vehicles during peak hours. This results in frequent bottlenecks.
- **Encroachments**: Shops, vendors, and parked vehicles encroach on the already narrow road, further reducing usable road width and exacerbating traffic congestion.
- **Lack of Proper Footpaths**: Pedestrians often spill onto the road due to inadequate sidewalks, adding to vehicular movement challenges.

2. Traffic Volume

- **High Vehicle Density**: This stretch connects several densely populated areas such as DJ Halli, KG Halli, and Nagawara. Auto-rickshaws, two-wheelers, buses, and private cars dominate the road.
- **Commercial Traffic**: Many small businesses and local markets in the area lead to increased goods transportation, which worsens the congestion.

3. Key Traffic Junctions and Bottlenecks

- **Pottery Town and MM Road Junction**: These intersections see frequent jams, especially during office hours and weekends.
- **Nagawara Junction**: Being a major junction leading to areas like Manyata Tech Park and ORR, this point experiences gridlock during rush hours.

4. Public Transport Impact

- **Bus Stops on the Main Road**: BMTC buses frequently stop on the road, disrupting the already slow-moving traffic.
- **Auto-rickshaws**: Autos often stop without warning to pick up or drop passengers, causing abrupt delays.

5. Event-Based Restrictions and Impact

- **Processions and Celebrations**: Religious festivals like Eid Milad and Ganesh Chaturthi often lead to temporary road closures or diversions, severely affecting traffic flow.
- **Political Rallies and Protests**: This area has seen disruptions due to demonstrations or rallies.

6. Ongoing Challenges

- **Road Repairs**: Potholes and uneven surfaces add to the slow pace of traffic, particularly during the rainy season.
- **Construction Work**: Any civic work or pipeline repairs often lead to partial road closures.

Constructing an **elevated corridor from Pottery Town to Nagawara** could significantly alleviate traffic congestion along Tannery Road and surrounding areas. Here's a detailed analysis of its potential benefits and challenges:

Potential Benefits

1. Decongestion of Surface Roads

•**Tannery Road's Limited Capacity**: Tannery Road is narrow, with encroachments and mixed traffic (buses, autos, two-wheelers, and pedestrians). An elevated corridor would provide a faster, dedicated route for through-traffic, bypassing these choke points.

•**Ease Traffic at Key Junctions**: Major intersections like Pottery Town, DJ Halli, KG Halli, and Nagawara Junction often experience gridlock. The elevated corridor could offer relief by diverting long-distance and through-traffic.

2. Faster Connectivity

•**Improved Commute Times**: The elevated road would enable quicker travel between Pottery Town and Nagawara, bypassing multiple traffic signals and bottlenecks.

•**Access to Outer Ring Road and Tech Parks**: Manyata Tech Park and other ORR destinations could be accessed more efficiently, reducing delays for commuters and businesses.

3. Reduction in Pollution

•**Minimized Idling**: By reducing the stop-and-go movement on the ground, the elevated road could lower vehicle emissions, improving air quality in the area.

4. Economic Benefits

•**Boost to Local Economy**: Efficient traffic flow can attract businesses and improve logistics for local traders.

•**Enhanced Real Estate Value**: Areas near the elevated corridor may see increased property demand due to better connectivity.

5. Complementing Upcoming Metro Lines

•The **Nagawara Metro Station** (part of Bengaluru Metro Phase 2B) could synergize with the elevated corridor, creating an integrated transport network for better commuter dispersal.

Proposed Elevated corridor Alignment

The proposed corridor begins at **Madava Mudiliyar Road** on the southern end and extends to **Nagawara Junction** on the Outer Ring Road (ORR) in the north. The up ramp starts at the beginning of M.M. Road and crosses the railway line at level one. It then traverses **Tannery Road**, a narrow two-lane stretch, up to the **D.J. Halli Junction**. From there, the corridor turns right onto **Arabic College Road**, which offers a wider 12-meter carriageway. Moving forward, it crosses another at-grade railway line near **HBR Layout** and continues along **Nagawara Main Road**. This section has several choke points where the road width abruptly reduces from 12 meters to 7 meters, leading to traffic jams during peak hours. Variations in road width persist until **Nagawara Junction**, where the road narrows further, resulting in significant congestion and vehicle queueing near the junction.

This corridor is one of the busiest routes connecting the **Central Business District (CBD)** to the **Outer Ring Road (ORR)**. Additionally, an **underground metro line** is planned and currently under construction along this stretch. The proposed **elevated corridor**, spanning **5.5 kilometers**, aims to facilitate long-distance travelers by significantly reducing travel time and ensuring a congestion-free commute.

The current **Volume-to-Capacity (V/C) ratio** along the corridor has exceeded 2, and the **Level of Service (LOS)** has deteriorated to **F**, indicating severe congestion. This highlights the urgent need for a long-term solution to address the growing traffic demand. However, with the **underground metro** under construction, a comprehensive analysis must be conducted as part of the **Detailed Project Report (DPR)** to effectively plan the elevated corridor.

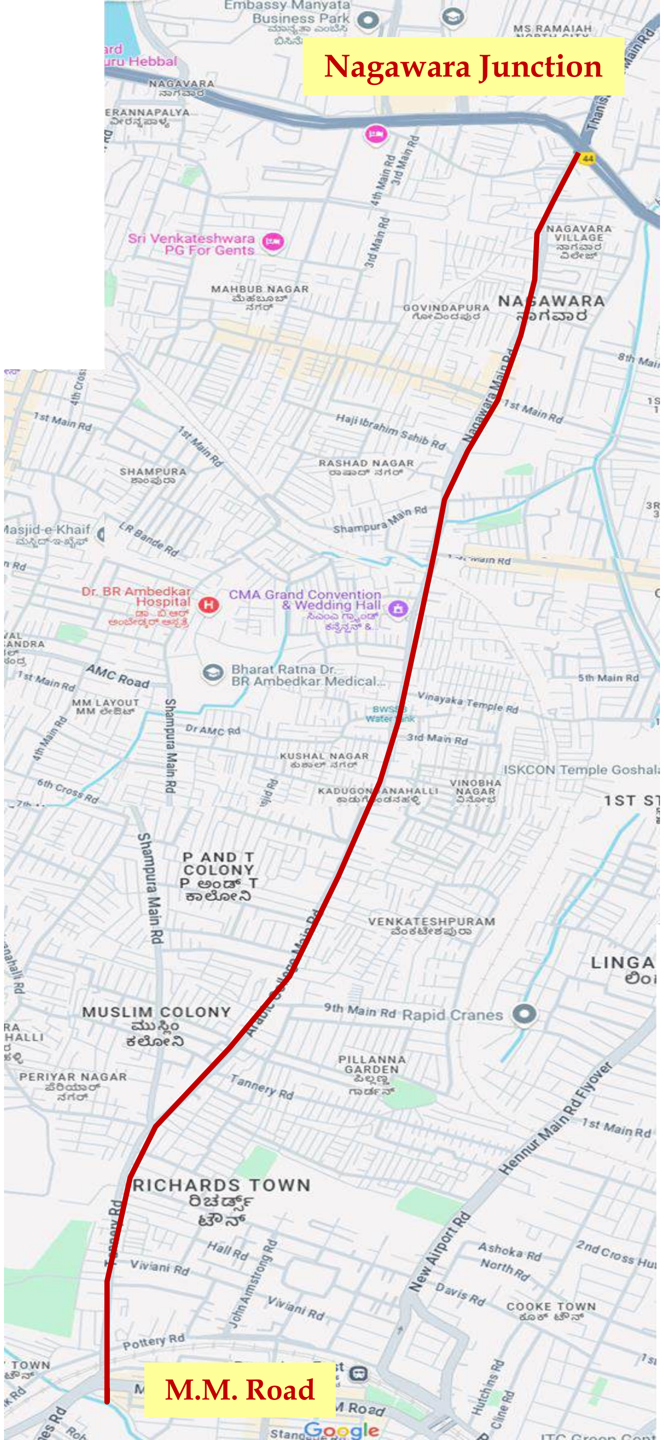
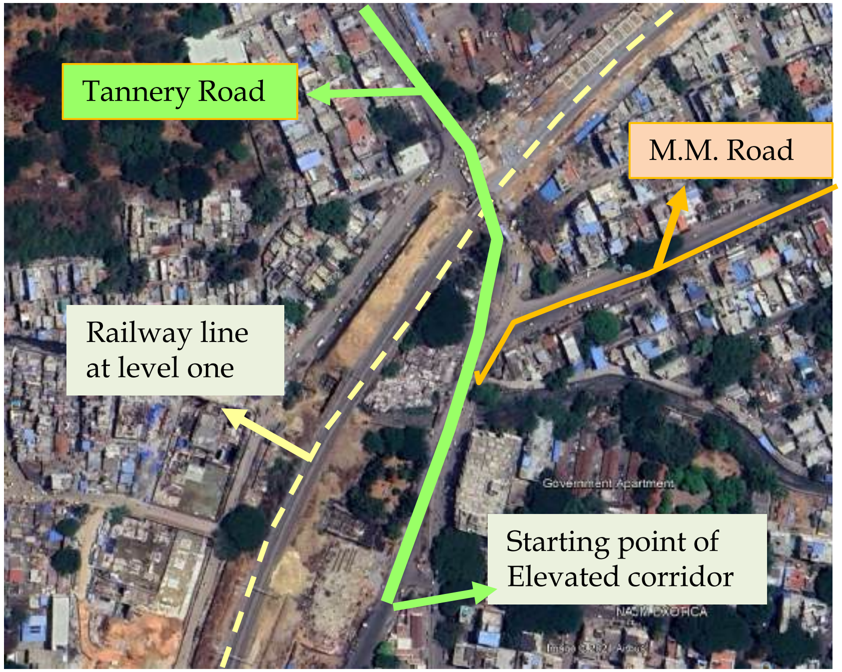


Figure 356. **Proposed elevated corridor from MM road to Nagawar junction**

Proposed Alignment details



The proposed elevated corridor begins just before the **Madava Mudiliyar (M.M.) Road intersection** and proceeds to cross the **existing railway line** at **level one** near the **Pottery Town intersection**, as illustrated in the accompanying figure. This alignment ensures minimal disruption to surface traffic while effectively addressing the bottlenecks caused by the railway crossing. The design aims to streamline traffic flow, particularly at key junctions, and provide seamless connectivity along the corridor.

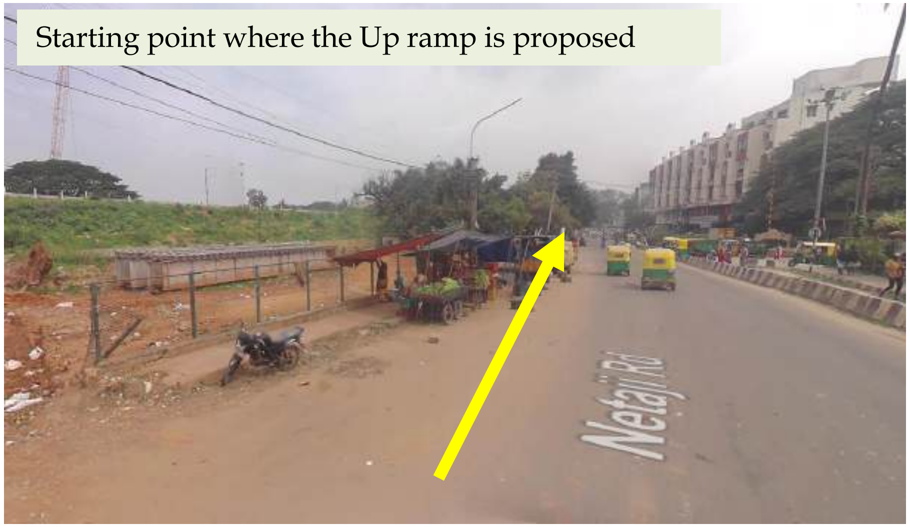
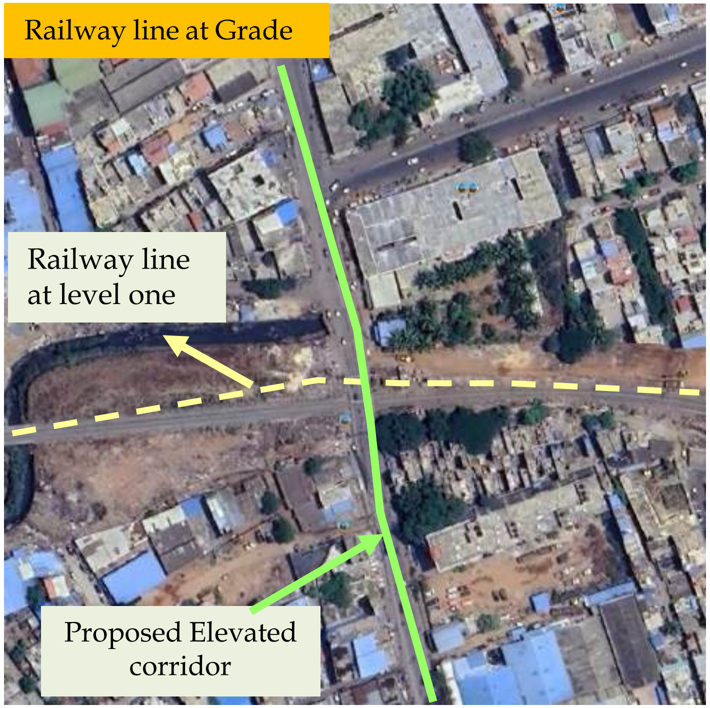


Figure 357. **Proposed elevated corridor from MM road to Nagawar junction**

The elevated corridor reaches D.J. Halli Junction, where it takes a right turn onto Arabic College Road and continues toward Nagawara Junction. Beyond this point, the road width increases to 12 meters and above. However, due to the ongoing Metro construction work and the barricades set up by the Metro authorities, the effective road width has been reduced, resulting in significant traffic congestion.

Figure 358. **Proposed elevated corridor from MM road to Nagawar junction**



The proposed elevated corridor crosses another railway line at grade and continues along Nagawara Main Road. This section faces significant traffic challenges, particularly at the railway crossing, which serves as a major congestion point. Long traffic queues form whenever the railway gate is closed for passing trains."

The proposed elevated corridor moves on Nagawara main road and at this stretch the carriageway width varies from 12 meters to less than 7 meters resulting in traffic congestion at every choke points.

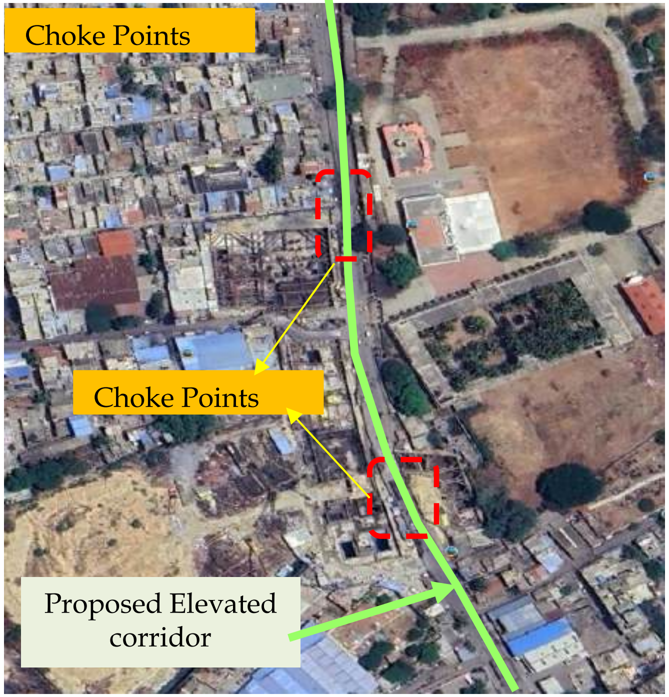
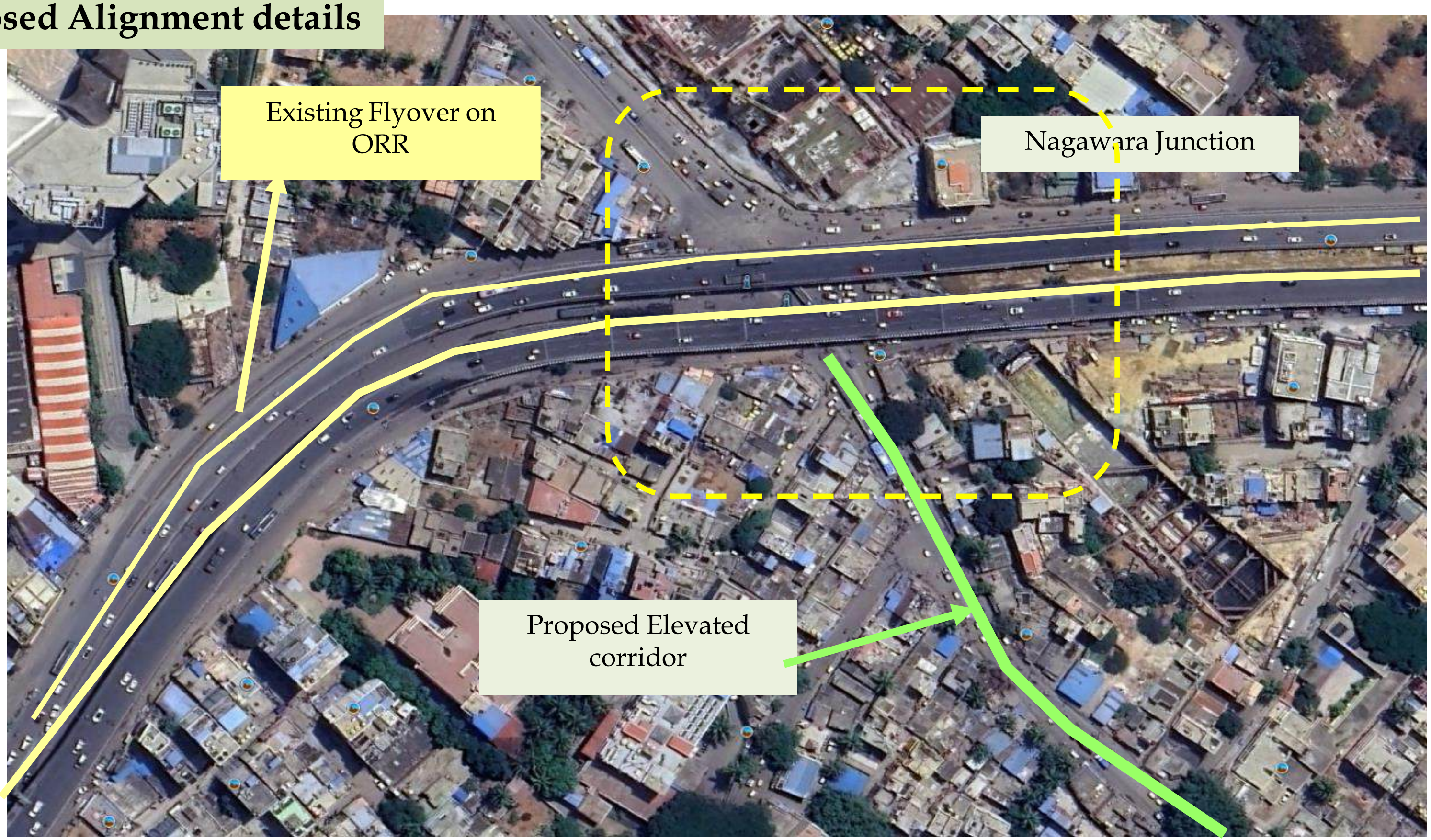


Figure 359. **Proposed elevated corridor from MM road to Nagawar junction**

Proposed Alignment details



"The proposed elevated corridor concludes at Nagawara Junction, connecting with the Outer Ring Road. Before reaching Nagawara Junction, the road narrows significantly, leading to traffic congestion and long queue lengths. To address this issue, land acquisition will be necessary along various stretches where the road width is insufficient.

Figure 360. **Proposed elevated corridor from MM road to Nagawar junction**

Proposed 4 lane divided Elevated corridor from Hennur junction to Baglur Main road

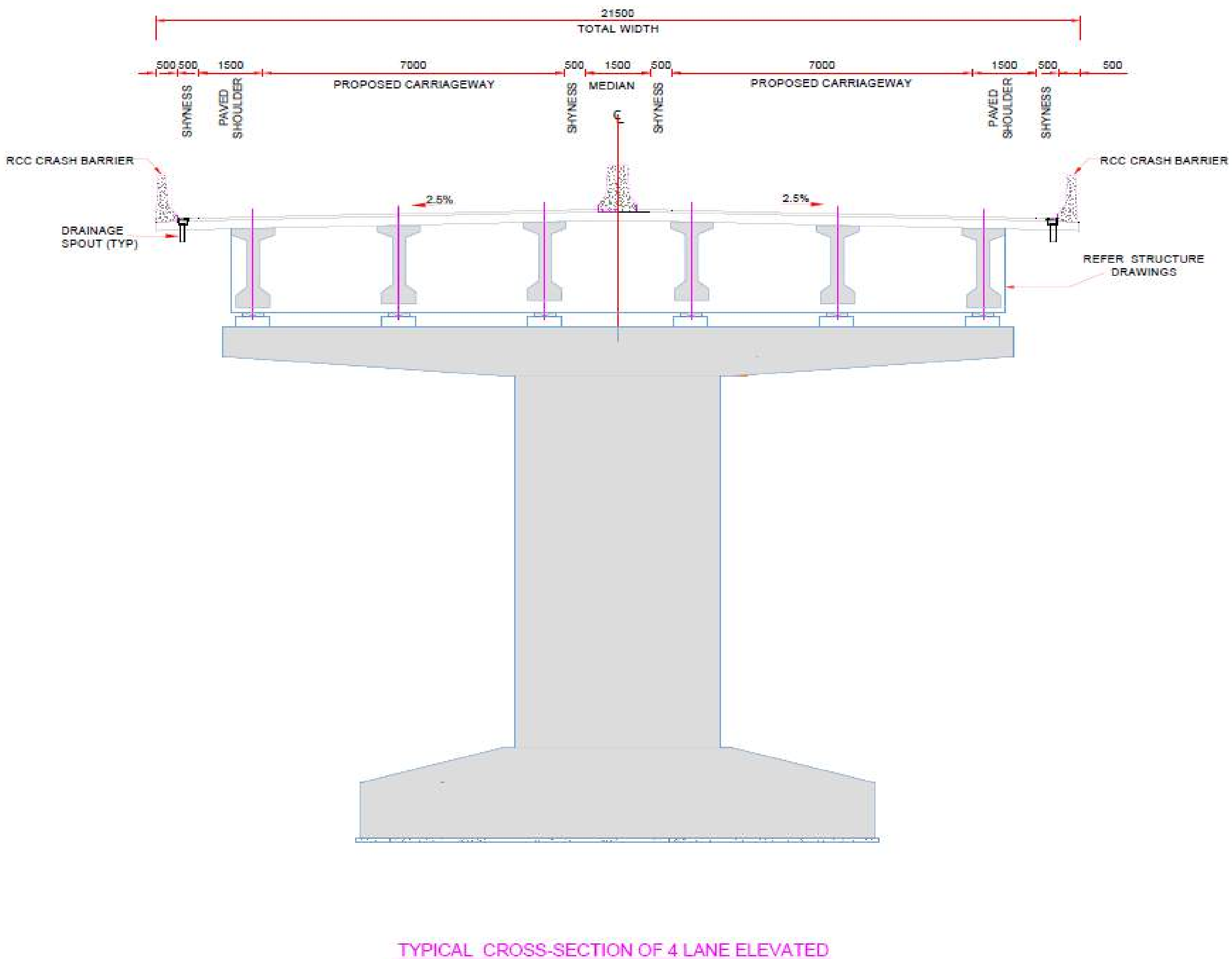


Figure 361. **Proposed cross section for the Elevated corridor from M.M road to Nagawara junction**

Proposed 6 lane divided Elevated corridor from Hennur junction to Baglur main road

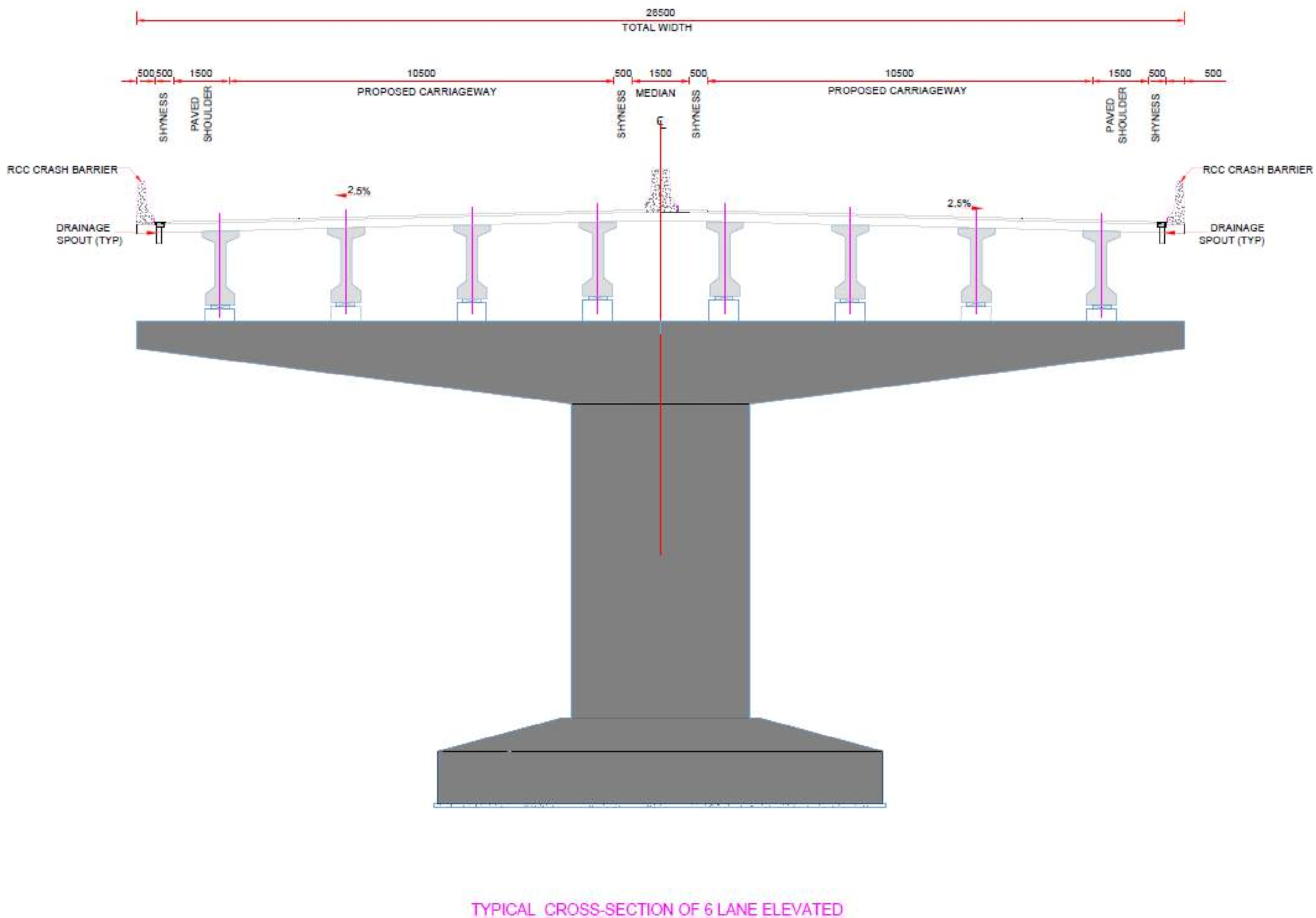
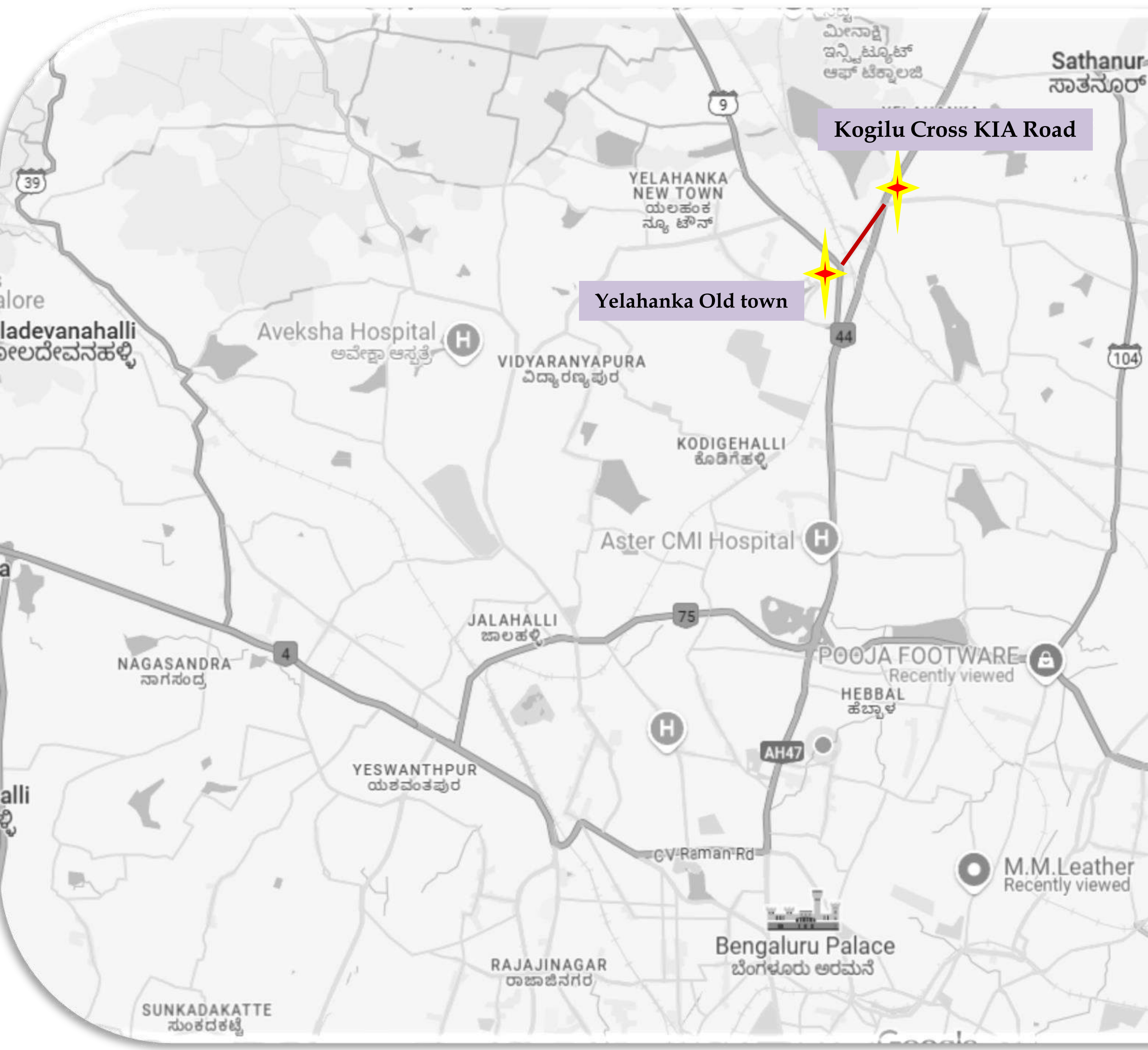


Figure 362. **Proposed cross section for the Elevated corridor from M.M road to Nagawara junction**



CORRIDOR 15

YELAHANKA NEW TOWN MAIN ROAD

Proposed Elevated corridor from Yelahanka Old Town to Kempegowda International Airport road.

Proposed Elevated corridor from Yelahanka Old Town to Kempe Gowda International Airport road – 4 kms

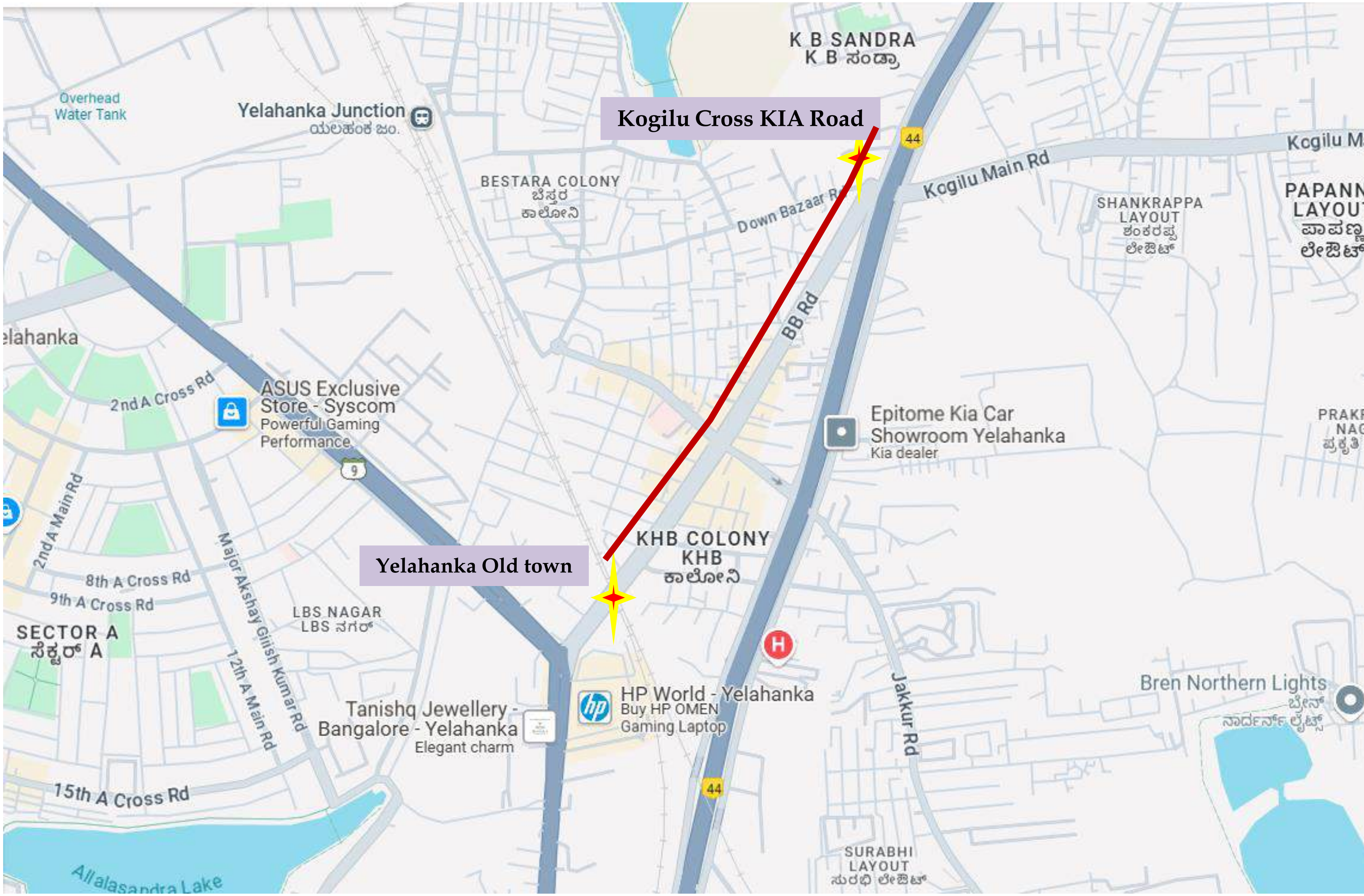


Figure 363. Proposed Elevated corridor from Yelahanka Old Town to Kempe Gowda International Airport road

The traffic scenario on Yelahanka Main Road, particularly the stretch from the Police Station Circle to Kogilu Cross, is characterized by significant congestion due to several factors:

Key Traffic Issues:

1.High Traffic Volume:

1. This stretch serves as a major arterial road connecting Yelahanka to Kogilu Cross and further to the Kempegowda International Airport.
2. It experiences heavy vehicular traffic throughout the day, including cars, buses, two-wheelers, and goods vehicles.

2.Choke Points:

1. The Police Station Circle is a key junction with multiple roads converging, leading to frequent bottlenecks.
2. Kogilu Cross, being a major intersection, adds to the congestion due to merging traffic from different directions.

3.Encroachments:

1. Encroachments along the roadside reduce the effective carriageway width, further worsening traffic flow.

4.Narrow Road Sections:

1. Certain sections of Yelahanka Main Road are relatively narrow, which cannot efficiently handle the volume of traffic, especially during peak hours.

5. Pedestrian Movement:

- Lack of adequate pedestrian crossings and footpaths forces pedestrians to cross the road haphazardly, adding to the traffic chaos.

6. Commercial Activities:

1. Shops, markets, and street vendors along the road generate additional vehicular and pedestrian activity, contributing to slow-moving traffic.

7. Signalized Intersections:

1. Traffic signals at key junctions often result in long queue lengths during peak hours due to inadequate signal timing and high vehicle density.

8. Public Transportation Stops:

1. Bus stops located near junctions or in narrow road sections lead to frequent stops and disruptions in the traffic flow.

Peak Hour Traffic:

•Morning peak hours see heavy outbound traffic towards the airport and IT corridors.
•Evening peak hours witness heavy inbound traffic as commuters return home.

Suggested Solutions:

1.Road Widening:
1. Acquire land where necessary to expand the road and increase its capacity.

2.Traffic Signal Optimization:
1. Improve signal coordination and implement adaptive traffic management systems.

3.Dedicated Lanes:
1. Introduce dedicated bus and two-wheeler lanes to streamline traffic movement.

4.Pedestrian Infrastructure:
1. Build proper footpaths and pedestrian crossings to reduce pedestrian-related disruptions.

5.Grade Separation:
1. Construct flyovers or underpasses at critical intersections like Kogilu Cross to allow smoother flow.

6.Relocation of Bus Stops:
1. Relocate bus stops to less congested areas and provide proper bays to prevent buses from blocking lanes.

By addressing these issues with focused infrastructure upgrades and traffic management strategies, the stretch from Police Station Circle to Kogilu Cross can witness a significant reduction in congestion and smoother traffic flow.

Constructing an elevated corridor on Yelahanka Main Road can address several traffic issues, but its effectiveness depends on careful planning and integration with existing infrastructure. Here's an analysis of its potential impact:

Benefits of an Elevated Corridor:

1.Bypassing Congested Intersections:

•The elevated corridor would allow through-traffic to bypass key choke points like Police Station Circle and Kogilu Cross, significantly reducing delays at ground level.

2.Increased Road Capacity:

•By adding an additional level for traffic, the corridor would effectively double the road's capacity, accommodating more vehicles during peak hours.

3.Reduced Travel Time:

•Commuters traveling long distances (e.g., towards Kempegowda International Airport or IT hubs) would benefit from uninterrupted traffic flow, leading to shorter travel times.

4.Segregation of Traffic:

•Heavy and long-distance traffic can use the elevated corridor, while local traffic remains on the ground level, leading to better traffic management.

5.Minimizing Land Acquisition:

•Unlike road widening, which often requires significant land acquisition, an elevated corridor can be constructed within the existing road alignment, reducing displacement and legal hurdles.

6.Enhanced Safety:

•Pedestrian and local vehicle safety can improve as the elevated corridor would reduce conflicts between fast-moving vehicles and ground-level users.

Challenges to Address:

1.Local Traffic Congestion:

- While the elevated corridor will benefit through-traffic, local congestion at ground level (e.g., near markets, bus stops, and residential areas) may persist unless additional measures are implemented.

2.Cost and Time:

- Elevated corridors are expensive and time-consuming to construct. Traffic disruptions during construction can exacerbate congestion temporarily.

3.Integration with Existing Infrastructure:

- The corridor must seamlessly integrate with junctions, flyovers, and other roads at both entry and exit points to avoid creating new bottlenecks.

4.Access for Local Traffic:

- The elevated corridor will primarily serve long-distance travelers. Local commuters might not benefit directly, necessitating parallel improvements to the ground-level road.

5.Maintenance and Environmental Concerns:

- Elevated structures require ongoing maintenance, and their construction might impact the environment or nearby properties.

Conclusion:

An elevated corridor on Yelahanka Main Road can significantly alleviate through-traffic congestion and improve overall traffic efficiency, especially for long-distance and airport-bound commuters. However, to comprehensively solve traffic issues, it should be complemented with improvements at ground level and other multimodal transport solutions.

Photos along the proposed Elevated corridor Alignment

Figure 364. Proposed Elevated corridor from Yelahanka Old Town to Kempe Gowda International Airport road

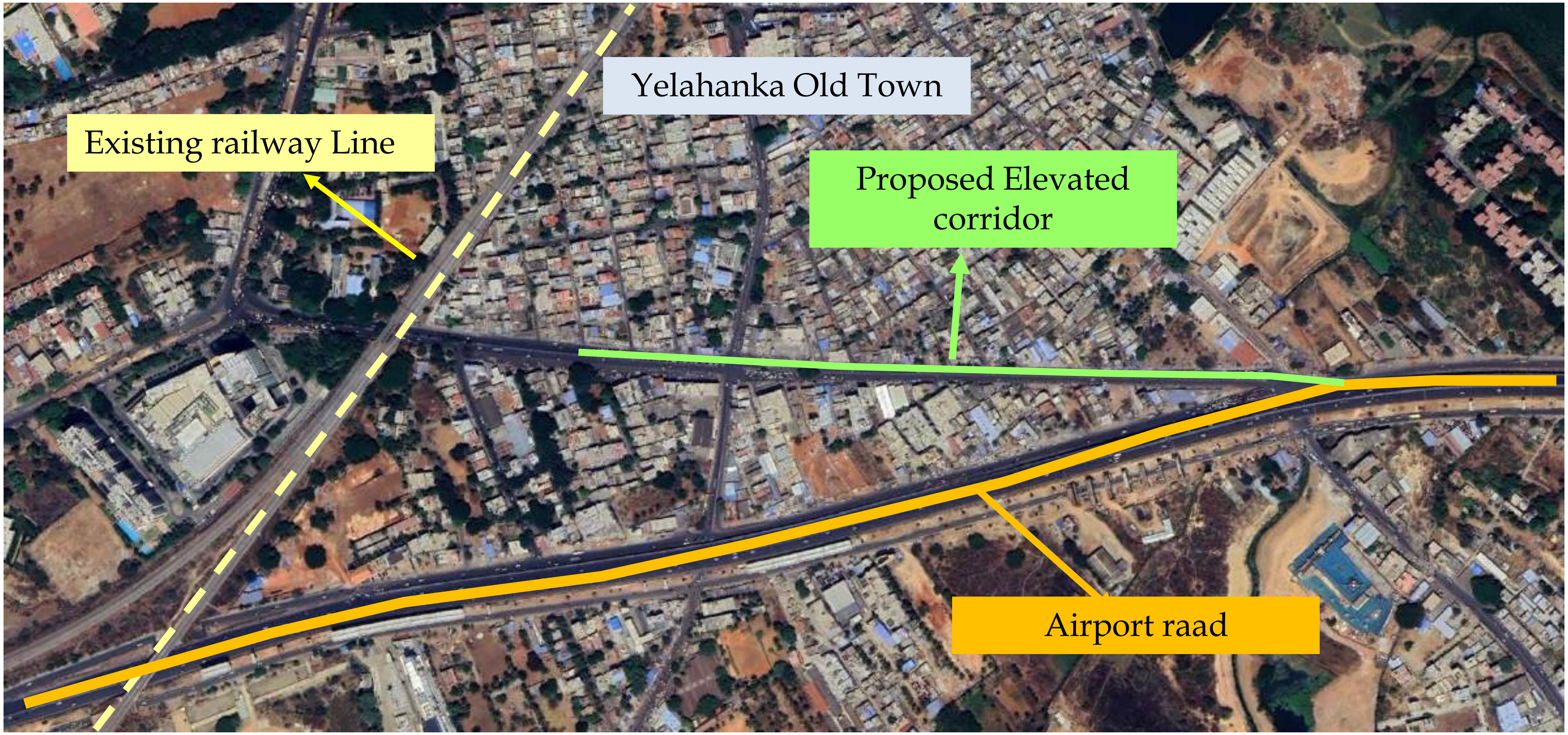


Figure 365. Proposed Elevated corridor from Yelahanka Old Town to Kempe Gowda International Airport road

The proposed elevated corridor mentioned starts from Yelahanka police station and extends 4 kilometers towards Kogilu Cross. It is planned to cross a significant railway junction and terminate at Kogilu Junction, connecting to the Airport corridor. This project is likely intended to streamline traffic flow in the area and provide improved connectivity to the airport.

Proposed 4 lane divided Elevated corridor from Hennur junction to Baglur Main road

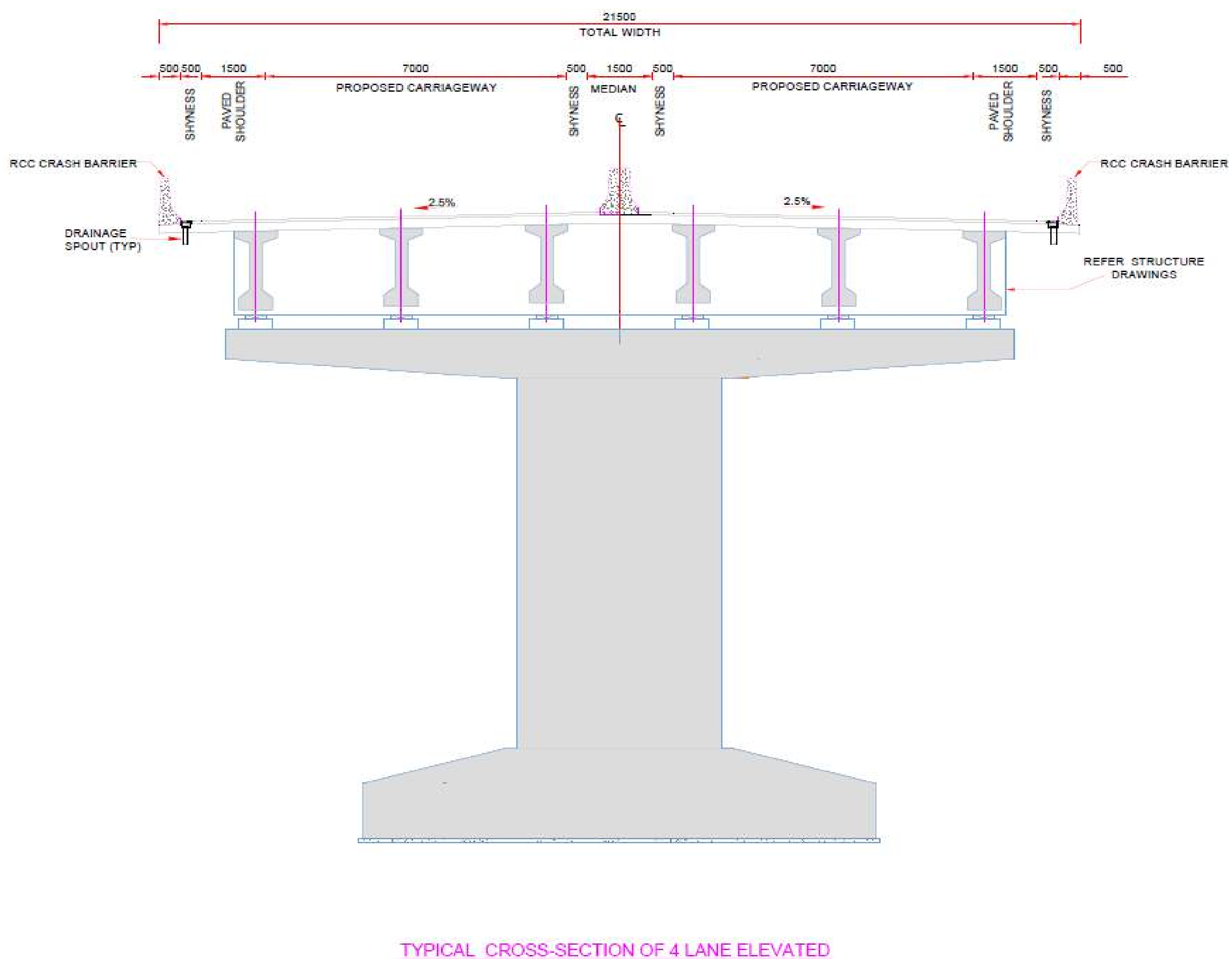


Figure 366. **Proposed cross section for the Elevated corridor from Yelahanka Old Town to Kogilu cross**

Proposed 6 lane divided Elevated corridor from Hennur junction to Baglur main road

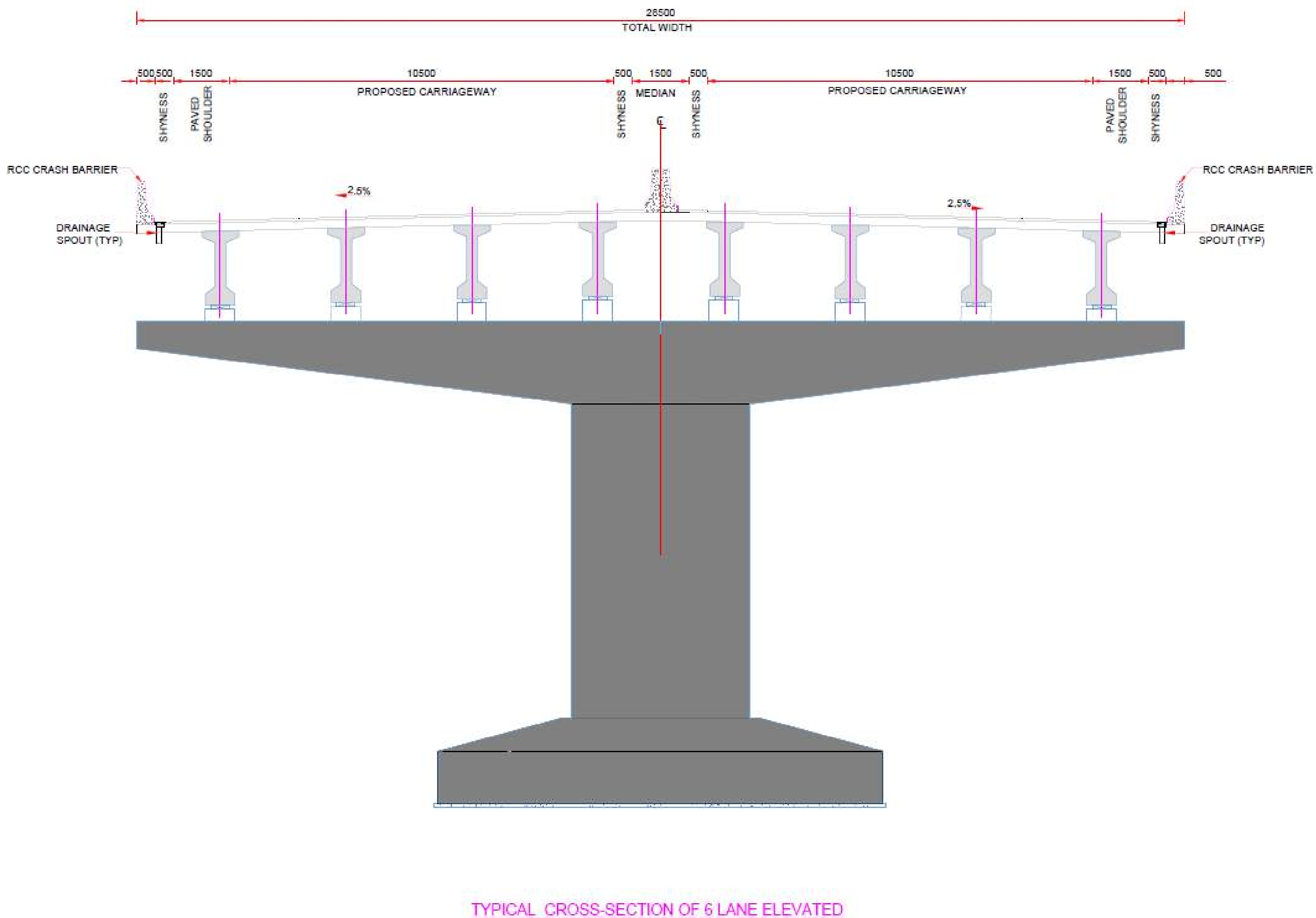
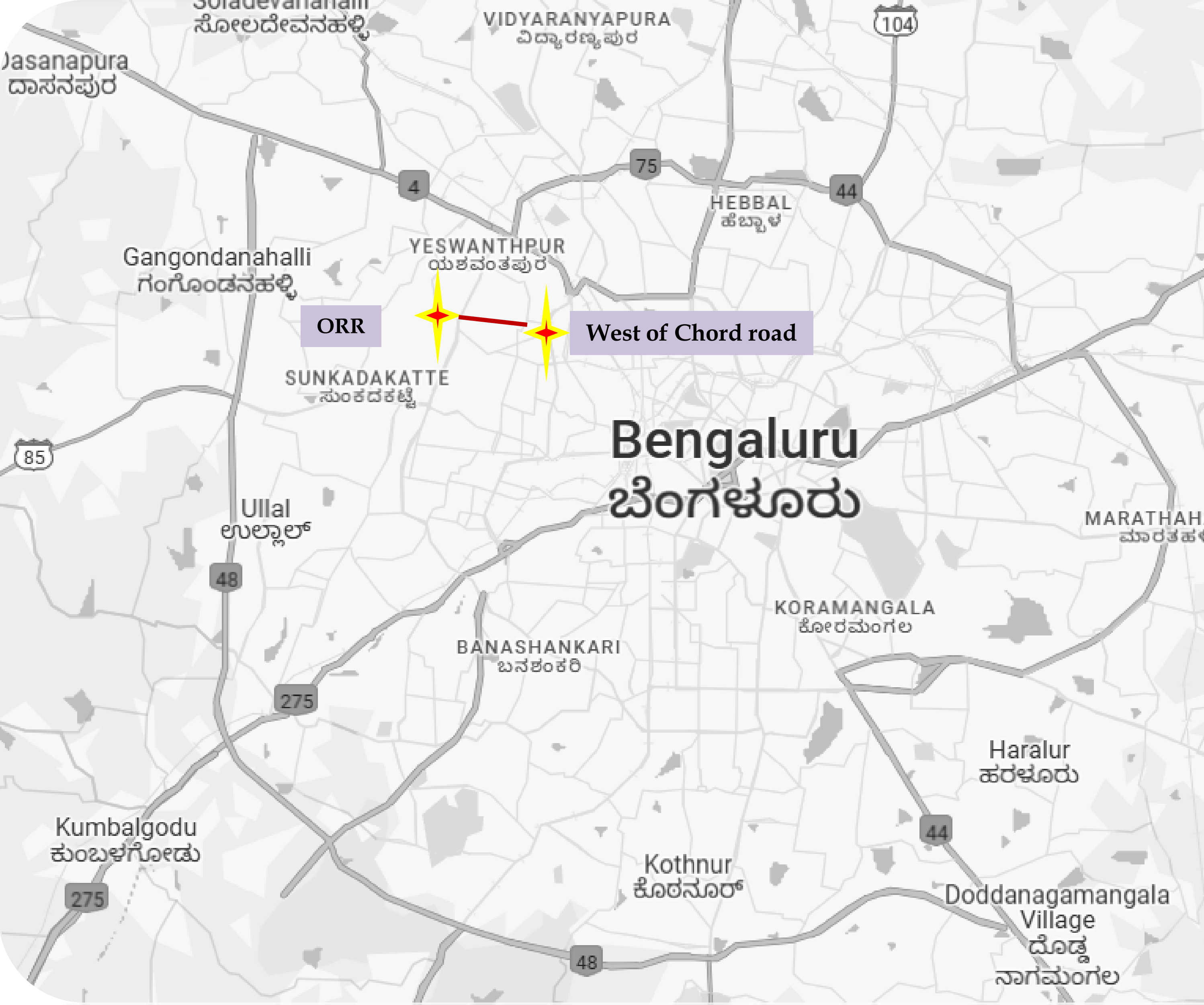


Figure 367. **Proposed cross section for the Elevated corridor from Yelahanka Old Town to Kogilu cross**



CORRIDOR

16

WEST OF CHORD ROAD

Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout).

Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout)- 4.5 Kms

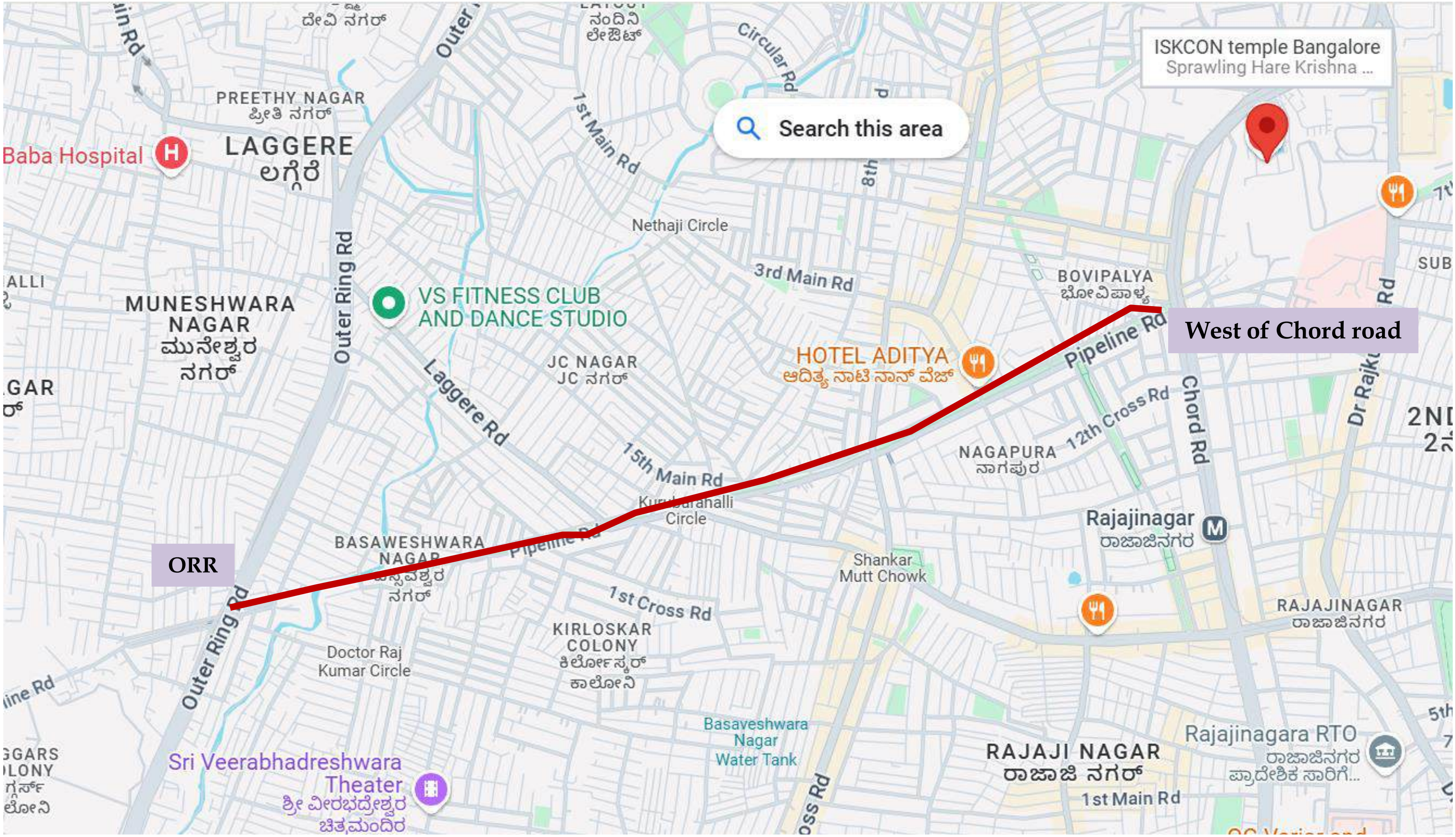


Figure 368. **Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout**

The traffic scenario from **West of Chord Road to ORR (Outer Ring Road) via Pipeline Road** depends on the specific area you are referring to, but I can provide a general overview of the route and typical traffic conditions in the region.

1. Starting Point: West of Chord Road

•**Chord Road** is a major road in Bangalore, connecting areas like **Malleswaram**, **Rajajinagar**, and **Vijayanagar** to other parts of the city. The western side of Chord Road generally includes localities such as **Basaveshwaranagar**, **Ravindra Kalakshetra**, and parts of **Vijayanagar**.

•**Traffic Flow:** Traffic on this stretch can be congested, particularly during peak hours (morning and evening), as it's a densely populated area with a mix of residential, commercial, and institutional traffic.

2. Heading towards Pipeline Road

•**Pipeline Road** runs parallel to Chord Road in the western part of Bangalore. It is a vital road that connects localities like **Kaval Byrasandra**, **West of Chord Road**, and **Bengaluru North** with nearby areas like **Mathikere**, **Yeshwanthpur**, and eventually with **Outer Ring Road (ORR)**.

•**Traffic Flow on Pipeline Road:** The stretch of Pipeline Road can get busy due to the mix of residential areas, commercial establishments, and intersections leading to key roads. However, the traffic is usually less dense compared to the main arterial roads like Chord Road, although bottlenecks can occur at intersections, especially if the road narrows or there are traffic signals.

3. Approaching the Outer Ring Road (ORR)

•**Outer Ring Road** is a significant road that encircles the city, providing connectivity to various IT hubs, business districts, and residential areas. There are multiple entry points to ORR, but traveling from Pipeline Road typically connects you to the **North or West** stretch of the ORR, near areas like **Nagawara**, **Bellandur**, or **Hebbal**.

•**Traffic Flow on ORR:** The ORR experiences varying traffic conditions depending on the time of day. During peak hours, heavy traffic congestion is common, especially near key junctions like **Hebbal**, **KR Puram**, or **Whitefield**. However, once you are on ORR, the roads are generally wide, and traffic moves faster unless there's an accident, construction, or a bottleneck at a junction.

General Observations

•**Peak Hours:** Traffic congestion on both Chord Road and Pipeline Road increases significantly during peak hours (8-10 AM and 5-7 PM), with slow-moving vehicles and occasional jams at major intersections.

•**Alternatives:** If there is heavy traffic, alternate routes through areas like **Yeshwanthpur** or **Malleswaram** may offer a smoother ride, but this can vary based on the time of day.

•**Infrastructure Development:** Over the years, there have been significant improvements to infrastructure in the region, such as flyovers and underpasses, which help reduce traffic bottlenecks in some areas. However, roadwork or new developments can still lead to disruptions at times.

Conclusion

In summary, while the route from West of Chord Road to ORR via Pipeline Road is generally straightforward, traffic conditions depend largely on the time of day, with congestion being the most severe during peak traffic hours. The key issues to watch out for are:

•Heavy traffic on Chord Road and around major intersections.

•Potential slowdowns on Pipeline Road due to residential and commercial traffic.

•Busy traffic conditions on ORR, particularly at junctions.

