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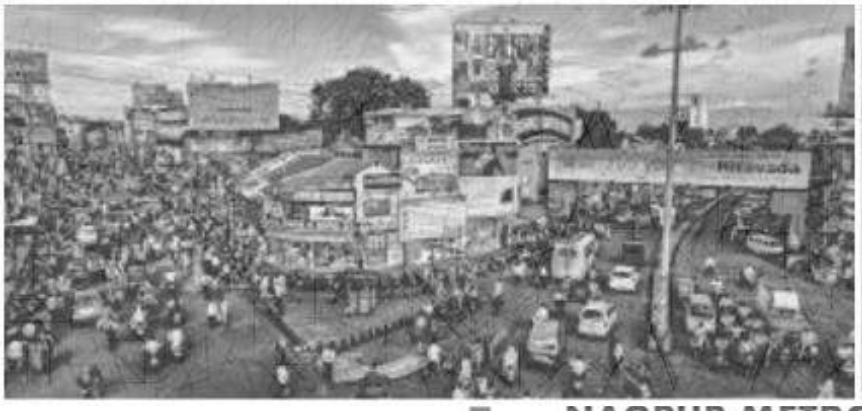
माझी मेट्रो
NAGPUR METRO

Urban Mass Transit Company Limited

COMPREHENSIVE FEEDER SERVICE PROJECT FOR NAGPUR METRO






FINAL REPORT

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CHAPTER 1 PROJECT BACKGROUND

1.1. STUDY CONTEXT

Nagpur is the 3rd largest city in Maharashtra state after Mumbai and Pune and is one of the fastest growing cities in India. With a population of 2.4 million (Census, 2011), it is ranked as the 13th largest city in the country and the 3rd largest city in Maharashtra following Mumbai and Pune. The jurisdiction of Nagpur Municipal Corporation (NMC) is spread across 227 Sq km encompassing major activities and represents the significant engine of growth for the whole of Nagpur District (51% of the Nagpur District's population and 45% of the District's Worker's population reside in Nagpur Municipal Corporation Area). Nagpur city with the presence of benchmarked zero mile stone is considered to be the geometric centre of the country, giving it a strategic connectivity to the important cities in the country. Nagpur city continues to be the focal point of hope, aspirations and opportunities for a wide range of urban migrants seeking to improve their well-being and economic advancement.

Cities in the developing world are in search of sustainable solutions to their accessibility and mobility issues. The process is complicated due to the rapid pace of urbanization, which is characterized by motorization, the co-existence of motorized and non-motorized modes, deteriorating public transport services and institutions along with the deteriorating air quality. Travel demands have grown faster than the population and expansion of the city resulting in movement to the city centre/activity centre from the suburbs/satellite towns. A variety of modes such as walking, cycling, two-wheelers, cars, para-transit, public transport etc., are used to meet the travel needs in the urban areas. Public transit systems, world over are struggling to compete with private modes and the shift is noticeable in the developing countries as well; the predominant modes being cars, two wheelers and other intermediary modes. The agencies operating often fail to respond to the demands. The resultant outcomes in most Indian cities have been increasing congestions due to the increasing private modes, accidents and rising air pollution levels issues.

Given the growth dynamics and dimensions of the transportation problems, Nagpur is no different from the other cities. The city needs to plan and develop transportation systems on a sustainable basis for long term perspective. Currently, the public transportation demand in the city is catered by the City Bus Services, Intermediate Para Transit Services such as the Auto Rickshaws, Shared Auto Rickshaws, E-Rickshaws and other application based Taxi services. To cater to the increasing travel demand and to encourage the public transport in the city, a rail based rapid transit system (MRTS) has been envisaged by the development authorities of Nagpur. Maha Metro Rail Corporation [1] has been entrusted with the implementation of the two corridors of 38.215 km which has been over a period of time being extended. It has been observed and experienced by the various cities in the country that the success of any public transport system depends on its accessibility from the various parts of the city. Since, Mass Rail Transit Systems (MRTS) are of higher order transit systems and their routes are pre-defined, penetration of the systems into all parts of the city is quite difficult. Hence, it is essential that metro systems are integrated with all lower modes of transport such as feeder services, city bus, cyclists and pedestrians to meet the day to day accessibility and mobility requirements to meet sustainable transportation requirements.

Currently, all the systems in Nagpur are acting independent of each other and require various levels of integration for a seamless travel such as physical integration of public transport services and infrastructure, institutional integration and fare integration. Keeping in view the need for seamless and enhanced passenger transport experience, German Development Bank (KfW) along with Maha Metro has taken the initiative to develop a Comprehensive Feeder Bus Service Project for Nagpur Metro. Accordingly, KfW invited Urban Mass Transit Company (UMTC) a joint venture of Ministry of Urban Development (MoUD), Government of India (GoI) and IL&FS for preparing the Comprehensive Feeder Bus Service Plan for Nagpur Metro.

1.2. STUDY OBJECTIVES

The study "Comprehensive Feeder Services Project for Nagpur Metro" is aimed at seamless integration of all modes of public transport systems (existing & planned) and the Non-Motorized modes as a means of enhancing the ridership along the transit corridors. The study is suitably divided into four modules namely;

[1] Maha Metro – Maharashtra Metro Rail Corporation Limited

- Module 1: Operation and Implementation Plan for Feeder Services,
- Module 2: Route Rationalization Plan for the City Bus Services,
- Module 3: Non-Motorized Transport (NMT) Master Plan and
- Module 4: Implementation Options Study

Maha Metro executed an agreement with UMTC as consultant on 19th October, 2015 for undertaking Operation and Implementation Plan for Feeder Bus Services for Nagpur city. The current study is being undertaken as an extension to the Module 1, wherein the main objective is to carry out review of all bus routes operating in Nagpur and prepare "Route Rationalization Plan", "Non-Motorized Transport Plan" and "Implementation Options Study" along the metro corridors.

The current report shall integrate the outcome of Module 1 with the Outcome of Module 2 i.e Feeder Services with Route Rationalization Plan for City Bus Services and Module 3 i.e Non-Motorized Transport Master Plan.

Module 2 shall assess the existing user demand for existing facilities and forecast the likely future demand for city bus services. Considering the above, the support infrastructure requirement, capital cost requirements and alternative implementation plans shall be worked out.

Module 3 is aimed at proposing/recommending for an integrated network of walkways and bicycle paths along with the related infrastructure facilities at the strategic locations within the city. This shall aim at enhancing walking and mobility experience of a pedestrian and bicyclist user in Nagpur. The major components of the study are; Non-Motorized Transport Master Plan, Public Bike Sharing Scheme and Concept Designs for Urban Place Making. Considering the above, the capital cost requirements and alternative implementation plans have been worked out.

The study is suitably divided into different phases as represented in Table 1-1, in order to effectively address the various activities identified as part of the study.

TABLE 1-1: STUDY DELIVERABLES AND PROGRESS

Submission	Deliverable Time	Status
Inception Report	M+1	Submitted in February, 2017
Interim Workshop to discuss broad options identified	M+3	Workshop Conducted in June, 2017
Draft Detailed Project Report	M+5	Submitted in November, 2017
Review Workshop for inputs and comments to the draft DPR and presentation of implementation options, Draft Implementation options Report	M+6	Workshop carried out
Final Detailed Project Report (including NMT Master Plan Final Report and Final Implementation Options Report)	M+7	This report submitted herewith

*M – Date of signing the Agreement

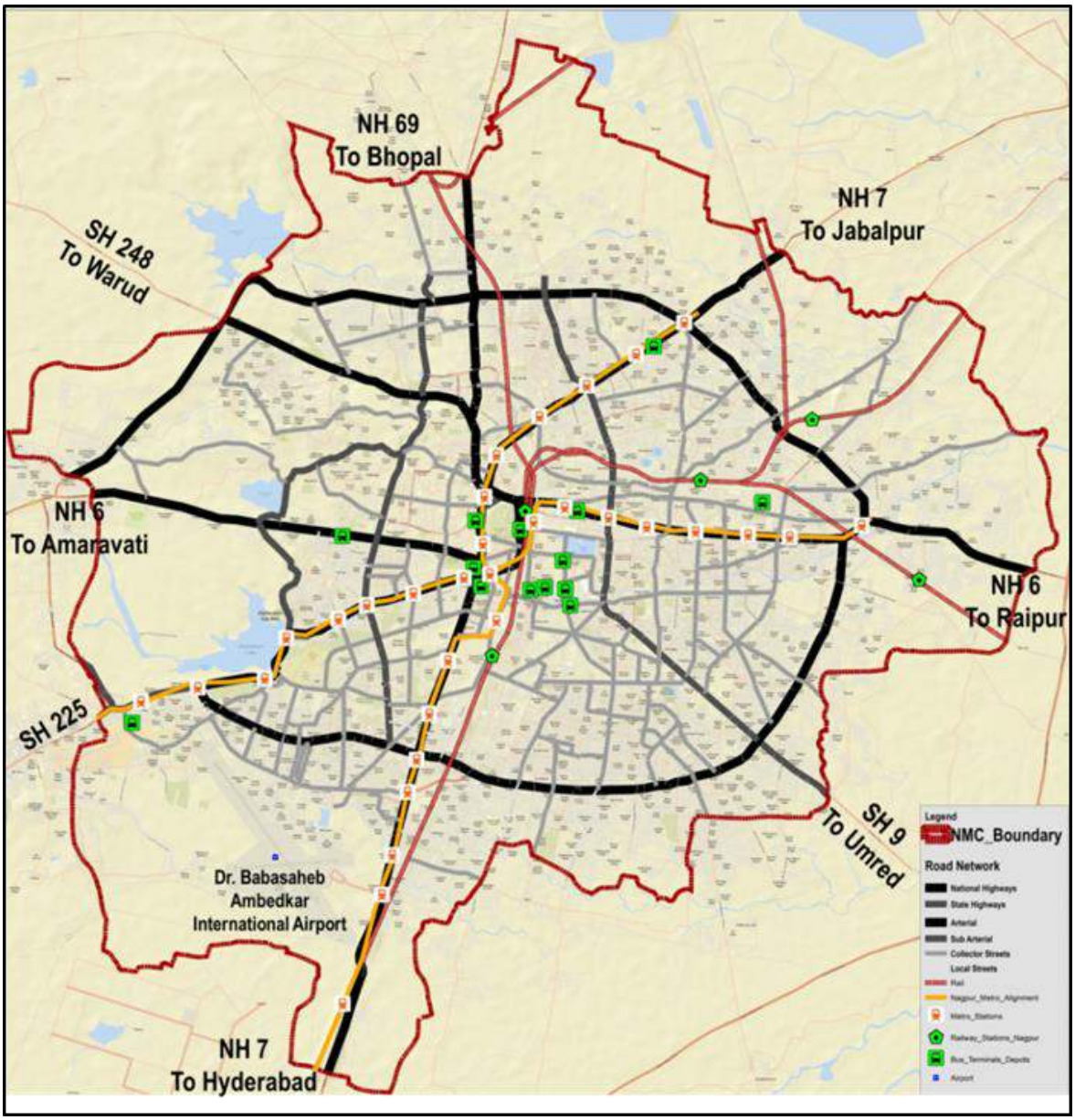
1.3. STUDY AREA DELINEATION

Comprehensive Feeder Services Plan for Nagpur shall aim at providing seamless integration of metro services with other modes of transport. Since, the study is looking at various components such as City Bus Services, Metro Feeder Services and NMT facilities all range from macro level to micro level the study area considered from each of the components is different as mentioned below:

- City Bus Services: An area of 227 Sq km within the jurisdiction of Nagpur Municipal Corporation (NMC) has been considered as Study Area.
- Metro Feeder Services: A buffer zone area with a radius of 2.5 km on either side of the metro alignment is considered;
- Non-Motorized Transport Plan: A buffer zone area with a radius of 500 m on either side of the metro alignment is considered

However, for the current study efforts have been made to integrate all the recommended proposals of each of mentioned components in a seamless manner. Figure 1-1 represents the Study Area Delineation of each of these components.

FIGURE 1-1: STUDY AREA DELINEATION



1.4. DATA BASE

1.4.1.SECONDARY DATA

Secondary Data shall include the following;

- Census of India, 1991, 2001, 2011 – Nagpur District, Maharashtra
- Motor Vehicle Registration Details – Road Transport Authority – Nagpur Division, Government of Maharashtra
- Bus Route/Shared Auto Route Permits details issued to the Private operators in Nagpur – RTO, Nagpur Division, Government of Maharashtra
- Bus Routes, Terminals, Depots & Workshop details of the City Bus Services
- Accident Details – Traffic Police

Previous Studies (but not limited to)

- City Development Plan for Nagpur - 2015
- Comprehensive Mobility Plan for Nagpur - 2013
- Detailed Project Report on Nagpur Metro Project – 2013
- Transit Oriented Development Action Plan for Nagpur - 2014
- Operation and Implementation Plan for Metro Feeder Services - 2016

1.4.2.PRIMARY DATA COLLECTION

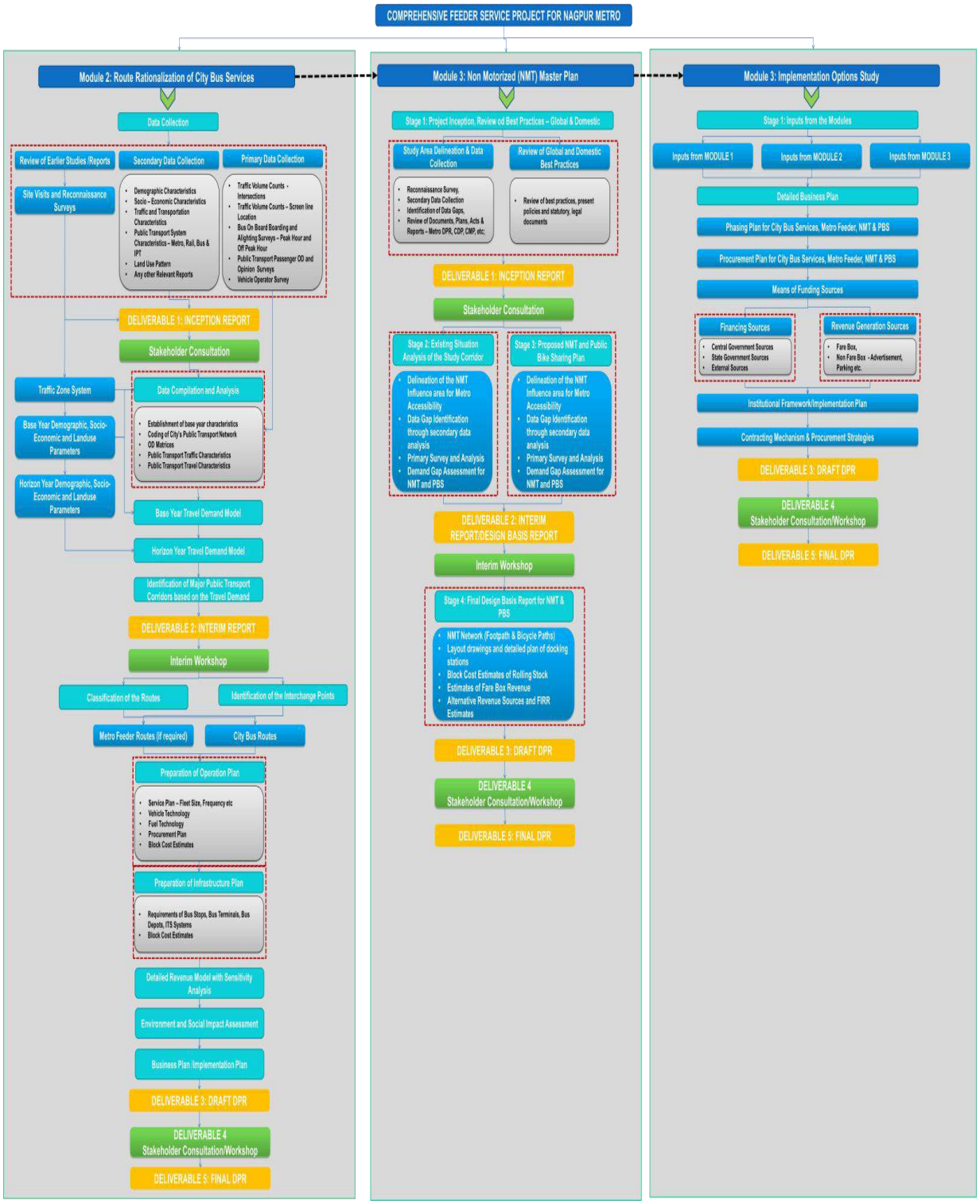
Based on the identified data gaps, primary surveys were carried out by UMTC, in consultation with the client. The primary data reflects the current situation of public transport system in Nagpur. The requisite primary surveys were conducted to update and validate the travel demand model built during the Comprehensive Mobility Plan and Transit Oriented Development Action Plan. The following primary surveys were carried out as part of this study (but not limited to);

- Classified Traffic Volume Counts at Screen Lines and Mid-Blocks
- Public Transport Occupancy Surveys
- Public Transport Speed and Delay Surveys
- On Board Boarding and Alighting Surveys
- Bus Passenger OD Surveys along with the Revealed Preference Surveys
- Vehicle Operator Survey
- Pedestrian and Cyclist Count Surveys along the Metro Corridor
- Pedestrian and Cyclist OD Surveys
- NMT Road Inventory Survey

1.5. APPROACH AND METHODOLOGY

As mentioned in the Section 1.3, the study shall constitute 4 Modules. FIGURE 1-2 represents the detailed methodology of study integrating all the four modules. Whereas Section 1.5.1, 1.5.2 & 1.5.3 describes detailed methodology of each module. The Module 1 on feeder service was awarded as a separate study and the outcomes of which are incorporated in Chapters 5 & 6.

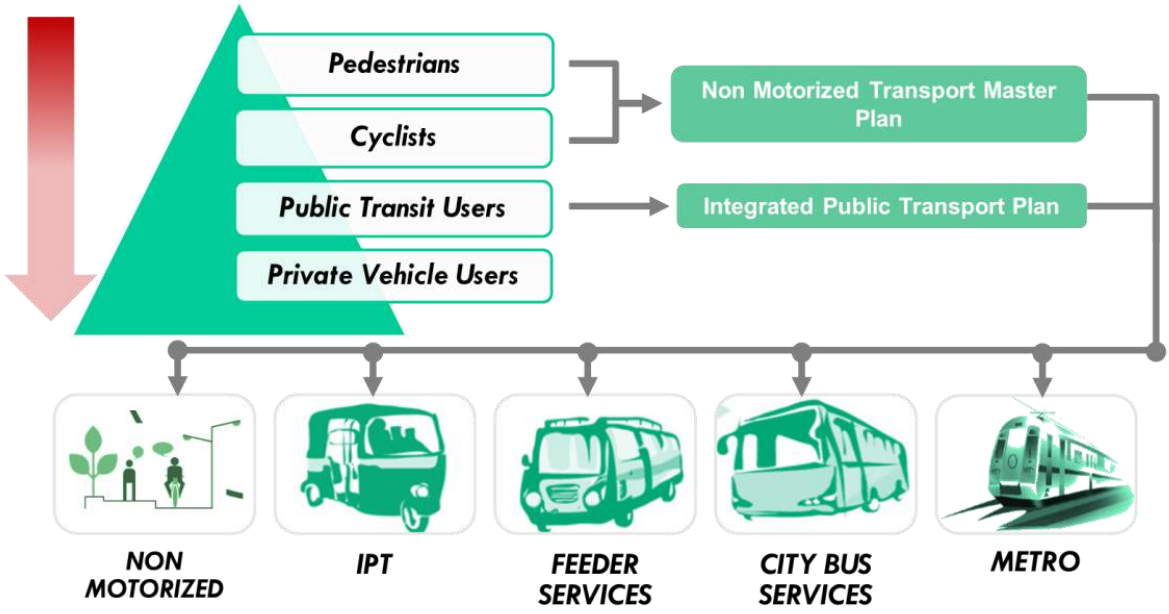
FIGURE 1-2: DETAILED METHODOLOGY FOR COMPREHENSIVE FEEDER SERVICES PROJECT FOR NAGPUR METRO



1.5.1. PUBLIC TRANSPORT APPROACH & METHODOLOGY

As per the National Urban Transport Policy (NUTP), it is essential to focus on movement of people rather than vehicles. In order to realize this, Maha Metro intends to prepare a "Comprehensive Feeder Service Project for Nagpur Metro", which intends to integrate transport systems such as Feeder Bus service Implementation and operation, Route rationalization, Non-Motorized Transport (NMT), Public Bike Sharing, Bus Transport, Parking, ITS and Smart solutions into a reliable and efficient system. This integration of multi modal transport systems is a multi-faceted approach considering the needs of all the public transport users. The priority to be considered in planning approach as mandated by National Urban Transport Policy, Government of India is presented in Figure 1-3.

FIGURE 1-3: VEHICLE PRIORITY ON MAJOR TRANSPORT CORRIDORS



In order to properly address various related issues and challenges while planning and designing, integrated multi modal public transport and feeder system requires an integrated approach, which have been analysed through following tasks.

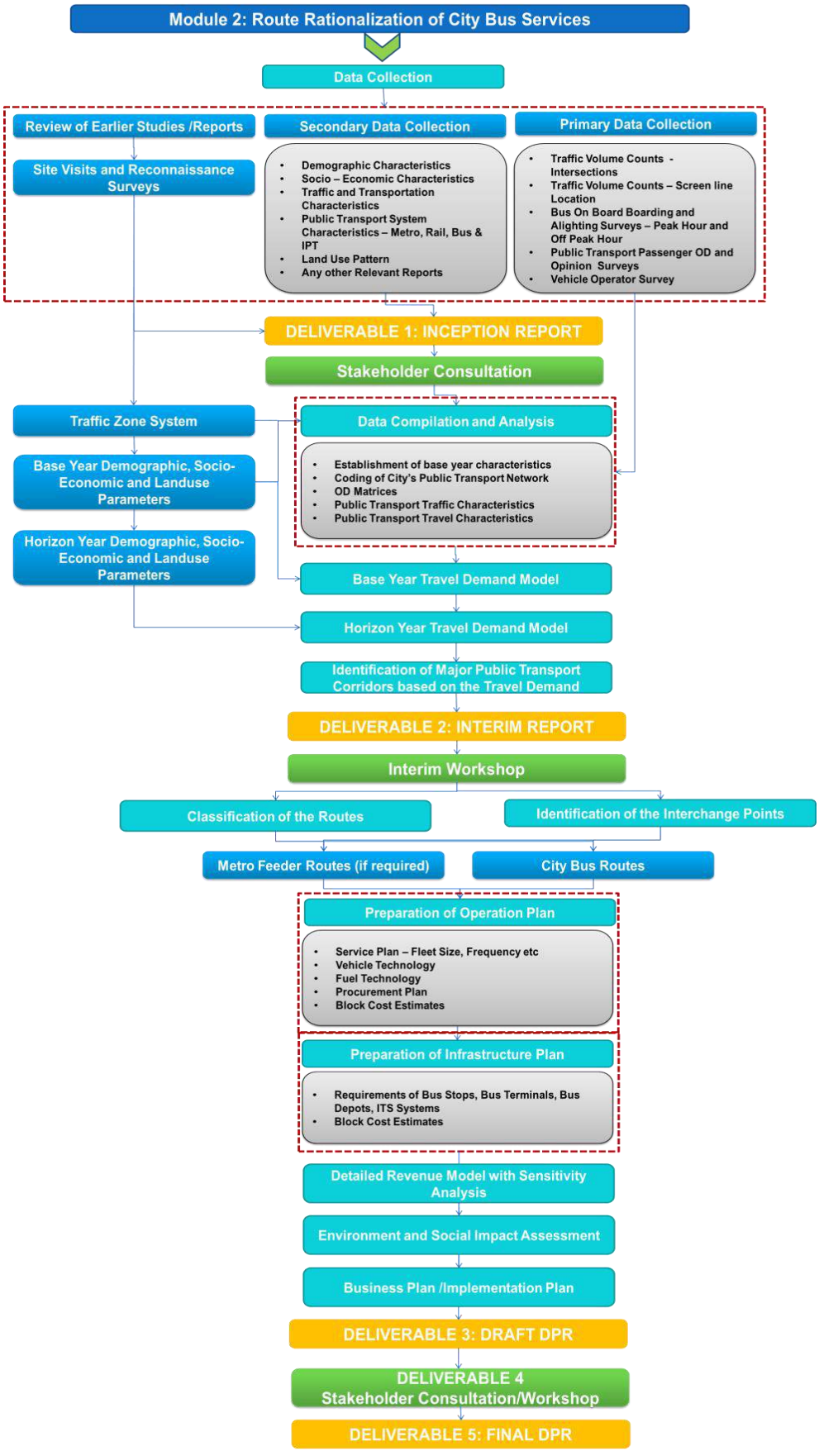
- Preparation of Data Base of existing characteristics
- Public Transport Demand Assessment and Forecasting
- Identification of major travel corridors, interchange points and public transport routes.
- Preparation of public transport operation plan including fare policy/integration
- Preparation of public transport infrastructure plan
- Preparation of Block Cost Estimates
- Business Plan with a revenue model and
- Implementation Strategy

All these tasks are interlinked with each other, considering the importance of each of these tasks in delivering an effective, reliable, efficient and sustainable public transport solutions, UMTC proposes to follow the methodology as presented in the flow chart emphasizing on the inter linking the various deliverables with each other.

1.5.1.1. DETAILED METHODOLOGY – PUBLIC TRANSPORT

The detailed methodology for the City Bus Route Rationalization Plan for Nagpur City is represented in the FIGURE 1-4.

FIGURE 1-4: METHODOLOGY FOR CITY BUS ROUTE RATIONALIZATION PLAN



It could be observed from FIGURE 1-4 that the methodology intends to divide the entire scope of work into 9 major tasks which are as follows;

1. Planning and provision of complementary public (other than private modes) transport systems for the commuters.
2. A comprehensive and integrated network of multi modal public transport systems; also aiming first & last mile connectivity.
3. Integration of various public transport modes of city.
4. Reduce overall travel time and waiting time to passengers.
5. Use of energy efficient and clean fuel technology to improve environmental quality.
6. Planning for Intelligent Transport System (ITS) - an advanced step towards modernization.
7. Operation and allied infrastructure plan for proposed complementary public transport modes.
8. Implementation and business plan for proposed public transport modes.
9. Identification of funding/ financing sources - to ensure the financial self-sustainability.

The above mentioned tasks are proposed to be addressed through a series of reconnaissance and primary surveys, analysis of previous transportation studies, land use studies and stakeholders consultations.

1.5.2. NMT APPROACH & METHODOLOGY

1.5.2.1. OVERALL APPROACH

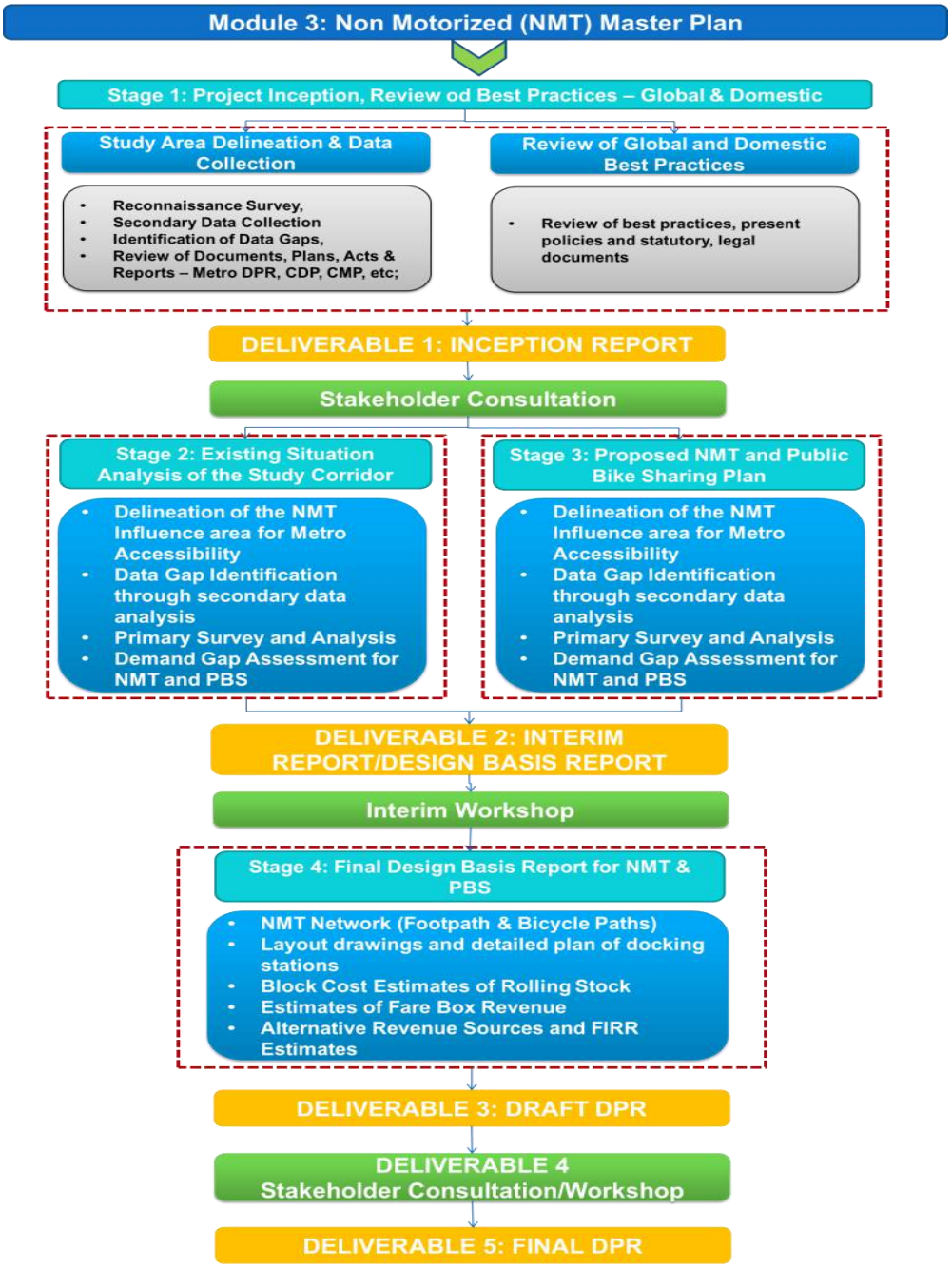
The NMT Master Plan has been prepared based on a holistic approach with an inherent mechanism of whole to part and part to whole planning. The overall approach adopted for this plan preparation is participatory in nature involving all the stakeholders so as to engage them in the planning process while understanding the city's needs from their perspective. The Project is divided into four broad stages as given below:

1. NMT Need Assessment: All secondary data available in relation to Urban Transport of Nagpur with special focus towards NMT, would be collected and analysed. Primary Surveys would be conducted to record the existing and forecasted NMT travel patterns in the study area. In order to undertake such an assignment, the volume of existing NMT usage in the study area and Origin and Destination of existing NMT Trips within study area will be mapped. User opinions and household characteristics would also be mapped to forecast projected NMT demand and usage.
2. DBR for NMT Plan: The NMT Need Assessment Matrix would establish the preferred NMT corridors and their projected usage. It would also prioritize NMT corridors to increase the ridership of metro and other PT systems of the city. The outcomes of the Need Assessment would guide towards creating a NMT Master Plan for the study area. The Master Plan would include NMT corridors, strategies for pedestrianisation, decongestion, location of PBS schemes and location of docking stations.
3. DPR for PBS Scheme: Areas for public bicycle sharing schemes would be chosen based on high probability of usage of the scheme in these areas. Principally, the PBS schemes would be proposed in areas where the ridership of the metro would benefit significantly with the introduction of the PBS Schemes. The PBS schemes would be detailed to further locate the bicycle sharing stations and hubs, preferred cycling corridors and proposed ITS systems for operating the PBS Schemes.
4. Preparation of Block Cost Estimates: International, National and local standards would be studied to prepare Design Standards, Specifications and Block Cost Estimates.

1.5.2.2. DETAILED METHODOLOGY – NMT MASTER PLAN

The main tasks for the project are as summarized in the flow chart below

FIGURE 1-5: METHODOLOGY FOR NMT MASTER PLAN



Broadly, the consultant shall be undertaking the following tasks for DPR preparation:

- Establishing a base line scenario for various NMT movements and identification of NMT movement pattern in the city and the study area
- Define the demand and supply gap in existing NMT infrastructure
- Planning and Designing of the NMT infrastructure in terms of design principles and specifications considering the network user requirements
- Preparation of DPR for bicycle sharing schemes in an integrated manner and assessment of its infrastructure, system specifications, Operation and Maintenance Plans, Revenue estimation and FIRR etc.

1.5.3. IMPLEMENTATION OPTIONS ASSESSMENT

1.5.3.1. OVERALL APPROACH

The Implementation Options Assessment would be prepared based on the holistic approach with an inherent mechanism of whole to part and part to whole planning. The overall approach adopted for this plan The overall approach adopted for this plan preparation is participatory in nature involving all the stakeholders so as to engage them in the planning process while understanding the city's needs from their perspective. The Project is divided into four broad stages.

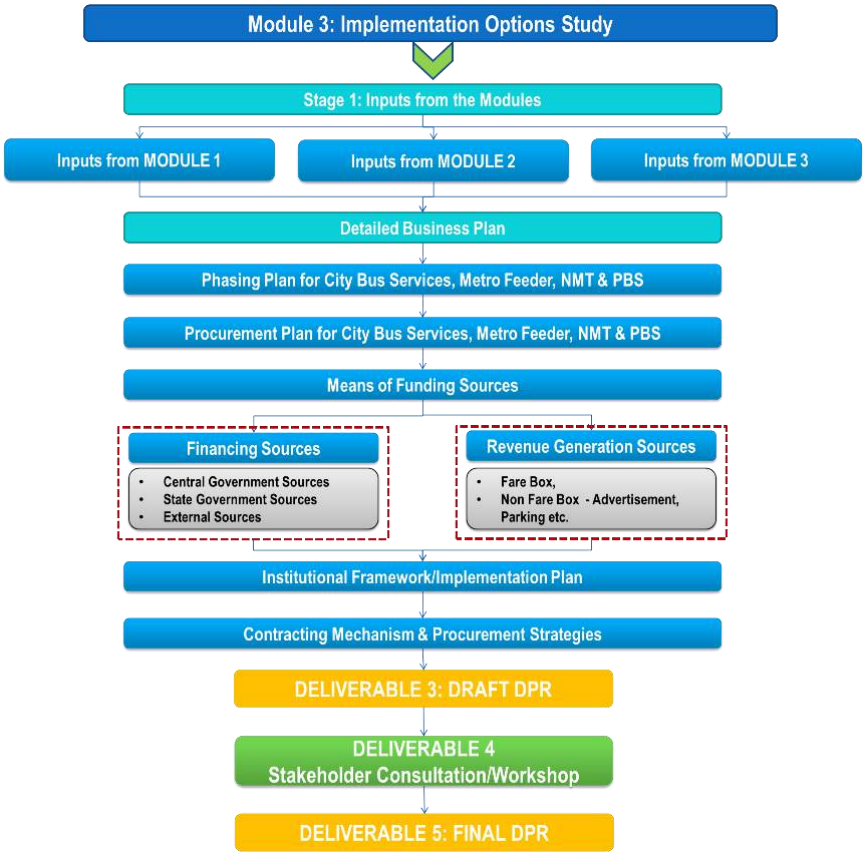
The approach for the four individual stages is as below:

1. Inputs from the Modules 1, 2 & 3: All the requisite inputs from the Modules 1, 2 & 3 shall be collected and analyzed.
2. Detailed Business Plan: The assessed information Detailed Business Plan shall be prepared covering, Phasing Plan, Procurement Plan, Means of Funding (Financing Sources for Investment and Long term Revenue Sources such as the Fare Box and Non-Fare Box.
3. Institutional Framework/Implementation Plan: The Institutional Framework identification shall also involve suitable coordination mechanism between the agencies for the implementation of public transport feeder system. On long term basis, suggestions will be provided for establishment of agency on the lines of UMTA.
4. Contracting Mechanism & Procurement Strategies: This stage shall involve recommendation of the appropriate contracting options such as the GCC, NCC or Hybrid based on the discussions with the stakeholders at various levels.

1.5.3.2. DETAILED METHODOLOGY – IMPLEMENTATION OPTIONS ASSESSMENT

The detailed methodology for the same is represented in Figure 1-6.

FIGURE 1-6: METHODOLOGY FOR IMPLEMENTATION OPTIONS ASSESSMENT



1.6. STRUCTURE OF THE REPORT

This report consists of 13 Chapters namely;

- Chapter 1: Project Background
- Chapter 2: Study Area Profile
- Chapter 3: Public Transport Characteristics
- Chapter 4: NMT Characteristics
- Chapter 5: Demand Analysis
- Chapter 6: Route and Service Plan
- Chapter 7: Infra and Development and Maintenance Strategy
- Chapter 8: ITS Development
- Chapter 9: Environmental and Social Screening
- Chapter 10: Project Cost Estimates
- Chapter 11: Revenue
- Chapter 12: Financial & Economic Analysis
- Chapter 13: Implementation Framework

CHAPTER 2 STUDY AREA PROFILE

2.1 CITY CHARACTERITICS

Nagpur is also known as the "Orange City" and is the winter capital of Maharashtra. Nagpur is the capital of 'Vidarbha' and the second capital of the state. The Nagpur Municipal Corporation (NMC) is the urban local body responsible for development activities of the city of Nagpur. The jurisdiction of NMC spreads across 227 sq.km, accommodating a population of 2.4 million (census 2011). The central location of Nagpur has given it a strategic connectivity to important cities of the country. The North-South and East-West rail corridors and two major national highways (NH7 – Varanasi-Kanyakumari & NH6 – Mumbai-Kolkata) pass through the city. The presence of an International airport provides connectivity to various parts of India and select international destinations. Within the NMC region, the road network spreads around 1150 km (CDP Study, 2015) and the presence of inner and outer ring roads provides the city a radial layout.

2.1.1. LOCATION

Nagpur is located at the exact center of the Indian peninsula. The Zero Mile marker, which represents the geographical center of India, lies in Nagpur. The city lies on the Deccan plateau of the Indian Peninsula and has a mean altitude of 310.5 meters above sea level.

FIGURE 2-1 LOCATION OF NAGPUR CITY

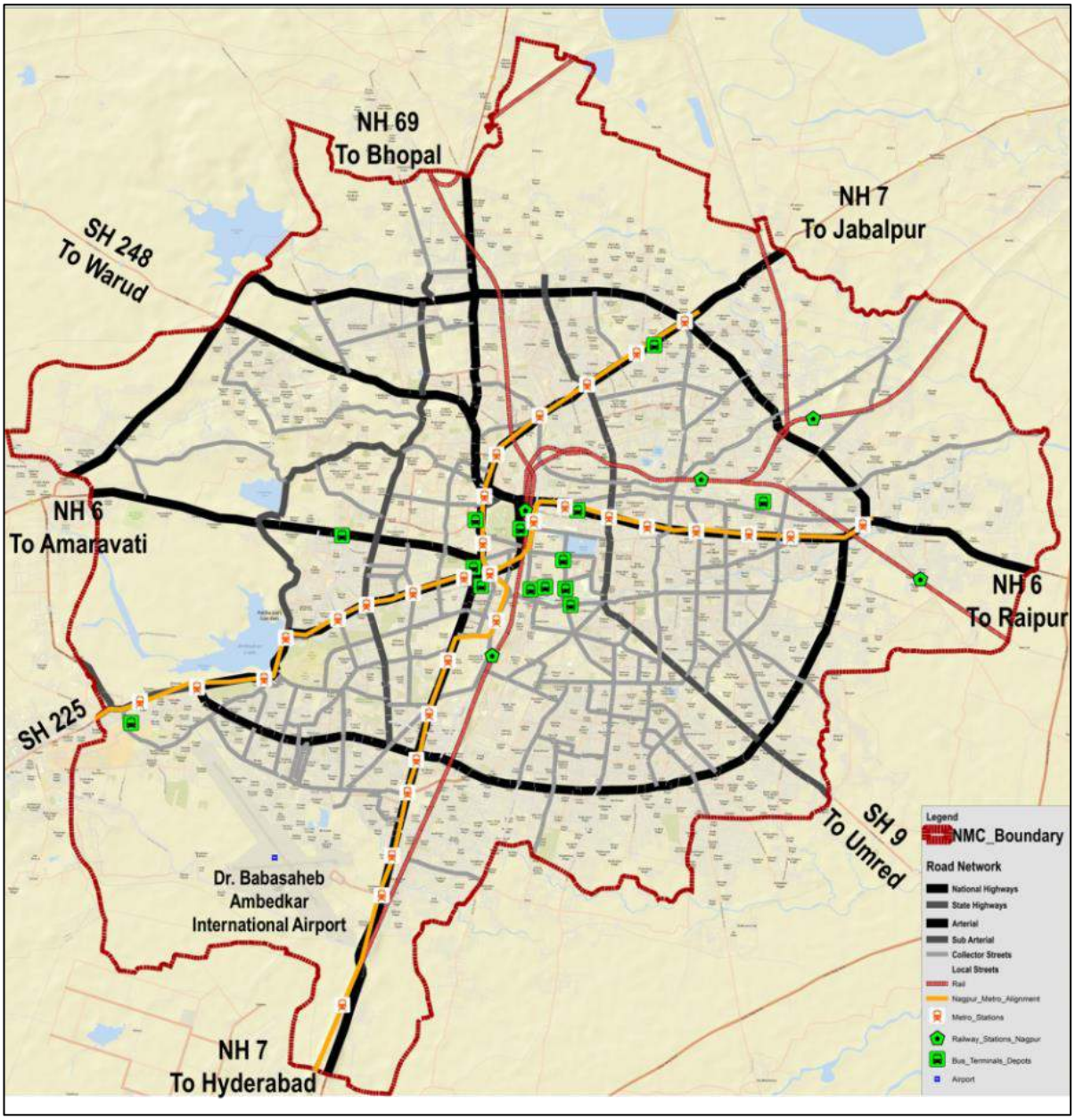
2.1.2. LINKAGES & CONNECTIVITY

Distance and connectivity with all the Indian cities through various transport modes gives Nagpur an inherent advantage. It can be seen as a transport hub, connecting the Indian cities to each other and international destinations as well. Various IT and ITES companies are also viewing these characteristics as a strong positive factor. Nagpur is well connected to other parts of the Country by road, rail and air transport.

By Air: Dr. Babasaheb Ambedkar International Airport is located in Sonegaon 7.5 km south of Nagpur City centre and is operated by Mihan India Private Limited (MIPL) and owned by Airports Authority of India (AAI). Nagpur is well connected by daily direct flights to domestic destinations such as Mumbai, Kolkata, Delhi, Bangalore, Pune, Indore, Raipur and Hyderabad. In addition to this international flights connecting to Sharjah, Singapore, Saudi Arabia and Bangkok also operate from Nagpur airport.

By Rail: Nagpur Central Railway Station connects major railway trunk routes. City is a divisional headquarters for the Central Railway and South East Central Railway Zone of Indian Railways. The other stations within the city include Ajni. Itwari, Kalamna, Kamthi, Godhni, Bharatwada, Kalameshwar, Kapri and Bahandewari Railway Stations which are represented in Figure 2-2.

FIGURE 2-2 TRANSPORT NETWORK OF NAGPUR[1]



By Road: Nagpur is located 837 km north east of Mumbai, 1094 km South of Delhi, 1092 km North of Chennai and 1140 km West of Kolkata. Nagpur is a major junction for roadways as India's two major national highways – National Highway (NH) 7 – Kanyakumari to Varanasi and National Highway (NH) 6 – Mumbai to Kolkata via Sambalpur pass through the city. NH 69

[1]Source: Extracted from Comprehensive Mobility Plan for Nagpur , 2013

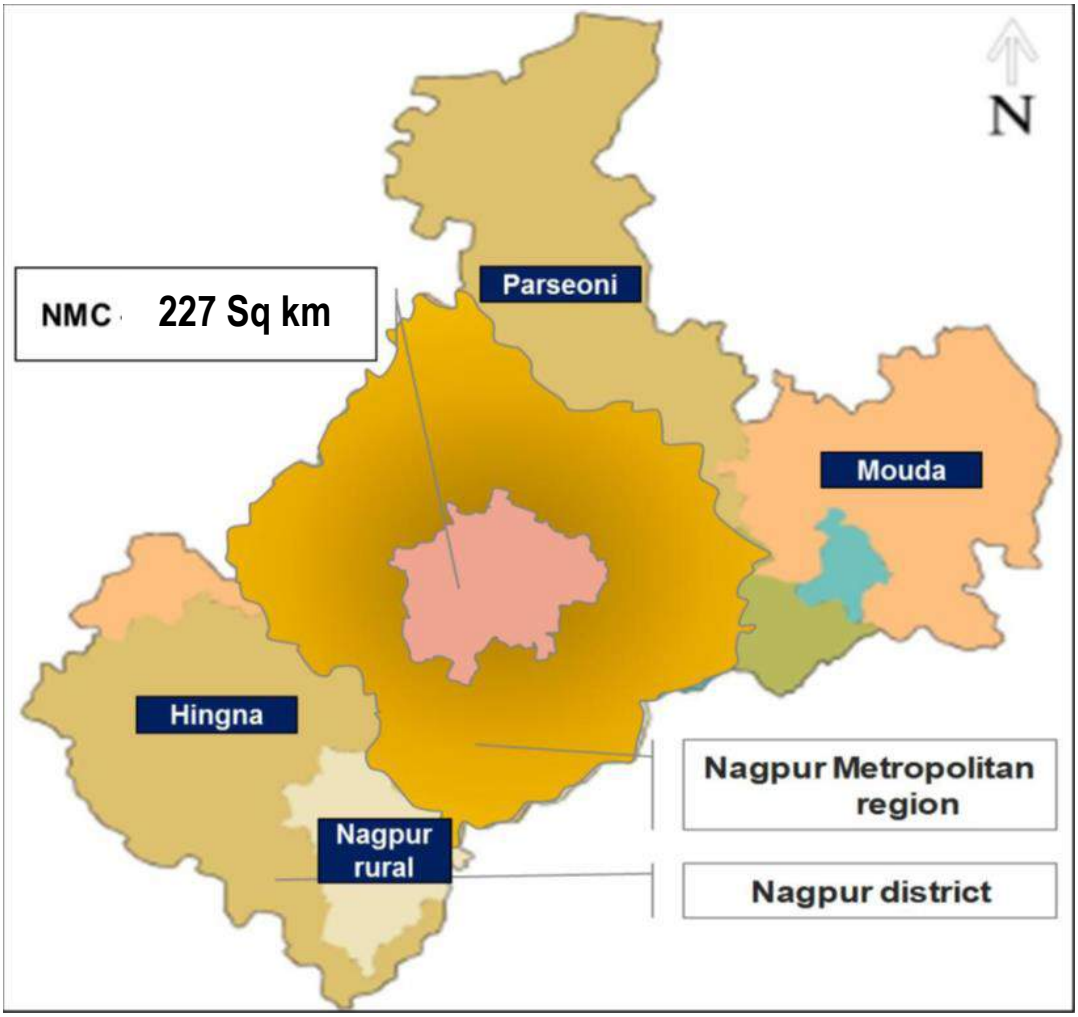
also connects Nagpur to Obaiddullaganj near Bhopal. Maharashtra Samruddhi Mahamarg connecting Nagpur-Aurangabad-Mumbai Expressway is a state highway is being constructed in two phases, in line with the National Express Highway Standards and is expected to be completed by 2019.

2.1.3. ADMINISTRATIVE SETTING OF NAGPUR CITY

Nagpur is an important urban center in the Vidarbha region. Nagpur is the administrative capital of the district and the largest urban center in the district in terms of population and area. The city is a part of the Nagpur division. The Nagpur Municipal Corporation (NMC) has 138 administrative wards.

Nagpur Municipal Corporation (NMC) and Nagpur Improvement Trust (NIT) are the two main authorities responsible for the provision of the services within the city. NMC is the main authority and responsible for carrying out all the obligatory functions as per the applicable act (Maharashtra Municipal Corporation Act, 2012). NIT was the planning authority for Nagpur city till the year 2000. As on date, NIT is a special planning authority for the Nagpur Metropolitan Region (NMR) and is also responsible for provision of infrastructure and certain services in the periphery of the NMC jurisdiction.

FIGURE 2-3 ADMINISTRATIVE BOUNDARIES – CITY, REGION AND DISTRICT[2]



[2] Source: Extracted from City Development Plan for Nagpur, 2041 – CRISIL 2015

As part of the current study, an area of 227. 29 Sq km within the jurisdiction of Nagpur Municipal Corporation (NMC) has been considered as Study Area.

2.2. DEMOGRAPHIC CHARACTERISTICS

This section illustrates the demographic profile like population, population growth rate and population density in study area. The details for each have been explained in the following sections:

2.2.1.POPULATION AND POPULATION DENSITY

2.2.1.1. POPULATION

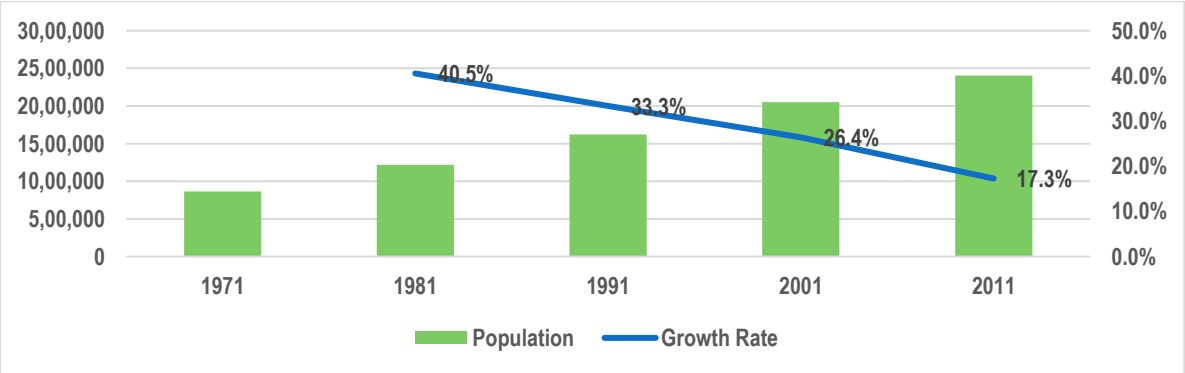
Nagpur city is the third largest urban agglomeration in the state of Maharashtra in terms of population. As per Census 2011, Nagpur accounted for 6% of total urban population of the state and 76% of the district urban population of Nagpur district. In addition, 52% of the total district population resides within NMC. Nagpur attracted the migration and floating population from the neighbouring districts of Maharashtra for education, employment, and business.

The population of Nagpur has increased from 1.5 Lakh in 1921 to 24.05 Lakh in 2011 as represented in Table 2-1 and Figure 2-4. As indicated in the table and figure below, it could be observed that the decade 2001-2011 has registered the lowest decadal change of only 17%. Most of the Indian cities have witnessed limited growth of population attributed to development of satellite towns in and around the city. The CBD areas in the cities have started having limited or negative growth trends owing to population moving to the suburban areas of the city.

TABLE 2-1: POPULATION TRENDS IN NAGPUR CITY – 1921 TO 2011[3]

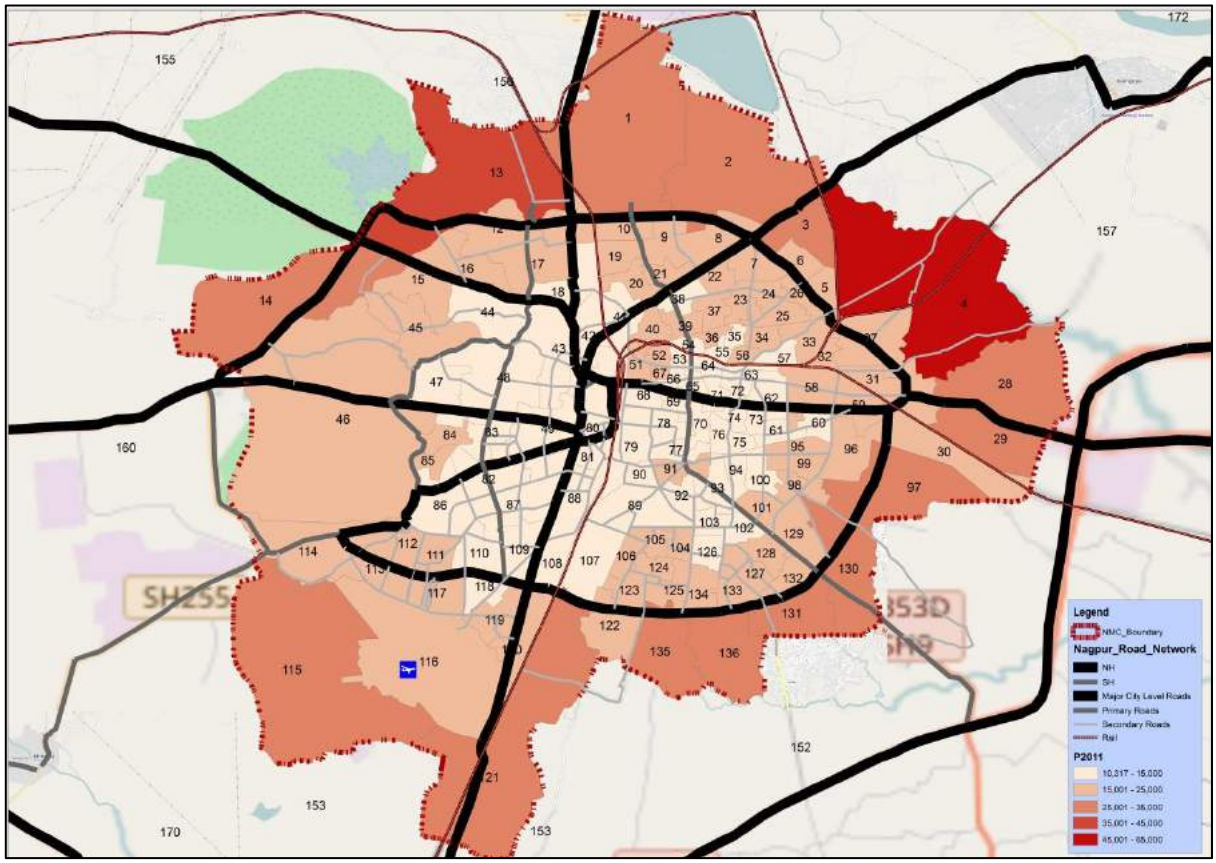
Decade	Population	Growth Rate
1971	8,66,000	-
1981	12,17,000	40.5%
1991	16,22,820	33.3%
2001	20,51,320	26.4%
2011	24,05,665	17.3%

FIGURE 2-4: POPULATION TREND IN NAGPUR CITY – 1921 TO 2011[4]



3&4 Source: Census of India – 2011 & Comprehensive Mobility Plan of Nagpur - 2013

FIGURE 2-5: DISTRIBUTION OF POPULATION IN NAGPUR CITY[5]



2.2.1.2. POPULATION DENSITY

Nagpur city is spread over an area of 227.29 sq. km with a population of 24.05 lakhs; with a gross population density is 10,688 persons/sq km.

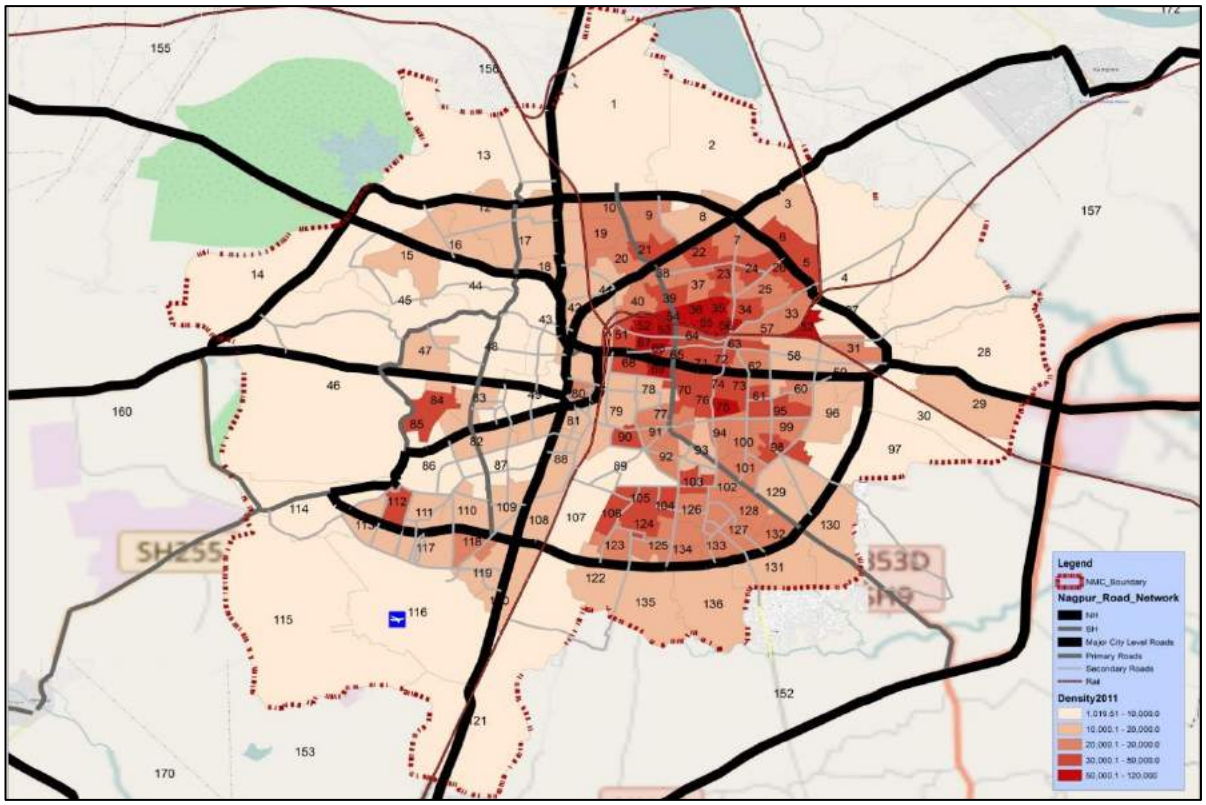
Based on the area of 138 administrative wards (erstwhile) and ward level population; the population density was calculated, which is represented in the Figure 2-6. It could be observed from the figure that the eastern part of the city has higher densities in comparison to the western part, majorly due to the educational and institutional institutes located in the western part of the city and commercial and activity hubs in the eastern part of the city.

TABLE 2-2: POPULATION DENSITIES IN NAGPUR CITY[6]

Sl. No.	Administrative Divisions	Area (Sq kms)	Population		Density (persons/ sq km)	
			2001	2011	2001	2011
1	Nagpur Municipal Corporation (NMC)	227.29	20,51,320	24,05,665	9113	10688

5 Source: UMTC, 2017
6 Source: Census of India – 2011 & Comprehensive Mobility Plan of Nagpur - 2013

FIGURE 2-6: DISTRIBUTION OF POPULATION DENSITY IN NAGPUR CITY[7]



2.3. ECONOMIC ACTIVITIES

Nagpur's economy has recovered from past slowdowns and the city has emerged as the 14th most competitive city in the country by the Institute for Competitiveness in its 2014.

Nagpur has presence of industries located in the periphery of the city and in region, which are contributing to city's economy and supports the local economic development. Apart from the industries, there is trade and commerce in the city that comprise retail and wholesale trade both contributing to the city's economy. Some of the industries present in Nagpur are: Chemicals, Cements, Coal based , Engineering, Electrical, Electronics, Food Processing, Paper products , Wood based, Pharmaceuticals, Textile, Ceramics, etc.

There are 8 industrial estates in Nagpur, which make the foundation of the economy of the city. These estates are spread over an area of 3,887 ha, with majority of the area located at the Butibori Industrial estate.

Multi-modal International Hub Airport at Nagpur (MIHAN) is a state government initiative to support the economic development in and around Nagpur region. MIHAN is a composite project consisting of international airport and an SEZ. The project will be developed over an area of 4,354 ha and will be developed by Maharashtra Airport Development Company Ltd. The project is

[7] Source: UMTC, 2017

delineated into two different parts which consists of International Airport which shall act as Cargo Hub and a Special Economic Zone (SEZ) which shall target at the commercial group. The proposed MIHAN project is expected to cost of Rs.2000 crores, with a capacity to handle 14 Million air passengers and 0.8 Million Tons of Cargo annually by year 2030. The employment generation potential is estimated to be about 0.1 Million direct jobs by year 2018. Around 18% of the working population is expected to cater to the Transportation sector and other related industries.

The city is important for the banking sector as it hosts the regional office of Reserve Bank of India, with two branches in Nagpur, one of which houses India's entire gold assets. Nagpur also has a strong presence in the Manufacturing segment and houses many of the country's FMCG brands such as Dinshaws, Haldiram's, Actchawa, Vicco etc.

Nagpur is also the biggest marketplace for oranges in the country. The Maharashtra Agro Industrial Development Corporation has its multi fruit processing division called Nagpur Orange Growers Association (NOGA) which has an installed capacity of 4,950 MT of fruits per annum. Orange is also exported to various regions in the country as well to other countries.

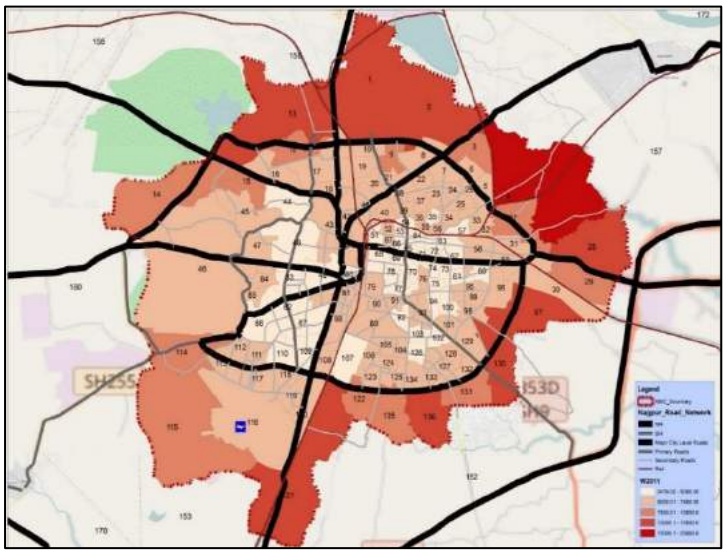
There is also an active investment from the IT sector in Nagpur with IT giants TCS, Infosys and Mahindra Satyam building campuses in MIHAN SEZ. TAL Manufacturing Solutions also has its facility in the SEZ for manufacturing structural components for Boeing's 787 Dreamliner aeroplanes. Air India has its MRO Facility in the SEZ which was constructed by Boeing and is ready for commercial operation. Owing to rich natural resources in the region, mining is a major activity. Several government organizations related to the mining industry are based in Nagpur, which includes Western Coalfields Limited, MOIL and Indian Bureau of Mines.

2.3.1. WORK FORCE PARTICIPATION RATE IN NAGPUR

Based on the 2011 census data it has been observed that the Worker population in Nagpur is 8,43,771 which constitutes about 37% of the total population, of which 78% of the working population is contributed by male population and remaining 22% is contributed by female population. The share of main workers is 86% in the total workforce, 8.1% is shared by the marginal workers, and 6% is the share of other workers. The Figure 2-7 represents the distribution of Worker Population in Nagpur City.

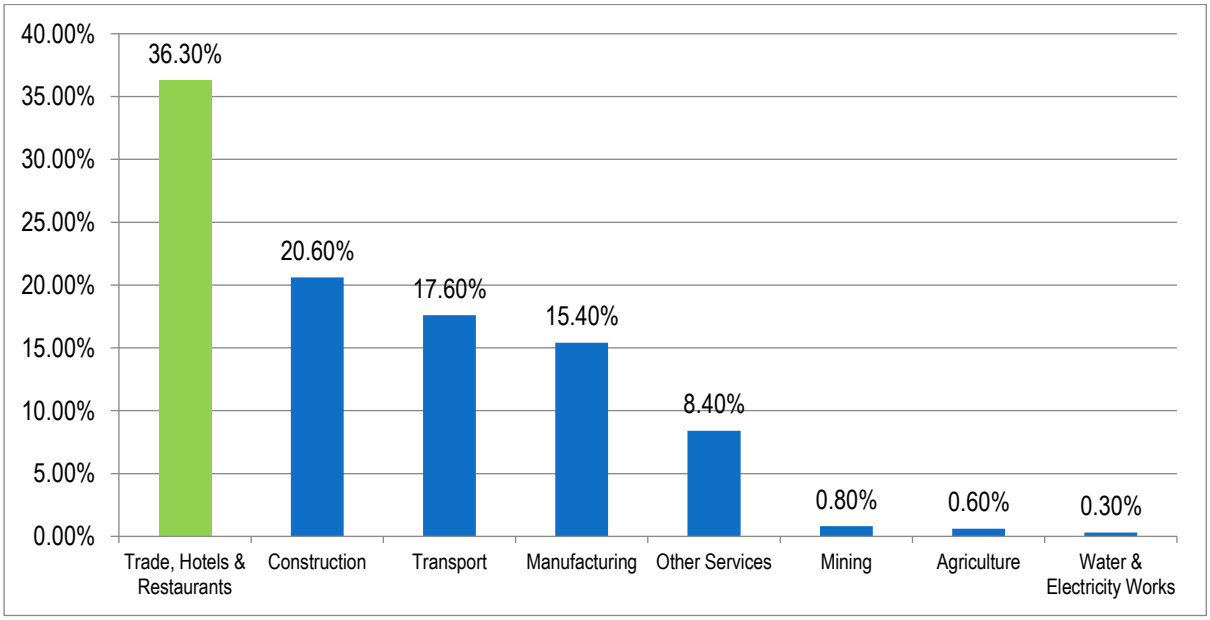
A detailed analysis of the workforce participation is shown in the Figure 2-8. It can be observed that Trade and Hospitality business is a major occupation of the residents followed by the construction industry. On the other hand Transportation industry has a share of almost 18% in the total workforce population. This serves as a clear indication of the concourse of the transportation activities being planned in the city and divergent effect of all the routes being merged in the city.

FIGURE 2-7: DISTRIBUTION OF WORKERS POPULATION IN NAGPUR CITY[8]



8 Source: Census of India – 2011 & Comprehensive Mobility Plan of Nagpur – 2013 & UMTC, 2017

FIGURE 2-8: CITY WORKFORCE PARTICIPATION IN NAGPUR CITY[9]



2.3.2.INCOME PROFILE

The average monthly household income was observed to be Rs. 27,000 as per DPR for Phase-II. Figure 2-9 represents the distribution of households by income profile in the Nagpur City.

FIGURE 2-9: DISTRIBUTION OF HOUSEHOLDS BY INCOME PROFILE IN NAGPUR[10]

S. No.	Income Group (Rs.)	No. of Households	Percentage
1	<5000	69	0.8
2	5000-10000	1075	13.2
3	10000-15000	1223	15.1
4	15000-20000	1319	16.2
5	20000-25000	1012	12.5
6	25000-50000	2702	33.3
7	>50000	723	8.9

2.4. POPULATION PROJECTIONS

Population projections play a vital role in the assessment of the future needs of the city. The projected population assists in estimating the demand for horizon years. As part of the Comprehensive Mobility Plan for Nagpur City, population for the Nagpur has been forecasted through various methods such as the Arithmetic Increase Method, Incremental Increase Method, Geometrical Progression Method, Exponential Method, Power Method and Log Method. Based on the actual growth trends and to effectively reduce the percentage error Incremental Increase Method was adopted for the population projections which is represented in the Figure 2-10.

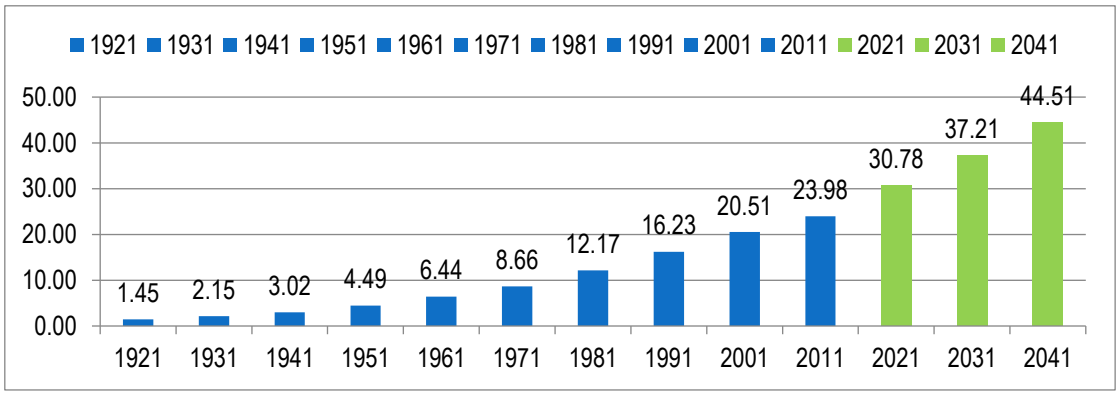
The population projections are made considering the recent development projects like MIHAN as it is expected to be established as one of the major IT sectors in the country. Nagpur also has large number of technical institutes which can cater

9 Source: NSS 55th Round, Census of India, 2001
10 Source: Detailed Project Report for Nagpur Metro Phase II Corridors, 2017

to the rising needs of the IT & ITES industry in the region by generating enough manpower resources. Nagpur also being considered as a low living cost city has become a prime destination for Information Technology Enabled Services (ITES) and Business Process Outsourcing (BPO) units.

Industry giants like Shapoorji Pallonji and L&T Infocity have already taken up the process of setting up their industries. All these factors in amalgamation will definitely have a considerable amount of impact on the population growth trends of the city.

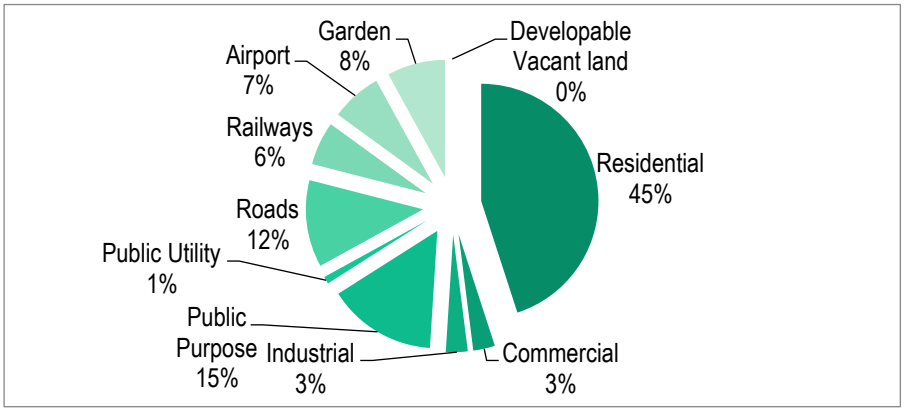
FIGURE 2-10: POPULATION PROJECTION FOR NAGPUR CITY FOR THE HORIZON YEARS OF 2021, 2031 & 2041[11]



2.5. LANDUSE CHARACTERISTICS

At present, Nagpur is spread over an area of 227 sq km. As per the 1984 land use plan, only 80% of the land was developable, which has been increased to 100% in 2011. Also, 15,033 hectares of area is developed, which is 69% of the total area, and developed area in last three decades (since 1984) has doubled. As per the existing land use, majority of the land portion is developed as residential which is 45%; commercial and industrial land use is 6%; land under public use is approximately 41%; and 8% is under parks and gardens. As per the Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines, the existing land use conforms to the norms in case of land under residential use, commercial use and land under public use.

FIGURE 2-11: EXISTING LANDUSE BREAKUP OF NAGPUR 2011[12]



Land under industrial and recreational use does not conform to the norms. But, land under recreational use is less and is adequately complimented by the large forest cover in the city. Area under water bodies has reduced by almost 50% in

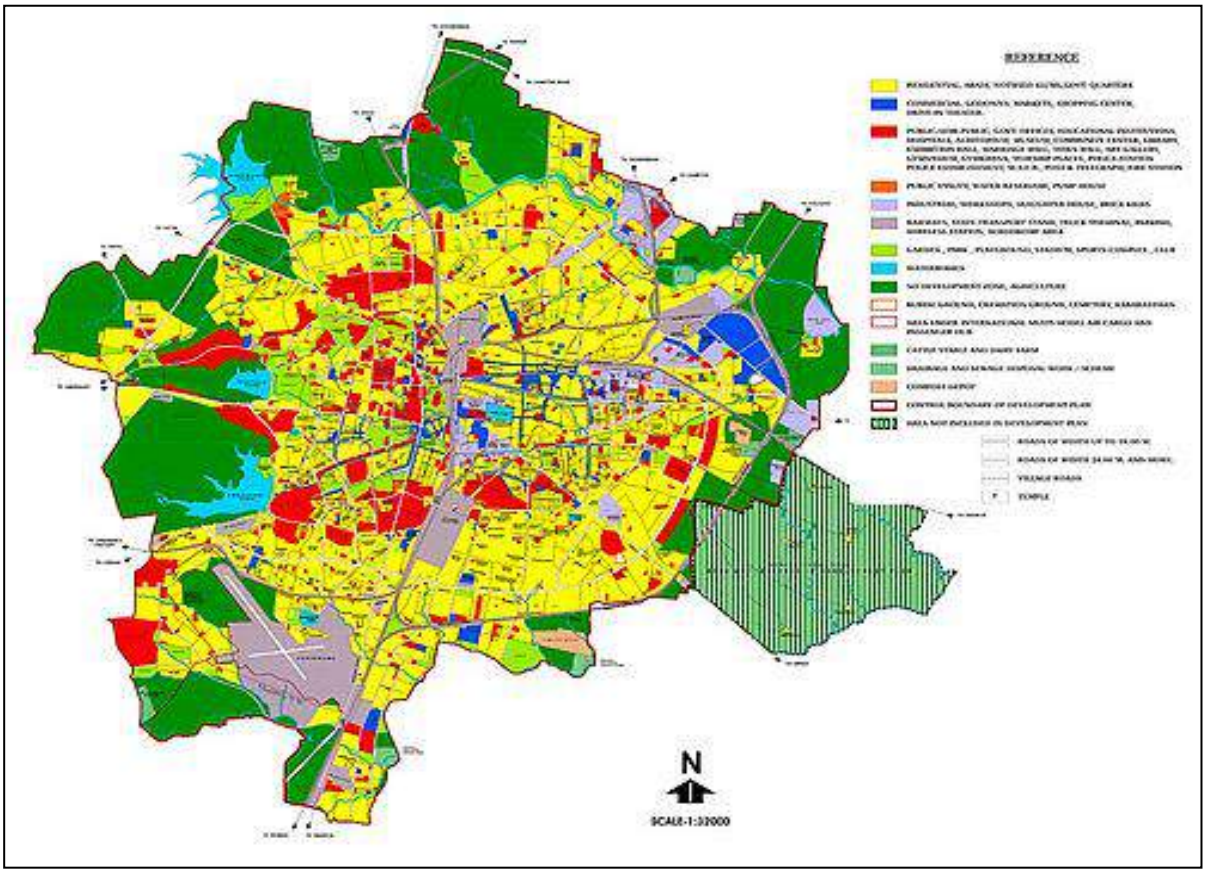
11 Source: Census of India – 2011 & Comprehensive Mobility Plan of Nagpur - 2013
12 Source: Revised Draft Development Plan of Nagpur city, 2011

comparison to 1984 land use. Figure 2-12 represents the Existing Land use plan of the Nagpur city. As discussed earlier in the section, comparison of existing landuse pattern with URDPFI guidelines is shown in the table below;

TABLE 2-3: EXISTING LAND USE AND COMPARISON WITH URDPFI GUIDELINES[13]

Category	URDPFI Guidelines	Existing (%)	Meets the Benchmark
Residential	40 – 45%	45%	Yes
Commercial	3 – 4%	3%	Yes
Industrial	8 – 10%	3%	No
Public & Semi Public	10 – 12%	16%	Yes
Recreational	18 - 20%	8%	No
Transportation	12 – 14%	25%	Yes
Agricultural/Vacant/Forest and Water Bodies	Balance	0%	No

FIGURE 2-12: EXISTING LAND USE PLAN OF NAGPUR CITY[14]



2.5.1. PROPOSED LANDUSE OF NAGPUR CITY

The total area considered under the revised development plan being prepared by NMC is 227 sq km. Of this, 217.56 sq km is under NMC jurisdiction, and rest 7.25 sq km is located outside NMC limits. An area of 17.65 sq km is earmarked for sewerage and drainage disposal schemes. NMC has divided the entire area into 7 planning units for preparing the development plan. Area of newly merged census town is 7.25 sq km which will also be added to the NMC area for future development under revised development plan.

13 Source: URDPFI Guidelines, 2014
14 Source: Revised Draft Development Plan of Nagpur city, 2011

In order to improve the land use and to conform to the required norms as per URDPFI guidelines, the Town Planning department has prepared the revised development plan for Nagpur. The following land use has been proposed for 2021 and 2031.

TABLE 2-4: PROPOSED LANDUSE FOR NAGPUR CITY[15]

Sl. No.	Landuse	2021 Area in Hectare	2021 % of Developed Area	2021 % of Total Area	2031 Area in Hectare	2031 % of Developed Area	2031 % of Total Area
1	Residential	6706	45%	31%	7000	47%	32%
2	Commercial	501	3%	2%	700	5%	3%
3	Industrial	495	3%	2%	800	5%	4%
4	Public Purpose	2312	15%	11%	2312	15%	11%
5	Public Utility	149	1%	1%	150	1%	1%
6	Roads	1754	12%	8%	1800	12%	8%
7	Railways	873	6%	4%	900	6%	4%
8	Airport	993	7%	5%	1000	7%	5%
9	Garden	1251	8%	6%	1300	9%	6%
10	Developable Vacant land	0	0%	0%	0	0%	0%
11	Agricultural Land	5774		27%	4846		22%
12	Water Bodies & Nallahs	463		2%	463		2%
13	Non-Developable Land	0		0%	0		0%
14	Drainage & Sewage Disposal	141		1%	141		1%
15	Cattle Stable & Dairy Farm	212		1%	212		1%
16	Compost Depot	131		1%	131		1%
	Total (B)	**6721**			**5793**		
	Grand Total (A+B)	**21755**			**21755**		

2.5.2. NAGPUR METROPOLITAN REGION (NMR) – PROPOSED LAND USE

The State Government of Maharashtra formed Nagpur Metropolitan Region (NMR) in 1999. The metropolitan region includes Nagpur city, Nagpur Gramin (rural), Hingna, Parshivni, Mauda, and Kamptee tehsils and parts of the Savner, Kalmeshwar, Umred, and Kuhi tehsils. The total metropolitan area considered for carrying out planning and preparing the land use plan is 3,780 sq km, excluding the Nagpur city area under NMC jurisdiction. Preparation of the land use plan for NMR will be carried out in two phases. In Phase – I, the land use plan for an area of 1,520 sq km has been prepared by NIT.

The proposed land use distribution of the city is envisaged to cater to the population and growth trends of the 2031 population and other economic activities. It can be observed that the major portion of land is allocated to green belt so as to preserve the environment. Table 2-5 shows the Proposed Area Land Use pattern for the city.

15 Source: City Development Plan for Nagpur, 2041 – CRISIL 2015

TABLE 2-5: PROPOSED LAND USE PATTERN OF THE NAGPUR METROPOLITAN REGION[16]

Sl. No	Type of User	Proposed Area (Ha)	% with Urbanizable Area
1	Residential	7037.84	22.68
2	Shops & other commercial	419.47	1.35
3	Weekly and or daily markets	100.25	0.32
4	Ware house & government Godowns	126.91	0.14
5	Industries & work shops	847.32	2.73
6	Educational institutions	1304.12	4.2
7	Government & other offices	840.05	2.71
8	Hospital & dispensaries	454.45	1.46
9	Worship Places	99.37	0.32
10	Open Spaces Gardens & Play Grounds	804.28	2.59
11	Roads (50 ft and above)	1164.39	3.75
12	Railways	1756.08	5.66
13	Airforce, defence & police premises	2418.42	7.79
14	Water bodies	930.56	3
15	Burning Ghats, Burial grounds	83.01	0.27
16	Open land committed under schemes	5354.6	17.25
17	Government agriculture farms	531.7	1.71
18	Vacant lands	174.78	0.56
19	Green belt & agricultural land	6592.7	21.24
	Total	**31040.3**	**100**

2.6. EXISTING TRAFFIC AND TRANSPORTATION CHARACTERISTICS

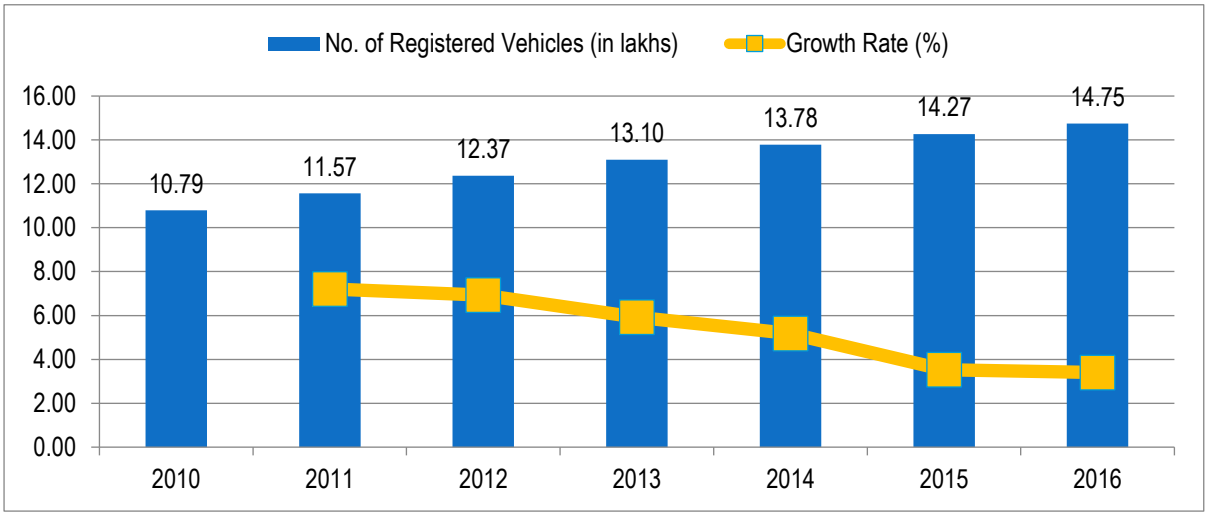
Profiling of the existing traffic and transportation scenario includes several dimensions. Documentation of these helps in appreciating the present scenario which is fundamental to any way forward. These dimensions of the base line transportation scenario presented in the ensuing section cover all the major aspects viz. network, travel patterns, traffic and travel characteristics, operational aspects of the public transportation systems etc.

2.6.1. VEHICULAR GROWTH AND COMPOSITION

With the rapid growth of urban population, there is an ever increasing demand on the city's infrastructure to serve the population. The rapid motorization rates have further complicated issues to compete with the public transport systems in the cities, as mode choices for commuting. The trips per household have increased over the years, with increasing per capita incomes and increase in vehicle ownership. With improving socio-economic level in the Indian cities and inadequate mass transport system, personalized motor vehicles have been growing at the rate of 6% to 15% per annum in different cities. In most of the cities, scooters/motor cycles comprise more than 60 per cent of the total motor vehicles. Figure 2-13 represents the growth of the vehicles in Nagpur City from 2010 to 2016.

16 Source: Nagpur City Environmental Status Report, 2011-12, Nagpur Municipal Corporation

FIGURE 2-13: GROWTH OF VEHICLES IN NAGPUR CITY[17]



From Figure 2-13 it could be observed that the no. of vehicles in the city of Nagpur is growing at 4.98% per annum which is about twice the population growth of the city. Table 2-6 represents the Mode wise distribution of the registered vehicles in Nagpur city from 2010 to 2016. (Source: Extracted from the Motor Transport Statistics of Maharashtra for 2012-13, 2013-14, 2014 – 15 & 2015-16).

TABLE 2-6: MODE-WISE DISTRIBUTION OF THE VEHICLES REGISTERED IN NAGPUR CITY[18]

Category		2010	2011	2012	2013	2014	2015	2016	2017
Motorcycles	No.s	350638	390102	429837	479056	513281	572295	612033	763240
Scooters	No.s	271318	293926	318999	329426	344553	327913	327913	361750
Moped	No.s	283371	283810	283771	283605	283427	282745	282745	326873
Total Two Wheelers	No.s	**905327**	**967838**	**1032607**	**1092087**	**1141261**	**1182953**	**1222691**	**1451863**
	%	**83.9%**	**83.6%**	**83.5%**	**83.3%**	**82.8%**	**82.9%**	**82.9%**	**82.50%**
Motor Cars	No.s	79639	89479	99233	108068	117721	123280	126684	144655
	%	**7.4%**	**7.7%**	**8.0%**	**8.2%**	**8.5%**	**8.6%**	**8.6%**	**8.22%**
Jeeps	No.s	26181	28244	29727	30813	33925	35678	36778	42302
	%	**2.4%**	**2.4%**	**2.4%**	**2.4%**	**2.5%**	**2.5%**	**2.5%**	**2.40%**
Station Wagons	No.s	842	842	842	842	842	842	842	904
	%	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.05%**
Taxi Cabs	No.s	0	0	0	0		0	0	0
	%	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.00%**
Meter fitted	No.s	0	0	0	0	9	9	9	83
	%	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.00%**
Tourist cabs	No.s	2388	2661	2907	3132	3380	3817	4407	6005
	%	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.3%**	**0.3%**	**0.34%**
Auto Rickshaws	No.s	16058	16417	17149	17281	17864	14251	14905	21604
	%	**1.5%**	**1.4%**	**1.4%**	**1.3%**	**1.3%**	**1.0%**	**1.0%**	**1.23%**
Stage Carriages	No.s	1715	1741	1741	1741	1741	1739	1739	2019
	%	**0.2%**	**0.2%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.11%**
	No.s	672	735	899	929	1020	1048	1111	1281

[17]Source: Motor Transport Statistics of Maharashtra, 2012-13, 2013-14, 2014-15 & 2015 - 16

[18]Source: Motor Transport Statistics of Maharashtra, 2012-13, 2013-14, 2014-15 & 2015 - 16

Category		2010	2011	2012	2013	2014	2015	2016	2017
Contract carriages /Minibuses	%	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.07%**
School Bus	No.s	513	575	615	703	1339	1432	1755	2340
	%	**0.0%**	**0.0%**	**0.0%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.13%**
Pvt Service Vehicles	No.s	1292	1307	1314	1324	1330	1333	1334	1382
	%	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.08%**
Ambulance	No.s	454	525	567	616	670	700	734	843
	%	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.05%**
Arti & Multi Veh	No.s	867	896	925	944	1018	1165	1251	1436
	%	**0.08%**	**0.08%**	**0.07%**	**0.07%**	**0.07%**	**0.08%**	**0.08%**	**0.08%**
Trucks and Lorries	No.s	12193	12658	13024	13635	15031	15230	15573	17415
	%	**1.1%**	**1.1%**	**1.1%**	**1.0%**	**1.1%**	**1.1%**	**1.1%**	**0.99%**
Tankers	No.s	2016	2275	2532	2566	2600	2642	2674	3034
	%	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.2%**	**0.17%**
Delivery Van (4 whlr)	No.s	11750	12879	14183	15883	17868	19013	20087	24515
	%	**1.1%**	**1.1%**	**1.1%**	**1.2%**	**1.3%**	**1.3%**	**1.4%**	**1.39%**
Delivery Van (3 whlr)	No.s	5792	6161	6844	7692	8331	9431	10398	14186
	%	**0.5%**	**0.5%**	**0.6%**	**0.6%**	**0.6%**	**0.7%**	**0.7%**	**0.81%**
Tractors	No.s	5292	5385	5402	5442	5458	5481	5569	13549
	%	**0.5%**	**0.5%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.77%**
Trailers	No.s	5166	5263	5348	5399	5405	5412	5437	8587
	%	**0.5%**	**0.5%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.4%**	**0.49%**
Other	No.s	1102	1153	1240	1247	1247	1247	1249	1766
	%	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.10%**
Total	No.s	**1079259**	**1157034**	**1237099**	**1310344**	**1378060**	**1426703**	**1475227**	**1759769**
	%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

It could be observed from Table 2-6 that the 2 Wheelers account for 83% of the total vehicles registered in Nagpur. The sharp increase of two-wheelers and cars could be attributed to the improved economic status of people and deficient public transport supply. The phenomenal increase of cars and the resulting demand for more road-space has resulted in dense concentration of traffic on roads. This trend has to be kept checked, in terms of the cost it imposes on users demand after a careful consideration.

Considering the registered vehicles and population of the city there are 446 two wheelers per 1000 persons and 58 four wheelers per 1000 persons.

2.6.2. ROAD ACCIDENTS

Increase in the number of the private vehicles and inter mixing of the slow and fast moving vehicles on roads has led to increase in the number of accidents on roads in Nagpur, which is a cause of concern. Considering the urban expanse, population growth and increase trends of vehicles on the city roads; the safety of the commuters is equally vital. There are many reasons for the growth in the vehicles in Nagpur such as the increase in the population and improvement of economy. They are also caused due to the casual approach of road users in observing driving rules, adhering to the safety precautions and regulations. Over-speeding and negligent driving has proved to be a frequent cause of serious and fatal accidents. Similarly, poor road geometry has also increased the incidence of accidents on urban roads.

An insight into the trends and type of accidents occurred in Nagpur City is represented in the Table 2-7. It could be observed from the table that the total no. of accidents occurred in 2015 are 1254 of which around 254 were fatal and 1000 were non-fatal. It could be observed that there is a decreasing trend in the no. of accidents within the city. The number of accidents per lakh population in Nagpur has been observed to be 113, which is three times more than the national average of 40 accidents per lakh population.

TABLE 2-7: ROAD ACCIDENTS IN NAGPUR CITY[19]

Year	Deaths			Serious			Minor			Total		
	Accidents	Death	Injured	Accidents	Death	Injured	Accidents	Death	Injured	Accidents	Death	Injured
2010	301	317	80	375	0	456	872	0	868	1548	317	1404
2011	228	237	45	367	0	446	637	0	658	1232	237	1149
2012	273	280	58	372	0	452	439	0	463	1084	280	973
2013	298	310	75	409	0	512	558	0	650	1265	310	1237
2014	263	281	65	409	0	496	477	0	533	1149	281	1094
2015	254	260	56	497	0	613	503	0	534	1254	260	1203

Considering the cumulative accident figures represented in the Table 2-8 and Figure 2-14, it was observed that most of the accidents take place at the intersections along the major roads within the areas close to the city center and with high population densities. It has also been observed that majority of the accidents involved pedestrians and cyclists with motor vehicles. The Location wise no. of accidents in the last 3 years has been provided by Nagpur Traffic Police department, wherein 35 black spot for accidents have been reported which is represented in the table and figure below.

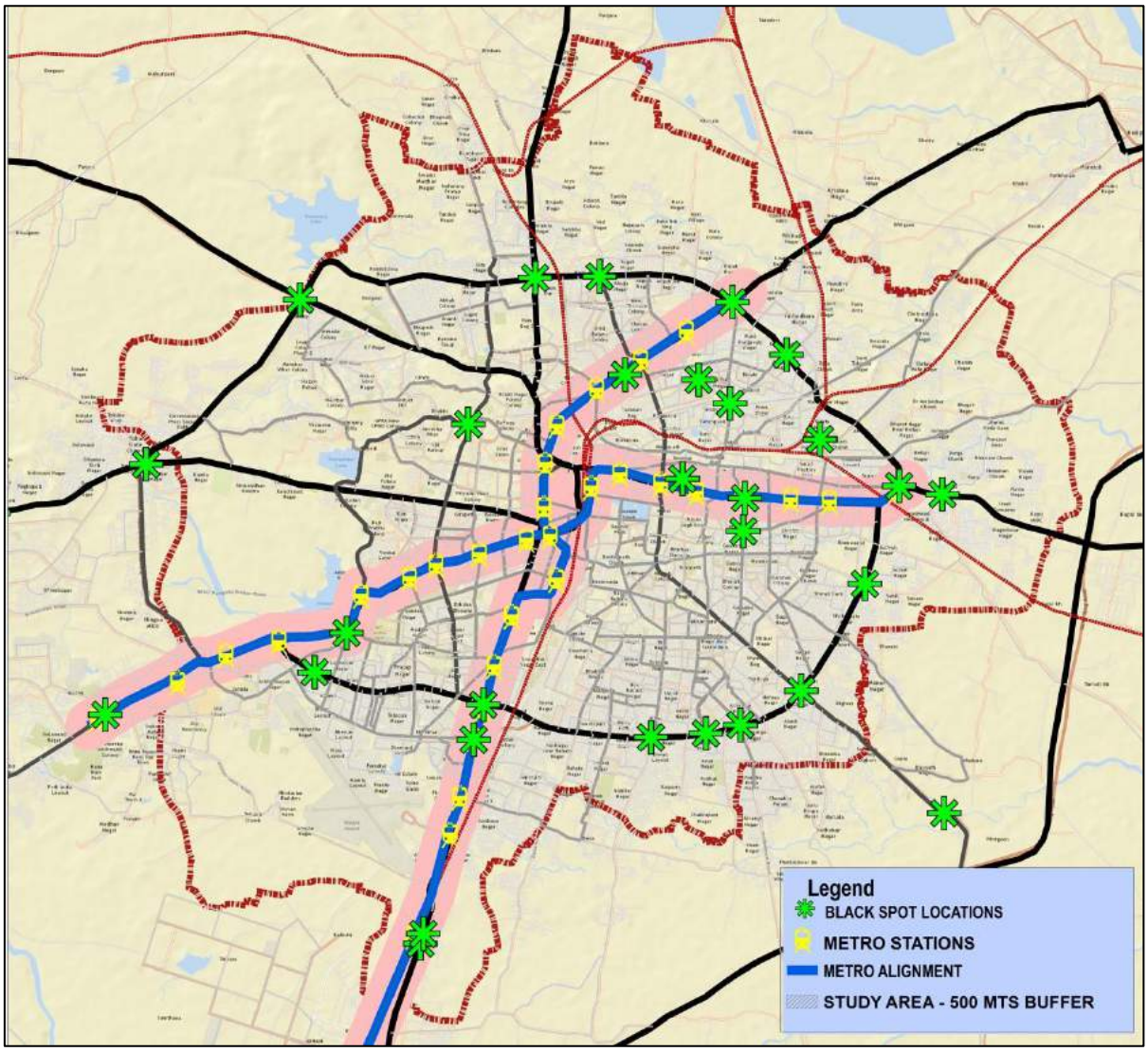
TABLE 2-8: LOCATION WISE ROAD ACCIDENTS IN NAGPUR [20]

Sl. No.	Locations	2013-15	Sl. No.	Locations	2013-15
1	Mhalangi Nagar Square	**13**	19	Jaripatka Ring Road Square	**37**
2	Wadi T Point	**51**	20	Maruti Showroom Square	**46**
3	Dongargaon	**9**	21	Uppalwadi Pooliya	**38**
4	Wathoda Ring Road	**5**	22	Witabhatti Square	**32**
5	Manewada Ring Road	**11**	23	Prakash High School Near Khapsi pooliya	**66**
6	New Katol Naka Square	**10**	24	I C Square	**19**
7	Japanese Garden Square	**4**	25	Vaishali Nagar Square	**3**
8	Nagpur Sawner Highway	**41**	26	Ordinance Factory Gate, 8th Mail	**35**
9	Telephone Exchange Square	**4**	27	Marwa Transport, Waddhamna	**22**
10	Gangabai Ghat Square	**3**	28	Manapur	**2**
11	Khapri Naka	**6**	29	Rajiv Nagar	**25**
12	Chinch Bhawan Square	**5**	30	Trimurti Nagar	**13**
13	Mihan Uddan Pul Mahesh Dhaba	**6**	31	Subhash Nagar	**5**
14	Chinchbhawan Pul Wardha Road	**2**	32	Chatrapati Nagar	**16**
15	Juna Pardi Naka	**66**	33	Mehdibagh Over Bridge	**6**
16	Mehta Wajan Kata, Dipti Signal	**3**	34	Chamat Chakki Chowk	**6**
17	Hanuman Mandir, Pardi	**11**	35	Vihirgaon Puliya	**5**
18	Prakash High School Chowk, Pardi	**7**			

[19] Source: Traffic Police Nagpur

[20] Source: Traffic Police, Nagpur

FIGURE 2-14: LOCATION WISE ROAD ACCIDENTS IN NAGPUR [21]



2.6.3. ROAD NETWORK CHARACTERISTICS

To understand and evaluate the traffic and transportation characteristics of Nagpur City, the road network characteristics from the Comprehensive Mobility Plan for Nagpur City and City Development Plan for Nagpur 2041 have been considered.

Majority of the roads have been developed under the integrated road development project (IRDP). The city is well connected to all major cities by the road network. Many major highways and railway lines pass through Nagpur. This in turn has helped the city become a major trade and transportation center in the region. The following National Highways (NH) and State highways (SH) pass through the city:-

- NH 7: Connecting Varanasi-Jabalpur-Nagpur-Hyderabad-Bangalore-Kanyakumari
- NH 6: Connecting Hajira, Gujarat-Surat-Dhule-Amravati-Nagpur-Raipur–Sambalpur–Kolkata
- NH 69: Connecting Nagpur-Betul-Obedullaganj near Bhopal
- Maharashtra Samruddhi Mahamarg connecting Nagpur – Aurangabad – Mumbai Expressway
- SH 9: Nagpur-Umred-Nagbhid-Chandrapur
- SH 248, SH 255, and SH 260

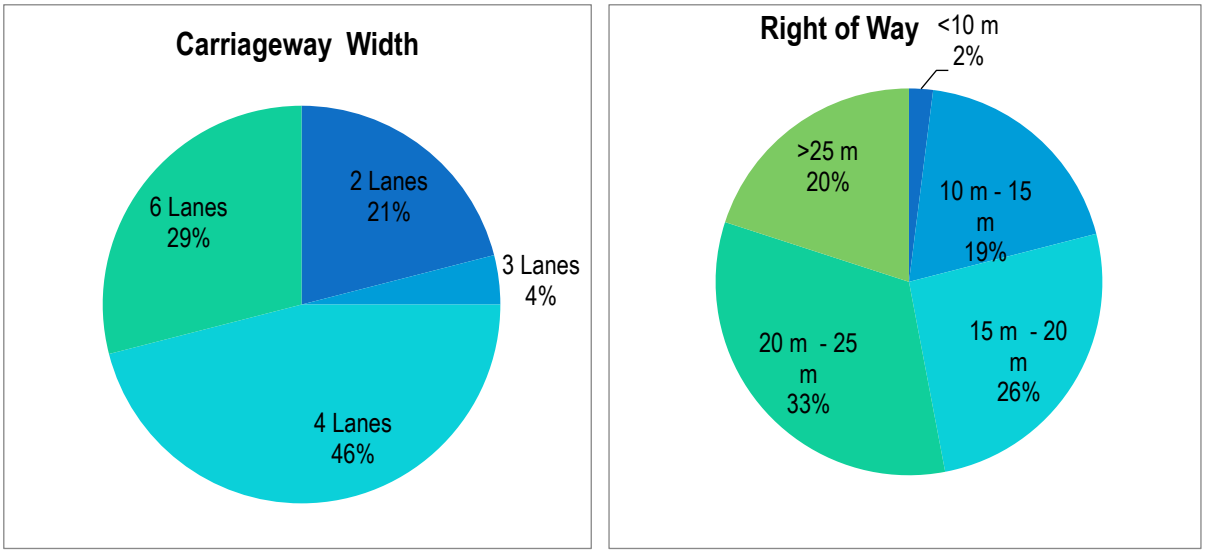
[21] Source: Traffic Police, Nagpur

The existing road network of Nagpur is represented in Figure 2-2. It could be observed from Figure 2-2 that the city has a distinct radial pattern and has two ring roads. As per the City Development Plan, the total length of the road network is about 1,907 km, of which 1,150 km of roads is within the jurisdiction of NMC, which means the city is having a road density of 6.23 km per 10,000 people and 6.66 km per sq km of surface area. Table 2-9 represents the Distribution of the road network by Hierarchy of the Roads. It could be observed from the table that of the 1,150 km of road network on 19.55% of the roads account for Arterial, Sub-Arterial and Collector Streets, whereas the Local Streets account for 80.43% of the road network.

TABLE 2-9 DETAILS OF THE ROAD HIERARCHY[22]

Category of Roads	Road Length (km)	% share
Arterial Roads	101	8.78%
Sub arterial Roads	91	7.91%
Collector Roads	33	2.86%
Local Roads	925	80.43%
Total length of Roads in NMC	**1,150**	**100%**

FIGURE 2-15: DISTRIBUTION OF ROAD NETWORK BY RIGHT OF WAY AND CARRIAGEWAY LANES IN NAGPUR CITY[23]



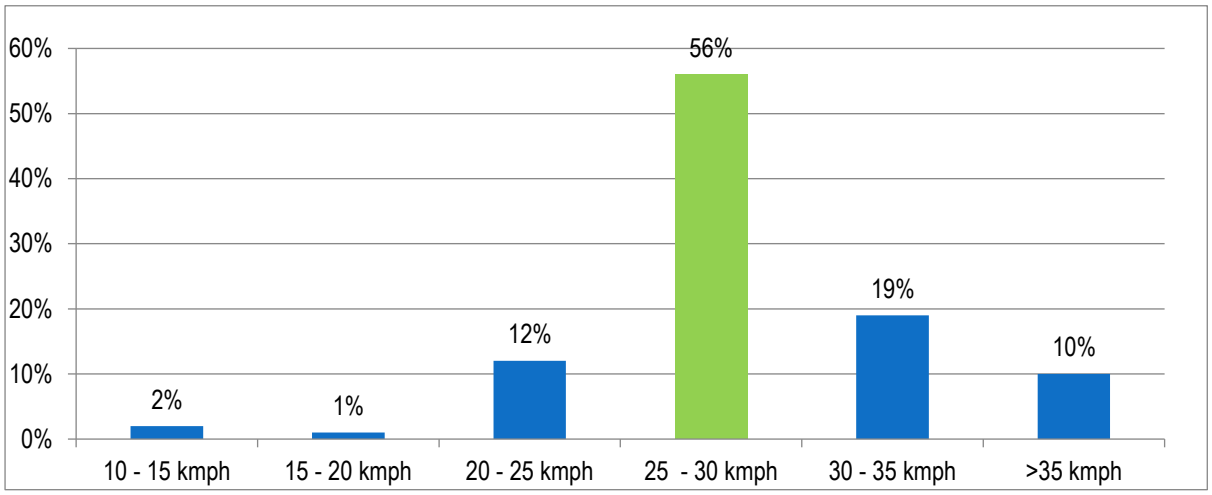
From Figure 2-15, it could be observed that 46% of the roads have 4 lane carriage way. It could also be observed from figure that 53% of the roads in Nagpur have a RoW more than 20mts

From the Figure 2-16, it could be observed that the journey speeds on the major corridors in Nagpur is 25 to 30 km/hr.

22 Source: City Development Plan for Nagpur 2041, CRISIL – March 2041

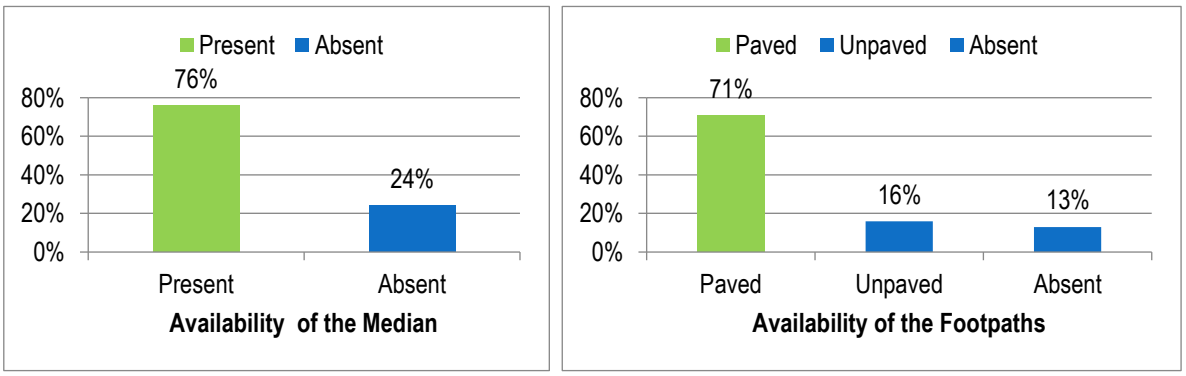
[23]Note: Distribution of Road Network by Right of Way and Carriageway Lanes is based on the Primary Surveys undertaken by the Comprehensive Mobility Plan for Nagpur City – 2013.

FIGURE 2-16: DISTRIBUTION OF ROAD NETWORK BY JOURNEY SPEEDS IN THE NAGPUR CITY[24]



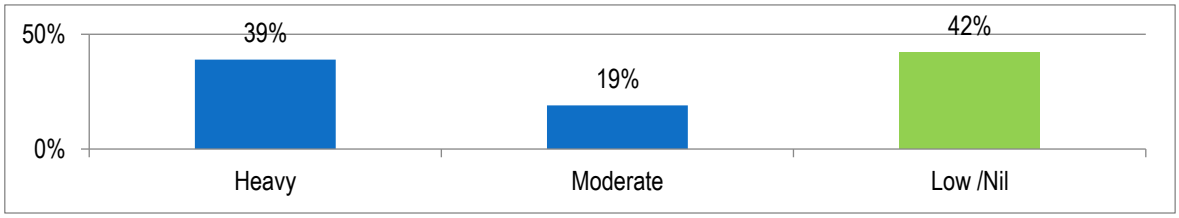
From Figure 2-17, it could be observed that majority of the main roads (especially radial roads/NH and SH) in Nagpur have medians. It could also be observed that 71% of the roads have availability of paved footpaths.

FIGURE 2-17: DISTRIBUTION OF ROAD NETWORK BY AVAILABILITY OF MEDIAN AND FOOTPATHS IN NAGPUR CITY[25]



Based on the reconnaissance survey, encroachments on footpaths and carriageways were observed in the form of parked vehicles, vendors, hawkers etc. it was observed that 67% of road network was encroached upon, resulting in less effective capacity of the road usage. About 39% of the road network has heavy encroachments, whereas 19% has moderate encroachments on roads and footpaths.

FIGURE 2-18: DISTRIBUTION OF ROAD NETWORK BY PRESENCE OF ENCROACHMENTS IN NAGPUR CITY[26][27]



24 Source: Comprehensive Mobility Plan for Nagpur City - 2013

[25]Source: Comprehensive Mobility Plan for Nagpur City - 2013

[26]Source: Comprehensive Mobility Plan for Nagpur City - 2013

[27] Note: Classification of Encroachments – Heavy – if more than or equal to 50% of the RoW is occupied by encroachment, Medium/Moderate – if 25% if the RoW is occupied by encroachments, Low – if less than 25% of the RoW is occupied by encroachments.

2.6.4. PARKING AND TRAFFIC MANAGEMENT

Parking facilities in Nagpur are inadequate as most of the city roads are clogged with vehicles parked haphazardly. The public transport facilities are being misused for parking, like some bus queue shelters are used for parking two wheelers. Furthermore, there are areas where parked vehicles completely hinder the smooth flow of traffic, as in Gandhi Bagh Park. At certain locations, parked vehicles reduce the ROW at major transit corridors like Mangalwari Bazar Road.

Parking for the city can primarily be classified into different areas which include:

- Central Business District (CBD): This consists of core area of Nagpur which lies in the center of the city. These areas are predominantly occupied by commercial activities. Areas such as Sitabuldi, Mangalwari, Walker Road & Mahal fall under this category. These areas are highly congested areas with major commercial activity taking place throughout the day. There is also a huge variation in the weekday and weekend traffic denoting a different parking structure on both days.
- Mobility Corridors: This category primarily covers the areas which are falling under the mobility corridors of the city. Some the prominent locations falling under these regions include Mominpura, Congress Nagar & Gandhi Bagh. These areas have activities throughout the week and are majorly falling on the metro corridor alignment.
- Public Areas: These areas include landuse covered majorly by public activities. Areas such as Ganeshpet Bus Stop, Dosar Bhavan, Tehsil Karyalay, NIT Parking lot etc can be categorized under this section.

The above mentioned areas are highly congested regions, which is a result of on-street parking of vehicles. It can also be observed that there are parking locations in the city which are used for unauthorized commercial activities. This brings down the effective parking supply available in the city and thereby encroaching road capacity for vehicular movement.This in turn results in issues like traffic jams, bottlenecks, and low travel speed along the transit corridors. Hence, it has become extremely important to develop and enforce strict parking norms in the city and make suitable parking arrangements in public spaces.

FIGURE 2-19: EXISTING PARKING BOTTLENECKS

(a) Parking near Mangalwari Bazar Rd

(b) Parking near Gandhibagh Park

(c) Parking near Chitnis Park

(d) Parking at Dosar Bhavan bus stop

As a tools to enhance the quality of transportation in the city, NMC decided to develop the "Parking Policy and Parking Master Plan" for the city with an aim of closing down the demand-supply gap and manage the future parking demand. In this regard, NMC developed Parking Policy and Parking Master Plan for the city of Nagpur which is attached as Annexure.

2.6.5. PEDESTRIAN AND NMV FACILITIES

Based on the CMP for Nagpur, the modal share of walk is 6% whereas that for the Cycle is 9%. The Comprehensive Mobility Plan carried Pedestrian Volume Count, which is represented in Table 2-10.

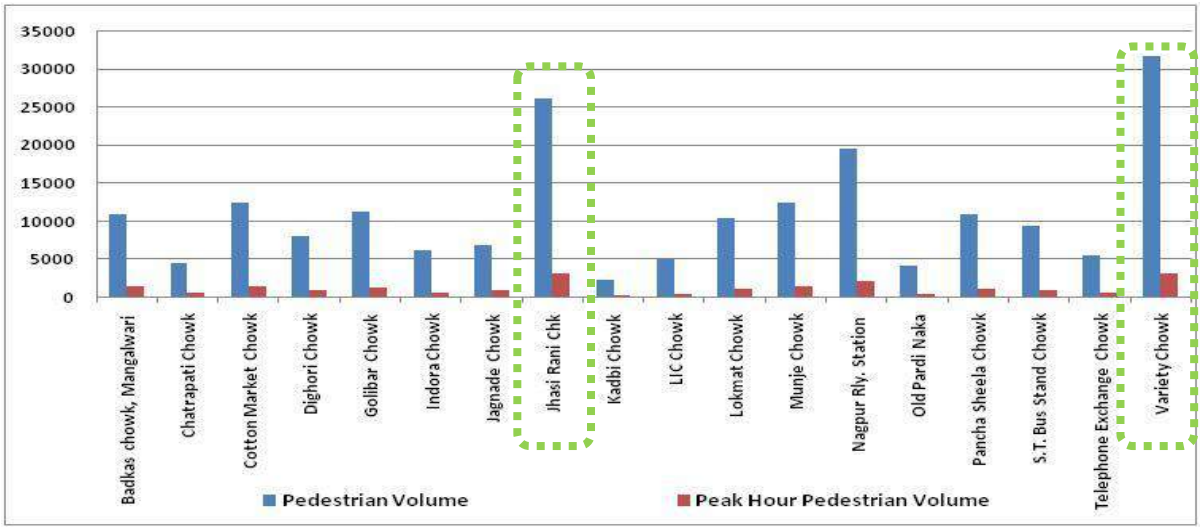
TABLE 2-10: PEDESTRIAN VOLUME COUNT SUMMARY – 12 HRS AND PEAK HOUR[28]

Sl No	Locations	Pedestrian Volume (12 Hrs)	Peak Hour	Peak Hour Pedestrian Volume
1	Badkas chowk, Mangalwari	10938	18:00 to 19:00	1501
2.	Chatrapati Chowk	4404	19:00 to 20:00	512
3.	Cotton Market Chowk	12498	11:00 to 12:00	1345
4.	Dighori Chowk	8063	18:00 to 19:00	923
5.	Golibar Chowk	11309	18:00 to 19:00	1309
6.	Indora Chowk	6089	10:00 to 11:00	612
7.	Jagnade Chowk	6931	19:00 to 20:00	981
8.	Jhasi Rani Chk	26234	17:00 to 18:00	3082
9.	Kadbi Chowk	2358	10:00 to 11:00	254
10.	LIC Chowk	5066	18:00 tp 19:00	487
11.	Lokmat Chowk	10469	17:00 to 18:00	1062
12.	Munje Chowk	12506	18:00 to 19:00	1434
13.	Nagpur Rly. Station	19530	9.00 to 10.00	2054
14.	Old Pardi Naka	4104	18:00 to 19:00	426
15.	Pancha Sheela Chowk	10922	10.00 to 11.00	1171
16.	S.T. Bus Stand Chowk	9420	17.00 to 18.00	937
17.	Telephone Exchange Chowk	5489	10.00 to 11.00	548
18.	Variety Chowk	31661	16.00 to 17.00	3201

It could be observed from the table that the maximum number of pedestrians was observed at Variety chowk with 31,000 pedestrians in a day followed by Jhasi Rani Chowk with over 26,000 pedestrians. The maximum peak hour pedestrians were observed at Variety Chowk with 3200 pedestrians.

[28] Source: Comprehensive Mobility Plan for Nagpur City, 2013

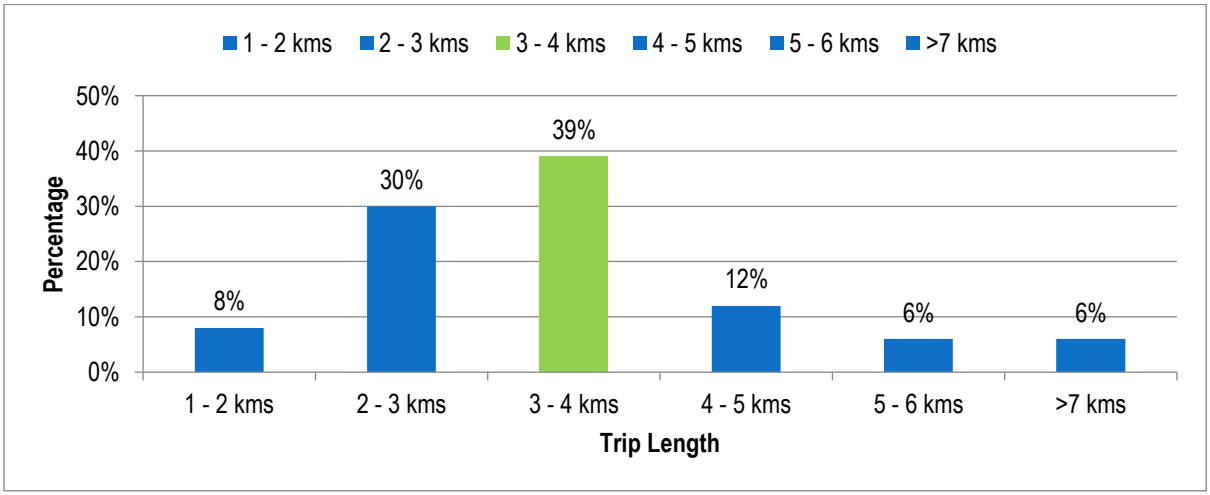
FIGURE 2-20: PEDESTRIAN VOLUME (DAILY AND PEAK HOUR)



2.6.5.1. TRAVEL CHARACTERISTICS OF CYCLISTS

The average distance travelled by the cyclists is 3.87 km, whereas the average trip time is around 28 minutes. The share of work/business trips is 78% followed by education trips about 14%.

FIGURE 2-21: TRIP LENGTH DISTRIBUTION - CYCLISTS[29]



The major concern for cyclists is absence of dedicated cycle tracks and high volume of motorised traffic shared in the right of way leading to vulnerability of accidents. It has also been observed that the cyclists usually face difficulty at crossing junctions along with the interference due to parking/pedestrians/bus stops problems while riding cycle in the city.

2.6.6. SOCIO-ECONOMIC AND TRAVEL CHARACTERISTICS

To understand and evaluate the socio economic and travel characteristic of Nagpur City, the survey data from Comprehensive Mobility Plan and the Detailed Project Report Nagpur Metro Phase II Corridors[31] have been considered. Major findings DPR for Phase-II w.r.t the Socio – Economic and Travel Characteristics are as follows;

[29] Source: Comprehensive Mobility Plan for Nagpur City, 2013

- **Vehicle Ownership:** It has been observed that the average ownership of cycle per household is 0.33, whereas that of 2 Wheelers is 1.33 and Cars is 0.09.
- **Income Profile:** It was observed that the average monthly income of the household was observed to be Rs 19,600.
- **Expenditure on Transport:** It has been observed that the average monthly expenditure on transport is Rs 2,500 which is approximately 12% of the household income.
- **Per Capita Trip Rate:** As per the Comprehensive Mobility Plan for Nagpur City, the per capita trip rate was found to be 1.26 with walk trips and 0.95 without walk trips. As per the recent study[30], the per capita trip rate was found to be 1.5 with walk and 1.4 without walk.
- **Modal Share:** Table 2-11 represents the Mode Share of Nagpur City; as per a recent study.

TABLE 2-11: MODE SHARE OF NAGPUR CITY[31]

Sl. No	Mode	Mode Share –2017 (Rites)
1	Car	5.70%
2	2 Wheeler	42.60%
3	Auto	19.80%
4	Bus	15.60%*
5	Train	0.40%
6	Cycle & Cycle Rickshaw	6.40%
7	Walk	9.50%

**Bus and IPT share*

- **Average Trip Length:** Table 2-12 represents the Mode Wise Average Trip Length (ATL) of the Nagpur City; it has been observed that the overall average trip length of the city in 2013 was 5.22 km which has increased to 7.6 km in 2017.

TABLE 2-12: MODE WISE AVERAGE TRIP LENGTH (KM)[32]

Sl. No	Mode	ATL (km) - 2017
1	Car	10.8
2	2 Wheeler	8.6
3	Auto	5.8
4	Bus	11.6*
5	Train	23.0
6	Cycle & Cycle Rickshaw	2.9
7	Walk	2.0

**Bus and IPT*

2.7. KEY OBSERVATIONS

Based on the site reconnaissance and review of the previous studies and the data collected from the NMC and primary surveys, it is observed that Nagpur is well placed in terms of the transport infrastructure, yet there is lot to be done with respect to improvement in the modal share of public transport in Nagpur, while analysing the existing transportation system, socio-economic structure and travel characteristics of the city, a few observations have been made which are described as under;

1. There has been a continuous increase in the private vehicles in Nagpur City, which has been growing at 4.98% per annum i.e; the vehicular growth is found to be 2X times the percent population growth in the city. It has also been observed that 10% of the public transport passenger trips are catered by less than 1% of the public transport vehicles on road.
2. It has been observed from the Comprehensive Mobility Plan of Nagpur City and the other previous studies that the modal share of public transport in Nagpur is ranging between 8 to 10%. As per the desirable modal split in the Indian

30 Detailed Project Report for Nagpur Metro Phase II Corridors – RITES Ltd - 2017
31 Source: Modal Share from Detailed Project Report for Nagpur Metro Phase II Corridors, 2017
32 Source: Average Trip Length from Detailed Project Report for Nagpur Metro Phase II Corridors, 2017.

cities as defined by the MoUD, GoI, a city with 20 to 50 lakhs population should ideally have a modal share of Public Transport in the range of 60%.

3. A holistic approach considering improvement to existing public transport system, efficient management of traffic, promotion of public transport system, including planning of feeder bus to metro, rationalizing of the existing bus transport including routes and augmentation of NMT infrastructure will go a long way in addressing the sustainable transport requirement of the city.

CHAPTER 3 PUBLIC TRANSPORTATION CHARACTERITICS

3.1. INTRODUCTION

Public Transport plays a vital role in creating competitive economies, and liveable, inclusive communities. It also has a role in reducing our reliance on fossil fuels and our carbon footprint. Public Transport enables people to access families and friends, jobs, recreation, education, health care and the many activities that contribute to individual and community well-being. It provides independence for people who cannot or do not drive.

City's public transport includes city buses, auto rickshaws, shared auto rickshaws etc. for internal transportation. In the Indian context, auto rickshaws are also included in the public transport system as they work as feeders for public transport services and add an option for group of people to commute from one place to another.

Public transport system is an efficient user of space and with reduced level of air and noise pollution. As the population of the city grows, share of public transport, whether road or rail-based, should increase. Nagpur city with its present population of 2.4 million and employment of 0.77 million has a travel demand of 3 million passenger trips per day, of which 0.32 million trips are performed during the peak hour. With the growing population and mega development plans coming up in Nagpur, the travel demand is expected to grow steeply. With inadequate public transport services passengers will shift to private modes, which is already evident from the high vehicle ownership trends in the city. This will not only aggravate the congestion on the city roads but will also increase the pollution levels. This section further details the public transport characteristics of Nagpur City.

3.2. EXISTING AND PLANNED PUBLIC TRANSPORT SYSTEMS IN NAGPUR

3.2.1. PUBLIC TRANSPORT SYSTEMS

3.2.1.1. MASS RAPID TRANSIT SYSTEM

As per the Comprehensive Mobility Plan, one of the goals for the city is to increase the public transport share to 50%. For this, Nagpur authorities have been considering augmentation of bus system including route rationalization, in addition to constructing a capital-intensive Metro system. However, it was found that bus systems alone may not be able to meet the desired goals, and on key corridors (mobility corridors), there is a case of setting up a higher order mass transit system, such as Metro Rail.

Two mass transit corridors have been proposed along the North – South and East – West of the Nagpur City. The alignment of the routes and the length of the individual corridors are presented in Table 3-1 and Figure 3-1.

TABLE 3-1: ALIGNMENT OF NAGPUR METRO RAIL CORRIDORS[1]

Alignment	Detail Route
Alignment 1: North – South Corridor (19.658 km, 17 Stations)	Automotive Square, along Kamptee Road, Wardha Road, Variety Square to Abhyankar Road, along Nag River alignment will fall on Humpyard Road, Rahate Colony Road, Wardha Road, Parallel to Railway Line, Khapri Station and finally in MIHAN Area near concord depot
Alignment 2: East – West Corridor (18.557 km, 19 Stations)	From Prajapati Nagar, along Central Avenue Road, Railway Feeder Road, Jhansi Rani Chowk, North Ambazari Road, Hingna Road, Lokmanya Nagar

[1]Source: Detailed Project Report for Nagpur Metro Rail Project - 2013

FIGURE 3-1: ALIGNMENT OF THE PROPOSED METRO CORRIDORS

The total daily boarding ridership in 2016 is estimated as 3.52 lakhs in the DPR in which the share of Corridor 1 is 47% and Corridor 2 is 53%. Average trip length is 6.41 km. The daily and peak hour details of the metro system for the horizon years from DPR is presented below:

TABLE 3-2: METRO RIDERSHIP ESTIMATES[2]

Boarding /Ridership (Day)		2016	2021	2026	2031	2036	2041
Corridor 1 - Automotive - Khapri)	Daily Ridership	1,68,361	1,85,531	2,03,720	2,24,316	2,48,419	2,77,704
	Maximum PHPDT	10,089	10,936	11,915	12,934	14,286	15,729
Corridor 2 - Prajapati – Lokmanya	Daily Ridership	1,84,081	1,97,908	2,15,415	2,34,577	2,60,237	2,86,031
	Maximum PHPDT	7,746	8,460	9,154	9,906	10,748	11,882
Total	Daily Ridership	3,52,442	3,83,439	4,19,135	4,58,893	5,08,656	5,63,735
	Maximum PHPDT	17,835	19,396	21,069	22,840	25,034	27,611
Average Trip Length (Km)		6.419	6.453	6.494	6.533	6.521	6.522

[2]Source: Detailed Project Report for Nagpur Metro Rail Project - 2013

TABLE 3-3: METRO RIDERSHIP ESTIMATES

SN	Station Name	Peak Hour Boarding & Alighting in 2041	Station Name	Peak Hour Boarding & Alighting in 2041
	North-South Corridor		East-West Corridor	
1	Automotive Sqre	3517	Prajapati Nagar	498
2	Nari Road	1696	Vaishnodevi Chowk	458
3	Indora Chowk	1366	Ambedkar Chowk	520
4	Kadvi Chowk	1469	Telephone Exchange	2066
5	Gaddi Godam Sqre	282	Chittar oli Chowk	1611
6	Kasturchand Park	1947	Agarsen Chowk	1028
7	Zero Mile	1161	Dosar Vaisyan Chowk	1155
8	Sitaburdi	5185	Nagpur Railway Station	4460
9	Congress Nagar	5869	Sitaburdi	3839
10	Rahate Colony	1485	Jhansi Rani Square	2969
11	Ajni Square	927	Institute of Engineers	3492
12	Chhatrapati Square	521	Shankar Nagar Square	2814
13	Jaiprakash Nagar	347	Lad Chowk	565
14	Ujjwal Nagar	524	Dharampeth College	1634
15	Airport	290	Subhash Nagar	315
16	New Airport	1058	Rachna (Ring Road Jn.)	423
17	Khapari	2905	Vasdev Nagar	819
18	-	-	Bansi Nagar	534
19	-	-	Lokmanya Nagar	1513

3.2.1.2. INTERMEDIATE PUBLIC TRANSPORT (IPT) SYSTEMS – AUTO RICKSHAWS & SHARED AUTO RICKSHAWS

Intermediate public transport (IPT) modes i.e Autos, Shared Autos and Taxis in large cities play an important role in meeting unstructured travel demands of users. IPT performs as feeder service to the main mass transport system (Both Rail and road based) and provides accessible movement in predefined areas. The services provided by the IPT are intermittent in nature and this has complete flexibility in destination which is determined by the passengers. Autos, Shared Autos and Taxis are the primary form of IPT available in Nagpur. Within Nagpur city, IPT acts as competent access/egress modes and competing with the road based public transport system especially on short trip lengths. Trip characteristics by these modes are entirely different compared to the trips made by other motorized modes, as these modes offer high flexibility, services from almost door to door, fare, etc.

As in case of Nagpur, IPT is unorganized and is operating independently by auto drivers. The current mode share of Auto rickshaws along with Bus system is observed to be 15.6%[3]. Table 3-4 illustrates the growth of IPT modes which includes 3 Wheelers, Motor Cabs, Maxi Cabs and other vehicles in the Nagpur City between 2010 & 2016. The average growth rate of these IPT vehicles in the city is observed to be -1.23% it could also be observed that maximum no. of Auto rickshaws have been registered in the past year, with a share of 1.01%. It could also be observed from the table that during the same period the average growth rate of Taxi's is witnessed to be 10.75% with a share of 0.30%.

[3] Detailed Project Report for Nagpur Metro Phase II Corridors – RITES Ltd - 2017

TABLE 3-4: GROWTH OF IPT VEHICLES IN NAGPUR CITY[4]

Category	2010	2011	2012	2013	2014	2015	2016
Taxi Cabs	2388	2661	2907	3132	3380	3817	4407
Growth Rate of Taxi		11.43%	9.24%	7.74%	7.92%	12.93%	15.46%
Auto Rickshaws	16058	16417	17149	16743	15764	8494	8437
Growth Rate of Auto Rickshaws		2.24%	4.46%	0.77%	3.37%	-20.23%	4.59%

The auto rickshaw permits are issued as per the Section 72 of Maharashtra Motor Vehicle Rules of 1989, which is valid for 5 years. The permitted passenger capacity of these vehicles is 3-4 PAX. There are several associations formed by the auto drivers in the absence of single associations, which is making it difficult for the authorities to manage the para transit since there is no common consensus. The Road Transport Authority, in discussion with the Nagpur Municipal Corporation and Traffic Police notifies the auto rickshaw stands for parking and providing service to the public. At present there are 317 authorized auto rickshaw stands in Nagpur City.

Apart from the regular auto rickshaws and shared auto rickshaws, battery operated vehicles also operate within the City. The shared autos are operating from the prime locations such as the Nagpur Railway Station, Medical Chowk, Ajni Railway Station, Ganeshpeth and Mayo Hospital etc. Table 3-5 & Figure 3-2 represent the list of the shared auto routes in Nagpur.

TABLE 3-5: LIST OF SHARED AUTO ROUTES IN NAGPUR[5]

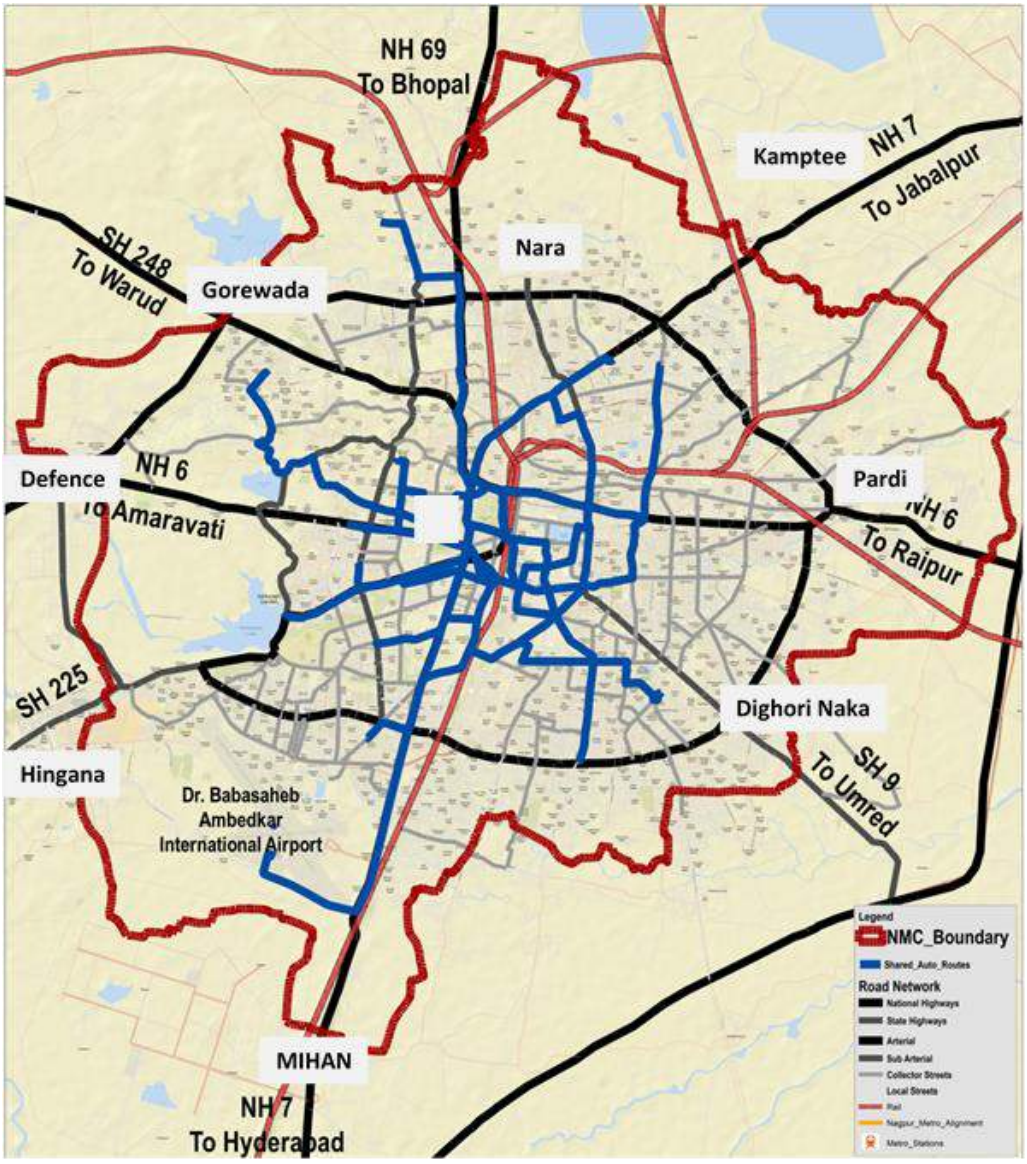
Sl. No	Route	Route Length	Fare (Rs)
1	Railway Station to Maratha Mandir	2.0	7.5
2	Railway Station to Chatrapati Chowk	5.7	19.5
3	Railway Station to Airport	9.0	30
4	Railway Station to Khamla	5.8	20
5	Railway Station to Dharampeth	3.6	12.5
6	Railway Station to Ambazari	5.9	20
7	Railway Station to Variety Chowk	5.9	8
8	Railway Station to Ravi Nagar	4.1	14.5
9	Railway Station to Chawni	2.7	10
10	Railway Station to Gaddi Godam	5.3	18
11	Railway Station to Mental Hospital	3.5	12.5
12	Railway Station to Zingabai Thakli	5.9	20
13	Railway Station to Indora Chowk	3.1	11
14	Railway Station to Ambedkar Chowk	5.1	20.5
15	Railway Station to Baidhyanath Chowk	2.9	10.5
16	Railway Station to Shakkardhara Chowk	5.0	17
17	Railway Station to Ganeshpeth Bus Stand	2.4	9
18	Medical Chowk to Ajni Chowk	3.0	11

[4]Source: Motor Transport Statistics of Maharashtra, 2012-13, 2013-14, 2014-15 & 2015 - 16

[5]Source: Motor Vehicle Department, Maharashtra- Feb-2016

Sl. No	Route	Route Length	Fare (Rs)
19	Medical Chowk to Cotton Market/Railway Station	2.1	8
20	Medical Chowk to Mayo Hospital	3.3	12
21	Ajni Railway Station to Chatrapati Chowk	2.4	9
22	Ajni Railway Station to Airport	5.1	17.5
23	Ajni Railway Station to Khamla	3.0	11
24	Ajni Railway Station to Medical Chowk	2.2	8
25	Ajni Railway Station to Manewada Chowk	5.7	22.5
26	Ajni Railway Station to Shakkardhara Chowk	4.4	15.5
27	More Bhawan to District Administrative Office	2.2	8
28	More Bhawan to High Court	3.9	13.5
29	More Bhawan to Airport	5.9	23.5
30	More Bhawan to Khamla	4.2	14.5
31	More Bhawan to Ambazari	3.7	13
32	More Bhawan to Law College	2.5	9
33	More Bhawan to Vidhyapeth	4.3	15
34	More Bhawan to Chawani	3.0	11
35	More Bhawan to Friends Colony	5.9	23.5
36	More Bhawan to Zingabai Thakli	5.6	19
37	More Bhawan to Teka Naka	5.2	21
38	More Bhawan to Railway Station	2.3	8.5
39	More Bhawan to Medical Chowk	4.1	14.5
40	More Bhawan to Manewada Chowk	5.8	23
41	More Bhawan to Ganeshpeth Bus Stand	2.2	8
42	Ganeshpeth to Ajni Railway Station	3.2	11.5
43	Ganeshpeth to Chatrapati Chowk	5.8	20
44	Ganeshpeth to Khamla	5.6	19
45	Ganeshpeth to Dikshabhoomi	4.1	14.5
46	Ganeshpeth to Variety Chowk	2.9	10.5
47	Ganeshpeth to Law College	5.0	17
48	Ganeshpeth to Vidhyapeeth	7.4	25
49	Ganeshpeth to Gaddigoddam	7.5	25
50	Ganeshpeth to Medical Hospital Chowk	5.5	22.5
51	Ganeshpeth to Railway Station	2.5	9.5
52	Ganeshpeth to Indora Chowk	5.0	20.5
53	Ganeshpeth to Mayo Hospital	2.5	9.5
54	Ganeshpeth to Ambedkar Chowk	5.5	22
55	Ganeshpeth to Manewada Chowk	5.1	17.5
56	Ganeshpeth to Shakkardhara Chowk	2.5	9
57	Mayo Hospital to Ajni Chowk	5.3	18
58	Mayo Hospital to More Bhawan	3.1	11
59	Mayo Hospital to Ganeshpeth Bus Stand	2.7	10
60	Mayo Hospital to Medical College Chowk	4.7	15

FIGURE 3-2: SHARED AUTO ROUTES WITHIN THE CITY OF NAGPUR



Even though these routes have been identified by the Regional Transport Office, Nagpur, yet majority of the shared auto services do not operate on the above identified routes and extend their services directionally across the city.

As per the Motor Vehicles Rules of Maharashtra State, even though the battery operated vehicles were exempted from the MV Tax, neither can they be registered by the RTO nor permits be issued by the RTO under the same. However, with the recent directions from the central and state governments, the state government of Maharashtra has made provisions under the Motor Vehicles Act of 1988 and Maharashtra Motor Vehicles Rules of 1989 for registration of the e-rickshaws. As of 2016, approximately 1000 battery operated e-rickshaws are operating within Nagpur City.

Radio Taxi and App based Taxi services such as Ola and Uber have made their presence felt in Nagpur. These services offer world class experience meeting the expectations of non-residents of Nagpur City, Tourists and Local residents alike. With an

intention of promoting electric vehicles within the country, Ola has also taken up a pilot initiative of introducing a fleet of 200 electric vehicles, including taxis, buses, e-rickshaws and auto within the city in cooperation with Mahindra and Mahindra.

3.2.1.3. CITY BUS SERVICES

The city bus systems play a vital role in meeting the travel needs of the city's population. The road transport services in Maharashtra State are operated and maintained by the Maharashtra State Road Transport Corporation (MSRTC), which typically operates the Inter City, Intra State and Inter State services within Maharashtra. MSRTC also operates City Bus Services in 7 cities in Maharashtra, namely Nashik, Nanded, Ratnagiri, Miraj, Vasai, Nalasopara, Aurangabad and Chandrapur.

The city bus service in Nagpur (i.e the Nagpur Municipal Boundary) is operated by the Nagpur Mahanagar Parivahan Limited (NMPL), a special purpose vehicle (SPV) of Nagpur Municipal Corporation (NMC). In 2007, the NMC signed an agreement with the private operator "Vansh Nimay Infraprojects Pvt Ltd (VNIL)" to purchase and operate the buses under Net Cost Contract (NCC), wherein VNIL paid corporation a fixed royalty per bus. The corporation was to earn back 50% of its revenue from advertisements on buses.

In this regard, VNIL procured 230 buses at its own expense and paid NMC with a fixed royalty per bus. Another 240 buses were procured by the NMC on behalf of the NMPL through the funding from the Ministry of Urban Development, Government of India under the JnNURM Scheme, which were passed onto VNIL for operations. A total of 470 buses were being operated by VNIL on behalf of NMC on 40 routes spread across the city. The snapshot of the City Bus Services till March 2017 is represented in the Table 3-6.

TABLE 3-6: SNAP SHOT OF CITY BUS SERVICES IN NAGPUR[6]

Sl. No	Particulars		2015-16
1	**Total Fleet Size (Diesel)**		**470**
2	**Fleet Owned by VNIL**		**230**
2a		*Standard Bus*	*150*
2b		*Midi Bus*	*80*
3	**Fleet Procured under JnNURM**		**240**
3a		*Standard Bus*	*240*
4	On Road Fleet		254
5	Operational Efficiency		54.04%
6	No. of Routes identified/planned		142
6a		*Routes operational*	56
6b		*Weekdays*	65
6c		*Weekends*	47
7	Average Daily Ridership		1 lakh
8	**Infrastructure**		
8a	No. of Depots/Stations		4
8b	No. of terminals		0
8c	No. of Bus Shelters		190

NMC has engaged an Integrated Bus Transport Management (IBTM) Operator or in other words a programme manager, who shall be managing the day to day coordination of bus services on behalf of NMC, who shall also provide technology based solutions to integrate all the domain elements of City Bus Services for a modern and efficient city bus services to the commuters of the city. Recently, NMC has allotted the operations of CBS to four operators (3 Diesel[7]& 1 Ethanol[8]) under a Gross Cost Contract to operate 487 buses. Since the new system is in the transition stage, NMC is currently continuing the

6 Source: Vansh Nimay Infraprojects Pvt Ltd.

[7]M/s Shyama Shyam, Delhi, M/s Travel Time, Pune & M/s Hansa, Nagpur

[8] M/s Scania

operations on the 38 routes (List of the operational routes is represented in the Table 3-11 with the support of the 4 new operators.

City bus services in Nagpur have not been able to live up to the expectations of the bus commuters in Nagpur, due to the quality of the buses and inefficient operations, lack of maintenance of buses etc. Considering this, there is a need to consider the city bus route rationalization plan with short term and long term improvement proposals and physical and financial performance parameters of the existing routes. The following section in detail analyses the various parameters of the city bus operations in Nagpur City.

A. FLEET SIZE

The fleet of NMC majorly consists of 44-seater Standard buses and 28 seater Midi Buses. However, due to the operational difficulty and revenue generation issues, of the 470 buses only 254 buses are operational and remaining 216 buses were kept parked without operating, with a the fleet utilization of 54.04%.

With the transition of operations from NCC Model to Gross Cost Contract (GCC) Model, the 4 operators are expected to the following fleet category into the system.

TABLE 3-7: PROPOSED FLEET INTRODUCTION BY NMC FOR CITY BUS OPERATIONS[9]

Total Fleet	**487 Buses**	
Fuel Type	Diesel	Ethanol
No. of Buses	432 Buses	55 Buses
No. of Operators	3 Operators	1 Operator
No. of Buses under each operator	144 Buses (33% of the total diesel buses)	55 Buses (100% of the total ethanol buses)
Type of Buses		
- ***Standard Buses[10]***	79 Buses	
- ***Midi Buses[11]***	50 Buses	
- ***Mini Buses***	15 Buses	

B. ROUTES

There are 183[12] Bus routes notified by the Regional Transport Office for Nagpur City of which till March 2017, only 36 routes were operated on daily basis. However, post March 2017, Integrated Bus Transport Manager has taken initiatives to improve the quality and reliability of the services on various routes and have increased the total no. of operated routes from 36 to 38. The list of the notified bus routes in Nagpur City is represented in the Annexure. Figure 3-3 represents the List of the Notified City Bus Routes in Nagpur City.

[9]Source: Nagpur Municipal Corporation & DIMTS

[10] Old Buses to be redistributed to the operators by NMC

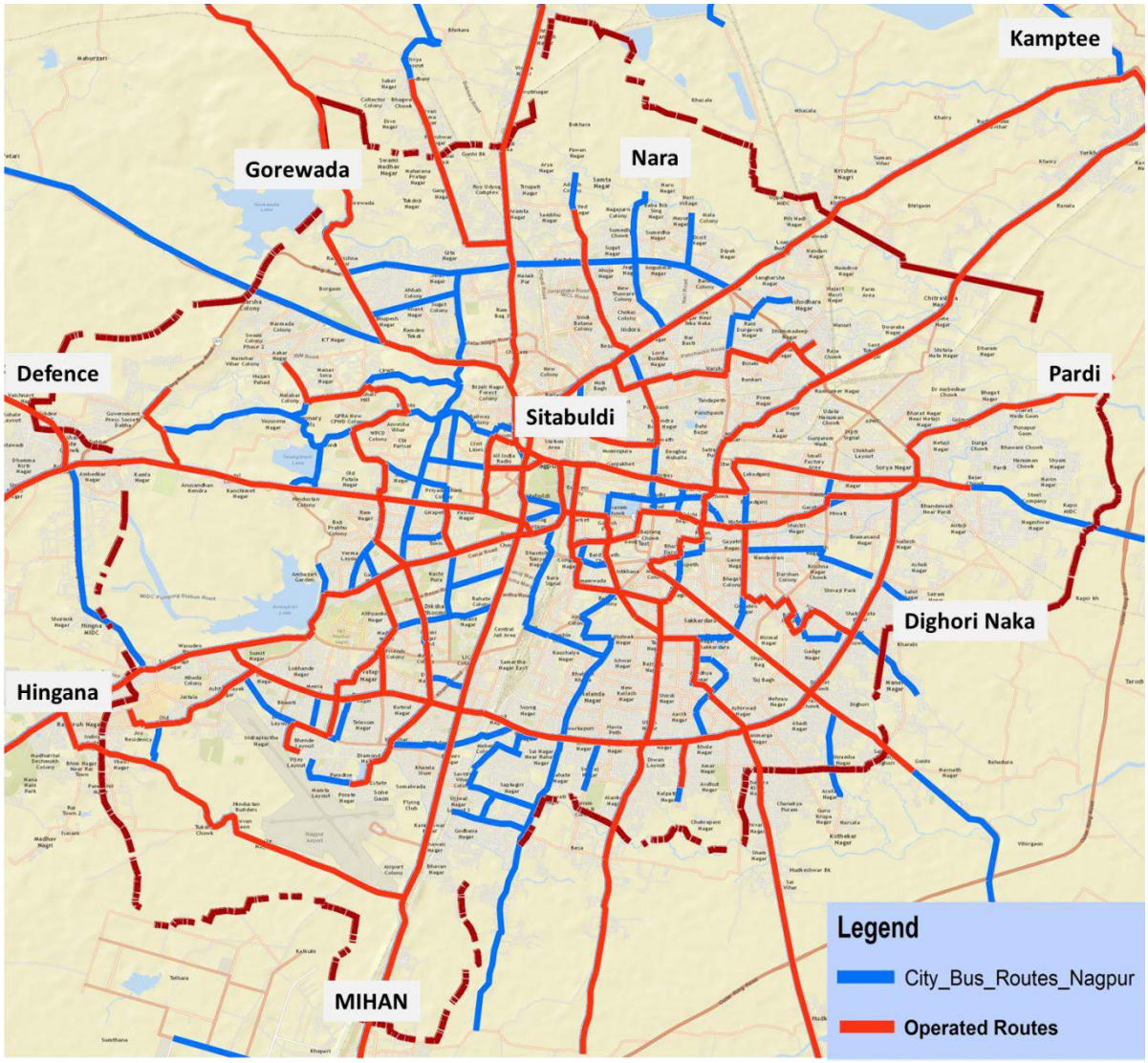
[11] Midi & Mini Buses to be procured by the Operators

[12] Total No. of City Bus Services Routes Notified by the RTO for operations by NMC is 183. However the team received list of 154 routes, which has been utilized for the current study. Of the 154 routes, 38 routes are operational and remaining 118 routes are non-operational.

FIGURE 3-3: CITY BUS SERVICES NOTIFIED ROUTE NETWORK[13]

[13]Source: UMTC, 2017

FIGURE 3-4: CITY BUS SERVICES OPERATIONAL ROUTE NETWORK[14]

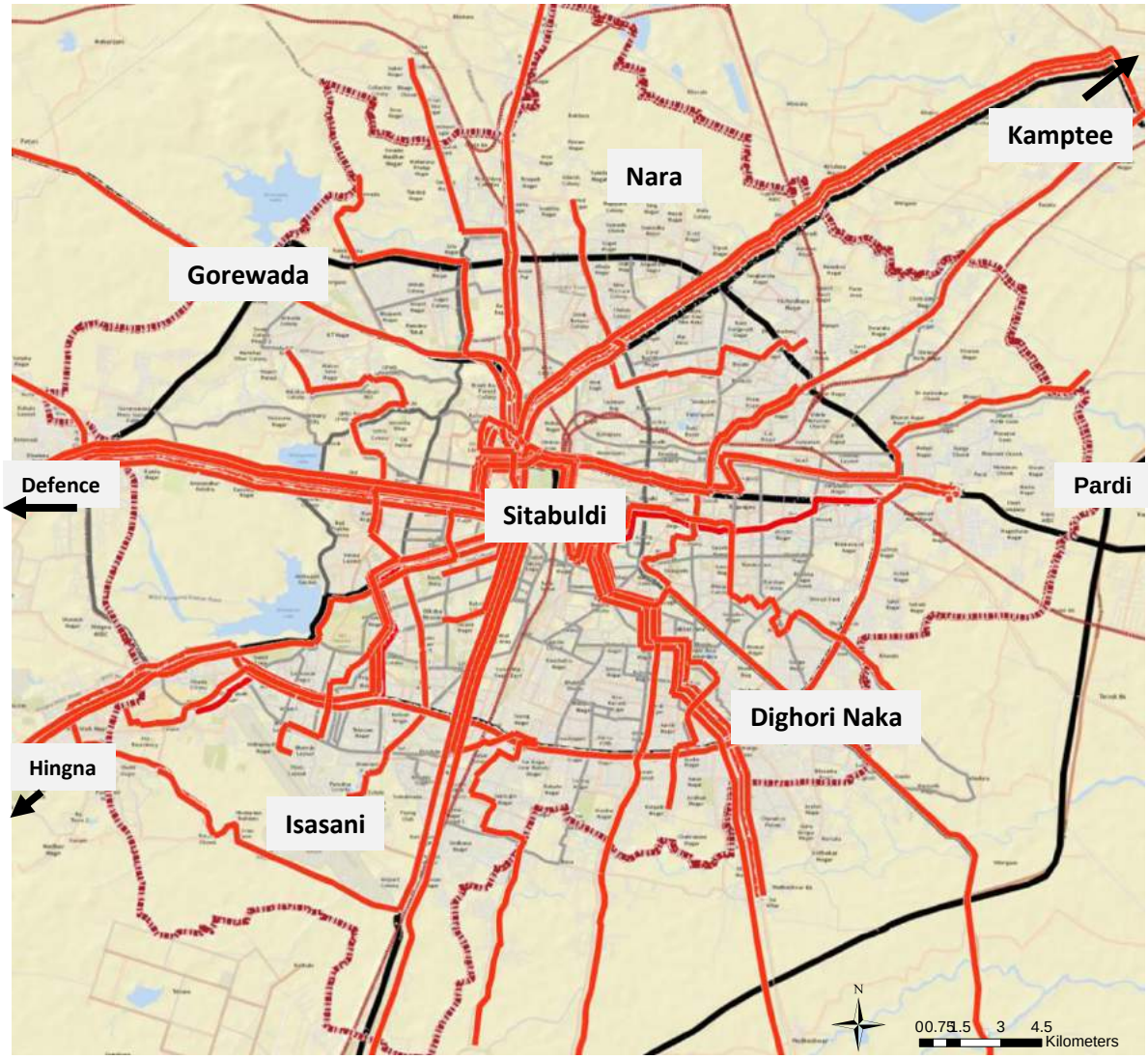


From Figure 3-4, it could also be observed that the current city bus route structure is Radial in nature, wherein the city has a strong central core at Sitabuldi, around which the development has taken place directionally. As in case of Nagpur the strong central core is Sitabuldi, wherein the city bus routes are connected to the major fringe areas around the city which are; Kamptee, Pardi, Kharbi, Piplafata, Buti Bori, MIDC, Gorewada, Suradevi, Khaparkheda etc.

Figure 3-5 represents the Intensity of the operational City Bus Routes on the major Corridors in Nagpur. As mentioned in the previous paragraph, majority of the operational city bus routes are overlapping with each other with common origin and destination locations. Majority of the services are destined toward, Kamptee, Hingna, Defence and Dighori.

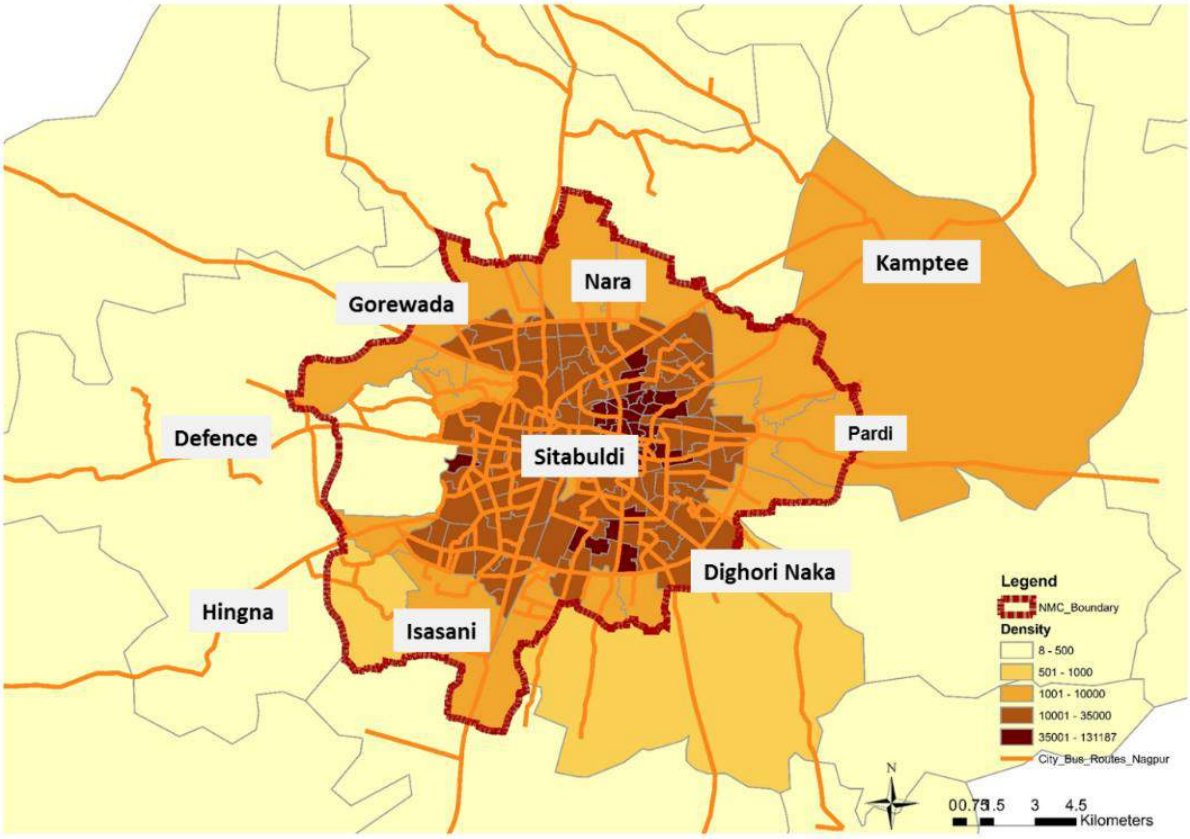
14Source: UMTC, 2017

FIGURE 3-5: INTENSITY OF CITY BUS ROUTES ON MAJOR CORRIDORS IN NAGPUR[15]



[15]Source: UMTC, 2017

FIGURE 3-6: OPERATIONAL CITY BUS ROUTES IN RELATIONSHIP WITH THE GROSS DENSITY OF THE CITY[16]



C. PHYSICAL PERFORMANCE

Physical Performance of existing city bus service includes analysis of no. of buses, percentage of fleet utilization, revenue kilometers and fuel performance. Table 3-8 represents the physical performance of City Bus Services operated in Nagpur.

TABLE 3-8: PHYSICAL PERFORMANCE OF CITY BUS SERVICES (2014 – 2016)[17][18]

S.No	Parameters	2014	2015	2016
1	Average no. of buses held	470	470	470
2	Average no. of buses on road	205	209	217
3	% of Fleet Utilization	43.61%	44.46%	46.14%
4	Total Operated km	1,55,49,490	1,55,78,409	1,66,33,754
5	Total Dead km	8,70,788	8,38,546	8,14,116
6	% of Dead km	5.60%	5.38%	4.89%
7	Avg. Km/day/bus	219	216	220
8	No. of Passengers Per Day	1,38,245	1,25,775	1,25,403
9	Load Factor	39.33%	35.50%	43.75%
10	Fuel Efficiency (KMPL)	3.18	3.21	3.22
12	Operating Revenue Per Bus Per Day	Rs. 7,806.52	Rs 7674.26	Rs. 7,516.18

This section would further compare the performance of the system Pre March 2017 (NCC) and Post March 2017 (GCC), which is represented in the Table 3-9.

[16]Source: UMTC, 2017
[17]Source: VNIL, March, 2017
[18] Note: Annual Physical Performance of City Bus Services in Nagpur

TABLE 3-9: COMPARISON OF PHYSICAL PERFOMANCE PRE & POST MARCH 2017[19][20]

Parameters	Pre March 2017	Post March 2017	Remarks
No. of Buses Held	470	487	
No. of Buses on Road	222	263	
Fleet Utilization	47.17%	54.00%	12.66% ↑
No. of Notified Routes	183	183	
No. of Routes Operated	36	38	
%age of Routes operated	19.67%	20.77%	5.26%↑
Scheduled No. of Trips	3295.00	3827.00	
Operated No. of Trips	3125.00	3722.00	
Missed/Cancelled No. of Trips	170.00	105.00	
% age of Missed/Cancelled No. of Trips	5.16%	2.74%	88.05% ↓
Total Operated Km Per Day	46003	59883	23.18% ↑
Vehicle Utilization (kms/bus/day)	208	228	8.86% ↑
Total Passengers	92194	98611	6.51% ↑
Load Factor (%)	48	61	20.52% ↑

The following aspects could be observed from the Table 3-9;

1. Pre March 2017, even though the system had a fleet of 470 buses, yet the fleet utilization was only 47.17%. Post March, 2017, it is anticipated that 487 buses would be put into the system by the operators, even though this has not been possible for the greater extent yet the system is able to operate minimum of 263 buses per day improving the fleet utilization to 54%.
2. The total no. of notified routes are 183 with the NMC, However Pre March, 2017 only 36 routes were operational and Post March 2017, 38 routes are operational, which means
    a. The system has been operating only 19% to 20% of the notified routes.
    b. The system has been operating on an average of 6 to 7 buses per route.
3. The total operated km per day has been improved from 46,003 km to 59,883 km, which is an improvement by 23.18%.
4. The percentage of missed/cancelled trips accounted for 5.16% per day pre March, 2017, whereas post March 2017, the percentage of missed cancelled trips has been reduced to 2.74%
5. The vehicle utilization of the system has also been improved from 208 km per day per bus to 228 km per day per bus.
6. The total no. of passengers carried by the system per day pre March 2017 was observed to be 92,194, whereas the no. of passengers carried by the system per day post March 2017 was observed to be 98,611, an improvement by 6.51%.
7. The Load Factor has also been improved from 48% Pre March, 2017 to 61% Post March 2017, an improvement by 20.52%, which means that each bus is carrying additionally 6 passengers per trip.

D. MANPOWER

The existing status of the total staff indulged in the operations of the city bus service has been shown in the Table 3-10 given below:

TABLE 3-10: MANPOWER DISTRIBUTION[21]

Job Description	No. of Staff	%age
Driver	565	34.35%
Conductor	674	40.97%
Maintenance Staff	209	12.71%

[19]Source: VNIL & NMC 2017
[20] Note: Information collected and compared is for a typical weekday Before March 2017 and Post March 2017.
21Source: VNIL & NMC 2017

Job Description	No. of Staff	%age
Administration Staff	197	11.98%
Total	1645	100.00%

Based on Table 3-10, it has been observed that the average Staff to Bus Ratio maintained is 7.32 Pre March 2017, However, the manpower distribution of the Post March 2017, system has not been yet been disclosed by the operating authorities.

E. FARE & TAX STRUCTURE

Fare Structure of City Bus Services in Nagpur

Table 3-11 represents the existing fare structure of the city bus services operated in Nagpur. The fares are revised as per the directives and concurrence of the Nagpur Municipal Corporation. The recent fare revision was in 2014.

TABLE 3-11: FARE STRUCTURE OF NAGPUR CITY BUS SERVICES[22]

KM		Fares	KM		Fares
0	2	₹ 8.00	26	28	₹ 38.00
2	4	₹ 8.00	28	30	₹ 38.00
4	6	₹ 9.00	30	32	₹ 42.00
6	8	₹ 11.00	32	34	₹ 42.00
8	10	₹ 13.00	34	36	₹ 46.00
10	12	₹ 16.00	36	38	₹ 46.00
12	14	₹ 19.00	38	40	₹ 50.00
14	16	₹ 23.00	40	42	₹ 50.00
16	18	₹ 26.00	42	44	₹ 54.00
18	20	₹ 30.00	44	46	₹ 54.00
20	22	₹ 30.00	46	48	₹ 58.00
22	24	₹ 34.00	48	50	₹ 58.00
24	26	₹ 34.00	-	-	-

Concessional Fare

The city bus services provides concessional passes on its fares and/or free travel facilities on its buses to various categories of citizens, such a promotional passes, student passes (free for the NMC operated schools), freedom fighters and handicapped.

Fare Fixation & Revision Mechanism for City Bus Services

The city does not follow a structure fare revision system. Municipal Commissioner and Standing committee jointly decide/pass the resolution on fare revision based on the hike in fuel prices and bus operation cost.

Existing Fare Collection Mechanism

Currently, the fare is collected by both hand held electronic ticket vending and verification machine (ETVM).

[22] Source: VNIL & NMC 2017

Tax Structure on City Bus Services

Public transport is subjected to a multitude of fees and taxes imposed by the Central, State and Local Governments. Road Tax, Toll Tax, Freight & Octroi, MV Tax, Passenger Tax, Nutrition Tax, VAT are applicable in Nagpur bus operations and form major part of the total operation cost.

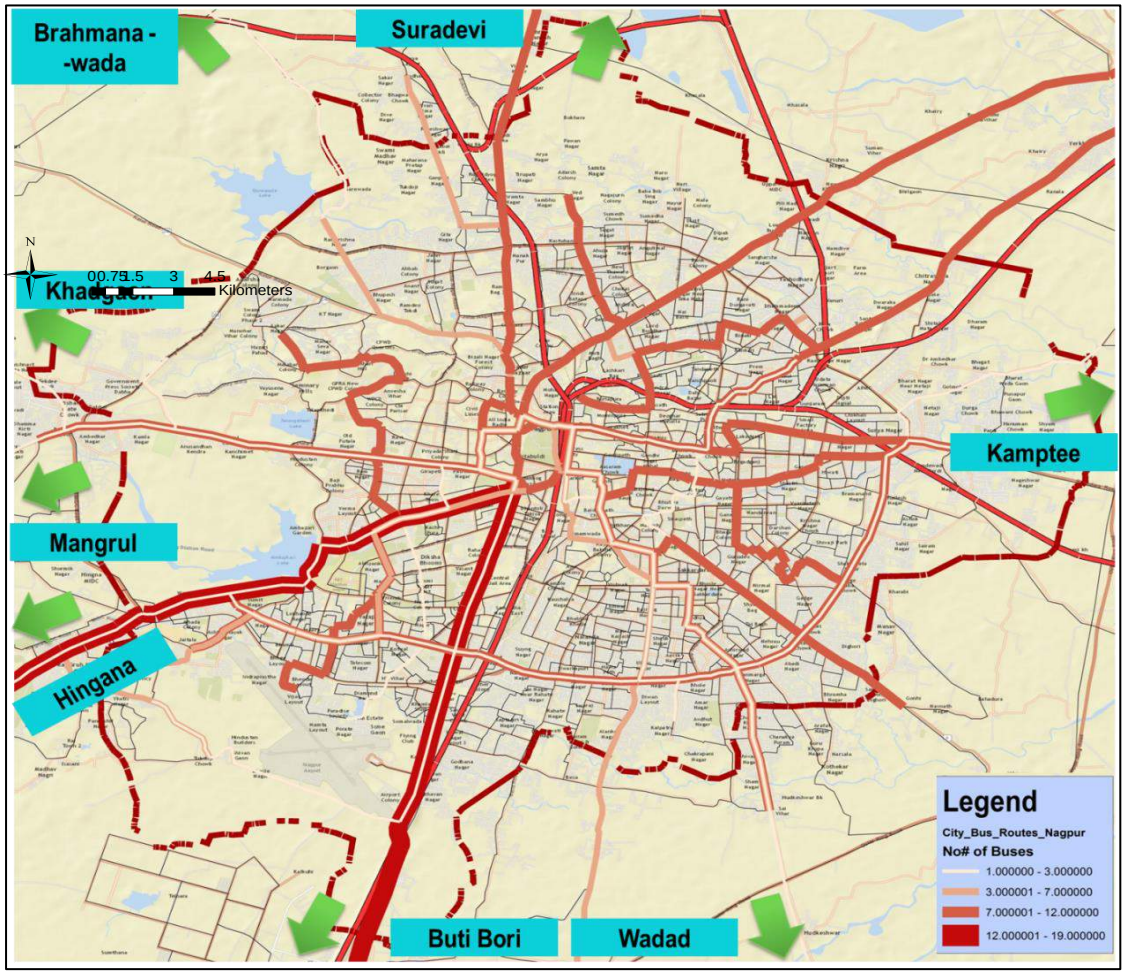
F. CITY BUS SERVICES SYSTEM OBSERVATIONS

For the purpose of understanding and analysing the city bus routes, within the Nagpur city, the team has undertaken extensive efforts to map the same and assess the route wise various performance parameters such as the Frequency of Services, Daily Ridership, Load Factor, Earning per Km, and Earning per Route per day etc.

It has been observed that of the 183 notified routes majority of them overlap with each other creating a competitive environment within the system. Of the 183 notified city bus routes, 80 routes originate from Sitabuldi. The same could be observed from the Figure 3-7. The city bus services are operating with approximately 6 buses per route and 9 buses per lakh population. It has to be however noted that, out of these notified routes there are however only 38 routes which are in operation.

No. of Buses: Based on the preliminary analysis, it has been observed that city bus services are operating with an average of 6 buses per route, i.e; 53% of the operational routes have less than 6 buses per route. Majority of the buses are allocated on two routes only i.e Buti Bori and Hingna. The average passenger lead is observed to be 7.79 km, which means that on any given route the bus is occupied for a minimum of 48% of the route.

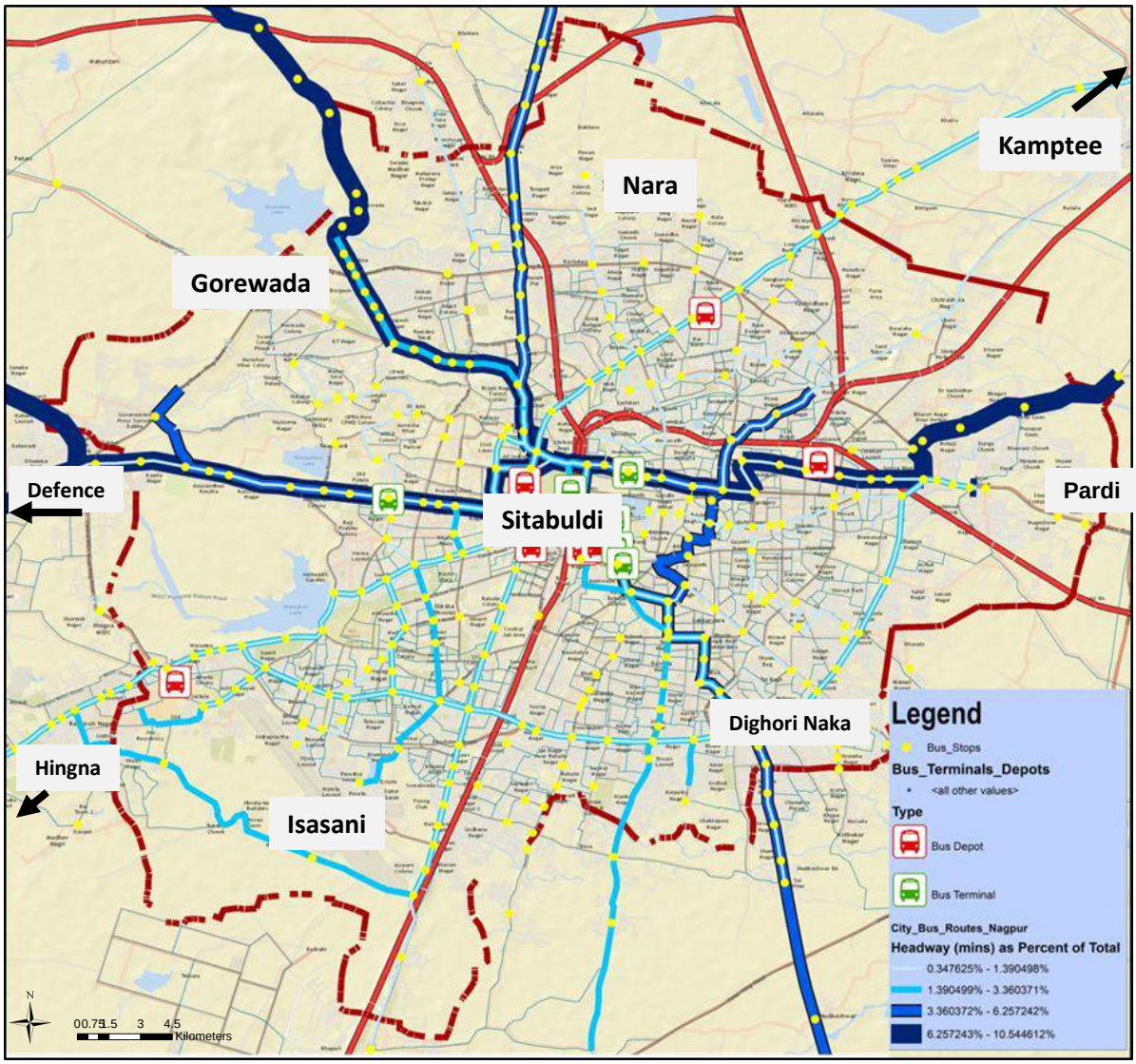
FIGURE 3-7: ROUTE WISE DISTRIBUTION OF NO. OF BUSES[23]



[23] Source: NMC Operational Parameters dated 24th April, 2017 and 1st June, 2017.

Frequency of Services: It has been observed that city bus services are operating with an average frequency of 15 mins. Majority of the routes with higher headways operate towards Brahmanawada, Suradevi, Kamptee, Wadad, Mangrul & Khadgaon. This may be because of the no. of buses allocated on these routes is less than or equal to 2.

FIGURE 3-8: ROUTE WISE DISTRIBUTION OF FREQUENCY OF CITY BUS SERVICES[24]



Daily Ridership: It has been observed that the average daily ridership is observed to be 98,611 passengers. The maximum daily passenger ridership is observed on the Sitabuldi to Hingna Route followed by Sitabuldi to Buti Bori Route. The average load factor on the operational city bus routes is observed to be 48%. However, it has been observed that 78% of the operational routes have a load factor that is less than 60%.

[24] Source: NMC Operational Parameters dated 24th April, 2017 and 1st June, 2017

FIGURE 3-9: ROUTE WISE DISTRIBUTION OF DAILY RIDERSHIP[25]

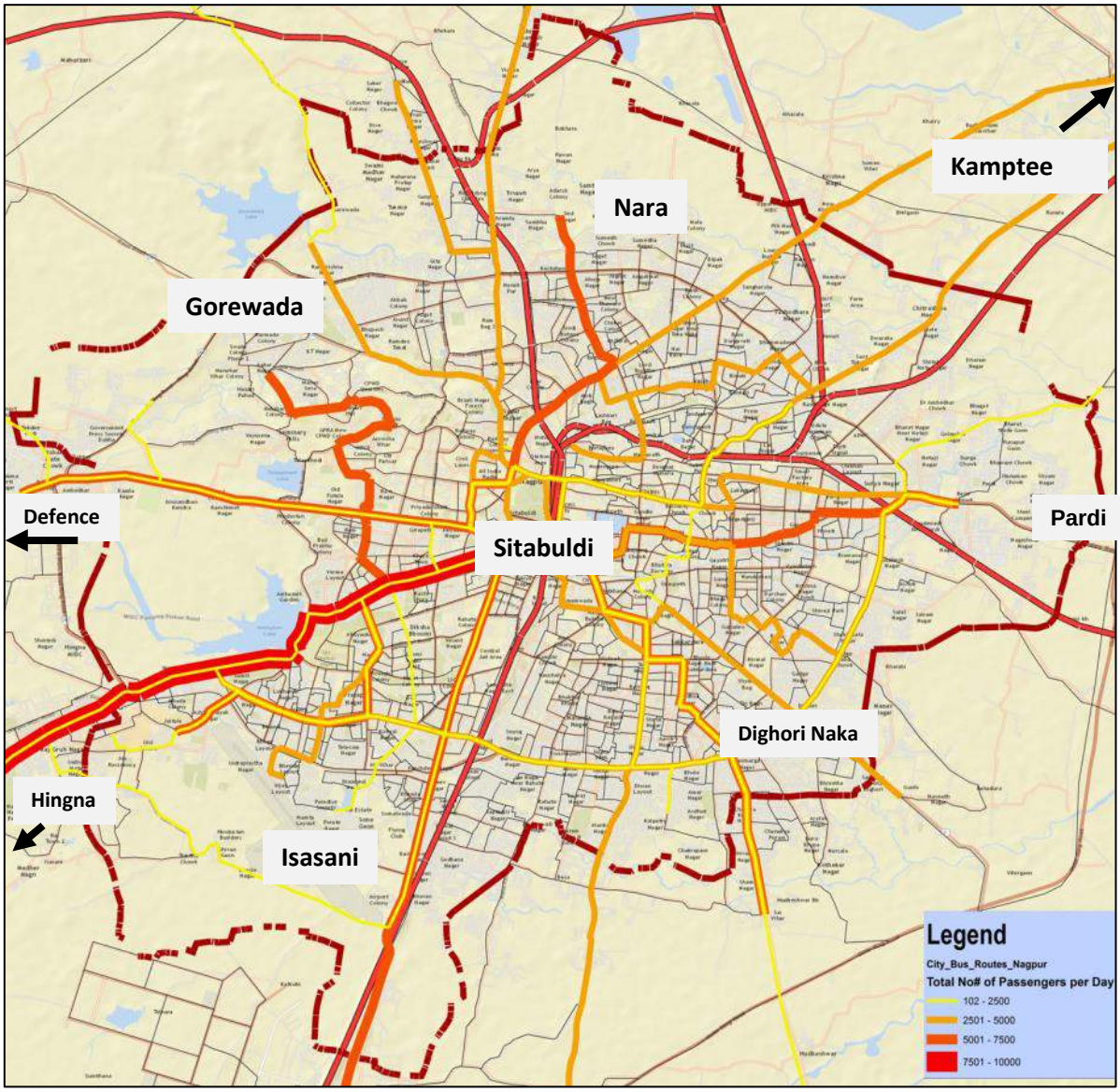


TABLE 3-12: EXISTING ROUTE DETAILS AND CITY BUS SERVICES RIDERSHIP[26]

Sl. No	Route Description	Route Length (km)	Existing One Way Running time (min)	Existing Headway (in mins)	No. of Passengers (Daily)	No. of Buses)
1	Pardi-Jaitala	20	41.0	5.13	5064	16
2	Piplafata-Hazaripahad	22	46.0	4.18	9154	22
3	Piplafata-Gandhibagh	12	25.0	50.00	171	1
4	Sitabuldi-Suradevi	18	37.0	74.00	326	1
5	Sitabuldi-New Narsala	14	29.0	58.00	324	1
6	Sitabuldi-Kamptee	18	37.0	14.80	1834	5
7	Sitabuldi-Sonegaon	12	25.0	25.00	445	2
8	Sitabuldi-Sonegaon	10	21.0	21.00	661	2

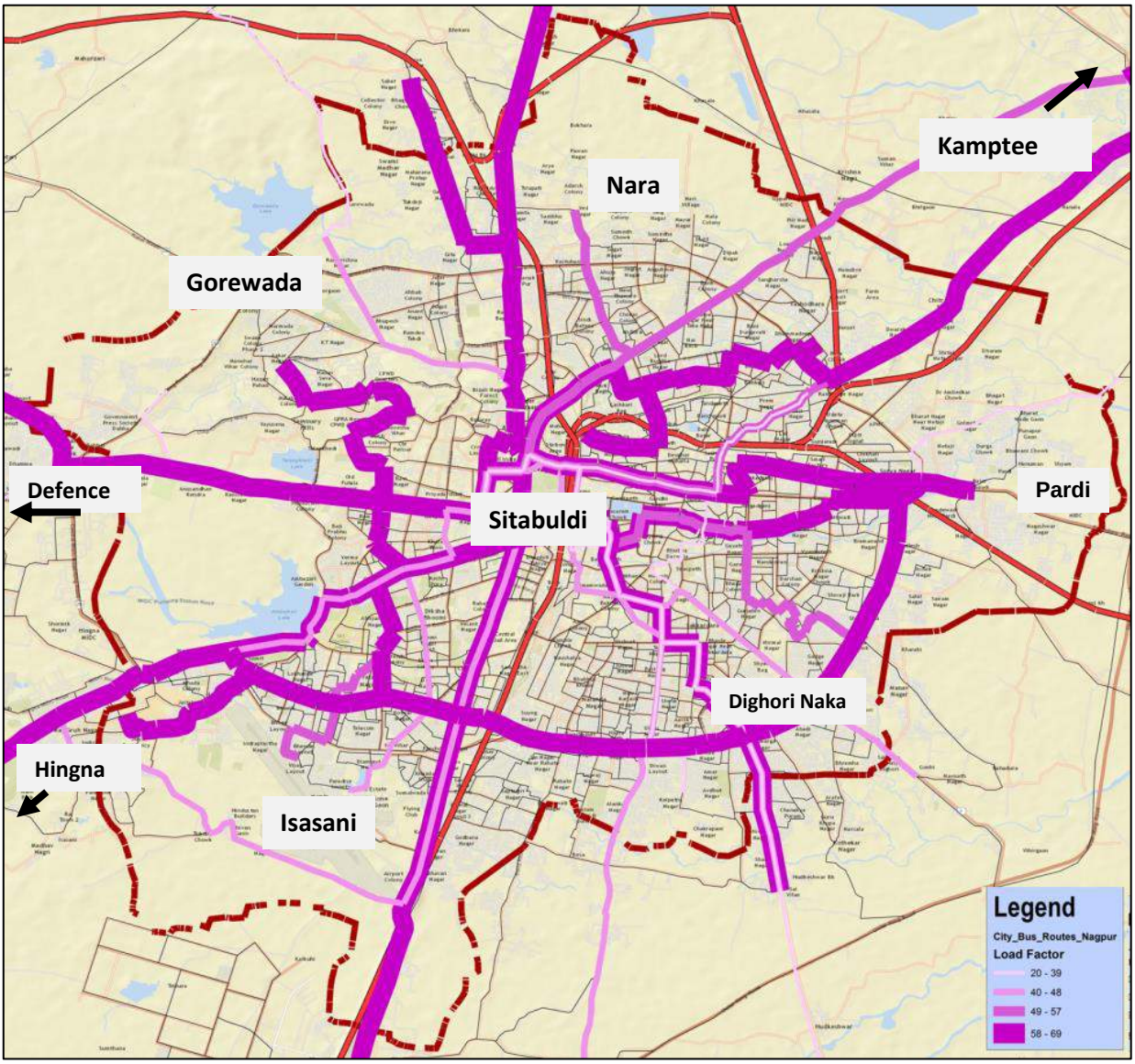
[25] Source: NMC Operational Parameters dated 24th April, 2017 and 1st June, 2017
[26] Source: NMC Operational Parameters dated 24th April, 2017 and 1st June, 2017

Sl. No	Route Description	Route Length (km)	Existing One Way Running time (min)	Existing Headway (in mins)	No. of Passengers (Daily)	No. of Buses)
9	Sitabuldi-Nagsenwan	10	21.0	8.40	2565	5
10	Sitabuldi-Godhani	12	25.0	5.00	3462	10
11	Sitabuldi-Khaparkheda	26	54.0	8.31	5174	13
12	Sitabuldi-Pardi	10	21.0	3.50	3879	12
13	Sitabuldi-Isasani	16	33.0	16.50	1394	4
14	Pardi-YCCE College	24	50.0	8.33	4779	12
15	Sitabuldi-JN Hospital	26	54.0	13.50	2586	8
16	Sitabuldi-Defence	16	33.0	5.50	6160	12
17	Defence-JN Hospital	18	37.0	14.80	462	5
18	Sitabuldi-Mangrul	22	46.0	92.00	136	1
19	Sitabuldi-Kamptee	18	37.0	8.22	3143	9
20	Sitabuldi-CRPF	14	29.0	19.33	1308	3
21	Sitabuldi-Nara	8	17.0	3.78	4426	9
22	Sitabuldi-Bhramani Fata	24	50.0	10.00	4041	10
23	Sitabuldi-Khadgaon	18	37.0	74.00	301	1
24	Sitabuldi-Wadad	26	54.0	108.00	295	1
25	Sitabuldi-Alesur	18	37.0	74.00	267	1
26	Sitabuldi-Pawangaon	16	33.0	66.00	255	1
27	Vela Hari-Gorewada	26	54.0	13.50	3232	8
28	Belatrodi-Sitabuldi	12	25.0	12.50	920	4
29	Sitabuldi-Vaishali Nagar	14	29.0	14.50	1412	4
30	Sitabuldi-Shanti Nagar	10	21.0	42.00	242	1
31	Sitabuldi-Shesh Nagar	12	25.0	25.00	486	2
32	Sitabuldi-Waddhamna	16	33.0	66.00	284	1
33	Sitabuldi-Panchgaon	20	41.0	6.31	5081	13
34	Sitabuldi-Indoram Gate No 6	26	54.0	4.50	9804	24
35	Dikshabhumi-Dragon Palace	22	46.0	92.00	175	1
36	Dikshabhumi-Sitabuldi	2	4.0	8.00	93	1
37	Sitabuldi-Hingna Gramin Hospital	18	37.0	3.52	9855	21
38	Kharbi T Point-Jaitala	24	50.0	6.25	4415	16
Total Fleet					263	
Total Daily Passengers by Bus					98,611	

Earning Per Bus: It has been observed that the average earning per bus is observed to be Rs 5,789 i.e, 53% of the operational routes have an Earning per bus which is less than Rs.6000. The maximum earning per bus is observed on the following routes;

1. Sitabuldi to Hingna
2. Sitabuldi to Buti Bori
3. Sitabuldi to Kamptee
4. Sitabuldi to Khaparkheda

FIGURE 3-10: ROUTE WISE DISTRIBUTION OF LOAD FACTOR[27]



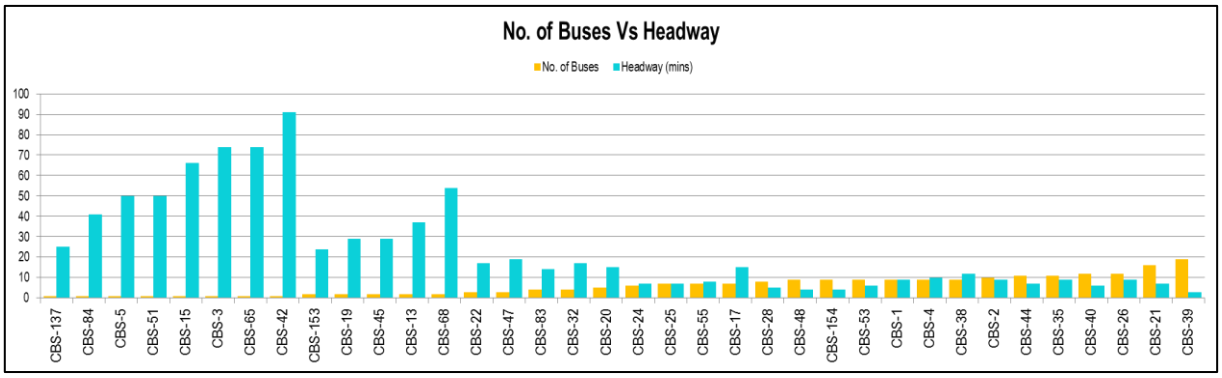
Based on this route wise preliminary analysis, the following observations were made;

1. Typically more the no. of buses per route better is the frequency of it operations. However, in the current case it was observed that some of the routes had higher headways more than the average frequency of the system as the no. of buses allocated on them were equal to or less than 2. The following are the routes with less no. of buses and lean frequency, which is represented in Figure 3-17.

    a. Sitabuldi to Jaripatka
    b. Sitabuldi to Shanti Nagar
    c. Piplafata to Gandhibagh
    d. Sitabuldi to Dabha
    e. Sitabuldi to Pawangaon
    f. Sitabuldi to Brahmanawada
    g. Sitabuldi to Khadgaon
    h. Sitabuldi to Mangrul

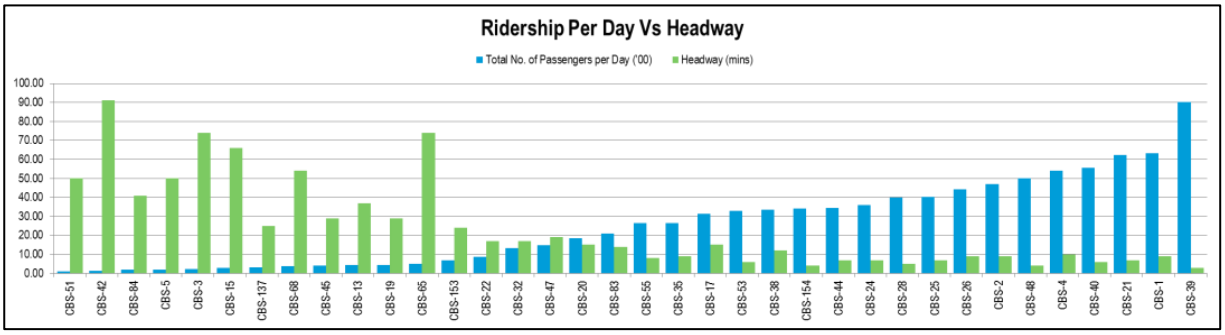
[27] Source: NMC Operational Parameters dated 24th April, 2017 and 1st June, 2017

FIGURE 3-11: ROUTE WISE NO. OF BUSES VS HEADWAY



2. Better frequency of services is reflected in the daily passenger ridership per route. However, in the current case it was observed that some of the routes had higher headways more than the average frequency of the system with less ridership. The following are the routes with higher frequency and less daily ridership which is represented in Figure 3-12.
    a. Sitabuldi to Jaripatka
    b. Sitabuldi to Shanti Nagar
    c. Piplafata to Gandhibagh
    d. Sitabuldi to Dabha
    e. Sitabuldi to Pawangaon
    f. Sitabuldi to Brahmanawada
    g. Sitabuldi to Khadgaon
    h. Sitabuldi to Mangrul

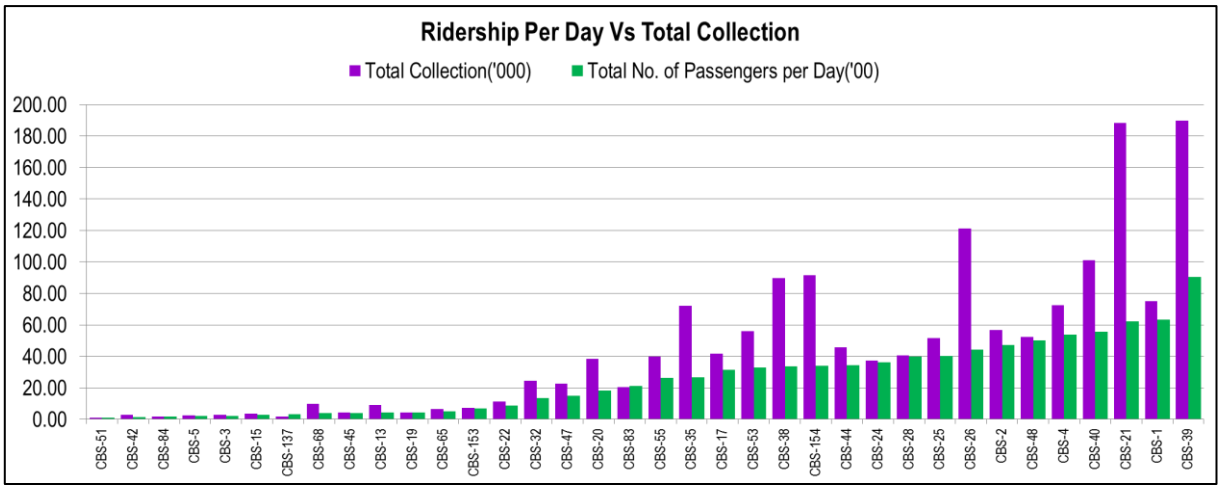
FIGURE 3-12: ROUTE WISE RIDERSHIP PER DAY VS HEADWAY



3. Higher ridership per day on each routes reflects on the total revenue collected from the passengers. However, in the current case it was observed that some of the routes have neither adequate ridership nor the adequate passenger revenue to meet the day to day operational cost. Operation of such routes reflects in the negative performance of the city bus routes. The following are the routes with higher frequency and less daily ridership which is represented in Figure 3-13.

    a. Sitabuldi to Jaripatka
    b. Sitabuldi to Shanti Nagar
    c. Piplafata to Gandhibagh
    d. Sitabuldi to Dabha
    e. Sitabuldi to Pawangaon
    f. Sitabuldi to Brahmanawada
    g. Sitabuldi to Mangrul

FIGURE 3-13: ROUTE WISE RIDERSHIP PER DAY VS TOTAL PASSENGER COLLECTION



G. BUS PASSENGER DATA ANALYSIS

To capture the travel characteristics of the public transport commuters in Nagpur, bus passenger boarding and alighting survey at 25 major Bus Stops was undertaken (along with the bus occupancy survey) & 2000 bus passenger opinion surveys were carried out at 20 various locations spread across the city. The survey was designed to reflect the overall passenger trip pattern along the major public transport routes within the Nagpur City. Observations from the surveys have been discussed in the following section of the report.

BUS BOARDING AND ALIGHTING SURVEY ANALYSIS

Bus Stop Boarding and Alighting survey was conducted for 16 hours one on a typical working day at the Bus Stops covering morning and evening peak periods. Table 3-12 & Figure 3-14 below summarizes the daily total boarding and alighting counts observed at the bus stops locations.

TABLE 3-13: BUS STOP BOARDING & ALIGHTING COUNTS[28]

Bus Stop Code	Bus Stop Location Name	Boarding	Alighting	Total
BS_ 286	A G office	133	118	251
BS_ 312	Ambazari T point Bus Stop	495	545	1040
BS_232	Central Jail Bus Stand	444	484	928
BS_151	Chatrapati Bus Stand	787	948	1735
BS_193	Gaddigoddam	2657	1722	4379
BS_121	GandhiBagh	835	696	1531
BS_189	Indora Bus Stop	814	1088	1902
BS_347	Itwari Railway station	908	945	1853
BS_051	Jagnade bus stop	238	200	438
BS_265	Kamal chowk	191	182	373
BS_106	Medical Chowk	1328	1400	2728
BS_004	Old Pardi Road	262	503	765
BS_071	Police line Takli bus stop	444	287	731
BS_034	Pratapnagar Bus stop	1014	696	1710
BS_134	Railway Station Bus Stand	1999	2055	4054
BS_056	RaviNagar stop	1423	2289	3712
BS_377	Sakkardar bus stop	809	697	1506
BS_395	Shanthinagar	799	663	1462
BS_186	Sharadha Chowk	736	407	1143
BS_024	Sitabuldi Terminus	1544	1938	3482

[28] Source: Primary Surveys UMTC, 2017

Bus Stop Code	Bus Stop Location Name	Boarding	Alighting	Total
BS_237	Somalawada Bus Stand	711	609	1320
BS_020	ST Bus Stand	2160	1792	3952
BS_129	Telephone Exchange	414	480	894

FIGURE 3-14: BUS STOP WISE BUS PASSENGER BOARDING & ALIGHTING[29]

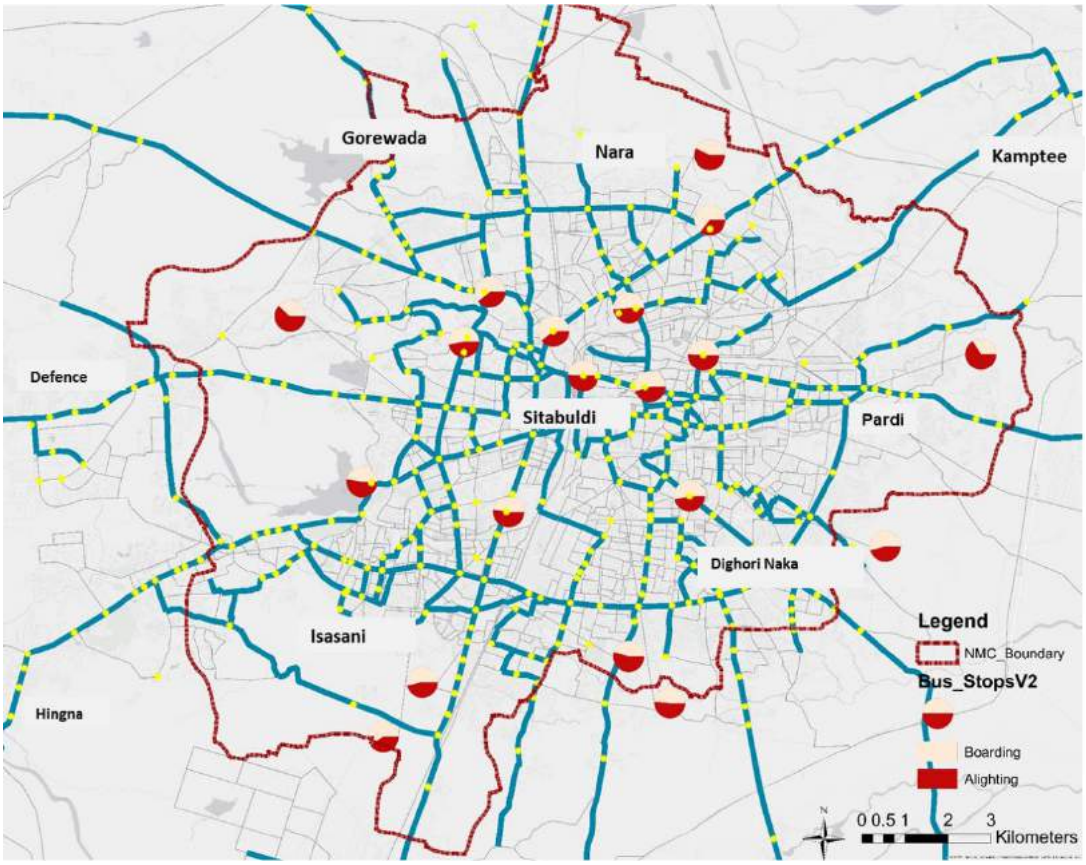
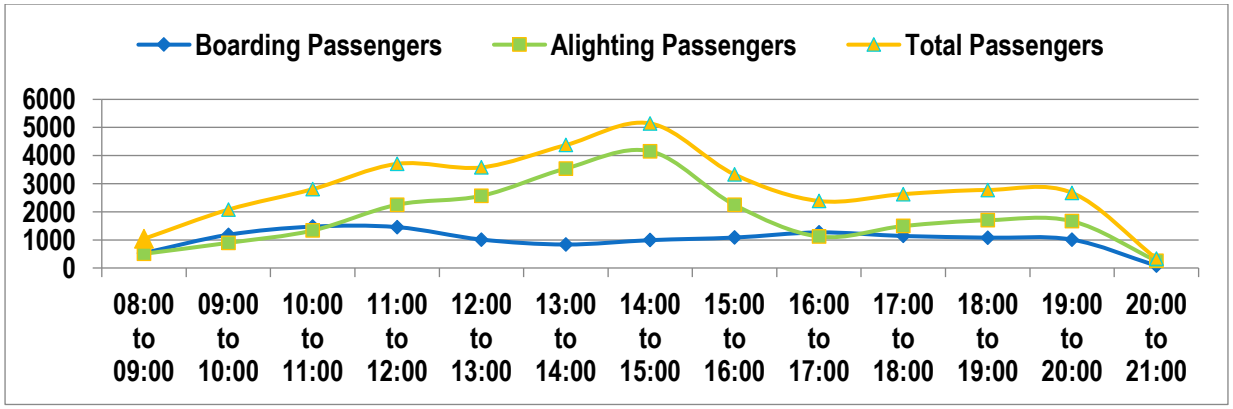


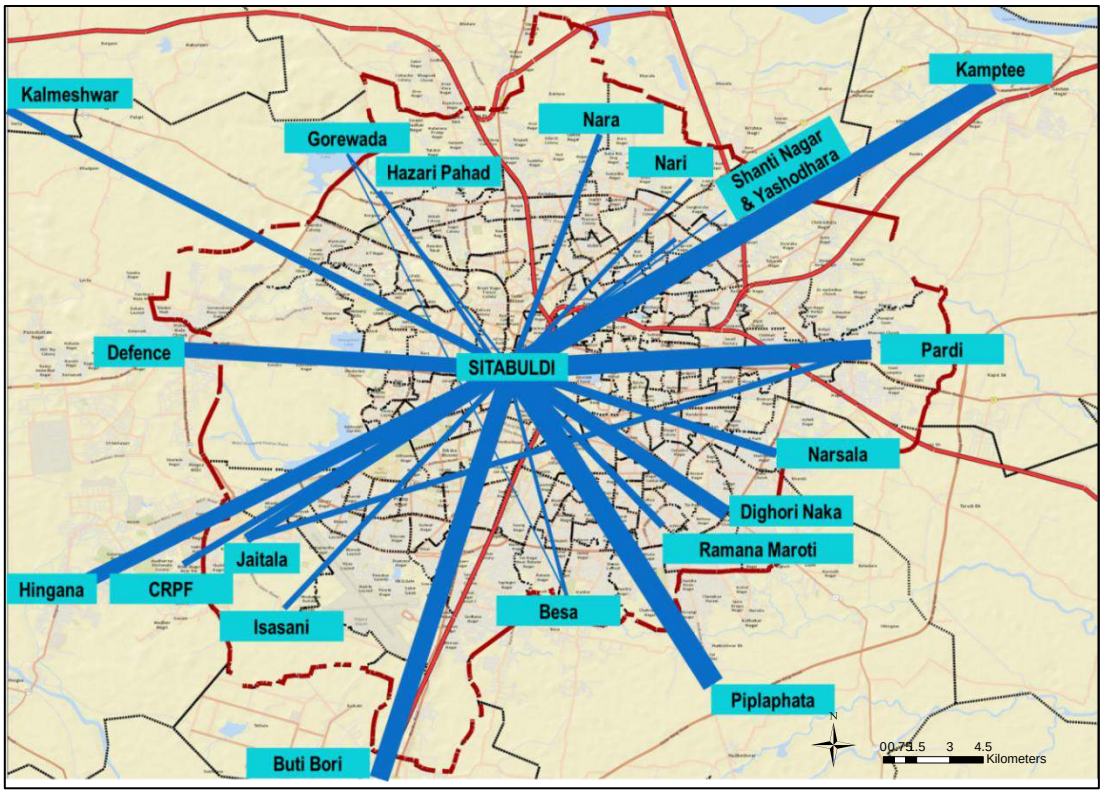
Figure 3-15 represents the hourly variation of Bus Stop Boarding and Alightings, it could be observed that the maximum flow of bus passengers during the afternoon hours between 1300 hrs to 1500 hrs, which account for 25% of the total bus passengers boarding and alighting.

FIGURE 3-15: HOURLY VARIATION OF BUS STOP BOARDING & ALIGHTING[30]



[29] Source: Primary Surveys UMTC, 2017
[30] Source: Primary Surveys UMTC, 2017

FIGURE 3-16: BUS STOP WISE MAJOR ORIGIN & DESTINATION[31]



BUS PASSENGER OPINION SURVEY

Bus Passenger Origin-Destination and opinion survey was carried out at 20 locations covering 1000 samples.

SOCIO ECONOMIC CHARACTERISTICS OF BUS PASSENGERS

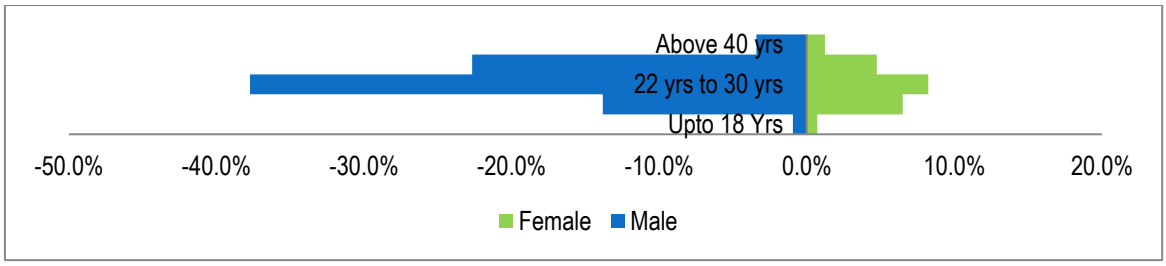
The socio economic characteristics of bus passengers in Nagpur City has been analysed in the form of age, sex pyramid, household income, expenditure on transport, occupation from the surveyed samples is analysed and presented in the following sections of the report.

a. Age Group & Sex Ratio

The age distribution shows that the individuals in the most productive age 22 yrs to 40 yrs formed 73.40% of the bus passengers, whereas the children and student population between the age group of 0 yrs to 22 yrs account for 21.96% of the total bus passengers. It has also been observed that 79% of the bus users are male. Figure 3-17 represents the age sex pyramid of the bus passengers.

[31] Source: Primary Surveys UMTC, 2017

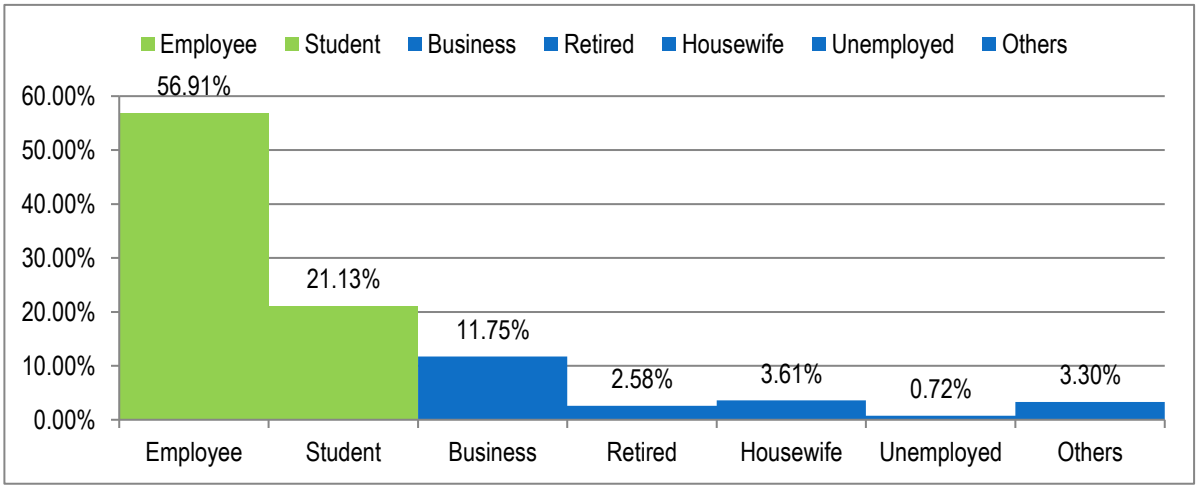
FIGURE 3-17: AGE SEX PYRAMID OF BUS USERS IN NAGPUR[32]



b. Occupation

Figure 3-18 represents the distribution of surveyed bus users by their occupation. It could be observed from the figure that approximately 78% of the bus users are either Employee or Students.

FIGURE 3-18: DISTRIBUTION OF BUS USERS BY OCCUPATION[33]

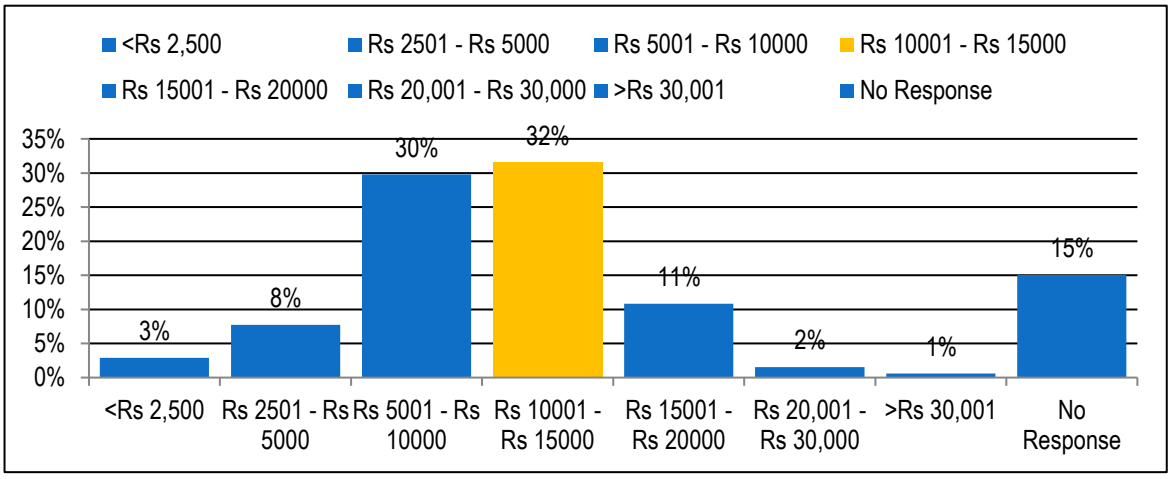


c. Income Profile

Distribution of bus users according to the monthly income ranges is presented in the Figure 3-19. It is observed that 72% of the users have monthly income less than or equal to Rs 15,000 and another 13% of the households have income between greater than Rs 30,000, whereas 15% of the bus users preferred not disclosing their income profile. The average household income per month is observed to be in between Rs 10,000 to Rs 15,000.

[32] Source: Primary Surveys UMTC, 2017
[33] Source: Primary Surveys UMTC, 2017

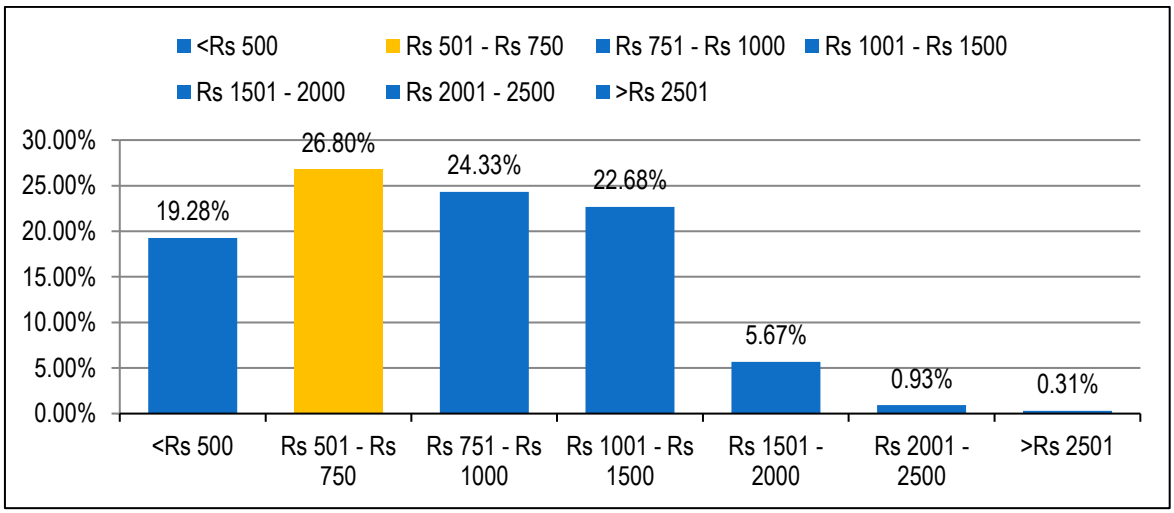
FIGURE 3-19: DISTRIBUTION OF BUS USERS BY THE MONTHLY HOUSEHOLD INCOME[34]



d. Expenditure on Transport

Distribution of bus users according to the monthly expenditure on transport is presented in the Figure 3-20. It could be observed that about 46% of the bus users spend less than Rs 750 per month on transport and nearly 70% of the bus users have a monthly expenditure on transport ranging between Rs 500 to Rs 1000.

FIGURE 3-20: DISTRIBUTION OF BUS USERS BY THE MONTHLY EXPENDITURE ON TRANSPORT[35]



TRIP CHARACTERISTICS OF BUS PASSENGERS

The trip characteristics of bus passengers in Nagpur City has been analysed in the form of purpose of trips, access & egress modes, time taken to access and egress from the system, No. of transfers undertaken by bus users and time taken to transfer at the terminal locations is analysed and represented in the following sections of the report.

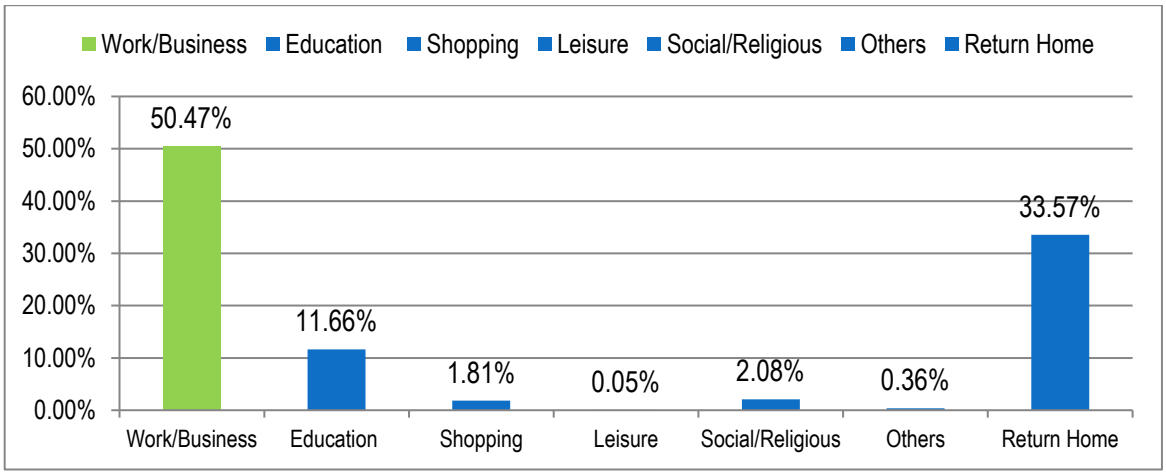
a. Purpose of Trips

Figure 3-21 represents the distribution of bus user trips by purpose of travel. It could be observed from the figure that 50.47% of the trips performed by the bus users is for work and business purposes, where as 11.66% of the trips are

[34] Source: Primary Surveys UMTC, 2017
[35] Source: Primary Surveys UMTC, 2017

education based and about 4.3% of the trips are other purpose trips including shopping, social, health and recreation, whereas approximately 33.57% of the trips are home based return trips.

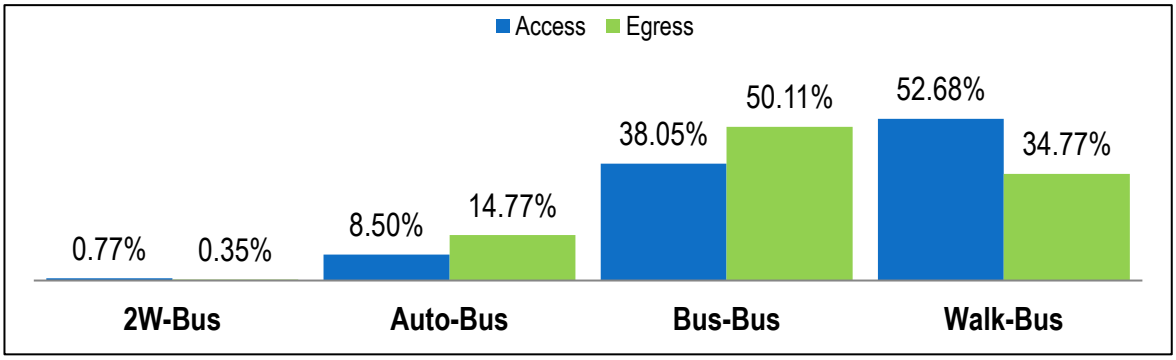
FIGURE 3-21: DISTRIBUTION OF BUS USERS BY THE PURPOSE OF TRIPS[36]



b. Access and Egress Modes of Bus Users and IPT Users

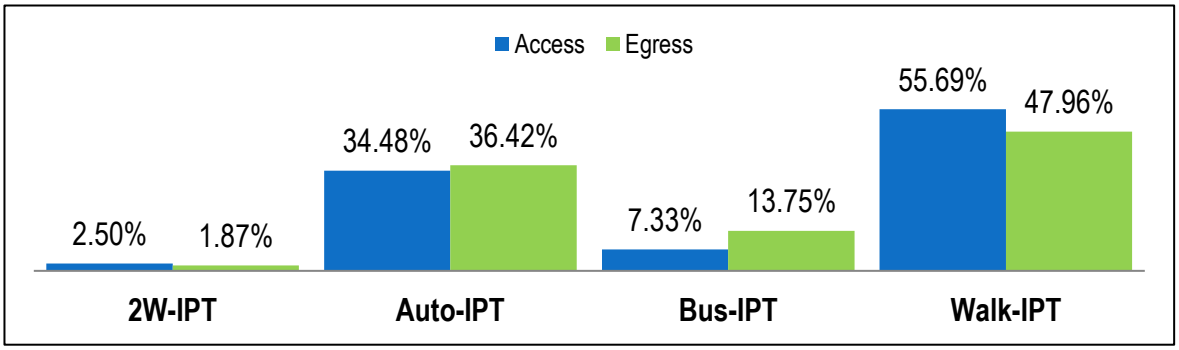
Share of access mode from origin to boarding point and dispersal mode from alighting point to the destination of the boarding bus passengers & IPT passengers is shown in the Figure 3-22 & Figure 3-23. It could be observed from Figure 3-22 & Figure 3-23 that Walk is the predominant mode of travel from origin to boarding point/alighting point to destination for both Bus passengers and IPT passengers, which is followed by Bus & Auto.

FIGURE 3-22: DISTRIBUTION OF BUS USERS BY ACCESS & EGRESS MODES[37]



[36] Source: Primary Surveys UMTC, 2017
[37] Source: Primary Surveys UMTC, 2017

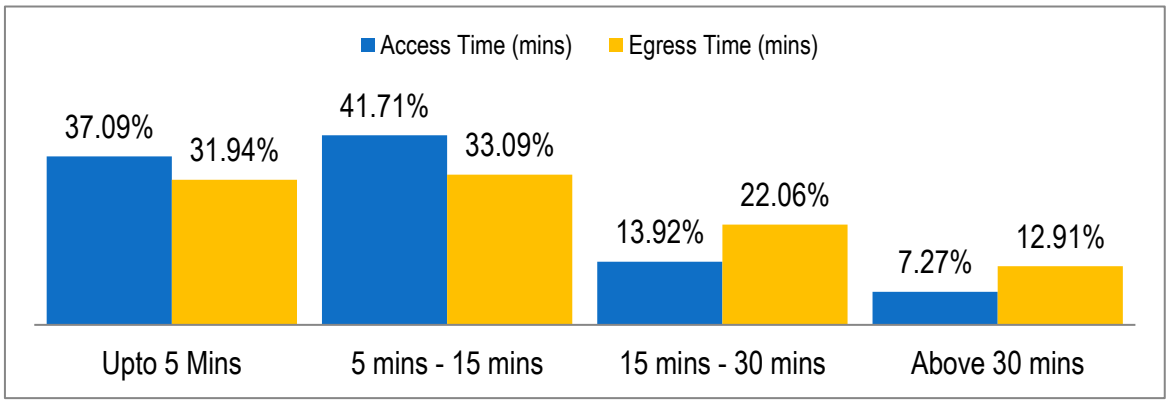
FIGURE 3-23: DISTRIBUTION OF IPT USERS BY ACCESS & EGRESS MODES[38]



c. ***Distribution of Bus Users and IPT Users by Travel Time Taken to Access & Egress from the System***

The average travel time to access & egress from the bus stop while boarding and alighting is represented in the Figure 3-24. It could be observed from the figure that 65 to 75% of the trips while accessing the boarding point and dispersing from the destination point is completed within 15 mins. The average access time is observed to be 20 mins, whereas average egress time is observed to be 18 mins.

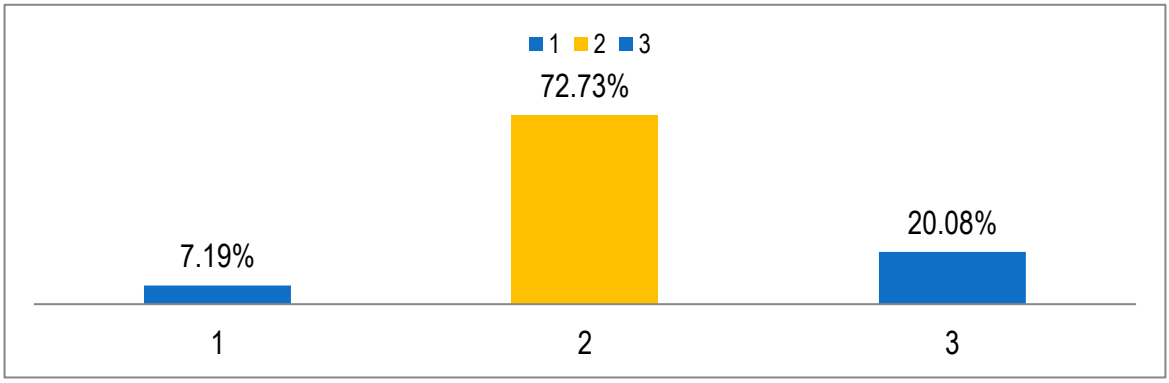
FIGURE 3-24: DISTRIBUTION OF BUS USERS BY ACCESS & EGRESS TRAVEL TIME[39]



d. ***No. of Transfers by Bus Users in Nagpur***

It has been observed that 57% of the bus users transfer modes or buses while travelling within the city. Of the 57% of the bus users who transfer from one mode to another mode. 72.73% of the passengers transfer twice as represented in Figure 3-25. Majority of these transfers take place at Sitabuldi.

FIGURE 3-25: DISTRIBUTION OF BUS USERS BY NO. OF TRANSFERS[40]

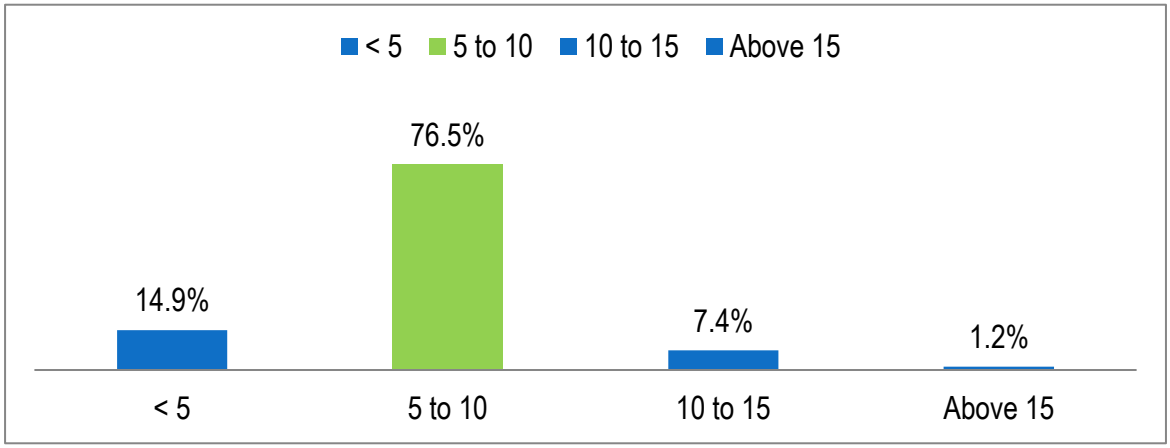


[38] Source: Primary Surveys UMTC, 2017
[39] Source: Primary Surveys UMTC, 2017
[40] Source: Primary Surveys UMTC, 2017

e. Time Taken to Transfer at the Terminal Location

It has been observed that the average time taken to transfer at the terminal location is 15 mins, which includes the Time taken to reach the stop and the waiting time at the stop to board the next bus. From the Figure 3-26, it could be observed that 76.5% of the bus users take 5 to 10 mins to transfer from one bus to another.

FIGURE 3-26: DISTRIBUTION OF BUS USERS BY TIME TAKEN TO TRANSFER AT THE TERMINAL[41]

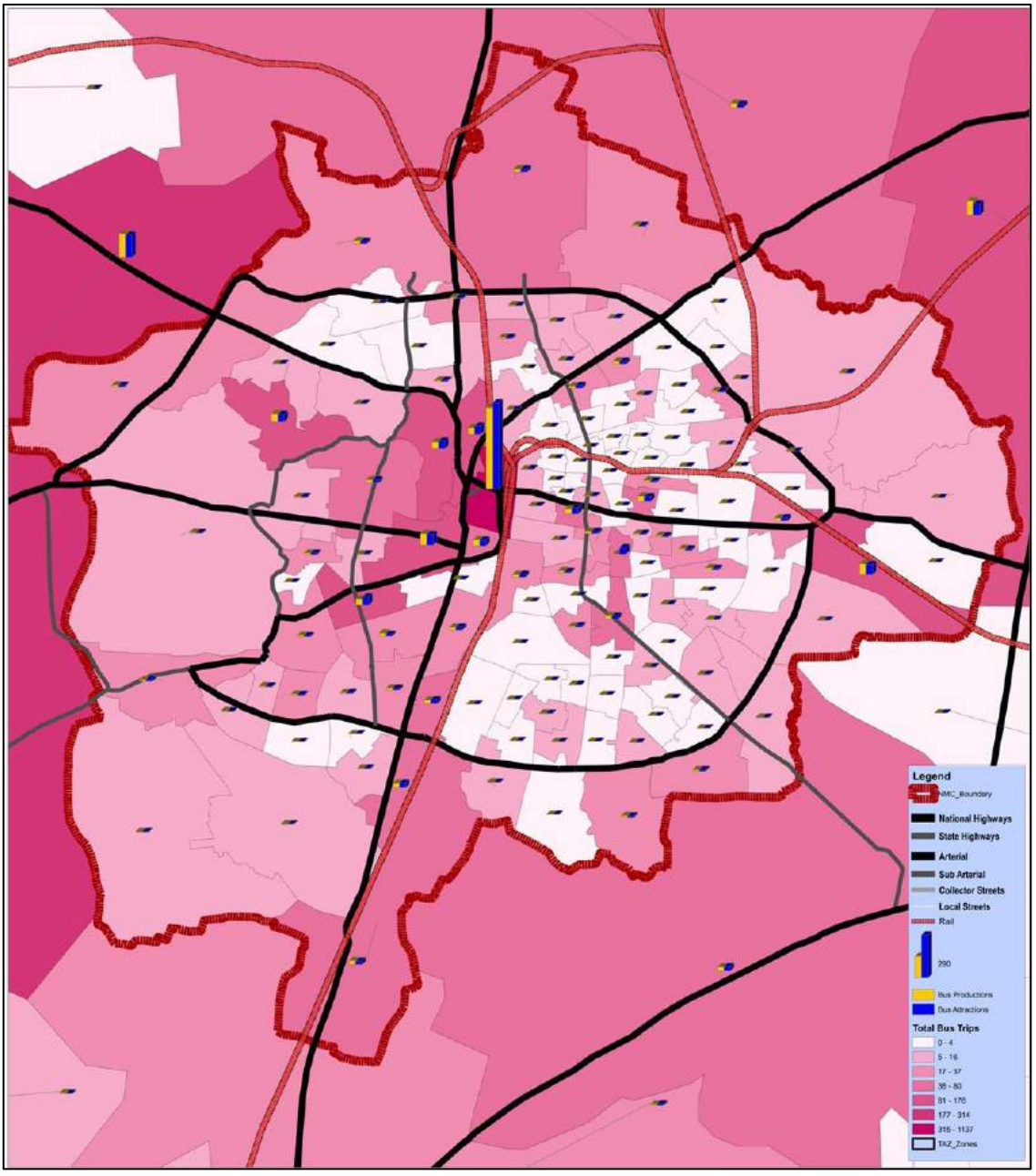


OPINION ON PUBLIC TRANSPORT

As part of the current study, opinion and revealed preference of users with respect to the various characteristics of a new and improved city bus transport system in Nagpur has been undertaken. The respondents were queried with regard to preference for a city bus services along with the quantum of extra fare they are willing to pay. It has been observed that about 85% of the bus users expressed their willingness to shift on to a safe, convenient, affordable and time saving city bus services. Of which 64% expressed their willingness to shift with regard to the savings in time i.e, savings by 5 to 10 mins, whereas as 35% expressed their willingness to shift with regard to saving in travel cost by approximately 50%.

[41] Source: Primary Surveys UMTC, 2017

FIGURE 3-27: DISTRIBUTION OF BUS PASSENGER TRIPS WITHIN THE STUDY AREA[42]



3.3. SUPPORT INFRASTRUCTURE

Mass Transit Systems need to be supported by transit infrastructure, operation and maintenance on a daily basis. The support infrastructure is essential for the successful operations of the mass transit systems in any given city, such as Bus Stops, Terminals, Depots and Intelligent Transport Systems (ITS). Without these support facilities, the system fails to attract the commuters. The following section of the report describes the existing support infrastructure of the existing public transport systems in Nagpur:

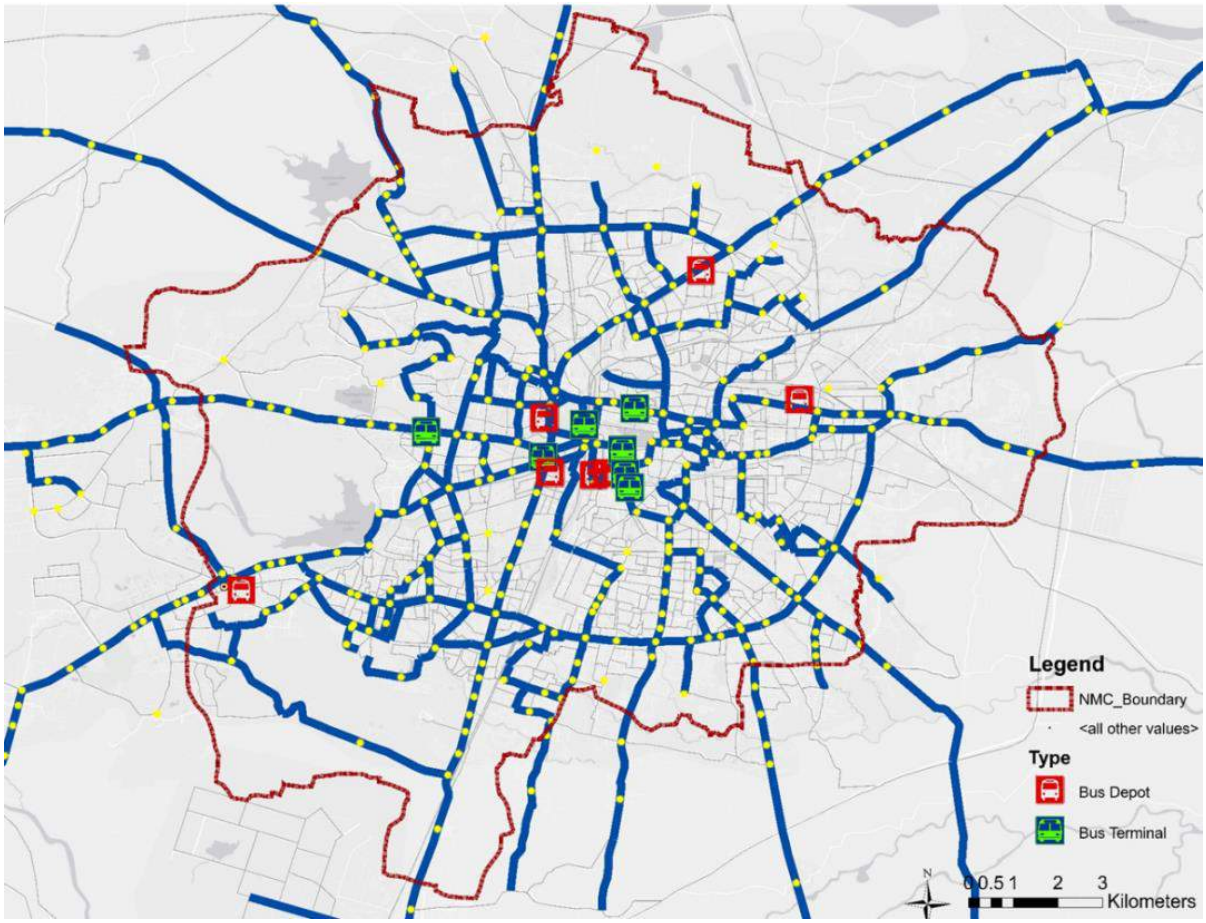
[42] Source: Primary Surveys UMTC, 2017

3.3.1. EXISTING BUS STOPS

Bus Stops/Bus Q shelters are designated places where buses stop for passengers to board and alight the buses, which are usually, positioned along the transit corridors. Bus Shelter is an essential part of any successful urban mass transit system. From the perspective of the city agency that is responsible for its management, the bus shelter needs to be low maintenance and vandal resistant, whereas from the perspective of the user, it needs to be easily accessible, comfortable, convenient, safe and provide clear information.

In case of Nagpur, the Bus Q Shelters are constructed and maintained by Nagpur Municipal Corporation. It has been observed that the scheduled bus stops are strategically located in such a manner that the average distance between two consecutive bus stops is 650 M to 700 M. Figure 3-28 represents the location of the scheduled Bus Stops/Q Shelters within the City. However, based on the information shared by the Nagpur Municipal Corporation only 190 bus Q shelters are constructed and maintained by NMC.

FIGURE 3-28: LOCATION OF THE BUS STOPS/Q SHELTERS WITHIN THE NAGPUR CITY[43]



[43] Source: NMC & Reconnaissance Survey by UMTC, 2017

FIGURE 3-29: TYPE OF BUS STOPS/Q SHELTERS WITHIN NAGPUR CITY

It could be observed from Figure 3-29 that there is definitive structure of the bus stops within the city, however the following have been observed;

1. Construction and Deconstruction of the pavement at the bus stops making them unusable.
2. Height of the bus stop level, forces the bus users to wait for the bus on the main carriageway.
3. Bus Stops are also being used for On Street Parking of 2 Wheelers and 4 Wheelers.

3.3.2. EXISTING TERMINALS & DEPOTS

A depot is a transport system operating base and provides the parking accommodations, servicing and maintenance facilities for the vehicles along with the administrative function and facilities for the staff, whereas a bus terminal is a designated place where a bus starts or ends its scheduled route.

In case of Nagpur, City bus services are operated by Nagpur Municipal Corporation (NMC), whereas the inter-city bus services are operated by the Maharashtra State Road Transport Corporation (MSRTC). Figure 3-28 and Table 3-13 represents the location of the Bus Terminals and Bus Depots within the Nagpur City.

TABLE 3-14: LIST OF THE MAJOR BUS DEPOTS/TERMINALS WITHIN THE NAGPUR CITY

Sl. No.	Type of Terminal	Location	Jurisdiction
1	Bus Depot	Hingna	NMC
2	Bus Terminal	Ravi Nagar	-
3	Bus Terminal	Mor Bhawan	MSRTC/NMC
4	Bus Depot	Patwardhan	NMC
5	Bus Depot	Zero Mile	NMC
6	Bus Terminal	M P Bus Stand	MSRTC
7	Bus Depot	Ghat Road	-
8	Bus Depot	Ganeshpeth	MSRTC
9	Bus Terminal	Agayaram Devi Chowk	
10	Bus Terminal	Ganeshpeth	MSRTC
11	Bus Terminal	Baidhyanath Chowk	-
12	Bus Terminal	Geetanjali Talkies, Gandhi bagh	-
13	Bus Depot	Teka Naka	NMC
14	Bus Depot	Vardhaman Nagar	MSRTC

Source-Compiled by UMTC, 2017

Depots and workshops are provided to park and service the buses. The depots provide short and long term parking spaces, maintenance, work shop facilities and fuel filling points. It also includes facilities for driver shift changes and rest room facilities for them. Almost all the depots, sub depots, operating centre mentioned above operate along with the bus stand, were typically buses start and end their scheduled trips. Figure 3-30 to Figure 3-34 represent the condition of bus terminal and depots within Nagpur City.

FIGURE 3-30: BUS TERMINALS AND DEPOTS IN NAGPUR – MOR BHAWAN[44]

[44] Source: Reconnaissance Survey by UMTC, 2017

Figure 3-30 represents the existing condition of the support infrastructure at Mor Bhawan. It could be observed from the images that the terminal traffic is not segregated from the non terminal traffic, no proper segregation of pedestrian and vehicular movements, no proper shelter for weather protection, improper platforms or bays for buses etc. It has also been observed that only a part of the bus terminal is in use.

FIGURE 3-31: BUS TERMINALS AND DEPOTS IN NAGPUR – TEKA NAKA[45]

Figure 3-31 represents the existing condition of the Bus Depot at Teka Naka, with an area of 1.45 acres. It has been observed that the depot is majorly used for Parking of City Buses. Even though small maintenance activities are undertaken, parts and accessories are required to be transported from Hingna Depot. Washing is done for 15 to 20 buses every day. There are no proper paving/shades for Buses.

FIGURE 3-32: BUS TERMINALS AND DEPOTS IN NAGPUR – ZERO MILE[46]

Figure 3-32 represents the existing condition of the Bus Depot at Zero Mile. Zero Mile Depot has an area of 0.5 acres. It has been observed that the Zero Mile depot is majorly used as Parking as well as maintenance activities. Even though small maintenance activities are undertaken, parts and accessories are required to be transported from Hingna Depot. Washing is done for 20 to 25 buses every day between 10 pm to 4:30 pm. There is no proper shelter for Buses.

[45] Source: Reconnaissance Survey by UMTC, 2017
[46] Source: Reconnaissance Survey by UMTC, 2017

FIGURE 3-33: BUS TERMINALS AND DEPOTS IN NAGPUR – PATWARDHAN[47]

Figure 3-33 represents the existing condition of the Bus Depot at Patwardhan. Patwardhan Depot has an area of 3.5 acres. Patwardhan Depot is the major city bus depot, all the small and major maintenance activities in regard to the city buses are undertaken at this depot. Inspection Pits, Washing Bays, Repair Bays and Spare parts Store are all available only in Patwardhan Depot. There is no proper shade for Buses.

FIGURE 3-34: BUS TERMINALS AND DEPOTS IN NAGPUR – HINGNA[48]

Figure 3-34 represents the existing condition of the Bus Depot at Hingna. Hingna Depot has an area of 5 acres. Hingna Depot is the major city bus depot, all the small and major maintenance activities in regard to the city buses are undertaken at this depot. Inspection Pits, Washing Bays, Repair Bays and Spare parts Store are all available only in Hingna Depot.

It could be observed from the above that the civil infrastructure and equipment at the operational depots are outdated and are not enough to cater to the maintenance requirements of additional fleet. Lack of appropriate maintenance of buses have resulted in reduction of operational efficiency and reduced life of the vehicles. Post March 2017, the responsibility of the maintenance of the buses lies with the IBTM/Nagpur Municipal Corporation.

[47] Source: Reconnaissance Survey by UMTC, 2017
[48] Source: Reconnaissance Survey by UMTC, 2017

3.3.3. EXISTING INTELLIGENT TRANSPORT SYSTEMS (ITS)

Intelligent Transport Systems (ITS) are systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users and in traffic management and mobility management as well as interfaces with other modes of transport.Intelligent Transport Systems (ITS) help transit agencies increase safety, operational efficiency and quality of service. Advanced technologies are used to collect process and disseminate real time data from vehicles and roadway sensors. The data is transmitted through a dedicated communication network to a central processing system where the data is transformed into useful information for the operator, the driver, and the commuter.

As in case of Nagpur City, it has been observed that 230 buses procured by the previous operator (i.e, VNIL) did not have any ITS facilities; whereas the 240 buses procured by the Nagpur Municipal Corporation under the JnNURM scheme in 2009 has ITS facilities such as LED based public display system. However, the fare collection system on the City Bus Services is through an electronic ticketing and vending machines (ETVM's).

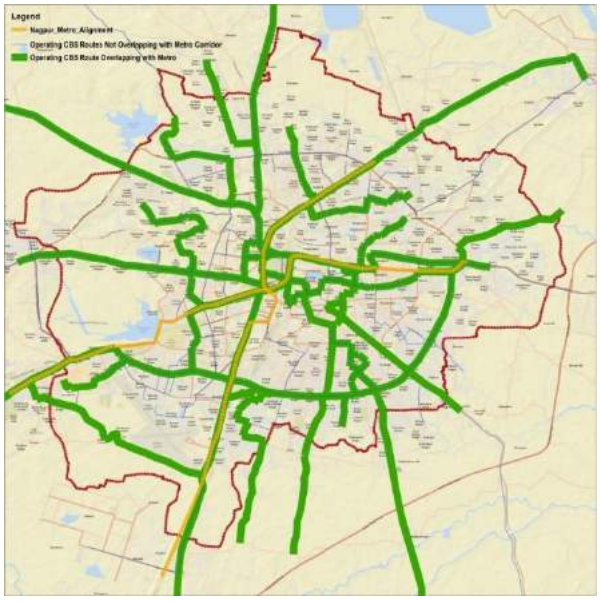
Currently, NMC is retaining 237 existing buses and operators are required to procure additional 195 Midi and Mini buses to maintain a fleet of 487 buses, all of which is anticipated to be equipped with GPS-GPRS, LED based public display system, mobile DVR based surveillance with cameras for vehicles and operation and control management applications. As part of the up gradation program of city bus services in Nagpur, NMC envisages to deploy ETVM's, LED display boards at the bus shelters, pass centers, mobile app etc. in Phase 1 and Wi-Fi routers, validators, ticket dispensers etc. in Phase II.

3.4. NEED FOR CITY BUS ROUTE RATIONALIZATION

The traditional system of the public transport route network planning is the destination oriented one, in which several origin and destination points are connected through services, where a commuter waits for a particular service that would take him/her directly to his destination without transfers en-route. These services tend to operate at a lesser frequency and passengers have to wait for a longer period. The alternative approach is direction oriented services, such as the trunk and feeder services or hybrid systems, which operate at a higher frequency. With the escalation of the mass transit projects such as the Metro, BRTS, LRTS, Monorail etc. there is a need to plan for the modification of the existing public transport routes by way of expanding the influence of the trunk corridors, ensuring affordable, efficient and comfortable system to the residents of Nagpur City.

As discussed in the previous sections, the city bus services are operated by Nagpur Municipal Corporation with a daily ridership of 98,611, with an average trip length of 7.5 kms, adding upto 7.39 lakh passenger kilometers. Figure 3-35 represents the existing operational city bus routes in Nagpur city.

FIGURE 3-35: OVERLAP OF OPERATIONAL CITY BUS ROUTES WITH THE METRO CORRIDORS



Considering the initiation of metro rail operations in the near future, it is essential that the public transport services are coordinated to better match the demand and to minimize the wasteful competition and duplication of services. To maintain and ensure healthy competition among service operators, the system needs to respond to the changes in the transport environment. It has been observed that 29 routes overlap over the proposed metro corridor which accounts for the 66% of the total city bus services operating within Nagpur city (refer to Figure 3-35).

It is evident that in the future years with the operations of Metro, some portion of the existing public transport demand shall shift to metro. Hence, methods to minimize the impacts of the mode shift into metro on city bus for the base year as well as horizon years needs to be looked into.

Rationalization is a process of making something seem consistent with or based on certain reasons, criterial and scientific and systematic organization. The concept of rationalization can also be defined as a structured process to increase the effectiveness with a maximum use of resources. Rationalization in terms of road infrastructure or systems can be achieved through various ways - by establishing hierarchy of routes, optimize bus stops locations, proper integration of motorized and non- motorized transport etc.

The city bus services provide connectivity between the major activity centers within the region, covering approximately 75 % of the city's road network.

City bus services in Nagpur are operated by the Nagpur Municipal Corporation (NMC), which accounts for 9 buses per lakh population within the Nagpur City, which is extremely lower when compared to the other cities with similar population size.

It has been observed from the Comprehensive Mobility Plan of Nagpur City and the other previous studies that the modal share of public transport in Nagpur is ranging between 8 to 10%. As per the desirable modal split in the Indian cities as defined by the MoUD, GoI, for a city with 20 to 50 lakhs of population should ideally have a modal share in the range of 60-70%.

City bus services in Nagpur are "Destination Oriented Services or Direct Services", leading to less no. of buses per route (6 to 7 buses per route) & decreased frequencies (average 30 mins), at some cases even 2 buses per route.

The aim of performing route rationalization is to maintain healthy competition among service providers and to ensure commuter choice. City bus transport play an important role, their role is particularly prominent in areas not conveniently served by railways. Against this general background, from time to time there is a need to rationalize bus services in response to the changes in the transport environment. The detailed methodology adopted for City Bus Route Rationalization is discussed in Chapter 5.

3.5. SUMMMARY OF OBSERVATIONS

Based on the site reconnaissance and review of the previous studies and the data collected from NMC and primary surveys, it could be observed that Nagpur is well placed in terms of the transport infrastructure, yet there is lot to be planned and implemented with respect to the improvement in the modal share of the public transport in Nagpur. While analysing the existing transportation system, socio-economic structure and travel characteristics of the city, a few observations have been made which are described as under;

- There has been a continuous increase in the private vehicles in the Nagpur City, which has been growing at 4.98% per annum i.e; the vehicular growth is found to be 2X times the population growth in the city. It has also been observed that 10% of the public transport passenger trips are catered by less than 1% of the public transport vehicles on road.
- Currently, the bus services are operating from the 4 bus depots namely; Teka Naka, Zero Mile, Patwardhan and Hingna. Considering all the depots, the total land area available is approximately 11 acres. Based on the site visit and discussions with the authorities, it has been observed that all the depot sites have day & night parking, repairing and maintenance facilities, spare parts & inventory management and washing facilities, however it needs to be noted that the existing facilities are outdated and need an urgent upgradation considering the shift from non-renewable sources of fuel to renewable sources of fuel for the operations of city bus services in the Nagpur city.
- The availability of on road buses per lakh population works out to be 9 buses, which is extremely lower when compared to the other cities with similar population size. If the entire fleet of 487 buses were to be operated on road, the no. of buses per lakh population works out to be more than 20. Since the operational efficiency of city bus operations in Nagpur is that of 54%, which is low.

- The city bus services provide connectivity between the major activity centers within the region, covering approximately 75% of the city's road network.
- Due to the lack of the adequate support infrastructure and convenience to the public, it is observed that there is low public transport share within the city. Bus Q Shelters/Stops in Nagpur city are constructed and maintained by Nagpur Municipal Corporation. Scheduled Bus stops are located at every 650 mts to 700 m. However only 190 bus Q Shelters are constructed and maintained by NMC, majority of which are located on the footpaths, without any definitive footpath space and many of which are in neglected conditions.
- It has been observed from the Comprehensive Mobility Plan of Nagpur City and the other previous studies that the modal share of public transport in Nagpur is ranging between 8 to 10%. As per the desirable modal split in the Indian cities as defined by the MoUD, GoI, for a city with 20 to 50 lakhs of population should ideally have a modal share of Public Transport to be in the range of 60-70%. The city administration will have to be working hard to achieve the target.
- Currently, Fare collection is through ETVM's and few buses have LED based public display boards in the buses, which need to be upgraded considering the technological advancements in the direction of public transport operations.
- With the metro operations, some portion of the existing public transport demand shall shift to metro. As a method to mitigate the impact of the Metro operations on City Bus Services, Route Rationalization of City Bus Services is recommended considering the base year and future year demand for Bus Services.

CHAPTER 4 NON-MOTORISED TRANSPORT CHARACTERISTICS

4.1. MAJOR TRANSPORTATION NODES & ACTIVITY CENTERS

Nagpur is well connected by road, rail and air transport system. The nearest airport is the Dr. Babasaheb Ambedkar International Airport located in Sonegaon, Nagpur. Nagpur is the divisional headquarters of the Central Railways and South Central Railway Zones of the Indian Railways. There are 6 railway stations within the Nagpur Municipal Corporation. As mentioned Maharashtra State Road Transport Corporation (MSRTC) operates the Inter City, Intra State and Inter State operations are operated from the ST Bus Stand, Ganeshpeth, whereas the city bus services are operated by Nagpur Mahanagar Parivahan Limited majorly from the Mor Bhawan Bus Terminal. Figure 4-1 represents the major transportation zones within the City.

FIGURE 4-1: MAJOR TRANSPORTATION NODES IN NAGPUR CITY

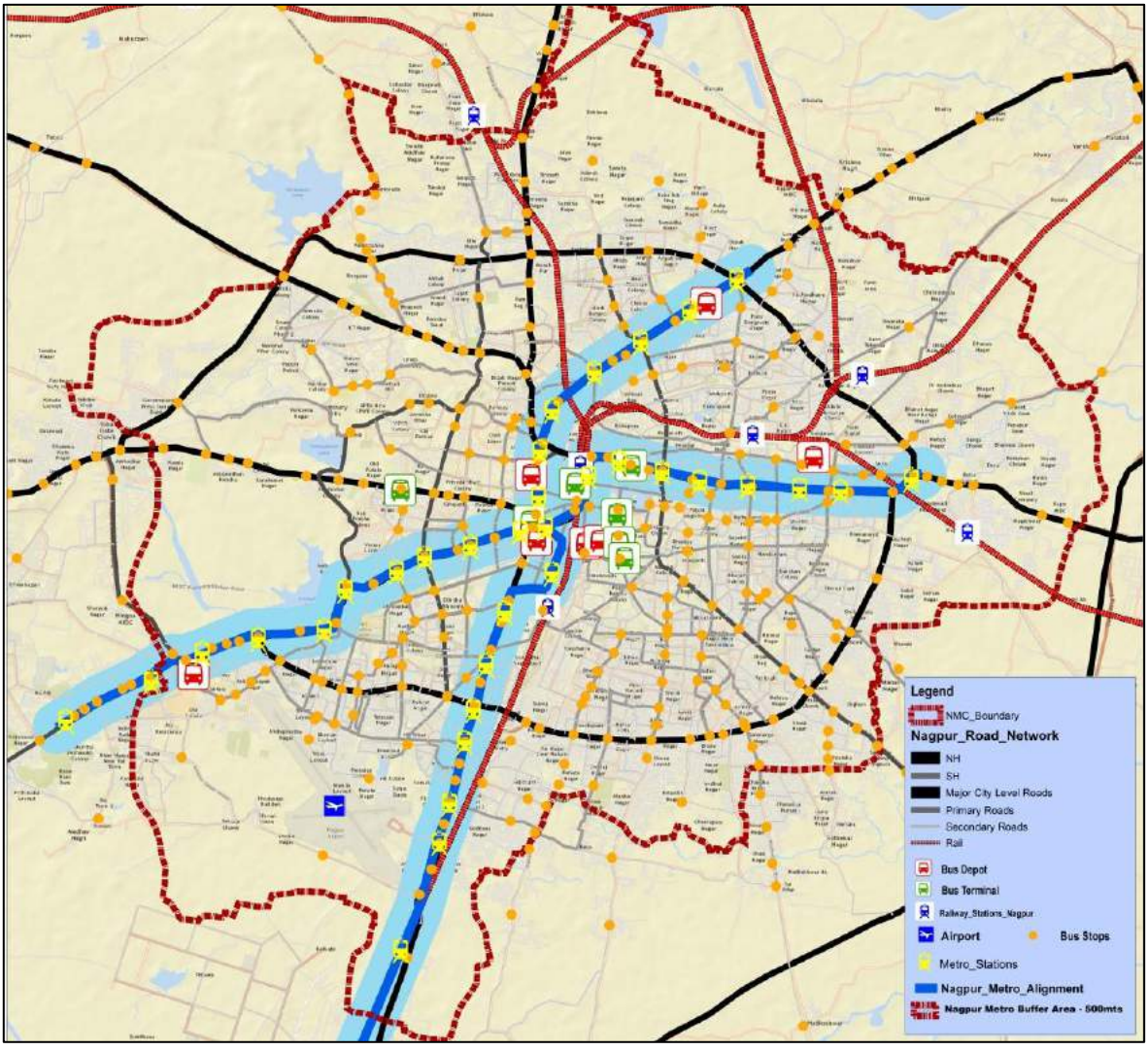
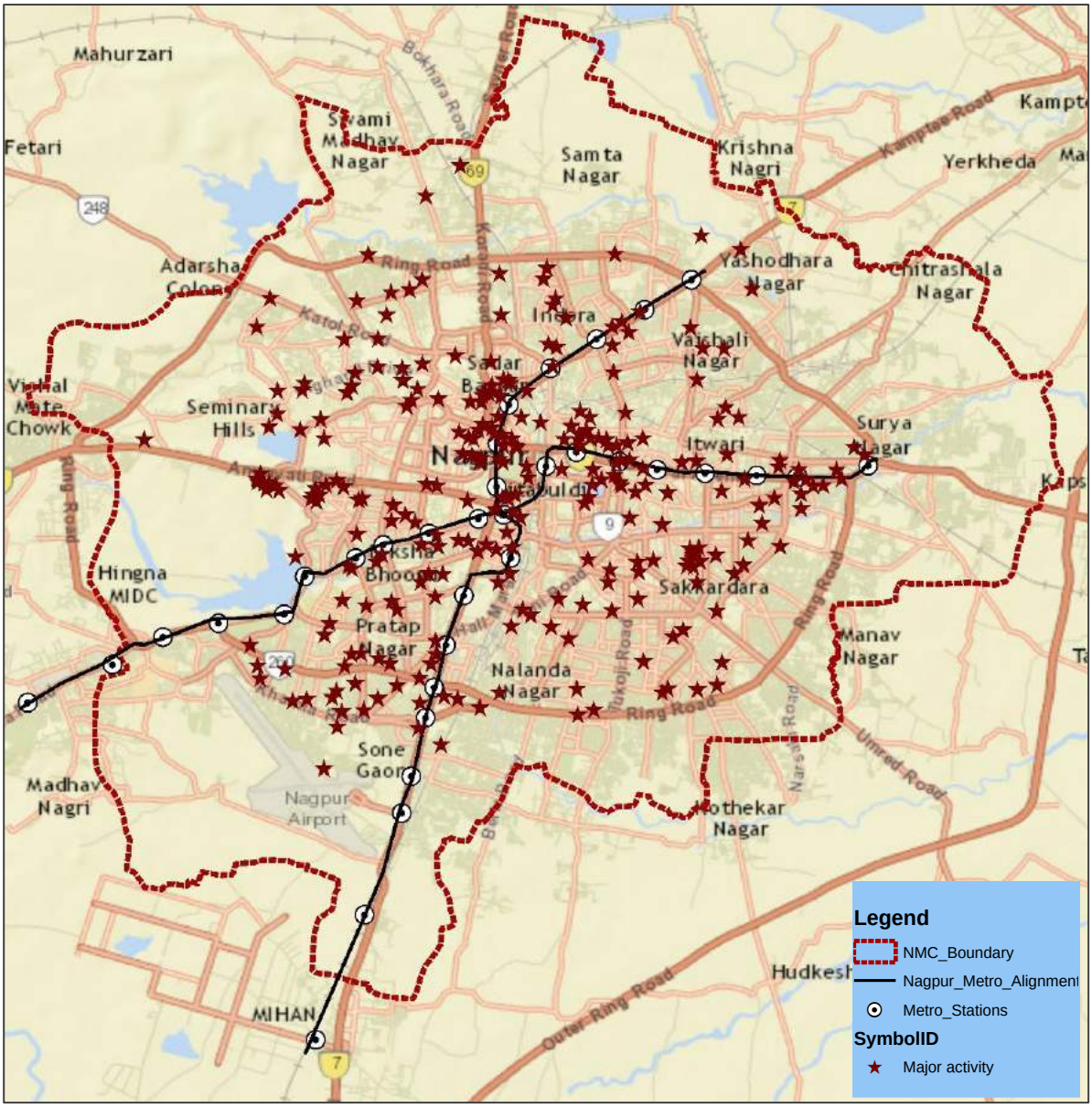


Figure 4-2 represents major activity centres in Nagpur City which includes Institutions, Hospitals, Places of worship, parks and shopping malls.The city also contains a famous places of worship include the Jama Masjid-Mominpura, Bohri Jamatkhana-Itwari, (dargah) of Hazrat Baba Tajuddin, many south Indian temples in Nagpur like Sarveshwara Devalayam, the most famous temple in Nagpur is Tekdi Ganesh Mandir.

FIGURE 4-2: MAJOR ACTIVITY CENTERS IN NAGPUR (PARKS, INSTITUTIONS, WORSHIP CENTERS, HOSPITALS)



4.2. TRAFFIC DATA ANALYSIS

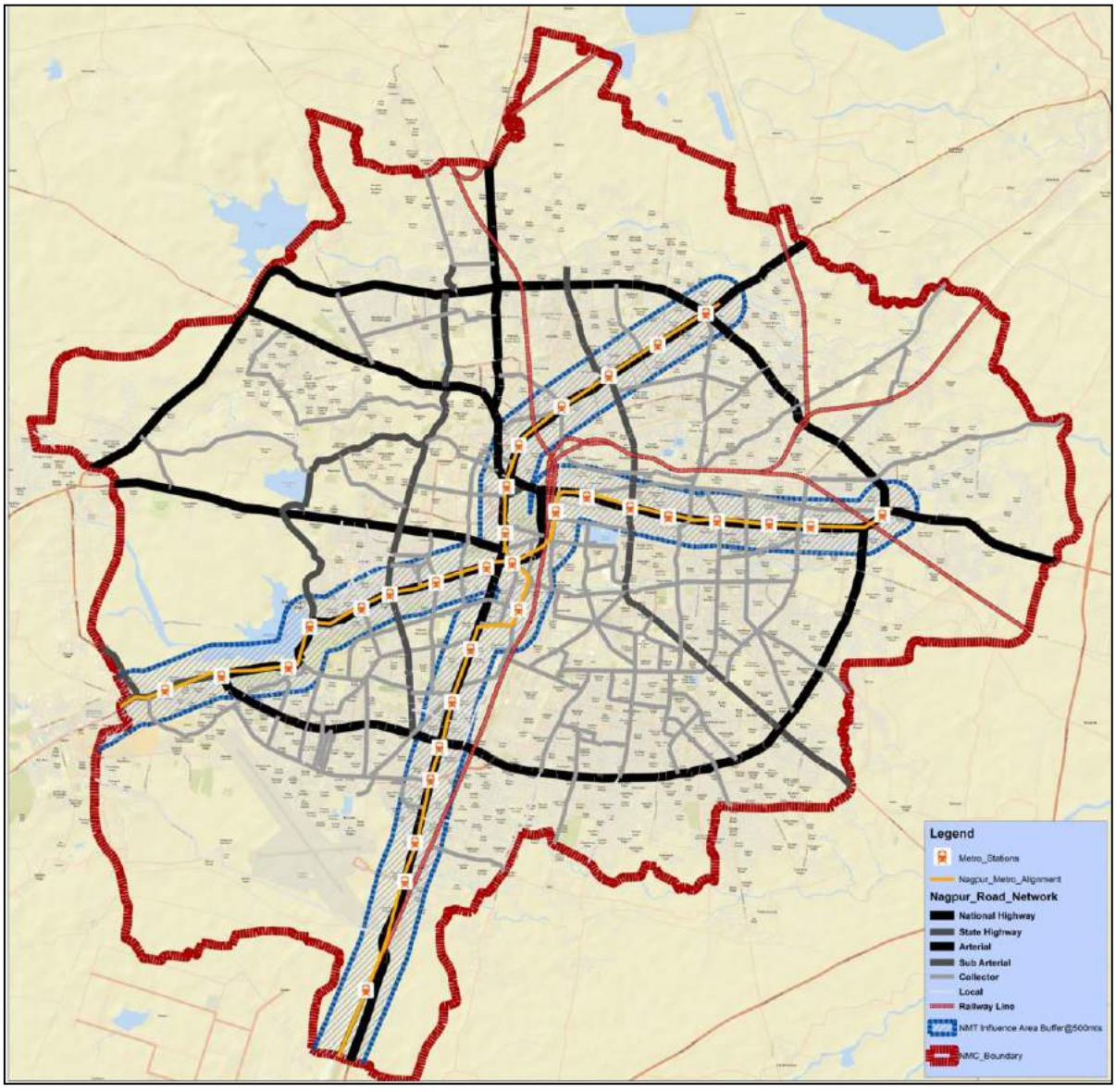
A combination of primary surveys and collection, compilation and analysis of secondary data was undertaken to integrate traffic and transport system and to predict travel patterns of bicyclists and pedestrians. This section describes the outcomes of surveys undertaken for the purpose.

4.2.1. ROAD NETWORK INVENTORY

4.2.1.1. HIERARCHY OF ROADS

- Road network density within the project area is 17.9 km of road per sq. km (of project area) and is higher than the international benchmark of 10 km of roads per Sq km[1]
- 10% of the total landuse used as road-network and is as per the benchmark set by URDPFI Guidelines of 10 – 12%.

FIGURE 4-3: DISTRIBUTION OF ROADS WITHIN THE STUDY AREA W.R.T THE HIERARCHY



4.2.1.2. RIGHT OF WAY

- 63% of the surveyed roads have RoW of more than 16 m (Refer Figure 4-4) and can accommodate dedicated footpaths and cycle tracks as per the traffic standards and requirements.

[1] UMTC Analysis - 2017

FIGURE 4-4: DISTRIBUTION OF ROADS WITHIN THE STUDY AREA W.R.T ROW

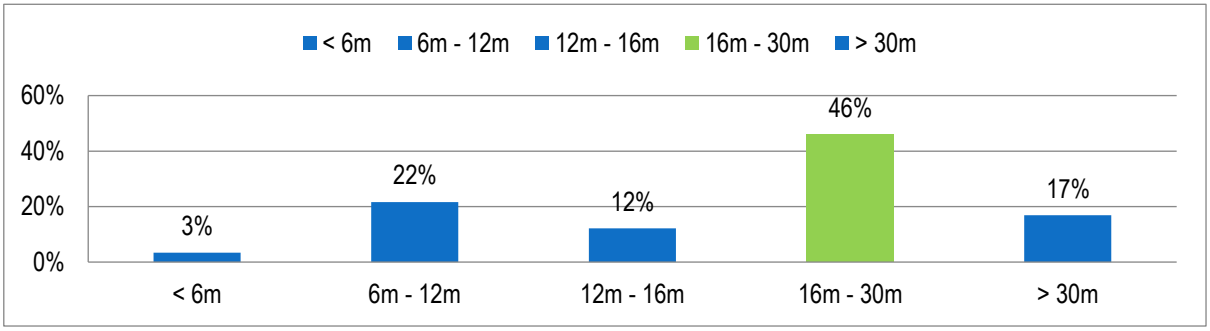
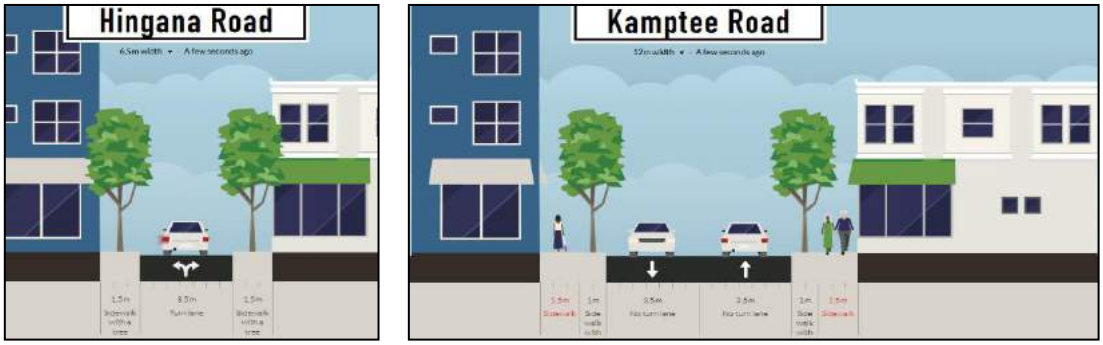
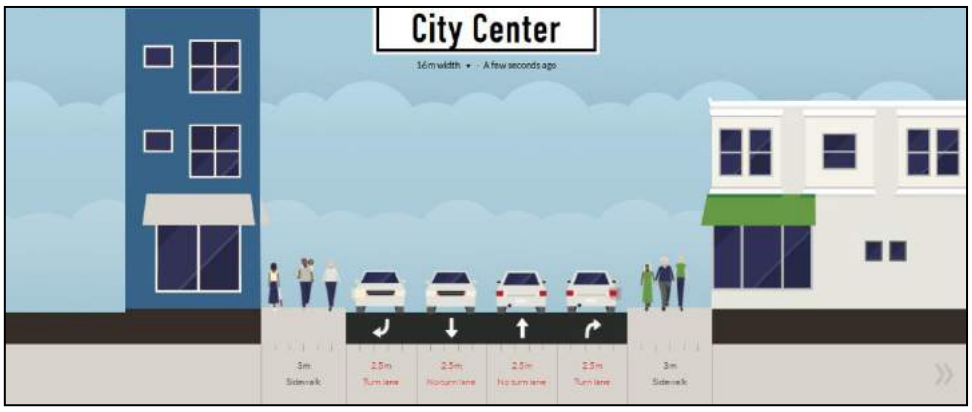


FIGURE 4-5: CATEGORY OF ROADS WITHIN THE STUDY AREA BASED ON AVAILABLE ROW

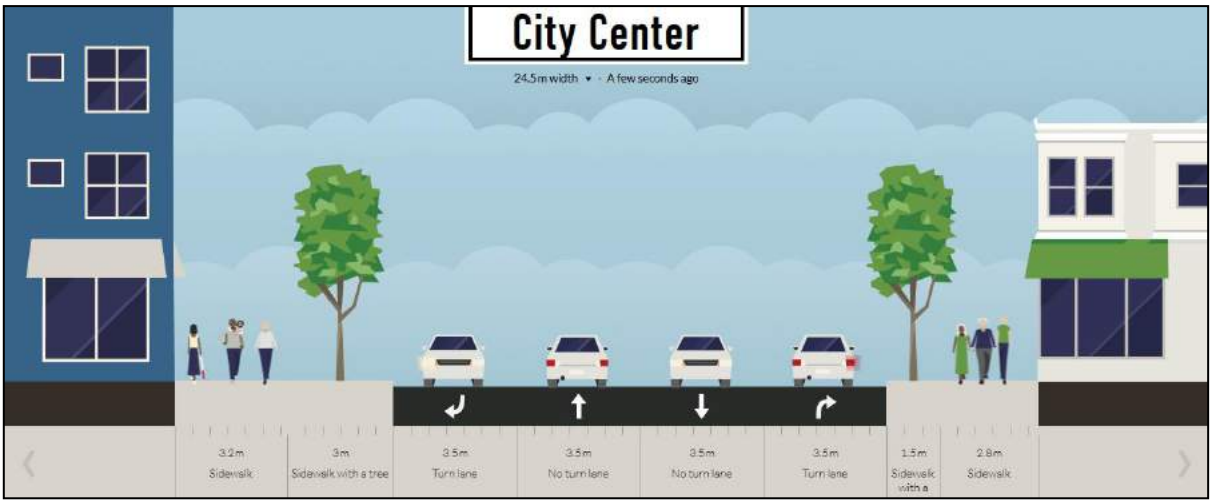


Road Cross Section of 6.5 M Road along Hingna Road (Left), Road Cross Section of 12 M Road along Kamptee Road (Right)

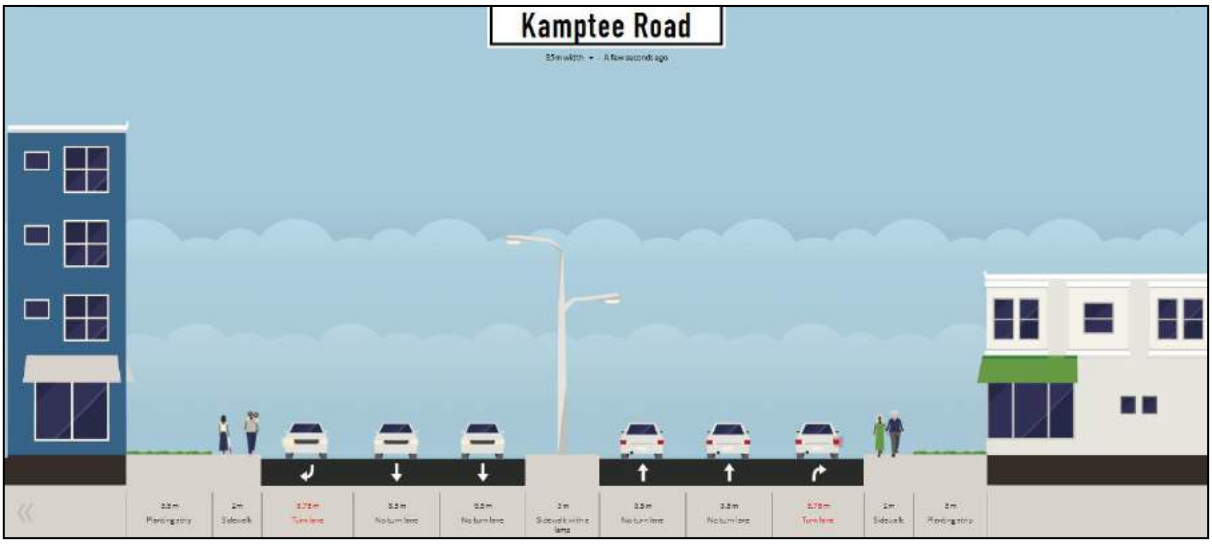


Road Cross Section of 16 M Road along City Center

Road Cross Section of 18.60 M Road along Airport Road



Road Cross Section of 24.5 M Road along City Center



Road Cross Section of 35 M Road along Kamptee Road

4.2.1.3. AVAILABILITY OF FOOTPATHS

- 61% of the roads have footpath available.

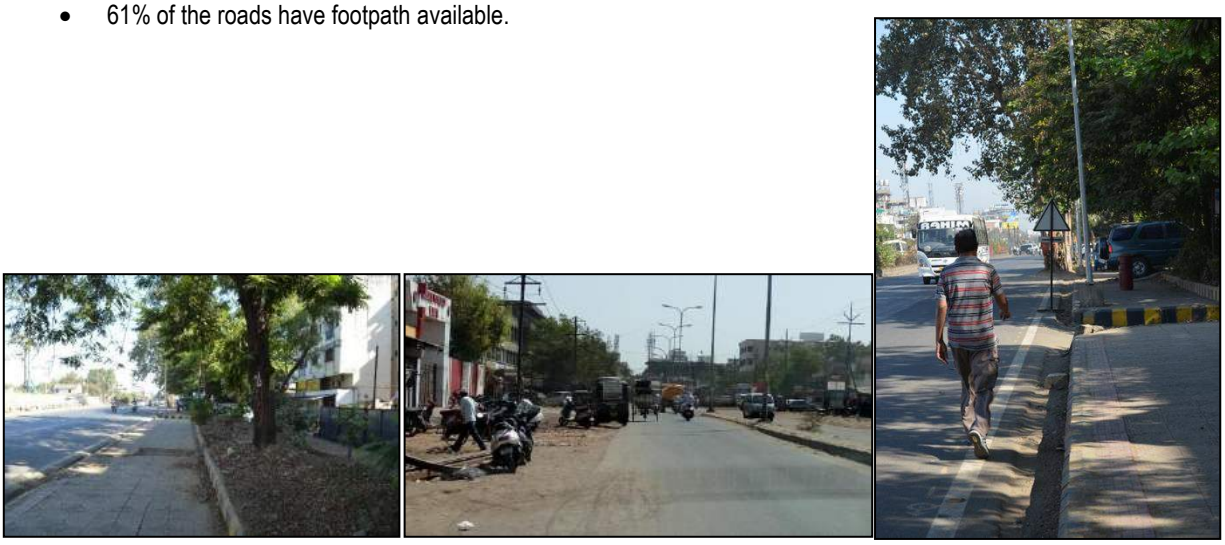
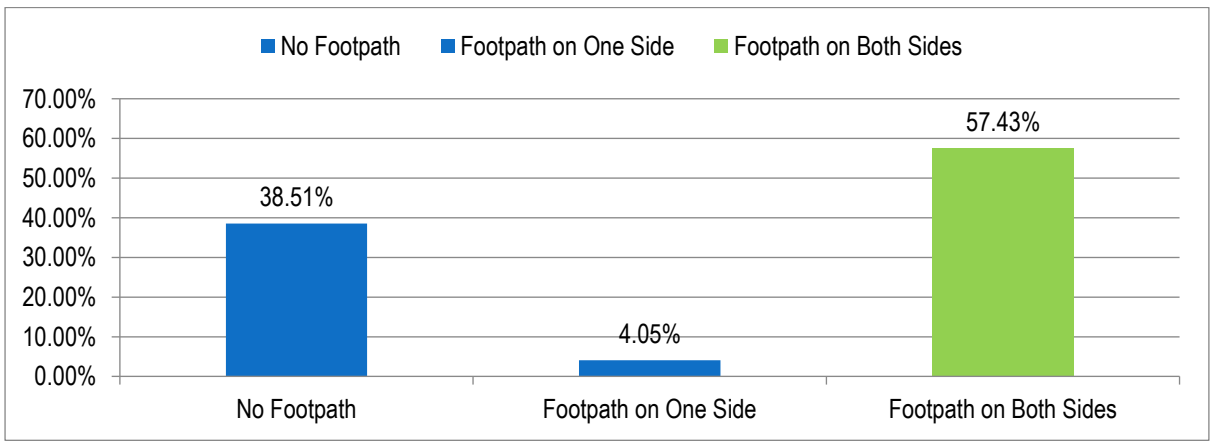


FIGURE 4-6: AVAILABILITY OF THE FOOTPATHS WITHIN THE PROJECT AREA.



4.2.1.4. USABLE FOOTPATH WIDTHS

- 57.43% of roads have usable footpaths on both sides of the roads, of which 43.24% have footpath more than 1.8 mts in width. These can accommodate two pedestrians walking shoulder to shoulder.
- 15.54% of roads have footpaths with less than 1.8 m wide.
- Approximately 38.51% of roads have no footpath (Refer to Table 4-1).

TABLE 4-1: AVAILABILITY OF USABLE FOOTPATHS WITHIN THE PROJECT AREA.

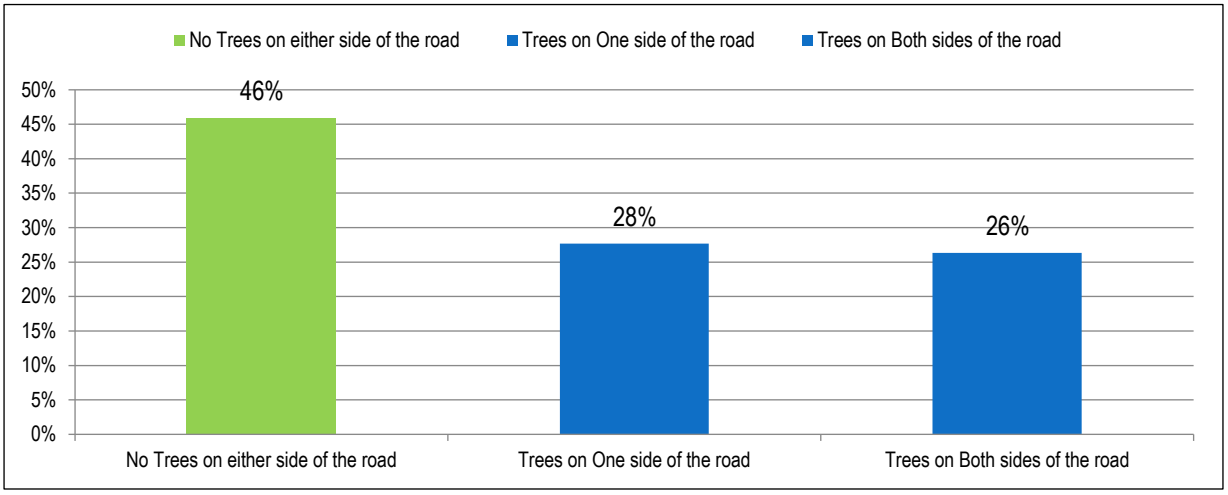
Row Labels	Footpath on Both Sides	Footpath on One Side	No Footpath	Grand Total
Less than 1.8 M	14.19%	1.35%	0.00%	15.54%
1.8 M to 2.5 M	29.05%	0.68%	0.00%	29.73%
Greater Than 2.5 M	14.19%	2.03%	0.00%	16.22%
No Footpath	0.00%	0.00%	38.51%	38.51%
Grand Total	57.43%	4.05%	38.51%	100.00%

4.2.1.5. AVAILABILITY OF UTILITY SERVICES[2] WITHIN THE ROAD SPACE

The following section describes the distribution of various utility services:

- About 54% of roads within the project area have fully grown trees within the road space.

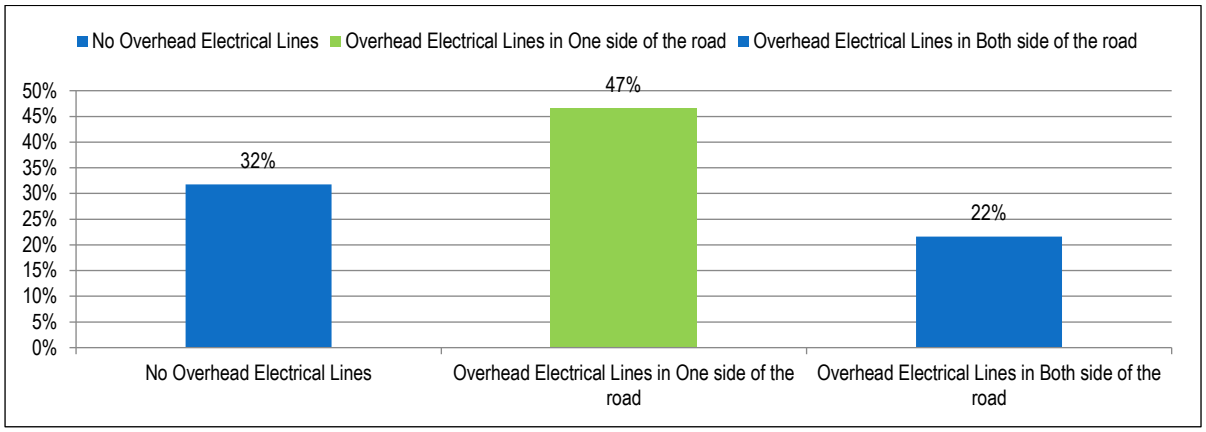
FIGURE 4-7: AVAILABILITY OF TREES WITHIN THE PROJECT AREA



[2] The street space is incomplete without the provision of basic utility services such as the trees for shade, street lights for adequate lighting during the night etc. However, there are other utility services such as the electric and telecommunication cables, which usually run through overhead cables; transformers and sub stations and storm water drains which runs under the footpaths which generally encroach upon the existing footpath spaces and indeed turning them into unusable spaces.