Photos along the proposed Corrdidor from West of chord road to ORR

Figure 369. **Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout**

Proposed 4 lane divided Elevated corridor from Hennur junction to Baglur Main road

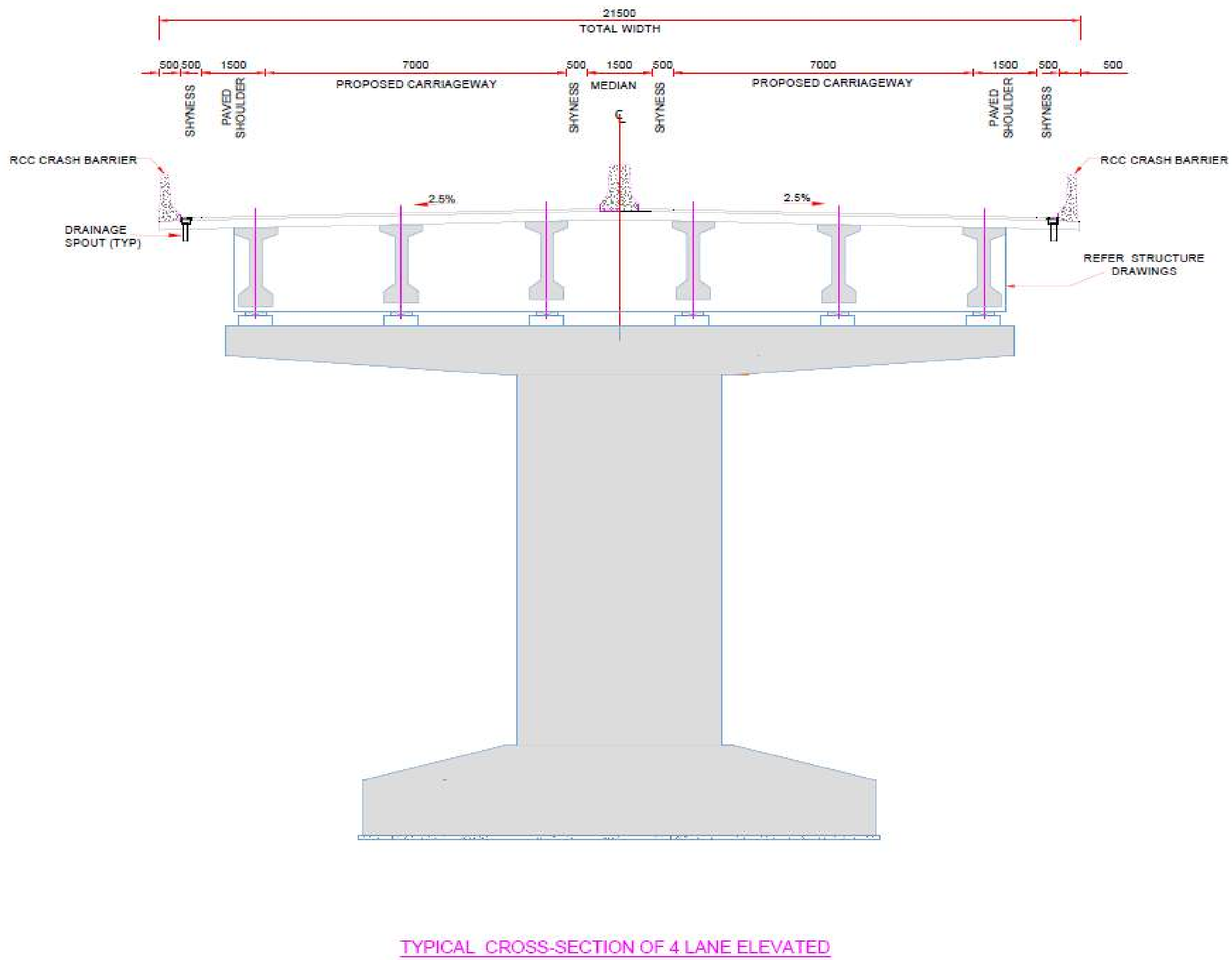


Figure 370. **Proposed cross section for the Elevated corridor from West of Chord road to ORR**

Proposed 6 lane divided Elevated corridor from Hennur junction to Baglur main road

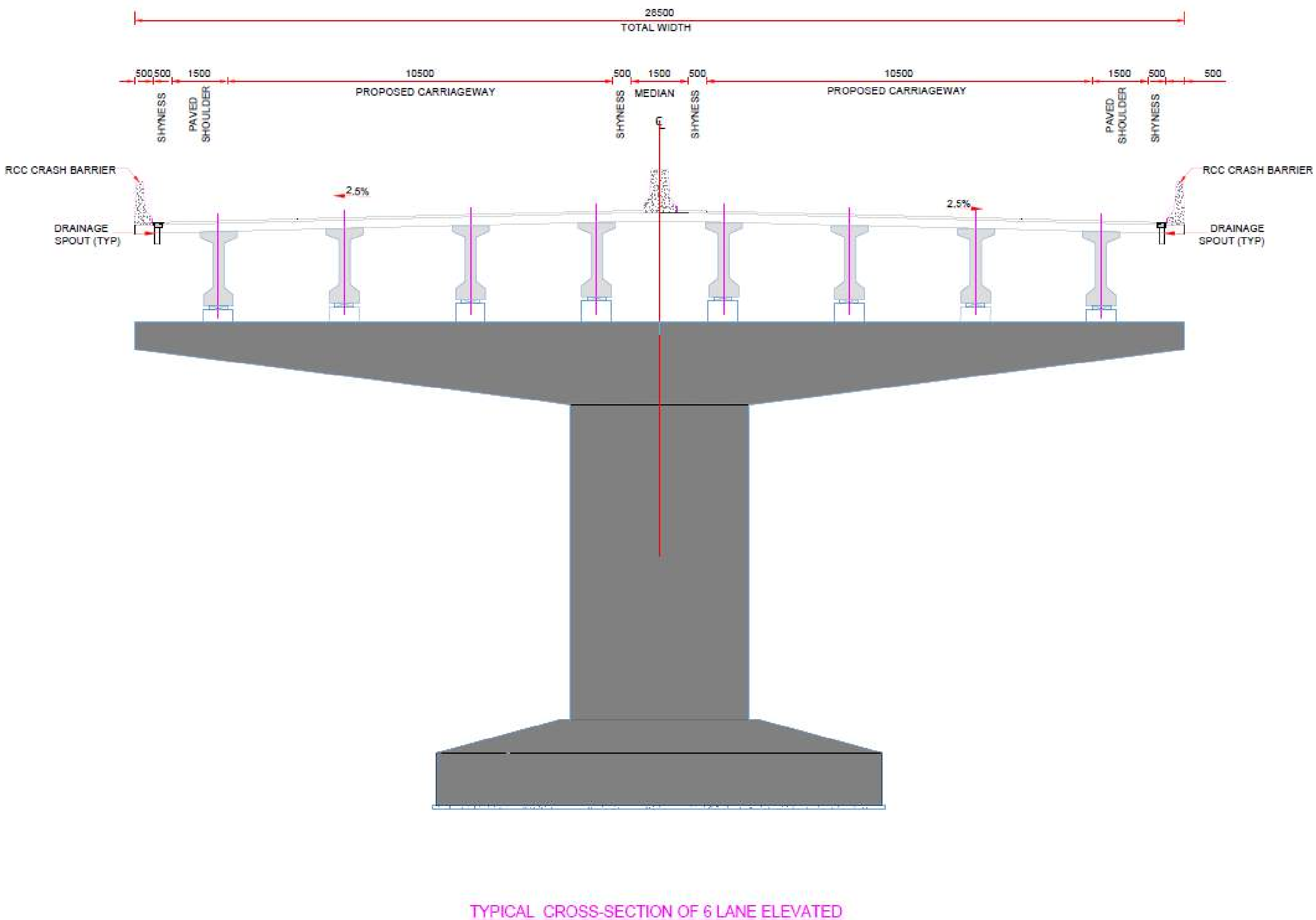
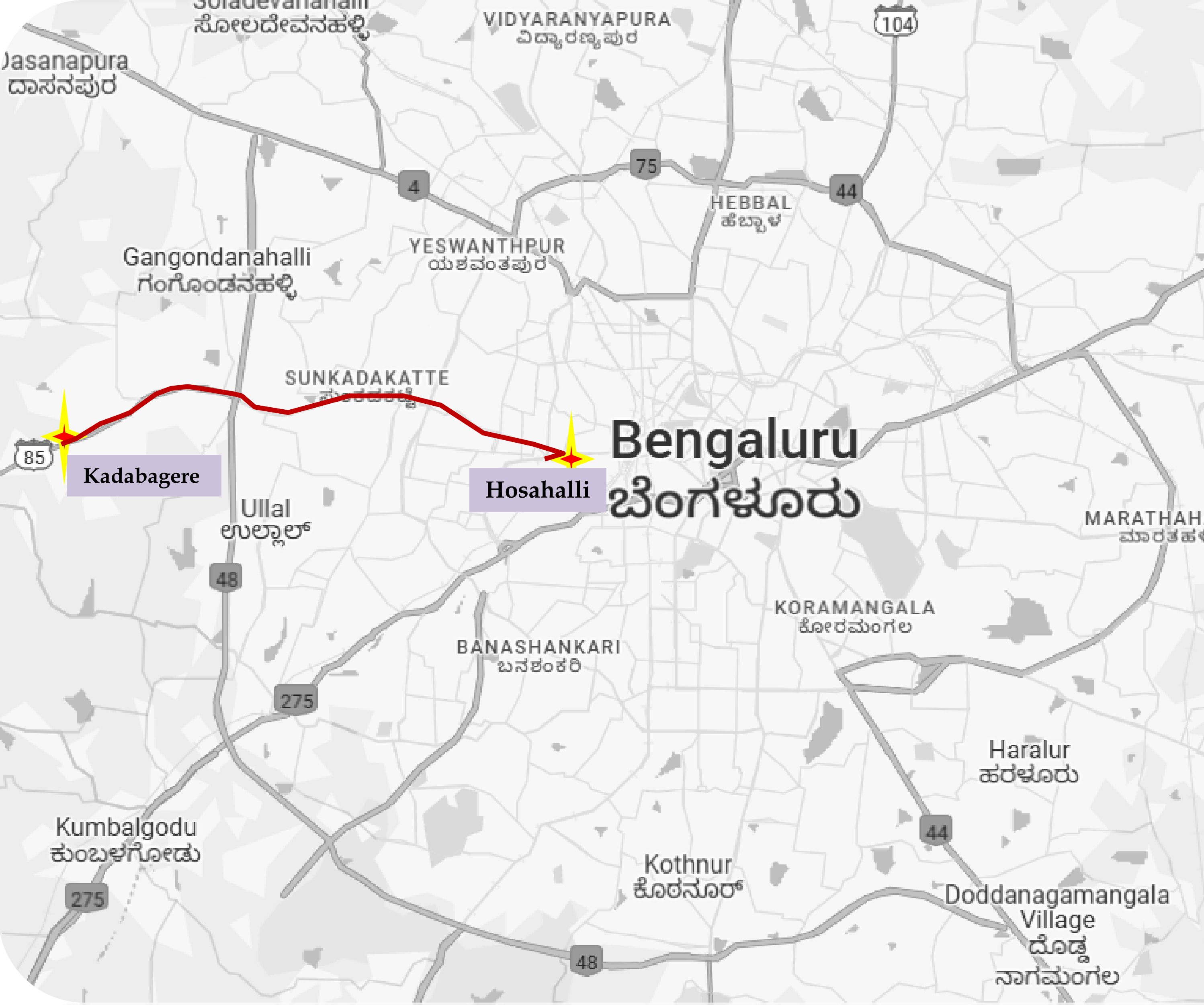


Figure 371. **Proposed cross section for the Elevated corridor from West of Chord road to ORR**



DOUBLE DECKER INTEGRATED WITH BMRCL - METRO

CORRIDOR

01

Magadi Road

Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.

Proposed Double Decker Corridor from Hosahalli to Kadabagere cross near Seegehalli along Magadi road

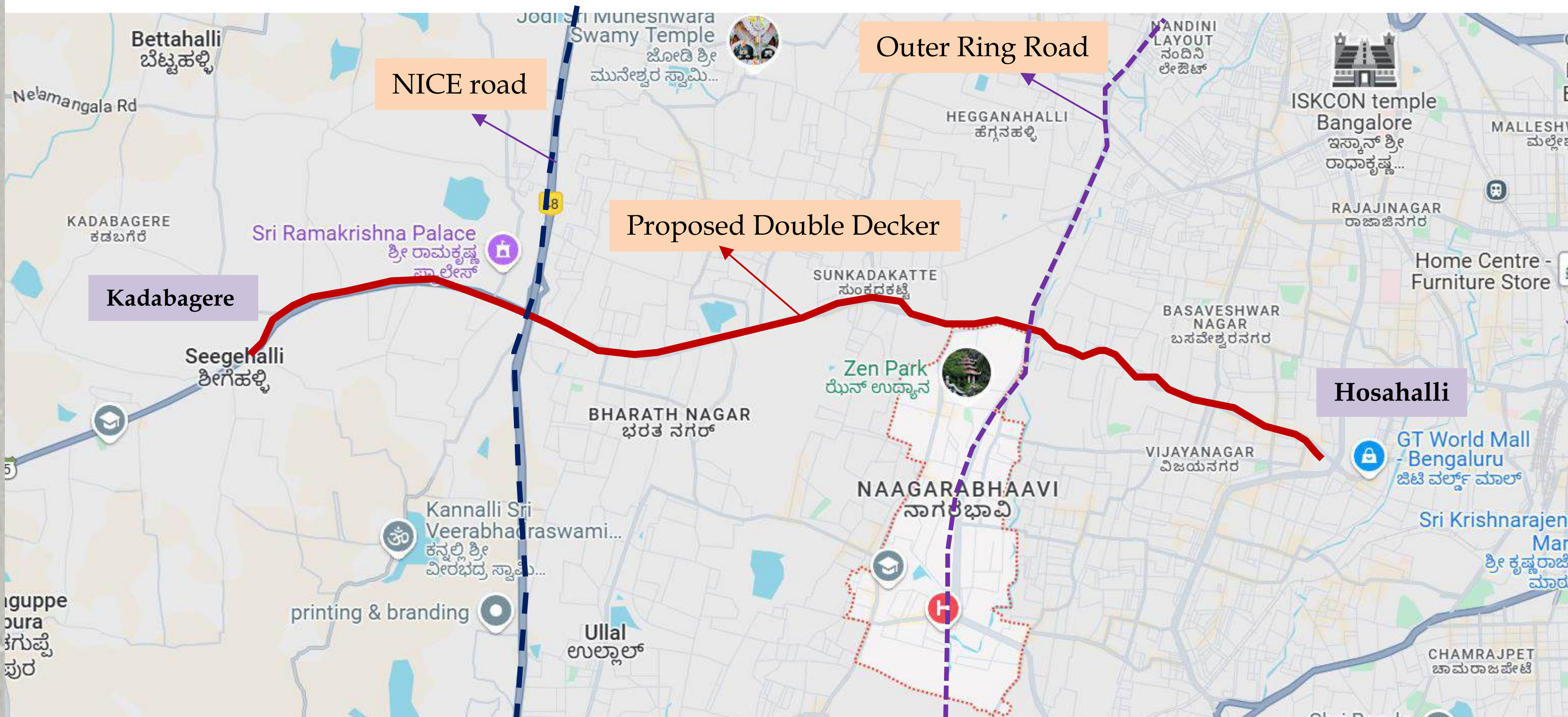


Figure 372. **Proposed Double Decker Corridor from Hosahalli to Kadabagere cross near Seegehalli along Magadi road**

The proposed double-decker corridor along Magadi Road spans approximately 12.5 km, beginning at Hosahalli and ending near Kadabagere Cross. It traverses major densely populated and congested areas such as the southern part of Basaveshwaranagar, the northern side of Vijayanagar, Sunkadakatte, and Tavarekere, before reaching Seegehalli. Along its route, it crosses the Outer Ring Road near Summanahalli and NICE Road. The corridor features a road width that varies between 4-lane and 6-lane divided carriageways, designed to accommodate the area's traffic demands.

The stretch from **Hosahalli to Seegehalli along Magadi Road** in Bangalore experiences varying traffic conditions, primarily influenced by the time of day, ongoing infrastructure development, and local activities. Here's an overview of the key factors affecting this route:

1. Traffic Patterns

•**Peak Hours (8:00–11:00 AM and 5:00–8:00 PM)**: Traffic congestion is generally heavy during these times due to commuting patterns. Residents traveling toward the city center or returning to suburban areas contribute to significant slowdowns.

•**Off-Peak Hours**: During the middle of the day or late at night, traffic flow tends to improve, though occasional bottlenecks can still occur near marketplaces or intersections.

2. Key Contributors to Traffic

•**Urbanization and Construction**: The Magadi Road corridor has seen significant residential and commercial development, leading to increased vehicle density.

•**Narrow Roads and Encroachments**: Certain stretches of Magadi Road are narrower, and encroachments by vendors or parked vehicles exacerbate the problem.

•**Intersections and Traffic Signals**: Key junctions, such as those near Tavarekere or local market areas, often witness slow-moving traffic due to inefficient traffic management.

•**Public Transport Stops**: The presence of BMTC bus stops can cause localized congestion when buses block lanes for passenger boarding and alighting.

3. Ongoing Issues

•**Road Conditions**: Potholes or uneven road surfaces, particularly during or after the monsoon, can slow down traffic.

•**Heavy Vehicles**: Magadi Road serves as a link for trucks and goods vehicles traveling to industrial areas, contributing to slower traffic movement, especially during the day.

4. Potential Solutions

•**Road Widening Projects**: Expanding narrow stretches could help accommodate increasing traffic volumes.

•**Signal Optimization**: Synchronizing traffic signals can help reduce waiting times at junctions.

•**Public Transport Improvements**: Increasing the frequency and efficiency of buses could encourage a shift from private vehicles, easing congestion.

•**Flyovers or Underpasses**: Infrastructure upgrades at major junctions could help segregate through traffic from local traffic, minimizing delays.

. METRO extension with flyover i.e Double Decker along the Magadi road.

Current Scenario

Real-time traffic information suggests that conditions vary daily, depending on external factors like weather, events, or accidents. If you'd like, I can provide real-time updates on traffic for this route.

1. Current Challenges Along Magadi Road

•**Traffic Congestion**: The road caters to mixed traffic—private vehicles, buses, heavy trucks, and two-wheelers—leading to frequent bottlenecks, especially during peak hours.

•**Lack of Rapid Transit Options**: Despite BMTC services, there is no high-capacity transit option, making private vehicle dependency high.

•**Road Geometry**: The existing road is not designed to handle increasing traffic volumes due to rapid urbanization.

•**Environmental and Safety Concerns**: Emissions from vehicles and road safety issues are critical problems.

2.Proposal: Metro with a Flyover

A metro line along Magadi Road, integrated with a flyover, would combine mass rapid transit with improved road infrastructure. Here's how it could work:

Metro

•**Elevated Metro Line**: A metro line constructed above Magadi Road would reduce ground-level disruption during construction and avoid acquiring large swathes of land.

•**Stations**: Strategically placed metro stations (e.g., Hosahalli, Kamakshipalya, Sunkadakatte, Seegehalli) would provide convenient access for commuters.

•**Reduction in Private Vehicle Dependency**: A metro line can significantly reduce the number of cars and two-wheelers on the road, cutting congestion and emissions.

Flyover

•**Dedicated Traffic Segregation**: A multi-lane flyover beneath the metro line would allow uninterrupted movement of through-traffic, reducing delays caused by intersections and local traffic.

•**Grade Separation**: Vehicles needing to bypass congested areas like Tavarekere or market zones could use the flyover, leaving surface roads for local commuters and buses.

3. Benefits of the Proposal

Traffic Decongestion

•**Reduced Travel Time**: The combination of the metro and flyover would streamline traffic and provide faster travel alternatives.

•**Reduced Mixed Traffic**: Public transport users shift to the metro, heavy vehicles can be routed to designated lanes or times, and local traffic uses surface roads.

Environmental Impact

•**Lower Emissions**: With reduced private vehicle usage and improved traffic flow, pollution levels would drop significantly.

•**Sustainability**: A metro is energy-efficient and contributes to long-term sustainable urban development.

Urban Development

•**Increased Accessibility**: The metro would improve connectivity between suburban and urban areas, encouraging residential and commercial development.

•**Real Estate Growth**: Enhanced infrastructure often drives property value appreciation in nearby areas.

Safety and Livability

•**Fewer Accidents**: Improved road design, grade separation, and reduced congestion contribute to safer conditions for drivers and pedestrians.

•**Better Public Transport Access**: Integration of metro stations with BMTC services and last-mile connectivity options like auto-rickshaws, shared cabs, or cycle tracks would improve the overall commuter experience.

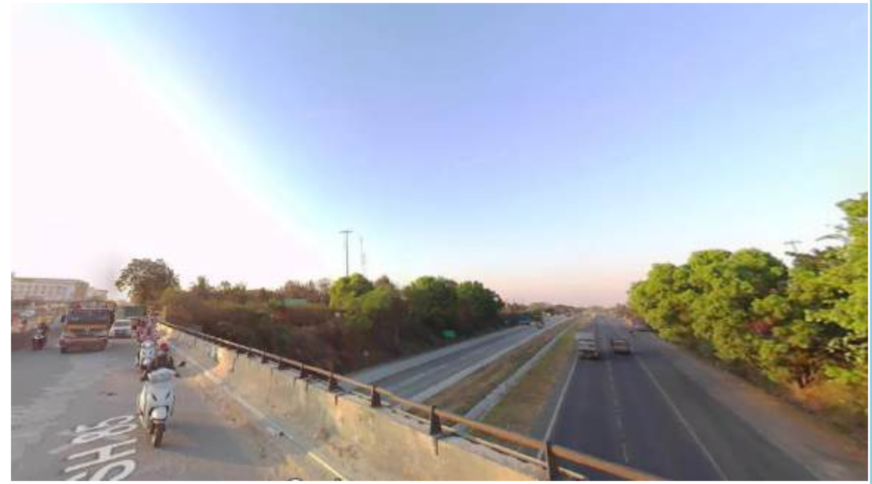
4. Long-Term Impacts

•**Traffic Flow**: A metro with a flyover would ensure a steady reduction in traffic congestion even with future growth in population and vehicle ownership.

•**Economic Growth**: Enhanced connectivity would boost local businesses, increase job opportunities, and make the area more attractive for investment.

•**Urban Sprawl Control**: By connecting suburbs like Seegehalli to the city efficiently, urban sprawl could be managed better, reducing pressure on the city's core.

Figure 373. **Proposed Double Decker Corridor from Hosahalli to Kadabagere cross near Seegehalli along Magadi road**



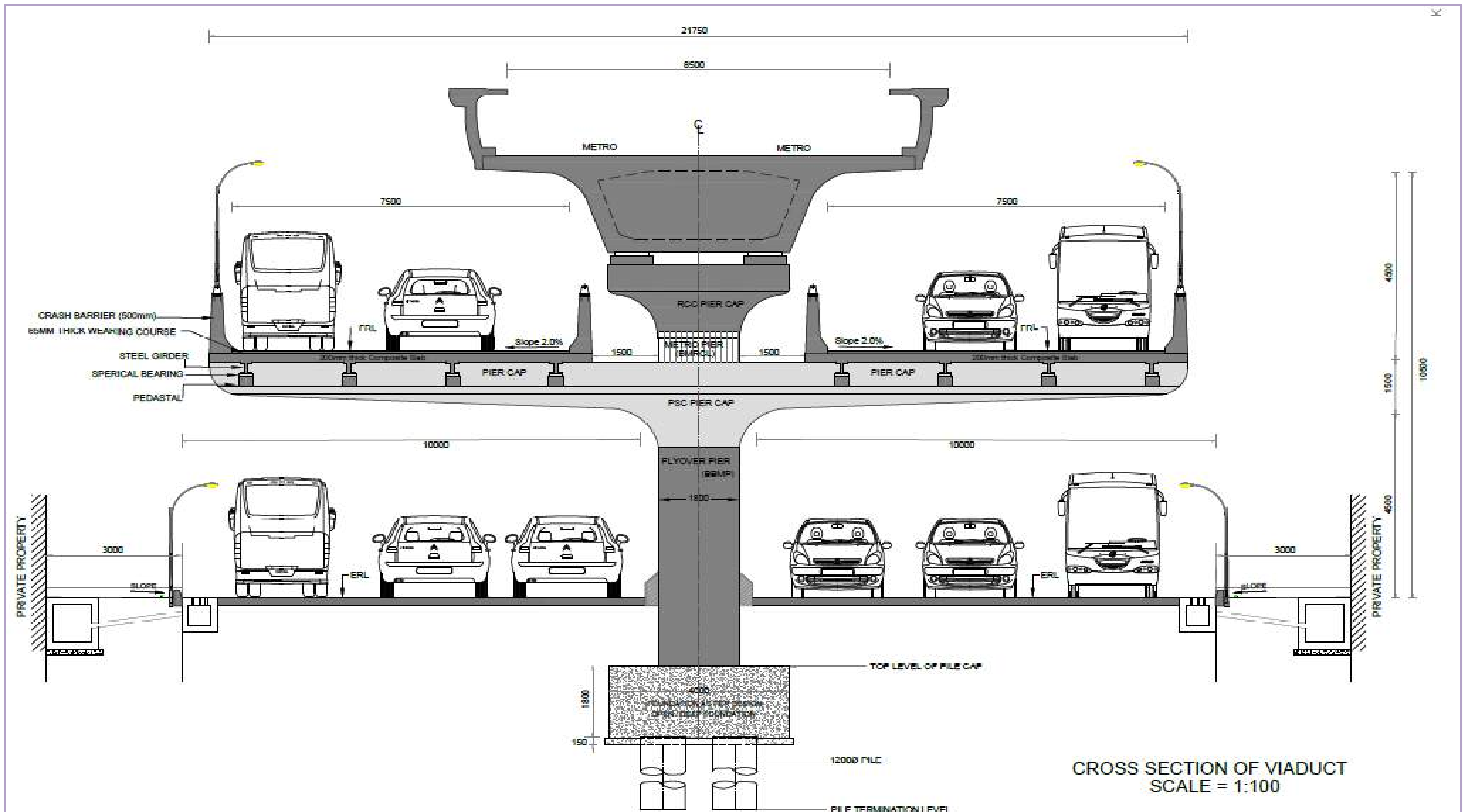
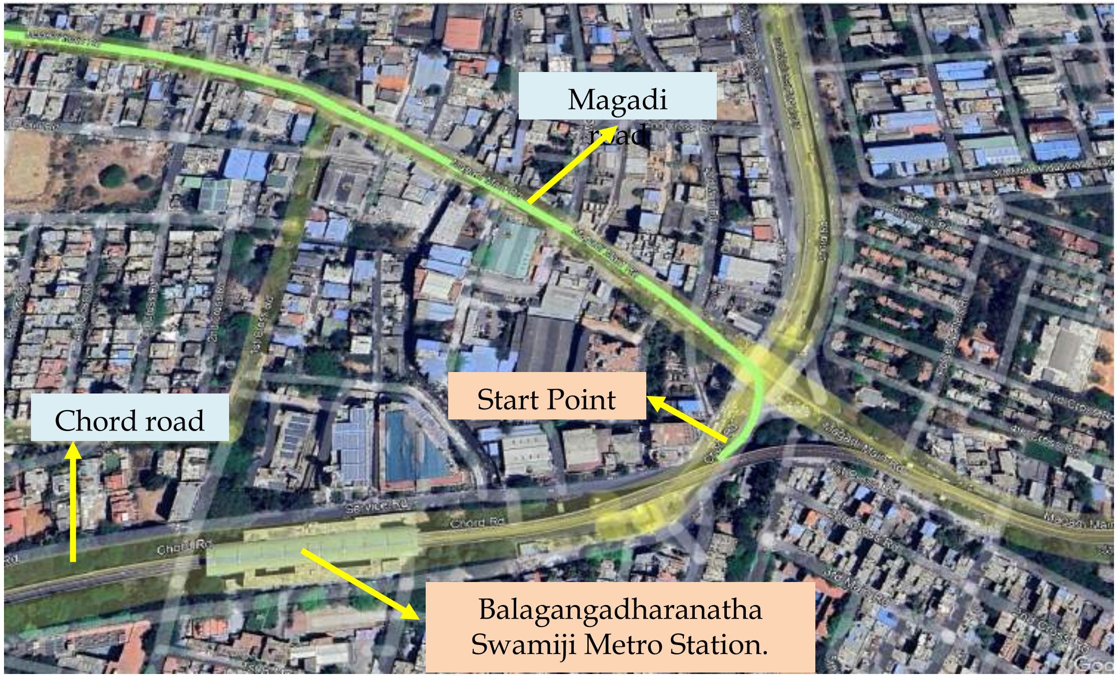


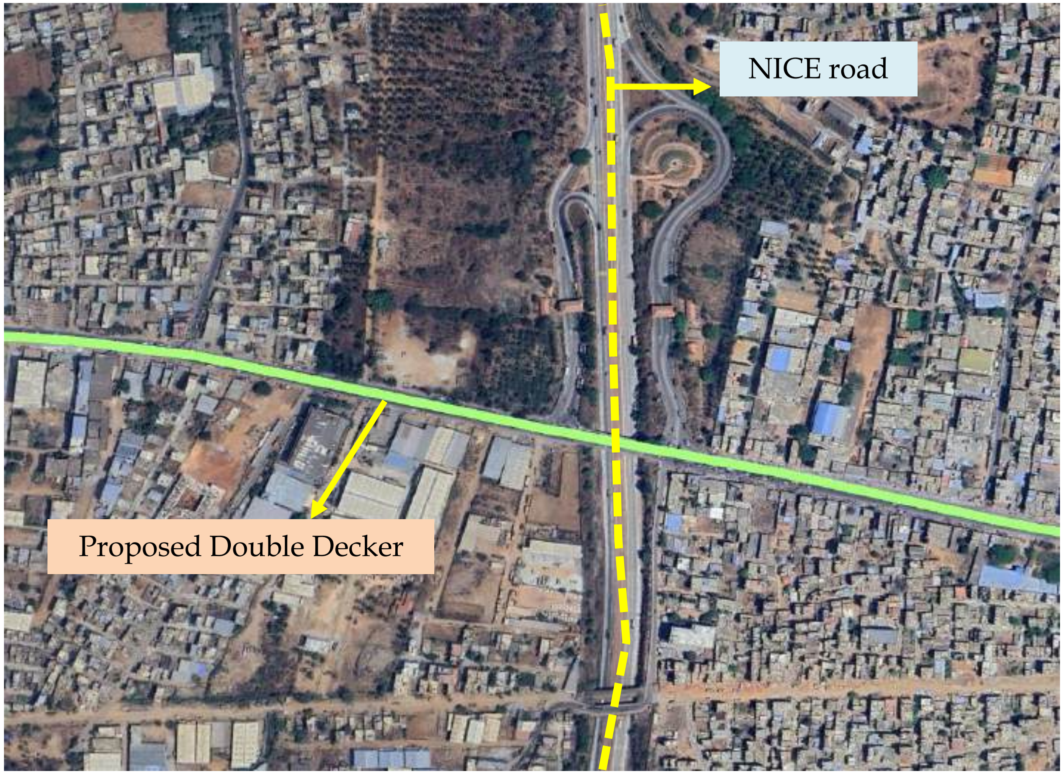
Figure 374. Typical Cross Section of Double Decker



The corridor begins at Hosahalli, near the junction of Chord Road and Magadi Road, close to the Balagangadharanatha Swamiji Metro Station. From this intersection, it turns left onto Magadi Road and proceeds toward the Outer Ring Road.

The corridor crosses the Outer Ring Road at a key junction near the Summanahalli Flyover, which serves as a critical point for connectivity. This crossing facilitates the integration of traffic between the Outer Ring Road and the corridor, helping to streamline vehicular movement in this highly congested area. The Summanahalli Flyover acts as an important link, reducing delays and improving access to other parts of the city.

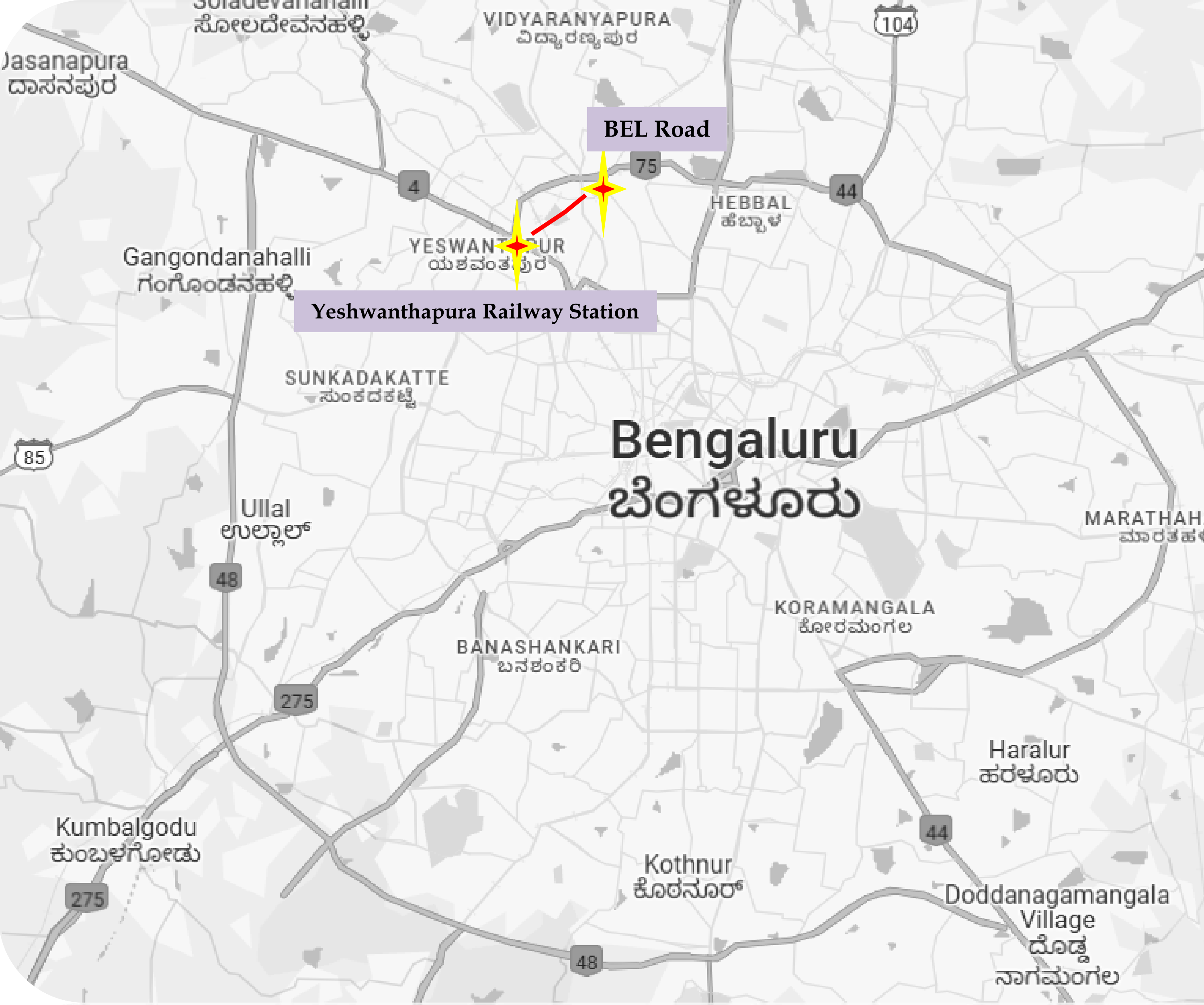
Figure 375. Proposed Double Decker Corridor from Hosahalli to Kadabagere cross near Seegehalli along Magadi road



The corridor intersects with the NICE (Nandi Infrastructure Corridor Enterprises) Road near Bydarahalli Layout, creating an essential junction that enhances connectivity between the two major routes. From this intersection, the corridor continues its path, moving through the suburban regions, and progresses toward Seegehalli, where it reaches its termination point. This stretch plays a significant role in facilitating smoother traffic flow and providing improved accessibility for commuters traveling between these areas and adjoining localities.

The corridor intersects with the NICE (Nandi Infrastructure Corridor Enterprises) Road, forming a critical point of connectivity that links regional and arterial traffic flows. From this junction, the corridor extends further and reaches Kadabagere Cross, a prominent landmark that serves as an important access point for nearby residential and commercial areas. Continuing its route, the corridor moves towards its final destination, ending near Seegehalli. This concluding stretch is designed to streamline traffic and improve accessibility for the surrounding neighborhoods, enhancing the overall transportation network in the region.

Figure 376. Proposed Double Decker Corridor from Hosahalli to Kadabagere cross near Seegehalli along Magadi road



CORRIDOR

16

MOHAN KUMAR ROAD

Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station.

DOUBLE DECKER INTEGRATED WITH INDIAN RAILWAYS

Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station- 2.2 Kms

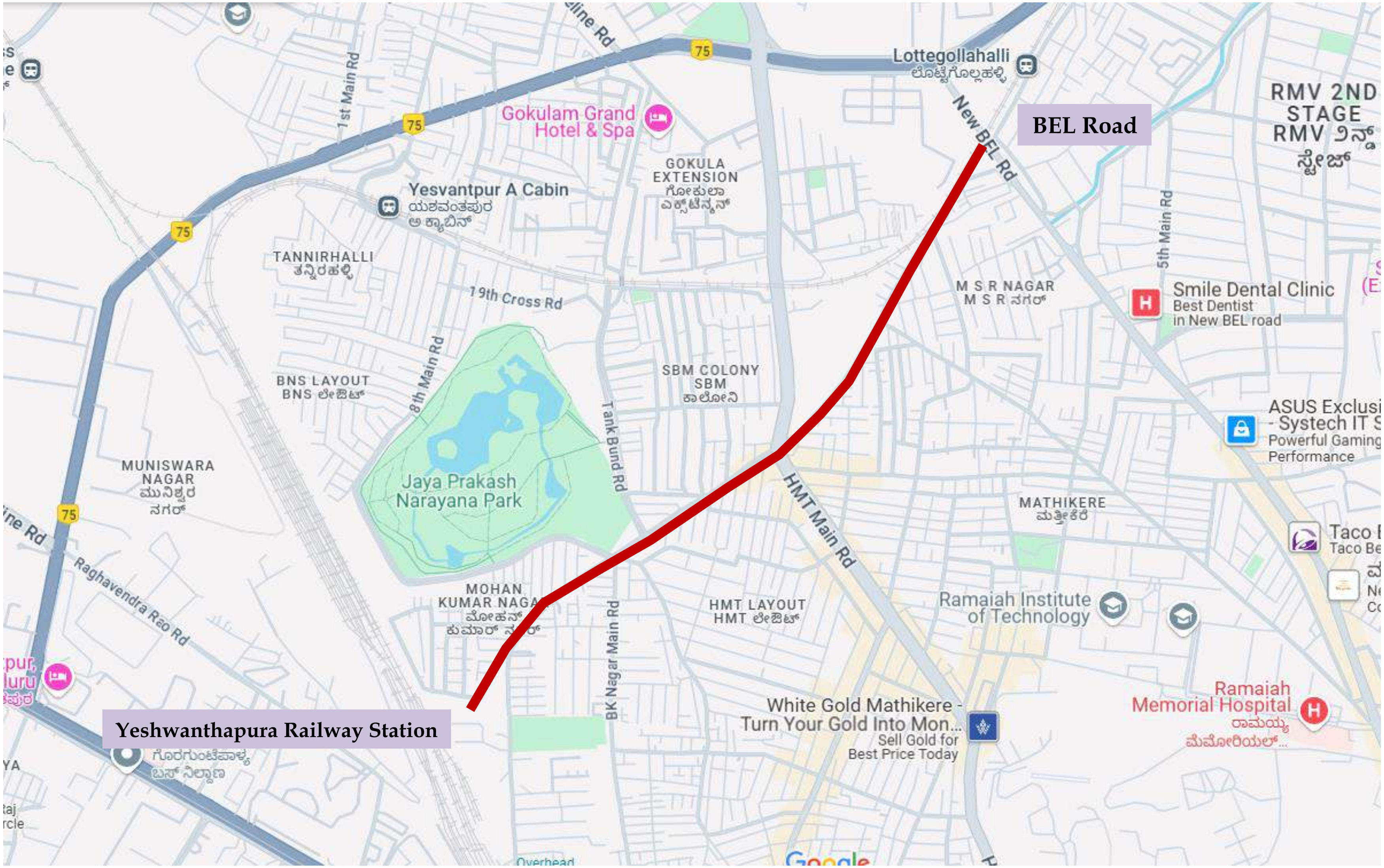


Figure 377. **Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station**

Mohan Kumar Road, connecting BEL Road to Yeshwanthpur, experiences significant traffic congestion due to a combination of factors:

1.Narrow Road Width: In several stretches, the road is narrow, leading to bottlenecks, especially during peak hours.

2.Mixed Traffic Flow: The road accommodates a mix of heavy vehicles, public buses, two-wheelers, and private cars, often causing slower movement and chaotic traffic conditions.

3.Intersection Congestion: Key intersections along this route, such as those near BEL Road and Yeshwanthpur, see heavy traffic due to merging vehicles and poor signal management.

4.Proximity to Railway Crossings: The area near Yeshwanthpur Railway Station adds to the congestion, with railway crossings frequently disrupting traffic flow.

5.Choke Points: The road has several choke points caused by encroachments, unauthorized parking, and the presence of commercial establishments, which reduce the effective carriageway width.

6.High Commuter Volume: This stretch serves as a critical link between residential, industrial, and commercial hubs, resulting in heavy commuter traffic throughout the day.

Possible Solutions:

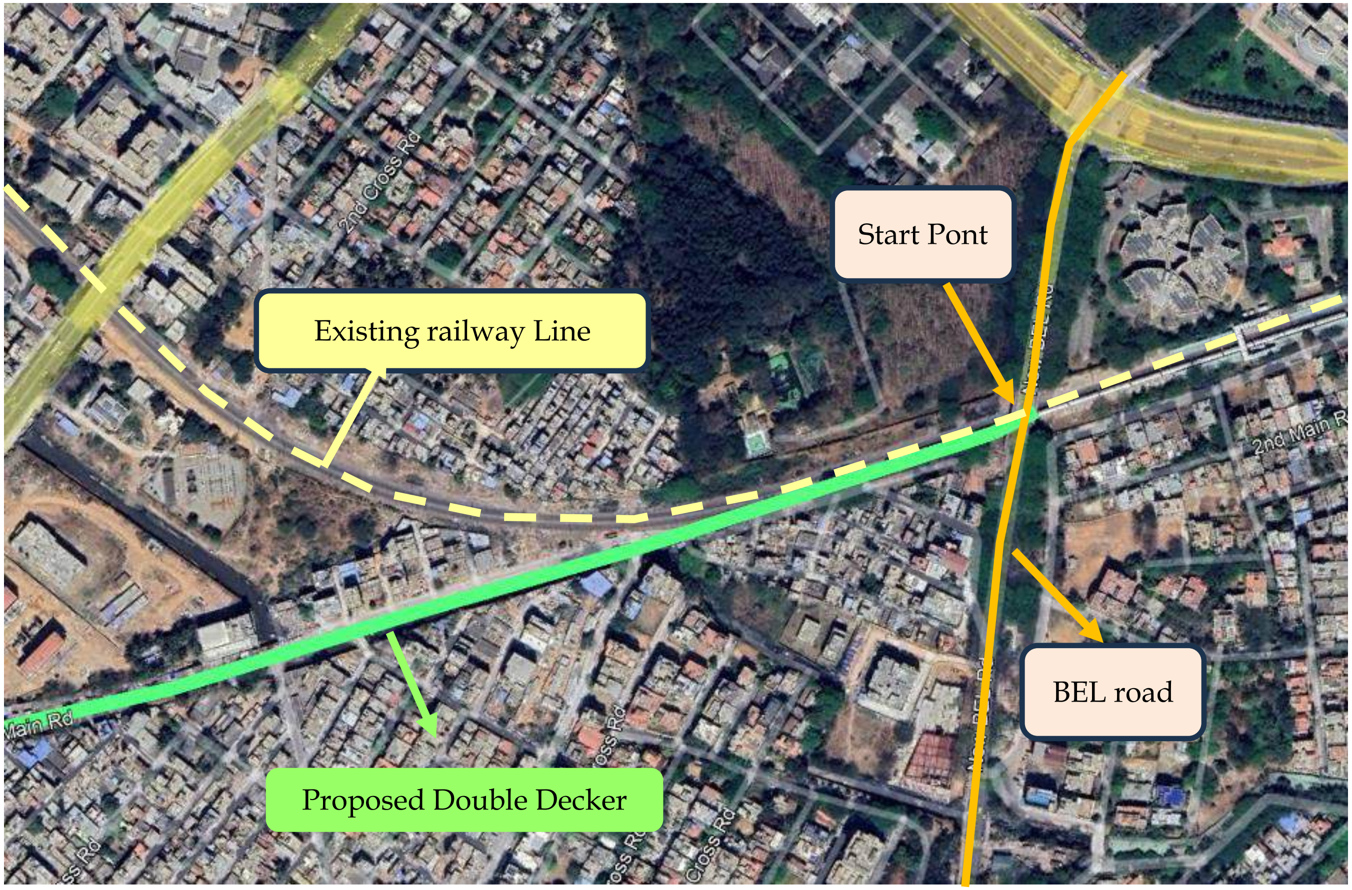
•**Widening the Road**: Land acquisition and road expansion to eliminate bottlenecks.

•**Improved Traffic Management**: Optimizing signal timings and deploying traffic personnel at key intersections.

•**Dedicated Bus Lanes**: Introducing bus priority lanes to encourage public transportation.

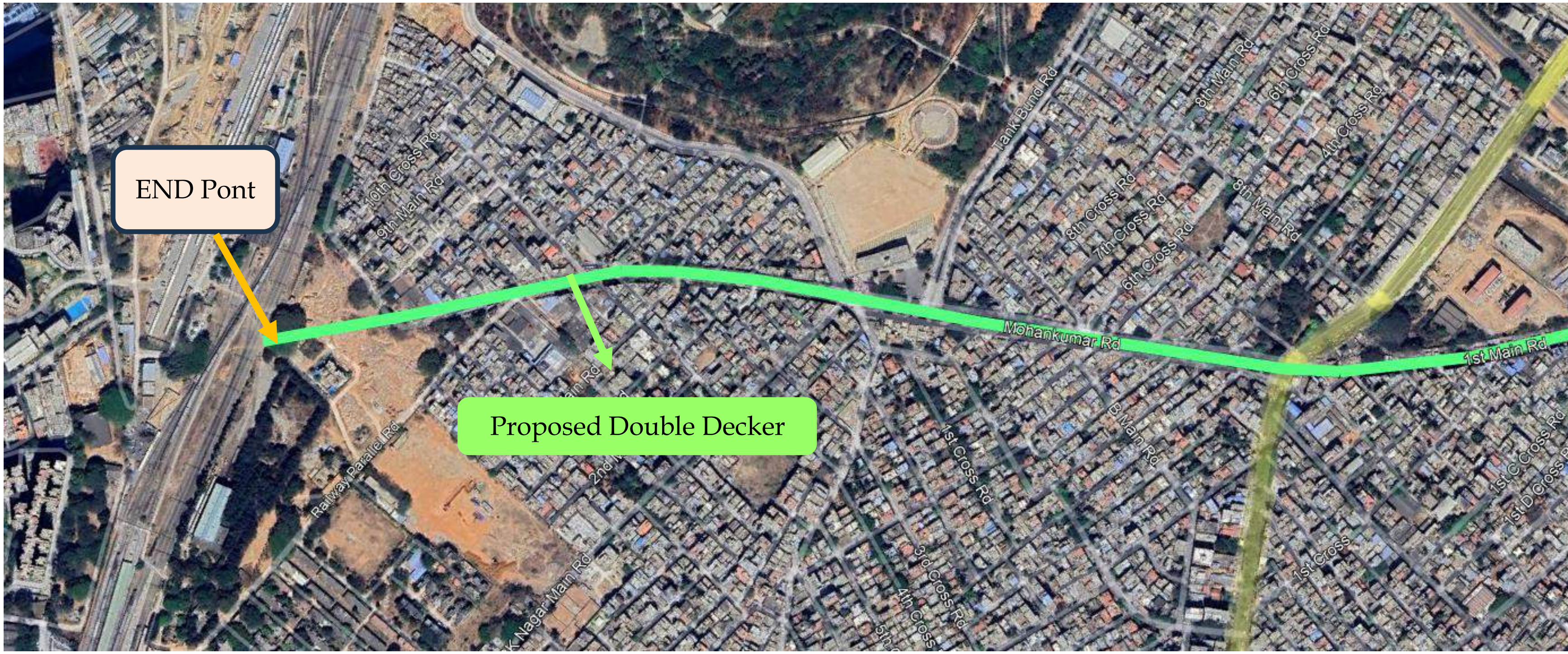
•**Proposed Elevated Corridor**: As mentioned, constructing an elevated corridor over this stretch could help segregate local and through traffic, easing congestion.

•Proposed Double Decker: as Mentioned constructing a double decker with Indian railways will have greater impact as railway connectivity will improve as it connects the Yeshwanthapura railways station from the rear end. Total proposed corridor is about 2.2 kms



The Double Decker corridor begins at the ROB on BEL Road, proceeds along 1st Main Road, and connects seamlessly to Mohan Kumar Road

Figure 378. **Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station**



The double-decker corridor concludes at the rear side of Yeshwanthpur Railway Station, providing seamless connectivity and dual functionality. The lower deck is designed to facilitate railway operations, ensuring smooth movement of trains and optimizing station access. The upper deck serves vehicular traffic, offering an elevated pathway to bypass congestion and improve overall traffic flow in the area. This strategic design ensures efficient use of space while addressing the needs of both railways and road users."

*Figure 379. **Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station***

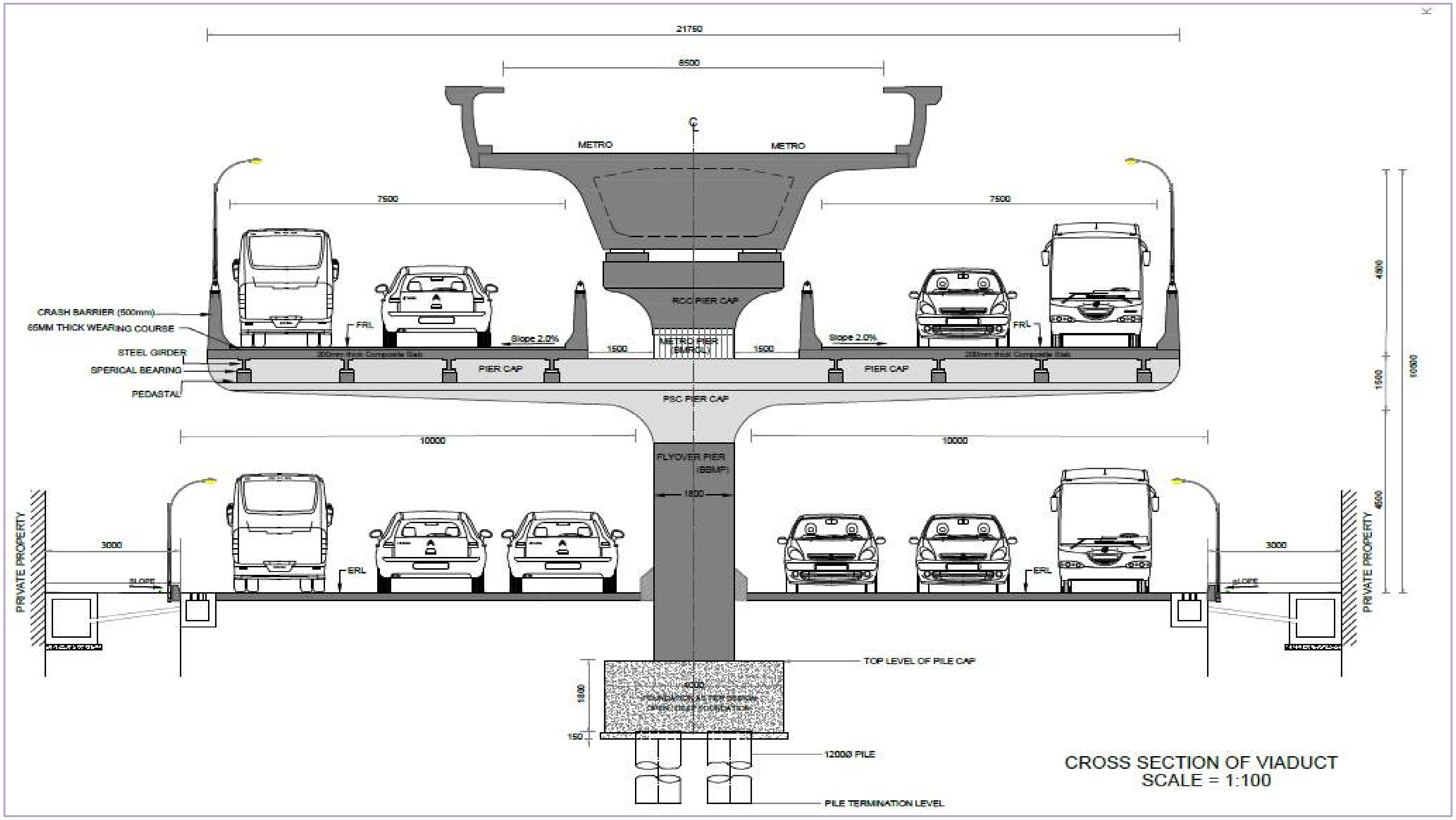
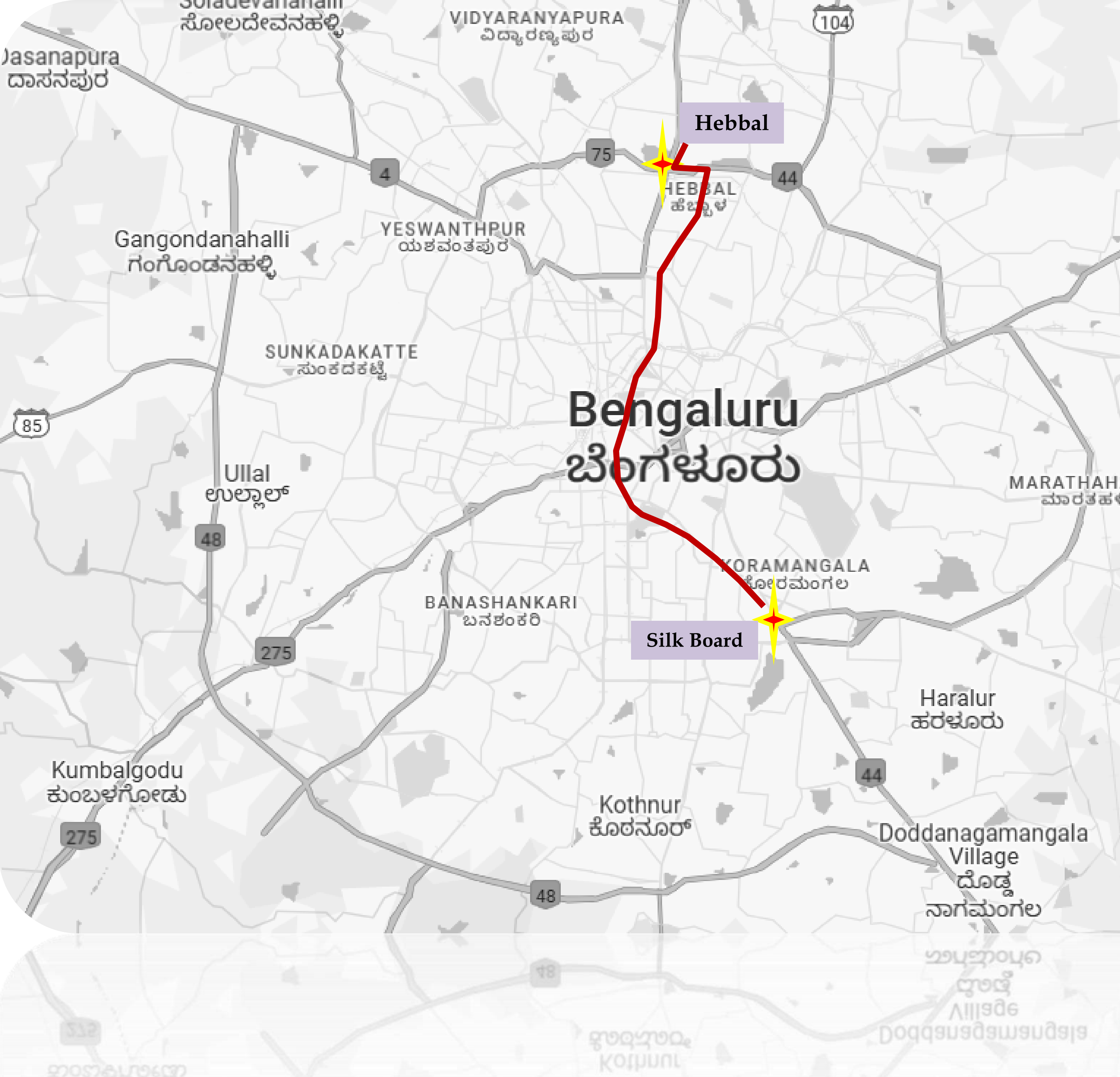


Figure 380. Typical Cross Section of Double Decker



CORRIDOR 01

Proposed North – South Tunnel Corridor from Hebbal to Silk Board

General

Bruhat Bengaluru Mahanagara Palike (BBMP) intends to Construct an Underground Vehicular Tunnel for the North – South Corridor starting from Hebbal Esteem Mall junction to Silk Board KSRP Junction.

In pursuance of the above, Rodic Consultants Pvt Ltd., New Delhi have been appointed as consultants to carry out Consultancy Services for Preparation of DPR for the work of Construction of Underground Vehicular Tunnel from Hebbal Esteem Mall junction to Silk Board KSRP junction.

Project Background

Bengaluru is the fifth largest city in India with an estimated population of over 115 Lakhs (2011). The city limit, which was around 425 Sq Km in 2007 has increased to over 800 Sq Km in a span of years. Bengaluru's population has grown dramatically, and the city now ranks among the top metropolitan areas in the country, both in terms of population and in terms of economic activity. Bengaluru has undergone rapid urbanization and has transformed into one of the fastest growing economic centers of the world which has attracted millions of job-seeking individuals from different part of countries and world.

However, the city road networks have not seen major improvements either in terms of enhancement of existing roadway capacity or creation of new road networks to reduce traffic congestion. The present-day vehicle population in the city is around 85 Lakh with an average increase in number of vehicles at the rate of 10% per annum.

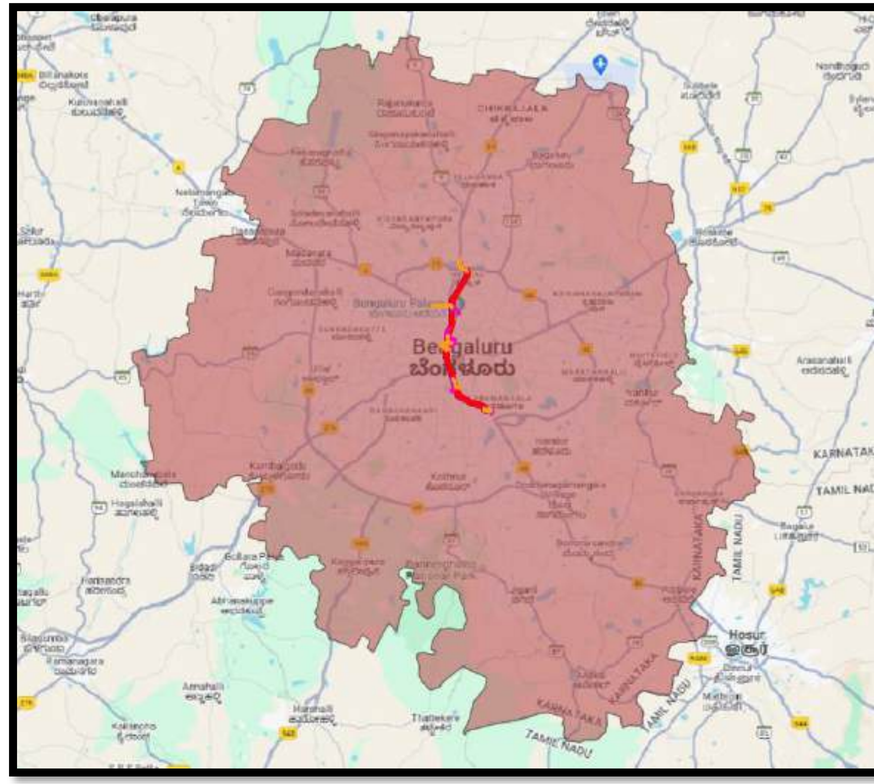


Figure 381: Project Location in Bangaluru Administrative Boundary

Increasing traffic volume and its associated adverse impacts on traffic congestion and noise pollution is a key problem in Bengaluru. And without the intervention of planned construction to decongest the traffic hot spots along with promotion of use of metros, public transport the situation is likely to deteriorate further. Reference from CMP 2020 (by BMRCL and DULT) has been taken to integrate our traffic studies and simulations for forecasting the future demand model. Due to the poor level of services (mostly section in LOS F) of the present route of North – South corridor, the passenger travelling from North to South part & vice versa for work trip & travel trip faces huge congestion during travel. This leads to an increase in VOC (vehicle operation cost) & VOT (Value of time cost) accumulating higher economical loss.

For decongestion of the Bengaluru city, BBMP has assigned the work of "Consultancy services for preparation of Comprehensive Bengaluru city road infrastructure plan to decongest traffic and to prepare comprehensive traffic management plan for proposal of vehicular tunnel / Grade separator /Road widening in selected corridors in the State of Karnataka" to *M/S Altinok Consulting Engineering Inc. In Jv With M/S Lion Engineering Consultants Pvt. Limited*. The feasibility study has identified North South corridor as the high traffic density corridor of the Bangaluru city. The decongestion of North-South corridor has been suggested in the feasibility study by providing underground tunnel from Hebbal to Silk Board. The major problem statement identified in feasibility studies are as under:

- In peak hour and even most of the day the traffic runs at average speed of 15-20 Kmph
- The Level of Service is between LOS-E and LOS-F i.e., 15 to 20 Kmph resulting in huge loss of fuel
- The city roads have exhausted their lane capacity and there is no land available to widen the roads due to heavy built-up areas and higher price of land.

One of the corridors that has been taken up for this assignment is North South Corridor which we have studied. The road sections connecting the electronic city (Southern part) to Hebbal Junction (Northern Part) is **Hebbal Flyover-Mekri circle-Chalyuka circle-Lalbagh Botanical Garden-Silk Board Jn.** The corridor width varies from 4 lane to Six lane. From Hebbal Junction the Airport is connected through NH-4. The North South Corridor is a very important connection and due to traffic congestion, it chokes during peak hour resulting loss of travel time and increase in Vehicle operation cost.

Need of Tunnel

Bengaluru's population has grown dramatically in the last decade, and the city now ranks among the top metropolitan areas in the country, both in terms of population and in terms of economic activity. The city has undergone a rapid transformation into one of the most storied economic centers of the world and attracted millions of job-seeking migrants. Increasing traffic volumes and its associated adverse impacts on congestion and air quality is a key problem in Bengaluru and elsewhere in India and this situation is likely to deteriorate further. The proposed North-South corridor is planned to reduce the congestion levels on roads and reduce the travel time of people

The present North South corridor connects the north & south part of Bengaluru and feeds the traffic for work trips, airport trip, tourism trip etc. Most of the residents of the North and eastern part of the city are travelling through this corridor for work purposes to white field & electronic city area. The high traffic during peak hours congests the major junction point and the corridor on the preset route. The existing route traversing from Hebbal- Mekri Circle to Golf Course to Chalukya Circle to Lalbagh to Silk board junction. From that point the traffic divided towards Whitefield & electronic city. Due to longer trip length, people use private mode of communication for travelling to the offices and others outdoor activities. During the peak the average speed on the north south corridor is just 10 to 15 km/h. Apart from above the K R Circle, Mother dairy circle also used to be congested during the peak hours. The present Level of service, speed and traffic density is as under- This LOS is as per Feasibility. Do we need to update/verify it as per our traffic output files.

Level of Service	Speed
The Present LOS is F	**Present travel speed is 15 Kmph.**

The city is growing at a fast pace and the per capita income is very good due to which people prefer private cars over public transport.

The present section from Hebbal to Golf Course, Golf Course to Chalukya Junction, Chalukya to Lal Bagh and Lal Bagh to Silk Board Junction is the main section running through the central part of Bengaluru city. The section traverses through most of the Government Offices, Official Residences of Members of Assembly, Vidhan Soudha and other prominent administrative blocks along with densely packed residential areas. The traffic from airport to Main city and through traffic also contributes to the of congestion of the North South Corridor.

The current road network capacity is already saturated. The capacity of the current road network needs to be increased to cater for the present and future traffic demand.

Project Benefits

The main objective of the project is to provide safe and efficient service levels to growing traffic movements and better connectivity between Silk board junction and Esteem mall junction. All road users will be benefited from the proposed improvement on account of comfort, safety and reduced vehicle operating costs. Community will accrue the benefit from proposed development project by way of improvement in the physical infrastructure; social infrastructure; development of economy; reduced pollution, vehicle maintenance, fuel saving; employment potential and other tangible benefits.

Key Benefits

- High-speed connectivity and access
- Decongestion of existing roads between Esteem mall junction and silk board junction
- Improved safety and reduced risk of accidents
- Reduced noise and air pollution
- Reduced vehicle operating & maintenance cost, fuel saving
- Improved quality of life

Figure 382: Project Key Benefit

Social And Economic Profile

Bengaluru Urban District

Bengaluru, officially known as Bengaluru, is the Capital of the Indian State of Karnataka. It has a population of over ten million, making it a megacity and the Third populous City and 5th most populous urban agglomeration in India.

The Deputy Commissioner, being the head of the District Administration, is officer vested with powers under the Central and State Laws. The D.C. office comes in direct contact with the people and people's representatives at various levels. The office of the Deputy Commissioner apart from having many original works enumerated under different Acts and Rules has got the supervisory and coordinating roles at the district level. Apart from regulatory functions, the Deputy Commissioner guides and coordinates the developmental activities of the district.

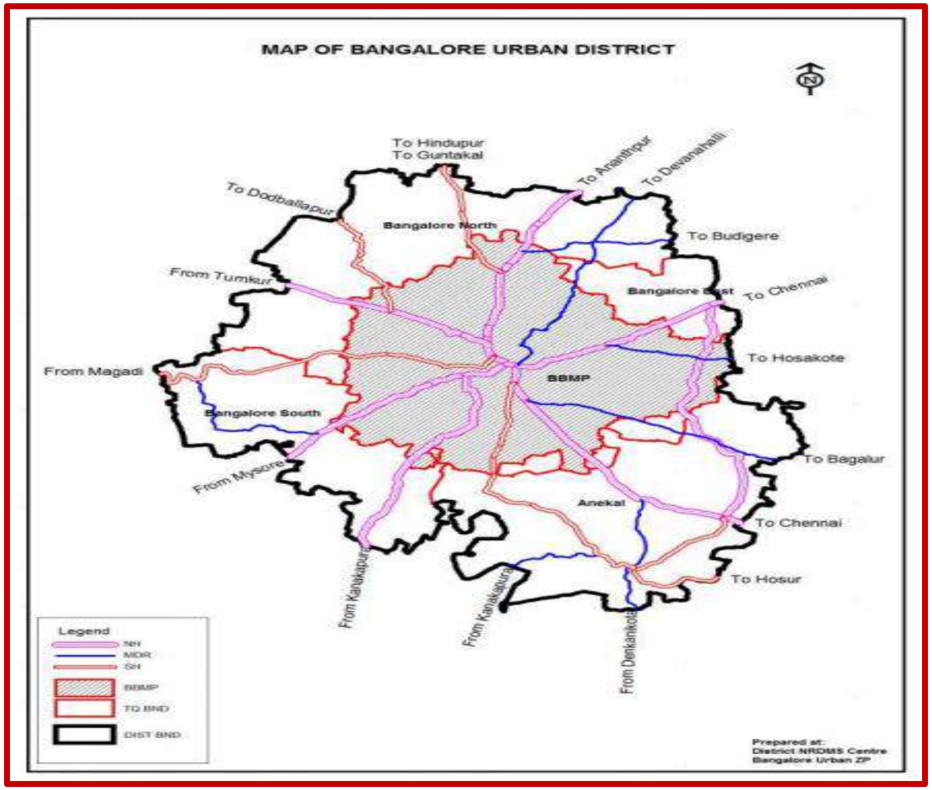


Figure 383: Bengaluru Districts Map

Topography

Bengaluru has two unique Topography terrains—North Bengaluru taluk and the South Bengaluru taluk. The North Bengaluru taluk is a relatively higher-level plateau and lies between an average of 839 to 962 meters above sea level. The middle of the taluk has a prominent ridge running NNE-SSW. The highest point in the city, Doddabettahalli, (962m) is on this ridge. There are gentle slopes and valleys on either side of this ridge. The low-lying area is marked by a series of water tanks varying in size from a small pond to those of considerable extent, but all shallow.

Geography

Bengaluru lies in the southeast of the South Indian state of Karnataka. It is in the heart of the Mysore Plateau (a region of the larger Precambrian Deccan Plateau) at an average elevation of 920 m (3,020 ft). It is positioned at 12.97°N 77.56°E and covers an area of 1741 km2 (673 mi2). Most of the city of Bengaluru lies in the Bengaluru Urban district of Karnataka and the surrounding rural areas are a part of the Bengaluru Rural district. The region comprising the Bengaluru Urban and Rural districts is known as the Bengaluru (region). The Government of Karnataka has carved out the new district of Ramanagara from the old Bengaluru Rural district.

Bengaluru has a handful of freshwater lakes and water tanks, some of which are Madivala tank, Hebbal Lake, Ulsoor Lake and Sankey Tank. Groundwater occurs in silty to sandy layers of the alluvial sediments. The Peninsular Gneissic Complex (PGC) is the most dominant rock unit in the area and includes granites, gneisses and migmatites, while the soils of Bengaluru consist of red laterite and red, fine loamy to clayey soils.

Seismicity

Because it lies in the seismically stable region, Zone III (encompassing parts of Karnataka, Maharashtra, Kerala, Tamil Nadu and Andhra Pradesh), Bengaluru has been untouched by major seismic events. Only mild tremors have been recorded in the city. The largest earthquake that has ever hit the city was of magnitude 6.4 in April 1843.

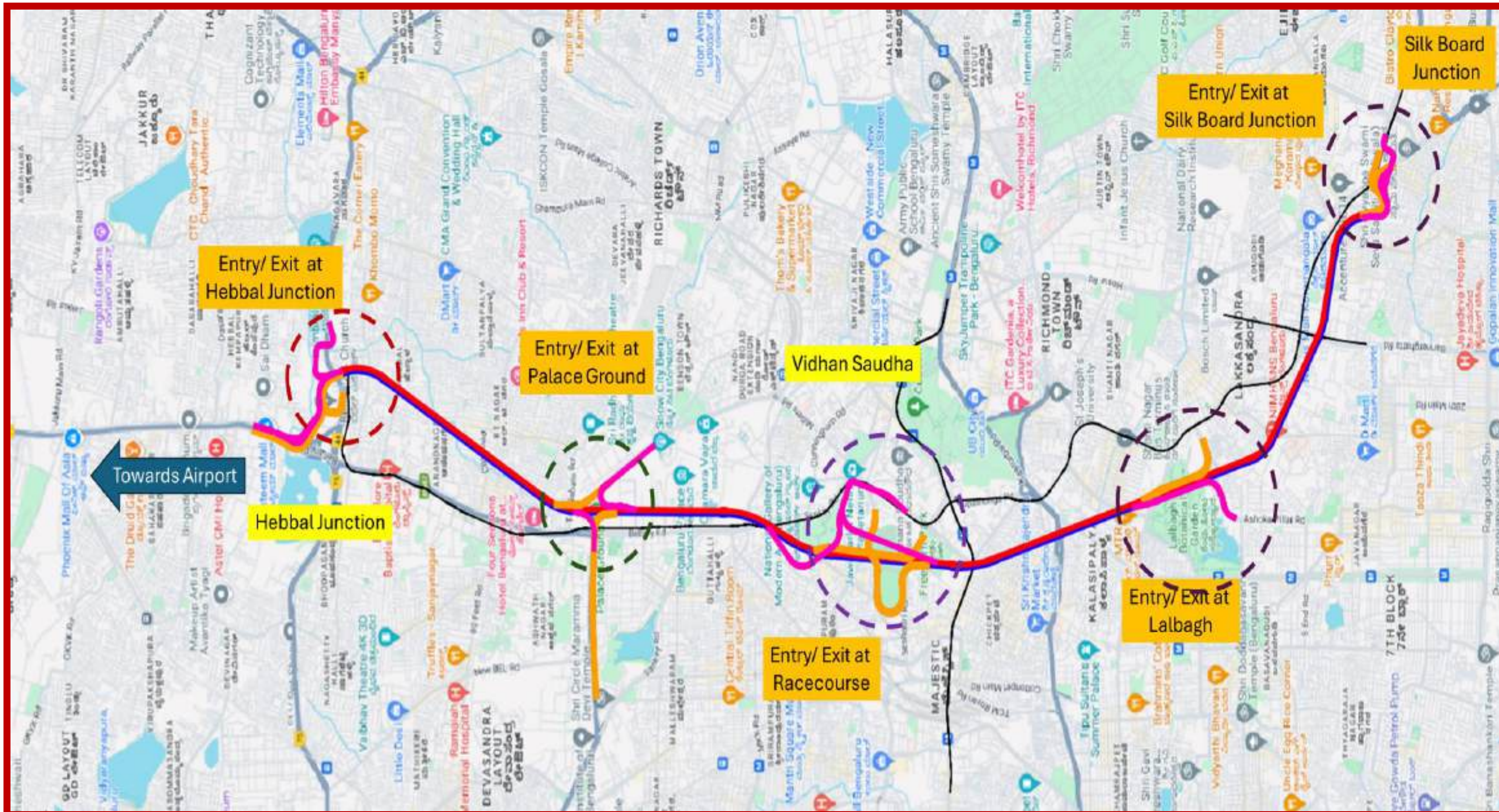


Figure 384 : Project Alignment

Project Location and Alignment

The entire project is in Bengaluru city and connecting the northern part to the southern part of the city.