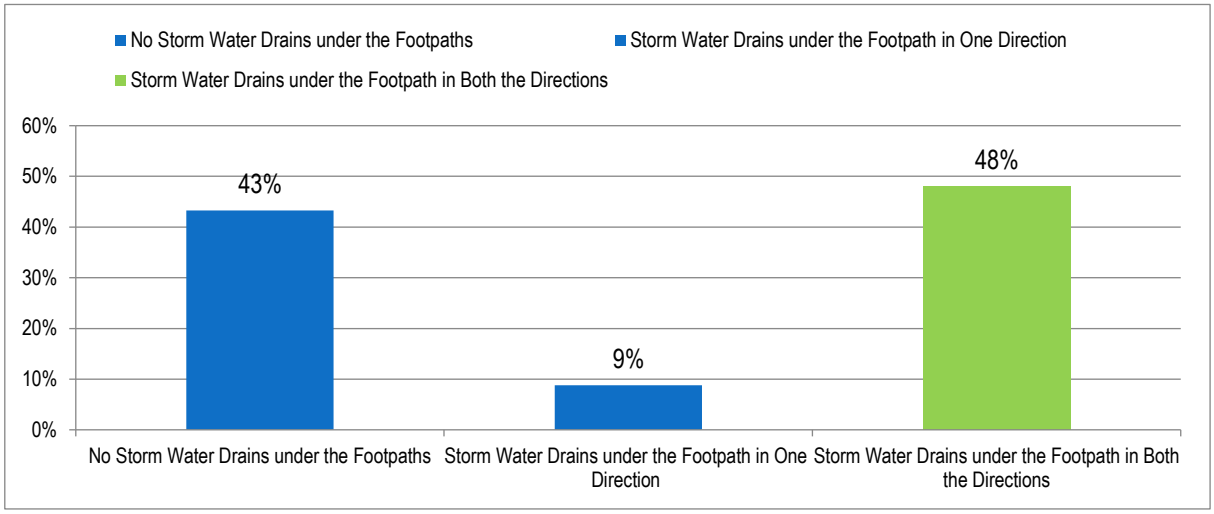
- 69% of streets i.e. 452.64 kms of the road lengths have overhead electrical lines running along its length

FIGURE 4-8: AVAILABILITY OF OVERHEAD ELECTRICAL LINES WITHIN THE PROJECT AREA



- 30% - 35% of the city's major road network had covered storm water drains running under it
- Primary surveys noted 48% of streets had storm water drains on either sides and under the footpaths.

FIGURE 4-9: AVAILABILITY OF STORM WATER DRAINS WITHIN THE PROJECT AREA

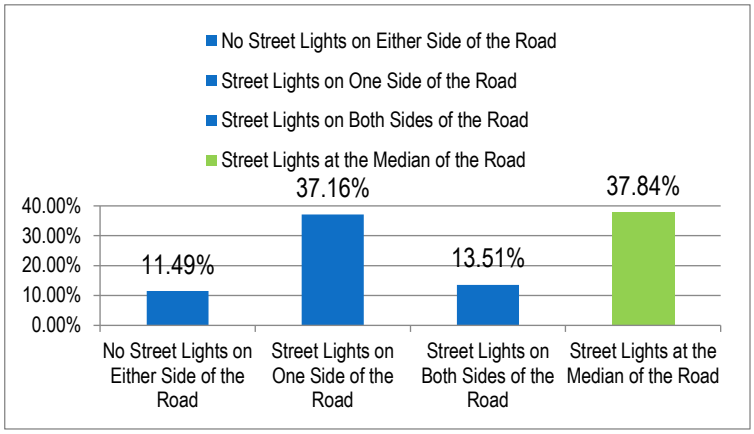


4.2.1.6. AVAILABILITY OF STREET LIGHTS WITHIN THE ROAD SPACE

Figure 4-10 represents the availability of the Street Lights within the Project Area.

- Approximately 89% of the streets have street-lights of which majority are located on the median
- 11.49% of the streets, especially local streets, do not have street lights

FIGURE 4-10: AVAILABILITY OF STREET LIGHTS WITHIN THE PROJECT AREA



- 55% of major and minor road are encroached mainly by illegal on street parking
- Till date, no observation has affirmed parking on footpaths

4.2.2. PEDESTRIAN AND CYCLIST COUNTS AND OD SURVEYS WITHIN THE STUDY AREA

The current mode share of Nagpur is 16% NMT trips (9.5% walk, 6.4% cycle)[3] which has seen drastic decline from 58% in 2008[4] to 25% in 2013[5]. The rapid decrease in NMT modal share is due to immediate profits derived from mechanized modes of travel. Urban sprawl and asymmetrical landuse and lack of dedicated infrastructure make NMT usage unviable. Further, studies also found that pedestrians and cyclists are the captive users and are most vulnerable, being exposed to fast moving traffic.

Hence, a number of traffic surveys were undertaken to develop a comprehensive database on pedestrian and cyclist composition at various locations. This section presents details of traffic volumes of pedestrians and cyclists:

4.2.2.1. PEDESTRIAN AND CYCLIST COUNTS

Detailed Analysis was undertaken to identify pedestrian and cyclist flow at identified locations and the summary is presented in Table 4-2 and Figure 4-11.

TABLE 4-2: PEDESTRIAN AND CYCLIST VOLUME COUNT SURVEY SUMMARY

Sl. No	Locations	Volume		Peak Hour		Peak Hour Volume		%age of Peak Hour Volume	
		Pedestrian	Cyclist	Pedestrian	Cyclist	Pedestrian	Cyclist	Pedestrian	Cyclist
1	PB 01*	2275	9544	11.15-12.15	10.15-11.15	296	1046	13.01%	10.96%
2	PB 02	3207	3676	12.30-13.30	10.15-11.15	272	368	8.48%	10.01%
3	PB 03	3142	4156	09.45-10.45	09.45-10.45	389	647	12.38%	15.57%
4	PB 04	3173	2935	16.45-17.45	17.00-18.00	297	259	9.36%	8.82%
5	PB 05	5897	8613	10.30-11.30	09.30-10.30	614	998	10.41%	11.59%
6	PB 06	8489	5045	15.00-16.00	09.15-10.15	793	396	9.34%	7.8%
7	PB 07	6460	5777	08.45-09.45	10.00-11.00	653	530	10.11%	9.17%
8	PB 08	2108	3028	18.45-19.45	09.30-10.30	236	246	11.20%	8.12%
9	PB 09	9199	13649	18.45-19.45	17.30-18.30	918	1298	9.98%	9.51%
10	PB 10	7148	9716	10.00-11.00	14.15-15.15	646	758	9.04%	7.80%

3 Detailed Project Report Nagpur Metro Phase II Corridors Feasibility Report – RITES - January 2017
4 Transportation Master Plan for Nagpur City – L and T Ramboll – 2008
5 Comprehensive Mobility Plan for Nagpur – UMTC - 2013

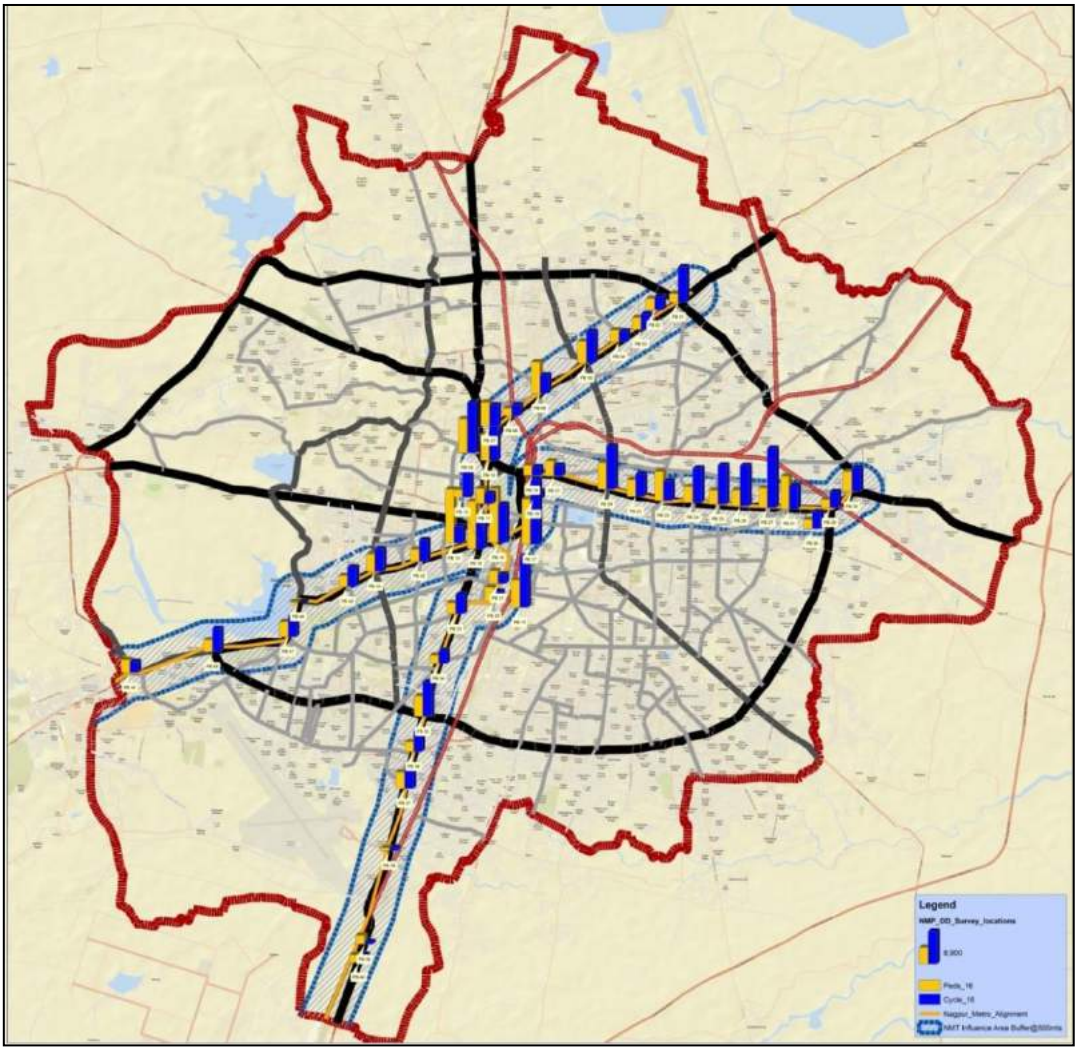
Sl. No	Locations	Volume		Peak Hour		Peak Hour Volume		%age of Peak Hour Volume	
		Pedestrian	Cyclist	Pedestrian	Cyclist	Pedestrian	Cyclist	Pedestrian	Cyclist
11	PB 11	4031	2785	11.45-12.45	17.45-18.45	356	291	8.83%	10.45%
12	PB 12*	1972	7904	19.15-20.15	10.30-11.30	197	664	9.99%	8.40%
13	PB 13	14577	4634	17.45-18.45	07.15-08.15	1291	423	8.86%	9.13%
14	PB 14	14613	10412	18.00-19.00	09.45-10.45	1392	824	9.53%	7.91%
15	PB 15	7457	13934	19.00-20.00	12.00-13.00	894	1211	11.99%	8.69%
16	PB 16	12890	8954	17.00-18.00	10.00-11.00	1355	751	10.51%	8.39%
17	PB 17	12317	17723	18.00-19.00	09.45-10.45	1212	1454	9.84%	8.20%
18	PB 18	4348	2282	12.00-13.00	12.00-13.00	393	215	9.04%	9.42%
19	PB 19	2737	2321	19.00-20.00	09.45-10.45	319	204	11.66%	8.79%
20	PB 20	7162	11789	08.45-09.45	11.45-12.45	712	1233	9.94%	10.46%
21	PB 21	4101	2944	17.30-18.30	15.30-16.30	356	268	8.68%	9.10%
22	PB 22	4565	6185	09.45-10.45	08.00-09.00	437	646	9.57%	10.44%
23	PB 23	7916	5409	13.45-14.45	15.45-16.45	758	445	9.58%	8.23%
24	PB 24	4315	9323	15.45-16.45	09.45-10.45	363	773	8.41%	8.29%
25	PB 25	3733	10524	17.00-18.00	09.45-10.45	349	1282	9.35%	12.18%
26	PB 26	4289	10958	19.00-20.00	11.15-12.15	504	922	11.75%	8.41%
27	PB 27	5307	16102	08.00-09.00	09.45-10.45	592	2047	11.16%	12.71%
28	PB 28	2467	4604	18.30-19.30	18.30-19.30	293	527	11.88%	11.45%
29	PB 29	2201	4321	14.15-15.15	09.15-10.15	192	432	8.72%	10.00%
30	PB 30	5375	6343	11.15-12.15	11.00-12.00	769	723	14.31%	11.40%
31	PB 31	3419	2510	12.30-13.30	18.45-19.45	285	216	8.34%	8.61%
32	PB 32	3768	2628	17.00-18.00	09.00-10.00	315	269	8.36%	10.24%
33	PB 33	3108	5285	11.30-12.30	13.00-14.00	319	451	10.26%	8.53%
34	PB 34	2275	3545	11.15-12.15	09.30-10.30	296	467	13.01%	13.17%

Sl. No	Locations	Volume		Peak Hour		Peak Hour Volume		%age of Peak Hour Volume	
		Pedestrian	Cyclist	Pedestrian	Cyclist	Pedestrian	Cyclist	Pedestrian	Cyclist
35	PB 35	5565	9422	18.30-19.30	18.00-19.00	862	1122	15.49%	11.91%
36	PB 36	2648	5512	18.15-19.15	18.15-19.15	338	569	12.76%	10.32%
37	PB 37	4416	6416	17.45-18.45	17.45-18.45	568	572	12.86%	8.92%
38	PB 38	781	853	09.15-10.15	09.15-10.15	113	93	14.47%	10.90%
39	PB 39	2482	837	20.15-21.15	07.15-08.15	223	80	8.98%	9.56%
40	PB 40	2041	2170	20.15-21.15	08.15-09.15	255	214	12.49%	9.86%
41	PB 41	1727	1402	06.00-07.00	06.00-07.00	247	203	14.30%	14.48%
42	PB 43	3208	5751	09.45-10.45	10.00-11.00	364	827	11.35%	14.38%
43	PB 44	4741	6132	17.15-18.15	17.45-18.45	460	571	9.70%	9.31%
44	PB 45	2960	5206	17.15-18.15	08.45-09.45	338	576	11.42%	11.06%
45	PB 47	4016	5518	18.15-19.15	09.30-10.30	440	600	10.96%	10.87%
46	PB 48	3205	6296	14.30-15.30	09.45-10.45	341	786	10.64%	12.48%
47	PB 49	3555	3092	18.00-19.00	18.00-19.00	386	339	10.86%	10.96%
48	PB 50	4518	4491	18.30-19.30	18.30-19.30	603	528	13.35%	11.76%
[6]49	PB 51	8870	6333	12.30-13.30	16.45-17.45	838	515	9.45%	8.13%

Table 4-2 represents the pedestrians and cyclist volume count summary on survey locations. It is observed that, maximum peak hour accounts for 15% of total pedestrian and cyclist volume at the identified locations. Maximum pedestrian and cyclists were noted in the CBD i.e. areas including LIC Chowk, Gaddigoddam, Sitabuldi, Zansi Rani Chowk, Cotton Market, Alankar Cinema, Agrasen Chowk etc.

*6 * At PB 01 – Pedestrians and Cyclists were not captured for one arm of the junction as it was closed for all types of traffic movements, where as in PB 12 – Cyclists were not captured on one arm of the junction as it was closed for vehicular movements.*

FIGURE 4-11: LOCATION WISE PEDESTRIAN AND CYCLIST VOLUME COUNTS FOR 16 HOURS

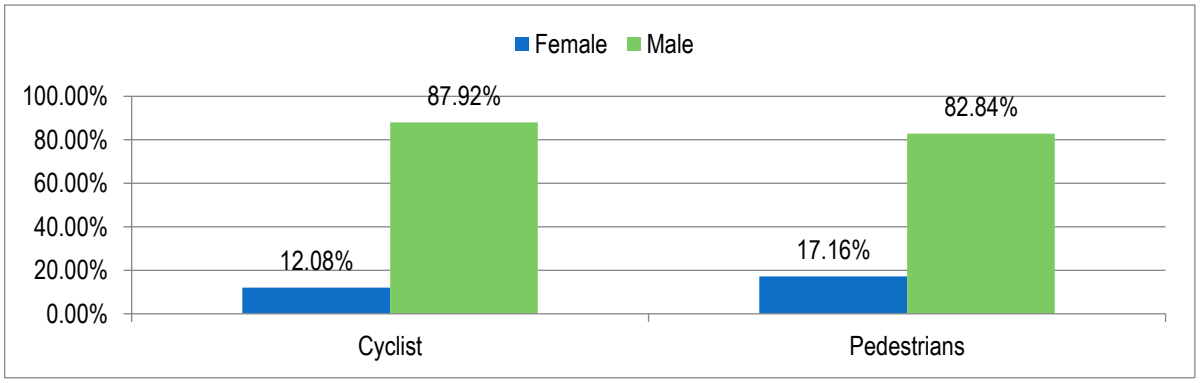


4.2.2.2. PEDESTRIAN AND CYCLIST ORIGIN AND DESTINATION SURVEY

Detailed Analysis was undertaken to profile the pedestrians and cyclists. The parameters considered were demographic characteristics, socio-economic profile and trip characteristics. The summary of findings is as follows:

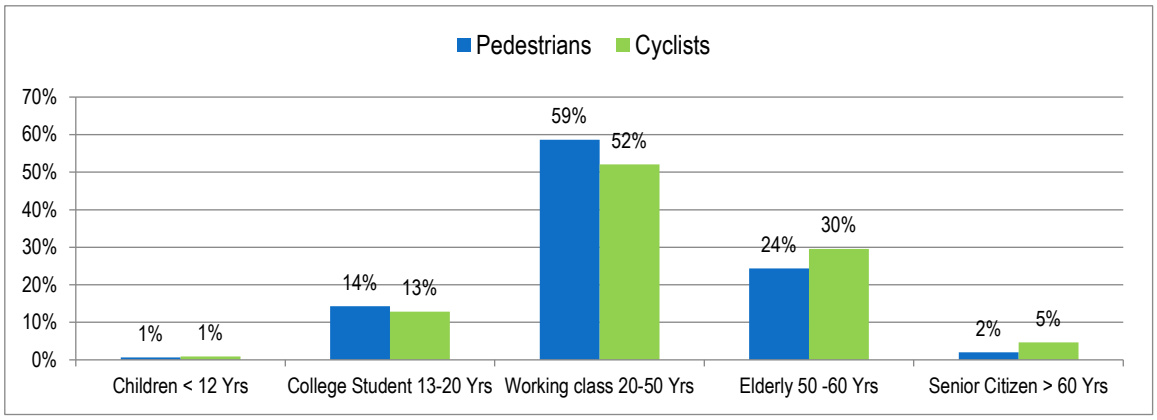
- **Gender Profile**: 87.92% of Cyclist and 82.84% Pedestrians are males. (Refer to Figure 4-12).

FIGURE 4-12: GENDER PROFILE OF CYCLISTS AND PEDESTRIANS IN THE PROJECT AREA



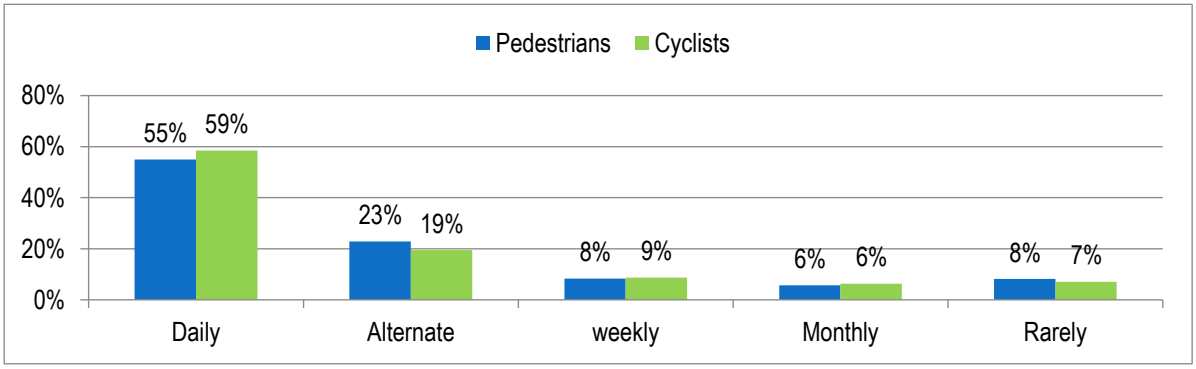
- **Age Profile**: 59% of Pedestrians and 52% Cyclists are between 20 -50 years whilst. 26% of Pedestrians and 35% of Cyclists are elderly people i.e. over 50 years.

FIGURE 4-13: AGE PROFILE OF CYCLISTS AND PEDESTRIANS IN THE PROJECT AREA



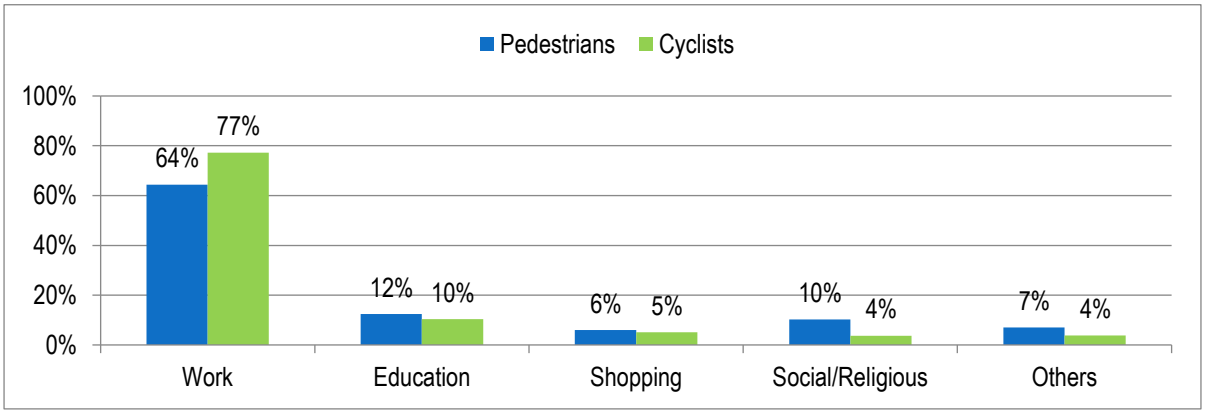
- **Trip Frequency:** 55% of the Pedestrians and 59% of the Cyclists perform their trips on a daily basis followed by alternate day (23% - Pedestrians & 19% - Cyclists).

FIGURE 4-14: TRIP FREQUENCY OF CYCLISTS AND PEDESTRIANS IN THE PROJECT AREA



- **Trip Purpose:** 64% and 12 % trips on foot are either for work or for education, respectively whereas 77% and 10% trips by cycle are either for work or for education, respectively.

FIGURE 4-15: TRIP PURPOSE OF CYCLISTS AND PEDESTRIANS IN THE PROJECT AREA



- **Trip Distance**: The average trip length of Walk Trips was observed to be1.79 km, whereas the average trip length of Cycle trips is observed to be 3.03 km.

4.2.2.3. NMT OPINION SURVEY AND WILLINGNESS TO SHIFT TOWARDS NON-MOTORIZED MODES OF TRANSPORT

According to opinion survey, 100% of the pedestrian and cyclists expressed their willingness to shift to walking or cycling if provided with adequate infrastructure and safety measures as without it cycling or walking is difficult. Parameters related to safety were identified as most critical to enable a shift to walking and/ or cycling. This was followed by comfort and reduction in travel time.

4.3. SWOT ANALYSIS

The SWOT analysis forms the summary of the critical findings from the primary surveys and secondary data analysis to establish need of NMT infrastructure/services and identify areas of intervention.

TABLE 4-3: SWOT ANALYSIS FOR THE PROJECT AREA

Aspects of Analysis	Strength	Weakness	Opportunities	Threats
Mobility	• ATL is 7.6 km (including walking) where for Pedestrians and Cyclists the count is1.79 km and 3.03 km respectively. • 50% of these are short trips (below 5 km). • Short trips by motorized modes of transport for first mile and last mile connectivity can be substituted by NMT	• City has an organized City Bus Service operated by NMC on a PPP basis. However, currently out of the 183 notified City bus routes only 38routes are operational. • Intermediate Public transport such as Auto, Shared Auto and E-Rickshaws are mostly semi-organized. • In the absence of a full-fledged city bus services and regulated IPT services, the first mile and end mile connectivity is not met by any organized transport system	• Nagpur metro services may enhance mass transit facilities by increasing possibilities to walk and cycle to public transport hubs. • initiatives are also taken under Smart City Mission • initiatives are taken by NMC to encourage use of bus/ electric vehicles, etc.	• Lack of implementation of the approved Parking Policy resulting in encroachment.
Geographical Setting, Environment and land form	• Wide roads, available green and open spaces, Presence of water bodies and commercial spaces have potential to encouragewalking and use of public spaces.	• Nagpur has a tropical savannah climate[7] with dry conditions prevailing most of the year. Summers are extremely hot wherein the temperatures rise as high as 48 °C. • Considering the above, the city frequently witnesses heat wave which	• Flat topography of the city renders large part of Nagpur accessible through walking and cycling. • Mixed Landuse character along major roads provide opportunity to improve NMT facilities	• Due to the unplanned Sewerage, Storm Water Drains and faulty design of the roads, usually leads to the Overflows and water logging of sewer network under carriage wat affect affecting walking

[7]Indian Meteorological Department.

Aspects of Analysis	Strength	Weakness	Opportunities	Threats
		adversely affects the walking and cycling conditions in the city especially during the summer months from March to July.		and cyclingduring monsoon. • Passage of unregulated traffic results in congestion, especially during the rainy season.
Urban Pattern (including street network)	• Nagpur has a defined ring radial pattern of road network with defined road hierarchy. • The Primary road network in the study area have footpath widths ranging between 1.2m to 1.8 m predominantly free from encroachments. • Mixed land use in major parts of the city may encourage walking for daily needs	• Within the project area 25% of streets have RoW less than 12 m. and are devoid of have footpaths. • Difference in planning in eastern and western parts of the city creates missing links and inhibitsinconsistent connectivity across it. • The railway line also truncate seamless connectivity through walking and cycling.	• Proposed metro corridor could change the structure of transit facilities and provide opportunityfor operating NMT servicesto provide end mile connectivity. • The Transit Oriented Development Policy of India requires state of the art NMT facilities to meet its aim.	
Physical Infrastructure		• Water logging due to the improper planning in the sewerage, storm water drainage and faulty road designs during monsoon season compromise pedestrians and cyclists movements within the city. • Street Lighting is adequately available on the primary network, however the secondary and tertiary road network connecting the various residential areas in the city are devoid of any street lights, which have raised serious safety and security issues for pedestrian and cyclists.		

CHAPTER 5 DEMAND ASSESSMENT

5.1. INTRODUCTION

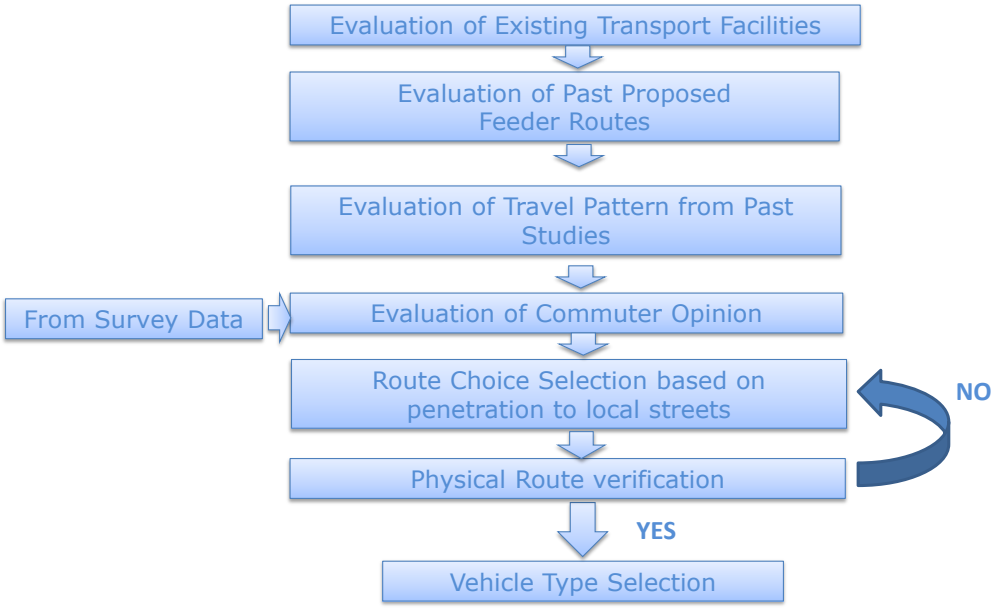
Chapter 3 and Chapter 4 discussed about the issues and concerns related to traffic and transportation system and public transportation system in Nagpur city. It has been discussed in the previous chapters, due to the lack of appropriate physical infrastructure for maintenance as well as the technology for transparency of the services, the current system would not sustain the demands of the metro feeder and new/additional fleet of City Bus Services. Hence, it is important to analyse the public transport demand (metro feeder & city bus services) across the city. Based on the demand analysed for the metro feeder services and city bus services, the modifications with regard to the routing pattern to help improve the catchment area is discussed in the following Chapter. This chapter of the report describes the travel pattern of the metro feeder users, city bus service users and NMT for Nagpur city.

5.2. DEMAND ASSESSMENT FOR METRO FEEDER SERVICES

5.2.1 APPROACH

The recently completed CMP and CDP study has been considered as base documents for utilizing the existing information for planning, designing and evaluation of feeder services. So the approach and methodology has been devised in a fashion where it would make a maximum utilization of existing data and any other secondary information available pertaining to the study area. The study identifies the Transport Pattern from past studies and defines potential feeder services that would enhance the connectivity to the Metro system. The approach adopted for the feeder route identification is presented in figure.

FIGURE 5-1: APPROACH FLOWCHART FOR METRO FEEDER SERVICE PLANNING



5.2.2 METHODOLOGY

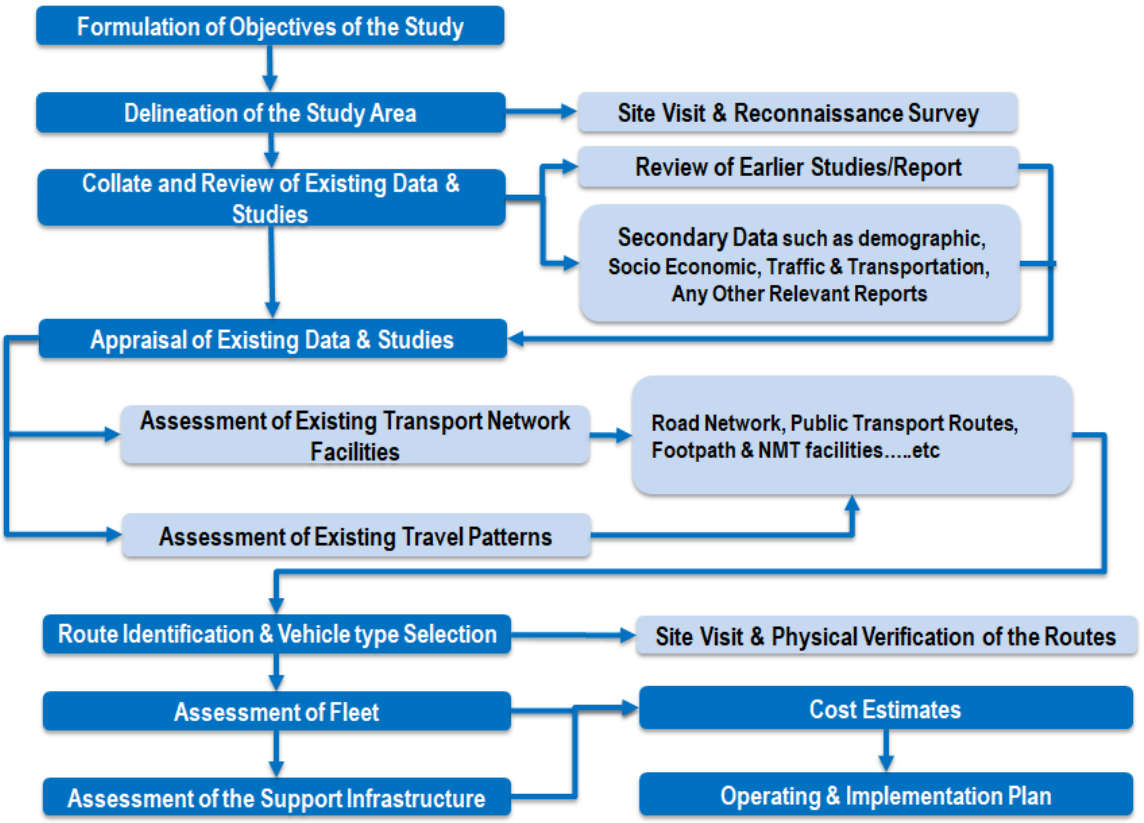
The Feeder system of a metro network shouldn't be limited only to the mass transit system such as buses. Here the objective is to provide connectivity to the metro stations by all the existing modes available. So the factors considered for route choice of the feeder system are mentioned below:

- The number of trips generated from a zone is a direct influence of its population and employment potential;

- Boarding, Alighting of each station is a critical acclamation of the station usage which is in turn governed by zones and the accessibility;
- Increase in the spread of the routes would result in greater coverage of the catchment area.

The detailed methodology which has been adopted for the current study is presented in the figure Figure 5-2.

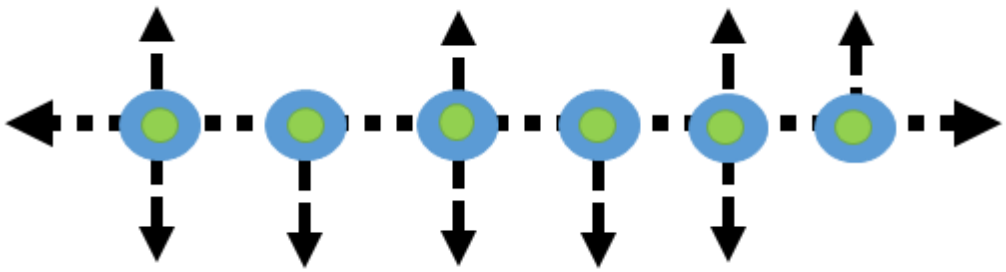
FIGURE 5-2: DETAILED METHODOLOGY



5.2.3 EVALUATION OF ROUTES

Feeder routes for the Nagpur Metro Rail System has been identified based on “Trunk and Feeder Concept”. The Trunk route here is the proposed MRTS and the feeder routes shall be aligned along the cross-section of the trunk routes to improve the accessibility of the users to the metro station. The figure below shows the typical concept of the trunk and feeder system.

FIGURE 5-3: TRUNK AND FEEDER CONCEPT FOR THE METRO SYSTEM



The methodology adopted for the identification of the routes based on the Trunk and Feeder Concept (Figure) is explained below:

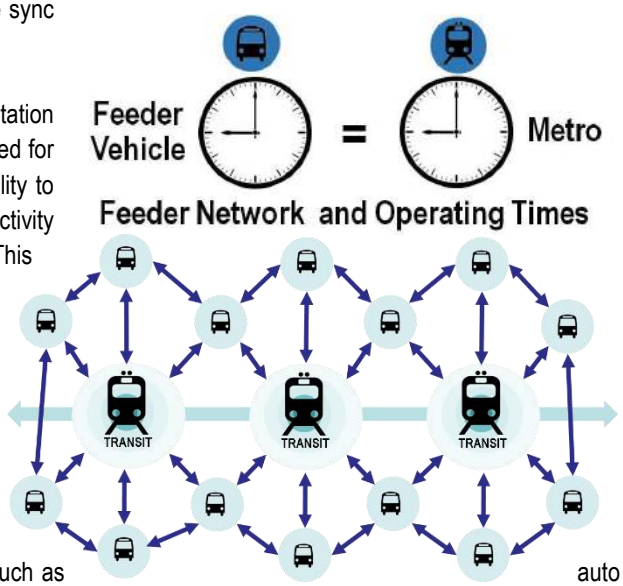
- Previous Feeder DPR has been thoroughly reviewed for the proposed study to understand the routing pattern and the zones covered by the proposed feeder system.
- Each of these routes have been critically analyzed and alternate route analysis has been done to ensure wider accessibility for the commuters and to reduce the walking distance to the metro station.
- To evaluate the zonal impact the Production Attraction values of each zone has been considered in route choice evaluation. The Production and Attraction values are the trips which are generated or attracted towards any particular zone respectively. These values are the effective indication of population and employment of any zone.
- In addition to the considerations of population-employment data, boarding-alighting data of each of the metro station shall also be reviewed to understand the demand of the feeder system.
- The distance covered by the feeder routes will have to be kept optimal since smaller routes tend to have a limited catchment area and may not be operationally feasible. On the other hand the longer route lengths for feeder is also not desirable as they tend to deviate from the scheduled frequency and may not synchronize with the metro train schedules.
- In addition to the above considerations a detailed review of the alternate feeder systems shall be carried out which shall vary from 8 seater to 32 seater and appropriate system shall be proposed for each of the routes identified.

5.2.4 TYPICAL CHARACTERISTICS OF A FEEDER SERVICES

The following section describes the general characteristics of the feeder systems in an urban setting;

a. **Route Lengths:** The Feeder Services ideally serves short distances, which serves typically 4 to 6 km.

b. **Frequency:** The Feeder services shall ideally operate 5 to 10 min. The frequency and efficiency of the feeder system can be best maintained when the frequencies are sync with mass transit system.



c. **Connectivity:** The mass transit system has a limitation in terms of its network, as the systems are designed for the trunk corridors. Feeder system has the flexibility to connect commercial, residential nodes and major activity destinations to the mass transit stations or CBD's. This system typically works as a Hub and Spoke Model, encouraging diversification of the routes and larger coverage.

d. **Number of Transfers:** For the feeder services, the users tend to transfer from the transit system to the alternate modes to reach the destinations.

e. **First/Last Mile connectivity:** Feeder services act as the first mile and last mile connectivity to the transit stations. No. of options are available such as auto rickshaws, bus services, shared auto/taxi services etc.

f. **Influence Area:** Since the trunk system cannot reach the internal residential areas, feeder services extends the trunk corridor's area of influence, connecting the major residential, commercial, and other activity centers to the trunk corridor.

g. **Vehicle Type:** The vehicle type generally varies from the trunk mode. As in case of India there are multiple modes available such as shuttle buses, mini vans, battery operated electric vehicles etc.

h. **Operations**: The feeder system operates amongst mixed traffic without priority infrastructure or space.

i. **Bus Stops:** Typically the feeder stops are generally spaced within the walking distance of each 300 to 400mts are ideally considered to be appropriate for feeder services.

5.2.5 CRITERIA FOR FEEDER ROUTE IDENTIFICATION

The identification of the feeder routes has been ascertained under conditions. The influence area considered for the current study has been reduced to 2.5 Km on either side of the metro station. This is due to the fact that the feeder system and city bus services are expected to run in co-ordination to complement the metro rail. Hence the feeder is mainly aimed to run for shorter distances with higher frequency which will be in sync with the metro. The criteria considered for the same is presented in table below:

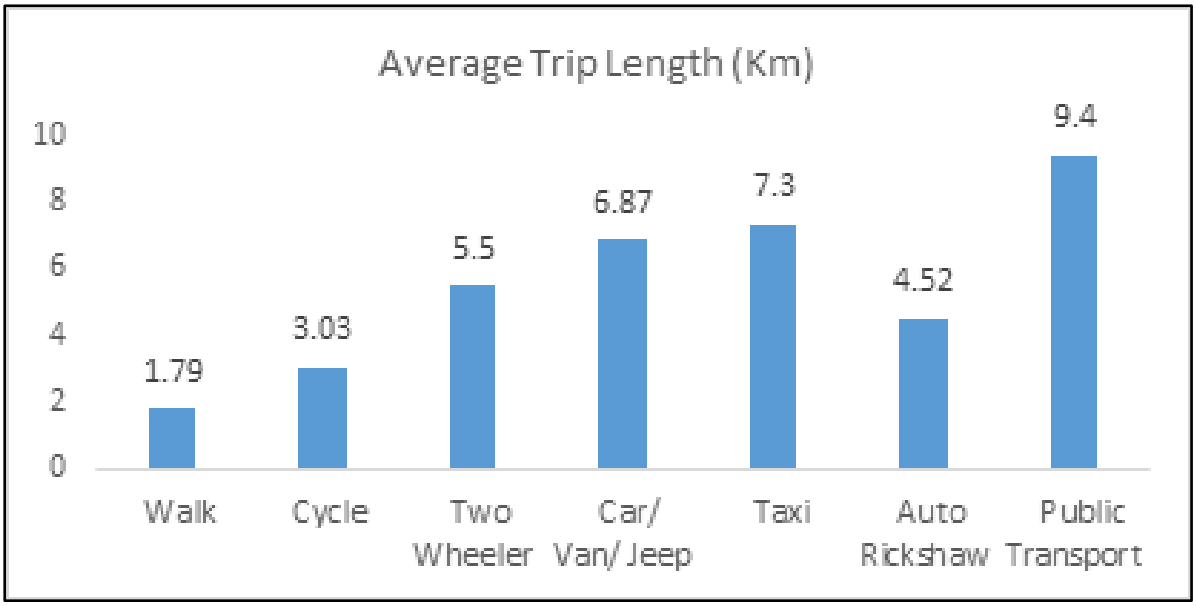
TABLE 5-1: CRITERIA FOR SELECTION OF FEEDER ROUTES

Characteristics	Criteria Considered for Feeder Services
Influence Area	Influence Area – 2.5 kms on either side of the metro corridor
Route Length (km)	Short Distances (Avg. 4 - 6 kms)
Service Frequency (mins)	Frequency to be in sync with Metro 6 to 13 min
Connectivity	The feeder services are planned to connect Economic Activity Hubs, Commercial Zones and Residential nodes with Metro Stations.
Feeder Stops	At every 300-400 mts.
Vehicle Type	Energy efficient and environment friendly vehicles to reduce the impact on the environment

5.2.6 DATA ANALYSIS

To understand the travel pattern of the bus users, primary data has been collected. A review of past data has also been done to get a clear image of the public transport users of the city. The average trip length for Bus users is 9.4 Km when compared to Car at 6.87 km. The figure below shows the average trip length of various modes.

FIGURE 5-4: MODE-WISE AVERAGE TRIP LENGTH[1]



From the above chart it can be understood that most of the public transport users are long distance users, suggesting that most of the metro commuters will be contributed by Buses. In addition, it also suggests that a very comprehensive feeder system is required so as to provide access to those users from metro to/from their final destination. In addition, it has also been found that the average monthly expenditure on transport is found to be Rs. 2500 which is on a higher side when compared to the average household income.

[1] *Source: Nagpur CMP-2013*

Most of the Bus users are further depending on the city Buses for their access or dispersal followed by autos and regional buses. This indicates that most of the bus users are undergoing one or more transfers to complete their journey. Even in the current transport system the commuters have to make at least one transfer to complete their trip. Hence, the introduction of feeder which requires at least one transfer between metro and feeder shall have minimal impact due to the number of transfers. On the other hand the feeder system is being designed to provide the last mile connectivity which connects to more core areas. This will further reduce the distance from the feeder stop to the ultimate destination of the users there by reducing their walk distance. Currently most of the users are depending on Auto Rickshaws for their last mile connectivity which also increases the total trip cost.

5.2.6.1. OPINION SURVEY

Apart from the above data opinion survey has also been conducted for the various PT and IPT users, to know their inclination towards the feeder system. From the data it has been estimated that 51% of the Bus users along the metro alignment were willing to use feeder system for their last mile connectivity.

FIGURE 5-5 BUS USERS WILLINGNESS TO USE FEEDER SERVICE

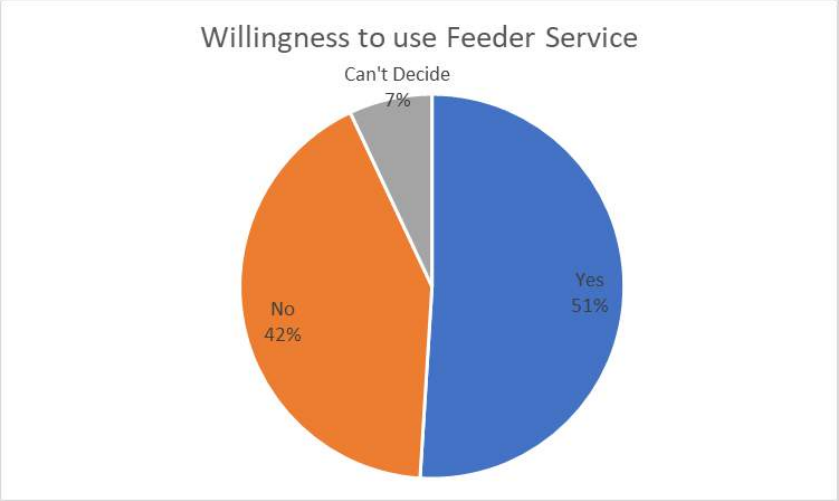
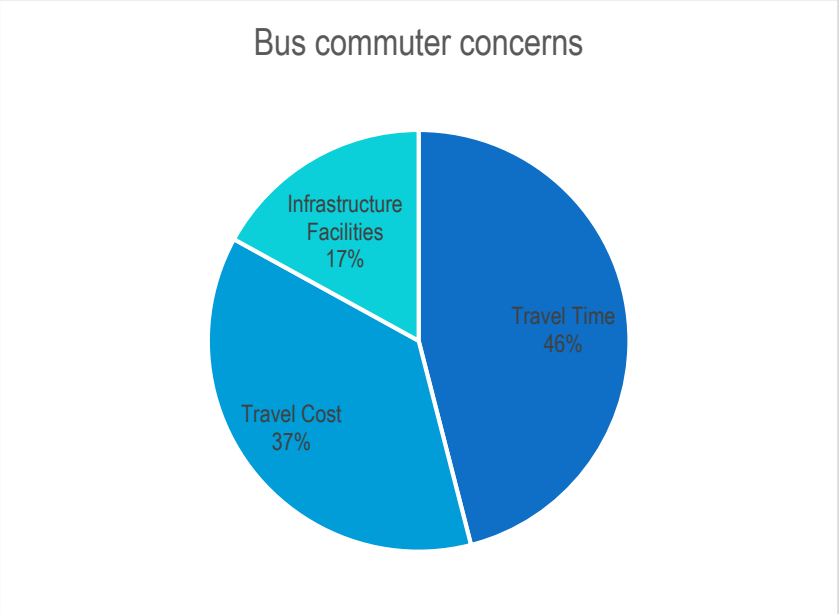
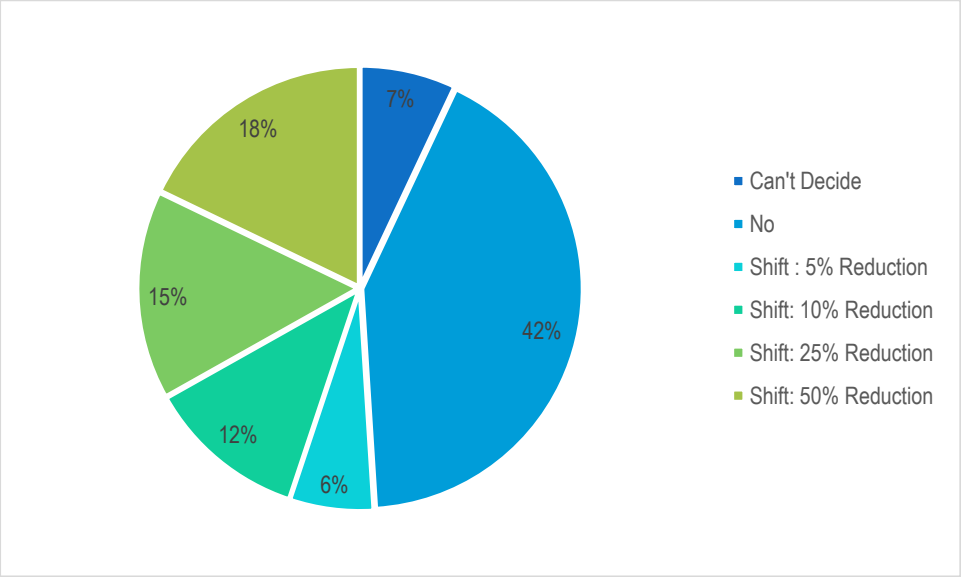


FIGURE 5-6 BUS USERS CONCERNS



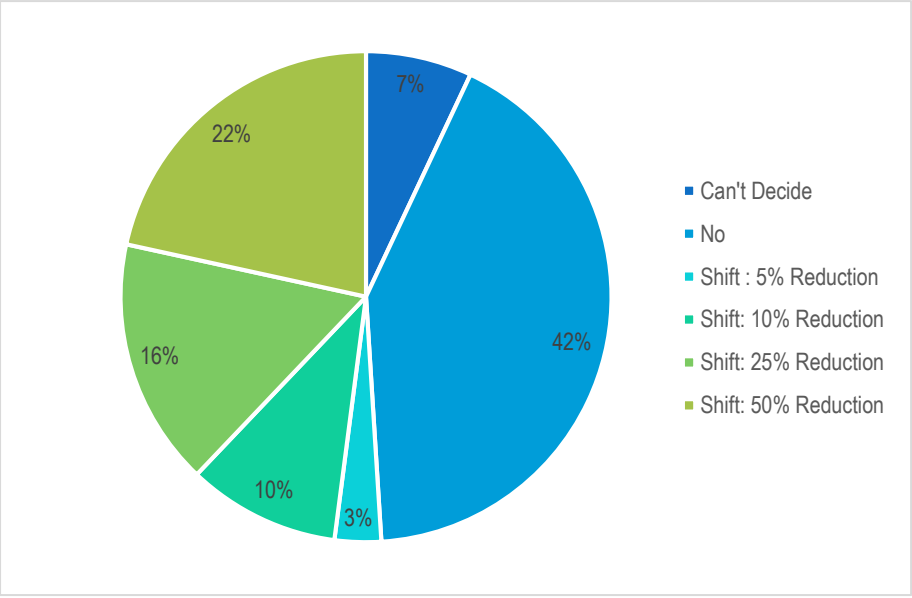
The primary concern is the walking distance from the feeder stop to the final destination and also the total travel cost. It was observed the commuters were willing to shift to feeder services if their access or egress time was reduced by at least 25%, which is 33% of the total samples surveyed.

FIGURE 5-7 BUS USERS WILLINGNESS TO USE FEEDER SERVICE W.R.T. ACCESS AND EGRESS TIME REDUCTIONS



Similarly, 22% of the commuters were willing to shift to feeder services if their total travel cost reduces by 50% and 16% with 25% reduction respectively.

FIGURE 5-8 BUS USERS WILLINGNESS TO USE FEEDER SERVICE W.R.T. TRAVEL COST REDUCTIONS



When coming to the walking distance, feeder routes are designed to penetrate to the core of the city hence covering most of the study area therefore reducing their walking distance which in turn reduces the cost as the commuter will not have to depend on other modes such as auto for their last mile connectivity.

Complementing the bus users, 63% of the IPT users are willing to shift to the feeder for their last mile connectivity which is a good sign as IPT users contribute to around 11% of the total mode share.

FIGURE 5-9 IPT USERS WILLINGNESS TO USE FEEDER SERVICE

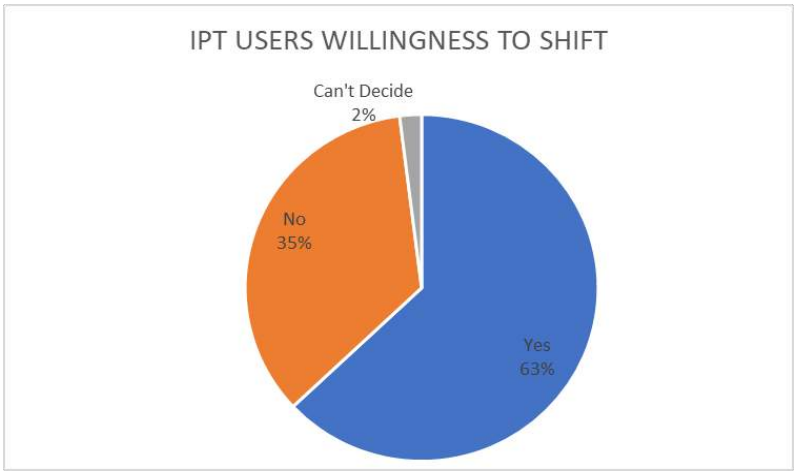
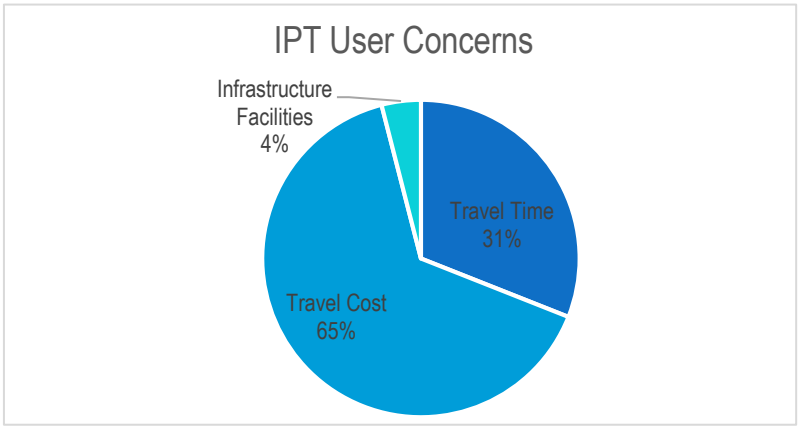


FIGURE 5-10 IPT USERS CONCERNS



The primary concerns of the IPT users are the total travel time and accessibility to the feeder stop. To address the issue of travel time the frequency of the feeder system shall be in synchronisation to the metro so as to reduce the waiting time. In addition, the feeder stops shall be located at every 300 meters which will reduce the effective last mile distance and provide better accessibility.

5.3. DEMAND ASSESSMENT FOR PUBLIC TRANSPORTATION

5.3.1. TRAVEL PATTERN

The travel demand modelling aims to establish the spatial distribution of travel explicitly by means of an appropriate system of zones. The base decisions include the choice of destination, the choice of the mode and choice of the routes.

Nagpur city has undertaken the detailed Comprehensive Mobility Plan as a vision document for next 20 years, which has been considered as the base for the current study. Year 2012 was considered as base year for this study and the base year trip matrices were developed using the data compiled from the household surveys, passenger information surveys and road side interview surveys. These have been validated with the counts observed on the links using the developed Travel Demand Model.

As part of the current study the base CMP travel demand model was extrapolated to the current year, which has been further utilized for estimation of the public transport ridership for the horizon years (i.e, 2018, 2023, and 2028). Some of the key findings are discussed in the following sections;

5.1.1.1. TRAVEL DEMAND

Under the sustainable development scenario for Nagpur, the Comprehensive Mobility Plan and Transit Oriented Development plan considered the future growth potential of the city along with the various improvement proposals such as;

1. Land use Transport Proposals
2. Public Transport Improvement Proposals
3. NMT Improvement Proposals
4. Freight Management Proposals
5. Parking Improvement Proposals
6. Traffic Engineering and Management Proposals

It has been anticipated that with the projects identified as part of the CMP and TOD study for Nagpur city will help achieve sustainable development goals by means of reducing private mode share, emission levels and travel time. It has been anticipated that with the implementation of the identified proposals in the CMP and TOD study the share of public transport shall increase from 10% to 15% by 2032.

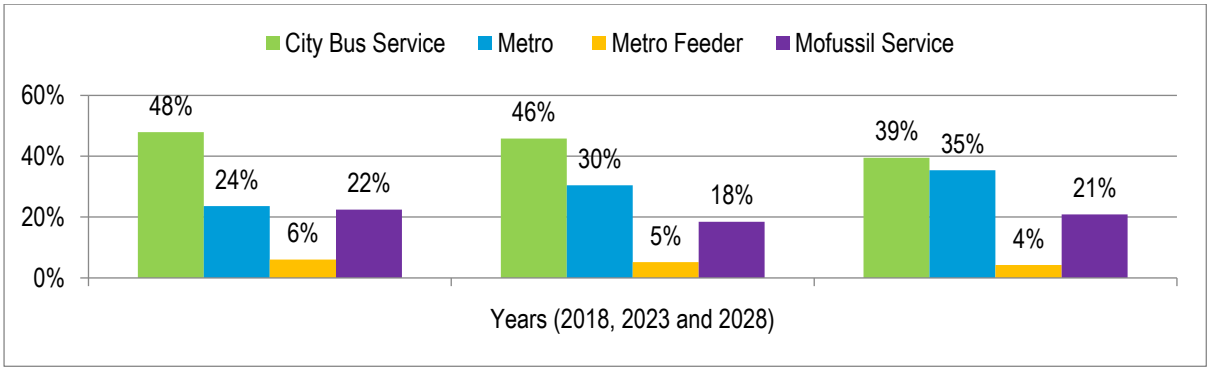
As mentioned above, the CMP/TOD study travel demand model was extrapolated to the current year based on the forecasted population, employment, various planned and proposed developments[2] within the city.

There are two major factors that determine the mode share, firstly the availability of the vehicles/vehicle ownership and secondly the improvements to the public transport systems. Currently, in Nagpur Maha Metro intends to operate the Metro in the near future along with the introduction of the Metro Feeder Services, whereas NMC intends to augment and rationalize the operations of the city bus services. The summary of the outcome are mentioned in Table 5-2.The share of City Bus Services, Metro, Metro Feeder and Mofussil Services in the overall public transport share is represented in the Figure 5-12.

TABLE 5-2: PUBLIC TRANSPORT DEMAND IN HORIZON YEARS

Year	2017	2018	2023	2028
Population	25,65,609	25,93,281	27,36,186	28,86,966
Peak Hour All Trips	3,44,048	3,47,759	3,66,923	3,87,142
Peak Hour Public Transport[3] Trips	34,405	34,776	48,801	65,040
Public Transport Share	10%	10%	13.3%	16.8%

FIGURE 5-11: DISTRIBUTION OF PUBLIC TRANSPORT TRIPS (X-AXIS UNIT/YEAR)



[2]A planned and proposed development includes the identified proposals identified as part of the Comprehensive Mobility Plan for Nagpur city and Strategic Transit Oriented Development Plan for the Nagpur City.
[3] Public Transport for the current scenario consists of Metro – North South and East West Alignments, Metro Feeder, City Bus Services and Mofussil Routes.

It could be observed from the Table 5-2 and Figure 5-12, the share of public transport would increase from 10% in 2017 to 16.8% by 2028, whereas in both CMP and TOD studies have anticipated that the public transport share shall maximum increase to 15% under the sustainable scenario and introduction of TOD concepts within the influence area of metro corridors.

The travel demand by the public transport has been assigned on to the public transport network for the base year and horizon years i.e 2018, 2023, 2028. The peak hour demand for the public transport services has been estimated at 34,776 trips in the 2018, which is expected to increase to 48,801 trips in 2023 and 65,040 trips in 2028. The share of Bus trips in the total public transport trips is expected to be 48% in 2018, 46% in 2023 and 39% in 2028. It could also be observed that, with the operation of Metro system in Nagpur, the share of city bus services in the overall public transport trips will reduce and city bus services shall be complementing with metro services for passengers.

Table 5-3 represents the comparison of the average trip lengths for the base year and horizon years. It could be observed from table that the average trip length of public transport shall increase from 6.3 km in 2018 to 8.7 km in 2028, this is because with the augmentation and rationalization of the public transport system in Nagpur city. The long distance trips previously made by private modes shall be made partially made through public transport modes. Additionally, the coverage as well as the availability of the alternate modes of public transport for day to day travel requirements of Nagpur city will also be increased.

TABLE 5-3: COMPARISION OF AVERAGE TRIP LENGTHS FOR THE BASE YEAR AND HORIZON YEARS

Modes	Base Year 2017	ATL (in km) 2018	2023	2028
2 Wheeler	5.86	7.4	7.8	7.9
Car		9.1	9.8	9.9
Auto	9.10	5.6	5.5	5.3
PT		6.3	7.9	8.7

Figure 5-12 to Figure 5-14 represents the spatial distribution of peak hour public transport trips within the Nagpur city for the horizon years.

FIGURE 5-12: SPATIAL DISTRIBUTION OF THE PEAK HOUR PUBLIC TRANSPORT TRIPS – 2018

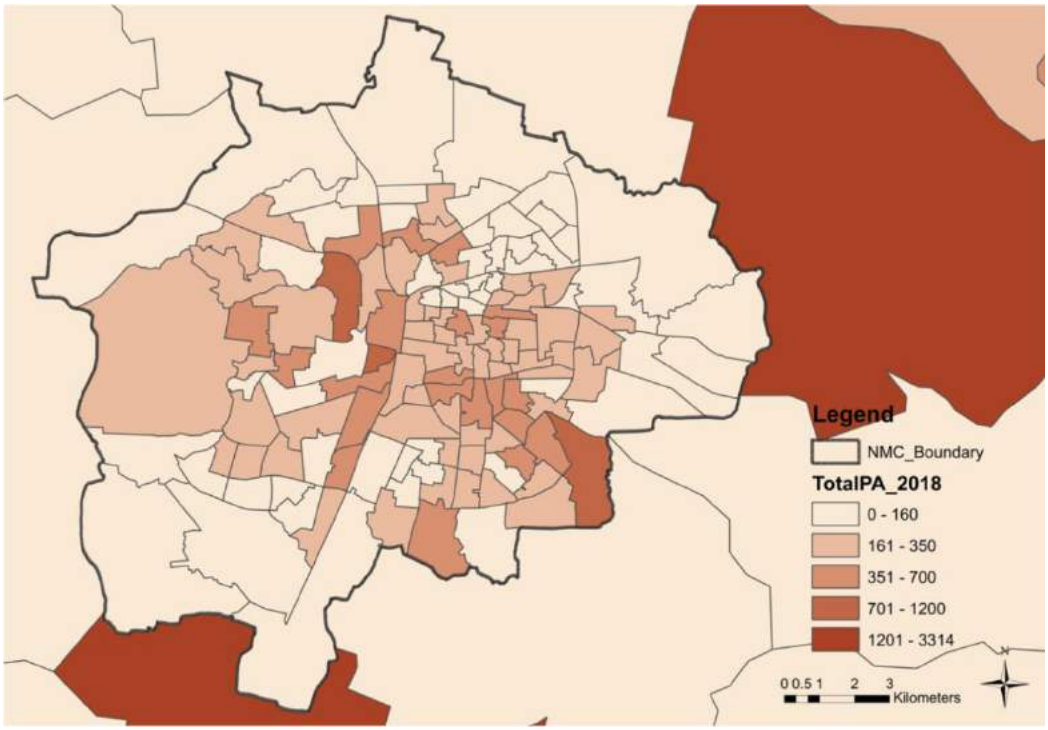


FIGURE 5-13: SPATIAL DISTRIBUTION OF THE PEAK HOUR PUBLIC TRANSPORT TRIPS – 2023

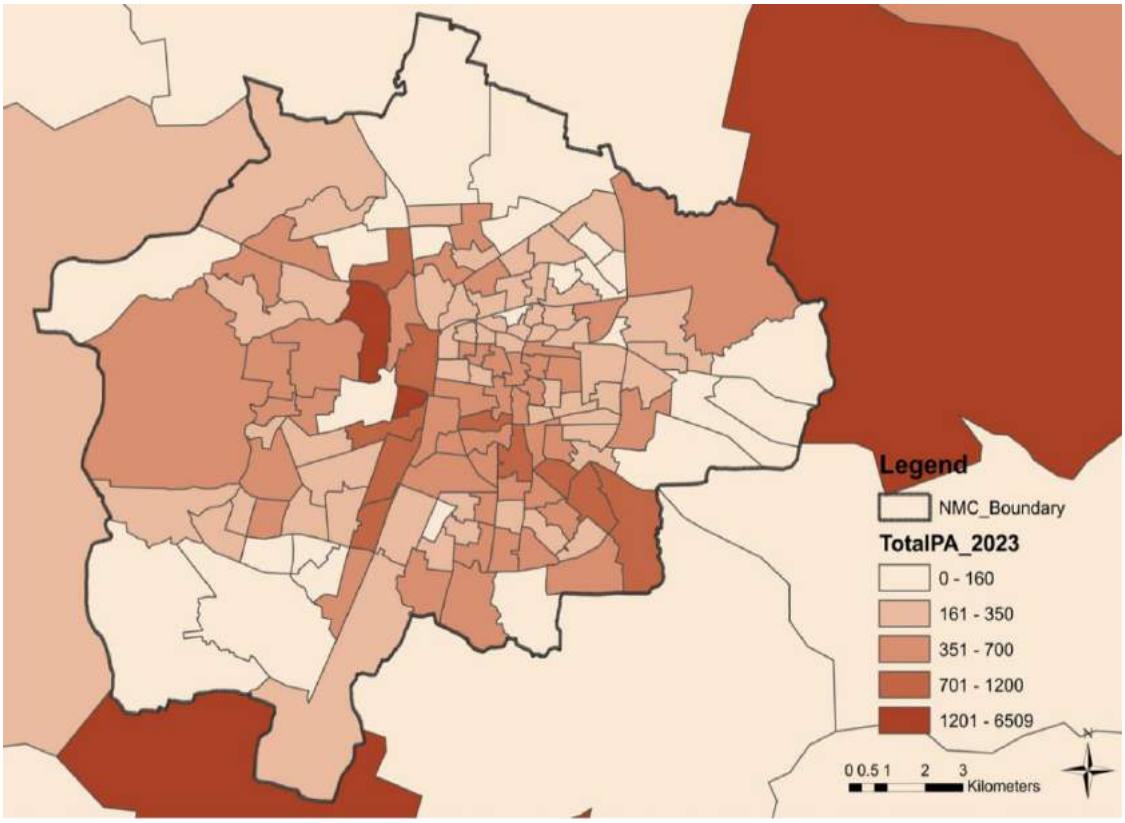


FIGURE 5-14: SPATIAL DISTRIBUTION OF THE PEAK HOUR PUBLIC TRANSPORT TRIPS - 2028

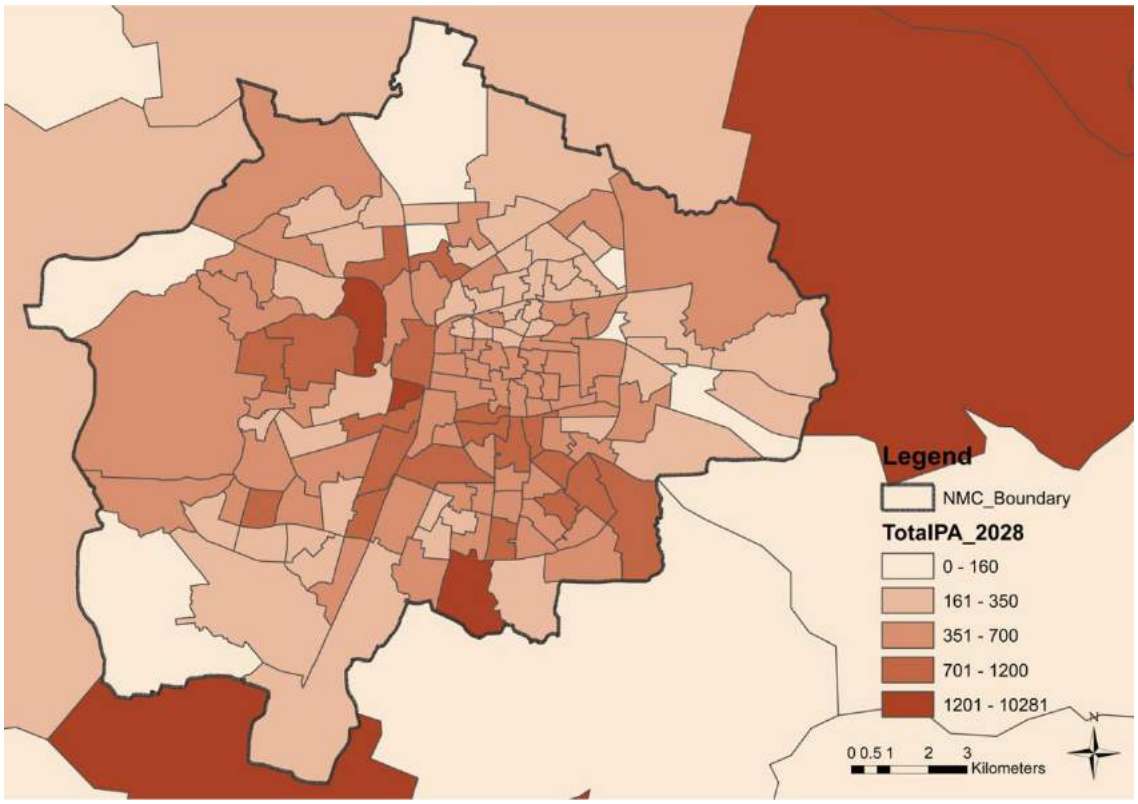
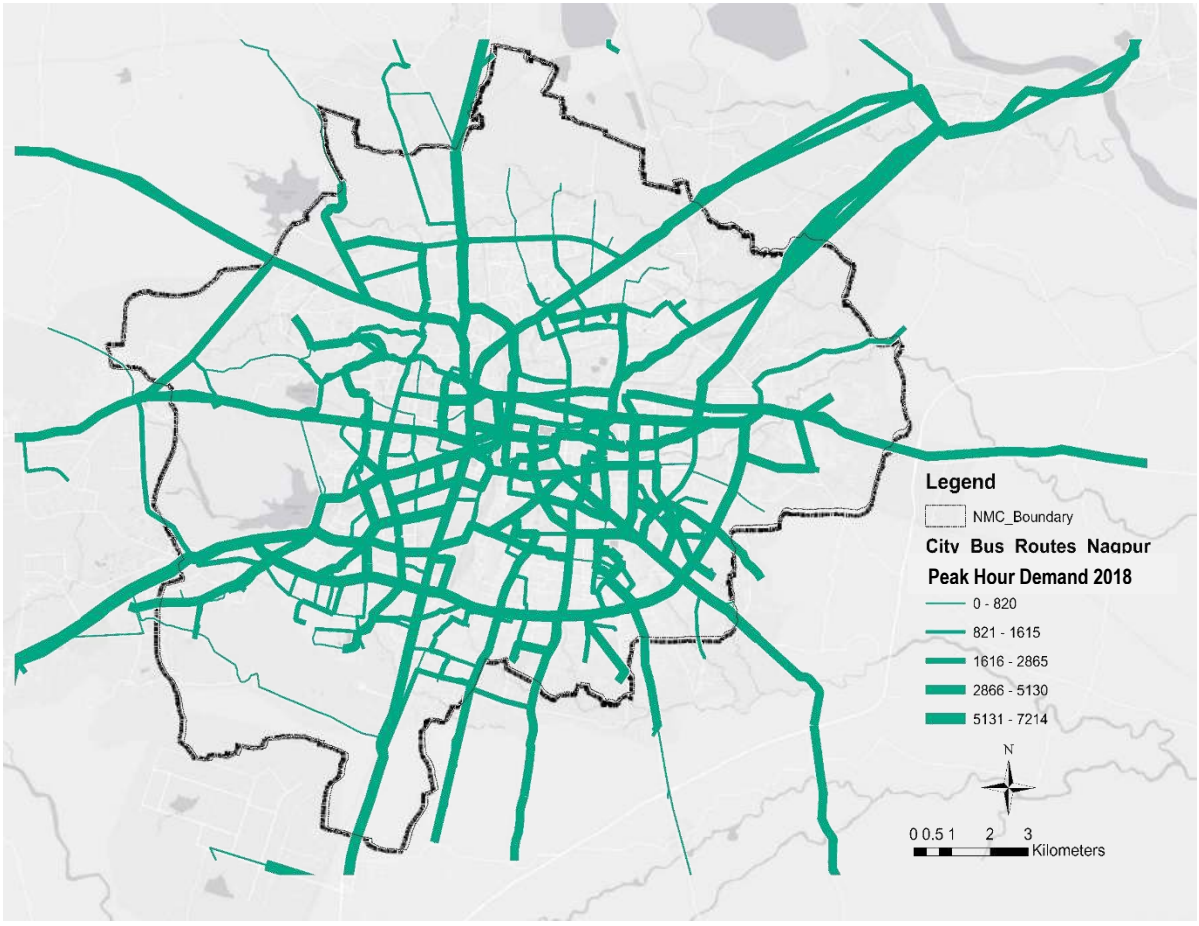


Figure 5-12 to Figure 5-14 represents the spatial distribution of the locations from where the potential public transport trips shall be generated. It has been observed that majority of these trips shall be generated from Sitabuldi, Kamptee, Pardi, Hingna, Buti Bori, Piplafata, Kharbi, Defence, Besa etc.

The estimated[4] PT Trips for the peak hour was assigned on the existing and proposed public transport systems covering the metro, metro feeder bus services, city bus services and shared auto services. Figures 5-15 to Figure 5-17 represent the demand on the existing and proposed PT system in Nagpur.

FIGURE 5-15: PEAK HOUR PUBLIC TRANSPORT DEMAND - 2018



[4] PT Trips have been estimated based on the various variables including the population, employment, vehicle ownership, landuse characteristics, proposed future developments etc.

FIGURE 5-16: PEAK HOUR PUBLIC TRANSPORT DEMAND – 2023

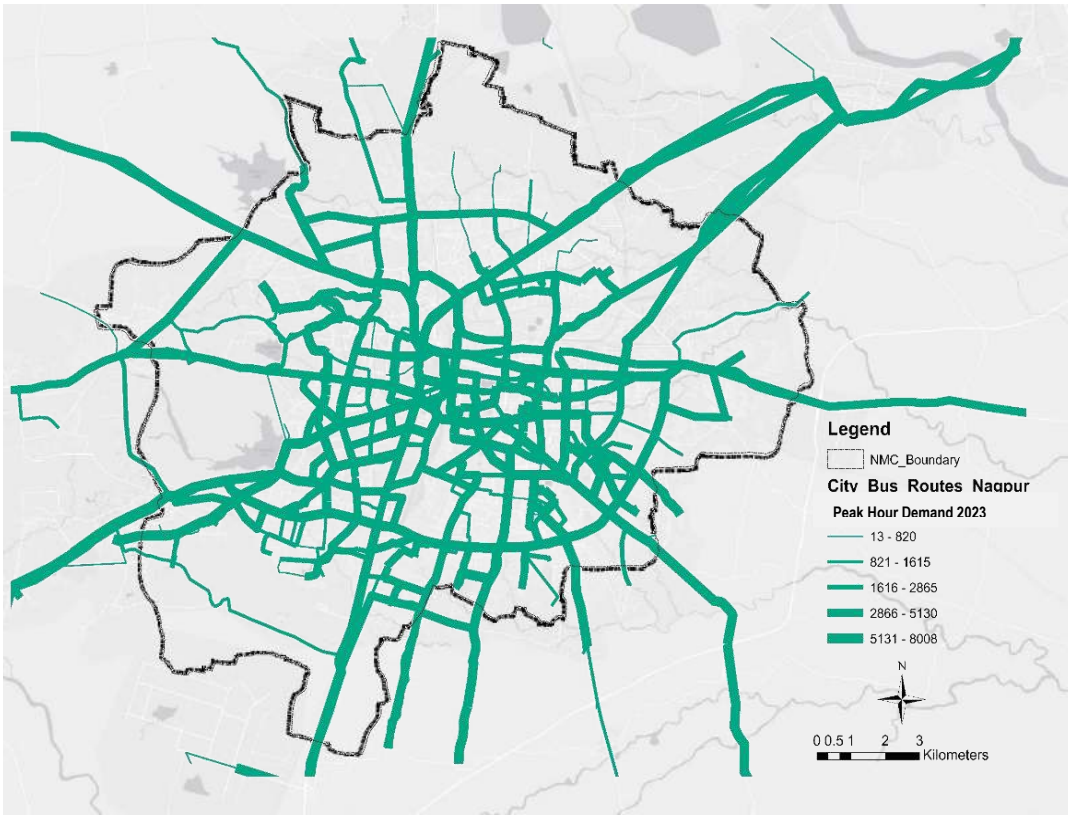


FIGURE 5-17: PEAK HOUR PUBLIC TRANSPORT DEMAND – 2028

From the above, it is evident that, with the introduction of the metro, there would be considerable shift of passengers from all modes of transport to metro. As mentioned in the previous chapters, there are 38 operational city bus routes in Nagpur, of which 29 no. of routes are operating parallel to the Metro Corridors and same is the case with the notified shared auto routes. It is well understood from the above discussion that there is a need to reduce the direct impact of the metro on the existing city bus services within the city. To achieve the inclusive mobility within the city of Nagpur, a holistic approach is required, wherein the rationalized city bus services and metro feeder services are connected to the major and minor activity centers within the city and region.

5.4. DEMAND ASSESSEMENT FOR NMT

Non- Motorized Transport (NMT) modes are an important and integral element of urban transport worldwide. The significance and function of non- motorized transport varies by country and over time. Planning for a people oriented city effectively encourages non-motorized transport and other options that would make it more liveable and improve the quality of life. A safe and comfortable NMT network could facilitate walking and cycling in Nagpur which would again derive various direct and indirect benefits, which have been time and again reflected in the many studies[5]such as;

1. Increased Safety – Planning for NMT will increase the safety of the vulnerable groups, who are often the victims of the road accidents. NMT oriented planning emphasizes on the adoption of the traffic calming measures indeed reducing the speed of the vehicles in the neighbourhoods making them more livable and safe for all road users.
2. Economic Viablility – Increasing the pedestrian and cycling options in a commercial area attracts more customers and increases the sales volumes, property and rental values in the area.
3. Environmental Friendly – NMT is the cleanest mode of travel. Walking and Cycling do not emit any emissions or pollute while being used when compared to the cars.
4. Health Benefits: Cycling and Walking provide aerobic exercise to the human body and hence protect participants from heart diseases, obesity and diabetes. For instance, walking and cycling to work every day could substitute daily exercise at a gym.
5. Transport Options: People using NMT for work would have more travel options than just driving a car. For example, they can take a walk or a bike ride to the public transport station, park their bicycle in the station, and go to work. This reduces the increased use of car travel and bolsters the efficiency of public transport.

5.4.1. NMT TRAGET USER GROUPS

It remains imperative to consider people across all income groups, age-groups, gender and physical conditions in planning NMT infrastructure. The purpose remains to ensure and enforce that:

- All users are entitled to reasonable access to other users, places, goods and services.
- Safety is a priority for all NMT users
- NMT is an integral part of the integrated transport system.
- Transport Impact Assessments must respond and address the needs of universal access and NMT requirements.

5.4.2. SUSTAINING EXISTING NMT USERS

The fact that there has been a rapid decline in the modal share of NMT usage and that the existing pedestrian infrastructure (in the study area) is under-utilized, call for remedying the public transport system through first-and-last mile connectivity, decreasing trip-distance, providing mass rapid transit systems and most importantly provide safe NMT infrastructure. The challenge remains in accommodating the combination of conflicting functions in available road space and may require land acquisition, rearranging available space among other measures. The study hence focuses on identifying ways to provide necessary infrastructure in a manner that it reverses the declining NMT modal share and encourages a modal shift.

[5] Victoria Transport Policy Institute (VTPI) – 2007, Litman – 2003, World Bank – 2000, SUTP Asia – 2006,

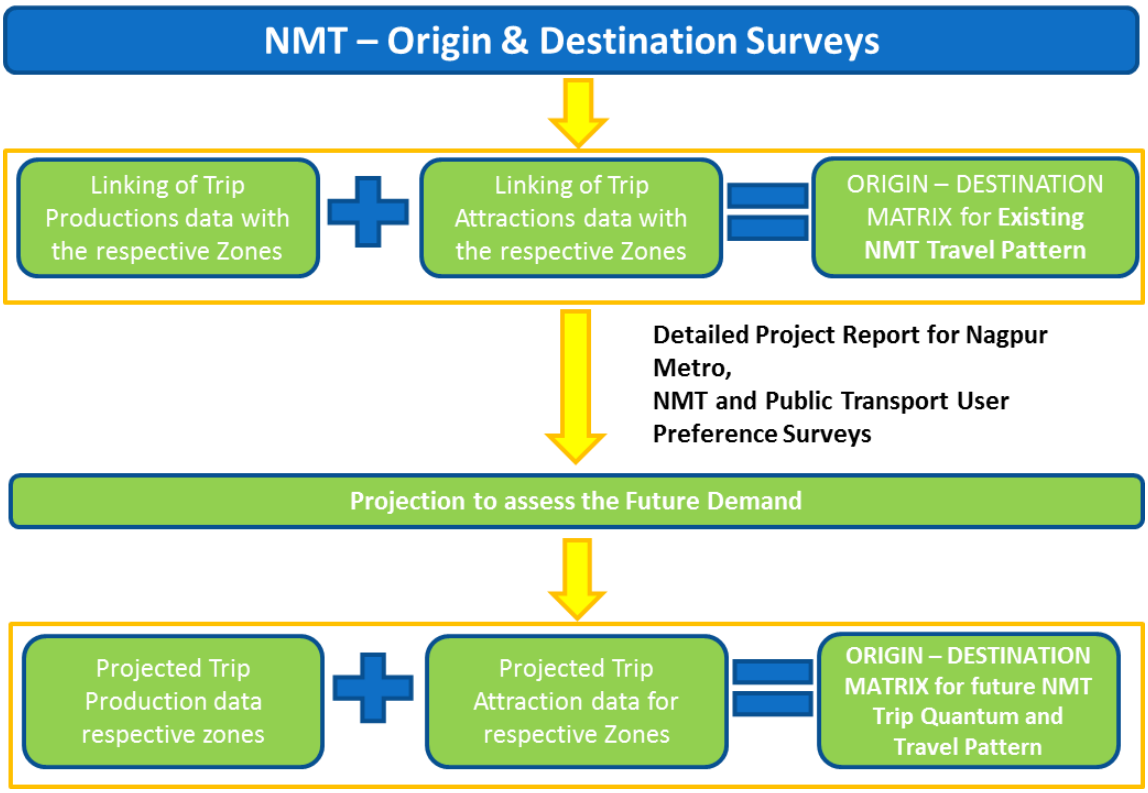
5.4.3. NMT DEMAND ASSESSMENT

Non-Motorized travel demand assessment refers to how much people would use non-motorized modes under the various circumstances. A number of specific factors can affect the demand for NMT in a particular situation. These include Trip Productions & Attractions, Trip Distances, Demographics, Land Use Patterns, Travel Conditions, Topography and Climate, Community Attitude, Time and Geographic Scope. Many of these specific factors have been discussed in the previous chapters. The current section of the report specifically deals with the identification of the areas with higher NMT trips and trip interactions within the study area based on the primary O-D surveys carried out. This section shall also enables identification of the major NMT trip productions and attraction zones within Nagpur.

5.4.3.1. METHODOLOGY FOR DATA ANALYSIS AND FUTURE NMT DEMAND ASSESSMENT

The methodology adopted to establish NMT need and generate the OD Matrix is represented in Figure 5-18.

FIGURE 5-18: METHODOLOGY FOR NMT NEEDS ASSESSMENT



The methodology for establishing the project NMT Trip volume for the horizon year is as follows;

A) PEDESTRIAN TRIPS

NMT-Origin and Destination Surveys established

- 83% of the trips performed by the pedestrians are under 5 km of length;
- The average trip length (ATL) of pedestrians is 1.79 km
- A list of attractions/hubs that generate/ produce pedestrian trip

Figure 5-19 below shows the total trips generated and a number of points that generate/ produce trips in the study area.

5.4.3.2. ESTABLISHING THE BASE CASE SCENARIO FOR EXISTING NMT TRIPS

B) CYCLIST TRIPS

The current mode share of cycles in the city of Nagpur is 5%. NMT Origin & Destination surveys identified existing cycle trip patterns along with the trip generators in the intensive zones of the city. The study also established average trip length (ATL) of the cyclists at 3.03 km.

FIGURE 5-19: DISTRIBUTION OF THE PEDESTRIAN TRIPS WITHIN THE STUDY AREA

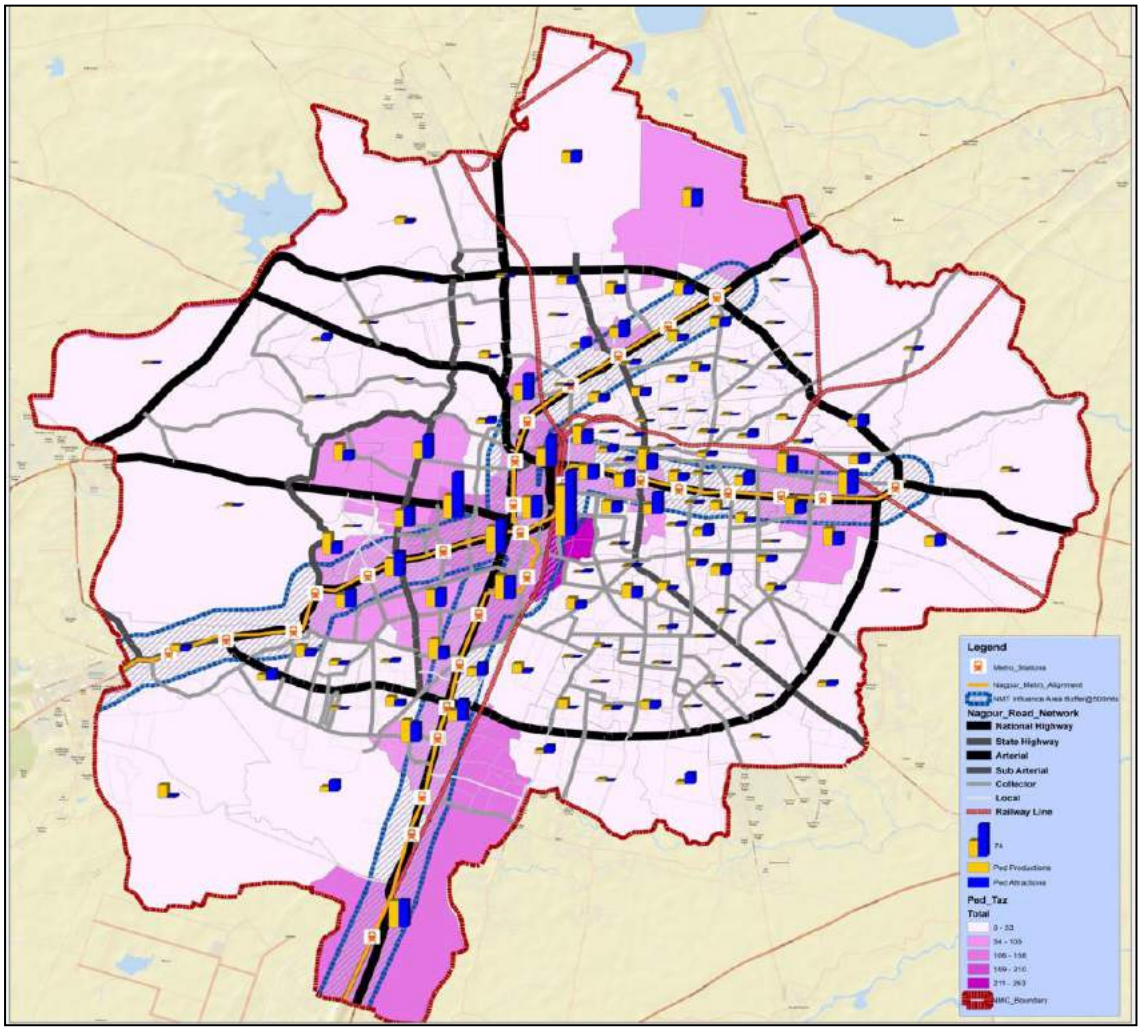


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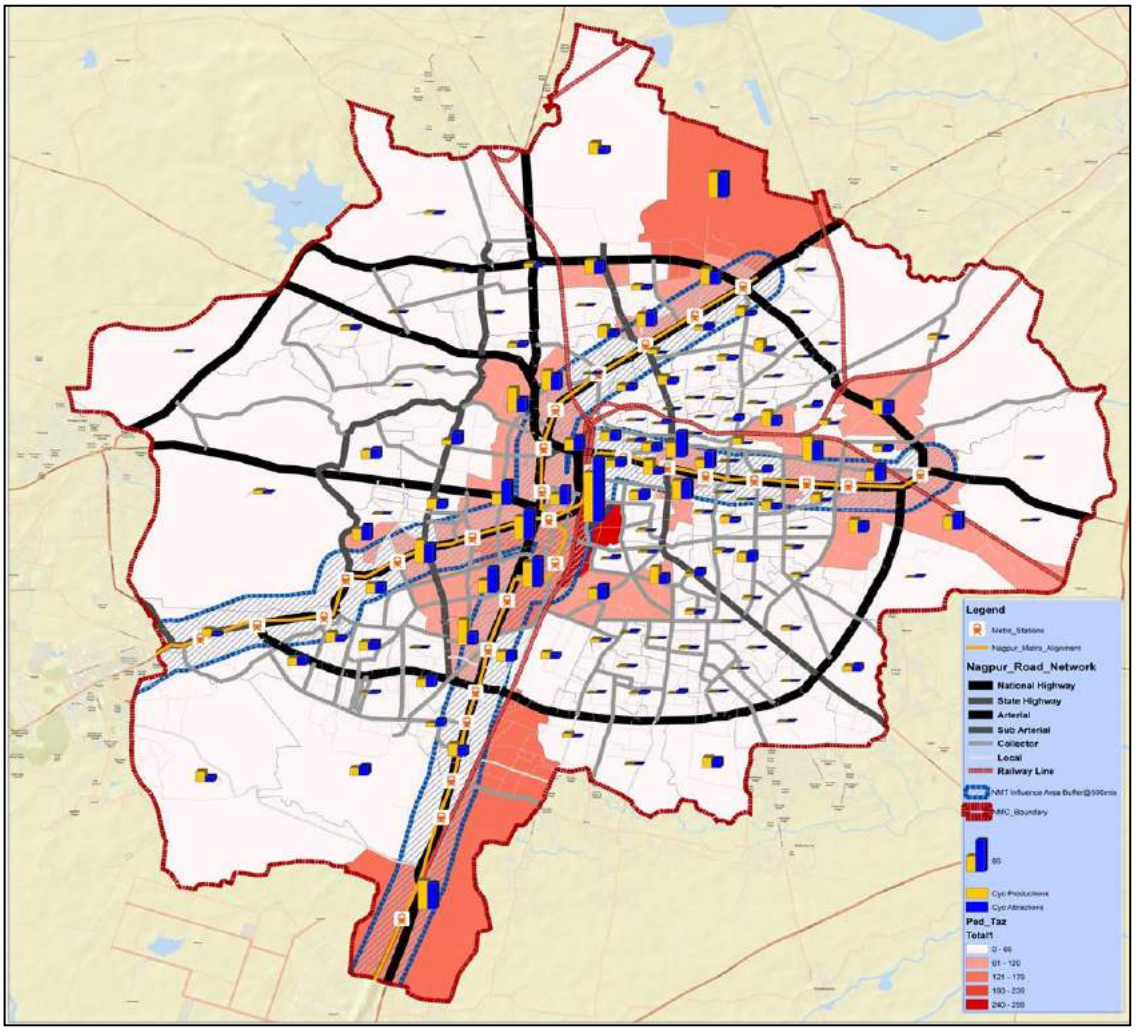
FIGURE 5-20: DISTRIBUTION OF THE CYCLIST TRIPS WITHIN THE STUDY AREA



5.4.3.3. ESTABLISHING THE NMT DEMAND FOR THE HORIZON YEAR

With the metro under construction and subsequent integration of all the public transport modes, it is envisaged that there will a surge in the number of PT users in Nagpur and hence would improve the mode share of Public Transport. This would lay stress on the need for the NMT infrastructure, which can enable smooth interchange at station areas as well as enhancing the first and last mile connectivity. The Detailed Project Report for the Nagpur Metro[6] is drafted by projecting future of Nagpur (2041) based on the city`s decadal population growth and projected modal shift due to proposed improvement in integrated public transport system and infrastructure.

To meet this aim, construction of metro (the phase I with 38 Metro Stations and a network of 38.215 km), provision of quality NMT infrastructure with smooth interchanges also have to be considered. NMT demand has been assessed considering that there is a captive-demand of NMT within influence areas and non-captive demand from the public transport and IPT users on a daily basis[7].

[6] *Detailed Project Report for Nagpur Metro*

[7] *Based on the NMT OD Surveys, the sampled number of origins per zone was identified. The available zone population, per capita trip rates, the mode share of the NMT modes has been used to calculate the total no. of captive pedestrian and cycle trips in each zone. Subsequently, expansion factor for each zone has been calculated on the basis of the total zonal trips and sampled zonal trips and applied across the sampled data, giving the total captive trips and the OD Matrix for the base year.*

Considering with the introduction of the metro and subsequent integration of all modes of public transport, there will be a surge in the number of PT users and hence, considerable amount of first mile and last mile trips shall be made by Pedestrians and Cyclists. Based on the DPR of Nagpur Metro, with the

The DPR is also important to enable the adoption of Transit Oriented Development for Nagpur, as it is bound to densify areas and change trip patterns in the city. The per capita trip rate with walk trips as per the Comprehensive Mobility Plan for Nagpur is observed to be 1.26 (which has been assumed to increase 1% per annum).

A) PEDESTRIAN TRIPS WITHIN THE STUDY AREA:

It is projected that the number of pedestrian trips will increase from 1.69 lakh captive trips per day in 2017 to 2.30 lakhs captive trips per day by 2041 i.e. growth rate of 1.29% per annum within the project influence area. It is anticipated that with the improvement in the pedestrian infrastructure, the first mile and the last mile trips from the public transport modes shall be additionally captured which accounts for approximately 35% of the captive pedestrian users. Hence, the total pedestrian trips are predicted to increase from 2.32 lakh to 2.98 lakh trip per day within the project influence area.

In comparison to the existing situation, there would be an inherent increase in the expected trip productions in the residential, institutional and commercial zones within the project area[8].

introduction of metro, certain trips from the private modes would shift onto the public transport and major shift would be witnessed in the zones which are easily accessible by public transport Based on the Random Public Transport User Opinion Survey, it has been observed that approximately 45.05% of the access and egress trips and 0.30% of the access and egress trips shall be made by Pedestrians and Cyclists. As part of the current study it has been assumed that, till 2041, this trend shall continue. These no. of pedestrian and cyclist trips are Potential NMT users.

[8]*Combining the Captive Users and Potential NMT Users, total pedestrian and cyclist trips have been worked out for the base year and projected for the horizon year of 2041.*

Accordingly as per the calculations it has been observed that
Total Captive Pedestrian Trips per day (2017) – 1.69 Lakhs
Total Potential Pedestrian Trips per day (2017) – 0.63 Lakhs
Total Pedestrian Trips Per Day (2017) – 2.32 Lakhs

Total Captive Pedestrian Trips Per Day (2041) – 2.30 Lakhs
Total Potential Pedestrian Trips Per Day (2041) – 0.67 Lakhs
Total Pedestrian Trips Per Day (2041) – 2.98 Lakhs
Therefore the Pedestrian trips are expected to increase at 22.13% i.e; 1.29% per annum

FIGURE 5-21: DISTRIBUTION OF THE PEDESTRIAN PRODUCTION TRIPS WITHIN THE STUDY AREA – 2041

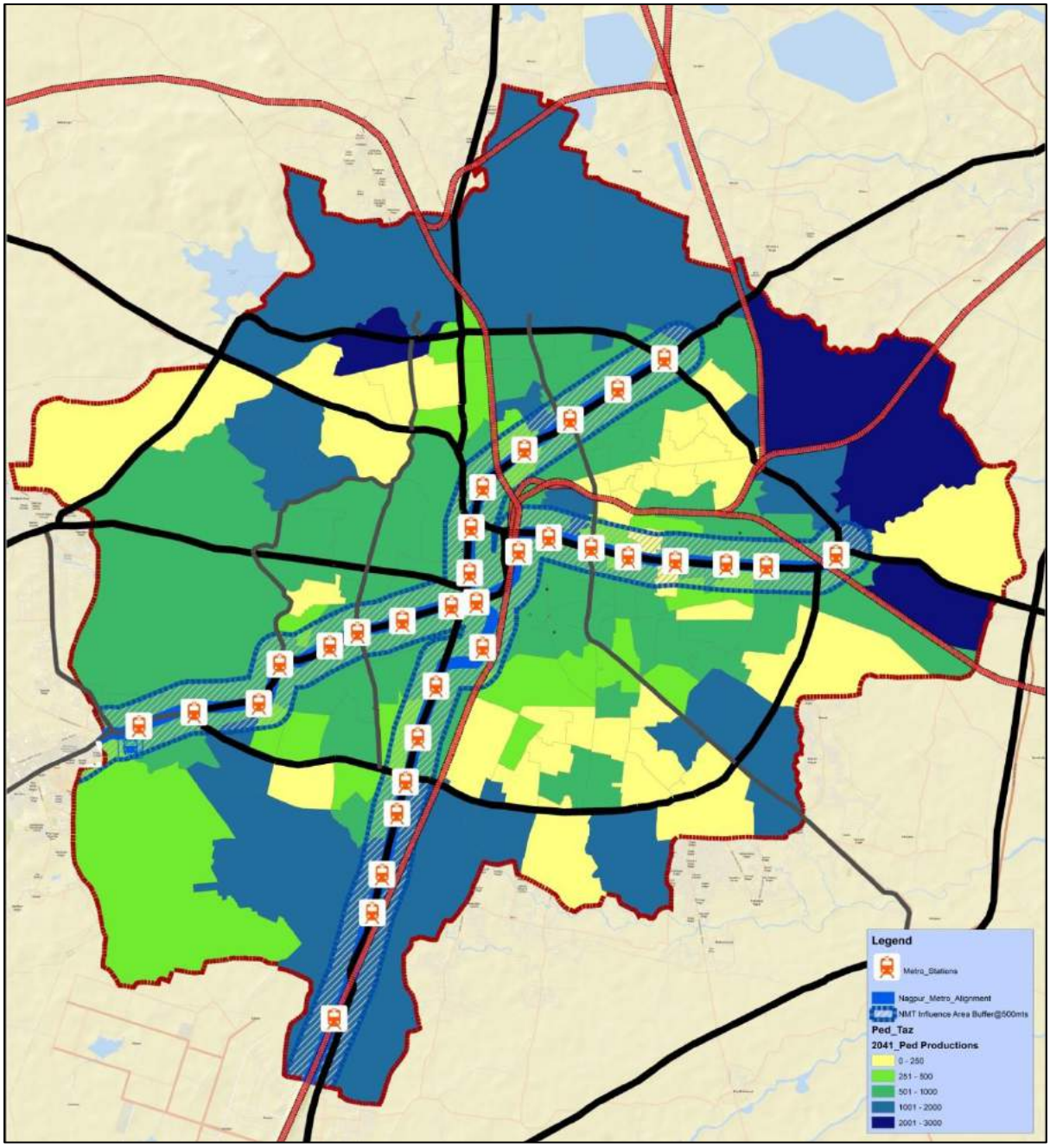
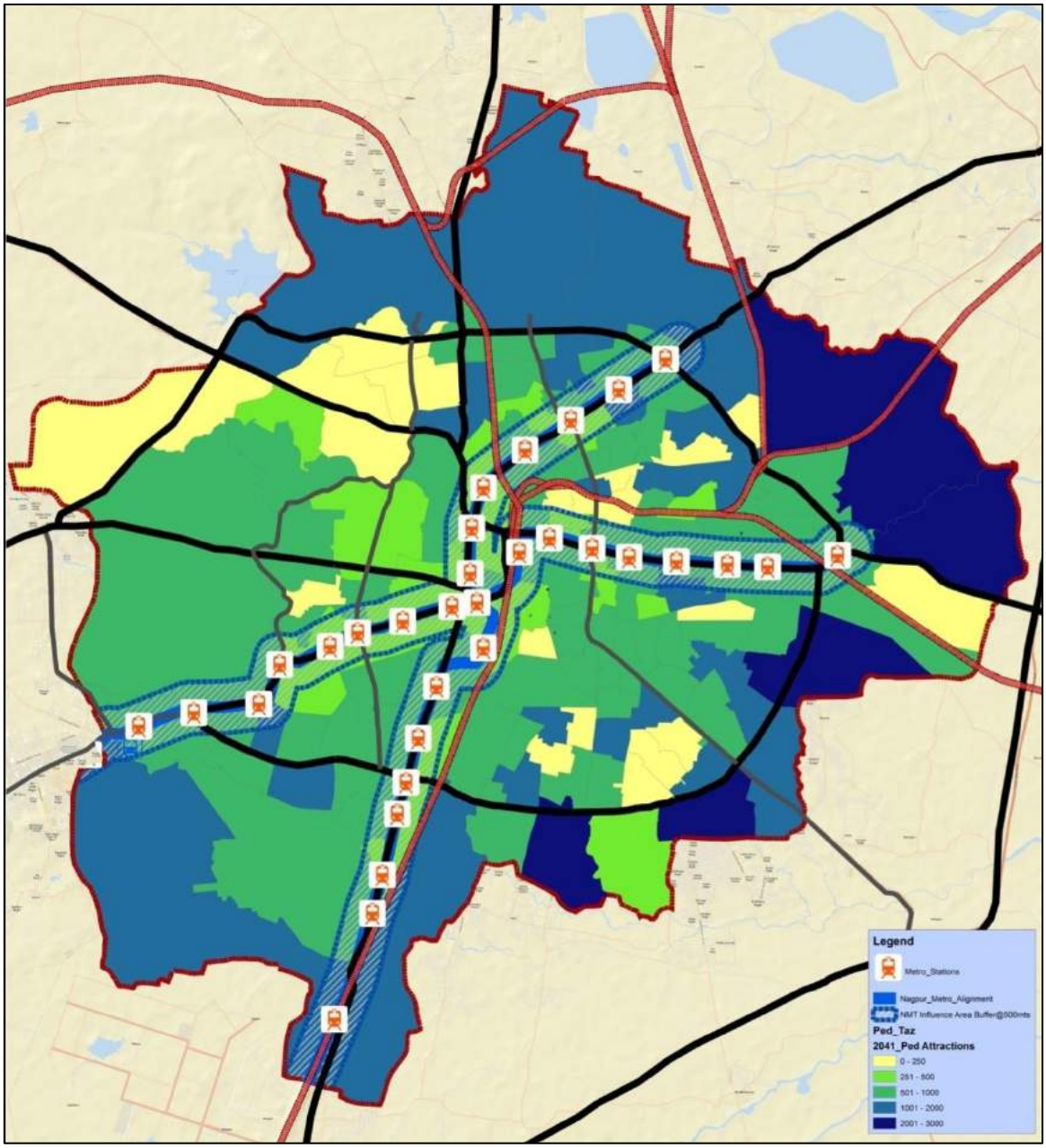


FIGURE 5-22: DISTRIBUTION OF THE PEDESTRIAN ATTRACTION TRIPS WITHIN THE STUDY AREA – 2041



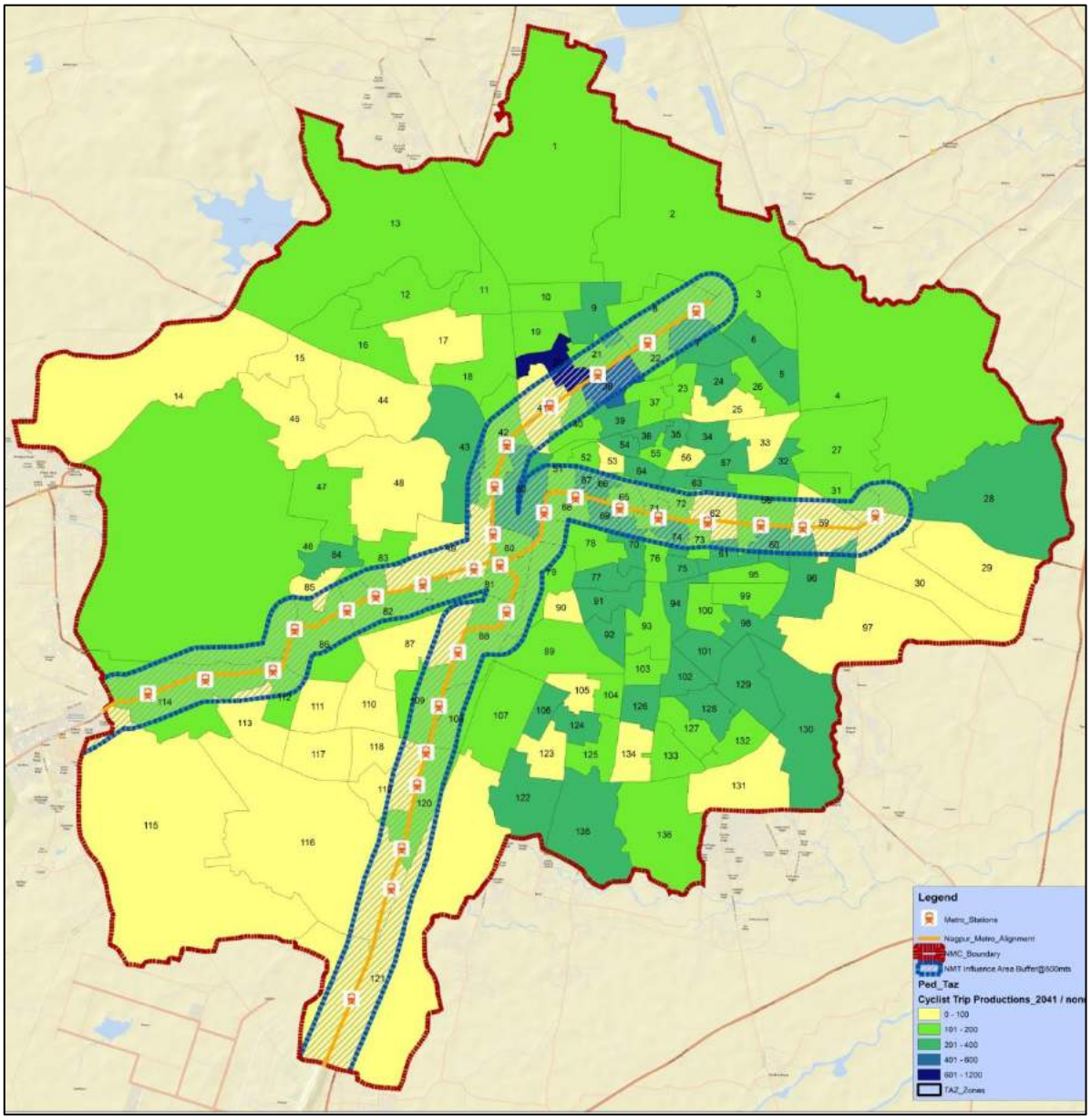
It is being observed that majority of the pedestrian trips are intra zonal trips. From Figure 5-21 and Figure 5-22 it could also be observed that inter zonal pedestrian trips is expected to be produced from the zones outside the study area and attracted to the zones within the study area predominantly due to the distribution of the various land uses spread across the study area.

B) CYCLE TRIPS IN THE STUDY AREA:

The approach and methodology adopted to estimate the pedestrian trips in the study area has been extended to estimate the cycle trips also. Based on the estimation, the number of captive cyclist trips within the project area is 47,233 captive trips per day in 2017, and is expected to increase to 69,702 by 2041. It is anticipated that with the introduction of PBS scheme, the first mile and the last mile trips from the public transport modes can be captured accounting for approximately 0.88% of the captive

cyclist users. Hence, total cycle trips would increase from 47,651 in 2017 to 70,154 trips by 2041 i.e. an annual growth rate of 1.63%[9].

FIGURE 5-23: DISTRIBUTION OF THE CYCLIST PRODUCTION TRIPS WITHIN THE STUDY AREA – 2041

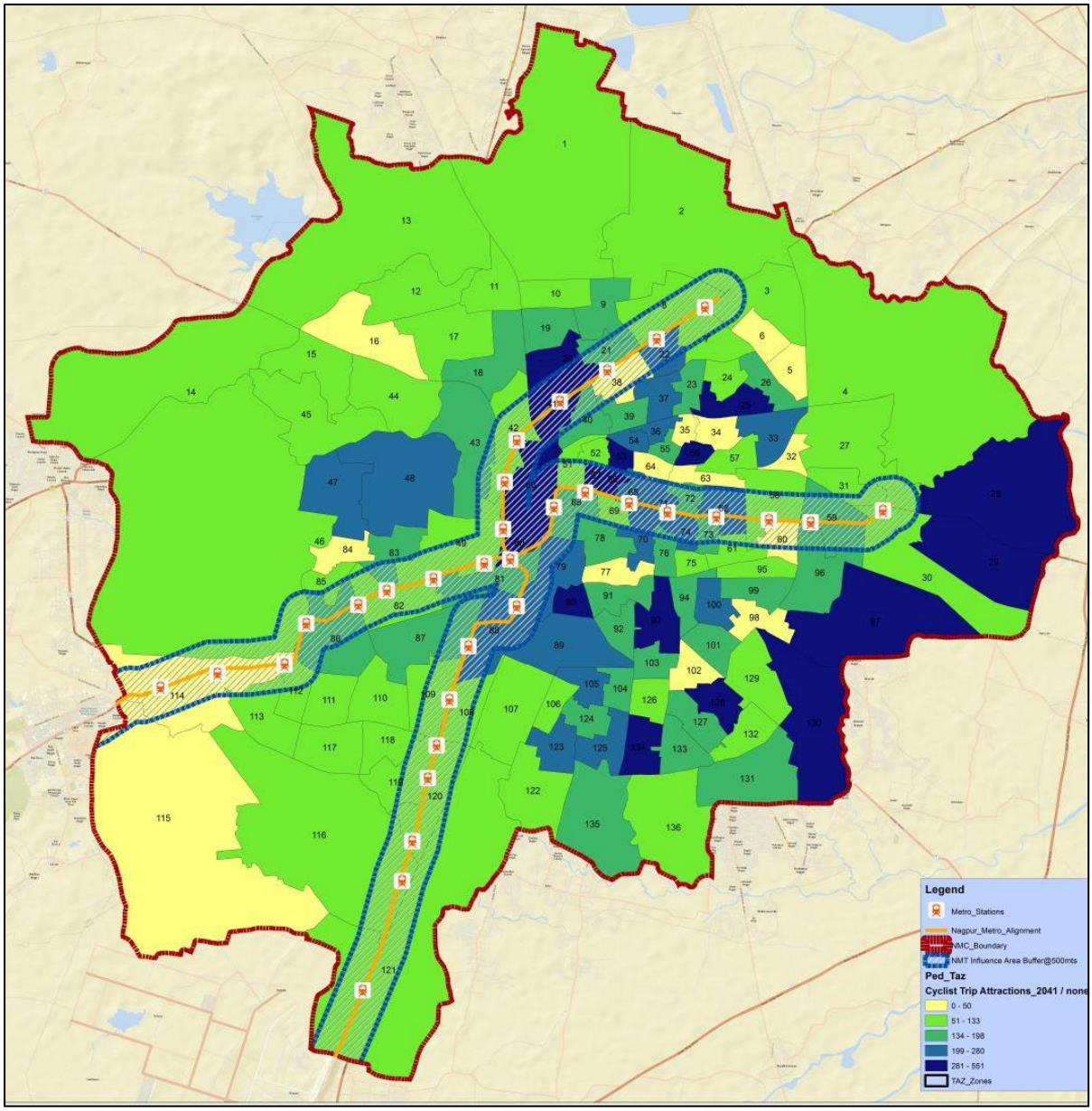


[9]*Combining the Captive Users and Potential NMT Users, total pedestrian and cyclist trips have been worked out for the base year and projected for the horizon year of 2041.*

Accordingly as per the calculations it has been observed that
Total Captive Cyclist Trips per day (2017) – 47,233
Total Potential Cyclist Trips per day (2017) – 418
Total Cyclist Trips Per Day (2017) – 47,651

Total Captive Cyclist Trips Per Day (2041) – 69,702
Total Potential Cyclist Trips Per Day (2041) – 452
Total Cyclist Trips Per Day (2041) – 2.98 Lakhs – 70,154
Therefore the Pedestrian trips are expected to increase at 32.08% i.e; 1.62% per annum

FIGURE 5-24: DISTRIBUTION OF THE CYCLIST ATTRACTION TRIPS WITHIN THE STUDY AREA – 2041



From Figure 5-23 and Figure 5-24 it could also be observed that inter zonal cyclist trips is expected to be produced from the zones outside the study area and attracted to the zones within the study area predominantly due to the distribution of the various land uses spread across the study area.

CHAPTER 6 ROUTE AND SERVICE PLANNING

6.1. BASIC PRINCIPLES OF ROUTE PLANNING

The bus routes should be located in such a way as to provide the highest quality service to potential users to meet the particular needs of a selected group of travellers. Such a service would provide:

- Direct linkage between the user's origin and destination with no or limited transfers
- At a time convenient to the user
- At a cost competitive with the automobile

In locating bus routes, the following factors were considered:

- Integration with rest of Network - Other competing services like IPT, transfer opportunities and similar parallel routes by shared auto services and metro
- Simplicity and Clarity – Directness, Imagination and Reasonable
- Marketing Factors - Attraction to choice riders; Relate to travel needs of target groups; Alternative to parking congestion and Serve established travel patterns of existing users
- Rider Access - Park-and-Ride and Walk-and-Ride
- Safety Considerations – Pedestrian and Rider
- Highway / Road network Geometry - Continuity, width, volume/capacity, traffic control, intersection problems
- Utilization of Special Facilities - Bus on freeways, Good stop locations, Transit Centres, Major trip generators and Weather protected areas
- Identification of Metro Feeder Services (the approach and methodology for Metro Feeder Services and route identification is defined in Chapter 5)

Guidelines used for the Route Allocation:

- A route should, if possible, begin and end at traffic generators.
- Routes should attempt to touch as many traffic generators as possible.
- Buses should, if possible, enter a traffic generator such as a shopping centre, apartment complex, or an industrial plant.
- Routes should be linear -- providing direct two-way service between all points on the route.
- Where transit rider origin-destination linkages exist between one sector of the city to another, through routes should be developed.
- Loop and reverse routing -- being circuitous and inconvenient to the riders – should be avoided.
- Unless patronage demands require, placing of several routes on one street should be avoided (generally, it is better to run four routes on four streets than four routes on one street).
- Routes should be spaced no closer together than the average acceptable walking distance to a bus stop in a given service area (In most instances, this is a 800 meter spacing or a maximum walking distance of 400 meter) for city bus services and 300- 400 meter for Metro Feeder Services.
- The traffic operational characteristics of potential transit route streets must be carefully considered.
- Transit routes should be considered as flexible and should be reviewed and evaluated periodically

6.2. ROUTE STRUCTURE

6.2.1. METRO FEEDER SERVICES

After asserting the catchment for each route and applying the route selection criteria a physical verification has been conducted as part of the ground survey to ensure proper right of way for the proposed feeder system. The site visit conducted by consultant

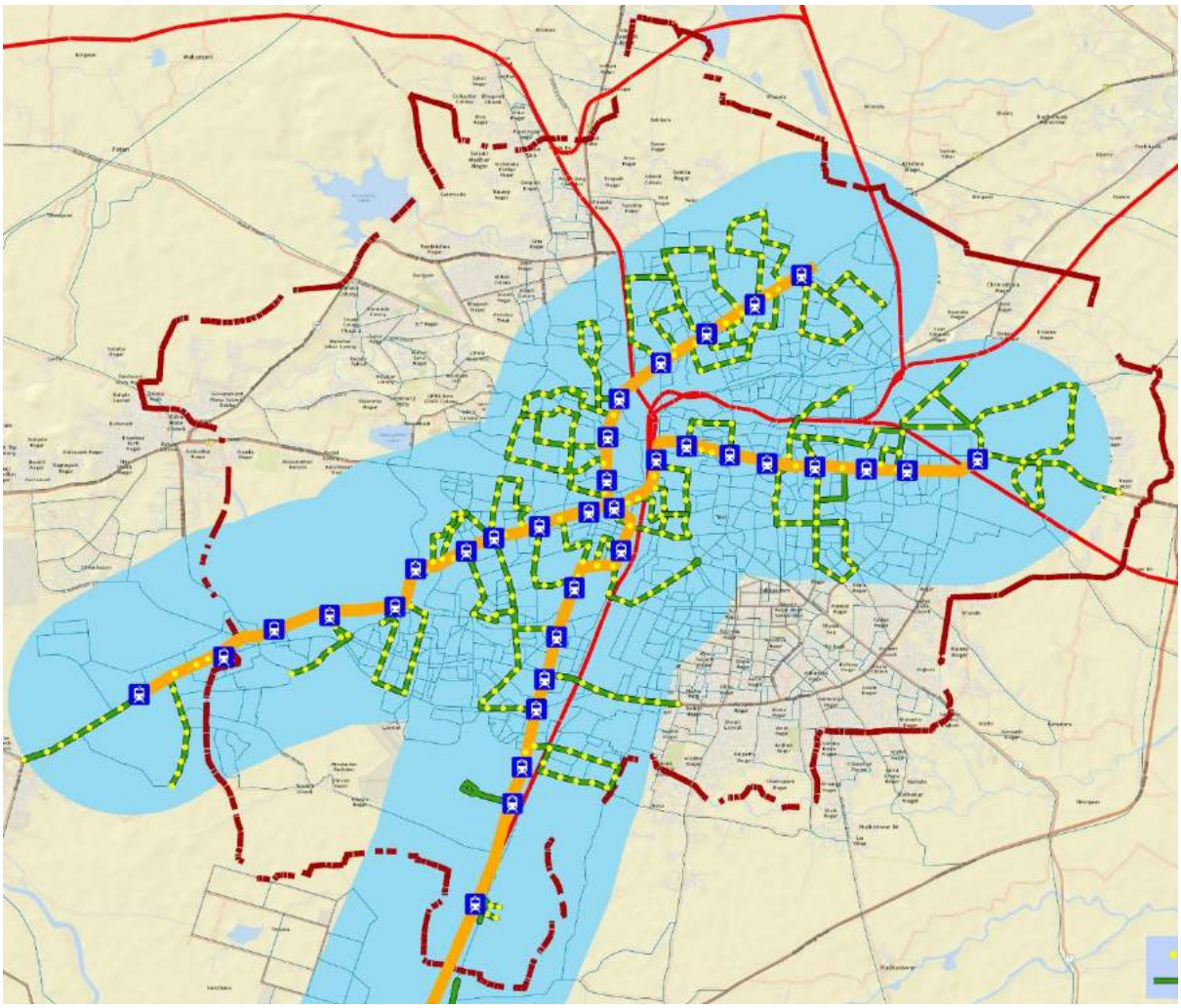
along with, Maha Metro Officials on 19th & 20th April 2016 has revealed that there are certain routes where the operations of the feeder services may not be feasible considering the right of way, terrain conditions, traffic regulations or physical encroachments. In addition, certain routes have been modified so as to cater to a greater demand of population. The feeder routes evaluated are shown in the table below:

TABLE 6-1:METRO FEEDER ROUTES

Corridor	Region	Route Type	Stations Covered	Route Length (Km)
E-W	R-1	Circular	Prajapati Nagar	6.17
	R-2	Point to Point	Prajapati Nagar	5.86
	R-3	Circular	Prajapati Nagar	4.37
	R-4	Circular	Vaishnov Devi Chowk	7.11
	R-5	Circular	Telephone Exchange, Dr Ambedkar Sq	5.10
	R-6	Circular	Telephone Exchange	6.61
	R-7	Circular	Telephone Exchange	3.77
	R-8	Circular	Telephone Exchange	5.43
	R-9	Circular	Agrasen Chowk, Dosar Vashya	3.18
	R-10	Circular	Nagpur Railway Station	4.15
	R-11	Circular	Sitaburdi	4.12
	R-12	Circular	Institution of Engineers	4.35
	R-13	Circular	Shankar Nagar, LAD Sq	4.49
	R-14	Circular	Shankar Nagar	3.54
	R-15	Circular	LAD Sq, Shankar Nagar	3.00
	R-16	Point to Point	Ambazari Lake View Stn	4.10
	R-17	Circular	Subhash Nagar	5.58
	R-18	Point to Point	Rachana	3.75
	R-19	Point to Point	Bansi Nagar	6.85
	R-20	Point to Point	Lokmanya Nagar	5.22
N-S	R-21	Point to Point	Automotive Sq	4.38
	R-22	Circular	Automotive Sq	4.00
	R-23	Circular	Nari Rd	5.33
	R-24	Circular	Nari Rd	3.41
	R-25	Circular	Indora Chowk	5.15
	R-26	Circular	Indora Chowk	3.21
	R-27	Circular	Kabdi Chowk	5.43
	R-28	Circular	Gaddi Godam	4.71
	R-29	Circular	Kasturchand Park	5.70
	R-30	Circular	Zero Mile	6.62
	R-31	Point to Point	Congress Nagar	9.32
	R-32	Point to Point	New Airport	2.00
	R-33	Point to Point	Chatrapati Sq	5.98
	R-34	Circular	Chatrapati Sq, Ajni Square, Jaya Prakash Nagar	6.34
	R-35	Circular	Ujwal Nagar	5.67
	R-36	Circular	Airport	2.18
	R-37	Point to Point	Khapri	2.69
	R-38	Point to Point	Khapri	31.30

A total of 38 routes have been identified where 20 routes are falling along East- West corridor and 18 routes are falling along North-South corridor. The average route length is of 5.53 Km and total route network length is of 210.17 Km. Out of the total 38 routes 27 are circular routes and 11 are point to point routes. Figure 6-1 represents the identified Metro Feeder Routes for Nagpur Metro. A total of 31 metro stations are connected with the feeder service. Each of these routes are presented in the Annexure.

FIGURE 6-1: METRO FEEDER ROUTES



6.2.2. CITY BUS SERVICES

Figure 6-2 represents the methodology adopted for the city bus route rationalization for Nagpur city. As part of the current study, total of 199[1] routes have been evaluated. The evaluation of the routes has been considered in two stages. Stage 1 considers the operational viability of the routes based on the demand, expected headways, expected fleet, expected occupancy ratio and expected earning potential and Stage 2 evaluates the viable routes based on the overlap with the proposed metro corridors, direct connectivity between the traffic generators, multi modal transfer facilities and easy access to city bus services. Considering Stage 1 and Stage 2, evaluation of City Bus Services, the route planning interventions have been adopted such as;

To improve the overall bus service in NMC, the route planning interventions are required under three areas -

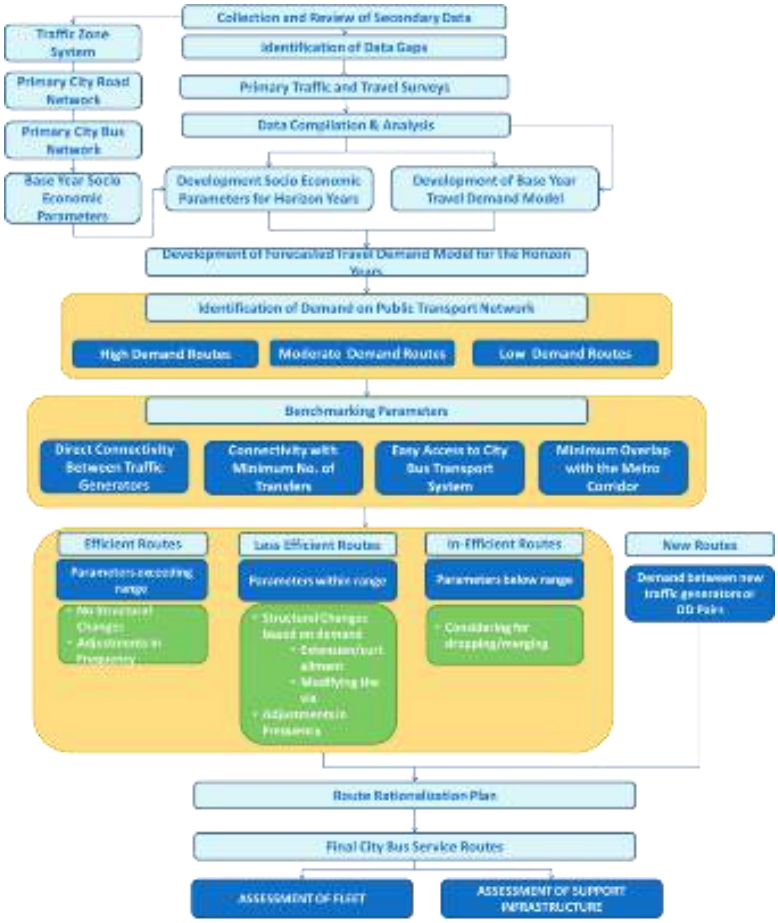
- Modification of existing bus routes – extension / curtailment of the route
- Proposed new bus routes
- Improved headway of existing routes to meet the required demand

Following sections will discuss modifications required in the present routing pattern of the city bus services for improving the catchment area in Nagpur. The type of bus is recommended based on the available road width and available turning radius. This

[1] Note: 38 operational city bus routes, 118 routes which are notified by RTO for City Bus operations in the Nagpur City, however these routes are non-operational at present. Based on the route wise operational data collected from NMC for 24th April, 2017 and 1st June 2017, followed by Primary surveys, the team identified additional 45 routes as new routes for bus operations.

will especially consider the connectivity through routes which will be parallel to the existing mobility corridors. This will improve the catchment for inner areas which are not directly connected to the mobility corridors.

FIGURE 6-2: METHODOLOGY OF CITY BUS ROUTE RATIONALIZATION



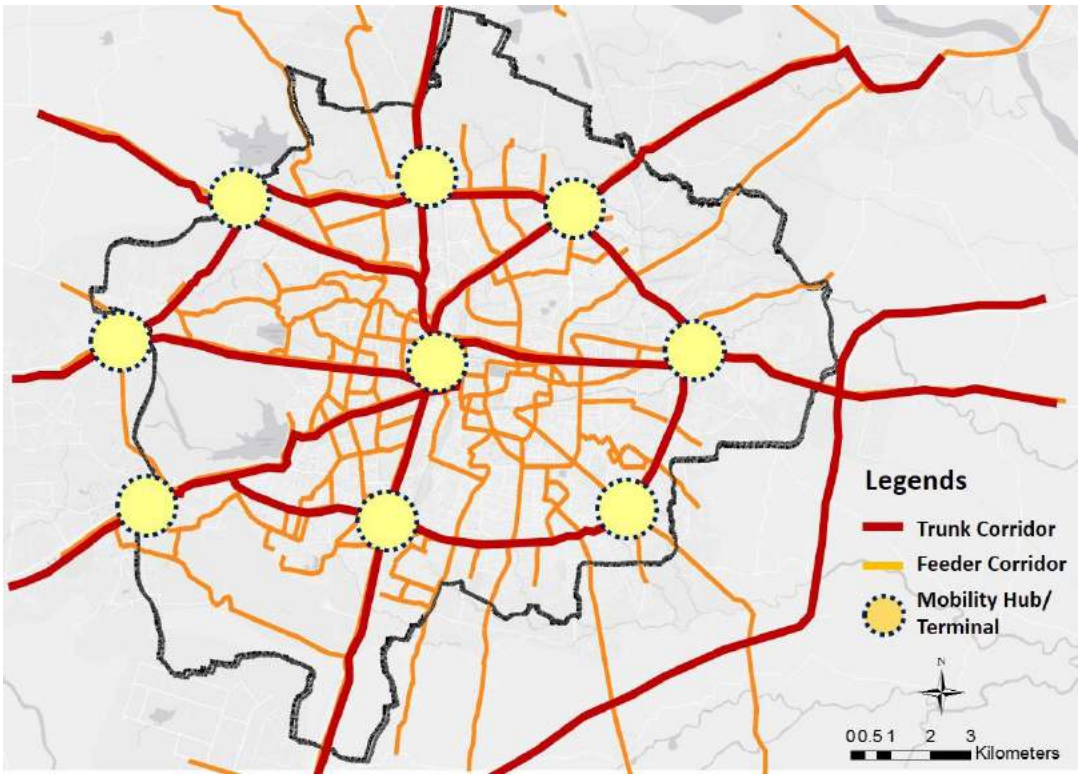
6.2.2.1. ROUTE STRUCTURE

As mentioned earlier the current city bus route structure is radial in nature, wherein the city has a strong central core around which the development has taken place directionally.

To optimize the existing route structure, the city bus routes in Nagpur have rationalized based on the “Hub & Spoke Model”. It is a system of connections arranged like a wire wheel, in which majority of the traffic is on the trunk corridors/routes as they connect to the major activity centers through feeder routes. The model is commonly used in the industry, particularly in transportation, telecommunications and freight. These are network configurations by which carrier can use larger vehicles and reduce the costs per unit through bundling flows in a hub. With this route concept, the small number of routes may lead to more cost efficient use of transportation resources, therefore creating competitive edges. Cities such as Singapore, Dubai, Frankfurt, London, Bhopal and Bengaluru have mastered the art of trunk and feeder concept in public transportation systems. The hub and spoke model requires excellent operational management for it to succeed and encourage “Direction Oriented Services”.

As in case of city bus services in Nagpur, the trunk routes would operate along the major transit corridors, direction wise connecting the major activity centers within the city (designated as Hubs) whereas the feeder routes would operate from hubs to the minor activity centers. Figure 6-3 represents the typical concept of Hub and Spoke Model.

FIGURE 6-3: HUB AND SPOKE MODEL FOR CITY BUS SERVICES



Based on the analysis of the origin and destination patterns of the city bus users in Nagpur city, it has been observed that there is need for change in the existing routing pattern, which emphasized on the modifications to the existing operational routes such as retained, extended/curtailed and terminated, followed by the operational viability of the notified non-operational city bus services has been worked out and new routes have been identified to improve the efficiency of the operations as well as extend the catchment area of the city bus services.

To rationalize the city bus routes in Nagpur 3 stage wise evaluation method was utilized as follows:

Stage 1: Listing of total existing/notified routes – 194 routes taken to Stage 2

Stage 2: Removal of Overlap considering Metro – 102 routes taken to Stage 3

Stage 3: Rationalisation of Routes – 76 routes for Horizon year of 2028 which will again be categorised for consideration in 2018, 2023 & 2028

Stage 1:Listing of Total Existing Routes Total notified routes were evaluated which included 36[2] operational routes, 118[3] Non-operational routes but notified for city bus routes operations and based on the OD pattern within the city 42 new routes were introduced. A total of 194 routes is considered at next stage for rationalisation. Table 6-2 represents the summary of the outcomes of the rationalized city bus routes, which has been further detailed in the following sections.

[2] Route No 22A and Route No 40AC have been combined together in Route No 22 and Route No 40 respectively.
[3] Total No. of City Bus Services Routes Notified by the RTO for operations by NMC are 183. However the team received list of 154 routes, which has been utilized for the current study. Of the 154 routes, 36 routes are operational and remaining 118 routes are non-operational.

Stage 1 gives the existing operational routes and notified routes put together which will be considered for Stage 2 evaluation. From the notified routes it has been observed that majority of routes have common origin and destinations, high frequency and high competition among the systems for adequate revenue generations. The current study aims at resolving the above mentioned issues. 194 routes from Stage 1 are taken to Stage 2 for evaluation.

Stage 2: Removal of Overlap with Metro The outcome of the Stage 1 has been further evaluated in Stage 2, where 168 routes overlap with the various bus routes as well as with the metro corridors. Hence, to avoid the competition among the alternate modes of public transport the operationally viable city bus routes have been further evaluated for structural modifications to the routes. Table 6-2 represents the intensity of overlap of city bus services with the metro corridors.

TABLE 6-2: INTENSITY OF OVERLAP OF CITY BUS SERVICES WITH METRO

Level of Impact		Operational Routes	Non-Operational Notified Routes	New Routes	Total
Least Impact	0 to 3 km	22	69	30	121
Medium Impact	3 to 5 km	6	23	5	34
High Impact	5 to 10 km	8	18	7	33
Severely Impact	More than 10 km	0	5	1	6
Total		36	115	43	194

It could be observed from the table that 62% of the identified routes have no impact/least impact on the metro corridors in Nagpur (No impact routes account for 14% of the total routes, whereas least impact routes account for 48% of the total routes). High impact and severely impacted routes account for 20% of the total routes, whereas the remaining routes are medium impacted. Considering the same, the retained operational, non-operational and new routes have been further evaluated and route planning interventions have been applied.

Based on the Stage 2 of evaluation, a network of 102 unique routes connecting the major activity centres in the city have been taken to Stage 3 for further evaluation. The list of the modified 102 routes are listed out in the Table 6-4 which will be subject to rationalisation in Stage 3. The recommended modification to the original routes is attached as Annexure.

TABLE 6-3: LIST OF CITY BUS ROUTES FOR NAGPUR FROM STAGE 2 TO STAGE 3 FOR EVALUATION

Sl. No	Unique Route ID	Route Description	Via	Route Length (km)
1	CBS-001-T	Pardi to Vaishali Nagar	Jaitala	20.94
2	CBS-002-T	Kharbi to Pannasay Layout	Zenda chowk, Ravi Nagar	23.13
3	CBS-003-F	Katol Naka to Brahmanawada	Gorewada gaon	12.43
4	CBS-003-T	Sitabuldii to Katol Naka	RBI, Raj Nagar	9.50
5	CBS-004-Fa	Dighori To Piplafata	Ashirwad nagar, Hudkeshwar Naka	4.47
6	CBS-004-Fb	Dattawadi to Hazaripahad	Futala lake corner, Ravi nagar, CGO	11.58
7	CBS-004-T	Dighori to Dattawadi	Medical sq, Ravi Nagar	18.64
8	CBS-005-T	Ashirwad Nagar to Gandhibagh	Krida sq, Tukdoji sq	6.32
9	CBS-006-F	Surya nagar to Mahalgaon	Kapsi, Mahalgaon	13.88
10	CBS-006-T	Sitabuldi to Surya nagar	Mayo hospital, Subhash putala	12.05
11	CBS-007-F	Dighori to Wadad	Pipla fata	11.95
12	CBS-008-T	Pardi to Mahindra & Mahindra	Tajbagh, Chatrapati sq	26.32
13	CBS-009-T	Sitaburdi to Defence	Ravi nagar	12.87
14	CBS-011-F	Tekanaka to Jn Hospital	Kamptee	26.44
15	CBS-011-T	Sitabuldi to Tekanaka	Kadbi chowk	6.54
16	CBS-013-F	Mankapur to Khaparkheda	Panjara bus stand,Suradevi	19.25
17	CBS-013-T	Sitabuldi to Mankapur	Pagalkhana sq	5.29
18	CBS-014-F	Mankapur to Itangodi	Babulkheda	21.17

Sl. No	Unique Route ID	Route Description	Via	Route Length (km)
19	CBS-015-F	Surya Nagar to Pawangaon	Gulmohar nagar	4.83
20	CBS-017-F	Sitaburdi to Vela hari	Krida sq, Manewada	13.18
21	CBS-017-T	Sitabuldi to Gorewada	CPWD Quarter, Chaoni	8.88
22	CBS-018-F	Chatrapati to Belatarodi	Shatabdi sq, Harihar nagar	9.59
23	CBS-021-T	Sitaburdi to Morarji	Chatrapati sq, Chinchbhavan	34.01
24	CBS-022-T	Burdi to Sonegaon	Shankar nagar	7.22
25	CBS-023-F	10 no Puliyai to Nagsengao	Yashodhara Nagar	7.88
26	CBS-025-F	Mankapur to Lonara	Godhani	7.88
27	CBS-027-F	Sitaburdi to jaywant Nagar	Vishwakarma nagar, shatabdi sq	10.77
28	CBS-029-F	Dighori to Banwadi	Pipla fata, chikna	16.56
29	CBS-031-F	Sitabuldi to Wayusena	GPO, Japnese garden	7.62
30	CBS-032-F	Hingna T point to Issasani	CRPF, Airforce station	7.21
31	CBS-032-T	Sitabuldi to Hingna	Gandhi Nagar, Pratap Nagar	8.12
32	CBS-037-F	Indora chowk to Kapil Nagar	Ring road, Power grid	3.88
33	CBS-039-F	Hingna T Point to Hingna	CRPF, VIP Factory	9.36
34	CBS-042-F	Dattawadi to Mangrul	Navnit nagar, Ordinance factory	24.05
35	CBS-043-T	Tekanaka to Mahindra & Mahindra	Ramdev baba college, Japnese garden, Ravi nagar	21.29
36	CBS-044-F	Gandhibagh to Kamptee	Itwari railway station	11.14
37	CBS-046-F	Indora Chowk to Samta Nagar	Barakholi, Ring Road	4.31
38	CBS-047-F	Chatrapati Sq to CRPF	Ganesh nagari, KTPS Colony	9.50
39	CBS-048-F	Indora Sq to Nara	Jaripataka, Barakholi	3.77
40	CBS-049-F	Indora Sq to Nari	Gramin police head quarter	4.26
41	CBS-050-F	Sitaburdi to Wanjari	Kadbi chowk, Hanspuri, Jagnnath Budhwari	8.67
42	CBS-052-T	Sitaburdi to Narsala	Mokshadham, Baidyanath	13.50
43	CBS-054-F	Katol Naka to Brahmani fata	Fetri godowan, Dahegaon	16.94
44	CBS-057-F	Sitabuldi to Prem Nagar	Baidyanath sq, Lokanchi shala	11.14
45	CBS-063-F	Tukdoji Sq to Nari	Mokshadham, Buldi, Akashwani sq	15.06
46	CBS-064-F	Tukdoji sq to Nara	Jaripatka	14.57
47	CBS-065-F	Katol Naka to Khadgaon	Wayusena, Dattawadi	7.99
48	CBS-070-F	Sitabuldi to Shesh nagar	Chatrapati sq	9.20
49	CBS-071-F	Buldi to Hazaripahad	Ravi nagar, WCL	13.62
50	CBS-072-F	Dattawadi to Alesur	Wadi, Ordinance Factory	8.90
51	CBS-073-F	Narendra Nagar to Vayusena	Shankar Nagar, Ravi nagar	11.11
52	CBS-074-F	Surya Nagar to Nandanwan	Hiwari Nagar, Shastri Nagar	4.68
53	CBS-075-F	Buldi to Karve Nagar	Shankar Nagar	10.79
54	CBS-078-F	Sitaburdi to Wayusena	Bal Bharthi	8.77
55	CBS-080-F	Defence to Dhamna	Wadi	17.02
56	CBS-081-T	Sitabuldi to Sitabuldi	Japnese Garden, Bharat Nagar, Sneh Nagar	20.15
57	CBS-093-T	Sitabuldi to Chakrapani nagar	Badkas chowk, Tukdoji sq	11.06
58	CBS-102-F	Sitabuldi to Ambazari garden	Ramdaspeth, East Shankar nagar	5.09
59	CBS-103-F	Mankapur to Koradi Yatra_Seasonal	Koradi naka	11.31
60	CBS-106-F	Dighori to Panchgaon	Dighori, Bahadur phata	13.22
61	CBS-109-T	Sitabuldi to MIHAN	Sneh nagar, Airport road	14.62
62	CBS-110-F	Hingna T Point to Mohgaon	CRPF, Rajiv nagar, Hingna	17.67
63	CBS-121-F	Kamptee to Koradi_Seasonal		15.80
64	CBS-128-F	Gandhibagh to Tajabad	Jagnade Chowk, Raghuji Nagar	7.71
65	CBS-131-F	Sitabuldi to Swaraj nagar Wathoda	Gandhi gate, Jagnade chowk	8.53

Sl. No	Unique Route ID	Route Description	Via	Route Length (km)
66	CBS-142-F	Defence to Dahegaon	Katol naka	21.69
67	CBS-143-F	Wardhaman Nagar to Dahegaon	Panchawati, Ashirwad Nagar, Chatrapati sq	23.17
68	CBS-162-F	Rahate Colony to Shitla mata mandir	Vishwakarma nagar	5.15
69	CBS-163-F	Binaki Layout to Panjara Colony	Power grid, Faras	11.05
70	CBS-164-F	Binaki Layout to Navin Nagar	Itwari railway stn, Wardhman nagar	10.95
71	CBS-166-F	Sadbhavna Nagar to Ghuti	Bhande plot, Raghuji nagar	23.77
72	CBS-167-F	Bajaria to Yogeshwar Nagar	Shakkardhara sq, Medical Sq, Agyaram sq	9.65
73	CBS-168-F	Pragati nagar to Sidheshwar Nagar	Agyaram sq, Lokanchi shala	18.16
74	CBS-169-F	Nildoh to Yogeshwar Nagar	Lokmat Sq	18.35
75	CBS-170-F	Ektamata Nagar to Kharbi road, Vaishnavi layout	Sitabuldi, Bajaj nagar	17.92
76	CBS-171-F	Gorewada sq to Sadguru Nagar	Sitabuldi	14.75
77	CBS-172-F	Sitabuldi to Purani basti Buti buri	Tukdoji sq	37.14
78	CBS-173-F	Sitabuldi to Natraj Talkies	Durgavati sq	9.95
79	CBS-174-F	Sitabuldi to Vaishnavmata nagar	Tilak putala, Manewada	10.87
80	CBS-175-F	Airport to Ganesh Nagari	Akashwani chowk	16.94
81	CBS-176-F	Gandhi Bagh to Kamala Nagar	LIC, Sadar	15.20
82	CBS-177-F	Jai Hind Society to Dhoke Layout	Sitabuldi, RBI	15.35
83	CBS-178-F	Jaitala to Kharbi Road	Sitabuldi, Shankar nagar	16.82
84	CBS-179-F	ISCB Colony to Pila road, Janki nagar	Ajni sq, Rahate colony	10.81
85	CBS-180-F	Central excise Colony to Pipla	Manas sq, Tukdoji sq	16.86
86	CBS-181-F	CBI Colony to Hudkeshwar Police station, Bhole Nagar	Cotton market, Tukdoji sq	10.58
87	CBS-182-F	YCCE College to Pardi Octroi Naka	Manewada	28.10
88	CBS-183-F	Jaitala to Sitabuldi Anand Talkies	Shankar nagar, Bajaj nagar	10.03
89	CBS-184-F	Swawlambi Nagar to Kendriya Vidyalay	Dikshabhumi, bhole petrol pump	14.41
90	CBS-186-F	Sitabuldi to Pragati Nagar	Ravi nagar, Gandhi nagar	13.87
91	CBS-187-F	Fetri to Yogeshwar Nagar	Sitabuldi	24.90
92	CBS-188-F	Seminary Hills to Kharbi road Ishwar nagar	Cotton market, RBI	12.22
93	CBS-189-F	Sitabuldi to Somwar Peth	Ajni sq	8.04
94	CBS-191-F	Deekshabhumi to Shankar Pur	Medical sq	15.35
95	CBS-192-F	Dindayal upadhyay Chowk to Sai Sewashram Society	Sitabuldi	12.22
96	CBS-193-F	Sitabuldi Post office to Nagpur University	Ambazari T point	6.81
97	CBS-194-F	Sitabuldi to Manewada Chowk	Ajni Railway Station	6.88
98	CBS-196-T	Shakti mata mandir to Jaitala	Subash nagar, Buldi, Baidyanath sq	15.39
99	CBS-197-F	Dahegaon to Kamgar Nagar	Chatrapati sq, Sitabuldi, Indora sq	22.13
100	CBS-198-F	Wandongri to Shiv Shakti Nagar	Ajni sq	24.12
101	CBS-201-F	CRPF to Maya Nagar	Rahate colony, Sitabuldi	30.47
102	CBS-203-F	Sitabuldi to Ambe	Tukdoji sq, Baidyanath Sq	12.58

Stage 3: Evaluation based on Operation & Revenue perspective for finalisation of Routes for Horizon year The modified/rationalized 102 routes were evaluated based on their PHPDT and viability in terms of operations as well as revenue generating capacity. Based on this evaluation, of the 102 rationalized routes, only 76 routes are found to be recommended for introduction and operation in a Phase wise manner. Table 6-4 & Figure 6-4 represents the list of the 76 city bus routes to be introduced in Nagpur along with PHPDT and Ridership.

TABLE 6-4: LIST OF 76 RATIONALISED CITY BUS ROUTES FOR NAGPUR

Sl. No.	Row Labels	Route Description	Route Length (km)	Typology of Routes	PHPDT			Peak Hour Ridership			Daily Ridership		
					Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028
1	CBS-001-T	Pardi to Vaishali Nagar	20.94	Trunk	465	1328	1375	819	1871	2007	10666	24363	26135
2	CBS-002-T	Kharbi to Pannasay Layout	23.13	Trunk	754	1471	2135	1233	2011	2744	16052	26185	35732
3	CBS-003-T	Sitabuldii to Katol Naka	9.50	Trunk	128	112	172	228	136	201	2965	1776	2613
4	CBS-004-Fa	Dighori To Piplafata	4.47	Feeder	19	127	145	33	185	237	429	2403	3090
5	CBS-004-T	Dighori to Dattawadi	18.64	Trunk	264	859	977	458	1186	1481	5969	15438	19284
6	CBS-005-T	Ashirwad Nagar to Gandhibagh	6.32	Trunk	239	622	875	372	1090	1500	4845	14194	19532
7	CBS-006-F	Surya Nagar to Mahalgaon	13.88	Feeder	67	117	161	113	208	224	1471	2713	2917
8	CBS-006-T	Sitabuldi to Surya nagar	12.05	Trunk	695	717	751	1137	1213	1251	14803	15789	16283
9	CBS-007-F	Dighori to Wadad	11.95	Feeder	18	135	192	29	220	300	378	2866	3908
10	CBS-008-T	Pardi to Mahindra & Mahindra	26.32	Trunk	1441	1417	1541	2732	2276	2376	35576	29634	30939
11	CBS-009-T	Sitaburdi to Defence	12.87	Trunk	629	1481	2188	959	2329	3321	12483	30330	43240
12	CBS-011-F	Tekanaka to Jn Hospital	26.44	Feeder	649	584	609	976	878	1014	12703	11439	13198
13	CBS-011-T	Sitabuldi to Tekanaka	6.54	Trunk	557	1088	1195	801	1727	1819	10425	22486	23684
14	CBS-013-F	Mankapur to Khaparkheda	19.25	Feeder	172	595	590	263	916	1110	3421	11923	14451
15	CBS-013-T	Sitabuldi to Mankapur	6.29	Trunk	324	466	606	540	694	949	7036	9033	12355
16	CBS-014-F	Mankapur to Itangodi	21.17	Feeder	84	92	476	117	120	680	1523	1563	8854
17	CBS-015-F	Surya Nagar to Pawangaon	4.83	Feeder	64	139	159	111	237	283	1448	3086	3683
18	CBS-017-F	Sitaburdi to Vela hari	13.18	Feeder	336	323	374	590	470	552	7678	6118	7185
19	CBS-017-T	Sitabuldi to Gorewada	8.88	Trunk	345	357	472	579	537	584	7543	6992	7604
20	CBS-018-F	Chatrapati to Belatarodi	9.59	Feeder	228	277	543	299	416	560	3893	5417	7292
21	CBS-021-T	Sitaburdi to Morarji	34.01	Trunk	729	1218	1733	1270	1794	2506	16536	23355	32629
22	CBS-023-F	10 no Puliyai to Nagsengao	7.88	Feeder	174	780	871	306	1224	1385	3986	15935	18029
23	CBS-025-F	Mankapur to Lonara	7.88	Feeder	67	68	113	113	113	182	1467	1473	2372
24	CBS-027-F	Sitaburdi to jaywant Nagar	10.77	Feeder	116	77	172	176	153	214	2287	1999	2790
25	CBS-029-F	Dighori to Banwadi	16.56	Feeder	8	69	82	15	120	147	189	1562	1917
26	CBS-031-F	Sitabuldi to Wayusena	7.62	Feeder	123	249	540	196	453	784	2548	5901	10213
27	CBS-032-T	Sitabuldi to Hingna	8.12	Trunk	192	404	483	312	631	655	4058	8222	8531
28	CBS-037-F	Indora chowk to Kapil Nagar	3.88	Feeder	199	260	302	277	342	382	3613	4458	4980
29	CBS-039-F	Hingna T Point to Hingna	9.36	Feeder	39	225	251	63	376	360	826	4902	4683
30	CBS-043-T	Tekanaka to Mahindra & Mahindra	21.29	Trunk	127	155	219	188	297	327	2448	3867	4258
31	CBS-044-F	Gandhibagh to Kamptee	11.14	Trunk	1122	1371	1144	1577	1500	1293	20539	19527	16836

Sl. No.	Row Labels	Route Description	Route Length (km)	Typology of Routes	PHPDT			Peak Hour Ridership			Daily Ridership		
					Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028
32	CBS-047-F	Chatrapati Sq to CRPF	9.50	Feeder	38	92	78	58	155	126	758	2012	1645
33	CBS-048-F	Indora Sq to Nara	3.77	Feeder	260	423	602	435	737	954	5668	9590	12426
34	CBS-049-F	Indora Sq to Nari	4.26	Feeder	51	320	249	83	487	337	1085	6340	4382
35	CBS-050-F	Sitaburdi to Wanjari	8.67	Feeder	22	63	107	35	103	138	456	1341	1797
36	CBS-052-T	Sitaburdi to Narsala	13.50	Trunk	487	592	896	749	695	954	9758	9056	12424
37	CBS-063-F	Tukdoji Sq to Nari	15.06	Feeder	33	210	231	55	268	308	719	3494	4014
38	CBS-064-F	Tukdoji sq to Nara	14.57	Feeder	233	543	650	452	647	696	5881	8431	9067
39	CBS-065-F	Katol Naka to Khadgaon	7.99	Feeder	11	37	106	15	52	126	190	682	1638
40	CBS-070-F	Sitabuldi to Shesh nagar	9.20	Feeder	100	503	1178	119	915	1789	1553	11911	23293
41	CBS-071-F	Buldi to Hazaripahad	13.62	Feeder	34	134	331	59	246	535	774	3199	6970
42	CBS-072-F	Dattawadi to Alesur	8.90	Feeder	11	61	83	15	98	157	194	1270	2050
43	CBS-074-F	Surya Nagar to Nandanwan	7.00	Feeder	64	78	183	90	126	303	1176	1641	3948
44	CBS-075-F	Buldi to Karve Nagar	10.79	Feeder	55	70	182	99	82	173	1294	1068	2253
45	CBS-078-F	Sitaburdi to Wayusena	8.77	Feeder	52	126	183	83	183	253	1085	2382	3290
46	CBS-102-F	Sitabuldi to Ambazari garden	6.00	Feeder	140	95	126	213	138	189	2771	1800	2461
47	CBS-103-F	Mankapur to Koradi Yatra_Seasonal	11.31	Feeder	59	340	614	100	475	851	1297	6179	11075
48	CBS-106-F	Dighori to Panchgaon	13.22	Feeder	9	11	420	11	18	499	143	234	6497
49	CBS-109-T	Sitabuldi to MIHAN	14.62	Trunk	1623	1964	1982	2584	2851	2789	33650	37116	36310
50	CBS-121-F	Kamptee to Koradi_Seasonal	15.80	Feeder	338	721	1462	360	1002	2015	4692	13050	26241
51	CBS-131-F	Sitabuldi to Swaraj nagar Wathoda	8.53	Feeder	28	323	204	51	522	303	667	6803	3948
52	CBS-142-F	Defence to Dahegaon	21.69	Feeder	22	71	144	37	96	181	487	1254	2359
53	CBS-143-T	Wardhaman Nagar to Dahegaon	23.17	Trunk	316	78	135	498	149	199	6483	1946	2593
54	CBS-162-F	Rahate Colony to Shitla mata mandir	5.15	Feeder	56	1616	1969	97	1620	1971	1268	21097	25662
55	CBS-163-F	Binaki Layout to Panjara Colony	11.05	Feeder	88	51	84	160	53	87	2078	688	1132
56	CBS-166-F	Sadbhavna Nagar to Ghuti	23.77	Feeder	122	83	71	184	139	104	2392	1813	1355
57	CBS-167-F	Bajaria to Yogeshwar Nagar	9.65	Feeder	589	245	309	804	343	418	10469	4460	5448
58	CBS-168-F	Pragati nagar to Sidheshwar Nagar	18.16	Feeder	98	827	928	158	862	956	2052	11223	12449
59	CBS-171-F	Gorewada sq to Sadguru Nagar	14.75	Feeder	146	138	171	265	202	224	3450	2634	2922
60	CBS-172-F	Sitabuldi to Purani basti Buti buri	37.14	Feeder	53	303	630	103	346	665	1346	4500	8659
61	CBS-173-F	Sitabuldi to Natraj Talkies	9.95	Feeder	169	128	44	301	167	70	3921	2171	908
62	CBS-174-F	Sitabuldi to Vaishnavmata nagar	10.87	Feeder	214	158	214	254	195	258	3307	2541	3356
63	CBS-176-F	Gandhi Bagh to Kamala Nagar	15.20	Feeder	206	195	174	314	303	290	4091	3944	3777
64	CBS-177-F	Jai Hind Society to Dhoke Layout	15.35	Feeder	32	51	128	62	76	197	810	993	2566

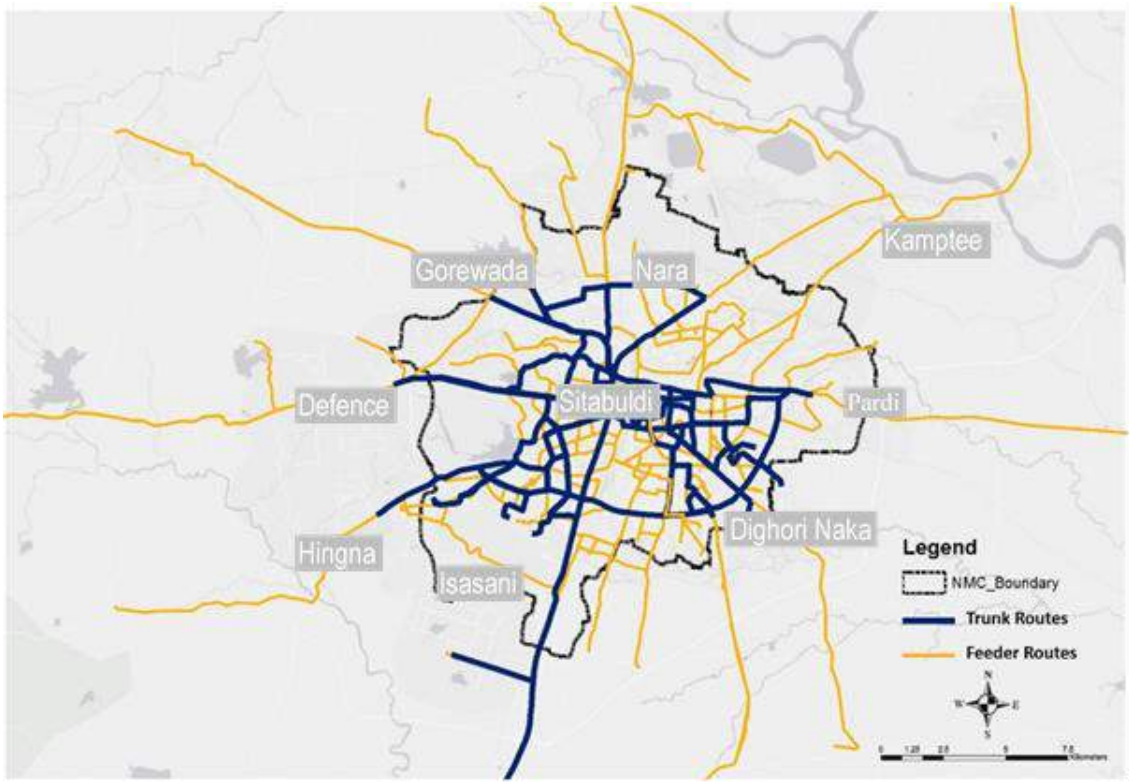
Sl. No.	Row Labels	Route Description	Route Length (km)	Typology of Routes	PHPDT			Peak Hour Ridership			Daily Ridership		
					Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028
65	CBS-178-F	Jaitala to Kharbi Road	16.82	Feeder	162	456	1300	232	724	1631	3019	9423	21240
66	CBS-182-F	YCCE College to Pardi Octroi Naka	28.10	Feeder	87	115	962	170	185	1813	2209	2409	23609
67	CBS-184-F	Swawlambi Nagar to Kendriya Vidyalay	14.41	Feeder	54	79	145	100	100	173	1307	1297	2250
68	CBS-188-F	Seminary Hills to Kharbi road Ishwar nagar	12.22	Feeder	124	434	738	144	452	776	1869	5890	10107
69	CBS-191-F	Deekshabhumi to Shankar Pur	15.35	Feeder	147	297	622	240	439	724	3124	5718	9423
70	CBS-192-F	Dindayal upadhyay Chowk to Sai Sewashram Society	12.22	Feeder	34	40	446	36	40	489	467	516	6372
71	CBS-194-F	Sitabuldi to Manewada Chowk	6.88	Feeder	58	837	1193	78	1026	1524	1019	13354	19845
72	CBS-196-T	Shakti mata mandir to Jaitala	15.39	Trunk	74	178	121	105	219	165	1372	2846	2145
73	CBS-197-F	Dahegaon to Kamgar Nagar	22.13	Feeder	30	987	1342	43	991	1343	562	12904	17490
74	CBS-198-F	Wandongri to Shiv Shakti Nagar	24.12	Feeder	176	194	155	318	270	296	4143	3521	3856
75	CBS-201-F	CRPF to Maya Nagar	30.47	Feeder	165	207	602	296	358	880	3856	4659	11462
76	CBS-203-F	Sitabuldi to Ambe	12.58	Feeder	86	496	697	126	855	1095	1647	11131	14252
		Total						27676	45732	61454	360363	595480	800183

As in case of city bus services in Nagpur, it is recommended that the trunk routes would operate along the major transit corridors, direction wise connecting the major activity centres within the city (designated as Hubs) whereas the feeder routes would operate from hubs to the minor activity centres. A total of 76 routes overall will have to be considered for implementation in Nagpur after route rationalisation.

Summary of Route Rationalisation of City Bus Services in Nagpur City for Horizon Year 2028.

SN	Stage	Remarks
1	194 routes	-
2	102 routes	After removal of overlap
3	76 routes	Considering viability

FIGURE 6-4: RECOMMENDED TRUNK AND FEEDER NETWORK OF THE MODIFIED CITY BUS ROUTES



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6.3. OPERATIONAL PLAN

6.3.1 SERVICE PLAN FOR METRO FEEDER SERVICES

6.3.1.1 ESTIMATION OF FLEET SIZE

Effective estimation of fleet size is quite essential for any public transit facility. As surplus fleet would often lead to underutilization and eventually increase the capital and operation costs. On the other hand insufficient fleet leads to reduction in the ridership values. So it is important that an optimal fleet size is determined and such a system needs to be developed which ensures enough fleet size to meet the ridership demand at the same time being self-sustainable and meeting the frequency.

A) FLEET SIZE ESTIMATION METHODOLOGY

This method is mainly adopted for the Feeder system where the dependability of the frequency is on the primary system. Here feeder system is expected to be in synchronisation with the metro schedule, hence policy or headway based method is adopted for estimation of the fleet.

To estimate the fleet size for the Feeder system various parameters have been considered which were derived from field surveys. The factors required are given below:

- **Average Running Speed** = Based on field surveys (15-28 Km/hr.)
- **Run Time** = (Route Length/Journey Speed)
- **Dwell Time** = 30 sec for each stop

- **Layover time** = 5 to 10 min
- **Headway** = 6 to 13 min (as per metro frequency)
- **Average Journey Speed** = (Route Length/(Dwell Time+ Delay+ Run Time)
- **Number of Buses Required** = Length / (Average journey Speed*Headway)

Based on the above assumptions and estimations the fleet has been estimated separately for both Peak Hour and Non-Peak Hour. The average speed has been estimated for each route separately based on GPS and the same has been considered for fleet estimation. The vehicle type considered is of Mini-Van and Mini-Bus with the occupancy of the vehicle is considered to be 7 and 24 persons per vehicle. The fleet has been estimated for base year based on the frequency of the metro. The estimated fleet is again evaluated to see if it can accommodate the number of boarding or alighting passengers at the metro station based on the arrival pattern. The total ridership of the feeder was estimated based on the ridership of the metro system. The Boarding Alighting values of the Metro DPR were considered as the base in the estimation of feeder ridership. The opinion survey conducted for the feeder survey reveals that more than 51% of the PT users are willing to use Metro feeder services. However these values seem to be quite high and ambiguous so based on the case studies of other cities 20% of the metro users were assumed to be part of feeder catchment.

B) CASE STUDY DELHI

Since currently Delhi has a feeder system in operation for the Metro services at various stations in Delhi a review of Delhi metro is conducted. It was observed that Delhi metro is operating feeder buses on various routes in Delhi using Midi and Mini type of buses. The seating capacity of these buses are 18 for Mini and 27 for Midi with standing capacity being around 27 and 47 passengers appx. In addition each of these routes operate at a peak hr headway of around 10 mins. The fleet for each route is also defined and presented in the Delhi Metro website in the Feeder section along with other details (Source: http://www.delhimetrorail.com/otherdocuments/Feederroutes.pdf). The Boarding Alighting details of each of the Metro Station for the peak hour was obtained from DMRC.

From the available Headway and the route length the total fleet available in the peak hour is estimated for each route. From the total fleet the total capacity which is served by the feeder in Peak hour is estimated from the seating and standing capacity of each bus. The total capacity served by the feeder is compared with the total boarding at the metro station in the peak hour and the share of the metro passengers served by the feeder is estimated for each of the routes. The values estimated for each of the routes is presented below:

TABLE 6-5: ESTIMATED FEEDER SHARE FOR DELHI METRO

SN	Route No.	Metro Station	To	No of buses	Route Lengt (km)	Operated By	Run Time (Min)	Journey Time (Min)	Daily Boardings	Peak Hr Boardings	Bus Type	Seating Capacity (Pass)	Seating + Standing (Pass)	Peak Hr Headway	Number of buses in peak hr	Total Capacity of Feeder in Peak Hr (pass)	Feeder Share
1	ML-05& 56	Shastri Park	Mayur Vihar Ph- III	22	18	M/s PPMS	108	154	13673	1367	MINI	18	27	9	7	189	14%
2	ML-06	Vishwa Vidyalay a	Keshav Nagar	8	13	M/s PPMS	78	111	22623	2262	MIDI	27	47	9	7	329	15%
3	ML-09	Inderlok	Uttam nagar	12	18	M/s RCCS	108	154	9631	963	MIDI	27	47	9	7	329	34%
4	ML-17	Rohini West	Rama Vihar	4	9	M/s VTT	54	77	20073	2007	MINI	18	27	9	7	189	9%
5	ML-19	Pitampur a	Pushpanj ali/West Enclave	4	7	M/s VTT	42	60	17427	1743	MINI	18	27	9	7	189	11%
6	ML-20	Kirti Nagar	Pushpanj ali/West Enclave	9	10	M/s PPMS	60	86	13918	1392	MINI	18	27	9	7	189	14%
7	ML-23	Krishi Kunj (Rajendr a Palace MS)	Anand Parbat	6	8	M/s PPMS	48	69	29260	2926	MINI	18	27	9	7	189	6%
8	ML-24	Kirti Nagar	Sagarpur	7	8	M/s PPMS	48	69	13918	1392	MINI	18	27	9	7	189	14%
9	ML-26	Janakpuri West MS	Sultanpuri Terminal	6	11	M/s RCCS	66	94	24882	2488	MIDI	27	47	9	7	329	13%
10	ML-33	Dwarka Sec-16 (Dwarka Sec-12 MS)	KAROL BAGH M.S.	13	23	M/s RCCS	138	197	6166	617	MIDI	27	47	9	7	329	53%
11	ML-35	Dwarka Sector-10	Najafgar h (Tr)	8	12	M/s PPMS	72	103	8760	876	MINI	18	27	9	7	189	22%
12	ML-39	Shadipur	Naraina Vihar Gurdwar	7	6	M/s PPMS	36	51	32105	3211	MINI	18	27	9	7	189	6%
13	ML-51	Azadpur	Gokalpuri	6	12	M/s PPMS	72	103	13624	1362	MIDI	27	47	9	7	329	24%
14	ML-53	Dilshad Garden M S	Mayur Vihar PH- III	7	11	M/s RCCS	66	94	37653	3765	MIDI	27	47	9	7	329	9%
15	ML-57	Chhattar pur	Aerocity	10	9	M/s PPMS	54	77	29351	2935	MINI	18	27	9	7	189	6%
16	ML-58	Chhattar pur MS	Fatehpur Beri	5	6.5	M/s RCCS	39	56	29351	2935	MIDI	27	47	9	7	329	11%

The average share of the metro passengers served by the Feeder is estimated to be around 17%. Thus the value of 20% is considered for the case of Nagpur feeder services.

Based on this the final fleet was estimated for each route for peak and non-peak hours and is presented in the table below:

TABLE 6-6: ESTIMATED FLEET FOR VARIOUS ROUTES FOR PEAK AND NON-PEAK HOUR FOR BASE YEAR CONSIDERING MINI-VAN & MINI-BUS

Route ID	Corridor	Route Type	Station Covered	Length (Km)	Vehicle Type	Fleet Required	
						2017	2027
R-1	E - W	Circular	Prajapati Nagar	6.17	MV	**6**	**6**
R-2	E - W	Point to Point	Prajapati Nagar	5.86	MV	**4**	**5**
R-3	E - W	Circular	Prajapati Nagar	4.37	MV	**4**	**4**
R-4	E - W	Circular	Vaishnov Devi Chowk	7.11	MV	**5**	**5**
R-5	E - W	Circular	Telephone Exchange, Dr Ambedkar Sq	5.10	MV	**4**	**4**
R-6	E - W	Circular	Telephone Exchange	6.61	MV	**5**	**5**
R-7	E - W	Circular	Telephone Exchange	3.77	MV	**3**	**3**
R-8	E - W	Circular	Telephone Exchange	5.43	MV	**5**	**5**
R-9	E - W	Circular	Agrasen Chowk, Dosar Vashya	3.18	MV	**7**	**11**
R-10	E - W	Circular	Nagpur Railway Station	4.15	MB	**4**	**6**
R-11	E - W	Circular	Sitaburdi	4.12	MB	**4**	**5**
R-12	E - W	Circular	Institution of Engineers	4.35	MV	**9**	**10**
R-13	E - W	Circular	Shankar Nagar, LAD Sq	4.49	MV	**3**	**3**
R-14	E - W	Circular	Shankar Nagar	3.54	MV	**3**	**3**
R-15	E - W	Circular	LAD Sq, Shankar Nagar	3.00	MV	**3**	**3**
R-16	E - W	Point to Point	Ambazari Lake View Stn	4.10	MB	**4**	**4**
R-17	E - W	Circular	Subhash Nagar	5.58	MV	**4**	**4**
R-18	E - W	Point to Point	Rachana	3.75	MV	**3**	**3**
R-19	E - W	Point to Point	Bansi Nagar	6.85	MV	**8**	**11**
R-20	E - W	Point to Point	Lokmanya Nagar	5.22	MB	**4**	**4**
R-21	N - S	Point to Point	Automotive Sq	4.38	MV	**8**	**10**
R-22	N - S	Circular	Automotive Sq	4.00	MV	**3**	**4**
R-23	N - S	Circular	Nari Rd	5.33	MV	**4**	**4**
R-24	N - S	Circular	Nari Rd	3.41	MV	**3**	**3**
R-25	N - S	Circular	Indora Chowk	5.15	MV	**4**	**4**
R-26	N - S	Circular	Indora Chowk	3.21	MV	**4**	**4**
R-27	N - S	Circular	Kabdi Chowk	5.43	MV	**4**	**5**
R-28	N - S	Circular	Gaddi Godam	4.71	MV	**5**	**5**
R-29	N - S	Circular	Kasturchand Park	5.70	MV	**6**	**5**
R-30	N - S	Circular	Zero Mile	6.62	MV	**5**	**5**
R-31	N - S	Point to Point	Congress Nagar	9.32	MB	**14**	**18**
R-32	N - S	Point to Point	New Airport	2.00	MV	**4**	**5**
R-33	N - S	Point to Point	Chatrapati Sq	5.98	MV	**5**	**5**
R-34	N - S	Circular	Chatrapati Sq, Ajni Square, Jaya Prakash Nagar	6.34	MV	**6**	**6**

Route ID	Corridor	Route Type	Station Covered	Length (Km)	Vehicle Type	Fleet Required	
						2017	2027
R-35	N - S	Circular	Ujwal Nagar	5.67	MV	**7**	**7**
R-36	N - S	Circular	Airport	2.18	MV	**2**	**3**
R-37	N - S	Point to Point	Khapri	2.69	MV	**5**	**6**
R-38	N-S	Point to Point	Khapri	31.30	MB	**12**	**12**
Total Mini- Van						**151**	**161**
Total Mini-Bus						**42**	**54**

As it was also observed that certain routes require larger fleet due to higher station loadings, it was suggested to have a mixed fleet or larger fleet for these routes. From the table it was observed that the total fleet required is 151 Mini-Vans and 42 Mini-Buses in 2017 and 151 Mini-Vans and 54 Mini-Buses in year 2027.

6.3.1.2 SPAN OF OPERATIONS

Since the feeder service is designed to cater specifically to the metro system, the services of it shall be aligned to the Metro. The service frequency and the hours of operations shall also be in line with the Nagpur Metro. The Nagpur Metro DPR suggests a running time of 19 Hrs. for the metro system from 5:00 am till Midnight. Since the dependability on feeder may not be that very high in the lean period the operations can be started at 07:00 Hrs. and can be functional till 23:00 Hrs. So the effective hours of operation for feeder shall be 15hrs. The frequency on the other hand shall be as that of the Metro Rail which varies from 6 to 6.5 min in peak hour and 12 to 13 min in non-peak hour. The hours of operation or the frequencies can further be changed when the metro is operational. The details of the frequency and operation are provided in table below:

TABLE 6-7: FREQUENCY AND OPERATION FOR BASE YEAR

Period	Headway (min)	Period of Operations	Hours of Operation (hrs)	Total Mini-Van Deployed (Base Year)	Total Mini-Bus Deployed (Base Year)
Peak Hour	6 to 6.5	8:00 hrs to 11:00 hrs, 16:00 hrs to 20:00 hrs	7	151	42
Non -Peak Hour	12 to 13	07:00 hrs to 08:00 hrs, 11:00 hrs to 16:00 hrs, 20:00 hrs to 22:00 hrs	8	88	20

6.3.1.3 FLEET DEPLOYMENT PLAN

Since the Mini-Vans operated as feeder services are run by battery operated vehicles and its total operation will be limited to only 100 -120 kms running for 6-8 hrs it's essential to have a proper deployment plan. The above fleet is the actual fleet required on the ground. This consist of both Mini-Vans (Electric) and Mini-Buses (Diesel). The detailed fleet deployment plan for Mini-Vans and Mini-Buses are shown in the tables below.

TABLE 6-8: DETAILED FLEET DEPLOYMENT PLAN FOR MINI-VAN

Time	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00	22:00-23:00
Hrs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Peak/Non-Peak	NP	P	P	P	NP	NP	NP	NP	NP	P	P	P	P	NP	NP	NP
Fleet Req	88	151	151	151	88	88	88	88	88	151	151	151	151	88	88	88

TABLE 6-9: DETAILED FLEET DEPLOYMENT PLAN FOR MINI-BUS

Time	07:00-08:00	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	17:00-18:00	18:00-19:00	19:00-20:00	20:00-21:00	21:00-22:00	22:00-23:00
Hrs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Peak/Non-Peak	NP	P	P	P	NP	NP	NP	NP	NP	P	P	P	P	NP	NP	NP
Fleet Req	20	42	42	42	20	20	20	20	20	42	42	42	42	20	20	20

From the above tables it can be observed that the total Mini-Vans required at night after 20:00 hrs is reduced to 88 keeping in view of the lean period and similarly for Mini-Bus it has been reduced to 22.

TABLE 6-10: FLEET DEPLOYMENT SUMMARY FOR MINI-VANS

Time	07:00-08:00	08:00-11:00	11:00-15:00	15:00-16:00	16:00-20:00	20:00-23:00
Hours of Operation	1	3	4	1	4	3
Peak/Non-Peak	Non-Peak	Peak	Non-Peak	Non-Peak	Peak	Non-Peak
Fleet Deployed	88	151	88	151	151	88
Remaining	151	88	151	0	0	0

TABLE 6-11: FLEET DEPLOYMENT SUMMARY FOR MINI-BUSES

Time	07:00-08:00	08:00-11:00	11:00-14:00	14:00-15:00	15:00-20:00	20:00-23:00
Hours of Operation	1	3	3	1	5	3
Peak/Non-Peak	Non-Peak	Peak	Non-Peak	Non-Peak	Peak	Non-Peak
Fleet Deployed	20	42	20	22	42	22
Remaining	22	0	22	20	0	20

6.3.2 SERVICE PLAN FOR CITY BUS SERVICES

6.3.2.1. FREQUENCY OF SERVICES

The existing average headway is 30 minutes, which is higher than the average travel time in the city. This is a deterring factor for any user who is willing to choose public transportation. This arises the need for suitably adjusting the headways of the rationalized city bus routes in Nagpur.

The total estimated ridership on the proposed city bus services network is the potential demand which can be captured once the complete rationalized city bus system is in place. The expected route frequency was calculated based on the possible peak hour ridership (supply) against the demand (PHPDT). Considering the mentioned parameters and depending on the route type (Trunk/Feeder Routes) and distance of the routes, the average headway derived during the peak and off-peak hours is represented in the Table 6-12 and Table 6-13.

TABLE 6-12: RECOMMENDED PEAK HOUR HEADWAY ON RATIONALIZED CITY BUS ROUTES

Route Length (Km)		Peak Hr Headway (min)		
		Phase-1 (2018)	Phase-2 (2023)	Phase-3 (2028)
0	5	22	14	12
5	10	26	18	14
10	15	24	20	11
15	20	26	18	16
20	25	18	17	13
25	30	15	10	5
	>30	15	10	5
Average		**20**	**15**	**10**

TABLE 6-13: RECOMMENDED OFF - PEAK HOUR HEADWAY ON RATIONALIZED CITY BUS ROUTES

Route Length (Km)		Peak Hr Headway (min)		
		Phase-1 (2018)	Phase-2 (2023)	Phase-3 (2028)
0	5	31	20	17
5	10	36	26	20
10	15	34	28	15
15	20	37	25	23
20	25	34	33	21
25	30	30	20	10
	>30	30	20	10
Average		**30**	**22**	**15**

To start with, the overall peak hour headway shall be decreased from 30 mins to 20 mins in 2018 for overall operations on 46 routes, which shall be further decreased to 10 mins by 2028 for overall operations on 76 routes. The frequency of the bus routes can be further optimized, once the rationalized bus routes are implemented and the route loadings are closely monitored to check the build of demand.

6.3.2.2. PHASING PLAN

It is recommended in the previous section that the operationally and financially viable 76 routes shall be introduced in a phase wise manner. 46 routes are recommended to be introduced in 2018, whereas additional 18 routes in 2023 and additional 12 routes in 2028. The phasing plan is recommended based on the PHPDT and demand on the rationalized city bus routes. The route wise operational plan is detailed out in the Annexure.

6.3.2.3. FLEET ESTIMATION

Estimation of Fleet size is quite essential for any public transport system. Surplus fleet often leads to underutilization and eventually increase the capital and operation costs. On the other hand, insufficient fleet drives the users to adopt a different mode leading to the reduction in the ridership values. So, it is important that an optimal fleet size is determined and such a system needs to be developed which ensures enough fleet size to meet the ridership demand at the same time being self-sustainable.

To estimate the fleet size for the rationalized city bus services for Nagpur city, various parameters have been considered which were derived from field surveys and model outputs. The fleet estimation assumptions are as follows;

- Hours of Operations – 16 hours
- Average Running Speed – 25 kmph
- Distance between bus stops – 500 m
- Dwell Time at the Bus stops – 30 seconds per stop
- Average Layover time – 20% of the total one way running time
- Total one way Journey Time – Total Run Time+ Dwell Time at the Bus Stops + Layover Time
- Headway (min) = (Passenger Capacity of vehicle * Peak Hour Load Factor * 60) / Peak Hour Demand
- Fleet Required – Total Journey Time (min) / Headway (min)
- Spare vehicles – 5% of the Total fleet.

Based on the above parameters and the project phasing plan, the fleet size and headway have been estimated for the 2018, 2023 & 2028. The details of routes proposed along with route length, proposed headway and fleet size are presented in annexure. Table 6-15 represents the summary of the fleet requirement.

TABLE 6-14: CONSOLIDATED PHASE WISE FLEET REQUIREMENT

Year	No. of Routes	No. of Buses (Including 5% contingency)		
		Yr_2018	Yr_2023	Yr_2028
In 2018	46	577	909	1199
In 2023	18	0	132	242
In 2028	12	0	0	78
Total	**76**	**577**	**1041**	**1519**
5% Contingency		30	52	77
Grand Total		**607**	**1093**	**1596**

With the route rationalization the total no. of buses required for the city bus operations in Nagpur city is 607 buses on 46 routes in 2018 i.e on an average 13 buses per route. In 2023, the city needs to operate 1093 buses on 64 routes i.e; 16 buses per route and In 2028, the city needs to operate 1596 buses on 76 routes i.e; 20 buses per route.

NMC has been currently operating 237 diesel fuelled standard buses 10 ethanol fuelled standard buses, i.e; a total of 248 buses. NMC has also made plans to introduce a total of 487 buses into the system including the already operational buses, in coordination with the 3 city bus operators. Considering the existing situation of NMC; the city would require adding another 120 buses and operating on additional 46 routes for efficient operations of the city bus services in Nagpur in 2018.

The detailed route wise fleet requirement for city bus services for 2018, 2023 and 2028 are attached as Annexure.

TABLE 6-15: CONSOLIDATED PHASE WISE FLEET REQUIREMENT BY

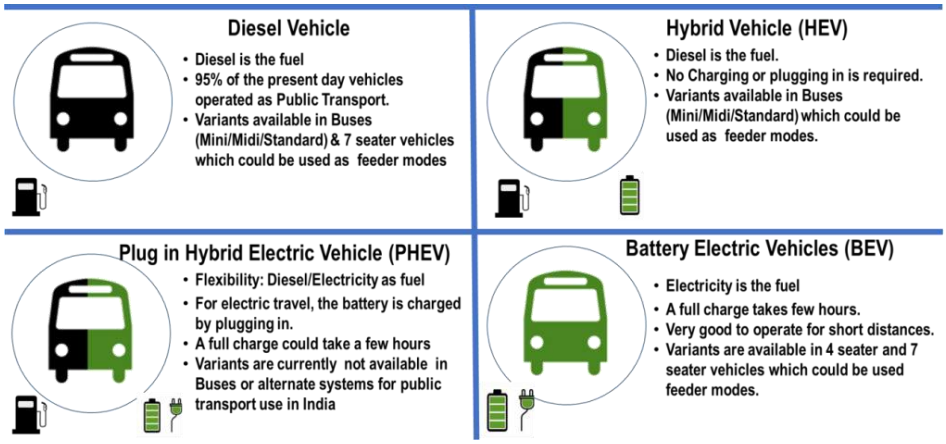
Type of Bus	No. of Buses		
	Yr_2018	Yr_2023	Yr_2028
Midi	16	73	172
Standard – B	114	156	196
Standard – D	396	724	1034
Standard – E	51	88	117
Total (A)	577	1041	1519
5% Contingency (B)	30	52	77
Grand Total (C = A+B)	**607**	**1093**	**1596**

6.4. VEHICLE SELECTION

For Metro Feeder Services and for City buses service, vehicles are important in bearing the ridership attraction, system performance, and environmental compatibility. Vehicles also play a strong role in determining the real performance in terms of speed, reliability and cost. They are critical from the perspective of commuters, the community as a whole and the operating entity for a number of reasons. Vehicles have a strong effect on every measurable aspect of system performance. Choice of an optimal vehicle is hence, the most important aspect of the system design and element selection.

Vehicle technology can be classified in two categories which are fuel based and vehicle based. Figure 6-5 represents the various vehicle options available along the general description of each of the technologies. Typically transit agencies across the world have extensively been dependent on diesel buses and other long standing technologies to move passengers. With the increasing concern on the degradation of the air quality in the urban set-up, transit agencies have been adopting cleaner and more efficient technologies such as electric vehicles and diesel hybrid vehicles, regenerative braking and energy storage, biofuels, natural gas vehicles, hydrogen fuel cell vehicles etc lately.

FIGURE 6-5: PUBLIC TRANSIT VEHICLE TECHNOLOGIES



6.4.1 VEHICLE TECHNOLOGY

As it is recommended to operate premium segment clean fuel buses on some of the trunk routes, a brief review of the various buses w.r.t the fuel technologies available has been represented in the Table 6-16. The vehicles are classified based on the fuel/source of energy that is used to power the transmission of buses. The vehicle segments can be broadly classified into two broad categories based on the technology: Conventional Internal Combustion Engines (ICE) vehicles and electric vehicles. Further following classifications have been considered for the assessment.

1. Conventional ICE Vehicles (ICEVs)
   - Diesel based buses
   - Compressed Natural Gas (CNG) based buses

- Biofuel/Ethanol mix buses

2. Electric Vehicles
   - Hybrid Electric Vehicles (HEVs)
   - Battery Electric Vehicles (BEVs)

The vehicles have been compared on factors such as operational costs and environmental impact which has been presented in the Table 6-16.

TABLE 6-16: COMPARISON OF FUEL TECHNOLOGIES IN BUSES

Sl No	Parameters	Diesel Buses	CNG Buses	Bio Fuels powered Buses	Hybrid Buses	Battery Electric Buses
1	Power Source	Diesel	CNG	Biofuels mix	Electricity + fuels	Electricity
2	Fuel Dispensing Infrastructure	Readily Available	Unavailable (High cost)	Unavailable (Marginal Cost)	Unavailable/Available (Medium cost)	Unavailable (Medium Cost)
3	Fuel Efficiency (Rs/km)	15-23	13-20	12-18	13-17	10
4	Emissions	High (baseline)	Low (equal CO2, less SOx, NOx and NMHC)	Low (less CO2, SOx, NOx)	Low (less CO2, SOx, NOx and NMHC)	Zero (local)
5	Noise	High (baseline)	High	High	Low (at slow speeds)	Minimum
6	Maintenance	High	High	Higher	Higher	Lowest
7	Maturity of Technology	High	High	Medium/ Trial runs performed	High/ not deployed on large scale	High/ deployed on large scale outside India
8	Government Policies	No specific benefits	No specific benefits	Not established	Fiscal incentives on rolling stock in the past (FAME Policy)	Fiscal incentive in past. Govt push for faster adoption of technology and lowering cost of rolling stock

6.4.1.1. RECOMMENDATION FOR METRO FEEDER SERVICES

For the city of Nagpur a total of 38 feeder routes have been suggested with an average route length of 4-6 km. considering the city profile and various other factors it is recommended to have vehicle with smaller dimensions such as Mini Van which runs on alternate fuel technology such as electricity. Apart from that certain routes with higher demand or larger route lengths were selected for Mini Bus, depending on the ROW available. The reasons for suggesting this technology are as follows:

- The average route length is very small, hence smaller vehicles shall be able to cover up this distance
- The motive of the Nagpur Metro is to provide environmentally sustainable public transport system. Hence a battery operated vehicle would be ideal for this case.
- In addition the total operating cost of the vehicle shall be low as there is no fuel cost associated with this vehicle type. This in turn can help in introducing subsidized fare for passenger.
- Since the routes identified are running into core residential areas with limited ROW at certain street sections, it is suggested to have vehicles with lesser turning radius for easy maneuverability.

- Larger vehicles tend to have lesser average speeds in the city due to congestion which increases the overall journey time hence calling in for more fleet to maintain the frequencies. So it is recommended to have smaller vehicles which can maintain the running schedule and reduce the number of deviations.

In addition the wait time associated at the stops is less since the vehicle carrying capacity is small hence the total journey time of the passenger shall come down. Therefore this will help in reducing the overall cost of the passenger.

Two Variants of vehicles are proposed to be procured for the successful operations of the Metro Feeder Services in the Nagpur City which are;

1. Mini Buses with a seating capacity of 13 - 22 passengers.
2. Mini Vans with a seating capacity of 7 passengers.

6.4.1.2. RECOMMENDATION FOR CITY BUS SERVICES

The fleet majorly consisted of 44-seater Standard buses and 28 seater Midi Buses. With the transition of operations from NCC Model to GCC Model the 4 operators are expected to utilise the following fleet into the system.

TABLE 6-17: PROPOSED FLEET INTRODUCTION BY NMC FOR CITY BUS OPERATIONS[4]

Total Fleet	**487 Buses**	
Fuel Type	Diesel	Ethanol
No. of Buses	432 Buses	55 Buses
No. of Operators	3 Operators	1 Operator
No. of Buses under each operator	144 Buses (33% of the total diesel buses)	55 Buses (100% of the total ethanol buses)
Type of Buses		
- ***Standard Buses***[5]	79 Buses	
- ***Midi Buses***[6]	50 Buses	
- ***Mini Buses***	15 Buses	

The aim of the bus system in Nagpur shall be firstly to cater the demand on the routes, secondly provide a higher vehicle quality services with improved comfort and branding to differentiate services from regular services and thirdly to lower local emissions (and possibly overall emissions) in the city.

NMC with support from Scania Commercial Vehicles India Ltd. has been operating 10 Green Buses i.e buses fuelled with ethanol produced from molasses in the Nagpur City for City Bus Operations and plans to introduce another 45 buses. As mentioned in the Chapter 3, with an intension of promoting electric vehicles within the country, the city has taken up initiatives by introducing electric vehicles such as taxis, e-rickshaws, buses and autos. It is anticipated that more such efforts shall be brought into the system in the long term. However, considering all the issues and options mentioned above,

Three variants of vehicles are proposed to be procured for the successful operations of the city bus services in Nagpur City which are;

1. Standard Buses & Midi Buses – Internal Combustion Engine (ICE) fuelled by Diesel/CNG with a seating and standing capacity of 55 passengers and 40 passengers is recommended.
2. Standard Buses - Internal Combustion Engine (ICE) fuelled by Ethanol with a seating and standing capacity of 55 passengers is recommended.
3. Standard Buses – Electric Bus with a seating and standing capacity of 55 passengers is recommended.

[4]Source: Nagpur Municipal Corporation & DIMTS

[5] Old Buses to be redistributed to the operators by NMC

[6] Midi & Mini Buses to be procured by the Operators

The propulsion system technologies, however, could be upgraded with the emission norms and availability of the proved, cost effective and more efficient technologies.

The broad specification of types of vehicles for service has been presented below. All bus procurement would follow the Urban Bus Specifications – II (UBS-II) issued by the Ministry of Housing and Urban Affairs (then Ministry of Urban Development) or any future specifications issued for Buses.

A) BUS SPECIFICATIONS OF STANDARD SIZE URBAN BUS (AC/NON AC)

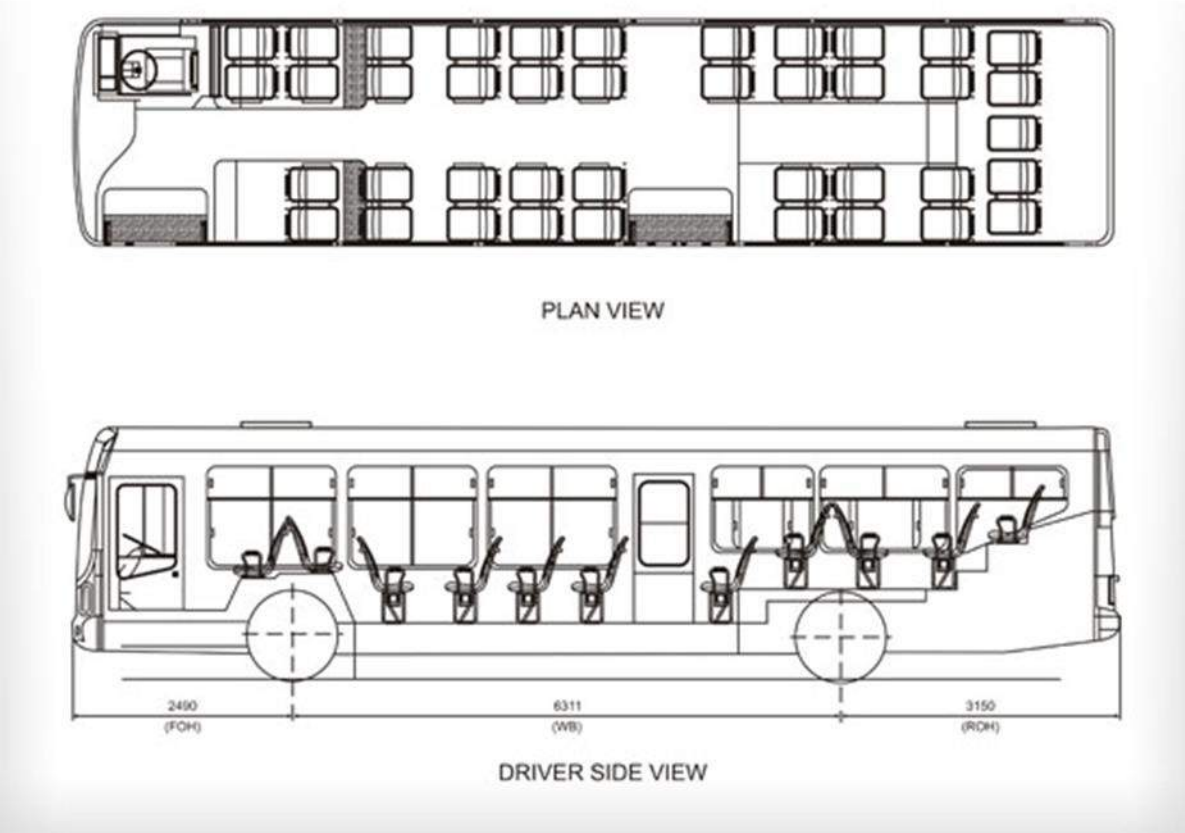
Standard Buses are 32 to 34 seater vehicles which are widely used as part of city bus services as well as inter-city movements in majority of the cities in the country. The overall length of the bus is 12 m as per the Urban Bus Specifications II. Some of the indicative specifications are mentioned in the following Table 6-18.

TABLE 6-18: INDICATIVE SPECIFICATION FOR THE STANDARD SIZE URBAN BUS (AC/NON AC)

Characteristics	Standard Size Urban Bus (AC/Non AC)
Propulsion System	ICE, Electrical, Hybrid, Fuel Cell, Bio Fuel
Emission	BS III/ BS IV/ latest as applicable
Seating Capacity	32 to 34
Seating Layout	2X2
Steering	Hydraulic Power Steering with height & angle adjustments
Turning Radius (m)	14
Overall Length (mm)	12,000 (minus tolerance of 100)
Overall Width (mm)	2600 (maximum)
Overall Height (mm)	3800 (maximum)
Maximum Floor Height (mm)	900/650/400
Life Cycle	12 Years or 10,00,000 kms[7]

[7]Typically considered but usually varies from bus agency to agency all across the country.

FIGURE 6-6: INDICATIVE LAYOUT FOR THE STANDARD SIZE URBAN BUS



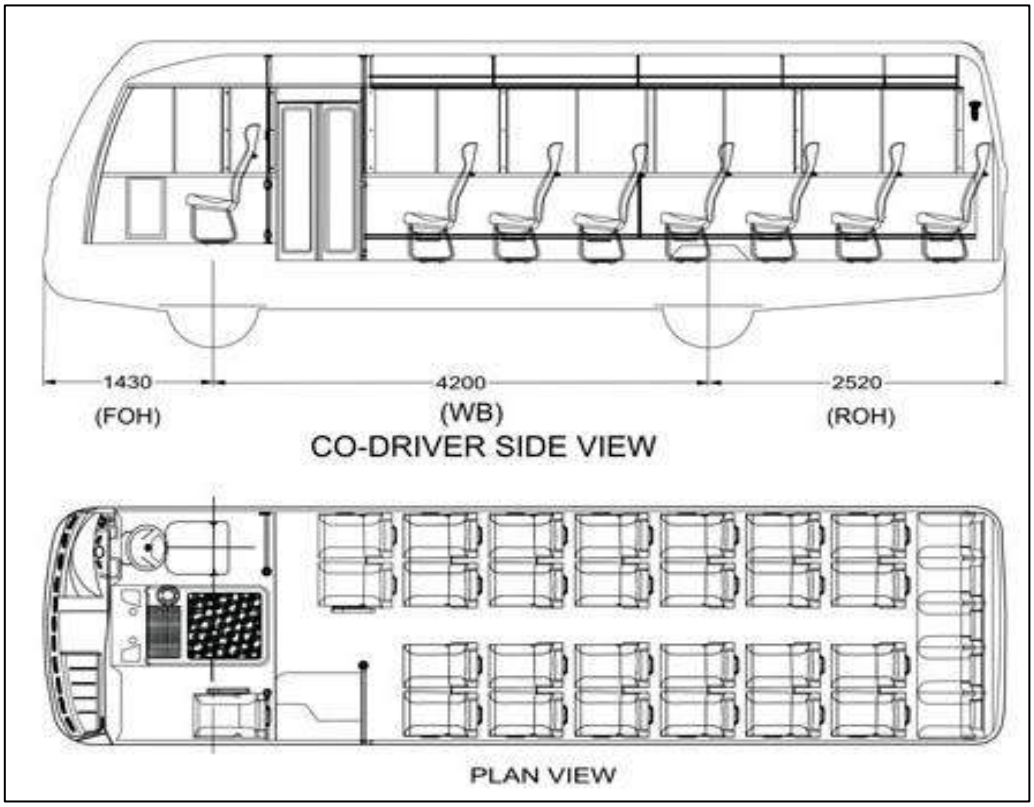
B) BUS SPECIFICATIONS OF MIDI SIZE URBAN BUS (AC/NON AC)

Midi type is a 23-28 seater vehicle which is widely used in many cities. The maximum length of the bus is up to 9.4 m as per the UBS-II specifications which are presented.

TABLE 6-19: SPECIFICATION OF MIDI BUSES

Characteristics	Midi Bus
Emission	BS III/B IV/latest as applicable
Gears	5+1
Steering	Power
Seating Capacity (As per AIS 052)	23 to 28
Turning Circle Diameter (m) (appx. Fig)	14
Wheelbase (mm)	<=5000
Overall Length (mm)	<=9400
Max Floor Ht (mm)	900/650/400
Overall Width (mm)	<=2500
Life Cycle	12 Years or 10,00,000 Km

FIGURE 6-7: TYPICAL LAYOUT OF MIDI BUSES



C) MINI TYPE:

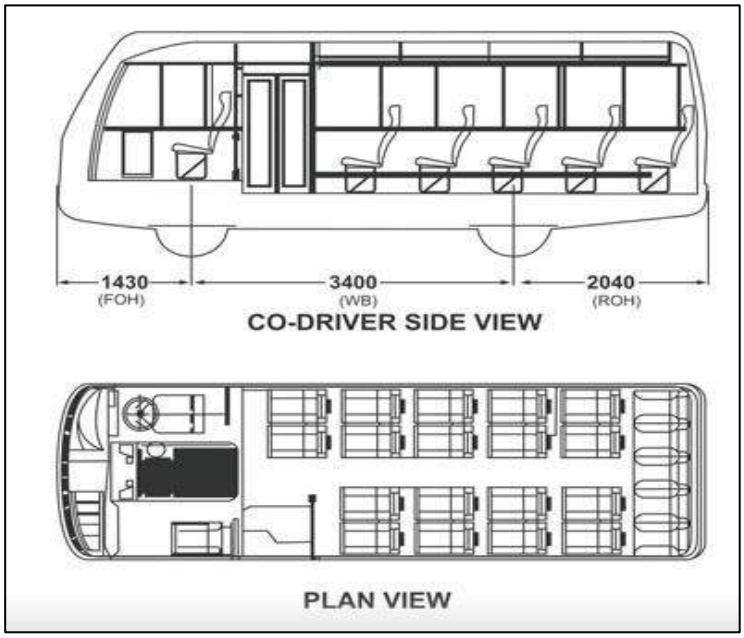
Mini type is a 13 to 22 seater vehicle which is widely used as part of feeder or connecting bus in many cities. The maximum length of the bus is up to 9.4 m as per the UBS-II specifications which are presented in the table below:

TABLE 6-20: UBS-II MINI BUS SPECIFICATION

Characteristics	Mini Bus
Emission	BS III/B IV/latest as applicable
Gears	5+1
Steering	Power
Seating Capacity (As per AIS 052)	13 to 22
Turning Circle Diameter (m) (approx. value)	13
Wheelbase (mm)	>=3000
Overall Length (mm)	<=7000
Max Floor Ht (mm)	900/650/400
Overall Width (mm)	<=2200
Life Cycle	12 Years or 10,00,000 Km

The figure below shows the typical plan and side view of the Mini Buses.

FIGURE 6-8: MINI BUS VIEW



D) MINI VAN:

This is a smaller type of vehicle with 6-7 seater capacity usually suitable for smaller distances and to have shorter headways. Mini Vans are not covered under the Urban Bus Specifications (UBS), hence industrial standard vehicles can be adopted in this case. The indicative specifications for the minivan are provided in table below:

TABLE 6-21: MINI VAN SPECIFICATION

Characteristics	Mini Van
Emission	NA
Gears	NA
Seating Capacity	7+1
Turning Radius (m)	4.6
Wheelbase (mm)	1950
Overall Length (mm)	3677
Overall Height (mm)	1845
Overall Width (mm)	1540

The figure below shows the typical plan and side view of the Mini Van.

FIGURE 6-9: MINI VAN VIEW

6.5. CONCLUSIONS

The demand based fleet assessment for the Metro Feeder Services and City Bus Services in Nagpur has been worked out. As mentioned in the previous section 193 Buses in 2017 and 215 Buses in 2027 for Metro Feeder Services. As mentioned in the previous sections, the fleet for city bus services has been worked out to be 607 buses in 2018, 1093 in 2023 and 1596 in 2028. Considering NMC has plans for introducing 487 buses into the system, additionally 120 buses need to be procured to be included into the system by 2018, additionally 579 buses in 2023 and 397 buses in 2028. Through the route rationalization process for the city bus services, some of the routes were proposed to be removed, extended/curtailed to improve the connectivity to the demand areas.

With the city bus route rationalization, the following benefits for the City Bus Services is anticipated;

- The daily ridership will be increased to 3.6 lakh in 2018, 5.9 lakh in 2023 and 8 lakh in 2028 from the current 98,000.
- The total no. of buses per route would be increased to 18 buses by 2028 as compared to the currently 9 buses
- To start with, the overall peak hour headway shall be decreased from 30 mins to 20 mins in 2018 for overall operations on 46 routes, which shall be further decreased to 10 mins by 2028 for overall operations on 76 routes. The frequency of the bus routes can be further optimized, once the rationalized bus routes are implemented and the route loadings are closely monitored to check the build of demand.

Considering this, it is recommended that Midi & Standard AC/Non AC buses propelled by ICE fuelled by Diesel/CNG compliant to BS III/IV emission norms be procured as per the UBS II specifications and prevailing CMVR Guidelines along with the Standard Ethanol and Standard Electric buses.

CHAPTER 7 INFRASTRUCTURE DEVELOPMENT AND MAINTENANCE STRATEGY

7.1 INTRODUCTION

Public transportation support infrastructure forms part of important initiatives of governments at all levels to meet challenge of reducing the use of private travel modes. Support infrastructure for the city bus services and feeder services such as depots, feeder stops and ITS (Intelligent Transport Systems) facilities etc. are essential for any public transport system to operate successfully. Without these facilities, the system is incomplete and would fail to attract the commuters.

The existing support infrastructure available within the Nagpur City is described in Chapter 3. It has been observed that the existing infrastructure is outdated and insufficient for the current and future system, making a case for new/revamped infrastructure to cater to the future demand. The current chapter aims at establishing the infrastructure requirements of the upgraded city bus services and proposed feeder services.

7.2 BUS Q SHELTERS

Bus Q Shelters act as collector points for passengers using public transport by means of bus services. It is one of the most important components required for the successful operations of the public transport system which would provide a dedicated place for boarding and alighting passengers. It is important that the design of the infrastructure provided at the bus stops is of high quality and of consistent standard so that the passengers use city bus services conveniently. Bus stops have been located considering passenger convenience, safety and other road users. The following objectives has been taken into consideration for the design of the bus stops;

FIGURE 7-1: OBJECTIVES FOR BUS Q SHELTERS

The details of existing situation of the Bus Q Shelters is discussed in Chapter 3, wherein Figure 3-28 represents the location of scheduled bus stops as per the city bus routes and Figure 3-29 represents the existing situation of the Bus Q Shelters in Nagpur City. Based on the discussions with NMC, NMC has constructed approximately 190 Bus Q Shelters in Nagpur, which have a definitive structure. However, it has been observed that there is frequent construction and destruction of pavement at the bus stops making them difficult to be used.

1. Due to Construction and Deconstruction of the pavement at the bus stops, On Street Parking of 2 Wheelers and 4 Wheelers making them unusable.
2. Height of the bus stop level, forces the bus users to wait for the bus on the main carriageway.

Typically, the distance between two consequtive bus stops and request stops in Nagpur are located 650 – 700 m apart. The bus stops should be located within the walking distance for the majority of the passengers.Hence, it is recommended that a bus stop can be located at a spacing of 500 m.

7.2.1 BUS Q SHELTER PLANNING

While planning the bus Q shelters, the following parameters have been considered for achieving efficient, safe, convenient and aesthetically appealing infrastructure;

1. The maximum area of shelter shall be used by the public to provide better level of comfort. This provides easiness between boarding alighting and waiting space.
2. Absence of backside covering at some part, in order to allow better natural light & ventilation at the shelter.
3. The arrangement of the bus shelter is assessed on a shelter-to-shelter basis and is determined by site constraints and passenger access requirements. However, it is planned in such a way that maximum utilization of space can be achieved for public comfort and adequate circulation space.
4. Sufficient space for queuing and passenger flow to be ensured at the shelter. However, the available space may be constrained by local site conditions. Besides this, the other considerations should be:
    a. Adequate capacity for passenger movements.
    b. Convenience, including good signage relating to system information, circulation and orientation.
    c. Safety and security, including a high level of protection against accidents.
    d. Adequate safety measures against fire to be taken.
    e. Electrical safety standards like ELCB and earthing etc. to be provided.
5. Also the following miscellaneous requirements have to be considered;
    a. Minimum operating costs are incurred consistent with maintaining efficiency and the safety of passengers.
    b. Flexibility of operation including the ability to adapt to different traffic conditions and provision for the continuity of operation during any extended maintenance or repair period, etc.
    c. Provision of good visibility at shelters, natural light, ventilation and other utilization areas aiding more efficiency and safety.
    d. Provision of display of passenger information and advertising.
    e. Passengers should be transferred efficiently from street to footpath and from footpaths to shelter and vice versa, the spatial planning has to be based on established principles of pedestrian flow and shall minimize avoidable walking distances and cross-flows between incoming and outgoing passengers.
    f. Passenger handling facilities comprise ramps, walkways and boarding - alighting area, required to process the peak traffic from street to platform and vice-versa. These facilities must also enable evacuation of the shelter under emergency conditions.
    g. The substructure and the super structures that afford maximum transmission of natural light and are architecturally/ aesthetically pleasing to look at are envisaged. The structures/sub components, wherever necessary, shall look compatible with both, modern environment as well as the lesser-built developments along various sections of the bus route corridor. This can be planned without compromising with environmental protection from sun and rain.

h. Shelter roofs can planned with materials such as sleek mild steel frame with polycarbonate sheet or better material to achieve slender appearance. The disposal of rain water and dirt from the roof should be taken care of.
i. Accessibility: Shelters are design on the concept of free flow of passenger traffic. In this regard, no gates would be required at the shelter. Ramp can be provided at the one side for physically challenged passengers.
j. Lighting: Since the bus operations are planned to be extend over a period of 16 hrs, adequate lighting is necessary along with natural lighting, ensuring minimum illumination levels of 60 lux in the waiting, boarding and alighting areas. The uniformity ratio (Average Intensity/ Minimum Intensity) should be 2 (Two). Solar panels and batteries for lighting in BQS and for the advertisements should be planned.
k. Floor/Landing Surfaces: Always the floor in the BQS can be of firm, stable and anti skid type, with an finishing of consisting of either concrete or pre polished concrete designer tiles 20 mm thick of approved colour, shape and pattern, in floor jointed with neat cement slurry/binding material, over a bed of 150 mm cement concrete mix of 1:4:8 and 50 mm thick cement mortar of 1:6 mix. The tactile tiles to be laid as per provisions for physically challenged. The advantages of this flooring would be easily washable and cleanable, acid resistant.
l. Necessary cut outs for electric connections, lighting, for advertisement panel's etc should be provided at required places in the sub structure or superstructure in a concealed manner.
m. Painting Work: It can be planned to the minimum extent possible by use of suitable material, however on plastered surfaces, a primer coat and three coats of Plastic paint and on mild steel members, a primer coat with 2/3 coats of enamel paint. In case of Aluminum section, anodizing of 20 microns can be recommended.
n. Steel Work/ frames: For the efficient utilization of space vertical/horizontal members for demarcating and segregating different types of areas, to the extent possible, to be of prefab type, able to house the hanging/fastening of display panels, informative maps etc.
o. Roof: Preferably can be of Polycarbonate sheets/any other similar material and Steel work in built up tubular trusses, to be Fire retardant. The characteristics may be summed up as: Virtually unbreakable, high resistance to weathering-temperature variation
p. Easily fabricated & installed, Low flammability, Light Weight, Easily Cleaned, Excellent Insulation Properties. The material should also be suitable for Cutting, Drilling, Bending and Thermoforming. The roof has to withstand live loads such as that of the cleaning staff and for monkeys, which jump on roofs.
q. Steel Work as Sub Structure: Considering the quality and faster deployment of BQS, always Pre fabricated should be preferred with Mild Steel in built up tubular trusses including cutting, hoisting, fixing in position, welded and bolted including special shaped washers etc. complete above plinth level.
r. Area for advertisements: The area of advertisement would be restricted to the prevailing norms and as per existing policy in Nagpur. The total advertisement area should not exceed 36 Sq. ft. in total in case of 10x3 m meter and 22 Sq. ft. in total in case of 6x3 m meter .
s. Construction materials can be planned such that they age well and do not require extensive maintenance or replacement. The Bus shelters existing and proposed were further analyzed by the following parameter in order to finalize the appropriate location of the bus shelter.
t. Along with the basic design keeping Indian condition in view the bus shelters would also require public convenience facilities that are kiosk, public utility and landscaping at the suitable locations.

TABLE 7-1: PARAMETERS FOR SETTING UP OF BUS Q SHELTERS

S no.	Parameters	Reasoning
Spatial Parameters		
1	Landmark	Adjoining landmark would act as the identity mark for the identification of the spot, in order to cross check the location of the spot with reference to the number of the same spot.
2	Adjoining Land use	The land use would indeed justify the allocation of the spot both in terms of spatial and local requirements.

S no.	Parameters	Reasoning
Physical Infrastructure		
3	Foot Path	The footpath would act as the base for the structure of the Bus shelter. Therefore its availability becomes foremost prerequisite for the BQS to set. Moreover the existing foot path could be analyzed as it would serve the BQS or not.
4	Gas Pipeline	The construction of any shelter act as a constraint due to presence of gas pipeline as the permission for the construction is required.
5	Electric Lines	The installation of ITS and the lights in the BQS would require availability of electric lines.
Ancillary Infrastructure		
6	Advertisement	The Presence of Advertisement boards would reduce the cost of refurbishing the existing BQS
7	Benches	The Presence of benches would reduce the cost of refurbishing the BQS
Constraints		
8	Trees	Since the trees are the environmental asset for the city and cutting of as a tree would lead to offence and in adverse condition would require permission from the Forest department.
9	Open Drains	The construction of the BQS would be difficult on the open drains as hard base slab would be required.
10	Parking	Some areas are using the Bus stop area as the parking areas which act as a constraint for the movement of the bus.
11	Encroachments	The road side Encroachment would obstruct the movement of the buses and would create the chaotic situation for the passengers.
Elements to be Considered		
12	Shelter area	The area should be taken into account incorporating the passengers, sitting and standing space that is 2.5 sqm sitting space and 1m s standing space.
13	Information signages	The shelters should rightly display the information, route map and timing for the passengers.
14	Ancillary infrastructure	The ancillary infrastructure comprises of the benches and lights for the convenience and safety of the passengers
15	Landscaping	Landscaping of the bus shelters should also be taken into consideration.
16	Kiosk	The condition of Noida as per the survey we generally find hawkers around the bus shelters so a kiosk would provide a designated place for the hawkers and would add for the convenience of the passengers
17	Public utility	At certain bus stops public toilets can be provided for public convenience.

7.2.2.LOCATION OF BUS Q SHELTER

The following factors can influence the detailed location of a bus Q shelter;

1. Proximity to the Intersections;
2. Proximity to the pedestrian crossings;
3. On-street Parking Locations
4. Access to the Points of Interests such as residential areas, commercial hubs, institutional set up, industrial locations and
5. Available Footpath or Walkway;

As per details in Chapter 2, it could be observed that approximately 225 kms i.e, 20% of the road network in Nagpur comprises Arterial, Sub-Arterial and Collector Streets. It is recommended that Bus Q Shelters in Nagpur would be located along the arterial,

sub-arterial and collector streets. It is also recommended that the bus shelters of 3X10 m dimension[1], as majority of the streets in Nagpur are wide enough to accommodate full-fledged Bus Q Shelter.

FIGURE 7-2: TYPICAL BUS Q SHELTER LOCATION AT MID-BLOCK

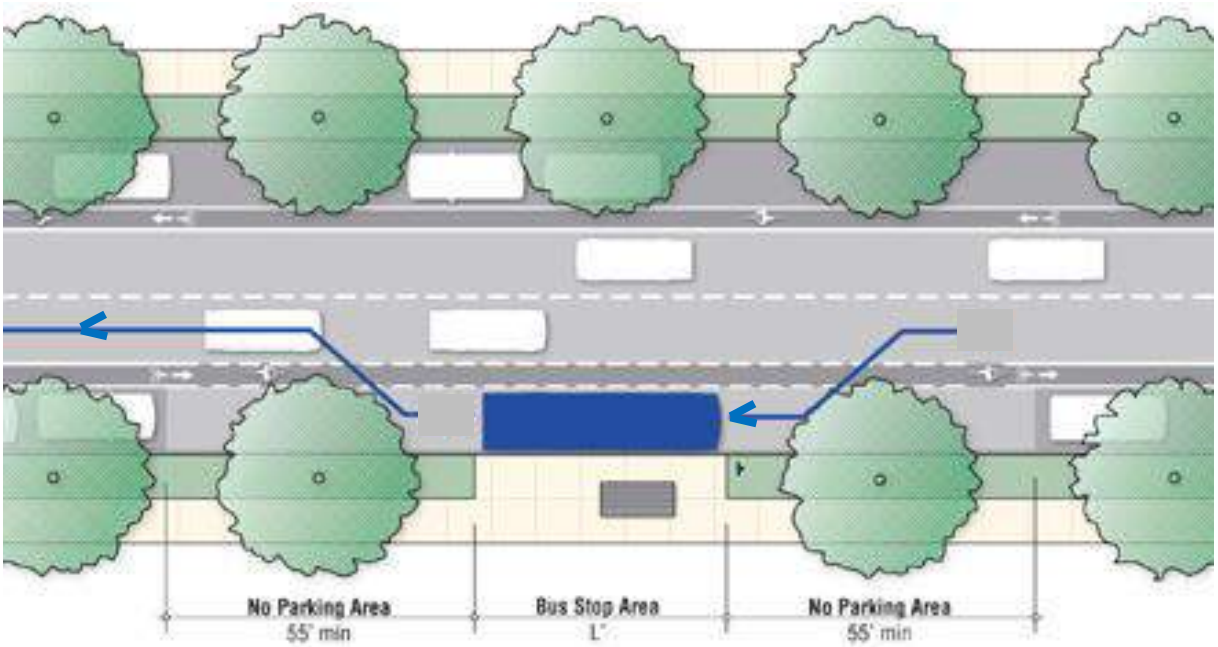
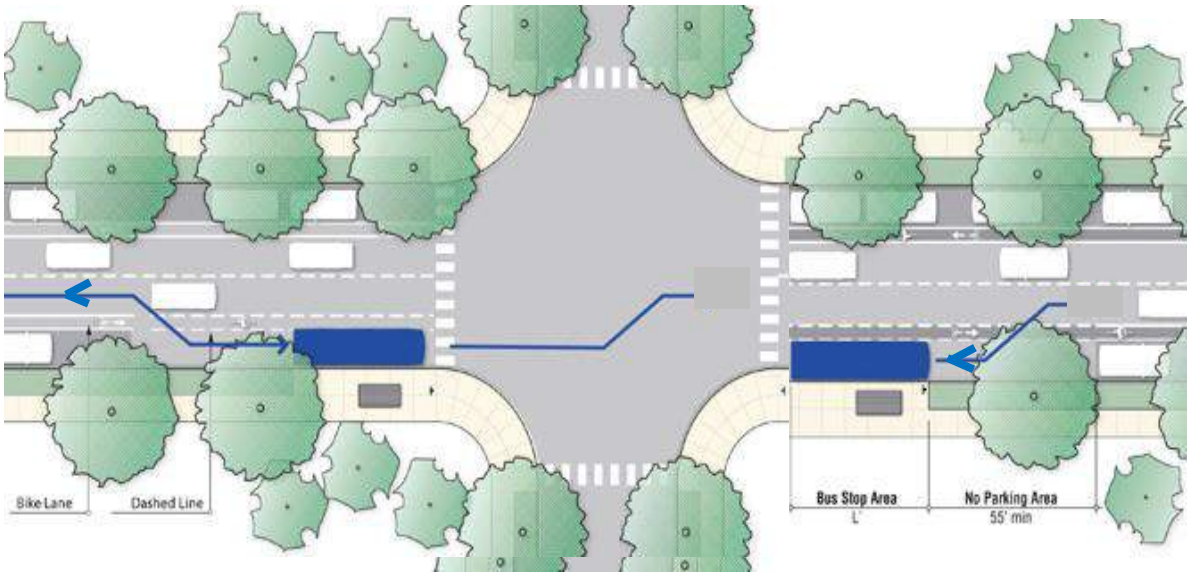


FIGURE 7-3: TYPICAL BUS Q SHELTER LOCATION AT INTERSECTION NEAR SIDED (LEFT) & FAR SIDED (RIGHT)



7.2.3. DESIGN OPTIONS

[1]The mentioned dimensions of 3 X 10 m and 3 X 6m are typical designs of Bus Q Shelters; these dimensions can be modified considering the site constraints during the design phase.

A bus queue shelter is a designated place where buses stop for passengers to board or alight from a bus. These are normally positioned on the major roads, central business and the construction of bus queue shelter tends to reflect the level of usage. As discussed in the above chapters queue shelter at busy locations may have shelters, seating and possibly electronic passenger information systems; less busy stops may use a simple pole and flag to mark the location and "customary stops/request stops" have no specific infrastructure being known by their description. Bus queue shelter may be clustered together into transport hubs allowing interchange between routes from nearby stops and with other public transport modes. Various design options for the bus queue shelters are given below.

FIGURE 7-4: BUS Q SHELTERS ACROSS THE CITIES

7.2.4.PROPOSED BUS Q SHELTERS FOR METRO FEEDER SERVICES

After thorough examination of the various feeder routes, BQS have been proposed in such a way that that the feeder system shall have two types of stops. One being a request stop usually located in the interior or sub road network where the vehicle would stop only on request if there are passengers and other being a proper bus shelter located on the main road network. This categorization has been adopted based on international practices where request and main stops are provided generally depending on the catchment of the stops or location of the stop. The picture below shows the general look of the Bus Queue Shelter and Request Stop.

FIGURE 7-5: REQUEST STOP

Upon through investigation of the various routes the bus tops have been calculated for each of the routes separately. The table below shows the number of the bus stops required for each route along with the classification of the actual BQS and a request stop.

TABLE 7-2: BUS Q SHELTERS FOR METRO FEEDER SERVICES

Route ID	Bus Queue Shelter	Request Stop	Total
R-1	12	8	20
R-2	6	0	6
R-3	4	3	7
R-4	7	5	12
R-5	6	2	8
R-6	17	0	17
R-7	3	4	7
R-8	3	5	8
R-9	4	5	9
R-10	7	7	14
R-11	4	5	9
R-12	8	4	12
R-13	5	5	10
R-14	2	8	10
R-15	0	6	6
R-16	0	8	8
R-17	3	13	16
R-18	6	1	7
R-19	3	8	11
R-20	7	0	7

Route ID	Bus Queue Shelter	Request Stop	Total
R-21	0	5	5
R-22	8	4	12
R-23	7	10	17
R-24	1	7	8
R-25	10	4	14
R-26	1	6	7
R-27	2	12	14
R-28	8	4	12
R-29	8	7	15
R-30	11	7	18
R-31	7	6	13
R-32	0	4	4
R-33	8	0	8
R-34	2	12	14
R-35	2	12	14
R-36	0	0	0
R-37	2	0	2
R-38	1	0	1
Total	**185**	**197**	**382**

Of the 185 Bus Q Shelters only 111 new Bus Q Shelters need to be developed as the existing/proposed City Bus Services Bus Q shelters and Metro stations could be utilized by metro feeder also.

7.2.5. PROPOSED BUS Q SHELTERS FOR CITY BUS SERVICES

Considering the parameters mentioned in the previous sections, typical layout design of the Bus Q Shelter, is presented in Figure 7-6. Total no. of 900 bus Q shelters would be required to be developed on 225 km of road network in Nagpur, considering an average distance of 500 m between two consecutive bus Q shelters on either side of the road network. Since, NMC already developed and maintains 190 bus Q shelters, additionally 710 bus Q shelters needs to be developed.

FIGURE 7-6: TYPICAL LAYOUT OF THE 3X10M BUS Q SHELTERS

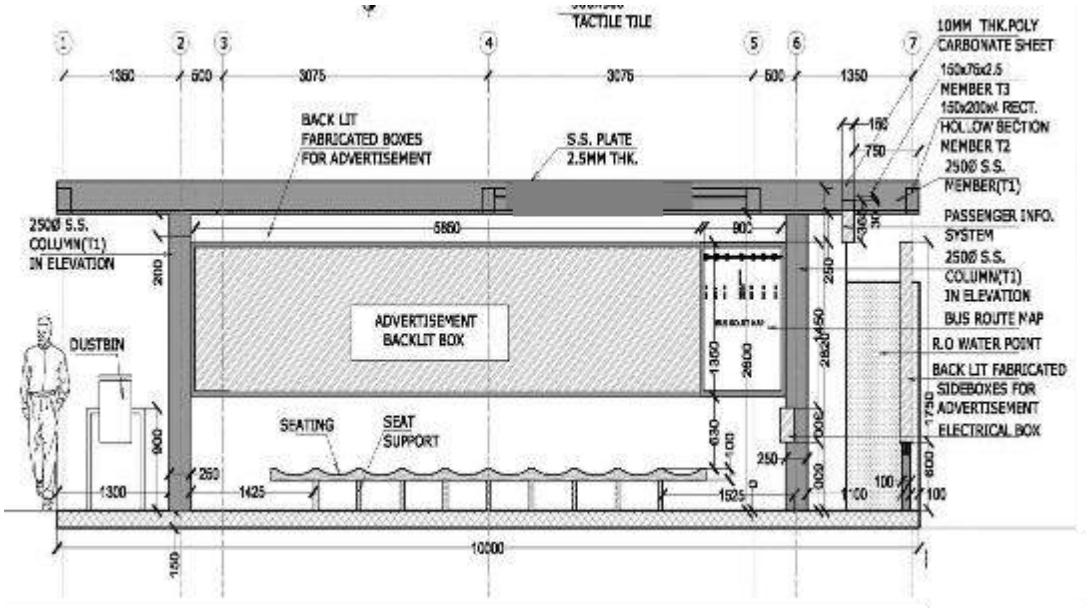


TABLE 7-3: SUMMARY OF THE PROPOSED BUS Q SHELTERS

S no.	Description	Total Road Length (km)	Average Distance between two consecutive stops (m)	No. of Bus Q Shelters
1	Total No. of Bus Q Shelters Proposed (A)	225	500	900
2	Existing No. of Bus Q Shelters (B)			190
3	**Additional No. of Bus Q Shelters to be developed (C = A-B)**			**710**

It is recommended that along the Metro Corridor, where ever possible Metro Feeder Stops be synced with the bus Q shelter locations as recommended in the "Metro Feeder Study".

As mentioned in the previous section that due to the frequent construction and deconstruction of the pavement at the bus stops make them unusable. Hence, considering the above mentioned parameters the exisitng Bus Q Shelters is also proposed to be relocated in such a manner that an average distance of 500 m is maintained between two consecutive bus stops and a clear footpath width of 1.5m to 1.8m is made available for free flow of pedestrians.

Further, to maintain the uniformity and image of the bus Q shelters as a face of public transport system, NMC can issues the guidelines w.r.t the location, layout/design and indicative cost of the bus Q shelter . At the same time, the urban local bodies can explore the revenue generation options from these bus Q shelters through rentals and advertisement.

7.3 DEPOTS, TERMINALS & INTERCHANGES

7.3.1. BUS DEPOTS

A bus depot is an essential part of support infrastructure for smooth and efficient operations of city bus services. It not only serves as an idle parking facility for buses, but also houses facilities for day to day servicing, repair and maintenance of buses besides providing space for administrative and operations planning, monitoring and control activities.

7.3.3.1 BASIC PRINCIPLE ADOPTED FOR DEPOT PLANNING

The size of depot depends on number of vehicle parking and the number of vehicles likely to need repairs. The configuration of the parking area can be a trade-off between parking efficiency and ease of entry. The internal layout and design of depot area shall allow for a logical movement of vehicles based on their typical requirements. Vehicles shall enter the depot as they are instructed by the control center to temporarily come out of service. Ideally, the entry and exit shall be two different points connecting the approach road but in some cases, it may be at same locations as per the site conditions. The general checking area, inspection ramp/area, refuelling area, major and minor pits, cleaning area and washing area shall be designed to facilitate easy access to all parts of the vehicle. The suggestive typical layout for a depot is shown in Figure 7-7.

FIGURE 7-7: TYPICAL LAYOUT FOR DEPOT

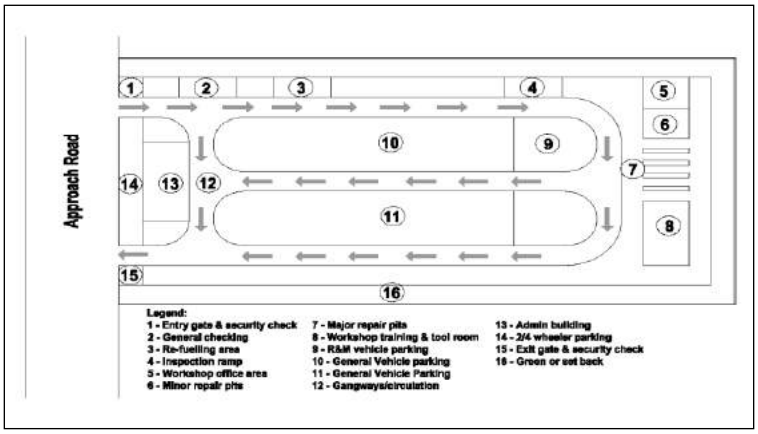
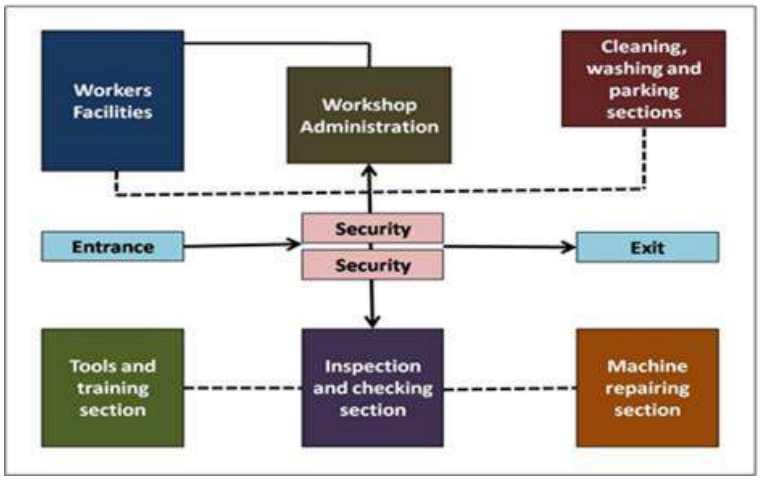


FIGURE 7-8: SUGGESTIVE PROGRAM OF FACILITIES IN A DEPOT



7.3.3.2 IDENTIFICATION OF LAND FOR METRO FEEDER

One of the governing factor in selection of the parking/depot locations for the feeder system is to minimize the total dead kilometers. This is only possible when the proposed location of the depot or the parking facility is closer to the operational routes or the metro corridor. So based on a review by UMTC certain land parcels have been identified in the city of Nagpur (Table 7-4) which can be proposed for the parking/depot locations of the feeder systems.

TABLE 7-4: POSSIBLE LAND PARCELS IDENTIFIED FOR DEPOT CUM PARKING LOCATION

Sl. No.	Corridor	Station Name	Area (sq.m)	Possible ECS	Capacity for Mini Vans	Capacity for Mini-Bus
1	N-S	Kasturchand Park	7285	291	291	194
2	N-S	Zero Mile	5773	231	231	154
3	N-S	Sitaburdi	25897	1036	1036	691
4	N-S	Ajini Sq	5179	207	207	138
5	N-S	Jai Prakash Nagar Sq	16651	666	666	444
6	N-S	Ujwal Nagar	7020	281	281	187
7	N-S	Airport	35136	1405	1405	937
8	N-S	New Airport	5250	210	210	140
9	N-S	Khapri	5250	210	210	140
10	E-W	Prajapati Nagar	1876	75	75	50
11	E-W	Jhansi Rani Sq	3423	137	137	91
12	E-W	Shankar Nagar Sq	937	37	37	25
13	E-W	Ambazari Lake View	1667	67	67	44
14	E-W	Subhash Nagar	1449	58	58	39
15	E-W	Rachana	3870	155	155	103

FIGURE 7-9: LAND PARCELS FOR CONSIDERATION

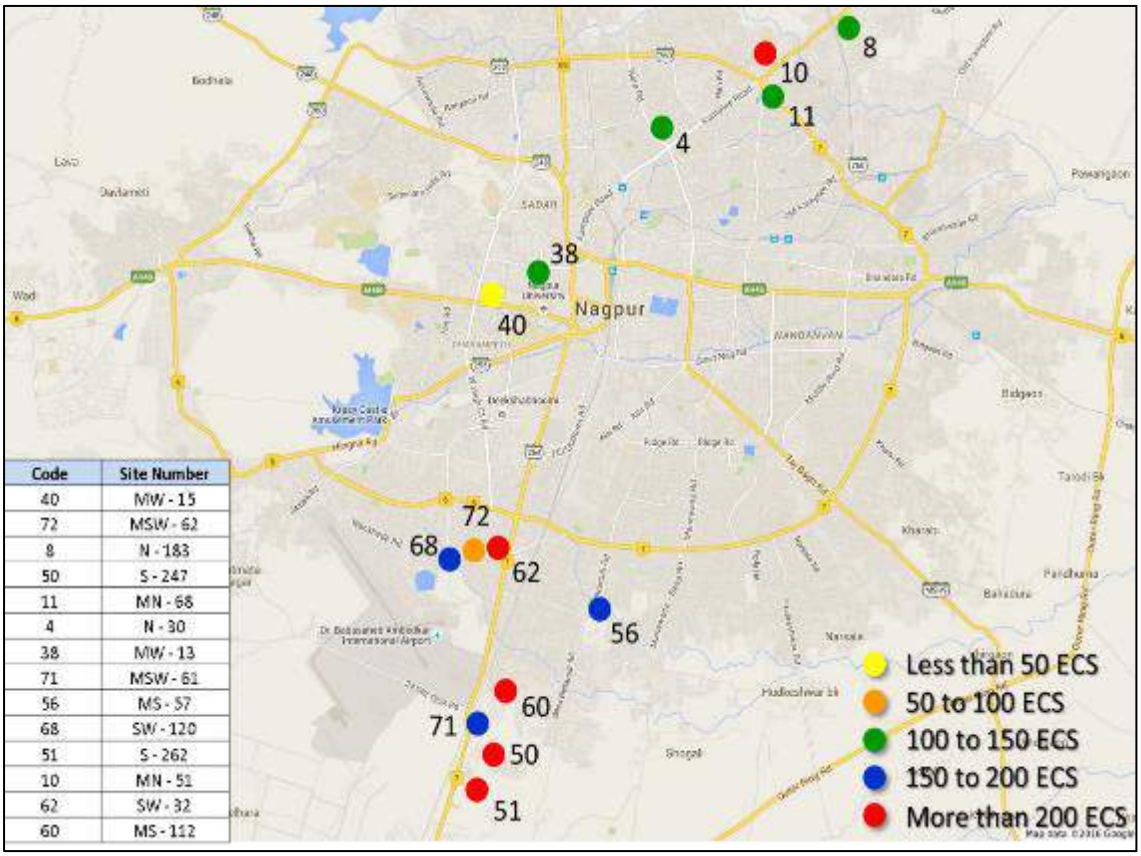
From the above locations and after discussions with the Maha Metro over the availability of land the following land parcels have been finally selected for the provision of Depot/ Terminal. Since the fleet suggested is smaller in size it is proposed that the vehicles shall be parked at the metro stations during the night period and shall use the Depot facilities only for service and maintenance.

Apart from the above mentioned locations, few locations were identified from the DP report, which could be used for feeder parking. The table below shows the proposed locations (Figure 7-10) for the provision of parking for the feeder services. The exact locations are presented in Annexure.

TABLE 7-5: LAND PARCELS IDENTIFIED FOR FEEDER PARKING BASED ON THE DEVELOPMENT PLAN FOR NAGPUR

Sl. No.	Zone	Site Number	Mouza	Survey No.	Area (Hectare)	ECS (Assuming 1 ECS = 25 sq.m.)
1	West	MW - 15	Gadga	15 (P), 16	0.0960	38
2	South - West	MSW - 62	Khamla	73/1, 73/1, 75/1	0.1680	67
3	North	N - 183	Wanjra	68 (P)	0.3580	144
4	South	S - 247	Chinchbhavan	236/1 (P), 236/2 (P)	0.3840	153
5	North	MN - 68	Wanjra	14 (P), 49AB (P)	0.4062	162
6	North	N - 30	Indora	94 (P)	0.4080	164
7	West	MW - 13	Sitabuldi	227	0.4352	175
8	South - West	MSW - 61	Chinchbhavan	8 (P), 9 (P)	0.4896	196
9	South	MS - 57	Somalwada	72/1 (P), 72/2 (P)	0.5130	205
10	South - West	SW - 120	Khamla	82 - 95 (P)	0.5600	223
11	South	S - 262	Chinchbhavan	192 to 194, 195 (P)	0.7680	308
12	North	MN - 51	Wanjra	14/1 (P), 25 (P)	0.8448	338
13	South - West	SW - 32	Somalwada	29 (P)	0.9888	396
14	South	MS - 112	Chinchbhavan	23 (P), 24/1 (P), 25 (P)	1.0400	416

FIGURE 7-10: FEEDER PARKING LOCATIONS BASED ON DP



Code	Site Number
40	MW - 15
72	MSW - 62
8	N - 183
50	S - 247
11	MN - 68
4	N - 30
38	MW - 13
71	MSW - 61
56	MS - 57
68	SW - 120
51	S - 262
10	MN - 51
62	SW - 32
60	MS - 112

7.3.3.3 IDENTIFICATION OF BUS DEPOT FOR CITY BUS SERVICES

The fleet required for the successful operations of the city bus services in Nagpur is 637 in 2018, 1093 in 2023 and 1596 in 2028. Considering 5 acres of land is required to cater to 100 buses[2], the no. of bus depots required by 2028 is 15 which shall be spread in an area of 75.95 acres. Currently, 4 depots are already in operation to cater to the need of city bus services. Hence, indicating huge demand and supply gap. This emphasizes on the need for development of additional bus depots for the city bus services in Nagpur.

Land is the major resource required for any developmental activity. To develop the depot facilities for the city bus services, there is a lack of potential site major constraint. For this purpose atleast 75.95 acres of land would be required, distributed all across the city. As part of the current study, the draft development plan has been reviewed to identify the potential 72 land parcels with total of 33.20 hectares i.e 82.03 acres.

7.3.3.4 LOCATION PLANNING – DEPOT AND TERMINAL

The location of depots identified for upgradation is based on the routing pattern. It aims to minimize the dead mileage and should also increase the operational efficiency. Basically, optimized use of the space in a depot is used depending upon the facilities and the kind of technologies proposed for the maintenance facilities, for which the identified depots for upgradation can be considered as a minimum requirement for the proposed depot functions.

[2] As a standard it is assumed that for a typical depot with all the requisite facilities such as administration, workshop, cleaning and parking areas, inspection and checking and tools and training sections would require 5 acres to cater to 100 buses.

As already mentioned, there are 4 depots (i.e, Zero Mile, Tekanaka, Hingna and Patwardhan) which are already in operation. Based on the current study outcome, it is very essential to upgrade the current depot infrastructure covering both civil infrastructure as well as depot equipment, as this will have a huge impact on the quality of city bus operations.

In addition to existing depots, 6 new depot locations have been identified tentatively in the city outskirts along the inner ring road to facilitate decongestion of city bus services at the city center, minimize the dead mileage and increase operational efficiency. However, the urban local bodies would be either required to identify potential new sites for depot development or allocate appropriate land space in identified potential depot locations accommodating minimum of 1596 buses by 2028. This has been considered in relation with the proposals made in Comprehensive Mobility Plan. The tentative locations of proposed new depots are as under (Refer to Figure 5-7);

1. Mankapur Chowk (junction on Koradi road and inner ring road)
2. Junction on Katol Road and Inner Ring Road
3. Junction on Amravati road and Inner Ring Road Dattawadi
4. Octroi Chekpost
5. Junction on Umred Road and Inner Ring Road Dighori
6. Surya Nagar

After detailed assessment of location of the existing depots in Nagpur, it has been noted that the Zero Mile Depot is located right in the heart of the city covering an area of 0.5 acres. Considering the activities undertaken in the depots, during the day and night, the depot shall create disturbance/noise pollution for the surrounding areas. Since the area is only 0.5 acres, depot doesn't have adequate space to accommodate enough no. of buses. Under the mentioned circumstances, it is recommended to shut down the depot at the aforementioned location and requisite land space be utilized for the other services of City Buses.

The Modified/recommended city bus routes and estimated buses have been assigned on to each of the existing and proposed depots. Total area under the existing depots is 9.95 acres, whereas to maintain and operate the 1596 buses by 2028, Nagpur city would require to allocate approxmately 75.95 acres (refer to Table 7-6). As mentioned in the previous section 72 land parcels with total of 33.20 hectares (i.e 82.03 acres) have been identified for parking as per the Draft Development Plan for Nagpur. The suitable locations can be identiifed after through verification of sites by authorities.

FIGURE 7-11: LOCATION OF EXISTING AND PROPOSED BUS DEPOTS IN NAGPUR

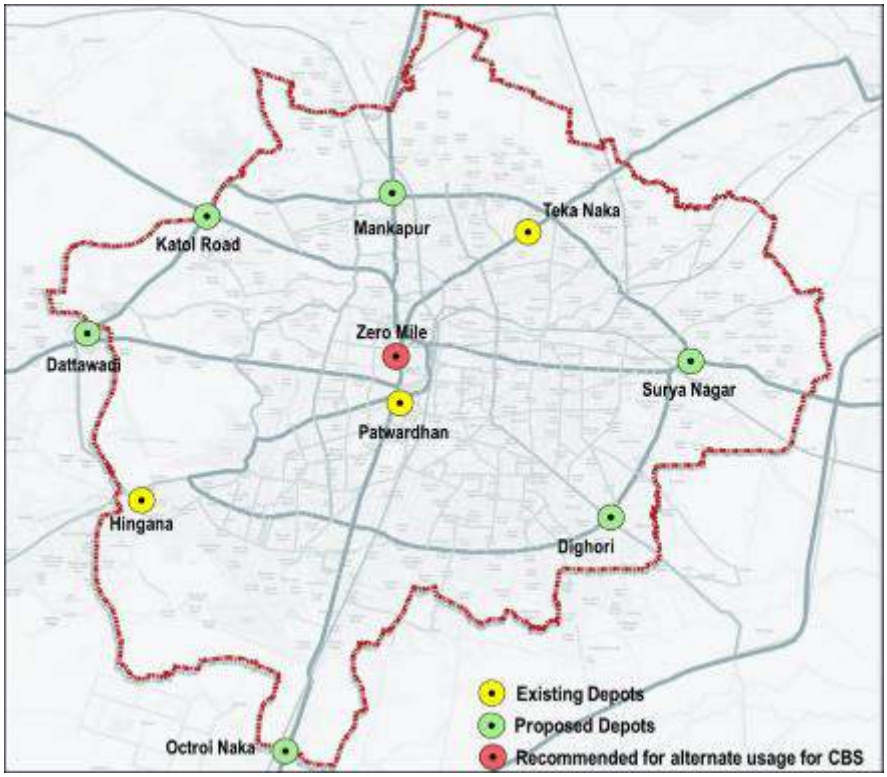


TABLE 7-6: SUMMARY OF PROPOSED BUS DEPOTS

Name of the Depot	Status	No. of Routes	Fleet			Area Required (acres)[3]	Area Available (acres)	Net Area Required (acres)
			2018	2023	2028			
Dattawadi	Proposed	8	31	61	96	6.8		6.8
Dighori	**Proposed**	**8**	**76**	**139**	**212**	**8.6**		**8.6**
Hingna	Existing	7	105	161	226	11.3	5	6.3
Katol Naka	**Proposed**	**3**	**8**	**8**	**13**	**0.65**		**0.65**
Mankapur	Proposed	7	19	47	96	4.8		4.8
Octroi Checkpost	**Existing**	**5**	**115**	**187**	**257**	**12.85**		**12.85**
Patwardhan	Existing	15	43	107	164	8.2	3.5	4.7
Surya Nagar	**Proposed**	**12**	**99**	**176**	**245**	**12.1**		**12.1**
Teka Naka	Existing	11	81	155	210	10.65	1.45	9.2
Grand Total*		**76**	**577**	**1041**	**1519**	**75.95**	**9.95**	**66.00**

*** Excluding Contingency**

From Table 7-6 it could be observed that to operate 1519 buses in 2028 approximately 75.95 acres of land is required for depot development. After considering the existing depot facilities at Teka Naka, Hingana and Patwardhan, the city still needs 66 acres of land for development of depots. Since Land is a very sensitive issue, the team has reviewed the Development Plan of Nagpur 2041 along with Transport Department and Town Planning Department of NMC. Summary of the status of the land availability at the recommended depot locations is represented in Table 7-7.

TABLE 7-7: SUMMARY OF THE LAND AVAILBILITY AT THE RECOMMENDED DEPOT LOCATIONS

Sr. No	Name of the Depot	Land Required (Acres)	Remarks
1	**Dattawadi**	**6.8**	**7.4 acres (~3 Ha) of land is available which can be utilized for City Depot.**
2	Hingna	11.3	Existing Land of 5 acres + 5.4 acres (~2.2 Ha) land is available.
3	**Octroi Naka**	**12.85**	**Land is Available.**
4	Dighori	8.6	4.18 Acre Land is available in Wathoda which is 3-4 km away from Dighori, which can be developed as a Depot/Terminal instead of Dighori.
5	**Surya Nagar**	**12.1**	**Not Available**
6	Tekanaka	10.65	Private Land can be engage on Rent for Depot/Terminal.
7	**Mankapur**	**4.8**	**Not Available**
8	Katol Road	0.65	Currently utilized by Police department which is in process of undertaking on name of Transport Stand.
9	**Patwardhan**	**8.2**	**Available.**

From the above table it could be noted that Land for Depot is not available at Surya Nagar and Mankapur. Based on discussion with NMC it was noted that land is available at few other locations as per the DP which is represented in Figure 7-11.

Considering the land and locational aspects, it is recommended to develop a depot at Takli instead of Mankapur where 10.56 acres of land is available for City Transport. As mentioned in the previous table 4.18 acres of land is available at Wathoda, hence it is recommended that Surya Nagar Depot be shifted to Wathoda and Dighori Depot be shifted to Babulkheda were 7.82 acres of land is available. Table 7-8 represents the list of the final depot locations and area availability.

TABLE 7-8: SUMMARY OF THE LAND RESERVED FOR CITY TRANSPORT AS PER THE DEVELOPMENT PLAN

Name of the Land location	Area in Ha	Area in Acre
Indora	**0.47**	**1.16**
Wanjari	3.23	7.98
Telankhedi	**3.78**	**9.35**

[3]Area Required considered based on the No. of Fleet to be operated from the respective depot in 2028

Name of the Land location	Area in Ha	Area in Acre
Takli	4.27	10.56
Wathoda	**1.69**	**4.18**
Jaitala	1.94	4.80
Lendhra	**1.76**	**4.36**
Lanora	1.42	3.52
Lendhra	**0.77**	**1.92**
Lendhra	1.54	3.82
Pandharaeodi	**1.25**	**3.08**
Babulkheda	3.16	7.82
Chinchbhavan	**1.64**	**4.06**
Chinchbhavan	0.83	2.05
Total		**68.66 Acres**

TABLE **7-9: LIST OF DEPOT LOCATIONS**

Name of the Depot	Status	Name of Proposed Depot	Area Required (acres)	Area Available (acres)
Dattawadi	**Proposed**	**Dattawadi**	**6.8**	**7.4**
Dighori	Proposed	Babulkheda	8.6	7.82
Hingana	**Existing**	**Hingana**[4]	**11.3**	**10.4**
Katol Naka	Proposed	Katol Naka	0.65	0.65
Mankapur	**Proposed**	**Takli**	**4.8**	**10.56**
Octroi Checkpost	Existing	Octroi Checkpost	12.85	12.85
Patwardhan	**Existing**	**Patwardhan**	**8.2**	**8.2**
Surya Nagar	Proposed	Wathoda	12.1	4.18
Teka Naka	**Existing**	**Teka Naka**[5]	**10.65**	**10.65**
Grand Total			75.95	72.71

It could be well observed from the above table that 72.71 acres of land in 9 locations can be developed for Depot purposes in Nagpur. Based on the proposed depot locations the routes and buses have been rearranged for operations, which is represented in the Table 7-10.

TABLE 7-10: SUMMARY OF THE REVISED PROPOSED BUS DEPOTS AS PER THE LAND AVAILBILITY

Name of the Depot	Status	No. of Routes	Fleet			Area Available (acres)
			2018	2023	2028	
Dattawadi	Proposed	9	31	108	155	7.4
Babulkheda	**Proposed**	**8**	**80**	**104**	**172**	**7.82**
Hingana	Existing	9	113	231	297	10.4
Katol Naka	**Proposed**	**3**	**10**	**8**	**13**	**0.65**
Takli	Proposed	7	21	47	96	10.56
Octroi Checkpost	**Propsoed**	**5**	**117**	**187**	**257**	**12.85**
Patwardhan	Existing	16	45	125	184	8.2
Wathoda	**Proposed**	**7**	**108**	**71**	**125**	**4.18**
Teka Naka[6]	Existing	12	81	160	220	10.65
Grand Total		**76**	**606**	**1041**	**1519**	**72.71**
*** Excluding Contingency**						

[4] If Required 1.61 acres of land at Indora can be developed for Depot purposes instead of engaging land from a private party on lease or rent for depot/terminal purposes.

[5] If Required 4.80 acres of land at Jaitala can be developed Depot purposes.

[6] If Required 1.61 acres of land at Indora can be developed for Depot purposes instead of engaging land from a private party on lease or rent for depot/terminal purposes.

7.3.3.5 INFRASTRUCTURE REQUIREMENTS FOR THE DEPOT

There should be sufficient land available in the depots to meet the various needs of engineering/ maintenance tasks. All buses returning after their scheduled duty have to undergo fuelling, cleaning, washing, periodical maintenance, rectification of defects pointed out by drivers and those noticed during inspection of the bus on the pit, periodic change of oil in engine, gear box, steering, differential, etc. Since most day-runner buses return to depots during the same time in the evening, there would be bunching of buses for fuelling, cleaning, washing, etc. There has to be ample space for movement of buses to and from the maintenance pits, repair bays, etc. Parking of buses should also leave sufficient space for a bus to be moved away or into the parking lot. A standard of 320 square feet parking space per bus is recommended. The circulation space will be additional as per the layout conditions.

The Infrastructural engineering facilities proposed would entail a land requirement of about 5 acres for 100 vehicle depot, Experience of many State Transport Undertakings reveal that it is difficult to acquire additional land in the future years, because of the congestion due to commercial and business activities developing in the surrounding areas.

This land should be as far as possible adjacent to the depot in order to reduce dead kilometres arising due to the movement of buses between the stand and the depot and the time spent by the crew in such movements. Close proximity between the bus stand and depot would result in proper control of vehicle movements. However, the bus stand complex should be distinct and separate from the depot, otherwise, passengers would enter the depot premises causing distraction of the depot staff giving rise to problems of security, safety etc.

Acquisition of land entails large outlays of finances and time. The NMC need to realize the advantages of planned transportation system such as passenger amenities, comfort, service level improvements, etc.

Requirement of water for washing the buses by three brush automatic washing machine is estimated at 150 litres per bus. If a recycling system for used water is employed, the requirement of water comes down to between 20 to 30 litres per bus. If in addition to the normal three brush machine, inside washing, under chassis washing and mopping of bus flooring requires additional water. Hence the water requirement would go up to above 250 litres per bus, without recycling. Another 200 litres per bus may be required for drinking, sanitation, as well as miscellaneous workshop needs including topping up of radiators. Storage of water is also essential for fire-fighting. Thus, the requirement of water should be worked out for the Depot considering its fleet strength. The local authority, such as Municipal Corporation and Municipal Councils should be requested to supply the required quantity of water to the depot and bus stand. At places where there is no municipal water supply or where there is scarcity of water, the Corporation should construct wells in the depot premises. Suitable slope should be provided to facilitate the smooth flow of water from washing platforms, parking area, workshop floors etc. to the drainage system.

7.3.3.6 DEPOT EQUIPMENT

The efficiency of the maintenance activity highly depends on the availability and effective use of the depot equipment. The ultimate aim would be performing the maintenance activity in the least amount of time and cost with least impact on environment and society without compromising the maintenance quality. The equipment should be

- Available in a market
- Able to use in efficient manner with health preservation of workers
- With low lifecycle cost and energy conservative
- Environmental Impact Reduction

A. LIST OF MODERN EQUIPMENT

The following section of the details out the list of the equipment required for the existing 4 depots and potential 6 depots. The total costing of the deployment of the equipment is represented in the Project Cost Estimates Chapter of the Report.

TABLE **7-11: DEPOT EQUIPMENTS**

Sr. No.	Description	Hingna	Teka Naka	Patwardhan	Dattawadi	Babulkheda	Katol Naka	Takli	Octroi Checkpost	Wathoda
	Area (Acres)	5	1.45	3.5	6	6	6	6	6	6
1	Air Compressors	3	1	2	4	4	4	4	4	4
2	Car Washing Machines	3	1	2	4	4	4	4	4	4
3	Pedestal Drilling Machine	3	1	2	4	4	4	4	4	4
4	Mech. Chain Pulley Block	2	0	1	2	2	2	2	2	2
5	Hoist (Electric Chin Pulley block	2	0	1	2	2	2	2	2	2
6	Greasing Machines	5	1	3	6	6	6	6	6	6
7	Electro Hydra Tyre changer (Tyre Mounting Demounting m/c)	3	1	2	4	4	4	4	4	4
8	Electric Arc Welding Set	3	1	2	4	4	4	4	4	4
9	a) Oxygen Gas Regulator	2	0	1	2	2	2	2	2	2
	b) Acetylene Gas Regulator	2	0	1	2	2	2	2	2	2
	c) Gas Welding Blow Pipe	2	0	1	2	2	2	2	2	2
	d) Gas cutting Blow Pipe	2	0	1	2	2	2	2	2	2
10	Battery Chargers	3	1	2	4	4	4	4	4	4
11	Battery Operated Brush Truck	2	0	1	2	2	2	2	2	2
12	Flipper	2	0	1	2	2	2	2	2	2
13	Floor Scrubbing Machine	2	0	1	2	2	2	2	2	2
14	Tapley Meter (Brake Efficiency Indicator)	2	0	1	2	2	2	2	2	2
15	Matra jack	3	1	2	4	4	4	4	4	4
16	Fogging Machine	2	0	1	2	2	2	2	2	2
17	Electric Impact Wrench	3	1	2	4	4	4	4	4	4
18	Pneumatic Impact Wrench	3	1	2	4	4	4	4	4	4
19	Pit Sump Pumps	3	1	2	4	4	4	4	4	4
20	MultistagePump	3	1	2	4	4	4	4	4	4
21	Oil Decanting Pump	3	1	2	4	4	4	4	4	4
22	Clamp meter	3	1	2	4	4	4	4	4	4
23	Bench Grinder	3	1	2	4	4	4	4	4	4
24	Buffing machine	3	1	2	4	4	4	4	4	4
25	Anvil	3	1	2	4	4	4	4	4	4
26	Injector Tester	2	0	1	2	2	2	2	2	2
27	Electric hand Drilling Machine	6	2	5	8	8	8	8	8	8

Sr. No.	Description	Hingna	Teka Naka	Patwardhan	Dattawadi	Babulkheda	Katol Naka	Takli	Octroi Checkpost	Wathoda
28	Straight hand Grinder 'Wolf'	3	1	2	4	4	4	4	4	4
29	Pneumatic Nut Runner	5	1	3	6	6	6	6	6	6
30	Metal pot For Thermostat Checking Unit	3	1	2	4	4	4	4	4	4
31	Dial Gauge For Drum Ovality Checking	3	1	2	4	4	4	4	4	4
32	Compression Guage	3	1	2	4	4	4	4	4	4
33	Hydraulic jacks	32	9	23	39	39	39	39	39	39
34	Digital Tachometer	3	1	2	4	4	4	4	4	4
35	Small Angle hand Grinder	3	1	2	4	4	4	4	4	4
36	Vaccum Cleanser For A.C. Buses	3	1	2	4	4	4	4	4	4
37	TyrePressure Master Guage	3	1	2	4	4	4	4	4	4
38	Outside Micrometer (0.001"3 to 4"	3	1	2	4	4	4	4	4	4
39	Outside Caliper (18")	3	1	2	4	4	4	4	4	4
40	Inside Caliper (18")	3	1	2	4	4	4	4	4	4
41	Digital Micrometer	3	1	2	4	4	4	4	4	4
42	Weighing Scale	2	0	1	2	2	2	2	2	2
43	Brake and clutch liner riveting machine	2	0	1	2	2	2	2	2	2
44	Hydraulic press	2	0	1	2	2	2	2	2	2
45	Brake unit testing machine	2	0	1	2	2	2	2	2	2
46	Spray painting machine	3	1	2	4	4	4	4	4	4
47	Hub pullers	6	2	5	8	8	8	8	8	8
48	Torque wrenches	13	4	9	16	16	16	16	16	16
49	Tool box set with pneumatic tools	32	9	23	39	39	39	39	39	39
50	Lathe machine	2	0	1	2	2	2	2	2	2

TABLE 7-12 JIGS, FIXTURES AND TOOLS

Sr. No.	Description	Hingana	Teka Naka	Patwardhan	Dattawadi	Babulkheda	Katol Naka	Takli	Octroi Checkpost	Wathoda
1	Tube Repair Stands	5	1	3	6	6	6	6	6	6
2	Tyre Safety Stand	2	0	1	2	2	2	2	2	2
3	Tyre Opener (Spreaders)	2	0	1	2	2	2	2	2	2
4	Tyre Racks (12 Tyres Cap.)	6	2	5	8	8	8	8	8	8
5	Radiator Repair Stand	2	0	1	2	2	2	2	2	2
6	Radiator Soldering Stand	2	0	1	2	2	2	2	2	2
7	Oil Drum Stands (4Drum Cap.)	3	1	2	4	4	4	4	4	4
8	Spring Racks	3	1	2	4	4	4	4	4	4
9	Spring Removing Trolley	3	1	2	4	4	4	4	4	4
10	Spring Carrying Trolley	2	0	1	2	2	2	2	2	2
11	Engine Oil Tank Topping Trolley	2	0	1	2	2	2	2	2	2
12	Portable Ladders (SD)	3	1	2	4	4	4	4	4	4
13	Portable Ladders (SD) For painters	2	0	1	2	2	2	2	2	2
14	Chassis Stands (SD)	6	2	5	8	8	8	8	8	8
15	Prop. Shaft Stands	3	1	2	4	4	4	4	4	4
16	Pit Planks	24	7	17	29	29	29	29	29	29
17	Pit Jacks (Sqare Type)	2	0	1	2	2	2	2	2	2
18	Pit Jacks (Hub Type)	6	2	5	8	8	8	8	8	8
19	Trolley for Oil Decanting Pump	2	0	1	2	2	2	2	2	2

TABLE 7-13 SPECIAL EQUIPMENT AS PART OF MODERNIZATION

Sr. No	Description	Hingana	Teka Naka	Patwardhan	Dattawadi	Babulkheda	Katol Naka	Takli	Octroi Checkpost	Wathoda
1	Automatic Washing Machine	2	0	1	2	2	2	2	2	2
2	Tyre dismantling and Assay machine	2	0	1	2	2	2	2	2	2
3	Automatic Tyre Inflator machine	2	0	1	2	2	2	2	2	2
4	Computerized wheel balancing and alignment machine	2	0	1	2	2	2	2	2	2
5	Smoke Meter	2	0	1	2	2	2	2	2	2
6	Tyre rim cleaning machine	2	0	1	2	2	2	2	2	2
7	Magnetic floor sweeper	2	0	1	2	2	2	2	2	2
8	Simulator for checking diesel consumption	2	0	1	2	2	2	2	2	2

Sr. No	Description	Hingana	Teka Naka	Patwardhan	Dattawadi	Babulkheda	Katol Naka	Takli	Octroi Checkpost	Wathoda
9	Fan Belt Tension Measuring Gauge	3	1	2	4	4	4	4	4	4
10	Brake Chamber Bend Push Rod Checking Gauge	3	1	2	4	4	4	4	4	4
11	Front Hub Bearing Play Adjustment Gauge	3	1	2	4	4	4	4	4	4
12	Engine Blow By Rate Indicator	3	1	2	4	4	4	4	4	4
13	Engine R.P.M. Meter	2	0	1	2	2	2	2	2	2
14	Generator set	3	1	2	4	4	4	4	4	4

7.3.3.7 CENTRAL WORKSHOP ACTIVITIES

As discussed in the last section, NMC would be required to equip the existing and proposed depots with the above mentioned equipment for day to day maintenance activities. However, major maintenance / workshop activity needs to be performed at central workshop. Currently these activities are being performed in the Patwardhan Depot & Hingana Depot. However, considering the increase in the fleet required for city bus operations, it is recommended that additional land be identified in one of the proposed depot locations for central workshop or integrate it with the regional workshop of MSRTC at Ganeshpeth after appropriate negotiations. The Central Workshop shall undertake the following activities with the help of various departments within the workshop;

- Bus Body Building
- Spare Parts Inventory
- Preventive Maintenance
- Gear Box Change
- Engine Change & Reconditioning
- Complete overhauling of units including FI pump, injector, break units, turbocharger, engine block, boring etc.
- Balancing of propeller shaft
- Repairing of clutch plates
- Testing of spare parts like rubber hose pipes, oil seals, tyre tube and flap, fanbelt

Some of these activities can be taken in-house, wereas the others can be out-sourced depending upon the need.

7.3.3.8 RECOMMENDATION FOR DEVELOPMENT/UPGRADATION OF THE DEPOT

For the effective operation of the city bus services in Nagpur, it is recommended to upgrade the existing depots and develop 6 new depots, both in terms of the civil infrastructure as well as depot equipment. The upgradation activity would be taken up by NMC itself, either through government funding or external funding. NMC would actively involve in all the stages of the process right from designing, construction and operation and maintenance of the depots. NMC in coordination with the other urban local bodies shall evaluate and identify the suitable land for the development of the depot and central workshop. These depots could also be developed on PPP mode.

7.3.2. BUS TERMINALS

Terminal/mobility hubs usually, refers to the large stations that are the major points of interchange between different bus routes – such as trunk, feeder and inter-city routes or different modes of transport. Bus Routes also begin and end at terminals. They are larger than other bus station in a system and often also provide auxiliary services to passengers such as food, ticketing and so on.

7.3.2.1 FUNCTIONS OF A BUS TERMINAL

The functions of bus terminal primarily includes processing of vehicles, passengers etc. with provision of necessary facilities for their smooth flow. The terminal serves as a point and unit where necessary information to user is made available for processing. To create seamless multi modal connectivity, the bus terminal should be integrated with other modes of transport (train, metro, pedestrian, intra and inter city bus services, water transport and private vehicles)

A bus terminal also functions as the centre of a neighbourhood with high density mixed use activities in its vicinity. To provide a safe and attractive place at all times, the presence of residential housing, shopping complexes, offices and other commercial activities can be encouraged around the terminal.

A passenger bus terminal broadly needs to perform the functions to meet the requirements of the following;

- Passengers and Vehicles
- Passengers Only
- Vehicles Only
- Crew
- Management
- The functions related to both passengers and vehicles include:
- Concentration
- Loading
- Dispersal
- Unloading
- Passenger only oriented functions of the terminal include provision of:
- Passenger platforms to board and alight (with ramps for disabled & elderly).
- Ticketing facilities.
- Waiting lounges.
- Rest houses/ rooms.
- Baggage Storage Facilities.
- Commercial: Basic Shopping and retail facilities.
- Utilities, Services and Amenities (including public toilets, ATM, drinking water etc.).
- Information System.
- Shelter from weather.
- Communication and postal facilities.
- Eating Places.

7.3.2.2 COMPONENTS

- The components related to vehicles (bus) only include provision of:
- Bays for loading and unloading
- Idle bus parking spaces
- Facilities related to maintenance
- Information system for movement with terminal
- The terminal components to meet the needs of crew are:
- Rest rooms
- Information system
- Communication facilities

- Eating places
- The terminal facilities for the management in terms of:
- Demand management on account of concentration
- Incurring minimum expenditure
- Development of centralised information
- Ensuring better control

7.3.2.3 DESIGN CRITERIA

The design criteria of terminal studies determine the size of the terminal and factors to be taken into consideration, while planning the facilities and activities that are primarily governed by the following factors;

The size of the terminal is primarily governed by the following factors;

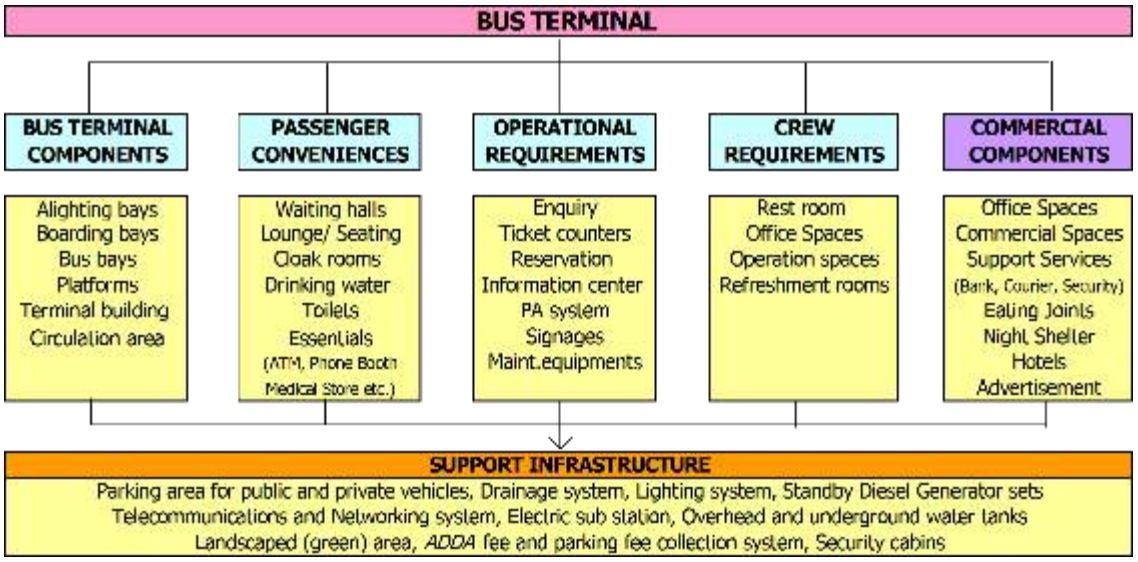
1. Bus Traffic Demand and Characteristics
2. Modes of access to the terminal and composition
3. Passenger Demand and Accumulation
4. Type of Facilities required based on the passenger characteristics
5. Operational requirements
6. Parking Demand Analysis

The other factors to be considered in terminal design by appreciating activity and facility inter-relationship are;

1. Segregation of terminal and non terminal traffic,
2. Segregation of vehicular and pedestrians traffic and movement,
3. Segregation of traffic by type, function and direction,
4. Co-ordination of different activities in terms of functional and spatial inter-relationships
5. Provision of good user and vehicular information
6. Provision of necessary and identified facilities to meet requirement of all user groups, achieving minimum passenger and vehicular processing time and distance
7. Achieving overall functional and spatial efficiency
8. Achieving smooth flow of all types of traffic to and from terminal

The basic services in a Bus Terminal are represented in the Figure 7-12

FIGURE 7-12: BASIC SERVICES IN A BUS TERMINAL



1 Company/operators offices
2 Waiting area
3 Toilets
4 Refreshments
5 Information
6 News/bookstand
7 Gift store
8 Communications-telephone/internet.

Seamless integration with Intra city transport system the concept design must incorporate the possibility of linkage and integration with the current and projected urban transport systems. The planned and ongoing urban transport system such as City bus system, Metro, Railway Station should have connectivity integration with the concept design of Terminal.

The proposed bus terminals/mobility hubs would be required to cater to the following type of bus operations;

1. Intra City Bus Services plying within the Nagpur City &
2. All Inter City Bus Services operated by MSRTC;

The primary function of the identified terminal/mobility hubs would be to serve the Intra City Services followed by the Inter City Services.

7.3.2.4 NORMS & STANDARDS[7]

For the purpose of functional requirements of bus terminal, the following norms represented in the Table 7-14 to be used.

TABLE 7-14: REQUIREMENT STANDARDS FOR BUS TERMINAL

S.No.	Item	Norm
1.	Bus Bays	11 bays for intercity operations, 10 idle parking bays is based on the turnaround time of 10 minutes per bus (based on the U.R.D.P.F.I. guidelines).
2.	Passenger Concourse Area	The minimum area required per passenger is 0.4 sqm per person. The total area required for the passenger concourse would be based on the no. of buses entering the terminal and no. of passengers each bus is catering to.
3.	Alighting Area	a platform of 1250 sqft to be used for alighting the passengers
4.	Enquiry offices, Reservation Offices & Ticketing Office along with enclosure for waiting space	Centralized enquiry office, reservation office and 6 ticketing counters provided with adequate furniture Sitting Arrangement for 40 at different counters The offices shall have large window for public interface There shall be enough waiting space in front of the office so as to enable the users to form proper queue and hence maintain orderliness. Railings to divide the queue may be provided in front of the public interface windows.
5.	Waiting Hall	One General waiting hall with appropriate seating capacity in the bus terminal. One Ladies waiting hall with appropriate seating capacity in the bus terminal.
6.	Toilet • WC for Ladies • WC for Gents Urinals for Gents (separately)	The Bathroom, WC and Urinals are to be provided in blocks, evenly distributed in the passenger concourse area. The gents and ladies blocks shall have separate access. Provide minimum 5 taps, 2 beveled edge mirrors (600x450mm) and 2 wash basins in each Gents toilet block Provide minimum 5 taps, 2 beveled edge mirrors (600x450mm) and 2 wash basins in each Ladies toilet block

[7] The norms and standards mentioned here are the minimum considerations to be used while designing the bus terminal. However, the respective norms and standards would need to be appropriately updated depending upon the no. of passengers, buses the Bus Terminal/Mobility Hub Serves.

S.No.	Item	Norm
		Each toilet block for gents and ladies in the bus terminal shall consist of one WC, urinal and bathroom suitable modified with all necessary fixtures for use by the handicapped, old and the disabled users of the bus terminal.
7	Cloak Room	Minimum built up area of 400 sqft with lockers, racks and cupboards.
8	Parking area	The parking area shall be suitable segregated into lots for various categories of private vehicles
9	Space for Paid Private Parking	The parking area shall be suitably segregated into lots for private vehicles such as Car, Scooters, Cab/Taxis etc.
10	Drinking Water Chambers	The water chambers are to be evenly distributed in the passenger concourse area. There should also be provision for purification of water. The water quality shall be match with the requirements stipulated by the respective urban local bodies or CPHEEO guidelines applicable for drinking water standards Suitable water coolers should also be provided. Provision should be made to provide room temperature drinking water along with cold water.
12	Seating Arrangements	Modular Hard Plastic Chairs over steel framework, grouted/fixed to the platform base provided in the bus terminal. The seating arrangement to be evenly distributed in the passenger concourse area and waiting areas in the bus terminal.
13	Dustbins	Provide 1 dustbin for every 3 bays on the platform apart from those provided near the shops/kiosks etc. The dustbins are to be placed at appropriate locations in the passenger concourse area in the bus terminal. The dustbins should contain disposable plastic bags so as to ease collection of waste.
14	Canteen / Restaurant / food court	One canteen supplying beverages, snacks, fast food etc shall be provided in the terminal. The seating capacity of the canteen shall be for atleast 50 persons.
15	Stalls / Kiosks	One stall at least for the selling general daily usage items, fruit stall, fruit juice kiosk, pan stall, paper/book stall.
16	Dormitory	Two Dormitories (to accommodate at-least 25 beds) shall be provided as a clean, cheap and economical facility for the users. It should be of adequate capacity segregated suitably for males and females with basic provision of cot, mattress, bed sheet and bed pillows for each bed. Adequate number of toilet and bathroom block separate for gents and ladies shall be provided in the same premises
17	Ramps for handicapped and Disabled people	Ramps with proper slope shall be provided at user entry and exit of bus terminal, connectivity to parking area and passenger concourse area, interconnectivity between the passenger concourse areas and at any such places adjacent to footsteps following upward and downward gradient in the bus terminal passenger concourse area. Handrail fixed to walls along the staircase and ramps shall be provided for ease and convenience of passengers.
18	Parcel Room	Two Parcel room shall be provided in the bus terminal premises in total built up area of 400 sqft.
19	Wheel Chairs	Atleast 4 wheel chairs shall be provided in the bus terminal as part of the passenger amenities. These wheel chairs shall be maintained by the bus terminal operating agency.
20	Police / Security Check Post	120 Square Feet

S.No.	Item	Norm
21	Post Office, ATMs, First Aid Centre, PCOs	630 Square Feet
22	Display Boards, Digital Displays and Variable Message Sign Boards	Provide at least 20 display boards in a bus terminal area with illumination at appropriate locations for information on bus routes, bus time table, fare lists, location of various passenger amenities in the terminal etc. Provide Digital Displays and Variable Message Sign Boards in the bus terminal at appropriate locations like entry and exit, waiting halls, enquiry counters, and passenger concourse area for providing updated information to the users.
23	Digital Display Clocks	Provide atleast 15 Digital Display Clocks suspended from the ceiling by suitable holders in the passenger concourse area,
24	Public Address System	An announcement booth shall be provided in the terminal in an area of at least 10 sqmt. Public Address System shall be provided in the terminal
25	Security Guard Cabins	Security Guard Cabins are to be provided near the bus terminal entry and exit gates.
26	Vacuum Cleaners, Floor Cleaners, Automatic Wipers or superior mechanized cleaning equipment	These shall be provided in adequate number in the terminal for housekeeping activities for ensuring dust free environment

7.3.3.1 LOCATION PLANNING – TERMINAL/MOBILITY HUB

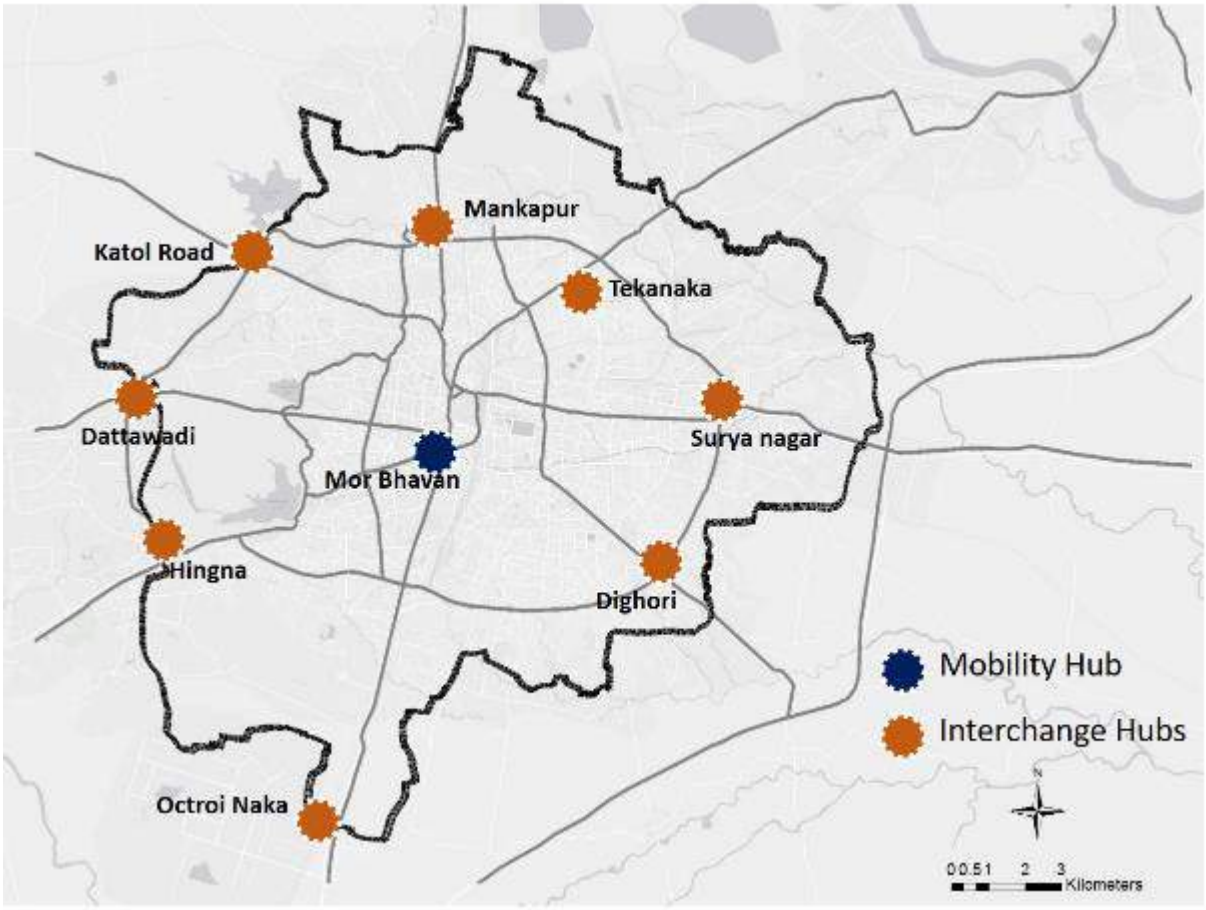
Currently, the terminal facilities in Nagpur are concentrated only at Mor Bhawan terminal, which is located in the city core area. Based on the routing pattern of the city bus services in Nagpur, the tentative location of the terminals/mobility hub has been identified. As an outcome of the study, additional 8 terminals have been identified and dispersed all across the Nagpur city. The location of these 8 terminals has been identified based on the concentration of bus routes (originating and destined) from the respective locations. Considering the above, it is recommended that the existing terminal at More Bhavan be developed and upgraded both interms of civil infrastructure and equipment.

In addition to the existing terminal, 8 new terminal locations have been identified tentatively in the outskirts of the city along the inner ring road to facilitate decongestion of city bus services from the city center and enabling direction oriented transfer facilities. These terminal facilities can be appropriately integrated with the exisitng and proposed bus depots. The tentative locations of the proposed new depots are as under (Refer to Figure 5-9);

1. Mankapur Chowk (junction on Koradi road and inner ring road)
2. Junction on Katol Road and Inner Ring Road
3. Junction on Amravati road and Inner Ring Road Dattawadi
4. Octroi Chekpost
5. Junction on Umred Road and Inner Ring Road Dighori
6. Surya Nagar
7. Teka Naka/Automotive Square
8. Hingna

Since, development/upgradation of the bus terminal is a cost intensive process and involves lot of stakeholders; it is recommended that the development/upgradation of the bus terminal in Nagpur be taken up on PPP basis in a phased wise manner with NMC being the primary coordination agency.

FIGURE 7-13: TENTATIVE LOCATIONS OF PROPOSED NEW TERMINALS



7.4 MULTIMODAL INTEGRATION STRATEGIES

Metro system for Nagpur is a higher order transport system. The transformation from lower order to higher order system often leads to more carrying capacity of the passengers, but reduces the flexibility of the system. Hence it's important to have proper planning and integration of various systems to get the maximum output from the system. Metro stations often act as interchange hubs where different transport modes come together seamlessly to facilitate access to the metro stations, employment locations, residential locations, recreational spaces, etc. Hence it's essential to integrate the metro system to the feeder along with the other modes of transport. This helps in reducing the waiting times and discourages the use of private vehicular modes for the first/last mile connectivity. This also provides an opportunity to increase the catchment areas of the metro system, especially in the lower density metro stations.

The most common challenges encountered with the feeder services is the lack of predictability of the service, due to the increasing traffic congestion, limited right of way near station areas, poor physical integration with the mass transit infrastructure and conflict with the existing modes of public transport, para transit systems such as auto rickshaws, taxis etc., and non-availability of non-motorized passenger (pedestrians and cyclists) systems at the stations premises.

The Feeder system planned as part of the current study, aims to be a support system for the primary metro corridors which enables to provide sustainable transportation by:

- Providing optimal frequency which is in synchronizing with Metro routes;
- Minimizing travel time by improving vehicle operational speeds and reducing dwell time;
- Providing better and direct connectivity to the metro systems by minimizing delays.

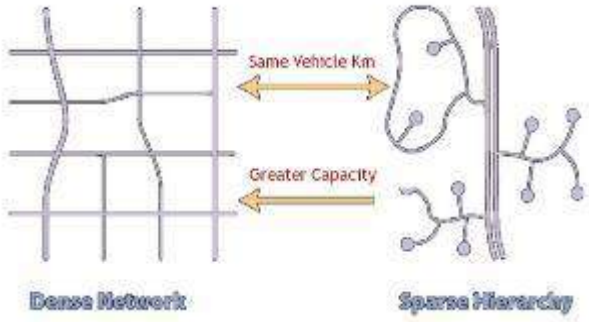
The feeder routes have been designed to cater the catchment region around the metro stations up to a radius of 2.5 km. The routes of the feeder system have been structured so as to provide an optimal combination of direction and destination oriented services. The routes are designed to provide access to the areas which lack proper public transport facilities and to enable greater penetration into dense regions.

Apart from Feeder, existing bus routes have also been rationalised and NMT plans have been prepared. To enable a proper system for the Nagpur Metro, it is essential that the station accessibility is also improved in line with the introduction of the feeder services by way of infusing following aspects;

Walkability: Walking is the most natural, affordable, healthy and clean mode of travel for short distances and a necessary component of a majority of transit trips. Walking can be the most enjoyable and productive way of getting around, if paths and streets are populated and desired services and resources are conveniently located. The key factors to making walking appealing are; safety, activity and comfort.

Cycling: Cycling is an emission free, healthy and affordable transport option for feeder service. This highly efficient and consumes little space and few resources. It combines the convenience of door to door travel, the route and schedule flexibility of walking and the range and speed of many local transit services. Bicycle and other means of para transit – activate streets and greatly increase the coverage area of transit stations. Cyclists however are among the most vulnerable road users. The key factors encouraging cycling is the provision of safe street conditions, and secure cycle parking and storage.