As per the feasibility report, the North – South Corridor starting from Hebbal Esteem Mall junction to Silk Board KSRP Junction is going to be developed as Underground Vehicular tunnel having 03 intermediate locations connected via ramps for entry & exit into the Main Tunnel. This alignment will connect the Hebbal and silk Board Junction and proposed 3 intermediate ramps at Mekri circle, Racecourse & Lalbagh directly. The travel time will be reduced from about 90 minutes to 20 minutes.

The details of alignment and its intermediate ramps have been provided in given table.

Table 109 : Alignment Details of Main Tunnel

From Hebbal to Silk Board	From Silk Board to Hebbal
Length: 16.681 km	Length: 16.680 km
Lane Configuration: 3 Lane	Lane Configuration: 3 Lane
Start: Approach of Hebbal Flyover	Start: Approach of Hebbal Flyover
End: Hosur Road (Silk Board Junction)	End: Hosur Road (Silk Board Junction)

The start Point of Project

The project Stretch Start from Hebbal near Esteem Mall and end near silk board junction, where existing road is a 6-lane divided carriageway road.

The starting point has two entry ramps into the tunnel and two exits. Each entry and exit have 2 lane configurations.

The Entry at the start location has been planned near esteem mall for connecting traffic from Airport flyover and another entry has been provided from service road for the traffic coming from Sahakarnagar & Yelahanka to the main tunnel for conflict free movement at junction another entry ramps have been proposed at the Ring Road. Similarly, two exits have been proposed, one towards the Ring road and another on service road.

Table 110: Alignment Details of Intermediate ramps

Sr. No.	Location	Description	Length	Direction Of Traffic	Lane Configuration
Ramps at Start of Main Tunnel					
1	Hebbal Junction	Entry Ramp 1 into Main Tunnel	0.360 Kms	From Service Road Airport to Bangaluru City	2 Lane
2		Exit Ramp 08 from Main Tunnel	0.700 kms	To Service Road towards Sahakar Nagar, Yelahanka	2 Lane
3		Entry Ramp 2 into Main Tunnel	0.814 Kms	From KR Puram on Outer Ring Road	2 Lane
4		Exit Ramp 07 from Main Tunnel	0.400 Kms	Towards Yeswanthpur on Outer Ring Road	2 Lane
Intermediate Ramps					
1	Near Palace Ground/ Mekri Circle	Entry Ramp 03 into Main Tunnel	1.255 Kms	From Jayamahal Road	2 Lane
2		Exit Ramp 06 from Main Tunnel	1.910 Kms	Towards CV Raman Road	2 Lane
3		Entry Ramp 4 into Main Tunnel	1.320 Kms	Entry from CV Raman Road towards Hebbal	2 Lane
4		Exit Ramp 05 from Main Tunnel	0.963 Kms	Exit Towards Jayamahal Road	2 Lane
1	Near Racecourse / Vidhan Saudha	Entry Ramp 5 into Main Tunnel	1.387 Kms	From Palace Road Towards Hebbal	2 Lane
2		Entry Ramp 6 into Main Tunnel	1.906 Kms	From Palace Road Towards Silk Board Junction	2 Lane
3		Exit Ramp 04 from Main Tunnel	1.376 Kms	On Seshadri Road (Towards KR Circle)	2 Lane
4		Exit Ramp 03 from Main Tunnel	1.864 Kms	On Race Couse Road (Towards Chalukya Circle	2 Lane
1	Near Lalbagh	Entry Ramp 7 into Main Tunnel	1.416 Kms	From Siddapura Road (Near Ashoka Pillar).	2 Lane
2		Exit Ramp 2 from Main Tunnel	1.073 Kms	On Siddapura Road Near Wilson Garden	2 Lane
Ramps at End of Main Tunnel					
1	Silk Board	Exit Ramp 1 from Main Tunnel	0.454 Kms	On Sarjapur Road / HSR layout (Ring Road)	2 Lane
2		Entry Ramp 8 into Main Tunnel	0.663 Kms	From Sarjapur Road / HSR layout (Ring Road)	2 Lane

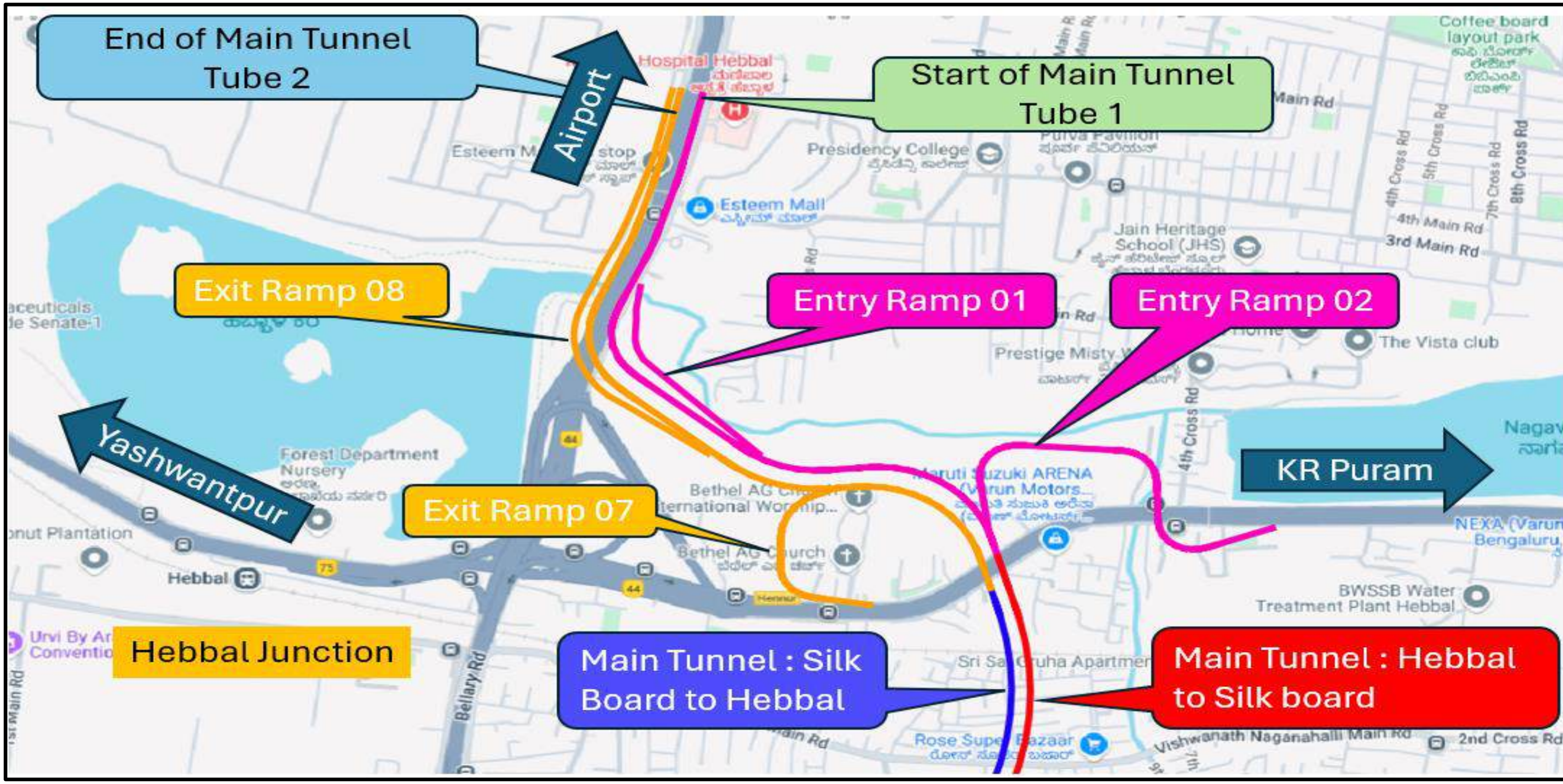


Figure 485 : Entry and Exit at Hebbal Junction

Table 111 : Entry Exit Details at Hebbal Junction

Sr. No.	Location	Description	Length	Direction Of Traffic	Lane Configuration
Main Tunnel					
1	Hebbal	Entry Ramp 1 into Main Tunnel	0.360 Kms	From Service Road Airport to Bangaluru City	2 Lane
2		Exit Ramp 08 from Main Tunnel	0.700 kms	To Service Road towards Sahakar Nagar, Yelahanka	2 Lane
3		Entry Ramp 2 into Main Tunnel	0.814 Kms	From KR Puram on Outer Ring Road	2 Lane
4		Exit Ramp 07 from Main Tunnel	0.400 Kms	Towards Yeswanthpur on Outer Ring Road	2 Lane

First Intermediate Ramps

The first intermediate location has been planned near Mehkri circle. Only two ramps has been provisioned, the entry ramp from Jayamahal main road for traffic going to silk board junction and exit ramps on C V Raman road.

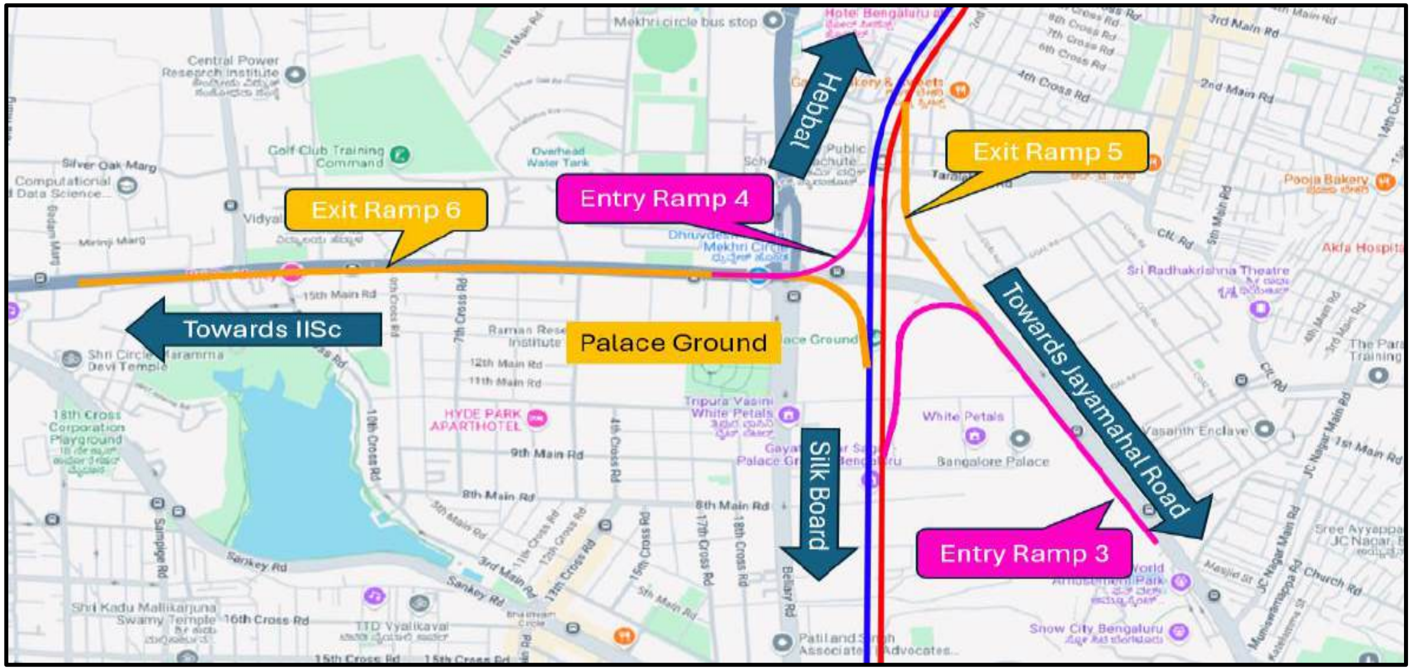


Figure 386 : Entry and Exit Ramps at Palace Ground

Table 112 : Ramps Details at Palace Ground/Mekri Circle

Sr. No.	Location	Description	Length	Direction of Traffic	Lane Configuration
Intermediate Ramps					
1	Near Palace Ground/ Mekri Circle	Entry Ramp 03 into Main Tunnel	1.255 Kms	From Jayamahal Road	2 Lane
2		Exit Ramp 06 from Main Tunnel	1.910 Kms	Towards CV Raman Road	2 Lane
3		Entry Ramp 4 into Main Tunnel	1.320 Kms	Entry from CV Raman Road towards Hebbal	2 Lane
4		Exit Ramp 05 from Main Tunnel	0.963 Kms	Exit Towards Jayamahal Road	2 Lane

Second Intermediate Ramps

The Second intermediate ramps have been planned near racecourse/ Vidhan Soudha to connect the central part of Bengaluru. Entry and exit ramps have been provisioned in both tunnel tubes. All the four ramps (2 entry and 2 exit ramps) have carriageway width of 2 lanes.

Two entry ramps from Palace Road, one towards Hebbal and one towards the Silk Board Junction. Two exit ramps, One exit on Seshadri Road (Towards KR Circle) and one exit on Race Course road (Toward Chalukya circle).

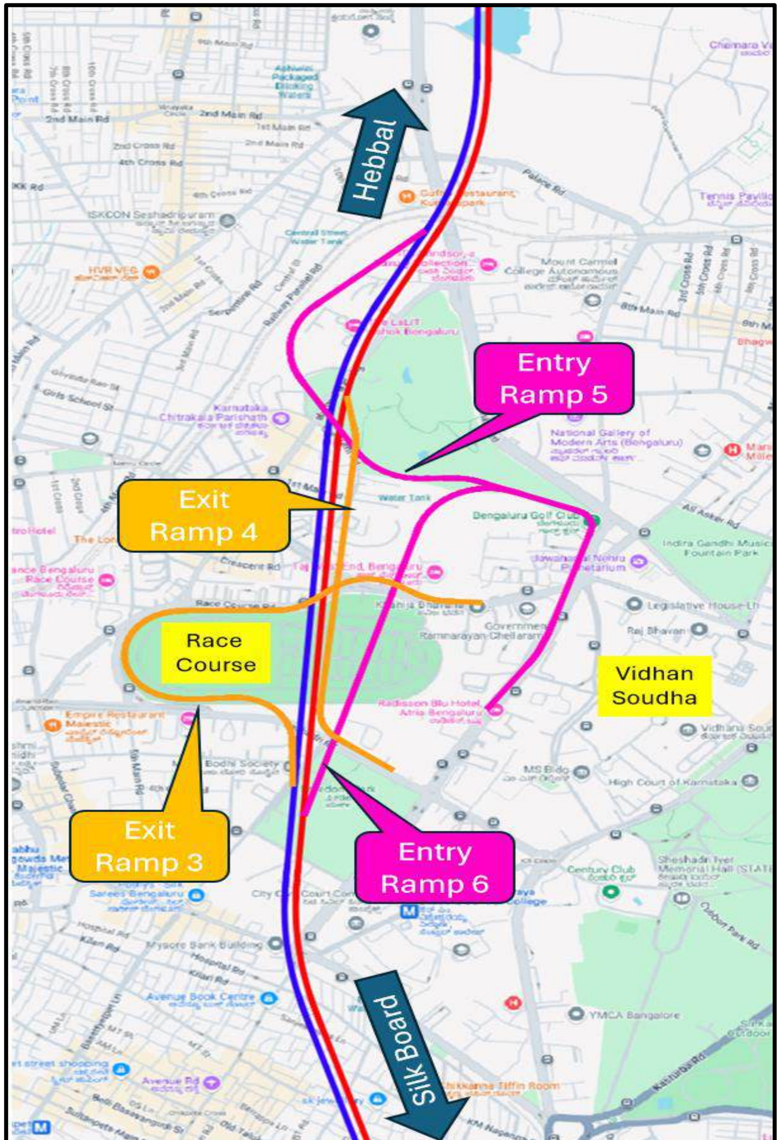


Figure 387 : Entry and Exit Ramps at Race Course and Vidhan Soudha

Table 113 : Ramps Details at Race Course/ Vidhan Saudha

Sr. No.	Location	Description	Length	Direction Of Traffic	Lane Configuration
Intermediate Ramps					
1	Near Race Course / Vidhan Saudha	Entry Ramp 5 into Main Tunnel	1.387 Kms	From Palace Road Towards Hebbal	2 Lane
2		Entry Ramp 6 into Main Tunnel	1.906 Kms	From Palace Road Towards Silk Board Junction	2 Lane
3		Exit Ramp 04 from Main Tunnel	1.376 Kms	On Seshadri Road (Towards KR Circle)	2 Lane
4		Exit Ramp 03 from Main Tunnel	1.864 Kms	On Race Couse Road (Towards Chalukya Circle	2 Lane

Third Intermediate Ramps

The 3rd intermediate location is planned near Lalbagh. Only two ramps have been provisioned, the entry ramp from Ashoka Pillar on Siddapura road for traffic going to Hebbal junction and exit ramps on Marigowda road towards Dairy circle at Wilson Garden.

Figure 388 : Entry and Exit Lalbagh Botanical Garden

Table 114: Ramps Details

Sr. No.	Location	Description	Length	Direction Of Traffic	Lane Configuration
Intermediate Ramps					
1	Near Lalbagh	Entry Ramp 7 into Main Tunnel	1.416 Kms	From Siddapura Road (Near Ashoka Pillar).	2 Lane
2		Exit Ramp 2 from Main Tunnel	1.073 Kms	On Siddapura Road Near Wilson Garden	2 Lane

- The entry ramp from Ashoka Pillar on Siddapura road for traffic going to Hebbal junction.
- Exit ramps on Siddapura road (marigowda road towards Dairy circle).

The End point of Project

The Tunnel ends before silk board junction on Hosur road. Both entry and exit ramps has been planned on Hosur Road for the traffic going to electronic city. However, additional, entry & exit ramp has been planned to connect the traffic going to Ring Road/ HSR layout area on Sarjapur road near St. John Hospital.

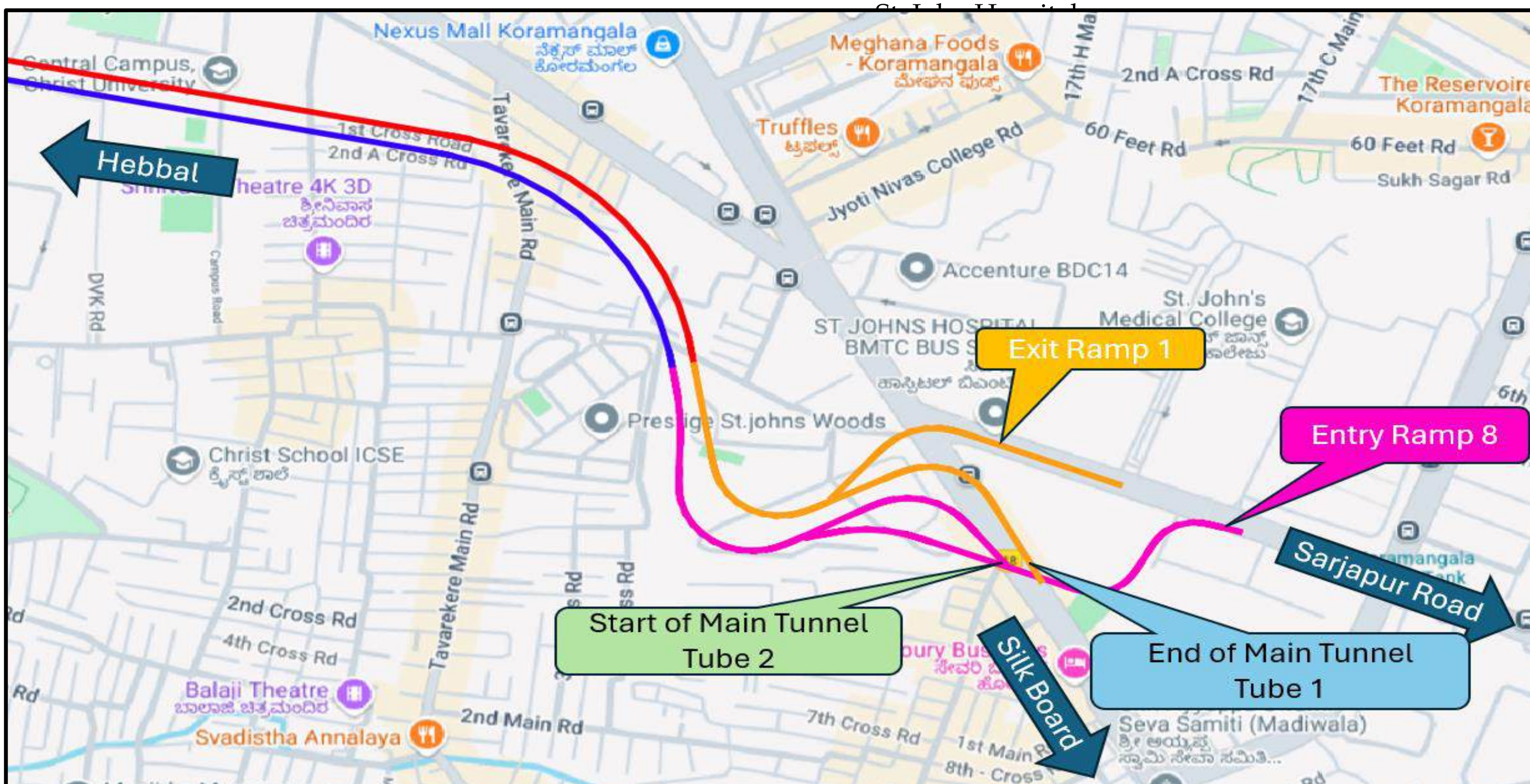


Figure 389 : End Point of Project Alignment

Feasible Alignment

The alignment option has been discussed with stake holders such as BBMP, BMRCL, KRIDE and BDA. The proposal has been planned in such a way to minimise the infringement with the ongoing surrounding development project. The alignment proposed has been agreed by BBMP and it is the best feasible option for tunnel and its ramps.

Table 115 : Entry and Exit Details

Sr. No.	Location	Description	Length	Direction Of Traffic	Lane Configuration
Main Tunnel					
1	Silk Board	Exit Ramp 1 from Main Tunnel	0.454 Kms	On Sarjapur Road / HSR layout (Ring Road)	2 Lane
2		Entry Ramp 8 into Main Tunnel	0.663 Kms	From Sarjapur Road / HSR layout (Ring Road)	2 Lane

Infringement with the proposed alignment:

The proposed tunnel alignment starting from Hebbal and ending at Silk Board junction including 3 intermediate ramps in between. The proposed development plan in having infringement with ongoing & planned work of Metro and K-Ride. The detail is as under-

Table 116 : Infringement Points with Proposed Tunnel

Proposed Tunnel Alignment Location/ CH	Infringement with	CH of metro/ Rail	Type of Infringement	Proposal in the instant Tunnel alignment	Remarks
KM 0.450 to 0.750	Metro Phase 2B (Elevated)	CH 11.480 to 11.600	Under construction Metro Pier is coming along alignment	Metro span to be increased	Discussion required with BMRCL
Km 1.425	Metro Phase 3 (elevated)	CH 10.500 to 10.600	Under construction Metro Pier is coming along alignment	Metro span to be increased	Discussion required with BMRCL
Km 1.425	Metro Phase 2B (elevated)	CH 10.500 to 10.600	Under construction Metro Pier is coming along alignment	Metro span to be increased	Discussion required with BMRCL
Km 1.600	K-Ride (C2 corridor, at grade)/ IR	10.200	Crossing alignment	Proposed Tunnel going Underground (with min. 1D cover)	Discussion required with KRIDE/ IR

Km 0.300 (Exit ramp 4 - CV Ramao Rd.)	Metro Phase 3A (UG)	CH 32.050	Crossing Proposed alignment	Proposed Tunnel going below proposed metro line (with 1D cover)	Discussion required with BMRCL
Km 7.000	K-Ride (C3 corridor, elevated)/ IR	CH 15.170 to 15.220	Crossing Proposed alignment	K-RIDE Span need to be re-checked if required	Discussion required with KRIDE/ IR
Km 7.000	Metro Phase 3A (UG)	CH 29.900 to 29.980	Crossing proposed alignment	Proposed Tunnel going below proposed metro line (with min. 1D cover)	Discussion required with BMRCL
Km 0.000 to km 0.750 (Entry ramp 1 – Palace Rd.)	Metro Phase 3A (UG)	CH 27.900 to 28.940	Parallel to proposed alignment	Proposed Tunnel ramps going parallel to metro line in Open cut and Cut & Cover; Integration is required	Discussion required with BMRCL
Km 8.550	Metro Phase 1 (UG)	CH 8.400 to 8.500	Crossing running metro line	Proposed Tunnel going below metro line (with min. 1D cover)	Discussion required with BMRCL
Km 14.550	Metro Phase 2 (UG)	CH 7.870 to 7.960	Crossing under construction metro line	Proposed Tunnel going below metro line (with minimum 1D cover)	Discussion required with BMRCL
Km 0.150 to 0.454 (exit 2 at silk board towards Sarjapur Rd., near St. john hospital)	Metro Phase 3A (UG)	CH 20.480 to 20.490	Crossing Proposed alignment	Proposed Tunnel ramps crossing proposed metro line in Cut & Cover; Integration is required	Discussion required with BMRCL
Km 0.550 to 0.663 (entry 4 at silk board towards Hebbal from Sarjapur Rd. near john hospital)	Metro Phase 3A (UG)	CH 20.040	Crossing Proposed alignment	Proposed Tunnel ramps crossing proposed metro line at grade; Integration is required	Discussion required with BMRCL

Engineering Surveys and Investigations

Based upon the objectives of the project. With careful planning and efficient use of resources different tasks have been done simultaneously. Based on the objectives and scope of the consultancy services, an appropriate methodology has been developed by the consultants to address the other requirements also, especially regarding various intermediate targets and completion period, manning schedule, and TOR.

A work plan has been prepared based on the methodology developed. A competent team of suitably qualified key professionals as per the requirements and other supporting staff has been selected to carry out the services fieldwork and office work.

Existing Features of Project

The project starts near Esteem Mall Hebbal Junction and Ends at Silk board Junction. The alignment passes through nodal points/ stretch of the Bengaluru city.

First stretch is Hebbal to Golf course whose existing roadway width is 6 lane divided carriageway, then further there is connectivity to Chalukya circle via 4 lane existing divided carriageway road. After that Calukya circle is connected to Lalbagh and finally Lalbagh to Silkboard junction all the stretches are 4 lane divided carriageway.

The location of entry and exit ramps have been analyzed.

- At the Start End, the road is 6 lanes with divided carriageway. There is presence of Minor bridges near Esteem mall which channelizes the stream if Hebbal lake. The construction of metro (name of metro line and its links) is underway, which affects our project start point.
- At the End Point the road is 4 lanes with divided carriageway. The road have a under construction double decker flyover at Silk Board junction and metro is also under construction at the project end location.

The alignment passes through some of the prominent stretches of the Bengaluru city which caters the heavy traffic throughout the day.

Reconnaissance Survey

A preliminary survey has been conducted to gather general information about the project area. The purpose of the reconnaissance survey is to get a broad understanding of the terrain, conditions, Environmental and Social Considerations, Safety and Risk Assessment of the project area.

Road Inventory

Road inventory was carried out in the first week of August 2024 over the possible locations of the project alignment. The road conditions are found to be good, some of the roads have undergone strengthening of bitumen surface through the provision of White Topping. Metro is being constructed at the starting point of our project alignment. However, the project influence area the volume of traffic is quite high.

Existing Carriageway

The existing road infrastructure includes lane configurations of 4 lanes, and 6 lanes in various segments. Furthermore, it is observed that several metro routes intersect with these corridors. The road stretches and lane details are as follows:

Table 117 : Existing Carriageway

Stretch	Lane Configuration
1. Hebbal to Golf course	6 lanes
2. Golf course to Chalukya	4 lanes
3. Chalukya to Lalbagh botanical garden	4 lanes
4. Lalbagh botanical garden to silk board	4 lanes

Alignment and Geometry

An current average travel speed is 15-20 km/hr in the project stretch because of traffic congestion.

Terrain and Land Use

Project area lies in plain terrain in entire length. The land-use pattern for the project area is densely populated builtup of Bengaluru City.

Traffic Survey at Site

For the evaluation of the traffic demand estimation on the proposed North – South corridor in Bengaluru and impact on the road network in study area, traffic model has been developed in PTV Visum 2024. Macro simulation analysis has been conducted to understand the overall travel patterns in the study area. PTV Visum 2024 helps to understand the existing traffic and travel patterns and bottlenecks in the transportation system. Further it is used for scenario testing according to the changes in demand and infrastructure. Comprehensive data collection has been done to understand the existing traffic and travel pattern and for development of the base year model. Further updating the demand and network in the model the diversion to the corridor have been estimated.

The traffic survey has been planned along the proposed corridor, The location of traffic survey mainly for classified Volume count, O-D Survey and Turning movement survey has been studied and detailed analysis has been described in Chapter 6 of this report.

Figure 390 : Traffic Surveys conducted at Project Location

Topography Survey:

The topography survey has been carried out using Drone LiDAR for the location which is in green zone however the yellow and red zone is still pending. The Topography survey using DGPS (Differential Global Positioning System) has been conducted for all the entry, exit and intermediate ramps locations.

Figure 391 : Topography Survey on Site

Geotechnical & Geophysical Investigation:

Secondary data from ongoing metro projects (Nearby Proposed tunnel alignment) has been considered for geological study. However, a confirmatory bore holes and geophysical survey (MASW-Multichannel Analysis of Surface Wave and SRT-Seismic Refraction Test), is being conducted to verify the reports collected for the design.

The details of the Secondary data is provided in GIR Volume submitted separately.

Figure 392 : Geophysical Survey on Site

Traffic Surveys Analysis

Classified Vehicle Count, Origin and Destination and Turning Movement Count has been conducted at numerous locations. The locations have been selected to get the real traffic trends that directly and indirectly affect our project. The traffic surveys have been extended to a larger area outside of our project.

At the following locations Traffic Locations have been conducted and their detailed Analysis is presented in chapter 6 of Main report.

Table 118: Traffic Survey Locations (Turning Moment Count)

Sr. No.	Turning Movement Count Locations
1	CN Rao underpass Junction
2	Banglore Cantt Junction
3	Basaveshwara circle
4	KR Circle
5	Cubbon Park UB City signal
6	Shoolay Circle
7	Lalbagh Chowk

Speed and Delay analysis has also been done for the project location. Traffic flow diagrams and traffic demand analysis have been done via PTV Vissum software and their findings are discussed in detail later in this report.

Table 119: Traffic Survey Locations (CVC and OD)

Sr. No.	Location	CVC	OD
1	NH-44 Bellary Road (Near-Sakar Nagar)	Done	Done
2	NH-75 Malur -Byranahalli Rd Outer Ring Road (Near-Nagavara park)	Done	Done
3	NH-75 Malur -Byranahalli Rd Outer Ring Road (Near-Devinagar BEL Circle)	Done	Done
4	AH-47 Malur Road (Near-Science Gallery)	Done	Done
5	Guttahalli Main Road (Near-Uniworth Plaza)	Done	Done
6	NR road (Near-Silver Jubilee Park)	Done	Done
7	Siddapura Road (Near-Maharaja Agrasena Bhavana)	Done	Done
8	Marigowda Road (Near-National Institute of Mental Health & Neuro Sciences)	Done	Done
9	NH-44 Bengaluru-Chennai Highway (Near-Madiwala footbridge)	Done	Done

The Turning Movement Count survey has been conducted at the following junctions in the project influence area.

Current level of Service in the project Influence Area

The Level of service is defined as per the IRC: IRC:106-1990-Guidelines for Capacity of Urban Roads in Plain Areas.

LOS	Description
A	Represents a condition of free flow with average travel speeds usually about 90 per cent of the free-flow speed.
B	Represents a zone of stable flow, with the drivers still having reasonable freedom to select their desired speed and maneuver within the traffic stream
C	This also is a zone of stable flow but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream.
D	Represents the limit of stable flow, with conditions approaching close to unstable flow. Due to high density, the drivers are severely restricted in their freedom to select desired speed and maneuver within the traffic stream.
E	Represents operating conditions when traffic volumes are at or close to the capacity level. The speeds are reduced to a low, but relatively uniform value, average value being one-third the free flow speed.
F	Represents zone of forced or breakdown flow

As per the findings of traffic volume count the current Level of Service on the below mentioned stretches in the project influence area is mentioned below.

Table 120 : LOS on the traffic cordon points on existing road

S. No.	Location Name	Directions	Level of Service (Base Year)
1	NH-44 Bellary Road (Near-Sakar Nagar)	Dir-I: Yelahanka to Hebbal	LOS F
		Dir I - Service Lane	LOS F
		Dir-II: Hebbal to Yelahanka	LOS F
		Dir II - Service Lane	LOS B
2	NH-75 Malur -Byranahalli Rd Outer Ring Road (Near-Nagavara park)	Dir-I: Bellary Road To Nagavara	LOS D
		Dir I - Service Lane	LOS E
		Dir-II :Nagavara To Bellary Road	LOS D
		Dir II - Service Lane	LOS C
3	NH-75 Malur -Byranahalli Rd Outer Ring Road (Near-Devinagar BEL Circle)	Dir-I : Hebbal To Yashwantpur	LOS E
		Dir-II : Yashwantpur To Hebbal	LOS C
4	AH-47 Malur Road (Near-Science Gallery)	Dir-I : Mekhri circle To Airport	LOS F
		Dir I - Service Lane	LOS E
		Dir-II : Airport To Mekhri circle	LOS F
		Dir II - Service Lane	LOS C
5	Guttahalli Main Road (Near-Uniworth Plaza)	Dir-I : Mahalakshmi Gudi Circle To Bengaluru Golf Club	LOS F
		Dir-II : Bengaluru Golf Club To Mahalakshmi Gudi Circle	LOS F
6	NR road (Near-Silver Jubilee Park)	Dir-I : Kempegowda Tower To Chamrajpet	LOS F
		Dir-II : Chamrajpet To Kempegowda Tower	LOS F
7	Siddapura Road (Near-Maharaja Agrasena Bhavana)	Dir-I : Ashoka Piller To Mallinge Hospital	LOS F
		Dir-II : Mallinge Hospital To Ashoka Piller	LOS C
8	Marigowda Road (Near-National Institute Of Mental Health & Neuro Sciences)	Dir-I : Dairy Circle To Wilson Garden	LOS F
		Dir-II :Wilson Garden To Dairy Circle	LOS F

Traffic Volume Counts at Cordon Points

Nine cordon points were identified for an understanding of the traffic characteristics in the study area. The analysis of the classified volume count survey at the cordons is given in the sub-sections below. The total inbound and outbound traffic flow at each of the cordons is presented in Table 142 **and** daily traffic on each cordon point is shown in Figure direction wise.

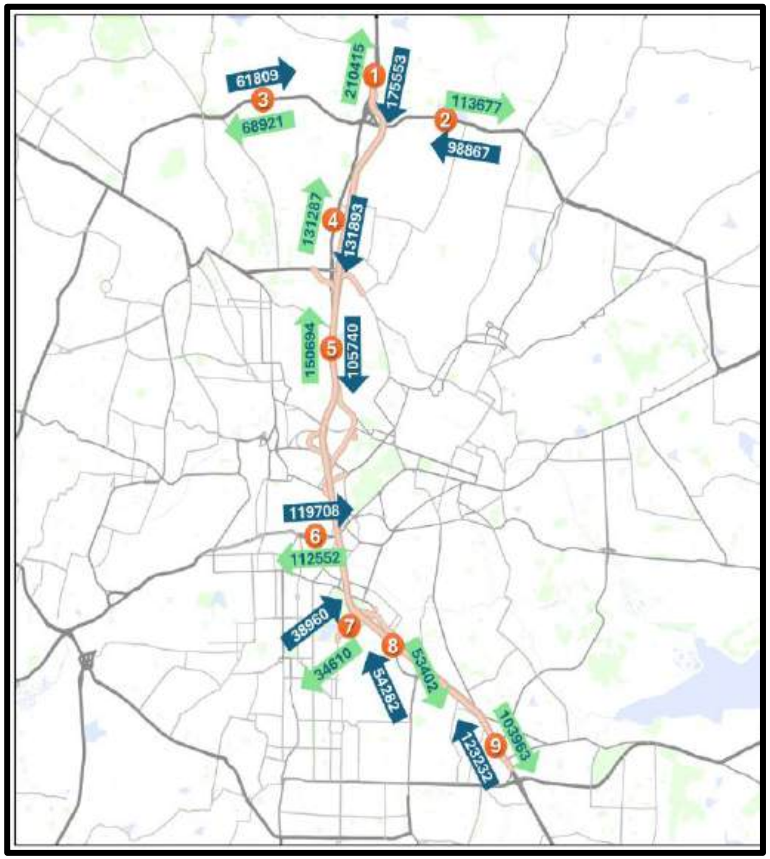


Figure 393 : Map Showing Locations of Traffic Volume Count Surveys.

Table 121 : Traffic Volume Counts at Cordon Locations

	Location	Direction	Vehicles	PCUs	Total Vehicles	Total PCUs
1	NH-44 Bellary Road (Near-Sakar Nagar)	Dir-I: Yelahanka To Hebbal	178815	175553	393137	385968
		Dir-II: Hebbal To Yelahanka	214322	210415		
2	NH-75 Malur - Byranahalli Rd Outer Ring Road (Near-Nagavara park)	Dir-I: Bellary Road To Nagavara	117553	113677	222323	212544
		Dir-II: Nagavara To Bellary Road	104770	98867		
3	NH-75 Malur - Byranahalli Rd Outer Ring Road (Near-Devinagar BEL Circle)	Dir-I: Hebbal To Yashwantpur	74262	68921	139793	130729
		Dir-II: Yashwantpur To Hebbal	65531	61809		
4	AH-47 Malur Road (Near-Science Gallery)	Dir-I: Malegaon To Nashik City	139418	131287	277295	263180
		Dir-II: Nashik City To Malegaon	137877	131893		
5	Guttahalli Main Road (Near-Uniworth Plaza)	Dir-I: Malegaon To Nashik City	111699	105740	267771	256433
		Dir-II: Nashik City To Malegaon	156072	150694		
6	NR road (Near-Silver Jubilee Park)	Dir-I: Malegaon To Nashik City	121760	112552	252461	232259
		Dir-II: Nashik City To Malegaon	130701	119708		
7	Siddapura Road (Near-Maharaja Agrasena Bhavana)	Dir-I: Ashoka Piller To Mallinge Hospital	43860	38960	83509	73569
		Dir-II: Mallinge Hospital To Ashoka Piller	39649	34610		
8	Marigowda Road (Near-National Institute Of Mental Health & Neuro Sciences)	Dir-I: Dairy Circle To Wilson Garden	54855	54282	108421	107685
		Dir-II: Wilson Garden To Dairy Circle	53566	53402		
9	NH-44 Bengaluru-Chennai Highway (Near-Madiwala footbridge)	Dir-I: Adugodi To Electronic City	120551	103963	265528	227195

Traffic Modelling on our project alignment

The North-South Corridor is proposed in Bengaluru to decongest the vehicular traffic congestion within the city. The diversion estimation for the proposed North-South Corridor is done considering the Modal Share prescribed in the Comprehensive Mobility Plan 2020 to understand the amount of traffic that will be diverted in the proposed facility.

The diversion estimation is done on state-of-the-art software PTV Visum 2024 to model real-life scenario for realistic traffic evaluation through the input of primary data as well as secondary data.

Table 143 below shows the total mode-wise estimated trips for horizon year 2031 and 2041 for all the three scenarios where Scenario 1 consist of largest share of cars and Scenario 3 consist of largest share of public transport due to which Scenario 1 has the highest number of car trips and Scenario 3 has the lowest number of car trips. Both scenario 1 and 3 are referred from CMP 2020. Scenario 2 is considered as the intermediate scenario having a reasonable modal share.

Table 122: Estimated Total trips during morning peak hour.

	Year 2031			Year 2041		
Mode	S1	S2	S3	S1	S2	S3
Auto Rickshaw	25111	23812	19859	29631	28098	23434
Two-Wheeler	153528	128708	100381	181163	151876	118449
Car	83005	72507	61168	97946	86211	72178

Further, all these three scenarios are evaluated considering toll and without toll conditions. In without toll condition, the Level of Service is compromised in year 2031 only for section 2 and 3 therefore it was not a viable option to be considered.

For with toll scenario, the average toll price considered for Car is Rs 16/km. Considering this, for horizon year 2031 and 2041 all the three scenarios were evaluated to understand the impact of the application of toll in the proposed North-South Corridor. However, the scenario 2 is considered as the reasonable scenario and it is considered for further evaluations.

The proposed corridor was divided into four sections based on the ramp locations. Table 123 shows section wise morning peak hour volume on the proposed corridor. It can be observed that all the sections of the corridor are having Level of Service B and C in horizon year 2031 and 2041. However, section 2 and 3 towards the Silk board Junction has high volume in horizon year 2031.

Table 123: Assignment Results - Scenario 2 (Morning Peak Hour PCU) for 2031 and 2041 (with toll)

Section		Year 2031 (With Toll)		Year 2041 (With Toll)	
		PCU/ Hr	LOS	PCU/Hr	LOS
Section 1	Towards Airport	902	LOS B	1276	LOS B
	Towards Bengaluru City	2645	LOS C	3770	LOS C
Section 2	Towards Airport	1834	LOS B	2333	LOS C
	Towards Bengaluru City	4030	LOS D	5161	LOS F
Section 3	Towards Airport	2653	LOS C	3742	LOS C
	Towards Bengaluru City	4705	LOS E	5559	LOS F
Section 4	Towards Airport	2005	LOS B	2951	LOS C
	Towards Bengaluru City	1551	LOS B	1811	LOS B

Considering the results obtained, a diversion of approximately 15% is estimated on the proposed North-South Corridor.

The detailed process of data collection, CMP-2020 incorporation in our project, Traffic analysis and traffic modelling through PTV Visum has been mentioned in detail in Traffic Chapter of Main Report.

Improvement Proposals

These improvement proposals are based on the findings of various engineering features carried out on the project roads such as Traffic Survey and Analysis, Inventory Data and Geotechnical & Geophysical Investigations.

The improvement proposals for proposed widening include the provisions for the following major items:

a) Main Tunnel (Twin tube uni-directional TBM tunnel, Cut & Cover, Open Cut)

b) Entry/ Exit ramps (NATM tunnel, Cut & Cover, Open Cut)

c) Tunnel Passage

d) Vertical Shaft

e) Traffic Control and Safety Measures

Design Standards

Geometric Design

Geometric design of a highway is the process whereby the layout of the road in specific terrain is designed to meet the needs of the road users keeping in view the road function, type and volume of traffic, potential traffic hazards and safety as well as convenience of the road users. The principal areas of control for fulfilment of this objective are- the horizontal alignment, vertical alignment and the road cross-section.

The Consultants have referred to the latest IRC publications and MORT&H circulars regarding design standards for National Highways in India. After careful review of all available data and requirements of the project road the proposed Design Standards for adoption on the project road have been recommended.

Design Speed

The project road passes through plain terrain. For geometric design of the highway, design speed is used as an index which links road function, traffic flow and terrain. An appropriate design speed should correspond to general topography and adjacent land use. The speed selected for design should also cater to travel needs and behaviour of the road users.

The design speed corresponding to the type of terrain as Per IRC 86-2018 is as under:

Table 124 : Design Speed Standards

Class of Urban Road	Design Speed (km/h)	
	Ruling	Minimum
Arterial Road	60	50

Levels of Service (LOS)

The Level of Service (LOS) characterizes the operating conditions on the roadway in terms of traffic performance measures related to speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience. The levels of service range from level-of-service A (least congested) to level-of-service F (most congested). The Highways Capacity Manual (HCM) provides the following levels of service definitions:

Table 125 : Standards for Level of Service

Level of Service (LOS)	General Operating Conditions
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

Considering the importance of the highway, whereas Level of Service (LOS) 'B' is desirable and level of service up to LOS- 'C' may be acceptable.

Main Tunnel

A twin tube uni-directional tunnel has been proposed for connecting the northern part to the southern part of Bengaluru City. The project alignment starts from Hebbal Esteem Mall junction and terminates at Silk Board KSRP Junction.

Key Features: -

Table 126: Tube 1 – Hebbal to Silk Board

Total Length	16.690 Km
Length of Tunnel (TBM)	14.550 Km
Lane Configuration	3 Lanes
Diameter	Outer – 14.600m, Inner – 13.500m
Carriageway width	10.500m
Walkway	0.700m
Crash Barrier	0.500m
Cut & Cover Section	At Hebbal – 950m, At Silk Board – 600m
Open Cut Section	At Hebbal – 430m, At Silk Board - 160m

For Bored Tunnels

Lining Type and Geometry

The finished inner diameter for the Underground Vehicular Tunnel is considered as 13.500m with a thickness of 550mm. Universal configuration of the segment is considered with 9+1 arrangement. The typical bored tunnel cross-section is shown in TCS-1 given later in the chapter along with their TCS Schedule.

Table 127 : Tube 2 – Hebbal to Silk Board

Total Length	16.678 Km
Length of Tunnel (TBM)	14.530 Km
Lane Configuration	3 Lanes
Diameter	Outer – 14.600m, Inner – 13.500m
Carriageway width	10.500m
Walkway	0.700m
Crash Barrier	0.500m
Cut & Cover Section	At Hebbal – 970m, At Silk Board -640m
Open Cut Section	At Hebbal – 430m, At Silk Board -108m

Design Considerations

The segments shall be designed to ensure that the full design life of 100 years is achieved. The design method for the analysis of the bored tunnel linings shall be done considering the interaction between the lining and the ground, the deflection of the lining and the redistribution of the loading dependent upon the relative flexibility of the lining, the variability and the compressibility of the ground, with this, the design shall take into account all additional loads, stresses and strains imposed by or on to adjacent Existing Building Structure (EBS).

The Loads acting on the lining include earth pressure, water pressure, dead load, reactions, surcharge & seismic forces. The lining shall also be checked to resist the various loads arising due to handling, stacking, temporary grout load pressure, TBM thrust, Load on Bolts & erector, gasket forces etc.,

The pre-cast concrete linings are designed in accordance with IS 456 However other International Codes may be used in addition to the Indian Standard as and when required.

The Analysis methods, Material and design calculation is mentioned in Design Report which is submitted as Volume II-B

For NATM Tunnel

As per the General arrangement Drawings prepared , there are two types of NATM sections available. i.e., Regular Cross Section and Regular Cross Section (VCP) which are use for the project. The NATM Tunnel is presented as TCS-5 and their Schedules which are mentioned later in chapter.

Design Considerations

The Tunnel tube is proposed to be constructed according to New Austrian Tunnelling Method (NATM) excavation in different weathering grade of rock mass. Ground excavations require the use of structural supports, to establish equilibrium and to limit the displacements around the excavation and at surface. The tunnel will be supported with primary support for temporary condition and a cast in-situ concrete as a permanent support. Primary support design has been done by considering site ground condition. The design has been performed for the combination of different load cases analyzed in STAAD. The Analysis methods, Material and design calculation is mentioned in Design Report which is submitted as Volume II-B

Cut and Cover Section

The Cross Sections of C&C Structures (C&C section of 2 lane and 3 lane) will be used as described Typical Cross Sections as TCS-6 (3 lane Section) and TCS-03 (2 Lane section) which are presented later in chapter. C&C Structures will have side walls, Bottom Slab and top slab with Reinforced Concrete Structure in which Bottom Slab of 1.0 m thick (2-lane) & 1.2m thick (3-lane) will casted over 0.2 m thick PCC and Side wall of 1.0 m thick (2-lane) & 1.2m thick (3-lane) and top slab with 1.0 m thick (2-lane) & 1.2m thick (3-lane).

The Analysis methods, Material and design calculation are mentioned in Design Report which is submitted as Volume II-B

Open Cut Section

The following Cross Sections of RAMP Structures (Ramp section of 2 lane and 3 lane) will be used as described in TCS-02 (3 Lane) and TCS-04 (2 Lane). RAMP Structures will have side walls and Bottom Slab with Reinforced Concrete Structure in which Bottom Slab of 1 m thick and Side wall of 1m with roofing C/W pipe truss and approved grade polycarbonate roofing sheets.

The Analysis methods, Material and design calculation are mentioned in Design Report which is submitted as Volume II-B.

Proposed Typical Cross Section

Typical cross section of the proposed section Main tunnel, Entry & Exit Ramps are as under:

Table 128 : Proposed Typical Cross Section for Main Tunnel Tube 1 and Tube 2

Tube 1 : Hebbal to Silk Board (Left)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+430	430	open cut	TCS 2	3 Lane
2	0+430	1+380	950	cut and cover	TCS 6	3 Lane
3	1+380	15+930	14550	main TBM tunnel	TCS 1	3 Lane
4	15+930	16+530	600	cut and cover	TCS 6	3 Lane
5	16+530	16+690	160	open cut	TCS 2	3 Lane
Total Length			16690			

Tube 2 : Hebbal to Silk Board (Right)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+430	430	open cut	TCS 2	3 Lane
2	0+430	1+400	970	cut and cover	TCS 6	3 Lane
3	1+400	15+930	14530	main TBM tunnel	TCS 1	3 Lane
4	15+930	16+570	640	cut and cover	TCS 6	3 Lane
5	16+570	16+678	108	open cut	TCS 2	3 Lane
Total Length			16678			

Table 129 : Entry/ Exit ramps at Hebbal Junction

Hebbal						
Entry Ramp 1 (Hebbal Service Road)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+170	170	TCS 4	Open Cut	2 Lane
2	0+170	0+360	190	TCS 3	Cut & Cover	2 Lane
Total Length			360			
Entry Ramp 2 (From ORR To Main Tunnel (km 1.300) Towards Silk Board/ Sarjapur road)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+600	600	Cut & Cover	TCS 3	2 Lane
2	0+600	814	214	Open Cut	TCS 4	2 Lane
Total Length			814			
Exit Ramp 8 (Hebbal Service Road)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+450	450	TCS 4	Open Cut	2 Lane
2	0+450	0+700	250	TCS 3	Cut & Cover	2 Lane
Total Length			700			
Exit Ramp 7 (From Main Tunnel (km 1.300) To ORR Towards ORR (Outer Ring Road))						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+300	300	Cut & Cover	TCS 3	2 Lane
2	0+300	400	100	Open Cut	TCS 4	2 Lane
Total Length			400			

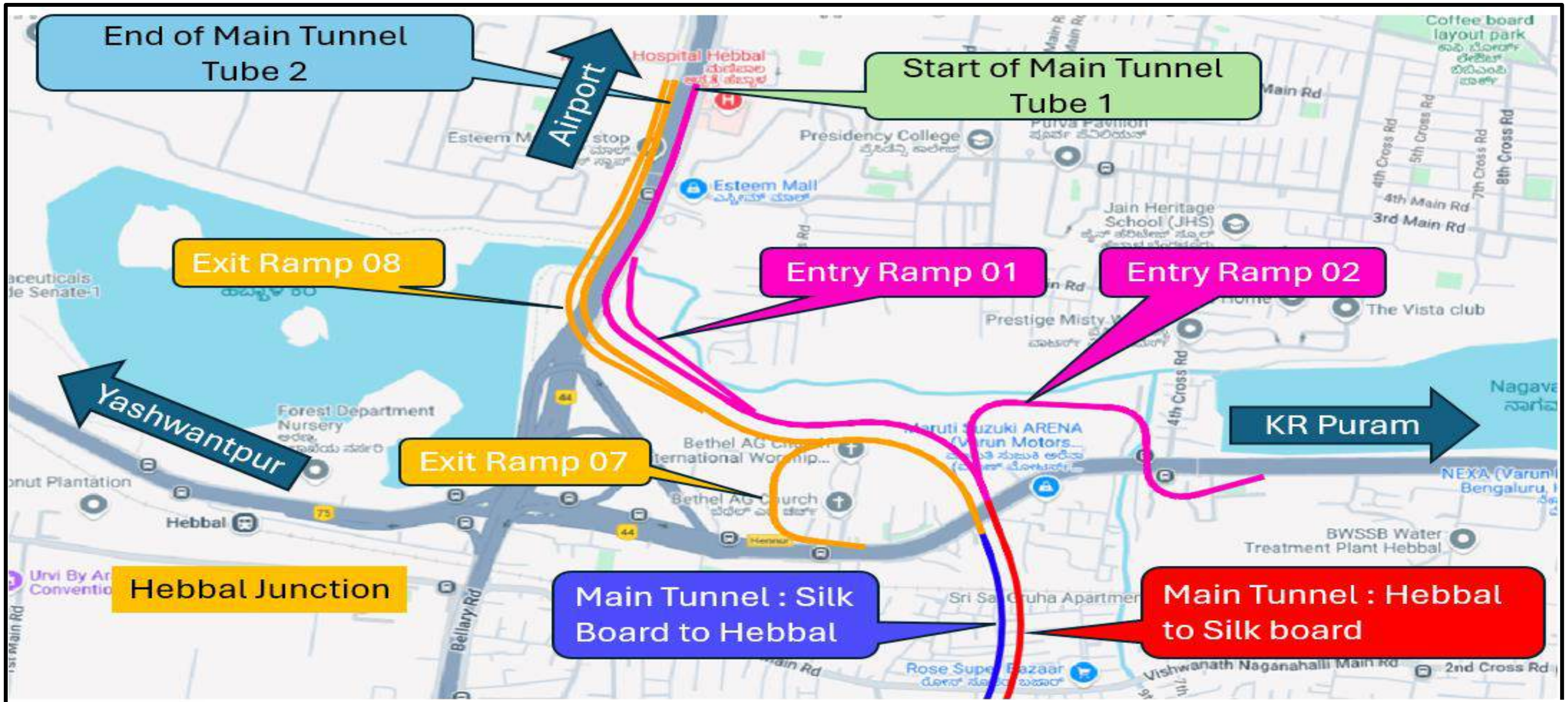


Figure 394 : Entry and Exit Ramps at Hebbal Junction

Table 130 : Entry/ Exit ramps at Palace Ground

Palace Ground						
Entry Ramp 03 (From Jaya Mahal Road)						
SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+000	0+170	170	Open Cut	TCS 2	3 Lane
2	0+170	0+360	190	Cut & Cover	TCS 6	3 Lane
3	0+360	1+255	895	NATM Tunnel	TCS 5	2 Lane
Total Length			1255			
Entry Ramp 4 (From CV Raman Road To Main Tunnel (km 4.700) Towards Hebbal)						
SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+000	1+320	1320	NATM Tunnel	TCS 5	2 Lane
Total Length			1320			
Exit Ramp 06 (Towards C V Raman Road)						
SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	1+320	0+000	1320	NATM Tunnel	TCS 5	2 Lane
2	1+320	1+610	290	Cut & Cover	TCS 6	3 Lane
3	1+610	1+910	300	Open Cut	TCS 2	3 Lane
Total Length			1910			
Exit Ramp 5 (From Main Tunnel (km 4.450) To Jaymahal Road Towards Jaymahal Road)						
SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+360	1+323	963	NATM Tunnel	TCS 5	2 Lane
Total Length			963			

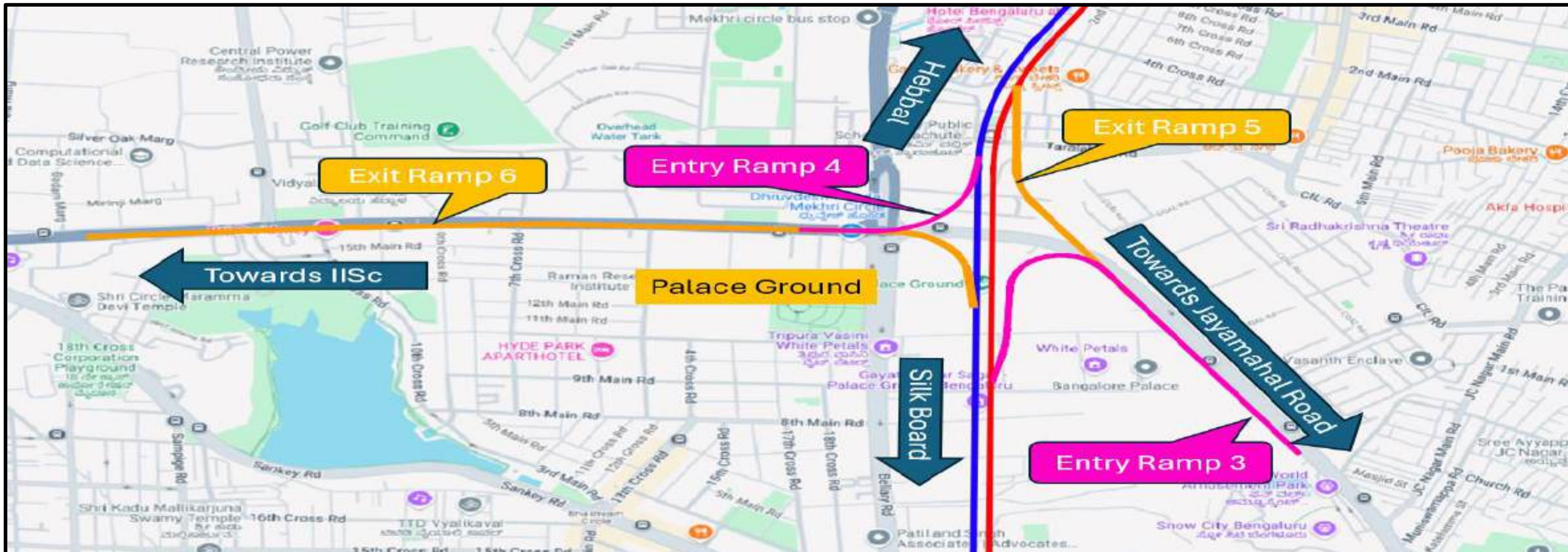


Figure 395 : Entry and Exit Ramps at Palace Ground

Table 131 : Entry/ Exit ramps at Race Course:

Race Course

Entry Ramp 5 (From Palace Road towards Hebbal)

SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+960	1+550	590	Cut & Cover	TCS 3	2 Lane
2	1+550	2347	797	NATM Tunnel	TCS 5	2 Lane
Total Length			1387			

Entry Ramp 6 (From Palace Road towards Silk Board)

SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+000	0+230	230	Open Cut	TCS 2	2 lane
2	0+230	0+960	730	Cut & Cover	TCS 6	3 Lane
3	0+960	1+100	140	Cut & Cover	TCS 3	2 Lane
4	1+100	1+906	806	NATM Tunnel	TCS 5	2 Lane
Total Length			1906			

Exit Ramp 4 (On Seshadri Road towards K R Circle from Hebbal)

SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+000	0+830	830	NATM Tunnel	TCS 5	2 Lane
2	0+830	1+060	230	Cut & Cover	TCS 3	2 Lane
3	1+060	1+376	316	Open Cut	TCS 4	2 Lane
Total Length			1376			

Exit Ramp 3 (On Race Course Road towards Chalukya Circle from Silk Board)

SL No	Chainage From	Chainage To	Length	TCS Type	TCS DETAILS	Lanes
1	0+000	0+880	880	NATM Tunnel	TCS 5	2 Lane
2	0+880	1+530	650	Cut & Cover	TCS 3	2 Lane
3	1+530	1+864	334	Open Cut	TCS 4	2 Lane
Total Length			1864			

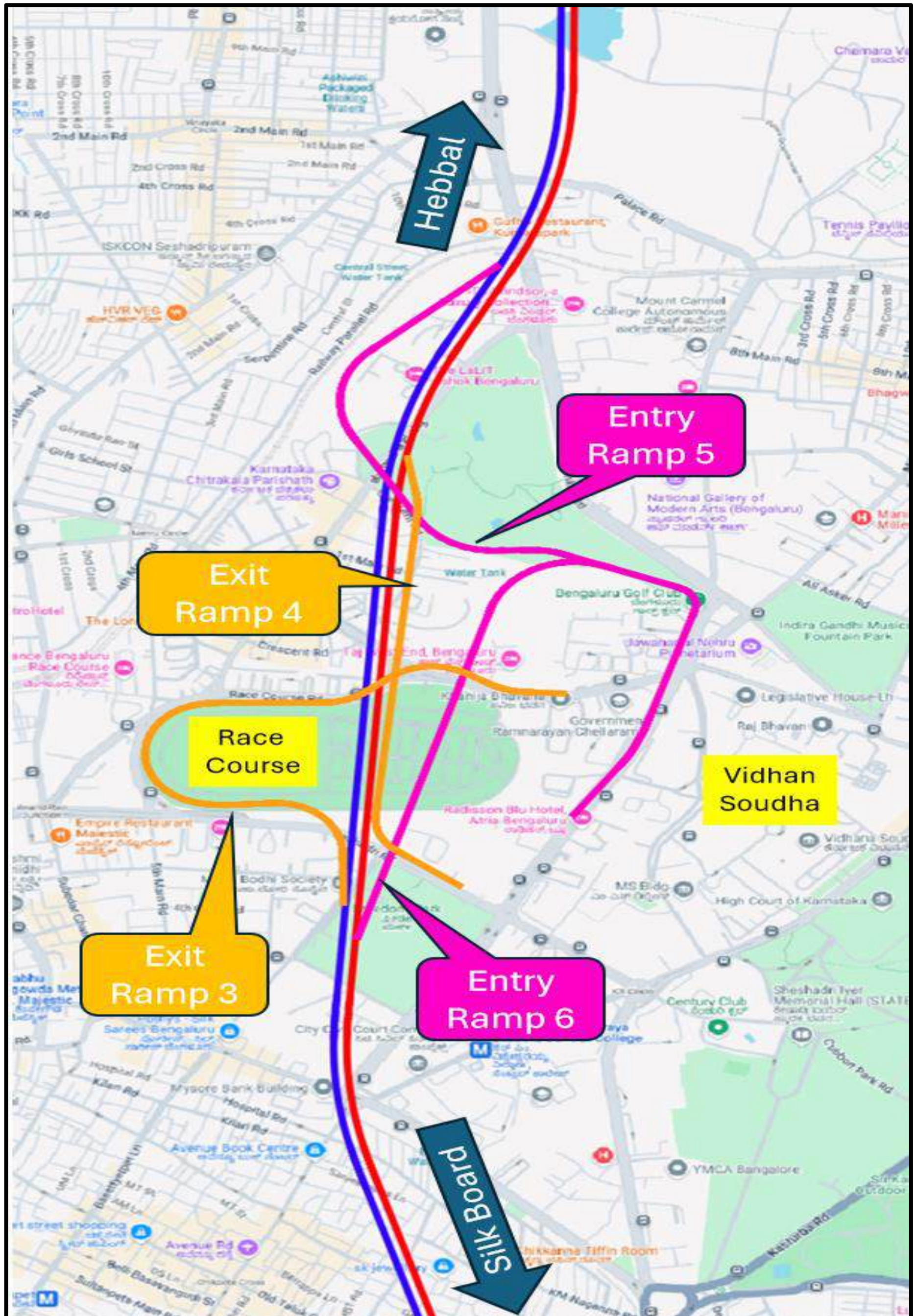


Figure 396 : Entry and Exit Ramps at Racecourse

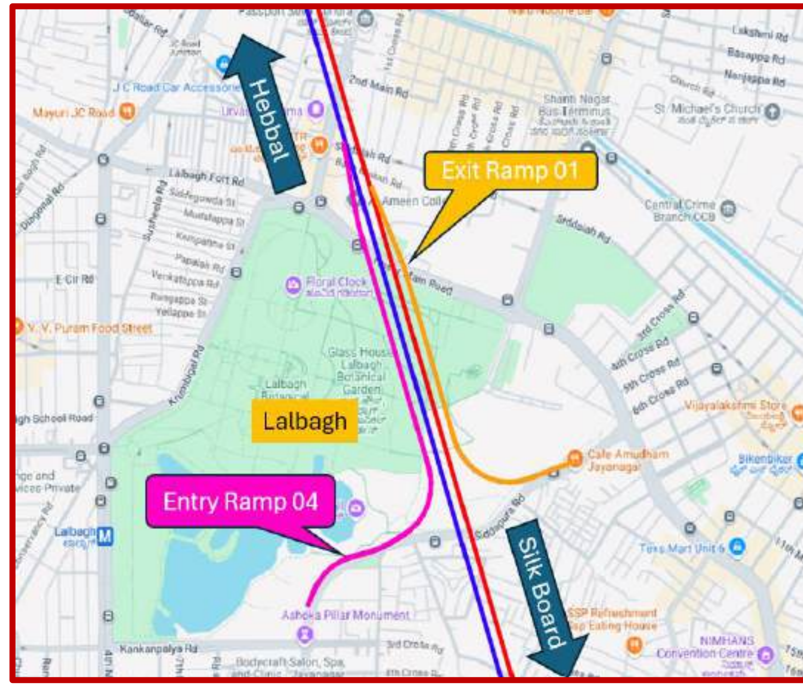


Figure 397 : Entry and Exit ramp at Lalbagh

Table 132: Entry/ Exit ramps at Lal Bagh

Lal Bagh						
Entry Ramp 7 (From Siddapura Road near Ashok Pillar)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+150	150	Open Cut	TCS 4	2 Lane
2	0+150	0+470	320	Cut & Cover	TCS 3	2 Lane
3	0+470	1+416	946	NATM Tunnel	TCS 5	2 Lane
Total Length			1416			
Exit Ramp 2 (Towards Siddapura Road near Wilson Garden)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+870	870	NATM Tunnel	TCS 5	2 Lane
2	0+870	0+930	60	Cut & Cover	TCS 3	2 Lane
3	0+930	1+073	143	Open Cut	TCS 4	2 Lane
Total Length			1073			

Table 133 : Entry/ Exit ramps at Silk Board

Silk board						
Entry Ramp 8 (From Sarjapur Road)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+400	400	TCS 3	Cut & Cover	2 Lane
2	0+400	0+663	263	TCS 4	Open Cut	2 Lane
Total Length			663			
Exit Ramp 1 (Towards Sarjapur Road)						
SL No	Chainage		Length	TCS Type	TCS DETAILS	Lanes
	From	To				
1	0+000	0+240	240	TCS 3	Cut & Cover	2 Lane
2	0+240	0+454	214	TCS 4	Open Cut	2 Lane
Total Length			454			