Connectivity: Short and direct pedestrian and cycling routes require highly connected networks of paths and streets around small, permeable blocks. A tight network of paths and streets offering multiple routes to many destinations can also make walking and cycling trips varied and enjoyable. Frequent street corners and narrower right of ways with slow vehicular speed and many pedestrians encourage street activity and local commerce.



Multi Modal Integration: Integration of the mass transit with the city bus system and extended to the NMT modes such as bicycles as well as IPT not only ensure first and last mile connectivity but also seamless transfer of network user. Integration of the multi modes exists at various levels such as institutional, physical, fare, operational and identity. The level at which multiple modes need to integrated shall depend on the local city authorities.

Urban Scape: When cities are shaped by the above mentioned principles, personal motor vehicles become largely unnecessary in the day to day life. Walking, Cycling and the use of high capacity transit are easy and convenient, and can be easily supplemented by a variety of intermediary transit modes. Scarce and valuable urban space can be reclaimed from unnecessary roads and parking, and can be reallocated to more socially and economically productive uses such as place making.

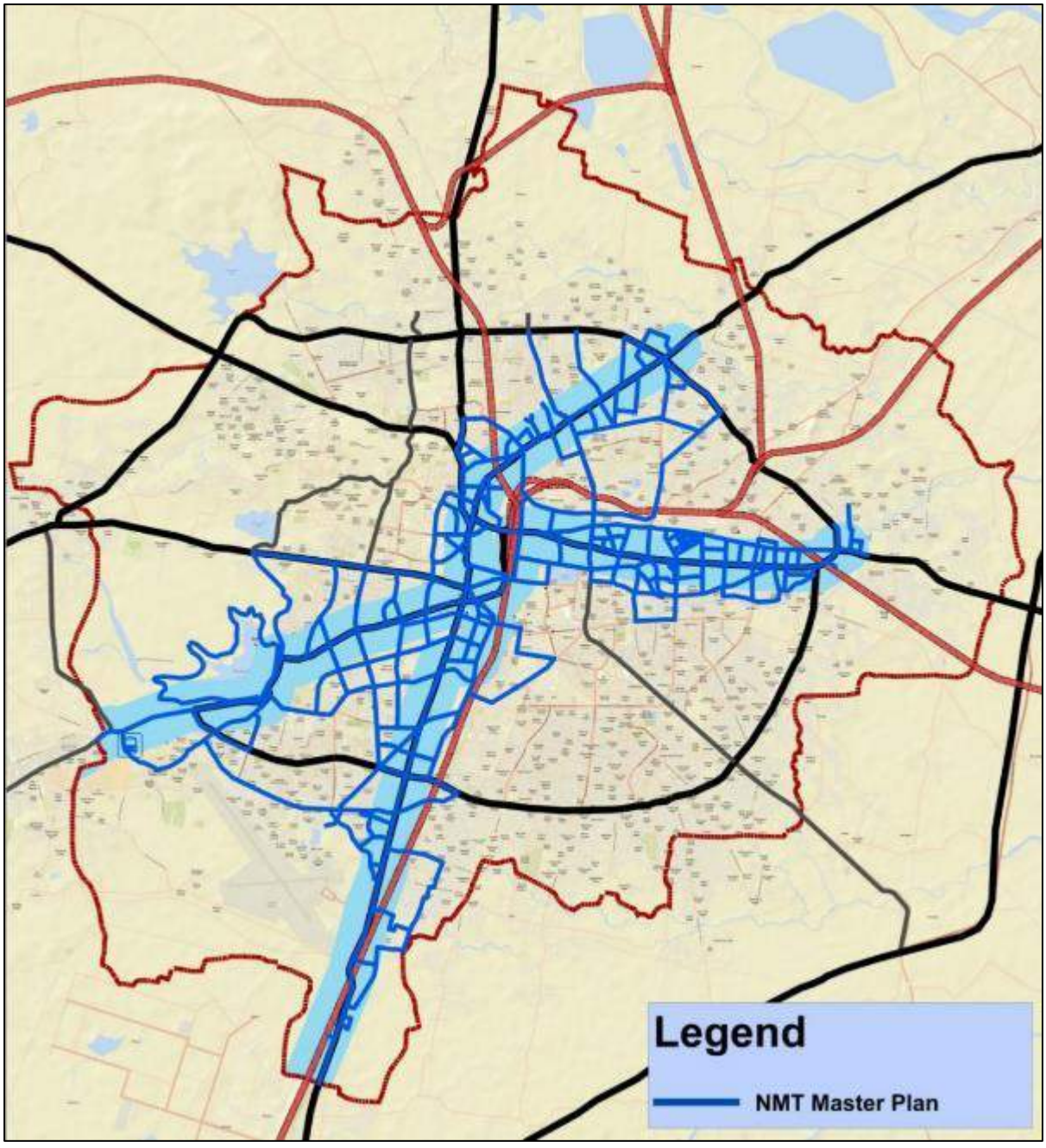
7.4.1.NON MOTORIZED TRANSPORT PLAN FOR 2041

The data assimilated through NMT based primary surveys conducted within the project area has been used to project the NMT demand for the horizon year of 2041. The analysis forms the basis for the proposed NMT Master Plan. As also highlighted in the previous section, some of the key constraints and opportunities, which have governed the proposed NMT Master Plan, are summarized below. The proposed master plan takes into account the existing road conditions and usage prepared a proposal which requires minimum dismantling/relocation of services.

Road Network of 739 km has been identified within the projects area which has been established as NMT priority corridors. The NMT priority corridors are further analysed to explore strategies for provision of NMT based on the existing conditions and future possibilities. Accordingly, the proposed NMT plan has following broad strategies for NMT provisions;

1. Primary NMT Corridors – *with provision of dedicated footpaths and cycle tracks of minimum clear widths of 1.8 M on both sides of the road*
2. Secondary NMT Corridors – *with the provision of dedicated footpaths of minimum clear width of 1.8M on both sides of the road and cycling within the shared traffic conditions.*
3. Tertiary NMT Corridors – *Walking and Cycling within the shared road space*

FIGURE 7-14: PROPOSED NMT MASTER PLAN FOR 2041



7.4.4.1 PRIMARY NMT CORRIDOR

A. BENCHMARKS FOR REQUIREMENT OF FOOTPATHS AND BICYCLE TRACKS

Dedicated footpaths are to be provided in cases where pedestrian volume for 2041 is expected to be greater than 300 per day. Most of the areas with pedestrian volumes < 300 are due to large proportion of short trips with trip length ranging from 0.1 Km to 0.8 Km. These zone are predominantly residential in character. Due to narrow RoWs within such zones, it becomes difficult to provide footpaths and hence alternative solutions such as cobbled/paved streets or kerb-less streets may be explored.

Providing a dedicated cycle track is dependent on the availability of RoW, as it requires a min of 18m carriageway. Zones with road RoWs greater than 18m and high projected cycle trip rates have been proposed to accommodate dedicated bicycle

tracks. However within other zones where demand of cycle trips for year 2041 are found to be high, and contain roads with RoWs much less than 18M bicycling have been proposed within mixed traffic conditions. For such roads with mixed traffic, measures would be proposed to ensure safety for cyclist, reduction in vehicular speeds and minimizing vehicle and cycle conflicts.

B. PROPOSED NMT CORRIDORS

The proposed NMT master plan has two broad categories of NMT corridors:

1. **Category-1:** NMT provisions with dedicated space for either walking or cycling or both (NMT only roads, Primary NMT corridors, Secondary NMT corridors)
2. **Category-2:** NMT usage within shared traffic conditions (Tertiary NMT Corridors).

Based on the proposed NMT master plan, all roads within Category-1 need to be retrofitted and upgraded for NMT usage by the horizon year of 2041. The roads under Category-2 require minor improvement works to ensure safety, comfort, and orientation for NMT users[8]. These measures typically include traffic calming, ensuring adequate street lighting, NMT parking provisions, orientation maps and signage etc.

Following are the list of the proposed NMT Corridors

1. Primary NMT Corridors: Primary Network consists of road length of 95.7 km along the North-South and East West Metro Corridors. Some of the major roads identified are as mentioned;
    a. FCI Godown road,
    b. Central bazar road,
    c. Ambazari road,
    d. Chandrapur Nagpur road,
    e. Sitabuldi,
    f. Dongarnath Nagpur road,
    g. Gangabai ghat road,
    h. Inox road,
    i. Masurkar marg,
    j. Bhandara road,
    k. Kalamna road,
    l. Queta colony road,
    m. Bus stop road,
    n. Sir Bejonji Mehta road,
    o. Kidwai road,
    p. Palm road,
    q. Red cross road,
    r. Mangalwari bazar road,
    s. Katol road,
    t. Chindwara road,
    u. Mecosbagh road,
    v. Panchasheel nagar road,
    w. Itwari station toad,
    x. Ring road,
    y. Sharda chowk,
    z. Nagpur gramin RTO road,

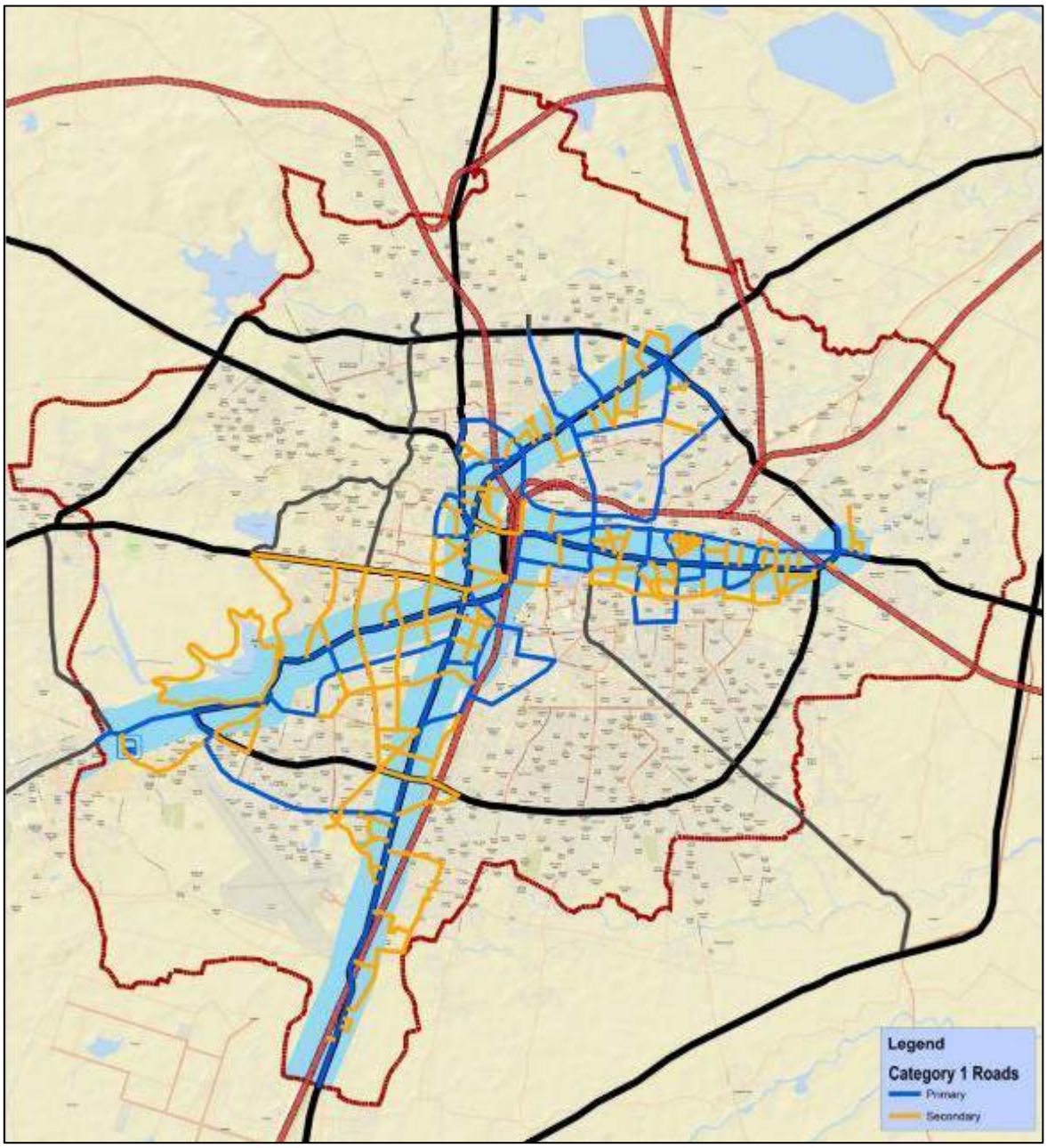
[8] Since, the study area covers the 500 mts buffer on either side of the metro corridor, the study team realised the need for maintaining the continuity of the NMT infrastructure within the city. Hence, as part of the NMT infrastructure, the team identified some portion of the network outside the study area.

aa. Tathagat chowk,
bb. Ambazari Hingna Road

2. Secondary NMT Corridors: Secondary Network consists of road length of 134.60 kms along the North-South and East West Metro Corridors. Some of the major roads identified are as mentioned;
   a. Nari road,
   b. Char khamba road,
   c. Kanji house road,
   d. Commercial road,
   e. Road near central museum Nagpur,
   f. Ashok chowk,
   g. Gurudwara, Kamal chowk,
   h. Dus number Puliya chowk,
   i. Awale babu chowk,
   j. Mount road,
   k. New colony,
   l. Link road,
   m. MAK azad road,
   n. Nagpur Aurangabad Highway,
   o. Road near maharaj bagh road,
   p. W high CTroad,
   q. VIP road, Temple road,
   r. Ambazari bypass road,
   s. Hill road,
   t. Abhyankar Marg,
   u. Balraj marg,
   v. Subhash road,
   w. Police station road,
   x. E High CT road,
   y. Canal road,
   z. RPTS road,
   aa. Umred road,
   bb. Subhash nagar road,
   cc. Walker road,
   dd. Old mangalwari bazar,
   ee. Old bagadganj road,
   ff. Navabpura road,
   gg. Inox road,
   hh. Lakadganj road,
   ii. Transport nagar,
   jj. warehouse chowk,
   kk. road near shreyash lawn,
   ll. East wardhaman nagar,
   mm. Shivaji chowk,
   nn. Vaishnow Devi square.

3. Tertiary NMT Corridors: Tertiary Network shall consist of a road length of 508.81 kms (approximately) within the study, which constitutes of all the collector and local streets.

FIGURE 7-15: PROPOSED CATEGORY 1 NETWORK



Approximately 230.30 kms of the road length consisting of Primary and Secondary Network as mentioned above would have to be upgraded by 2041 with provisions of dedicated NMT Infrastructure. All the remaining roads within the project area fall under Category 2 Corridors.

FIGURE 7-16: PROPOSED CATEGORY 2 NETWORK

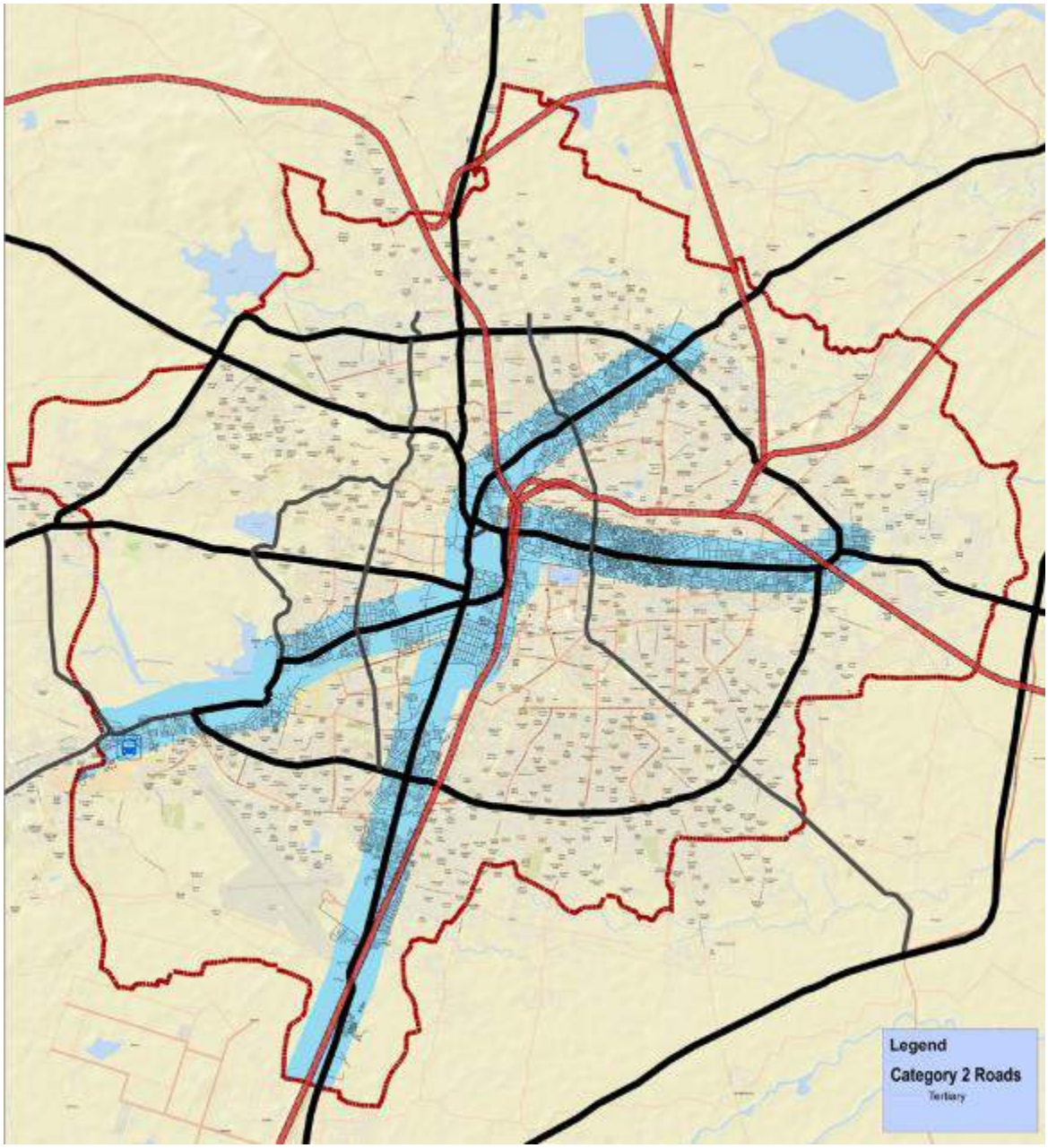


TABLE 7-15: PROPORTION OF CATEGORY 1 & CATEGORY 2 NMT CORRIDORS

Type of NMT Corridor		Description	Corridor Length
Category 1	Primary Corridors	*– with provision of dedicated footpaths and cycle tracks of minimum clear widths of 1.8 M on both sides of the road*	95.7 km
	Secondary Corridors	*with the provision of dedicated footpaths of minimum clear width of 1.8M on both sides of the*	134.60 km

Type of NMT Corridor		Description	Corridor Length
		road and cycling within the shared traffic conditions.	
Category 2	Tertiary Corridors	*Walking and Cycling within the shared road space*	508.81 km

7.4.2. PHASING OF THE NON -MOTORIZED TRANSPORT PLAN

Considering the horizon year, a tentative phasing of the road improvement works to retrofit all roads within the project area as per the proposed NMT plan is shown in the Table 7-16.

TABLE 7-16: TENTATIVE PHASING OF ROAD IMPROVEMENT WORKS

Road Type	Immediate Improvement (2017)	Improvements by 2027	Improvement by 2041	Total
Primary NMT corridors	90 kms	5.70 km		95.70 km
Secondary NMT Corridors		33.78 km	100.82 km	134.60 km
Tertiary NMT Corridors		253.5 km	253.5 km	508.81 km

7.4.3. PUBLIC BICYCLE SHARING (PBS)

PBS is a public transportation system based on cycles, which are generally stored in a closely spaced network of stations. With a smart card or any other form of identification, a user can check out a bicycle from a station and return it to any other station. The central concept of this system is to provide affordable access to cycles for short-distance trips in urban areas as an alternative to motorized public transportation or private vehicles.

Unlike traditional bicycle rental systems found in several Indian cities, PBS is a more flexible system which allows it's user to rent a cycle from a station and return it to any other depending on the user's comfort. It hence allows its users the freedom to make one way trips. While traditional systems had users renting cycles for an hour to several days, PBS encourages its users to rent cycles for a shorter time period which range from a few minutes to a few hours. Users are economically incentivised to return cycles at the earliest by making usage free for the first thirty minutes or so. Moreover, while traditional systems use cycles which are commercially available, PBS make use of cycles which are specially designed for the system and hence unique.

As part of the current study, the Public Bike Sharing System is proposed in two phases, wherein the Phase 1 covers 122 kms of network and Phase 2 cover 88 kms of network considering the demand as well as the near future developmental activities near the identified locations and transit stations (Refer to Figure 7-17).

As per the NMT OD and Opinion Surveys, the following nine areas with high proportion of cycling trips originating or destined towards them have been identified for the Pilot Public Bike Sharing Scheme (Refer to Figure 7-18);

1. Civil Lines Institutional Area
2. Nagpur Central Business District (CBD)
3. Rahate Colony Institutional Hub
4. Manish Nagar Somalwada
5. MIHAN SEZ
6. Hingana Industrial Area
7. Ambazari Lake Leisure Trail
8. Shankar Nagar Square & VNIT
9. Automotive Square Industrial Hub

FIGURE 7-17: PROPOSED PUBLIC BIKE SHARING NETWORK (PHASE 1 & PHASE 2)

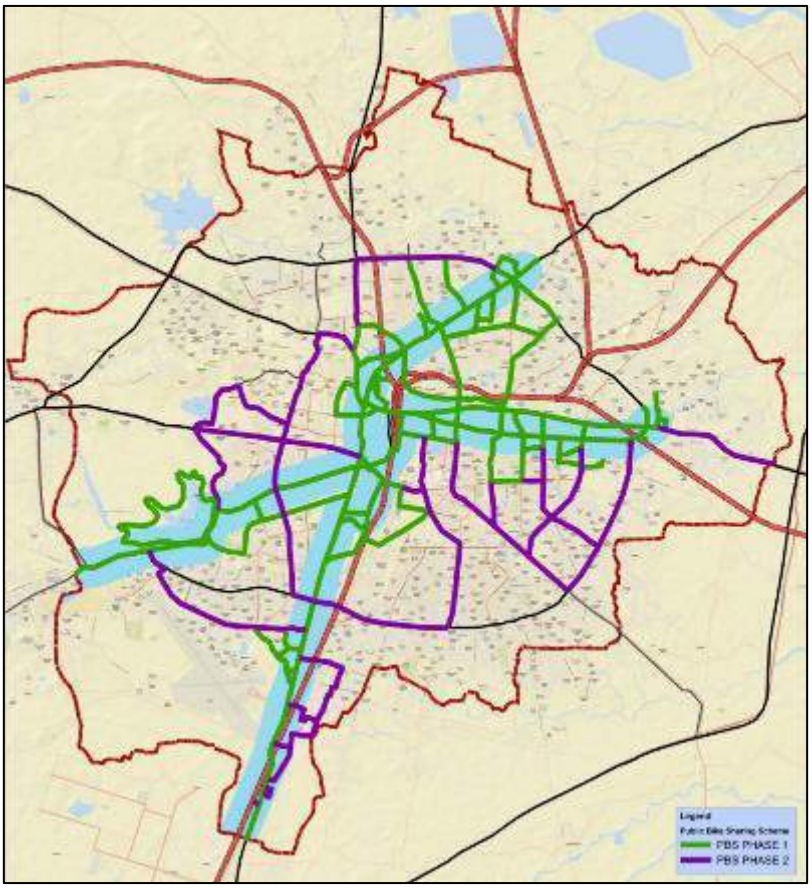
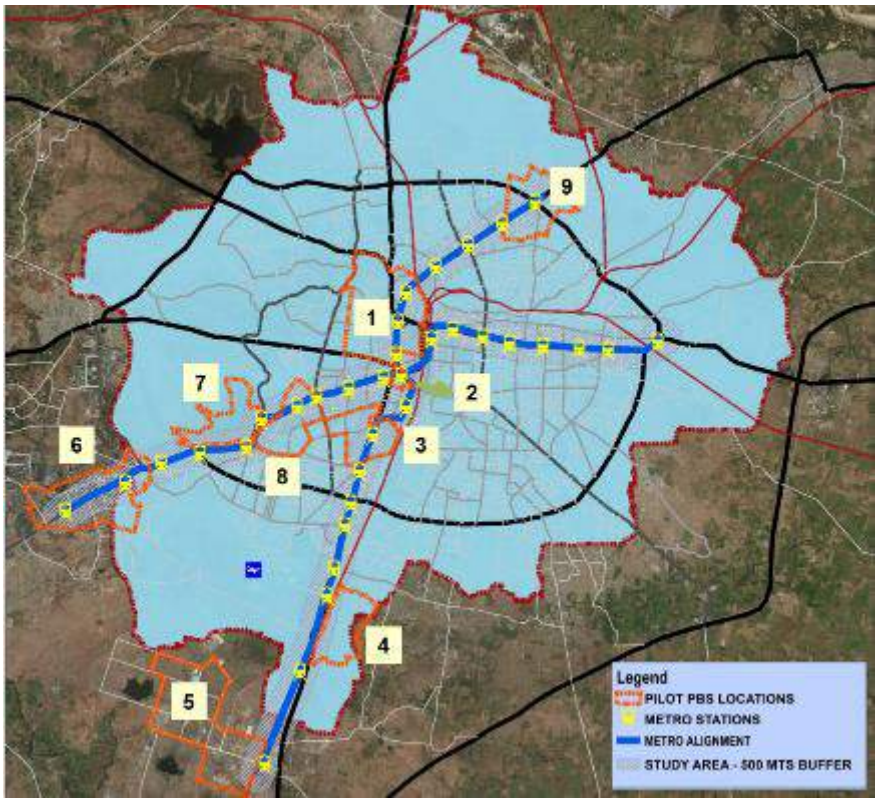


FIGURE 7-18: PROPOSED PRIORITY LOCATIONS FOR PUBLIC BIKE SHARING SCHEME IN NAGPUR



Out of the above mentioned nine locations, MIHAN SEZ can be taken in Phase 2 of the PBS implementation. As it has been observed that there is an delay in the execution of the project and currently only 3 companies are operating from this area.

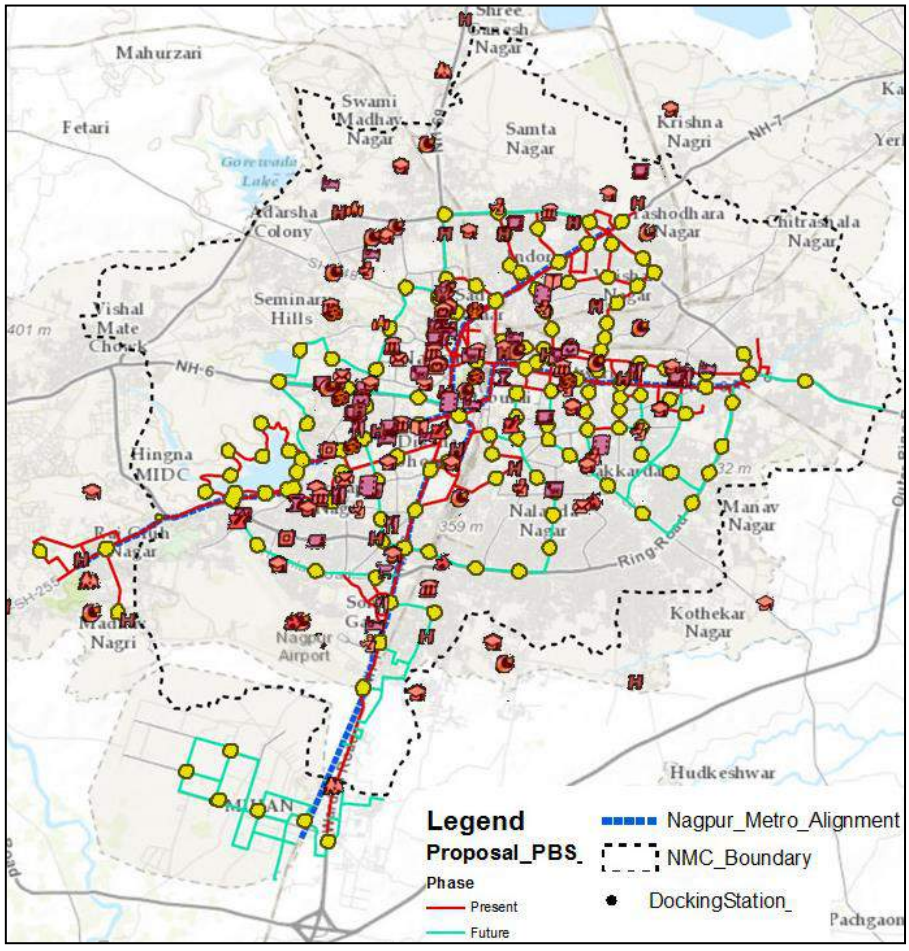
7.3.3.1 PROPOSED PBS STATIONS

For the public bicycle sharing scheme, a total of 146 docking stations with a total holding capacity of 4330 bicycles with 6540 docks[9] have been proposed in 2 phases.

The location of the PBS Docking stations has been located considering the close proximity to the proposed bicycling infrastructure to increase the connectivity to the jurisdiction's bicycle network. Stations have been roughly located at uniform distance from one another, which in the case of Nagpur is approximately 500 m – 750 m. The size of the station is determined as a function of the anticipated demand and attraction of a particular area, and the station's location shall be dependent of the actual site environment. Bicycle stations are located near metro stations, bus stops, IPT stands, within the vicinity of the junctions, residential areas, public institutions & activity centers such as the schools, colleges, parks, market places, commercial areas, offices, institutions and other activity nodes.

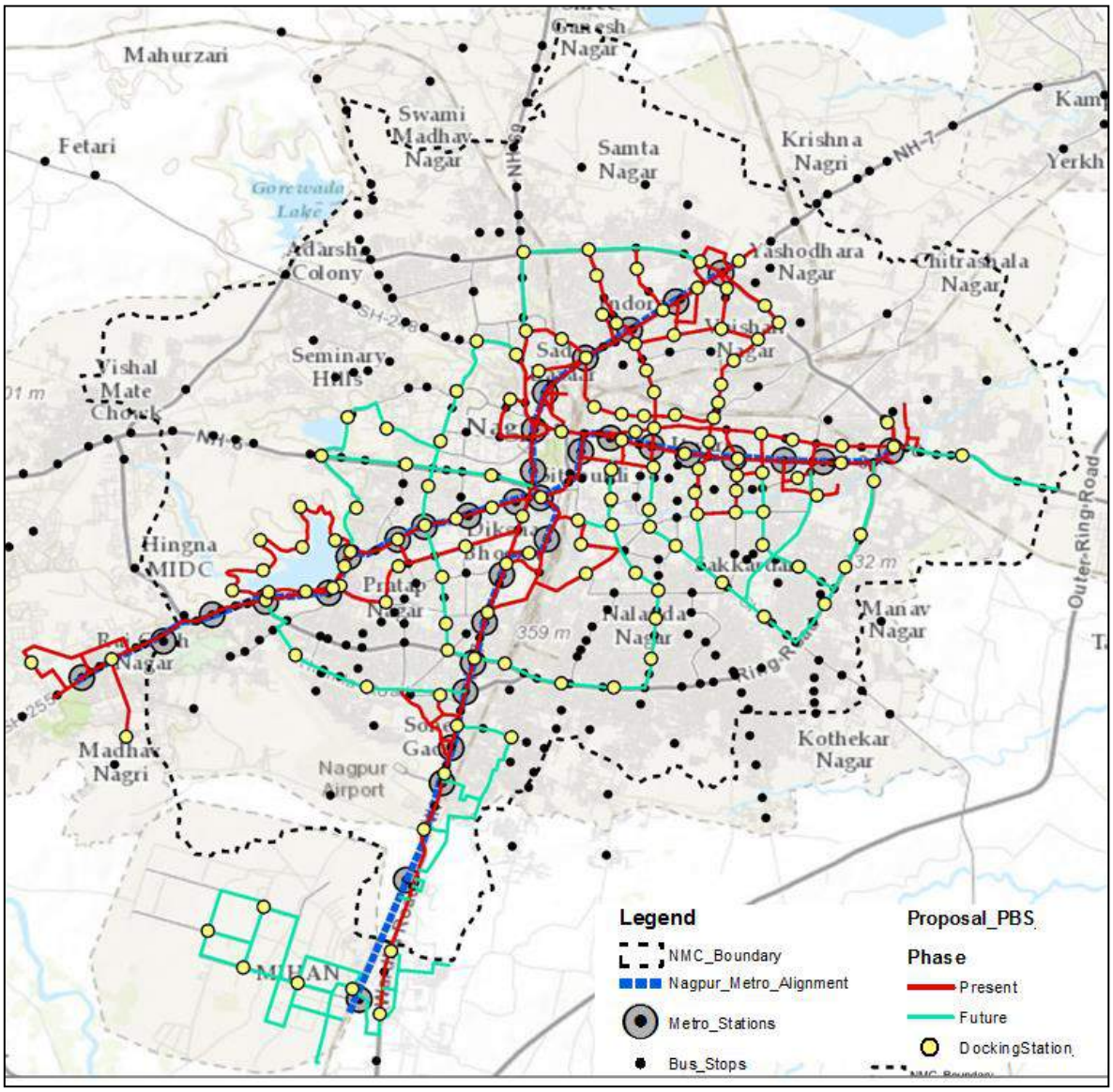
The distribution of the PBS stations of different sizes is based on the density and intensity of activities in the vicinity. Figure below represents the distribution of major activity centers within the study area. Lower Figure represents the location of the transit stops within the study area.

FIGURE 7-19: IDENTIFICATION OF PBS STATIONS BASED ON MAJOR ACTIVITY CENTERS



[9]No. of Docks – 1.5 times the no. of cycles

FIGURE 7-20: IDENTIFICATION OF PBS STATIONS BASED ON LOCATION OF TRANSIT STOPS



Considering the activity centers and transit nodes, the location of the docking stations has been identified. The stations are classified as Small, Medium and Large stations[10]. The largest stations (housing more than 40 s) are located near activities generating maximum traffic such as the major transit nodes etc. The medium stations (housing 20 - 40 s) are proposed near high intensity uses such as offices, institutes and recreation spaces. The small stations (housing 10-20 s) are proposed to be distributed evenly among the residential areas. Figure below epresents the location of the docking stations and classification of the same as per the Phasing. Figure 7-22 represents the classification of the docking stations.

[10]As per the best practices provided in the PBS Guidance Document

FIGURE 7-21: LOCATION OF THE PROPOSED DOCKING STATIONS

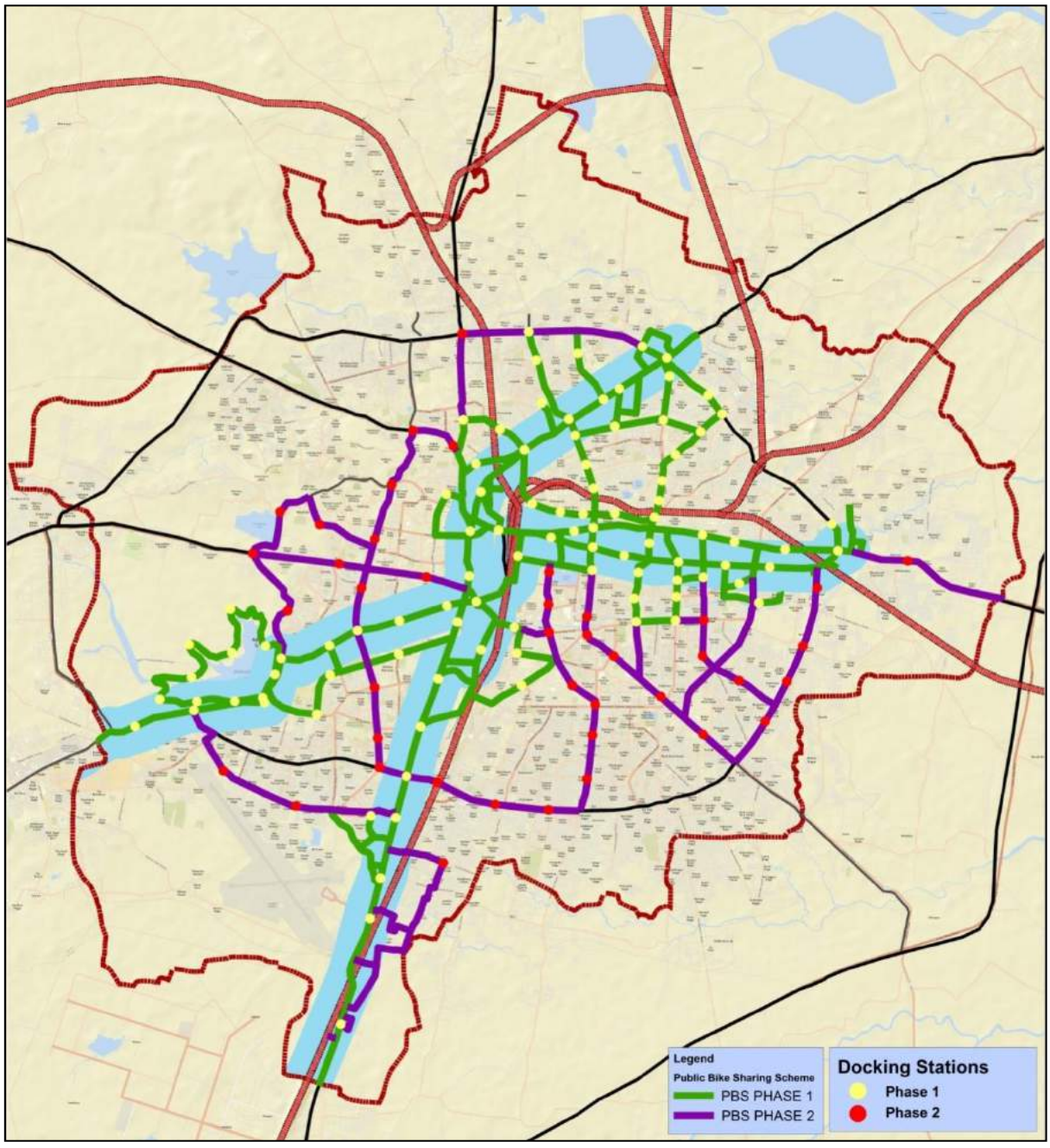


FIGURE 7-22: DISTRIBUTION OF PROPOSED DOCKING STATION BASED ON THE TYPOLOGY

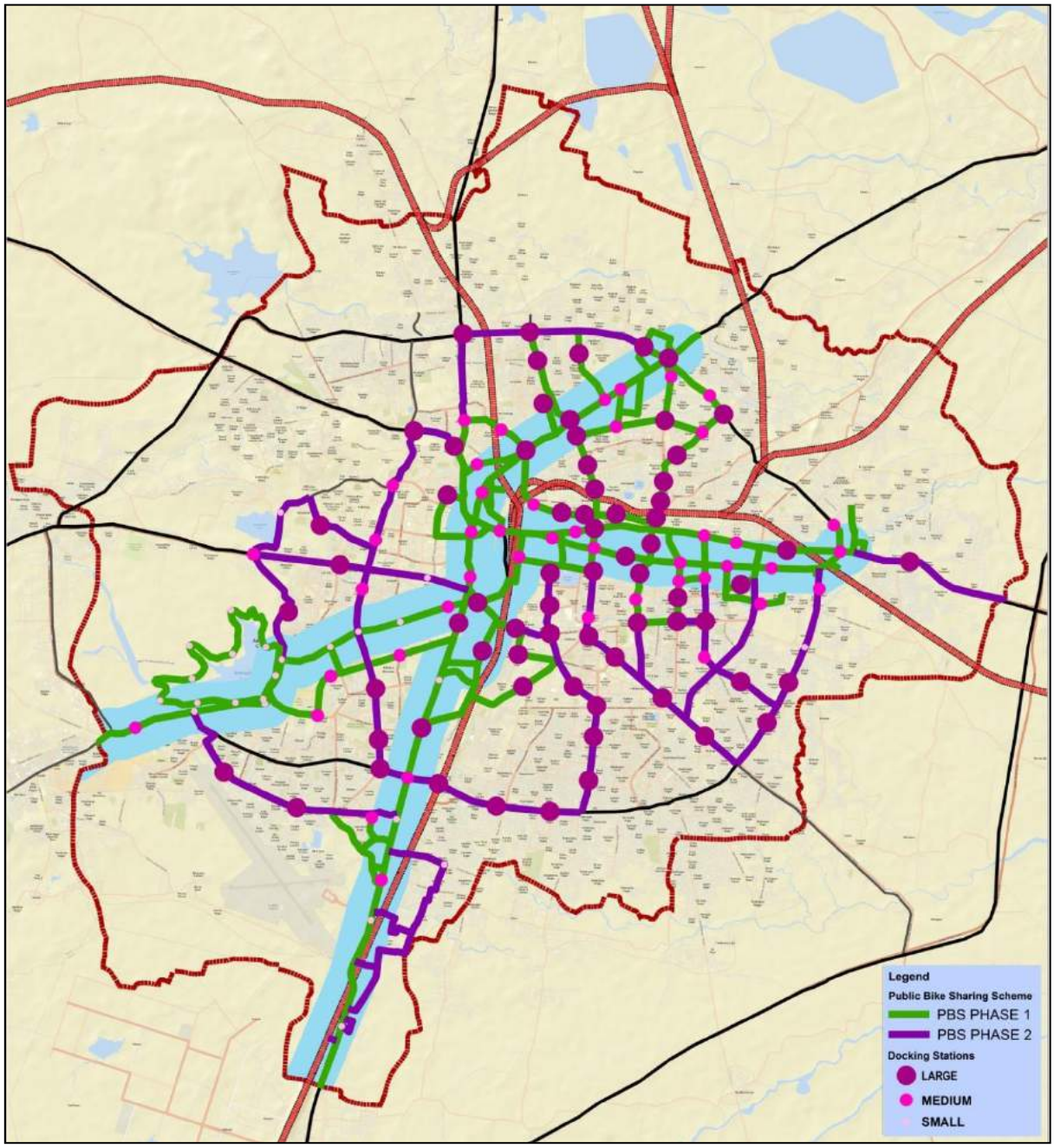


TABLE 7-17: LIST OF BICYCLE DOCKING STATIONS

Sl. No.	Unique ID	Name of the Docking Stations	No. of Cycles		No. of Docking Stations		Type of Station	Phase
			2017	2041	2017	2041		
1	**PBS-01**	**Sharda Company Bus Stop**	**36**	**54**	**55**	**80**	**Large**	**Phase 1**
2	PBS-02	Kamgar Nagar	32	47	50	70	Large	Phase 1
3	**PBS-03**	**Mohommad Rafi Sq**	**15**	**22**	**25**	**35**	**Medium**	**Phase 1**
4	PBS-04	Parwesh Nagar Ring road	20	30	30	45	Medium	Phase 1
5	**PBS-05**	**Itabhatti chowk**	**30**	**53**	**45**	**80**	**Large**	**Phase 1**
6	PBS-06	Kanji house chowk	24	35	35	55	Medium	Phase 1
7	**PBS-07**	**Rani Durgawati chowk**	**26**	**39**	**40**	**60**	**Large**	**Phase 1**
8	PBS-08	Mahdi bagh road	26	38	40	55	Large	Phase 1
9	**PBS-09**	**Char khamba chowk**	**16**	**23**	**25**	**35**	**Medium**	**Phase 1**
10	PBS-10	Dr ambedkar road, cement road	38	56	55	85	Large	Phase 1
11	**PBS-11**	**Panchpaoli flyover**	**37**	**54**	**55**	**80**	**Large**	**Phase 1**
12	PBS-12	Mahadevmandir, Ambedkar road	38	56	55	85	Large	Phase 1
13	**PBS-13**	**Dhammadipnagaritwari station road**	**26**	**38**	**40**	**55**	**Large**	**Phase 1**
14	PBS-14	Lalganjdahi bazar chowk	31	45	45	70	Large	Phase 1
15	**PBS-15**	**Dahi bazar chowk, Masurkarmarg**	**29**	**42**	**45**	**65**	**Large**	**Phase 1**
16	PBS-16	Cradak road. Pathrabemohalla	31	46	45	70	Large	Phase 1
17	**PBS-17**	**Patankar chowk**	**37**	**54**	**55**	**80**	**Large**	**Phase 1**
18	PBS-18	Indora Bus Stop	28	41	40	60	Large	Phase 1
19	**PBS-19**	**Mahatma gandhi high school**	**25**	**44**	**40**	**65**	**Large**	**Phase 1**
20	PBS-20	Bhim chowk Nara road	27	39	40	60	Large	Phase 1
21	**PBS-21**	**Ring road Jaripataka Police station road**	**38**	**55**	**55**	**85**	**Large**	**Phase 1**
22	PBS-22	Byramji town Indsind bank	12	18	20	25	Medium	Phase 1
23	**PBS-23**	**Kadbi chowk**	**28**	**41**	**40**	**60**	**Large**	**Phase 1**
24	PBS-24	Mangalwari ground, NIT	18	26	25	40	Medium	Phase 1
25	**PBS-25**	**Hotel panchawatigaurao Mount road sadar**	**34**	**50**	**50**	**75**	**Large**	**Phase 1**
26	PBS-26	Kasturchand park	22	39	35	60	Medium	Phase 1
27	**PBS-27**	**GMC Boys hostel Kidwai road**	**19**	**28**	**30**	**40**	**Medium**	**Phase 1**
28	PBS-28	Timki Mominpura road, Nuri street	27	49	40	75	Large	Phase 1
29	**PBS-29**	**Samta Nagar buddhvihar**	**25**	**37**	**40**	**55**	**Large**	**Phase 1**

Sl. No.	Unique ID	Name of the Docking Stations	No. of Cycles		No. of Docking Stations		Type of Station	Phase
			2017	2041	2017	2041		
30	PBS-30	Mansoor baba street Hasanpuri road	22	39	35	60	Medium	Phase 1
31	**PBS-31**	**Ganjakhet chowk**	**34**	**51**	**50**	**75**	**Large**	**Phase 1**
32	PBS-32	Geetanjali chowk	22	39	35	60	Medium	Phase 1
33	**PBS-33**	**Chitnis park chowk**	**34**	**50**	**50**	**75**	**Large**	**Phase 1**
34	PBS-34	Chandrashekhar Azad chowk	34	50	50	75	Large	Phase 1
35	**PBS-35**	**LadpuraMasurkarmarg**	**29**	**42**	**45**	**65**	**Large**	**Phase 1**
36	PBS-36	Ayachitmandir Bus stop	34	49	50	75	Large	Phase 1
37	**PBS-37**	**Itwari telephone Exchange chowk**	**12**	**18**	**20**	**25**	**Medium**	**Phase 1**
38	PBS-38	Gangabaighat road Sidheshwar park garbamaidan	12	18	20	25	Medium	Phase 1
39	**PBS-39**	**Dana ganj chowk**	**12**	**18**	**20**	**25**	**Medium**	**Phase 1**
40	PBS-40	Bhandara road Pritam complex sudarshan chowk	12	17	20	25	Medium	Phase 1
41	**PBS-41**	**Inox road Anil bar and restaurant shastrinagar chowk**	**27**	**40**	**40**	**60**	**Large**	**Phase 1**
42	PBS-42	Gangabaighat chowk	27	39	40	60	Large	Phase 1
43	**PBS-43**	**Shri radhakrishna hospital chowk**	**20**	**29**	**30**	**45**	**Medium**	**Phase 1**
44	PBS-44	Kushinarabuddha Vihar Padolenagar	16	23	25	35	Medium	Phase 1
45	**PBS-45**	**Old Pardinaka**	**15**	**21**	**25**	**30**	**Medium**	**Phase 1**
46	PBS-46	Shrinagar Kanyakumari highway State bank of bikaner and Jaipur	20	30	30	45	Medium	Phase 1
47	**PBS-47**	**Shani mandirShakkardhara road Nandajinagar**	**21**	**37**	**30**	**55**	**Medium**	**Phase 1**
48	PBS-48	Bholaganesh chowk Mahaveernagar	31	45	45	70	Large	Phase 1
49	**PBS-49**	**KDK College roadAnandfarsanmishtannabhandar**	**32**	**47**	**50**	**70**	**Large**	**Phase 1**
50	PBS-50	Munje Chowk	39	56	60	85	Large	Phase 1
51	**PBS-51**	**Big bazar Aurangabad Nagpur Highway**	**26**	**39**	**40**	**60**	**Large**	**Phase 1**
52	PBS-52	SenapatiBapat chowk	15	11	25	15	Medium	Phase 1
53	**PBS-53**	**Shankar nagar square**	**9**	**13**	**15**	**20**	**Small**	**Phase 1**
54	PBS-54	Kachipura chowk	20	29	30	45	Medium	Phase 1
55	**PBS-55**	**VNIT Ground**	**13**	**19**	**20**	**30**	**Medium**	**Phase 1**
56	PBS-56	Hingna T point Bus stop	7	10	10	15	Small	Phase 1
57	**PBS-57**	**Saduru Medical Nildoh CRPF Bus stop**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
58	PBS-58	Kalimatamandir	34	51	50	75	Large	Phase 1
59	**PBS-59**	**Sardarpatel chowk**	**31**	**45**	**45**	**70**	**Large**	**Phase 1**
60	PBS-60	Ajni road Wanjaronagar road	30	44	45	65	Large	Phase 1
61	**PBS-61**	**Rambagh road Shivkrupa motor royal enfield service center**	**32**	**47**	**50**	**70**	**Large**	**Phase 1**

Sl. No.	Unique ID	Name of the Docking Stations	No. of Cycles		No. of Docking Stations		Type of Station	Phase
			2017	2041	2017	2041		
62	PBS-62	Nemad lane Ajni square	35	26	55	40	Large	Phase 1
63	**PBS-63**	**High court society RohitsaojiRrestaurant**	**16**	**23**	**25**	**35**	**Medium**	**Phase 1**
64	PBS-64	Somalwada square parking	10	15	15	25	Small	Phase 1
65	**PBS-65**	**ShantiniketanGyanpeet convent 24 meter ODR road Airort colony**	**7**	**7**	**10**	**10**	**Small**	**Phase 1**
66	PBS-66	Chaprusarvoday Mandal Chaprunagarshastrinagar	12	18	20	25	Medium	Phase 1
67	**PBS-67**	**Haldiram factory wardhamannagar colony**	**26**	**38**	**40**	**55**	**Large**	**Phase 1**
68	PBS-68	Kamptee road bank colony Elecronica finance limited	15	22	25	35	Medium	Phase 1
69	**PBS-69**	**Lal godam bus stop Sidharthnagar**	**16**	**23**	**25**	**35**	**Medium**	**Phase 1**
70	PBS-70	Mecosbagh Methodist Church	12	18	20	25	Medium	Phase 1
71	**PBS-71**	**Chatrapati Shivaji square**	**18**	**26**	**25**	**40**	**Medium**	**Phase 1**
72	PBS-72	Nagpur airport Bus stop sonegao police station	22	22	35	35	Medium	Phase 1
73	**PBS-73**	**Ambazari Bypass Hingna Road**	**9**	**13**	**15**	**20**	**Small**	**Phase 1**
74	PBS-74	Subhashnagar chowk	7	10	10	15	Small	Phase 1
75	**PBS-75**	**Shiwalkar complex garden police madatkendraAmbazarird**	**13**	**19**	**20**	**30**	**Medium**	**Phase 1**
76	PBS-76	Ambazari Lake Four	10	10	15	15	Small	Phase 1
77	**PBS-77**	**Ambazari Lake Six**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
78	PBS-78	Ambazari Lake Seven	10	10	15	15	Small	Phase 1
79	**PBS-79**	**Ambazari Lake Eight**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
80	PBS-80	Ambazari Lake Nine	10	10	15	15	Small	Phase 1
81	**PBS-81**	**Ambazari Lake Five**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
82	PBS-82	Ambazari lake Three	10	10	15	15	Small	Phase 1
83	**PBS-83**	**Nag river start location Ambazari lake walk One**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
84	PBS-84	Ambazari lake Two	10	10	15	15	Small	Phase 1
85	**PBS-85**	**Ambazari Lake Ten**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
86	PBS-86	DurawellMetsys MIDC Hingna Road	10	10	15	15	Small	Phase 1
87	**PBS-87**	**Panchsheel Bus stop Digdoh**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
88	PBS-88	Rahate colony Ambazri road Wardha road	10	10	15	15	Small	Phase 1
89	**PBS-89**	**Gandhi nagar square**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
90	PBS-90	DharampethVidyalay Bus stop	10	10	15	15	Small	Phase 1
91	**PBS-91**	**Hotel dwarakaKhapriwardha road nagpur**	**10**	**10**	**15**	**15**	**Small**	**Phase 1**
92	PBS-92	Mankapur chowk	0	28	0	40	Large	Phase 2
93	**PBS-93**	**Nagpur resort MTDC**	**0**	**19**	**0**	**30**	**Medium**	**Phase 2**

Sl. No.	Unique ID	Name of the Docking Stations	No. of Cycles		No. of Docking Stations		Type of Station	Phase
			2017	2041	2017	2041		
94	PBS-94	CP and Berar management Institute Forest colony	0	41	0	60	Large	Phase 2
95	**PBS-95**	**Dr PanjabraoDeshmukh Chowk**	**0**	**11**	**0**	**15**	**Small**	**Phase 2**
96	PBS-96	Times of India W high ct road	0	19	0	30	Medium	Phase 2
97	**PBS-97**	**Futala chowk**	**0**	**15**	**0**	**25**	**Medium**	**Phase 2**
98	PBS-98	NagmandirAmbazari campus road	0	45	0	70	Large	Phase 2
99	**PBS-99**	**Dindayal upadhyaychokw**	**0**	**29**	**0**	**45**	**Large**	**Phase 2**
100	PBS-100	W High Ct Road near Indian oil petrol bunk	0	36	0	55	Large	Phase 2
101	**PBS-101**	**Orange city hospital square**	**0**	**25**	**0**	**40**	**Large**	**Phase 2**
102	PBS-102	Yogeshwar Krishna mandir modern society ring road	0	45	0	70	Large	Phase 2
103	**PBS-103**	**Zinga T point near rameshwari square**	**0**	**36**	**0**	**55**	**Large**	**Phase 2**
104	PBS-104	South point school near omkarnagar chowk	0	44	0	65	Large	Phase 2
105	**PBS-105**	**Balajinagar square**	**0**	**50**	**0**	**75**	**Large**	**Phase 2**
106	PBS-106	Jadumahal road lane 5	0	42	0	65	Large	Phase 2
107	**PBS-107**	**Arunjoshi college of education hanuman nagar road**	**0**	**45**	**0**	**70**	**Large**	**Phase 2**
108	PBS-108	Tukdoji chowk	0	37	0	55	Large	Phase 2
109	**PBS-109**	**Kamgarnagar square**	**0**	**40**	**0**	**60**	**Large**	**Phase 2**
110	PBS-110	Ganeshpethchowk, subhash road	0	45	0	70	Large	Phase 2
111	**PBS-111**	**Gandhisagar lake**	**0**	**45**	**0**	**70**	**Large**	**Phase 2**
112	PBS-112	ArmoriNagour highway kashibai palace	0	23	0	35	Medium	Phase 2
113	**PBS-113**	**Ashok chowk**	**0**	**25**	**0**	**40**	**Large**	**Phase 2**
114	PBS-114	Reshimbagh chowk	0	37	0	55	Large	Phase 2
115	**PBS-115**	**Umred road Bhelonde Bal rugnalay**	**0**	**40**	**0**	**60**	**Large**	**Phase 2**
116	PBS-116	KDK College chowk	0	32	0	50	Large	Phase 2
117	**PBS-117**	**Aurangzeb chowk**	**0**	**20**	**0**	**30**	**Medium**	**Phase 2**
118	PBS-118	Vathoda hanuman chowk	0	11	0	15	Small	Phase 2
119	**PBS-119**	**ShidheshwarnagarGulmohar S Ridge road**	**0**	**36**	**0**	**55**	**Large**	**Phase 2**
120	PBS-120	HP Petrol pump Bhandara road Bhandewadi	0	54	0	80	Large	Phase 2
121	**PBS-121**	**Salasernagar parking Lot**	**0**	**17**	**0**	**25**	**Medium**	**Phase 2**
122	PBS-122	DhammabhumiTajbagh road	0	35	0	55	Large	Phase 2
123	**PBS-123**	**Somalwadabesa road Manish nagarSomalwada**	**0**	**10**	**0**	**15**	**Small**	**Phase 2**
124	PBS-124	Shankar nagarKhamla road	0	27	0	40	Large	Phase 2
125	**PBS-125**	**Shiv temple trimurtinagarKhamla**	**0**	**25**	**0**	**40**	**Large**	**Phase 2**

Sl. No.	Unique ID	Name of the Docking Stations	No. of Cycles		No. of Docking Stations		Type of Station	Phase
			2017	2041	2017	2041		
126	PBS-126	Katol road Electricity boadSEminary hills	0	31	0	45	Large	Phase 2
127	**PBS-127**	**Srinagar kanyakumari highway nandannagar**	**0**	**47**	**0**	**70**	**Large**	**Phase 2**
128	PBS-128	Kharbi road New diamond nagarShaktimatanagarKharbi	0	31	0	45	Large	Phase 2
129	**PBS-129**	**Katol road shubham Nursing home**	**0**	**31**	**0**	**45**	**Large**	**Phase 2**
130	PBS-130	Futala road Japnese garden	0	19	0	30	Medium	Phase 2
131	**PBS-131**	**Amravati road Dr PanjabraoDeshmukh Polytechnic**	**0**	**33**	**0**	**50**	**Large**	**Phase 2**
132	PBS-132	Swami Vivekanand medical misisionParsodi Srinagar kanyakumari highway	0	10	0	15	Small	Phase 2
133	**PBS-133**	**Khapri 1**	**0**	**10**	**0**	**15**	**Small**	**Phase 2**
134	PBS-134	Khapri 2	0	10	0	15	Small	Phase 2
135	**PBS-135**	**Mihan 1**	**0**	**10**	**0**	**15**	**Small**	**Phase 2**
136	PBS-136	Mihan 2	0	10	0	15	Small	Phase 2
137	**PBS-137**	**Mihan3**	**0**	**10**	**0**	**15**	**Small**	**Phase 2**
138	PBS-138	Futala lake Bharat nagar	0	10	0	15	Small	Phase 2
139	**PBS-139**	**Balajinagar bus stop near Nildoh**	**30**	**33**	**45**	**50**	**Medium**	**Phase 1**
140	PBS-140	Near perfect boys hostel Hingna road	30	33	45	50	Medium	Phase 1
141	**PBS-141**	**Cotton market road Railway station nagpur**	**30**	**33**	**45**	**50**	**Medium**	**Phase 1**
142	PBS-142	Near latamangeshkar hospital Chandrapurmancheriyal highway	30	33	45	50	Medium	Phase 1
143	**PBS-143**	**Near RBI Suare Bus stop**	**30**	**33**	**45**	**50**	**Medium**	**Phase 1**
144	PBS-144	Near gaddigodam bus stop	30	33	45	50	Medium	Phase 1
145	**PBS-145**	**Near drambedkar park NH6 , central Ave road**	**30**	**33**	**45**	**50**	**Medium**	**Phase 1**
146	PBS-146	Central ave road, near gandhibagh Bus stop	30	33	45	50	Medium	Phase 1
			2145	**4330**	**3250**	**6540**		

Table below lists the location of the identified docking stations within the NMT study area for Nagpur. The table also gives the number of cycles and no. of docking points to be provided at the each PBS stations during the Phase 1 and Phase 2. The estimation of the bicycles and docking stations are based on the demand estimation of the bicycling trips. Also for important junctions and nodes additional demand is assumed. Post the scheme implementation, the demand for bicycles and parking docks may increase. Accordingly, either more docking stations may be added to the PBS scheme or the capacity of the existing stations may be increased by adding additional docking points at the docking stations.

Below table represents the summary of Proposed PBS Scheme for Nagpur.

TABLE 7-18: SUMMARY OF THE PROPOSED PBS SCHEME FOR NAGPUR

Components	Phase 1	Phase 2	Total
Bicycling Network (km)	122	88	209
Bicycle	2145	2185	4330
Docks	3250	3290	6540
Docking Stations	99	47	146
Small Docking Stations	23	10	33
Medium Docking stations	38	7	45
Large Docking stations	38	30	68

7.3.3.2 PROPOSED PBS SYSTEM SPECIFICATIONS

Based on the observations and rational experiences from the other parts of the country, it has been recommended that PBS for Nagpur shall be a fourth generation – demand responsive, multi modal system[11]. The system specifications for the Nagpur PBS are described in the following section of the chapter covering the following components;

1. Bicycles
2. Docking Points/Docks
3. Docking Terminals
4. Docking Stations
5. Maintenance Depots
6. Redistribution Vehicles
7. Control Center and ITS

A. BICYCLES

The bicycles in a PBS system are the most important component that promises to offer the convenience of access and appeal of a modern, safe and smart vehicle.

Considering the use of commute of people of all age groups, gender and size, the proposed bicycles have to be versatile and unique characteristics to provide flexibility ease of use and unique identity. Specifications of the bicycles in Nagpur PBS have been given below and same has been shown in the following picture;

- Bicycles shall be unisex frame; which can be used by all kinds of people
- Bicycles will weigh between 16 kg to 22 kg, heavier than typical personal s affording greater stability and be sturdy to be used 10 and 15 times a day in all weather conditions.
- The bicycles will be smart cycles with inbuilt computer board at the rear end which shall enable locking and unlocking.
- Bicycles will be equipped with a GPS and RFID tag, for fleet management and retrieving lost or stolen bicycles.

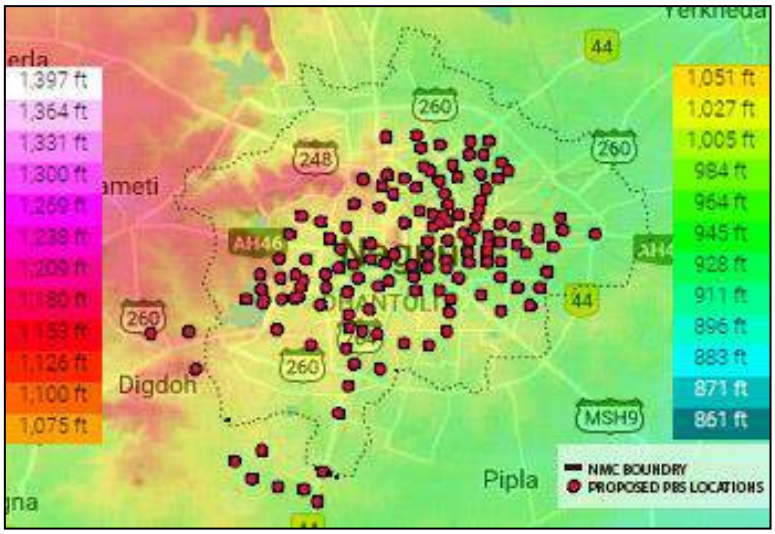
[11]The addition to the fourth generation PBS is the bicycle redistribution system. In case of the fourth gen bicycle sharing system, docking stations that are more efficient (mobile, solar powered, etc.) are used, it also includes a touch screen kiosk for user interface linked to public transit smartcard.

- Bicycles will be theft-proof as its components will be custom-made and incompatible with other bicycles and require special tools for disassembly.
- The front frame shall contain a steel fork with an integrated electronic lock.
- The handle bar shall be equipped with a handle lock to ensure safety.
- It shall have a LED status signal near the computer board to indicate correct docking/undocking of bicycles.
- All bicycles in a fleet will have consistent design and distinctive look imparting a brand identity
- Bicycles will have adjustable seats, mudguards, internal hub gears with different speeds, internal hub brakes, enclosed chain, reflective strips and lights on front and rear wheels, rear-view mirror and a bell. Other in-built features include handlebar mounted basket for convenience.

FIGURE 7-23: GRAPHICAL REPRESENTATION OF PROPOSED FOR NAGPUR

One of the concerns of currently impeding acceptance of existing PBS models in India is the design of bicycles, available advertisement space, and technology integration for easing the access and deterring thefts. When compared to the old systems in Delhi and Mumbai the newer system as in Bhopal and Mysore was capable to attract the users through its design. Thus, based on these learning the bicycles for Nagpur has been customised based on the city's requirements.

FIGURE 7-24: TOPOGRAPHY OF NAGPUR AND PROPOSED DOCKING STATIONS



Based on the topography of Nagpur city and the location of the docking stations are represented in figure. It is recommended that the docking stations at the higher terrains to have a combination of the gear based and non-gear based bicycles, while the rest of the stations shall have only gearless bicycles. It has been assumed that 10% of the total no. of bicycles required at the docking stations shall be gear based cycles. Accordingly, 32 docking stations have been identified, wherein 99 gear based bicycles shall be deployed in two phases. Table below represents the distribution of the gear based cycles at the 32 docking stations.

TABLE 7-19: DISTRIBUTION OF GEAR BASED CYCLES

Sl. No.	Unique ID	Name of the Docking Stations	Total No. of Cycles		No. Of Gear Cycles		Phase
			2017	2041	2017	2041	
1	**PBS-22**	**Byramji town Indsind bank**	**12**	**18**	**1**	**2**	**1**
2	PBS-24	Mangalwari ground, NIT	18	26	2	3	1
3	**PBS-25**	**Hotel panchawatigaurao Mount road sadar**	**34**	**50**	**3**	**5**	**1**
4	PBS-56	Hingna T point Bus stop	7	10	1	1	1
5	**PBS-57**	**Saduru Medical Nildoh CRPF Bus stop**	**10**	**10**	**1**	**1**	**1**
6	PBS-58	Kalimatamandir	34	51	3	5	1
7	**PBS-59**	**Sardarpatel chowk**	**31**	**45**	**3**	**5**	**1**
8	PBS-73	Ambazari Bypass Hingna Road	9	13	1	1	1
9	**PBS-74**	**Subhashnagar chowk**	**7**	**10**	**1**	**1**	**1**
10	PBS-75	Shiwalkar complex garden police madatkendraAmbazarird	13	19	1	2	1
11	**PBS-76**	**Ambazari Lake Four**	**10**	**10**	**1**	**1**	**1**
12	PBS-77	Ambazari Lake Six	10	10	1	1	1
13	**PBS-78**	**Ambazari Lake Seven**	**10**	**10**	**1**	**1**	**1**
14	PBS-79	Ambazari Lake Eight	10	10	1	1	1
15	**PBS-80**	**Ambazari Lake Nine**	**10**	**10**	**1**	**1**	**1**
16	PBS-81	Ambazari Lake Five	10	10	1	1	1
17	**PBS-82**	**Ambazari lake Three**	**10**	**10**	**1**	**1**	**1**
18	PBS-83	Nag river start location Ambazari lake walk One	10	10	1	1	1
19	**PBS-84**	**Ambazari lake Two**	**10**	**10**	**1**	**1**	**1**
20	PBS-85	Ambazari Lake Ten	10	10	1	1	1
21	**PBS-86**	**DurawellMetsys MIDC Hingna Road**	**10**	**10**	**1**	**1**	**1**
22	PBS-87	Panchsheel Bus stop Digdoh	10	10	1	1	1
23	**PBS-88**	**Rahate colony Ambazri road Wardha road**	**10**	**10**	**1**	**1**	**1**
24	PBS-89	Gandhi nagar square	10	10	1	1	1
25	**PBS-90**	**DharampethVidyalay Bus stop**	**10**	**10**	**1**	**1**	**1**
26	PBS-91	Hotel dwarakaKhapriwardha road nagpur	10	10	1	1	1
27	**PBS-92**	**Mankapur chowk**	**0**	**28**		**3**	**2**
28	PBS-100	W High Ct Road near Indian oil petrol bunk	0	36	0	4	2
29	**PBS-129**	**Katol road shubham Nursing home**	**0**	**31**	**0**	**3**	**2**
30	PBS-130	Futala road Japnese garden	0	19	0	2	2
31	**PBS-139**	**Balajinagar bus stop near Nildoh**	**30**	**33**	**3**	**3**	**1**
32	PBS-140	Near perfect boys hostel Hingna road	30	33	3	3	1

B. DOCKING POINTS

A dock is the structural unit where the bicycles are parked and which supports and secures a bicycle when not checked out by a user. Docks are integral part of the automated systems. As in case of Nagpur, it is recommended to have bollard style[12] dumb docks as the key as the key functions shall be performed by the smart bicycles. The number of docking points per docking station will depends on projected demand and space available on site. Based on the PBS Guidance Document, it has been estimated that there would be a requirement of 1.5 Docks per cycle.

FIGURE 7-25: GRAPHICAL REPRESENTATION OF PROPOSED DOCKING POINTS FOR NAGPUR

C. DOCKING STATIONS

The locations at which a user can pick up or return a bicycle are known as "Docking Stations". A Docking station at minimum includes bicycles, docks, terminal, advertisement spaces and other structures such as shade protection.

As for the Nagpur, it is recommended that the Docking Stations are placed such that they are safe, convenient, accessible and highly visible. Docking stations can be placed at the following locations based on the site conditions;

1. Entrance/Exist of Metro Stations
2. On Street Parking Spaces
3. Transportation Infrastructure (Under Flyover/Foot over Bridges etc)
4. Sidewalks near Intersections
5. Adjacent to NMT infrastructure
6. Private Developments (Commercial Spaces, Residential Apartments, Office Spaces, Institutions etc.)

The size of the Docking Stations is dependent on the demand in the vicinity which shall determine the no. of parking docks. Considering the station design guidelines mentioned in the PBS Guidance Document, the following Station Size and Type has been recommended for Nagpur (Refer table and figures below).

The characteristics of the docking stations are given as under;

[12]Bollard style docks are proposed considering that they can be fixed to the ground without any vertical support.

Parameters	Small	Medium	Large
No. of Cycles	10 – 20 s	20 – 40 s	More than 40 s
Location	Residential Areas	Commercial Centers, Offices, Institutes and Recreation Spaces	Maximum traffic generating areas – such as junctions, major transit nodes etc.
Area	15 Sqmts	30 Sqmts	60 Sqmts
Type of Structure	Open Structure which can be completely covered if required by slight modifications in the structure.		
Facilities	Docks & Shelter	Docks & Shelter	Docks, Shelter, Terminal, Kiosks & Private Parking
Advertisement Panels	2 Side Panels and Back Panel	2 Side Panels and Back Panel	2 Side Panels and Back Panel

Integration of the station with the street has to be dealt carefully catering to the following;

- High Visibility of the bicycle and the user catering to the safety of both.
- Stations need to be oriented towards the bicycle tracks and towards the Bus Shelters and Metro Exit Gates.

Each docking station would require only one main module and the number of secondary modules shall vary based on the demand and fleet size. Stations shall be solar powered and wirelessly networked/ controlled making each a completely self-contained unit.

Installation will comprise placing the modules in the desired location and can be erected or disassembled in 20 minutes or less.

FIGURE 7-26: GRAPHICAL REPRESENTATION OF PBS DOCKING STATIONS PROPOSED FOR NAGPUR

D. TERMINALS @ DOCKING STATIONS

The proposed system fully automated and is primarily operated though smart s, mobile app and smart card. For the convenience of all kind of users terminals are proposed at certain strategic stations which shall help in registration and payments for the non-registered users and users without smart mobiles. Along with the terminals manual assistance shall be provided at these stations to ease the access to the bicycle share. The docking terminal shall control the following:

- Registration
- Generating code for releasing lock
- Dispense ticket/ receipt
- Coordinate services of payment and registration.
- Provide information about the scheme
- Provide maps for way-finding and location of other docking stations in proximity

The docking terminal shall essentially have the following:

- Touch-sensitive screen - user interface – For purchasing daily, weekly, or annual passes, using the credit/debit card terminal.
- Information on how to use the system
- Information on and parking space availability at other stations in the network
- Mobility card (Smart card) reader- For registered users, allows users to check account information, such as usage charges.
- Credit/Debit card terminal- Accepts credit and debit cards which shall be used in conjunction with touch sensitive screen to purchase day, week, or annual passes along with transferring money into the common mobility card.
- Advertising space on the terminal which will be leased out to supplement additional revenue generation.
- All information will be made available in two languages: Marathi and English.

The docking terminals will be a four-sided unit of maximum height of 2.4m, having at least one screen and can be increased depending on demand. It should ideally be placed in an enclosure, or be made IP – 65 (Ingress Protection-65) compliant to be resilient to weather-conditions (refer to figure)

The stations with less than 65 cycles or 75 docking points shall have one screen each, while the stations with more than 65 cycles or 75 docking points shall have screens on either face. The remaining face can display other information Apart from this; the terminal will also include the facility to capture images of all system users for security purposes.

These terminals are located at large docking stations which are the centres of high bicycle demand areas such major activity nodes, metro stations etc. to increase the users base. For Nagpur, a total of 36 terminals have been proposed at 36 stations, of which 26 terminals shall be installed in the Phase 1 and remaining 10 in Phase 2. The list of the location of the proposed terminals is represented in the Table 7-20.

FIGURE 7-27: GRAPHICAL REPRESENTATION OF PBS DOCKING TERMINAL PROPOSED FOR NAGPUR (FACE A, B, C AND D

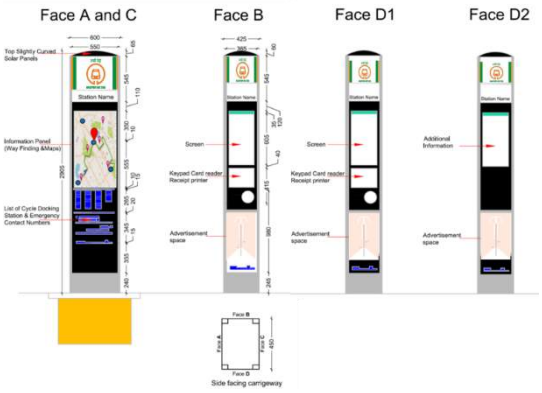


TABLE 7-20: STATIONS WITH TERMINAL LOCATIONS

Sl. No.	Unique ID	Name of the Docking Stations	Type of Station	Phase
1	PBS-01	Nilgiri apartment Kamptee Road, Dixit Nagar	Large	Phase 1
2	PBS-02	Kamgarnagar	Large	Phase 1
3	PBS-05	Itabhatti chowk	Large	Phase 1
4	PBS-10	Dr ambedkar road, cement road	Large	Phase 1
5	PBS-11	Panchpaoli flyover	Large	Phase 1
6	PBS-12	Mahadevmandir, Ambedkar road	Large	Phase 1
7	PBS-14	Lalganjdahi bazar chowk	Large	Phase 1
8	PBS-15	Dahi bazar chowk, Masurkarmarg	Large	Phase 1
9	PBS-16	Cradak road. Pathrabemohalla	Large	Phase 1
10	PBS-17	Patankar chowk	Large	Phase 1
11	PBS-19	Mahatma gandhi high school	Large	Phase 1
12	PBS-21	Ring road Jaripataka Police station road	Large	Phase 1
13	PBS-25	Hotel panchawatigaurao Mount road sadar	Large	Phase 1
14	PBS-28	Timkimominpura road, Nuri street	Large	Phase 1
15	PBS-31	Ganjakhet chowk	Large	Phase 1
16	PBS-33	Chitnis park chowk	Large	Phase 1
17	PBS-34	Chandrashekhar Azad chowk	Large	Phase 1
18	PBS-35	LadpuraMasurkarmarg	Large	Phase 1
19	PBS-36	Ayachitmandir Bus stop	Large	Phase 1
20	PBS-48	Bholaganesh chowk Mahaveernagar	Large	Phase 1
21	PBS-49	KDK College roadAnandfarsanmishtannabhandar	Large	Phase 1
22	PBS-50	Munje Chowk	Large	Phase 1
23	PBS-58	Kalimatamandir	Large	Phase 1
24	PBS-59	Sardarpatel chowk	Large	Phase 1
25	PBS-60	Ajni road Wanjaronagar road	Large	Phase 1
26	PBS-61	Rambagh road Shivkrupa motor royal enfield service center	Large	Phase 1
27	PBS-98	NagmandirAmbazari campus road	Large	Phase 2
28	PBS-102	Yogeshwar Krishna mandir modern society ring road	Large	Phase 2
29	PBS-104	South point school near omkarnagar chowk	Large	Phase 2
30	PBS-105	Balajinagar square	Large	Phase 2
31	PBS-106	Jadumahal road lane 5	Large	Phase 2
32	PBS-107	Arunjoshi college of education hanuman nagar road	Large	Phase 2
33	PBS-110	Ganeshpethchowk, subhash road	Large	Phase 2
34	PBS-111	Gandhisagar lake	Large	Phase 2
35	PBS-120	HP Petrol pump Bhandara road Bhandewadi	Large	Phase 2
36	PBS-127	Srinagar kanyakumari highway nandannagar	Large	Phase 2

E. MAINTENANCE DEPOT

The depot is where bicycles are kept while serviced or stored; it provides all the facilities and equipment for management, repair, cleaning and has a mobile maintenance unit which will be responsible for repairs. Depots may be provided with a control room for monitoring and redistribution of vehicles which will act as an opportunity for cost sharing. The depot also provides with a storage unit for bicycles and stations for Public bicycle sharing.

Depot space is proposed to have a space for spare cycles, stations, parts, maintenance equipment and storage space for redistribution vehicles. In the case of damaged s, the operator would normally fix minor repairs on-site, while collecting bicycles that need major repairs to be done at the depot. Therefore, the minimum specifications of a depot are:

- Space for Storage and Parking Space for Spare Fleet
- Parking Space for the vehicles of the staff members

- Space for washing and drying of spare fleet.
- Space for repair and maintenance with space for repair instruments
- Space to hold terminals and ITS components
- Space for resting purposes and leisure activities
- Spare for eatery purposes

The depots shall have a space requirement of approximately 700 Sqmts for handling capacity of 1000 s, i.e; for Nagpur 4 Maintenance Depots shall be required with a total area of 2800 Sq mts. Considering land development cost of Rs 3500 per Sq ft. The cost to be incurred for the development of the depot spaces in Phase 1 and Phase 2 works out to be Rs 10.54 Crores[13], which accounts for approximately 40% of the total capital expenditure.

To optimize the capital cost for the implementation of the PBS for Nagpur City, it is recommended that the maintenance depot infrastructure can be shared with the already built infrastructure of bus terminals/depots or with the proposed metro depot or with the identified parking areas for Metro feeder. Cost sharing can greatly decrease capital investment in the cases like these. In cases, wherein the sharing the available infrastructure is not possible, depots and maintenance areas will have to be provided for the upkeep of the s.

F. REDISTRIBUTION SYSTEM

Redistribution in PBS Scheme is a process of transferring bicycles from one station to another to meet the demand and supply at different locations. It could be either manual or through redistribution vehicles.

Bicycle redistribution is essential to ensure regular availability of s at docking stations, especially during peak hours. Bicycle redistribution vehicles carry multiple bicycles to empty docking stations to meet the peak demand. With integration of IT systems, operators of bicycle systems are able to redistribute the bicycles between the stations by knowing the capacities at different PBS stations.

Redistribution of the vehicles is also undertaken to move the bicycles from the repair and maintenance depots for servicing and back to their respective stations.

As in case of Nagpur, it is recommended that total of 8 Redistribution Vehicles (4 in Phase 1 and 4 in Phase 2) be deployed with a carrying capacity of 20 bicycles at a time. The redistribution vehicles will be parked at the repair/maintenance depot. The redistribution vehicle for Nagpur PBS shall be modelled as trailers towed by service cars or ape autos.

7.4.4. LOCATION FOR URBAN PLACE MAKING SCHEMES

A. APPROACH FOR IDENTIFICATION OF INTERVENTION AREAS

In a number of places in the NMT project area, urban place-making schemes have been proposed. This has been done with the aim of encouraging people to walk and/or cycle to access their nearest public transport stations and/or destination.

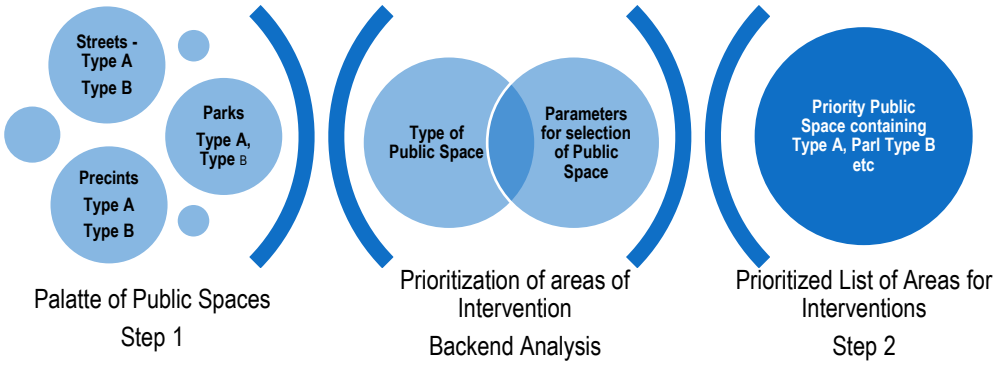
The areas selected are based on the following parameters:

1. Nearness of the place to MRTS, PT and NMT network in the project area.
2. Land use of the surrounding plots- Highest priority given to areas frequented by large number of people, like work places educational institutions and markets.
3. Intensity of footfalls at the Place.
4. Historic importance of the Place.
5. Socio-cultural significance of the Place.

[13] Cost of the Civil Infrastructure and Equipments have been considered.

Ownership and use of the place and adjoining land parcels- Higher priority given to existing areas that have high footfall like commercial zones, public institutions, etc.

FIGURE 7-28: GRAPHICAL REPRESENTATION OF THE METHODOLOGY



B. METHODOLOGY FOR IDENTIFICATION OF INTERVENTION AREAS

STEP 1: CATEGORIZATION OF PUBLIC SPACES

The public spaces of Nagpur have been studied and categorized into various types of public spaces. Subsequently, priority public spaces are selected in a manner that each priority public space covers more than one type of public space.

PARAMETERS FOR PRIORITIZING AREAS FOR INTERVENTION

The categorization of Urban Public Realm, in the earlier section has been used to select priority public spaces for preparation of concept scheme for Urban Place Making. Each priority public space is a set of more than one type of Urban Public Space.

Following parameters have been used to prioritize areas for Urban Place Making:

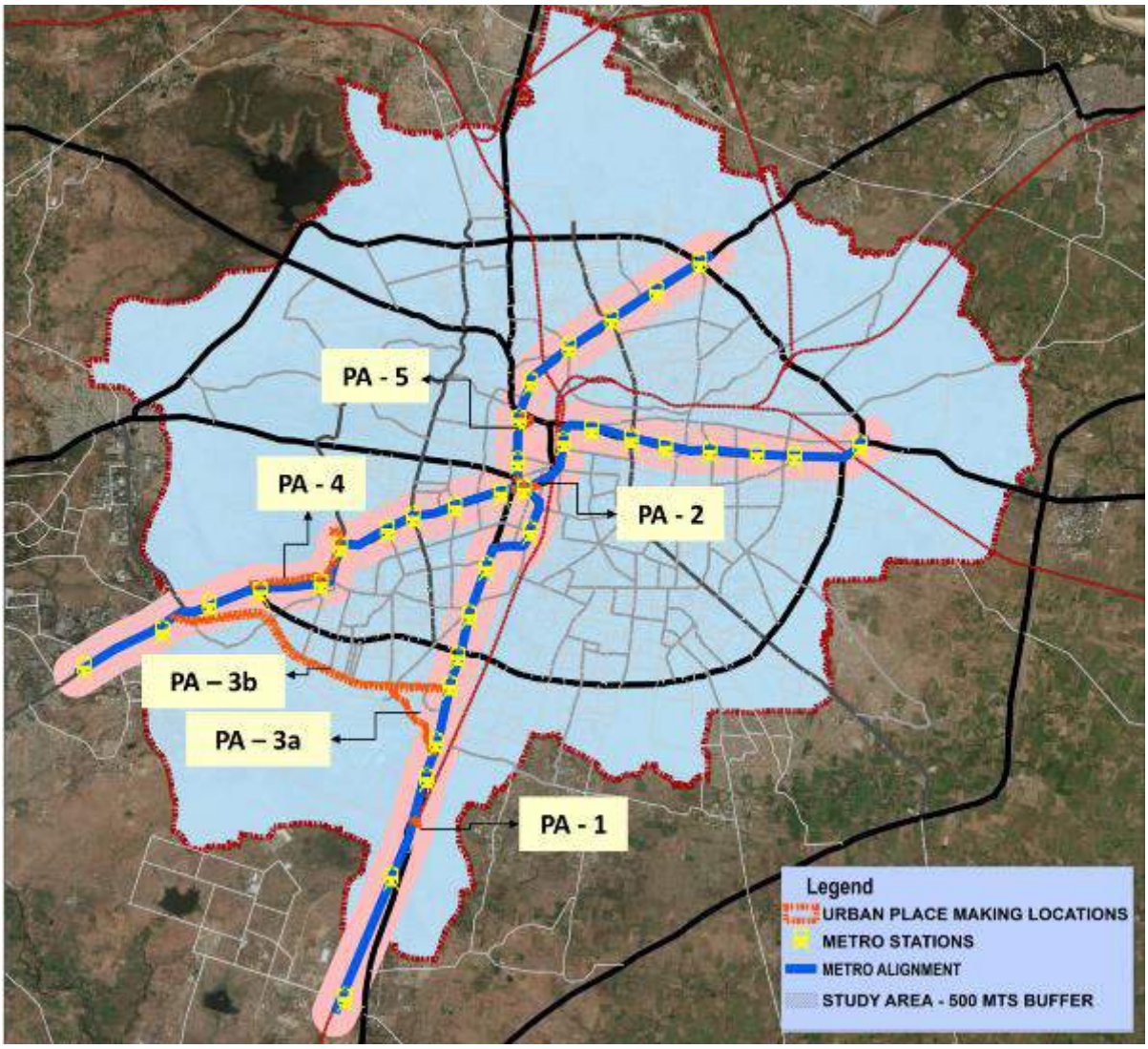
1. Land use of the surrounding plots- Highest priority given to areas frequented by large number of people, like work places educational institutions and markets.
2. Intensity of footfalls at the Place.
3. Historic Importance of the Place.
4. Socio-cultural significance of the Place.
5. Ownership and use of the place and adjoining land parcels- Higher priority given to areas which are public in nature and have large number of public institutions adjoining them.
6. Distance to the nearest MRTS, PT and NMT network of the project area.

STEP 2: SELECTED LOCATIONS FOR URBAN PLACE MAKING SCHEMES

Based on the categorization of public spaces and parameters for selection of priority public spaces for urban place making interventions, following six areas have been identified for preparation of concept proposals (Refer to Figure 7-29):

1. PA 1 - South Airport Metro Station
2. PA 2 - Nagpur Central Business District Urban Renewal
3. PA 3a - Ujjwal Nagar Ecomobility
4. PA 3b - London Street Ecomobility
5. PA 4 - Ambazari Lakefront
6. PA 5 - Kasturchand Park Renewal

FIGURE 7-29: AREAS SELECTED FOR URBAN PLACE MAKING PROPOSALS

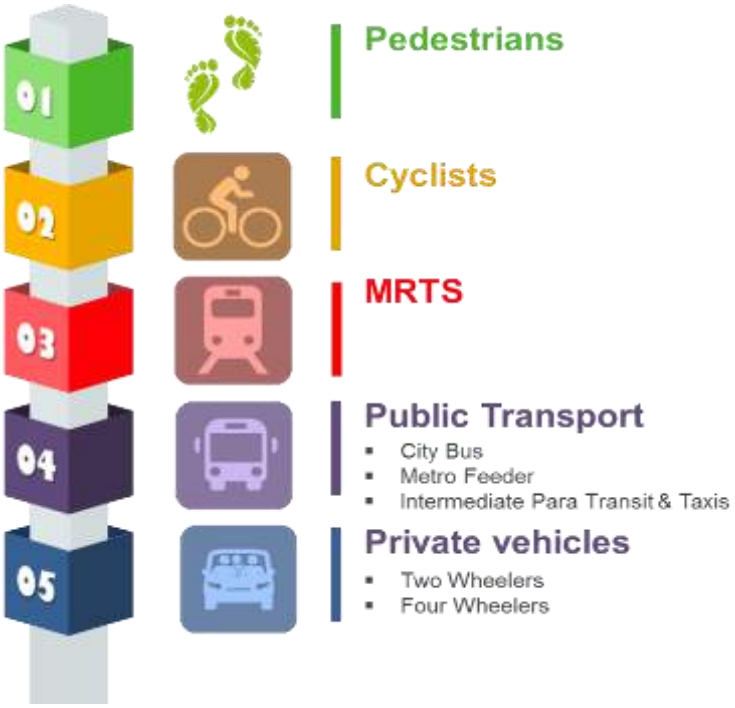


7.4.5. FIRST & LAST MILE CONNECTIVITY TO TRANSIT

Integrating pedestrian and bicycling infrastructure with mass transit facilities, including buses, metro, metro feeder, auto rickshaws and shared auto rickshaws will help provide a safer NMT environment while also increasing transit ridership. In order to strengthen first mile and last mile connections, a number of design components are identified including;

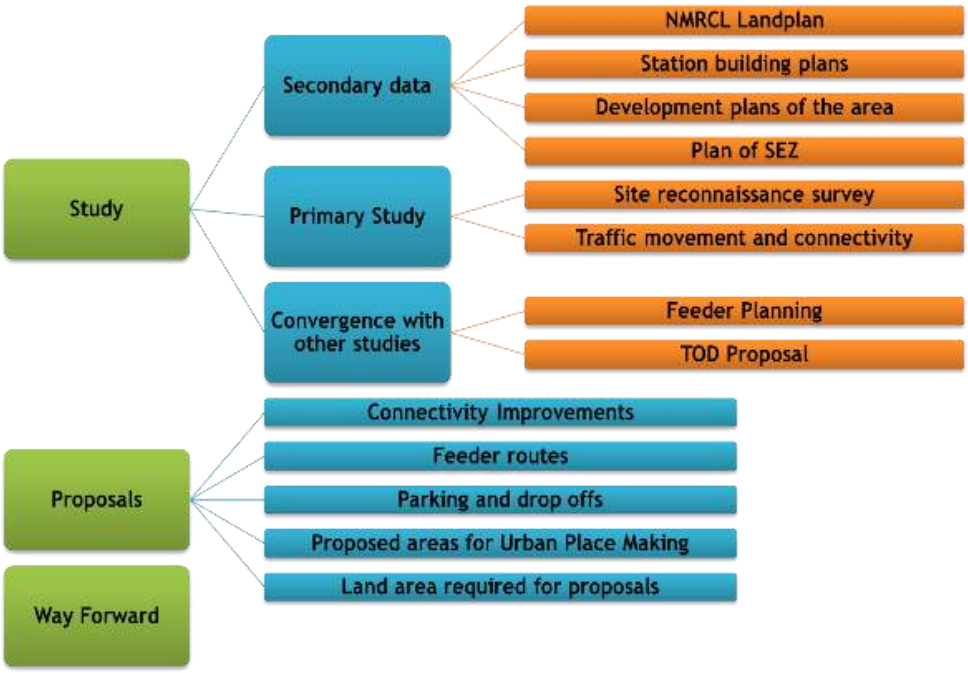
- Well-designed footpaths with safe pedestrian crossings within the influence areas of the metro stations and bus stops as a critical intervention required for improving the access experience of the transit commuters.
- Network of bicycle lanes connecting the transit station and major destinations are identified along with dedicated spaces for bicycle parking near the station to promote multi-modal integration.
- Pedestrian safety measures such as refuge islands, table top crossings, push buttons to be incorporated at intersections and mid-block crossings.
- Create clear, direct, and short transfers between different transit modes by minimizing walking distances and removing physical and perceived barriers within transit stations.
- Provide clearly marked and protected access for pedestrians and cyclists at station areas to minimize conflicts, particularly at passenger pick-up and drop-offs (PPUDO), bus facilities, IPT stops and parking access points
- Prioritise accessible bicycle sharing schemes to encourage public transit users in particular and public in general to use cycle as a mode to perform their first and last mile journey as well as to make regular short trips without using private vehicles.

- Incorporate cycle rickshaw parking and three wheeler parking bays near metro stations.
- All pedestrian facilities should be barrier free for universal access by all persons with reduced mobility including those with hearing and visual impairments.



Considering the above to enhance the first & last mile connectivity within the study area, the priority for the various modes have been given in the following levels, wherein the primary priority is towards Pedestrians and Cyclists.

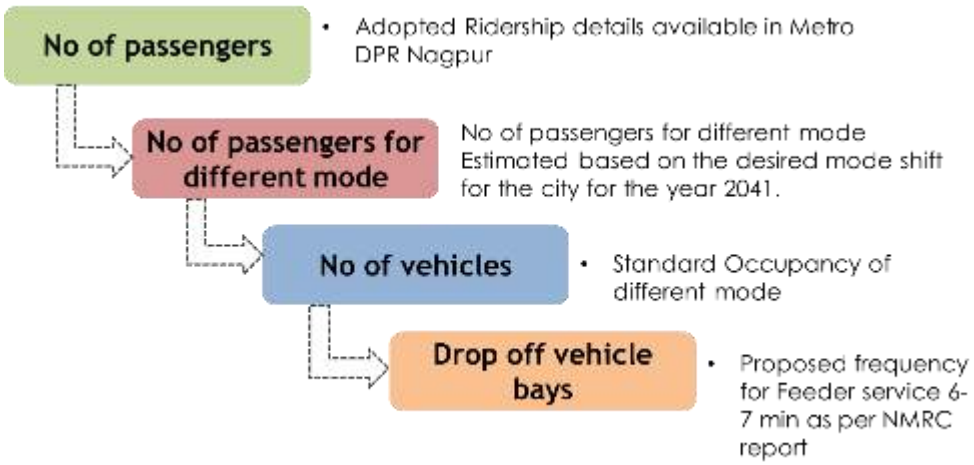
FIGURE 7-30: METHODOLOGY FOR THE FIRST AND LAST MILE CONNECTIVITY TO THE TRANSIT



A. METHODOLOGY FOR THE FIRST MILE AND LAST MILE CONNECTIVITY TO THE TRANSIT STATION

METHODOLOGY FOR CALCULATION OF PARKING/PASSENGER PICK UP & DROP OFF BAYS

FIGURE 7-31: METHODOLOGY FOR THE VEHICLE PARKING/PASSENGER PICK UP & DROP OFF BAYS



Based on the above mentioned methodology, the parking requirements at the metro stations and the requirement of the vehicle pick up and drop off bays has been assessed, which is represented in the Table 7-21 and Table 7-22.

TABLE 7-21: REQUIREMENT OF VEHICLE PICK UP AND DROP OFF BAYS AT THE METRO STATIONS

Sl. No	Name of the Metro Station	2017				2041			
		4 Wheeler	Tw	Auto	Mini Bus	Car	Tw	Auto	Mini Bus
1	Khapri	8	12	6	4	12	18	8	6
2	New Airport	4	4	3	2	5	8	4	3
3	South Airport14	3	3	2	2	4	5	3	2
4	Old Airport	2	3	2	2	3	3	2	2
5	Ujwal Nagar	3	3	2	2	3	5	3	2
6	Jaiprakash Nagar	2	3	2	2	3	4	2	2
7	Chatrapati Station	3	3	2	2	3	5	3	2
8	Ajni Square	4	5	3	2	5	7	4	3
9	Rahate Colony	5	7	4	3	7	10	5	4
10	Congress Nagar	16	24	11	8	23	36	15	11
11	Automotive Square	8	11	6	4	14	22	10	7
12	Nari Road	4	6	3	3	8	11	6	4
13	Indora Square	4	6	3	3	6	9	5	4
14	Kadvi Square	5	7	4	3	7	10	5	4
15	Gaddigodam Square	2	2	2	2	3	3	2	2
16	Kasturchand Park	6	8	4	3	9	13	6	5
17	Zero Mile station	5	7	4	3	6	8	4	3
18	Sitaburdi square	13	20	9	6	20	32	14	9
19	Dharampeth College Station (Ambazari lake view)	3	3	2	2	3	4	3	2
20	Shankar Nagar	7	10	5	4	9	13	6	5

[14] Due to the absence of the Metro Station Boarding and Alighting data of South Airport Metro Station, Parking Requirement and Drop Off and Pick Up Bay Requirements has been calculated based on the average boarding and alighting of New Airport and Old Airport Metro Stations.

Sl. No	Name of the Metro Station	2017				2041			
		4 Wheeler	Tw	Auto	Mini Bus	Car	Tw	Auto	Mini Bus
21	Zansi Rani	8	12	6	4	12	19	9	6
22	Institute of Engineering	11	17	8	6	14	22	10	7
23	LAD Sq	3	4	2	2	4	5	3	2
24	Subhash Nagar	2	3	2	2	3	3	2	2
25	Rachna ring Rd	2	3	2	2	3	4	3	2
26	Vasudev Nagar	3	5	3	2	4	6	3	3
27	Bansi Nagar	3	3	2	2	3	5	3	2
28	Prajapati Nagar	3	4	2	2	3	4	3	2
29	Vaishnao Devi Square	3	3	2	2	3	4	3	2
30	Ambedkar Square	3	4	2	2	3	5	3	2
31	Telephone Exchange	6	9	4	3	9	14	6	5
32	Chittaroli Square	5	7	4	3	7	11	5	4
33	Dosar vaisya Chowk	DATA NOT AVAILABLE							
34	Nagpur Railway Sttaion	DATA NOT AVAILABLE							
35	Lokmanya Nagar (Reach 3)	5	7	4	3	7	10	5	4

TABLE 7-22: REQUIREMENT OF PARKING BAYS AT THE METRO STATIONS

Sl. No.	Name of the Metro Station	2017			2041		
		4 Wheeler	TW	Total ECS Required15	4 Wheeler	TW	Total ECS Required
1	Khapri	25	50	37	25	50	37
2	New Airport	16	25	22	25	44	36
3	South Airport16	10	16	14	16	28	23
4	Old Airport	5	8	7	8	12	11
5	Ujwal Nagar	9	14	12	14	22	19
6	Jaiprakash Nagar	6	9	8	9	14	12
7	Chatrapati Station	9	14	12	14	22	19
8	Ajni Square	15	24	21	24	39	33
9	Rahate Colony	23	37	32	25	50	37
10	Congress Nagar	25	50	37	25	50	37
11	Automotive Square	25	50	37	25	50	37
12	Nari Road	21	33	29	25	50	37
13	Indora Square	20	32	28	25	50	37
14	Kadvi Square	23	37	32	25	50	37
15	Gaddigodam Square	4	6	5	7	12	10
16	Kasturchand Park	25	47	36	25	50	37
17	Zero Mile station	25	42	35	25	48	37
18	Sitaburdi square	25	50	37	25	50	37
19	Dharampeth College Station (Ambazari lake view)	8	12	11	11	18	15
20	Shankar Nagar	25	50	37	25	50	37
21	Zansi Rani	25	50	37	25	50	37
22	Insti of Engg	25	50	37	25	50	37
23	LAD Sq	10	16	14	15	23	20
24	Subhash Nagar	5	9	7	8	13	11
25	Rachna ring rd	6	10	8	11	18	15

[15] Space required for parking conditions have been calculated based on ECS requirement mentioned below in table.

Sl. No.	Name of the Metro Station	2017			2041		
		4 Wheeler	TW	Total ECS Required15	4 Wheeler	TW	Total ECS Required
26	Vasudev nagar	14	22	19	21	34	29
27	Bansi Nagar	9	14	12	14	22	19
28	Prajapati Nagar	9	15	12	13	21	18
29	Vaishnao Devi Square	9	14	12	12	19	16
30	Ambedkar Square	10	15	13	14	22	19
31	Telephone exchange	25	50	37	25	50	37
32	Chittaroli Square	25	41	35	25	50	37
33	Dosar vaisya Chowk	DATA NOT AVAILABLE			DATA NOT AVAILABLE		
34	Nagpur Railway Sttaion	DATA NOT AVAILABLE			DATA NOT AVAILABLE		
35	Lokmanya Nagar (Reach 3)	25	41	35	25	50	37

Considering the above mentioned parameters the first mile and last mile connectivity to the metro stations have been planned. Some of the sample concept plans for the same are represented in the Figure 7-32 to Figure 7-34.

FIGURE 7-32: CONCEPT FIRST & LAST MILE CONNECTIVITY FOR AIRPORT METRO STATION

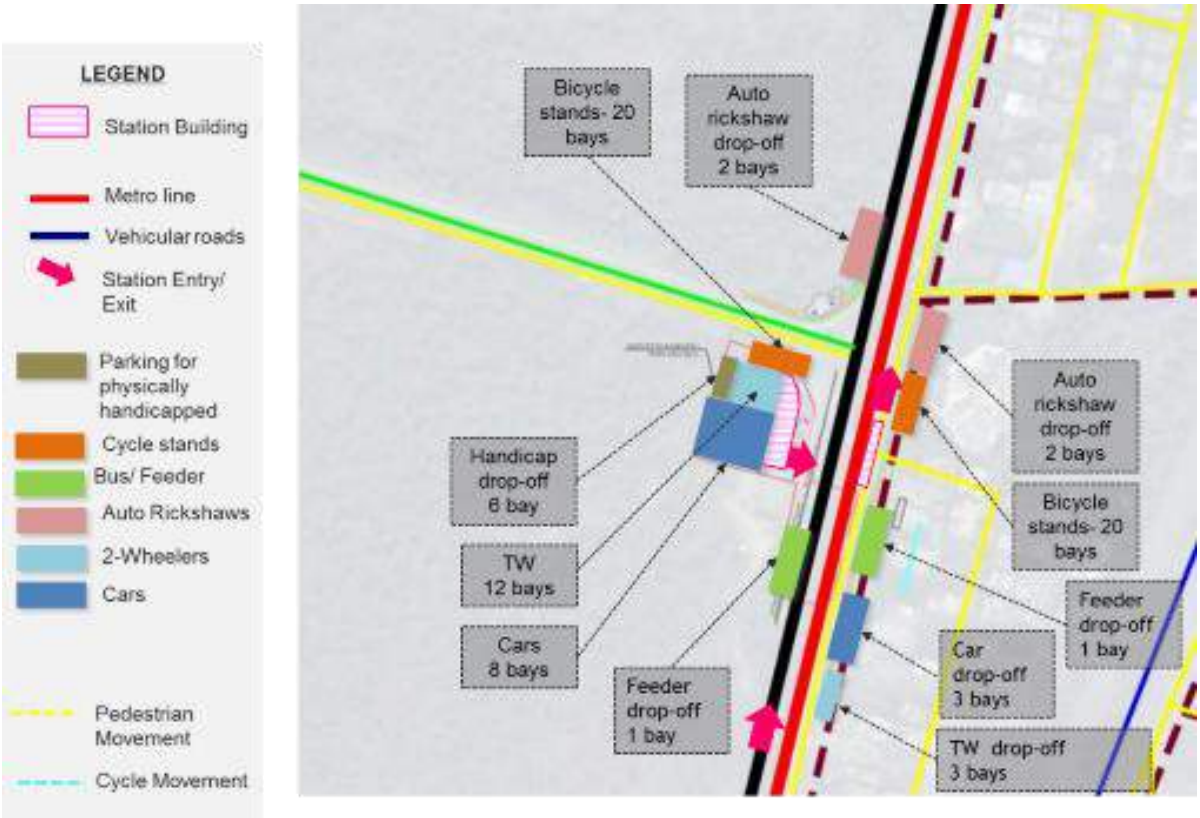


FIGURE 7-33: CONCEPT FIRST & LAST MILE CONNECTIVITY FOR UJJWAL NAGAR METRO STATION

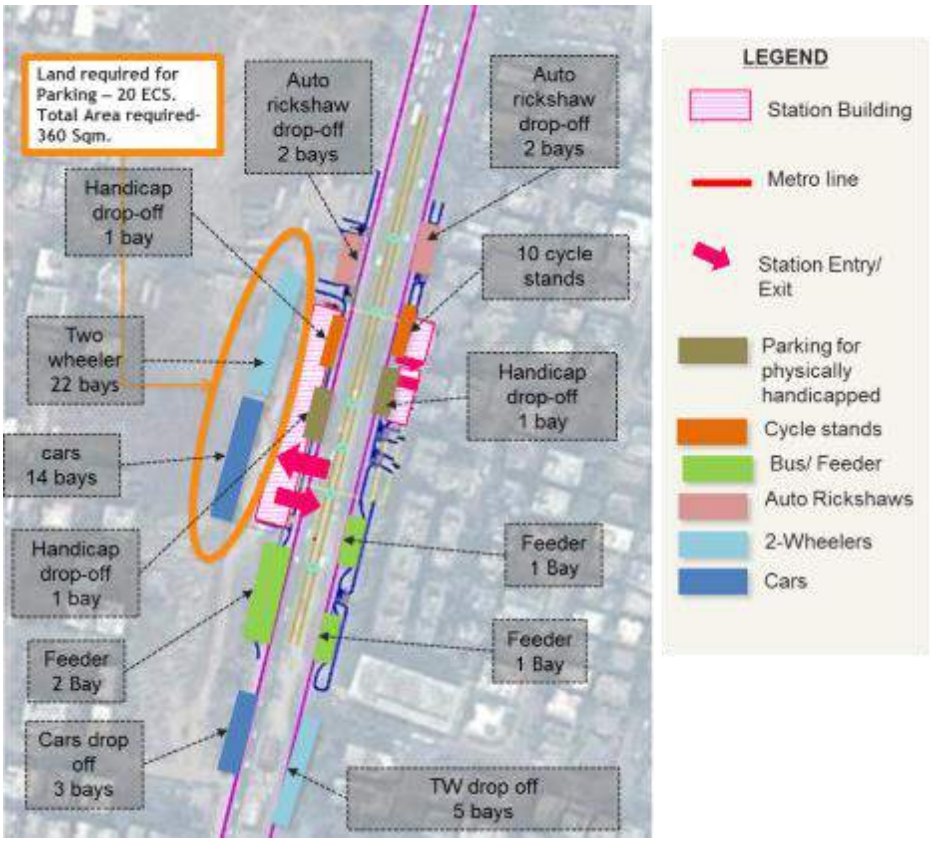
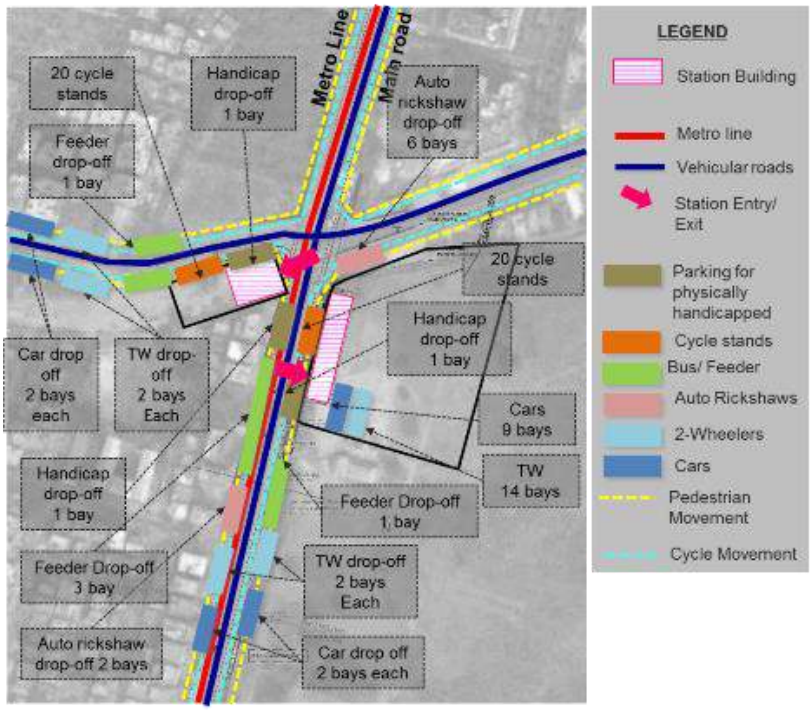


FIGURE 7-34: CONCEPT FIRST & LAST MILE CONNECTIVITY FOR JAI PRAKASH NAGAR METRO STATION



7.5 SUMMARY/CONCLUSIONS

Feeder Bus: Total no. of 111 bus queue shelters have been planned in addition to 197 request bus stops. 5 parking lots have also been planned for Feeder Buses.

Bus Q Shelter: Total no. of bus Q shelters to be developed is 710. NMC can issue the guidelines w.r.t the location, layout/design and indicative cost of the bus Q shelter. At the same time, the urban local bodies can explore the revenue generation options from these bus Q shelters through rentals and advertisement.

Bus Depots: For the effective operation of the city bus services in Nagpur, it is recommended to upgrade the existing 4 depots and develop 6 new depotsto be operated by NMC. The depot infrastructure need to be developed both in terms of the civil infrastructure as well as the depot equipment. The upgradation activity would be taken up by NMC itself, either through government funding or external funding. NMC to actively involve in all the stages of the process right from desiging, construction and operation and maintenance of the depots and depotsbe developed in a PPP mode. .

Bus Terminal: For the effective operations of the intra city services in Nagpur, 9 bus terminals/mobility hubs have been identified for development /upgradation as part of the current study. Since, development/upgradation of the bus terminal is a cost intensive propaganda and involves lot of stakeholders; it is recommended that the development/upgradation of the bus terminal in Nagpur be taken up on PPP basis in a phased wise manner with NMC being the primary coordination agency.

CHAPTER 8. INTELLIGENT TRANSPORT SYSTEM DEVELOPMENT

8.1 INTRODUCTION

Intelligent Transportation Systems (ITS) is the application of computer, electronics, and communication technologies and management strategies in an integrated manner to provide traveller information to increase the safety and efficiency of the road transportation systems. This paper mainly describes ITS user services, ITS architecture and ITS planning. The various user services offered by ITS have been divided in eight groups have been briefly described. The ITS architecture which provides a common framework for planning, defining, and integrating intelligent transportation systems is briefly described emphasizing logical and physical architecture.

Intelligent Transport System (ITS) is one of the key sectors for improving the public transport system. Considering the gaps identified in existing ITS system in NMC, this chapter discusses the functional requirement for city bus service and propose modernization plan for ITS with its potential benefits.

8.2 ITS FUNCTIONAL REQUIREMENT – CITY BUS & FEEDER BUS SERVICES

8.2.1 FLEET MONITORING SYSTEM

8.2.1.1 BUS VEHICLE TRACKING DEVICE

A) GPS AND GPRS BASED VEHICLE TRACKING UNIT – BUS DRIVER CONSOLE

The Bus Driver Console shall be installed on the buses. There shall be an interface with the on-board computer to take necessary data required for control & operations purposes.

The Driver Console Unit with wireless communication module (based on GPRS/EVDO/Wi-Fi) shall be used to provide vehicle tracking accurately and reliably. The back end system shall be able to produce MIS reports of the vehicle schedule adherence report and operated kilometres by each bus, by route and by fleet of each Service provider. It shall be possible for NMC to extract additional information from the vehicle tracking information logged at the control centre. The system shall be able to provide on line WEB interface for positioning of the vehicles in the system. The unit shall allow AFCS devices such as handheld ticketing unit and bus card validators to use its GPRS/EVDO communication module as a data path to transmit AFCS data to the CCS.

The unit would additionally have an interface module in front of the bus driver for two way communication, messages to be sent by driver and messages to be sent to the driver from the control centre. The Bus Driver Console unit has to be mounted on board the bus and the assembly has to be designed in a way that integrates with the dashboard of the bus. The design shall be theft proof and shall not be in normal circumstances removed from the bus unless standard technique specified is applied. The bus driver console will act as the sole management console for devices on-board like PIS and AFCS equipment. The BDC shall operate PIS manually in-case of GPS outage.

8.2.1.2 AUTOMATIC VEHICLE LOCATION SYSTEM (AVLS) SOFTWARE:

The software shall be web based and shall utilize high resolution digital map to show real-time position of the vehicles. The software shall provide map based tracking and transit route line based tracking of vehicles by the control centre operators. The software is expected to have enterprise capabilities which enable multiple user type to be enabled to carry out various functions like, Alarm Management, Vehicle Schedule Tracking, Speed Management, Stoppage management, Route replays, bus tracking

dashboard etc. as a standard functionality. The software shall enable control centre management staff quick decision making capability, which shall be achieved by providing graphical tools for visualization. The software shall enable NMC to drill and analyse information and online data in a multidimensional manner. Comprehensive analysis and reporting capabilities are expected to be part of the application delivery which matches the world standard capabilities of AVLS systems.

Maintenance Requirements

- Device settings shall be updated including software/firmware updates through transmission via the secured communication network set up by the service provider. For reasons of security, device settings shall not be modifiable by field staff of the service provider/others.
- Any device settings modifications including software/firmware updates as well as business rules such as fare settings, discounts etc. shall be done with prior authorization by NMC. A digital log of all changes of settings on each and every device shall be maintained and delivered to NMC.
- Any faulty equipment shall be replaced with a tested unit from the spares maintained by service provider.
- Only a maintenance engineer with maintenance access card shall be able to access maintenance mode of the device which shall allow the maintenance engineer to diagnose the faults and update the device settings directly, if required.
- A repaired unit shall be tested for full functionality as at the time of initial deployment and certified before it is reinstalled at any site.

8.2.2 PASSENGER INFORMATION SYSTEM

Passenger Information System hardware shall consist of LED based display system for bus stations, Terminals and Buses. Following are the technical specifications for the display units.

The passenger information system shall comprise following components:

- Display Screen on Bus Stations
- Display Screen on Bus
- Voice announcement system on Bus
- Web Portal for Bus route Schedule & ETA
- Mobile Schedule Access System

8.2.2.1 PIS AT BUS STATIONS AND TERMINALS

LED display screens that provide sufficient visibility in broad daylight condition shall be installed at NMC bus stations and terminals. There shall be two displays per station. They shall display route and estimated arrival time (ETA). They may also be used to display public service information. The display shall receive encoded information of route and ETA from the AVTS control center through

the common wired/wireless communication link set up at each bus station as part of the AFCS system. The displays shall have the ability to decode the information received from CCS and display appropriate message on the screen.

8.2.2.2 INTEGRATED VOICE ANNOUNCEMENT SYSTEM

A noise free integrated voice announcement system of adequate volume (which could be heard by all the bus commuters (4 watt, 2 nos.) shall be fitted one at the front (behind the driver along with LED display) and one at the rear side-inside. Two more speakers for exclusive use of the passengers outside the bus, especially for the persons with disabilities shall be fitted - one speaker mounted on/near the front gate along with LED display and the other on/near the rear gate. Synchronization of voice messages / announcements with the visual displays is essential.

Control Panels shall have the following features –

- Easily operable, robust, water & dust proof, control switches/keys/touch type within easy reach of driver
- Control Panel layout and content shall be simple and easily comprehensible by crew who is not highly educated.
- The displays shall have all weather visibility.
- Crew access to the requisite information by operating least no. of robust buttons / switches / keys.
- Console to have over-riding provision to jump the information operation sequence like skipping a particular stop, etc.
- Mechanism/port etc. are provided to load/amend/upgrade on-board stored data from PC at the workshop office complete with any related software interfacing hardware required.
- Easy and quick recovery of the all the memory whenever required.
- Easy accessibility to microprocessor / controller by driver / conductor from his seat inside the bus. Provision for upgrading / modifying the existing information as well as additions and deletions. The size, quality, robustness etc. of the microprocessor / controller be such as to accommodate the entire information required for this system including that required in flashing advertisement messages.
- All information pre-programmable and loaded on to the micro-controller through PC. Ability to retain the entire data in memory in the event of power failure or any other kind of failure shall be provided in the system.

8.2.2.3 WEB PORTAL FOR BUS SCHEDULE & ETA

NMC's web portal shall extend capabilities to passengers to download route information, route schedule and real-time ETA etc. This information must be accessible using WAP enabled mobile phones also.

8.2.3 FINANCIAL MANAGEMENT SYSTEM

8.2.3.1 CENTRAL ACCOUNTING SYSTEM

The central Accounting system shall consist of following sub-systems/ modules.

- Payments Accounting Module/Sub-system (Treasury section)
- Receipts Accounting Module/Sub-System (Treasury section)
- Daily Receipts and payments
- Cross Verification (Daily Sheets) (Accounting Section).
- Bank Reconciliation.
- Investment Module.
- Liability module.
- Suspense (Advances) Module.

8.2.3.2 RECEIPTS ACCOUNTING MODULE (RAM)

The receipt of funds shall be a centralized/de-centralized activity in NMC and shall be managed by central financial management system. The receipts from the transportation and allied activities of NMC shall be managed in the central accounting system. The RAM shall cover the following major activities:

- Receipt of Funds (Treasury Section)
- Posting in Daily Sheets
- Consolidation into Classified Registers
- Cross Check with Collection Centers and Treasury Section
- Trial Balance (monthly & annually) .

8.2.3.3 PAYMENT ACCOUNTING MODULE (PAM)

Payment accounting module shall allow the payees to be able to put up their requests by means of credit bill or Performa invoice to the department, which has placed an order for supplies or for the work or service provided. After due verification of the supplies received or the work done, the concerned department shall prepare 'payment-memo', debits it to the appropriate budget-head and then the head of that department or the person who has budget-drawing powers shall signs it. This payment-memo is then sent to the Central Accounts Department. The PAM shall cover the following major activities: -

- Real-time settlement system including electronic fund transfer
- Payment Memo Approval
- Payment
- Daily-sheet preparation/posting
- Posting in Bills/Budget Ledgers
- Consolidation into Classified Register
- Trial Balance Preparation

8.2.3.4 DAILY RECEIPTS AND PAYMENTS CROSS-TALLY

- The accounting system shall provide facility for Item-wise receipts and payment statements (Daily-Sheets) under RAM and PAM every day. These shall be prepared on the basis of paid vouchers and receipt challans, while bank-book (Journal) and cash-book (Journal) shall be written as and when challans are received along with cash or cheque or voucher is paid in cash or by cheque.
- In order to ensure correctness of daily accounts (receipts and payments) the cash and bankbooks (or main journal) shall be cross-tallied with the sum of the budget item-wise daily statement. If the gross receipts & payments of the day (as per journals) tallies with the sum of the daily sheet, the accounts are presumed to be correct.

8.2.4 AUTOMATED FARE COLLECTION SYSTEM

The Automated Fare Collection system shall be driven by a Central Computing environment which enables the devices and applications to exchange information based on the operational requirements of NMC. The components that shall be used to perform various functions are described as below:

- Station ticket terminal
- Smart Card
- Bus Card Validator

- Bulk Initialization Machine (BIM)

Station ticket terminal, Bus Card Validator, shall act as the primary sources for fare collection. Smart Cards shall facilitate users to pay for the travel using above devices and the smart cards shall be made available for dispensing after the cards have been initialized by BIM and CPD. The fare collection and authentication devices as mentioned above shall communicate with Central Computing environment and Terminal Management System based on the operational requirements of NMC. There may be more than one mode of transport & multiple classes of each mode. It is envisaged that the system hooks up seamlessly to the other transit modes whenever those systems become operational. The system is also envisaged to operate automated fare collection by way of using contact less smart card and paper tickets. The travellers who own smart card shall be required to use smartcard at on-board validators.

8.2.5 VEHICLE SCHEDULING AND DISPATCH SYSTEM

Scheduling/dispatch software shall be used to aid designing and modifying transit routes. It shall also be used to route, schedule, and dispatch vehicles in demand response operations.

The application shall combine GIS and AVL to coordinate different transit functions. Combined technologies such as, computer-aided dispatching and AVL shall increase the efficiency of transit operations, enhance safety, improve service. For example, systems integrating automated scheduling and dispatching and AVL enable a dispatcher to know the exact location and status of each bus under control. This real-time information allows the dispatcher to address any problems with service or to respond to any emergency. In addition, automated dispatching software and AVL allows the coordination of services among many separate transportation agencies.

Vehicle scheduling and dispatching systems shall be capable of dynamic planning and Capable of optimizing 1000s of vehicle movements and be capable of automatic dispatch distribution and transport operations, dynamically rescheduling vehicle and driver assignments based on real-time events.

8.2.5.1 REAL-TIME SCHEDULING SYSTEMS & DYNAMIC PLANNING SOFTWARE

- Dynamic routing and scheduling of vehicles (including dynamic scheduling of multi-drops or multi-collects and dynamic assignment of work to resources)
- Real time distribution scheduling (last minute orders, variable demand, etc.)
- Efficient fleet and driver usage, taking account of working time directives, shift
- Scheduling, vehicle maintenance scheduling and customer constraints
- Reduced spot-scheduling costs and better utilization of own-fleet
- Improved service levels, including better adherence to schedule and greater flexibility
- Real time optimization based on operational constraints and business objectives
- Improved visibility at all levels of the operation
- Real time planning in response to last minute orders, cancellations, redirections, etc.
- Advanced warning of potential delays due to traffic congestion or breakdowns, and tactical response.

In an operation where fulfilment windows are very narrow, and penalties for late operations may be substantial, the system shall have ability to react quickly to operational problems such as traffic delays, breakdowns, last minute dispatches, etc. The system shall allow planners to tackle this problem by re-planning optimally, thus reducing the need for over resources and spot-scheduling while improving service levels. The user-friendly graphical planning interface shall allow fast and effective interaction with the dispatcher & vehicle tracking system through on-screen maps, reports and editors. The system shall be capable of automatically assigning parking berth to the incoming vehicles at the central terminus extending ease of operations to station management and customers. The System shall be flexible enough to accurately model all real time transport operations, and may be configured to exactly match business requirements.

8.2.6 DEPOT MANAGEMENT SYSTEM

8.2.6.1 INTEGRATED DEPOT MANAGEMENT SYSTEM

This module enables to automate depot operations, which include workshop management, fuel management, traffic management, vehicle management, and so on. The module shall also cover administrative activities and stores requirement.

8.2.6.2 STORES AND INVENTORY SYSTEM

This module shall enable automation of stores and inventory for various items at each depot, workshop, division and so on. The module also covers purchase and procurement processes right from sampling to evaluation of products to tendering to purchases to consumption. It also enables to exchange the information across the depots, divisions and workshops for products availability and requisitions.

8.2.6.3 PERSONAL INFORMATION SYSTEM

This module covers the various processes related to Payroll and HR activities of Personnel working at Central Units, Divisions, Depots and Workshops. It offers centralized system for better control as well as employee satisfaction.

8.2.7 RECOMMENDATIONS FOR THE DEPLOYMENT OF ITS INFRASTRUCTURE

The applications of ITS for the Metro Feeder System for Nagpur shall include;

1. Passenger Information System (PIS)
2. Automatic Vehicle Location System (AVL)
3. Electronic Fare Collection System
4. Central Control Center

The ITS applications need to be upgraded/ implemented for City Bus Services in Nagpur shall include;

1. Automated Fare Collection System
2. Fleet Monitoring System
3. Vehicle Scheduling & Dispatch System
4. Passenger Information System
5. Financial Management System
6. Depot Management System
7. Incident Management System
8. Business Intelligence System
9. Enterprise Management System

The deployment of hardware and software components of the above mentioned ITS infrastructure would be taken care by NMC for the City Bus Services and by Maha Metro for Feeder Services.

8.3 ITS FUNCTIONAL REQUIREMENT – PUBLIC BIKE SHARING SCHEME

IT systems can play very crucial role in the long term operations of the Public Bicycle Sharing Schemes depending upon the choice of technology adopted. The operations of PBS are classified primarily into three categories depending on the technology adopted, namely;

1. Fully Automated System
2. Hybrid System/Semi Automated
3. Manual System

IT system can store, retrieve, and transmit information and connects the hardware of the s, docks and terminals with that of the control center. It is in essence the link between the various communication portals. The application of information technology can make PBS a cost-effective transportation solution on a larger scale, as with IT not only the transfer of information will be more accurate, but its speed could also be measured in seconds rather than hours or days. With the advent of IT systems in PBS have reduced the manpower requirement, theft and vandalism of the cycles and stations. The various merits and demerits of the various PBS schemes based on the technology has been represented in the **TABLE 8-1**

TABLE 8-1: COMPARISION OF PBS TECHNOLOGIES

Fully Automated		Hybrid		Manual	
Advantage	Disadvantage	Advantage	Disadvantage	Advantage	Disadvantage
Minimal Human Resource is required to manage the system	Since the system is highly technology centric, the cost of implementation and maintenance is high	Since, the process is semi-automated, hence the initial cost of setup is relatively low in comparison to fully automated system	The system being semi-automated, there are chances of pilferage	Lower cost of deployment	Highest pilferage possible
Ease of Management in terms of revenue and asset management	High dependence of communication system and any failure in the system could lead to service non-availability	The system offers automation to some degree and also offers human intervention which may be conducive to certain section of society	There are higher chances of asset theft because of lesser control on asset tracking	Easily available to users as no or minimal technology used	Almost no control on asset tracking
The system offers tremendous ease of use to users and hence would encourage use of system	Users acceptance shall take a little more time because of the use of automated technology	The cost of operations is lower	The system is highly human resource centric	The implementation can be done in the fastest manner	Prone to Theft

Therefore, considering the shortcoming of the semi-automated and manual based IT systems and their association with theft vandalism and poor resource utilization; Nagpur PBS has been proposed for a fully automated PBS system. In the fully automated system, the IT applications is high and involves the application of smart cycles, use of terminals and mobile based application and use of smart card/key for success. The information dissemination and tracking accurate information depends on string internet networking. Fully automated system is a fourth generation system and is mostly found in most sharing schemes all over the world. The whole process of bicycle sharing scheme is represented in Figure 8.1[1].

FIGURE 8-1: PROCESS OF RENTING A BICYCLE FROM THE USER END

[1] Source: PBS Guidance Document

The proposed components and ITS applications proposed for the PBS Scheme in Nagpur[2] includes

1. Smart Card
2. Unique Cycle ID or RFID
3. Card Reader Kiosks at Terminal Docking Stations
4. Board Computer on Cycles
5. Control Room
6. Mobile App & Web Portal
7. Docks

The IT Systems of PBS for Nagpur City is recommended to be integrated with the Control Center of Metro along with the Metro Feeder and City Bus Services or to be integrated with the OCC of Nagpur City Program, both of which shall enable multi modal system integration. With the onset of Nagpur metro the people of Nagpur shall be exposed to the some of the IT components such as the smart card, terminal recharge facilities, balance check, locate station and fare structure. PBS in addition will add validation of the user to the similar system with complete registration process to ensure the safety and security of the bicycles. The proposed IT components of the Nagpur PBS are;

1. Board Computer on the Cycles
2. Transaction Terminals
3. Operations and Control Center
4. Central Fare Management with
    a. Easy Recharge
    b. Online Web based registration
    c. App/SMS based information dissemination

Utilizing the various components the following applications need to be active

8.3.1 USER ACCESS, REGISTRATION AND VALIDATION

The system needs to facilitate the user to register, pay and use the system as well as alter, check or update their accounts to have their changes take immediate effect. Payment processing is also automated and instantaneous, making even the small payments cost effective and eliminating the possibility of users avoiding payment.

The system also needs to validate the individual user while checking out/in from PBS station. System after authenticating registration process of user will give out the smart card to its user.

The users in Nagpur needs to be facilitated with information on the web portals, mobile apps etc. in regard to the system and its specifications such as

1. System specification
2. Location of the Stations
3. Availability of the s
4. Membership Information
5. Registration Process etc.

This user access, registration and validation of the system shall be supported by chip based smart card which will be attached with individual's identity, to ease out the registration validation and payment process. The terminal kiosks, web portal and mobile apps

[2] Source: Dwarka Bicycle Sharing System

need to be enabled with user information like bicycle availability at the docking stations, network/service coverage, fare structure, nearest transit stations, activity centers, shortest route etc along with the locking and unlocking mechanism.

To access the information by the user as well as the operator all the components of the system needs to be interlinked with the operation control center.

8.3.2 FARE COLLECTION

Multiple options of fare collection shall help the system to attract more users to the system. For Nagpur PBS the following fare collection system is recommended (further elaborated in Section 4.3.4)

1. Smart card based Fare management System
2. Mobile Based Fare Management System
3. Terminal Based Fare Management System

To enable the same, the fare collection system needs to be connected with central interface for the efficient authentication and process management. To support the above procedure, the following components have to be provided;

1. Chip based smart card
2. Smart card readers attached to the board computer of the cycle for locking and unlocking of the cycle

8.3.3 STATION CAPACITY AND BICYCLE AVAILABILITY

The central control center is required to relay station capacity to the following user platforms

- Station Terminals
- Websites
- Mobile apps
- Other transport operators

Communicating the availability of bicycles and open docks at various stations will help the operator manage the redistribution system, and users to get informed about available bicycles and station information.

The proposed system will be supported by the following components:

- GPS on bicycle
- Sensor on docks
- Screen on station terminals
- Terminals connected to operation control centre

8.3.4 DATA TRACKING AND DISSEMINATION

A well-designed IT system will ensure the accuracy of the collected data. Besides trip pattern data, it will provide information on user profiles and preferences, which will be used to adjust the operational and revenue models and maximize efficiencies. The IT functionality of the system will serve a larger utility such as allowing public use of the system data, which will enhance the user experience.

For the above said system, the elements provided in Nagpur are:

- Smartphone applications, which will allow a user to tap their phone to find the closest station and its current capacity.
- Inter linkages between other transit modes and the bicycle sharing stations will also be provided through apps.

- Trip-planning apps using real-time availability will suggest routes, times and availability of a PBS with respect to other modes of transport

8.3.5 TRACKING

The movement of the at any given point would be tracked with the help of GPS and RFID tags with the latter associating it with the user, while the RFID reader will actively gleantag's information as soon as the tag will come in its contact. Interlinking the s with docks, terminals and operation control centre will help in comprehensive records of the user's account or history which will include information such as the type of account, good or bad standing with the system, previous trip data, and any balance on the account.

In Nagpur, the bicycle tracking system shall be provided with the following components:

- RFID tags: These tags are electronic tags that will hold the identity (of the user or the bicycle) in a small chip. There have to be two types of RFID tags:
    - One that identifies the user and which is housed in a card
    - The other which identifies the bicycle and is housed in the bicycle.
- Both these tags will be passive in nature, meaning they will be simply used as storage devices of the identity.
- RFID reader: These readers will be placed in the docks, the terminals and in any other device that will be required to read the identity of the user's card or bicycle.
- GPS enabled bicycles

8.3.6 OPERATIONS CONTROL CENTER

Proposed operation center will serve as a central authority where a large physical facility or physically dispersed services will be monitored. It will serve the user with information and also coordinate with the online portals, and keep account of s whereabouts, by looking at the IT infrastructure. (Refer to Figure 8-2*)*

Control center will have connection with all the stations, bicycles and the users through IT. Basic infrastructure in control center would be:

- Multiple electronic displays
- Control panels conducting video surveillance and recording for security and personnel accountability purposes
- GPS tracking unit
- Electrical system to manage electronics and mechanical units.

The key functions of the Central Control Center shall be as under;

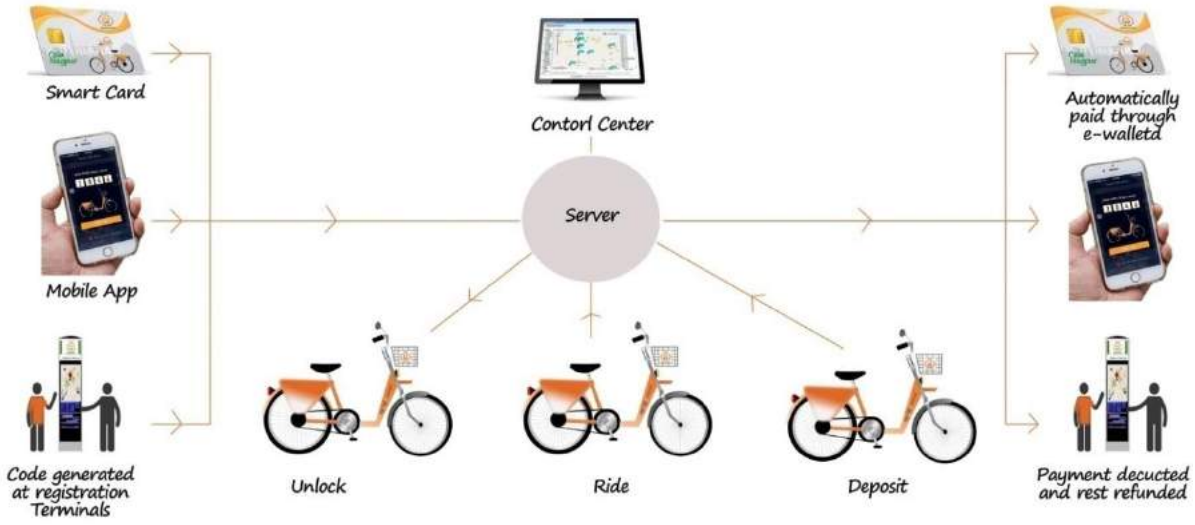
- Fleet Management
    - Disseminate information regarding redistribution
    - Respond to the breakdown of reported by a station in charge or user
    - Tracking of s through GPS
- User Interface Management
    - Provide information to the user on /dock availability via app, sms, phone call
    - Authorization of smart card/ key or code used by the user to sign into the systemat any PBS station.
    - Maintain the website and disseminate information online –via app, sms, phone call, about station location, subscription detail, user fee and other information concerning the user. The terminals act as interface between the user and control room in this process as well.
    - Track information the user through RFID tags installed in their smart card/key or code generated through the terminals.
- Fare collection
    - Centrally manage fare collection.

- System Management
  - Staff management
  - Prepare daily weekly and Monthly report

8.3.7 OPERATING SYSTEM FOR NAGPUR

The success of the PBS system depends on an efficient operator implementing an effective operating system. The activities outlined below need to be monitored to ensure compliance with requisite quality and address grievances timely. The operational procedures of PBS involve the user to tap the smart card, enter the code at station to unlock the bicycle. Only smart cards/ mobile apps with a minimum reserve of Rs100 can be used to undock a bicycle and start the trip. On completion of the ride the bicycle is deposited and charges are deducted.

FIGURE 8-2: OPERATION SYSTEM OF PROPOSED PBS FOR NAGPUR



The operations of the system are discussed under the following heads:

1. Trip Creation
2. Trip Monitoring
3. Customer service operations
4. Fare Collection handling

8.3.7.1 TRIP CREATION

The operating system at control centre creates a Trip ID and associates the smart card ID or the code generated (for mobile app or at registration terminals) with the cycle code. The linked bicycle is then unlocked the docking point and the journey is tracked through the GPS on the bicycle. At the time of return of the bicycle is firmly sided into an empty docking point the operating system shall detect it and automatically lock the bicycle and close the trip associated with the and deducts money from the e-wallet/smart card linked with the trip ID. (Refer Figure 8-3).

8.3.7.2 TRIP MONITORING

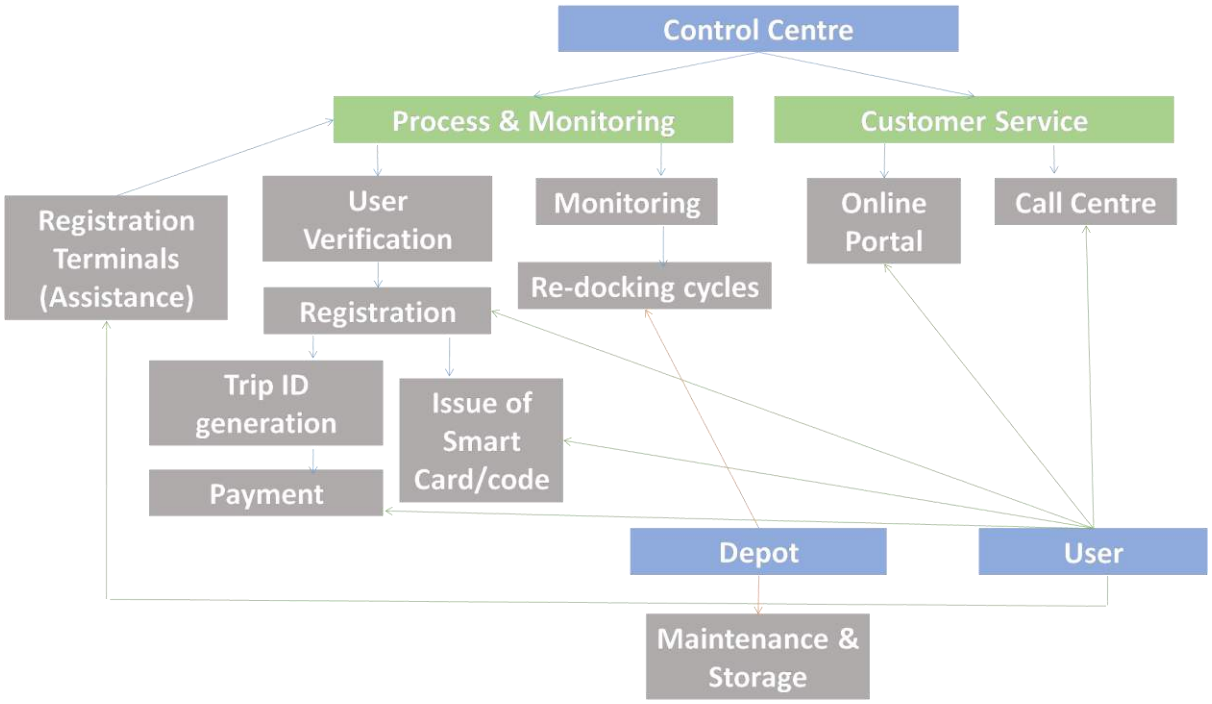
The trips shall be monitored at the control centre by their trip ID. In case of any discrepancy or lack of data flow from the docking points, an alert is raised at the control station to the concerned maintenance staff to verify the same on ground. Similarly if in case any bicycle leaves the system catchment area, or is not in use for more than 30 minutes an alert shall be raised and the movement/

location of the same shall be monitored respectively. Also a SMS shall be sent to the registered mobile number notifying the user of the same. This shall ensure smooth running and effective management. Also in case of accidents, theft of bicycle or any other distress, the user or the by-stander can notify the call centre for help.

8.3.7.3 CUSTOMER SERVICE

The customer service handles the online portal and helpline services. It troubleshooting and addressing concerns on real time basis. It is to ensure a 24/7 window for commuters to recharge their smart cards, find answers to queries, report repair notifications/theft of s and docking stations and acts as emergency contact in cases of distress.

FIGURE 8-3: OPERATIONS OF CONTROL CENTRE



8.3.7.4 FARE COLLECTION & MANAGMENT

The system is managed through central control centre through ITS. The bicycles and the control centre will be connected via a GPRS system. The fare structure and operations management system configurations shall be driven by the central system and all field devices would work based on the central fare management rules. The central server shall have capability of fare consolidation and reporting. The application shall be hosted in a data centre which would provide application continuity by way of primary and secondary application and data servers.

The choice of fare collection system for Nagpur PBS is evidently automated. Manual assistance is provided at stations with terminals to assist the usage of automated fare system, registration process and etc.

The fully automated system for Nagpur shall function through Smart Cards, Mobile Application and Code generated through Terminals/Kiosks at Docking Stations.

(A) SMART CARD BASED FARE MANAGEMENT:

The smart card is used as a medium for fare payment. The proposed smart card for Nagpur is an integrated travel. The card with a minimum balance of Rs 100 is accepted to usage. The users are required to load or recharge the smart card which enables them to operate and pay for their usage. The smart card is issued at terminals or depots on registration. It is centrally connected to the fare management and authorization. With the creation of trip the trip ID is recorded and tracked on the completion or on deposition of the bicycle the fare is calculated and deducted from the card centrally and the ID is there after lapsed.

FIGURE 8-4: GRAPHICAL REPRESENTAION OF SMART CARD AND MOBILE APPLICATION REQURIED FOR NAGPUR PBS

(B) MOBILE BASED FARE MANAGEMENT:

This system utilizes a mobile application as the fare deduction device. It operates in conjunction with the application as a value added service linked with the e-wallets operators. The users can request for the bicycle using the mobile application by entering the desired cycle number. The central cloud serve sends the authentication code on the application. The user on entering the code on the bicycle the system management serve sends the unlock command and the bicycle releases itself and creates a unique trip ID. On deposition of the bicycle the fare is estimated centrally and deducted the e-wallet, which is reflected on the application payments option. Similarly the ID is lapsed on the completion of the payment.

(C) TERMINAL BASED FARE MANAGEMENT:

It is similar to the mobile based fare management. The only variation with this system is that the request for the bicycle is send using the terminal instead of mobile. This facility is proposed to include the users without a smart mobile or mobile application. The registration is done at the terminal and the code is transmitted through a generated receipt. Similar to the mobile based fare management the fare is deduced from the e-wallet recharged and can viewed at terminals by entering the registration details.

8.3.8 MAINTAINENCE SCHEDULE

Maintenance of the system is very important for its success and smooth running. The maintenance schedule to be followed for PBS in Nagpur is listed as under;

- **Every two days (to be done at docking stations):** inflation of tyres; removal of dust and grease from cycles, docks, and terminals.
- **Every two weeks (to be done at maintenance depots):** drive chain lubrication, handlebar cantering and tightening, check for proper functioning of brakes, inspection for saddle wear and tear, verification that lights and reflectors are intact and function properly, and general observation of all other cycle components.
- **Once per year (to be done at maintenance depots):** remove and clean entire drive train, adjust tension and true wheels, inspect and replace tires that are worn, and inspect and service hubs and the bottom bracket.

- **Maintenance Log-** for onsite or off site repairs, data will be maintained to generate reports.

In addition to bicycle maintenance, the maintenance teams will be trained for fixing minor problems at docking stations, terminals and also cycle breakdowns during trips. They will also undertake the cleaning and maintenance of the station area.

8.3.9 STAFF REQUIREMENT

The staff requirement for the successful operation of the PBS depends on the type of system, operational hours of the system, size of the system, bicycle service area of the system and redistribution requirement of the system. A fully automated system reduces the overhead operating expenses and increases the efficiency of the system as compared to a manually operated PBS system. To ensure adequate security at the stations, majority of the PBS stations are planned adjoining the transit stations.

The PBS system in Nagpur shall require dedicated staff to operate and administer the new system. The staffing requirement for the PBS Nagpur has been worked out based on the Staffing requirement as defined in the PBS Guidance Document - MoUD, GoI (refer Annexure 3). Considering the guidelines, for a fully automated system with 500 cycles, 50 docking stations and 750 docks would require atleast 82 staff members i.e, 0.16 staff per cycle with 2 shifts and 20% of the relieving staff.

As in case of Nagpur, the total staff requirement considering both Phase 1 and Phase 2 is 444 (including 20% relieving staff) i.e 0.10 staff per cycle with 2 shifts. The total staff requirement for the PBS Nagpur is represented in Table 8-2.

TABLE 8-2: TOTAL MANPOWER REQUIREMENT

Staff Roles	Phase 1	Phase 2	Total
Operations Manager	2	2	4
Shift In Charge	6	7	13
Control Center Operators	11	11	22
Customer Service Call Center	11	11	22
Administration	4	4	8
Human Resources	4	4	8
Marketing Manager	2	2	4
Accounts	4	4	8
Station Attendant	0	0	0
Point of Sale Operators	26	26	52
Driver	26	26	52
Helper	26	26	52
IT Support	11	11	22
Workshop Mechanics	11	11	22
Guard	9	9	18
Cleaner	24	24	48
TOTAL = A	**177**	**178**	**355**
Relieving Staff = B	**44**	**45**	**89**
TOTAL (C = A+B)	**221**	**223**	**444**

CHAPTER 9. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Based on the anticipated impacts, the project may bring about an environmental management strategy, which has been outlined in the following section. The current section includes post project environmental monitoring programmes. This programme aims at signalling any potential environmental problem during construction and operations, which would allow for timely implementation of the mitigation measures.

9.1. EXISTING LEGAL FRAMEWORKS FOR EIA & SIA

As part of the current study, there is an intermittent need for a well-developed legal mechanism to conserve natural resources, protect the environment and ensures the health and wellbeing of the people in Nagpur. NMC also needs to fulfill the requirements of all state and national level environmental legal requirements, which are briefly described in the Table 9-1.

TABLE 9-1: APPLICABLE LEGISLATIONS OF THE GOVERNMENT OF INDIA[1]

Sl. No	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
1	The Environmental (Protection) Act. 1986, and the Environmental (Protection)Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	MoEF, State Department of Environment, CPCB and MPCB
2	Notification for use of Fly ash,3rd November 2009	Reuse fly ash discharged from Thermal Power Station to minimize land use for dispersal and minimize borrow area material. The onus shall lie with the implementing authority to use fly ash unless it is not feasible as per IRC	Yes	Thermal Power station located in 100 Km radius of the Nagpur city	MoEF, MPCB
3	The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1978 and 1988	Central and State Pollution Control Board to establish / enforce water quality and effluent standards, monitor water quality, prosecute fenders, and issue licenses for construction / operation of certain facilities	Yes	Consent required for not Polluting ground and Surface water during construction. The depot activity is Orange category because of automobile servicing.	MPCB
4	The Air (Prevention And Control of Pollution) Act. 1981	Empowers SPCB to set and monitor air quality standards and to prosecute	Yes	Consent required for establishing and operation of D.G. Set, plants and crushers. The depot activity is Orange category because of automobile	MPCB

[1] Source: Transport Department, Nagpur Municipal Corporation 2017

Sl. No	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
				servicing.	
5	Noise Pollution (Regulation And Control) Act, 2000	Standards for noise emission for various land uses	Yes	construction machineries and vehicles to confirm to the standards for construction	MPCB
6	The motor vehicle act 1988	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate is issued to reduce vehicular emissions	Yes	All vehicles used for construction and buses during operation phase will need to comply with the provisions of this act.	State Motor Vehicles Department
8	Public Liability And Insurance Act,1991	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials may be used for construction	Chief Controller of Explosives
9	Hazardous Wastes (Management and Handling)Rules, 1989	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes might get generated due to activities like of maintenance & repair work on vehicles	MPCB
10	E-waste (M&H) rules 2011	Protection against electronic waste handling & disposal	Yes	The bus depots will have personal computers and other electronic goods during operation phase	MPCB
11	Batteries (Management and Handling) Amendment Rules, 2010.	Protection to the general public against handling and used batteries disposal	Yes	Batteries will be used for buses during operation phase of the project	NMC / MPCB
12	Chemical Accidents (Emergency Planning, Preparedness and Response)Rules,1996	Protection against chemical accident while handling any hazardous chemicals resulting	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during construction	District & Local Crisis Group headed by the DM and SDM
13	Municipal Solid Wastes (Management and Handling) Rules, 2000 and amended on July 2013	Protection against MSW during construction and operation phase	Yes	Handling of Municipal solid waste	NMC / MPCB
14	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996	Employing Labour / workers	Yes	Employing labours workers	District Labour Commissioner
15	Environmental Impact Assessment (EIA) notification: 2006	Proposed activity may encroach and pollute	Yes	Construction area will not exceed 20,000 Sq. Mt.	State Environment Impact Assessment Authority

Sl. No	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for application	Implementing / Responsible Agency
		environmental resources. Hence Environmental Clearance should be there with proper impacts and mitigations		(Clarification asked from DOE, Government of Maharashtra)	Maharashtra
17	International Environmental regulation in which India is a signatory	International environmental issues such as emission of greenhouse gases	Yes	Global environmental issues	kfW
18	ECBC: Energy Conservation Act, 2001(52 of 2001)	Energy consumption increases due to the equipment required in the maintenance, waiting rooms, rest rooms, external and internal lighting etc.	Yes	Applicable to nonresidential buildings	NMC
19	Persons with Disabilities Act, 2011	The existing Persons with Disabilities should get Equal Opportunities, Protection of Rights and Full Participation	Yes	Applicable for disabled persons for employment opportunities	NMC

As part of the project preparations, following clearances and No Objection Certificates will be required:

- No Objection Certificate (NOC) and Consents under Environmental Protections Acts for Air, Water, Noise, Hazardous Waste rules of Maharashtra Pollution Control Board (MPCB) for establishing and operating plants from MPCB.
- PUC certificate for use of vehicles for construction from Department of Transport.
- Explosive license from Dept. of Geology and Mines & Chief controller of explosives.
- No Objection Certificate (NOC) for water extraction for construction and allied works from Ground Water Authority, if used.
- An Emergency Action Plan should be prepared by the contractor and approved by the Engineer for accidents before the construction starts.

Considering the current project, it needs to be understood that an effective Environmental and Social Managment System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the project proponent, its workers, local communities directly or indirectly affected by the project and other stakeholders. The ESMS entails a methodological approach to managing environmental and social risks and impacts in a structured way on an ongoing basis. A good ESMS appropriate to the nature and scale of the project promotes sound and sustainable environmental and social performance, and can lead to improved financial, social, and environmental outcomes.

9.2. ENVIRONMENTAL EXAMINATION AND ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS

The present study is carried out though secondary data collection. Various sources of pollution with respect to performance standard are discussed, herein with details in both construction and operation phase. The following section gives an update of 9 depots which are proposed to be developed and upgraded as part of the current study;

There are 4 depots in operations to cater to the day to day maintenance activities of the city bus services in Nagpur. Additional 6 new depot locations have been identified tentatively in the outskirts of the city along the inner ring road to facilitate decongestion of city bus services from the city centre, minimize the dead mileage and increase the operational efficiency.

Total area under the existing depots is 9.95 acres, whereas to maintain and operate the 1596 buses by 2028 would require approximately 72.71 acres.

TABLE 9-2: SUMMARY OF THE PROPOSED BUS DEPOTS IN NAGPUR

Name of the Depot	Status	No. of Routes	Fleet			Area Available (acres)
			2018	2023	2028	
Dattawadi	Proposed	9	46	108	155	7.4
Babulkheda	Proposed	8	65	104	172	7.82
Hingana	Existing	9	136	231	297	10.4
Katol Naka	Proposed	3	8	8	13	0.65
Takli	Proposed	7	19	47	96	10.56
Octroi Checkpost	Propsoed	5	115	187	257	12.85
Patwardhan	Existing	16	61	125	184	8.2
Wathoda	Proposed	7	46	71	125	4.18
Teka Naka[2]	Existing	12	81	160	220	10.65
Total		**76**	**577**	**1041**	**1519**	**72.71**
5% Contingency			**30**	**52**	**77**	
Grand Total			**607**	**1093**	**1596**	

This will require acquisition of 62.76 acres of land. As mentioned in the previous chapter, the requisite allocation of the depots have been done based on the Development Plan for Nagpur in consultation with the Town planning and Transport Department of NMC. Since, most of the identified land parcels are govt. lands and allocated for the use of urban transport in city, the need for Resettlement and Rehabilitation doesn't arise.

Given below is the list of various environmental and social impacts, which would be caused as a result of proposed project.

9.2.1 DESIGN PHASE IMPACTS

The planning and design of this project should be carried out by the project proponent while the construction works will be carried out by the contractors and supervised by the project proponent. Design phase impacts are related to site features, selection of technology and design of project. It is intended to engage consultants to undertake the Environmental and Social Impact Assessment (ESIA).

9.2.2 PRE CONSTRUCTION PHASE IMPACTS

9.2.1.1 AIR AND NOISE ENVIRONMENT

The evacuation and clearance of the project may contribute towards environmental degradation i.e. noise, water and air pollution. Land clearance for existing terminal construction and depot upgradation would result in release of pollutants like NOx, SO2 gases and Particulate Matters by construction equipment. Noise pollution is another problem caused as a result of usage of construction equipment.

9.2.1.2 TERRESTRIAL ECOLOGY

The all existing depots are under operation area have major tree count. Hence no tree cutting is envisaged, thus adverse impacts on the ecological environment are considered to be minor. But transplantation and cutting of trees may be carried out at places where retention is not possible. However the landscape plan will be considered to abate the resultant pollution in construction and operation stage.

[2] If Required 1.61 acres of land at Indora can be developed for Depot purposes instead of engaging land from a private party on lease or rent for depot/terminal purposes.

9.2.1.3 SOCIO-ECONOMIC IMPACTS:

Population around the bus depots will be affected due to increased noise and air pollution caused by demolition of existing structures.

9.2.1.4 IDENTIFICATION OF TECHNOLOGY

Vehicle technology, fleet type as well as fuels options are studied. Advanced diesel/CNG/ethanol and electric vehicles producing very low emissions are considered. On the basis of which Introduction of Low Carbon City Bus Service is proposed.

9.2.3 CONSTRUCTION PHASE IMPACTS

9.2.3.1 AIR AND NOISE ENVIRONMENT:

This phase involves transportation of construction materials to the project site. Various raw materials used during this phase include water, steel, cement, fly-ash, wood, glass, paints, polyvinyl chloride (PVC), rubber, etc. Usage of raw materials for the construction activity release dust emissions, SO2, NOx and particulate matters. The major noise generating sources will be DG sets, crusher excavators, crane, concrete mixer / dredgers etc., which may produce noise level in the range of 70-90 dBA and may increase the background noise levels. However, since these temporary works will be confined to the project area, disturbance to local people will be minimal[3].

EMP should presumably set rules for max noise levels and times. ESIA should highlight areas particularly affected and principles of mitigation to be applied

9.2.3.2 WATER, WASTEWATER AND SOLID WASTE MANAGEMENT

A. WATER ENVIRONMENT:

Construction & Development of site: Development of the proposed site could lead to stockpiling and excavation activity on site, thereby causing erosion of base soil. The runoff from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season. The waste water generated shall be discharged in the existing sewer drain with prior consent. The total water requirement in construction phase is given in Table 9-4. The calculation criteria is based on NBC standards[4]

TABLE 9-3: TOTAL WATER REQUIREMENT IN CONSTRUCTION PHASE[5]

Dattawadi			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	9811.7	17,17,048.65
Plastering	85 l/sq.mt	3270.6	2,77,998.35
Pointing	60 l/sq.mt	3270.6	1,96,234.13
White washing, colour washing & dispensing	3 l/sq.mt	3270.6	9,811.71
Total Water Requirement			22,01,092.84

Babulkheda			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	10368.6	18,14,502.76
Plastering	85 l/sq.mt	3456.2	2,93,776.64
Pointing	60 l/sq.mt	3456.2	2,07,371.74
White washing, colour washing & dispensing	3 l/sq.mt	3456.2	10,368.59
Total Water Requirement			23,26,019.73

[3] As per Noise Pollution (Regulation and Control) Rules, 2000
[4] As per norms prescribed in NBC
[5] Tentative Area Statement, which could vary at the detailed designing stages.

Hingana			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	13789.4	24,13,149.45
Plastering	85 l/sq.mt	4596.5	3,90,700.39
Pointing	60 l/sq.mt	4596.5	2,75,788.51
White washing, colour washing & dispensing	3 l/sq.mt	4596.5	13,789.43
Total Water Requirement			30,93,427.77

Katol Naka			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	861.8	1,50,821.84
Plastering	85 l/sq.mt	287.3	24,418.77
Pointing	60 l/sq.mt	287.3	17,236.78
White washing, colour washing & dispensing	3 l/sq.mt	287.3	861.84
Total Water Requirement			1,93,339.24

Takli			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	14001.6	24,50,274.82
Plastering	85 l/sq.mt	4667.2	3,96,711.16
Pointing	60 l/sq.mt	4667.2	2,80,031.41
White washing, colour washing & dispensing	3 l/sq.mt	4667.2	14,001.57
Total Water Requirement			31,41,018.97

Octroi Checkpost			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	17037.9	29,81,631.77
Plastering	85 l/sq.mt	5679.3	4,82,740.38
Pointing	60 l/sq.mt	5679.3	3,40,757.92
White washing, colour washing & dispensing	3 l/sq.mt	5679.3	17,037.90
Total Water Requirement			38,22,167.96

Patwardhan			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	10872.4	19,02,675.53
Plastering	85 l/sq.mt	3624.1	3,08,052.23
Pointing	60 l/sq.mt	3624.1	2,17,448.63
White washing, colour washing & dispensing	3 l/sq.mt	3624.1	10,872.43
Total Water Requirement			24,39,048.82

Wathoda			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	5542.3	9,69,900.45
Plastering	85 l/sq.mt	1847.4	1,57,031.50
Pointing	60 l/sq.mt	1847.4	1,10,845.77
White washing, colour washing & dispensing	3 l/sq.mt	1847.4	5,542.29
Total Water Requirement			12,43,320.01

Teka Naka			
Type of material	**Water requirement**	**Area (Sq m)**	**Total water in litres**
Brick work, Masonry, concreate	175 l/cum	14120.9	24,71,157.85
Plastering	85 l/sq.mt	4707.0	4,00,092.22
Pointing	60 l/sq.mt	4707.0	2,82,418.04
White washing, colour washing & dispensing	3 l/sq.mt	4707.0	14,120.90
Total Water Requirement			31,67,789.01

B. WASTEWATER:

Workshop: The repair and maintenance of construction equipment/vehicles on site would generate waste containing oil and grease. The wastewater stream would also be generated from vehicle washing. The impact can be mitigated to a great extent by installing oil and grease traps on the construction site.

C. WASTE DISPOSAL:

Constructional activity on site will generate debris & solid waste. If excavated soil/debris and borrow materials are stored at only designated locations within the project area, it will decrease significant impact in this regard. During the construction phase, solid waste generated will include mass from land clearing activities, waste from the labour camp and construction waste. Construction activities would generate solid wastes that need to be disposed; these are sand, concrete, gravel, stone, bricks, plastic, paper, wood, metal, glass etc.

TABLE 9-4: CRITERIA FOR ESTIMATING CONSTRUCTION WASTE

Facilities Provided	Waste Generation Norms		Basis of Assumption
Office and Admin area	0.2	kg/Capita/day	Source: Manual for municipal solid waste management
Service and utlity area	0.07	kg/sq.m/day	CIWMB Guidelines
Kitchen or canteen waste	0.07	kg/sq.m/day	CIWMB Guidelines
Waste generation from pathways	30	kg/km/day	Based on the field studies for the other similar kind of projects in India.
Garden and open space	0.003	kg/sq.m./day	Discussion with Horticulturists
STP Sludge	250	kg per MLD of wastewater treated	Manual for Sewerage and Sewage treatment by CPHEEO

TABLE 9-5: REEFERENCES FOR SOLID WASTE GENERATION DURING CONSTRUCTION PHASE

Construction and Demolition Debris Weight to Volume Conversion

Note: These numbers are used throughout this training

	Volume	Weight (pounds)	Weight (tons)
Trash[2]			
Residential waste (uncompacted at curb)	1 cubic yard	150 – 300	.075 – .15
Commercial-industrial waste (uncompacted)	1 cubic yard	300 – 600	.15 – .30
Mixed Waste[1]	1 cubic yard	350	.175
Asphalt[3]	1 square yard 1 inch thick	110 - 115	0.055 – 0.057
Asphalt[3]	1 cubic yard	4,050 – 4,140	2.025 – 2.07
Cans & Bottles[2]			
Aluminum cans (whole)	1 cubic yard	50 – 75	.025 – .038
Glass bottles (whole bottles)	1 cubic yard	500 – 700	.25 – .35
Plastic bottles (soda bottles)	1 cubic yard	30 – 40	.015 – .02
Corrugated Cardboard[1]			
Uncompacted	1 cubic yard	50 – 150	.025 – .075
Compacted	1 cubic yard	300 – 500	.15 – .25
Concrete[4]	1 cubic yard	4,050	2
Rubble[1]	1 cubic yard	1,400	.7
Drywall[1]	1 cubic yard	500	.25
Scrap Metal[1] (loose light iron sheet metal)	1 cubic yard	1,000	.5
Wood – pallets[2]	1 cubic yard	286	.143
Wood – pallets[2] (Each)	1 Unit	30 – 50	.015 – .025
Scrap Wood[1]	1 cubic yard	300	.15

1 US Green Building Council. "LEED Reference Guide for Green Building Design and Construction 2009 Edition, Section 6• Calculations, Table 2• Solid Waste Conversion Factors. Page 360.

2 US Environmental Protection Agency. "Measuring Recycling. A Guide for State and Local Governments." September 1997 Appendix B. Standard Volume•to•Weight Conversion Factors pp. 59 – 62. W ww.epa.gov/epawaste/conserve/tools/recmeas/docs/guide_b.pdf

3 Asphalt Pavement Association of Michigan (4,050 lbs/yd^3) and LEED EB v. 2.0 Reference Guide (p. 258) Table 2 Volume to Weight Conversions (115 lbs per yd^2 or 4,140 lbs per yd^3).

4 Reade Advanced Materials, Providence RI 401.433.7000 www.reade.com/Particle_Briefings/spec_gra2.html

TABLE 9-6: DEPOT WISE SOLID WASTE GENERATED (IN TONNES) DURING THE CONSTRUCTION PHASE

Type of waste	Dattawadi	Babulkheda	Hingana	Katol Naka	Takli	Octroi Checkpost	Patwardhan	Wathoda	Teka Naka
Trash									
Commercial-industrial waste (un compacted)	24673.77	26074.18	34676.66	2167.291	35210.14	42845.68	27341.21	13937.35	35510.23
Mixed Waste	13981.81	14775.37	19650.11	1228.132	19952.42	24279.22	15493.35	7897.832	20122.47
Asphalt3	4688.017	4954.093	6588.564	411.7853	6689.927	8140.678	5194.829	2648.096	6746.943
Cans & Bottles									
Aluminium cans (whole)	3125.338	3302.722	4392.367	274.523	4459.942	5427.108	3463.213	1765.394	4497.953
Glass bottles (whole bottles)	28786.08	30419.88	40456.11	2528.507	41078.51	49986.63	31898.08	16260.24	41428.61
Plastic bottles (soda bottles)	1644.921	1738.281	2311.781	144.4863	2347.346	2856.383	1822.75	929.1579	2367.352
Corrugated Cardboard									
Un compacted	6168.453	6518.554	8669.177	541.8236	8802.549	10711.43	6835.313	3484.342	8877.571
Compacted	20561.49	21728.49	28897.23	1806.077	29341.8	35704.75	22784.35	11614.46	29591.88
Concrete	164491.9	173827.9	231177.8	14448.61	234734.4	285637.9	182274.8	92915.69	236734.9
Rubble	57572.15	60839.76	80912.21	5057.013	82157.02	99973.26	63796.17	32520.49	82857.22
Drywall	20561.49	21728.49	28897.23	1806.077	29341.8	35704.75	22784.35	11614.46	29591.88
Scrap Metal (loose light iron sheet metal)	41122.96	43456.97	57794.43	3612.152	58683.58	71409.47	45568.69	23228.92	59183.72
Wood – pallets	11761.17	12428.7	16529.22	1033.076	16783.51	20423.12	13032.65	6643.473	16926.55
Scrap Wood	12336.89	13037.09	17338.33	1083.645	17605.07	21422.84	13670.6	6968.674	17755.11
Total	411476.4	434830.5	578291.2	36143.2	587188	714523.3	455960.4	232428.6	592192.4

9.2.3.3 SUSTAINABILITY AND CARBON FOOTPRINT

The project will involve additional buses and additional trip and hence additional fuel consumption. It will also include higher energy consumption from fully functional workshop and buildings constructed for other facilities.

During construction phase the energy consumption and carbon emission would happen through the construction process and construction material. High embedded energy materials and high energy consumption construction processes may increase the carbon footprint of the project. Use of low embedded energy material and optimisation of energy/ material consumption during construction phase would provide mitigation to this impact.

9.2.3.4 COMMUNITY HEALTH, SAFETY & SECURITY ASPECTS

During construction phase impact on occupational health and safety of contractor workers is anticipated from exposure to high noise generated from fugitive dust generated from material stockpiles, cut and fill operations and vehicular movement along unpaved roads. Continuous exposure of workers to high level fugitive dust may lead to adverse health impacts viz. headache, asthma, allergy, hearing loss etc. Increased frequency of bus trips may increase chances of accidents on the approach roads especially at night times.

9.2.3.5 HOUSEKEEPING:

To provide a first line of difference against accident and injuries the working environment shall be cleared of all unnecessary waste. General Housekeeping shall be carried out by the contractor and ensured at all times at Work Site, Construction Depot, Batching Plant, Stores, Offices and toilets/urinals. Full height fence, barriers, barricades etc. be erected around the site in order to prevent the surrounding area from excavated soil, rubbish etc. The barricade/fence especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the contractor. These shall be maintained in one line and level.

9.2.3.6 WORKING AT HEIGHT:

The places designed above ground level for performing specific task shall be protected by fence of at least 1.2 m. height and if temporary working is to be done from a high place then net below the working place shall be suitably placed to protect the working person from any personal injury. Slipping, Tripping, Cutting, Drowning and Falling Hazards

- All places should be free from dust, debris or similar materials.
- Sharp projections or any protruding nails or similar objects shall be suitably guarded or shall even be avoided to make the place safe to work.

Contractor shall not allow workmen to work or use platforms, scaffolds/passageways or any walkways, which has water, or oil or similar substances spilt and has a slipping hazard, unless it is cleaned off or covered or sanded or saw dusted or make it safe with any suitable material.

9.2.3.7 CONSTRUCTION MACHINERY:

Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers piling rigs, vibration hammers, rail welding equipment's, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc. These machineries shall be operated by a trained licence holder skilled person. All safety precautions shall be taken as per the manual of the specific machinery.

9.2.3.8 SOCIO-ECONOMIC ASPECTS:

A. TRANSIENT LABOUR POPULATION:

Construction activity may lead to influx of construction labours. Though majority of work force would be recruited locally, labours with specific skills, may be from outside. However, such labours would be limited in number and that too on daily basis. Hence no worker camps are required. The basic amenities like drinking water, public toilet etc. are on place as the depots are in operation. Therefore no significant pressure on local infrastructure is envisaged.

B. JOB OPPORTUNITY:

The local people would also get the job opportunities closer to their places of stay. Expenditure incurred by those employed at the project will boost local economy. Jobs would be created for unskilled, semi-skilled as well as skilled labour category, for which local population would be given preference. Thus, the project is expected to contribute to the overall development of the area.

9.2.4 OPERATION PHASE IMPACTS

9.2.4.1 AIR AND NOISE ENVIRONMENT:

During operation phase of project major pollutant contributors will be vehicular movement and operation of workshop and maintenance area of the buses. The main pollutant will be SO2, NOx, particulate matter of PM10, PM2.5, Carbon Monoxide, Benzene etc. from vehicular operation and operation work shop. The diesel generator of work shop during emergency is also a source of pollutant. The source of the above pollutant will be at the following locations: Workshop and depots, Parking area, Buses pick up point and terminal, along the bus routes.

All the bus depots consist of washing and maintenance facilities within the premises which will contribute towards noise generation in the operation phase along with the regular vehicle movement in the premises. To determine the noise level produced by the vehicles, the internal traffic density and the vehicular movement paths within the depot will be studied and quantified during final DPR perpetration. The noise limit for passenger or commercial vehicles above 4 MT and up to 12 MT is 89dB as per Noise standards for automobiles, domestic appliances and construction equipment's have been notified in Part 'E', Schedule-VI of Environment(Protection)Rules,1986, as amended on 19th May,1993. As there are no specific norms for noise generation by washing and scrap bins, the same is assumed to be 89dB also.

9.2.4.2 SOLID WASTE MANAGEMENT:

Solid waste generation is mainly of municipal solid waste from depots, hazardous waste and e-waste generation from maintenance area. Based on the criteria mentioned in Table 8-4 & 8-5, the detailed quantification per depot is represented in Table 9-8,

TABLE 9-7: DEPOT WISE SOLID WASTE GENERATED (IN TONNES) DURING THE OPERATION PHASE

Facilities Provided	Dattawadi		Babulkheda		Hingana		Katol Naka		Takli		Octroi Checkpost		Patwardhan		Wathoda		Teka Naka	
	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste	Unit	Total Waste
Office and Admin area (No. of Persons)	326	0.065	345	0.069	458	0.092	29	0.006	465	0.093	566	0.113	361	0.072	184	0.037	469	0.094
Service and utlity area (Sq mts)	74	0.005	74	0.005	74	0.005	74	0.005	74	0.005	74	0.005	74	0.005	74	0.005	74	0.005
Kitchen or canteen waste (Sq mts)	222	0.156	235		313		20		317		386		246		126		320	
Waste generation from pathways	20	0.600	20		20		20		20		20		20		20		20	
Garden and open space	8986	0.027	9496		12629		789		12823		15604		9957		5076		12932	
STP Sludge (million lts per day)	0.01	0.003	0.006	0.003	0.006	0.003	0.006	0.003	0.006	0.003	0.006	0.003	0.006	0.003	0.006	0.003	0.006	0.003
Total Bio Degradable		**0.848**		**0.862**		**0.948**		**0.622**		**0.954**		**1.030**		**0.875**		**0.740**		**0.957**
Total Non-Bio Degradable		**0.008**		**0.008**		**0.008**		**0.008**		**0.008**		**0.008**		**0.008**		**0.008**		**0.008**
Total Waste Generated (Tonnes Per Day)		**0.855**		**0.869**		**0.956**		**0.629**		**0.961**		**1.038**		**0.882**		**0.747**		**0.964**

9.2.4.3 WATER ENVIRONMENT:

Contamination of surface & ground water may be possible due to accidental spillage of oil, grease and diesel from the vehicles during operation phase of project. Other emissions from work shop and maintenance are as follows: Solvent Emission, Waste oil, Brake fluid, Coolant, Solvent, Wash down waters from floor, wastewater generation from bus washing, Detergents, Degreaser, Storm water from maintenance area. Detailed quantification per depot is represented in Tables 9-9 to 9-17.

TABLE 9-8: WATER REQUIREMENT AND STP CAPACITY OF DATTAWADI DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	326	15	4890	3912	
Flushing	326	30	9780	9780	
Gardening	NA	5	0		
Total				13692	13

TABLE 9-9: WATER REQUIREMENT AND STP CAPACITY OF BABULKHEDA DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	345	15	5175	4140	
Flushing	345	30	10350	10350	
Gardening	NA	5	0		
Total				14490	14

TABLE 9-10: WATER REQUIREMENT AND STP CAPACITY OF HINGANA DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	458	15	6870	5496	
Flushing	458	30	13740	13740	
Gardening	NA	5	0		
Total				19236	20

TABLE 9-11: WATER REQUIREMENT AND STP CAPACITY OF KATOL NAKA DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	29	15	435	348	
Flushing	29	30	870	870	
Gardening	NA	5	0		
Total				1218	1

TABLE 9-12: WATER REQUIREMENT AND STP CAPACITY OF TAKLI DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	465	15	6975	5580	
Flushing	465	30	13950	13950	
Gardening	NA	5	0		
Total				19530	20

TABLE 9-13: WATER REQUIREMENT AND STP CAPACITY OF OCTROI CHECKPOST DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	458	566	15	8490	6792
Flushing	458	566	30	16980	16980
Gardening	NA	NA	5	0	
Total					23772

TABLE 9-14: WATER REQUIREMENT AND STP CAPACITY OF PATWARDHAN DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	361	15	5415	4332	
Flushing	361	30	10830	10830	
Gardening	NA	5	0		
Total				15162	15

TABLE 9-15: WATER REQUIREMENT AND STP CAPACITY OF WATHODA DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	184	15	2760	2208	

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Flushing	184	30	5520	5520	
Gardening	NA	5	0		
Total				7728	7

TABLE 9-16: WATER REQUIREMENT AND STP CAPACITY OF TEKA NAKA DEPOT

Facilities	Population	Litres per capita	Water demand in litres	Waste Water generation	STP capacity
Drinking	469	15	7035	5628	
Flushing	469	30	14070	14070	
Gardening	NA	5	0		
Total				19698	20

A. DISCHARGE OF SURFACE RUN-OFF /RAIN WATER HARVESTING:

During monsoon the surface run-off generated from the site area may lead to the alteration of flow rates and increase in suspended solids thereby interfering with its usage for domestic purpose. Such run-off water may also characterized by contaminants viz. oil, lubricants etc. thereby leading to degradation of the water quality of the drainage channel.

Keeping in mind the importance of water and its scarcity it is proposed to conserve rainwater by harvesting which will improve the subsoil water condition / moisture content maintained / improved to a great extent. It is proposed to collect rainwater from roof area in the rain water harvesting tank.

B. WATER REQUIREMENT AND WASTEWATER GENERATION:

Waste water generation will be mainly of sewage and effluent from maintenance facility at depot site. Actual requirement of water and wastewater quantification is represented in Table 9-8 to Table 9-13.

9.2.4.4 COMMUNITY HEALTH, SAFETY & SECURITY ASPECTS:

Health & safety of the passengers is of primary concern and required measures are to be taken to ensure that health and safety of people are not compromised at any end.

The following measures shall be taken by the depot authorities to ensure the safety of the passengers during operation phase:

- Installation of cameras at places of concern like depots terminal and boarding points. The authorities would ensure continuous surveillance of these areas
- Display of emergency numbers at the places easily accessible for both the working staff as well as the passengers
- Provision of safety measures like fire extinguishers close to the fuelling stations apart from regular safety drills and equipment check-ups. Precautions should be made during fuelling of buses like de boarding of all the passengers before fuelling of buses
- Provision of safety equipment at the bus maintenance areas along with regular check-ups of the maintenance machinery
- Regular check-ups and maintenance of buses should be carried out

9.2.4.5 SOCIO-ECONOMIC ASPECTS:

It is expected that due to ease of movement and extra passengers there would be a general improvement of livelihood of all people. As the project envisions provision of these services it is expected to contribute the opportunities for women, children and senior citizens to access a safe public transport & use to it emancipate their social & economic rights. Thus this project will certainly have positive impacts on the various population groups of that area.

9.2.4.6 CLIMATE RISK ASPECTS:

Introduction of low carbon buses will get positive impact on the environment and in turns lower the risk of climate change risk.

9.3 SUGGESTED MITIGATION MEASURES

9.3.1 DESIGN PHASE / PRE-CONSTRUCTION PHASE

Measures to mitigate possible environmental impacts shall be incorporated in the design, and appropriate contract provisions should be included to minimize the possible impacts during the construction stage.

9.3.1.1 TECHNOLOGY SELECTION:

Technology of the construction should be as such to reduce the major impacts on environment. Design of the project components shall be such that best architectural design for energy saving, sustainability.

9.3.1.2 AIR AND NOISE ENVIRONMENT:

In order to manage the impacts identified, necessary steps shall be taken. As mentioned earlier, this phase requires evacuation of site. Risk assessment is an important step mandatory prior to any step taken for controlling pollution. Apart from this, safety precautions must be taken during construction to avoid major accidents. Provisions, like ear muffs and ear plugs, have to be supplied to the workers present in the site during the time construction. Periodic measurement of air quality and noise equivalent noise levels has to be monitored during daytime and night times and compare it with the standards as per National Ambient Air Quality Standards (NAAQS) as well as National Ambient Noise Quality Standards (NANQS), as specified by the CPCB.

9.3.1.3 LAND ENVIRONMENT:

Boundaries of the construction area must be clearly marked prior to the commencement of vegetation clearance; Clearing and disposal of cleared vegetation whenever and wherever required shall be in accordance with the Administering Authority requirements. A green belt programme is being planned which will help in improving the ecological condition and pollution abatement in the region.

9.3.2 CONSTRUCTION PHASE

9.3.2.1 AIR AND NOISE ENVIRONMENT:

Transportation of construction materials and the process of construction of the terminals lead to air pollution. Pollutants like Particulate Matter (PM, SPM), NOx, CO2, CO may be released. Any leakages of fuels from vehicles may result in pollution of groundwater as well as soil. Dust emission from vehicles as well as from raw materials like cement also contributes to air pollution. Necessary steps, such as regular water spray to minimise fugitive emissions and baseline ambient air monitoring given by CPCB, have to be taken to minimise the pollution generated during this phase.

Noise levels are to be checked and personal protective gears to be provided during periods of noise exposure. Maintenance of equipment and machinery are to be checked regularly. Measures have to be taken for the characterization and proper disposal of muck expected to be generated at various sites. A first-aid box needs to be provided at the construction site.

9.3.2.2 WATER, WASTEWATER AND SOLID WASTE MANAGEMENT:

Contamination of surface & ground water may be possible due to accidental spillage of oil, grease and diesel from the vehicles during operation phase of project. Other emissions from work shop and maintenance are as follows.

a) Solvent Emission

b) Waste oil

c) Brake fluid

d) Coolant

e) Solvent

f) Wash down waters from floor

g) Detergents

h) Degreaser

i) Storm water from maintenance area

The construction phase involves treating the effluents released from construction site by providing settling tank to precipitate suspended impurities before discharge into existing drain. Toilet facilities are already these hence no water pollution due to sewage is envisaged. However STP is proposed for domestic wastewater treatment. Solid waste disposal should be planned in a way proving harmless to the environment. Out of which 30% of waste will be reused and remaining waste will be will be collected and kept in an identified location near to the site and then this will be handed over for proper disposal to the authorised vendor/municipality.

The effluent from workshop, bus wash system will be collected and treated in ETP. The ETP shall be used to treat the water produced during bus washing and for radiant and hopping. The ETP capacity of the bus depots is represented in Table 9-18.

TABLE 9-17: ETP CAPACITY OF THE DEPOTS

Name of Depot	ETP Capacity (KLD)
Dattawadi	33
Babulkheda	35
Hingna	47
Katol Naka	3
Takli	48
Octroi Checkpost	58
Patwardhan	37
Wathoda	19
Teka Naka	48

The waste will be generated from construction area and presumably this will be controlled by establishing proper wastewater collection.

Potential pollution problems during construction activities include dumping of construction debris into or nearby low-lying areas. Proposed mitigation measures will suggest maximum reuse of construction waste on site or removal of waste from the site and proper disposal, which would reduce the adverse impact, if any, significantly. Labour on site may generate some food waste through the canteen or in case of labour camp municipal solid waste during their stay. This waste will be handover to authorised local agency for proper management.

9.3.2.3 COMMUNITY HEALTH, SAFETY & SECURITY ASPECTS:

While constructing the depots and terminals, safety precautions have to be taken for handling the construction materials by the workers. They shall be provided with gloves while handling the paints and care should be taken while carrying the materials made up of glass. This phase has a high risk for occupational hazards and hence, mitigation measures have to be planned accordingly.

9.3.3 OPERATION PHASE

9.3.3.1 AIR AND NOISE ENVIRONMENT:

Regular maintenance and cleaning of fleets will restrict air and noise pollution. Also it is proposed to run the fleets on CNG / electric based batteries to reduce air pollution. CNG stations are already these at each depot site which shall be upgraded as increasing number of fleets. Authorities should strictly monitor all operational phase activities and rules and regulations should be strictly adhered to. All environmental parameters must be checked regularly by an Environmental Safety Officer and should be maintained within permissible limits.

9.3.3.2 WASTEWATER AND SOLID WASTE MANAGEMENT:

There will be provision of wastewater treatment at the depots. The desired quantity and technology of STP will be estimated in detail later. The solid waste will be collected and segregated as dry and wet waste at the identified location on the site and then this will be handed over to the municipality for further processing and treatment.

9.3.3.3 BIOLOGICAL ENVIRONMENT: FLORA, FAUNA AND ECOSYSTEMS:

Greenbelt / landscape plan will be prepared and implemented on the depot premises especially around the periphery of the depot as per the guidelines of State Pollution Control Board. The indigenous species shall be planted which will also attenuate the air and noise pollution.

9.3.3.4 COMMUNITY HEALTH, SAFETY & SECURITY ASPECTS:

A. PASSENGER & STAFF SAFETY:

For the purpose of safety and security, CCTV surveillance systems shall be installed at each depot / terminal and in each of the fleet.

In emergencies or as required it shall be possible, without any additional resources, to view images from any/all cameras and/or record any dynamically selected location on the system at Central Control Centre. Intelligent Video Analytics shall be implemented on the proposed cameras. Different features of the video analytics shall include but not limited to:

- Intrusion detection,
- Unattended baggage detection,
- Crowd estimation and crowd management alarms,
- Counter flow detection overcrowding detection,
- Camera tampering alerts and
- Street lights

The Video Analytics functionality shall have mechanisms to continue alarm generation in case of failure of the Server. The Video Analytics shall not be bound to the MAC address of the device and hence any video analytics feature shall be possible to be deployed on any camera.

B. TRANSPORTATION SAFETY:

Intelligent Transportation System a cellular communication based system is recommended for implementation and integration of bus transport. Implementation of ITS is divided into the following categories:

- Global Positioning System (GPS).
- Passenger Information System (PIDS/PAS)
- Master Clock.
- CCTV inside fleets
- Automatic Fare Collection System.
- Central Operational Control Centre.

All the fleets proposed in this project will be provided with 'state of art' ITS equipment and navigation systems. Fleets will be capable of sending information to the Central operational Control Centre.

9.3.3.5 SOCIO-ECONOMIC ASPECTS:

- The project will have a positive effect due to improved transportation services and facilities.
- For the other Impacts like environment related or Social will be provided with appropriate solutions, so that the impacts of increased activity during the construction & operational period will be within acceptable limits on the locality.

9.4 ENERGY AND ENVIRONMENT MODELLING

Energy for the motorized transport

The energy for the motorized transport can be calculated based on the following equation for each fuel

Fuel Consumption = Vehicle Kilometers travelled (VKT) X Average Fuel Efficiency

The first step is to estimate the mix of vehicles in terms of the fuel usage. This mix for the base year is obtained from the previous studies. In this case of the future, the fuel mix of public transport vehicles operated by the NMC would be Diesel, Ethanol and Electric and the fuel mix of all remaining modes of transport shall remain the same.

TABLE 9-18: VEHICLE TYPE AND FUEL MIX

Vehicle Type	Base Year (2015)				Horizon Year (2028)			
	Petrol	Diesel	Gas	Electricity	Petrol	Diesel	Ethanol	Electricity
Cars	72%	28%			72%	28%		
2 Wheelers	100%				100%			
Auto Rickshaw	100%				100%			
Buses		100%				70%	10%	20%

The average fuel efficiencies for the different vehicle categories for the existing vehicles are as assumed:

TABLE 9-19: AVERAGE FUEL EFFICIENCY

	Petrol (km/lt)	Diesel (km/lt)	Ethanol (km/lt)	Electricity
Cars	0.13	0.1		
2 Wheelers	0.03			
Auto Rickshaw	0.06			
Buses		0.26	0.58	1

Co2 Emissions

Fuel use can be converted to Co2 emissions using default co-efficients for different fuels provided in Table 9-21.

TABLE 9-20: CO2 COEFFICIENTS FOR DIFFERENT FOSSIL FUELS

Fuel	Kg Co2/Litre of Fuel
Petrol	3.3
Diesel	3.2
Ethanol	0
Electricity	0

Based on the above assumptions, the savings in the Co2 emissions have been worked out based on the three methods.

1. Savings in the Co_2 emissions with the change in Fuel Type of NMC Buses within Nagpur City.
2. Savings in the Co_2 emissions with the shift from other modes of transport to NMC Services.

9.4.1 METHOD 1: SAVINGS IN CO2 EMISSIONS WITH THE CHANGE IN FUEL TYPE OF NMC BUSES WITHIN NAGPUR

The total no. of buses operated by NMC is anticipated to increase from 247 buses in the base year to 607 buses in the horizon year. Accordingly, Vehicle kilometers travelled (VKT), Fuel Consumption (Lts) and Co2 emissions (Kg Co2/Kg of fuel Consumed) has been worked out and represented in Table 9-21. From the table it could be observed that, with the change in the fuel, the fuel consumption reduces by 56% and Co2 emissions reduces by 58%. There is a saving of 93 grams of Co2 per passenger km travelled, with the introduction of Ethanol and Electric Buses along with the Diesel Buses.

TABLE 9-21: SAVINGS IN CO2 EMISSIONES WITH THE CHANGE IN THE FUEL TYPE OF NMC BUSES

	Base Year (2015)	Horizon Year (2028)	Savings
Passenger Km travelled	19,30,601	23,32,110	
Vehicle Km travelled	56,069	1,26,863	
Fuel Consumption (KL/year)	65,898	1,49,102	83,204 (Reduction by 56%)
Co2 emissions (Crores kg Co2/year)	21.09	33.40	12.31 (Reduction by 58%)
Co2 emissions (grams) per passenger km travelled	392.36	299.25	(93.11)

9.4.2 METHOD 2: SAVINGS IN CO^2 EMISSIONS WITH THE SHIFT FROM OTHER MODES OF TRANSPORT TO NMC SERVICES

It has been estimated through the travel demand models that with the introduction of metro and rationalization of public transport there be a shift from private modes of transport to public transport. This scenario estimates the savings in Co2 with the shift from private modes to public transport and introduction of Ethanol and Electric Buses along with the Diesel Buses for city bus transport in Nagpur. The assumptions for this scenario are the same as mentioned in Table 9-21. Table 9-22 represents the change in the modal share, passenger trips, average trip lengths and vehicle occupancy in both the scenarios with addition of buses to the system and without addition of buses to the system. From table it could be observed that there is shift of 8.80% from private modes to the public transport. Of the 8.80%, 3.90% shift from the private modes is towards Metro and remaining 4.90% shift is towards bus transport, which is between MSRTC services and Private Buses.

TABLE 9-22: MODE WISE MODAL SHARE & PASSENGER TRIPS

Modes	Scenario 1: Without the Addition of the Buses		Scenario 2: With the Addition of Buses		Difference
	Modal Share	Passenger Trips	Modal Share	Passenger Trips	
Car	9.00%	272802	8.50%	332762	-59960
2 Wheeler	48.00%	1454946	47.00%	1839980	-385034
Auto	10.00%	303114	9.50%	371911	-68797
PT – NMC Buses	8.00%	242491	7.60%	297529	-55038
Metro	_	0	2.40%	93956	93956
NMT (Walk & Cycle)	25%	757784	25%	978713	-220928

Currently, with the route rationalization, it is witnessed that NMC services are majorly operated along the major arterial and sub arterial roads, within the city and serving the major traffic generators such as Kamptee, Buti Bori, Mahindra & Mahindra, Piplafata, Pardi, Defence, Dattawadi, etc within the city. The entire project is designed in such a manner that the NMC and Metro services are complemented by each other. This means that the City Bus Services would continue to be used by the current passengers and would get more passengers from the other modes of transport. Hence, the current model anticipates that there would be shift from the other modes to PT modes i.e Buses and Metro.

However, it has been observed that the users of personalized modes of transport would have separate disposition towards different modes of public transport e.g. A vehicle owner user is less likely to shift to the bus transport as compared to the users who hire auto and taxis given the differences in walking and waiting time between the two and the similarities of the latter to the bus services. These pre-dispositions have been considered for allocating the shift from these modes in aggregate to the NMC Bus Services

TABLE 9-23: SHIFT IN PASSENGER TRIPS TO NMC BUS SERVICES

	Car	2 Wheeler	Auto	Total
Passenger Trips	14933	52266	13067	80266

From Table 9-24, it could be observed that the total of 80266 passenger trips would shift from other modes of transport to NMC services. Based on the passenger trips shifted from the other modes to NMC services, further analysis and estimates with respect to the savings in reduction in carbon emissions, whereas the monetary quantification of the Co2 emissions along with other pollutants, fuel costs, vehicle operating costs, accidents, travel time and employment generation, have been considered in economic analysis.

From Table 9-25,it could be observed that with the shift from private modes to public transport modes and addition of buses there would be a reduction in fuel consumption by 3.7%, whereas the Co_2 emissions would be reduced by 3.1%. There is a saving of 5.80 grams of Co2 emissions per passenger km travelled.

TABLE 9-24: SAVINGS IN CO2 EMISSIONS WITH THE SHIFT FROM OTHER MODES OF TRANSPORT TO NMC SERVICES

	Scenario 1: Without the addition of the Buses	Scenario 2: With addition of the Buses
Passenger Km travelled	**13456130**	**22092290**
Car	1874153	3294348
2 Wheeler	8002204	14535844
Auto	1373105	1971128
PT – NMC Buses	2206668	2290971
Vehicle Km travelled	**5441555**	**9653497**
Car	551221	968926
2 Wheeler	4445669	8075496
Auto	371110	532737
PT – NMC Buses	73556	76366

	Scenario 1: Without the addition of the Buses	Scenario 2: With addition of the Buses
Fuel Consumption (lts)	**2,43,996**	**437286**
Car	67029	1,17,821
2 Wheeler	133370	2,42,264
Auto	22267	31,964
PT – NMC Buses	21331	45236
Co2 emissions (Kg Co_2/year)	**12,55,104**	**9,56,534**
Car	219651	386098
2 Wheeler	440121	799471
Auto	73480	105482
PT – NMC Buses	69260	44475

Savings in Fuel Consumption	Total Savings in Fuel Consumption from the Private Vehicles (lts)	1,69,385
	Total Savings From the Fuel Consumption from the NMC Buses	23,905
	Net Savings in Fuel Consumption	**14.1%**
Savings in Co2 Emissions	Total Savings in Co2 Emissions from the Private Vehicles (Kg Co_2)	557799
	Total Savings in the Co_2 emissions from the MSRTC Buses (Kg Co_2)	23784
	Net Savings in Co_2 Emisssions (Kg Co_2)	**4.3%**
Co2 Emissions per Passenger Kms	Scenario 1: Without the addition of Buses (grams per passenger km)	60.45
	Scenario 2: With the addition of buses (grams per passenger kms)	59.56
	Net Savings in Co_2 emissions per passenger km travelled	**0.88 (1.49%)**

CHAPTER 10 PROJECT COST ESTIMATES

10.1. INTRODUCTION

The estimation of the capital investment is an important component of any proposed project as it provides vital inputs to the economic evaluation as well as financial modelling and analysis. The cost estimates have been prepared for each of the Module separately comprising of the following;

Cost estimates for Metro Feeder and City Bus Services comprises of the following;

1. Procurement of the Fleet for Metro Feeder Services and City Bus Services
2. Infrastructure Cost
    - A. Development & Upgradation of the Bus Q Shelters/Bus Stops –Metro Feeder Services and City Bus Services
    - B. Development & Upgradation of the Existing & Proposed Depots for Metro Feeder Services and City Bus Services
        - – Depot Civil Infrastructure Cost
        - – Depot Equipment Cost
    - C Development & Upgradation of the Existing & Proposed Terminals for Metro Feeder Services and City Bus Services
    - D. Cost of the ITS Infrastructure for Metro Feeder Services and City Bus Services.

Cost Estimates for the Non-Motorized Transport comprises of the following:

1. Road Hierarchy Wise Street Improvement Cost.
2. NMT Street Retrofitting Cost
3. Station Accessibility Improvements
4. Urban Place Making Schemes
5. Cost for Public Bike Sharing Schemes

This section comprises the brief for the cost estimates for all the above mentioned components

10.2. PROJECT INVESTMENT COST

10.2.1. COST OF FEEDER SERVICES

10.2.1.1. PROCUREMENT OF THE METRO FEEDER FLEET

The vehicle type recommended for the metro feeder system is a battery run Mini Van of 7 seater and a Mini Bus. Hence, the costing for the same has been considered for the estimated fleet size.

TABLE 10-1: FLEET ESTIMATION COST FOR THE FEEDER COMPONENTS

Sl. No.	Component Considered	No. of items	Item Cost (Rs.)-2017	Cost of the Components for year 2017 (Rs. Cr)
1	Mini Van (Electric)	151	12,50,000	18.87
2	Mini Bus (CNG)	42	25,00,000	10.5
	Total Fleet Procurement Cost (Rs. Cr)			**29.37**

10.2.1.2. INFRASTRUCTURE DEVELOPMENT COST

The infrastructure required for the Metro Feeder Services would include the various components such as Bus Q Shelters, ITS components etc. The summarized cost is represented in the table below;

TABLE 10-2: INFRASTRUCTURE DEVELOPMENT COST FOR FEEDER COMPONENTS

Sl. No.	Component Considered	No. of Items	Item Cost (Rs.) 2017	Cost of the Components for Year 2017 (Rs. Cr)
1	Bus Queue Shelters (New)	111	1,50,000	2.2
2	Bus Request Stops	197	1,00,000	1.97
3	Electric Vehicle Charging Points	100	3,00,000	3.0
4	Parking Lots and Other Infrastructure	5	50,00,000	2.5
5	ITS Setup including Ticketing Devices	-	-	2.0
	Total Cost (Rs. Cr)			**11.67**

Total project cost for the Metro Feeder Services for Nagpur works out to be Rs 41.01 Crores.

TABLE 10-3: TOTAL COST OF FEEDER BUS SERVICE

Sl. No.	Component Considered	Cost of the Components for Year 2017 (Rs. Cr)
1	Procurement Cost of Fleet	29.37
2	Bus Request Stops	11.67
	Total Cost (Rs. Cr)	**41.01**

10.2.2. COST OF CITY BUS SERVICES

10.2.2.1. COST OF PROCUREMENT OF FLEET FOR CITY BUS SERVICES

The choice of type of vehicles is crucial and is based on the type of service that needs to be provided to the commuters. As in the current case, mentioned in the additional fleet for the City Bus Services would be procured by NMC.

Based on the assessment in the previous chapters, Standard AC/Non AC 650 mm – Diesel, Midi AC/Non AC 650 mm – Diesel, Standard Ethanol Buses and Standard Electric Bus have been recommended for the successful operations of the City Bus Services. These buses shall be equipped with the ITS such as GPS, PIS etc. This effectively increases the service quality of the public transport ride. The life span of the vehicles is considered to be12 years or 10,00,000 kms.

Table 10-4 represents the total cost of procurement of additional fleet along with the spare vehicles[1] requirement. Additionally 174 Buses needs to be procured for Nagpur Metro, which are basically Standard AC/Non AC 650 mm – Diesel, Midi AC/Non AC 650 mm – Diesel Buses and Standard Electric Buses. The total cost of the procurement of the additional fleet works out to be Rs 150 Crores.

TABLE 10-4: COST OF THE PROCUREMENT OF ADDITIONAL FLEET FOR CITY BUS SERVICES IN NAGPUR CITY

Sl. No.	Type of Vehicle	Total	Cost per Vehicle (Rs.)	Total Cost (Rs in Crores)
1	Standard AC/Non AC650 mm – Diesel	75	₹ 62,50,000.00	47.00
2	Midi AC/Non AC 650 mm –Diesel	1	₹45,00,000.00	0.45
3	Standard Electric	89	₹1,15,00,000.00	103.00

[1]Spare Vehicles - 5% of the total no. of buses required.

Sl. No.	Type of Vehicle	Total	Cost per Vehicle (Rs.)	Total Cost (Rs in Crores)
	Total	174		150.00

10.2.2.2. COST OF SUPPORT INFRASTRUCTURE

A. BUS STOPS/Q SHELTERS

The cost of development of Bus Q Shelter for the City Bus Services works out to be Rs 45.30 Crores

TABLE 10-5: INDICATIVE COST OF THE DEVELOPMENT OF BUS Q SHELTER IN NAGPUR

S no.	Description	No. of Bus Q Shelters	Item Cost (Rs.)	Total Cost (Rs in Crores)
1	No. of Bus Q Shelters 10X3 m	710	₹6,38,000	₹45.30
Total Cost of the Development of Bus Q Shelters				**₹45.30**

B. COST OF DEVELOPMENT/UPGRADATION OF THE DEPOT

Depot Civil Infrastructure

It has been worked out that, for the upgradation of the civil infrastructure at the existing depots will cost around Rs 18.25 Crores, whereas for the civil infrastructure development of the new depots will cost around Rs 48.16 Crores, accounting for a total cost of **Rs 66.41 Crores**. However, the location wise preliminary cost estimates are attached in the Annexure. The detailed costing will be conducted at the DPR stage after the preparation of the BOQ's for the identified sites.

Depot Equipment Cost

It has been worked out that, for the total depot equipment cost is Rs 33.60 Crore.

10.2.2.3. COST OF DEVELOPMENT/UPGRADATION OF BUS TERMINAL

The cost of development /up gradation of the Bus Terminals work out to be Rs. 195 Crores.[2]

TABLE 10-6: COST OF DEVELOPMENT/UPGRADATION OF BUS TERMINAL

Sl. No.	Item	Item Cost (Rs in Crore)	No. of Items	Total Cost (Rs in Crore)
1	Mobility Hub @ More Bhawan	100	1	100
2	11 Bus Terminal	8.6	11	95
	Total Cost (D)		**12**	**195**

10.2.2.4. COST OF INTELLIGENT TRANSPORT SYSTEMS

The detailed ITS cost is presented in Table 10-7. The main component comprises software, Hardware, server cost, Communication Cost, Control Room etc which work out to be Rs 6.25 Crore.

[2]The detailed costing will be conducted at the stage of DPR after the preparation of BOQ's for the all the identified sites.

TABLE 10-7: COST OF ITS INFRASTRUCTURE

Sr. No	Description	Unit Cost(Rs.)	Qty.	Total (Rs.)
1	Servers , Software License and Network costs :			
1.1	Firewall	1,75,000	1	1,75,000
1.2	Web Server	3,00,000	2	6,00,000
1.3	Database Server	6,00,000	2	12,00,000
1.4	Application Sever	3,50,000	2	7,00,000
1.5	Directory Server	3,00,000	1	3,00,000
1.6	Reporting Server	2,00,000	1	2,00,000
1.8	GIS Server	3,50,000	1	3,50,000
1.9	SAN Array 2 Tb	6,50,000	1	6,50,000
1.1	Storage Manager	3,85,000	2	7,70,000
1.11	System Software licenses			12,00,000
1.12	Network components with Installation			4,70,000
1.13	Video Wall - 75"' single LED	5,00,000	1	5,00,000
			Total	**71,15,000**
2	Application Software for ITS			
2.1	Electronic Fare Collection Software	20,00,000	1	20,00,000
2.2	Automated Vehicle Locating Software	30,00,000	1	30,00,000
2.3	Financial Management System	10,00,000	1	10,00,000
2.4	Depot Management System	15,00,000	1	15,00,000
2.5	Passenger Information System Management System	20,00,000	1	20,00,000
2.6	Vehicle Scheduling & Dispatch System	15,00,000	1	15,00,000
2.7	Web Portal Upgradation	12,00,000	1	12,00,000
2.8	Incident Management System	10,00,000	1	10,00,000
2.9	Enterprise Management System and Business Intelligence Software	25,00,000	1	25,00,000
2.1	MapXtreme	8,00,000	1	8,00,000
			Total	**1,65,00,000**
3	IT operations Hardware - Data Centre			
3.1	Workstations/Computers with Split monitor	70,000	3	2,10,000
3.2	Multifunction Printer	15,000	2	30,000
3.3	UPS (servers and computers)	5,00,000	1	5,00,000
3.4	Generator	9,00,000	1	9,00,000
3.5	Access Control	30,000	1	30,000
			Total	16,70,000
4	IT operations Hardware - City Control Centre			
4.1	Workstations/Computers	55,000	10	5,50,000
4.2	Multifunction Printer	15,000	1	15,000
4.3	UPS (servers and computers)	1,50,000	1	1,50,000
4.4	Generator	2,00,000	1	2,00,000
4.5	Network components (Racks, Switches, Routers, Patch cables)	1,50,000	1	1,50,000
4.6	Access Control	30,000	1	30,000
4.7	Video Wall - 75"' single LED	5,00,000	1	5,00,000

Sr. No	Description	Unit Cost(Rs.)	Qty.	Total (Rs.)
4.8	Application Software for ITS	50,000	10	5,00,000
			Total	**20,95,000**
5	IT operations Hardware - Depot / Terminals			
5.1	Workstations/Computers	55,000	15	8,25,000
5.2	Multifunction Printer	15,000	1	15,000
5.3	UPS (servers and computers)	75,000	1	75,000
5.4	Storage	50,000	1	50,000
5.5	Network components (6 U Racks, Switches, Routers, Patch cables)	1,00,000	1	1,00,000
5.6	Application Software for ITS	50,000	3	1,50,000
			Total	**12,15,000**
Bus terminal PIS Unit with 1 display unit at each Terminal				
6	Bus Terminal Display Unit	3,50,000	15	52,50,000
			Total	**52,50,000**
Hand held Devices				
7	Electronic Ticket Vending Machines (ETVM's) @ 2 units per vehicle	25000	575	2,87,50,000
			Total	**2,87,50,000**
			Grand Total	**6,25,95,000**

10.2.2.5. TOTAL PROJECT COST FOR CITY BUS SERVICE

The total project cost including the cost of vehicle procurement for City Bus Services, Bus Q Shelter, depot infrastructure, terminal development and ITS facilities is estimated Rs. 496.55 Crores. Table 10-8 represents the project component wise breakup of the cost.

TABLE 10-8: TOTAL PROJECT COST

Sl. No.	Project Components	Rs in Crores
1	Procurement of Fleet	₹ 150.00
2	**Support Infrastructure**	**₹346.55**
2a	Bus Q Shelters	₹45.30
2b	Depot Development/Upgradation	₹100.00
2c	Bus Terminal Development (PPP) & Bus Terminal Upgradation	₹195.00
3	**ITS Infrastructure**	**₹6.25**
Total Project Cost		**₹ 496.55**

10.2.3. COST OF NON MOTORIZED TRANSPORT PLAN

This section contains the Block Cost Estimates for all NMT Improvement, the overall project costs, financing options and revenue generation strategies.

10.2.3.1. TYPICAL UNIT COSTS

Typical Block Unit costs of various road components are in **TABLE 10-9**.

TABLE 10-9: UNIT COSTS OF ROAD COMPONENTS

Road Components	Unit	Unit Cost
Vehicular Carriage (Top)	Cum	₹ 18,000
Vehicular Carriage (Sub base)	Cum	₹ 22,000
Footpath (Excluding MUZ) (Top)	Sqm	₹ 1,400
Footpath (Sub base)	Sqm	₹ 3,400
Cycle Track (Cold applied paint)	Sqm	₹ 1,600
Lane Marking (Paint)	Sqm	₹ 625
Kerb Stone	Cum	₹ 4,300
Construction of Storm Water Drain in RCC with drain covers	M	₹ 9,000
Pipes for electrical and LT	M	₹ 450
Pedestrian Street Lights	Nos	₹ 44,000
Car Street Lights	Nos	₹ 57,000
Integrated Car and Pedestrian street light	Nos	₹ 74,600
Garbage Bins (Fixed to every 10th Street light)	Nos	₹ 5,500
Drinking Water ATMs	Nos	₹ 2,25,000
Traffic Signal with pelican signals (Per junction)	Nos	₹ 26,00,000
Concrete Bollards	Nos	₹ 2,375
Retractable Bollards	Nos	₹ 3,500
Potted Plants	Nos	₹ 200
Vending Kiosks	Nos	₹ 80,000
Cat Eyes (edge of carriageway)	Nos	₹ 750
Man hole for SWD	Nos	₹ 15,000
Man hole for other utilities	Nos	₹ 14,000
Man Hole Cover	Nos	₹ 4,500
Tree Grits	Nos	₹ 600
Public Toilet	Nos	₹ 6,52,650
Outdoor Benches (Steel)	Nos	₹ 13,800
Traffic signages 3mm aluminium composite sheet -custom size:		
60 cm equilateral triangle	Nos	₹ 3,500
60 cm circular	Nos	₹ 4,500
60 x 45 cm rectangular	Nos	₹ 4,500
Advertisement Hoarding		
4ft x 6ft (for pedestrians)	Nos	₹ 36,000
12ft x 20 ft (for Cars)	Nos	₹ 12,00,000
Landscaping		
Site Preparation (Only Parks)	SqM	₹ 25
Manure and Sweet Earth (Only Parks) (Lump Sum)	SqM	₹ 70
Tree Planting (Including digging holes)	Nos	₹ 750
Shrubs and Ground Cover (Including digging holes)	SqM	₹ 650
Site Preparation, Manure and Sweet Earth for Landscaping	Sqm	₹ 150
Potted Plants	Nos	₹ 200

10.2.3.2. ROAD HIERARCHY WISE STREET IMPROVEMENT COST

The typical road hierarchy wise costs as per typical street designs placed earlier in this report are provided in TABLE 10-10.

TABLE 10-10 : TYPICAL ROAD HIERARCHY WISE COSTS (PER KM BASIS)

Sl. No.	Road Row (m)	Component Category	Cost (In Rs. Cr)
1a	45	Retrofitting the street to incorporate NMT Infrastructure	₹ 4.24
1b		Street Light	₹ 2.41
1f		Advertisement hoardings	₹ 0.59
		TOTAL	**₹ 7.23**
2a	36	Retrofitting the street to incorporate NMT Infrastructure	₹ 2.14
2b		Street Light	₹ 2.41
2f		Advertisement hoardings	₹ 0.55
		TOTAL	**₹ 5.10**
3a	30	Retrofitting the street to incorporate NMT Infrastructure	₹ 2.20
3b		Street Light	₹ 2.41
3f		Advertisement hoardings	₹ 0.55
		TOTAL	**₹ 5.16**
4a	24	Retrofitting the street to incorporate NMT Infrastructure	₹ 1.46
4b		Street Light	₹ 1.97
4f		Advertisement hoardings	₹ 0.55
		TOTAL	**₹ 3.98**
5a	18	Retrofitting the street to incorporate NMT Infrastructure	₹ 1.30
5b		Street Light	₹ 1.74
5f		Advertisement hoardings	₹ 0.55
		TOTAL	**₹ 3.58**
6a	12	Retrofitting the street to incorporate NMT Infrastructure	₹ 0.81
6b		Street Light	₹ 1.55
6f		Advertisement hoardings	₹ 0.04
		TOTAL	**₹ 2.40**
Less than 6		**Lump Sum Improvement Cost**	**₹ 0.80**

10.2.3.3. NMT STREET RETROFITTING COSTS

Street identified in the NMT Master Plan are categorized in three types i.e. Primary (taken in phase-1) secondary (taken in phase-2) and tertiary (taken in phase-3). Block costs Improvement of roads for incorporating NMT components are shown mentioned in the TABLE 10-11.

TABLE 10-11 : PHASE-I- ROAD IMPROVEMENT COSTS

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
I	Primary	NS alignment	₹ 77.6
I	Primary	EW Alignment	₹ 62.7
Total value of works to be done by Maha Metro			**₹ 140.3**
I	Primary	Rambagh road, Ajni road	₹ 13.4
I	Primary	Nara road	₹ 7.7

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
I	Primary	Ring road, Kanji house road, Mahdi bagh road, Itwari station road, Cradak road, Dr Ambedkar road	₹ 34.8
I	Primary	Bus stop road, great Nag road	₹ 6.4
I	Primary	FCI Godown road	₹ 7.4
I	Primary	Unnamed Road-1	₹ 1.3
I	Primary	Central bazar road Ambazari road	₹ 20.4
I	Primary	Chandrapur Nagpur road Sitaburdi	₹ 8.6
I	Primary	Dongarnath Nagpur road	₹ 4.5
I	Primary	Masurkar marg Bhandara road	₹ 5.8
I	Primary	Gangabai ghat road Inox road	₹ 6.4
I	Primary	Bhandara Road	₹ 10.0
I	Primary	Kalamna Road	₹ 2.8
I	Primary	Bhandara road Masurkar road	₹ 6.1
I	Primary	Queta colony road	₹ 2.4
I	Primary	Gangabai ghat road Dighorikar chowk	₹ 4.3
I	Primary	Bus stop road	₹ 1.9
I	Primary	Gangabai ghat road Dighorikar chowk	₹ 1.4
I	Primary	Sir Bejonji mehta road, Panchpaoli road	₹ 11.8
I	Primary	Hansapuri road, ganjakhet road	₹ 5.2
I	Primary	Kidwai road	₹ 10.2
I	Primary	Palm road, red cross road	₹ 6.3
I	Primary	Mangalwari bazar road	₹ 2.9
I	Primary	Katol road, chindwara road, Mecosabagh road	₹ 14.1
I	Primary	Panchasheel nagar main road, Itwari station road	₹ 11.6
I	Primary	Ring road sharoada chowk	₹ 4.4
I	Primary	nagpur Gramin RTO Road, Tathagat chowk	₹ 5.9
I	Primary	Ambazari hingna Road	₹ 32.4
I	Primary	Unnamed Road-2	₹ 6.9
I	Primary	Umred road, subhash nagar road	₹ 4.5
I	Primary	Unnamed Road-3	₹ 3.1
Total value of works to be done by NMC=			**₹ 265.1**

TABLE 10-12 : PHASE-II- ROAD IMPROVEMENT COSTS

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
II	Secondary	Unnamed Road-2	₹ 1.5
II	Secondary	Unnamed Road-3	₹ 0.4
II	Secondary	Mangaldeep colony	₹ 2.2
II	Secondary	Unnamed Road-4	₹ 1.3
II	Secondary	Proposed Road	₹ 3.0
II	Secondary	Unnamed Road-5	₹ 2.1
II	Secondary	Unnamed Road-6	₹ 0.9
II	Secondary	Unnamed Road-7	₹ 1.0
II	Secondary	Unnamed Road-8	₹ 1.4

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
II	Secondary	Stretch identified as Urban Place Making Scheme - Eco Mobility Corridor	₹ 7.1
II	Secondary	Unnamed Road-9	₹ 0.6
II	Secondary	Kapil nagar	₹ 1.5
II	Secondary	Kapil nagar	₹ 1.0
II	Secondary	Kanji house road	₹ 1.8
II	Secondary	Teka naka kamptee road	₹ 1.7
II	Secondary	Kingsway road, Dongargarh nagpur road	₹ 3.5
II	Secondary	Unnamed Road-10	₹ 1.9
II	Secondary	Unnamed Road-11	₹ 0.8
II	Secondary	Unnamed Road-12	₹ 3.5
II	Secondary	Middle ring road	₹ 1.1
II	Secondary	Unnamed Road-13	₹ 1.0
II	Secondary	Unnamed Road-14	₹ 4.4
II	Secondary	Unnamed Road-15	₹ 5.6
II	Secondary	Unnamed Road-16	₹ 1.4
II	Secondary	Unnamed Road-17	₹ 4.0
II	Secondary	Nildoh	₹ 9.0
II	Secondary	Nildoh	₹ 1.0
II	Secondary	Unnamed Road-18	₹ 4.0
II	Secondary	Unnamed Road-19	₹ 0.6
II	Secondary	Unnamed Road-20	₹ 16.6
II	Secondary	Unnamed Road-21	₹ 17.2
II	Secondary	Unnamed Road-22	₹ 2.4
II	Secondary	Unnamed Road-23	₹ 15.8
II	Secondary	Unnamed Road-24	₹ 4.7
II	Secondary	Unnamed Road-25	₹ 3.1
II	Secondary	Unnamed Road-26	₹ 3.7
II	Secondary	Unnamed Road-27	₹ 9.3
II	Secondary	Unnamed Road-28	₹ 5.6
II	Secondary	Unnamed Road-29	₹ 3.0
II	Secondary	Unnamed Road-30	₹ 1.4
II	Secondary	Unnamed Road-31	₹ 6.4
II	Secondary	Unnamed Road-32	₹ 0.6
II	Secondary	Unnamed Road-33	₹ 2.9
II	Secondary	Unnamed Road-34	₹ 1.4
II	Secondary	padole nagar	₹ 0.5
II	Secondary	Road near eastern sports club	₹ 0.8
II	Secondary	Nari road	₹ 2.3
II	Secondary	Char khamba road	₹ 0.4
II	Secondary	Knaji house road	₹ 1.1
II	Secondary	Commercial road	₹ 2.6
II	Secondary	Road near central museum Nagpur	₹ 1.4
II	Secondary	Ashok chowk, Gurudwara	₹ 1.6
II	Secondary	Kamal chowk, Dus number puliya chowk, Awale babu chowk	₹ 3.6

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
II	Secondary	Unnamed Road-35	₹ 1.2
II	Secondary	Unnamed Road-36	₹ 0.4
II	Secondary	Unnamed Road-37	₹ 1.4
II	Secondary	Unnamed Road-38	₹ 1.0
II	Secondary	Mount road	₹ 0.7
II	Secondary	New Colony	₹ 1.6
II	Secondary	New Colony	₹ 0.7
II	Secondary	Link road	₹ 0.9
II	Secondary	Road near VCA	₹ 1.7
II	Secondary	MAK Azad road	₹ 2.0
II	Secondary	Red Cross road, napur aurangabad highway	₹ 7.9
II	Secondary	Road near Maharaj bagh road	₹ 2.7
II	Secondary	W High ct road	₹ 2.6
II	Secondary	VIP Road	₹ 3.8
II	Secondary	Temple Road	₹ 2.9
II	Secondary	Amravati road	₹ 18.1
II	Secondary	Ambazari bypass road	₹ 9.8
II	Secondary	Hill Road	₹ 7.0
II	Secondary	Unnamed Road-39	₹ 2.1
II	Secondary	Abhyankar Marg	₹ 1.2
II	Secondary	W High ct road	₹ 5.0
II	Secondary	Nagpur road Bicchua road, Main road	₹ 6.5
II	Secondary	Balraj marg	₹ 1.4
II	Secondary	Subhash road	₹ 5.4
II	Secondary	Abhyankar marg	₹ 3.8
II	Secondary	Police station road	₹ 1.6
II	Secondary	Unnamed Road-40	₹ 1.6
II	Secondary	E High ct road	₹ 2.3
II	Secondary	Ambazari road,Abhyankar nagar road	₹ 4.6
II	Secondary	S Ambazari road	₹ 7.3
II	Secondary	Canal road	₹ 2.7
II	Secondary	Unnamed Road-41	₹ 2.0
II	Secondary	W High ct road	₹ 1.9
II	Secondary	Unnamed Road-42	₹ 3.5
II	Secondary	Shanivar bazar road, Ring road	₹ 6.9
II	Secondary	W High ct road, Khamla road	₹ 10.5
II	Secondary	Unnamed Road-43	₹ 2.1
II	Secondary	RPTS Road	₹ 3.2
II	Secondary	Unnamed Road-44	₹ 1.7
II	Secondary	Unnamed Road-45	₹ 2.8
II	Secondary	Umred road, subhash nagar road	₹ 7.9
II	Secondary	New Itwari road	₹ 1.2
II	Secondary	Mata mandir main road	₹ 6.5
II	Secondary	Jaitala road	₹ 5.4
II	Secondary	Mohammad Ali road	₹ 1.0
II	Secondary	Jagannath road	₹ 1.3

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
II	Secondary	Guru Teg bahadur road	₹ 1.7
II	Secondary	Post office road, Jm Thakkar marg	₹ 3.3
II	Secondary	Unnamed Road-46	₹ 0.5
II	Secondary	Armori nagpur highway, killa road	₹ 2.7
II	Secondary	Unnamed Road-47	₹ 1.3
II	Secondary	walker road	₹ 3.2
II	Secondary	Old mangalwari road	₹ 2.5
II	Secondary	Old Bagdganj road	₹ 1.5
II	Secondary	Unnamed Road-48	₹ 1.0
II	Secondary	Navabpura road	₹ 1.3
II	Secondary	Unnamed Road-49	₹ 0.5
II	Secondary	Unnamed Road-50	₹ 1.7
II	Secondary	Unnamed Road-51	₹ 0.7
II	Secondary	Unnamed Road-52	₹ 1.1
II	Secondary	Unnamed Road-53	₹ 0.9
II	Secondary	Inox road	₹ 3.3
II	Secondary	Unnamed Road-54	₹ 0.8
II	Secondary	Unnamed Road-55	₹ 1.7
II	Secondary	Unnamed Road-56	₹ 1.1
II	Secondary	Unnamed Road-57	₹ 1.0
II	Secondary	Unnamed Road-58	₹ 0.9
II	Secondary	Lakadganj road	₹ 1.1
II	Secondary	road between sudarshan chown and dr ambedkar square	₹ 1.6
II	Secondary	Transport nagar warehouse chowk	₹ 2.3
II	Secondary	road near shreyash lawns	₹ 0.9
II	Secondary	East wardhaman nagar	₹ 0.8
II	Secondary	Shivaji chowk, vaishnow devi square	₹ 2.3
II	Secondary	Unnamed Road-59	₹ 1.1
II	Secondary	Unnamed Road-60	₹ 1.1
II	Secondary	Unnamed Road-61	₹ 2.8
II	Secondary	Jaitala road	₹ 4.6
Total value of works to be done by NMC=			**₹ 406.0**

TABLE 10-13 : PHASE-II- ROAD IMPROVEMENT COSTS

Phase of Implementation	Category of Road	Road Name	Cost for NMT Works (In Rs. Cr)
III	Tertiary Roads	Hierarchy 1	₹ 136.8
III	Tertiary Roads	Hierarchy 2	₹ 109.7
III	Tertiary Roads	Hierarchy 3	₹ 152.4
III	Tertiary Roads	Hierarchy 4	₹ 243.8
Total value of works to be done by NMC=			**₹ 642.7**

10.2.3.4. BLOCK COSTS FOR STATION ACCESSIBILITY IMPROVEMENTS

The costs of foot over bridges and subways for station area accessibility improvement are provided in this section. These costs are based on station area studies and proposals (see appendix A) coupled with industry experience. Refer TABLE 10-14.

TABLE 10-14 : BLOCK COSTS FOR STATION ACCESSIBILITY IMPROVEMENTS

Station name	Proposed Connectivity improvements	Total Costs (In Rs. Cr)
	Reach 1	
Airport	NMT only subway	₹ 2.40
Ujwal Nagar	NMT only FOB crossing	₹ 2.00
Congress Nagar	NMT connectivity on Proposed road(due to the change in the alignment)	--
	Reach 2	
Zero Mile	Additional FOB Required	₹ 2.50
	Reach 3	
Dharampeth College/ Ambazari lake view	-Direct entry/ exit from metro station to Ambazari Lake Proposed	₹ 1.50
Subhash Nagar	Road widening of narrow lane between Shastri Nagar Layout and the vacant land towards south west of the proposed station	₹ 9.90
	Total =	**₹ 18.30**

10.2.3.5. BLOCK COSTS FOR URBAN PLACE MAKING SCHEMES

Project wise cost for Urban Place Making schemes are shown in ***TABLE 10-15***

TABLE 10-15 : BLOCK COST ESTIMATES FOR URBAN PLACE MAKING SCHEMES

Public Space	Broad Proposals	Component	Cost of Component	Grand Total
PA-1- Public space in front of South Airport Station	1. Proposed NMT subway under Railway line with at-grade NMT walkway through railway land.	NMT Subway	₹ 2.40 Cr	₹ 4.88 Cr
	2. Creation of public space for open air exhibitions with landscaping to create safe and active space around the at-grade NMT walkway.	Landscaping of the public Space	₹ 2.48 Cr	
PA-2- Sitabuldi pedestrianisation	1. Traffic Diversion from Munjhe Chowk to other roads	Cost of Street Scaping has been considered in the cost for NMT based improvements for the area	Additional Funds not required	₹ 10.35 Cr
	2. Pedestrianization of four arms of Munjhe Chowk			
	3. Streetscaping/ landscaping of pedestrianised area	Streetscaping/ landscaping of pedestrianised area	₹ 10.35 Cr	
PA-3a- Ecomobility corridors near	1. Proposal of ecomobility corridor along existing canal between Dharampeth Society and Airport land	Cost of Road Side Landscaping	₹ 6.15 Cr	₹ 45.47 Cr

Public Space	Broad Proposals	Component	Cost of Component	Grand Total
Jaiprakash Nagar station	2. Canal front design and improvement. 3. Provisions of footpaths, cycle tracks and recreation areas.	Cost of Street Scaping (As per typical Street Design	₹ 39.32 Cr	
PA-3b- Eco-mobility corridors near Ujwal Nagar station	1. Proposal of ecomobility corridor along linear patch of Railway land stretching from Jaiprakash Nagar to Racha Ring road station	Landscaping of Canal Edge	₹ 1.48 Cr	₹ 5.44 Cr
	2. Design and retrofitting of street edges with dedicated footpaths and cycle tracks. 3. Ensuring connectivity between the two sides of the land parcel.	Cost of Street scaping	₹ 3.96 Cr	
PA-4- Ambazari Lakefront	1. Ambazari Lake front development 2. Creation of walking and cycling trails around Ambazari Lake	Landscaping of Lake Front	₹ 22.14 Cr	₹ 51.98 Cr
	3. Upgrading recreation spaces around Ambazari 4. Direct connectivity with metro station	Cost of Street Furniture, lighting etc.	₹ 29.84 Cr	
PA-5- Kasturchand Park place making	1. Kasturchand park edges to be redesigned to create wider spaces for walking and bicycling. 2. The park edge to be made more porous	Cost of Street scaping has been considered in the cost for NMT based improvements for the area	No Additional Funds required. Cost covered in the street improvement works	

10.2.3.6. COST OF PUBLIC BIKE SHARING SCHEME

Cost estimates have been prepared for the project comprising of the following components;

1. Bicycles
2. Docking Points/Docks
3. Docking Stations
4. Terminals @ Docking Stations
5. Installation Cost
6. Maintenance Depot
7. Redistribution Vehicles
8. Control Center & ITS
9. Marketing Cost

To establish the tentative costs of the proposed PBs scheme in Nagpur, a detailed study on the similar systems operational in other cities of the country had been studied. The following scheme were studied and analysed;

1. Delhi cycles (Operational)
2. Planet green bikes – Delhi (Operational)
3. Cycle Chalao- Mumbai (Closed)
4. Fre'mo- Delhi (Operational)
5. Namma Cycles- Chennai (Operational)
6. Atcag- Bangalore (Operational)

In addition to the schemes mentioned, Public Bicycle Sharing Systems – a planning toolkit for the Indian cities – December 2012 and Public Bike Sharing Guidance Document – May 2016 have been referred to establish the costs of the individual components of the PBS scheme for Nagpur. The proposed estimates for Nagpur shall have a 10% margin of error.

A. ASSUMPTIONS FOR CAPITAL COST ESTIMATION

Table 10.16 represents the assumptions with regard to the Capital Costs of the various components of the PBS.

TABLE 10-16: CAPITAL COST ASSUMPTIONS

Item/Component	Unit Rate (₹)	Units
Bicycles – High Quality	35,000	Per Unit
Bicycles – Non Gear	9,000	Per Unit
Bicycle- Gear	12,000	Per Unit
Docks/Docking Point	30,000	Per Unit
Docking Stations – Small	1,25,000	Per Unit
Docking Station - Medium	2,50,000	Per Unit
Docking Station - Large	3,75,000	Per Unit
Terminals @ Docking Stations	1,50,000	Per Unit
Installation Cost	Installation Cost is considered as part of the cost of the Docking Stations @ 25% of the Cost of Docking Station	
Maintenance Depot	Area Requirement – 700 Sqmts (i.e 7532 Sqft) per Depot for 1000 bicycles Cost – ₹ 3500/- per Sqft	
Redistribution Vehicles	7,00,000	Per Unit
Control Center	20,00,000	Per Unit – One time construction /installation cost
Software (Front End and Back End)	60,00,000	One Time Investment

Based on the Cost assumptions mentioned in the Table 10-16, the total project cost including all the components works out to be approximately Rs 39.96 Crores (₹ 20.59 Crores in Phase 1 and ₹ 19.37 Crores in Phase 2) are mentioned in Table 10-17.

TABLE 10-17: TOTAL COST OF PUBLIC BIKE SHARING – OPTION 1 – FULLY AUTOMATED

SN	Components	Phase 1	Phase 2	Total
1a	Bicycle - Non Gear Cycles	₹ 1,89,54,000.00	₹ 1,94,67,000.00	₹ 3,84,21,000.00
1b	Bicycle - Gear Cycles	₹ 4,68,000.00	₹ 2,64,000.00	₹ 7,32,000.00
1	**BICYCLES**	**₹ 1,94,22,000.00**	**₹ 1,97,31,000.00**	**₹ 3,91,53,000.00**
2	**PARKING BAYS**	**₹ 9,75,00,000.00**	**₹ 9,87,00,000.00**	**₹ 19,62,00,000.00**
3a	Docking Stations - Small	₹ 28,75,000.00	₹ 12,50,000.00	₹ 41,25,000.00
3b	Docking Stations - Medium	₹ 95,00,000.00	₹ 17,50,000.00	₹ 1,12,50,000.00
3c	Docking Stations - Large	₹ 1,42,50,000.00	₹ 1,12,50,000.00	₹ 2,55,00,000.00
3	**PARKING STATIONS**	**₹ 2,66,25,000.00**	**₹ 1,42,50,000.00**	**₹ 4,08,75,000.00**
4	**TERMINALS @ Docking Stations**	**₹ 39,00,000.00**	**₹ 15,00,000.00**	**₹ 54,00,000.00**
5	**MAINTENANCE DEPOT**	**₹ 0.00**	**₹ 0.00**	**₹ 0.00**
6	**REDISTRIBUTION VEHICLES**	**₹ 28,00,000.00**	**₹ 28,00,000.00**	**₹ 56,00,000.00**
7	**CONTROL CENTER & ITS**	**₹ 0.00**	**₹ 0.00**	**₹ 0.00**
8	**MARKETING COST**	**₹ 0.00**	**₹ 0.00**	**₹ 0.00**
9	**TOTAL COST (1+2+3+7)**	**₹ 15,02,47,000.00**	**₹ 13,69,81,000.00**	**₹ 28,72,28,000.00**
	Per Cycle Cost	**₹70,045**	**₹63927**	**₹66334**

Based on the Table 10-17, the average cost per bicycle works out to be Rs 70,045 in Phase1 and Rs 63,927 in Phase 2. If the Bicycles the normal Gear and Non-Gear bicycles are considered instead of High Quality Bicycles the total Project cost in Phase-1 will be Rs. 15.02 Crores and in Phase-2 will be Rs.13.69 Crores. Hence, the total project cost for the implementation of Public Bike Sharing Scheme in Nagpur works out to be Rs 28.72 Crores.

Based on the discussions with NMC and Maha Metro, wherein dockless facilities have been recommended for PBS in Nagpur. Considering which an alternate option has been recommended which is represented in Table 10-18. The average cost of the bicycle works out to be Rs 13,129 in Phase 1 and Rs 13,063 in Phase 2. The total project cost in Phase 1 works out to be Rs 2.81 Crores and Phase 2 works out to be Rs 2.85 Crores. Hence, the total project cost for the implementation of Public Bike Sharing Scheme in Nagpur works out to be Rs 5.67 Crores. The cost and implementation of the PBS system in Nagpur shall be undertaken by Nagpur Municipal Corporation.

TABLE 10-18: TOTAL COST OF PUBLIC BIKE SHARING – OPTION 2 – PARTIALLY AUTOMATED

SN	Components	Phase 1	Phase 2	Total
1a	Bicycle - Non Gear Cycles	₹ 2,10,60,000.00	₹ 2,16,30,000.00	₹ 4,26,90,000.00
1b	Bicycle - Gear Cycles	₹ 3,90,000.00	₹ 2,20,000.00	₹ 6,10,000.00
1	**BICYCLES**	**₹ 2,14,50,000.00**	**₹ 2,18,50,000.00**	**₹ 4,33,00,000.00**
2	**PARKING BAYS**	**₹ 65,00,000.00**	**₹ 65,80,000.00**	**₹ 1,30,80,000.00**
3a	Docking Stations - Small	₹ 23,000.00	₹ 10,000.00	₹ 33,000.00
3b	Docking Stations - Medium	₹ 76,000.00	₹ 14,000.00	₹ 90,000.00
3c	Docking Stations - Large	₹ 1,14,000.00	₹ 90,000.00	₹ 2,04,000.00
3	**PARKING STATIONS**	**₹ 2,13,000.00**	**₹ 1,14,000.00**	**₹ 3,27,000.00**
4	**TERMINALS @ Docking Stations**	₹ 0.00	₹ 0.00	₹ 0.00
5	**MAINTENANCE DEPOT**	₹ 0.00	₹ 0.00	₹ 0.00
6	**REDISTRIBUTION VEHICLES**	₹ 0.00	₹ 0.00	₹ 0.00
7	**CONTROL CENTER & ITS**	₹ 0.00	₹ 0.00	₹ 0.00
8	**MARKETING COST**	₹ 0.00	₹ 0.00	₹ 0.00
9	**TOTAL COST (1+2+3+7)**	**₹ 2,81,63,000.00**	**₹ 2,85,44,000.00**	**₹ 5,67,07,000.00**
	Per Cycle Cost	**₹ 13,129.60**	**₹ 13,063.62**	**₹ 13,096**

10.2.3.7. TOTAL PROJECT COST FOR NMT MASTER PLAN

The total project cost for NMT Master Plan is estimated at Rs 1582.99 Crores. Table 10-16 represents the project component wise breakup of the cost.

TABLE 10-19: TOTAL PROJECT COST

Sl. No.	Project Components	Rs in Crores
1	NMT Street Retrofitting Costs – Primary Roads	392.2
2	NMT Street Retrofitting Costs – Secondary Roads	406.0
3	NMT Street Retrofitting Costs – Tertiary Roads	642.7
4	Station Accessibility Improvements	18.30
5	Urban Place Making Schemes	118.12
6	Public Bike Sharing Scheme	5.67
Total		**1582.99**

10.2.4. GRAND SUMMARY

The estimated summary of all works related to Metro Feeder Services, City Bus Services, NMT Improvements, Public Bike Sharing Scheme and development and application of Multi Modal Integration is represented in the Table 10-20.

TABLE 10-20 : GRAND SUMMARY OF ESTIMATED BLOCK COSTS

Sl. No.	Component	Rs. In Crore						
		Total Project Cost	Phase 1		Phase 2		Phase 3	
			Maha Metro	NMC	Maha Metro	NMC	Maha Metro	NMC
1	Metro Feeder Services	₹ 41.0	₹ 41.0	-	-	-	-	-
2	City Bus Services	₹ 496.6	-	₹ 496.6	-	-	-	-
3	NMT & PBS							
3a	NMT Street Retrofitting Costs – Primary Roads	₹ 392.2	**₹ 140.3**	**₹ 251.9**	-	-	-	-
3b	NMT Street Retrofitting Costs – Secondary Roads	₹ 406.0	-	-	-	₹ 406.0	-	-
3c	NMT Street Retrofitting Costs – Tertiary Roads	₹ 642.7	-	-	-	-	-	₹ 642.7
3d	Station Accessibility Improvements	₹ 18.3	₹ 18.3	-	-	-	-	-
3e	Urban Place Making Schemes	₹ 118.1	₹ 4.9	₹ 52.0	-	₹ 15.7	-	₹ 45.5
3f	Public Bike Sharing Scheme	₹ 5.7	-	₹ 2.8	-	₹ 2.9	-	-
	Sub-Total of NMT & PBS	₹ 1,583.0	₹ 163.5	₹ 306.7	₹ 0.0	₹ 424.6	₹ 0.0	₹ 688.2
	Grand Total (1+2+3)	₹ 2,120.6	₹ 204.5	₹ 803.3	₹ 0.0	₹ 424.6	₹ 0.0	₹ 688.2

10.3. OPERATION AND MAINTENANCE (O & M) COST

10.3.1. O & M COST OF METRO FEEDER SERVICES

The O & M cost shall include the cost of the maintenance of the rolling stock, fuel cost, staff cost, insurance, overheads etc. So in order to evaluate the cost a financial model has been developed for the period of 10 years which clearly indicates the O&M Cost, Revenue from various sources, Operating Profit, Depreciation etc. It also covers the Cash Surplus/Deficit along with Loan schedule for the operation of Feeder system as a whole. The detailed model is presented below considering the Electric & CNG mini vans along with CNG Mini Buses.

TABLE 10-21 FINANCIAL MODEL FOR OPERATION OF FEEDER VEHICLES (CONSIDERING ELECTRIC MINI VANS)

Year		1	2	3	4	5	6	7	8	9	10
Fare Revenue		1924	2061	2207	2365	2533	2713	2907	3114	3336	3573
Advertising Revenue from Buses		13	12	13	14	15	16	17	18	19	20
Advertising Revenue from Stops		13	14	15	15	16	17	18	19	20	21
Total Revenue		**1950**	**2087**	**2235**	**2394**	**2564**	**2746**	**2941**	**3150**	**3374**	**3614**
Expenses											
Fuel Cost											
Mini Vans	Electric	140	147	156	165	174	184	195	206	218	230
Mini Bus	CNG	332	351	371	393	415	439	464	490	518	548
Fuel Cost		472	499	527	557	589	623	658	696	736	778
O&M Cost											
Mini Vans	Electric	266	287	311	337	364	394	427	462	500	541
Mini Bus	CNG	185	200	216	234	253	274	297	321	348	376
Maintenance Costs		450	487	527	571	618	668	723	783	847	917
Staff Salary		1231	1338	1454	1591	1728	1877	2060	2237	2429	2654

Year		1	2	3	4	5	6	7	8	9	10
Insurance		85	72	59	46	32	81	69	56	43	31
Overheads		224	240	257	277	297	325	351	377	406	438
Total Operating Cost		**2462**	**2636**	**2824**	**3042**	**3264**	**3575**	**3862**	**4149**	**4461**	**4817**
Operating Profit		**-513**	**-549**	**-589**	**-648**	**-700**	**-829**	**-921**	**-999**	**-1087**	**-1204**
Depreciation		698	706	715	729	737	727	745	754	765	781
Interest		47	36	25	14	3	31	21	10	0	-1
Net Profit Before Tax		**-1258**	**-1291**	**-1329**	**-1391**	**-1441**	**-1587**	**-1687**	**-1763**	**-1851**	**-1983**
Tax											
PAT		-1258	-1291	-1329	-1391	-1441	-1587	-1687	-1763	-1851	-1983
CPKM		25.6	26.7	28.0	29.6	31.1	33.4	35.4	37.4	39.5	42.0
EPKM		15.3	16.3	17.4	18.5	19.7	20.9	22.3	23.7	25.2	26.8
Feeder Pax p.a.	Lakh	214	218.8	223.8	229.0	234.3	239.7	245.2	250.9	256.7	262.6
Metro Pax p.a.	Lakh	1069	1094.0	1119.2	1145.1	1171.5	1198.5	1226.2	1254.4	1283.4	1313.0
With Capex											
Subsidy/Feeder Pax	Rs.	-5.9	-5.9	-5.9	-6.1	-6.1	-6.6	-6.9	-7.0	-7.2	-7.6
Subsidy/Metro Pax	Rs.	-1.2	-1.2	-1.2	-1.2	-1.2	-1.3	-1.4	-1.4	-1.4	-1.5
Without Capex											
Subsidy/Feeder Pax	Rs.	2.40	2.51	2.63	2.83	2.99	3.5	3.8	4.0	4.2	4.6
Subsidy/ Metro Pax	Rs.	0.48	0.50	0.53	0.57	0.60	0.69	0.75	0.80	0.85	0.92
Cash Surplus/ (Deficit)	-16206	-1498	-1523	-1552	-1600	-1641	-1797	-1879	-1947	-2025	-745
Loan Schedule											
Opening Balance		4262.6	3324.8	2428.6	1532.8	667.0	-227.9	2013.7	1207.0	357.7	-457.1
Additional Loan	4262.6	0.0	41.6	42.0	72.0	42.8	3179.4	131.1	88.4	123.0	124.9
Repayment		22%	22%	22%	22%	22%	22%	22%	22%	22%	
Repayment		938	938	938	938	938	938	938	938	938	-457
Interest	1.25%	47.4	36.2	25.0	14.2	3.0	31.0	20.9	10.3	0.1	-1.3
Closing Balance		3324.8	2428.6	1532.8	667.0	-227.9	2013.7	1207.0	357.7	-457.1	124.9

TABLE 10-22 FINANCIAL MODEL FOR OPERATION OF FEEDER VEHICLES (CONSIDERING CNG MINI VANS)

Year		1	2	3	4	5	6	7	8	9	10
Fare Revenue		1924	2061	2207	2365	2533	2713	2907	3114	3336	3573
Advertising Revenue from Buses		13	12	13	14	15	16	17	18	19	20
Advertising Revenue from Stops		13	14	15	15	16	17	18	19	20	21
Total Revenue		1950	2087	2235	2394	2564	2746	2941	3150	3374	3614
Expenses											
Fuel Cost											
Mini Vans	CNG	199	211	223	235	249	263	278	294	311	328
Mini Bus	CNG	332	351	371	393	415	439	464	490	518	548
Fuel Cost		531	562	594	628	664	702	742	784	829	876
O&M Cost											
Mini Vans	CNG	177	192	207	224	243	263	285	308	333	361
Mini Bus	CNG	185	200	216	234	253	274	297	321	348	376
Maintenance Costs		362	391	424	458	496	537	581	629	681	737
Staff Salary		1231	1338	1454	1591	1728	1877	2060	2237	2429	2654
Insurance		70	60	50	40	29	68	58	48	38	28
Overheads		219	235	252	272	292	318	344	370	398	429
Total Operating Cost		2414	2587	2773	2989	3209	3502	3785	4067	4373	4724
Operating Profit		-464	-500	-538	-595	-645	-756	-844	-917	-999	-1110
Depreciation		548	556	563	577	584	591	607	616	625	641
Interest		39	30	21	12	3	24	16	8	-1	-1
Net Profit Before Tax		-1052	-1085	-1122	-1183	-1232	-1371	-1467	-1540	-1624	-1750
Tax											
PAT		-1052	-1085	-1122	-1183	-1232	-1371	-1467	-1540	-1624	-1750
CPKM		23.9	25.1	26.4	27.9	29.5	31.7	33.7	35.7	37.7	40.2
EPKM		15.3	16.3	17.4	18.5	19.7	20.9	22.3	23.7	25.2	26.8

Year		1	2	3	4	5	6	7	8	9	10
Feeder Pax p.a.	Lakh	214	218.8	223.8	229.0	234.3	239.7	245.2	250.9	256.7	262.6
Metro Pax p.a.	Lakh	1069	1094.0	1119.2	1145.1	1171.5	1198.5	1226.2	1254.4	1283.4	1313.0
With Capex											
Subsidy/Feeder Pax	Rs.	-4.9	-5.0	-5.0	-5.2	-5.3	-5.7	-6.0	-6.1	-6.3	-6.7
Subsidy/Metro Pax	Rs.	-1.0	-1.0	-1.0	-1.0	-1.1	-1.1	-1.2	-1.2	-1.3	-1.3
Without Capex											
Subsidy/Feeder Pax	Rs.	2.17	2.28	2.40	2.60	2.75	3.2	3.4	3.7	3.9	4.2
Subsidy/Metro Pax	Rs.	0.43	0.46	0.48	0.52	0.55	0.63	0.69	0.73	0.78	0.85
Cash Surplus/(Deficit)	-14043	-1277	-1303	-1332	-1380	-1421	-1554	-1633	-1698	-1772	-673
Loan Schedule											
Opening Balance		3515.2	2741.9	2005.3	1269.2	563.2	-171.8	1571.3	916.3	223.1	-435.4
Additional Loan	3515.2	0.0	36.8	37.3	67.4	38.3	2516.4	118.4	80.1	114.9	117.0
Repayment		22%	22%	22%	22%	22%	22%	22%	22%	22%	
Repayment		773	773	773	773	773	773	773	773	773	-435
Interest	1.25%	39.1	29.9	20.7	11.9	2.7	24.5	16.3	7.6	-0.6	-1.3
Closing Balance		2741.9	2005.3	1269.2	563.2	-171.8	1571.3	916.3	223.1	-435.4	117.0

From the above figures it can be understood that the CPKM for Electric vehicles is slightly higher than the CNG vehicles. But considering the long term dynamic shift towards Electric fuel technology the cost of the Electric vehicles shall come down, thereby making it more viable.

10.3.2. O&M COST OF CITY BUS SYSTEM

10.3.2.1 RUNNING COSTS

The running costs for the various types of buses (Standard - Diesel, Midi, Standard Ethanol & Standard Battery) has been computed separately. The following assumptions were made in this regard. Table 10-23 represents the assumptions made with regard to the running costs for the city bus services.

TABLE 10-23: RUNNING AND OPERATING COSTS FOR THE CITY BUS SERVICES

	Standard - D	Standard - E	Standard - B	Midi
Fuel Efficiency (Km/Kg)	3.75	1.7	1	5
Maintenance Cost/Km	5	8.6	3	8

The maintenance and fuel costs are expected to increase by 5% p.a. The mileage is assumed to reduce by 1.7% p.a. The buses are expected to operate maximum of 16 hours/day.

10.3.2.2 MAINTENANCE COSTS

The maintenance costs are estimated on a per km basis separately for each type of bus. Also the costs are assumed to increase with the age of the vehicles.

10.3.2.3 STAFFING COSTS

The drivers are assumed to put in 8 hours at the wheel on an average per shift. At least 1.25 drivers are assumed per shift considering weekly off/leaves/holidays. Accordingly, the requirement for the drivers has been estimated. One maintenance staff is assumed for every 2 vehicles. In addition to the drivers and maintenance staff, one person is assumed per operating route for managing the operations smoothly. Table 10-24 represents the estimated staffing costs.

TABLE 10-24: MANPOWER COSTS FOR THE CITY BUS SERVICES

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Staff Required										
Drivers	1385	1508	1643	1790	1950	2124	2302	2495	2703	2930	3175
Conductors	1385	1508	1643	1790	1950	2124	2302	2495	2703	2930	3175
Maintenance	121	132	144	157	171	186	201	218	237	256	278
Other Staff	579	630	687	748	815	887	962	1042	1129	1224	1326
Total	3470	3779	4117	4485	4885	5321	5767	6249	6773	7340	7954
Total Salary Cost	₹ 73	₹ 85	₹ 100	₹ 118	₹ 138	₹ 162	₹ 185	₹ 211	₹ 242	₹ 276	₹ 316

10.3.2.4 INSURANCE

Insurance cost has been provided at the rate of 2.5% of the net asset value.

10.3.2.5 DEPRECIATION

The vehicles are expected have a life of 10 years with proper maintenance and have a salvage value of 5%. Therefore it is depreciated on SLM basis @ 9.5% p.a.

10.3.2.6 OVERHEADS

Overheads are estimated at the rate of 3% of the total operating expenses based on past experience of NMC.

10.3.2.7 INTEREST COSTS:

The project is assumed to be funded using multilateral funding on the following terms:

- Rate of Interest : 1.25%
- Repayment : 10% p.a. over 10 years

The main capital expenditure for the city bus services is the procurement of the buses. The vehicles are expected to have a life span of 10 years. Based on the above mentioned parameters the estimated operating costs has been worked out, which is represented in Table 10-25.

TABLE 10-25: ESTIMATED OPERATING COST FROM THE CITY BUS SERVICES

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fuel Cost	₹ 71	₹ 82	₹ 97	₹ 115	₹ 138	₹ 167	₹ 185	₹ 205	₹ 71	₹ 82	₹ 97
Manpower Cost	₹ 25	₹ 30	₹ 35	₹ 42	₹ 51	₹ 61	₹ 69	₹ 77	₹ 25	₹ 30	₹ 35
O & M Cost	₹ 73	₹ 85	₹ 100	₹ 118	₹ 138	₹ 162	₹ 185	₹ 211	₹ 73	₹ 85	₹ 100
Civil Maintenance Cost	₹ 9	₹ 9	₹ 10	₹ 10	₹ 11	₹ 11	₹ 12	₹ 12	₹ 9	₹ 9	₹ 10
Insurance Cost	₹ 4	₹ 3	₹ 3	₹ 3	₹ 2	₹ 2	₹ 2	₹ 2	₹ 4	₹ 3	₹ 3
Overheads	₹ 9	₹ 11	₹ 12	₹ 14	₹ 17	₹ 20	₹ 23	₹ 25	₹ 9	₹ 11	₹ 12
Total Operating Costs	**₹ 190**	**₹ 221**	**₹ 257**	**₹ 302**	**₹ 356**	**₹ 424**	**₹ 475**	**₹ 533**	**₹ 598**	**₹ 672**	**₹ 756**

Considering the above estimation of Revenue and O & M Costs, the Net surplus/deficit has been calculated. The following Table 10-26 briefs the same.

TABLE 10-26: NET SURPLUS/DEFICIT (RS IN MILLION)

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Total Revenue	₹ 206	₹ 246	₹ 295	₹ 353	₹ 422	₹ 506	₹ 583	₹ 671	₹ 773	₹ 890	₹ 1,025
Total Operating Cost	₹ 190	₹ 221	₹ 257	₹ 302	₹ 356	₹ 424	₹ 475	₹ 533	₹ 598	₹ 672	₹ 756
Profit Before Taxes, Depreciation and Interest	₹ 16	₹ 26	₹ 37	₹ 51	₹ 66	₹ 82	₹ 108	₹ 138	₹ 175	₹ 218	₹ 270
Depreciation	**₹ 47**	**₹ 53**	**₹ 59**	**₹ 64**	**₹ 70**	**₹ 76**	**₹ 81**	**₹ 87**	**₹ 93**	**₹ 98**	**₹ 104**
Interest	₹ 5	₹ 5	₹ 4	₹ 4	₹ 4	₹ 3	₹ 3	₹ 2	₹ 2	₹ 1	₹ 0
Net Surplus/Deficit	-₹ 36	-₹ 32	-₹ 26	-₹ 18	-₹ 8	₹ 3	₹ 23	₹ 49	₹ 80	₹ 119	₹ 165
CPKM	₹ 51	₹ 51	₹ 50	₹ 50	₹ 50	₹ 50	₹ 52	₹ 53	₹ 55	₹ 57	₹ 59

As in the case of City Bus Services operated by NMC, results in a break even scenario wherein the revenue generated is nullified by the expenditure during this period. Based on the above mentioned assumptions, the above calculations were carried out and financial viability of the project was estimated, which worked out at 3%.

10.3.3. O&M COST OF PUBLIC BICYCLE SHARING

10.3.3.1 OPERATION COSTS

The operation cost includes the following;

1. Cost of the Manpower/staffing
2. Recurring Cost of the Insurance (Old Cycles + New Cycles)
3. Cost of the Maintenance of the s, Docking Stations and Redistribution Vehicles

Hence the following section of the report shall discuss overall operation and maintenance costs of Nagpur PBS.

10.3.3.2 MANPOWER

The staff requirement for the successful operation of the PBS depends on the type of system, operational hours of the system, size of the system, and bicycle service area of the system and redistribution requirement of the system. A fully automated system reduces the overhead operating expenses and increases the efficiency of the system as compared to a manually operated PBS system. To ensure adequate security at the stations, majority of the PBS stations are planned adjoining the transit stations.

The PBS system in Nagpur shall require dedicated staff to operate and administer the new system. The staffing requirement for the PBS Nagpur has been worked out based on the Staffing requirement as defined in the PBS Guidance Document - MoUD, GoI (refer Annexure 3). Considering the guidelines, for a fully automated system with 500 cycles, 50 docking stations and 750 docks would require atleast 82 staff members i.e, 0.16 staff per cycle with 2 shifts and 20% of the relieving staff.

As in case of Nagpur, the total staff requirement considering both Phase 1 and Phase 2 is 444 (including 20% relieving staff) i.e 0.10 staff per cycle with 2 shifts. The total staff requirement for the PBS Nagpur is represented in table.

TABLE 10-27: TOTAL MANPOWER REQUIREMENT

Staff Roles	Phase 1	Phase 2	Total
Operations Manager	2	2	4
Shift In Charge	6	7	13
Control Center Operators	11	11	22
Customer Service Call Center	11	11	22
Administration	4	4	8
Human Resources	4	4	8

Staff Roles	Phase 1	Phase 2	Total
Marketing Manager	2	2	4
Accounts	4	4	8
Station Attendant	0	0	0
Point of Sale Operators	26	26	52
Driver	26	26	52
Helper	26	26	52
IT Support	11	11	22
Workshop Mechanics	11	11	22
Guard	9	9	18
Cleaner	24	24	48
TOTAL = A	**177**	**178**	**355**
Relieving Staff = B	**44**	**45**	**89**
TOTAL (C = A+B)	**221**	**223**	**444**

Based on the above mentioned staffing requirement for the PBS for Nagpur, it is worked out that the manpower cost per cycle at ₹2,732 with an increase of 10% per annum. Table 10.28 represents the Manpower Costs.

TABLE 10-28: MANPOWER COSTS

Year	No. of Cycles	Manpower	Manpower Cost (Rs in Crores)
2017	2145	221	₹ 0.060
2018	557	278	₹ 0.084
2019	81	286	₹ 0.095
2020	83	295	₹ 0.107
2021	86	304	₹ 0.122
2022	88	313	₹ 0.138
2023	90	322	₹ 0.156
2024	93	332	₹ 0.177
2025	95	342	₹ 0.200
2026	100	352	₹ 0.227
2027	101	362	₹ 0.257
2028	103	373	₹ 0.291
2029	108	384	₹ 0.329
2030	112	396	₹ 0.374
2031	113	408	₹ 0.423
2032	118	420	₹ 0.480
2033	121	432	₹ 0.543
2034	125	445	₹ 0.615
2035	128	458	₹ 0.696
2036	132	472	₹ 0.789
2037	136	486	₹ 0.894
2038	139	500	₹ 1.011
2039	145	515	₹ 1.146
2040	147	530	₹ 1.297
2041	148	545	₹ 1.467

10.3.3.3 MAINTENANCE COST OF THE BICYCLES

As mentioned in the earlier section the cost of the gear bicycle is ₹ 12,000/- and non-gear bicycles is ₹ 9,000/- has been assumed, the repair and maintenance cost of each of the is assumed at 20% of the cost of the bicycles annually.

10.3.3.4 MAINTENANCE COST OF THE DOCKING STATIONS

For the repair and maintenance of the docking stations is assumed at an incremental cost of 5% is taken on the base cost of 20% of construction cost for the annual repair and maintenance of the docking stations.

Maintenance Cost of the Redistribution vehicles

Annual maintenance expenses for the redistribution vehicles are assumed to be at 20% of the total cost, which is represented in Table 10-29.

TABLE 10-29: MAINTENANCE COST OF BICYCLES, DOCKING STATIONS AND REDISTRIBUTION VEHICLES

Year	Operation and Maintenance Cost (₹ in Crores)			
	Bicycles	Docking Stations	Redistribution Vehicles	Total
2017	₹ 0.388	₹ 0.533	₹ 0.056	₹ 0.977
2018	₹ 0.100	₹ 0.559	₹ 0.056	₹ 0.715
2019	₹ 0.015	₹ 0.587	₹ 0.056	₹ 0.658
2020	₹ 0.015	₹ 0.616	₹ 0.056	₹ 0.687
2021	₹ 0.016	₹ 0.647	₹ 0.070	₹ 0.733
2022	₹ 0.016	₹ 0.680	₹ 0.070	₹ 0.766
2023	₹ 0.016	₹ 0.714	₹ 0.070	₹ 0.800
2024	₹ 0.017	₹ 0.749	₹ 0.070	₹ 0.836
2025	₹ 0.017	₹ 0.787	₹ 0.070	₹ 0.874
2026	₹ 0.018	₹ 0.826	₹ 0.070	₹ 0.914
2027	₹ 0.018	₹ 0.867	₹ 0.084	₹ 0.970
2028	₹ 0.019	₹ 0.911	₹ 0.084	₹ 1.013
2029	₹ 0.020	₹ 1.241	₹ 0.084	₹ 1.345
2030	₹ 0.020	₹ 1.303	₹ 0.084	₹ 1.408
2031	₹ 0.020	₹ 1.369	₹ 0.084	₹ 1.473
2032	₹ 0.021	₹ 1.437	₹ 0.084	₹ 1.542
2033	₹ 0.022	₹ 1.509	₹ 0.098	₹ 1.629
2034	₹ 0.023	₹ 1.584	₹ 0.098	₹ 1.705
2035	₹ 0.023	₹ 1.663	₹ 0.098	₹ 1.785
2036	₹ 0.024	₹ 1.747	₹ 0.098	₹ 1.868
2037	₹ 0.025	₹ 1.834	₹ 0.098	₹ 1.956
2038	₹ 0.025	₹ 1.926	₹ 0.112	₹ 2.063
2039	₹ 0.026	₹ 2.022	₹ 0.112	₹ 2.160
2040	₹ 0.027	₹ 2.123	₹ 0.112	₹ 2.262
2041	₹ 0.027	₹ 2.229	₹ 0.112	₹ 2.368

10.3.3.5 INSURANCE COST OF THE BICYCLES

Cost of the insurance renewal on the old bicycles and new insurance on newly purchased bicycle fleet annually is given in Table 10-30.

TABLE 10-30: INSURANCE COSTS

Year	No. of Cycles	Insurance Cost of the New Cycles	Insurance Cost of the Old Cycles	Total Insurance Cost (₹ in Crores)
2017	2145	₹ 0.107	₹ 0.000	₹ 0.107
2018	557	₹ 0.028	₹ 0.119	₹ 0.147

Year	No. of Cycles	Insurance Cost of the New Cycles	Insurance Cost of the Old Cycles	Total Insurance Cost (₹ in Crores)
2019	81	₹ 0.004	₹ 0.155	₹ 0.159
2020	83	₹ 0.004	₹ 0.155	₹ 0.159
2021	86	₹ 0.004	₹ 0.154	₹ 0.159
2022	88	₹ 0.004	₹ 0.154	₹ 0.159
2023	90	₹ 0.005	₹ 0.154	₹ 0.159
2024	93	₹ 0.005	₹ 0.154	₹ 0.159
2025	95	₹ 0.005	₹ 0.154	₹ 0.159
2026	100	₹ 0.005	₹ 0.153	₹ 0.158
2027	101	₹ 0.005	₹ 0.153	₹ 0.158
2028	103	₹ 0.005	₹ 0.153	₹ 0.158
2029	108	₹ 0.005	₹ 0.153	₹ 0.158
2030	112	₹ 0.006	₹ 0.152	₹ 0.158
2031	113	₹ 0.006	₹ 0.152	₹ 0.158
2032	118	₹ 0.006	₹ 0.152	₹ 0.158
2033	121	₹ 0.006	₹ 0.152	₹ 0.158
2034	125	₹ 0.006	₹ 0.152	₹ 0.158
2035	128	₹ 0.006	₹ 0.151	₹ 0.158
2036	132	₹ 0.007	₹ 0.151	₹ 0.158
2037	136	₹ 0.007	₹ 0.151	₹ 0.157
2038	139	₹ 0.007	₹ 0.150	₹ 0.157
2039	145	₹ 0.007	₹ 0.150	₹ 0.157
2040	147	₹ 0.007	₹ 0.150	₹ 0.157
2041	148	₹ 0.007	₹ 0.150	₹ 0.157

The operating cost per cycle per year in Indian case studies is observed to be ₹ 24,000 per cycle. Where as in Nagpur, based on the above mentioned assumptions the average operating cost per bicycle per year comes out to be ₹ 4,954 (~₹ 5000 per cycle per year). This is because the proposed bicycle sharing system is fully automated and the cost of the maintenance of the control center and the ITS software requirement for the front end and back end process is transferred on to either the NMRC or Smart City Nagpur, where the OCC and software shall be integrated with the other modes of public transport in Nagpur. It is also observed that since, the system is fully automated; it has reduced the overheads for the staff etc. and brought down the operating cost for the system proposed for Nagpur.

CHAPTER 11 REVENUE

11.1. FARE FIXATION

Fare is one of the most crucial elements of any public transport project. There is always a trade-off between the ridership and fare with revenue being the focal point. The demand being highly price elastic in urban transport projects it also effects the sustainability of the system. Fare also is very sensitive and impacts the mode choice of the commuter and thus impacts the congestion levels that the public transport seeks to reduce. Some of the basic guiding principles for determination of fare is given in Table 11-1.

TABLE 11-1: GUIDING PRINCIPLES FOR THE FARE DETERMINATION

Principles	Description
Affordability	The fares should be within the means of middle income and lower income groups of the society. Majority of the population from these groups use cheaper modes of transportation for short and long distances. Thus price elasticity is very high.
Quality	Low fare structure should not affect the quality of services of the transportation system. Inferior service level would discourage the class of commuters who appreciate time saving and comfortable journey.
Sustainability	The fare structure should also offer the system financial sustainability during the operation period. Fare should ideally cover Operation and Maintenance (O&M) costs and capital maintenance. Ideally the system also needs to generate operating surplus (Operating Revenue - Operating cost) over a reasonable period of time to recover the investment made initially (if not fully then partially), so that funds become available for regular asset replacement.
Competitiveness	Fare structure should be competitive with other modes of transport. The principle is interconnected with Affordability. Fares should not exceed the nearest competing transportation system, meaning the system which offers similar benefits in terms of time, comfort level etc. At the same time fares should not be very low or high as they could impact sustainability and affordability.
Flexibility	The fare structure should be linked with a periodic revision method. The method should be acceptable to the public and should stand legal scrutiny. It should also be able to maintain the compatibility and integrity of the fare structure.
Equity	Fares should distribute financial and other burdens fairly among citizens and assure the availability of a suitable public transport system to all income groups.

11.1.1 EXISTING FARE SYSTEM FOR CITY BUS SERVICE

Keeping in the view of the above guidelines the fare pattern of the existing public transport system has been analyzed. The fare structure of the City Bus systems indicates that the minimum fare is currently Rs.8 for 2 km of distance and continues to be the same till 4 km. The maximum fare range for 48 to 50 km is Rs. 58. The table below shows the fare chart for the CBS on Nagpur. It can be observed that the fare is seen increasing at a constant rate of Rs. 3 to Rs. 4 per stage and each stage distance is around 2 km. Hence indicating an average fare of Rs. 1.3 to Rs. 1.5 per km.

TABLE 11-2: EXISTING FARE STRUCTURE FOR CITY BUS SYSTEM

KM		Fares
0	0	0
0	2	8
2	4	8
4	6	9
6	8	11
8	10	13
10	12	16
12	14	19
14	16	23
16	18	26
18	20	30
20	22	30
22	24	34

KM		Fares
24	26	34
26	28	38
28	30	38
30	32	42
32	34	42
34	36	46
36	38	46
38	40	50
40	42	50
42	44	54
44	46	54
46	48	58
48	50	58

11.1.2 EXISTING FARE SYSTEM FOR AUTO RICKSHAW & SHARE AUTOS

The city of Nagpur currently has Auto Rickshaws and Share Autos as Intermediate Public Transport. The base fare of Auto Rickshaw is Rs. 14 for the first km and thereafter increases in the same trend of Rs.14 for every additional km. Thus the average fare of Auto Rickshaw is much higher than that of the Metro system. The figure below shows the RTO notified fare structure for the Auto Rickshaws for the city of Nagpur.

FIGURE 11-1: RTO NOTIFIED FARE FOR AUTO RICKSHAW[1]

Revised Autorikshaw Tariff Card w.e.f. 01.09.2014

Meter calibrated 1.00 Rupee flag for 1 Km. is divided in 10 flags showing 10 parts fare. For first flag of 1 Km. fare is Rs. 14.00
The customers are requested to pay the fare shown in the column fare payable.

Meter Reading	Revised Fare Payable (Rs.)	Meter Reading	Revised Fare Payable (Rs.)	Meter Reading	Revised Fare Payable (Rs.)	Meter Reading	Revised Fare Payable (Rs.)	Meter Reading	Revised Fare Payable (Rs.)
1.00	**14.00**	**4.00**	**56.00**	**7.00**	**98.00**	**10.00**	**140.00**	**13.00**	**182.00**
1.1	15.00	4.1	57.00	7.1	99.00	10.1	141.00	13.1	183.00
1.2	17.00	4.2	59.00	7.2	101.00	10.2	143.00	13.2	185.00
1.3	18.00	4.3	60.00	7.3	102.00	10.3	144.00	13.3	186.00
1.4	20.00	4.4	62.00	7.4	104.00	10.4	146.00	13.4	188.00
1.5	21.00	4.5	63.00	7.5	105.00	10.5	147.00	13.5	189.00
1.6	22.00	4.6	64.00	7.6	106.00	10.6	148.00	13.6	190.00
1.7	24.00	4.7	66.00	7.7	108.00	10.7	150.00	13.7	192.00
1.8	25.00	4.8	67.00	7.8	109.00	10.8	151.00	13.8	193.00
1.9	27.00	4.9	69.00	7.9	111.00	10.9	153.00	13.9	195.00
2.00	**28.00**	**5.00**	**70.00**	**8.00**	**112.00**	**11.00**	**154.00**	**14.00**	**196.00**
2.1	29.00	5.1	71.00	8.1	113.00	11.1	155.00	14.1	197.00
2.2	31.00	5.2	73.00	8.2	115.00	11.2	157.00	14.2	199.00
2.3	32.00	5.3	74.00	8.3	116.00	11.3	158.00	14.3	200.00
2.4	34.00	5.4	76.00	8.4	118.00	11.4	160.00	14.4	202.00
2.5	35.00	5.5	77.00	8.5	119.00	11.5	161.00	14.5	203.00
2.6	36.00	5.6	78.00	8.6	120.00	11.6	162.00	14.6	204.00
2.7	38.00	5.7	80.00	8.7	122.00	11.7	164.00	14.7	206.00
2.8	39.00	5.8	81.00	8.8	123.00	11.8	165.00	14.8	207.00
2.9	41.00	5.9	83.00	8.9	125.00	11.9	167.00	14.9	209.00
3.00	**42.00**	**6.00**	**84.00**	**9.00**	**126.00**	**12.00**	**168.00**	**15.00**	**210.00**
3.1	43.00	6.1	85.00	9.1	127.00	12.1	169.00	15.1	211.00
3.2	45.00	6.2	87.00	9.2	129.00	12.2	171.00	15.2	213.00
3.3	46.00	6.3	88.00	9.3	130.00	12.3	172.00	15.3	214.00
3.4	48.00	6.4	90.00	9.4	132.00	12.4	174.00	15.4	216.00
3.5	49.00	6.5	91.00	9.5	133.00	12.5	175.00	15.5	217.00
3.6	50.00	6.6	92.00	9.6	134.00	12.6	176.00	15.6	218.00
3.7	52.00	6.7	94.00	9.7	136.00	12.7	178.00	15.7	220.00
3.8	53.00	6.8	95.00	9.8	137.00	12.8	179.00	15.8	221.00
3.9	55.00	6.9	97.00	9.9	139.00	12.9	181.00	15.9	223.00
								16.00	**224.00**

टिप :- हकीम समितीचे शिफारसीनुसार ०.०० पैसे ते ०.४९ पैसे पर्यंतच्या आलेले अक्षम, ०.५० पैसे ते ०.९९ पैसे नजीकच्या पूर्ण रुपयामध्ये रुपांतरीत केले आहे.

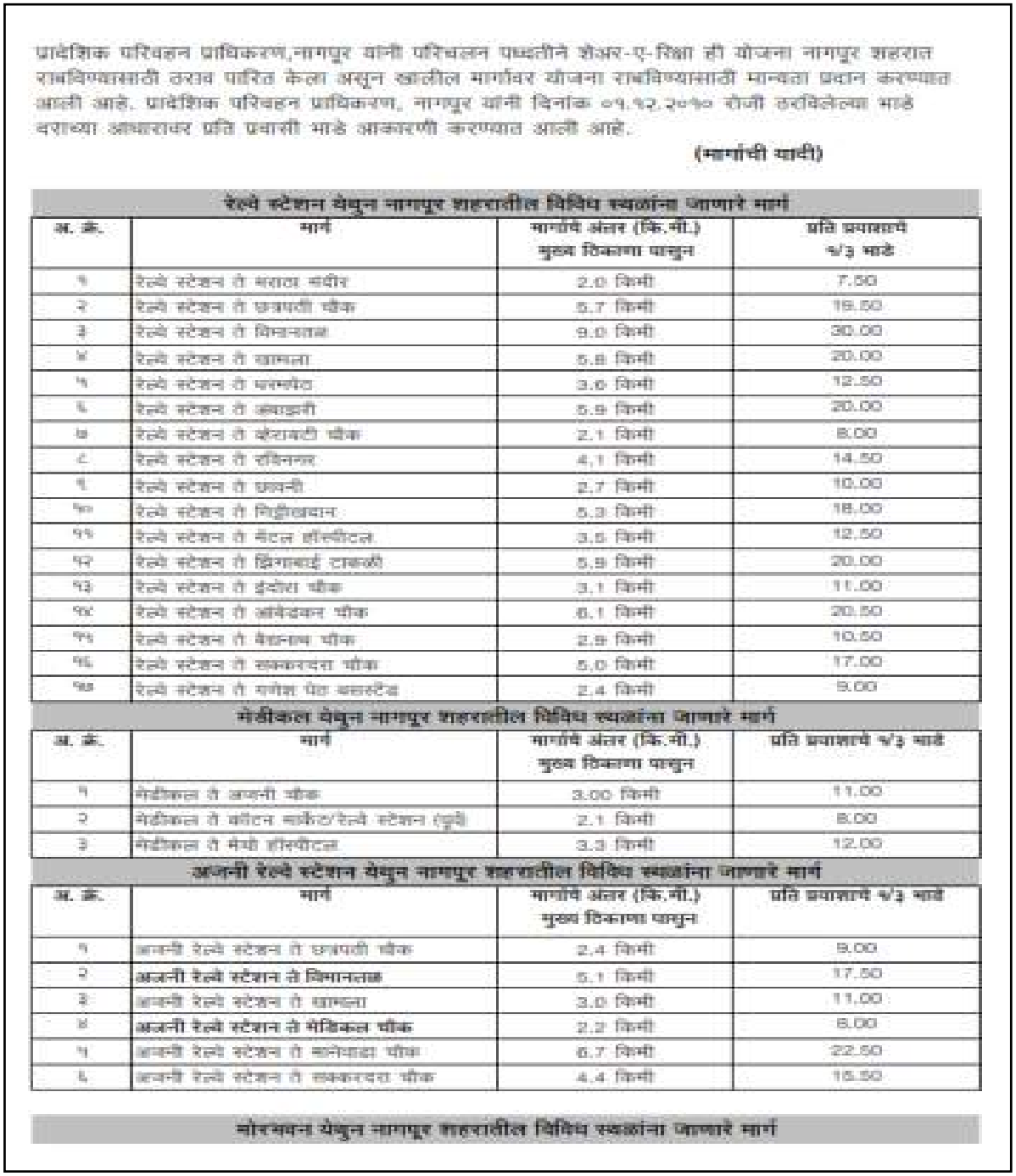
ऑटोरिक्षा चालक आणि प्रवाशांसाठी महत्वाच्या सूचना,प्रवाशांच्या काही तक्रारी असल्यास टोल फ्री क्र.१८००२३३३३ ८८ वर तक्रार नोंदवावी.

Complaints :- For any complaint about non plying by meter, refusal, excess fare, rude behavior etc. against the driver, contact **Toll**

[1] Source: Motor Vehicles Department Maharashtra – February, 2016

Similarly, the city also has many Share Autos operating from prime locations such as Nagpur Railway Station, Medical, Ajini Railway Station, Ganeshpeth & Mayo Hospital. The average fare of Share Autos is Rs. 3 to Rs. 4 per km. Though the fare of Share Auto is in competition with the Metro fare the coverage of the Share Auto is very limited. In addition the Share Autos do no provide the same amount of comfort as that of the Metro System. Apart from that since the designed feeder system of the proposed metro is expected to be integrated with the metro system it also provides the first and last mile connectivity which the Share auto fails to provide. The fare of the Shared Auto is presented in the figure below:

FIGURE 11-2: RTO NOTIFIED FARE FOR SHARE AUTO[2]



प्रादेशिक परिवहन प्राधिकरण,नागपुर यांनी परिचलन पध्दतीने शेअर-ए-रिक्षा ही योजना नागपुर शहरात राबविण्यासाठी तरतुद पारित केला असून खालील मार्गावर योजना राबविण्यासाठी मान्यता प्रदान करण्यात आली आहे. प्रादेशिक परिवहन प्राधिकरण, नागपुर यांनी दिनांक ०१.१२.२०१० रोजी ठरविलेल्या भाडे दराच्या आधारावर प्रति प्रवासी भाडे आकारणी करण्यात आली आहे.

(मार्गांची यादी)

रेल्वे स्टेशन येथुन नागपुर शहरातील विविध स्थळांना जाणारे मार्ग

अ. क्रं.	मार्ग	मार्गाचे अंतर (कि.मी.) मुख्य ठिकाणा पासुन	प्रति प्रवासाचे भ/३ भाडे
१	रेल्वे स्टेशन ते मराठा मंदीर	2.0 किमी	7.50
२	रेल्वे स्टेशन ते छत्रपती चौक	5.7 किमी	16.50
३	रेल्वे स्टेशन ते विमानतळ	9.0 किमी	30.00
४	रेल्वे स्टेशन ते खामला	5.8 किमी	20.00
५	रेल्वे स्टेशन ते धरमपेठ	3.6 किमी	12.50
६	रेल्वे स्टेशन ते अंबाझरी	5.9 किमी	20.00
७	रेल्वे स्टेशन ते धंतोली चौक	2.1 किमी	8.00
८	रेल्वे स्टेशन ते रविनगर	4.1 किमी	14.50
९	रेल्वे स्टेशन ते छावनी	2.7 किमी	10.00
१०	रेल्वे स्टेशन ते सिव्हीललाईन	5.3 किमी	18.00
११	रेल्वे स्टेशन ते मेडिकल हॉस्पीटल	3.5 किमी	12.50
१२	रेल्वे स्टेशन ते झिंगाबाई टाकळी	5.9 किमी	20.00
१३	रेल्वे स्टेशन ते इंदोरा चौक	3.1 किमी	11.00
१४	रेल्वे स्टेशन ते आयेदकर चौक	6.1 किमी	20.50
१५	रेल्वे स्टेशन ते वैशनव चौक	2.9 किमी	10.50
१६	रेल्वे स्टेशन ते सक्करदरा चौक	5.0 किमी	17.00
१७	रेल्वे स्टेशन ते गणेश पेठ बसस्टैंड	2.4 किमी	9.00

मेडीकल येथुन नागपुर शहरातील विविध स्थळांना जाणारे मार्ग

अ. क्रं.	मार्ग	मार्गाचे अंतर (कि.मी.) मुख्य ठिकाणा पासुन	प्रति प्रवासाचे भ/३ भाडे
१	मेडीकल ते अजनी चौक	3.00 किमी	11.00
२	मेडीकल ते वोटेन मार्केट/रेल्वे स्टेशन (जुने)	2.1 किमी	8.00
३	मेडीकल ते मेयो हॉस्पीटल	3.3 किमी	12.00

अजनी रेल्वे स्टेशन येथुन नागपुर शहरातील विविध स्थळांना जाणारे मार्ग

अ. क्रं.	मार्ग	मार्गाचे अंतर (कि.मी.) मुख्य ठिकाणा पासुन	प्रति प्रवासाचे भ/३ भाडे
१	अजनी रेल्वे स्टेशन ते छत्रपती चौक	2.4 किमी	9.00
२	अजनी रेल्वे स्टेशन ते विमानतळ	5.1 किमी	17.50
३	अजनी रेल्वे स्टेशन ते खामला	3.0 किमी	11.00
४	अजनी रेल्वे स्टेशन ते मेडिकल चौक	2.2 किमी	8.00
५	अजनी रेल्वे स्टेशन ते कानेटाटा चौक	6.7 किमी	22.50
६	अजनी रेल्वे स्टेशन ते सक्करदरा चौक	4.4 किमी	15.50

मोरभवन येथुन नागपुर शहरातील विविध स्थळांना जाणारे मार्ग

[2] Source: Motor Vehicles Department Maharashtra – February, 2016

अ. क्रं.	मार्ग	मार्गावे अंतर (कि.मी.) मुख्य ठिकाणा पासुन	प्रति प्रवाशासे भाडे
१	मोरभवन ते जिल्हाधिकारी कार्यालय	2.2 किमी	8.00
२	मोरभवन ते हायकोर्ट	3.9 किमी	13.50
३	**मोरभवन ते विमानतळ**	6.9 किमी	23.50
४	मोरभवन ते खामला	4.2 किमी	14.50
५	मोरभवन ते लॉयब्ररी	3.7 किमी	13.00
६	मोरभवन ते लॉ कॉलेज	2.5 किमी	9.00
७	**मोरभवन ते विद्यापीठ परिसर**	4.3 किमी	15.00
८	मोरभवन ते छावनी	3.0 किमी	11.00
९	मोरभवन ते क्रेडाई कॉलनी	6.9 किमी	23.50
१०	मोरभवन ते हिंगणघाट टाकळी	5.6 किमी	19.00
११	मोरभवन ते टेका नाका	6.2 किमी	21.00
१२	**मोरभवन ते रेल्वे स्टेशन**	2.3 किमी	8.50
१३	**मोरभवन ते मेडिकल चौक**	4.1 किमी	14.50
१४	मोरभवन ते मानेवाडा चौक	6.8 किमी	23.00
१५	मोरभवन ते गणेश पेठ बसस्टँड	2.2 किमी	8.00

गणेश पेठ (बस स्टॅण्ड) येथुन नागपुर शहरातील विविध स्थळांना जाणारे मार्ग

अ. क्रं.	मार्ग	मार्गावे अंतर (कि.मी.) मुख्य ठिकाणा पासुन	प्रति प्रवाशासे भाडे
१	गणेश पेठ ते अजनी रेल्वे स्टेशन	3.2 किमी	11.50
२	गणेश पेठ ते छत्रपती चौक	5.8 किमी	20.00
३	गणेश पेठ ते खामला	5.6 किमी	19.00
४	गणेश पेठ ते विश्रामुमी	4.1 किमी	14.50
५	गणेश पेठ ते व्हेरायटी चौक	2.9 किमी	10.50
६	गणेश पेठ ते लॉ कॉलेज	5.0 किमी	17.00
७	**गणेश पेठ ते विद्यापीठ परिसर**	7.4 किमी	25.00
८	गणेश पेठ ते सिव्हीलाइन	7.5 किमी	25.00
९	गणेश पेठ ते मेडिकल हॉस्पीटल चौक	6.6 किमी	22.50
१०	गणेश पेठ ते रेल्वे स्टेशन	2.6 किमी	9.50
११	गणेश पेठ ते इंदोरा चौक	6.0 किमी	20.50
१२	**गणेश पेठ ते मेयो हॉस्पीटल**	2.6 किमी	9.50
१३	गणेश पेठ ते आंबेडकर चौक	6.5 किमी	22.00
१४	गणेश पेठ ते मानेवाडा चौक	5.1 किमी	17.50
१५	गणेश पेठ ते सक्करदरा चौक	2.5 किमी	9.00

मेयो हॉस्पीटल येथुन नागपुर शहरातील विविध स्थळांना जाणारे मार्ग

अ. क्रं.	मार्ग	मार्गावे अंतर (कि.मी.) मुख्य ठिकाणा पासुन	प्रति प्रवाशासे भाडे
१	मेयो हॉस्पीटल ते अजनी चौक	5.3 किमी	18.00
२	मेयो हॉस्पीटल ते मोरभवन	3.1 किमी	11.00
३	मेयो हॉस्पीटल ते गणेश पेठ बसस्टँड	2.7 किमी	10.00
४	**मेयो हॉस्पीटल ते मेडिकल चौक**	4.7 किमी	16.00

11.1.3 PROPOSED FARE FOR NAGPUR METRO FEEDER SERVICES

DMRC DPR on Nagpur Metro suggests a starting fare of Rs. 15 for 0-2 km for the year 2018-2019. The fare has been proposed keeping in view of the other public transport systems in the city and the average fare levied on these systems. The current Delhi Metro fare is Rs. 8 for the year 2009. Hence Rs. 15 for the services offered by Nagpur Metro seems reasonable. The table below shows the fare structure proposed for Nagpur Metro DMRC DPR.

TABLE 11-3: FARE STRUCTURE PROPOSED FOR NAGPUR METRO

Distance in Km	DMRC Fare as Revised in 2009	Nagpur Metro Fare (Rs.) in 2018-19
0-2	8	15
2-4	10	19
4-6	12	23
6-9	15	28
9-12	16	30
12-15	18	34
15-18	19	36
18-21	21	39
>21	22	41

Apart from the above fare of DMRC Metro, it also runs a feeder system. A review of the Delhi Metro feeder system reveals an average fare of Rs. 5 to Rs.15. Delhi Metro currently adopts Non AC Mini Buses with frequency of 10 to 15 min for providing feeder services. The fare system of the Delhi Metro feeder has been adopted keeping in view of the average trip length of the users and the various routes in operation. Therefore, after a review of the above fare pattern and considering the average route length of the feeder route which is around 6 to 8 km it is suggested to have a slab based fare system for the feeder services for the Nagpur Metro.