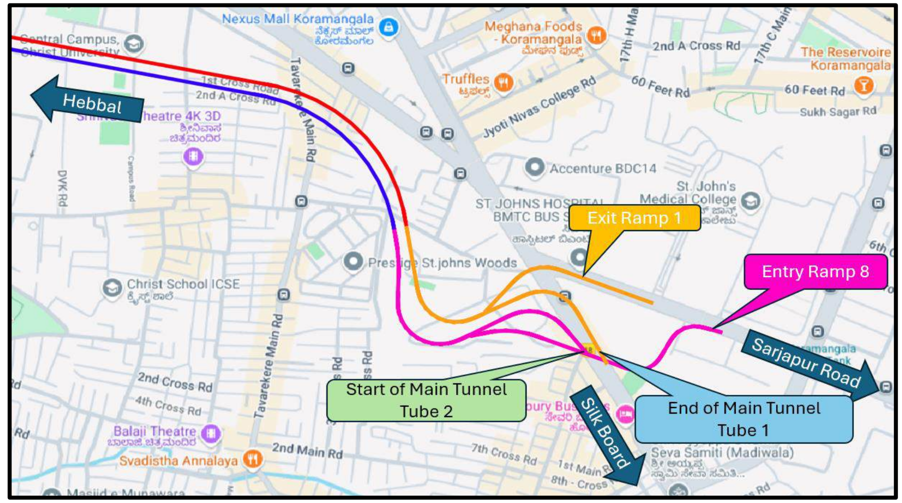


Figure 398: Entry and Exit ramp at Silk board

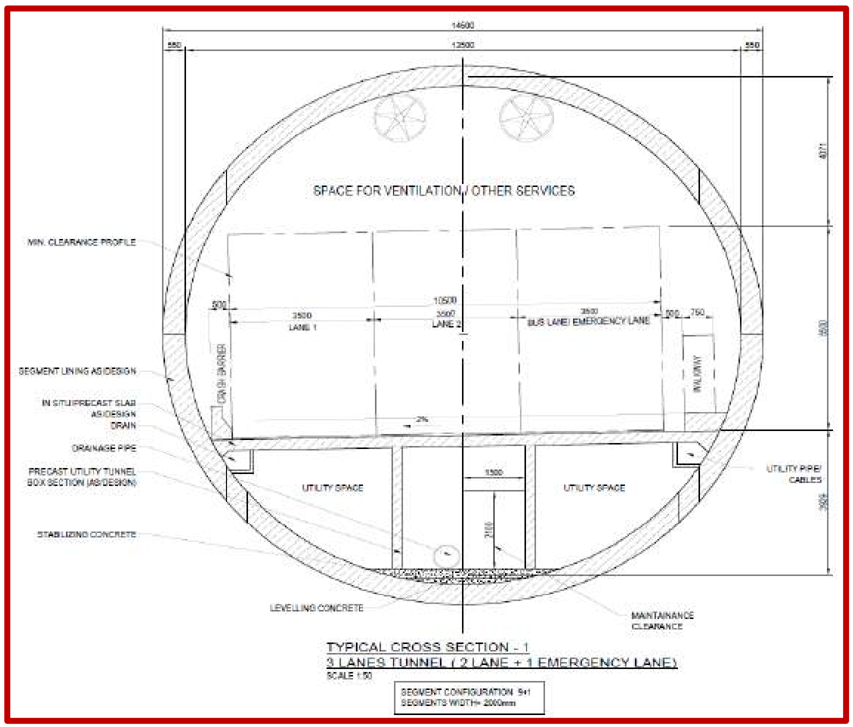


Figure 399 : TCS-1, TBM Tunnel Cross-Section

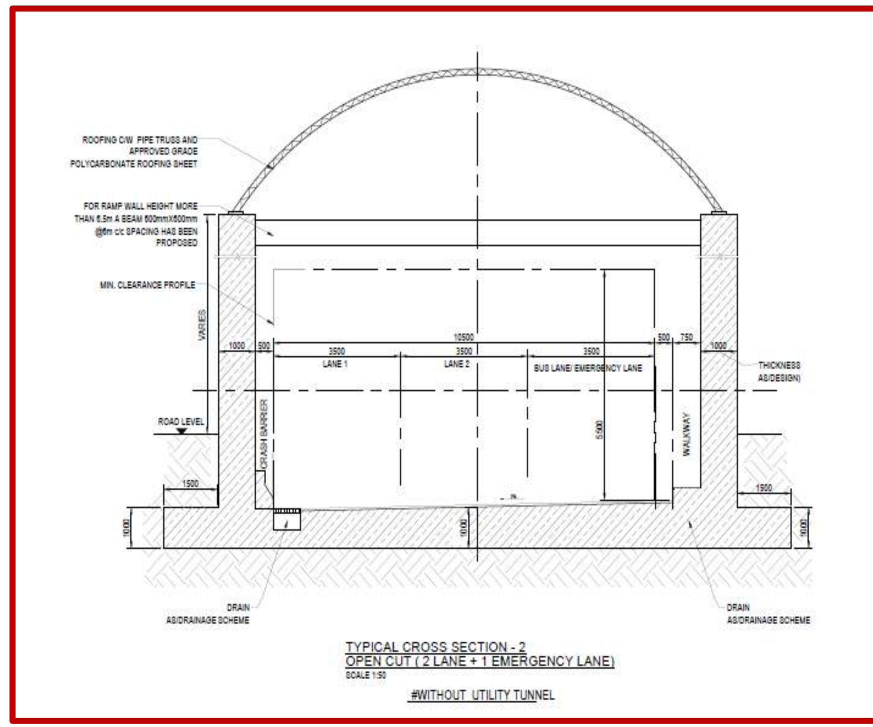


Figure 400.: TCS-2, 3 lane Open Cut Section

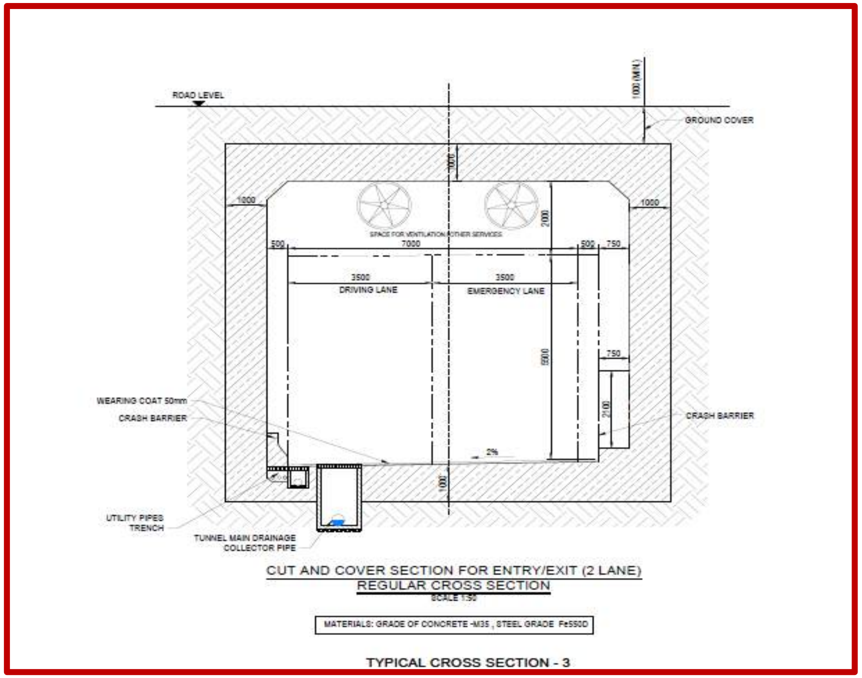


Figure 401 : TCS-3, 2 lane Cut & Cover Section

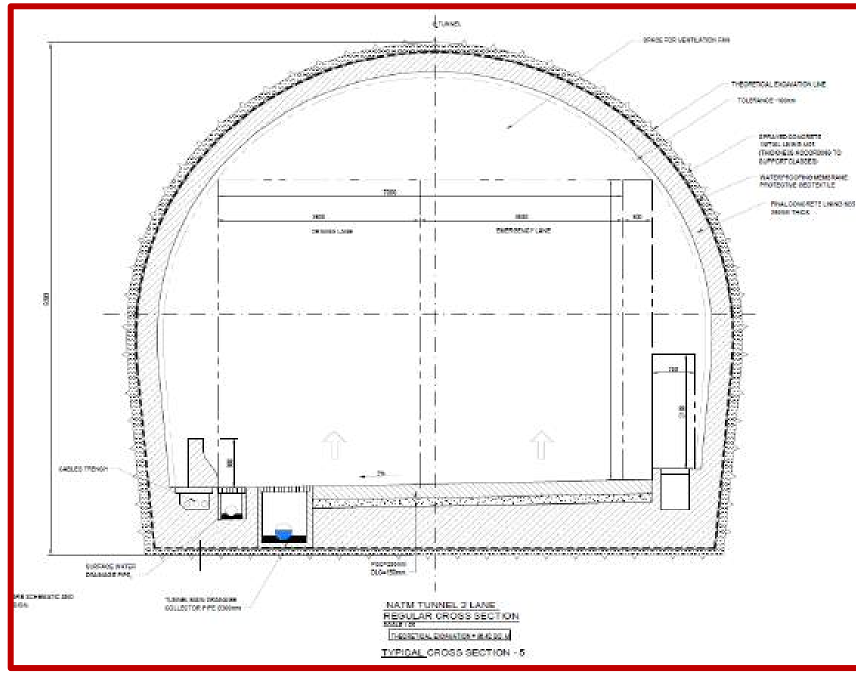


Figure 402 : TCS-5, 2 lane NATM Tunnel Section

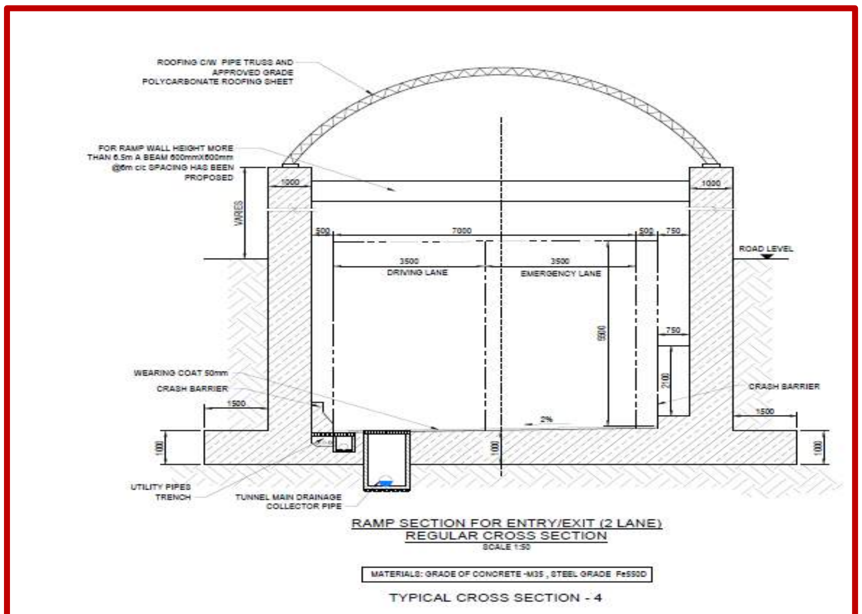


Figure 403 : TCS-4, 2 lane Open Cut Section

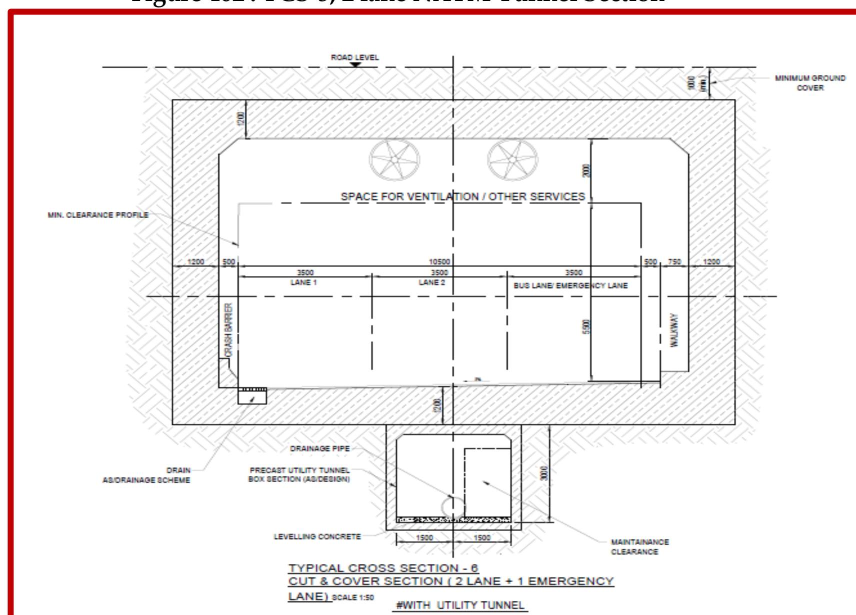


Figure 404 : TCS-6, 3 lane Cut & Cover Section

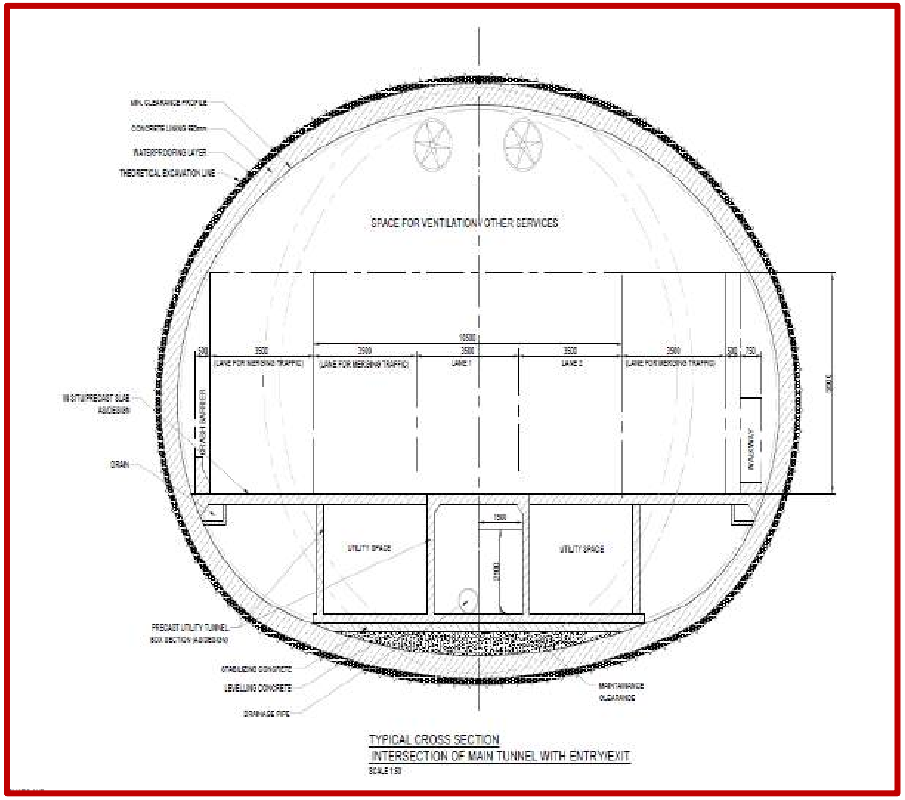


Figure 405 : Typical Cross Section for merger section of Entry/ Exit Ramps & Main Tunnel

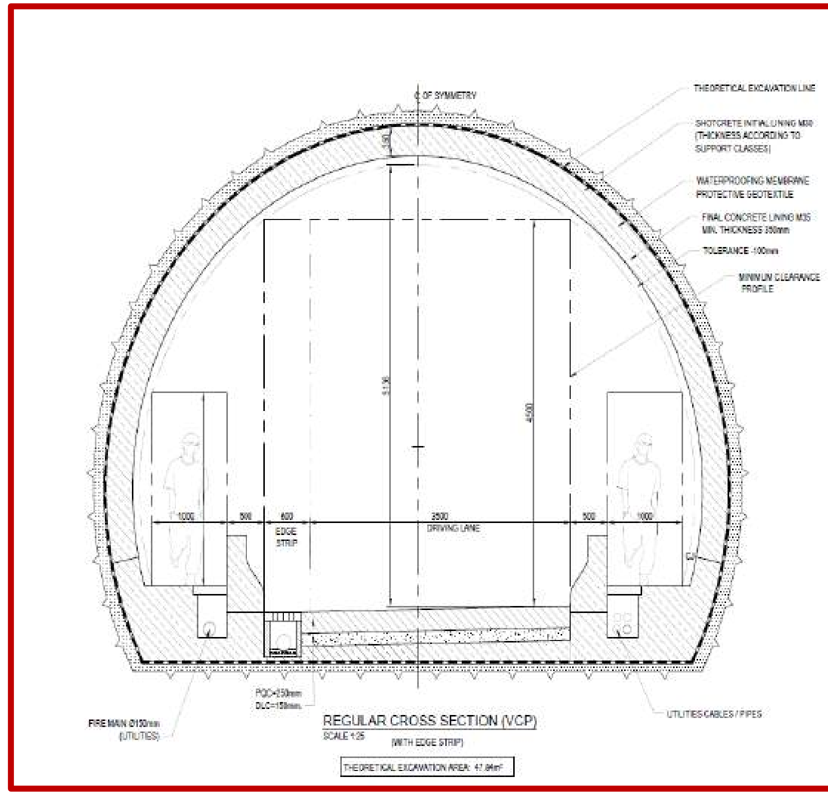


Figure 406 : TCS for Tunnel Cross Passage

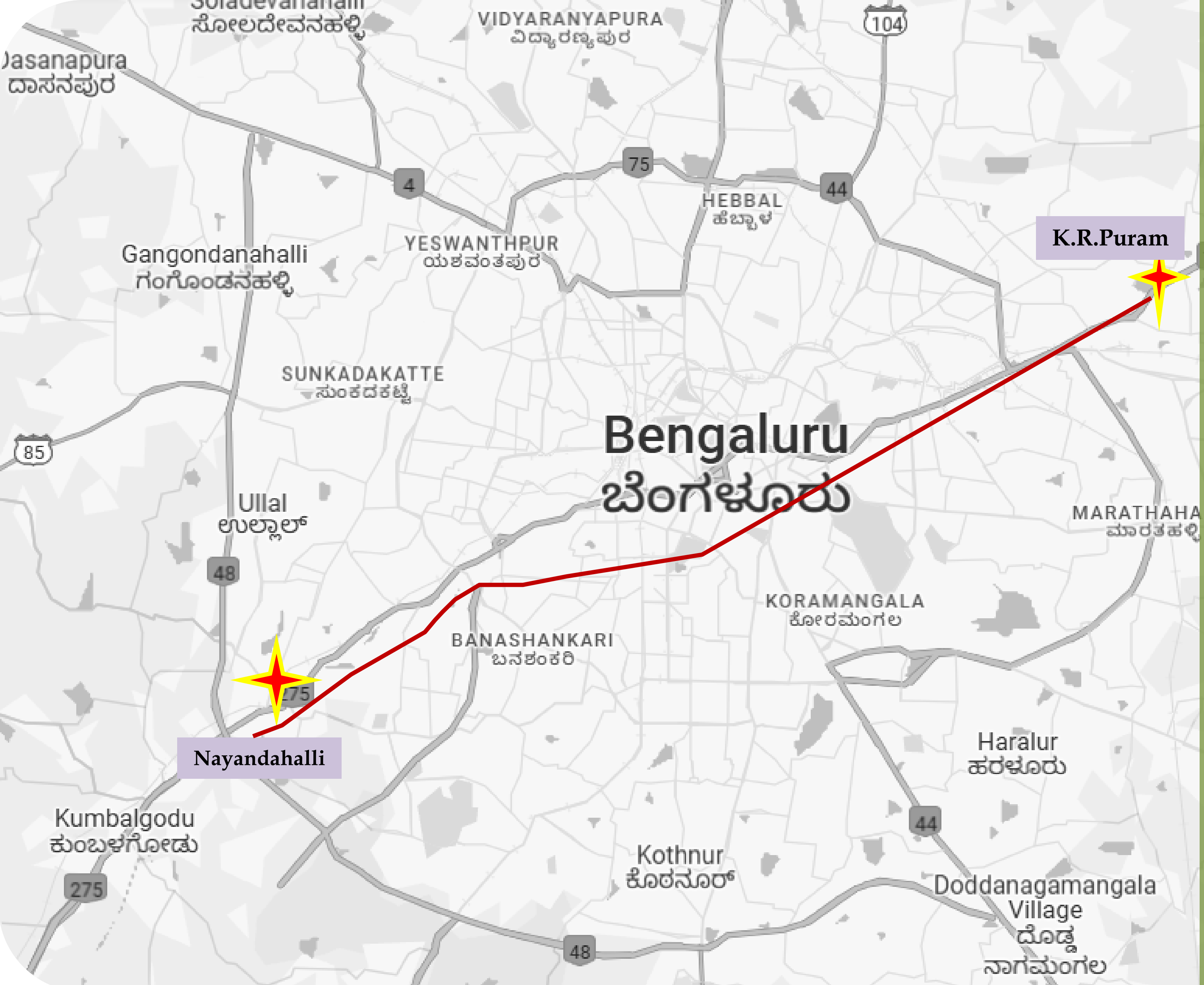
Summary of Cost Estimate

Table 134 : Summary of the Cost

S.No	Description	Length (km)	Rate	Total Amount in Rs.	Total Amount (Rs. in Crores)
BILL NO. 1	Site Clearance			78,89,328.33	0.79
BILL NO. 2	Earth Works			63,05,013.00	0.63
	Sub Total (Bill-1+Bill-2)			1,41,94,341.33	1.42
BILL NO. 3	Tunnel Work				
A	Main Tunnel				
a.	Tunnelling By TBM (Twin Tunnel)	14.54	415.70	60,44,26,70,696.60	6,044.27
b.	Cross Passages (27 No's)			28,88,85,247.22	28.89
c.	Cut And Cover Tunnel	4.08	238.96	9,74,95,68,000.00	974.96
d.	Open Cut (Ramps)	1.53	77.03	1,17,70,18,400.00	117.70
e.	Shafts (5 No's)			2,65,53,79,134.97	265.54
f.	Buildings (Control Center)			15,44,08,200.00	15.44
B	Intermediate Entry/Exit				
a.	Open Cut (Ramps)	3.67	72.77	2,67,35,69,800.00	267.36
b.	Cut And Cover Tunnel	4.26	219.46	9,34,89,96,000.00	934.90
c.	NATM Tunnel	8.61	87.02	7,48,98,11,400.00	748.98
C	Sub Total Cost Of Tunnel Works(A+B)			93,98,03,06,878.80	9,398.03
D	Electro- Mechanical Works @ 8% Of C			7,51,84,24,550.30	751.84
E	Tunnel Ventilation & Fire Fighting			4,84,73,00,000.00	484.73
G	Pavement			46,08,95,480.54	46.09
H	Inter Modal Logistic Building			6,08,81,90,000.00	608.82
BILL NO. 4	Traffic Signs, Markings, Crash Barrier Appurtenances			32,42,87,806.70	32.43
BILL NO. 5	Road Restoration and Development				
a.	Reclamation Of Existing Road in Approach Area & Ramps			68,00,75,000.00	68.01
b.	Street level Development near shaft Location (Road, Footpath, Lighting etc.)			30,00,00,000.00	30.00
c.	Junction Development			11,56,51,855.12	11.57

Table 135: Summary of the Cost

BILL NO. 6	Safety, Environmental Management Plan and Traffic Management During Construction @ 0.25% on (C) Cost of Tunnel Works.			23,49,50,767.20	23.50
BILL NO.7	High-Capacity & High-Speed Busses with Driving And Trailing Coaches (Neo-Bus System)				
a.	Traction & Power Supply (OHE)			50,00,00,000.00	50.00
b.	Telecommunication & Passenger Information System			10,00,00,000.00	10.00
c.	Fare Collection System			5,00,00,000.00	5.00
d.	Articulated Coach of Minimum 18 M Length			40,00,00,000.00	40.00
BILL NO. 8	Miscellaneous (Trees, Artwork in Tunnel, Construction Depot & Casting Yard, Tree Trans Plantation And Landscaping etc.)			65,08,23,320.00	65.08
BILL NO. 9	GPS/GNSS-Based Tolling	10.00	1.10	11,00,00,000.00	11.00
B) Estimated Construction Cost Without GST				1,16,37,51,00,000.00	11,637.51
GST @ 18% Payable on Construction Cost Only (On B)				20,94,75,18,000.00	2,094.75
C) Construction Cost Including GST				1,37,32,26,18,000.00	13,732
Contingencies @ 1% Of (B)				1,16,37,51,000.00	116.38
Construction Supervision Charges @ 2% Of (B)				2,32,75,02,000.00	232.75
D) Total Cost Including Centages				1,40,81,38,71,000.00	14,081.39
Land Acquisition, Resettlement, Rehabilitation Cost				8,00,00,00,000.00	800.00
Utility Shifting Cost				1,00,00,00,000.00	100.00
E) Total Project Cost (Sum of All the Above)				1,49,81,38,71,000.00	14,981.39



CORRIDOR

02

Proposed EAST-WEST Tunnel Corridor from K.R.Puram to Nayandahalli

Alignment and Geometry

The proposal of the project tunnel is newly constructed a Double Decker Tunnel with 3 lanes at lower deck and 2 lanes at upper deck. As such the horizontal and vertical is upgraded as per the design standard stipulated in the manual and as per relevant Standards. The proposed project tunnel Starts from NH-44, & and the total length of tunnel is 18+234 km and in the State of Karnataka city Bangalore.

The total length of the project for East-West Corridor is 28.181 Km. The alignment comprises of structures like cut & cover, underpasses. The proposal is a two-deck system in which upper deck (KR Puram to Nayandahalli Circle) & lower deck (Nayandahalli Circle to KR Puram).

Note: The detailed Plan, Profile & L-Section is shown in Annexure-I & Geological L-Section is given in Annexure-II.

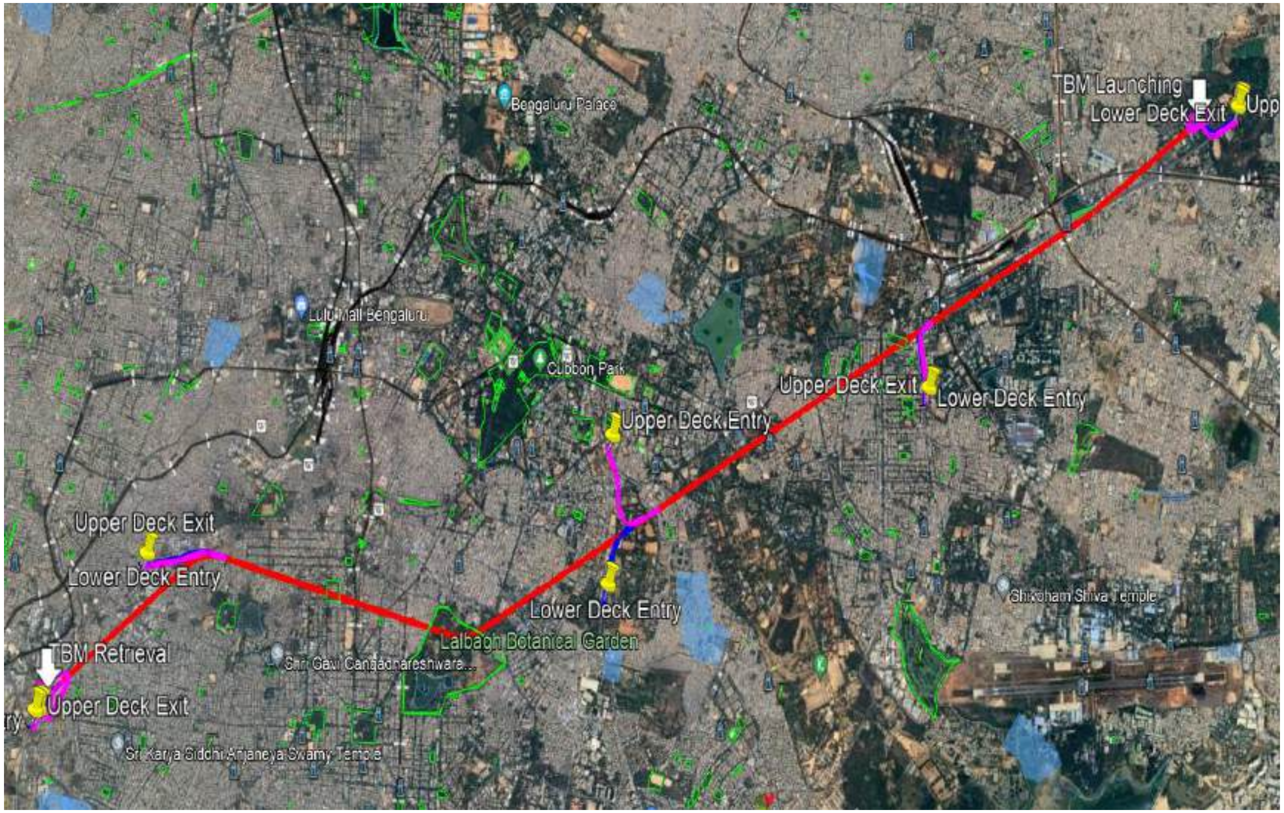


Figure 407. TBM tunnel proposal alignment (East-West Corridor)

1. Lane Width

- Width of carriageway for lower deck of tunnel is 3 x 3.5 = 10.5 m.
- Width of carriageway for upper deck of tunnel is 2 x 3.5 m = 7 m.

Existing Junctions Along the Alignment

Table 136. Existing Junctions along the Alignment

Existing Junctions				
S.No.	Type of Existing Junction	Coordinates		Remarks
		Northing	Easting	
1.	Y-3 Legged	1437666.24 m N	788260.93 m E	Near Gopalan Signature Mall
2.	Y- 3 Legged	1437233.04 m N	787341.00 m E	Near Baiyappanahalli Depot
3.	T- 3 Legged	1436257.91 m N	787119.75 m E	Near Chinmaya Mission Hospital
4.	X-4 Legged	1436250.99 m N	786528.31 m E	Indiranagar
5.	T-3 Legged	1436852.77 m N	786459.56 m E	Indiranagar
6.	X-4 Legged	1436213.71 m N	786051.46 m E	Near Indiranagar Metro station intersecting with Road and proposed Tunnel Alignment
7.	Y-3 Legged	1436586.63 m N	785466.34 m E	Near Murphy Town
8.	X- 5 Legged	1434967.69 m N	783303.97 m E	Near Victoria Layout
9.	X-4 Legged	1434837.80 m N	782808.77 m E	Near BWSSB Pump House
10.	X-5 Legged	1435462.35 m N	782833.78 m E	Ashok Nagar
11.	X-4 Legged	1435369.38 m N	782590.59 m E	Near Ashok Nagar
12.	X-4 Legged	1433458.26 m N	781157.16 m E	Near Annipura
13.	X-4 Legged	1433207.13 m N	781064.94 m E	Mavalli
14.	T-3 Legged	1432900.84 m N	781371.25 m E	Jayanagar
15.	X-5 Legged	1433598.69 m N	779911.90 m E	Near Vishweshwarapura
16.	Y-3 Legged	1433299.77 m N	775739.22 m E	Mysore Road

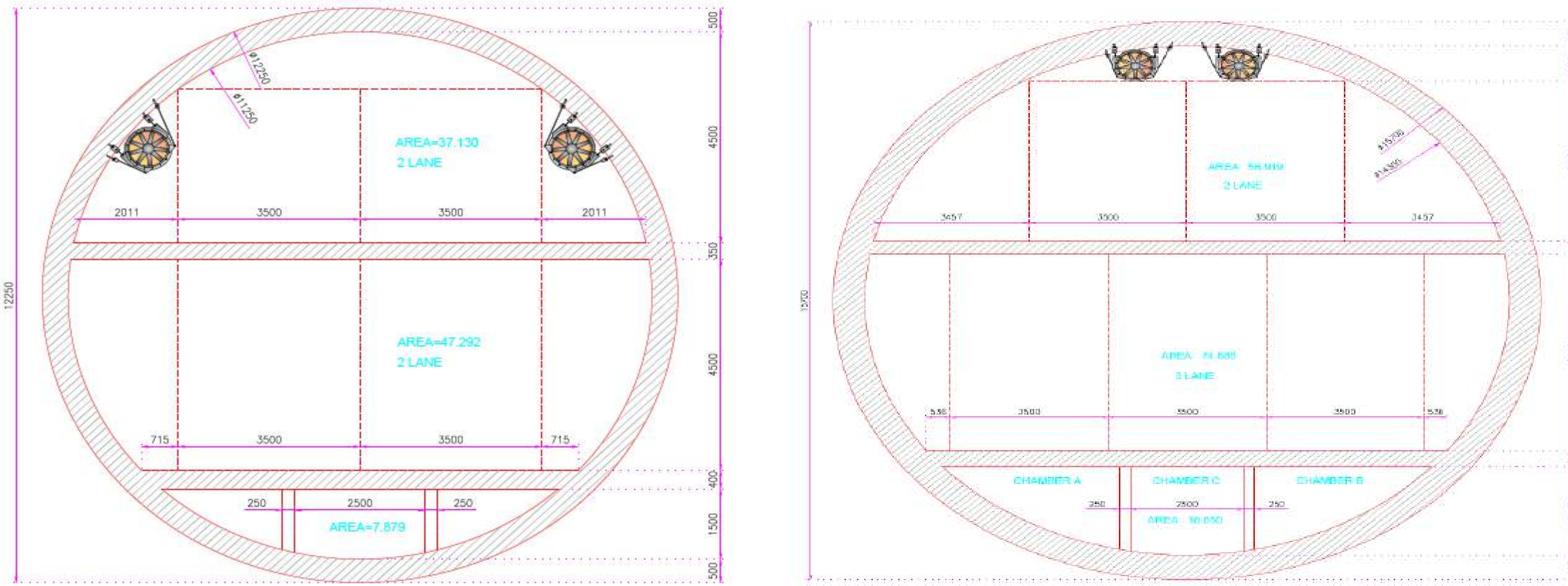


Figure 408. 4 & 5-lane Road TBM Tunnel Typical Cross Section

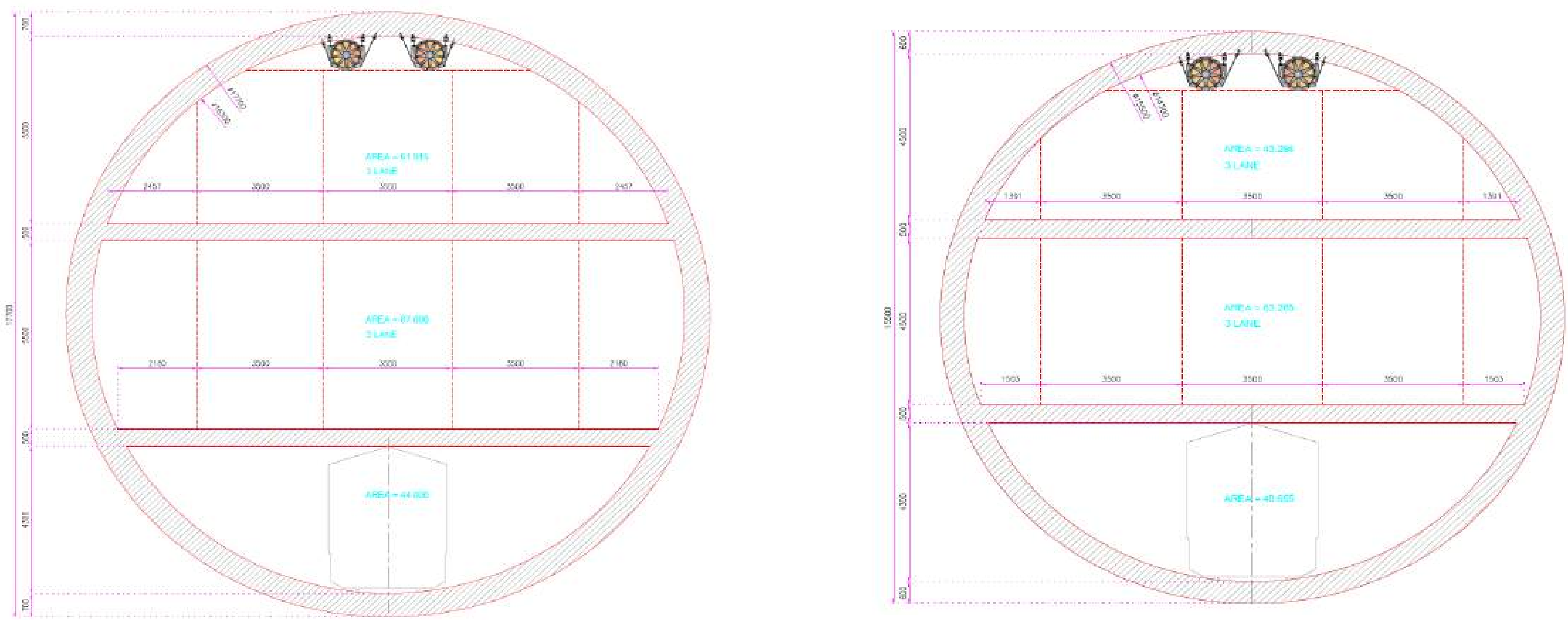


Figure 409. 6-lane Road TBM Tunnel Typical Cross Section

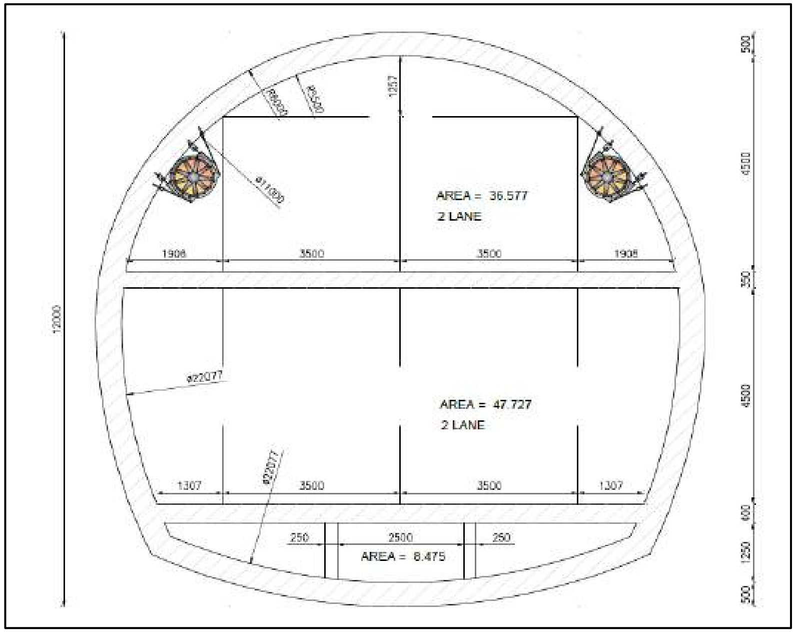


Figure 410. 4-Lane Horse Shoe Tunnel Typical Cross Section

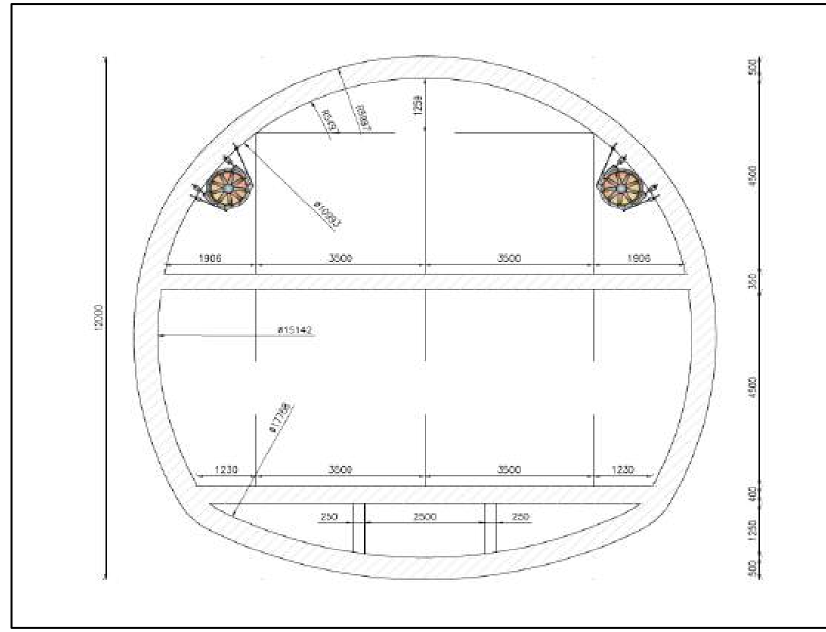


Figure 411. 4-Lane Modified Horse Shoe Tunnel Typical Cross Section

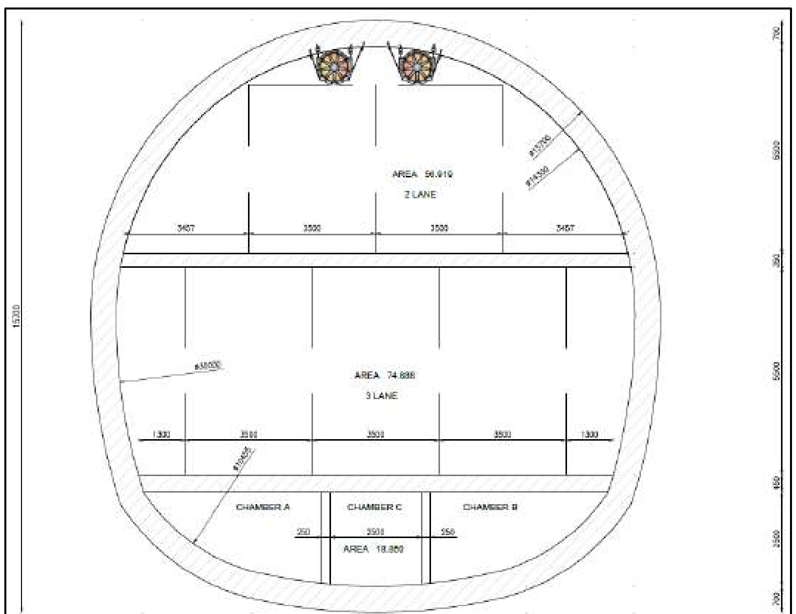


Figure 412. 5-Lane Horse Shoe Tunnel Typical Cross Section

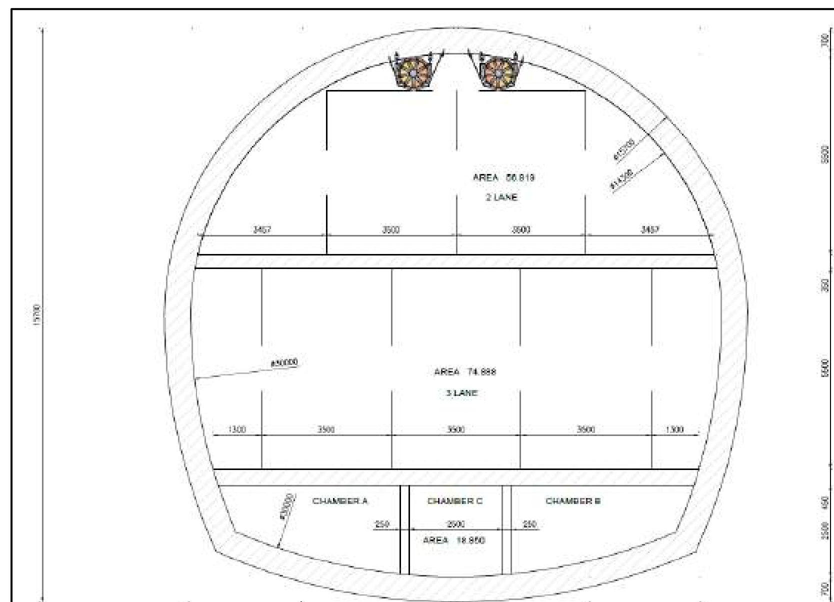


Figure 413. 5-Lane Modified Horse Shoe Tunnel Typical Cross Section

Comparison between 5 Lane and 6 Lane Double Deck Tunnel System

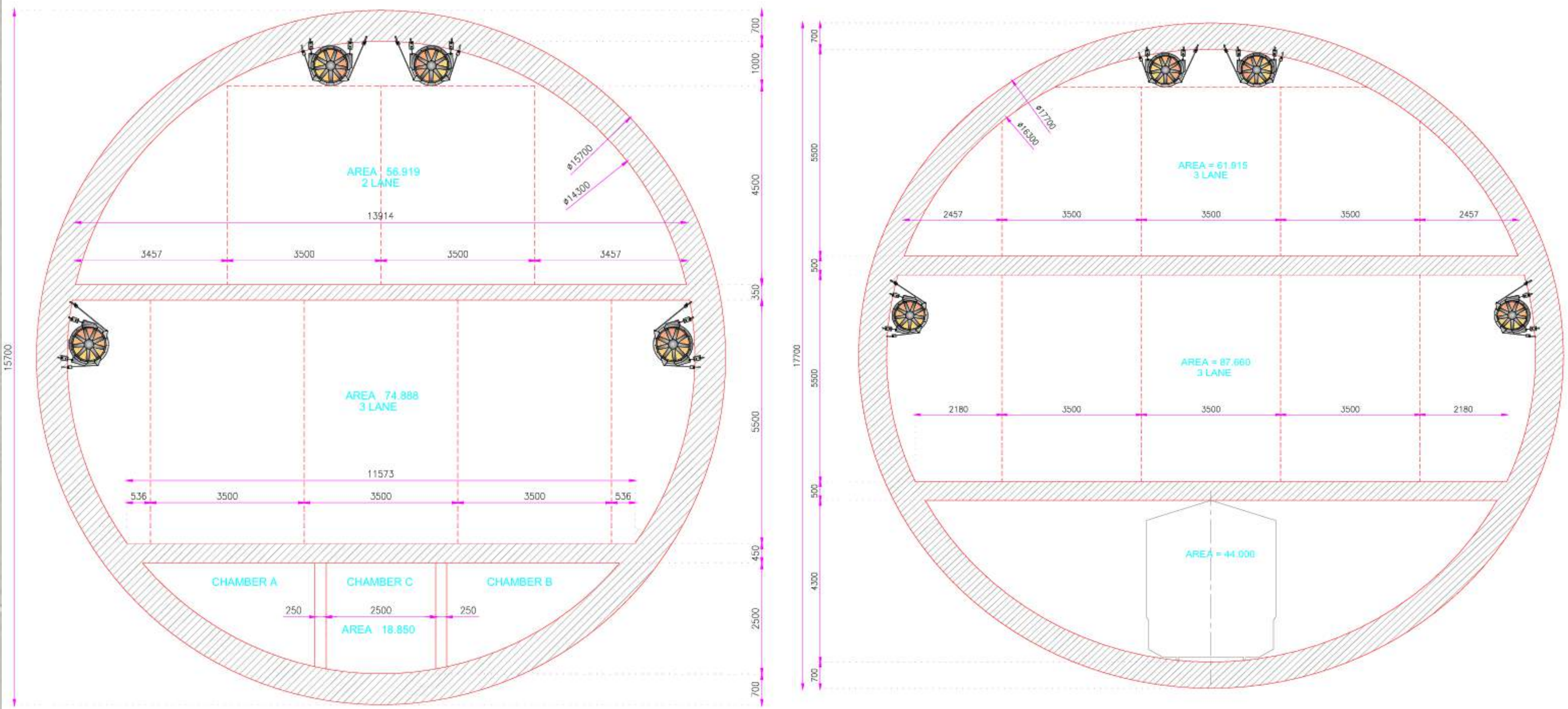


Figure 414 C/s for Comparison between 5 lane and ^ lane Double Decker Tunnel System

Points	Dia. 15.5 m (5 Lane)	Dia. 17.2m (6 lane)
Geometry	• Upper Deck: 2 lanes • Lower Deck: 3 lanes • Total Lanes: 5 lanes • Diameter: 15.6 meters	· Upper Deck: 3 lanes · Lower Deck: 3 lanes · Total Lanes: 6 lanes · Diameter: 17.2 meters
Traffic Volume Capacity	4500 PCU/hour	5400 PCU/hour
Vehicular Envelope	With a tighter diameter, any extra space for emergency breakdown lanes or maintenance walkways is limited. The tunnel design may need to compromise on lane width or shoulder space.	The larger diameter provides more flexibility for additional space. Potential for wider shoulders, emergency breakdown lanes, and maintenance walkways. This adds to safety and operational efficiency.
Cost comparison	The smaller diameter (15.6 meters) generally results in lower construction costs due to less excavation, reduced material use, and potentially lower costs for ventilation and lighting systems. However, the cost savings need to be balanced against the reduced capacity and space constraints. Lower construction and operational costs but limited capacity and flexibility.	The larger diameter (17.2 meters) increases construction costs due to more excavation, higher material use, and more extensive systems for ventilation and lighting. However, these higher initial costs are balanced by the increased capacity and additional safety and operational benefits. Higher construction and operational costs but increased capacity and flexibility.

Note: Cross-Section of tunnels with different dia are given in Annexure-III.

Features of the Stretch

S. No.	Location	Upper Deck Length(m)	Lower Deck Length(m)	Length of Tunnel (m)	Carriageway width
1.	KR Puram, Vellara Jn, Gopalan Mall Sirsi circle, Nayandhalli circle on Mysore road	UD1=863 UD2=1007 UD3=1397 UD4=1215 UD5=682 Total Length=5164	LD1=843 LD2=1014 LD3=1016 LD4=1225 LD5=685 Total Length=4783	18234	10.7 m for Lower Deck & 7 m for Upper Deck

Note: UD (Upper Deck) & LD (Lower Deck)

TBM Launching, retrieval and Approaches Locations

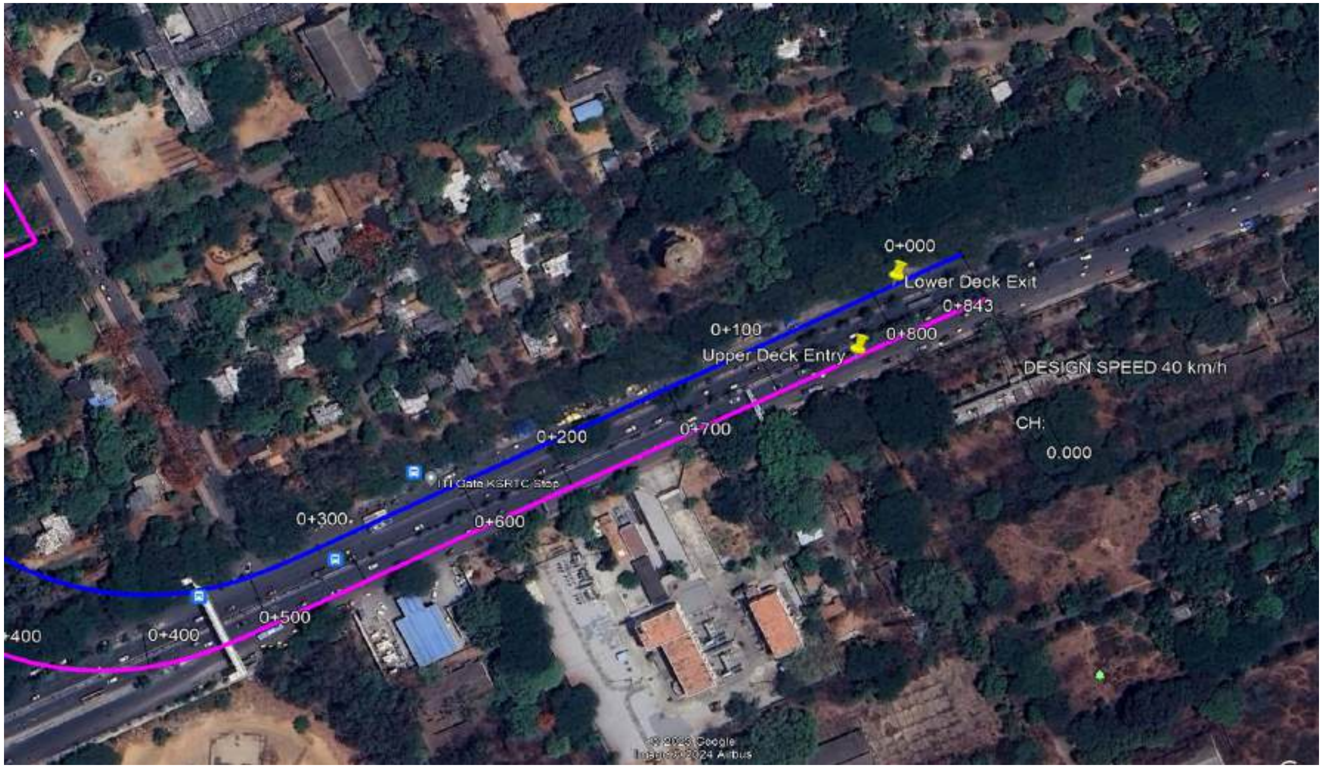


Figure 415. Upper Deck Entry and Lower Deck Exit (Near KR Pura)

Figure 416.TBM Launching Location (Jawaharlal Nehru Park)

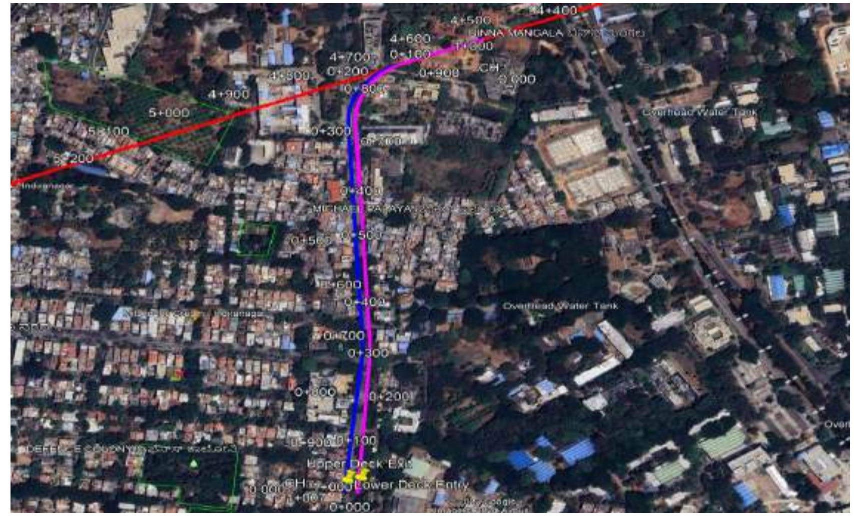


Figure 417. Upper Deck Exit & Lower Deck Entry (near CV Raman General Hospital)

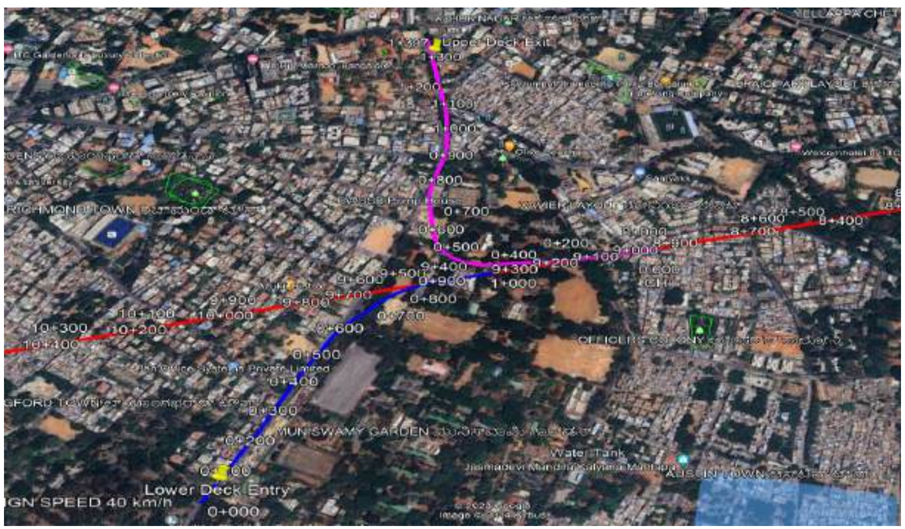


Figure 418. Upper Deck Exit & Lower Deck Entry (Near Muniswamy Garden)

Figure 419. Upper Deck Exit & Lower Deck Entry

Figure 420. TBM Retrieval Location (near Vrishabawathi River)

Figure 421. Upper Deck Exit & Lower Deck Entry (Nayandalli Circle on Mysore Road)

Intersection Location of East-West and North-South Corridors

Figure 422. Intersection point of Metro Line, East-West & North-South Corridor at Lalbagh Botanical garden

The intersection at the Lalbagh Botanical Garden is a critical point where the Metro Line, East-West Corridor, and North-South Corridor converge. This junction enhances connectivity across Bangalore by linking major parts of the city.

Existing Structures along the Alignment

Figure 423 FOB near TBM launching location

Figure 424. Crossing Railway Track at Krishnarajapuram

Figure 425. Crossing Benniganahalli Metro Station

Figure 426.. Railway Track Crossing

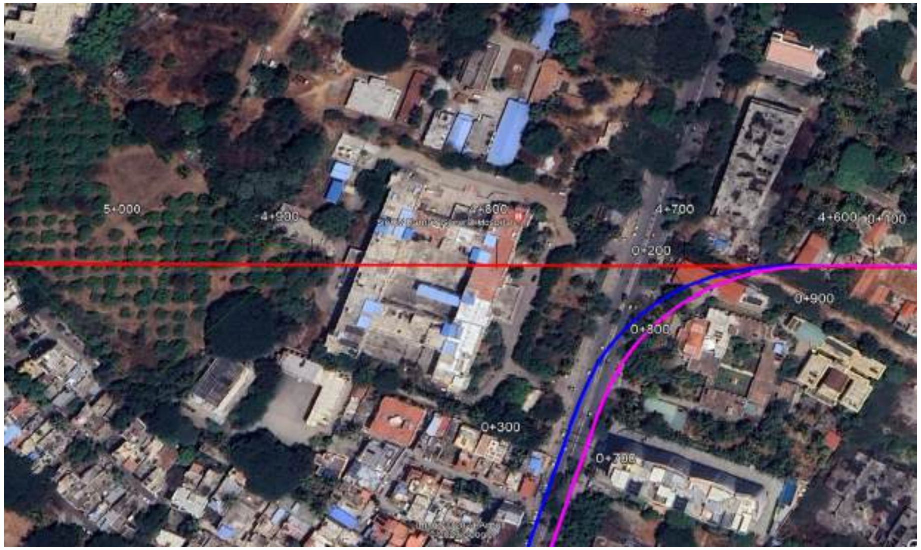


Figure 427. Passing through CV Raman General Hospital

Figure 428.. Crossing Metro Track at Indiranagar

Figure 429. Crossing Nallah Location

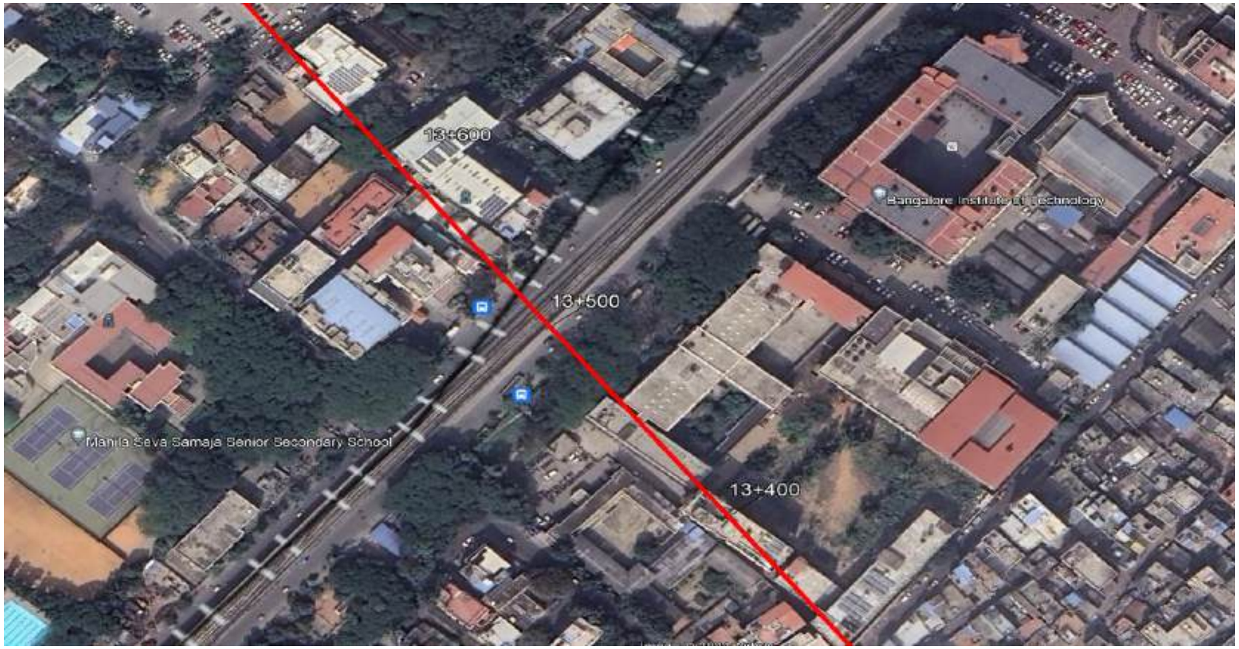


Figure 430. Crossing Metro track at National College

Figure 431. FOB near Gopalan Mall Sirsi Circle

Figure 432. Y- 3 Legged at Ch.3+200 near Gopalan Signature Mall

Figure 433. Y-3 Legged near Baiyappanahalli Depot

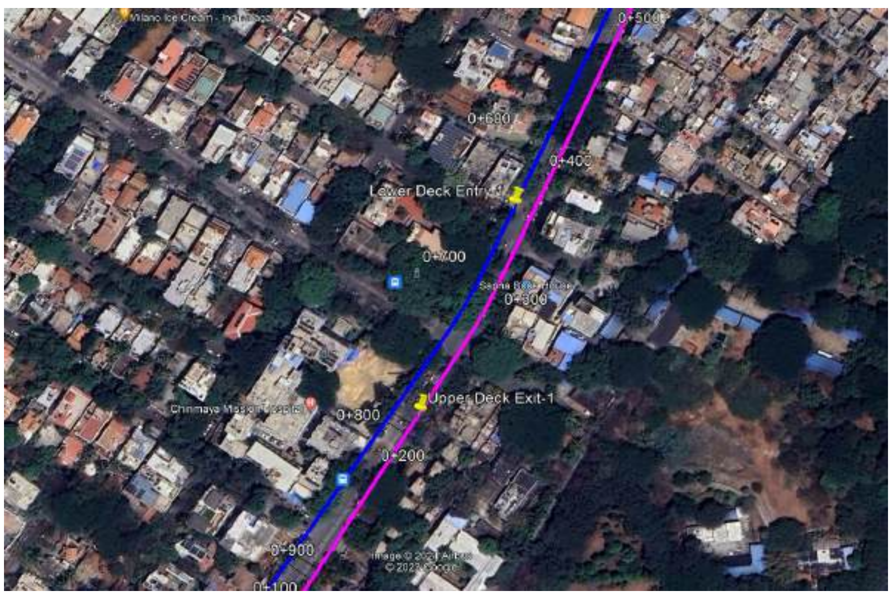


Figure 434. T-3 Legged near Chinmaya Mission Hospital

Figure 435. X-4 Legged at Indiranagar

Figure 436. T-3 Legged at Indiranagar

Figure 437.X-4 Legged near Indiranagar Metro station intersecting with Road and proposed Tunnel Alignment

Figure 438. Y-3 Legged near Murphy Town

Figure 439. X-5 Legged near Victoria Layout

Figure 440 X-4 Legged near BWSSB Pump House

Figure 441. X-5 Legged at Ashok Nagar

Figure 442. X-4 Legged near Ashok Nagar

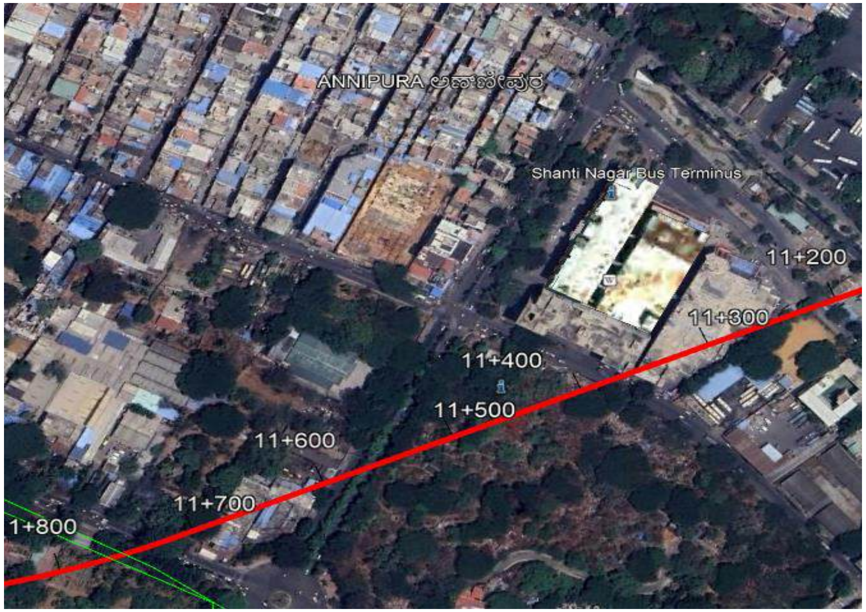


Figure 443. X-4 Legged near Annipura

Figure 444. X-4 Legged at Mavalli

Figure 445. T-3 Legged at Jayanagar

Figure 446. X-5 Legged near Vishweshwarapura

Figure 447. Y-3 Legged on Mysore Road

TRAFFIC SURVEY

Traffic surveys are essential tools for gathering data on various aspects of traffic flow, vehicle types, and pedestrian movements. This information helps in planning, designing, and managing transportation systems. Here are several common traffic survey methods:

- **Automatic Traffic Counting and Categorization (ATCC):** A good traffic and transportation study needs precision based traffic counter as a core component. Such a road traffic survey helps to assess growth in vehicle volume on roads, the load borne by the road, and estimating traffic volume. For this road traffic survey exercise, it is important to have near 100% accuracy in counting and classification of vehicles passing through a certain point in a particular place. The vehicle counter sensor and video based automatic traffic counter equipment. Every single vehicle passing through is counted and classified in a supporting document for traffic count data analysis.
- **Turning Movement Surveys:** Get precise data on how traffic moves at intersections and the time and volume of cars that pass through a given time. This allows optimization of intersection route and movement for better traffic flow.

Traffic Survey Locations

As part of our comprehensive traffic survey in Bangalore, we have strategically positioned cameras at various key locations throughout the city to capture detailed traffic data. The following table lists the locations of these cameras along with their geographical coordinates:

Table 137 Traffic Survey Locations

ID	Longitude	Latitude	Place
CAM-1	77.6938372	13.0083663	K R Puram
CAM-2	77.6783191	13.0002791	Near K R Puram Metro Station
CAM-3	77.6627282	12.9939261	Near Gopalan Signature Mall
CAM-4	77.6285885	12.9783197	Near Shri Venkataramana Swamy Temple
CAM-5	77.6142706	12.9684	Near Welcomhotel by ITC Hotel
CAM-6	77.6067797	12.9664605	Near Shoolay Circle
CAM-7	77.5971007	12.9649311	Richmond Circle
CAM-8	77.5416911	12.9531188	Near Shri Gali Anjaneya Swamy Temple
CAM-9	77.5300857	12.9441248	Nayandahalli Junction

Traffic Composition

The traffic composition data of Bangalore gives us important information about the types of vehicles on the city's roads. The pie chart shows the different kinds of vehicles, such as two-wheelers, cars, buses, trucks, and bicycles. This information helps us understand how busy the roads are and what kinds of vehicles are most common. By looking at this data, we can figure out where traffic jams happen most often and plan how to improve the roads. This analysis is essential for making Bangalore's traffic flow more smoothly and ensuring the city can handle more vehicles as it grows.