It is therefore proposed to have a stage based fare starting at Rs. 5 for the first 2km in the case of Nagpur metro feeder services. The following table provides the fare structure adopted for Nagpur Feeder.

TABLE 11-4 FARE STRUCTURE OF NAGPUR METRO FEEDER

Distance in Km	Nagpur Metro Feeder (Rs.) in 2018-19
0-2	5
2-5	10
Above 5km	15

This ensures that the feeder fare structure is competitive when compared to that of city bus service and auto-rickshaw. When considering share auto, though the feeder fare structure is higher, the metro feeder services offer a reliable and comfortable travel experience to the metro passengers.

The maximum fare which a passenger can incur along with the travel in metro services would be Rs.71 including the last mile connectivity (assuming that the distance covered in feeder bus is more than 5km for both access and egress trips). This fare is also competitive to the CBS maximum fare which is Rs. 58. In addition the services offered by the Metro system are far more superior to the other public transport modes and since the feeder is expected to connect to the core areas the last mile connectivity charges shall be minimal unlike in City buses where the commuters have to depend on IPT or other private modes to reach their final destination.

11.1.4 FARE COLLECTION MECHANISM FOR NAGPUR METRO FEEDER SERVICES

The fare collection for feeder can be done using a smart card where a Smart card reader or a handheld ticketing device can be made available in the feeder vehicle with the driver or a pole mounted tapping device can also be provided if required.

It is suggested that the passengers using Metro and Feeder system be provided some incentive as to passengers who are using Feeder alone. In this case the Smart cards can be programmed to deduct full fare of the feeder if the commuter is not using metro in a user defined time period. In case if the commuter uses the metro in the user defined time period after using feeder services his fare can be subsidized in the metro fare. This can also work for the metro alighting passengers where if the commuter is using a feeder after using the metro in the same user defined period then the fare can be subsidised in the feeder vehicle.

However, Maha Metro has to further explore the options of fare collection mechanism as this option only limits to the commuters who have the smart cards. The passengers who are willing to pay directly by cash will have no other option then to shift to other modes which again will reduce the feeder catchment.

11.1.5 PROPOSED FARE COLLECTION MECHANISM FOR CITY BUS SERVICES

To identify the most optimal fare collection system, the following factors were considered:

1. The present system of fare collection which is being used by City Bus Services in Nagpur
2. Number of boarding & alighting passengers
3. Cost of the system

Currently, the fare collection process is an on board system, which is validated by the conductor, who uses cash and paper as a medium of transaction. However, in some of the buses of NMC, fare is collected with the help of ETVM's. Since the automatic fare collection mechanism is not extensive enough, it is prone to challenges such as higher dwell time at the bus stops, essentially leading to the increase the travel time of the passenger, higher manpower deployment for issuing the tickets as well as for random validation.

As part of the current project, as mentioned in the previous chapter, it is recommended that automatic fare collection system is introduced to the entire city bus system in Nagpur City. It is recommended that each of the bus be provided with the hand held electronic ticket vending and verification machine (ETVM). The machines shall be capable of verification of/charging from the contact less cards, magnetic cards/smart cords and other user traffic charging instruments such as seasonal passes, prepaid cards, single journey tickets, integrated tickets, etc issued earlier or off board.

With the improvement in the technology, the independent fare collection platforms of Metro and City Bus Services can be brought onto the common platform for future transactions. It is also recommended that the city authorities explore the option of integrating city bus services and metro services through common mobility cards and accordingly incentives can be proposed to the mobility card holders for using available public transportation systems.

11.1.6 PROPOSED FARE STRUCTURE FOR CITY BUS SERVICES

As part of the current project, no revised fare structure is recommended. However, it is recommended that NMC adopt a fair and transparent system to increase the fares. Fare revision is also one of the key considerations to achieve sustainability and viability of city bus services in Nagpur. Fares of the city bus transport system is recommended to be revised from time to time basis based on the following formula with the due approval from the state government, keeping in view the parameters such as increase in the fuel prices, spare parts and revision of wages etc. The fare adjustment process is linked with the cost of the manpower and fuel cost.

1. **Increase in the diesel price from Rs XX paisa per litre to Rs XX paisa per litre**

   Diesel price adjustment fare

   F (DPA) = (F-D) + (RPD/BPD) XD

   Where,

   F = Is Total Cost per Passenger km at the time of previous fare revision

   D = is Diesel Cost per passenger km at the time of previous fare revision

   RPD = is revised price of Diesel and

   BPD = is Basic Price of Diesel when the last fare revision was permitted

2. **Increase in Dearness Allowance Rate**

   F(R) =F+ (CPKM (L)/CPKM) X P/100 X F

   Where,

F (R) is Revised Fare paise per passenger km

F is the Present Fare in paise per passenger km

CPKM (L) is staff cost in paise per km at the time of previous fare revision

CPKM is Total cost in paise per km at the time of previous fare revision

P is % increase in Staff Cost due to increase in DA rates over the staff cost at the time of previous fare revision.

Frequency for the change in the fare should be annual with respect to the change in Wholesale Price Index (WPI) and monthly with respect to fuel prices. The fare revision should be automatic and free from any political interference.

11.1.7 FARE STRUCTURE FOR PUBLIC BIKE SHARING SCHEME IN NAGPUR

FARE STRUCTURE OF MYSORE TRIN-TRIN & BHOPAL

A. Mysore's Trin Trin

As in case of Mysore, to become a member, one has to register in any one of the 6 registration centers or Karnataka One Centers by paying Rs 350/- which includes a refundable security deposit of Rs 250/- & processing fees. Members can pay by cash or credit/debit cards or through online portals.

TABLE 11-5: USAGE FEES FOR MYSORE'S TRIN TRIN[3]

USAGE TIME	MEMBER USER FEES IN RS.
Upto 1 Hour	0/-
Upto 2 Hours	5/-
Upto 3 Hours	10/-
Upto 4 Hours	20/-
Upto 6 Hours	50/-
Upto 8 Hours	100/-
Upto 12 Hours	150/-
Greater than 12 Hours	250/-

TABLE 11-6: MEMBERSHIP ACCOUNT RECHARGE FEES OF MYSORE'S TRIN TRIN[4]

Account Recharge Fees	Validity
Rs 50	30 days
Rs 20	10 days

B. Fare Structure of Bhopal PBS

As in case of Bhopal, to become a member, one has to register to gain access to the system using a valid ID proof at the notified registration centers of the BMC and the service provider by paying Rs 50/- as processing fees.

TABLE 11-7: USAGE FEES FOR BHOPAL PBS

Usage Time	User Fees in Rs.
0 – 30 mins	10
Upto 60 mins	20

[3] Source: https://www.mytrintrin.com/?page_id=5407
[4] Source: https://www.mytrintrin.com/?page_id=5407

Usage Time	User Fees in Rs.
Upto 90 mins	40
Upto 120 mins	60
Every 30 mins after 120 mins	30

Users can also subscribe to the system to become a member. The members are offered 50% discounts on the user fees for the first 30 mins. There are three types of membership offered by the system which is as follows;

TABLE 11-8: MEMBERSHIP SUBSCRIPTION OF BHOPAL PBS

Subscription Type	User Fees in Rs.	Validity
One Year Pass	999	1 Year
Three Month Pass	299	3 Months
One Month Pass	149	1 Month

11.1.7.1 PROPOSED FARE STRUCTURE OF PBS NAGPUR

Based on the rational experiences from Global and Indian case studies, the fare box revenue streams generally comprises of the membership fees/subscription fees and user pricing. The general recommendation as per the best practices is that the operator should be paid by the government based on the service level provided, and not directly from the revenue streams, as it gives the government some control over the performance of the system.
The fares levied for the PBS scheme for Nagpur shall be;

1. Subscription Fees on the issue of the smart card for member users for limited period of time
2. Time based user fees

A. Subscription Fees

Subscription fees shall contribute towards a significant portion of the revenue stream, which shall ensure a captive ridership, help deter vandalism or theft of the vehicle and track active users by requiring them to update their user profile and payment details on a regular basis at the time recharge of the subscription. Members with active subscription shall be granted with the benefit of unlimited number of cycle hires of the trip lengths of equal to or less than half an hour during time of their membership. The smart card issued shall be a common mobility card for usage across all modes of transport within Nagpur city.

In case of Nagpur, a registration fee shall be levied at the time of the issue of the smart card which shall constitute security deposit and processing fees. Over and above the registration fee, the potential members can opt for the preferable subscription option. Since the same card is proposed to be used for all modes of transport, the onetime membership fee for joining the PBS scheme shall be overloaded on the metro security card.

TABLE 11-9: PROPOSED SUBSCRIPTION FEES FOR NAGPUR PBS

Subscription Type	User Fees in Rs.	Validity
One year Pass	599	1 Year
6 Month Pass	299	6 Months
3 Month Pass	249	3 Months
One Month Pass	99	1 Month

The subscription members can be offered with various incentives such as discounts on the user fees as well as the registration fees etc.

B. User Fees

A hierarchical time based usage fees is proposed for the PBS Scheme in Nagpur. Time based user fee is based on the following principles;

- Encouraging shorter trips to contain the usage of s within smaller catchment areas. This would reduce the overhead costs towards cycle distribution.
- Fee incentives towards return of s within same catchment zones.
- The initial half an hour would not be charged, to encourage use of Public Bicycle Sharing Scheme.
- After the first half an hour, the fare would increase telescopically, to encourage use of PBS for shorter trips and discourage longer trips.

Considering the above mentioned parameters as well as encouraging the people to maintain the equipment carefully, the proposed fare structure for the PBS Nagpur is represented in the table. It is recommended to have the initial 30 mins as a free ride followed by increasing rental fares for every 30 minutes. This shall discourage the long term use and keep more cycles in circulation.

TABLE 11-10: PROPOSED USER FEE STRUCTURE OF NAGPUR PBS

Duration of Use		Base fare (in Rupees)
From (mins)	To (mins)	
0	30	0
30	60	5
60	90	10
90	120	20
120	180	30
180	240	50
240	360	70
360	480	90

It is also recommended to impose penalty fees on the members and non-members alike for the loss of the smart card, issue of the duplicate card, for the loss or damage to the or any other major/minor infrastructure of the system etc. The members choosing monthly/annual subscription fee will not be charged the user fee separately.

11.2. REVENUE ESTIMATES

11.2.1. REVENUE ESTIMATES FROM FEEDER BUS SERVICES

The proposed Feeder System would lead to many benefits to the users of the system. The benefits of the system could be direct and indirect. Direct benefits would include availability of better connectivity to the metro system, advertisement opportunities for the commercial establishments etc. Indirect benefits would include property development options, rise in market land value etc. Though there are multiple ways of generating revenue, all of them can be categorized into two different types, i.e. Fare Revenue and Non-Fare Revenue.

Fare Box Revenue constitutes to the total amount of money collected from the fare of the travelling passengers. This has been estimated based on the number of kilometres travelled by the vehicle and the total pax-km/year. The pax-km is calculated from the average trip length of the user group and the cost in block km. On the other hand, Non-Fare Revenue is the revenue generated from other secondary sources which are not directly part of the fare box revenue. Categories contributing towards the non-fare revenue include the revenue generated from advertisements at bus stops and buses, revenue from Transit Oriented Development and revenue from other secondary sources. The Advertisement revenue has been estimated from two different sources i.e. advertisement at the bus shelters and advertisement on the buses. The revenue is estimated based on the advertisement cost of Rs. 1,500/van/month, Rs. 3,000/bus/month and Rs. 7,500/Stop/month. These values were assumed based on the rates of cities of similar capacity.

The expenses incurred include:

- The cost of the fuel required for the operation of the buses;
- Cost of Manpower required for the maintenance and operation of the buses;
- Cost of Maintenance of the buses which would cover general servicing;
- Cost of Insurance;
- Depreciation cost of the bus

Final Revenue for the Feeder system has been estimated based on the previously mentioned assumptions of fuel and maintenance cost. In addition to that the escalations in Fuel and Fare Rates have been considered as 5% p.a. with increase in Manpower cost rate at 7.5% p.a. Based on the above assumptions, the estimated revenue for both mini-vans and buses are given in the following tables.

TABLE 11-11 REVENUE FROM MINI VAN

Fleet Type	Mini-Van-Electric (Mahindra E-Maximo)	Mini-Van-CNG (Tata Magic 8 Seater)	Mini-Van-Diesel-Non AC (Mahindra Maximo-VX)
No. of Trips/day/Bus	17	26	26
Pax-km/year	6,660,403	7,981,912	7,981,912
Total Fare/Year	66,604,032	79,819,118	79,819,118
Advertisement revenue/Year	2,268,000	1,812,000	1,812,000
Total Revenue	**68,872,032**	**81,631,118**	**81,631,118**

TABLE 11-12 REVENUE FROM MINI BUS

Fleet Type	Mini- CNG-AC	Mini- Diesel-AC
No. of Trips/day/Bus	22	22
Pax-km/year	8,628,475	8,628,475
Total Fare/Year	86,284,749	86,284,749
Advertisement revenue/Year	2,127,000	2,127,000
Total Revenue	**88,411,749**	**88,411,749**

The operational and maintenance calculations were carried out in the previous chapter. The depreciation rate and insurance have been assumed to be 20%p.a. and 3% of the capital cost for both mini vans and buses. Based on the following assumptions, the estimated expenses for mini vans and buses were calculated.

TABLE 11-13 EXPENSES FOR MINI VAN

Fleet Type	Mini-Van-Electric (Mahindra E-Maximo)	Mini-Van-CNG (Tata Magic 8 Seater)	Mini-Van-Diesel-Non AC (Mahindra Maximo-VX)
Fuel	9,168,750	10,230,722	21,825,540
Manpower	30,302,862	24,258,477	24,258,477
Maintenance	6,070,680	8,002,698	7,275,180
Insurance	1512000	604000	528500
Depreciation	30240000	12080000	10570000
Total Expenses	**77,294,292**	**55,175,897**	**64,457,697**

TABLE 11-14 EXPENSES FOR MINI-BUS

Fleet Type	Mini- CNG-AC	Mini- Diesel-AC
Fuel	27,962,650	37,283,533
Manpower	23,307,000	23,307,000
Maintenance	9,786,928	8,388,795
Insurance	1175000	1410000
Depreciation	14687500	17625000
Total Expenses	**76,919,078**	**88,014,328**

Based on the revenue and expense calculations, the net surplus/deficit for mini vans and buses were calculated. The following tables briefs on the same.

TABLE 11-15 NET SURPLUS/DEFICIT (PER YEAR) FOR MINI VAN

Fleet Type	Mini-Van-Electric (Mahindra E-Maximo)	Mini-Van-CNG (Tata Magic 8 Seater)	Mini-Van-Diesel-Non AC (Mahindra Maximo-VX)
Total Revenue	68,872,032	81,631,118	81,631,118
Total Expenses	77,294,292	55,175,897	64,457,697
Net Surplus/Deficit (Per Year)	(8,422,260)	26,455,221	17,173,421
Net Surplus/Deficit (Per Month)	**-701,855**	**2,204,602**	**1,431,118**

It could be observed that the in the case of mini vans, there is a net deficit in electric vehicle fuel types. However, it could also be noted that the CNG mini vans offer more operational profit as compared to the diesel. As Nagpur metro is all set to be an example to the nation for appreciating sustainable and green initiatives, it is advisable to opt for CNG or Electric Mini vans for the feeder bus operations for Nagpur Metro.

TABLE 11-16 NET SURPLUS/DEFICIT (PER YEAR) FOR MINI-BUS

Fleet Type	Mini- CNG-AC	Mini- Diesel-AC
Total Revenue	88,411,749	88,411,749
Total Expenses	76,919,078	88,014,328
Net Surplus/Deficit (Per Year)	11,492,671	397,420
Net Surplus/Deficit (Per Month)	**957,723**	**33,118**

The CNG mini bus offers a significant operational profit over the diesel mini bus. Hence, for the operation of feeder services where mini buses have been found as the viable option, it is advisable to go for CNG mini bus.

11.2.2. REVENUE ESTIMATES FROM CITY BUS SERVICES

11.2.2.1. FARE REVENUE

The fare revenue for the city bus services has been estimated based on the route wise peak hour ridership estimated. The existing fare structure of the City Bus Services has been considered for the following study.

The fare is expected to increase by 10% per annum commensurate with the increase in operating costs. Based on the estimates the traffic shall increase at 7.33% per annum. The year wise revenue on the modified city bus routes is estimated as under;

Table 11-17 represents the year wise revenue on the city bus services in Nagpur.

TABLE 11-17: ESTIMATED FARE REVENUE FROM THE CITY BUS SERVICES

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Ridership (Crore Pax/year)	14.80	16.09	17.49	19.01	20.66	22.46	23.80	25.22	26.73	28.32	30.01
Fare Revenue (₹ Crore/year)	₹ 201	₹ 240	₹ 288	₹ 344	₹ 412	₹ 494	₹ 569	₹ 655	₹ 754	₹ 869	₹ 1,001
EPKM (₹ /km)	₹ 45	₹ 47	₹ 48	₹ 49	₹ 50	₹ 52	₹ 55	₹ 59	₹ 63	₹ 67	₹ 71

11.2.2.2. ADVERTISEMENT REVENUE

The monthly advertisement revenue is assumed at ₹1000 per bus stop per month and an average of ₹5500 per bus per month, which is expected to increase at 10% per annum.

The year wise estimated total revenue from the City Bus Services from Fare and Advertisement revenue is represented in the Table 11-18.

TABLE 11-18: ESTIMATED REVENUE FROM THE CITY BUS SERVICES

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fare Revenue	₹ 201	₹ 240	₹ 288	₹ 344	₹ 412	₹ 494	₹ 569	₹ 655	₹ 754	₹ 869	₹ 1,001
Advertisement Revenue	₹ 5	₹ 6	₹ 7	₹ 9	₹ 10	₹ 12	₹ 14	₹ 16	₹ 19	₹ 22	₹ 25
Total Revenue	₹ 206	₹ 246	₹ 295	₹ 353	₹ 422	₹ 506	₹ 583	₹ 671	₹ 773	₹ 890	₹ 1,025
EPKM	₹ 45	₹ 47	₹ 48	₹ 49	₹ 50	₹ 52	₹ 55	₹ 59	₹ 63	₹ 67	₹ 71

11.2.3. REVENUE FROM PBS

ESTIMATE FOR REVENUE GENERATION FOR PUBLIC BIKE SHARING

All the operational Public Bicycle Sharing Scheme in India has shown that it cannot generate enough revenue from fare collection. The collected fare can only ensure that the system is used efficiently and responsibly by the cyclists. Higher fares can discourage people to use it, while meagre fares can make the system susceptible to damages and losses due to negligence from cyclists. As such, a basic minimum fare would be put in place, while larger share of revenue will have to be generated through alternate sources.

FARE BOX REVENUE STREAMS FOR PUBLIC BIKE SHARING

The fare box revenue streams generally comprise of the subscription fees and user pricing as mentioned in this chapter. The same has been considered for fare revenue calculation. It has also been assumed that the fares would be increased annually at 10%. Table 11-19 represents the expected revenue from the Subscription Fees.

TABLE 11-19: EXPECTED FARE BOX REVENUE FROM THE SUBSCRIPTION FEES FOR PBS

Year	Total No. of Subscription Users[5]				Total Revenue from the Subscription Fees (₹ in Crores)				
	Annual Users	Half Yearly Users	Quarterly Pass Users	Monthly Pass Users	Annual Users	Half Yearly Users	Quarterly Users	Monthly Users	Total
2017	7469	3734	3734	3734	₹ 0.45	₹ 0.11	₹ 0.09	₹ 0.04	₹ 0.69
2018	7653	3826	3826	3826	₹ 0.46	₹ 0.11	₹ 0.10	₹ 0.04	₹ 0.71
2019	7842	3921	3921	3921	₹ 0.47	₹ 0.12	₹ 0.10	₹ 0.04	₹ 0.72
2020	8035	4017	4017	4017	₹ 0.48	₹ 0.12	₹ 0.10	₹ 0.04	₹ 0.74
2021	8234	4116	4116	4116	₹ 0.49	₹ 0.12	₹ 0.10	₹ 0.04	₹ 0.76
2022	8437	4218	4218	4218	₹ 0.51	₹ 0.13	₹ 0.11	₹ 0.04	₹ 0.78
2023	8645	4322	4322	4322	₹ 0.52	₹ 0.13	₹ 0.11	₹ 0.04	₹ 0.80
2024	8858	4429	4429	4429	₹ 0.53	₹ 0.13	₹ 0.11	₹ 0.04	₹ 0.82
2025	9077	4538	4538	4538	₹ 0.54	₹ 0.14	₹ 0.11	₹ 0.04	₹ 0.84
2026	9301	4650	4650	4650	₹ 0.56	₹ 0.14	₹ 0.12	₹ 0.05	₹ 0.86
2027	9530	4764	4764	4764	₹ 0.57	₹ 0.14	₹ 0.12	₹ 0.05	₹ 0.88
2028	9765	4882	4882	4882	₹ 0.58	₹ 0.15	₹ 0.12	₹ 0.05	₹ 0.90
2029	10006	5002	5002	5002	₹ 0.60	₹ 0.15	₹ 0.12	₹ 0.05	₹ 0.92
2030	10253	5126	5126	5126	₹ 0.61	₹ 0.15	₹ 0.13	₹ 0.05	₹ 0.95
2031	10506	5252	5252	5252	₹ 0.63	₹ 0.16	₹ 0.13	₹ 0.05	₹ 0.97
2032	10765	5382	5382	5382	₹ 0.64	₹ 0.16	₹ 0.13	₹ 0.05	₹ 0.99
2033	11030	5514	5514	5514	₹ 0.66	₹ 0.16	₹ 0.14	₹ 0.05	₹ 1.02
2034	11303	5651	5651	5651	₹ 0.68	₹ 0.17	₹ 0.14	₹ 0.06	₹ 1.04
2035	11581	5790	5790	5790	₹ 0.69	₹ 0.17	₹ 0.14	₹ 0.06	₹ 1.07
2036	11867	5933	5933	5933	₹ 0.71	₹ 0.18	₹ 0.15	₹ 0.06	₹ 1.09
2037	12160	6079	6079	6079	₹ 0.73	₹ 0.18	₹ 0.15	₹ 0.06	₹ 1.12
2038	12460	6229	6229	6229	₹ 0.75	₹ 0.19	₹ 0.16	₹ 0.06	₹ 1.15
2039	12767	6383	6383	6383	₹ 0.76	₹ 0.19	₹ 0.16	₹ 0.06	₹ 1.18
2040	13082	6540	6540	6540	₹ 0.78	₹ 0.20	₹ 0.16	₹ 0.06	₹ 1.21
2041	13405	6701	6701	6701	₹ 0.80	₹ 0.20	₹ 0.17	₹ 0.07	₹ 1.24

The revenue expected from the User Fees is given in the Table 11-20.

TABLE 11-20: EXPECTED FARE BOX REVENUE FROM THE USER FEES FOR PBS

Year	No. of Non -Members[6]	Total Revenue from User Fees (₹ in Crores)
2017	5975	₹ 1.47

[5] The assumptions for the subscription numbers are given in the Annexure 4

[6] *Distribution of the Non-Members based on the Fare Stages is as under to estimate the User Fees from the Non-Members/Non Regular Users*

Duration of Use		% of Trips
From (mins)	To (mins)	
0	30	60.00%
30	60	15.00%
60	90	10.00%
90	120	7.50%
120	180	3.00%
180	240	2.00%
240	360	1.00%
360	480	1.00%

Year	No. of Non -Members[6]	Total Revenue from User Fees (₹ in Crores)
2018	6122	₹ 1.66
2019	6273	₹ 1.70
2020	6428	₹ 1.74
2021	6587	₹ 1.79
2022	6749	₹ 1.83
2023	6916	₹ 1.87
2024	7086	₹ 1.92
2025	7261	₹ 1.97
2026	7440	₹ 2.01
2027	7624	₹ 2.06
2028	7812	₹ 2.12
2029	8005	₹ 2.17
2030	8202	₹ 2.22
2031	8404	₹ 2.28
2032	8612	₹ 2.33
2033	8824	₹ 2.39
2034	9042	₹ 2.45
2035	9265	₹ 2.51
2036	9493	₹ 2.57
2037	9728	₹ 2.64
2038	9968	₹ 2.70
2039	10213	₹ 2.77
2040	10465	₹ 2.84
2041	10723	₹ 2.90

NON-FARE BOX REVENUE FOR PUBLIC BIKE SHARING

The other sources of revenues have been explored and total revenue has been estimated from the following non fare box avenues:

i. Levy of premium for sale of additional FSI in Transit Oriented Development (TOD) zone of proposed metro corridors
ii. Levy of premium on additional FSI towards ancillaries (staircases/ balconies)
iii. Revenue from Stamp Duty
iv. Revenue from Development charges.

A. Non-fare box Revenue from Public Bike Sharing

User fee revenue on its own will not cover the operating costs, hence a combination of advertising, sponsorship, or private parking fee revenue will be required to cover the operating cost of the scheme to ensure that the operator of the scheme receives a fair return on investment. Global and national examples show that bicycle sharing systems that try to cover their costs only through fare box revenues become financially unviable either for the operator or the users. Similar to any other public transport system, alternate sources of revenue (non-farebox) will have to ensure that the cycle sharing scheme is both financially successful and available to a broad spectrum of the population at affordable rates. Some of the potential non-fare box revenue sources are:

- Revenue from selling scrap bicycles – bicycles need to be maintained from time to time as the life span of a is very less and hence is potential source of revenue.
  As in case of Nagpur, it has been assumed that 20% of the net bicycles would be replaced annually and would be sold at a depreciated price of 5% of the original cost. The income from the selling of scrap bicycles is tabulated.
- Advertisement Revenues on the bicycles and docking stations: The sale of advertising space at the PBS Stations and on the cycles is a potentially significant source of revenue.
  As in case of Nagpur, the monthly revenue from the advertisement on each cycle is taken at ₹ 100/month and advertisements on the docking stations is assumed to be charged at ₹ 200 per Sqft month. It is further assumed that there would be no annual increment advertisement revenue.
- System Sponsorship: A private entity can sponsor the whole system in exchange for branding rights. One of the key interest groups may be the bicycle manufacturing companies.
  System sponsorship may be pursued with the leading IT and corporate houses of the city. As in case of Nagpur this opportunity needs to be explored in relation of the local entities.
- Station branding rights: The PBS Stations can be sponsored by corporates or other private entities against station branding and naming rights.
  The branding rates for PBS terminals at metro stations and in the CBD may be priced differently as compared to the residential localities and other places with lower visibility. As in case of Nagpur this needs to be further explored in relation to the local entities.
- Motor vehicle parking fees: Charges for on-street motor vehicle parking in the cycle sharing coverage area can provide a sizable revenue stream[7].
  The parking master plan for the city shall provide the exact distribution of parking revenue towards the public bicycle sharing scheme and other public transport uses.
- Retail at stations: The hub docking stations and large spoke stations may be provided with kiosks to for public convenience and to assist with the redistribution of cycles. These kiosks can be rented out as retail outlets for soft drinks, snacks, newspapers or bicycle repair mechanics. A portion of the rentals from these kiosks may be forwarded as Viability Gap Funding towards the bicycle sharing scheme.

Table 11-21 represents expected Revenue from the Fare Box and Non Fare Box Source

TABLE 11-21: EPXECTED REVENUE FROM FARE BOX & NON FARE BOX REVENUE SOURCES FOR PBS

Year	Fare Box Revenue (₹ in Crores)			Non Fare Box Revenue (₹ in Crores)			Total Revenues (₹ in Crores)
	Revenue from Subscription Fees (A)	Revenue from User Fees (B)	Total Revenue from Fares C = A+B	Advertisement Revenue[8] D	Revenue from Scrap E	Total Non Box Revenue F = D+E	G = C+F
2017	₹ 0.69	₹ 1.47	₹ 2.16	₹ 1.02	₹ 0.000	₹ 1.02	₹ 3.19
2018	₹ 0.71	₹ 1.66	₹ 2.36	₹ 1.09	₹ 0.019	₹ 1.11	₹ 3.47
2019	₹ 0.72	₹ 1.70	₹ 2.42	₹ 1.10	₹ 0.020	₹ 1.12	₹ 3.54
2020	₹ 0.74	₹ 1.74	₹ 2.48	₹ 1.11	₹ 0.020	₹ 1.13	₹ 3.61
2021	₹ 0.76	₹ 1.79	₹ 2.55	₹ 1.12	₹ 0.021	₹ 1.14	₹ 3.69
2022	₹ 0.78	₹ 1.83	₹ 2.60	₹ 1.13	₹ 0.022	₹ 1.15	₹ 3.76
2023	₹ 0.80	₹ 1.87	₹ 2.67	₹ 1.14	₹ 0.022	₹ 1.16	₹ 3.83
2024	₹ 0.82	₹ 1.92	₹ 2.74	₹ 1.15	₹ 0.023	₹ 1.18	₹ 3.92
2025	₹ 0.84	₹ 1.97	₹ 2.81	₹ 1.16	₹ 0.024	₹ 1.19	₹ 4.00
2026	₹ 0.86	₹ 2.01	₹ 2.87	₹ 1.18	₹ 0.024	₹ 1.20	₹ 4.07
2027	₹ 0.88	₹ 2.06	₹ 2.94	₹ 1.19	₹ 0.025	₹ 1.21	₹ 4.16
2028	₹ 0.90	₹ 2.12	₹ 3.02	₹ 1.20	₹ 0.026	₹ 1.23	₹ 4.24

[7] For example, Barcelona pioneered an innovative policy of devoting 100 percent of revenues from on-street parking fees to the city's Bicycle sharing system (ITDP 2011).
[8]Advertisement Revenue Includes Revenue from Advertisement on Cycles and at Docking Stations

Year	Fare Box Revenue (₹ in Crores)			Non Fare Box Revenue (₹ in Crores)			Total Revenues (₹ in Crores)
	Revenue from Subscription Fees (A)	Revenue from User Fees (B)	Total Revenue from Fares C = A+B	Advertisement Revenue[8] D	Revenue from Scrap E	Total Non Box Revenue F = D+E	G = C+F
2029	₹ 0.92	₹ 2.17	₹ 3.09	₹ 1.62	₹ 0.027	₹ 1.65	₹ 4.74
2030	₹ 0.95	₹ 2.22	₹ 3.17	₹ 1.64	₹ 0.027	₹ 1.67	₹ 4.83
2031	₹ 0.97	₹ 2.28	₹ 3.25	₹ 1.65	₹ 0.028	₹ 1.68	₹ 4.93
2032	₹ 0.99	₹ 2.33	₹ 3.33	₹ 1.67	₹ 0.029	₹ 1.70	₹ 5.02
2033	₹ 1.02	₹ 2.39	₹ 3.41	₹ 1.68	₹ 0.030	₹ 1.71	₹ 5.12
2034	₹ 1.04	₹ 2.45	₹ 3.49	₹ 1.70	₹ 0.031	₹ 1.73	₹ 5.22
2035	₹ 1.07	₹ 2.51	₹ 3.58	₹ 1.71	₹ 0.032	₹ 1.74	₹ 5.32
2036	₹ 1.09	₹ 2.57	₹ 3.67	₹ 1.73	₹ 0.033	₹ 1.76	₹ 5.43
2037	₹ 1.12	₹ 2.64	₹ 3.76	₹ 1.74	₹ 0.034	₹ 1.78	₹ 5.53
2038	₹ 1.15	₹ 2.70	₹ 3.85	₹ 1.76	₹ 0.035	₹ 1.79	₹ 5.65
2039	₹ 1.18	₹ 2.77	₹ 3.94	₹ 1.78	₹ 0.036	₹ 1.81	₹ 5.76
2040	₹ 1.21	₹ 2.84	₹ 4.04	₹ 1.79	₹ 0.037	₹ 1.83	₹ 5.88
2041	₹ 1.24	₹ 2.90	₹ 4.14	₹ 1.81	₹ 0.038	₹ 1.85	₹ 5.99

CHAPTER 12 FINANCIAL AND ECONOMIC ASSESSMENT

12.1. FINANCIAL ANALYSIS

As mentioned in Chapter 10 and 11, the total project cost for Metro Feeder Services, City Bus Services and NMT Master Plan works out to be Rs 41.01 crores, Rs 496.55 Crores and 1582.99 Crores. Accordingly, the operation and maintenance cost and revenue streams for the Metro Feeder and City bus Services have been discussed in detail in Chapter 10 and Chapter 11 respectively.

As mentioned in the Chapter 10, from the figures presented for Feeder Services, it can be understood that the CPKM for Electric vehicles is slightly higher than the CNG vehicles. But considering the long term dynamic shift towards Electric fuel technology the cost of the Electric vehicles shall come down, thereby making it more viable.

As already presented in Chapter 10 & 11, in the case of City Bus Services operated by NMC, results in a break even scenario wherein the revenue generated is nullified by the expenditure during this period. Based on the above mentioned assumptions, the above calculations were carried out and financial viability of the project was estimated, which worked out at 3%. The details of which are represented in the following sections.

12.2. PROJECT FUNDING

12.2.1. PROJECT FUNDING FOR CITY BUS SERVICES

The project envisages utilizing eco-friendly electric and ethanol fuelled buses which are at present more expensive than the conventional diesel buses. Further public transport in general and especially intra city operations are generally not financially viable only on the basis of fare revenue. Hence, the city bus services for Nagpur need to be encouraged with generous share of capital subsidy/grants from Government of India, Government of Maharashtra, and Municipal Corporation of Nagpur and multilateral funding agencies. Accordingly the following funding assumptions have been used:

TABLE 12-1: MEANS OF FINANCING

Financing	%age	Amount (₹Crores)
Debt	80%	₹ 397.24
Equity	20%	₹ 99.31
Total Capex		₹ 496.55

12.2.1.1. CASH FLOW STATEMENT

Based on the above financial structure, the cash flow statement is presented in the Table 12-2.

TABLE 12-2: CASH FLOW STATEMENT

Cash Flow Statement	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Capex	-₹ 497	-₹ 58	-₹ 58	-₹ 58	-₹ 58	-₹ 58	-₹ 58	-₹ 58	-₹ 58	-₹ 58	-₹ 58
Operating Surplus	-₹ 64	-₹ 59	-₹ 52	-₹ 41	-₹ 26	-₹ 8	₹ 20	₹ 56	₹ 101	₹ 158	₹ 229
Debt	₹ 397	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0
Equity	₹ 99	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0
Debt Repayment	-₹ 12	-₹ 16	-₹ 20	-₹ 24	-₹ 28	-₹ 40	-₹ 44	-₹ 48	-₹ 52	-₹ 56	-₹ 60
Interest	-₹ 5	-₹ 5	-₹ 4	-₹ 4	-₹ 4	-₹ 3	-₹ 3	-₹ 2	-₹ 2	-₹ 1	₹ 0
Salvage Value	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0	₹ 0
Net Cashflow	-₹ 81	-₹ 138	-₹ 134	-₹ 127	-₹ 116	-₹ 109	-₹ 84	-₹ 52	-₹ 10	₹ 44	₹ 111
DSCR	-0.7x	-0.1x	0.5x	1.0x	1.5x	1.6x	2.2x	2.9x	3.6x	4.5x	5.5x

Based on the above projected profitability and cash flow projections, the summary of financial indicators are estimated as under

- Average DSCR : 1.20
- Project IRR : 2%

The above estimations do not consider the exchange rates. It can be seen that the project is not only operationally self-sustainable, but it is expected to support the repayment of the loans taken by the Government of Maharashtra.

12.2.1.2. SENSITIVITY ANALYSIS

Sensitivity Analysis is conducted by applying the following adjustments in the assumptions.

TABLE 12-3: SENSITIVITY ANALYSIS

Event	FIRR	Avg. DSCR
Base Case	4.03%	1.20
5% increase in Capex	3.26%	1.16
5% increase in fuel costs	2.86%	1.13
5% increase in salary	2.94%	1.14
5% increase in Maintenance Costs	3.50%	1.17

It can be seen that the IRR remains positive and DSCR is also above 1.1 in all the above scenarios.

12.2.2. PROJECT FUNDING FOR NON-MOTORIZED TRANSPORT

This section touches upon the funds required vs availability and the deficit/surplus in the three phases of implementation of the NMT Master Plan.

TABLE 12-4 : FUNDS REQUIRED BY MAHA METRO FOR NMT IMPROVEMENTS

Fund Management	Phase-I	Phase-II	Phase-III
Required	₹ 163.5 Cr. (excluding feeder service)	0	0
Available	₹ 173.6 Cr is available as per Nagpur Metro DPR (2% of the total cost =8680 Cr.)	0	0
Surplus	₹ 10.1 Cr.	0	0

TABLE 12-5: FUNDS REQUIRED BY NMC FOR NMT IMPROVEMENTS

Fund Management	Phase-I	Phase-II	Phase-III
Required	₹ 306.7 Cr.	₹ 424.6 Cr.	₹ 688.2 Cr
Available	₹ 42.5 Cr. to be diverted from concretization of roads under smart city mission. + ₹ 0.10 Cr. For implementation of PBS under smart city mission. **Note:** No funds allocate under AMRUT scheme towards Urban transport / road improvements	--	--
Deficit	₹ 274.5 Cr.	₹435.5 Cr.	₹688.1 Cr

12.1.2.1. POSSIBLE SOURCES OF ADDITIONAL FUND

1. **Loan from Multi-lateral funding agency-** Both Maha Metro and Nagpur Municipal Corporation may seek funds from various Multi-Lateral Agencies. The same can be repaid through the possible sources of revenue mentioned in Section 7.9 below
2. **Budget Allocation (state/central) -** NMC may seek budget allocation for NMT based improvements in the city.
3. **Central government grant/ fund-** NMC may approach the central government for allocation of additional grants/ funds under Smart City Mission/ AMRUT scheme or future schemes of GOI.
4. **Biodiversity Act-** To implement the Urban Place Making scheme around Ambazari Lake, and ecomobility corridors along nallahs of the city, NMC may seek funds under the National Biodiversity Act.
5. **PPP / Crowd sourcing-** Private be invited to adopt certain roads and public spaces to fund improvement works. Similarly, funds may be raised via Resident welfare association, traders associations and SEZs through crowd sourcing.

12.1.2.2. REVENUE SOURCES

Revenue sources are divided under three sections direct, indirect and induced. The details of possible revenue sources are listed in TABLE 12-6.

TABLE 12-6 : POSSIBLE SOURCES OF REVENUE FOR NMT IMPROVEMENTS

Direct	Indirect	Induced
Advertisement revenue **from boards and hoardings proposed in street improvements works and urban placemaking schemes**	**Increased property taxes** Improved streets and public spaces shall result in higher circle rates and property rates. A portion of Increased Property tax can be diverted to improve streets and public spaces.	**Improved budget** • All these measures will increase revenue collection of the city • Higher budget allocation can be sought towards improvement upkeep and maintenance of streets and public spaces.
Mobile/ web application **will also host advertisements for the Promotion. Revenue from these advertisements would also be available.**	**Increased Commercial Activity** because of higher footfall in around the area shall increase tax collection.	**Less maintenance** Overall expenditure of city towards maintenance will come down and reduce the burden on exchequer.
PBS Implementation **will generate direct revenue**	**Increased GST**- Improvement of streets and public spaces shall enhance economic activity and hence result in Higher tax collection	--
Tickets / Rents • **Some urban placemaking projects may be ticketed- like parks and lake fronts etc** • **Rents from Kiosks, Vending zones and paid toilets.**	**Betterment levy -** additional charges over the property tax for the services may be collected	--

NOTE: Road owing/maintaining agency along with NMC should commission a study to access and quantify the direct, indirect and induced economic benefits of the NMT improvements in Nagpur.

12.3. ECONOMIC ANALYSIS

The purpose of this section is to explore the economic feasibility of the current project. In order to do that we will have to focus on the following;

1. The economic benefits from the project
2. The economic costs of the project
3. The balance of these expressed in present value terms or in terms of economic IRR

12.3.1. METHODOLOGY

The economic evaluation provides overall contribution of the project towards achieving social objectives and uses the social cost benefit approach. The overall measure of the social benefit is the Economic IRR. All future economic costs and benefits are assessed at current prices net of taxes and other non-economic costs and economic IRR is estimated. The benchmark EIIR generally used for Indian projects is 12%. The other measure for social cost benefit analysis is the benefit to cost ratio. The present value of the economic benefits and costs are computed and the project is recommended if the benefits to cost ratio is more than 1. This ratio can be used for comparing competing projects.

For this project, the EIRR analysis considers a period of 11 years (1 year implementation and 10 year operation) since the life of the assets funded under this project is considered to be 10 years.

Various estimated costs and benefits include the element of taxes which is not an economic cost. Hence economic factor have been applied for converting the project costs and benefits to economic benefits as show in Table 12-7. Saving in fuel cost is estimated at shadow prices net of taxes and therefore no further reduction is necessary.

TABLE 12-7: ECONOMIC FACTORS USED IN ECONOMIC ANALYSIS

Sr.	Item	Factor
1.	Capital Costs	80%
2.	O&M Costs	80%
3.	Savings in vehicle operating costs	80%
4.	Savings in travel time cost	80%
5.	Savings in accidents	100%
6.	Savings Pollution Costs	100%

12.3.2. ESTIMATED COSTS

The cost of implementing and operating the project includes the capital costs, the manpower costs, fuel costs, maintenance and other miscellaneous costs. These costs have already been explained in detail in the financial analysis section. Non-economic costs like interest; insurance expenses etc. have been excluded.

12.3.3. ECONOMIC BENEFITS:

This project is being implemented primarily for providing 2 benefits to residents of Nagpur

i. Use of eco-friendly technology/fuel to reduce carbon emission as well as other pollutants which have adverse effects on health of the citizens
ii. Provide better coverage and frequency to reduce overall travel time and motivate users to use more efficient public transport

The estimation of economic benefits of the above are explained in the following sections

12.3.3.1. MODAL SHIFT

The modal shift of passengers from personalized modes to the City Bus services have already been discussed. Based on the analysis of shifted passenger trips from other modes to City Bus Services, further analysis and estimates with respect to the savings in reduction in carbon emissions, other pollutants, fuel costs, vehicle operating costs, accidents, travel time and employment generation, have been worked out which is described in the following sections.

12.3.3.2. REDUCTION IN CARBON EMISSION:

The project will use Diesel, Ethanol and Electric buses which are environment friendly. The consumption of various fuels (Diesel and Petrol) is estimated for the expected users of the project before implementation of the project and the total emission is then compared with emissions resulting from the project.. It could be observed from the previous Chapter that with the up gradation of the city bus services in Nagpur, there is a reduction of Co2 per passenger from 53.63 grams per passeneger to 47.83 grams per passenger, a saving of 5.80 grams per passengers (approximately 10.82%). The savings are quantified into monetary terms @ ₹1000/ton of CO2.

12.3.3.3. REDUCTION IN OTHER POLLUTANTS:

Personalised transports (Car/Taxi, Auto, 2 wheelers) are also cause higher levels of other air pollutants such as SOx, NOx, particulate matter etc. as compared to mass public transport like buses. Further, CNG has much lower pollution levels than diesel/ petrol. Hence the pollution caused by the present passenger trips is estimated and compared with the passenger trips using the Ethanol and Electric buses proposed under the project. The reduction is converted into savings @ ₹ 10,00, 000/ton.

TABLE 12-8: VEHICLE EMISSION (G/KM) 2011-2021 (CPCB) AND COST (IN RS)

VEHICLE	CO	HC	NOx	PM
Cars	1.39	0.15	0.12	0.02
Autos	2.45	0.75	0.12	0.08
Taxis	1.39	0.15	0.12	0.02
Bus (Diesel)	3.72	0.16	6.53	0.24
2 Wheelers	1.4	1.32	0.08	0.05
Total Emission Avoided (Tons/year)	17.47	10.71	4.01	0.63
Bus (Ethanol)	0.00	0.00	0.00	0.00
Bus(Electric)	0.00	0.00	0.00	0.00
Project Emissions	0.00	0.00	0.00	0.00
Reduction In Emissions	17	11	4	1
Health Cost	₹1000000/Ton			
Total Savings (₹lakhs/Year)	1.7471	1.0714	0.4015	0.0630

12.3.3.4. REDUCTION IN FUEL COSTS:

The project results in shifting of usage pattern from personalised transport to public transport resulting in less fuel consumption. The consumption of various fuels (Diesel and Petrol) is estimated for the expected users of the project before implementation of the project and quantified using shadow prices of respective fuel.

TABLE 12-9: SHADOW PRICES FOR FUEL

Particulars	Petrol (₹/Litre)	Diesel (₹/Litre)	Ethanol(₹/Litre)
Gate Price	27.91	28.24	39.83
Excise Duty (1)	21.48	17.33	4.92

Particulars	Petrol (₹/Litre)	Diesel (₹/Litre)	Ethanol(₹/Litre)
Commission	2.3	1.46	
Total	51.69	47.03	44.75
VAT (2)	18	13.31	2.24
Total/Unit (3)	69.69	60.34	46.99
Shadow Price (3-2-1)	30.21	29.7	39.83

12.3.3.5. VEHICLE OPERATING COSTS:

The shifting of users from personalised to public transport will also lead to reduction in vehicle operating costs. The total VOC for various types of vehicles are assumed as under:

TABLE 12-10: VEHICLE OPERATING COSTS

Vehicle Operating Cost (₹ Per km)	Bus	4 Wh (Large)	4 Wh (Small)	2 Wh (MC)	2 Wh (SC)	3 Wh (Auto)
Total VOC (2015-16)	6.98	6.58	3.54	0.82	0.96	3.27
Total VOC (2017-18)	7.70	7.25	3.90	0.90	1.06	3.61

70% of the cars in Nagpur are assumed to be small cars whereas equal proportion of Motor Cycles and Scooters is assumed.

12.3.3.6. ACCIDENT REDUCTION:

With the reduction in the number of vehicles on the road, there will be reduction in number of accidents and related costs. The saving in accident costs is assumed as under:

	Accident Rate/Crore Veh-km	Cost/Accident in ₹	₹/Crore Veh-km
All Types of Accidents	1.42	5,88,911	0.0835
Fatal Accidents	0.18	16,92,648	0.0302

12.3.3.7. REDUCTION IN TRAVEL TIME COSTS

The users will benefit from increased route coverage and frequency of the buses. It is expected that the walking distance to/from the bus stop will reduce from 2.2 km to 1.1 km. At average walking speed of 4.5 km/hour, this will result in saving of 15 mins of walking time for passengers. However, since some of them use motorised transport for last mile connectivity, conservatively, a saving of 10 minutes bus existing bus passengers is assumed. However, the persons using personalised modes of transport will have to walk/wait a little more than present and for them travel time is likely to increase on an average.

Further, with lesser number of vehicles on road, the average travel speed of the buses will increase which will also result in travel time savings.

The cost of travel time for various users is estimated as under:

Passenger currently using	Car	2 Wheeler	Auto	Existing Buses
Income/Month	25,000	20,000	17,500	12,000
Cost Per Hour	128	99	99	71

12.3.3.8. EMPLOYMENT GENERATION

The city bus project is likely to add 360 buses (excluding spare buses) to the NMC fleet. This is likely to provide direct employment to above ~3500 persons in the form of drivers, conductors, and maintenance staff besides employment generated

in producing these vehicles. However, at the same time, this is expected to reduce income of taxi and auto owners/drivers in similar proportion. Hence the project is not expected to have any material incremental benefit or cost in terms of employment generation.

TABLE 12-11: IMPACT ON EMPLOYMENT GENERATION

Mode	Avg. Occupancy	Passenger Shifted	Trips Reduced/day
Auto	1.80	13067	5,450
Total trips reduced/day			9,150
Employment reduction (assuming 20 trips/day)			458

12.3.3.9. RESULTS OF THE ECONOMIC ANALYSIS

Based on the economic benefits and costs, the EIRR works out to be 29%. The benefit to cost ratio is 1.18 Since this EIRR is more than the bench mark EIRR of 12% and benefit to cost ratio is more than 1, the project is recommended for implementation.

A sensitivity analysis is carried out to see if the project remains economically viable under various scenarios:

TABLE 12-12: ECONOMIC SENSITIVITY ANALYSIS

Sr.	Scenario	EIRR	BC Ratio with discounting rate of 12%
1.	Base Case	29%	1.18
2.	10% increase in capital Costs	24.3%	1.23
3.	10% increase in operating costs	24.3%	1.21
4.		20.8%	1.15
5.	10% decrease in benefits	14.9%	1.05
6.	All the above (2,3,4)	24.3%	1.23

As can be seen, the project remains viable under all the above scenarios. However, it is more susceptible to the reduction in benefits and hence special attention needs to be given to ensure that the benefits arising from the project are obtained as envisaged.

CHAPTER 13. IMPLEMENTATION FRAMEWORK

13.1. INTRODUCTION

The operations and management of the Urban Transport system is not coordinated and highly segregated. This gets more complex as Indian cities have many alternative modes of transport, each one having its own importance and relevance. There are a number of agencies which are involved in dealing with various modes in the system which complexes the coordination process. Implementation Strategy is vital to the success of the project. The objective of implementation strategy is to have a detailed coordinated plan for all the aspects of the Metro Feeder Services and City Bus Operations in Nagpur.

13.2. PRESENT SCENARIO

The organisational form selected and institutional set up has a great impact on the functioning of the public transport system. The city bus services in Nagpur is undertaken by Nagpur Municipal Corporation through Private Operators. The Nagpur Metro is to be operated by Maha Metro. While some of the other transport related activities are performed by the various stakeholders in Nagpur, a host of them fall under the purview of State Governments. These activities are divided in a number of departments making coordination difficult, time consuming and non-responsive to the expectations of the citizens. The transport system in Nagpur is no exception to the above situation.

Currently transport related functions in Nagpur, as in any other Indian Cities, performed by various agencies are listed in the Table 13-1.

TABLE 13-1 : INSTITUTIONAL INVOLVEMENT IN URBAN TRANSPORT

Sl.No.	Organisation	A Few Urban Transport Related Functions
1	Ministry of Housing and Urban Affairs (MoHUA), Government of India (GOI)	Urban Transport Policy formulation
2	Nagpur Improvement Trust & Nagpur Municipal Corporation	✓ Land use planning and distribution ✓ Preparation of Master Plans including that of urban transport ✓ Provisioning and maintenance of traffic signals, road signages, street furniture ✓ Construction and Maintenance of city roads ✓ Clearance of ROW encroachments
3	Department of Road transport and highways, GOI	Motor vehicle act., its preparation, notification and administration
4	Public Works Department, Government of Maharashtra	✓ Construction and maintenance of State Roads ✓ Construction and maintenance of city roads under their Jurisdiction
5	District Road Transport office	✓ Preparation and administration of State Motor Vehicle Rules ✓ Administration of transport vehicle tariffs ✓ Inspection Certification and Registration of Motor Vehicles ✓ Administration and Control of route permits for public transport, IPT ✓ Administration of passenger tax, motor vehicle tax, road tax etc. ✓ Licensing of transport crew.
6	Nagpur Police	✓ Enforcement of traffic and other related laws ✓ Administration and Control of traffic movement.
7	Ministry of Environment and Forest, GOI	✓ Setting Vehicular Emission Norms

It is observed from above table, that a number of agencies control urban transport system. Such multiplicity of control leads to:

- ✓ Inter organizational conflicts where disagreements can over-ride shared values between agencies.
- ✓ A need for very high level of coordination
- ✓ Fragmentation of functional responsibilities

- ✓ Lack of local expertise
- ✓ Lack of focused attention and integrated approach in planning, budgeting, operation and control of the urban transport
- ✓ "Passing the Buck" approach to stakeholder needs, expectations and grievances from urban transport system
- ✓ Urban planning and transportation issues lacking in a coherent approach
- ✓ Multiplicity of command and control
- ✓ Paucity of expertise in innovative approach for raising finances for public transport

There are various State Transport Undertakings (STUs) in the country, which are operating urban transport services in various cities.

On the basis of organisational set up, the above urban Transport undertakings can be categorised into 4 forms; viz.

i Incorporated under RTC act 1950 (PRTC, DTC Delhi; CSTC Kolkata; APSRTC – Hyderabad; RSRTC – Jaipur).

ii Under companies Act 1956 (e.g. MTC Chennai, ST Pondicherry)

iii As a Municipal Undertaking (e.g. BEST Mumbai, AMTS Ahmedabad, , KMT – Kolhapur, SMT – Solapur)

iv Government Departments (e.g. CTU – Chandigarh)

Financially, most of these urban STUs incur loss irrespective of their organisational structure, though their physical performance has been comparable with the expected levels.

Thus, there is a need for institutional set up for the proposed PT system to adopt innovative business model and design its organisation to suit the challenges of urban transport sector as proposed under National Urban Transport Policy, 2006.

13.3. INSTITUTIONAL ARRANGEMENT

At present, there is no single authority controlling the public transport operations in Nagpur. Since, there are no. of institutions and departments involved, coordination is difficult, time consuming and non-responsive to the expectations of the citizens. There is a need for a robust institutional arrangement for proper functioning of the metro feeder and city bus services.

13.3.1. UNIFIED METROPOLITAN TRANSPORT AUTHORITY (UMTA)

The National Urban Transport Policy (NUTP, 2006) has recommended setting up of Unified Metropolitan Transport Authorities (UMTAs) in all million plus cities. The NUTP (2006) envisages that UMTA shall facilitate more coordinated planning and implementation of urban transport programmes & projects and integrated management of urban transport systems. The setting up of such umbrella bodies shall regulate the overall performance of the public transport systems and ensure that the city has a comprehensive public transport system.

With a view to coordinate all the urban transport activities within Nagpur, it is recommended that a Unified Metropolitan Transport Authority (UMTA) be set up, which can act as an umbrella institution for planning, monitoring and decision making body for efficient operations of all matters related to the urban transport within the city.

Structure of UMTA in Nagpur

- Managing Director, Nagpur Metro Rail Ltd – Chairman
- Municipal Commissioner, Nagpur Municipal Corporation (NMC) – Member Secretary
- Chairman , Nagpur Improvement Trust (NIT) - Member
- District Collector – Member

- Commissioner of Police – Nagpur – Member
- Managing Director, Maharashtra State Road Transport Corporation or his nominee – Member
- Area Manager, Central Railway – Nagpur – Member
- Area Manager, South East Central Railway – Nagpur - Member
- District Transport Officer, Nagpur – Member

The functions of UMTA for Nagpur are as follows;

1. It is proposed to recommend fares for the use of public transport as well as para-transit to the appropriate fare fixation authority prescribed under the MV Act and also fix fees, if any, for the use of depots, terminals and all such infrastructure that may be provided by one agency but used by another .
2. Determine, prescribe, monitor and direct the enforcement of performance parameters and quality of service standards for all modes of public transport, including standards relating to safety of operations that are outside the purview of the STA or the Commissioner of Railway Safety
3. Allocate routes amongst different operators through a transparent process
4. Evolve policies for private sector involvement in public transport in the city, including decisions relating to minimum fleet size, etc
5. Procure public bus services for different routes by any method such as contracting, concessioning, etc. as it may deem fit
6. Monitor and enforce contracts
7. Ensure compliance of terms and conditions of license
8. Recommend revocation of license for non-compliance of terms and conditions of the license
9. Carry out surveys and manage a database for scientific planning of public transport requirements
10. Co-ordinate fare integration among different bus operators and also between different modes of public transport as well as determine the principles for sharing of revenues earned from common tickets or passes
11. Operate a scheme of passes for the use of public transport and channelize subsidies to operators for any concessions that are offered in accordance with government policy
12. Regulate the arrangement amongst operators for the sharing of their revenue derived from the use of passes;
13. Facilitate competition and promote efficiency in the operation of public transport services;
14. Protect the interest of the consumers of public transport service;
15. Settle disputes between different operators and between operators and infrastructure providers;
16. Render advice to the State Government in the matters relating to the development of vehicle technology and any other matter relating the public transport industry in general, including the provision of special facilities for the physically challenged, senior citizens, women and children;
17. Levy fees and other charges at such rates and in respect of such services as may be determined by regulations;
18. Perform such other functions including such administrative and financial functions as may be entrusted to it by the State Government or as may be necessary to carry out the provisions of the act.

However, the various authorities under UMTA should perform their individual function under the purview of UMTA.

13.4. IMPLEMENTATION AGENCIES

Based on the existing roles, responsibilities and operational capabilities of various institutions and as per their corresponding jurisdiction, the agencies responsible for implementation of the current projects are given the Table below;

TABLE 13-2 PROJECT WISE IMPLEMENTING AGENCIES

Sl. No.	Component	Role of UMTA	Agencies responsible for Implementation	Implementation Options	
				Deployment/Construction	Operation and Maintenance
1	Procurement of Fleet for Metro Feeder	Technical Specification of the vehicles shall be defined as per the UBS II or the prevailing CMVR Rules which shall be recommended/supports by UMTA	Maha Metro		
1	Procurement of Fleet for City Bus Services	Technical Specification of the vehicles shall be defined as per the UBS II or the prevailing CMVR Rules which shall be recommended/supports by UMTA	Nagpur Municipal Corporation		
3	Bus Q Shelters for Metro Feeder and City Bus Services	UMTA shall issue the guidelines w.r.t the location, Layout/design for the Bus Q shelters (city bus services & metro feeder) along with the indicative cost the BQS	Nagpur Municipal Corporation		
4	Bus Depots	UMTA shall identify additional land parcels for the development of additional depots for the Metro Feeder Operations and City Bus Operations	Existing Bus Depots of CBS – upgradation activities to be taken up by NMC (designing, construction and operations & maintenance, Smart City Additional Depots – Land identification w.r.t NIT and Alternate Financing Options would be explored by UMTA		
5	Bus Terminals	UMTA shall identify land parcels for new bus terminals at the identified locations with NIT. Planning, Designing and Implementation responsibility of UMTA	UMTA	Smart City, Public Sector organizations like PWD	UMTA
6	ITS	UMTA shall undertake the integration of different platforms of ITS systems on a common system. It shall integrate the ITS of Metro, Feeder, City Bus Services and Waterways at two levels, namely,	NMC & Maha Metro	Smart City, NMC & Maha Metro	NMC & Maha Metro and UMTA

Sl. No.	Component	Role of UMTA	Agencies responsible for Implementation	Implementation Options	
				Deployment/Construction	Operation and Maintenance
		Information Integration and Fare Integration			
7	Multi Modal Integration	UMTA shall take the responsibility of Physical integration of all modes of transport at Bus Terminal, Metro Stations and Railway Station in coordination with the Urban Local Bodies and stakeholders	UMTA	UMTA	UMTA
8	NMT Street Improvements	Retrofitting Urban Streets with Footpaths and Cycle tracks	Maha Metro and NMC within their respective jurisdiction		
9	Station Accessibility		Maha Metro		
10	Urban Place Making		Maha Metro and NMC		
11	Public Bike Sharing Scheme		Smart City, NMC, Maha Metro along with the Private operator within the purview of UMTA		

13.5. IMPLEMENTATION PLAN

The feeder service supports the metro system by providing last mile connectivity option. Being a part of a major High Priority Transport system, feeder service should be operated in conjunction with the Metro System. The objective of the feeder is to support the Metro system so its contracting strategies shall be in alignment with the Metro System. With respect to Nagpur, the Maha Metro acts as the SPV. The contracting models is required by the SPV (Maha Metro) for the appointment of the feeder operator.

NMC has allotted the operations of CBS to four operators (3 Diesel1& 1 Ethanol2) under a Gross Cost Contract to operate 487 buses. NMC has also engaged DIMTS as Integrated Bus Transport Management (IBTM) Operator or in other words a programme manager, who shall be managing the day to day coordination of bus services on behalf of NMC, who shall also provide technology based solutions to integrate all the domain elements of City Bus Services for a modern and efficient city bus services to the commuters of the city.

13.5.1. AREA CONTRACT

If the permit issued to the private operator by the transport authority/ULB authorizes the exclusive operation in an area that form all or a substantial part of the city, it is described as area contract. This is suitable when the city has a number of relatively self-contained areas. The Area contract can further be classified as Gross Cost and Net Cost Contracts. These are further discussed latter based on the appropriate contract for the city of Nagpur. An Area contract will be more appropriate if:

[1]M/s Shyama Shyam, Delhi, M/s Travel Time, Pune & M/s Hansa, Nagpur
[2] M/s Scania

- The city has various pockets of area which are mostly self-contained;
- The authority would like to entrust the contractor with bus service planning as well;
- The authority would like the bus operator to act as an independent agency and be recognized as a Bus Service provided.

13.5.2. ROUTE CONTRACT

If the permit issued to the private operator by the transport authority/ULB authorizes the exclusive operation in a route or a group of routes, then it is described as a route contract. A route contract is applicable when the transport authority/ULB intends to:

- Retendering of routes has to be taken on after certain number of years;
- If the authorities would like to determine the routes and schedules;
- If the authority would like to be recognized as a Bus Service Provider;
- To offer opportunities for small service providers;
- To uptake the responsibility of the service planning.

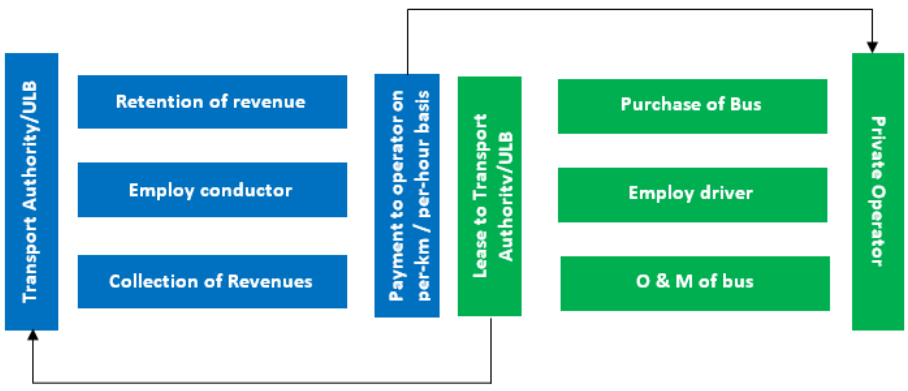
In case of the Feeder services and City Bus Services in Nagpur, the routes are pre-evaluated and the service is designed with an objective of providing connectivity to a metro system and not to be operated as an individual service. This makes route contracts a valid option for the operation of feeder services and City Bus Services in Nagpur. The Route Contract is further classified into various types based on the contractual obligations and the responsibility entrusted to the various agencies. The various types of contracting methods are broadly described in subsequent sections.

13.5.3. GROSS COST MODEL

This is a most widely adopted contracting model by the public agencies. The model envisages that the operation would be customer driven. The principle of the model is that the buses will be owned and operated by a private operator over a pre-agreed concession period of say 5-7 years. The operator will be paid based on bus-kms operated by him with a guaranteed km per bus per annum. In case of an incentive scheme, the public transport authority can share the commercial risk with the operator. The operator takes the risk on the operating costs and the public transport authority takes the commercial risk on the commercial revenues. The operator selected shall have adequate experience in bus operation and shall also have sufficient experience in transport sector and should have professional staff who are qualified and competent in executing the operations.

The Gross Cost Contracts differs from Cost Plus Contracts in the following ways; In Cost-plus contracts, the transport authority/ULB has a higher liability as it reimburses the operating costs incurred by the private operator, whereas, the transport authority/ULB is only accountable to the negotiated per-hour or per-kilometer rates based on the service in the Gross Cost Contracts. Hence in a gross-cost contract, private operator shares the operation risk with the transport authority. This will provide a better operational efficiency as the operator's efficiency is directly proportional to the cost savings, as revenues are fixed.

FIGURE 13-1 GROSS COST MODEL



The advantages of this kind of model are:

- Limited potential for disputes
- Easy Bid Process and contract management
- Flexibility in fare/schedule alteration
- Flexibility in adding services

The disadvantages of the model are:

- Need of effective ITS based control systems for proper monitoring and enforcement
- No incentive for high ridership
- Risk of revenue leakage borne by the Public entity

In this type of contracting the SPV (Special Purpose Vehicle) or Transport Operator will be directly monitoring the performance standards of the operators and set up service level benchmarks which need to be attained by the operator. The SPV shall have leverage in issuing warrants or penalties against the service standards of the Operator. In this type of contract, the SPV shall be responsible for purchase of buses as per the required fleet and the private players would operate and maintain the buses as per the agreed schedule and terms. The tasks of enforcing the system is restored with the SPV and this shall be done by extensive usage of the ITS technology. The main public transport policy goal here is to improve the quality of public transport in the relevant area which in turn is expected to result in more passengers.

TABLE 13-3 ROLES AND RESPONSIBILITIES OF THE PRIVATE OPERATOR AND THE TRANSPORT AUTHORITY/ULB

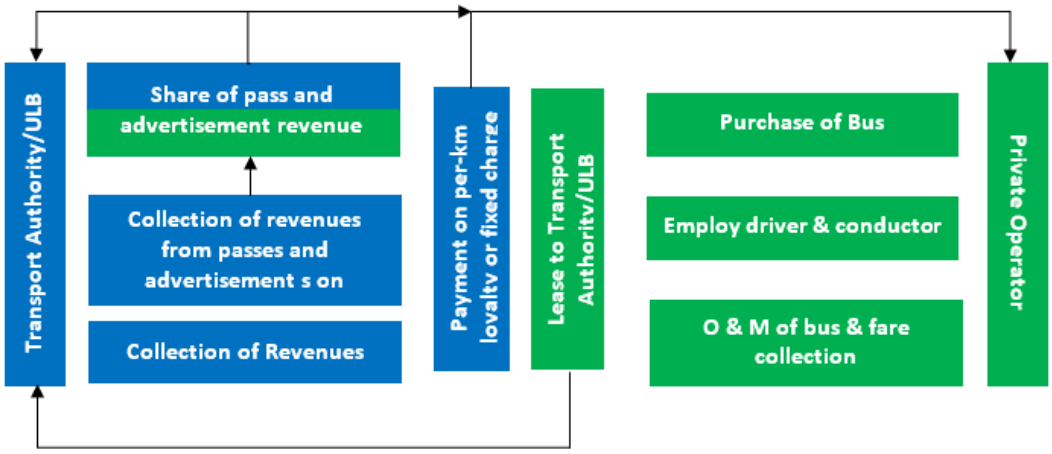
Item	Private Operator	Transport Authority/ULB
Primary Task	• Procurement of Bus, deploy skilled staff for operation and maintenance • Procurement of permits • Procurement of diesel, spares, engine oil, and other consumables for running of buses	• Setting fare, route planning and management of transport infrastructure (BQS & terminals) • Performance and quality management • Collection of all revenues such as fare-box and advertising revenue
Fares and payments	• Receipt of a fixed amount based on per-km or per-hour operation of buses	• Fare setting and collection
Operating Expense	• Spares, minor and major repairs, fuel, any other operation and maintenance expense • Bus registration	-
Capital expense	• Capital expenditure for the procurement of buses	-
Asset Ownership	• Takes over the assets at the end of contract period	• Buses are sun under the transport authority/ULB during the contract period

13.5.4. NET COST MODEL

This model of contracting has a unified approach where in the operator will be responsible for operation and maintenance of the buses. The operator would also be responsible to operate the buses as per the frequency specified by the authorities. In addition to that the operator will be solely responsible for the collection of fares and for the system maintenance cost.

The procedure of appointing an operator would usually involve a bidding process where any private entity with certain pre-requisites is entitled for the bidding. The specifications of the frequency or headway to be maintained, routes to be covered etc. shall be the part of the bidding document.

FIGURE 13-2 NET COST MODEL



The private operator pays the Transport Authority/SPV a fixed charge or per-km loyalty as agreed upon.

Advantages of this model are:

- Risk of passenger demand and revenue leakage is the responsibility of the operator
- Low financial commitments of public entity
- Effective incentive for higher ridership

Disadvantage of this model are:

- Passenger dissatisfaction due to monopoly
- Complex tendering and contracting process
- Difficult to change the contract terms during the agreement period
- High potential for disputes

The basic disadvantage of this kind of model is the difficulty in adhering to the prescribed frequencies. Any plunge in the ridership values shall have serious repercussions in the revenue to be generated by the operator. This most often leads to the termination of the contract in the mid-way and effects the entire operations thus causing inconvenience to the passengers and affecting the metro ridership.

TABLE 13-4 ROLES AND RESPONSIBILITIES OF THE PRIVATE OPERATOR AND THE TRANSPORT AUTHORITY/ULB

Item	Private Operator	Transport Authority/ULB
Primary Task	• Procurement of Bus, deploy skilled staff for operation and maintenance and supervision of operations • Fare collection • Procurement of permits • Procurement of diesel, spares, engine oil, and other consumables for running of buses	• Setting fare, route planning and management of transport infrastructure (BQS & terminals) • Performance and quality management • Collection of revenues from advertisements and passes
Fares and payments	• Collection of passenger fare • Payment to ULB based on per-km royalty or fixed monthly charge • Receipt of share in advertisement and pass revenue from the transport authority/ULB	• Fare setting and collection • Collection of seasonal pass revenues and advertisement tariffs
Operating Expense	• Spares, minor and major repairs, fuel, any other operation and maintenance expense • Bus registration	-
Capital expense	• Capital expenditure for the procurement of buses	-

Item	Private Operator	Transport Authority/ULB
Asset Ownership	• Takes over the assets at the end of contract period	• Buses are sun under the transport authority/ULB during the contract period

A brief understanding of each of the contracting mechanisms discussed above has been presented in the Table 13-5. Various aspects involved in each of the contracting procedure are also covered.

TABLE 13-5: COMPARISON CHART OF VARIOUS CONTRACT MODELS

Field	Gross cost contracts	Net cost contracts
Remuneration	Contribution based on the km operated, index often updated in relation to changes in costs (diesel, gas, salaries, sales price of buses, etc.).	Operator remunerated by keeping the ticket revenues, compensation is paid by the authority (a fixed sum)
Ticket sales	Operator collects revenues on behalf of the public transport authority	Revenues related to operation belong to the operator
Incentive schemes	Quality or revenue incentives will encourage the operator to focus not only on the production / costs but also revenue / passenger satisfaction	Quality incentives frequently make use of stated minimum demands or results on customer surveys
Ancillary activities	Operator retains ancillary revenues	Operator retains ancillary revenues
Monitoring	Authority monitors the operator regarding service performance through qualitative and quantitative assessments	
Definition of the services	Decided by the public transport authority	Often shared responsibility, however with significant operator influence
Quality	Authority: strategic responsibility to define the level of quality	
	Operator: managerial and operational responsibility	
Tariffs and fares	All related issues under the responsibility of the public transport authority	Policy defined by authority, autonomy for the operator for commercial fares such as discounts, fare sections
Information and promotion	All related issues usually a shared responsibility	
Personnel and employment conditions	All related issues usually a shared responsibility but may also be wholly an operator responsibility	

Source: PROCEED, Directorate-General Energy and Transport, Europe

13.5.5. HYBRID MODEL

The applications of GCC and NCC are widely known to all, and each has its own pros and cons. Hence a Hybrid model is developed after careful review of both the models and by adopting the best in both type of models. Since GCC model is the one which reduces the risk of the operator by removing the ambiguity on the revenue generated and the NCC model helps in encouraging the operator for improving the services by linking the revenue the advantages of both the models are here in accommodated in the Hybrid model. The idea of Hybrid model is to reduce the risk of the operator by assuring him minimum km for operation and at the same time providing incentives based on his performance. Here the performance based incentives can be linked to two parameters as mentioned below:

- Revenue based Incentive: In this model the general GCC model is adopted with revenue sharing option. The operator will be given some assured km and over and above a share in the revenue generated. This model is adopted to encourage the operator to provide better services to attract more commuters, which inturn benefits, the operator and the metro authorities. The usual revenue share can vary from 5-10% of the net profit.

- Performance based Incentive: In this model certain performance parameters are fixed for the operator in terms of punctuality, cleanliness of the vehicles, appearance of the driver, service quality, vehicle quality etc. Here each parameter will be assigned some points which inturn can be converted into kms and paid as per the cost per km. The advantage of this model is it can also have a penalty based rating where if the service quality goes beyond certain index than negative points can be assigned which will induce penalty on the operator compelling him to maintain better service quality.

13.5.6. CONTRACTING RECOMMENDATIONS

Nagpur is one of the emerging cities in India. With a population of just over 2.4 Million, Nagpur has a substantial growth potential. On the other hand, the mobility operations of the city are also depended on the physical/geographical structure of the city. Nagpur being a radially oriented city has to be facilitated with various modes of transportation. This also brings in the existing public transport modes into the perspective.

The Net Cost Model and Gross Cost Model are the two contract methodologies generally adopted in the Indian cities for the operation of Public Transport. The responsibility of the Public and Private agencies varies based on the contracting methodology adopted which is provided in the following table. The matrix provides the responsibilities the Public and Private Agencies under the Gross and Net Cost Contracting Models share.

TABLE 13-6: RESPONSIBILITY MATRIX UNDER VARIOUS IMPLEMENTATION MODES

Functions	NCC	GCC
Procurement of Vehicle	P or G	P or G
Bus Operation	P	P
Bus Maintenance	P	P
Route planning and scheduling	P and G	G
Monitoring	G	G
Fare Collection	P	G
Fare Fixation and revision	G	G
Provision of Infrastructure	G	G

P-Private, G-Government

The advantages of adopting a Gross Cost Model for the city are that it effectively reduces the process of fare collection and management by the operator which can be outsourced to a third party. It also helps in having clear payment structure which is based on per km basis. So the operations can be monitored by the use of ITS devices which record the total km travelled. With the varying economic developments taking place in the city, the travel patterns are also expected to change with time.

So this raises a need for the operational flexibility of the system which can easily be possible by adopting the Gross Cost Model. The feeder routes were developed keeping in view of the existing transport network and its ability to have a greater spread covering the maximum possible potential catchment areas. So the objective of the feeder is to facilitate the metro system and not to counter the existing transport facilities.

A. OPERATOR WORKSHOP

In Nagpur, the feeder service and City Bus Services in Nagpur has offered by a combination of Standard Buses, Midi Buses and Mini-buses and Mini-vans. Hence an Operator Workshop had been organized by Maha Metro and UMTC on 8th March 2017 in Nagpur where various Bus Operators from across the country were invited. The Workshop primarily aimed at understanding the requirements of the Metro Rail and the issues faced by the Operators. A brief presentation was made to the Operators where various models of operation were discussed and the issues or concerns raised by them were noted. The following section discuss about the various contracting recommendations for the Nagpur city for Operation of Feeder Services.

FIGURE 13-3: OPERATOR WORKSHOP HELD AT NAGPUR

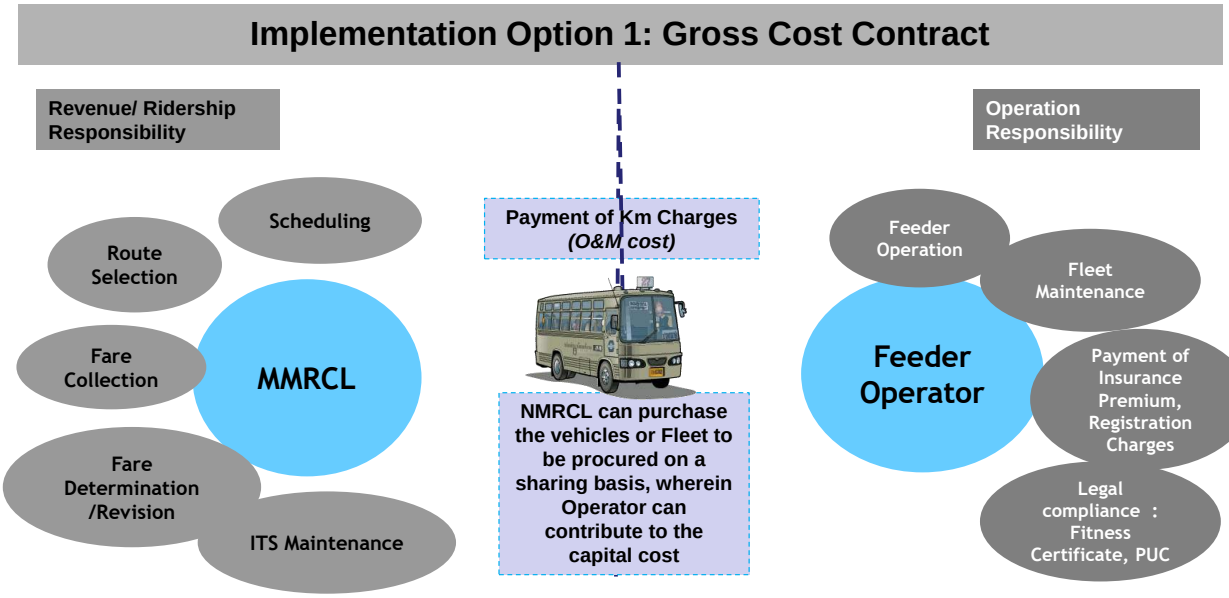
B. IMPLEMENTATION OPTION-I: GROSS COST CONTRACT

Gross Cost Contract (GCC) is one of the most widely adopted models. Here the Ridership responsibility mainly lies with Nagpur Metro Authority (herein referred as Maha Metro Rail Corporation Ltd.- MMRCL) and Operational responsibility lies with the Operator. Some of the significant recommendations in adopting this model include:

- MMRCL can purchase the vehicles on their own or on sharing basis, wherein Operator can contribute to the capital cost
- MMRCL can provide power to the Operator for operation of Electric vehicles on actual cost basis
- Non-fare revenue can be additional revenue for MMRCL
- Payment to the Operator shall be on Km basis

The figure below represents the various roles undertaken by MMRCL and Feeder Operator

FIGURE 13-4: RECOMMENDED IMPLEMENTATION OPTION 1



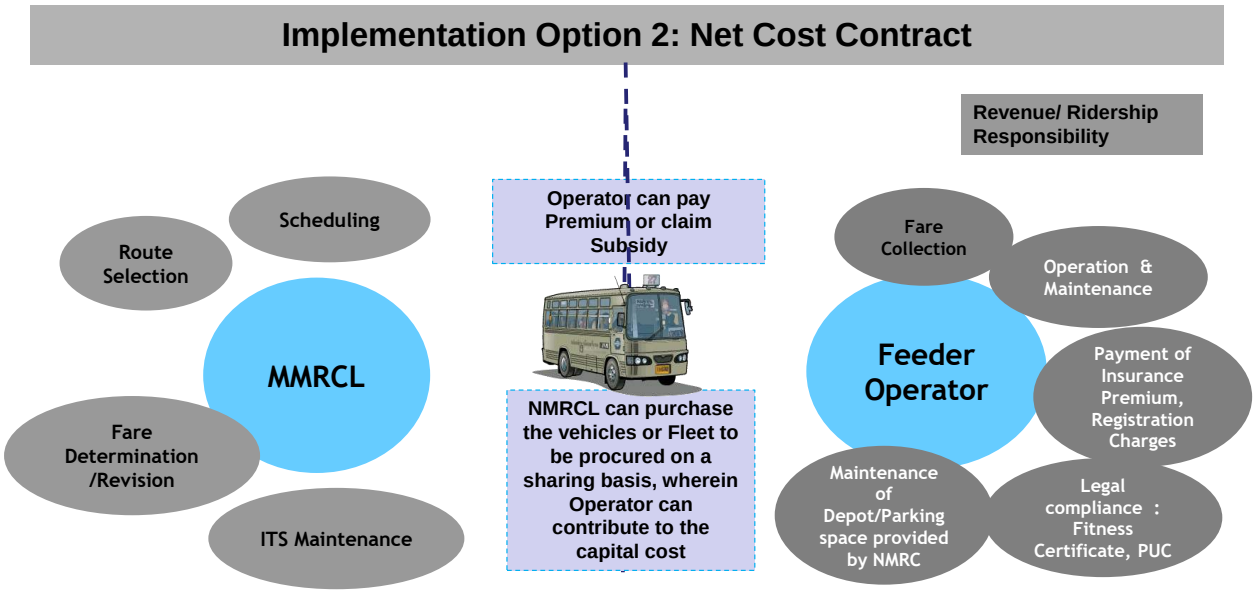
C. IMPLEMENTATION OPTION-2: NET COST CONTRACT

Net Cost Contract (GCC) is another model which is in operation in the many cities. Here the Ridership responsibility mainly lies with the Operator and he will also be responsible for maintenance and upkeep of the vehicles. MMRCL will be responsible for route selection, scheduling and fare determination. Some of the significant recommendations in adopting this model include:

- MMRCL can purchase the vehicles on their own or on sharing basis, wherein Operator can contribute to the capital cost
- Routes can be grouped as a package to make the operation of feeder more viable
- NMRCL to provide the power at the actual cost for the Electric vehicles
- Non fare-box revenue related to vehicles shall be part of the Operators revenue

The figure below represents the various roles undertaken by MMRCL and Feeder Operator.

FIGURE 13-5: RECOMMENDED IMPLEMENTATION OPTION 2



D. IMPLEMENTATION OPTION-3: GROSS COST CONTRACT WITH INCENTIVE

This option is similar to that of the Gross Cost Contract, except the fact that the performance will be linked to the Incentives and Penalties. This kind of model is recently gaining its attention as it benefits both the Operator and the Authority. Based on certain set of parameters developed by the authority the operator is either given an incentive or penalised based on his performance. The payment to the operator shall be on Km basis after incentivising or penalizing based on the operators performance. This model is also known as a Hybrid model as it accommodates a GCC model with Incentives.

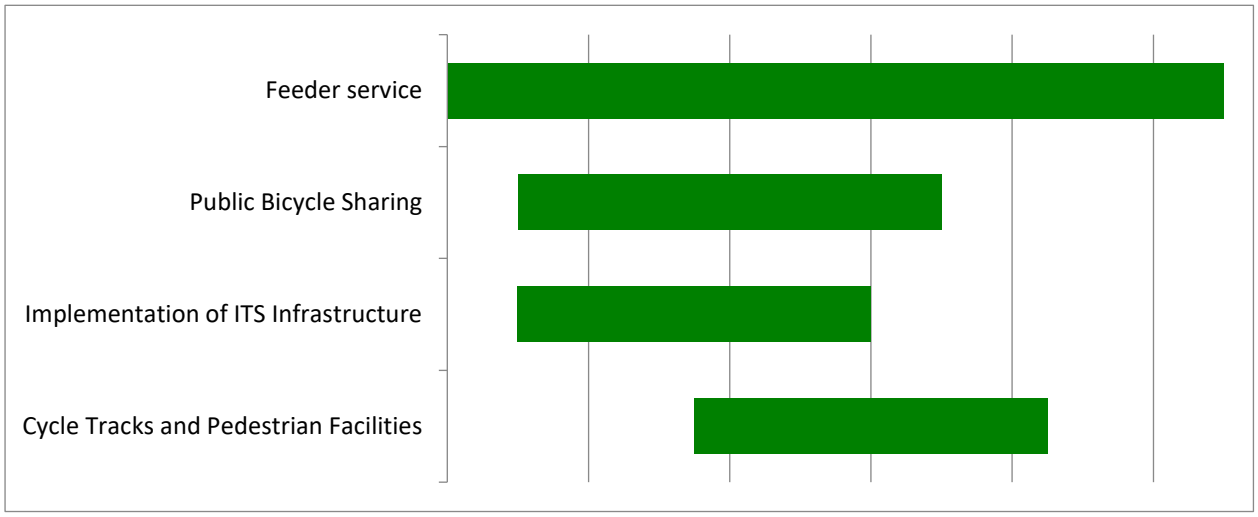
13.6. PROJECT PHASING

13.6.1. PROJECT PHASING FOR METRO FEEDER SERVICES

The Feeder system suggested for the city has multiple components. To attain maximum effective utilization of the system it is quite important to categorize the implementation based on the short and long term needs of the city. The short term plan would mainly focus on the projects which can be implemented immediately. The focus of the Mid-term projects would generally concentrate on the developments in the coming 5-10 years. On the other hand, Long term projects would mainly be focused on the developments which need to be considered in next 15-20 years.

Keeping in view of the current Transport scenario of the city, it is very imperative that the city would be requiring good NMT facilities which would enable the safety of NMT users. The suggestions made in terms of NMT facilities include laying of the Cycle tracks which would enable the safety of the bicycle users. In the Mid-Term projects the Feeder System can be implemented as the Metro Rail might take another three to five years to materialize and the Feeder shall be operational in parallel with the Metro services. The implementation of the ITS components shall also be done in parallel with the Feeder system as the components of the ITS are mostly related to the Feeder System. In addition to this it is also recommended that all the Public Transport facilities in the city be brought under a single system where a common ITS platform can be used for monitoring and controlling the operations of these systems. This kind of strategy would not only effectively reduce the cost, but would also facilitate a one-point control system which helps in the integration of the public transport systems. The long term projects would mainly include the Public Bicycle Sharing system. The effective utilization of this project would also take time as the public response towards such advance concepts has been very meek in the country. Figure below shows the Project Phasing along with the cost of the project in the respective phase.

FIGURE 13-6 PROJECT PHASING FOR THE IMPLEMENTATION OF THE VARIOUS PROJECTS



It gives a general view of the phasing of the various projects to be carried out over time. But the actual initiation date and duration of the project depends on the time taken for the implementation of the project. This has to be in accordance with the commencement of the Metro Rail. It gives a picture as to when the project has to be initiated in respect to the Metro Rail. The value 'D' indicates the date of commencement of the Metro Rail and the figure beside it indicates the duration in months the project has to be initiated.

13.6.2. IMPLEMENTATION PLAN AND SCHEDULE FOR CITY BUS SERVICES

The physical work of procuring the fleet for city bus services, procuring the equipment for the depot and the central control center as well as for the civil works is proposed to be completed maximum within 2 years, enabling a smooth transition and operationalization of the services.

The implementation schedule for Feeder as well as City Bus Services is presented in the Table 13-7. The schedule indicates major activities required to be undertaken up for the initiation and completion of feeder, NMT and City Bus Services for the public use.

13.6.3. PREREQUISITES FOR IMPLEMENTATION OF NMT/PBS INFRASTRUCTURE

1. **Creating General Awareness-** Based on the finalized proposals, the affected people, institutions and other stakeholders need to be sensitized through raising awareness regarding the need of NMT in Nagpur. This can be done in the following manner:

a. NMT Awareness Campaigns.

b. Car free Sundays.

c. NMT idea workshops.

d. Public Space rejuvenation campaigns.

e. Workshops/ biennales may be conducted to generate a scheme for use of public art in rejuvenating Public Space and connecting them back to the prevailing culture of the place.

f. Sensitizing other PT and IPT operators regarding the need and benefits of NMT.

2. **Institutional Capacity Building-** Based on the finalized proposals, all the concerned stakeholders might have to undergo institutional capacity building to implement, operate, maintain and enforce the proposals.

3. **Discussion with other stakeholders to align their action plans to deliver relevant parts of the finalized proposals-** The proposals of this project would require some other departments of Nagpur to work in tandem with Maha Metro to make it a success. As such, it is important that the same departments start working towards a common vision with overlapping action plans.

TABLE 13-7: IMPLEMENTATION SCHEDULE

IMPLEMENTATION PLAN FOR FEEDER & CITY BUS SERVICES IMPLEMENTATION IN NAGPUR													
S. No.	Activity	Jan-March2019			Apr-June 2019			Jul-Sep 2019			Oct-Dec 2019		
1	Approval of Combined Feeder Study Proposals												
2	Initiation and Finalisation of Feeder Buses Procurement												
3	Initiation & Procurement of City Buses												
4	Planning & Construction of NMT Facilities for Phase-1												
5	Planning & Implementation of PBS Phase-1												
6	RfP for Selection of Civil Contractor & Completion of Works												
7	Selection of ITS agency & Completion of Works for both Feeder & City Bus Services												
8	Selection & Appointment of Operator for Feeder Bus Services												
9	Implementation of Rationalised Routes in coordination with Feeder & allied plans												
	Commencement of Metro Rail - Nagpur Metro Phase-I												

Annexure to Main Report

EXECUTIVE SUMMARY

NAGPUR PARKING POLICY - 2016

NAGPUR MUNICIPAL CORPORATION

Introduction

Nagpur is the Capital of Vidarbha region and also known as the Winter Capital of Maharashtra. The Nagpur Municipal Corporation (NMC) is the local urban body responsible for the developmental activities in the city of Nagpur. The jurisdiction of NMC spreads across 217.65 sq.km, accommodating a population of 2.4 million (census 2011) encompassing the CBD (Central Business District) area with major activities. Within the NMC region, the road network spreads around 1150 km (CDP Study, 2015) and the presence of inner and outer ring roads provides the city a radial layout. With a vision for the sustainable development of the city, Nagpur is preparing for a mass transit system in the form of a metro rail. Along with this, promoting Non-Motorized Transport (NMT), through cycling and walking, and improvement of existing public transport system is also on its way. NMC has decided to develop the "Parking Policy and Parking Master Plan for the city" with an aim of closing down the demand-supply gap and manage the future parking demand.

Vision and Objectives

To be a model parking policy that provides a sustainable and livable city back to its citizens.

Following are the main objectives of the study:

- Assess the current parking policy and regulations of Nagpur;
- Assess the existing parking inventory and utilization (both on and off street)
- Assess the effectiveness of current parking management systems, including parking fees, meters, parking time limits, and enforcement efforts;
- Analyze primary and secondary data to identify locations where parking management is necessary to ensure the efficient and equitable use of public street space;
- Develop strategies to ensure a fee based parking system which is commercially viable.

Parking Scenario in the City

From the reconnaissance survey, it was observed that the major transit corridors faced problems arising from unorganized parking along the road sides along with two wheelers dominating the parking spaces in the city. Haphazard parking was observed at some of the junctions like Anjuman College Junction, Variety Square etc. It was observed that the average parking charges per hour is far less when compared to any other city and also the parking at public places such as Railway Stations and Airport is also much less when compared to other cities. The lower parking charges call for lower cost of operating private vehicles, resulting in increase in private vehicle share users when compared to public transport users. Hence a

telescopic fare structure is required for parking in the city which can be categorized based on the land use.

Parking Duration

From the primary data analysis, it was observed that three of the sites Eternity Mall Rd., Tehsil Karyalay, Mangalwari Bazar Rd had Quick parking characteristics (less than 30 minutes) and the remaining four sites (Wardha Rd parking, Gandhi Bagh Park, Sitaburdi Market and ST Bus Stand) had long stay parking characteristics (more than 2 hour).

Capacity Utilization

On reviewing the peak hour capacity utilization parameter, it is worth noting that for Sitaburdi Market (Off-Street parking), the values of capacity utilization during peak hour was 116% (weekday) and 99% (weekend). Other two critical locations with respect to peak hour capacity utilization are Gandhi Bagh Park (96% during weekend) and ST bus stand (94% during weekday).

Parking Accumulation

Peak hour accumulation values are observed to be higher during weekdays except in Gandhi Bagh Park for which the value was observed to be 306 ECS as against a parking capacity of 320 ECS during weekend. For ST bus stand – it is observed to be 313 ECS as against a parking capacity of 333 ECS during weekday. For Sitaburdi Market parking, the values for weekday and weekend peak hour accumulation are 77 ECS and 66 ECS as against a parking capacity of 67 ECS.

Existing Facilities

It should also be noted that the presence of NIT parking complex located adjacent to the Eternity Mall is not being utilized for its purpose. The presence of an unauthorized parking in and around the Eternity Mall and the supply gap at Sitaburdi Market parking could be solved to some extent by operating the parking facility. Moreover, the off-street parking along the Walker Rd is under-utilized and there exist unauthorized on-street parking along the Walker Rd.

Process for framing of Parking policy

Need for Parking Policy

With the advent of Nagpur Metro rail, the city of Nagpur is set to follow the sustainable path and parking policy along with the other policies ensures the successful implementation and functioning of the public transport system. A change in this approach should focus on providing parking based on the proximity to public transport corridor, wherein properties coming within the influence zone of the public transport should have lower parking requirements.

Process flow adopted

The process adopted for parking study is divided into four stages as mentioned below:

Stage-1: Parking Demand Supply Gap analysis

Stage-2: Preparation of Parking Policy

Stage-3: Forecast future Parking Demand

Stage-4: Parking Master Plan

Stakeholders

The role of Government and its various authorities/ institution is paramount in providing basic transport and parking infrastructure to the city. Following Stakeholders have been identified for NMC, who have reviewed the parking policy measures to form a distinctive framework of measures to be adopted for the city:

- Regional Transport Office (RTO), Nagpur
- Nagpur Improvement Trust (NIT)
- Maharashtra State Road Transport Corporation (MSRTC)
- Vidarbha Truck Association, Nagpur
- Traffic Police Department, Nagpur
- Town Planning Department
- Transportation Association
- Citizens of Nagpur

Legal provisions for parking

National Urban Transport Policy (NUTP) 2006

The National Urban Transport Policy recognizes that in a developing economy, ownership of personal vehicles will continue to increase for the next few years. Hence, the Policy does not discourage the ownership of such vehicles but only seeks to discourage daily usage. Limiting the availability of parking space and the levy of a high parking fee should be used as a means to curb the use of personal motor vehicles. Preference in the allocation of parking space for public transport vehicles and non-motorized modes as well as easier access of work places to and from such spaces would go a long way in encouraging the use of sustainable transport systems. Park and ride facilities for bicycle users, with convenient inter-change, would be another useful measure. Simultaneously, a graded scale of parking fee, that recovers the economic cost of the land used in such parking, should be adopted.

Development Control Regulations & Amendment (2000 & 2014)

The Development Control Regulation (DCR)-2000 is a document sanctioned by Govt and came into effect from 2001. Currently, the development control regulations require a uniform minimum parking space for all private developments. A change in this approach should focus on providing parking based on the proximity to public transport corridor, wherein properties coming within the influence zone of the public transport should have lower parking requirements.

Maharashtra Municipal Corporation act, 1949

This department of Law and Judiciary of Government of Maharashtra has come up with the Maharashtra Municipal Corporation act of 1949, which clearly defines the roles, responsibilities and powers associated to the Municipal corporations and its authorities. The act also includes the parking provision requirements and the powers bestowed upon the Commissioner of the Municipal Corporation by the Govt. The following are the acts relevant to the parking provision.

The Section 243 (a) and Section 208 in the act articulates the authority and rights of commissioner which he could apply in the city for regulating the traffic and parking.

The Motor Vehicle act, 1988

The motor vehicle act, in which Section 117 articulates the measures to be taken about parking place and halting station, section 122 - vehicle leaving in dangerous position, Section 127 - Removal of motor vehicles abandoned or left unattended on a public place, Section 201 - Penalty for causing obstruction to free flow of traffic.

Public parking policy for Nagpur

Short term measures

- Differential parking tariffs
- Have effective penalties for parking violation and enforce them
- No free residential parking on main roads, no On-street within 75 m of entry/exit points near important/major traffic junctions and buildings
- Improve public transport to realize mode shift

Medium and Long term measures

Medium and long term measures would be promoting technology for effective enforcement of parking violations, Develop and approve a differential parking tariff to encourage use of peripheral parking, Parking Restriction and Enforcement, congestion charge, Cash-out measures, Transit incentives, unbundling, curb side parking meters, price sensitivity, shared

parking, parking regulation, remote parking and public transport facilities, improved enforcement and control.

CBD/Commercial Areas/Core City Areas

Zone Description	Zone details	Strategy
City Core area / Business District	Sadar, Sitaburdi, Empress City, Congress Nagar, Itwari, Moominpura, Lakadganj, Mahal, Dharampeth, Ganeshpeth Colony	• Discourage use of private vehicles by means of restricting on-street parking at most of the locations. • Encourage vehicle free zones • No parking spillover should be allowed for railway station/terminals/bus stands

Along The Mobility Corridors

The following areas shall be considered under the Mobility corridor and the strategy adopted shall be as proposed below.

Zone Description	Zone details	Strategy
Area along the mobility corridors	Along Metro Corridor and major radial roads converging at Nagpur city which include Wardha Road, Higna Road, Amravati Road, Chhindwara Road, Katol Road, Kamptee Road, Central Avenue Road, Taj Bagh Road and Outer Ring Road.	• Promote park and ride system at terminals, interchange points • Keep at least 50m to 75m no parking zone near metro stations and from important junctions • Promote intermodal integration , spaces for pick and drop facility near bus stop/stations • If required, off-street parking facility may be given near Interchange points with minimum requirements. The initial supply may be based on the existing demand but can be further controlled based on the pricing strategy. • The integrated fare system can be introduced to minimize use of parking bays from subordinate landuse.

Sensitive Areas

Zone Description	Zone details	Strategy
Sensitive Areas	Area near Hospital, Schools, Administrative buildings, Worship	• The sufficient parking should be provided within the plot boundary and the spillover on approach roads should be strictly banned

	places, Heavy industries Eg: Anjuman College, Mangalwari Bazar Road, Red Cross Road, Udyog Bhavan, High Court, MIHAN, Khapri etc.	• Paid, time based off-street parking may be reserved for parking purpose. • In case of higher demand the area of parking plot should be capable for developing multi-level parking facility. The area requirement varies based on the preferred technology for multi-level parking.

Roads other than Mobility Corridor

Zone Description	Zone details	Strategy
Roads other than mobility corridor	500 m stretch for roads approaching mobility corridors. And other major streets	• Roads with more than 24M RoW and V/C ratio less than 0.6 may be considered for one side alternate day parallel parking • Roads with more than 30M RoW and V/C ratio less than 0.6 may be considered for two side parallel parking • The 75m portion near junction of approach road and mobility corridor should be no parking zone. • It will be responsibility of the residents to accommodate their vehicles within their own plot boundary • No parking zone for roads less than 6m RoW shall be permitted • Parking shall not be part of compulsory items while purchasing new house from builder. It should be optional. • New building control rules should remove the concept of minimum requirement and shall encourage for lesser parking provision. • Alternate day paid parallel parking should be provided for road more than 12m RoW

Parking encroaches the carriageway in all major streets of Nagpur. This has to be tackled seriously so that the right of way will be reserved for non-motorized modes, public transport and other moving vehicles.

- Improve enforcement and control of parking in all the roads in Nagpur.
- Demarcate clearly the parking zones and no parking roads.
- Prevent the misuse of footpath for parking

Ensure that places for parking of vehicles are used for the designated purpose only.

Residential Street

Residential streets consists of internal residential streets which are connected by collector roads which feed the traffic to other major roads. The areas under Residential Streets is as below:

Zone Description	Zone details	Strategy
Residential Streets	Collector streets, Internal residential roads	• It will be responsibility of the residents to accommodate their vehicles within own plot boundary • No parking zone for roads less than 6m RoW. • Parking shall not be part of compulsory items while purchasing new house from builder. It should be optional. • New building control rules should remove the concept of minimum requirement and shall encourage for lesser parking provision. • Alternate day paid parallel parking should be provided for road more than 12m RoW

Phasing Plan

Parking policy along with other public transport oriented policies when carried out in a phased out manner delivers the best outcome. With this in mind, the parking policy implementation should be carried out in three stages; short, medium and long term. Short Term (0 – 2 years), Medium Term- Up to 5 years and Long Term - More than 5 years.

Special Approach

Pay & Park Scheme, Nagpur

Nagpur Municipal Corporation under section 310 (a) of NMC act has prepared a Pay & Park scheme for the city of Nagpur in consultation with other stake holders. The scheme allows any agency to operate and maintain the parking facilities of NMC and charge a parking fees as prescribed by NMC under the scheme. The interested operators shall bid under the provisions of the Pay & Park scheme and will be entitles to operate for 1 year. The rate for Off Street Parking prescribed by NMC under the scheme is as mentioned in below table:

Sl.No	Type of Vehicle	Rate/Time
1	Bicycle	Rs. 2/- For each 8 Hours
2	Two Wheeler (Scooter/Motor Cycle)	Rs. 5/- For each 8 Hours
3	Four Wheeler (LCV car)	Rs. 10/- For each 8 Hours

4	Commercial/Business vehicle- Three wheeler, Four wheeler & Five wheeler (Taxi, Tempo, LCV, car etc.)	Rs. 10/- For each 4 Hours

Concept of Paid Parking – Nagpur

Wherever possible, charge directly for using parking facilities. This is more efficient and fair than paying for parking facilities indirectly. Following objectives were formulated to introduce paid parking system in Nagpur:

1. Manage and price the most convenient parking spaces to favour priority users. Charge higher rates and use shorter pricing periods at more convenient parking spaces.
2. Implement parking pricing as part of an integrated parking management program that also includes improved user information on parking and transportation options, commuter trip reduction programs, improvements to alternative modes, and adequate, predictable and courteous enforcement.
3. Improve pricing methods to make parking pricing more cost effective, convenient and fair. Avoid excessive parking supply and avoid discounts for long-term parking leases.
4. Parking fees should be coordinated throughout a district or region, so that comparable areas have comparable fees. Tax parking spaces - Reform existing tax policies that favour free parking.

Utilization of Revenue from Parking in Nagpur

The revenue collected from parking fees can be utilized for different recommendations such as - the fees collected should be deployed for creating the infrastructure, devising methods and strategies for parking management, fund should be made available for creation of parking infrastructure for land based, multi-story, basements or Bus, truck terminals, Encourage the sharing of facilities and Introduction of Transfer of Development Rights, tax subsidies, capital subsidy, if needed. In order to promote public transportation system, incentives may be given to government staff employees and private sector for utilizing the public transportation system, etc.

Parking Sites identified based on DP given below in table:

Sl. No.	Zone	Site Number	Mouza/Area	Survey Number	Area (Hectare)
1	North	N - 30	Indora	94 (P)	0.4080
2	North	N - 183	Wanjra	68 (P)	0.3580
3	North	MN - 19	Nari	119 (P)	0.7168
4	North	MN - 51	Wanjra	14/1 (P), 25 (P)	0.8448
5	North	MN - 68	Wanjra	14 (P), 49AB (P)	0.4062
6	North - West	NW - 56	Talki (Police)	8 (P), 19 (P)	0.6228
7	North - West	NW - 101	Borgaon	159 (P)	0.1584
8	North - West	NW - 110	Borgaon	46 (P), 47 (P), 48 (P), 60 (P)	0.5184
9	North - West	MNW - 77	Telankhedi	10 (P), 11 (P)	0.3520
10	North - West	MNW - 80	Takli (pol)	46 (P)	0.5120
11	East	ME - 30	Wathoda	27 to 40 (P)	0.6336
12	East	ME - 33	Wathoda	43 (P), 52 (P), 53 (P)	1.0560
13	East	ME - 75	Dighori	53 (P), 54 (P)	0.8640
14	East	ME - 86	Nagpur	573 (P)	0.3600
15	West	W - 55	Sitaburdi	283	0.1296
16	West	W - 73	Sitaburdi	88 (P), 89 (P)	0.3264
17	West	MW - 5	Pandhra Bodi	27 (P)	0.0500
18	West	MW - 13	Sitaburdi	227	0.4352
19	West	MW - 15	Gadga	15 (P), 16	0.0960
20	West	MW - 21	Lendra	30/1 (P), 2-3/1, 5/1, 6-7 (P)	0.2540
21	South	S - 247	Chinchbhavan	236/1 (P), 236/2 (P)	0.3840
22	South	S - 262	Chinchbhavan	192 to 194, 195 (P)	0.7680
23	South	MS - 57	Somalwada	72/1 (P), 72/2 (P)	0.5130
24	South	MS - 112	Chinchbhavan	23 (P), 24/1 (P), 25 (P)	1.0400
25	South - West	SW - 32	Somalwada	29 (P)	0.9888
26	South - West	SW - 120	Khamla	82 - 95 (P)	0.5600
27	South - West	MSW - 08	Bhamti	19 (P)	0.2880
28	South - West	MSW - 21	Pardosi	38 (P), 39 (P)	0.2496
29	South - West	MSW - 61	Chinchbhavan	8 (P), 9 (P)	0.4896
30	South - West	MSW - 62	Khamla	73/1, 73/1, 75/1	0.1680

Responsibility Matrix

Public Awareness

General public is the end user of the parking facilities. In the absence of adequate facilities and dismal enforcement by the authorities, illegal parking on roads have become a routine. This attitude needs to be changed, which is only possible through public awareness initiatives. Hence several initiatives would need to be taken to bring a level of awareness & sensitization in public, before the policy is implemented. Such as - Create a few zero tolerance zones with all infrastructures such that no violations in terms of pedestrian, parking and traffic occur, need of advocacy and awareness building, conducting education and awareness program to spread the benefits of organized parking and avoiding road space for parking, etc.

Road Markings and Signage

Awareness about parking and no-parking zones could be easily visually communicated to the public through well planned and implemented road markings and road signs, such as -Clear standardized guidelines and designs for Road signage and road marking and implement it on Parking and No parking zone.

Integration with Other Development Plans

Parking provisions should be well incorporated in all future development plans like Master Plans or any other statutory document recognized by the competent authorities. CMP has also made recommendations and included provisions and actions to be taken in terms of parking provisions for the city.

Institutional Framework

The role of Government and its various authorities/ institution is paramount in providing basic transport and parking infrastructure to the city. Presently there are numerous civic bodies and other institutes involved in the development of such infrastructure, and each of these civic bodies is independent of the other, resulting in serious lack of co-ordination and decision making. There shall be a formation of one nodal body to look after all the transport and parking related planning, integration and creating the required infrastructure. NMC can look after the frame work for hierarchy, role, responsibilities and Stake of all the other civic bodies and institutions and their relationship with nodal bodies need to be very clearly established to bring in clear accountability.

Role of Stakeholder

There will be various stakeholder which will look after the framework, their role and coordination with other stakeholder which will make ensure the integration in developing the infrastructure and making planning to related development.

Government of Maharashtra

It will co-ordinate activities at the department through a process of review and appraisal and offer technical support in detailing any aspect of the Policy to encourage adaptability and implementation and it will assist in formation of a parking cell for funding and organize training and sensitization programs.

Nagpur Municipal Corporation

NMC will carry out necessary studies for detailing and arriving at a consistent framework for various areas and it will revise the bye laws to incorporate the policy recommendations and will set up the Special Purpose vehicle for funding, monitoring and enforcement. It will co-ordinate with other department for joint programs and will set up fast track cell for identifying "parking spaces" during special occasions.

Nagpur Improvement Trust (NIT)

NIT will look into incorporating and adaption of policy recommendations in the zonal regulation, creation of spaces for organized parking in the new developments, provision of Multi-level car parking facilities at their shopping complexes, provision and allocation of space for private bus stand and truck terminals, the transport system should be extended to all parts of the city such that "walk to the bus" should be possible, etc.

Traffic Police

The Police are responsible for maintaining public order and as such the enforcement of laws and regulations pertaining to traffic is within their domain. They are responsible for enforcing the regulations concerned with parking policy. Patrolling of parking areas, ensuring that parking spaces are correctly used, removal of obstructions, issuing and collecting of summons these are some functions within their domain.

Transport Department

Transport department are responsible for developing a mechanism for issue of parking certificates on registration, levy of fees for the vehicles entering the city and exiting the city, Provision and allocation of space for private bus stand and truck terminals, the transport system should be extended to all parts of the city such that "walk to the bus" should be possible, Adoption of pricing strategy to keep the parking fees optimal, etc. and it will advise and set up routing of buses to accommodate high density users

Parking Offenses and Penalties

There is a need to set-up a dedicated department of traffic police for enforcing the parking regulations, which shall enforce parking regulations along with keeping a check on parking offences such as parking without displaying valid parking tickets, failing to produce any coupon, vehicle parked outside the designated parking space etc. and penalties for the same.

Penalties

a) When a parking offence is committed, reminder notices will be sent to the vehicle owner or driver for settlement. If there is no response or payment made within the stipulated grace periods, an additional Rs 100 will be imposed on the original amount.

b) If no payment is made, person should be presented in the court. A Warrant of Arrest shall be issued against him/her if they refrain from attending the court proceedings.

Apart from this, provision shall be made under section -90 (3) of New Road Transport Safety bill, vehicle shall only be registered when proof of parking of vehicle (either at residence or depot; apart from on-street) shall be accompanied with other documents. Traffic police personnel shall verify the site of parking at time of registration of vehicle. In the absence of any such proof, registration fee should be higher or the person should be charged heavily for parking on-street. The costs of penalties will be such that early payment will incur less of a fine than if a payment were to be delayed.

Conclusion

This Parking Master Plan provides a comprehensive parking solution to the city of Nagpur based on our analysis. The report recommends policies and strategies to provide a sustainable parking solution to the city. Based on the review and comments received on the Draft Parking Master Plan, the Final Parking Master Plan has been prepared incorporating the views and suggestions.

The next step shall be implementing the strategies of various zones in a phased manner as recommended by the policy report. The revenue generated from the parking charges shall be utilized in funding public transport & NMT facilities such as additional bus services, construction of footpaths, development of pedestrian friendly zones etc.

ANNEXURE 2. LIST OF BUS ROUTES

LIST OF NOTIFIED CITY BUS ROUTES IN NAGPUR CITY[1]

Route No.	From	To	Route Length (kms)	Route Status
1	Pardi	Jaitala	20	Operating
2	Kharbi	Pannasay Layout	22	Not Operating
3	Sitabuldi	Bramhanwada	18	Not Operating
4	Piplafata	Hazaripahad/Sitabuldi	22	Operating
5	Piplafata	Gandhibagh	12	Operating
6	Mahalgaon	Sitabuldi	18	Not Operating
7	Wadad	Sitabuldi	24	Not Operating
8	Pardi	Mahindra & Mahindra	22	Not Operating
9	Kharbi	Defence	24	Not Operating
10	Pardi	Defence	26	Not Operating
11	Kamptee	Defence	32	Not Operating
12	Piplafata	Defence	26	Not Operating
13	Sitabuldi	Suradevi	18	Operating
14	Sitabuldi	Babulkheda	28	Not Operating
15	Sitabuldi	Pawangaon	16	Not Operating
16	Kharbi	Vaishali Nagar	24	Not Operating
17	Vela Hari	Gorewada	26	Not Operating
18	Sitabuldi	Belatrodi	12	Not Operating
19	Sitabuldi	New Narsala	14	Operating
20	Sitabuldi	Via Indora Square to Kamptee	18	Operating
21	Sitabuldi	Morarji	28	Not Operating
22	Sitabuldi	Via Chatrapati Square to Sonegaon	12	Operating
23	Sitabuldi	Yashodhara	10	Not Operating
24	Sitabuldi	Nagsenwan	10	Operating
25	Sitabuldi	Godhani	12	Operating
26	Sitabuldi	Khaparkheda	26	Operating
27	Sitabuldi	Jaywant Nagar	14	Not Operating
28	Sitabuldi	Via Gandhibagh to Pardi/Kapasi	10	Operating
29	Banwadi	Sitabuldi	24	Not Operating
30	Sitabuldi	Satgaon	22	Not Operating
31	Piplafata	Wayusena	22	Not Operating
32	Sitabuldi	Isasani	16	Operating
33	Sitabuldi Jilhapheri	Pannasay Layout	16	Not Operating
34	Sitabuldi	Belatrodi	12	Not Operating
35	Pardi	YCCE College	24	Operating
36	Kharbi Jilhaferi	Haazaripahad	20	Not Operating
37	Sitabuldi	Kapil Nagar	12	Not Operating
38	Sitabuldi	JN Hospital	26	Operating
39	Sitabuldi	Hingana	16	Not Operating
40	Sitabuldi	Defence	16	Not Operating
41	Sitabuldi	Itangoti	20	Not Operating

[1]Source: Nagpur Municipal Corporation & VNIL

Route No.	From	To	Route Length (kms)	Route Status
42	Sitabuldi	Mangrul	22	Operating
43	Kamptee	Mahindra & Mahindra	32	Not Operating
44	Sitabuldi	Via Shanti Nagar to Kamptee	18	Operating
45	Sitabuldi	Shesh Nagar	14	Not Operating
46	Sitabuldi	Samata Nagar	10	Not Operating
47	Sitabuldi	CRPF	14	Operating
48	Sitabuldi	Nara/Nari	8	Operating
49	Sitabuldi	Nari	10	Not Operating
50	Sitabuldi	Kamptee	18	Not Operating
51	Sitabuldi	Dabha	12	Not Operating
52	Sitabuldi	Narsala	16	Not Operating
53	Sitabuldi	Dighori Naka	14	Not Operating
54	Sitabuldi	Bhramani Fata	24	Operating
55	Sitabuldi	Piplafata	14	Not Operating
56	Dighori Naka	CGO	18	Not Operating
57	Sitabuldi	Prem Nagar	14	Not Operating
58	Sitabuldi	Pawangaon	16	Not Operating
59	Sitabuldi	Amar Nagar	14	Not Operating
60	Sitabuldi	Shyam Nagar	10	Not Operating
61	Sitabuldi	Reliance Industries	28	Not Operating
62	Kamptee	Lonara	24	Not Operating
63	Tukdoji Square	Nari	16	Not Operating
64	Tukdoji Square	Nara	14	Not Operating
65	Sitabuldi	Khadgaon	18	Operating
66	Hazaripahad	Piplafata	24	Not Operating
67	Sitabuldi	Banwadi	26	Not Operating
68	Sitabuldi	Wadad/Banwadi	26	Operating
69	Uday Nagar	CGO	16	Not Operating
70	Shesh Nagar	CGO	12	Not Operating
71	Kharbi	Haazaripahad	20	Not Operating
72	Sitabuldi	Alesur	18	Operating
73	Narendra Nagar	Wayusena	16	Not Operating
74	Kapasi	Nandanwan	10	Not Operating
75	Sitabuldi	Karve Nagar	10	Not Operating
76	Sitabuldi	Pawangaon	16	Operating
77	Sitabuldi	JN Hospital	24	Not Operating
78	Wayusena Gate	CRPF	22	Not Operating
79	Besa/Vela Hari	Gorewada	26	Operating
80	Sitabuldi	Dhamna	32	Not Operating
81	Sitabuldi	Sitabuldi	26	Not Operating
82	Sitabuldi	Via Rameshwari to Belatrodi	12	Operating
83	Sitabuldi	Vaishali Nagar	14	Operating
84	Sitabuldi	Shanti Nagar	10	Operating
85	Sitabuldi	Shesh Nagar	12	Operating
86	Sitabuldi	Waddhamna	16	Operating
87	Sitabuldi	Kapasi	12	Not Operating
88	Jaripatka	TB Ward	8	Not Operating
89	Gandhibag	Gorewada	12	Not Operating
90	Gandhibag	Gorewada	14	Not Operating
91	Sitabuldi	Bhanegaon	26	Not Operating
92	Sitabuldi	Shesh Nagar	14	Not Operating
93	Sitabuldi	Chakrapani Nagar	12	Not Operating
94	Kharbi	Jaitala	20	Not Operating

Route No.	From	To	Route Length (kms)	Route Status
95	Kharbi	Jaitala	22	Not Operating
96	Kharbi	Pannasay Layout	20	Not Operating
97	Sitabuldi	Defence	24	Not Operating
98	Sitabuldi	Defence	22	Not Operating
101	Sitabuldi	Futala Talao	10	Not Operating
102	Sitabuldi	Ambazari Talao	6	Not Operating
103	Sitabuldi	Koradi Yatra	16	Not Operating
104	Nagpur Railway Station	Radhaswami	18	Not Operating
105	Gandhibag	Dighori Naka	12	Not Operating
106	Sitabuldi	Bahadura Fata/Narsala	20	Operating
107	Sitabuldi	Indoram Gate No 6	26	Operating
108	Sitabuldi	Morarji	28	Not Operating
109	Sitabuldi	MIHAN	26	Not Operating
110	Sitabuldi	Mohgaon	26	Not Operating
111	Dikshabhumi	Dragon Palace	22	Operating
112	Sitabuldi	Dragon Palace	20	Not Operating
113	Dikshabhumi	Sitabuldi	2	Operating
114	Sitabuldi	Ambazari T Point	4	Not Operating
115	Dikshabhumi	Nara	10	Not Operating
116	Dikshabhumi	Nari	12	Not Operating
117	Dikshabhumi	Nagsenwan	12	Not Operating
118	Dikshabhumi	Indora Zopada Maidan	8	Not Operating
119	Pardi	Dikshabhumi	12	Not Operating
120	Belatrodi	Dikshabhumi	14	Not Operating
121	Kamptee	Koradi	12	Not Operating
122	Pardi	Koradi Yatra Stand	28	Not Operating
123	Piplafata	Koradi	30	Not Operating
124	Dattawadi	Koradi Yatra Stand	28	Not Operating
125	Kamptee	Koradi	22	Not Operating
126	Dikshabhumi	Yashodhara	12	Not Operating
127	Giddoba Nagar	Dikshabhumi	16	Not Operating
128	Gandhibag	Tajabad	8	Not Operating
129	Tajabad	Sitabuldi	10	Not Operating
130	Belatrodi	Sitabuldi	12	Not Operating
131	Sitabuldi	Wathoda	8	Not Operating
132	Railway Station	Khapri Satsang	20	Not Operating
133	Sitabuldi	Jamtha Special	20	Not Operating
134	Kapsi Umiya Dham	Sitabuldi	14	Not Operating
135	Sitabuldi	Hingana Gramin Hospital	18	Operating
136	Sitabuldi	Mahalgaon	16	Not Operating
137	Sitabuldi	Jaripatka	6	Not Operating
138	Jaripatka	Medical Square	10	Not Operating
139	Sitabuldi	Bahadura Fata	16	Not Operating
140	Kharbi T Point	Pannasay Layout	24	Not Operating
141	Kharbi T Point	Jaitala/Pannasey Layout	24	Operating
142	Sitabuldi	Dahegaon	20	Not Operating
143	Wardhaman Nagar	Dahegaon	26	Not Operating
144	Shanti Nagar	Dahegaon	26	Not Operating
145	Sonegaon	Dahegaon	24	Not Operating
146	Jaripatka	Dahegaon	30	Not Operating
147	Sitabuldi	Dahegaon	16	Not Operating
148	Nagpur Railway Station	Dahegaon	20	Not Operating
149	Bahadura Fata	CGO	20	Not Operating

Route No.	From	To	Route Length (kms)	Route Status
150	Pardi	YCCE College	26	Not Operating
151	Pardi	YCCE College	26	Not Operating
152	Kamptee	Mominpur	15.8	Not Operating
153	Kharbi	Sitabuldi	11.7	Not Operating
154	Sitabuldi	Gourkhede	9.07	Not Operating
155	Kapil Nagar	Dikshabhumi	11.59	Not Operating
156	Hiwari Naagr	Dikshabhumi	6.61	Not Operating
157	Sitabuldi	Sonegaon Via Laxmi Nagar	12	Operating
158	Defence	JN Hospital /MIHAN/Butibori	17.81	Operating

ANNEXURE 3. RECOMMENDED MODIFICATIONS TO THE CITY BUS ROUTES

LIST OF RECOMMENDED MODIFICATIONS TO THE CITY BUS ROUTES

Sl. No.	Unique Route ID	Route Status	Existing Route Description	Route Length (kms)	Existing Headway (mins)	Existing No. of Buses	Overlapping with Metro Corridor	Modified Unique Route ID	Type of Route	Route Description	Terminal/Hub
1	CBS-001	Operational	Pardi-Jaitala	20	5	16	Y	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
2	CBS-002	Non Operational	Kharbi-Pannasay Layout	22	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
3	CBS-003	Non Operational	Sitabuldi-Bramhanwada	22	0	0	Y	CBS-003-T	Trunk Corridor	Sitabuldii to Katol Naka	Katol Naka
3	CBS-003	Non Operational	Sitabuldi-Bramhanwada	22	0	0	Y	CBS-003-F	Feeder Corridor	Katol Naka to Brahmanawada	Katol Naka
4	CBS-004	Operational	Piplafata-Hazaripahad	22	5	22	Y	CBS-004-T	Trunk Corridor	Dighori to Dattawadi	Dighori
4	CBS-004	Operational	Piplafata-Hazaripahad	22	5	22	Y	CBS-004-Fa	Feeder Corridor	Dighori To Piplafata	Dighori
4	CBS-004	Operational	Piplafata-Hazaripahad	22	5	22	Y	CBS-004-Fb	Feeder Corridor	Dattawadi to Hazaripahad	Dattawadi
5	CBS-005	Operational	Piplafata-Gandhibagh	12	50	1	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
6	CBS-006	Non Operational	Mahalgaon-Sitabuldi	18	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
6	CBS-006	Non Operational	Mahalgaon-Sitabuldi	18	0	0	Y	CBS-006-F	Feeder Corridor	Surya nagar to Mahalgaon	Surya Nagar
7	CBS-007	Non Operational	Wadad-Sitabuldi	24	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
7	CBS-007	Non Operational	Wadad-Sitabuldi	24	0	0	Y	CBS-007-F	Feeder Corridor	Dighori to Wadad	Dighori
8	CBS-008	Non Operational	Pardi-Mahindra & Mahindra	22	0	0	Y	CBS-008-T	Trunk Corridor	Pardi to Mahindra & Mahindra	Hingana
9	CBS-009	Non Operational	Kharbi-Defence	24	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
10	CBS-010	Non Operational	Pardi-Defence	26	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
11	CBS-011	Non Operational	Kamptee-Defence	32	0	0	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
11	CBS-011	Non Operational	Kamptee-Defence	32	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
11	CBS-011	Non Operational	Kamptee-Defence	32	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
12	CBS-012	Non Operational	Piplafata-Defence	26	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
12	CBS-012	Non Operational	Piplafata-Defence	26	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
13	CBS-013	Operational	Sitabuldi-Suradevi	18	75	1	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
13	CBS-013	Operational	Sitabuldi-Suradevi	18	75	1	Y	CBS-013-F	Feeder Corridor	Mankapur to Khaparkheda	Mankapur
14	CBS-014	Non Operational	Sitabuldi-Babulkheda	28	0	0	Y	CBS-014-F	Feeder Corridor	Mankapur to Itangodi	Mankapur
14	CBS-014	Non Operational	Sitabuldi-Babulkheda	28	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
15	CBS-015	Non Operational	Sitabuldi-Pawangaon	16	0	0	Y	CBS-015-F	Feeder Corridor	Surya Nagar to Pawangaon	Surya Nagar
15	CBS-015	Non Operational	Sitabuldi-Pawangaon	16	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
16	CBS-016	Non Operational	Kharbi-Vaishali Nagar	24	0	0	Y	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
16	CBS-016	Non Operational	Kharbi-Vaishali Nagar	24	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
17	CBS-017	Non Operational	Vela Hari-Gorewada	26	0	0	N	CBS-017-T	Trunk Corridor	Sitabuldi to Gorewada	Dattawadi
17	CBS-017	Non Operational	Vela Hari-Gorewada	26	0	0	N	CBS-017-F	Feeder Corridor	Sitaburdi to Vela hari	Patwardhan
18	CBS-018	Non Operational	Sitabuldi-Belatrodi	12	0	0	Y	CBS-018-F	Feeder Corridor	Chatrapati to Belatarodi	Patwardhan
19	CBS-019	Operational	Sitabuldi-New Narsala	14	60	1	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
20	CBS-020	Operational	Sitabuldi-Kamptee	18	15	5	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
20	CBS-020	Operational	Sitabuldi-Kamptee	18	15	5	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
21	CBS-021	Non Operational	Sitabuldi-Morarji	28	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
22	CBS-022	Operational	Sitabuldi-Sonegaon	12	10	4	Y	CBS-022-T	Trunk Corridor	Burdi to Sonegaon	Patwardhan
23	CBS-023	Non Operational	Sitabuldi-Yashodhara	10	0	0	Y	CBS-023-F	Feeder Corridor	10 no Puliyai to Nagsengao	Teka Naka
24	CBS-024	Operational	Sitabuldi-Nagsenwan	10	10	5	Y	CBS-023-F	Feeder Corridor	10 no Puliyai to Nagsengao	Teka Naka
25	CBS-025	Operational	Sitabuldi-Godhani	12	5	10	Y	CBS-025-F	Feeder Corridor	Mankapur to Lonara	Mankapur
25	CBS-025	Operational	Sitabuldi-Godhani	12	5	10	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
26	CBS-026	Operational	Sitabuldi-Khaparkheda	26	10	13	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
26	CBS-026	Operational	Sitabuldi-Khaparkheda	26	10	13	Y	CBS-013-F	Feeder Corridor	Mankapur to Khaparkheda	Mankapur
27	CBS-027	Non Operational	Sitabuldi-Jaywant Nagar	14	0	0	Y	CBS-027-F	Feeder Corridor	Sitaburdi to jaywant Nagar	Patwardhan
28	CBS-028	Operational	Sitabuldi-Pardi	10	5	12	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
29	CBS-029	Non Operational	Banwadi-Sitabuldi	24	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
29	CBS-029	Non Operational	Banwadi-Sitabuldi	24	0	0	Y	CBS-029-F	Feeder Corridor	Dighori to Banwadi	Dighori
30	CBS-030	Non Operational	Sitabuldi-Satgaon	22	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost

Sl. No.	Unique Route ID	Route Status	Existing Route Description	Route Length (kms)	Existing Headway (mins)	Existing No. of Buses	Overlapping with Metro Corridor	Modified Unique Route ID	Type of Route	Route Description	Terminal/Hub
31	CBS-031	Non Operational	Piplafata-Wayusena	22	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
31	CBS-031	Non Operational	Piplafata-Wayusena	22	0	0	Y	CBS-031-F	Feeder Corridor	Sitabuldi to Wayusena	Patwardhan
32	CBS-032	Operational	Sitabuldi-Isasani	16	15	4	Y	CBS-032-T	Trunk Corridor	Sitabuldi to Hingna	Hingana
32	CBS-032	Operational	Sitabuldi-Isasani	16	15	4	Y	CBS-032-F	Feeder Corridor	Hingna T point to Issasani	Hingana
33	CBS-033	Non Operational	Sitabuldi Jilhapheri-Pannasay Layout	16	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
34	CBS-034	Non Operational	Sitabuldi-Belatrodi	12	0	0	Y	CBS-018-F	Feeder Corridor	Chatrapati to Belatarodi	Patwardhan
35	CBS-035	Operational	Pardi-YCCE College	24	10	12	Y	CBS-008-T	Trunk Corridor	Pardi to Mahindra & Mahindra	Hingana
36	CBS-036	Non Operational	Kharbi Jilhaferi-Haazaripahad	20	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
36	CBS-036	Non Operational	Kharbi Jilhaferi-Haazaripahad	20	0	0	Y	CBS-004-Fb	Feeder Corridor	Dattawadi to Hazaripahad	Dattawadi
37	CBS-037	Non Operational	Sitabuldi-Kapil Nagar	12	0	0	Y	CBS-037-F	Feeder Corridor	Indora chowk to Kapil Nagar	Teka Naka
37	CBS-037	Non Operational	Sitabuldi-Kapil Nagar	12	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
38	CBS-038	Operational	Sitabuldi-JN Hospital	26	15	8	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
38	CBS-038	Operational	Sitabuldi-JN Hospital	26	15	8	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
39	CBS-039	Non Operational	Sitabuldi-Hingana	16	0	0	Y	CBS-032-T	Trunk Corridor	Sitabuldi to Hingna	Hingana
39	CBS-039	Non Operational	Sitabuldi-Hingana	16	0	0	Y	CBS-039-F	Feeder Corridor	Hingna T Point to Hingna	Hingana
40	CBS-040	Operational	Sitabuldi-Defence	16	5	17	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
41	CBS-041	Non Operational	Sitabuldi-Itangoti	20	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
41	CBS-041	Non Operational	Sitabuldi-Itangoti	20	0	0	Y	CBS-014-F	Feeder Corridor	Mankapur to Itangodi	Mankapur
42	CBS-042	Operational	Sitabuldi-Mangrul	22	90	1	N	CBS-042-F	Feeder Corridor	Dattawadi to Mangrul	Dattawadi
42	CBS-042	Operational	Sitabuldi-Mangrul	22	90	1	N	CBS-009-T	Feeder Corridor	Sitaburdi to Defence	Dattawadi
43	CBS-043	Non Operational	Kamptee-Mahindra & Mahindra	32	0	0	Y	CBS-043-T	Trunk Corridor	Tekanaka to Mahindra & Mahindra	Teka Naka
43	CBS-043	Non Operational	Kamptee-Mahindra & Mahindra	32	0	0	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
44	CBS-044	Operational	Sitabuldi-Kamptee	18	10	9	Y	CBS-044-F	Feeder Corridor	Gandhibagh to Kamptee	Surya Nagar
45	CBS-045	Non Operational	Sitabuldi-Shesh Nagar	14	0	0	Y	CBS-017-F	Feeder Corridor	Sitaburdi to Vela hari	Patwardhan
46	CBS-046	Non Operational	Sitabuldi-Samata Nagar	10	0	0	Y	CBS-046-F	Feeder Corridor	Indora Chowk to Samta Nagar	Teka Naka
46	CBS-046	Non Operational	Sitabuldi-Samata Nagar	10	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
47	CBS-047	Operational	Sitabuldi-CRPF	14	20	3	Y	CBS-047-F	Feeder Corridor	Chatrapati Sq to CRPF	Patwardhan
48	CBS-048	Operational	Sitabuldi-Nara	8	5	9	Y	CBS-048-F	Feeder Corridor	Indora Sq to Nara	Teka Naka
49	CBS-049	Non Operational	Sitabuldi-Nari	10	0	0	Y	CBS-049-F	Feeder Corridor	Indora Sq to Nari	Teka Naka
50	CBS-050	Non Operational	Sitabuldi-Kamptee	18	0	0	Y	CBS-050-F	Feeder Corridor	Sitaburdi to Wanjari	Surya Nagar
51	CBS-051	Non Operational	Sitabuldi-Dabha	12	0	0	N	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
52	CBS-052	Non Operational	Sitabuldi-Narsala	16	0	0	Y	CBS-052-T	Trunk Corridor	Sitaburdi to Narsala	Dighori
53	CBS-053	Non Operational	Sitabuldi-Dighori Naka	14	0	0	Y	CBS-052-T	Trunk Corridor	Sitaburdi to Narsala	Dighori
53	CBS-053	Non Operational	Sitabuldi-Dighori Naka	14	0	0	Y	CBS-004-T	Trunk Corridor	Dighori to Dattawadi	Dighori
54	CBS-054	Operational	Sitabuldi-Bhramani Fata	24	10	10	Y	CBS-054-F	Feeder Corridor	Katol Naka to Brahmani fata	Katol Naka
54	CBS-054	Operational	Sitabuldi-Bhramani Fata	24	10	10	Y	CBS-003-T	Trunk Corridor	Sitabuldii to Katol Naka	Katol Naka
55	CBS-055	Non Operational	Sitabuldi-Piplafata	14	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
56	CBS-056	Non Operational	Dighori Naka-CGO	18	0	0	Y	CBS-052-T	Trunk Corridor	Sitaburdi to Narsala	Dighori
56	CBS-056	Non Operational	Dighori Naka-CGO	18	0	0	Y	CBS-031-F	Trunk Corridor	Sitabuldi to Wayusena	Patwardhan
57	CBS-057	Non Operational	Sitabuldi-Prem Nagar	14	0	0	Y	CBS-057-F	Feeder Corridor	Sitabuldi to Prem Nagar	Patwardhan
58	CBS-058	Non Operational	Sitabuldi-Pawangaon	16	0	0	N	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
58	CBS-058	Non Operational	Sitabuldi-Pawangaon	16	0	0	N	CBS-015-F	Feeder Corridor	Surya Nagar to Pawangaon	Surya Nagar
59	CBS-059	Non Operational	Sitabuldi-Amar Nagar	14	0	0	Y	CBS-043-T	Feeder Corridor	Tekanaka to Mahindra & Mahindra	Teka Naka
59	CBS-059	Non Operational	Sitabuldi-Amar Nagar	14	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
60	CBS-060	Non Operational	Sitabuldi-Shyam Nagar	10	0	0	Y	CBS-018-F	Feeder Corridor	Chatrapati to Belatarodi	Patwardhan
61	CBS-061	Non Operational	Sitabuldi-Reliance Industries	28	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
62	CBS-062	Non Operational	Kamptee-Lonara	24	0	0	N	CBS-025-F	Feeder Corridor	Mankapur to Lonara	Mankapur
62	CBS-062	Non Operational	Kamptee-Lonara	24	0	0	N	CBS-043-T	Trunk Corridor	Tekanaka to Mahindra & Mahindra	Teka Naka
63	CBS-063	Non Operational	Tukdoji Square-Nari	16	0	0	Y	CBS-063-F	Feeder Corridor	Tukdoji Sq to Nari	Patwardhan
64	CBS-064	Non Operational	Tukdoji Square-Nara	14	0	0	Y	CBS-064-F	Feeder Corridor	Tukdoji sq to Nara	Patwardhan
65	CBS-065	Operational	Sitabuldi-Khadgaon	18	75	1	N	CBS-065-F	Feeder Corridor	Katol Naka to Khadgaon	Katol Naka
65	CBS-065	Operational	Sitabuldi-Khadgaon	18	75	1	N	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
66	CBS-066	Non Operational	Hazaripahad-Piplafata	24	0	0	Y	CBS-004-T	Trunk Corridor	Dighori to Dattawadi	Dighori

Sl. No.	Unique Route ID	Route Status	Existing Route Description	Route Length (kms)	Existing Headway (mins)	Existing No. of Buses	Overlapping with Metro Corridor	Modified Unique Route ID	Type of Route	Route Description	Terminal/Hub
66	CBS-066	Non Operational	Hazaripahad-Piplafata	24	0	0	Y	CBS-004-Fa	Feeder Corridor	Dighori To Piplafata	Dighori
66	CBS-066	Non Operational	Hazaripahad-Piplafata	24	0	0	Y	CBS-004-Fb	Feeder Corridor	Dattawadi to Hazaripahad	Dattawadi
67	CBS-067	Non Operational	Sitabuldi-Banwadi	26	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
67	CBS-067	Non Operational	Sitabuldi-Banwadi	26	0	0	Y	CBS-029-F	Feeder Corridor	Dighori to Banwadi	Dighori
68	CBS-068	Operational	Sitabuldi-Wadad	26	110	1	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
68	CBS-068	Operational	Sitabuldi-Wadad	26	110	1	Y	CBS-007-F	Feeder Corridor	Dighori to Wadad	Dighori
69	CBS-069	Non Operational	Uday Nagar-CGO	16	0	0	Y	CBS-004-T	Trunk Corridor	Dighori to Dattawadi	Dighori
69	CBS-069	Non Operational	Uday Nagar-CGO	16	0	0	Y	CBS-031-F	Feeder Corridor	Sitabuldi to Wayusena	Patwardhan
70	CBS-070	Non Operational	Shesh Nagar-CGO	12	0	0	Y	CBS-070-F	Feeder Corridor	Sitabuldi to Shesh nagar	Patwardhan
70	CBS-070	Non Operational	Shesh Nagar-CGO	12	0	0	Y	CBS-031-F	Feeder Corridor	Sitabuldi to Wayusena	Patwardhan
71	CBS-071	Non Operational	Kharbi-Haazaripahad	20	0	0	Y	CBS-071-F	Feeder Corridor	Buldi to Hazaripahad	Patwardhan
71	CBS-071	Non Operational	Kharbi-Haazaripahad	20	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
72	CBS-072	Operational	Sitabuldi-Alesur	18	75	1	N	CBS-072-F	Feeder Corridor	Dattawadi to Alesur	Dattawadi
72	CBS-072	Operational	Sitabuldi-Alesur	18	75	1	N	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
73	CBS-073	Non Operational	Narendra Nagar-Wayusena	16	0	0	Y	CBS-073-F	Feeder Corridor	Narendra Nagar to Vayusena	Patwardhan
74	CBS-074	Non Operational	Kapasi-Nandanwan	10	0	0	Y	CBS-074-F	Feeder Corridor	Surya Nagar to Nandanwan	Surya Nagar
75	CBS-075	Non Operational	Sitabuldi-Karve Nagar	10	0	0	Y	CBS-075-F	Feeder Corridor	Buldi to Karve Nagar	Patwardhan
76	CBS-076	Operational	Sitabuldi-Pawangaon	16	65	1	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
76	CBS-076	Operational	Sitabuldi-Pawangaon	16	65	1	Y	CBS-015-F	Feeder Corridor	Surya Nagar to Pawangaon	Surya Nagar
77	CBS-077	Non Operational	Sitabuldi-JN Hospital	24	0	0	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
77	CBS-077	Non Operational	Sitabuldi-JN Hospital	24	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
78	CBS-078	Non Operational	Wayusena Gate-CRPF	22	0	0	Y	CBS-078-F	Feeder Corridor	Sitaburdi to Wayusena	Dattawadi
79	CBS-079	Operational	Vela Hari-Gorewada	26	15	8	Y	CBS-017-T	Trunk Corridor	Sitabuldi to Gorewada	Dattawadi
79	CBS-079	Operational	Vela Hari-Gorewada	26	15	8	Y	CBS-017-F	Feeder Corridor	Sitaburdi to Vela hari	Patwardhan
80	CBS-080	Non Operational	Sitabuldi-Dhamna	32	0	0	N	CBS-080-F	Feeder Corridor	Defence to Dhamna	Dattawadi
80	CBS-080	Non Operational	Sitabuldi-Dhamna	32	0	0	N	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
81	CBS-081	Non Operational	Sitabuldi-Sitabuldi	26	0	0	Y	CBS-081-T	Trunk Corridor	Sitabuldi to Sitabuldi	Patwardhan
82	CBS-082	Operational	Belatrodi-Sitabuldi	12	10	4	Y	CBS-018-F	Feeder Corridor	Chatrapati to Belatarodi	Patwardhan
83	CBS-083	Operational	Sitabuldi-Vaishali Nagar	14	15	4	Y				
84	CBS-084	Operational	Sitabuldi-Shanti Nagar	10	40	1	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
84	CBS-084	Operational	Sitabuldi-Shanti Nagar	10	40	1	Y	CBS-044-F	Feeder Corridor	Gandhibagh to Kamptee	Surya Nagar
85	CBS-085	Operational	Sitabuldi-Shesh Nagar	12	25	2	Y	CBS-017-F	Feeder Corridor	Sitaburdi to Vela hari	Patwardhan
86	CBS-086	Operational	Sitabuldi-Waddhamna	16	65	1	N	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
87	CBS-087	Non Operational	Sitabuldi-Kapasi	12	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
87	CBS-087	Non Operational	Sitabuldi-Kapasi	12	0	0	Y	CBS-006-F	Feeder Corridor	Surya nagar to Mahalgaon	Surya Nagar
88	CBS-088	Non Operational	Jaripatka-TB Ward	8	0	0	N	CBS-064-F	Feeder Corridor	Tukdoji sq to Nara	Patwardhan
89	CBS-089	Non Operational	Gandhibag-Gorewada	12	0	0	Y	CBS-017-T	Trunk Corridor	Sitabuldi to Gorewada	Dattawadi
90	CBS-090	Non Operational	Gandhibag-Gorewada	14	0	0	Y	CBS-017-T	Trunk Corridor	Sitabuldi to Gorewada	Dattawadi
91	CBS-091	Non Operational	Sitabuldi-Bhanegaon	26	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
91	CBS-091	Non Operational	Sitabuldi-Bhanegaon	26	0	0	Y	CBS-013-F	Feeder Corridor	Mankapur to Khaparkheda	Mankapur
92	CBS-092	Non Operational	Sitabuldi-Shesh Nagar	14	0	0	Y	CBS-017-F	Feeder Corridor	Sitaburdi to Vela hari	Patwardhan
93	CBS-093	Non Operational	Sitabuldi-Chakrapani Nagar	12	0	0	Y	CBS-093-T	Trunk Corridor	Sitabuldi to Chakrapani nagar	Patwardhan
94	CBS-094	Non Operational	Kharbi-Jaitala	20	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
95	CBS-095	Non Operational	Kharbi-Jaitala	22	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
96	CBS-096	Non Operational	Kharbi-Pannasay Layout	20	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
97	CBS-097	Non Operational	Sitabuldi-Defence	24	0	0	Y	CBS-032-T	Feeder Corridor	Sitabuldi to Hingna	HIngana
97	CBS-097	Non Operational	Sitabuldi-Defence	24	0	0	Y	CBS-032-T	Trunk Corridor	Sitabuldi to Hingna	Hingana
98	CBS-098	Non Operational	Sitabuldi-Defence	22	0	0	N	CBS-032-T	Feeder Corridor	Sitabuldi to Hingna	HIngana
98	CBS-098	Non Operational	Sitabuldi-Defence	22	0	0	N	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
99	CBS-101	Non Operational	Sitabuldi-Futala Talao	10	0	0	Y	CBS-078-F	Feeder Corridor	Sitaburdi to Wayusena	Dattawadi
100	CBS-102	Non Operational	Sitabuldi-Ambazari Talao	6	0	0	Y	CBS-102-F	Feeder Corridor	Sitabuldi to Ambazari garden	Patwardhan
101	CBS-103	Non Operational	Sitabuldi-Koradi Yatra	16	0	0	Y	CBS-103-F	Feeder Corridor	Mankapur to Koradi Yatra_Seasonal	Mankapur
101	CBS-103	Non Operational	Sitabuldi-Koradi Yatra	16	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur