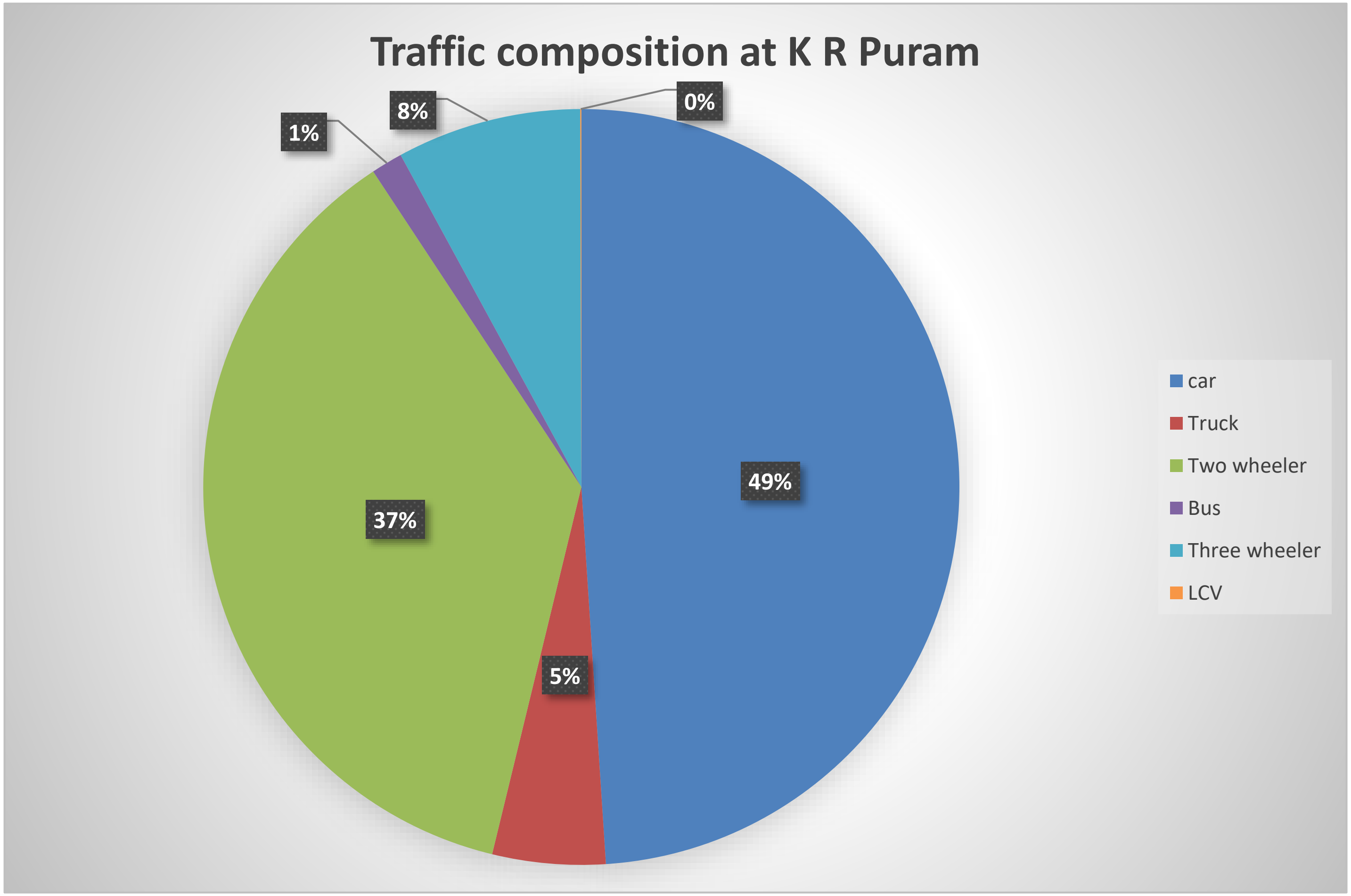


Figure 448.Traffic Composition at KR Puram.

Peak Hour Traffic

Peak hour traffic refers to the time period when traffic volume on a highway reaches its highest capacity, causing congestion and reduced vehicle speeds. It occurs during morning and evening rush hours, driven by commuter travel patterns and roadway capacity constraints.

The peak hour traffic in PCU/Hour at various location has been given below:

Table 138. Peak Hour traffic in PCU/hr

S.No.	Location Of Traffic Camera	Existing Traffic @ Peak Hour (PCU/Hr)
1	K R Puram	5099
2	Near K R Puram Metro Station	6019
3	Near Gopalan Signature Mall	4936
4	Near Shri Venkataramana Swamy Temple	5182
5	Near Welcome hotel by ITC Hotel	697
6	Near Shoolay Circle	2823
7	Richmond Circle	2634
8	Near Shri Gali Anjaneya Swamy Temple	7605
9	Nayandahalli Junction	5252

Traffic Analysis

Traffic analysis involves the systematic study and interpretation of traffic data to understand patterns, volumes, and flow characteristics on roadways. It utilizes various methodologies and tools to assess congestion, determine capacity utilization, and inform transportation planning and infrastructure improvements for efficient traffic management.

Table 139. Traffic Analysis Sheet

S. No.	Location	Traffic in 2024 (PCU/day)	Expected traffic in 2039 (PCU/day)	Expected traffic in 2044 (PCU/day)	Expected traffic in 2049 (PCU/day)
1	K R Puram	42020	87341	98818	111804
2	K R Puram Metro Station	52970	110106	124575	140945
3	Gopalan Signature Mall	45620	94830	107292	121391

4	**Shri Venkataramana Swamy Temple**	**42410**	**88162**	**99747**	**112855**
5	Welcomhotel by ITC Hotel	5370	11151	12617	14275
6	Shoolay Circle	22690	47165	53363	60375
7	Richmond Circle	19410	40351	45654	51653
8	Shri Gali Anjaneya Swamy Temple	33950	70568	79841	90333
9	Nayandahalli Junction	51150	106326	120299	136107

Note: The detailed traffic analysis are given in annexure-IV.

Service Volume Recommendations

Indo HCM Table 4.9 defines Levels of Service (LOS) for an 8-lane divided urban expressway based on traffic density, V/C ratio, and daily service volume thresholds. LOS ranges from A to E, guiding engineers in managing traffic flow and determining design strategies to optimize roadway performance.

Table 167. Indo HCM Table 4.9 LOS Threshold for 8-Lane divided Urban Expressway

LOS	DENSITY (PCU/km/direction)	V/C ratio	Service Volume (PCU/Day)	Recommended DSV
A	<=30	<=0.25	< 47600	69600 @ LOS B
B	31-62	0.26-0.50	47601-91500	
C	63-103	0.51-0.75	91501-137300	
D	104-167	0.76-0.93	137301-170200	
E	168-204	0.94-1.00	170201-183000	

The traffic study in Bangalore covers diverse surveys and analyses essential for urban transportation planning. It includes detailed traffic patterns at key locations like K R Puram and Richmond Circle, insights into vehicle composition, and peak hour traffic data. Indo HCM Table 4.9 provides guidelines for managing traffic volume and achieving optimal roadway performance through recommended service volumes and Levels of Service (LOS) thresholds. These findings inform strategies to enhance traffic flow and prepare for future growth in the city's traffic demands.

ADVANTAGE OF UNDERGROUND STRUCTURE OVER ELEVATED STRUCTURE

Choosing between a tunnel system and an elevated structure for urban transportation involves considering various factors such as aesthetics, land use, environmental impact, and practical engineering challenges. Here are some reasons why a tunnel system might be preferred over an elevated structure in a city:

Aesthetics and Urban Landscape

Visual Impact:

- Tunnels: Being underground, tunnels do not alter the city's skyline or visual landscape. This is particularly important in cities with historic architecture or scenic views.
- Elevated Structures: These can be visually intrusive and can negatively impact the aesthetics of a city. Elevated tracks, stations, and supporting structures can disrupt the visual harmony of urban environments.

Land Use and Space

Surface Land Availability:

- Tunnels: Tunnels preserve the surface land, allowing it to be used for other purposes like parks, pedestrian zones, or additional buildings. This is particularly valuable in densely populated urban areas where land is scarce and expensive.
- Elevated Structures: Require significant space for pillars, tracks, and stations. This can lead to the reduction of available land for other uses and may disrupt existing urban layouts.

Environmental Impact

Noise Pollution:

- Tunnels: Underground systems significantly reduce noise pollution compared to elevated structures. The noise from trains or vehicles is contained within the tunnel, minimizing disturbance to residents and businesses.
- Elevated Structures: Generate considerable noise, especially when trains or vehicles are running. This noise can affect nearby residential areas, businesses, and public spaces.

Environmental Disruption:

- Tunnels: Though their construction is complex, once completed, tunnels have a minimal impact on the surface environment. They do not disrupt the ecosystem and can even run beneath existing structures without affecting them.

- Elevated Structures: Can disrupt local ecosystems and require removal or modification of existing structures and landscapes. They can also create barriers for wildlife and human movement.

Safety and Weather Protection

Safety:

- Tunnels: Generally considered safer in terms of protecting transportation systems from weather-related disruptions. They are shielded from extreme weather conditions such as heavy rain, snow, and wind.
- Elevated Structures: More exposed to weather conditions, which can lead to operational disruptions and maintenance challenges. They are also more susceptible to natural disasters such as earthquakes and hurricanes.

Urban Integration

Traffic and Pedestrian Flow:

- Tunnels: Do not interfere with surface-level traffic and pedestrian flow. This is particularly advantageous in congested urban areas where maintaining smooth surface-level traffic is crucial.
- Elevated Structures: Can create barriers at the street level, disrupting traffic flow and making pedestrian movement more difficult. The need for support pillars and elevated stations can also limit accessibility and connectivity.

Construction and Maintenance

Construction Impact:

- Tunnels: While tunnel construction is complex and expensive, modern tunneling technologies (e.g., tunnel boring machines) can minimize surface disruption. Construction activities are largely confined underground, reducing the impact on daily life.
- Elevated Structures: Construction is typically more disruptive to the surface environment. Building pillars and elevated tracks often requires significant alteration of existing infrastructure and can cause prolonged surface-level disruptions.

Maintenance:

- Tunnels: Although maintenance of tunnels can be challenging due to their underground location, modern monitoring and maintenance technologies can manage these tasks effectively.
- Elevated Structures: Maintenance activities often require surface-level disruptions, such as lane closures or traffic diversions, which can inconvenience urban residents and commuters.

Cost Considerations

Initial Costs:

- Tunnels: Typically involve higher initial construction costs due to the complexity of excavation and engineering required. However, the long-term benefits in terms of reduced surface disruption and maintenance can justify the investment.
- Elevated Structures: Generally have lower initial construction costs compared to tunnels but can result in higher long-term social and environmental costs due to their impact on the urban landscape and ongoing maintenance needs.

Conclusion

While tunnel systems present higher initial costs and engineering challenges, their benefits in terms of aesthetics, land use, environmental impact, safety, and urban integration often make them a preferred choice in urban settings. Elevated structures, despite being more economical to construct initially, can disrupt the urban environment and impose long-term challenges that may outweigh their cost advantages.

COST ESTIMATE

Table 140 BOQ for East West Corridor (Single Tube TBM Tunnel)

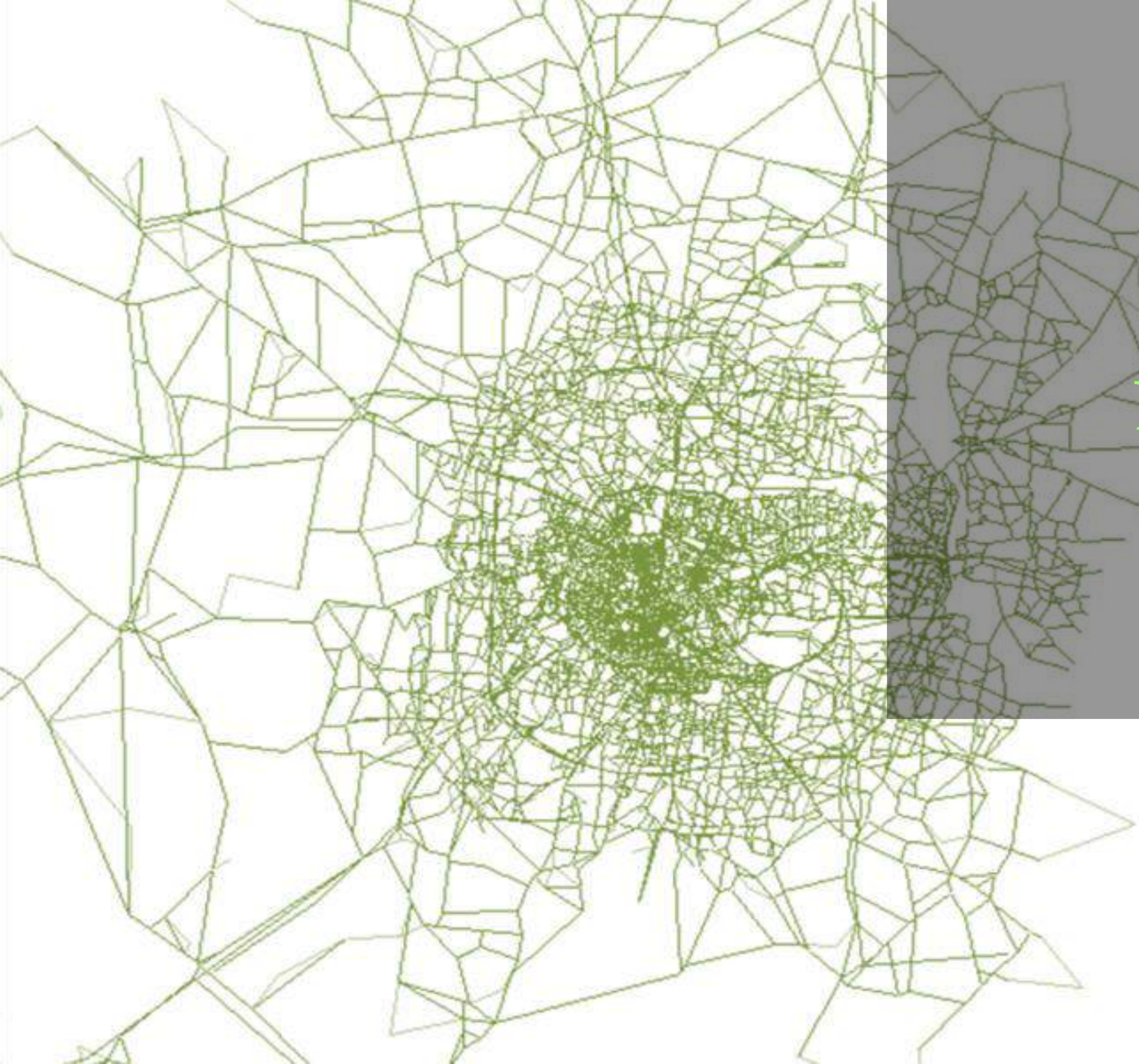
Consultancy services for preparation of Comprehensive Bengaluru city road infrastructure plan to decongest traffic and to prepare comprehensive traffic management plan for proposal of vehicular tunnel / Grade separator / Road widening in selected corridors

BOQ-Abstract

Sr. No	Description of work	Amount
A	Site Clearing	4,31,98,095
	Tree Cutting	15,00,881
	Site Survey and Investigation	3,35,96,980
B	Excavation for Tunnel by TBM	12,08,75,37,408
C	Muck Disposal for Tunnel	6,35,43,41,522
D	Tunnel Segment Lining & Concreting work	21,60,43,62,817
E	Road Work (Tunnel Road Portion)	1,64,90,73,553
F	Box tunnel and Ramp from Free way	20,12,19,97,279
G	**Subtotal (civil cost)**	**61,89,56,08,535**
H	E&M work	8,04,64,29,110
I	**Subtotal (Construction Cost)**	**69,94,20,37,645**
J	Contigency @ 1% of I	69,94,20,376
K	Price Escalation @ 5% of I	3,49,71,01,882
L	Project Management Consultancy Charges @ 2% of I	1,39,88,40,753
AA	**Subtotal (J+K+L)**	**5,59,53,63,012**
	GST@ 18%	13,59,67,32,118
AA	**Grand Total**	**89,13,41,32,775**
	Say	**8913.5Cr**

Table 141. BOQ for Twin Tube TBM Tunnel

Summary of Bill of Quantities		
Sl. No.	Description of Schedule	Estimated Cost in Rs.
1	Cost of Civil work for Tunnel	56,76,01,98,749.54
2	Cost of Electromechanical works Tunnel	5,10,84,17,887.46
3	Cost of civil work for side slope face protection Tunnel, P1 & P2	4,98,51,109.82
4	Box tunnel and Ramp from Free way	20,12,19,97,279.00
	Total	**82,04,04,65,025.83**
A	Contingency @1%	82,04,04,650.26
B	Agency Charges @3%	2,46,12,13,950.77
C	Quality control and Road Safety@ 0.5%	41,02,02,325.13
D	Escalation @5%	4,10,20,23,251.29
E	Supervision @3%	2,46,12,13,950.77
F	GST @ 18%	14,76,72,83,704.65
G	**Total**	**25,02,23,41,832.88**



07. Travel Demand Model Forecast

Zoning

Traffic Analysis Zones (TAZs) are geographically defined areas that are used to model traffic flow and demand within a transportation network. These zones typically represent neighbourhoods, commercial districts, industrial areas, or other distinct land-use zones. By dividing a study area into TAZs, transportation planners can analyse traffic patterns, forecast future demand, and evaluate the effectiveness of various transportation improvement projects. The size and shape of TAZs can vary depending on the specific study objectives and the characteristics of the study area.

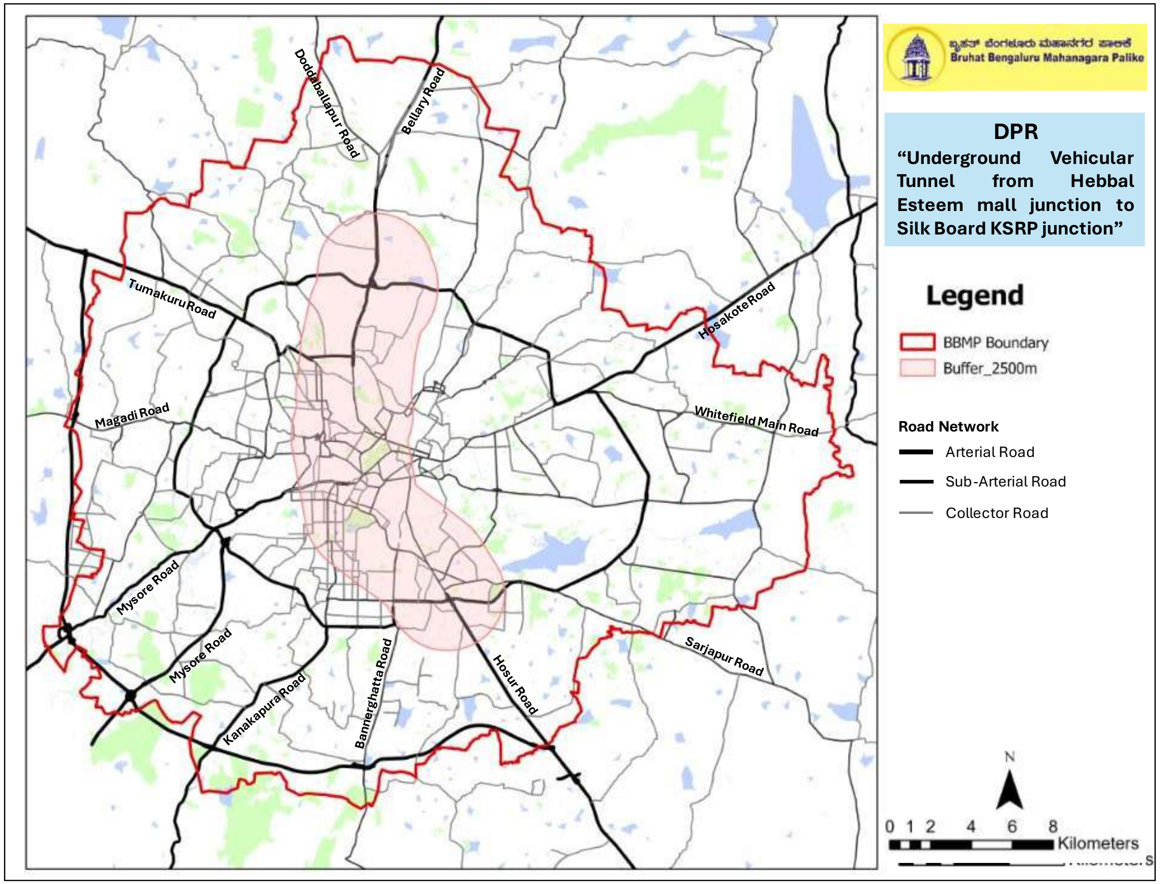


Figure 449 : Study Area

In CMP 2020 ward boundaries were taken as TAZs. As this study is related to the estimation of traffic on proposed North-South Corridor, therefore the wards along the proposed corridor are sub-divided into smaller zones up to an influence area of approximately 2 km (Zone 1 to 74) and these zones are considered as internal zones for this study. The Wards outside the influence area are clubbed into larger zones (Zone 201 to 307) and these are the immediate external zones. The area outside the BBMP is divided into 4 Zones i.e. Zone no. 501, 502, 503 and 504 based on direction (North, West, South and East respectively). Figure 46 shown the TAZs of study area.

Road Network

Bengaluru's road network is a testament to the city's rapid growth and development, boasting a vast expanse of arterial roads, sub-arterial roads, and Collector roads as shown in Figure 47.

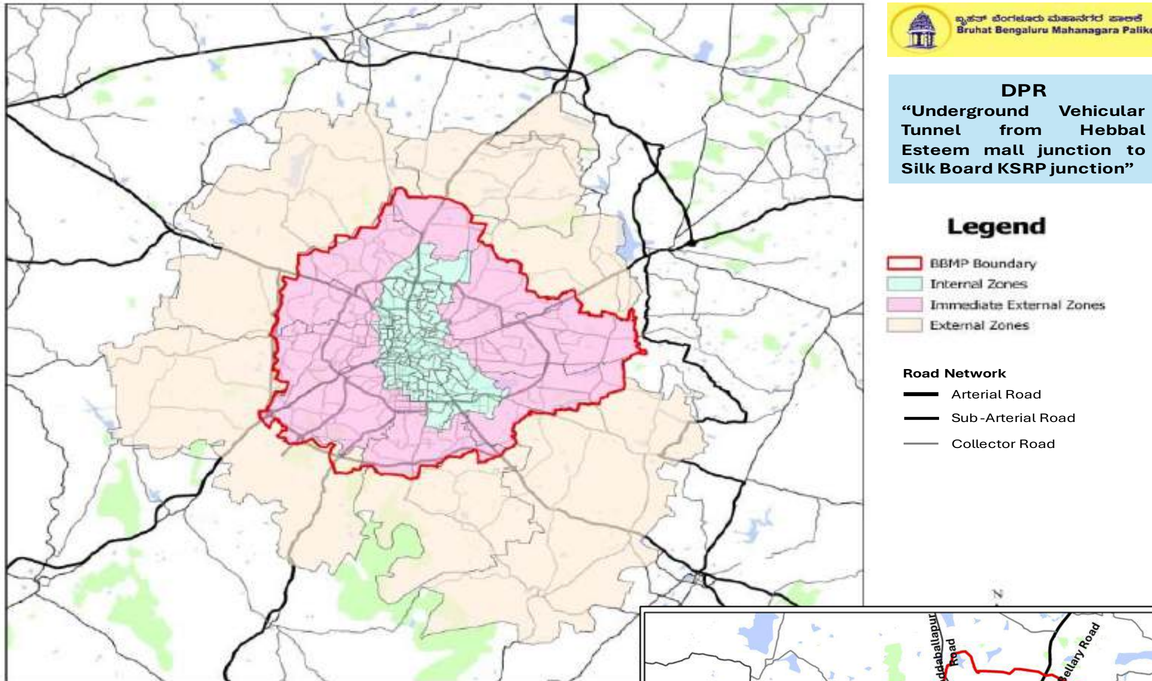


Figure 450 : Zoning of Study Area

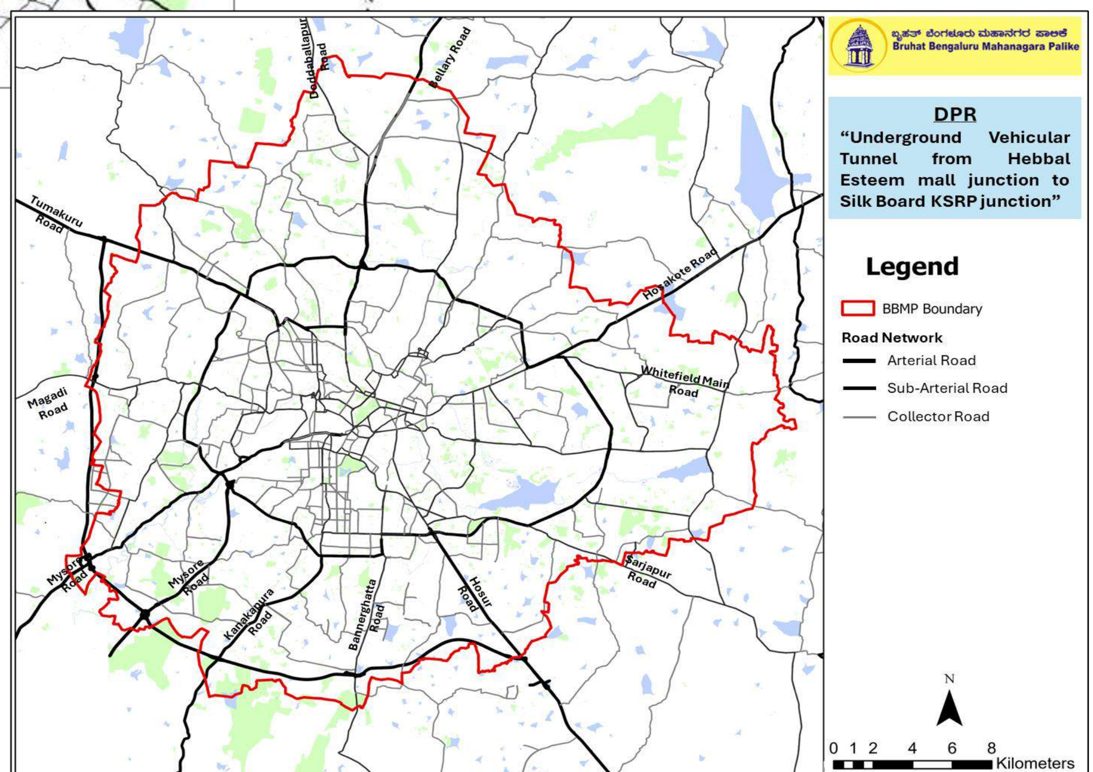


Figure 451: Bengaluru Road Network

City Urban Transport Scenario and Secondary Data Information

City Profile

Bengaluru, the capital of Karnataka, is a bustling metropolis renowned as India’s "Silicon Valley," largely due to its influential technology sector. With a population of over 12 million, it ranks among the most populous cities in India. Despite its economic vitality, Bengaluru faces significant challenges related to traffic and transportation. The city's rapid urbanization has led to severe traffic congestion, exacerbated by an influx of vehicles and inadequate road infrastructure. Although Bengaluru boasts an expanding metro system and a well-developed road network, these developments have struggled to keep pace with the growing demand. Addressing these traffic and infrastructure issues remains crucial for maintaining the city’s economic and livability standards.

Population

Population of Bengaluru Metropolitan Area has been growing since independence as shown in Figure 48. The BMA area, which had a population of about 17 Lakh in 1971, reached 85 lakhs in 2011. Bengaluru was one of the fastest-growing Indian metropolises for the decade 1991–2011. It has an average density of about 148 people / hectare. In CMP 2020 the estimated population is 122.98 Lakh for 2018.

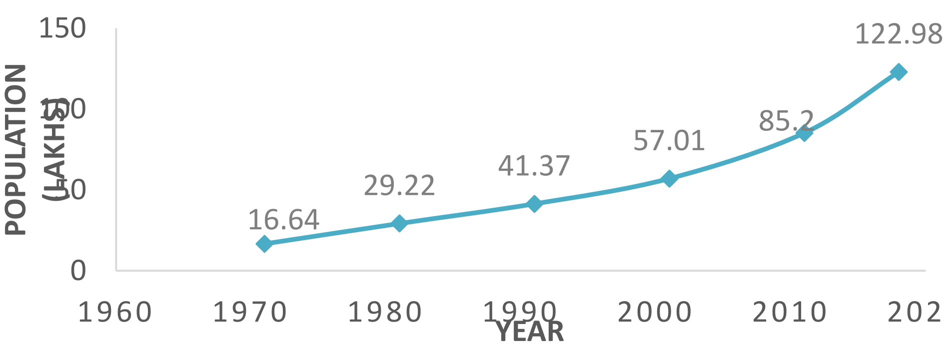


Figure 452: Growth of Population in BMA

Road Network

Bengaluru is endowed with a ring radial pattern of road network in the core area of the city. Bengaluru's road network, spanning 14,000 km of the road network consists of ring roads, major roads (arterial roads, sub-arterial roads and other mobility corridors) and residential streets. However, there is no clear hierarchy of roads, and this situation has resulted in low speeds, increased conflicts of traffic, etc. Though there is a large network of roads in the city, the major arterial road network comprised less than 20% of the total road network in the city. The major roads in the study area are shown in Figure 501.

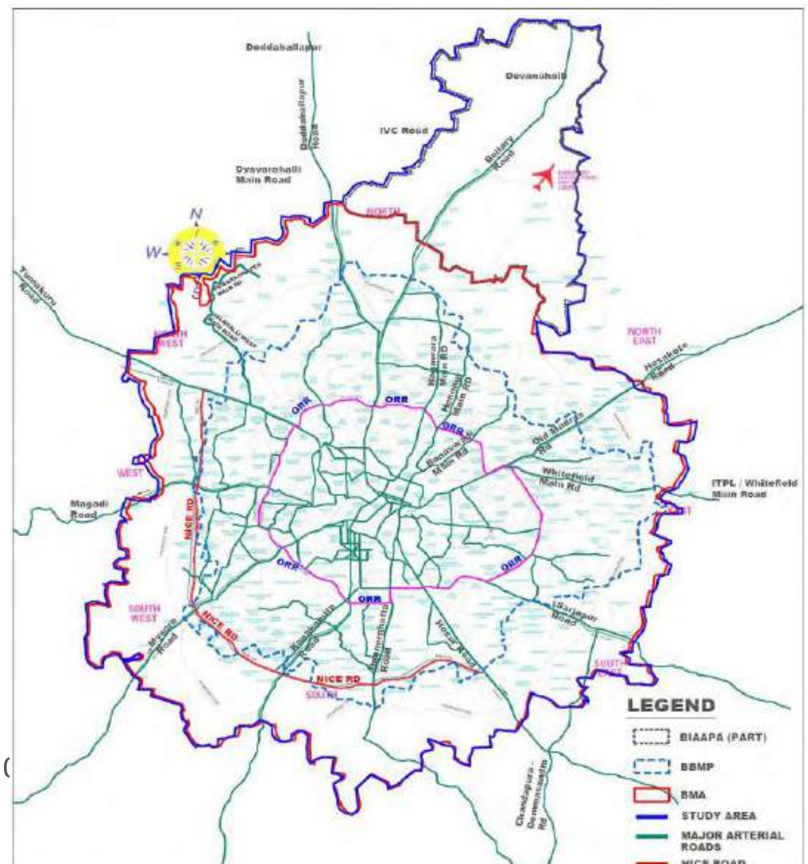


Figure 453 : Road Network of Bengaluru City

Overview of Public Transport

Bus

The bus system operated by BMTC has been the primary public transport system in Bengaluru City. BMTC has established 45 depots for providing services in the city. BMTC is operating 6143 schedules (as of Aug 2018) every day. The Physical performance of BMTC is presented in Table 170.

Table 170: Bus Performance in Bengaluru

Parameter	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Depots	39	39	40	40	43	44	45
Fleet Operated	6139	6473	6244	6216	6219	6143	6143
Vehicles Held	6431	6775	6522	6401	6161	6677	6634
Effective Km. Per day (Lakh)	12.71	13.14	12.9	12.21	11.52	11.42	11.38
Total Service km (Lakh km)	4638.38	4795.9	4708.6	4469.8	4205.2	4164.5	-
Veh. Utilization (Km)	221.1	218.2	214.5	208.5	206.5	203.8	202
Passengers carried per day (Lakh)	48.46	50.25	51.3	50.74	45.34	44.37	-
Passenger load factor (%)	68.5	67.2	75.8	74.2	68.8	66.8	-

Metro

Two corridors of Metro Rail are in operation in Bengaluru. One is the East-West corridor, and the other is the North-South corridor. The East-West Corridor starts at Baiyappanahalli (R1) and ends at Mysore Road (R2). The North-South Corridor starts at Nagasandra (R3) and ends at Puttenahalli (R4). The total length of the Metro Rail network under operation is 42.30 Km. Table 46 presents the operational metro in Bengaluru.

Sub-Urban Rail

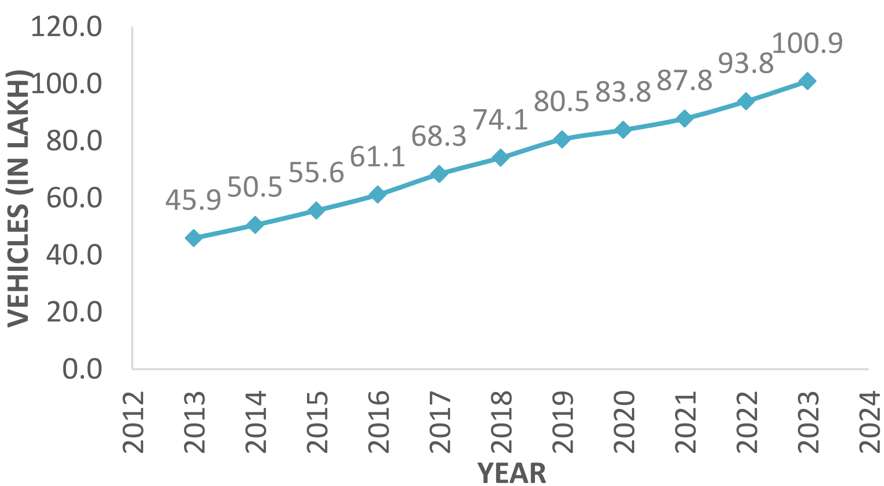
Bengaluru city has a good rail network of about 62 km within the city. There are a few diesels operated passenger trains that connect to Bengaluru City with Tumkur, Mysore and Kuppam (Andhra Pradesh). The trains run in the morning and return in the evening catering to commuters from suburban areas, satellite towns and neighboring cities. They are well patronized and in the recent past the patronage has shown a good growth rate. But their frequency and availability are not adequate to make this as primary / preferred mode of transportation. The utilization of existing railway network in the city for running robust sub-urban rail services connecting the peripheral areas and settlements around Bengaluru is being explored and a detailed study has been made by Indian Railways to introduce a commuter rail service including identifying the improvement requirement to the railway network.

Table 142: Metro Corridors along with Stretches and their Status

S. No.	Corridor	Length (km)	Status
Phase 1			
1	Baiyappanahalli to Mysore Road (East - West Corridor- Purple Line) (R1 & R2)	18.1	Operational
2	Nagasandra to Yelachenahalli (North- South Corridor- Green Line) (R3 & R4)	24.2	Operational

Vehicle Growth in the City

Bengaluru City has a total registered vehicular count of approximately 1 crore vehicles in 2023, vehicle has grown at an average growth rate of 8% over the past 10 years. The vehicle registration trend is shown in below.



Transport and Infrastructure Proposals

Road

Currently there are three road projects that are sanctioned in Bengaluru, which are Satellite Town Ring Road, Intermediate Ring Road and Peripheral Ring Road as shown in Figure.

a) **Satellite Town Ring Road:** To ensure safe, smooth, efficient, and high-speed transport corridor to Bangalore city, it is impetus that the infrastructure of city and adjoining towns anticipated the development. National Highways NH 648 (NH 207), NH 48 (NH 4), NH 275, NH 948, NH 209 & NH 75 (Hassan road), and majority of State Highways SH 3, SH 85, & SH 35 pass through Bangalore city comprising heavy commercial traffic movement. Most of this traffic are not intend to pass through the Bangalore city. This traffic further aggravate the scenario in the city roads and resulting huge traffic jams.

b) **Peripheral Ring Road:** The proposed “Peripheral Ring Road” is 65 km long and connects 10 major Highways namely Tumkur Road(NH-4), Hesaraghatta Road(SH-39), Doddaballapura Road(SH-09), Bellary Road (NH-7), Hennur- Baglur Road (SH-104), OMR (NH-4), Whitefield road, Channasandra Main Road, Hoskote-Anekal Road(SH-35), Sarjapur Road and Hosur Road(NH-7). Overall, it intersects 4 National Highways and 6 state Highways. The proposed PRR length from start point on Tumkur road upto end point on Hosur road is 64.201 Km. Since, the alignment is getting integrated with NICE road on Tumkur road (~ 368m) and Hosur road (~ 546m), the total length of the project road is considered to be 65.115 Km.

Figure 454: Vehicular growth in Bengaluru

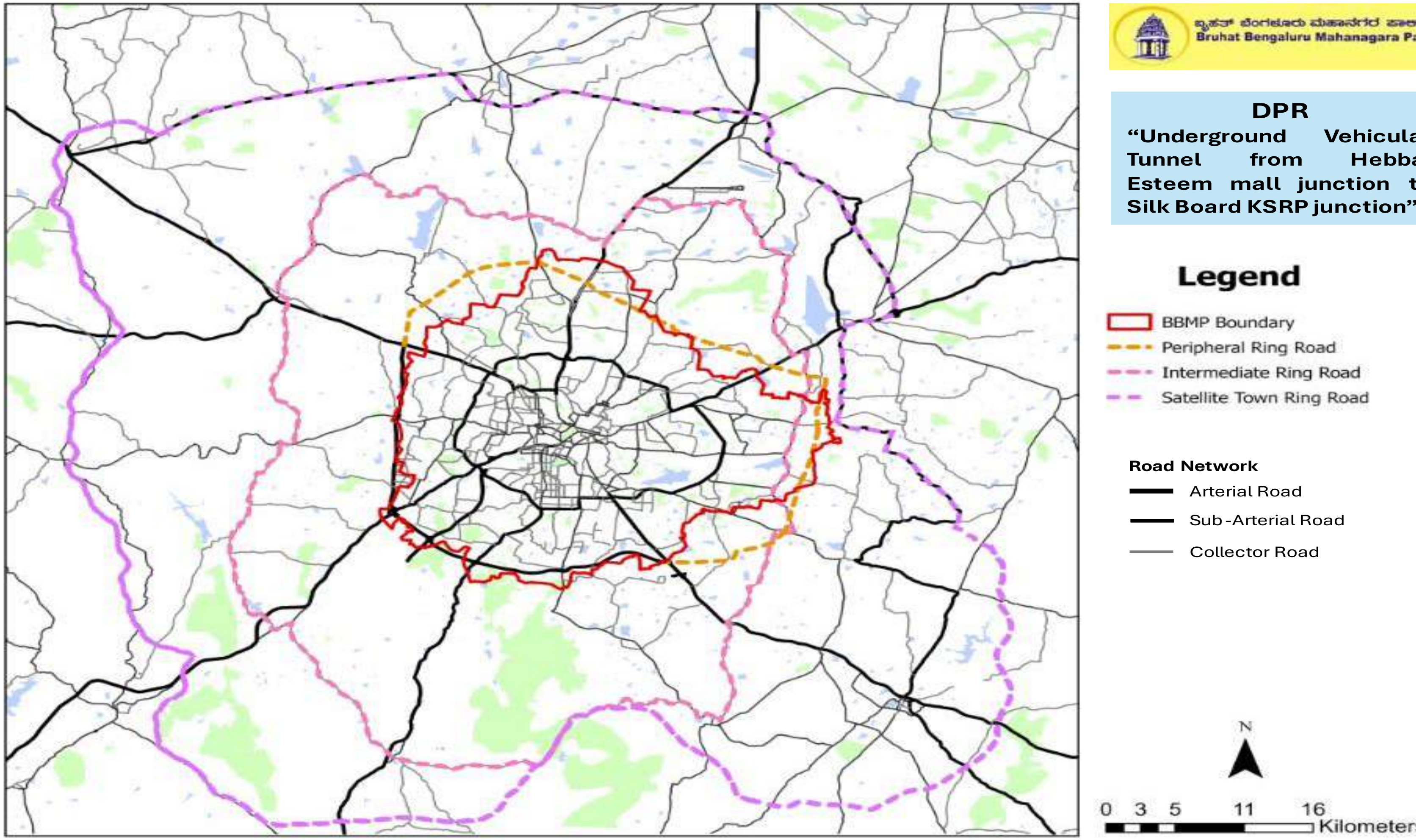


Figure 455 : Proposed Roads in Bengaluru

Metro

Transport Demand Forecast Study and Identification of Phase III Corridors of Bengaluru Metro was undertaken by Bengaluru Metro Rail Corporation Limited (BMRCL) to extend the metro system in Phase-III for the areas not covered by Phase-I & II and interconnect the metro system network as shown in Figure 52. All metro routes of Phase-I are operational, some routes of Phase-II are operational, and the rest are ongoing projects and all routes in Phase-III are the upcoming projects as given in the metro DPRs. The details of Phase-I, Phase-II and Phase-III are shown in Table 172 &173

Table 143: Merto Ongoing Projects

S. No	Phase	Detail	Length in KM			No of Stations		
			UG	Elevated	Total	UG	Elevated	Total
1	Phase 1	Mysore Road To Kempegowda Metro Station, Majestic, Kempe Gowda Metro Station Majestic to Baiyappanahalli, Nagasandra To Yeshwantpur, Yeshwantpur To Kempegowda Metro Station Majestic, Kempegowda Metro Station Majestic To Yelachenahalli	8.79	33.51	42.3	9	34	43
2	Phase 2	Baiyappanahalli to Krishnaraja Pura, Kengeri to Challaghatta, Krishnarajapura To Whitefield, Yelachenahalli To Silk Institute, Kengeri To Mysore Road	-	31.51	31.51	-	27	27
3	Phase 2	Nagasandra to Madavara (BIEC),Bommasandra to Beratena Agrahara, Beratena Agrahara To Bommanahalli, Bommanahalli To R.V. Road,Kalena Agrahara To Tavarekere, Tavarekere to Rashtriya Military School, Rashtriya Military School To Shivajinagar, Shivajinagar Station to Tannery Road, Tannery Road To Nagawara	13.88	29.66	43.54	12	25	37
4	Phase 2A	Central Silk Board To Kadubeesanahalli, Kodibeesanahalli To K.R. Puram	-	19.75	19.75	-	13	13
5	Phase 2B	Kasturi Nagar To Kempapura, Hebbal To Bagalur Cross, Bettahalasuru To KIA Terminal	-	38.44	38.44	-	17	17

Table 173 : Metro Up coming Projects

S. No	Phase	Section		Length in KM			No of Stations		
		From	To	UG	Elevated	Total	UG	Elevated	Total
1	Phase-3	1. Hebbal	1. J.P. Nagar 4th Phase	-	31	43		40	40
		2. Hosahalli	2. Kadabagere		12				
2	Phase-3A	1. Sarjapur	1. Hebbal	17	19	36	14	15	29

ಬೃಹತ್ ಬೆಂಗಳೂರು ಮಹಾನಗರ ಪಾಲಿಕೆ
Bruhat Bengaluru Mahanagara Palike

DPR
"Underground Vehicular Tunnel from Hebbal Esteem mall junction to Silk Board KSRP junction"

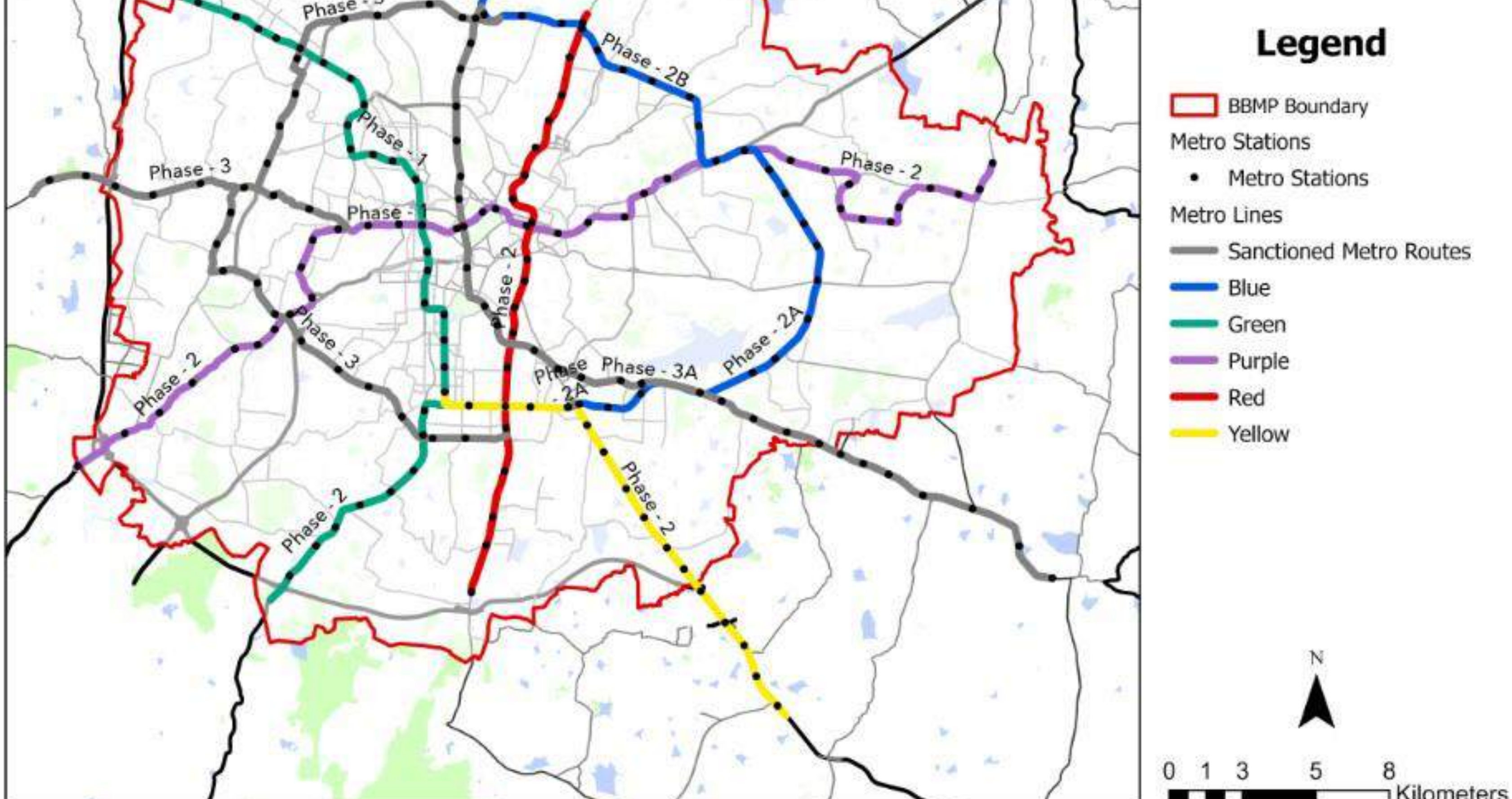


Figure 456 : Bengaluru metro network

Travel Characteristics

This section discussed the trip characteristics based on the CMP 2020 report. These trip characteristics will be used the validate the outputs from this study.

Mode Share Motorized trips

The modal split of motorized trips referred from CMP 2020 is shown in Table 144.

Table 144 : Mode Share (Motorized Trips)

S. No.	Mode	No. of trips	Trips
1	Car/Taxi	264649	21.0%
2	2-Wheeler	296468	23.5%
3	Auto Rikshaw	96655	7.7%
4	Public Transport	601861	47.8%
Total		1259633	100%

Mode wise Distribution of Average Trip Length

Average trip length as per CMP 2020 by mode of travel is presented in Table 175. Average trip length for walk is 1.0 Km, for 2-wheeler 8.0 km, for car and taxi is 12.8 km and 13.1 km respectively and for Bus it is about 10.7 km.

Table 145 : Mode Wise Average Trip Length

S. No.	Mode	Average Trip Length (Km)
1	Car	12.8
2	Taxi	13.1
3	Shared Taxi	15.4
4	2- Wheelers	8
5	Auto	3.7
6	Bus	10.7
7	Minibus	10.7
8	School Bus	5.1
9	Chartered Bus	15.1
10	Cycle	2.6
11	Walk	1

Travel Demand Assessment

The travel demand assessment was carried out in the CMP 2020 with the focus to develop a long-term transportation strategy for Bengaluru with the help of an urban transport planning model. The outputs from the CMP will be used for trips forecasting for the current study. This section summarizes the main outputs.

Population Forecasting

The population in CMP 2020 has been forecasted up to year 2051 shown below in Table 146 The population of BMA Area and Extended Area has been forecasted separately.

Table 146: Forecasted population in CMP Study Area

Area	2015	2031	2041	2051
BMA	1,12,27,977	2,03,13,499	2,57,09,017	3,16,36,758
Extended Area	2,55,449	5,50,000	8,95,892	16,04,406
Total	1,14,83,426	2,08,63,499	2,66,04,909	3,32,41,165

Scenarios

For horizon year mode share and average trip lengths, CMP 2020 will be referred where the projections have been done in various scenarios. The scenarios are given below:

a) Scenario 1: Business as Usual scenario

The mode share and average trip length calculated in the Scenario 1 are shown in Table 147

Table 147 : Comparison of Travel Characteristics between Base Year and Horizon Year

Modes	Peak Hour Trips	Base Year (2015)	BAU (2031)	
		Mode Share	Peak Hour Trips	Mode Share
Car + Taxi	264649	21%	689673	30%
Two-Wheeler	296468	24%	666685	29%
Auto Rickshaw	96655	8%	114946	5%
Public Transport	601861	48%	827608	36%
Total	1259633		2298912	

Scenario 2: Public Transport Augmentation and Efficiency Improvement, and Multimodal Transport.

The mode share calculated in the Scenario 2 are shown in Table 148.

Table 148: Forecast Mode Share – Scenario 2

Modes	BAU (2031)		Scenario 2	
	Peak Hour Trips	Mode Share	Peak Hour Trips	Mode Share
Car + Taxi	689673	30%	572638	25%
Two-Wheeler	666685	29%	304780	13%
Auto Rickshaw	114946	5%	71406	3%
Public Transport	827608	36%	1350088	59%
Total	2298912		2298912	

Scenario 3 – Public Transport Augmentation Plus Enhances Capacity and Efficiency of Road Infrastructure.

The mode share calculated in the Scenario 1 are shown in Table 149.

Table 149: Forecast Mode Share – Scenario 3

Modes	BAU (2031)		Scenario 3	
	Peak Hour Trips	Mode Share	Peak Hour Trips	Mode Share
Car + Taxi	689673	30%	532581	23%
Two-Wheeler	666685	29%	261240	11%
Auto Rickshaw	114946	5%	67922	3%
Public Transport	827608	36%	1437168	68%
Total	2298912		2298912	

Scenario 4 – Comprehensive Mobility Strategy: Transit Oriented Development, Factoring-in full cost of externalities, Regulations on private vehicles, besides Public Transport Augmentation Plus Enhances Capacity and efficiency of Road Infrastructure, and cleaner technology Vehicles. The mode share calculated in the Scenario 4 are shown in Table 150 .

Table 150: Forecast Mode Share – Scenario 4

Modes	BAU (2031)		Scenario 3	
	Peak Hour Trips	Mode Share	Peak Hour Trips	Mode Share
Car + Taxi	689673	30%	394472	17%
Two-Wheeler	666685	29%	181126	8%
Auto Rickshaw	114946	5%	42669	2%
Public Transport	827608	36%	1680644	73%
Total	2298912		2298912	

Primary Data Collection and analysis

In any transport planning exercise, data collection is the cornerstone and the very foundation on which rests the superstructure. The data, so collected, is used to analyze the existing transport and traffic situation in the study area and to develop an urban transport demand model for the study area. This activity is undertaken to understand traffic and travel characteristics and highlight city-specific problems. The first and foremost step to initiate in the development of a transport demand model is the collection of relevant data to understand travel patterns and the factors that influence them. These travel patterns shall be the guiding principles in determining the traffic on the north-south corridor. The following surveys were carried out as shown in Table to meet the above objectives.

Traffic Conditions

Objective of Survey: Surveys were conducted at critical identified locations along the proposed NS Corridor.

Scope of Survey: Counting of vehicles, classified by the type of vehicle, at selected locations, covering all turning movements, midblock & screen line.

Conduct: Videographic traffic counts were carried out at all the locations listed. At each identified station, both directional counts were done by vehicle type, i.e., fast-moving passenger vehicles, goods vehicles and slow-moving non-motorized vehicles. The vehicles counted were converted to Passenger Car Units (PCU) by adopting equivalent PCUs. The PCUs corresponding to urban roads as per IRC: 106-1990 is used and the values adopted are given in Table 151 below.

Table 151: Survey Details

S. No.	Particulars of Survey	Unit	Quantity	Survey Date
1	Classified Traffic Volume Count	Location	9	Aug-2024
2	Turning Moment Count at Intersections	Location	7	Aug-2024
3	Passenger Origin-Destination Survey	Locations	11	Aug-2024
4	Speed and delay survey	KM	25	Aug-2024

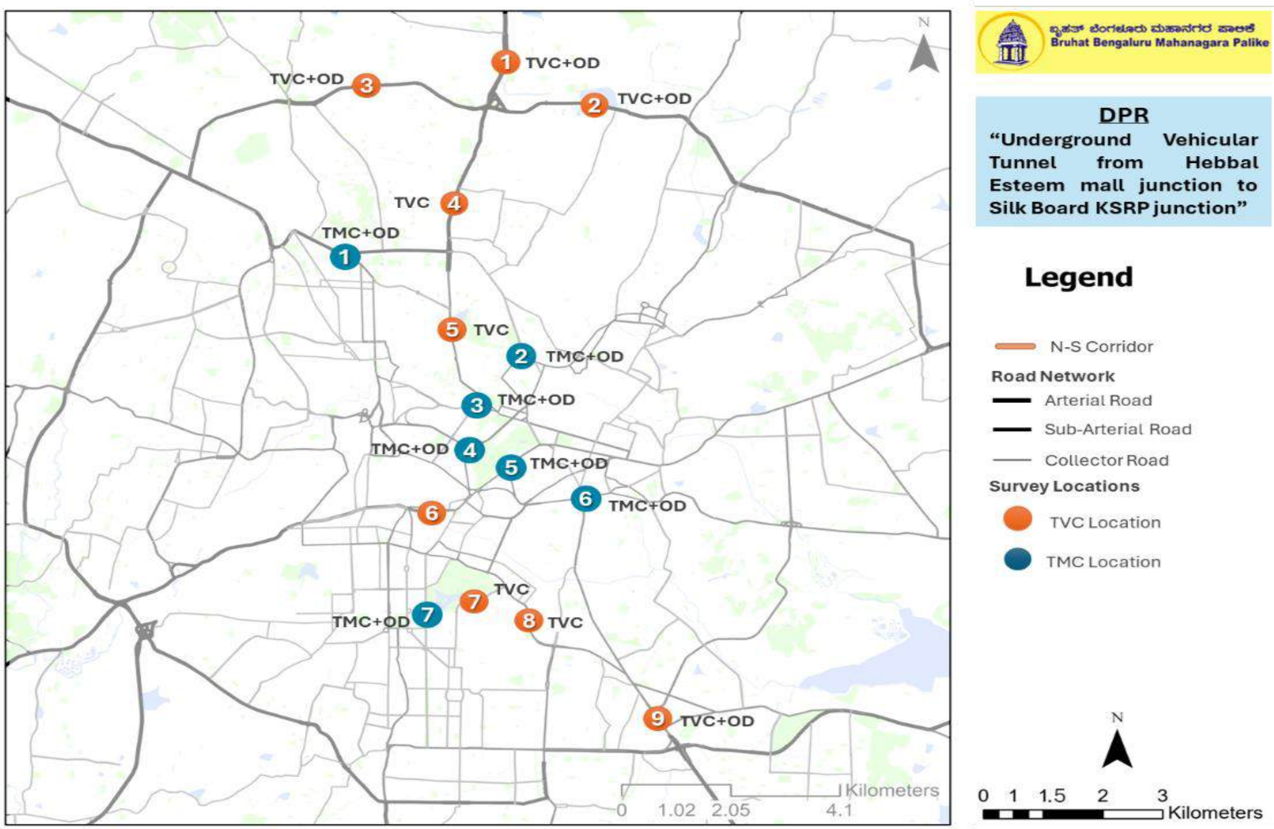


Figure 457 : Survey Locations

Table 152: PCU Values for Different Categories of Vehicles

Vehicle Type	PCU Values	
	Urban	
	UP TO 5%	> 5%
Bus	2.2	3.7
Car/Jeep/Van/Taxi	1	1
Two-Wheeler	0.5	0.75
E-Rickshaw	1.2	2
Auto-Rickshaw	1.2	2
Truck	2.2	3.7
MAV	4	5
LCV	1.4	2
Cycle	0.4	0.5
Tractor	4	5
Cart	2	3
Cycle Rickshaw	1.5	2

Traffic Volume Counts at Cordon Points

Nine cordon points were identified for an understanding of the traffic characteristics in the study area. The analysis of the classified volume count survey at the cordons is given in the sub-sections below. The total inbound and outbound traffic flow at each of the cordons is presented in Table 153 and daily traffic on each cordon point is shown in Figure direction wise.

Table 153: Daily Traffic Volume Counts at Cordon Locations

	Location	Direction	Daily Vehicles per Direction	Daily PCUs per Direction	Total Daily Vehicles	Total Daily PCUs
1	NH-44 Bellary Road (Near-Sakar Nagar)	Dir-I : Yelahanka To Hebbal	144592	138970	288243	276854
		Dir-II : Hebbal To Yelahanka	143651	137884		
2	NH-75 Malur -Byranahalli Rd Outer Ring Road (Near-Nagavara park)	Dir-I : Bellary Road To Nagavara	117553	113677	222323	212544
		Dir-II :Nagavara To Bellary Road	104770	98867		
3	NH-75 Malur -Byranahalli Rd Outer Ring Road (Near-Devinagar BEL Circle)	Dir-I : Hebbal To Yashwantpur	74262	74124	139793	140205
		Dir-II : Yashwantpur To Hebbal	65531	66081		
4	AH-47 Malur Road (Near-Science Gallery)	Dir-I : Mekhri circle To Airport	128808	122070	246077	232456
		Dir-II : Airport To Mekhri circle	117269	110386		
5	Guttahalli Main Road (Near-Uniworth Plaza)	Dir-I : Mahalakshmi Gudi Circle To Bengaluru Golf Club	103247	97762	203804	195093
		Dir-II : Bengaluru Golf Club To Mahalakshmi Gudi Circle	100557	97332		
6	NR road (Near-Silver Jubilee Park)	Dir-I : Kempegowda Tower To Chamrajpet	82397	83027	180589	177180
		Dir-II : Chamrajpet To Kempegowda Tower	98192	94154		
7	Siddapura Road (Near-Maharaja Agrasena Bhavana)	Dir-I : Ashoka Piller To Mallinge Hospital	31705	28716	65075	58422
		Dir-II : Mallinge Hospital To Ashoka Piller	33370	29706		
8	Marigowda Road (Near-National Institute Of Mental Health & Neuro Sciences)	Dir-I : Dairy Circle To Wilson Garden	54855	54282	108421	107685
		Dir-II :Wilson Garden To Dairy Circle	53566	53402		
9	NH-44 Bengaluru-Chennai Highway (Near-Madiwala footbridge)	Dir-I : Adugodi To Electronic City	117725	109335	232494	216724

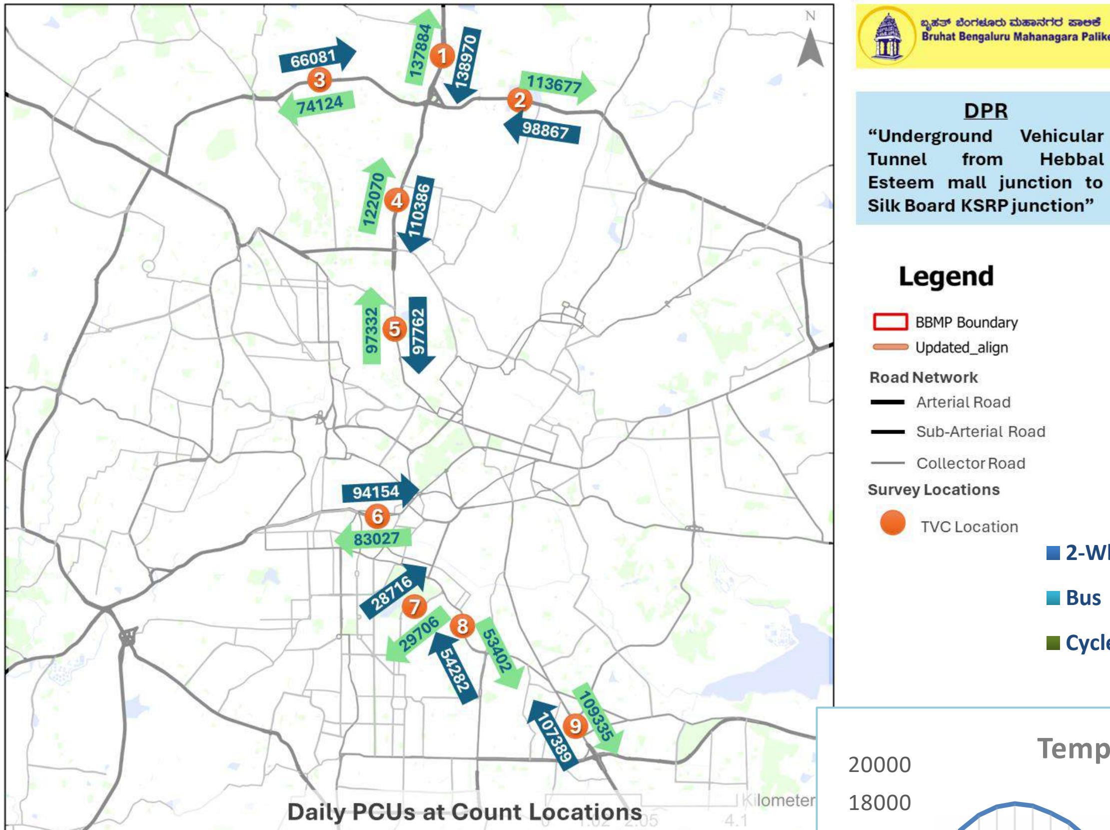


Figure 458: Map Showing Daily Traffic Volume at Count Locations.

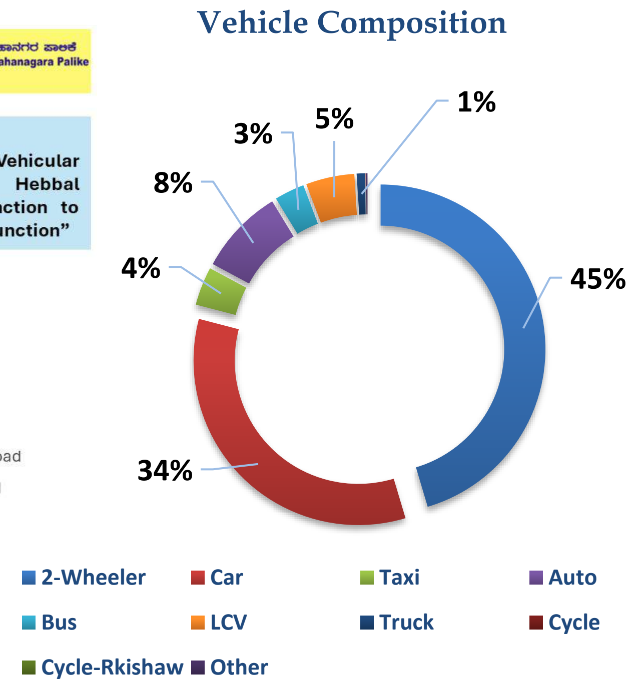


Figure : Overall traffic composition

Figure presents the overall vehicle composition of the traffic. The highest share is of private vehicles, at 80%, of which two-wheelers constitute 42% and four-wheelers 38%. This is followed by IPT vehicles, which contribute to about 9% of the total traffic.

The temporal variation of the traffic flow at each cordon is given in Figure below. Based on primary data for all the cordons, the morning peak period can be considered from 09:00 to 12:00 hours and the evening peak period can be considered from 17:00 to 20:00 hours.

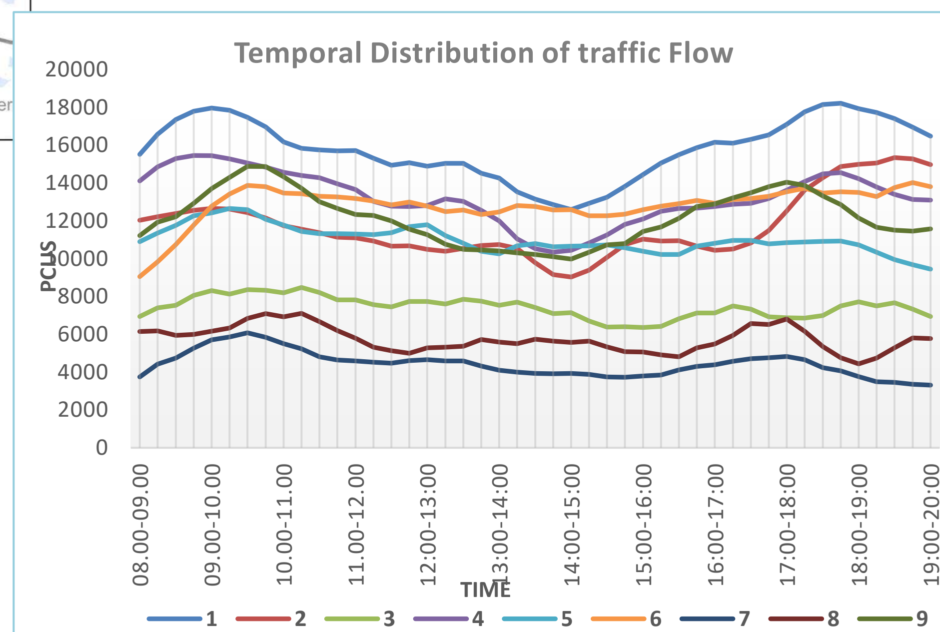


Figure 459: Temporal Distribution of traffic at cordon points

The peak volume and peak period at each cordon location are given in Table 154 below . The volume in the peak hour varies in the range of 7-8% of the total volume.

Table 154: Morning Peak hour Volume at Surveyed Locations

Location		Direction	Both Direction Vehicles	Peak Vehicles	Segregated Peak Vehicles	Both Direction PCUs	Peak PCUs	Segregated Peak PCUs	Peak Hour %	Level of Service	Peak Time
1	NH-44 Bellary Road (Near-Sakar Nagar)	Dir-I : Yelahanka To Hebbal (Towards Bengaluru)	19755	9794	6335	17967	8962	5718	6%	LOS F	09.00-10.00
		Dir I - Service Lane (Towards Bengaluru)			3459			3244		LOS E	
		Dir-II : Hebbal To Yelahanka (Towards Airport)		9961	9634		9005	8627		LOS F	
2	NH-75 Malur - Byranahalli Rd Outer Ring Road (Near-Nagavara park)	Dir-I : Bellary Road To Nagavara	13865	7728	4945	12441	7011	3797	6%	LOS C	09.30-10.30
		Dir I - Service Lane			2785			2321		LOS E	
		Dir-II :Nagavara To Bellary Road		6137	4440		5430	3377		LOS C	
		Dir II - Service Lane			1697			1242		LOS C	
3	NH-75 Malur - Byranahalli Rd Outer Ring Road (Near-Devinagar BEL Circle)	Dir-I : Hebbal To Yashwantpur	10563	5567	5567	9663	5171	5171	7%	LOS F	10.15-11.15
		Dir-II : Yashwantpur To Hebbal		4996	4996		4493	4493		LOS E	
4	AH-47 Malur Road (Near-Science Gallery)	Dir-I : Mekhri circle To Airport	17156	8914	5568	15443	7988	4996	7%	LOS E	09.00-10.00
		Dir I - Service Lane			3346			2991		LOS F	
		Dir-II : Airport To Mekhri circle		8242	5743		7455	5362		LOS F	
		Dir II - Service Lane			2499			2093		LOS D	

The peak volume and peak period at each cordon location are given in Table 155 below . The volume in the peak hour varies in the range of 7-8% of the total volume.

Table 155: Morning Peak hour Volume at Surveyed Locations

	Location	Direction	Both Direction Vehicles	Peak Vehicles	Segregated Peak Vehicles	Both Direction PCUs	Peak PCUs	Segregated Peak PCUs	Peak Hour %	LOS	Peak Time
5	Guttahalli Main Road (Near-Uniworth Plaza)	Dir-I : Mahalakshmi Gudi Circle To Bengaluru Golf Club	13777	8129	8129	12651	7318	7318	6.5%	LOS F	09.15-10.15
		Dir-II : Bengaluru Golf Club To Mahalakshmi Gudi Circle		5648	5648		5333	5333		LOS F	
6	NR road (Near-Silver Jubilee Park)	Dir-I : Kempegowda Tower To Chamrajpet	12753	4814	4814	11773	4534	4534	6.64%	LOS D	09.30-10.30
		Dir-II : Chamrajpet To Kempegowda Tower		7938	7938		7240	7240		LOS F	
7	Siddapura Road (Near-Maharaja Agrasena Bhavana)	Dir-I : Ashoka Piller To Mallinge Hospital	5897	3750	3750	5133	3307	3307	9%	LOS F	09.30-10.30
		Dir-II : Mallinge Hospital To Ashoka Piller		2147	2147		1826	1826		LOS C	
8	Marigowda Road (Near-National Institute Of Mental Health & Neuro Sciences)	Dir-I : Dairy Circle To Wilson Garden	7510	3845	3845	7105	3702	3702	7%	LOS F	10.15-11.15
		Dir-II :Wilson Garden To Dairy Circle		3665	3665		3404	3404		LOS F	
9	NH-44 Bengaluru-Chennai Highway (Near-Madiwala footbridge)	Dir-I : Adugodi To Electronic City	16872	7056	7056	14875	6186	6186	7%	LOS F	09.30-10.30
		Dir-II : Electronic City To Adugodi		9816	9816		8690	8690		LOS F	

Table 156 : Evening Peak hour Volume at Surveyed Locations

	Location	Direction	Both Direction Vehicles	Peak Vehicles	Segregated Peak Vehicles	Both Direction PCUs	Peak PCUs	Segregated Peak PCUs	Peak Hour %	Peak Time	LOS
1	NH-44 Bellary Road (Near-Sakar Nagar)	Dir-I : Yelahanka To Hebbal (Towards Bengaluru)	19609	10256	5507	18214	9483	5201	7%	17:45-18:45	LOS F
		Dir I - Service Lane (Towards Bengaluru)			4749			4282			LOS F
		Dir-II : Hebbal To Yelahanka (Towards Airport)		9353	8746		8731	8100			LOS F
		Dir II - Service Lane (Towards Airport)			607			632			LOS B
2	NH-75 Malur - Byranahalli Rd Outer Ring Road (Near-Nagavara park)	Dir-I : Bellary Road To Nagavara	17381	9904	6337	15341	8673	5549	7%	18:30-19:30	LOS F
		Dir I - Service Lane			3569			3125			LOS F
		Dir-II :Nagavara To Bellary Road		7477	5409		6668	4824			LOS E
		Dir II - Service Lane			2068			1844			LOS C
3	NH-75 Malur - Byranahalli Rd Outer Ring Road (Near-Devinagar BEL Circle)	Dir-I : Hebbal To Yashwantpur	9271	5140	5140	8673	4839	4839	6%	18:00-19:00	LOS E
		Dir-II : Yashwantpur To Hebbal		4131	4131		3833	3833			LOS C
4	AH-47 Malur Road (Near-Science Gallery)	Dir-I : Mekhri circle To Airport	15816	8358	5404	14555	7715	4998	6%	17:45-18:45	LOS E
		Dir I - Service Lane			2954			2717			LOS F
		Dir-II : Airport To Mekhri circle		7458	6240		6840	5769			LOS F
		Dir II - Service Lane			1218			1072			LOS B

Table 157: Evening Peak hour Volume at Surveyed Locations

	Location	Direction	Both Direction Vehicles	Peak Vehicles	Segregated Peak Vehicles	Both Direction PCUs	Peak PCUs	Segregated Peak PCUs	Peak Hour %	Peak Time	LOS
5	Guttahalli Main Road (Near-Uniworth Plaza)	Dir-I : Mahalakshmi Gudi Circle To Bengaluru Golf Club	11487	5341	5341	10964	5083	5083	6%	16:15-17:15	LOS E
		Dir-II : Bengaluru Golf Club To Mahalakshmi Gudi Circle		6146	6146		5882	5882			LOS F
6	NR road (Near-Silver Jubilee Park)	Dir-I : Kempegowda Tower To Chamrajpet	11519	6087	6087	11022	5897	5897	6%	18:45-19:45	LOS F
		Dir-II : Chamrajpet To Kempegowda Tower		5432	5432		5125	5125			LOS E
7	Siddapura Road (Near-Maharaja Agrasena Bhavana)	Dir-I : Ashoka Piller To Mallinge Hospital	4844	1971	1971	4336	1823	1823	7%	17:00-18:00	LOS C
		Dir-II : Mallinge Hospital To Ashoka Piller		2873	2873		2514	2514			LOS E
8	Marigowda Road (Near-National Institute Of Mental Health & Neuro Sciences)	Dir-I : Dairy Circle To Wilson Garden	6994	3469	3469	6806	3358	3358	6%	17:00-18:00	LOS F
		Dir-II :Wilson Garden To Dairy Circle		3525	3525		3448	3448			LOS F
9	NH-44 Bengaluru-Chennai Highway (Near-Madiwala footbridge)	Dir-I : Adugodi To Electronic City	15427	9198	9198	14048	8267	8267	6%	17:00-18:00	LOS F
		Dir-II : Electronic City To Adugodi		6229	6229		5781	5781			LOS F

The cordon-wise traffic composition during the peak hour for the cordons is given in Figure 57. Private modes (cars and two-wheelers) occupy the major share, at 83.4%, followed by Auto which is 9%.

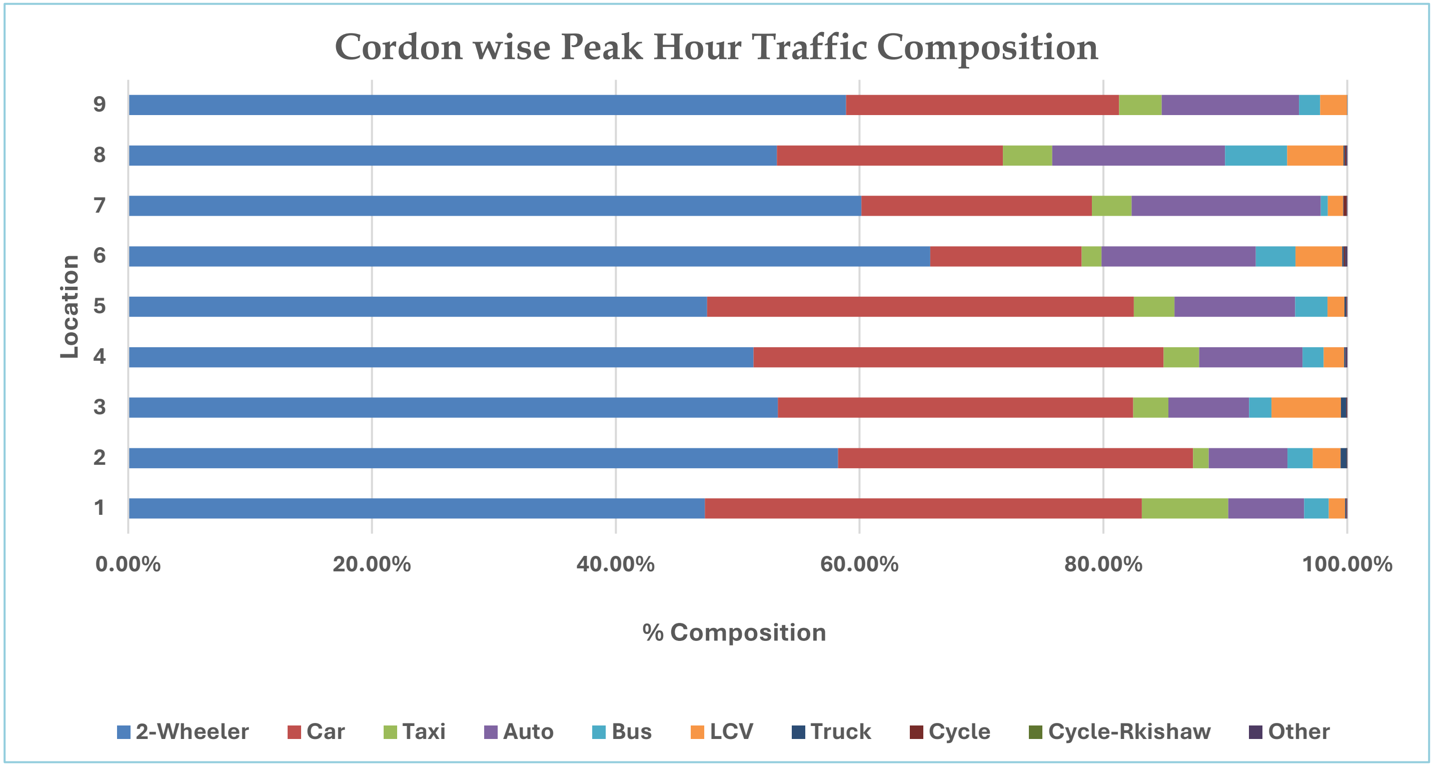


Figure 460: Cordon wise Peak hour Traffic Composition

Turning Movement Counts at Intersections

A total of 7 critical intersections were identified where the volume of vehicles in all turning directions were noted. The analysis of the urning movement volume count survey at the intersections is given in sub-sections below. Amongst the identified locations above, it was observed that, on an average, the total traffic is more than 1,50,000 vehicles per day, with the highest per day vehicular volume observed at Basaveshwara circle, where 2,38,685 vehicles had accumulated, followed by Shoolay circle, Bangalore Cantt Jn, Cn Rao Underpass Jn with 1,87,462, 1,70,379, 1,72,303 vehicles, respectively. The lowest per day traffic volume was observed at Lalbagh Chowk with 1,19,980 vehicles in one day. Table shows the total volumes recorded at the intersections and Figure shows the Temporal distribution of traffic at the Intersections.

Table 158 : Traffic Volume at Intersections

Location	Name of Junction	Daily Vehicles	Daily PCU	Morning			Evening			Direction of maximum Flow
				Peak Hour	Peak Hour Vehicles	Peak Hour PCUs	Peak Hour	Peak Hour Vehicles	Peak Hour PCUs	
1	CN Rao underpass Junction	172303	158783	10.45-11.45	13658	12244	18:45-19:45	12599	11237	Mekhri circle
2	Banglore Cantt Junction	170379	155088	09.30-10.30	12797	11267	18:45-19:45	12589	11161	Vasant Nagar
3	Basaveshwara circle	238685	218271	09.00-10.00	15026	13347	18:00-19:00	16817	15053	Vasanth Nagar
4	KR Circle	163363	148977	10.15-11.15	13119	11432	16:00-17:00	10901	9686	Anand Rao Junction
5	Cubbon Park UB City signal	155057	142475	09.30-10.30	9681	8351	19:15-20:15	10617	9453	Kempegowda Tower
6	Shoolay Circle	187462	175475	09.30-10.30	12574	11160	18:45-19:45	11619	10335	Malitry Area
7	Lalbagh Chowk	119980	108159	10.45-11.45	7451	6581	16:30-17:30	7925	7034	South End Circle

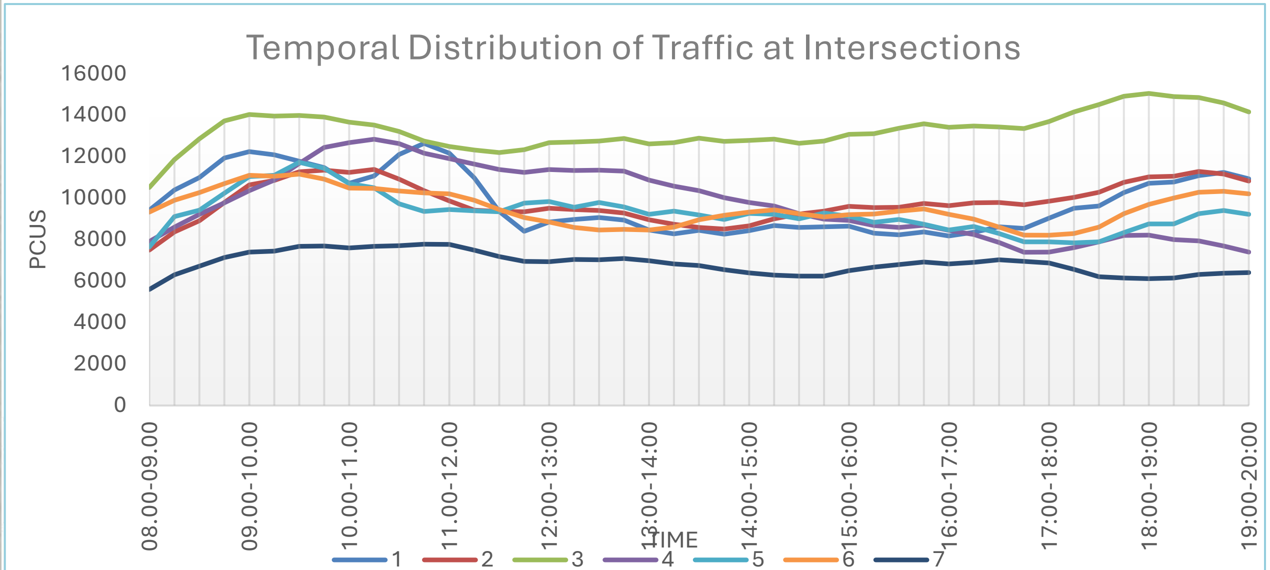
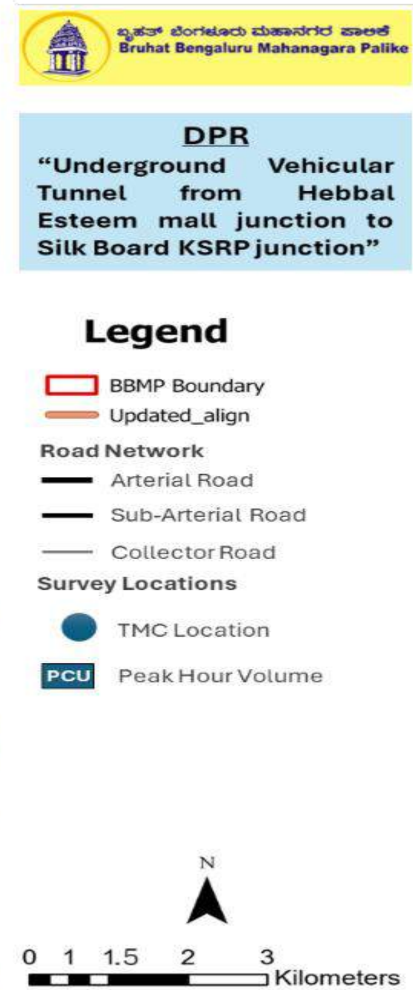


Figure 461: Temporal Distribution of traffic at Intersections

Figure shows the turning moment count survey locations spatially with the daily volume at each intersection. An average traffic of 1,58,000 PCU are observed on the intersections with the highest traffic at Basaveshwara circle consisting of 2,18,271 PCUs.



Speed and Delay

Speed and Delay study is done along the road connecting from Hebbal to Silk Board Junction (Upto Ring Road). As Shown in Figure 60 the route is congested at most of the locations, especially near the core area

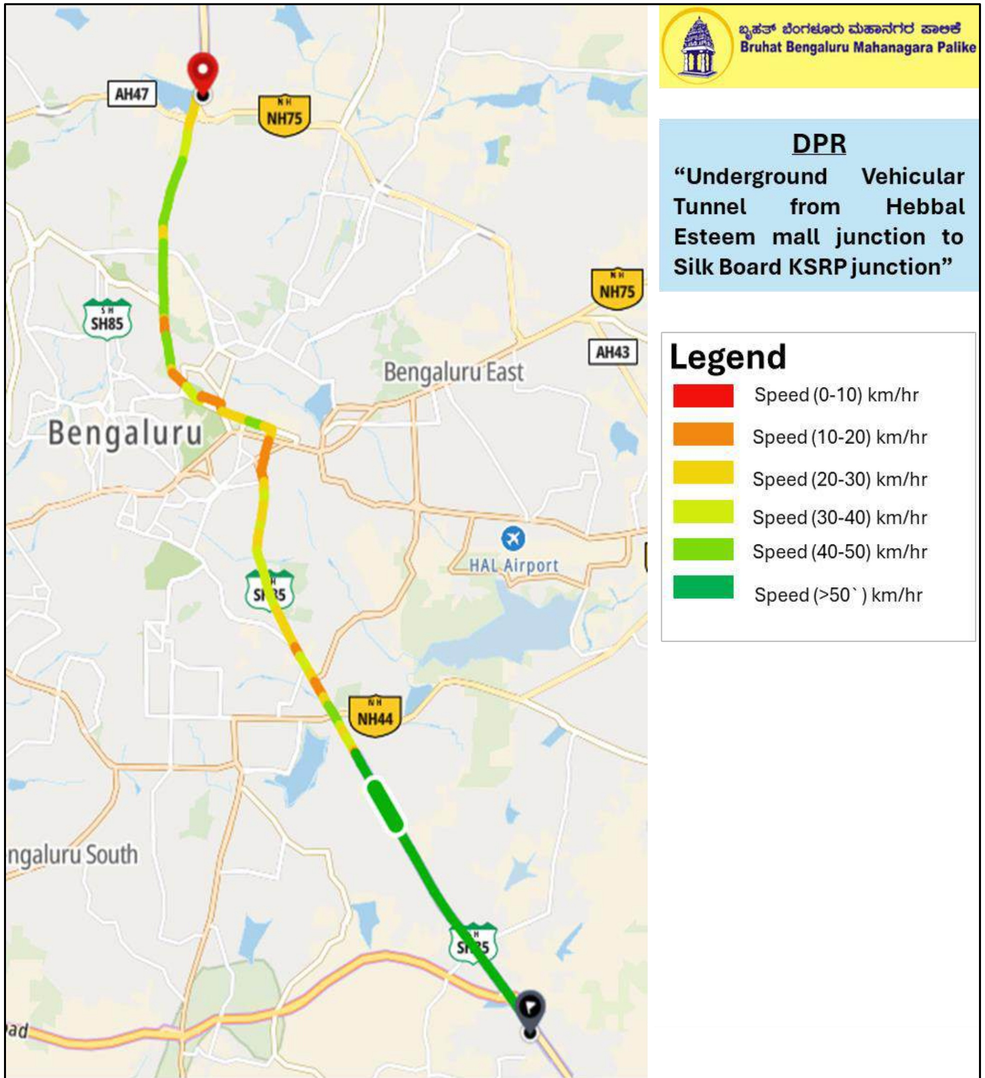


Figure 462: Speed and Delay

Travel Behaviour

1. **Origin-Destination Survey at Cordon Points**

Roadside interviews were carried out on a sample basis to understand the characteristics of the ongoing trips. They captured details like purpose, modes, origin-destination, etc.

OBJECTIVE

- To derive the passenger and freight travel pattern by road
- These surveys will be aimed at analysing the movement between the study area and external zones.

METHOD

- Interviews will be carried out on a sample basis by stopping the vehicles

OUTPUT

- Information's like origin and destination of trip, occupancy, trip purpose and in the case of goods vehicles their type and tonnage.

Average Trip lengths

Based on analysis of OD data the average trip lengths (ATL) for each mode is calculated as shown in Table 159. For internal-to-internal movement the ATL of car is 8 km followed by two-wheeler having 7.6 km ATL and 6.6 km for Auto.

Table 159: Averagse Trip Lengths (km)

	I-I	I-E	E-E	E-I
2-Wheeler	7.6	15.8	19	14.7
CAR	8.0	16.2	24.5	18.4
AUTO	6.6	13.5	16.2	12.7
LCV	7.1	18.3	24	20
HCV	5.8	13.6	14.1	18

Frequency Distribution

Trip Length Frequency Distribution for car for Internal to Internal, Internal to External, External to External and External to Internal is shown below.

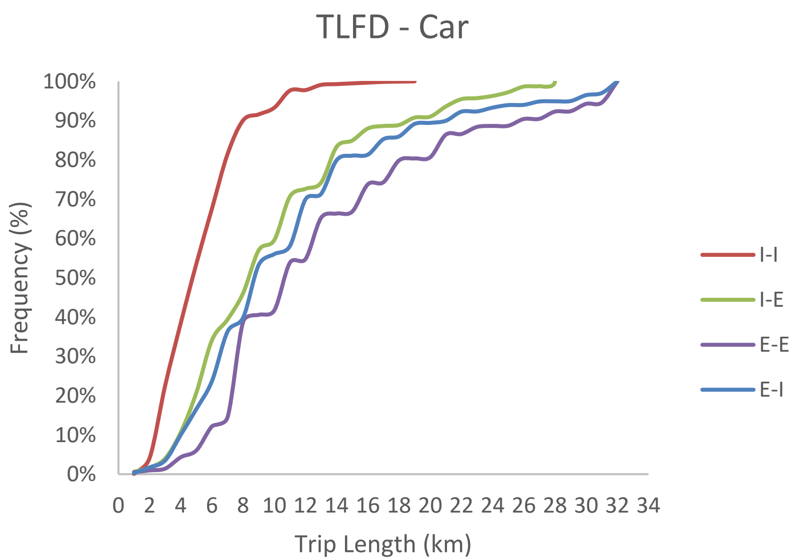


Figure 463 : Trip Length Frequency Distribution Curve for Car

Trip Purpose

The purpose wise distribution of trips is shown in Figure 62. The work trips has highest share of 69% followed by Business trips 16% out of the total trips.

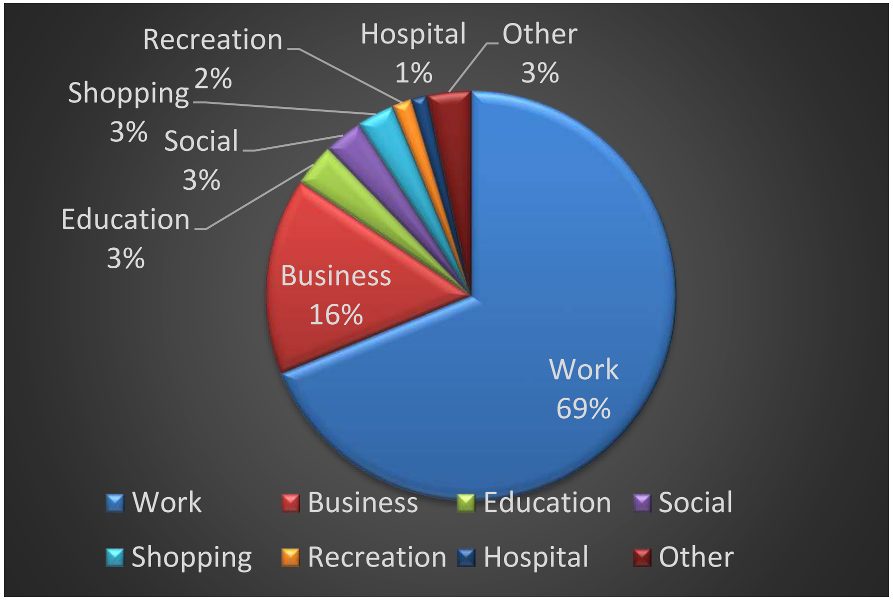


Figure 464: Purpose wise Distribution of Trips during peak hour

Base Year Travel Demand Model

Introduction

The base year model is developed for the year 2024 to understand and validate the travel patterns. A validated base year model acts as a check of the network credibility and is used to further evaluate future scenarios. For the present assignment base model, PTV VISUM 2024 is used. The model is developed for private transport models only. The bus PCU's on the road network are taken as preload based on the count data.

PTV Visum 2024 is a comprehensive, flexible software system for strategic traffic and transport planning. Around the globe,

Estimated Trips

Table 160 shows the total no. of estimated trips produced by each mode for the study area. The maximum no. of trips produced is observed for Two-wheeler i.e., 1,20,288 trips followed by Car i.e., 59,322 and 25,603 by Autorickshaw among passenger vehicle in the modelled peak hour. A total of 3,854 trips are produced by freight vehicles in the modelled peak hour.

Table 160: Total no. of Trips (Mode-wise)

Mode	No. of Trips
Car	59,322
Two-Wheeler	1,20,288
Autorickshaw	25,603
Light Commercial Vehicle	3,640
Heavy Commercial Vehicle	214

Summary

After running multiple iteration of base year assignment, the base year model has been calibrated and the model is fit for the calculation of future travel demand of horizon year.

Horizon Year Model

Planning Period

The demand to be calculated for the future is to be estimated for 5 years, 15 years and 25 years from the base year i.e., 2024. For future growth estimation, three scenarios are developed to estimate the number of trips diverted on the North-South corridor for Horizon Year. The model runs are done for the years of 2031, 2041 and 2051, and other results are extracted from the result of these 2 years.

Planning Parameters

Population data is referred from CMP 2020 and the zone wise population distribution has been carried out for base year and zonal distribution of population has been done for horizon year considering similar distribution.

The horizon year population is given bellow in Table .

Table 161 : BBMP Population Projections

Year	Population
2021	1,28,62,825
2024	1,32,62,233
2031	1,68,56,904
2041	1,98,67,161

Transport Modeling Consultant's Approach

Consultant's focused in using the already available Transport model that was prepared for the Comprehensive Mobility Plan 2020 by updating the present traffic data and network and coding the same into the model to make the current situation as realistic as possible. The proposed road network of Elevated Corridors and the Tunnel alignments were then coded into the network to run different scenarios and their evaluation with outputs of travel demand modeling. The existing metro phase-I and Phase-II have been coded for running the base year BAU scenario. All other proposed metro lines and sub urban railway lines have been coded for scenarios 2041 and 2051.

Business as Usual (BAU)

The CMP considers Business as Usual Scenario (BAU) for 2031 wherein the present base year trends are assumed to continue for the horizon years with minimum changes to occur in the future. This scenario assesses the transport system with base year trends and assumes no radical policy interventions for sustainable development and emission mitigations to identify the effects on travel infrastructure, mode share and PT systems in the city.

Scenario Building

Following three scenarios were considered for this feasibility study.

Scenario 1 (S1)

This scenario considers the mode share estimates as per the BAU scenario of CMP.

Scenario 2 (S2)

This is considered as an intermediate scenario. The projections are based on the intermediate growth rates estimated for each Zones and committed projects.

Scenario 3 (S3)

This scenario considers all future developments inclusive of all Metro Lines, Proposed elevated corridors, Sub Urban rails and Proposed Tunnels (North- South & East-West Tunnels).

The modal share for all scenarios is shown below in Table 68 which is referred from CMP 2020.

The scenario 1 and 3 are directly taken from CMP 2020 where S1 shows a high share of cars whereas S3 shows a low share of cars and high share of public transport. Scenario 2 is considered as an intermediate scenario whose modal share falls in between these two scenarios 1 and 3.

Business as Usual Scenario Do Minimum

In " Do Minimum" Business as Usual (BAU-DM) scenario, the existing road network with committed development projects are considered. The list of committed projects proposed by various departments includes the following:
The major transport proposals committed include:

a) Metro- The phase 2 of Metro will see the network expand by a distance of

72.095 km. This stretch of the project will see the development of 61 metro stations. Out of these proposed 61 stations, 12 stations are to be built underground. The complete stretch of the 72.095 km long network will be divided into an underground stretch of 13.79km, an elevated stretch of 57.825 km, and 0.48 km will be at grade.

Peripheral ring road:

(b). The BDA proposes that the peripheral ring road be built (78 kilometers) around Bengaluru. This stretch connects Tumkur Road (NH4) and Hosur Road(NH7) on the northern side acting complementary to existing Nice Road (which is on southern side of city).

(c). Elevated Corridors: There is a need for augmenting the capacity of arterial roads in the CBD areas, as well as beyond the ORR. While at-grade augmentation is the default option and should be pursued for peripheral areas, limitations of land acquisition in the CBD require consideration of road capacity augmentation through elevated roads. Hence, the Government of Karnataka is planning on further augmentation of urban road capacity through elevated corridors, with particular attention to the equitable allocation of road space, by prioritizing movements of public transport vehicles, pedestrians and bicyclists. A total of 100 kms of elevated corridors are proposed within the city limits along with around 50kms of tunnel is proposed and these have been coded into the transport model along with the current traffic data and other transportation data as required as an input into the transport model to develop different scenarios.

(d) Augmentation of BMTC buses to double the existing fleet: BMTC's bus augmentation plan for the future years to meet the ever increasing demand.

The Updated data and travel characteristics updated to the year 2024 have been used to develop the business as usual scenario as a beginning. The findings of model out put of this scenario is indicated as below;

Figure 465 .V/ C Ratio on al l the Links (BMA Area) – 2 0 3 1

Network considered for running the model for different scenarios

1. All Metro Corridor
2. All proposed elevated corridors
3. All proposed tunnels

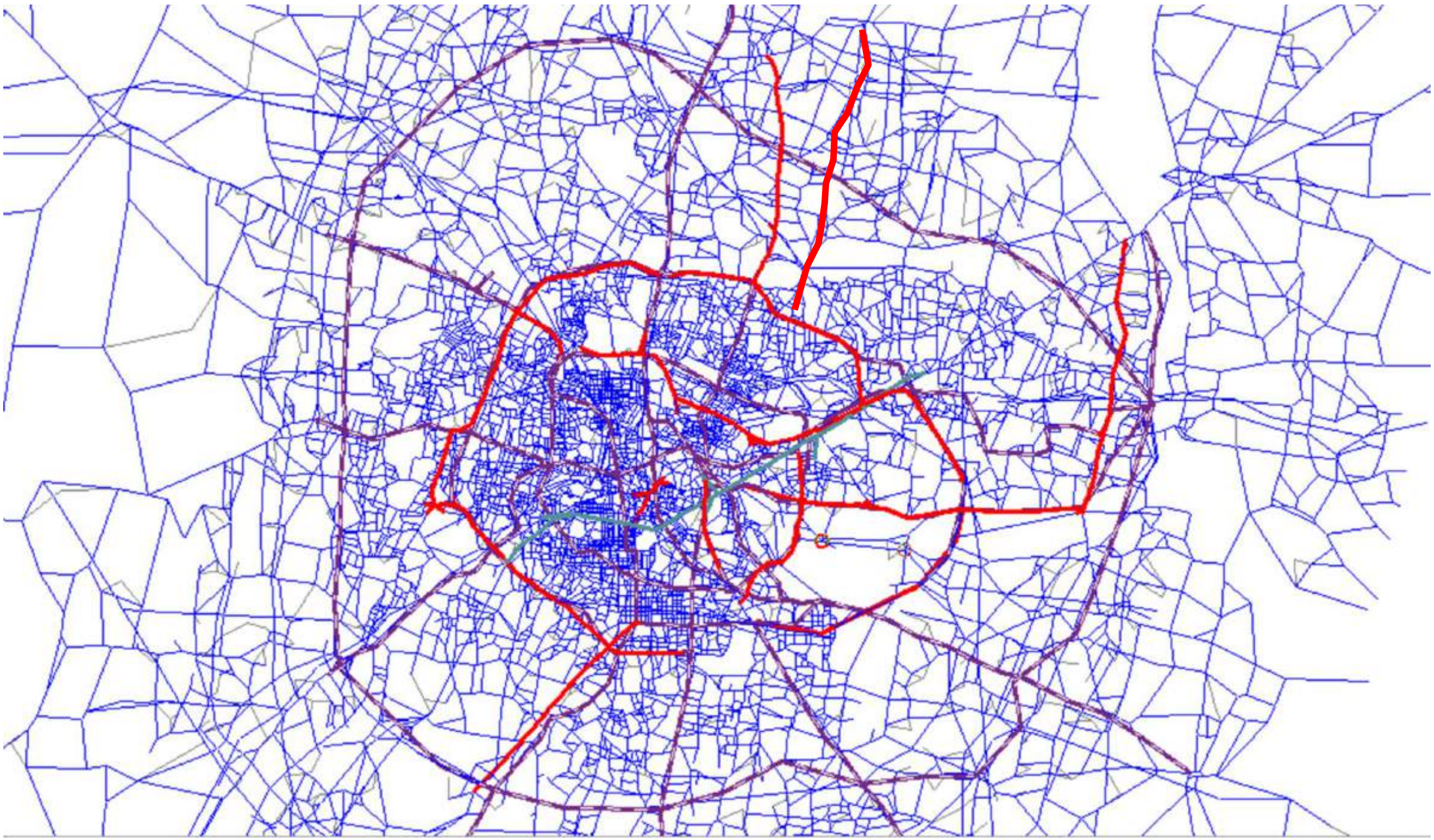


Figure.466 .Existing Bangalore Network coded with all the proposals in CUBE Model

Tunnel Network coded for running different scenarios

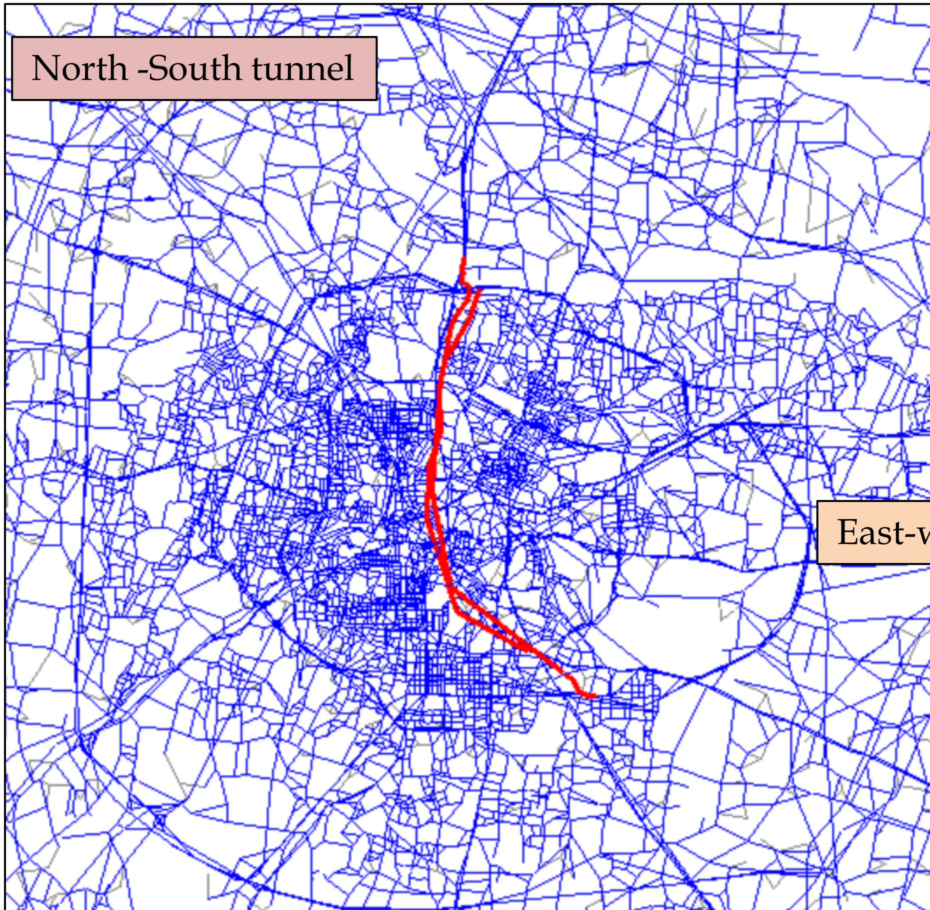


Figure.467. Proposed North-South Tunnel from Hebbal to Silk Board coded in the network

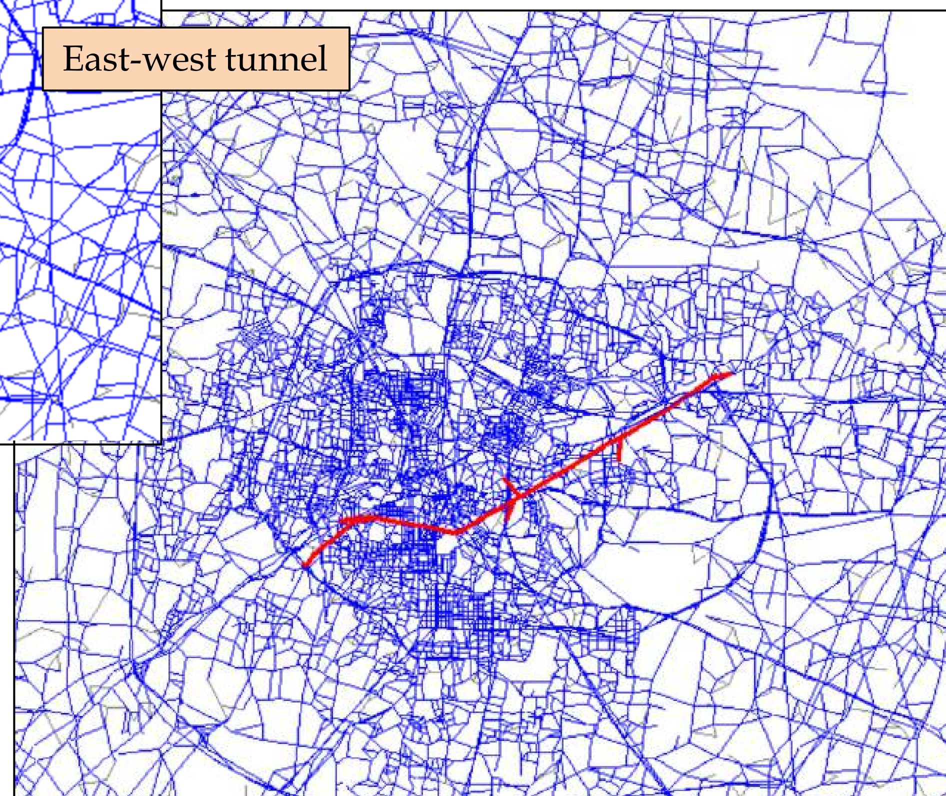


Figure.468 .Proposed East- West Tunnel from K.R.Puram to Nayandahalli coded in the network

Construction of Split flyover at MEI junction on Tumakuru road

The model output indicates that the Level of service have changed from E from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.49
LOS-E

V/c- 0.91
LOS-**C**

Existing Speed
25 Kmph

Anticipated Speeds
30 Kmph

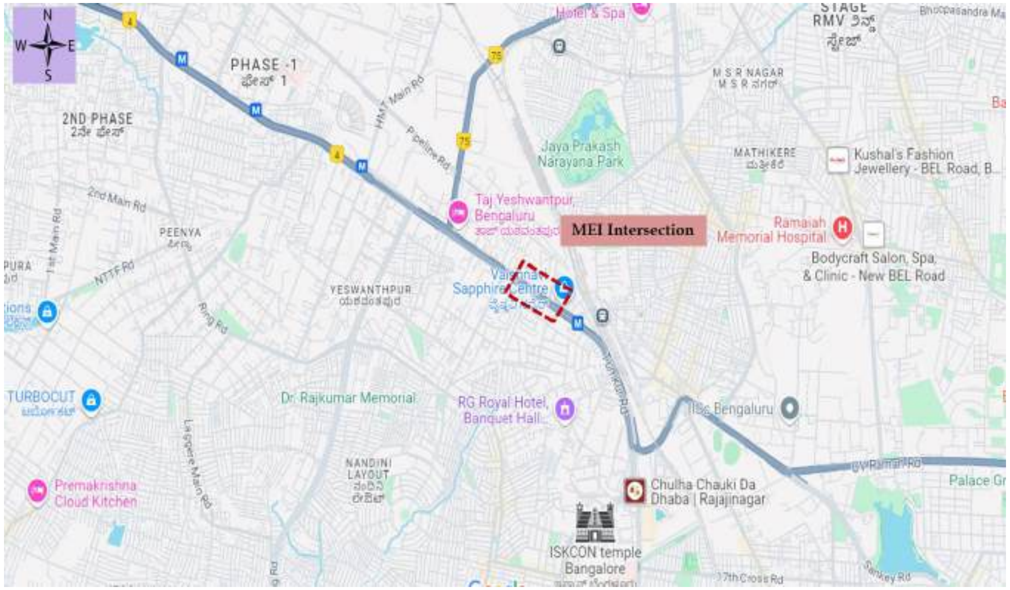


Table 162 : V/c & LoS Projections as per Travel demand for the Underpass at 100 feet Goraguntaepalya junction on Tumakuru road

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/c	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/c	LoS
	Scenario 2031									
1.B	**Split flyover at MEI junction**	13449	1.49	E	5742	0.64	C	7706	0.49	B
	Scenario 2041									
1.B	**Split flyover at MEI junction**	15075	1.67	F	5121	0.57	C	9953	0.70	C
	Scenario 2051									
1.B	**Split flyover at MEI junction**	16700	1.86	F	4500	0.50	C	12200	0.91	C

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service B in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.72
LOS-F

V/c- 0.44
LOS-**B**

Existing Speed
Below 15 Kmph

Anticipated Speeds
40 Kmph

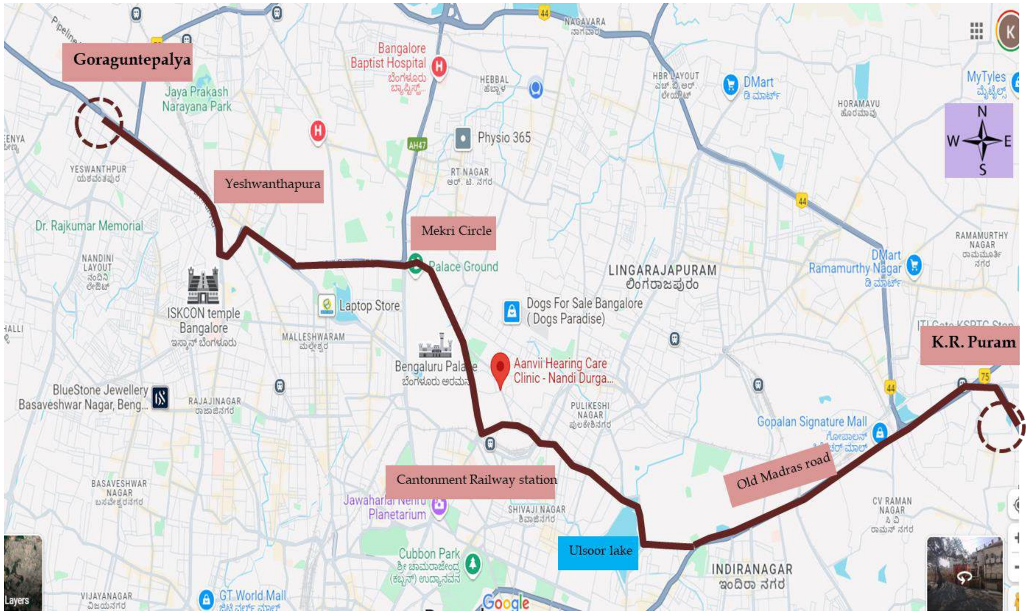


Table 163 : V/c & LoS Projections as per Travel demand forecast from K.R.Puram to Mathikere

Corridor No.1	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/C Ratio	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/C Ratio	LoS
	Scenario 2031									
1.C	**KR puram-Old madaras road-Ulsoor lake-St.John Chruch road-Jaymahal road-Mekhri circle-IISC-Mathikere Cross**	15498	1.72	F	6300	0.7	C	4600	0.66	C
	Scenario 2041									
1.C	**KR puram-Old madaras road-Ulsoor lake-St.John Chruch road-Jaymahal road-Mekhri circle-IISC-Mathikere Cross**	16261.535	1.807	F	9700	1.078	D	4262.825	0.546	C
	Scenario 2051									
1.c	**KR puram-Old madaras road-Ulsoor lake-St.John Chruch road-Jaymahal road-Mekhri circle-IISC-Mathikere Cross**	17025.35	1.89	F	13100	1.46	E	3925.35	0.44	B

Integrated Elevation from Hudson Circle to Minerva Circle (Minerva Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service D in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.92
LOS-F

→

V/c- 1.07
LOS-**D**

Existing Speed
Below 15 Kmph

→

Anticipated Speeds
25 Kmph

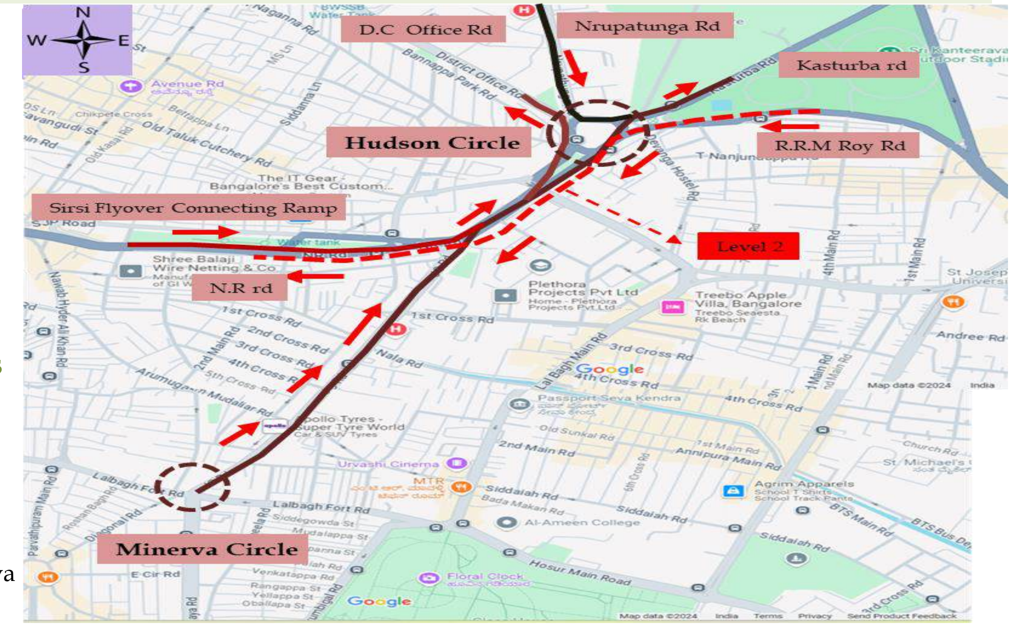


Table 164 : V/c & LoS Projections as per Travel demand from Minerva to Hudson Circle

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/C Ratio	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/C Ratio	LoS
	Scenario 2031									
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	17323	1.92	F	8413	0.93	C	8910	0.80	C
	Scenario 2041									
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	19439	2.16	F	10556	1.17	D	8883	0.93	C
	Scenario 2051									
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	21555	2.39	F	12699	1.41	E	8856	1.07	D

Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction -Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.78
LOS-F

→

V/c- 0.52
LOS-C

Existing Speed
Below 15 Kmph

→

Anticipated Speeds
30 Kmph

Table 165 : V/c & LoS Projections as per Travel demand from Anaepalya junction to Silk Board

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/c	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/c	LoS
	Scenario 2031									
7.B	Hosur Road from Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	10669	1.78	F	5800	0.64	C	4869	0.61	C
	Scenario 2041									
7.B	Hosur Road from Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	11750	1.60	E	7055	0.78	C	4695	0.57	C
	Scenario 2051									
7.B	Hosur Road from Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	12831	1.43	E	8310	0.92	C	4521	0.52	C

Elevated corridor from Sirsi circle to Nayandahalli

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.62
LOS-F → V/c- 0.63
LOS-C

Existing Speed
Below 15 Kmph → Anticipated Speeds
30 Kmph

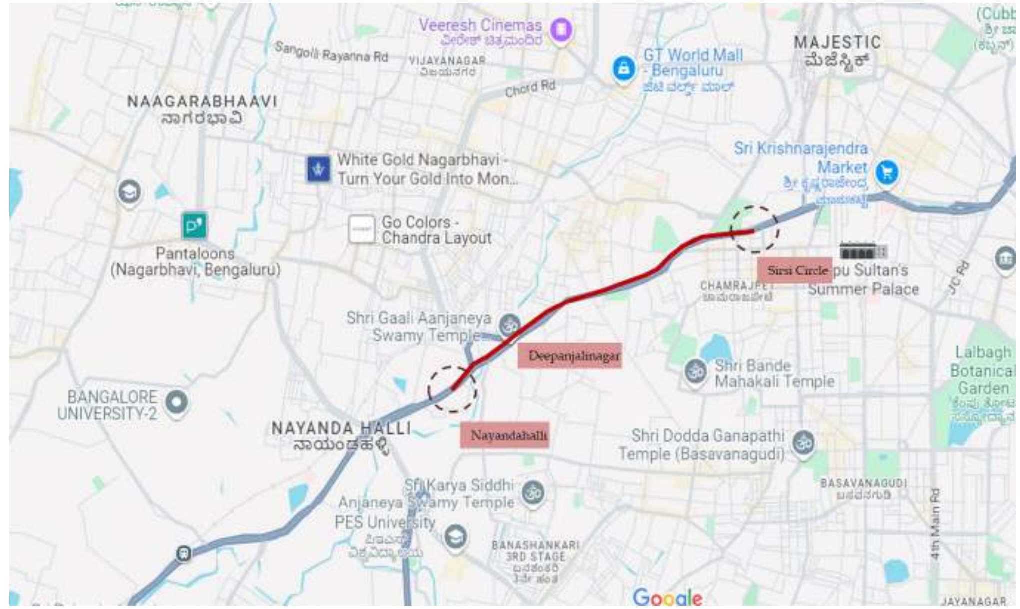


Table 166 : V/c & LoS Projections as per Travel demand from Sirsi circle to Nayandahalli

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/C Ratio	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/C Ratio	LoS
	Scenario 2031									
8	Integrated Elevated flyover fromSirsi Circle to Nayandahalli	9722	1.62	F	6599	0.73	C	3123	0.52	C
	Scenario 2041									
8	Integrated Elevated flyover fromSirsi Circle to Nayandahalli	10217	1.70	F	7321	0.81	C	3633	0.61	C
	Scenario 2051									
8	Integrated Elevated flyover fromSirsi Circle to Nayandahalli	11213	1.87	F	7734	0.86	C	3788	0.63	C

Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala.

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.59
LOS-F

V/c- 0.80
LOS-C

Existing Speed
Below 15 Kmph

Anticipated Speeds
30 Kmph

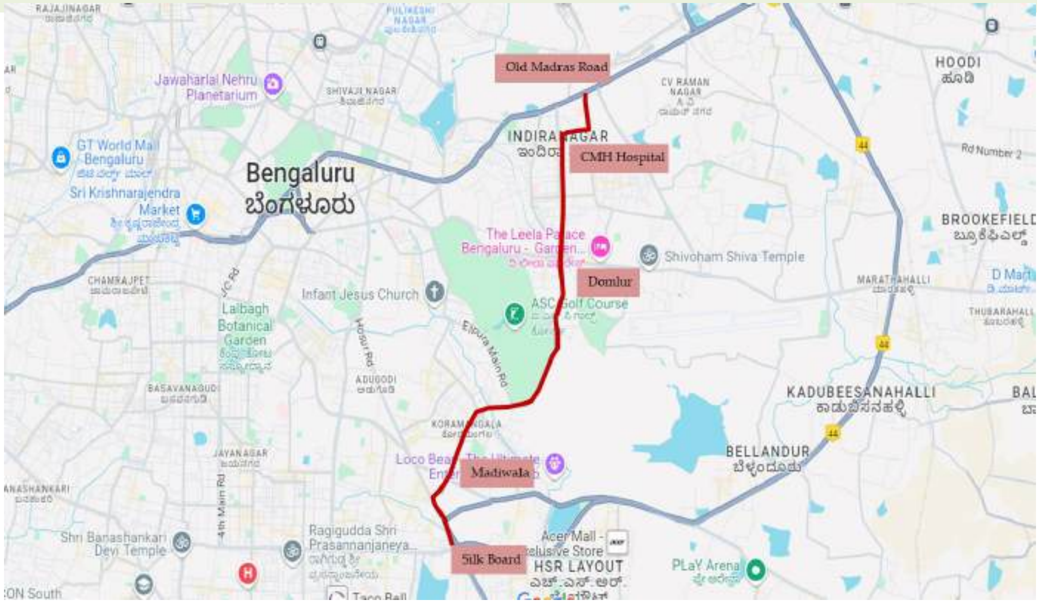


Table 167 : V/c & LoS Projections as per Travel demand from Old Madras road to Hosur road Madiwala

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/c	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/c	LoS
	Scenario 2031									
10	Old Madras Road,Vivekananda Metro Station to Silk Board Junction via Indiranagar-Domlur- Madiwala	14318	1.59	F	7250	0.81	C	7067	0.86	C
	Scenario 2041									
10	Old Madras Road,Vivekananda Metro Station to Silk Board Junction via Indiranagar-Domlur- Madiwala	15765	1.75	F	8036	0.89	C	7729	0.83	C
	Scenario 2051									
10	Old Madras Road,Vivekananda Metro Station to Silk Board Junction via Indiranagar-Domlur- Madiwala	17213	1.91	F	8821	0.98	C	8391	0.80	C

Integrated Elevated flyover from Nagawara junction-Ramakrishna Hedgede Nagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road.

The model output indicates that the Level of service have changed from E from the base year 2031 to the Level of service E in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.38 LOS-E → V/c- 1.25 LOS-E

Existing Speed 25Kmph → Anticipated Speeds 25 Kmph

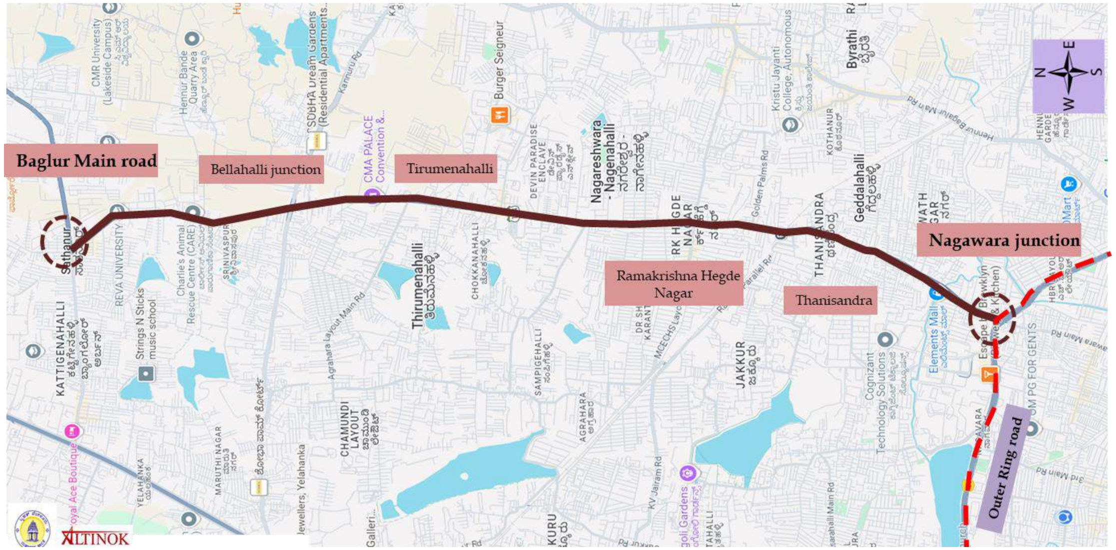


Table 168 : V/c & LoS Projections as per Travel demand from Nagawara to Baglur

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/c	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/c	LoS
	Scenario 2031									
11	Integrated Elevated flyover from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	8296	1.38	E	3230	0.36	B	5066	1.13	D
	Scenario 2041									
11	Integrated Elevated flyover from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	9371	1.27	D	4227	0.47	B	5144	1.19	D
	Scenario 2051									
11	Integrated Elevated flyover from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	10446	1.16	D	5224	0.58	C	5222	1.25	E

Elevated Corridor from Marenahalli main road connecting Kanakapura main road-Thalghattapura Nice road.

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service E in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.58 LOS-F → V/c- 1.50 LOS-E

Existing Speed Below 15Kmph → Anticipated Speeds 25 Kmph

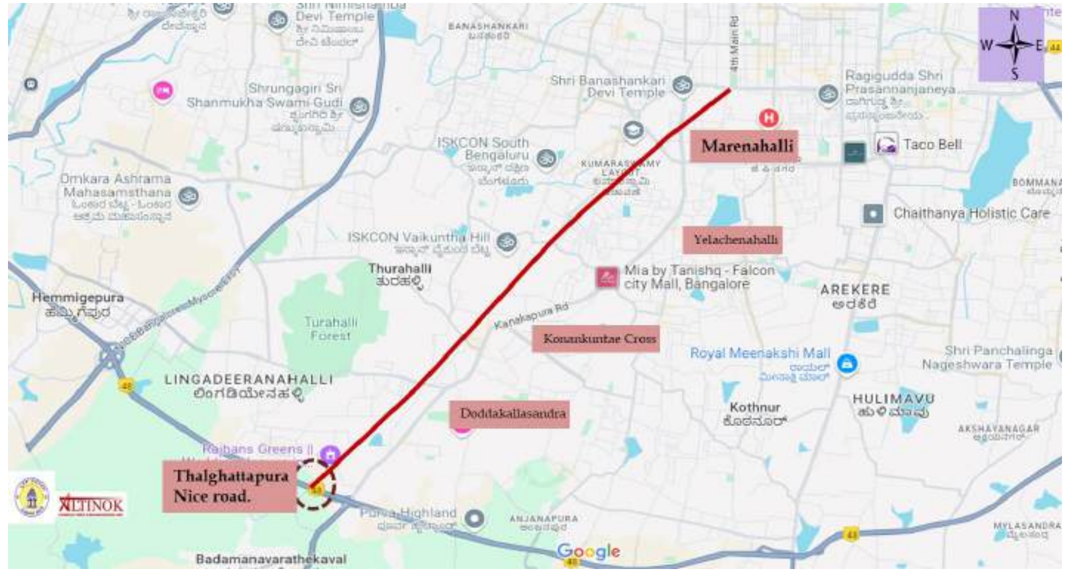


Table 169 : V/c & LoS Projections as per Travel demand from Marenahalli to Thalghattapura

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/c	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/c	LoS
	Scenario 2031									
12.B	Elevated Corridor from Marenahalli main road connecting Kanakapura main road-Thalghattapura Nice road	9469	1.58	F	4128	0.46	B	5341	0.85	C
	Scenario 2041									
12.B	Elevated Corridor from Marenahalli main road connecting Kanakapura main road-Thalghattapura Nice road	11022	1.49	E	4622	0.51	C	6401	1.17	D
	Scenario 2051									
12.B	Elevated Corridor from Marenahalli main road connecting Kanakapura main road-Thalghattapura Nice road	12576	1.40	E	5115	0.57	C	7460	1.50	E

Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction.

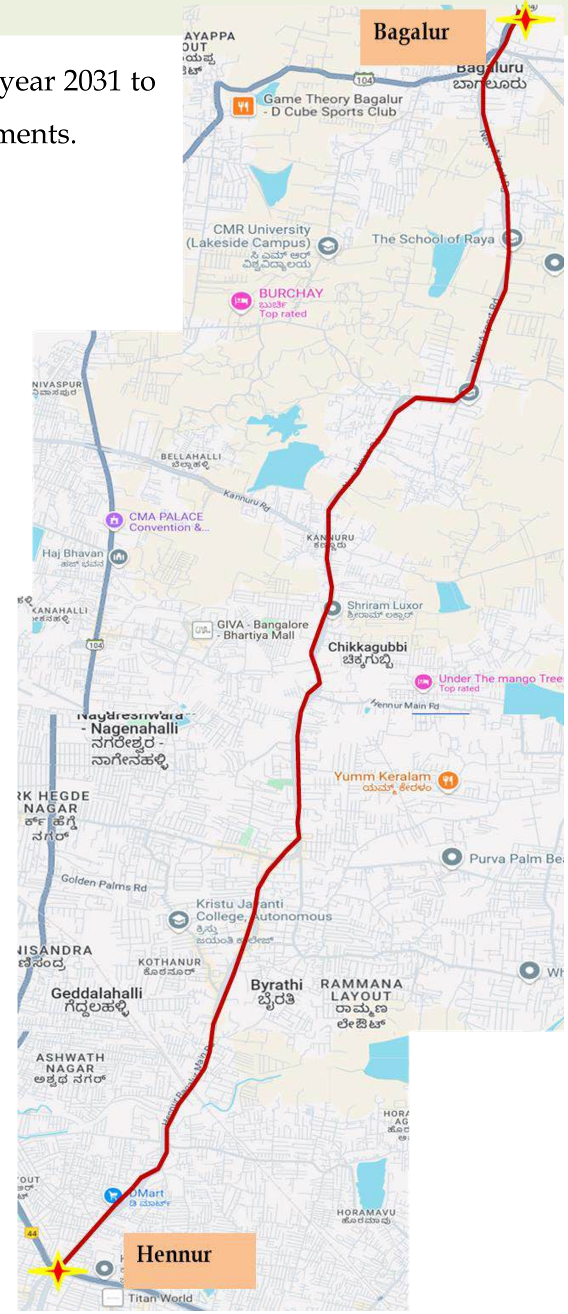
The model output indicates that the Level of service have changed from E from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-1.89 LOS-F → V/c- 0.65 LOS-C

Existing Speed Below 15kmhp → Anticipated Speeds 30kmhp

Table 170: V/c & LoS Projections as per Travel demand from Hennur to Baglur

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/C Ratio	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/C Ratio	LoS
	Scenario 2031									
14	Integrated Elevated flyover from Hennur to Baglur	11345	1.89	F	7894	0.88	C	3451	0.58	C
	Scenario 2041									
14	Integrated Elevated flyover from Hennur to Baglur	13387	2.231	F	8433	0.94	B	3421	0.57	C
	Scenario 2051									
14	Integrated Elevated flyover from Hennur to Baglur	14231	2.37	F	9356	1.04	C	3877	0.65	C



Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service B in the horizon year, justifying the proposed infrastructure improvements.

V/c-2.60
LOS-F

→

V/c- 0.65
LOS-**B**

Existing Speed
Below 15kmhp

→

Anticipated Speeds
40Kmph

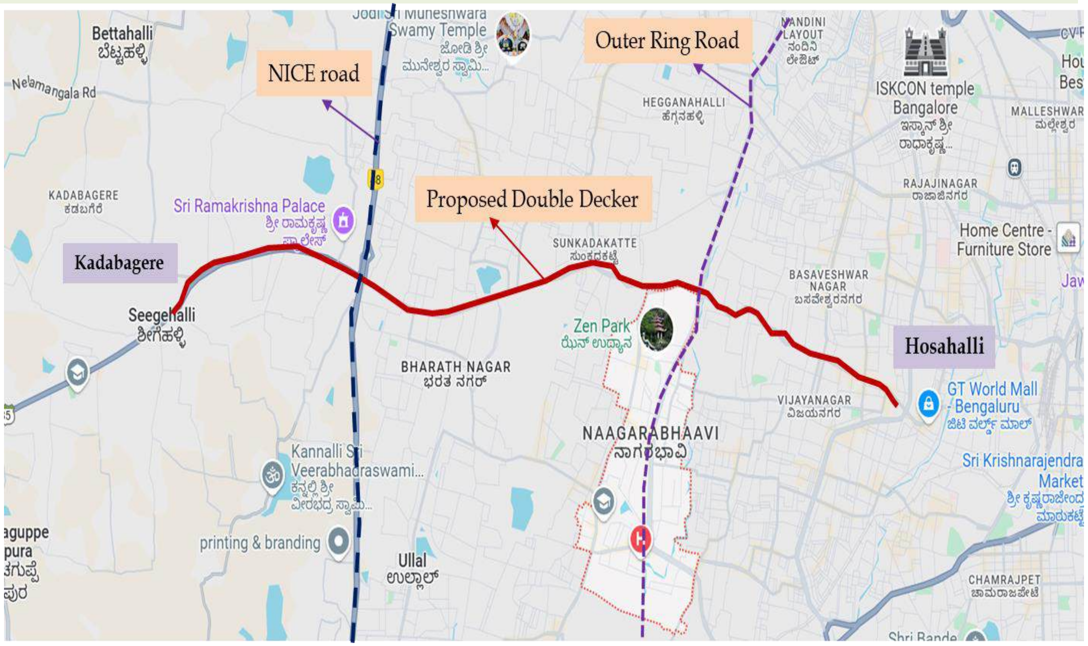


Table 171 : V/c & LoS Projections as per Travel demand from Hosahalli to Kadabagere cross

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/C Ratio	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/C Ratio	LoS
	Scenario 2031									
2	Double Decker from Hosahalli to Kadabagere cross	11703	2.60	F	5852	0.65	B	5852	0.65	B
	Scenario 2041									
2	Double Decker from Hosahalli to Kadabagere cross	15425	3.43	F	7713	0.86	B	7713	0.86	B
	Scenario 2051									
2	Double Decker from Hosahalli to Kadabagere cross	16046	3.57	F	8023	0.89	B	8023	0.89	B

North-South Tunnel Corridor from Hebbal to Silk Board

The model output indicates that the Level of service have changed from F from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-2.49
LOS-F

V/c- 0.63
LOS-**C**

Existing Speed
Below 15kmhp

Anticipated Speeds
30Kmph

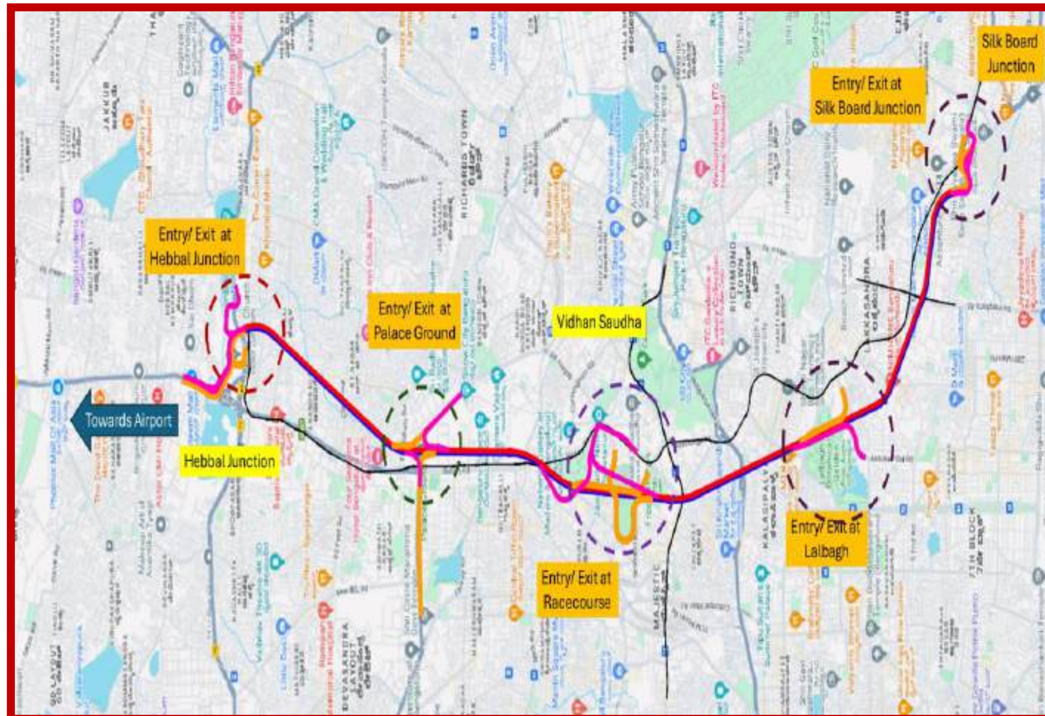


Table 172 : V/c & LoS Projections as per Travel demand from Tunnel (NORTH_SOUTH) from Hebbal to Silk Board

Corridor No.	Corridor	Total PCU's on Existing peak hour traffic on both the directions	V/C Ratio	LoS	Total PCU's On Elevated corridor both directional traffic	V/c	LoS	Total PCU's At grade traffic after the Elevated Corridor is developed	V/C Ratio	LoS
	Scenario 2031									
2	North - South Tunnel (from Hebbal to Silk board)	22407	2.49	F	7394	0.82	C	15013	1.67	F
	Scenario 2041									
2	North - South Tunnel (from Hebbal to Silk board)	17965	2.00	F	10779	1.20	D	7186	0.80	C
	Scenario 2051									
2	North - South Tunnel (from Hebbal to Silk board)	11567	1.29	F	6940	0.77	C	3788	0.63	C

East- West Tunnel Corridor from K.R.Puram to Nayandahalli

The model output indicates that the Level of service have changed from E from the base year 2031 to the Level of service C in the horizon year, justifying the proposed infrastructure improvements.

V/c-2.49
LOS-F

V/c- 0.63
LOS-C

Existing Speed
Below 15kmhp

Anticipated Speeds
30Kmph

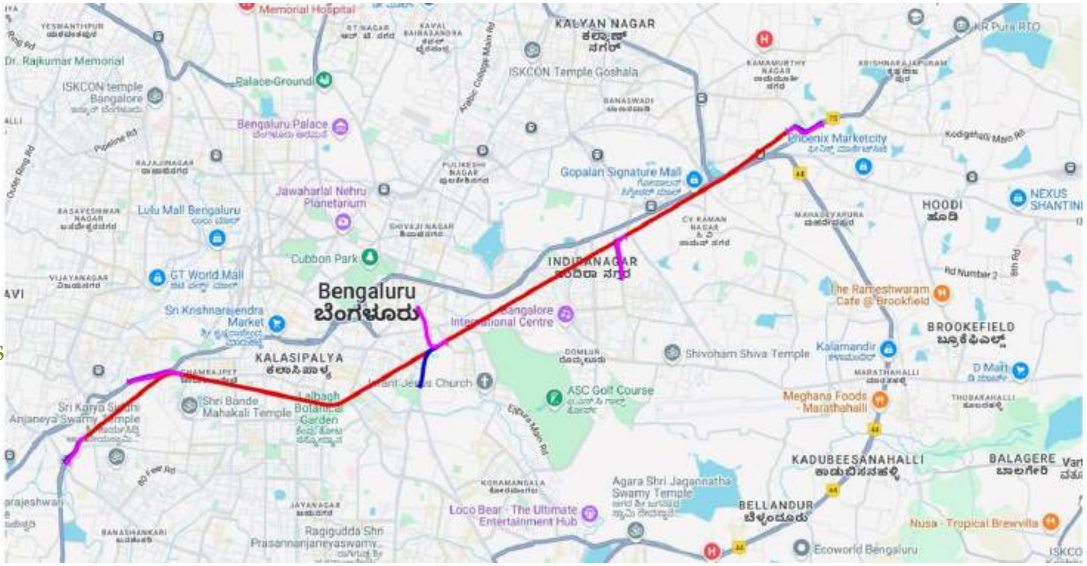


Table 172 : V/c & LoS Projections as per Travel demand from Tunnel (EAST_WEST) from K.R.Puram to Nayandahalli

Corridor No.	**Corridor**	**Total PCU's on Existing peak hour traffic on both the directions**	**V/C Ratio**	**LoS**	**Total PCU's On Elevated corridor both directional traffic**	**V/c**	**LoS**	**Total PCU's At grade traffic after the Elevated Corridor is developed**	**V/C Ratio**	**LoS**
	Scenario 2031									
2	East-West Tunnel (from K.R.Puram to Nayandahalli)	16223	1.80	F	8112	0.90	C	8112	0.90	C
	Scenario 2041									
2	East-West Tunnel (from K.R.Puram to Nayandahalli)	17432	1.94	F	10459	1.16	D	6973	0.77	C
	Scenario 2051									
2	East-West Tunnel (from K.R.Puram to Nayandahalli)	10134	1.13	F	6080	0.68	C	3788	0.63	C


08.
Environmental
Impact
Assessment

INTRODUCTION

This report has been prepared as per the EIA Notification, 2006 & its amendments and the guiding document EIA Guidance Manual for Highway project.

The Objectives of the EIA study are as follows:

i. To describe the proposed project and associated works together with the requirements for carrying out the proposed development.

ii. To identify and describe the elements of the community and environment likely to be affected by the proposed development

iii. To identify and quantify emission sources and determine the significance of impacts on sensitive receptors.

iv. To identify, predict and evaluate environmental and social impacts during the construction and usage of the project in relation to the sensitive receptors.

v. To develop an Environmental Management Plan that identifies the negative impacts and develops mitigation measures so as to minimize pollution, environmental disturbance and nuisance during the construction and operations of the development.

Bangalore's population has grown dramatically in the last decade, and the city now ranks among the top metropolitan areas in the country, both in terms of population and in terms of the economic activity. The city has undergone a rapid transformation into one of the most storied economic centres of the world and attracted millions of job-seeking migrants.

Increasing traffic volumes and its associated adverse impacts on congestion and air quality is a key problem in Bangalore and elsewhere in India and this situation is likely to deteriorate further. Addressing the issue of travel demand solely through largescale road construction is neither a viable nor a sustainable option as the impact on our local communities would be huge in terms of the environment, land take, property demolition and isolation. The need, therefore to find other solutions that can meet peoples' desire to travel, by creating a Traffic Management Study plan that includes both short-term and long-term, the ones that can begin to grapple with the complex demands of traffic and transport management.

Table .173 The corresponding is the list of proposed Elevated corridors, underpasses and Tunnels in Bangalore

Sl. No	Corridor	Length kms
1	Split Flyover at MEI Junction	0.5
2	Yeshwanthpura (Mathikere cross) -IISC-Mekri circle-Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram.	27
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	2.7
4	Proposed flyover / Underpass at Konankuntae Cross for Through Traffic from Kanakapura to Banashankari	0.9
5	Proposed Flyover at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road	0.8
6	Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road	1.7
7	Extension of Existing Madiwala underpass till Traffic police station junction	0.5
8	Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction -Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	7.4
9	Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road	3.5
10	Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala	10
11	Proposed Elevated Corridor from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	15
12	Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.	**10.5**
13	Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction	15

Sl. No`	Corridor	Length Kms
14	Proposed Elevated Corridor along Tannery road from Madava Mudiliyar road to Nagawara Junction.	5.5
15	Proposed Elevated Corridor from Yelahanka New town to Kempegowda International Airport Road	4
16	Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout).	4.5
DD1	Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.	13
DD2	Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station via Mohan Kumar Road.	2.2
T1	Proposed North – South Tunnel Corridor from Hebbal to Silk Board	18
T2	Proposed East- West Tunnel Corridor from K. R. Puram (I.T.I Colony) to Nayandahalli NICE intersection	28
	Total Length	170.7
	Total Length of Tunnels	46
	Total length of Elevated corridors/ Double Deckers/ Underpasses	124.7

POLICY AND FRAMEWORK:

Review of environmental regulations indicates that the project requires Prior Environmental Clearance from MoEFCC. However, permission for cutting the trees within the proposed right of way of the project road will be required from the Forest Department. In addition to the above, the concessionaire would require the following NOCs & licenses from the authorities during construction:

1. NOC and Consents under Air Act, Water Act, EP Acts & Noise Rules from Karnataka SPCB for establishing and operation.
2. NOC under Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 20019 from SPCB.
3. PUC certificate for use of vehicles for construction from Department of Transport.
4. Quarry lease deeds and license and Explosive license from State Dept. of Geology and Mines & Chief controller of explosives.
5. NOC for water extraction for construction and allied works from Ground Water Authority Apart from the above clearances, the Concessionaire also has to comply with the following:
   a. Clearance for location and layout of Worker's Camp, Equipment yard and Storage yard.
   b. Clearance for Traffic Management Plan for each section of the route after it has been handed over for construction.
   c. An Emergency Action Plan should be prepared by the Contractor and approved by the Engineer for accidents responding to involving fuel & lubricants before the construction starts.
   d. Submit a Quarry Management Plan to the Engineer along with the Quarry lease deeds.

TABLE 174. General Impacts on Environment

Environment -al Components	**Pre - Construction Phase**	**Construction Phase**							**Operation Phase**
	Land acquisition	Removal of structures	Removal of trees and Vegetation	Earth works including quarrying	Laying of Pavement	Vehicle & Machine Operation & maintenance	Asphalt & Crusher	Sanitation & waste (labour campus)	Vehicle operation
Land	Loss of Productive Land	Generation of Construction Debris	Erosion and loss of top fertile soil	Erosion and loss of top fertile soil	Reduction of ground water recharge area due to compaction	Contamination by fuel & lubricants compaction of soil	Contamination compact ion of soil	Contamination from wastes disposal	Spill from accidents
Air		Dust generation during dismantling, handling of construction materials	Reduced buffering of air & noise pollution, Hotter, drier microclimate	Dust generation	Asphalt odour and emission	Noise, dust pollution	Noise, soot, odour, dust pollution	Odour/Smoke	Noise, dust pollution, gaseous emission
Water	Loss of water Resources	Siltation due to loose earth	Siltation due to loose earth	Alteration of drainage, break in continuity of ditches Siltation, Stagnant water pools in quarries		Contamination by fuel & lubricants	Contamination by asphalt leakage or fuel	Contamination from wastes Overuse	Spill Contamination by fuel, lubricants & washing of vehicles
Noise		Noise pollution	Noise pollution due to machinery	Noise Pollution		Noise Pollution	Noise Pollution		Noise Pollution

TABLE 175 . General Impacts on Environment

Environment-al Components	Pre - Construction Phase	Construction Phase							Operation Phase
	Land acquisition	Removal of structures	Removal of trees and Vegetation	Earth works including quarrying	Laying of Pavement	Vehicle & Machine Operation & maintenance	Asphalt & Crusher	Sanitation & waste (labour campus)	Vehicle operation
Flora	Loss Flora	Loss of Biomass		Lowered productivity loss of ground for vegetation n		Removal of Vegetation	Lower productivity Use as fuel wood	Felling trees for Fuel	Impact of pollution on Vegetation, Toxicity of Vegetation
Fauna			Disturbance, habitat loss	Disturbance		Disturbance	Disturbance	Poaching	Collision with vehicular traffic
Agricultural land		Change in land use	Loss of land economic value	Loss of standing crops	Loss of productive land				
Buildings and built-up structures			Loss of structures, Debris generation, noise and air pollution		Noise vibration may cause damage to structures		Noise vibration - damage to structures		Vibration and Noise

TABLE 176 . General Impacts on Environment

Environment-al Components	**Pre - Construction Phase**	**Construction Phase**							**Operation Phase**
	Land acquisition	Removal of structures	Removal of trees and Vegetation	Earth works including quarrying	Laying of Pavement	Vehicle & Machine Operation & maintenance	Asphalt & Crusher	Sanitation & waste (labour campus)	Vehicle operation
People and community	Anxiety and fear among community		Displacement of people psychological impact on people loss of livelihood	Loss of shade and community trees, loss of fuel wood and fodder	Noise & air Pollution	Odour and dust	Noise & air pollution collision with pedestrians livestock and vehicles	Community clashes with migrant labour	Noise pollution, Risk of accidents
Cultural assets			Displacement of structures from Row	loss of sacred trees	Noise vibration may cause damage to structures		Damage from vibration and air pollution		Damage from vibration and air pollution
Utilities & amenities			Interruption in supply				Damage to utility and amenities	Pressure on Existing amenities	
Labour's health & safety					Increase of Stagnant water and diseases	Asphalt odour and dust	collision with pedestrians livestock and vehicles	Increase in communicable diseases	collision with pedestrians livestock and vehicles

KEY FINDINGS OF THE CONSULTATION

Major findings related to key issues identified, till date during screening survey and detailed social survey (being carried out), such as general perception about the project; suggestions to mitigate hardships resulting from dislocation and loss of livelihood are presented below:

a. It was observed that people are not only aware of the project but also welcomed the project in general. However, some PAPs (People affected by a project) .have shown their concern due to acquisition of their properties.

b. The PAPs in general and specially the legal titleholders were very much concerned about the mode of compensation.

c. People want that their views should be considered in every matter where it counts for new road options.

d. They requested for facilities and amenities like underpasses, bus stand and safer accessibility at points of habitant's area.

e. Affected population wanted to know about the exact period when the work will start. Sufficient time should be given before the acquisition in order to avoid any inconvenience.

f. People requested about creation of employment opportunities during road construction and later phases of the project.

g. People suggested that adequate safety measures should be provided such as speed breakers, signage's etc. In brief, it was felt during consultation that regular meeting with the local population / community could easily resolve any dispute between the community people and implementing agency settlements. Service road is one of the concerns of the people. They wanted to know whether service road is considered in the design or not.

h. The RAP shall address the social issues brought to the fore during the public consultations.

i. The EMP – both generic and specific would be designed to address environmental related issues.

Summary Of Environmental Monitoring And Documentation Plan

a. Environmental Monitoring Program during Construction period

Based on the above, the following environmental monitoring program during construction activities is proposed for proposed project Proponent. The monitoring program would be discussed and approved by SPCB and has been shown in Table 177

Table 177 Proposed Monitoring Program for Construction Phase

Sr. No.	Type	Locations	Parameters & Frequency	Period and Frequency
1	DG Stack Emissions Monitoring	Stacks of all operating DG set	Particulates, SO2, NO2, CO Quarterly	As per CPCB & SPCB requirements
2	Ambient Air Quality Monitoring	Project Site	PM10, PM2.5, SO2, NO2 and CO Quarterly	As per CPCB & SPCB requirements
3	DG Noise Monitoring	All DG sets at Project Site	To check the effectiveness of Acoustic enclosure. Quarterly	As per CPCB & SPCB requirements
4	Ambient Noise Monitoring	Project site	Noise level both during daytime and nighttime Quarterly	As per CPCB & SPCB requirements
5	Water Quality Testing	Nearest operational bore well	Drinking water parameters as per IS 10500 Quarterly	As per CPCB & SPCB requirements

Six monthly Environmental Compliance report to be submitted regularly based on the EC conditions.

a. Post-Project Environmental Monitoring Program

Based on the above, the following post-project environmental monitoring program is proposed for the proposed project. The monitoring program would be done as per the standard practice and guidelines of CPCB/SPCB. Monitoring parameters has been shown in Table 178.

Table 178 Proposed Monitoring Program for Operational Phase

S. No.	Type	Locations	Parameters & Frequency	Period and Frequency
1	Stack Emissions Monitoring	All Stacks proposed to be installed in the project.	Particulates, SO2, NO2, CO Quarterly	As per EC Conditions and CPCB/ SPCB requirements
2	Ambient Air Quality Monitoring	Project Site	PM10, PM2.5, SO2, NO2 and CO Quarterly	As per EC Conditions and CPCB/ SPCB requirements
3	Ambient Noise Monitoring	Project site	Noise level (db) both during daytime and night time. Quarterly	As per EC Conditions and CPCB/ SPCB requirements
4	DG Noise Monitoring	All DG sets at Project Site	To check the effectiveness of Acoustic enclosure. Quarterly	As per EC Conditions and CPCB/ SPCB requirements
5	Water Quality Testing	From Drinking Water Points	Drinking water parameters as per IS 10500. Quarterly	As per EC Conditions and CPCB/ SPCB requirements
6	Treated Wastewater Quality	Inlet and outlet of the STP	Parameters for assessing compliance with standards for Recycling and horticulture use. Quarterly	As per EC Conditions and CPCB/ SPCB requirements

ENVIRONMENT MANAGEMENT CELL

An Environment Management Cell (EMC) to be constituted, which will be responsible for implementation of the EMP during Construction and Operation Phase of the project. The composition of the proposed Environment Management Cell and responsibilities of its members and responsibilities of Environment Management cell is mentioned in Fig. 469.

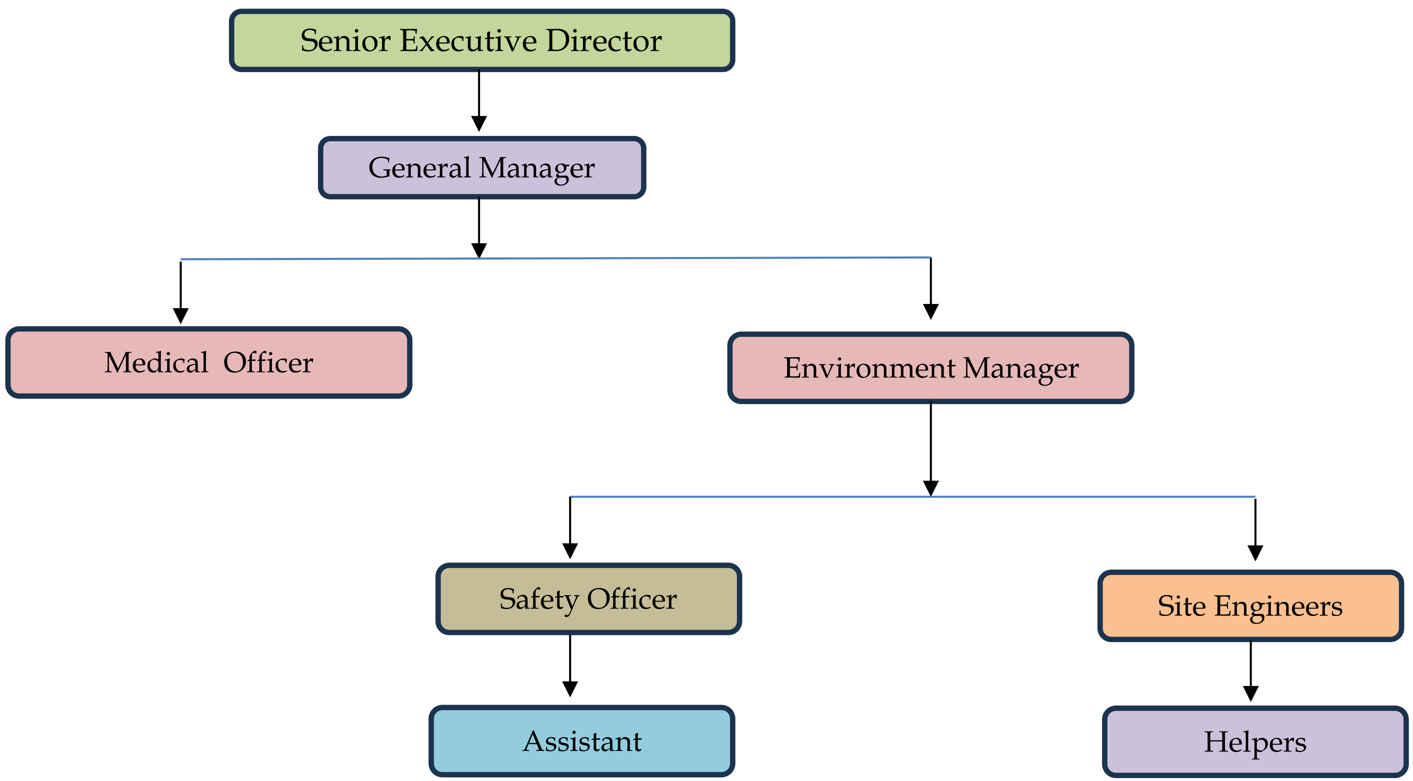


Figure 469 .General Structure of Environment Management Cell

Table 179. Responsibilities of Environment Management Cell

S. No.	Designation	Proposed Responsibility
1.	Senior Executive Director	**Environmental policy and directions**
2.	General Manager	**Secondary responsibility for environment management and decision making for all environmental issues**
3.	Medical Officer	**Responsibility for Health Hazards if any.**
4.	Environment Manager	• **In-charge of operation of environment management facilities** • **Ensuring legal compliance and interaction with regulatory agencies**
5.	Safety officer	**Responsible for all safety aspects at the work place**
6.	Site Engineers	**Ensure environmental monitoring as per requirements of the statutory body**
7.	**Assistant & Helper**	**Will assist the seniors for day-to-day activities.**

ENVIRONMENTAL DOCUMENTATION

Documentation and reporting of environmental performance is an important management tool for ensuring sustainable operation of the proposed project both during Construction and operation Phase. Documents/Records will be maintained for regulatory, monitoring and operational issues. Documentation requirements for the proposed project by the PP are summarized in Table 180

Table 180. Environmental Documentation for Construction and Operational Phase

Parameter	Particulars
Air Emissions (incl. Noise)	• **Consent to Establish from SPCB** • **Consent to Operate for Air Emissions from SPCB** • **Operational details of DG sets and air pollution control equipment including number of hours of operation, fuel usage, etc.** • **Ambient Air Quality and DG Stack Emissions Monitoring records** • **"Type Approval Certificates" and "Conformance Labels" for the DG sets** • **Ambient Noise Monitoring Records**
Water Supply	• **Water Quality Monitoring records**
Wastewater Discharges	• **Consent to Establish from SPCB** • **Consent to Operate for Wastewater Discharges from SPCB** • **Details of quantity of wastewater discharged from various sources and discharged from the outlet of the STP for recycling.** • **Operational details of STP including number of hours of operation, chemical usage, in-process wastewater quality, electricity requirements etc.** • **Wastewater Quality and Quantity Monitoring records**
Waste Management	• **Agreement for disposal of solid wastes.** • **Wastes Management Inventory including details of quantity of wastes generated on-site and mode of their disposal.** • **Inventory of wastes stored on-site** • **Records of hazardous wastes stored on-site (in Form-3)** • **Annual Returns for hazardous wastes (in Form-4) to SPCB.** • **Annual Returns for E-wastes (in Form-3) to SPCB.** • **Documentation related to off-site transportation and disposal of hazardous wastes (including Form-9 and Form-10)**

REPORTING SCHEDULE

The rational for a reporting system is based on accountability to ensure that the measures proposed as part of the Environmental Monitoring Plan get implemented in the project both during the Construction Phase and Operation phase. The monitoring and evaluation of the management measures are critical activities in implementation of the project. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for the project management to keep the program on schedule. The rational for a reporting system is based on accountability to ensure that the measures proposed as part of Environmental Management Plan get implemented in the project.

Table 181. Reporting Schedule

Sr. No.	Details	Indicators	Stage	Responsibility
A	**Pre-Construction Stage: Environmental Management Indicators & Monitoring Plan**			
1	Suitable location for dumping of excavated soil and wastes has to be identified.	Storage Location for Excavated Soil Dumping Locations	Pre- construction	**Projects / Contractor**
2	Suitable location for construction worker camps have to be identified (if applicable) and parameters indicative of environment in the area has to be reported	Construction camps	Pre- construction	**Projects / Contractor**
3	Construction of 10mtr high wind breaking wall as per the Notification issued by the Government.	Wind Breaking wall	Pre- construction	**Projects / Contractor**
B	**Construction Stage: Environmental Condition Indicators and Monitoring Plan**			
1.	Dust suppression at construction site	Construction site	Construction	**Projects / Contractor**
2	The parameters to be monitored as per frequency, duration & locations of monitoring specified in the Environmental Monitoring Programme	Air quality	Construction	**Projects through approved monitoring agency**
3	Treatment of sewage to be generated from the Labour camp.	Sewage Treatment	Construction	**Projects / Contractor**
4.	Waste Collection and disposal from the labour camp	Waste management	Construction	**Projects / Contractor**
5.	Suitable location for collection and storage of Construction and Demolition (C&D) waste	Storage location for C&D waste	Construction	**Projects / Contractor**
6.	05 number of full grown Tree Cutting	Tree Cutting	Construction	**Projects / Contractor**
C	**Operation Stage: Management & Operational Performance Indicators**			

Sr. No.	Details	Indicators	Stage	Responsibility
1	Solid waste generation, utilization and disposal	As per the notifications/ guidelines specified by statutory authorities	Operation	EMC
2	Hazardous waste re-utilization disposal.	As per the notifications/ guidelines specified by statutory authorities.	Operation	EMC
3	Stack Emissions	All parameters as specified for stacks	Operation	EMC
4	Meteorology, Ambient air quality, Waste water discharge	All parameters as specified by Statutory Authorities	Operation	EMC

ANALYSIS OF ALTERNATIVES

The chapter discusses how environmental parameters were assigned due importance and were carefully considered in the analysis of alternatives.For this project no alternative site will be used

Mitigation, Avoidance and Enhancement Measures

INTRODUCTION

The negative impacts of road projects can be reduced or minimized only if proper safeguards are put in place during the design and construction stage itself. These can include reducing pollutant discharge from the harmful activities at source or protecting the sensitive receptor. An effective mitigation strategy will utilize a combination of both options to arrive at practically implementable measures.

Mitigation Measures Proposed

These measures will fully and adequately incorporate in the Environmental Management Plan prepared.

Meteorological Parameters

The microclimate will be likely to be temporarily modified by vegetation removal, loss of roadside plantations and the addition of increased pavement surface. Though no major change in the macro climatic setting (precipitation, temperature and wind) will be envisaged due to the project.

Land

Land acquisition, soil erosion and contamination of soil can be emerged as a major source of land impact. But the project will certainly increase the economic growth of that area.

Table 182. Projected Mitigation Measures for Impact on Land

S.No	Particular	Reason	Mitigation / Enhancement
1.	Change in Geology	Extraction of materials (borrow earth, coarse and fine aggregates)	• No blasting is envisaged. • Quarry Development Plan need to be enforced.
2.	Change in Seismology	-	• Cross drainage structures are checked and complied with the seismological settings of the region (Zone)
3.	Loss of land	Land Acquisition, Change in land use pattern	• Land acquisition minimized. LA only at locations which require geometric correction and where bypasses are proposed
4.	Generation of Debris	May contaminate air, water and land, if not disposed properly	• Disposed properly to avoid contamination
5.	Soil Erosion	Road slopes and spoils Construction of new bridges and culverts Quarry and Borrow areas	• Residual spoil needto be disposed properly • Silt Fencing need to be provided • Quarries need to be reclaimed
6.	Contamination of Soil	Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix and Production of hot mix and rejected materials Residential facilities for the labour and officers Routine and periodical maintenance	• Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. • Oil Interceptor will be provided for accidental spill of oil and diesel • Rejected material will be laid as directed by engineer. • Septic tank will be constructed for waste disposal.
7.	Soil quality Monitoring	Effectiveness / shortfall (if any) Any unforeseen impact	• Measures will be revised & Improved to mitigate / enhance environment due to any unforeseen impact.

Soil

Table 183 *Projected Mitigation Measures for Soil Contamination*

Potential impact	Mitigation
Scarified Bituminous Wastes	• No scarification involved. • In case concessionaire decides to scarify then the material to be reused in the GSB layer. • Non reusable Bituminous wastes to be dumped in 30cm thick clay lined pits with the top 30cm layer covered with good earth for supporting vegetation growth over a period only after obtaining permission of Independent Engineer.
Scarified Non Bituminous Material	Used in the normal GSB layer (not the drainage layer)
Cut material	Reused as embankment, median & shoulder fill materials Excess material to be used for filling up of borrow areas identified by the concessionaire and approved by the Independent Engineer
Construction debris generated from dismantling of structures	Guidelines for Identification of Debris Disposal Sites & Precautions needed Guideline for Rehabilitation of Dumpsites & Quarries will be applicable
Soil Contamination due to accident spills	An emergency response team to be created. The team shall contain members of the district and police administration and also have specialist in remediation. Responsibility of Concessionaire to inform the team to take actions. The roles and responsibility of the members of the ram shall be framed in conjunction with all the parties to address the situation arising out of the accidental spills resulting in situation like water and soil contamination, health hazards in the vicinity of the accident spot, fire and explosions etc.
Soil contamination due to Highway run off	Improvements of design shall lead to less accidents and hence less spillage of oil and grease
Soil Contamination during construction stage from fuel spills	• Fuel storage will be in proper bunded areas. • All spills and collected petroleum products to be disposed off in accordance with MoEFCC and SPCB guidelines and as per the directions of the Emergency Response team. • Fuel storage and fueling areas will be located at least 300m from all cross drainage structures and significant water bodies.

Productive top soil

To conserve the productive top soil the following measures can be proposed:

a) The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles.

b) To retain soil and to allow percolation of water, silt fencing shall protect the edges of the pile.

c) The stockpiles shall be covered with gunny bags or tarpaulin.

d) Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes, medians, incidental spaces etc.

Soil quality monitoring – Mitigation

The quality of the soil shall be monitored to find out the effectiveness of the mitigation measures and further improvement in designs if required. The monitoring plan shall be functional in construction as well as in operation stages.

Air Mitigation

Table 184. Projected Mitigations Measures for Impacts on Air Quality

S.No.	Item	Reason	Mitigation / Enhancement
1.	Meteorological factors and climate	Due to production and laying of hot bituminous mix	• Comprehensive afforestation • Avenue plantation • Shrub plantation in the median / island
2.	Dust generation	Shifting of utilities, removal of trees & vegetation, transportation of material	• Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Plant to be installed in down wind direction from nearby settlement.

3.	Gaseous pollutants	Clearing and grubbing materials dumping brushing of the surface access roads to borrow area hot mix plants, Crushers paving of asphalt layers, Labour Camps	• Air pollution Norms will be enforced. • Labourers will be provided mask. • Local people will be educated on safety and precaution on access • roads, newly constructed embankment etc.
4.	Air quality emissions	Air pollutants from traffic	• Compliance with future statuary • regulatory requirements
5.	Air quality monitoring	Effectiveness shortfall of any unforeseen impact	• Measures will be revised & • improved to mitigate enhance

Air quality monitoring

Apart from provision of the mitigation measures, ambient air quality shall be monitored regularly during construction phase of the project. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan.

Water Mitigation

Table 185. Projected Mitigation Measures for Impacts on Water

S. No.	Item	Reason	Mitigation / Enhancement
1.	Loss of water bodies	Part or complete acquisition of source of water	Land acquisition to be minimized with provision of Retaining walls. Relocation of ground / surface water sources
2.	Alteration of Cross Drainage/River	Major bridge constructions Widening of minor bridges and culverts.	Widening & construction of bridges, there will be an improvement in the drainage characteristics of the project area.
3.	Runoff and drainage	Siltation of water bodies Reduction in ground recharge Increased drainage discharge	Silt fencing to be provided. Recharge well to be provided to compensate the loss of pervious surface. Continuous drain is provided, unlined in rural area and lined in urban area.

4.	Water requirement for project	Water requirement for construction activity. Water requirement for labour.	Contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources. This is required to avoid depletion of water sources. Water harvesting structures to be provided.
5.	Increased sedimentation	Increased sediment laden run-off after the nature and capacity of the watercourse	Silt fencing to be provided Instructions given in Guidelines for Sediment Control to be enforced.
6.	Contamination of Water	Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix. Production facilities for the labour and officers. Routine and periodical maintenance.	Hazardous wastes (Management, Handling and Trans-boundary Movement) Rules, 2008 to be enforced. Oil Interceptor will be provided for accidental spill of oil and diesel. Rejected material will be laid as directed by IC. Septic tank will be construction for waste disposal.
7.	Water quality monitoring	Effectiveness / shortfall (if any) Any unforeseen impact.	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

Water Quality Monitoring

Apart from provision of the mitigation measures, water quality shall be monitored to understand the effectiveness and further improvement in designs in reducing the concentration of pollutants. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan.

Noise Mitigation

The contribution of project design towards mitigation of increased noise levels would be the improved riding surface and geometry, which will reduce vehicular noise generation, at least during the initial years after construction. The mitigation measures for noise are essentially aimed at protecting the receptor.

Table 186. Sources of Noise Pollution, Impacts and Generic Mitigation Measures

S. No	Item	Reason	Mitigation / Enhancement
1.	Sensitive receptors	Increase in noise pollution Man, material and machinery movements.	• Noise barrier to be provided • Traffic calming devises to be used. • No Horn Zone sign Post
2a.	Noise Pollution (Pre- Construction Stage)	Establishment of labour camps, onsite offices, stock yards and construction plants	• Area specific and for short duration. • Machinery to be checked and complied • With noise pollution regulations. • Camps to be setup away from the • settlements, in the down wind direction
2b.	Noise Pollution (Construction Stage)	Stone crushing, asphalt production plant and batching plants, diesel generators etc. Community residing near to the work zones.	• Camps to be setup away from the settlements, in the down wind direction. • Noise pollution regulation to be monitored and enforced. • Temporary as the work zones will be • Changing with completion of construction.
2c.	Noise Pollution (Operation Stage)	Due to increase in traffic (due to improved facility)	Will be compensated with the uninterrupted movement of heavy and light vehicles
3.	Noise Pollution Monitoring	Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised and improved to mitigate / enhance environment due to any Unforeseen impact.

The effectiveness of mitigation measures and further improvement in designs to reduce the noise level due to construction and operational activity shall be monitored. The frequency, duration and monitoring plan shall be functional in construction as well as in operation stages as per the Environmental Monitoring Plan.

BIOLOGICAL ENVIRONMENT

Flora

The major adverse impacts on flora shall involve the removal of trees, shrub and ground cover from within the Corridor of Impact.

Table 187. Biological Environment

S.No.	Item	Reason	Mitigation / Enhancement
1.	Forest area	Acquisition of forest land	• Minimum diversion of forest land • Bearing the cost for NPV • Bearing the cost for Compensatory Afforestation
2.	Wild Life	Presence of Wild Life Sanctuary or National Park within 10 Km radius	• Not Applicable
3.	Trees Cutting	Increase in soil erosion, silting of water bodies. Dust and noise pollution Loss of shade and loss of tree products	• Compulsory tree plantation • Option of compensatory afforestation through Forest Department. • Avenue plantation along corridor, where ever possible. • Transplantation of trees also explored.
4.	Vegetation	Increase in soil erosion, silting of water bodies, noise pollution, dust pollution	• Clearing and grubbing will be minimized, and sprinkled with water to reduce dust pollution. • Exposed surface like embankment slopes will be protected with stone pitching and turfing. • Open land in and around plant will be vegetated.

Fauna

The following measures need to be taken up during the construction stage by the contractor and the concessionaire:

- All works are to be carried out such that minimum damage and disruption to fauna is caused.
- Construction workers shall be instructed to protect natural resources and fauna, including wild animals and aquatic life.
- Hunting and unauthorized fishing shall be prohibited.
- During construction, at any point of time, if a rare / endangered / threatened fauna species is spotted, the contractor and the concessionaire shall make all arrangements to intimate the wild life authorities and measures will be taken as for is conservation during the operation period also.

SOCIAL ENVIRONMENT

Entire corridor will acquire a pattern of urban stretches.

Loss of land

As far as possible the land acquisition has been kept to the minimum, by restricting the geometric improvement within the existing right of way.

Community/ cultural resources

The project proposes the relocation and replacement of all community resources likely to be impacted. Apart from replacing these community resources along the highway generic enhancement measures will be worked out for the enhancement of these resources.

Risks associated – mitigation

The contractor and the concessionaire will supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor and the concessionaire has to comply with all regulation regarding sage scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

Risks from electrical equipment

Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes.

Risks at hazardous activity

All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers will be provided with protective goggles and clothing band.

First Aid

At every workplace, a readily available first and unit including an adequate supply of sterilized dressing material and appliances will be provided as per the Factory Rules. Suitable transport will be provided to facilitate take injured or ill person(s) to the nearest applicable hospital.

Potable water

In every workplace at suitable and easily accessible places a sufficient supply of cold potable water (as per IS) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided.

Hygiene

The Contractor and the concessionaire during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer.

Enhancement

As part of good environmental practices, enhancement measures for water bodies and community properties shall be drawn after consultations with the community.

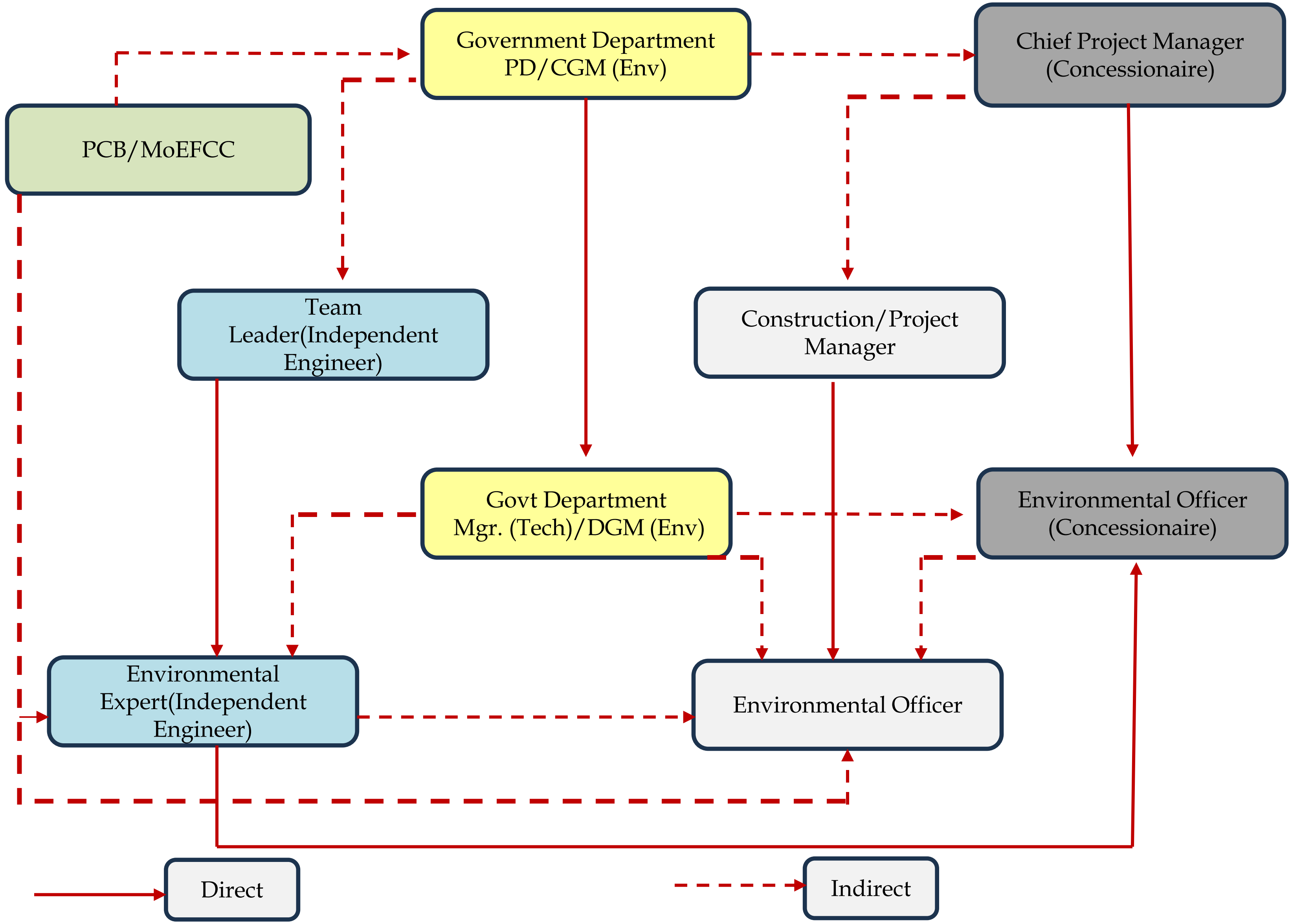


Figure 470. Proposed Organisation Chart

ENVIRONMENTAL MANAGEMENT PLAN

INTRODUCTION

The Environmental Management Action Plan (EMP) is required to ensure sustainable development of the road during construction and operational phases. EMP would be location and time specific. In general, Government Department (with assistance from Contractor / Concessionaire and Independent Engineer) is the responsible entity for ensuring that the mitigation measures will be carried out. The list provides reference (MoRTH specification), implementing organization and responsible entity.

Table 188. Environmental Management Plan

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Geometric Design	The proposed alignment is selected / adjusted (within IRC / MoRTH specifications) to minimize land disturbance to avoid culturally & environmentally sensitive areas – cultural properties, water bodies etc.		During alignment Design	**Concessionaire /Contractor**
Issues from stakeholder Consultations	Various issues raised were examined & suitably Incorporated based on merit & other road safety measures.		During Design	**Concessionaire /Contractor**
Impact on Cultural Properties	Provide access facilities and / or relocate the affected structure as per the mitigation measures recommended.	All along the project road	During alignment Design	**Concessionaire /Contractor**
Preservation of trees	**No tree will be cut beyond toe line.** **Identify incidental spaces for plantation of trees**		**During alignment Design**	**Concessionaire / Contractor**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Road safety issue due to poor geometrics	Design of Geometric improvements as per IRC codes and MoRTH Specifications		During alignment Design	**Concessionaire / Contractor**
Implementation of RAP and LA	All requirements of the RAP shall be complete before start of construction stage. The activities broadly include acquisition of structures, cultural properties, relocation of utilities, common property resources etc. The land acquisition will be done as per latest LA Act. Compensation will be paid to PAPs based on the RAP that includes the Entitlement Policy.	Right of Way (ROW)	Before construction starts	**NGOs, Collaborating Agencies, Grievance Redressal Cells (GRC), District Revenue authorities**
Soil Erosion and Sedimentation control	Main reason of soil erosion is rains. Concessionaire / Contractor should plan the activities so that No naked / loose earth surface is left out before the onset of monsoon, for minimizing the soil erosion following preventive measures to be taken such as: • Embankment slopes to be covered, soon after completion. • Next layer / activity to be planted, soon after completion of clearing and grubbing, laying of embankment layer.	Throughout Project corridor, Service roads and equipment storage sites, etc.	Upon completion of construction Activities at these sites. During construction	**Concessionaire / Contractor**
Relocation of Utilities	**All community underground and overhead utilities will be shifted as per Utility Shifting Plan, prior permission will be required from regional offices of Electricity, Telecomm-indications, OFC, Water works etc.**		**Post design to Pre-construction**	**R&R Officer, Concessionaire / Contractor**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Loss of drinking water source	Private drinking water source will replace according to RAP Temporary arrangements shall be provided, if the existing water supply is disrupted accidentally.		Post design to Preconstruction-on Concessionaire / Contractor	**Concessionaire / Contractor**
Cultural Properties	Cultural properties affected to be relocated as per RAP and Public Consultation. Mitigation / enhancement measures will be suggested for each of the cultural property individually.		Pre- construction	**Concessionaire / Contractor**
Removal of Vegetation	Vegetation will be removed from the ROW before the commencement of Construction after obtaining necessary permissions from the AP forest Department.	ROW	Before construction Starts After center line marking at site	**Concessionaire / Contractor**
Procurement of Crushers, Hot-mix plants & Batching Plants, other construction Vehicles, Equipment and Machinery	Specifications of crushers, hot mix plants and batching plants, other Construction Vehicles, Equipment and Machinery to be procured will comply to the relevant Bureau of Indian Standard (BIS) norms and with the requirements of the relevant current emission control legislations		Prior to mobilization at site	**Concessionaire / Contractor**
Setting up of construction camps	**The construction camps will be located away from habitations from sensitive locations.** **The Concessionaire / Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the IE.**	**All areas in immediate vicinity of construction campsite chosen by the Concessionaire/ Contractor and approved by the Independent Engineer (IE).**	**During Establishment , Operation And Dismantling of Such Camps.**	**Concessionaire / Contractor**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Setting up of Hot mix Plants and crushers Identification of dumping sites	Hot mix plants, crushers and batching plants shall be located away from the nearest habitation. The Concessionaire / Contractor shall obtain the consent to operate the plants from the SPCB and submit a copy to the Independent Engineer (IE).	All Hot mix Plants Batching Plants	During erection, testing, operation and dismantling of such plants	**Concessionaire / Contractor**
Identification of dumping sites	Location of dumping sites shall be finalized based on the guidelines & the Independent Engineer (IE) shall certify that : • These are not located within designated forest areas. • The dumping does not impact natural drainage courses and Settlements are located away from the site.	Throughout the corridor	During Mobilisation	**Concessionaire / Contractor**
Clearances and approvals	**Secure the following clearances prior to start of construction activity:** • **Top soil from borrow area, Debris disposal sites; borrow area, construction site to be protected /covered for soil erosion.** • **Debris due to excavation of foundation, dismantling of existing cross drainage structure will be removed from the water course immediately.** • **Diversions for bridges will be removed from the water course before the onset of monsoon**		**Construction stage (Prior to initiation of any work).** **Time period in getting the permission is 2-3 months**	**SPCB,CPCB, Chief Controller of Explosives, District Collector State Department of Mines, State Ground Water Board, State Irrigation Department, Labour Commissioner Officer(if applicable)**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Loss of agricultural top soil	All areas of cutting and all areas to be permanently covered will be stripped. The stockpiles will be covered with gunny bags or tarpaulin. It will be ensured by the Concessionaire / Contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles.	All along Project Corridor, where productive land is acquired	During construction	**Concessionaire / Contractor**
Compaction of Soil and Damage to Vegetation	Construction vehicles should operate within the Corridor of Impact avoiding damage to soil and vegetation. Diversions, access road used will be redeveloped by Concessionaire / Contractor, to the satisfaction of the owner / villagers. Construction vehicle, machinery and equipment shall move or be stationed in the ROW only.	Throughout Project Corridor and all areas temporarily acquired.	During construction	**Concessionaire / Contractor**
Contamination of soil	• **Guidelines of latest "Hazardous Waste Management Rule will be enforced.** • **Vehicle / machinery and equipment operation, maintenance and refuelling shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. An "oil interceptor" will be provided for wash down and refuelling areas** • **Fuel storage shall be in proper bunded areas. All spills and collected petroleum products shall be disposed off in accordance with MoEF&CC and SPCB guidelines at designated locations.** • **Plant to be set up away from surface water body.** • **Oil interceptor will be installed at construction site.** • **Septic tank will be constructed for safe disposal of waste.**	**At fuel storage areas – usually at construction camps, temporarily acquired site**	**During Construction.**	**Concessionaire / Contractor**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
1. **Quarrying** 1. **Material sources**	• Quarry material shall be sourced from approved and licensed aggregate and sand quarries. Copy of licenses to be submitted to the IE. • For operating new quarries, the Concessionaire / Contractor shall obtain materials from quarries only after consent of the DoF Adequate safety precautions shall be ensured during transportation of quarry material from quarries to the construction site. Vehicles transporting the • Material shall be covered to prevent spillage.		During Construction.	**Concessionaire / Contractor**
Generation of Debris	Debris generated due to the dismantling of the existing pavement structure shall be suitably reused in the proposed construction as fill materials for embankments	Throughout Project Corridor.	During Construction.	**Concessionaire / Contractor**
Disposal of Debris	**The disposal of debris shall be carried out only at sites identified for the purpose.**	**Sites identified by the Concessionaire / Contractor & approved by the Independent Engineer (IE).**	**During Construction.**	**Concessionaire / Contractor**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Equipment Selection, Maintenance and Operation	All vehicles, equipment and machinery used for construction shall conform to the relevant Bureau of Indian Standard (BIS) norms. • All vehicles, equipment and machinery used for construction shall be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of SPCB and the Independent Engineer (IE).	Throughout Project Corridor, all access roads, sites temporarily acquired and all borrow areas	During Construction.	**Concessionaire / Contractor**
Loss of water bodies/ surface / ground	• No excavation from the bund of the water bodies. • No debris disposal near any water body. • Prior written permission from authorities for use of water for construction activity will be submitted to IC. • Construction labours to be restricted from polluting the source or misusing the source. • Shifting of source to be completed prior to disruption of the actual source. • Construction work shall be restricted to 3m – 4m width from the existing formation near ponds.	Near all water bodies	During construction	**Concessionaire / Contractor**
Alteration of drainage	• **Diversions will be constructed during dry season, with adequate drainage facility, and will be completely removed before the onset of monsoon.** • **Debris generated due to the excavation of foundation or due to the dismantling of existing structure will be removed from the water course.** • **Temporary Silt fencing to be provided on the mouth of discharge into natural streams.**	**Throughout Project Corridor, all access roads, temporarily acquired sites**	**Whenever encountered during construction**	**Concessionaire / Contractor**

Environmental Impact/ Aspect	Mitigation Measures	Location	Time Frame	Responsibility Implementation
Runoff and drainage	Throughout continuous drain is provided. • Increased runoff due to increased impervious surface is countered through increased pervious surface area through soak pits and rain water harvesting structures		During Construction	**Concessionaire / Contractor**
Water requirement for project	• Prior to use of source Concessionaire / Contractor will take the written permission from authority, to use the water in construction activity, and submit a copy to IE. • During construction only permitted quantity (permission taken) from approved sources will be used. • Concessionaire / Contractor will ensure optimum use of water; discourage labour from wastage of water.	Throughout Project Corridor, all access roads, temporarily acquired sites	During Construction	**Concessionaire / Contractor**
Contamination of water	• **Measures suggested under "Contamination of soil" will be enforced.** • **Construction work close to water bodies will be avoided during monsoon.** • **Labour camps will be located away from water bodies.**	**All areas in immediate vicinity of construction campsite chosen by the Concessionaire /Contractor**	**Throughout construction period, During Establishment, Operation and Dismantling of Labour Camps**	**Concessionaire / Contractor**

ENVIRONMENTAL MONITORING PROGRAM

MONITORING OF EARTHWORKS ACTIVITIES

Most of the environmental problems related to the construction works may anticipated to be associated with the earthworks. Details regarding the guidelines and procedures adopted to minimize the environmental impacts of opening, operating and closing of Quarries and Borrow Areas.

Monitoring of Concessionaire / Contractor's Facilities, Plant and Equipment

All issues related to negative environmental impacts of the Concessionaire / Contractor's Facilities, Plant and equipment are to be controlled through:

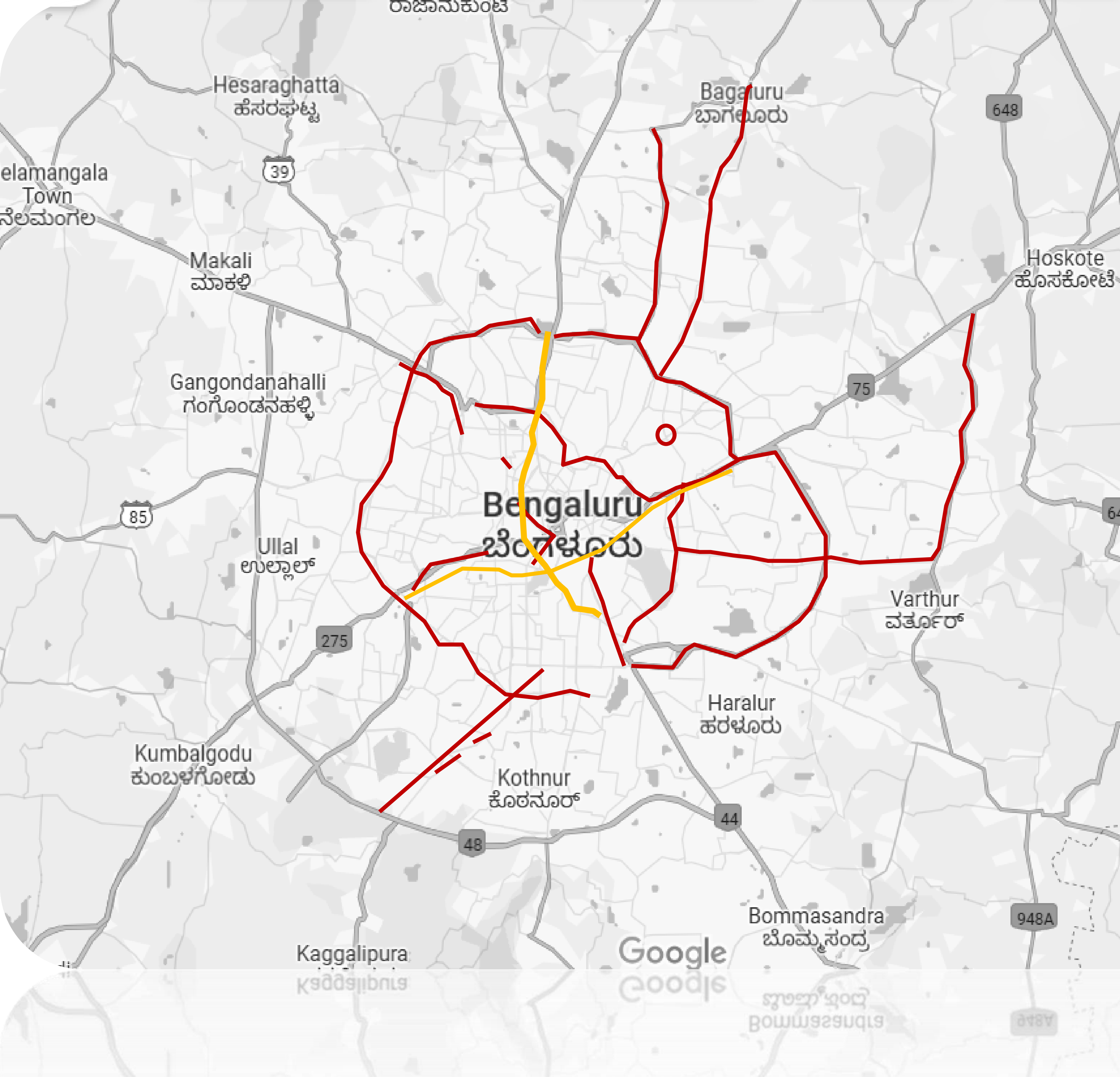
a. The Concessionaire / Contractor's self-imposed quality assurance plan

b. Regular / periodic inspection of the Concessionaire / Contractor's plant and equipment

c. Monthly appraisal of the Concessionaire / Contractor.

Other environmental impacts are to be regularly identified and noted on the monthly appraisal inspection made to review all aspects of the Concessionaire / Contractor's operation. The officer is to review all monthly appraisal reports, and through the team leader is to instruct the Concessionaire / Contractor to rectify all significant negative environmental impacts.

09. CONCLUSIONS



Conclusions

The consultants have identified key traffic issues and proposed countermeasures based on extensive traffic and transportation surveys, as well as the Comprehensive Mobility Plan (CMP) model for Bangalore. These measures aim to enhance mobility along the 18 identified corridors.

1.Traffic Analysis Findings:

- •The traffic volume-to-capacity (V/C) ratios for all the corridors have reached critical levels, with most operating at Level of Service (LOS) E or F, indicating severe congestion. Projections suggest that conditions will deteriorate further in the coming years.

2.Congestion and Saturation:

•All the identified corridors are currently operating at full capacity, with heavy congestion observed throughout the day, particularly during peak hours.

3.Signal Optimization:

•Existing traffic signals are incapable of managing the high traffic volumes. There is an urgent need to replace them with adaptive traffic signal systems to better regulate vehicular flow.

4.Intersection Redesign:

•Several intersections along these corridors require comprehensive redesigns and upgrades to align with current and projected traffic conditions.

5.Reduced Travel Speeds:

•During peak hours, vehicle speeds on many corridors have dropped to below 10 km/h, highlighting the severity of the congestion
•The level of service is has already reached to F and the anticipated speeds have increased up to 40 kmph for the year 2051 once the elevated corridors are built.

6.Proposed Long-Term Solution:

•To address issues such as severe congestion, long queues, high stress levels for commuters, and elevated carbon emissions, the consultants have recommended the construction of elevated corridors. These structures aim to provide seamless travel across the city by bypassing surface-level traffic bottlenecks.

•The proposal includes approximately 127 kilometers of elevated corridors, supplemented by two strategic tunnels:
  - •A **North-South tunnel** spanning 16 kilometers.
  - •An **East-West tunnel** extending 28 kilometers.

•Together, these measures are designed to offer a sustainable, long-term solution to Bangalore's mobility challenges, ensuring faster, more efficient, and less stressful travel across the city.

The proposed development of elevated corridors, vehicle underpasses, and tunnels offers a comprehensive and lasting solution to Bangalore's persistent traffic challenges. These infrastructure projects aim to drastically enhance travel efficiency by increasing vehicle speeds, improving road accessibility, and significantly reducing travel times. They are also expected to minimize stress and congestion, lower vehicle operating costs and fuel consumption, and contribute to better air quality by cutting down emissions.

A network of approximately 127 kilometers of elevated corridors, underpasses, and tunnels is envisioned to streamline the city's North-South and East-West traffic flows. This extensive plan is designed to meet traffic demands projected over the next 30 years, addressing the city's ever-increasing congestion. Among these, the proposed 127 kilometers of elevated corridors are set to transform Bangalore’s transportation landscape by enabling vehicles to bypass traffic bottlenecks, intersections, and signals, thereby ensuring an uninterrupted flow of traffic. This will lead to significant time savings, reduced fuel consumption, and lower vehicular emissions, fostering a healthier and more sustainable urban environment.

The project is meticulously planned to strengthen connectivity across the city, linking key economic hubs, residential zones, and public amenities. By decongesting surface roads, it will alleviate the daily frustrations of commuters, providing faster and more reliable travel experiences. Furthermore, the integration of these elevated corridors with existing public transit systems, such as the metro rail and bus networks, will encourage a shift toward multi-modal transportation solutions, reducing the reliance on private vehicles and promoting sustainable mobility.

Beyond its immediate benefits, this ambitious initiative is poised to drive Bangalore's long-term sustainable urban growth. The enhanced mobility will boost economic activity, attract investments, and increase productivity, making the city a more desirable place to live and work. By accommodating the rising population and growing vehicular density, the elevated corridors represent a forward-looking infrastructure development that ensures both economic vitality and environmental sustainability.
Once completed, these projects will not only address Bangalore's pressing traffic woes but also position the city as a leader in innovative urban planning. This initiative underscores a commitment to creating a modern, well-connected, and commuter-friendly metropolitan area that balances the needs of its growing population with environmental and economic priorities.

Proposed Elevated Corridors , Underpasses and Tunnel for Bangalore City

Twenty one (23) Long term projects where identified on the corridors mentioned in the below Table no 2 & 3. these include important arterials that carry significant traffic and mass transit services along the RoW like buses and metro

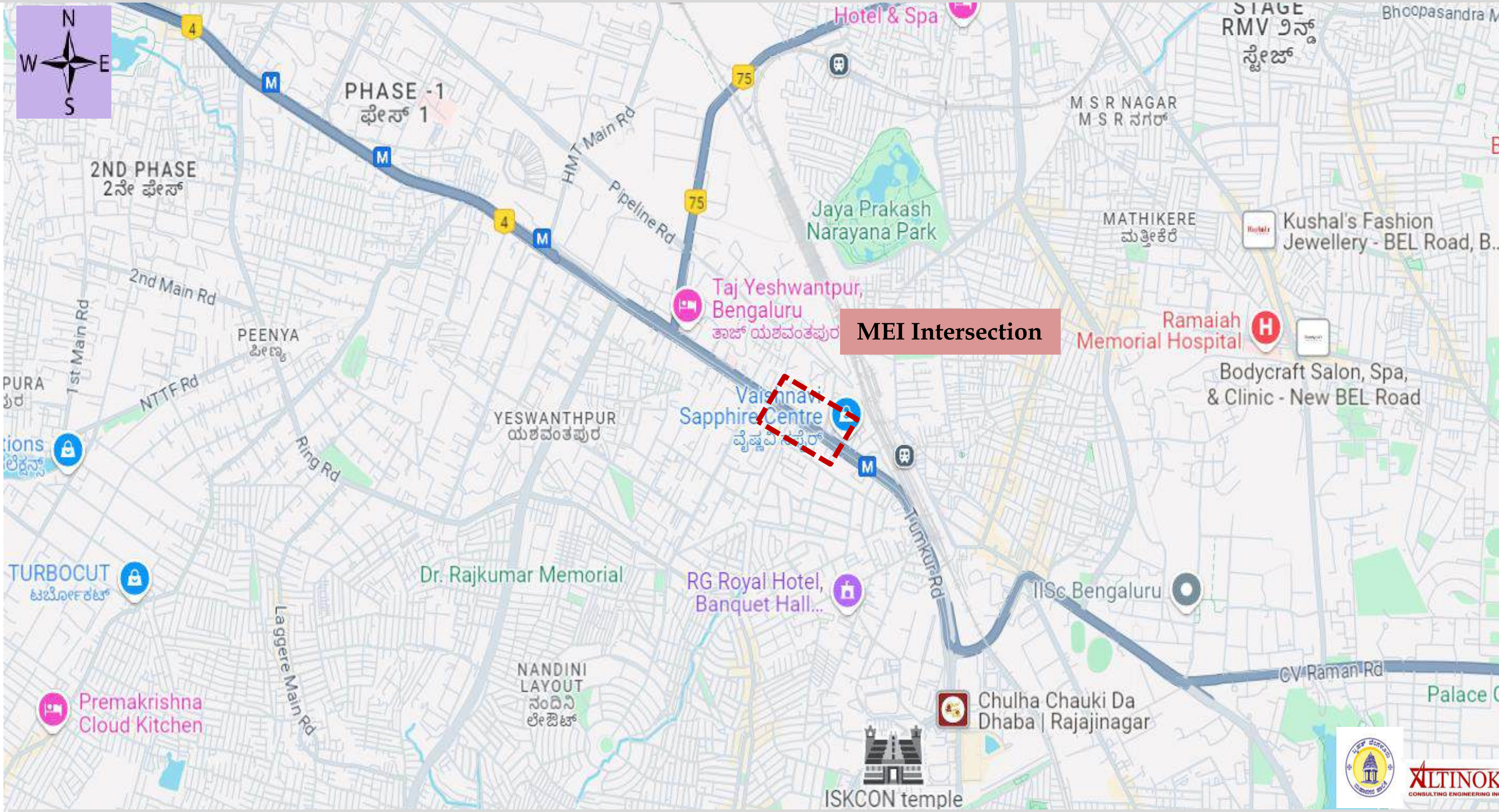
Table 189. Proposed Corridors in the Study Area

Sl. No	Corridor	Length kms
1	Split Flyover at MEI Junction	0.5
2	Yeshwanthpura (Mathikere cross) -IISC-Mekri circle-Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram.	27
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	2.7
4	Proposed flyover / Underpass at Konankuntae Cross for Through Traffic from Kanakapura to Banashankari	0.9
5	Proposed Flyover at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road	0.8
6	Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road	1.7
7	Extension of Existing Madiwala underpass till Traffic police station junction	0.5
8	Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction -Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	7.4
9	Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road	3.5
10	Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala	10
11	Proposed Elevated Corridor from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	15
12	Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.	**10.5**
13	Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction	15

Table 190: Proposed Corridors in the Study Area after the site reconnaissance Surveys

Sl. No`	Corridor	Length Kms
14	Proposed Elevated Corridor along Tannery road from Madava Mudiliyar road to Nagawara Junction.	5.5
15	Proposed Elevated Corridor from Yelahanka New town to Kempegowda International Airport Road	4
16	Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout).	4.5
DD1	Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.	13
DD2	Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station via Mohan Kumar Road.	2.2
T1	Proposed North – South Tunnel Corridor from Hebbal to Silk Board	18
T2	Proposed East- West Tunnel Corridor from K. R. Puram (I.T.I Colony) to Nayandahalli NICE intersection	28
	Total Length	**170.7**
	Total Length of Tunnels	**46**
	Total length of Elevated corridors/ Double Deckers/ Underpasses	**124.7**

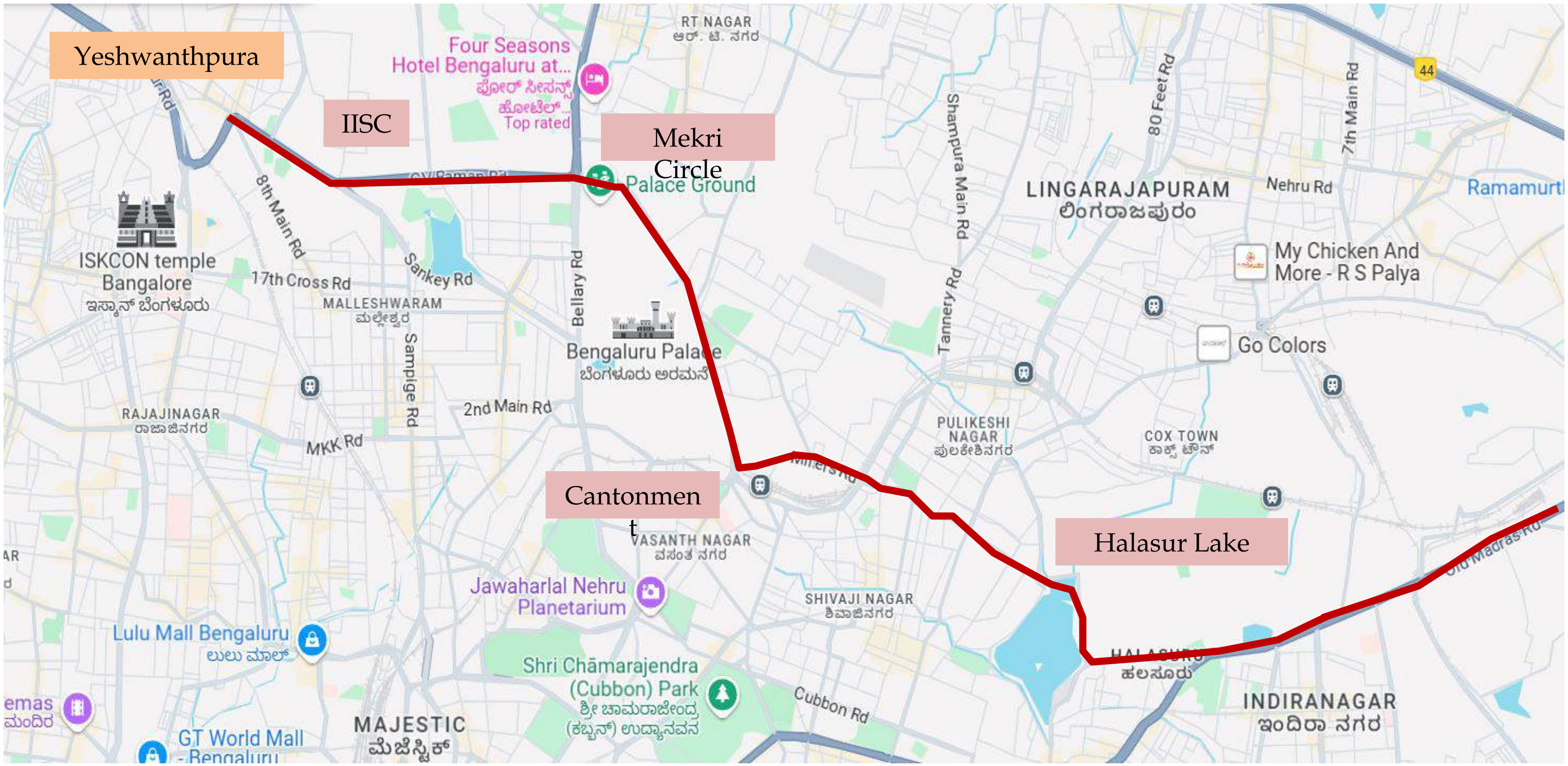
Corridor 1: Construction of Split Flyover at MEI intersection on Tumakuru road



"The corridor spans a total of 0**.5 kilometers**, featuring a four-lane, two-way Split flyover. Approximate cost is **₹ 60 Crores**

Figure 471. Key Map of proposed Split flyover at MEI intersection on Tumakuru road

Corridor 2: K R Puram-Old Madaras road-Ulsoor lake-St.John Chruch road-Jaymahal road-Mekhri circle-IISC-Yeshwanthapura (Mathikere cross)- 27 kms



"The corridor spans a total of 27 **kilometers**, featuring a four-lane. Approximate cost is **₹ 3240 Crores**

Figure 472. Key Map of Proposed Elevated Corridor from Tumakuru Road to Old Madras Road

Corridor 3: Integrated Elevation from Hudson Circle to Minerva Circle (Minerva Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)

"The corridor spans a total of **2.7 kilometers**, approximate project cost is 324 crores

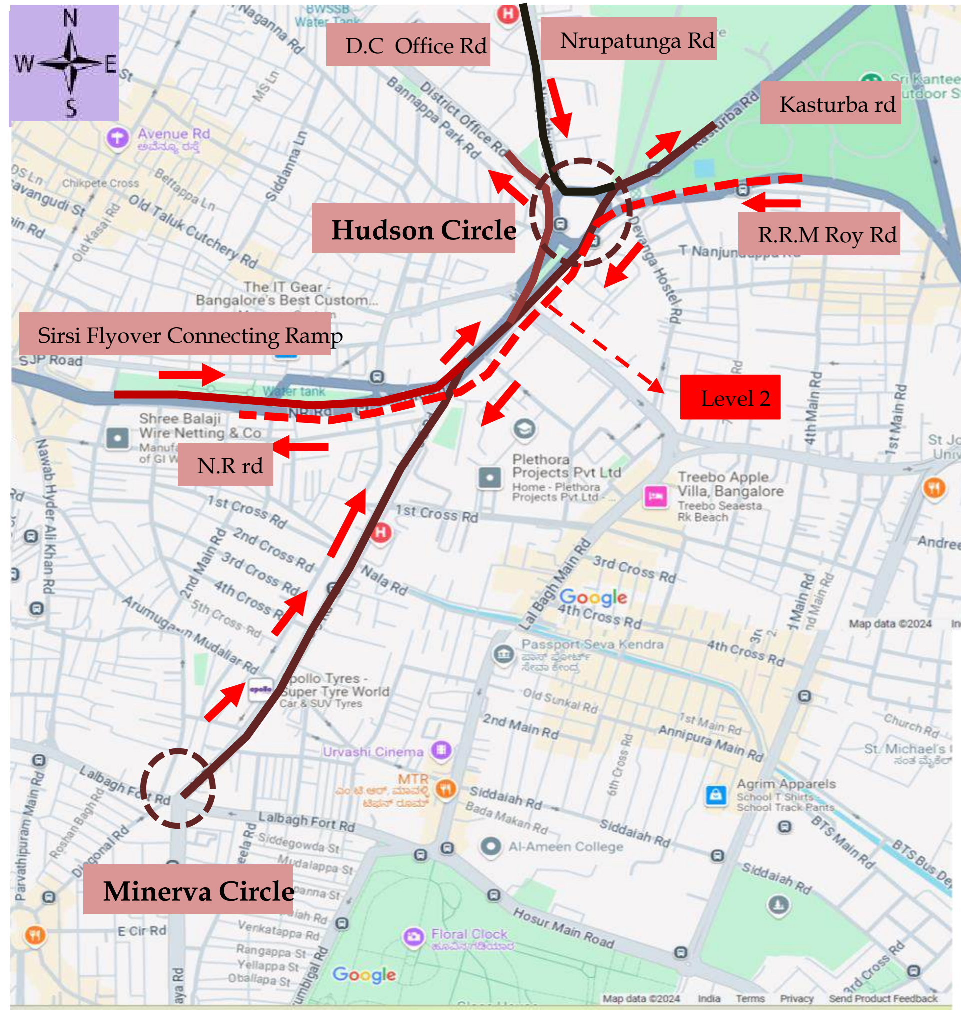
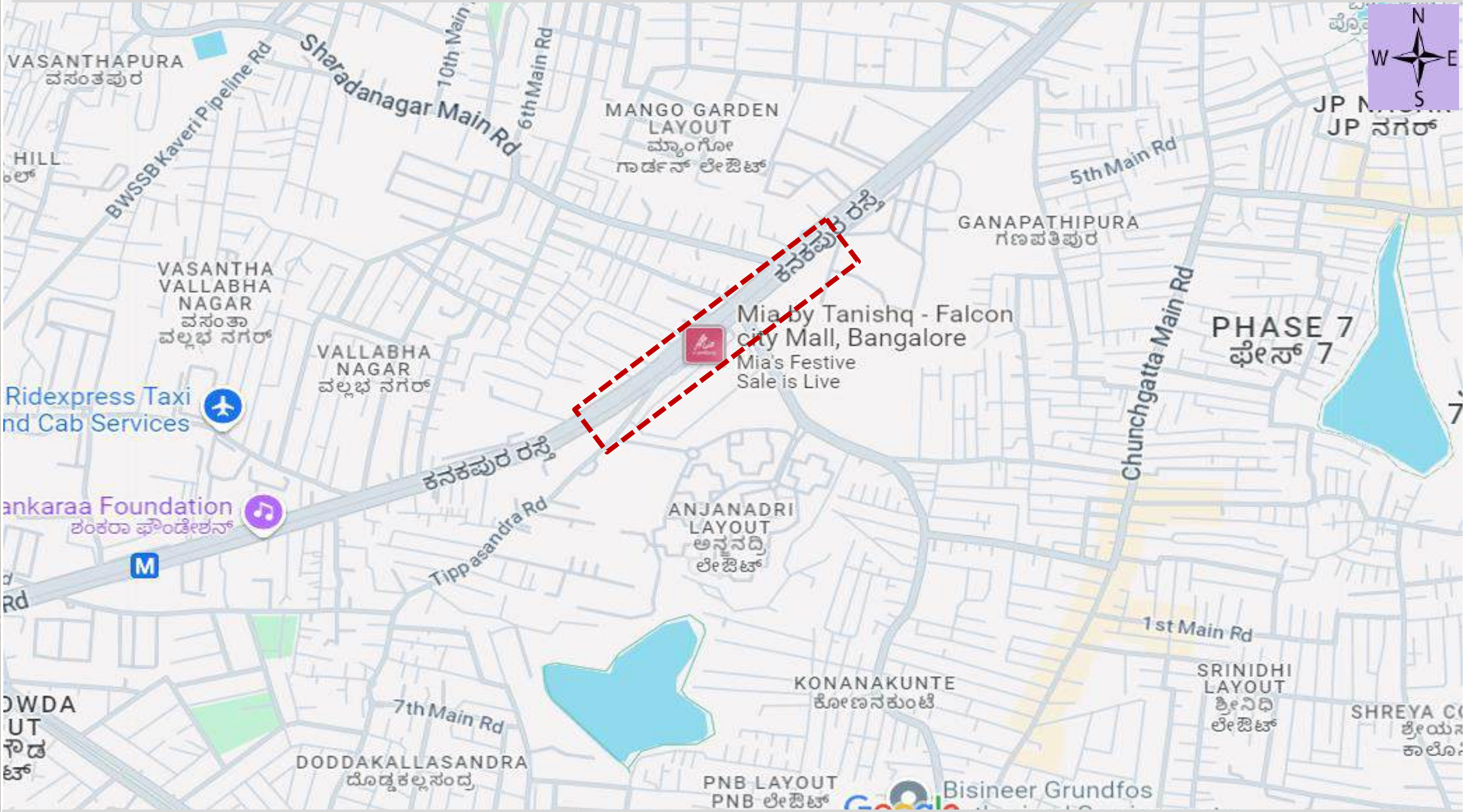


Figure 473. Key Map of proposed Elevated Corridor from Minerva circle to Hudson circle

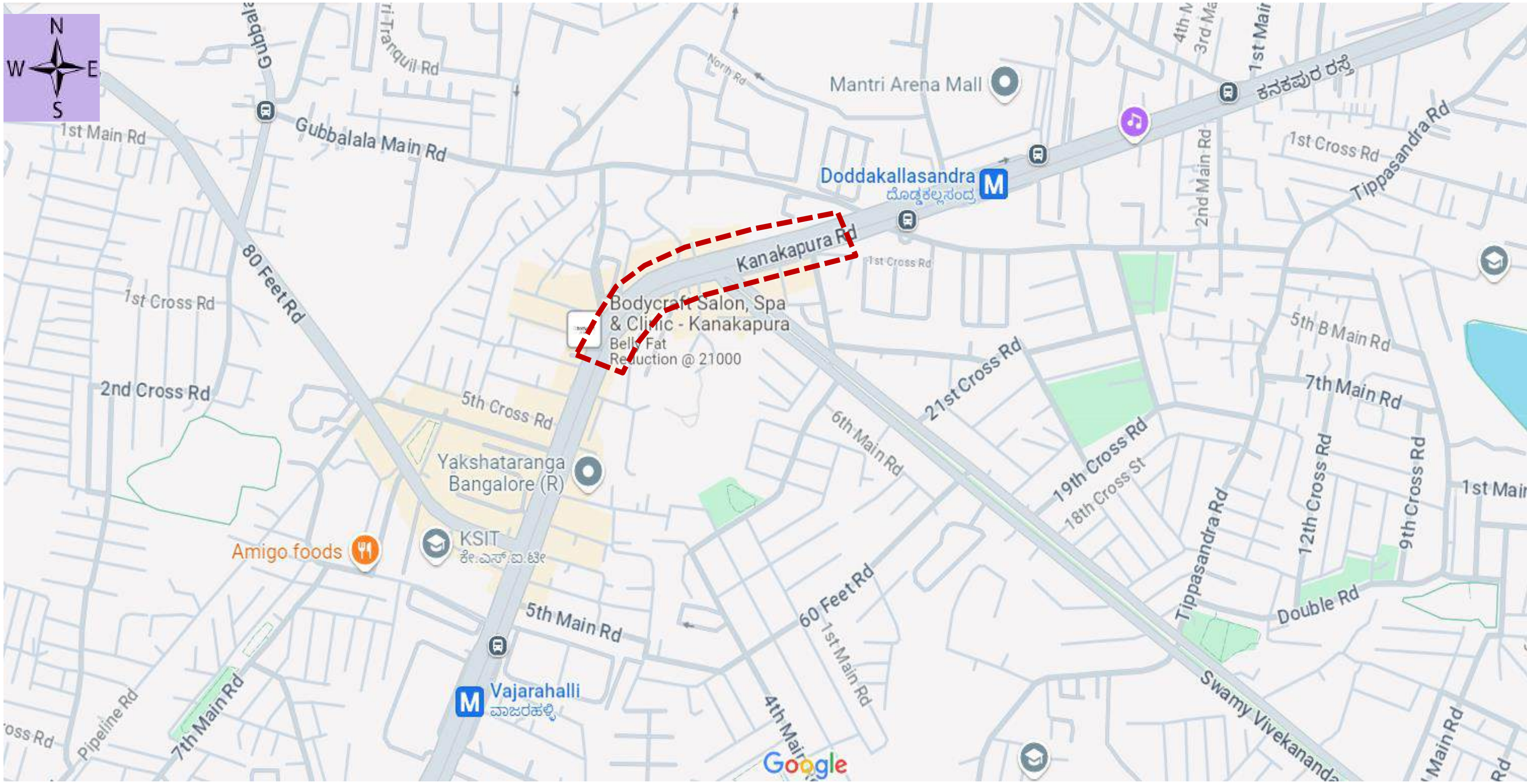
Corridor 4: Konanakuntae Cross Signal, Kanakapura Road



"The corridor spans a total of **0.9 kilometers**, featuring a four-lane split flyover . Approximate cost is **₹ 108 Crores**

Figure 474. Key Map of proposed split flyover at Konanakuntae Cross Signal, Kanakapura Road

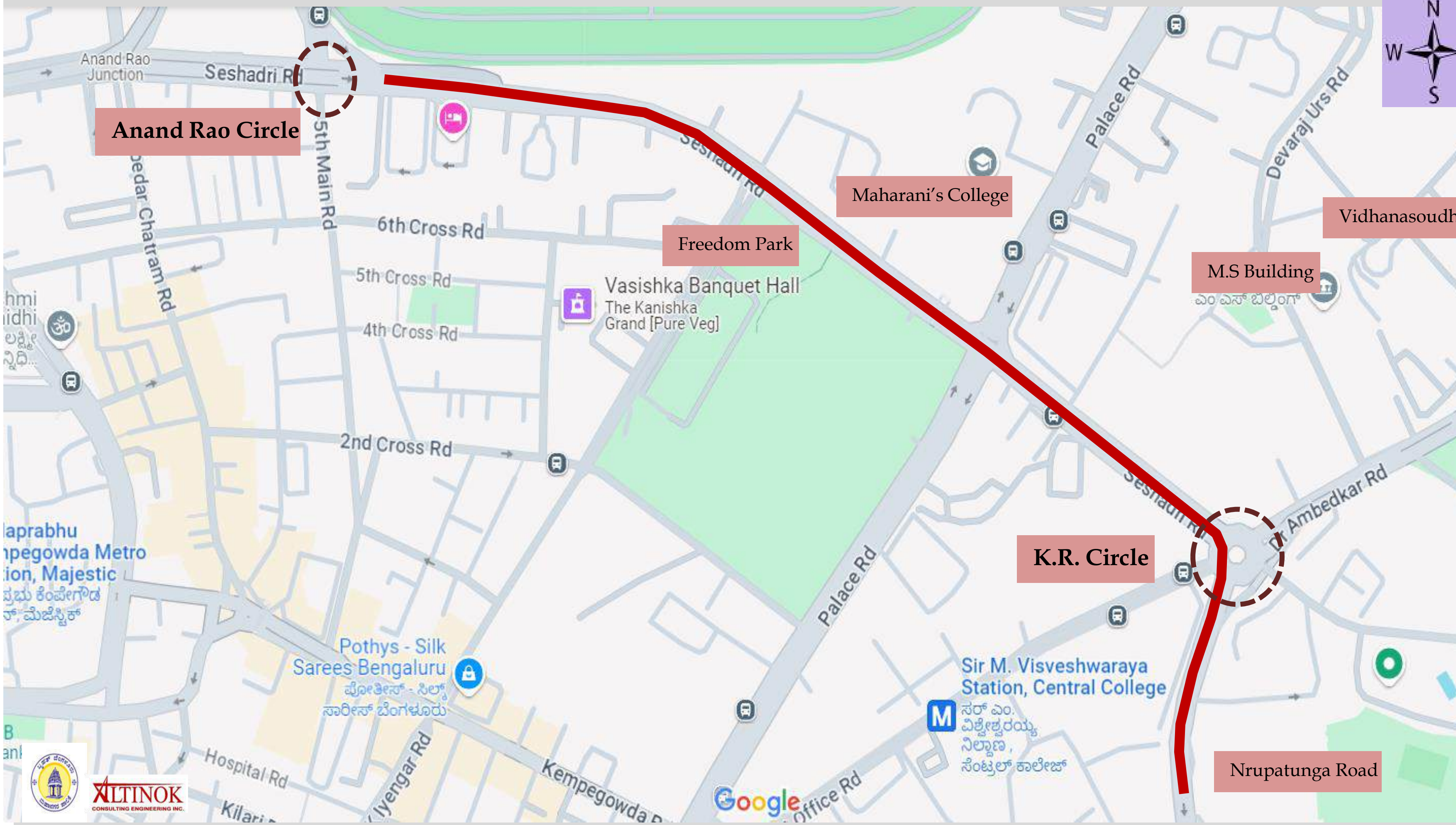
Corridor 5: Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road



"The corridor spans a total of **0.8 kilometers**, featuring a four- lane Split flyover Approximate cost is **₹ 96 Crores**

Figure 475. Key Map of proposed split flyover at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road

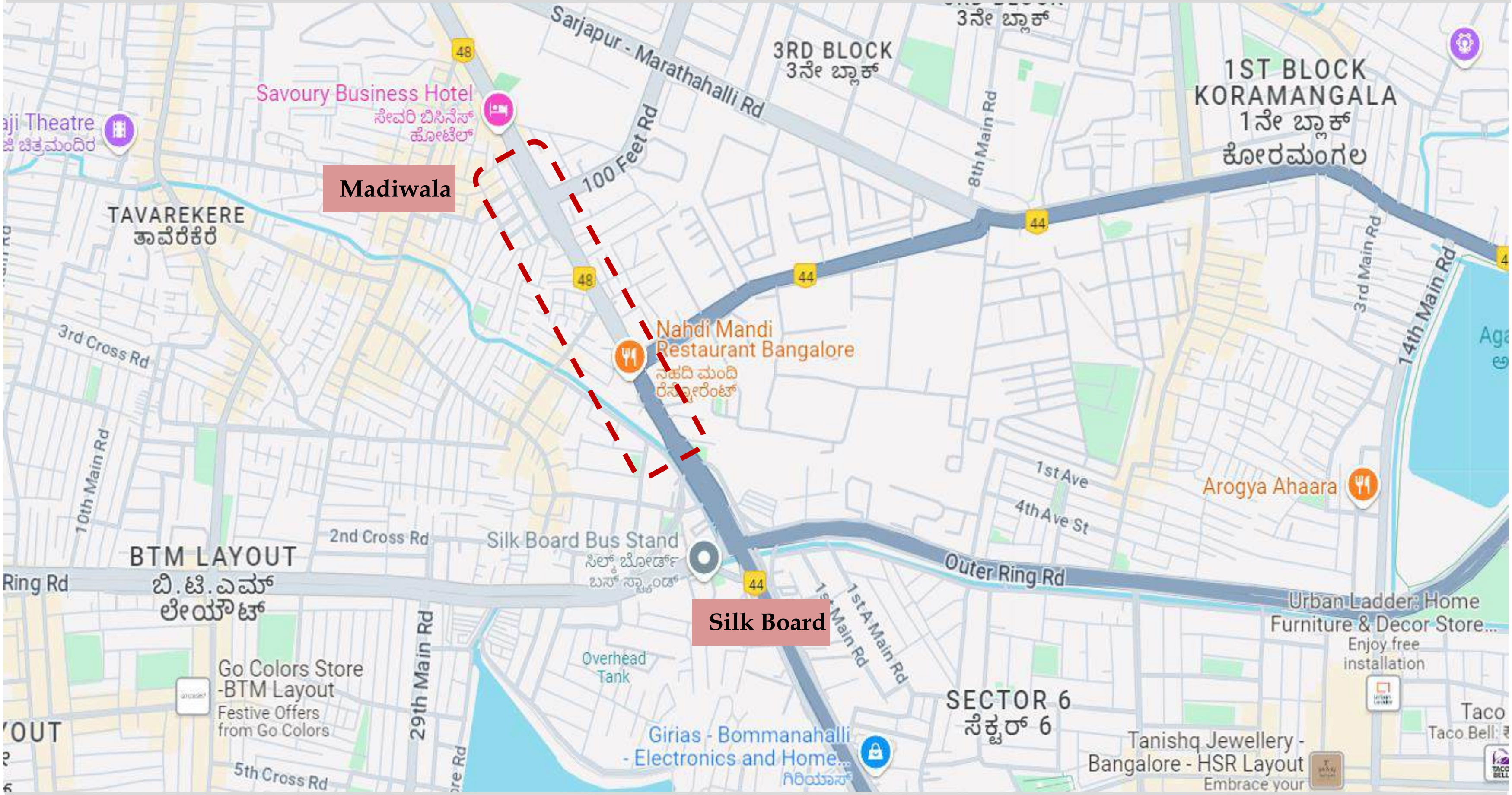
Corridor 6: Continuation of Ananda Rao Circle flyover up to K.R. Circle



"The corridor spans a total of **1.7 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated project cost is approximately **₹204 cr**ores."

Figure 476. Key Map of proposed elevated corridor from Ananda Rao Circle flyover up to K.R. Circle

Corridor 7 : Madiwala underpass extension till Silk Board



""The corridor spans a total of **0.5 kilometers**, featuring a four-lane, two-way divided underpass. Cut and Cover, approximate cost is **₹ 60 crores.**

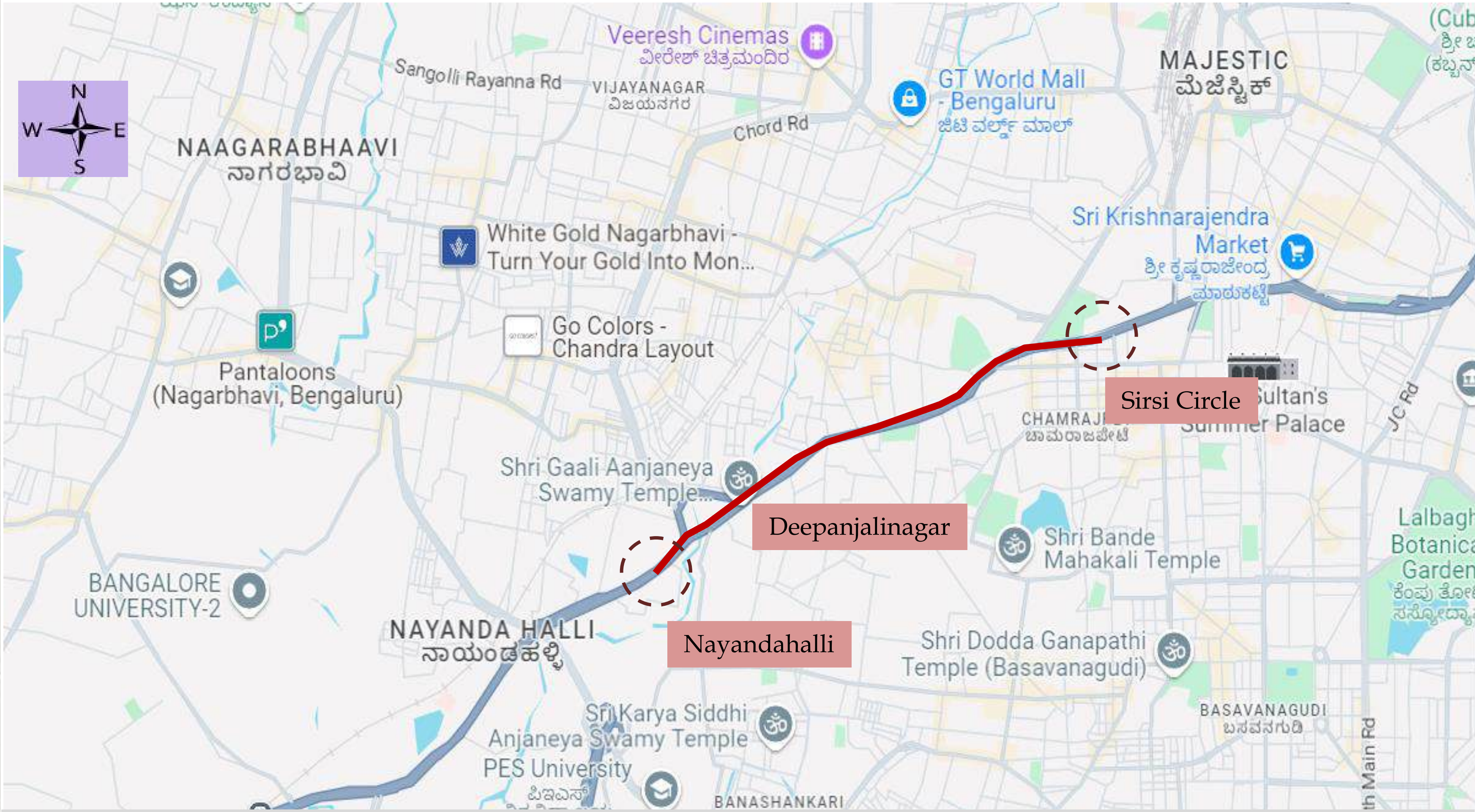
Figure 477. Key Map of proposed underpass from ***Madiwala underpass extension till Silk Board***

Corridor 8: Hosur Road from Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction- Silk board Junction.

"The corridor spans a total of **7.4 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated cost of the project is approximately **₹888 cr**ores."

Figure 478. Key Map of proposed elevated corridor from Hosur road to Old Madras road

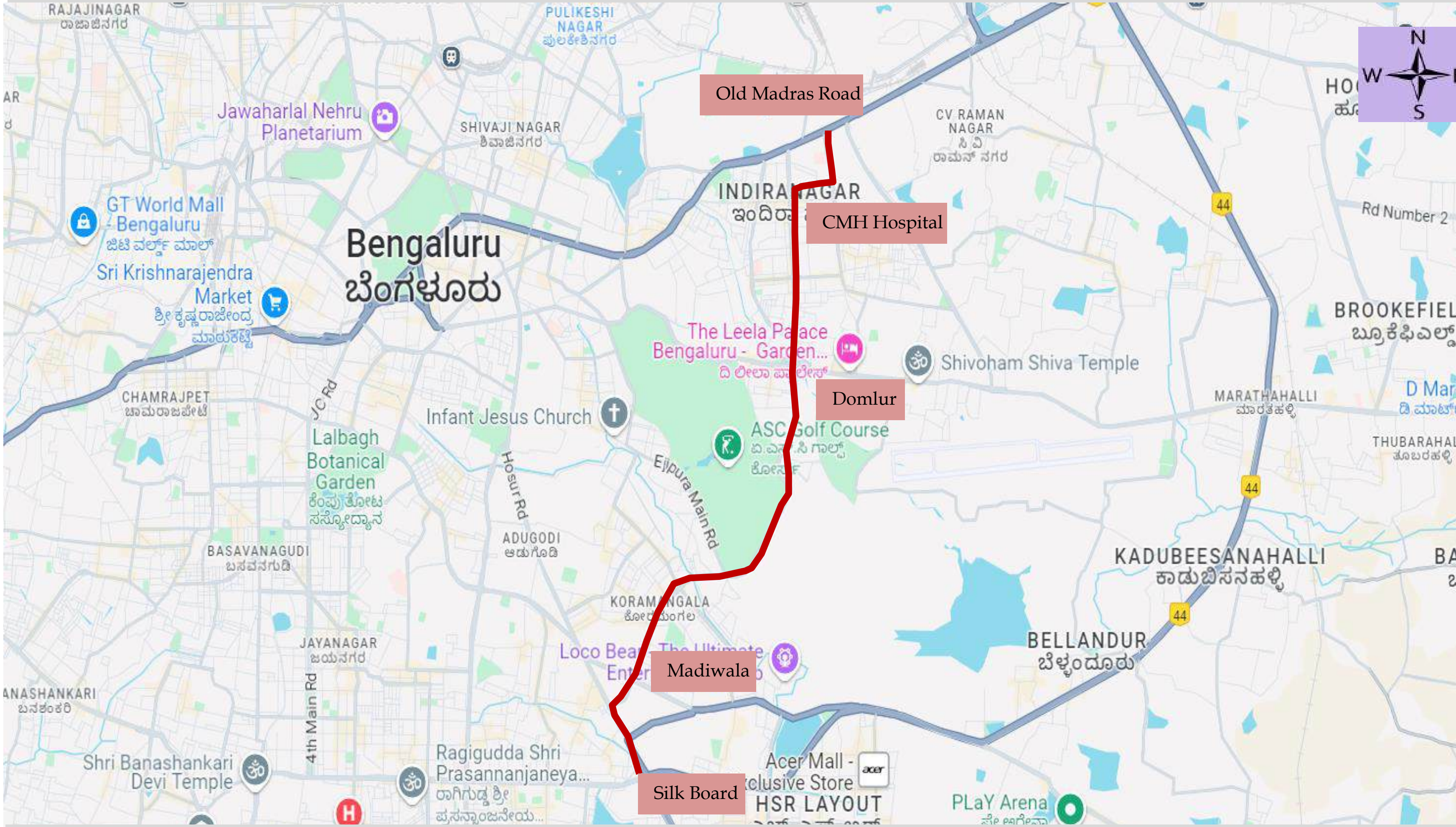
Corridor 9: Elevated corridor from Sirsi circle to Nayandahalli



""The corridor spans a total of **3.5 kilometers**, featuring a four-lane, two-way elevated corridor. The estimated of the project is approximately **₹420 cr**ores."

Figure 479. Key Map of proposed elevated corridor from Sirsi circle to Nayandahalli

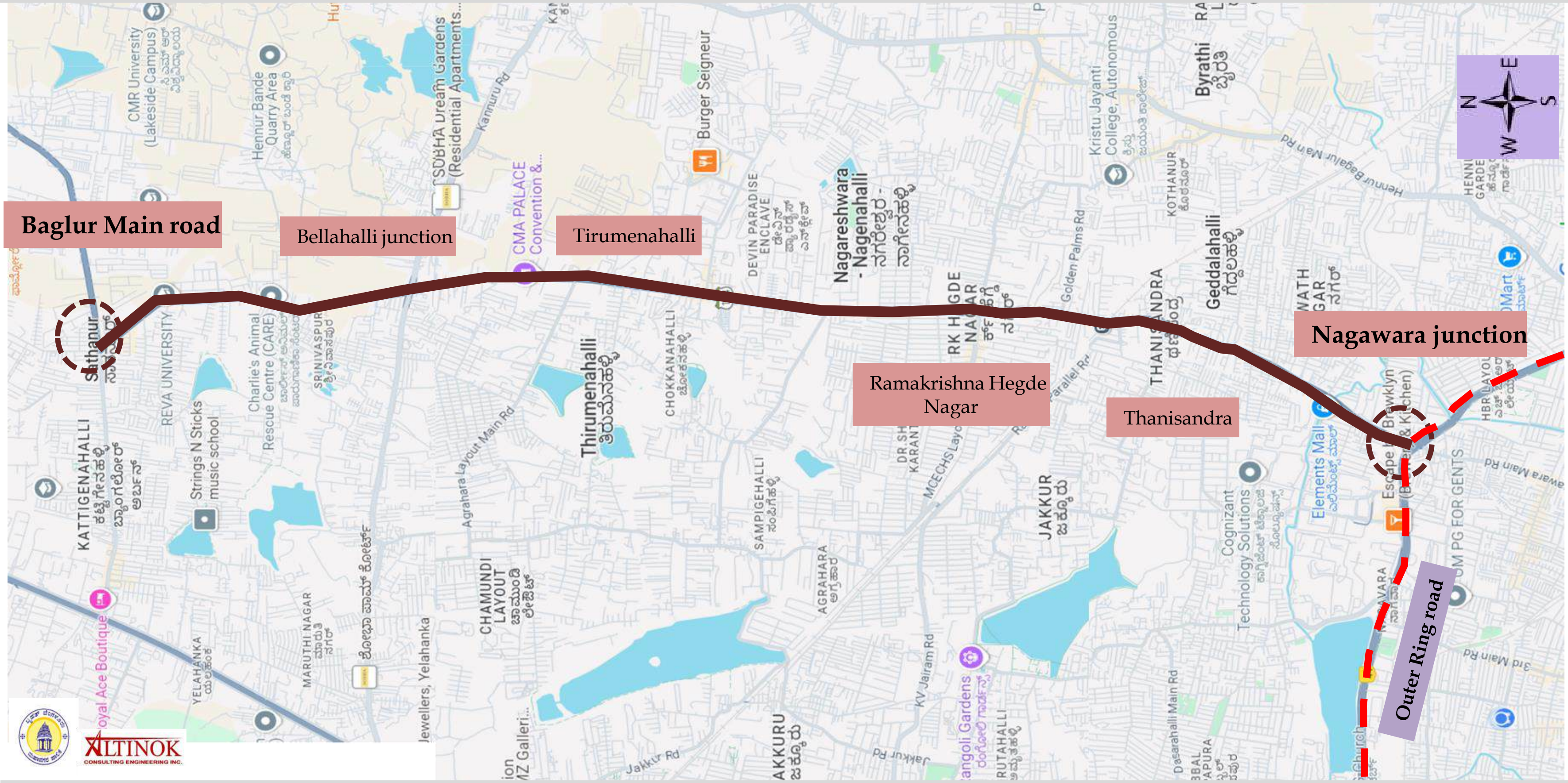
Corridor 10: Old Madras Road,Vivekananda Metro Station to Silk Board Junction via Indiranagar-Domlur- Madiwala



"The corridor spans a total of **10 kilometers**, featuring a two-lane, elevated structure. The estimated cost of the project is approximately **₹1200 cr**ores."

Figure 480. Key Map of proposed elevated corridor from Hosur road to Old Madras road

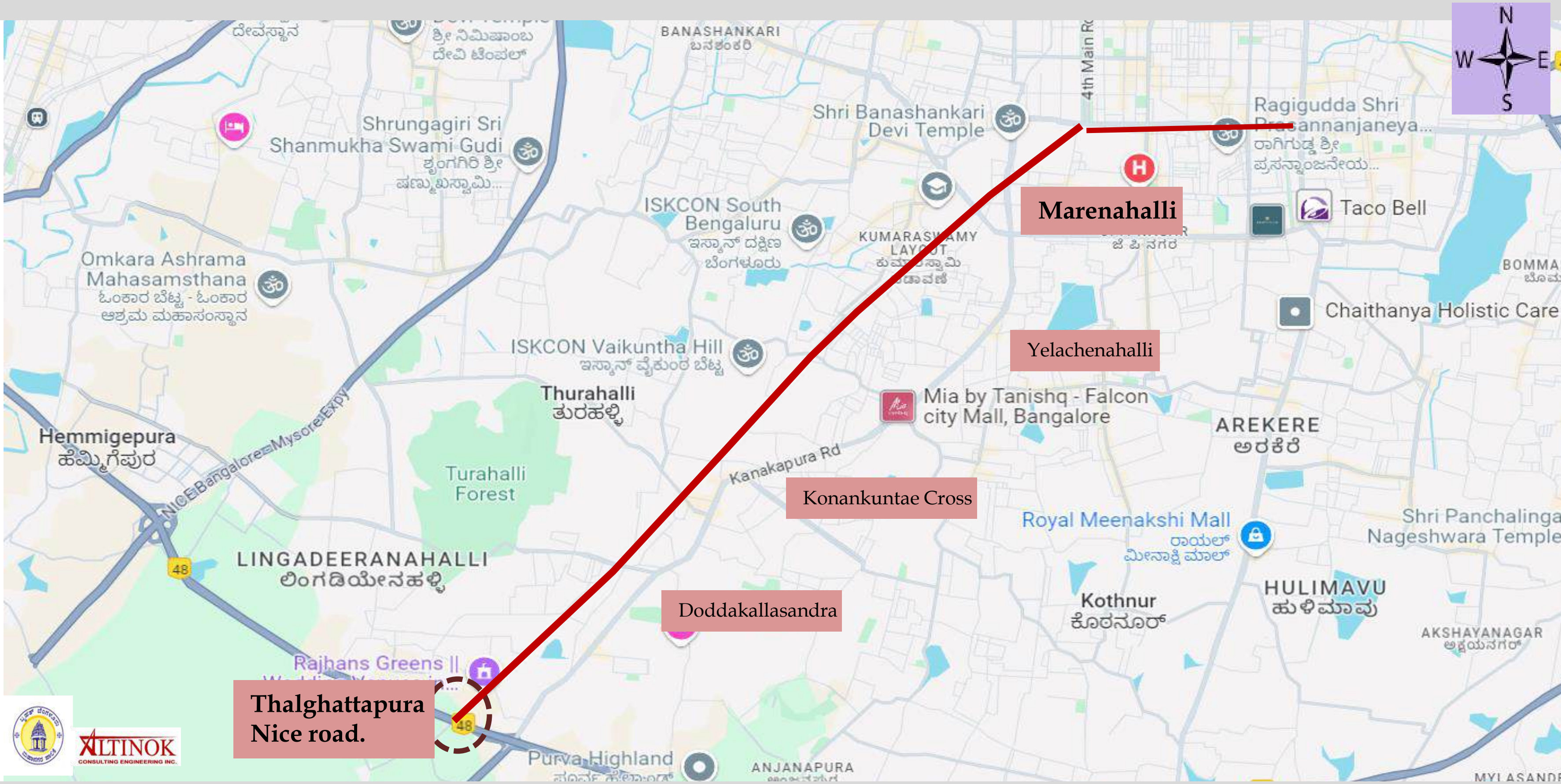
Corridor 11: Integrated Elevated flyover from Nagawara junction-Ramakrishna Hedgede Nagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road.



"The corridor spans a total of **15 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated cost of the project is approximately **₹1, 800 cr**ores."

Figure 481. Key Map of proposed elevated corridor from Nagawara to Baglur main road

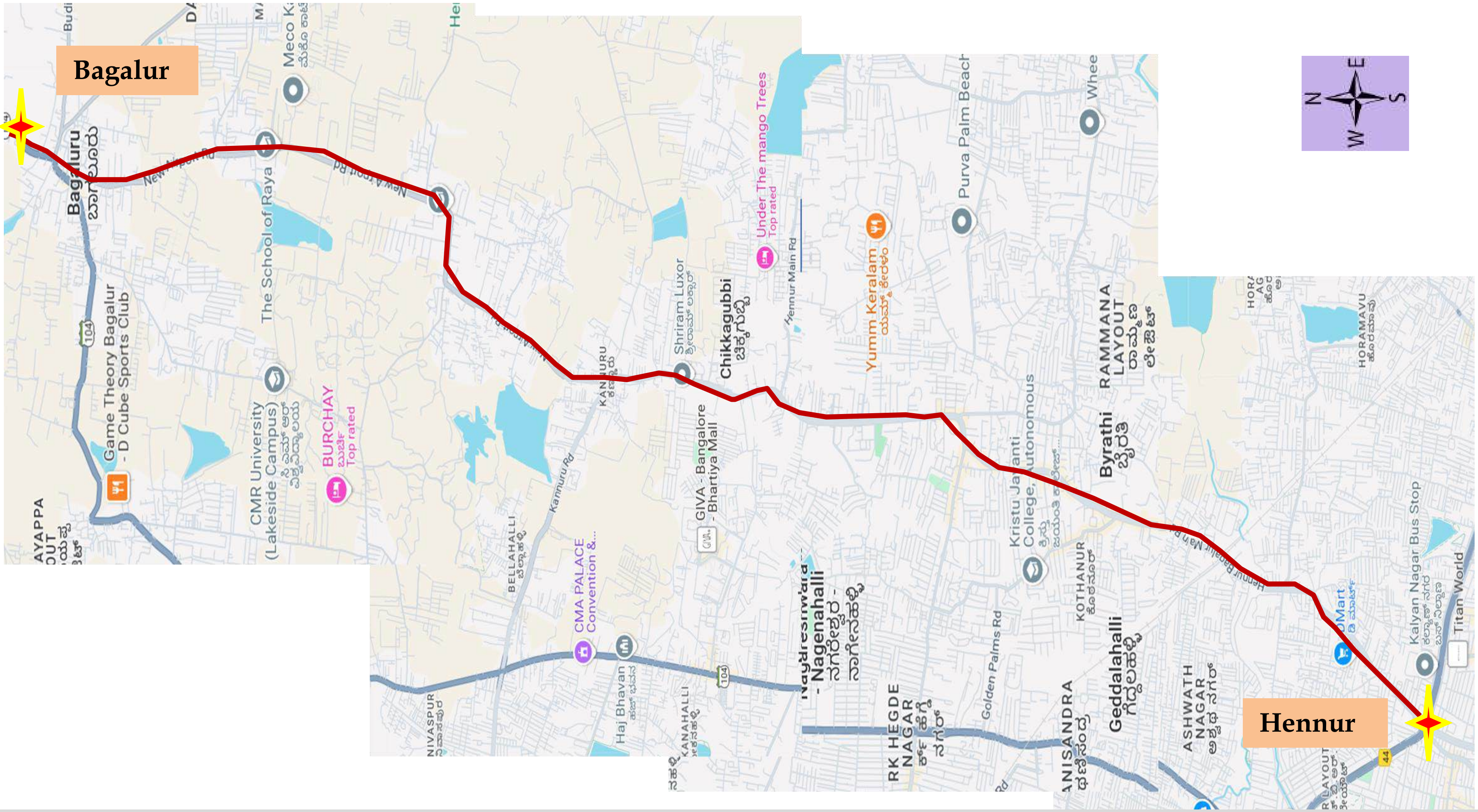
Corridor 12: Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.



"The corridor spans a total of **10.5 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated cost of the project is approximately **₹1260 cr**ores."

Figure 482. Key Map of proposed elevated corridor form Marenahalli main road connecting Kanakapura main road-Thalghattapura Nice road.

Corridor 13: Proposed Elevated Corridor from Hennur to Bagalur - Alignment details



"The corridor spans a total of **15 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated cost of the project is approximately **₹1800 cr**ores."

Figure 483. Key Map of proposed elevated corridor form Hennur to Bagalur

Corridor 14: Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.

"The corridor spans a total of **5.50 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated cost of the project is approximately **₹ 660 crores.**"

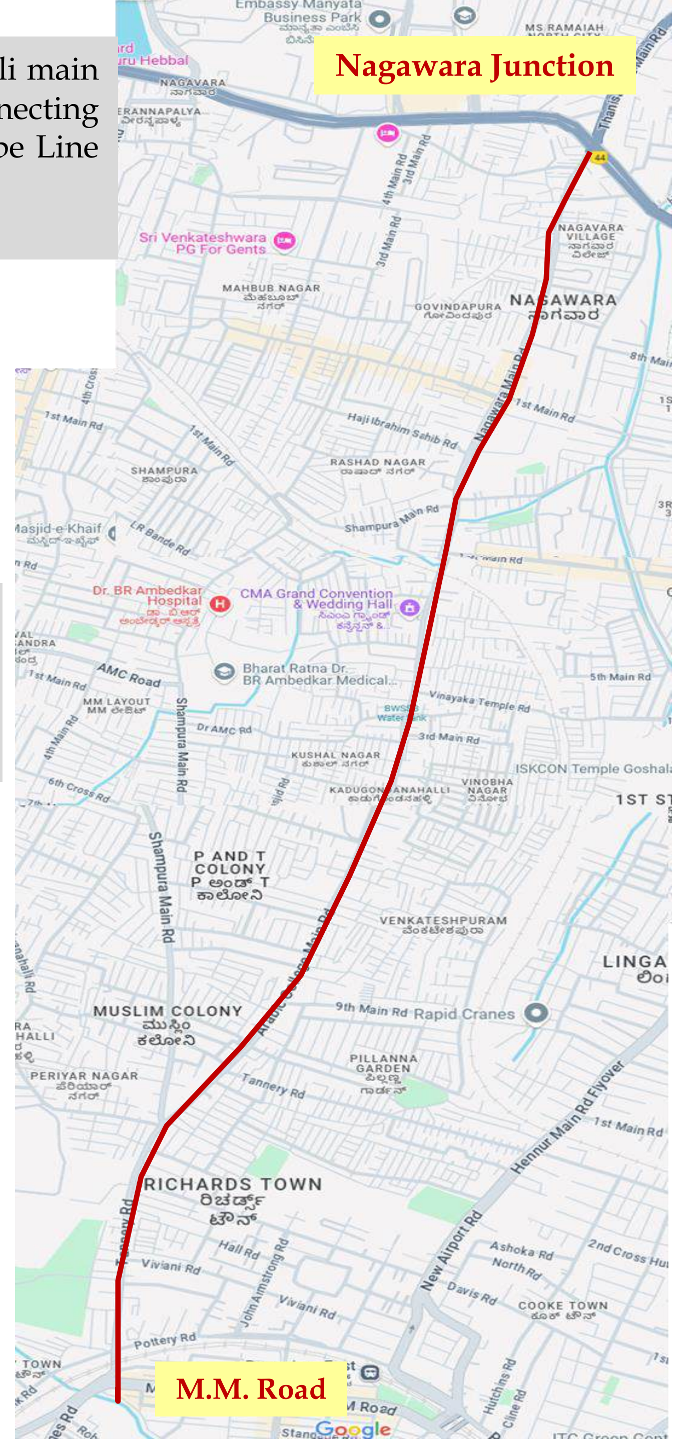
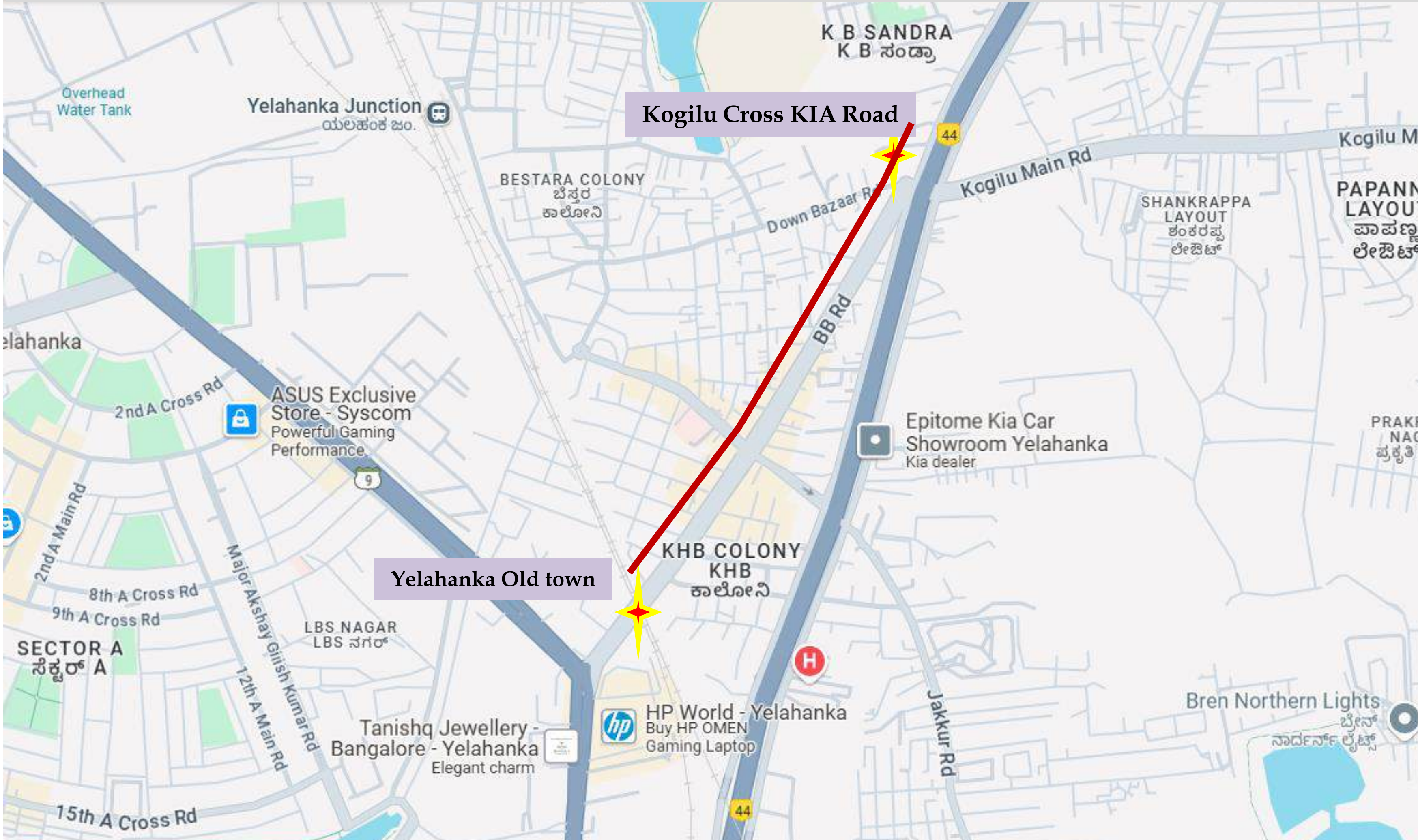


Figure 484. Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.

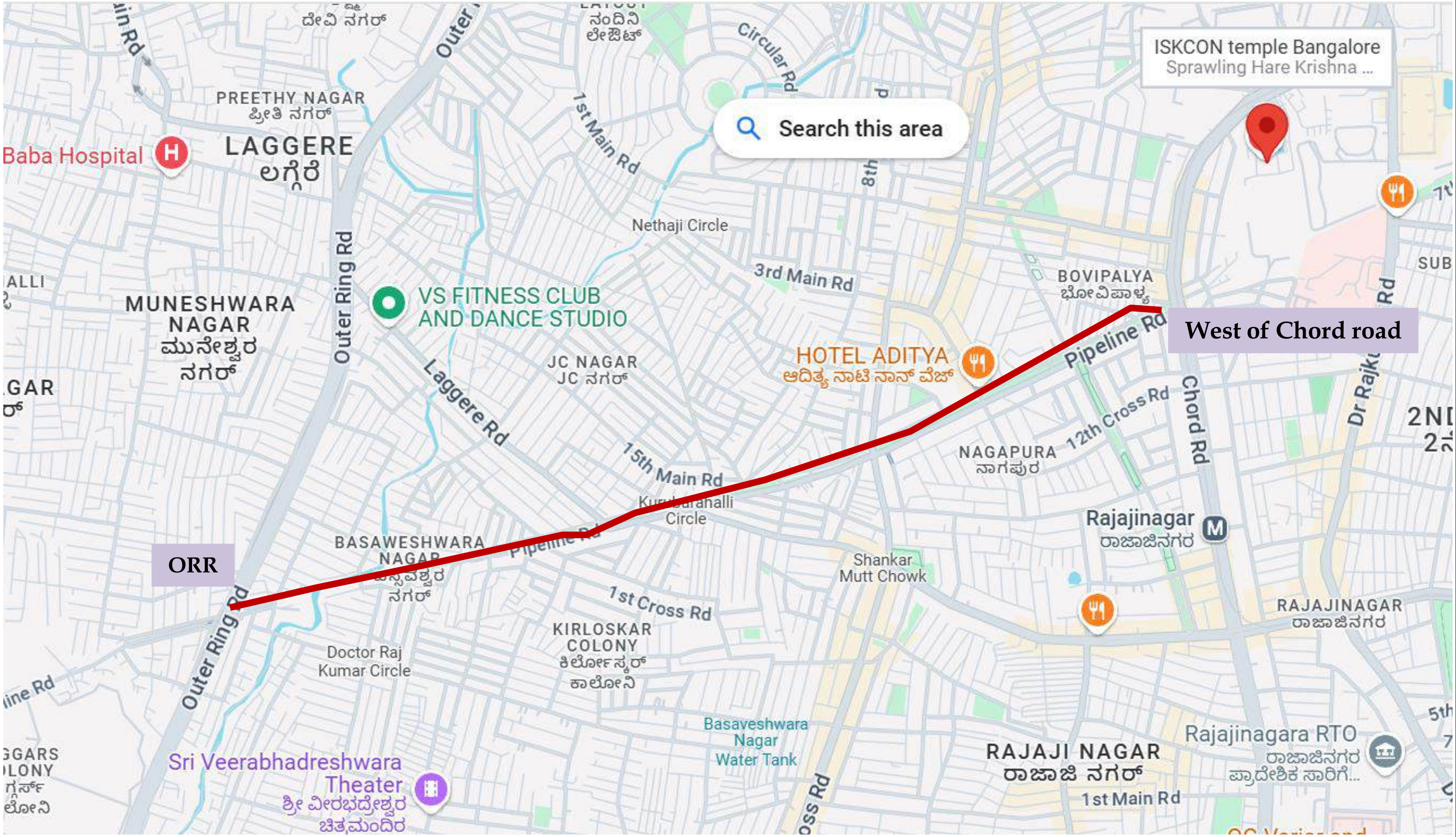
Corridor 15: Proposed Elevated corridor from Yelahanka Old Town to Kempe Gowda International Airport road – 4 kms



"The corridor spans a total of **4 kilometers**, featuring a four-lane, two-way divided elevated structure. The estimated cost of the project is approximately **₹ 480 cr**ores."

Figure 485. Key Map of **Proposed Elevated corridor from Yelahanka Old Town to Kempe Gowda International Airport road**

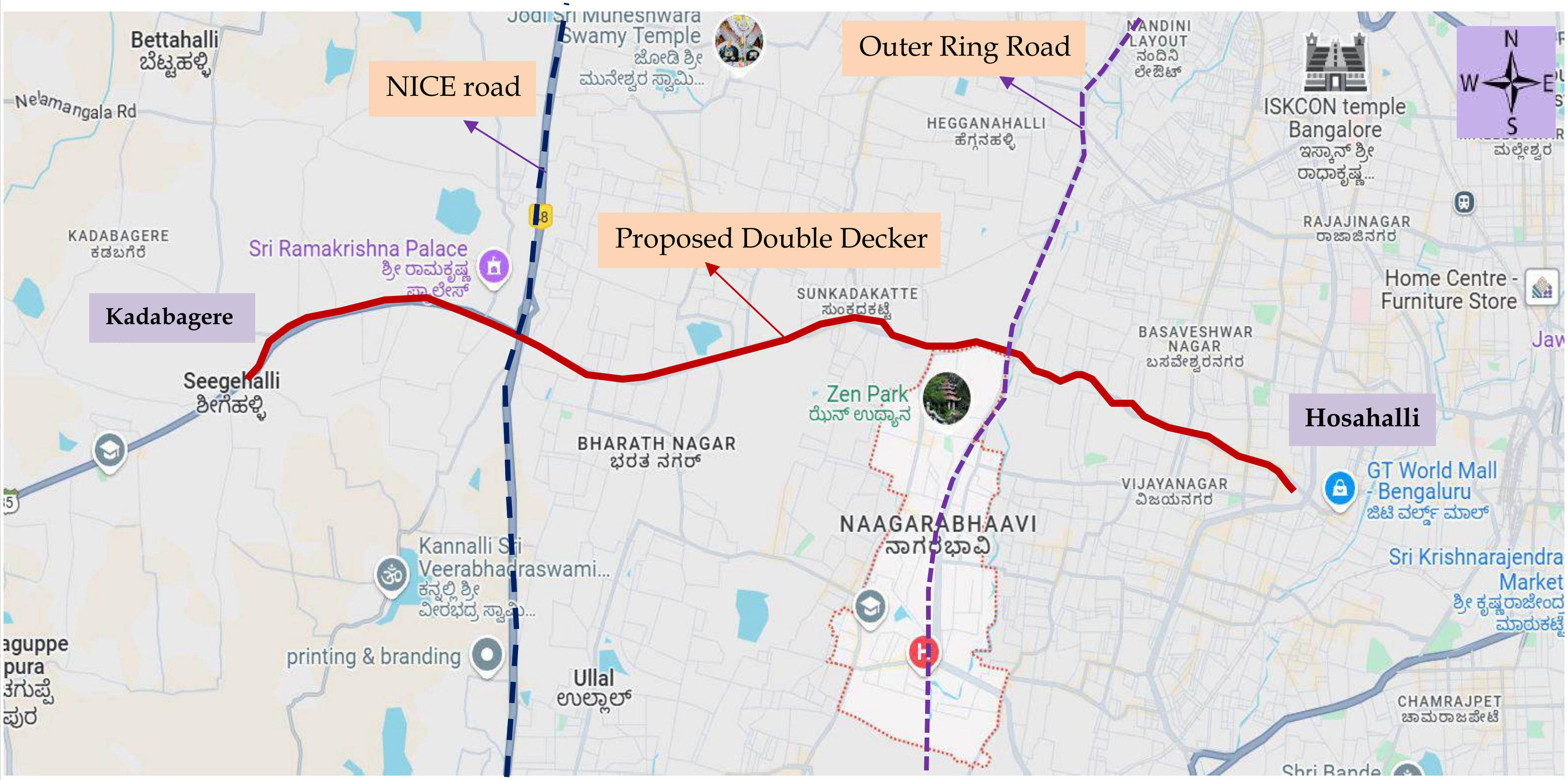
Corridor 16: Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout)- 4.5 Kms



"The corridor spans a total of **4.5 kilometers**, The estimated project is approximately **₹ 540 cr**ores."

Figure 488. Key Map of **Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout)-**

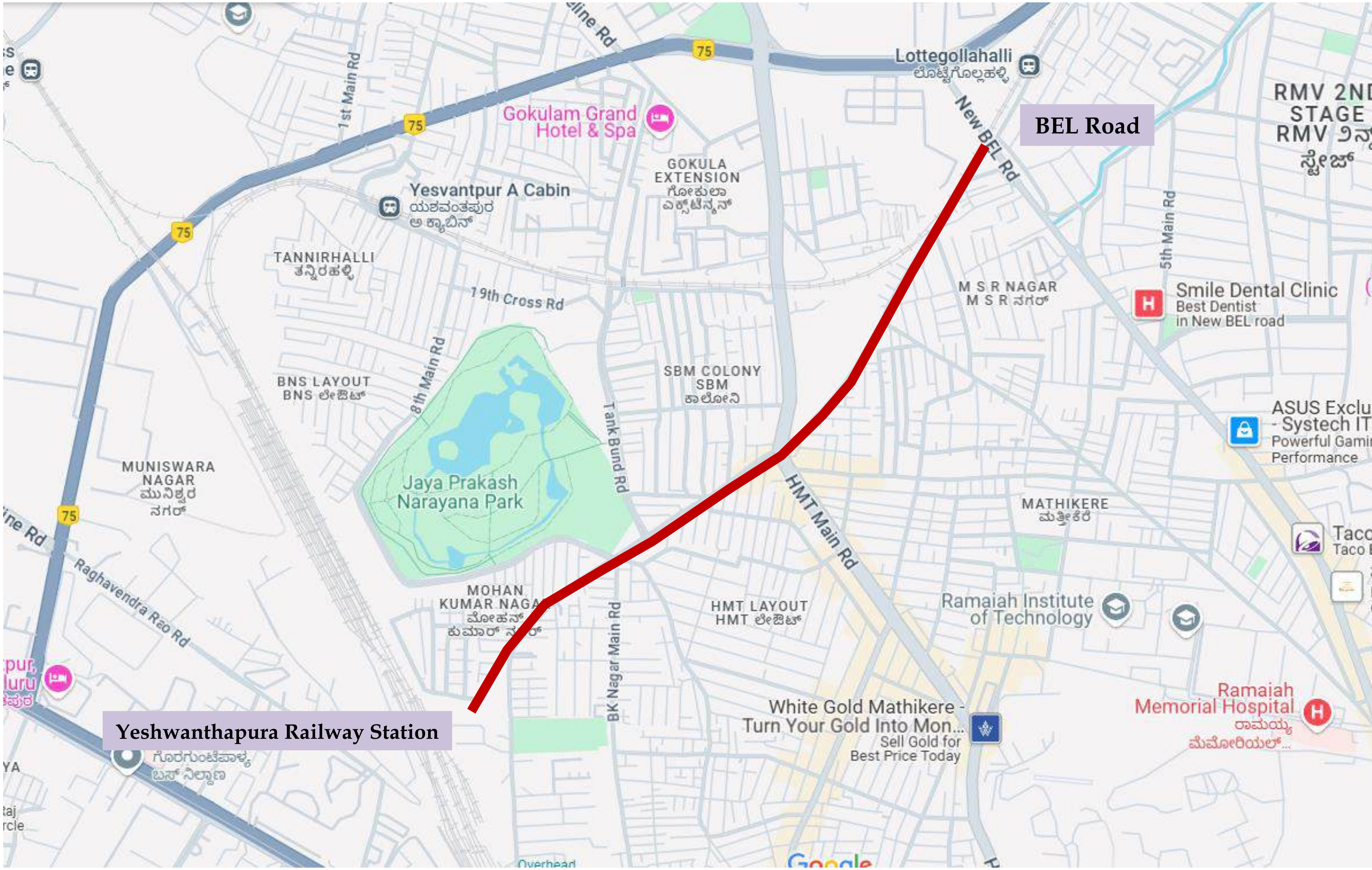
Double Decker 01 : Proposed Double Decker Corridor from Hosahalli to Kadabagere cross near Seegehalli along Magadi road- Integrated with METRO



"The corridor spans a total of **13 kilometers**, The estimated project is approximately **₹1560 cr**ores."

Figure 486. Key Map of proposed elevated corridor form Hennur to Bagalur

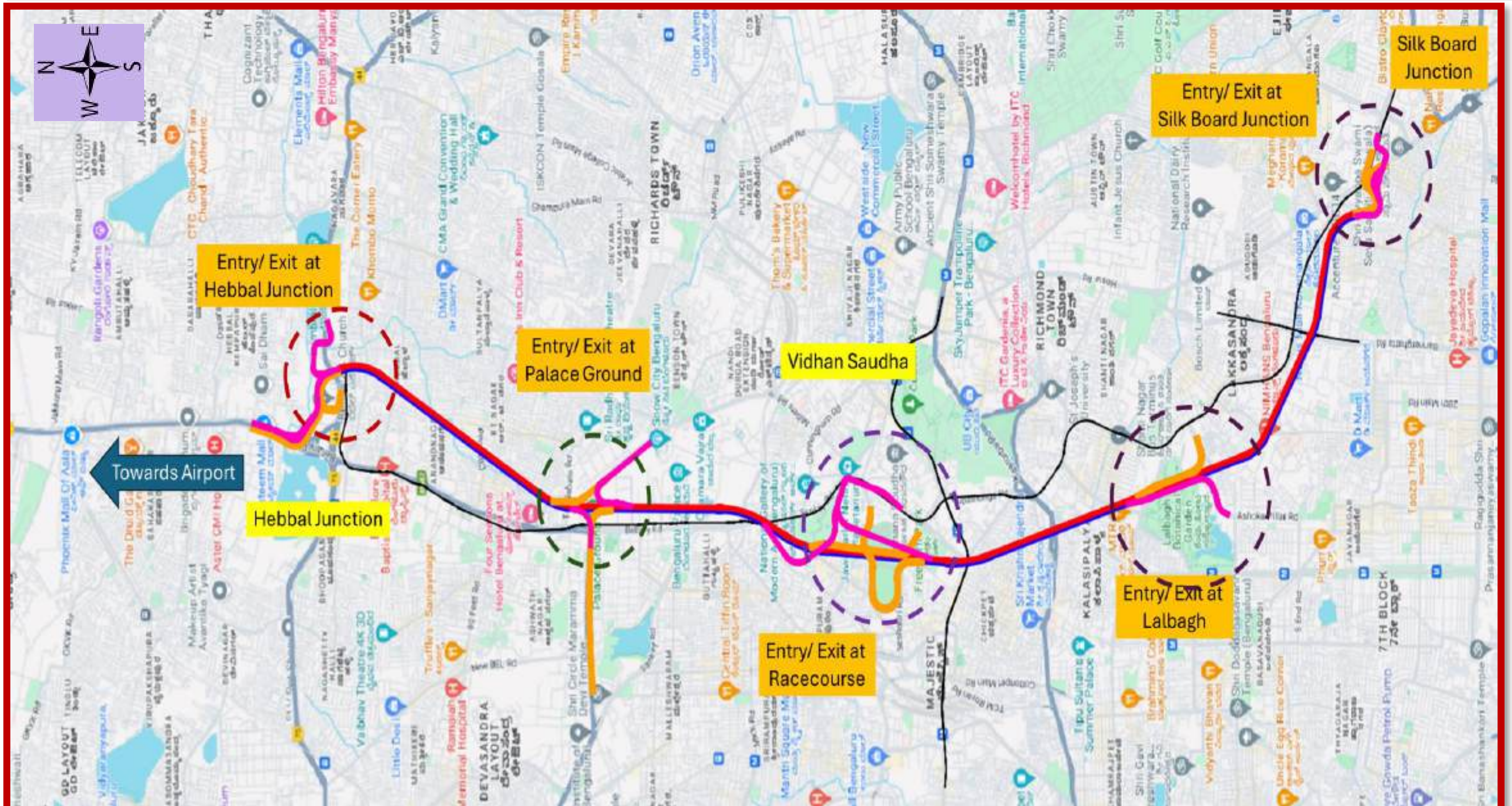
Double Decker 2: Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station- Integrated with Indian Railways



"The corridor spans a total of **2.2 kilometers**, The estimated project is approximately **₹264 cr**ores."

Figure 487. Key Map of Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station- Integrated with Indian Railways

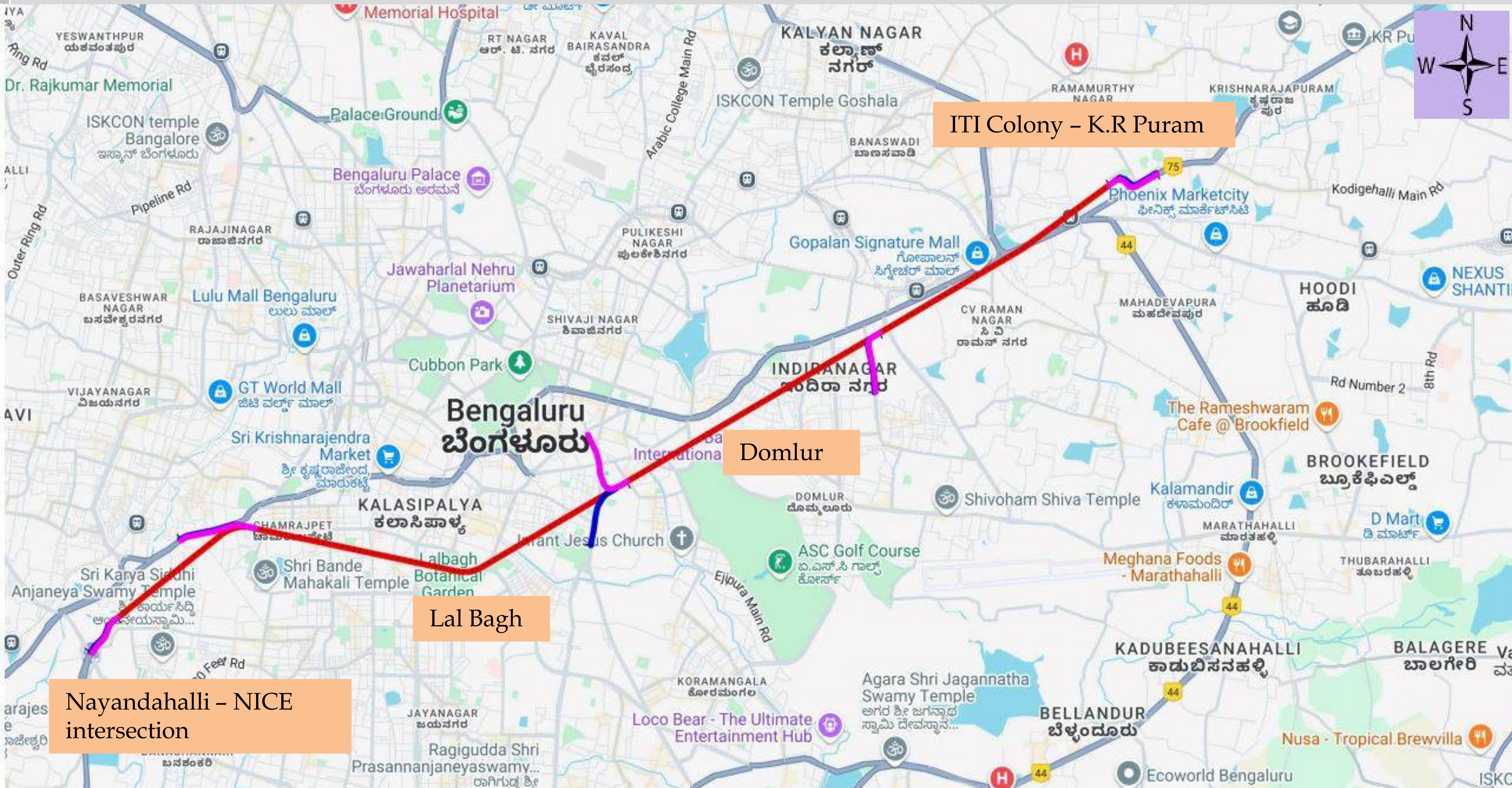
Tunnel 01 :North-South Tunnel Corridor from Hebbal to Silk Board



""The corridor spans a total of **18 kilometers**. The estimated cost per kilometer is approximately **₹889 crores**, bringing the total project cost to **₹16,000 cr**ores."

Figure 489. Key Map of proposed underground Tunnel NORTH-SOUTH Corridor from Hebbal to Silk Board

Tunnel 02: East- West Tunnel Corridor from K.R.Puram to Nayandahalli



""The corridor spans a total of **28 kilometers**. The estimated cost per kilometer is approximately **₹889 crores**, bringing the total project cost to ~**₹25,000 cr**ores."

Figure 490. Key Map of proposed underground Tunnel EAST-WEST Corridor from Hebbal to Silk Board

Table 191.Total Cost Summary for the proposed Elevated Corridors, Underpasses and Tunnels

Sl. No	Corridor	Length	Cost in Crores
1	Split Flyover at MEI Junction	0.5	60
2	Yeshwanthpura (Mathikere cross) -IISC-Mekri circle-Jayamahal-St John Church road-Ulsoor lake-Old Madras Road -KR Puram.	27	3240
3	Integrated Elevation from Hudson Circle to Minarva Circle (Minavara Circle, Bharat-Talks, Shivaji Talkies, Town Hall, LIC, Halasuru Police Station, Hudson Circle, Cubbon Park)	2.7	324
4	Proposed flyover / Underpass at Konankuntae Cross for Through Traffic from Kanakapura to Banashankari	0.9	108
5	Proposed Flyover at Adayar Ananda Bhavan, Raghuvanahalli, Kanakapura Road	0.8	96
6	Proposed Continuation of Ananda Rao Circle flyover up to K.R. Circle towards Nrupatunga road	1.7	204
7	Extension of Existing Madiwala underpass till Traffic police station junction	0.5	60
8	Elevated Corridor from Hosur Road from Shoolay circle – Vellara junction -Anepalya Junction-Adugodi Junction-Forum junction-St.John Chruch junction-Madiwala junction-Silk board Junction	7.4	888
9	Proposed Elevated corridor from Sirsi Circle to Nayandahalli on Mysuru road	3.5	420
10	Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur road via Indiranagar-Domlur- Madiwala	10	1200
11	Proposed Elevated Corridor from Nagawara junction-Ramakrishna HedgedeNagar Junction-Sampigehalli-Tirumenahalli-Bellahalli junction-Bagalur main road	15	1800
12	Proposed Elevated Corridor from Maraenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalghattapura Nice road via Pipe Line road.	10.5	1260
13	Proposed Additional link road to KIA, Elevated Corridor from Outer Ring Road – Hennur main road junction to Bagalur Junction	15	1800
14	Proposed Elevated Corridor along Tannery road from Madava Mudiliyar road to Nagawara Junction.	5.5	660
15	Proposed Elevated Corridor from Yelahanka New town to Kempegowda International Airport Road	4	480
16	Proposed Elevated corridor from West of Chord Road to Outer Ring road via Pipe Line road (Nandini Layout).	4.5	540
DD1	Proposed Double Decker Elevated corridor with Metro line from Hosahalli to Kadabagere cross along Magadi road crossing ORR and NICE corridor.	13	1560
DD2	Proposed Double-Decker Corridor in collaboration with Indian Railways, connecting the BEL Road intersection to the rear side of Yeshwanthpur Railway Station via Mohan Kumar Road.	2.2	264
T1	Proposed North – South Tunnel Corridor from Hebbal to Silk Board	18	15000
T2	Proposed East- West Tunnel Corridor from K. R. Puram (I.T.I Colony) to Nayandahalli NICE intersection	28	25000
	Total Length	170.7	54964
	Total Length of Tunnels	46	40000
	Total length of Elevated corridors/ Double Deckers/ Underpasses	124.7	14964

Government of Karnataka

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