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102	CBS-104	Non Operational	Nagpur Railway Station -Radhaswami	18	0	0	N	CBS-102-F	Feeder Corridor	Sitabuldi to Ambazari garden	Patwardhan
103	CBS-105	Non Operational	Gandhibag-Dighori Naka	12	0	0	Y	CBS-052-T	Trunk Corridor	Sitaburdi to Narsala	Dighori
103	CBS-105	Non Operational	Gandhibag-Dighori Naka	12	0	0	Y	CBS-005-T	Trunk Corridor	Ashirwad Nagar to Gandhibagh	Dighori
104	CBS-106	Operational	Sitabuldi-Panchgaon	20	5	13	Y	CBS-106-F	Feeder Corridor	Dighori to Panchgaon	Dighori
104	CBS-106	Operational	Sitabuldi-Panchgaon	20	5	13	Y	CBS-052-T	Trunk Corridor	Sitaburdi to Narsala	Dighori
105	CBS-107	Operational	Sitabuldi-Indoram Gate No 6	26	5	24	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
106	CBS-108	Non Operational	Sitabuldi-Morarji	28	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
107	CBS-109	Non Operational	Sitabuldi-MIHAN	26	0	0	Y	CBS-109-T	Trunk Corridor	Sitabuldi to MIHAN	Octroi Checkpost
108	CBS-110	Non Operational	Sitabuldi-Mohgaon	26	0	0	Y	CBS-032-T	Trunk Corridor	Sitabuldi to Hingna	Hingana
108	CBS-110	Non Operational	Sitabuldi-Mohgaon	26	0	0	Y	CBS-110-F	Feeder Corridor	Hingna T Point to Mohgaon	Hingana
109	CBS-111	Operational	Dikshabhumi-Dragon Palace	22	90	1	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
109	CBS-111	Operational	Dikshabhumi-Dragon Palace	22	90	1	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
110	CBS-112	Non Operational	Sitabuldi-Dragon Palace	20	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
110	CBS-112	Non Operational	Sitabuldi-Dragon Palace	20	0	0	Y	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
111	CBS-113	Operational	Dikshabhumi-Sitabuldi	2	10	1	Y				
112	CBS-114	Non Operational	Sitabuldi-Ambazari T Point	4	0	0	Y				
113	CBS-115	Non Operational	Dikshabhumi-Nara	10	0	0	Y	CBS-048-F	Feeder Corridor	Indora Sq to Nara	Teka Naka
114	CBS-116	Non Operational	Dikshabhumi-Nari	12	0	0	Y	CBS-049-F	Feeder Corridor	Indora Sq to Nari	Teka Naka
115	CBS-117	Non Operational	Dikshabhumi-Nagsenwan	12	0	0	Y	CBS-023-F	Feeder Corridor	10 no Puliyai to Nagsengao	Teka Naka
116	CBS-118	Non Operational	Dikshabhumi-Indora Zopada Maidan	8	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
117	CBS-119	Non Operational	Pardi-Dikshabhumi	12	0	0	Y	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
118	CBS-120	Non Operational	Belatrodi-Dikshabhumi	14	0	0	Y	CBS-018-F	Feeder Corridor	Chatrapati to Belatarodi	Patwardhan
119	CBS-121	Non Operational	Kamptee-Koradi	12	0	0	N	CBS-121-F	Feeder Corridor	Kamptee to Koradi_Seasonal	Teka Naka
120	CBS-122	Non Operational	Pardi-Koradi Yatra Stand	28	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
120	CBS-122	Non Operational	Pardi-Koradi Yatra Stand	28	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
120	CBS-122	Non Operational	Pardi-Koradi Yatra Stand	28	0	0	Y	CBS-103-F	Feeder Corridor	Mankapur to Koradi Yatra_Seasonal	Mankapur
121	CBS-123	Non Operational	Piplafata-Koradi	30	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
121	CBS-123	Non Operational	Piplafata-Koradi	30	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
121	CBS-123	Non Operational	Piplafata-Koradi	30	0	0	Y	CBS-103-F	Feeder Corridor	Mankapur to Koradi Yatra_Seasonal	Mankapur
122	CBS-124	Non Operational	Dattawadi-Koradi Yatra Stand	28	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
122	CBS-124	Non Operational	Dattawadi-Koradi Yatra Stand	28	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
122	CBS-124	Non Operational	Dattawadi-Koradi Yatra Stand	28	0	0	Y	CBS-103-F	Feeder Corridor	Mankapur to Koradi Yatra_Seasonal	Mankapur
123	CBS-125	Non Operational	Kamptee-Koradi	22	0	0	N	CBS-121-F	Feeder Corridor	Kamptee to Koradi_Seasonal	Teka Naka
124	CBS-126	Non Operational	Dikshabhumi-Yashodhara	12	0	0	Y	CBS-023-F	Feeder Corridor	10 no Puliyai to Nagsengao	Teka Naka
125	CBS-127	Non Operational	Giddoba Nagar-Dikshabhumi	16	0	0	Y	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
126	CBS-128	Non Operational	Gandhibag-Tajabad	8	0	0	Y	CBS-128-F	Feeder Corridor	Gandhibagh to Tajabad	Dighori
127	CBS-129	Non Operational	Tajabad-Sitabuldi	10	0	0	Y	CBS-128-F	Feeder Corridor	Gandhibagh to Tajabad	Dighori
128	CBS-130	Non Operational	Belatrodi-Sitabuldi	12	0	0	Y	CBS-018-F	Feeder Corridor	Chatrapati to Belatarodi	Patwardhan
129	CBS-131	Non Operational	Sitabuldi-Wathoda	8	0	0	Y	CBS-131-F	Feeder Corridor	Sitabuldi to Swaraj nagar Wathoda	Surya Nagar
130	CBS-132	Non Operational	Railway Station -Khapri Satsang	20	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
131	CBS-133	Non Operational	Sitabuldi-Jamtha Special	20	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
132	CBS-134	Non Operational	Kapsi Umiya Dham-Sitabuldi	14	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
133	CBS-135	Operational	Sitabuldi-Hingana Gramin Hospital	18	5	21	Y	CBS-032-T	Trunk Corridor	Sitabuldi to Hingna	Hingana
133	CBS-135	Operational	Sitabuldi-Hingana Gramin Hospital	18	5	21	Y	CBS-039-F	Feeder Corridor	Hingna T Point to Hingna	Hingana
134	CBS-136	Non Operational	Sitabuldi-Mahalgaon	16	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
134	CBS-136	Non Operational	Sitabuldi-Mahalgaon	16	0	0	Y	CBS-006-F	Feeder Corridor	Surya nagar to Mahalgaon	Surya Nagar
135	CBS-137	Non Operational	Sitabuldi-Jaripatka	6	0	0	Y	CBS-048-F	Feeder Corridor	Indora Sq to Nara	Teka Naka
135	CBS-137	Non Operational	Sitabuldi-Jaripatka	6	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
136	CBS-138	Non Operational	Jaripatka-Medical Square	10	0	0	N	CBS-064-F	Feeder Corridor	Tukdoji sq to Nara	Patwardhan
137	CBS-139	Non Operational	Sitabuldi-Bahadura Fata	16	0	0	Y	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
138	CBS-140	Non Operational	Kharbi T Point-Pannasay Layout	24	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
139	CBS-141	Operational	Kharbi T Point-Jaitala	24	5	16	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
140	CBS-142	Non Operational	Sitabuldi-Dahegaon	20	0	0	Y	CBS-142-F	Feeder Corridor	Defence to Dahegaon	Dattawadi

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140	CBS-142	Non Operational	Sitabuldi-Dahegaon	20	0	0	Y	CBS-009-T	Trunk Corridor	Sitaburdi to Defence	Dattawadi
141	CBS-143	Non Operational	Wardhaman Nagar-Dahegaon	26	0	0	Y	CBS-143-T	Trunk Corridor	Wardhaman Nagar to Dahegaon	Surya Nagar
142	CBS-144	Non Operational	Shanti Nagar-Dahegaon	26	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
142	CBS-144	Non Operational	Shanti Nagar-Dahegaon	26	0	0	Y	CBS-006-T	Trunk Corridor	Sitabuldi to Surya nagar	Surya Nagar
142	CBS-144	Non Operational	Shanti Nagar-Dahegaon	26	0	0	Y	CBS-044-F	Feeder Corridor	Gandhibagh to Kamptee	Surya Nagar
143	CBS-145	Non Operational	Sonegaon-Dahegaon	24	0	0	Y				
144	CBS-146	Non Operational	Jaripatka-Dahegaon	30	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
144	CBS-146	Non Operational	Jaripatka-Dahegaon	30	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
144	CBS-146	Non Operational	Jaripatka-Dahegaon	30	0	0	Y	CBS-048-F	Feeder Corridor	Indora Sq to Nara	Teka Naka
145	CBS-147	Non Operational	Sitabuldi-Dahegaon	16	0	0	Y				
146	CBS-148	Non Operational	Nagpur Railway Station -Dahegaon	20	0	0	Y	CBS-021-T	Trunk Corridor	Sitaburdi to Morarji	Octroi Checkpost
147	CBS-149	Non Operational	Bahadura Fata-CGO	20	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
147	CBS-149	Non Operational	Bahadura Fata-CGO	20	0	0	Y	CBS-031-F	Feeder Corridor	Sitabuldi to Wayusena	Patwardhan
148	CBS-150	Non Operational	Pardi-YCCE College	26	0	0	Y	CBS-008-T	Trunk Corridor	Pardi to Mahindra & Mahindra	Hingana
149	CBS-151	Non Operational	Pardi-YCCE College	26	0	0	Y	CBS-008-T	Trunk Corridor	Pardi to Mahindra & Mahindra	Hingana
150	CBS-152	Non Operational	Kamptee-Mominpur	15.8	0	0	N	CBS-044-F	Feeder Corridor	Gandhibagh to Kamptee	Surya Nagar
151	CBS-153	Non Operational	Kharbi-Sitabuldi	11.7	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
152	CBS-154	Non Operational	Sitabuldi-Gourkhede	9.07	0	0	Y	CBS-017-T	Trunk Corridor	Sitabuldi to Gorewada	Dattawadi
153	CBS-155	Non Operational	Kapil Nagar-Dikshabhumi	11.59	0	0	Y	CBS-037-F	Feeder Corridor	Indora chowk to Kapil Nagar	Teka Naka
153	CBS-155	Non Operational	Kapil Nagar-Dikshabhumi	11.59	0	0	Y	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
154	CBS-156	Non Operational	Hiwari Naagr-Dikshabhumi	6.61	0	0	Y	CBS-001-T	Trunk Corridor	Pardi to Vaishali Nagar	Surya Nagar
155	CBS-157	New Routes	Jaitala-Ramna maruti Chowk	13.9	0	0	Y	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
156	CBS-158	New Routes	Sitabuldi-Godhani	9.81	0	0	Y	CBS-013-T	Trunk Corridor	Sitabuldi to Mankapur	Mankapur
156	CBS-158	New Routes	Sitabuldi-Godhani	9.81	0	0	Y	CBS-013-F	Feeder Corridor	Mankapur to Khaparkheda	Mankapur
157	CBS-159	New Routes	Sitabuldi-Dumri Khurd	33	0	0	N	CBS-011-T	Trunk Corridor	Sitabuldi to Tekanaka	Teka Naka
157	CBS-159	New Routes	Sitabuldi-Dumri Khurd	33	0	0	N	CBS-011-F	Feeder Corridor	Tekanaka to Jn Hospital	Teka Naka
158	CBS-160	New Routes	Sitabuldi-Kharbi	9.07	0	0	N	CBS-002-T	Trunk Corridor	Kharbi to Pannasay Layout	Dighori
159	CBS-161	New Routes	Sitabuldi-Mumbai Kolkata highway, pipla	11.7	0	0	Y	CBS-004-T	Trunk Corridor	Dighori to Dattawadi	Dighori
159	CBS-161	New Routes	Sitabuldi-Mumbai Kolkata highway, pipla	11.7	0	0	Y	CBS-004-Fa	Feeder Corridor	Dighori To Piplafata	Dighori
160	CBS-162	New Routes	Katol Naka-Shitala mata mandir	14.5	0	0	Y	CBS-162-F	Feeder Corridor	Rahate Colony to Shitla mata mandir	Patwardhan
161	CBS-163	New Routes	Binaki layout-Panjara Colony	10.3	0	0	N	CBS-163-F	Feeder Corridor	Binaki Layout to Panjara Colony	Teka Naka
162	CBS-164	New Routes	Binaki Layout-Navin Nagar	10.6	0	0	Y	CBS-164-F	Feeder Corridor	Binaki Layout to Navin Nagar	Surya Nagar
163	CBS-165	New Routes	Telipura-Bele Nagar	20.4	0	0	Y	CBS-044-F	Feeder Corridor	Gandhibagh to Kamptee	Surya Nagar
164	CBS-166	New Routes	Sadbhavana Nagar-Ghuti	23.6	0	0	Y	CBS-166-F	Feeder Corridor	Sadbhavna Nagar to Ghuti	Octroi Checkpost
165	CBS-167	New Routes	Bajaria-Yogeshwar Nagar	9.44	0	0	Y	CBS-167-F	Feeder Corridor	Bajaria to Yogeshwar Nagar	Dighori
166	CBS-168	New Routes	Pragati nagar-Sidheshwar nagar (Ramna maruti main road)	18	0	0	N	CBS-168-F	Feeder Corridor	Pragati nagar to Sidheshwar Nagar	Hingana
167	CBS-169	New Routes	Nildoh-Yogeshwar Nagar	17.9	0	0	Y	CBS-169-F	Feeder Corridor	Nildoh to Yogeshwar Nagar	Hingana
168	CBS-170	New Routes	Ekatmata Nagar-Kharbi road, Vaishnavi layout	17.6	0	0	N	CBS-170-F	Feeder Corridor	Ektamata Nagar to Kharbi road, Vaishnavi layout	Hingana
169	CBS-171	New Routes	Gorewada square-Sadguru Nagar	14.9	0	0	Y	CBS-171-F	Feeder Corridor	Gorewada sq to Sadguru Nagar	Katol Naka
170	CBS-172	New Routes	Sitabuldi-Purani Basti, Buti bori	35.9	0	0	Y	CBS-172-F	Feeder Corridor	Sitabuldi to Purani basti Buti buri	Octroi Checkpost
171	CBS-173	New Routes	Sitabuldi-Natraj Talkies, Killa road	10.01	0	0	Y	CBS-173-F	Feeder Corridor	Sitabuldi to Natraj Talkies	Patwardhan
172	CBS-174	New Routes	Sitabuldi-Vaishnavmata Nagar	10.9	0	0	N	CBS-174-F	Feeder Corridor	Sitabuldi to Vaishnavmata nagar	Patwardhan
173	CBS-175	New Routes	Airport-Ganesh Nagari	17	0	0	Y	CBS-175-F	Feeder Corridor	Airport to Ganesh Nagari	Mankapur
174	CBS-176	New Routes	Gandhibag-Kamala Nagar	15.9	0	0	Y	CBS-176-F	Feeder Corridor	Gandhi Bagh to Kamala Nagar	Dattawadi
175	CBS-177	New Routes	Jai Hind society-Dhoke Layout	15.4	0	0	Y	CBS-177-F	Feeder Corridor	Jai Hind Society to Dhoke Layout	Mankapur
176	CBS-178	New Routes	Jaitala-Kharbi road, New Diamond Nagar	16.8	0	0	Y	CBS-178-F	Feeder Corridor	Jaitala to Kharbi Road	Hingana
177	CBS-179	New Routes	ISCB Colony-Pipla Road, Janki Nagar	10.8	0	0	Y	CBS-179-F	Feeder Corridor	ISCB Colony to Pila road, Janki nagar	Patwardhan
178	CBS-180	New Routes	Central excise Colony-Pipla	16.5	0	0	N	CBS-180-F	Feeder Corridor	Central excise Colony to Pipla	Dattawadi
179	CBS-181	New Routes	CBI Colony-Hudkeshwar Police station, Bhole Nagar	10.5	0	0	Y	CBS-181-F	Feeder Corridor	CBI Colony to Hudkeshwar Police station, Bhole Nagar	Patwardhan
180	CBS-182	New Routes	YCCE College-Pardi Octroi Naka	27.6	0	0	Y	CBS-182-F	Feeder Corridor	YCCE College to Pardi Octroi Naka	Surya Nagar
181	CBS-183	New Routes	Jaitala-Sitabuldi Anand Talkies	10.01	0	0	Y	CBS-183-F	Feeder Corridor	Jaitala to Sitabuldi Anand Talkies	Hingana

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182	CBS-184	New Routes	Swawalambi Nagar-Kendriya Vidyalaya Vayusena Nagar	13.9	0	0	Y	CBS-184-F	Feeder Corridor	Swawlambi Nagar to Kendriya Vidyalay	Dattawadi
183	CBS-185	New Routes	Outer ring road, Mumbai Kolkata highway, Hingna-Navin Nagar	27.3	0	0	Y	CBS-001-T	Feeder Corridor	Pardi to Vaishali Nagar	Surya Nagar
184	CBS-186	New Routes	Sitabuldi-Pragati Nagar	13.9	0	0	N	CBS-186-F	Feeder Corridor	Sitabuldi to Pragati Nagar	Hingana
185	CBS-187	New Routes	Fetri-Yogeshwar Nagar	24.8	0	0	Y	CBS-187-F	Feeder Corridor	Fetri to Yogeshwar Nagar	Dighori
186	CBS-188	New Routes	Seminary hills-Kharbi road, Ishwar Nagar	11.9	0	0	Y	CBS-188-F	Feeder Corridor	Seminary Hills to Kharbi road Ishwar nagar	Surya Nagar
187	CBS-189	New Routes	Sitabuldi-Somwarpeth	8.03	0	0	Y	CBS-189-F	Feeder Corridor	Sitabuldi to Somwar Peth	Patwardhan
188	CBS-190	New Routes	Deekshabhumi-Wanadongri	13.7	0	0	N				
189	CBS-191	New Routes	Deekshabhumi-Shankarpur	15.4	0	0	Y	CBS-191-F	Feeder Corridor	Deekshabhumi to Shankar Pur	Octroi Checkpost
190	CBS-192	New Routes	Dindayal upadhyay Chowk-Sai sewashram Society	12.4	0	0	Y	CBS-192-F	Feeder Corridor	Dindayal upadhyay Chowk to Sai Sewashram Society	Mankapur
191	CBS-193	New Routes	Sitabuldi Post office-Nagpur University	6.5	0	0	Y	CBS-193-F	Feeder Corridor	Sitabuldi Post office to Nagpur University	Patwardhan
192	CBS-194	New Routes	Anand talkies sitabuldi-Rama nagar	7.13	0	0	Y	CBS-194-F	Feeder Corridor	Sitabuldi to Manewada Chowk	Patwardhan
193	CBS-195	New Routes	Sitabuldi-Pipla	11.7	0	0	N	CBS-004-T	Feeder Corridor	Dighori to Dattawadi	Dighori
194	CBS-196	New Routes	Jitala-Shaktimata nagar	15.5	0	0	Y	CBS-196-T	Trunk Corridor	Shakti mata mandir to Jaitala	Hingana
195	CBS-197	New Routes	Dahegaon-Kamgar Nagar	22.4	0	0	Y	CBS-197-F	Feeder Corridor	Dahegaon to Kamgar Nagar	Teka Naka
196	CBS-198	New Routes	Wanadongri-Shiv Shakti nagar	23.6	0	0	Y	CBS-198-F	Feeder Corridor	Wandongri to Shiv Shakti Nagar	Surya Nagar
197	CBS-201	New Routes	CRPF-Maya nagar	29.8	0	0	Y	CBS-201-F	Feeder Corridor	CRPF to Maya Nagar	Hingana
198	CBS-203	New Routes	Sitabuldi-Ambe	12.7	0	0	N	CBS-203-F	Feeder Corridor	Sitabuldi to Ambe	Surya Nagar
199	CBS-207	New Routes	Sitabuldi-New Indora	5.96	0	0	Y				

ANNEXURE 4. RECOMMENDED ROUTEWISE HEADWAY AND FLEET

Sr.	Row Labels	Route Description	Route Length (kms)	Terminal/Hub	Route Used	Type of Route	Type of Bus	Maximum Sectional PHPDT			Daily Demand			Peak Hour Headway			Fleet Required		
								Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028
1	CBS-001-T	Pardi to Vaishali Nagar	20.94	Surya Nagar	1	Trunk	Standard-D	465	1328	1375	10666	24363	26135	7	3	2	22	60	63
2	CBS-002-T	Kharbi to Pannasay Layout	23.13	Dighori	1	Trunk	Standard-B	754	1471	2135	16052	26185	35732	5	3	2	34	66	96
4	CBS-003-T	Sitabuldii to Katol Naka	9.50	Katol Naka	1	Trunk	Standard-E	128	112	172	2965	1776	2613	26	30	19	3	3	4
5	CBS-004-Fa	Dighori To Piplafata	4.47	Dighori	2	Feeder	Standard-B	19	127	145	429	2403	3090	30	29	25	0	1	2
7	CBS-004-T	Dighori to Dattawadi	18.64	Dighori	1	Trunk	Standard-D	264	859	977	5969	15438	19284	13	4	3	11	35	40
8	CBS-005-T	Ashirwad Nagar to Gandhibagh	6.32	Dighori	1	Trunk	Standard-D	239	622	875	4845	14194	19532	14	5	4	4	9	13
9	CBS-006-F	Surya Nagar to Mahalgaon	13.88	Surya Nagar	2	Feeder	Midi	67	117	161	1471	2713	2917	30	21	15	0	5	7
10	CBS-006-T	Sitabuldi to Surya nagar	12.05	Surya Nagar	1	Trunk	Standard-D	695	717	751	14803	15789	16283	5	5	4	18	18	20
11	CBS-007-F	Dighori to Wadad	11.95	Dighori	2	Feeder	Midi	18	135	192	378	2866	3908	30	18	13	0	5	7
12	CBS-008-T	Pardi to Mahindra & Mahindra	26.32	Hingana	1	Trunk	Standard-B	1441	1417	1541	35576	29634	30939	3	3	2	78	75	81
13	CBS-009-T	Sitaburdi to Defence	12.87	Dattawadi	1	Trunk	Standard-E	629	1481	2188	12483	30330	43240	5	2	2	17	39	56
14	CBS-011-F	Tekanaka to Jn Hospital	26.44	Teka Naka	1	Feeder	Standard-D	649	584	609	12703	11439	13198	5	6	6	39	35	36
15	CBS-011-T	Sitabuldi to Tekanaka	6.54	Teka Naka	1	Trunk	Standard-E	557	1088	1195	10425	22486	23684	6	3	3	9	16	18
16	CBS-013-F	Mankapur to Khaparkheda	19.25	Mankapur	1	Feeder	Standard-D	172	595	590	3421	11923	14451	19	6	6	8	25	25
17	CBS-013-T	Sitabuldi to Mankapur	6.29	Mankapur	1	Trunk	**Standard-E**	324	466	606	7036	9033	12355	10	7	6	5	7	9
18	CBS-014-F	Mankapur to Itangodi	21.17	Mankapur	1	Feeder	Standard-D	84	92	476	1523	1563	8854	30	30	7	6	6	22
19	CBS-015-F	Surya Nagar to Pawangaon	4.83	Surya Nagar	2	Feeder	Midi	64	139	159	1448	3086	3683	30	17	15	0	2	2
20	CBS-017-F	Sitaburdi to Vela hari	13.18	Patwardhan	1	Feeder	Standard-D	336	323	374	7678	6118	7185	10	10	9	10	9	11
21	CBS-017-T	Sitabuldi to Gorewada	8.88	Dattawadi	1	Trunk	Standard-E	345	357	472	7543	6992	7604	10	9	7	7	7	10
22	CBS-018-F	Chatrapati to Belatarodi	9.59	Patwardhan	1	Feeder	Standard-D	228	277	543	3893	5417	7292	15	12	6	5	6	12
23	CBS-021-T	Sitaburdi to Morarji	34.01	Octroi Checkpost	1	Trunk	Standard-D	729	1218	1733	16536	23355	32629	5	3	2	53	87	121
25	CBS-023-F	10 no Puliyai to Nagsengao	7.88	Teka Naka	1	Feeder	Standard-D	174	780	871	3986	15935	18029	19	4	4	4	14	16
26	CBS-025-F	Mankapur to Lonara	7.88	Mankapur	3	Feeder	Midi	67	68	113	1467	1473	2372	30	30	21	0	0	3
27	CBS-027-F	Sitaburdi to jaywant Nagar	10.77	Patwardhan	1	Feeder	Midi	116	77	172	2287	1999	2790	21	30	14	4	3	6
28	CBS-029-F	Dighori to Banwadi	16.56	Dighori	3	Feeder	Midi	8	69	82	189	1562	1917	30	30	29	0	0	5
29	CBS-031-F	Sitabuldi to Wayusena	7.62	Patwardhan	1	Feeder	Midi	123	249	540	2548	5901	10213	20	10	5	3	6	13
31	CBS-032-T	Sitabuldi to Hingna	8.12	Hingana	1	Trunk	Standard-E	192	404	483	4058	8222	8531	17	8	7	4	8	9
32	CBS-037-F	Indora chowk to Kapil Nagar	3.88	Teka Naka	1	Feeder	Standard-D	199	260	302	3613	4458	4980	17	13	11	2	2	3
33	CBS-039-F	Hingna T Point to Hingna	9.36	Hingana	2	Feeder	Midi	39	225	251	826	4902	4683	30	11	10	0	7	7
35	CBS-043-T	Tekanaka to Mahindra & Mahindra	21.29	Teka Naka	1	Trunk	**Standard-E**	127	155	219	2448	3867	4258	26	21	15	6	8	11
36	CBS-044-F	Gandhibagh to Kamptee	11.14	Surya Nagar	1	Trunk	Standard-D	1122	1371	1144	20539	19527	16836	3	3	3	27	32	28
38	CBS-047-F	Chatrapati Sq to CRPF	9.50	Patwardhan	2	Feeder	Midi	38	92	78	758	2012	1645	30	26	30	0	3	3
39	CBS-048-F	Indora Sq to Nara	3.77	Teka Naka	1	Feeder	Standard-D	260	423	602	5668	9590	12426	13	8	6	2	3	5
40	CBS-049-F	Indora Sq to Nari	4.26	Teka Naka	2	Feeder	Midi	51	320	249	1085	6340	4382	30	8	10	0	4	3
41	CBS-050-F	Sitaburdi to Wanjari	8.67	Surya Nagar	3	Feeder	Midi	22	63	107	456	1341	1797	30	30	23	0	0	3
42	CBS-052-T	Sitaburdi to Narsala	13.50	Dighori	1	Trunk	Standard-D	487	592	896	9758	9056	12424	7	6	4	14	17	26
45	CBS-063-F	Tukdoji Sq to Nari	15.06	Patwardhan	2	Feeder	Midi	33	210	231	719	3494	4014	30	12	11	0	9	10
46	CBS-064-F	Tukdoji sq to Nara	14.57	Patwardhan	1	Feeder	Standard-D	233	543	650	5881	8431	9067	14	6	5	8	17	20
47	CBS-065-F	Katol Naka to Khadgaon	7.99	Katol Naka	3	Feeder	Midi	11	37	106	190	682	1638	30	30	23	0	0	3
48	CBS-070-F	Sitabuldi to Shesh nagar	9.20	Patwardhan	2	Feeder	Standard-D	100	503	1178	1553	11911	23293	30	7	3	0	11	23
49	CBS-071-F	Buldi to Hazaripahad	13.62	Patwardhan	2	Feeder	Midi	34	134	331	774	3199	6970	30	18	7	0	6	13
50	CBS-072-F	Dattawadi to Alesur	8.90	Dattawadi	3	Feeder	Midi	11	61	83	194	1270	2050	30	30	29	0	0	3
52	CBS-074-F	Surya Nagar to Nandanwan	7.00	Surya Nagar	3	Feeder	Midi	64	78	183	1176	1641	3948	30	30	13	0	0	4
53	CBS-075-F	Buldi to Karve Nagar	10.79	Patwardhan	3	Feeder	Midi	55	70	182	1294	1068	2253	30	30	13	0	0	6
54	CBS-078-F	Sitaburdi to Wayusena	8.77	Dattawadi	2	Feeder	Midi	52	126	183	1085	2382	3290	30	19	13	0	4	5
58	CBS-102-F	Sitabuldi to Ambazari garden	6.00	Patwardhan	1	Feeder	Standard-D	140	95	126	2771	1800	2461	24	30	26	2	2	2
59	CBS-103-F	Mankapur to Koradi Yatra_Seasonal	11.31	Mankapur	2	Feeder	Standard-D	59	340	614	1297	6179	11075	30	10	5	0	9	15
60	CBS-106-F	Dighori to Panchgaon	13.22	Dighori	3	Feeder	Midi	9	11	420	143	234	6497	30	30	6	0	0	16
61	CBS-109-T	Sitabuldi to MIHAN	14.62	Octroi Checkpost	1	Trunk	Standard-D	1623	1964	1982	33650	37116	36310	2	2	2	48	59	59

Sr.	Row Labels	Route Description	Route Length (kms)	Terminal/Hub	Route Used	Type of Route	Type of Bus	Maximum Sectional PHPDT			Daily Demand			Peak Hour Headway			Fleet Required		
								Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028	Yr_2018	Yr_2023	Yr_2028
63	CBS-121-F	Kamptee to Koradi_Seasonal	15.80	Teka Naka	1	Feeder	Standard-D	338	721	1462	4692	13050	26241	10	5	2	13	26	52
65	CBS-131-F	Sitabuldi to Swaraj nagar Wathoda	8.53	Surya Nagar	2	Feeder	Midi	28	323	204	667	6803	3948	30	8	12	0	9	6
66	CBS-142-F	Defence to Dahegaon	21.69	Dattawadi	3	Feeder	Midi	22	71	144	487	1254	2359	30	30	17	0	0	10
67	CBS-143-T	Wardhaman Nagar to Dahegaon	23.17	Surya Nagar	1	Trunk	Standard-D	316	78	135	6483	1946	2593	11	30	25	16	6	7
68	CBS-162-F	Rahate Colony to Shitla mata mandir	5.15	Patwardhan	1	Feeder	Standard-B	56	1616	1969	1268	21097	25662	30	2	2	2	14	17
69	CBS-163-F	Binaki Layout to Panjara Colony	11.05	Teka Naka	3	Feeder	Midi	88	51	84	2078	688	1132	27	30	29	0	0	3
71	CBS-166-F	Sadbhavna Nagar to Ghuti	23.77	Octroi Checkpost	1	Feeder	Midi	122	83	71	2392	1813	1355	20	29	30	9	6	6
72	CBS-167-F	Bajaria to Yogeshwar Nagar	9.65	Dighori	1	Feeder	Standard-D	589	245	309	10469	4460	5448	6	14	11	13	6	7
73	CBS-168-F	Pragati nagar to Sidheshwar Nagar	18.16	Hingana	1	Feeder	Standard-D	98	827	928	2052	11223	12449	30	4	4	5	34	37
76	CBS-171-F	Gorewada sq to Sadguru Nagar	14.75	Katol Naka	1	Feeder	Standard-D	146	138	171	3450	2634	2922	23	24	19	5	5	6
77	CBS-172-F	Sitabuldi to Purani basti Buti buri	37.14	Octroi Checkpost	2	Feeder	Standard-D	53	303	630	1346	4500	8659	30	11	5	0	25	51
78	CBS-173-F	Sitabuldi to Natraj Talkies	9.95	Patwardhan	1	Feeder	Standard-D	169	128	44	3921	2171	908	20	26	30	4	3	3
79	CBS-174-F	Sitabuldi to Vaishnavmata nagar	10.87	Patwardhan	1	Feeder	Standard-D	214	158	214	3307	2541	3356	16	21	15	5	4	6
81	CBS-176-F	Gandhi Bagh to Kamala Nagar	15.20	Dattawadi	1	Feeder	Standard-D	206	195	174	4091	3944	3777	16	17	19	7	7	6
82	CBS-177-F	Jai Hind Society to Dhoke Layout	15.35	Mankapur	3	Feeder	Midi	32	51	128	810	993	2566	30	30	19	0	0	6
83	CBS-178-F	Jaitala to Kharbi Road	16.82	Hingana	1	Feeder	Standard-D	162	456	1300	3019	9423	21240	20	7	3	7	17	48
87	CBS-182-F	YCCE College to Pardi Octroi Naka	28.10	Surya Nagar	2	Feeder	Standard-D	87	115	962	2209	2409	23609	30	29	4	0	8	59
89	CBS-184-F	Swawlambi Nagar to Kendriya Vidyalay	14.41	Dattawadi	2	Feeder	Midi	54	79	145	1307	1297	2250	30	30	17	0	4	6
92	CBS-188-F	Seminary Hills to Kharbi road Ishwar nagar	12.22	Surya Nagar	1	Feeder	Standard-D	124	434	738	1869	5890	10107	27	8	5	4	12	19
94	CBS-191-F	Deekshabhumi to Shankar Pur	15.35	Octroi Checkpost	1	Feeder	Standard-D	147	297	622	3124	5718	9423	23	11	5	5	10	20
95	CBS-192-F	Dindayal upadhyay Chowk to Sai Sewashram Society	12.22	Mankapur	3	Feeder	Midi	34	40	446	467	516	6372	30	30	5	0	0	16
97	CBS-194-F	Sitabuldi to Manewada Chowk	6.88	Patwardhan	2	Feeder	Standard-D	58	837	1193	1019	13354	19845	30	4	3	0	14	19
98	CBS-196-T	Shakti mata mandir to Jaitala	15.39	Hingana	2	Trunk	Standard-D	74	178	121	1372	2846	2145	30	19	27	0	6	4
99	CBS-197-F	Dahegaon to Kamgar Nagar	22.13	Teka Naka	1	Feeder	Standard-D	30	987	1342	562	12904	17490	30	3	3	6	47	63
100	CBS-198-F	Wandongri to Shiv Shakti Nagar	24.12	Surya Nagar	1	Feeder	Standard-D	176	194	155	4143	3521	3856	19	17	21	9	10	8
101	CBS-201-F	CRPF to Maya Nagar	30.47	Hingana	1	Feeder	Standard-D	165	207	602	3856	4659	11462	20	16	6	11	14	40
102	CBS-203-F	Sitabuldi to Ambe	12.58	Surya Nagar	1	Feeder	Standard-D	86	496	697	1647	11131	14252	30	7	5	3	14	19

ANNEXURE 5. AREA STATEMENT OF EXISTING AND PROPOSED DEPOTS

TENTATIVE AREA STATEMENT OF THE EXISTING AND PROPOSED DEPOTS

S.No	Item	Hingana Depot			Teka Naka Depot			Patwardhan Depot			Proposed 6 Depots		
		No's	Area in Sq.m	Total Area	No's	Area in Sq.m	Total Area	No's	Area in Sq.m	Total Area	No's	Area in Sq.m	Total Area
1	Site clearance	1	20200	20200	1	5858	5858	1	14140	14140	1	145440	145440
2	Boundary wall	1	20200	20200	1	5858	5858	1	14140	14140	1	145440	145440
3	Administrative Office	1	350	350	1	101.5	101.5	1	245	245	1	2520	2520
4	Canteen/refreshment Area & Kitchen	1	150	150	1	43.5	43.5	1	105	105	1	1080	1080
5	Wash Room (Male & Female) & toilets	1	90	90	1	26.1	26.1	1	63	63	1	648	648
6	Minor Pits	2	15	30	0.58	15	8.7	1.4	15	21	14.4	15	216
7	Major Pits	4	14.4	57.6	1.16	14.4	16.704	2.8	14.4	40.32	28.8	14.4	414.72
8	Washing Ramp/area	2	200	400	0.58	200	116	1.4	200	280	14.4	200	2880
9	Maintenance Bus parking Area	20	75	1500	5.8	75	435	14	75	1050	144	75	10800
10	Towing vehicle Parking	5	75	375	1.45	75	108.75	3.5	75	262.5	36	75	2700
11	Buses Parking	100	75	7500	29	75	2175	70	75	5250	720	75	54000
12	Ticket Counter/work shop room	2	36	72	0.58	36	20.88	1.4	36	50.4	14.4	36	518.4
13	Spare Parts Room/store	1	262	262	1	262	262	1	262	262	1	262	262
14	Store Room &changing room	4	36	144	1.16	36	41.76	2.8	36	100.8	28.8	36	1036.8
15	Training room / Office area Space	2	30	60	0.58	30	17.4	1.4	30	42	14.4	30	432
16	Water Recylcing Area	1	625	625	0.29	625	181.25	0.7	625	437.5	7.2	625	4500
17	Water Tank (litres)	15000	10	10	4350	10	2.9	10500	10	7	108000	10	72
18	Staff/Car/ two Parking	20	23	460	5.8	23	133.4	14	23	322	144	23	3312
19	Fire Fighting Tank (litres)	15000	10	10	4350	10	2.9	10500	10	7	108000	10	72
	Fixed Facilities (minimum requirements)												
1	Security Cabin	1	48	48	1	48	48	1	48	48	1	48	48
2	Control room/Electrical room	1	122	122	1	122	122	1	122	122	1	122	122
3	Power Station	1	16	16	1	16	16	1	16	16	1	16	16
4	Bank	1	75	75	1	75	75	1	75	75	1	75	75
5	Augmented Inspection Team (AIT) Section	1	36	36	1	36	36	1	36	36	1	36	36
6	Painting and Denting Section	1	66	66	1	66	66	1	66	66	1	66	66
7	Cleaning Area	1	105	105	1	105	105	1	105	105	1	105	105
8	Retro Room	1	30	30	1	30	30	1	30	30	1	30	30
9	Tyre Room/Foreman's cabin	2	30	60	2	30	60	2	30	60	2	30	60
10	watch towers	4	6	24	4	6	24	4	6	24	4	6	24
11	Fuel Filling Station (in Case of CNG)	1	1000	1000	1	1000	1000	1	1000	1000	1	1000	1000

DEPOT WISE CIVIL INFRASTRUCTURE COST ESTIMATES (RS IN LAKHS)

Sr. no.	Description of Items	Hingana	Teka Naka	Patwardhan	Proposed Depots
1	Site Clearance	₹ 11.36	₹ 3.30	₹ 7.95	₹ 81.81
2	Security Cabin	₹ 5.64	₹ 5.64	₹ 5.64	₹ 5.64
3	Administartive Office	₹ 45.89	₹ 17.63	₹ 33.95	₹ 292.64
4	Canteen/refreshment Area & Kitchen	₹ 21.57	₹ 8.85	₹ 16.20	₹ 132.65
5	Wash Room (Male & Female) & Toilets	₹ 15.16	₹ 7.80	₹ 12.05	₹ 79.38
6	Control room/Electrical room	₹ 17.65	₹ 17.65	₹ 17.65	₹ 17.65
7	Power Station	₹ 3.77	₹ 3.77	₹ 3.77	₹ 3.77
8	Ticket Counter/work shop room	₹ 11.91	₹ 6.05	₹ 9.44	₹ 63.12
9	Bank	₹ 12.72	₹ 12.72	₹ 12.72	₹ 12.72
10	Augmented Inspection Team (AIT) Section	₹ 6.73	₹ 6.73	₹ 6.73	₹ 6.73
11	Minor Pits	₹ 8.70	₹ 5.91	₹ 7.53	₹ 33.07
12	Major Pits	₹ 27.17	₹ 19.23	₹ 23.81	₹ 96.53
13	Spare Parts Room/store	₹ 31.89	₹ 31.89	₹ 31.89	₹ 31.89

Sr. no.	Description of Items	Hingana	Teka Naka	Patwardhan	Proposed Depots
14	Painting and Denting Section	₹ 10.67	₹ 10.67	₹ 10.67	₹ 10.67
15	CNG - Filling Station/Plant Area	₹ -	₹ -	₹ -	₹ -
16	Washing Ramp/area	₹ 45.48	₹ 17.51	₹ 33.66	₹ 289.69
17	Cleaning Area	₹ 15.44	₹ 15.44	₹ 15.44	₹ 15.44
18	Store Room & Changing room	₹ 20.48	₹ 9.40	₹ 15.80	₹ 117.21
19	Training room / Office area Space	₹ 22.50	₹ 8.69	₹ 16.66	₹ 143.10
20	Retro Room	₹ 5.85	₹ 5.85	₹ 5.85	₹ 5.85
21	Tyre Room/Foreman's cabin	₹ 9.46	₹ 9.46	₹ 9.46	₹ 9.46
22	Water Recylcing Area (25 m X 25 m)	₹ 21.66	₹ 21.66	₹ 21.66	₹ 21.66
23	Water Tank (15000 litres)	₹ 5.57	₹ 2.63	₹ 4.33	₹ 31.18
24	Maintenance Bus parking Area	₹ 7.80	₹ 7.80	₹ 7.80	₹ 7.80
25	Towing vehicle Parking	₹ 1.95	₹ 1.95	₹ 1.95	₹ 1.95
26	Buses Parking	₹ 40.09	₹ 39.82	₹ 39.98	₹ 42.45
27	Staff/Car/ two Parking	₹ 0.32	₹ 0.32	₹ 0.32	₹ 0.32
28	Boundary Wall	₹ 42.08	₹ 27.13	₹ 35.76	₹ 172.64
29	Fire Fighting	₹ 5.57	₹ 2.63	₹ 4.33	₹ 31.18
30	Watch Towers	₹ 30.49	₹ 30.49	₹ 30.49	₹ 30.49
31	**Sub total**	**₹ 505.56**	**₹ 358.62**	**₹ 443.47**	**₹ 1,788.69**
32	Cost escallation on 2012 DSR (10%)	₹ 556.12	₹ 394.49	₹ 487.82	₹ 1,967.56
33	Electrical Work @ 12% of total civil construction cost	₹ 66.73	₹ 47.34	₹ 58.54	₹ 236.11
34	Plumbing Items Cost @7% of total civil construction cost	₹ 38.93	₹ 27.61	₹ 34.15	₹ 137.73
35	**Base Cost(29+30+31)**	**₹ 661.78**	**₹ 469.44**	**₹ 580.51**	**₹ 2,341.39**
36	Non Core Component				
37	Design, detailing and monitoring of projects during Implementation etc. (1%+2.5% of base cost)	**₹ 23.16**	**₹ 16.43**	**₹ 20.32**	**₹ 81.95**
38	Sub Total(31+34)	**₹ 684.94**	**₹ 485.87**	**₹ 600.83**	**₹ 2,423.34**
39	Project Contingencies @ 3% over Itemno.13	**₹ 20.55**	**₹ 14.58**	**₹ 18.02**	**₹ 72.70**
40	Total Project Cost (INR)(35+36)	**₹ 705.49**	**₹ 500.44**	**₹ 618.85**	**₹ 2,496.04**
41	Say Total Project Cost (INR Crores)	**₹ 7.05**	**₹ 5.00**	**₹ 6.19**	**₹ 24.96**

DEPOT EQUIPMENT COSTING

Sr. No.	Description	Quantity	Cost per[2]Unit (Rs)	Total Cost (RS in Crores)
1	Air Compressors	30	152100	₹ 0.46
2	Car Washing Machines	30	91000	₹ 0.27
3	Pedestal Drilling Machine	30	28600	₹ 0.09
4	Mech. Chain Pulley Block	15	52000	₹ 0.08
5	Hoist (Electric Chin Pulley block	15	104000	₹ 0.16
6	Greasing Machines	45	14300	₹ 0.06
7	Electro Hydra Tyre changer (Tyre Mounting Demounting m/c)	30	780000	₹ 2.34
8	Electric Arc Welding Set	30	130000	₹ 0.39
9	a) Oxygen Gas Regulator	15	10400	₹ 0.02
	b) Acetylene Gas Regulator	15	10400	₹ 0.02
	c) Gas Welding Blow Pipe	15	10400	₹ 0.02
	d) Gas cutting Blow Pipe	15	10400	₹ 0.02
10	Battery Chargers	30	97500	₹ 0.29

[2]Source: GEF 5 Efficient & Sustainable City Bus Service Project (ESCBS) for MBMC

Sr. No.	Description	Quantity	Cost per²Unit (Rs)	Total Cost (RS in Crores)
11	Battery Operated Brush Truck	15	780000	₹ 1.17
12	Flipper	15	26000	₹ 0.04
13	Floor Scrubbing Machine	15	104000	₹ 0.16
14	Tapley Meter (Brake Efficiency Indicator)	15	104000	₹ 0.16
15	Matra jack	30	65000	₹ 0.20
16	Fogging Machine	15	32500	₹ 0.05
17	Electric Impact Wrench	30	91000	₹ 0.27
18	Pneumatic Impact Wrench	30	65000	₹ 0.20
19	Pit Sump Pumps	30	26000	₹ 0.08
20	MultistagePump	30	65000	₹ 0.20
21	Oil Decanting Pump	30	9100	₹ 0.03
22	Clamp meter	30	5850	₹ 0.02
23	Bench Grinder	30	9100	₹ 0.03
24	Buffing machine	30	9100	₹ 0.03
25	Anvil	30	22100	₹ 0.07
26	Injector Tester	15	27300	₹ 0.04
27	Electric hand Drilling Machine	61	6500	₹ 0.04
28	Straight hand Grinder 'Wolf'	30	15600	₹ 0.05
29	Pneumatic Nut Runner	45	26000	₹ 0.12
30	Metal pot For Thermostat Checking Unit	30	780	₹ 0.00
31	Dial Gauge For Drum Ovality Checking	30	6500	₹ 0.02
32	Compression Guage	30	7800	₹ 0.02
33	Hydraulic jacks	298	5200	₹ 0.15
34	Digital Tachometer	30	10400	₹ 0.03
35	Small Angle hand Grinder	30	6500	₹ 0.02
36	Vaccum Cleanser For A.C. Buses	30	32500	₹ 0.10
37	Tyre Pressure Master Guage	30	23400	₹ 0.07
38	Outside Micrometer (0.001"3 to 4"	30	3900	₹ 0.01
39	Outside Caliper (18")	30	3900	₹ 0.01
40	Inside Caliper (18")	30	3900	₹ 0.01
41	Digital Micrometer	30	7000	₹ 0.02
42	Weighing Scale	15	1300	₹ 0.00
43	Brake and clutch liner reviting machine	15	140000	₹ 0.21
44	Hydraulic press	15	55000	₹ 0.08
45	Brake unit testing machine	15	165000	₹ 0.25
46	Spray painting machine	30	80000	₹ 0.24
47	Hub pullers	61	5500	₹ 0.03
48	Torque wrenches	122	18000	₹ 0.22
49	Tool box set with pneumatic tools	298	11000	₹ 0.33
50	Lathe machine	15	150000	₹ 0.23
	Total			₹ 9.18

COST OF JIGS, FIXTURES AND TOOLS

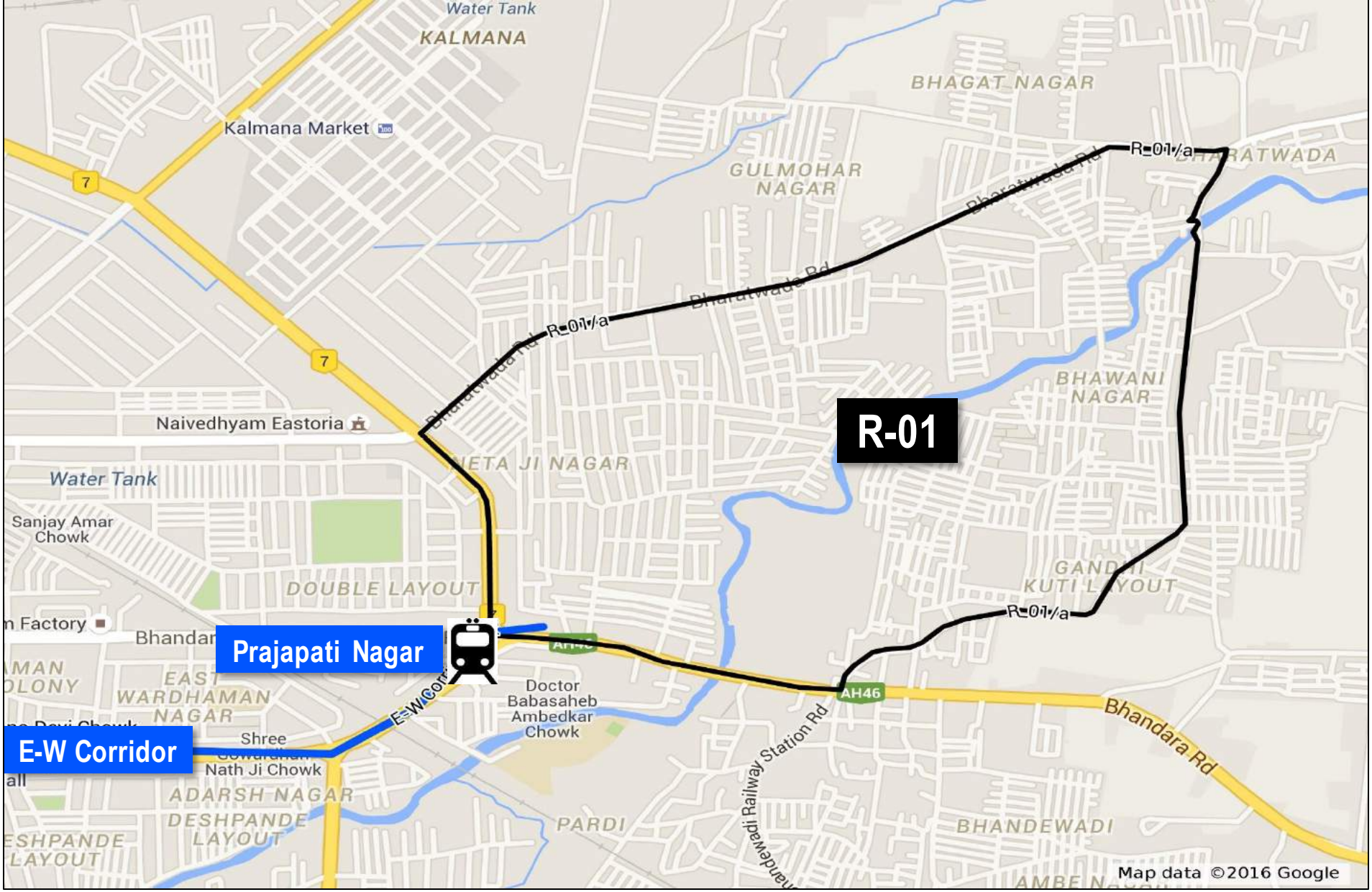
Sr. No.	Description (Jigs Fixtures and Tools)	Quantity	Cost per Unit[3] (Rs)	Total Cost (Rs in Crores)
1	Tube Repair Stands	45	7800	₹ 0.04
2	Tyre Safety Stand	15	8700	₹ 0.01
3	Tyre Opener (Spreaders)	15	13800	₹ 0.02
4	Tyre Racks (12 Tyres Cap.)	61	11700	₹ 0.07
5	Radiator Repair Stand	15	5850	₹ 0.01
6	Radiator Soldering Stand	15	8775	₹ 0.01
7	Oil Drum Stands (4Drum Cap.)	30	11700	₹ 0.04
8	Spring Racks	30	15600	₹ 0.05
9	Spring Removing Trolley	30	3900	₹ 0.01
10	Spring Carrying Trolley	15	5850	₹ 0.01
11	Engine Oil Tank Topping Trolley	15	7800	₹ 0.01
12	Portable Ladders (SD)	30	15600	₹ 0.05
13	Portable Ladders (SD) For painters	15	15600	₹ 0.02
14	Chassis Stands (SD)	61	11700	₹ 0.07
15	Prop. Shaft Stands	30	15600	₹ 0.05
16	Pit Planks	222	9750	₹ 0.22
17	Pit Jacks (Sqare Type)	15	23400	₹ 0.04
18	Pit Jacks (Hub Type)	61	25350	₹ 0.15
19	Trolley for Oil Decanting Pump	15	5850	₹ 0.01
	Total			₹ 0.88

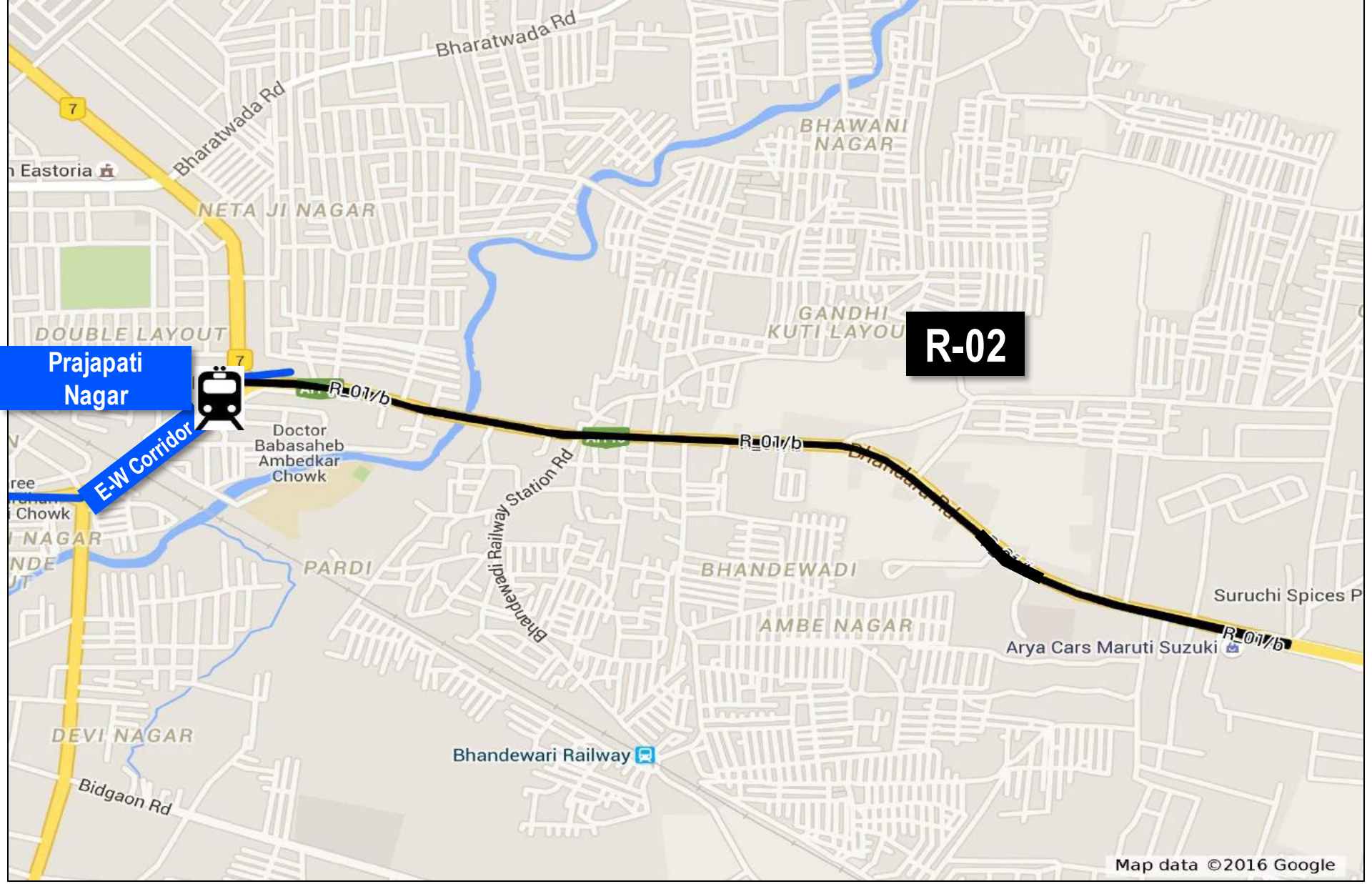
COST OF SPECIAL EQUIPMENT FOR MODERNIZING THE CITY BUS SYSTEM IN NAGPUR

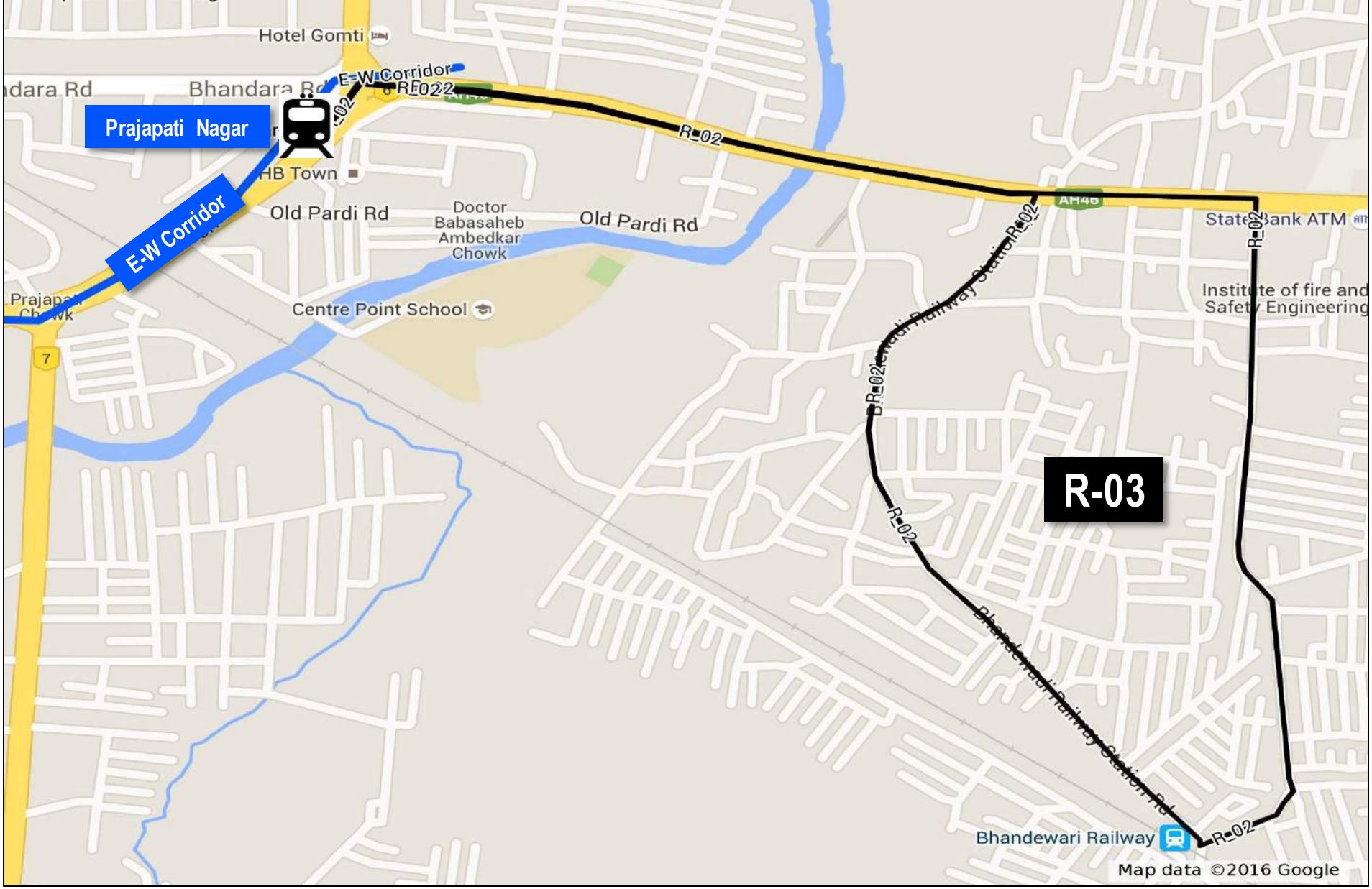
Sr. No	Description	Quantity	Cost per [4]Unit (Rs)	Total Cost (Rs in Crores)
1	Automatic Washing Machine	15	4000000	₹ 6.00
2	Tyre dismantling and Assay machine	15	750000	₹ 1.13
3	Automatic Tyre Inflator machine	15	120000	₹ 0.18
4	Computarised wheel balancing and alignment machine	15	2100000	₹ 3.15
5	Smoke Meter	15	400000	₹ 0.60
6	Tyre rim cleaning machine	15	200000	₹ 0.30
7	Magnetic floor sweeper	15	100000	₹ 0.15
8	Simulator for checking diesel consumption	15	160000	₹ 0.24
9	Fan Belt Tension Measuring Guage	30	2500	₹ 0.01
10	Brake Chamber Bend Push Rod Checking Guage	30	5000	₹ 0.02
11	Front Hub Bearing Play Adjustment Guage	30	5500	₹ 0.02
12	Engine Blow By Rate Indicator	30	25000	₹ 0.08
13	Engine R.P.M. Meter	15	9000	₹ 0.01
14	Generator set	30	225000	₹ 0.68
Total				₹ 12.55

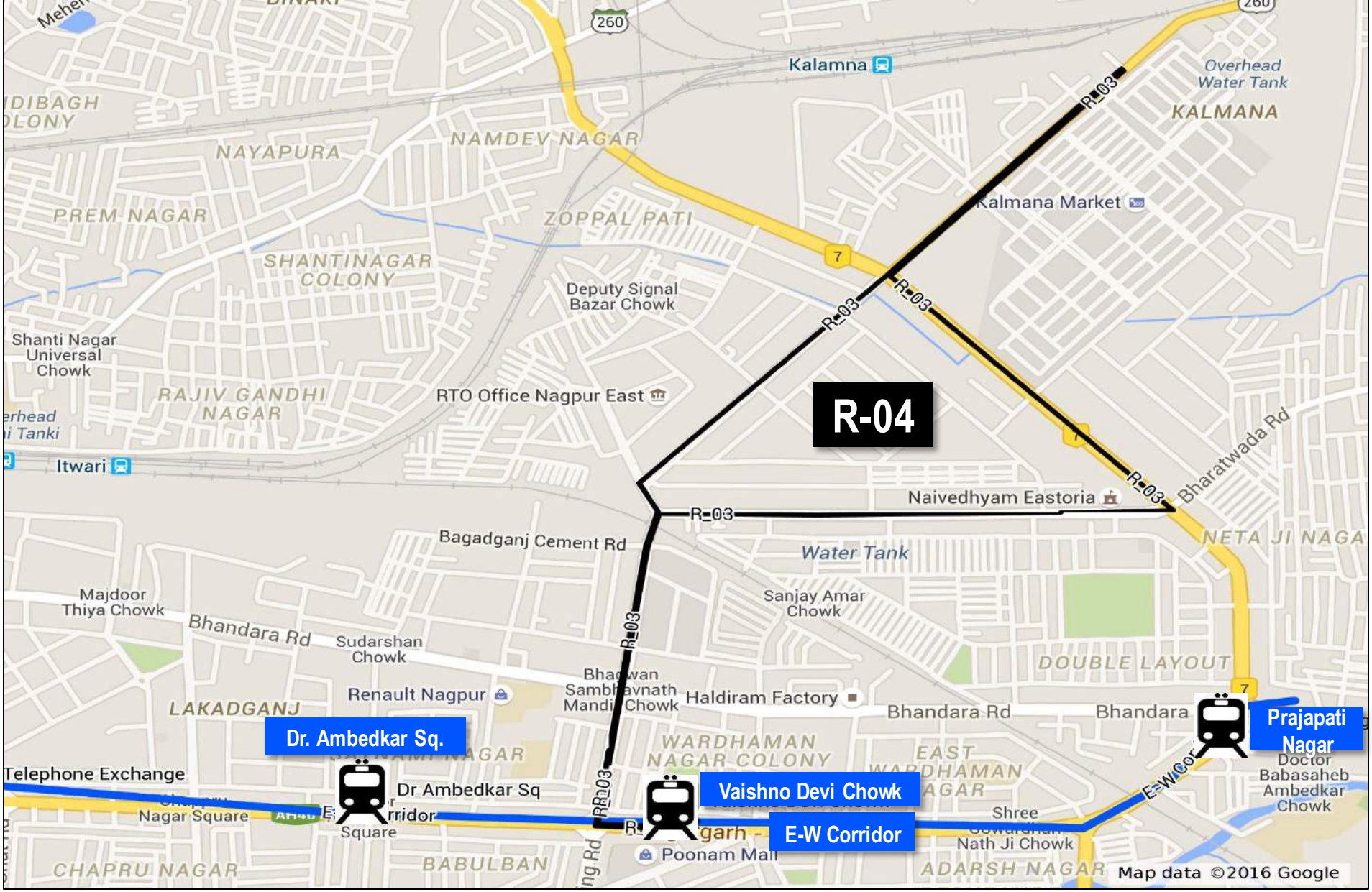
[3]Source: GEF 5 Efficient & Sustainable City Bus Service Project (ESCBS) for MBMC
[4]Source: GEF 5 Efficient & Sustainable City Bus Service Project (ESCBS) for MBMC

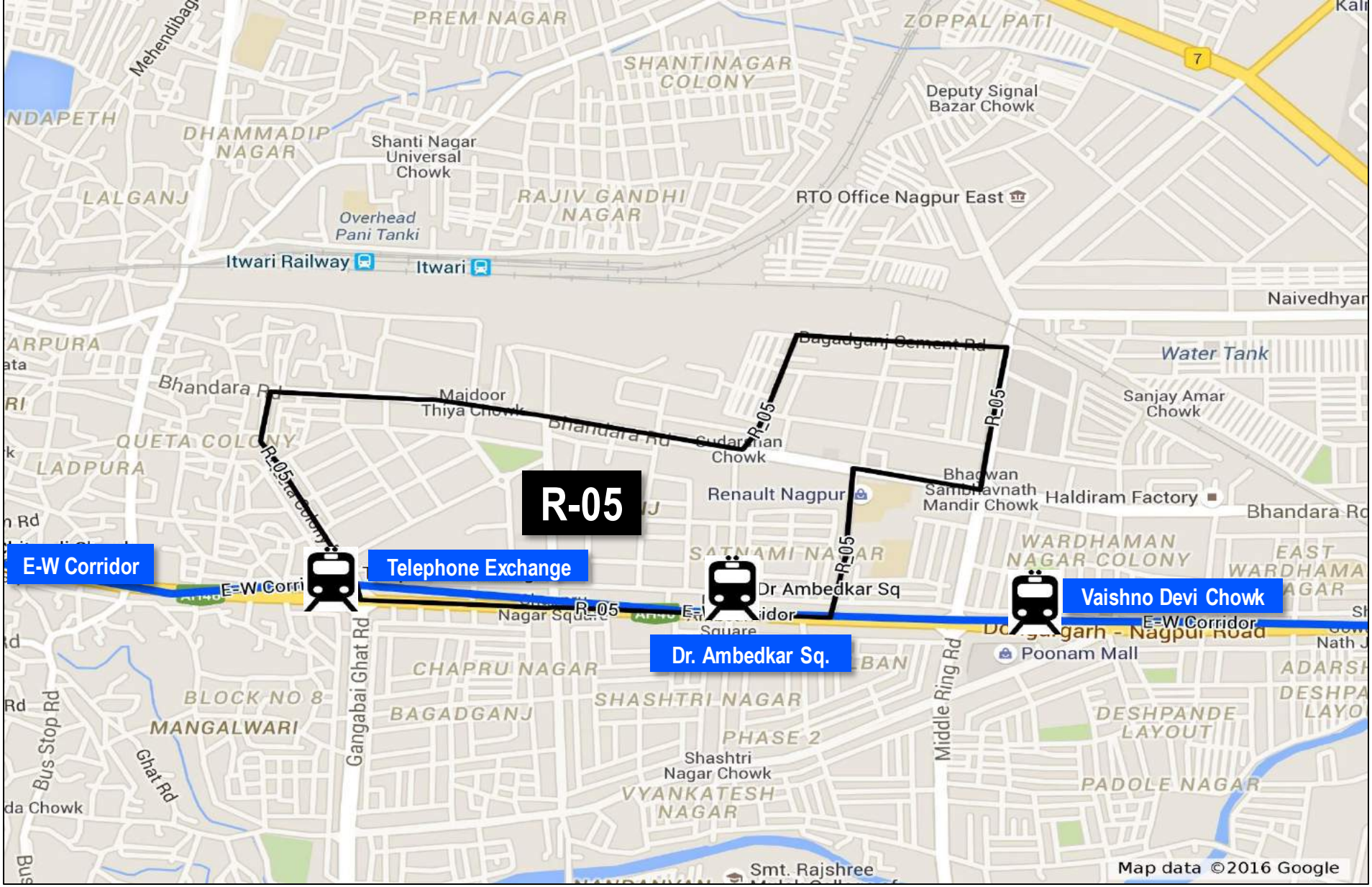
METRO FEEDER ROUTES

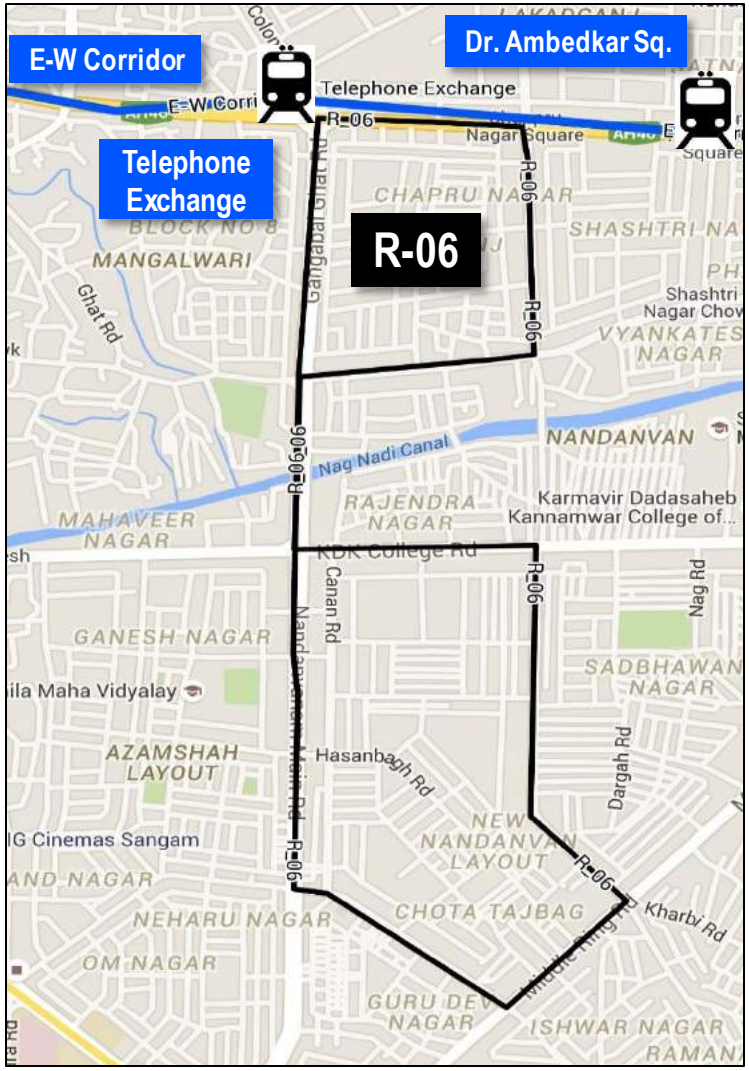

Water Tank
KALMANA
Kalmana Market
BHAGAT NAGAR
GULMOHAR NAGAR
BHARATWADA
Bharatwada Rd
R-01/a
BHAWANI NAGAR
R-01
Naivedhyam Eastoria
NETA JI NAGAR
Water Tank
Sanjay Amar Chowk
DOUBLE LAYOUT
GANDHI KUTI LAYOUT
Factory
Bhandar
Prajapati Nagar
EAST WARDHAMAN NAGAR
E-W Corridor
Shree
Nath Ji Chowk
Doctor Babasaheb Ambedkar Chowk
AH46
Bhandara Rd
Railway Station Rd
ADARSH NAGAR
DESHPANDE LAYOUT
PARDI
BHANDEWADI
Map data ©2016 Google

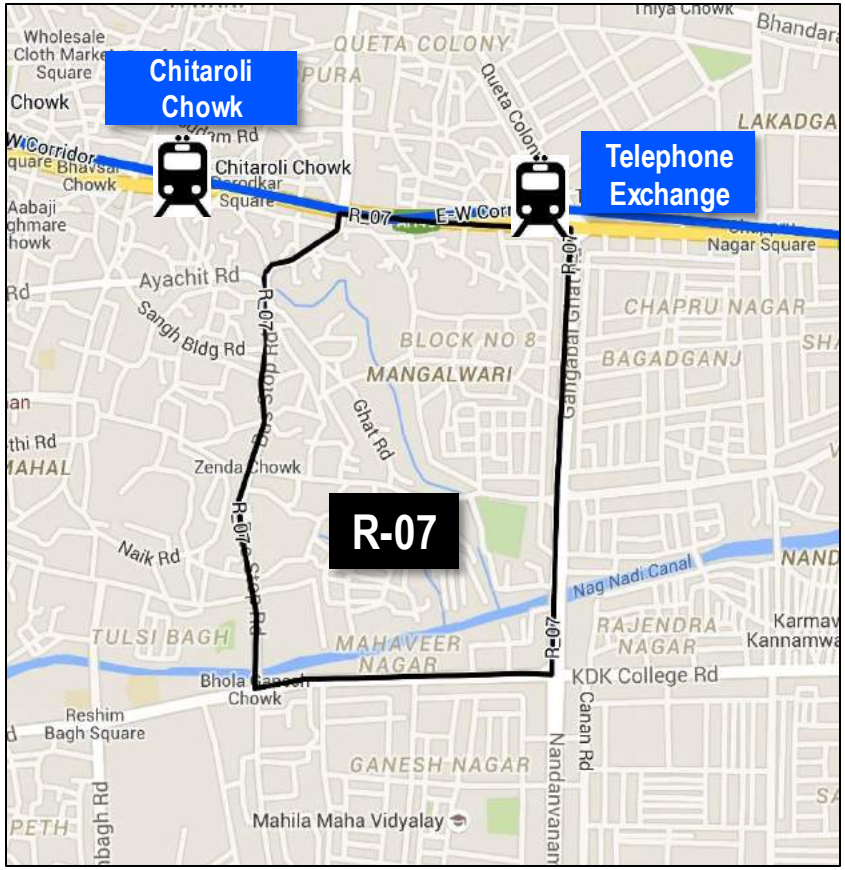

R-02
Prajapati Nagar
E-W Corridor
R-01/b
R-01/b
R-01/b
Bharatwada Rd
Bharatwada Rd
BHAWANI NAGAR
NETA JI NAGAR
GANDHI KUTI LAYOU
DOUBLE LAYOUT
Doctor Babasaheb Ambedkar Chowk
Bhandewadi Railway Station Rd
PARDI
BHANDEWADI
AMBE NAGAR
Suruchi Spices P
Arya Cars Maruti Suzuki
DEVI NAGAR
Bhandewari Railway
Bidgaon Rd
Eastoria
Chowk
NAGAR
Map data ©2016 Google

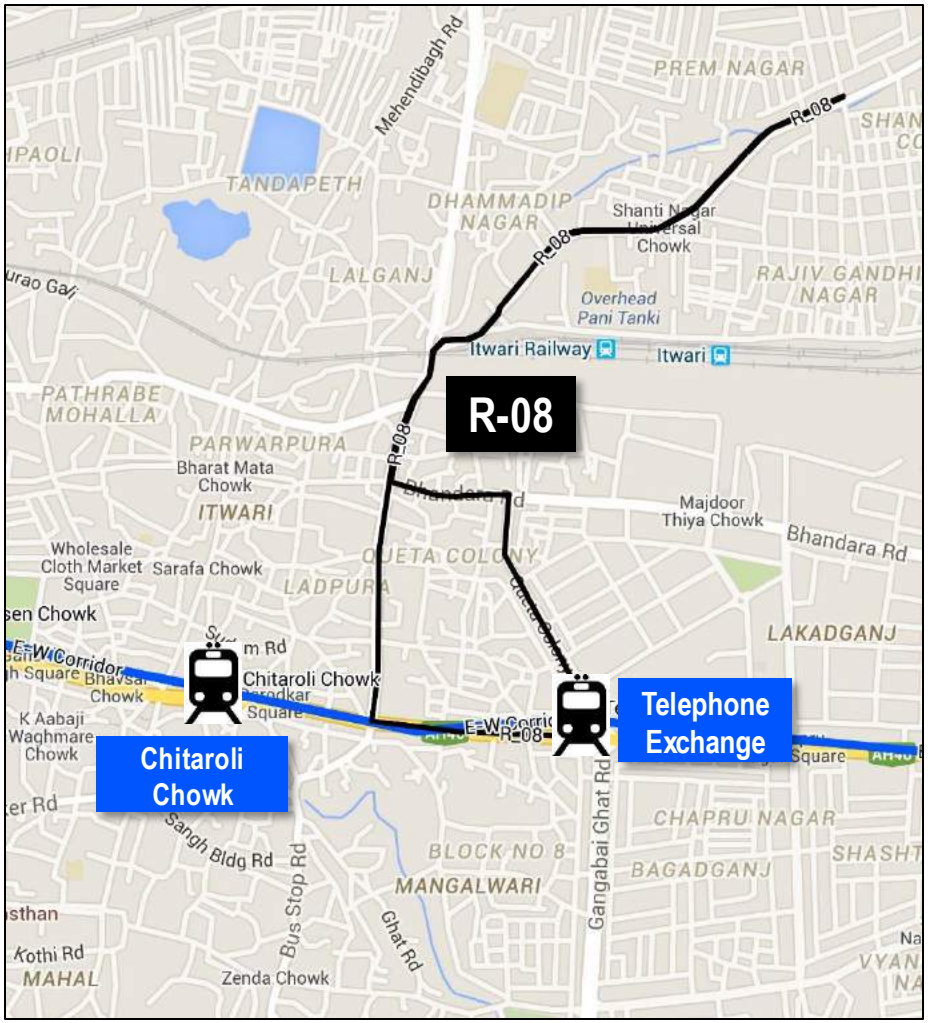

Hotel Gomti
Bhandara Rd
E-W Corridor
R-02
Prajapati Nagar
HB Town
E-W Corridor
Old Pardi Rd
Doctor Babasaheb Ambedkar Chowk
Old Pardi Rd
AH46
State Bank ATM
Institute of fire and Safety Engineering
Centre Point School
7
R-03
Bhandewari Railway
Map data ©2016 Google

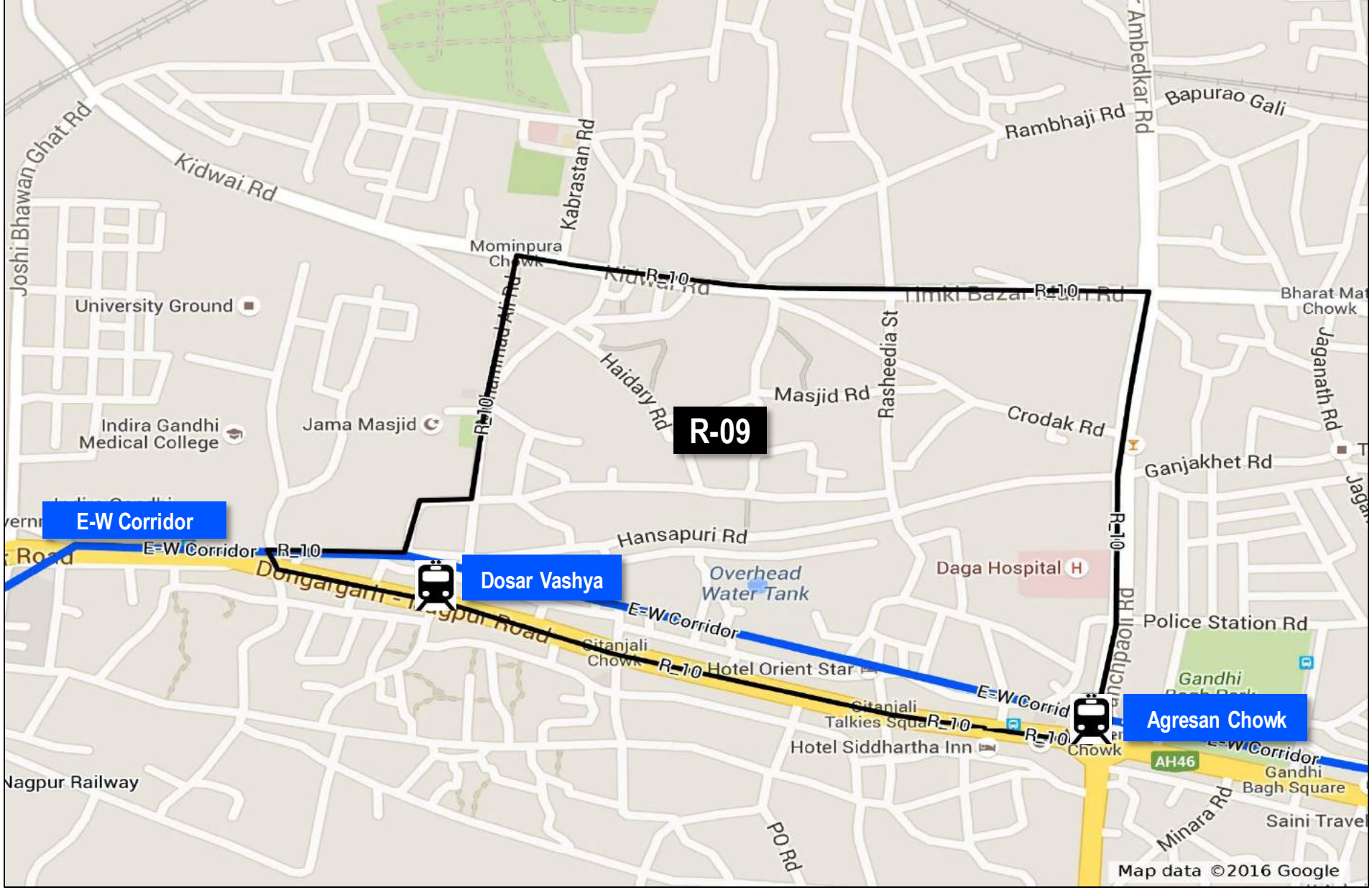

R-04
Dr. Ambedkar Sq.
Vaishno Devi Chowk
E-W Corridor
Prajapati Nagar
Kalamna
Overhead Water Tank
KALMANA
NAMDEV NAGAR
NAYAPURA
PREM NAGAR
ZOPPAL PATI
SHANTINAGAR COLONY
Deputy Signal Bazar Chowk
Kalmana Market
Shanti Nagar Universal Chowk
RAJIV GANDHI NAGAR
RTO Office Nagpur East
Itwari
Naivedhyam Eastoria
Bharatwada Rd
Bagadganj Cement Rd
Water Tank
NETA JI NAGA
Majdoor Thiya Chowk
Bhandara Rd
Sudarshan Chowk
Sanjay Amar Chowk
DOUBLE LAYOUT
Renault Nagpur
Haldiram Factory
LAKADGANJ
Bhandara Rd
Bhandara
WARDHAMAN NAGAR COLONY
EAST WARDHAMAN NAGAR
Telephone Exchange
Dr Ambedkar Sq
Nagar Square
Square
Shree
Nath Ji Chowk
Doctor Babasaheb Ambedkar Chowk
Poonam Mall
CHAPRU NAGAR
BABULBAN
ADARSH NAGAR
Map data ©2016 Google

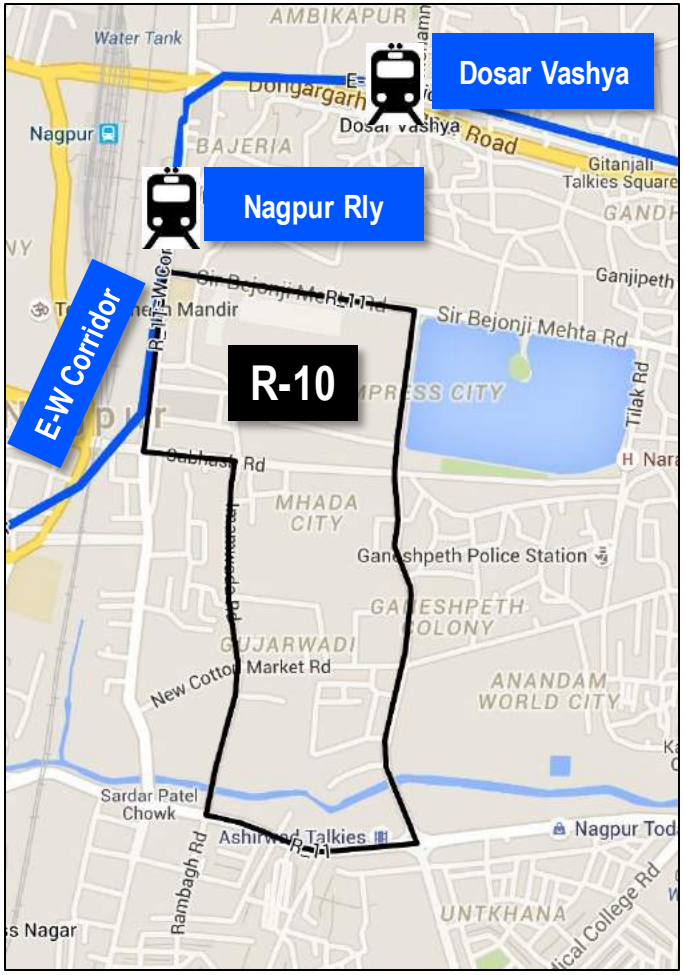

R-05
E-W Corridor
Telephone Exchange
Dr. Ambedkar Sq.
Vaishno Devi Chowk
PREM NAGAR
ZOPPAL PATI
SHANTINAGAR COLONY
Deputy Signal Bazar Chowk
DHAMMADIP NAGAR
Shanti Nagar Universal Chowk
LALGANJ
RAJIV GANDHI NAGAR
RTO Office Nagpur East
Overhead Pani Tanki
Itwari Railway
Itwari
Water Tank
Sanjay Amar Chowk
Bhandara Rd
Majdoor Thiya Chowk
QUETA COLONY
LADPURA
Renault Nagpur
Haldiram Factory
WARDHAMAN NAGAR COLONY
SATNAMI NAGAR
Dr Ambedkar Sq
Nagar Square
Poonam Mall
E-W Corridor
CHAPRU NAGAR
BLOCK NO 8
MANGALWARI
BAGADGANJ
SHASHTRI NAGAR
PHASE 2
Shashtri Nagar Chowk
VYANKATESH NAGAR
DESHPANDE LAYOUT
PADOLE NAGAR
Gangabai Ghat Rd
Middle Ring Rd
Bus Stop Rd
Ghat Rd
Smt. Rajshree
Map data ©2016 Google

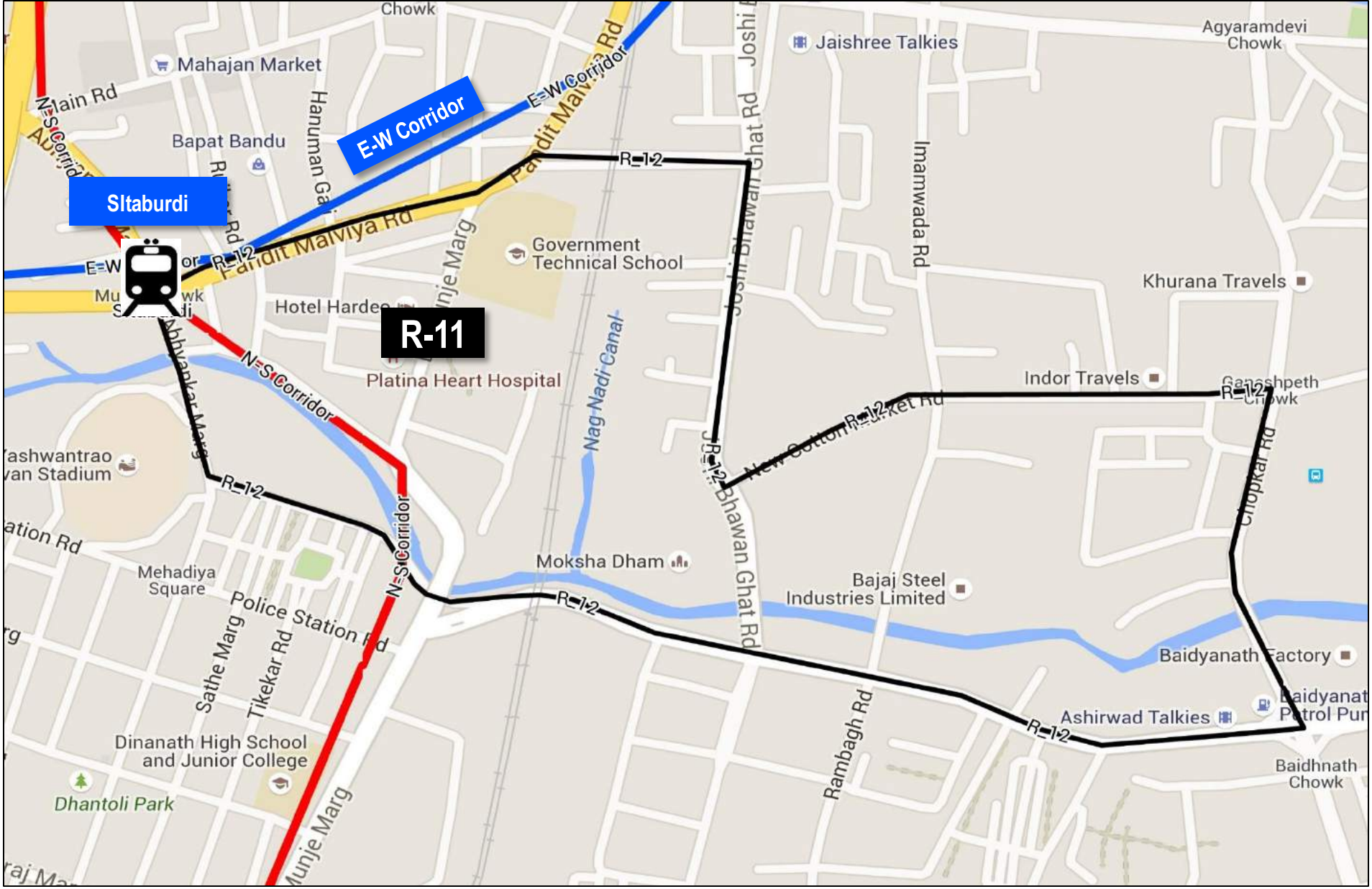

E-W Corridor
Telephone Exchange
Dr. Ambedkar Sq.
R-06
Telephone Exchange
E-W Corri
R-06
Nagar Square
CHAPRU NAGAR
SHASTRI NA
BLOCK NO 8
MANGALWARI
Ghat Rd
Bandgudi Ghat Rd
R-06
R-06
Shashtri Nagar Chov
VYANKATES NAGAR
NANDANVAN
Nag Nadi Canal
R-06
RAJENDRA NAGAR
Karmavir Dadasaheb Kannamwar College of...
MAHAVEER NAGAR
KDK College Rd
Canan Rd
R-06
Nag Rd
GANESH NAGAR
SADBHAWAN NAGAR
ila Maha Vidyalay
AZAMSHAH LAYOUT
Hasanbagh Rd
Dargah Rd
G Cinemas Sangam
R-06
NEW NANDANVAN LAYOUT
R-06
Kharbi Rd
AND NAGAR
NEHARU NAGAR
CHOTA TAJBAG
OM NAGAR
GURU DEV NAGAR
ISHWAR NAGAR
RAMAN

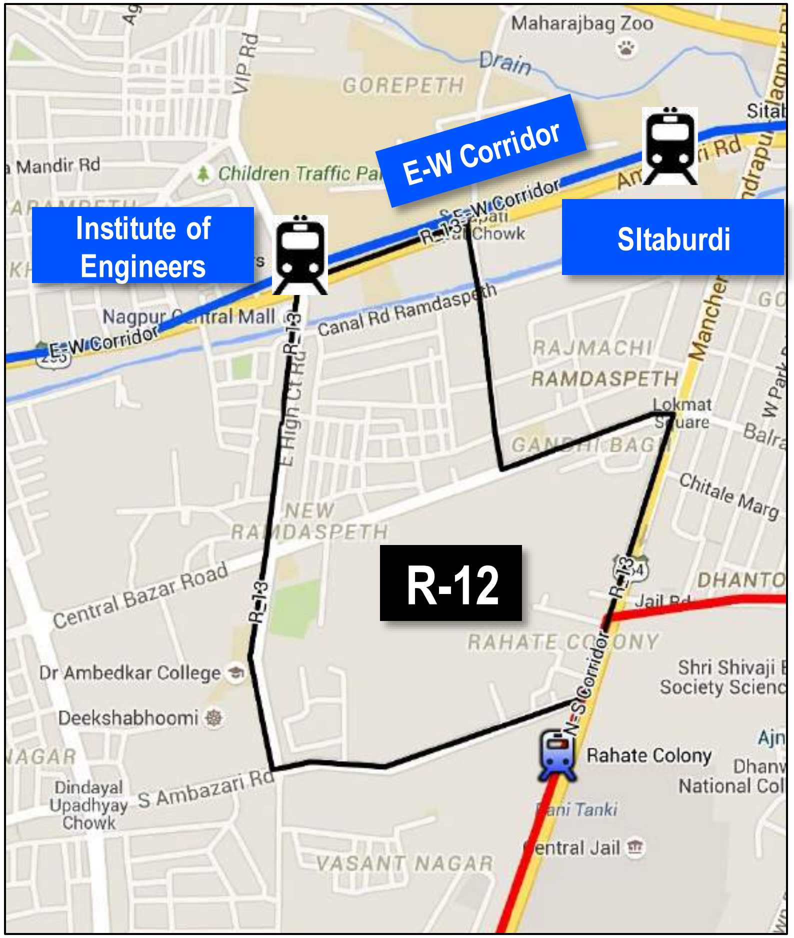

Chitaroli Chowk
Telephone Exchange
R-07
Wholesale Cloth Market Square
Chowk
QUETA COLONY
Queta Colony
Bhandara
LAKADGA
Chitaroli Chowk
Nagar Square
Ayachit Rd
Sangh Bldg Rd
CHAPRU NAGAR
BLOCK NO 8
BAGADGANJ
MANGALWARI
Ghat Rd
Zenda Chowk
Naik Rd
Nag Nadi Canal
TULSI BAGH
MAHAVEER NAGAR
RAJENDRA NAGAR
KDK College Rd
Bhola Ganesh Chowk
Reshim Bagh Square
GANESH NAGAR
Canan Rd
Mahila Maha Vidyalay


R-08
Chitaroli Chowk
Telephone Exchange
Mehendibagh Rd
PREM NAGAR
TANDAPETH
DHAMMADIP NAGAR
Shanti Nagar Universal Chowk
LALGANJ
RAJIV GANDHI NAGAR
Overhead Pani Tanki
Itwari Railway
Itwari
PATHRABE MOHALLA
PARWARPURA
Bharat Mata Chowk
ITWARI
Majdoor Thiya Chowk
Bhandara Rd
Wholesale Cloth Market Square
Sarafa Chowk
LADPURA
LAKADGANJ
Chitaroli Chowk
K Aabaji Waghmare Chowk
Sangh Bldg Rd
Bus Stop Rd
BLOCK NO 8
MANGALWARI
CHAPRU NAGAR
BAGADGANJ
Gangabai Ghat Rd
Ghat Rd
Kothi Rd
Zenda Chowk

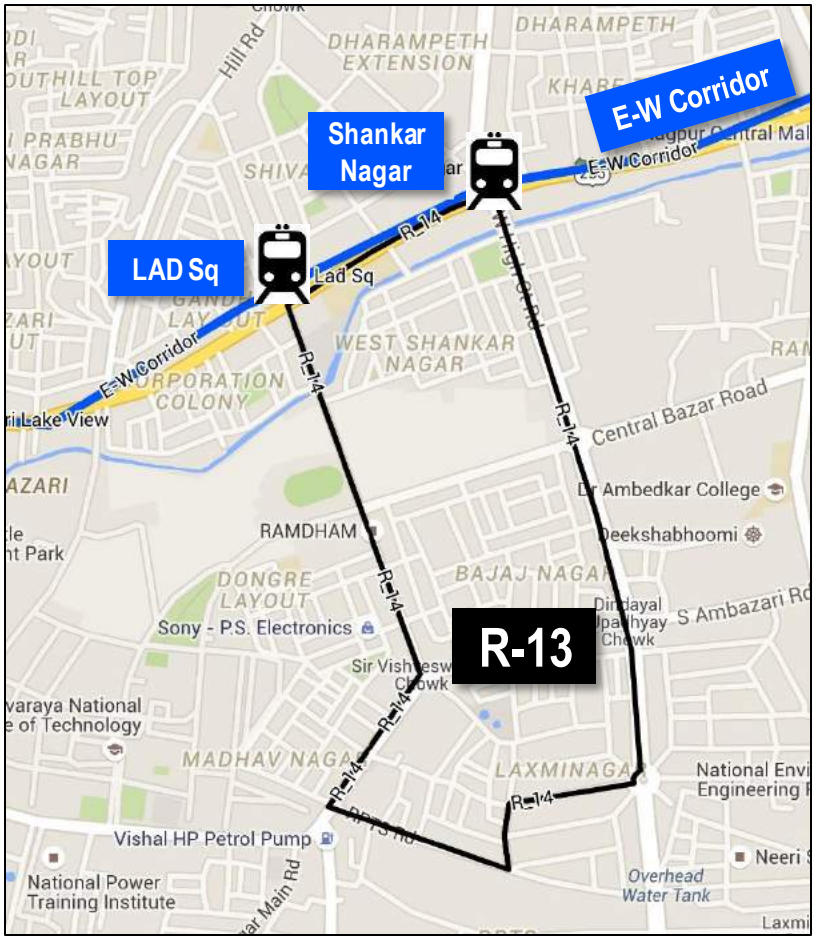

R-09
E-W Corridor
Dosar Vashya
Agresan Chowk
Joshi Bhawan Ghat Rd
Kidwai Rd
Kabrastan Rd
Mominpura Chowk
University Ground
Indira Gandhi Medical College
Jama Masjid
Haidary Rd
Masjid Rd
Rasheedia St
Crodak Rd
Ganjakhet Rd
Rambhaji Rd
Ambedkar Rd
Bapurao Gali
Bharat Mata Chowk
Jaganath Rd
Hansapuri Rd
Overhead Water Tank
Daga Hospital
Police Station Rd
Sitanjali Chowk
Hotel Orient Star
Sitanjali Talkies Square
Hotel Siddhartha Inn
Gandhi Bagh Square
Saini Travels
Minara Rd
PO Rd
Nagpur Railway
AH46
R-10
Map data ©2016 Google

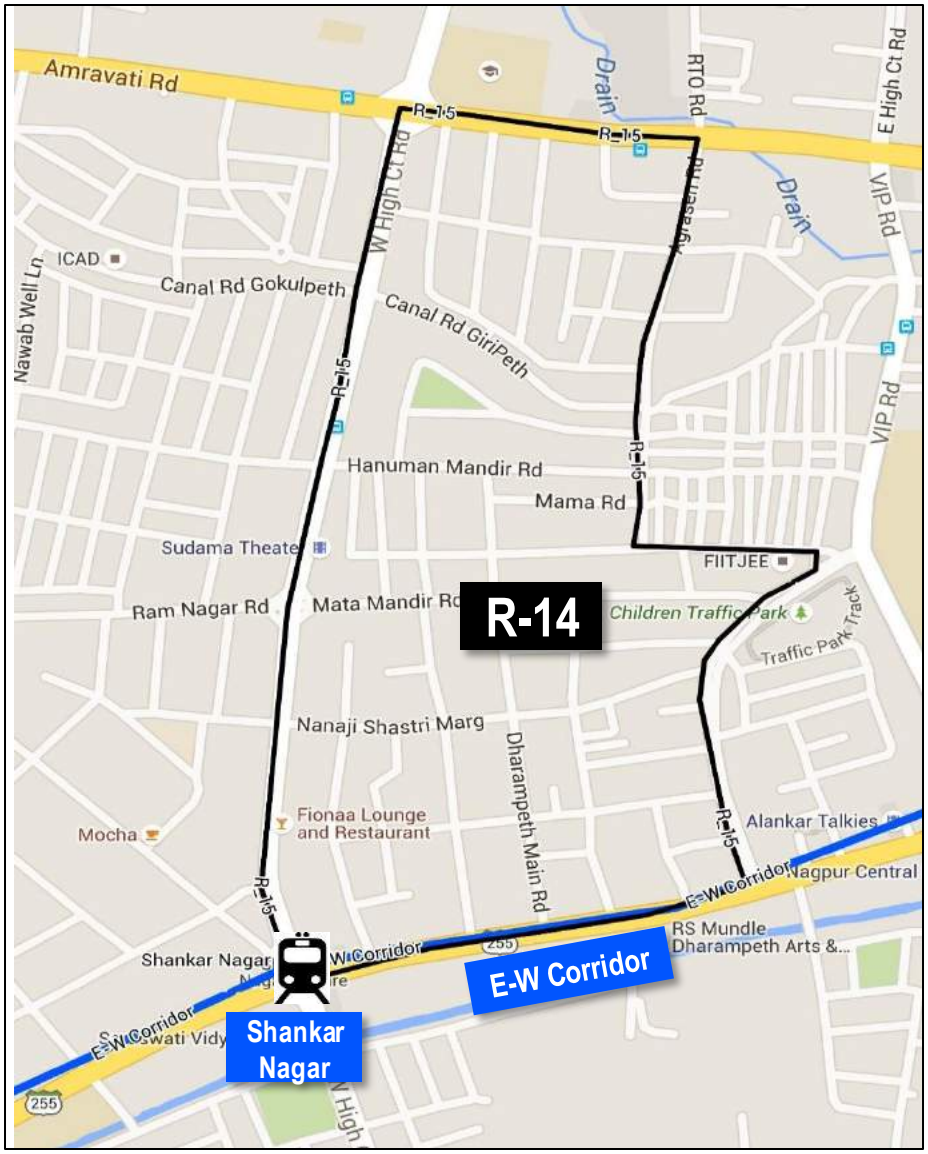

Dosar Vashya
Nagpur Rly
E-W Corridor
R-10
AMBIKAPUR
Water Tank
Nagpur
BAJERIA
Dosar Vashya Road
Gitanjali Talkies Square
Ganjipeth
Sir Bejonji Mehta Rd
Tilak Rd
MHADA CITY
Ganeshpeth Police Station
GANESHPETH COLONY
GUJARWADI
New Cotton Market Rd
ANANDAM WORLD CITY
Sardar Patel Chowk
Ashirwad Talkies
Rambagh Rd
UNTKHANA

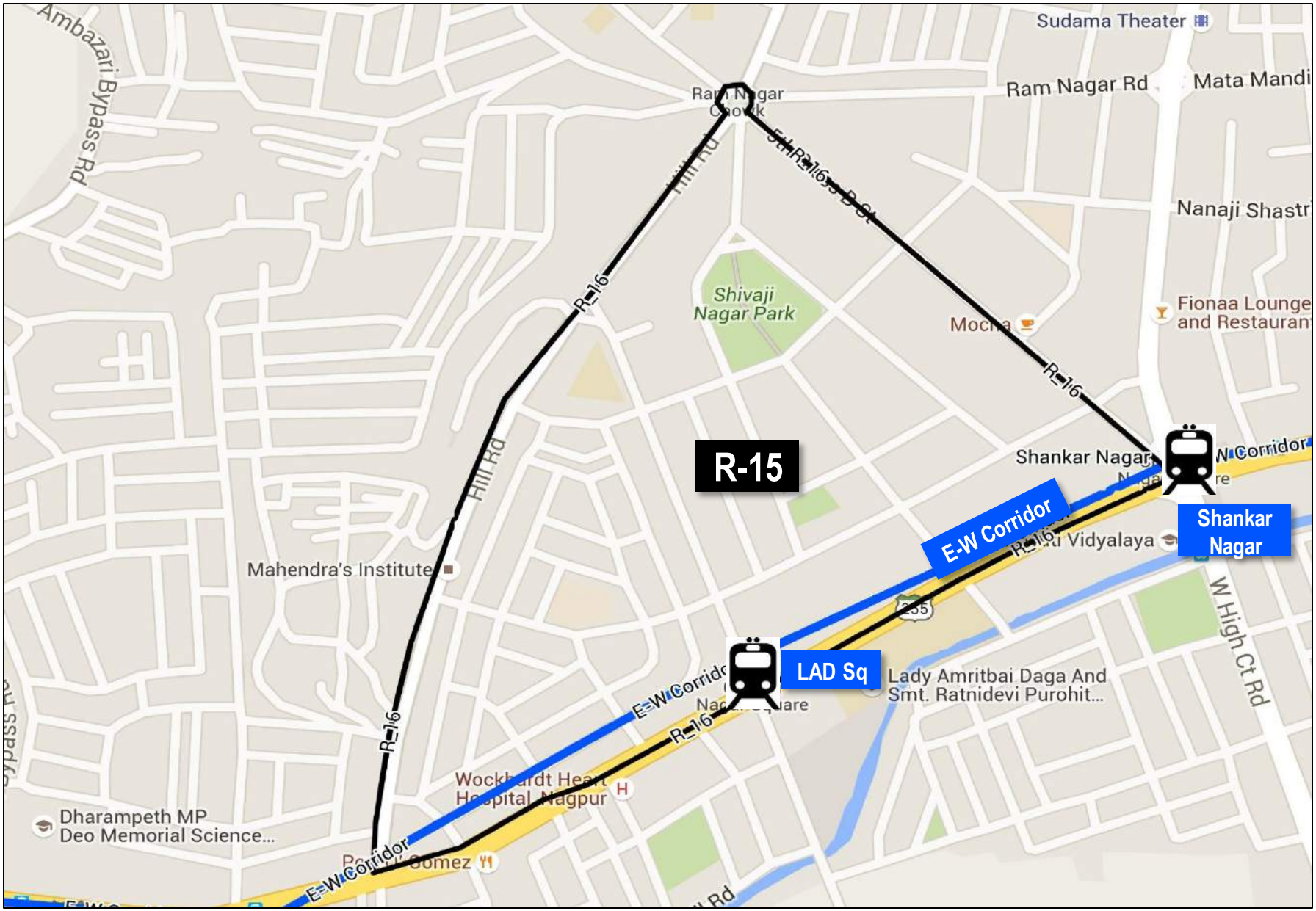

R-11
SItaburdi
E-W Corridor
N-S Corridor
R-12
Chowk
Mahajan Market
Bapat Bandu
Hanuman Ga
Pandit Malviya Rd
Government Technical School
Hotel Hardee
Platina Heart Hospital
Nag Nadi Canal
Munje Marg
Abhyankar Marg
Jaishree Talkies
Agyaramdevi Chowk
Joshi Bhawan Ghat Rd
Imamwada Rd
Khurana Travels
Indor Travels
Ganeshpeth Chowk
New Cotton Market Rd
Chopkar Rd
Moksha Dham
Bajaj Steel Industries Limited
Baidyanath Factory
Ashirwad Talkies
Baidhnath Chowk
Rambagh Rd
Mehadiya Square
Police Station Rd
Sathe Marg
Tikekar Rd
Dinanath High School and Junior College
Dhantoli Park

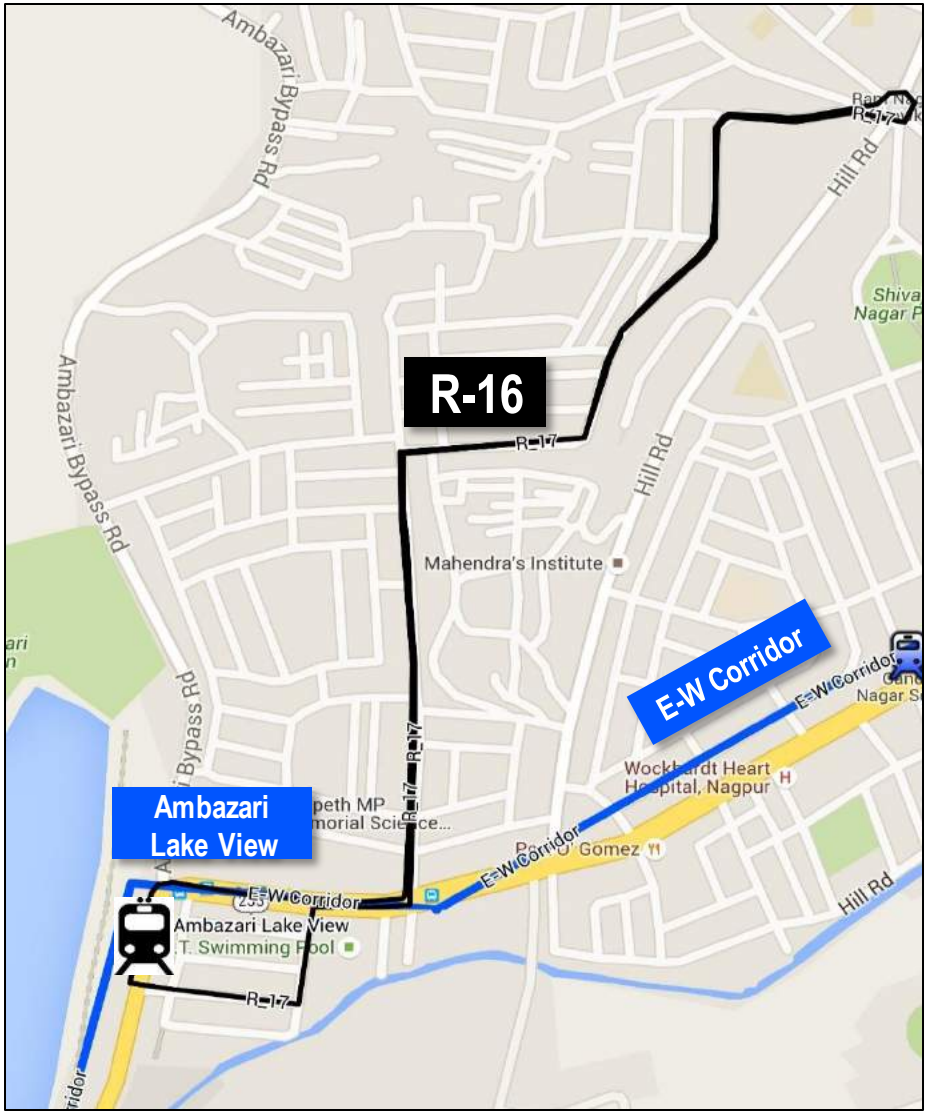


Institute of Engineers
E-W Corridor
SItaburdi
R-12
Maharajbag Zoo
Drain
GOREPETH
VIP Rd
Children Traffic Park
Nagpur Central Mall
Canal Rd Ramdaspeth
RAJMACHI
RAMDASPETH
Lokmat Square
GANDHI BAGH
Chitale Marg
NEW RAMDASPETH
Central Bazar Road
Jail Rd
RAHATE COLONY
N-S Corridor
Rahate Colony
Dr Ambedkar College
Deekshabhoomi
Dindayal Upadhyay Chowk
S Ambazari Rd
VASANT NAGAR
Central Jail
E High Ct Rd
R-13


E-W Corridor
Shankar Nagar
LAD Sq
R-13
Lad Sq
E-W Corridor
Hill Rd
DHARAMPETH
DHARAMPETH EXTENSION
HILL TOP LAYOUT
PRABHU NAGAR
SHIVA
WEST SHANKAR NAGAR
CORPORATION COLONY
Lake View
RAMDHAM
DONGRE LAYOUT
BAJAJ NAGAR
Central Bazar Road
Ambedkar College
Deekshabhoomi
Sony - P.S. Electronics
S Ambazari Rd
MADHAV NAGAR
LAXMINAGAR
Vishal HP Petrol Pump
National Power Training Institute
Overhead Water Tank
National Engineering
R-14


R-14
Shankar Nagar
E-W Corridor
Amravati Rd
W High Ct Rd
E High Ct Rd
RTO Rd
Drain
VIP Rd
Nawab Well Ln
ICAD
Canal Rd Gokulpeth
Canal Rd Giripeth
Hanuman Mandir Rd
Mama Rd
Sudama Theate
FIITJEE
Ram Nagar Rd
Mata Mandir Rd
Children Traffic Park
Traffic Park Track
Nanaji Shastri Marg
Dharampeth Main Rd
Fionaa Lounge and Restaurant
Mocha
Alankar Talkies
Nagpur Central
RS Mundle Dharampeth Arts &...
R-15
255


R-15
Shankar Nagar
E-W Corridor
LAD Sq
Sudama Theater
Ram Nagar Rd
Mata Mandi
Nanaji Shastri
Shivaji Nagar Park
Fionaa Lounge and Restaurant
Mocha
Mahendra's Institute
Hill Rd
Ambazari Bypass Rd
Lady Amritbai Daga And Smt. Ratnidevi Purohit...
W High Ct Rd
Wockhardt Heart Hospital, Nagpur
Dharampeth MP Deo Memorial Science...
R-16
E-W Corridor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E-W Corridor
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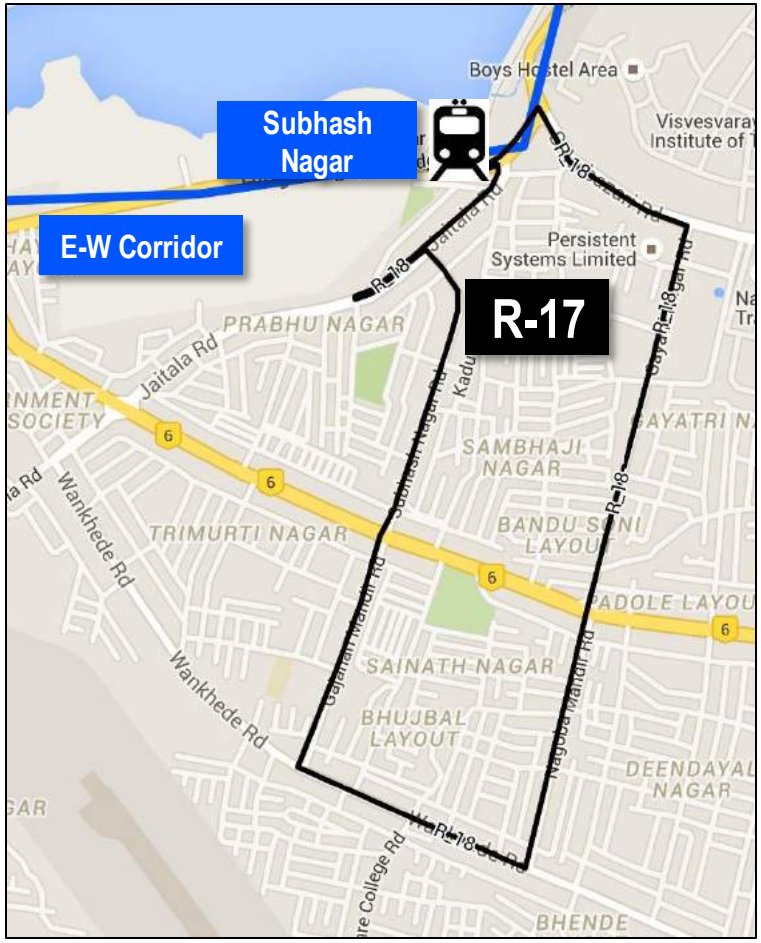
Ambazari Bypass Rd
Hill Rd
Mahendra's Institute
Wockhardt Heart Hospital, Nagpur
Ambazari Lake View
R-17
E-W Corridor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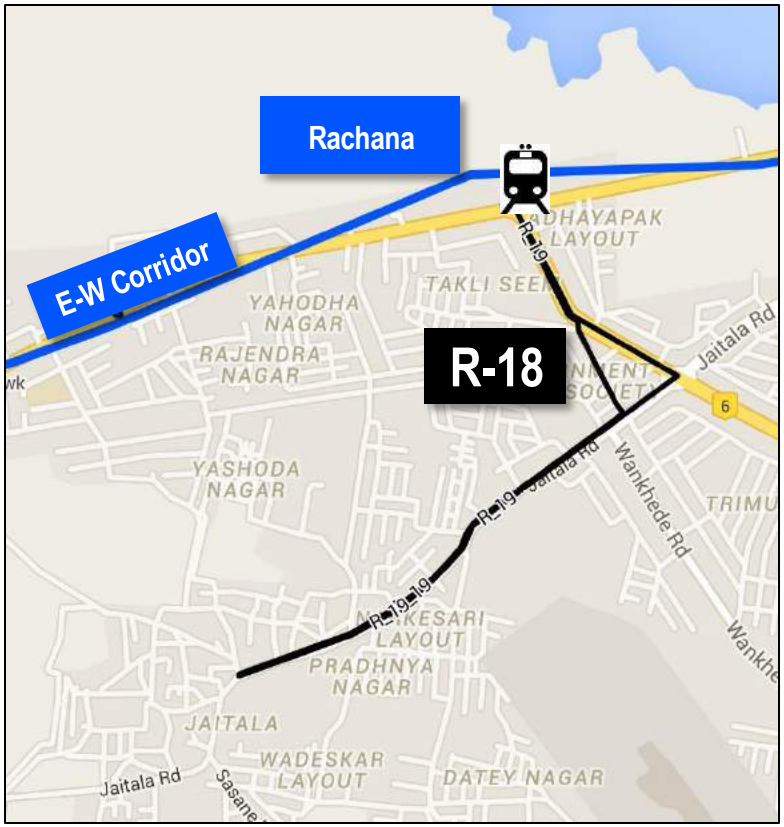
Wankhede Rd
SAINATH NAGAR
BHUJBAL LAYOUT
DEENDAYAL NAGAR
BHENDE
6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RAJENDRA NAGAR
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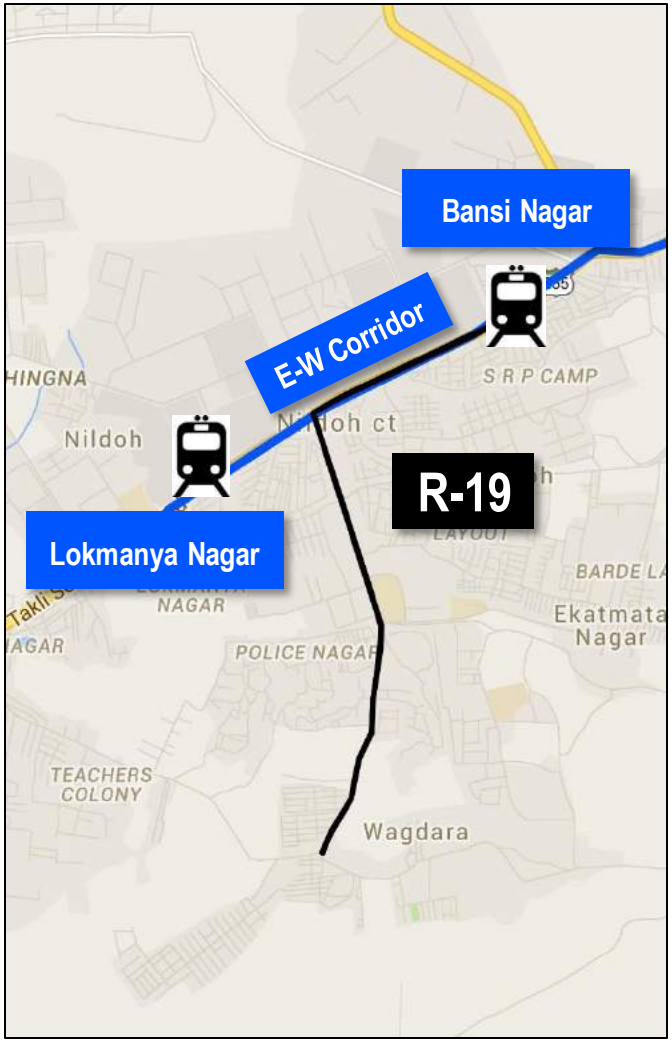
Jaitala Rd
Wankhede Rd
6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E-W Corridor
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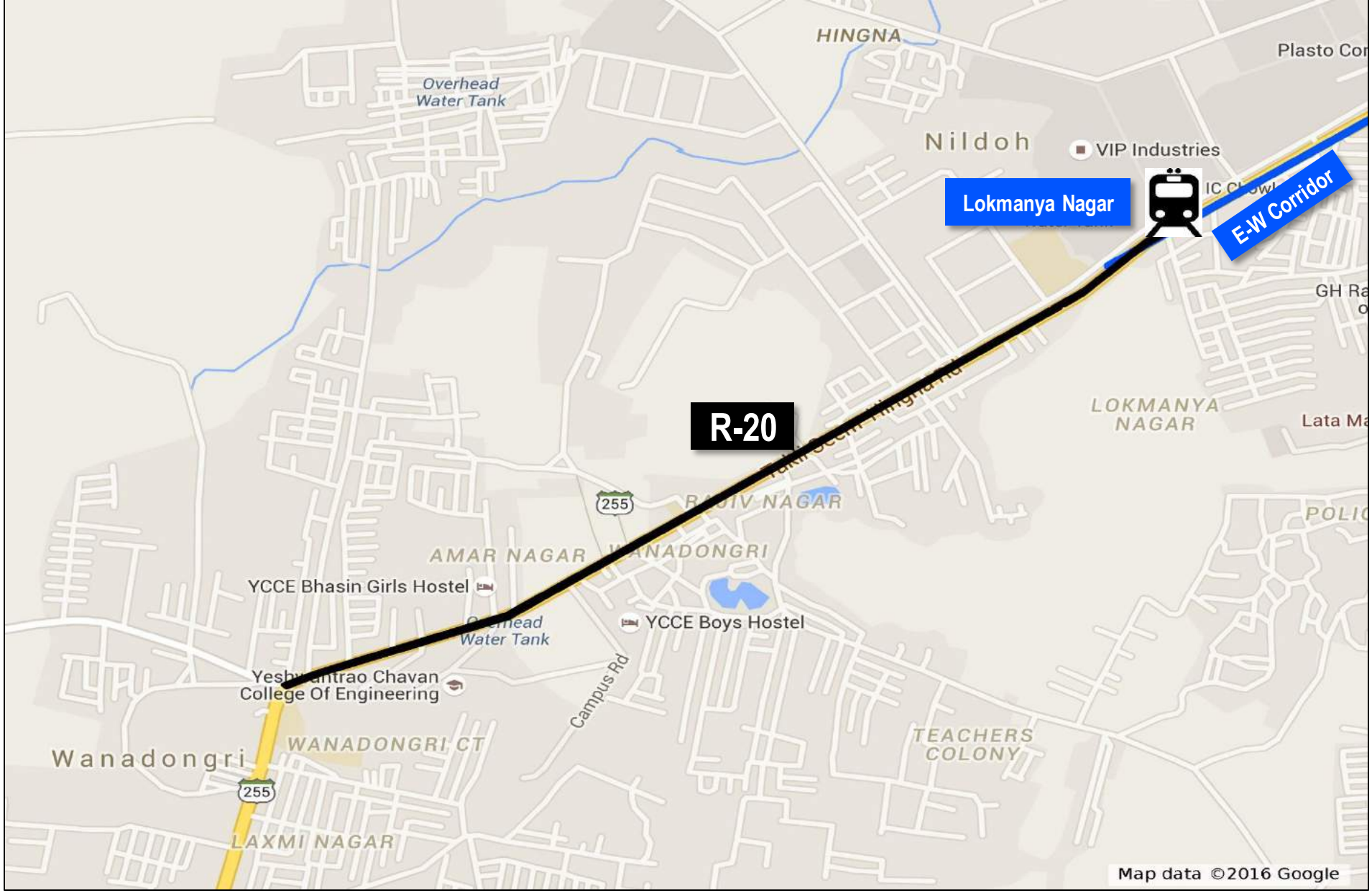
Nildoh
S R P CAMP
NAGAR
POLICE NAGAR
TEACHERS COLONY
Wagdara
Ekatmata Nagar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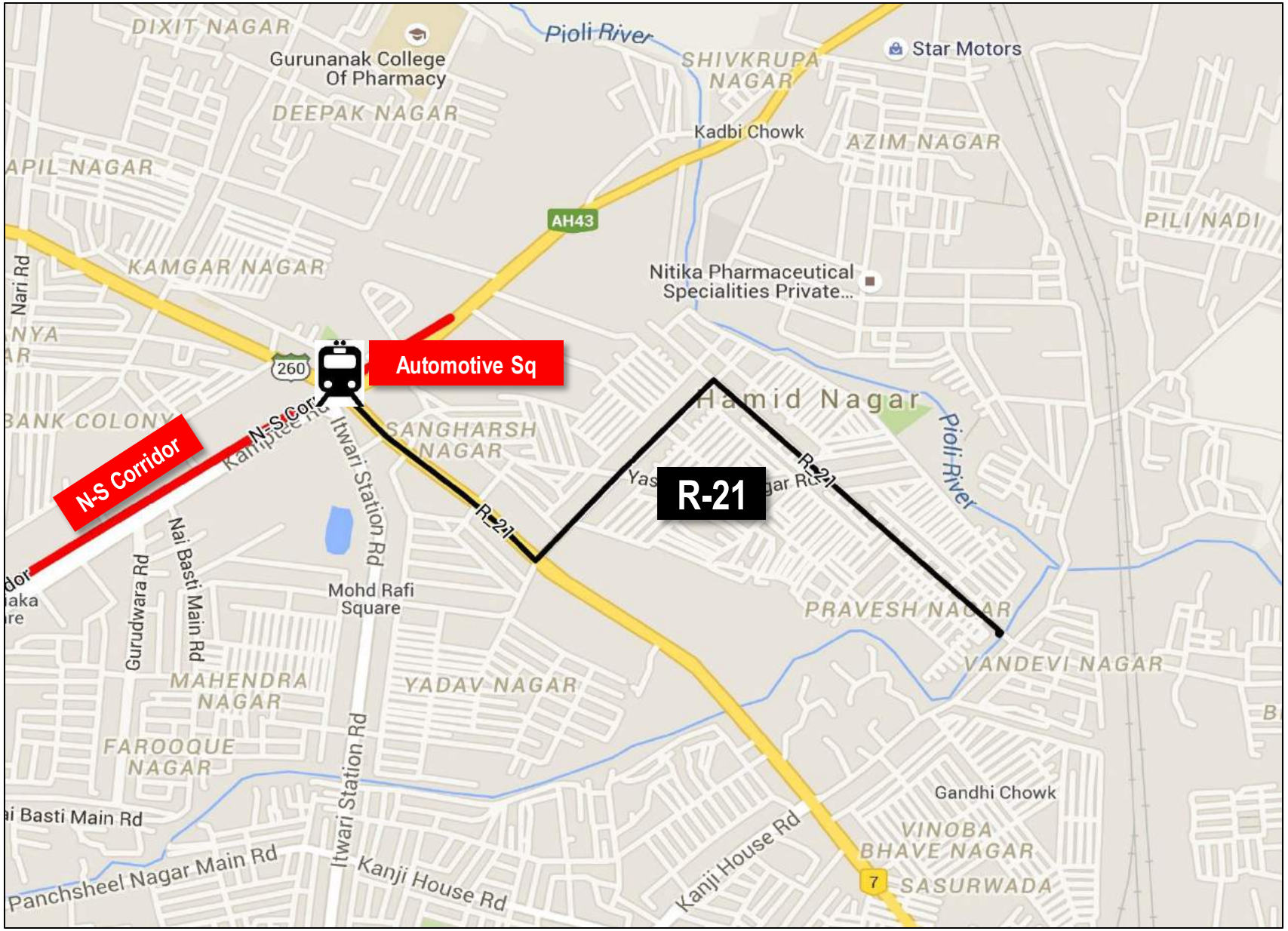
Nildoh
VIP Industries
Lokmanya Nagar
E-W Corridor
R-20
LOKMANYA NAGAR
255
RAJIV NAGAR
AMAR NAGAR
WANADONGRI
YCCE Bhasin Girls Hostel
YCCE Boys Hostel
Overhead Water Tank
College Of Engineering
Campus Rd
TEACHERS COLONY
Wanadongri
WANADONGRI CT
255
LAXMI NAGAR
Map data ©2016 Google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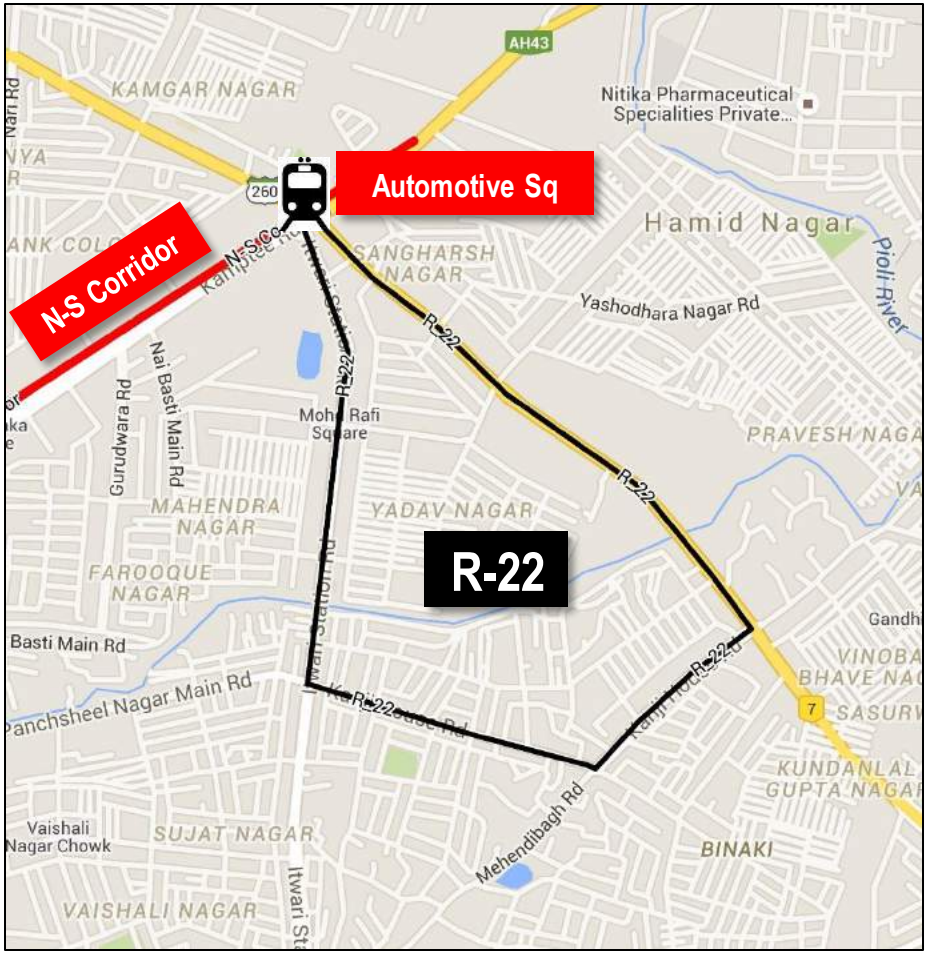
Gurunanak College Of Pharmacy
Pioli River
SHIVKRUPA NAGAR
Star Motors
DEEPAK NAGAR
Kadbi Chowk
AZIM NAGAR
APIL NAGAR
AH43
PILI NADI
KAMGAR NAGAR
Nitika Pharmaceutical Specialities Private...
Nari Rd
260
Automotive Sq
Hamid Nagar
BANK COLONY
N-S Cor
SANGHARSH NAGAR
N-S Corridor
Itwari Station Rd
R-21
Pioli River
Gurudwara Rd
Nai Basti Main Rd
Mohd Rafi Square
PRAVESH NAGAR
VANDEVI NAGAR
MAHENDRA NAGAR
YADAV NAGAR
FAROOQUE NAGAR
Gandhi Chowk
Nai Basti Main Rd
Panchsheel Nagar Main Rd
Kanji House Rd
VINOBA BHAVE NAGAR
7
SASURWADA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R-22
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Nitika Pharmaceutical Specialities Private...
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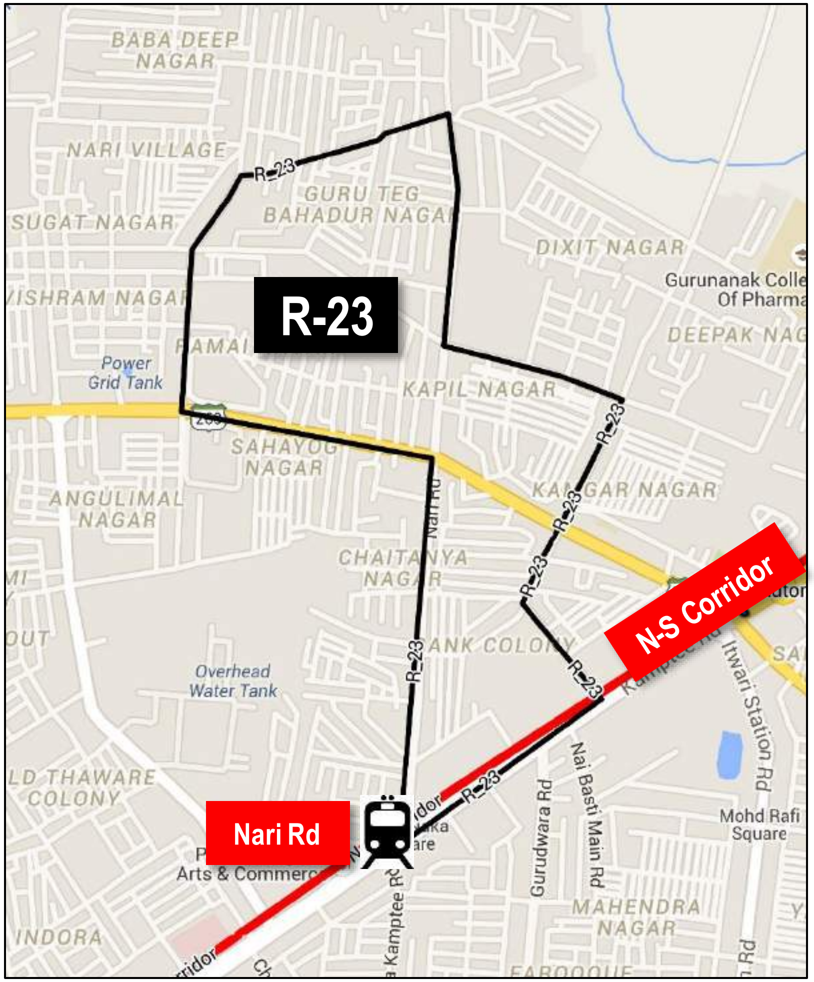
Yashodhara Nagar Rd
Pioli River
Gurudwara Rd
Nai Basti Main Rd
Mohd Rafi Square
PRAVESH NAGA
MAHENDRA NAGAR
YADAV NAGAR
FAROOQUE NAGAR
Basti Main Rd
Panchsheel Nagar Main Rd
Gandh
VINOBA BHAVE NA
SASUR
7
KUNDANLAL GUPTA NAGA
Vaishali Nagar Chowk
SUJAT NAGAR
Mehendibagh Rd
BINAKI
VAISHALI NAGAR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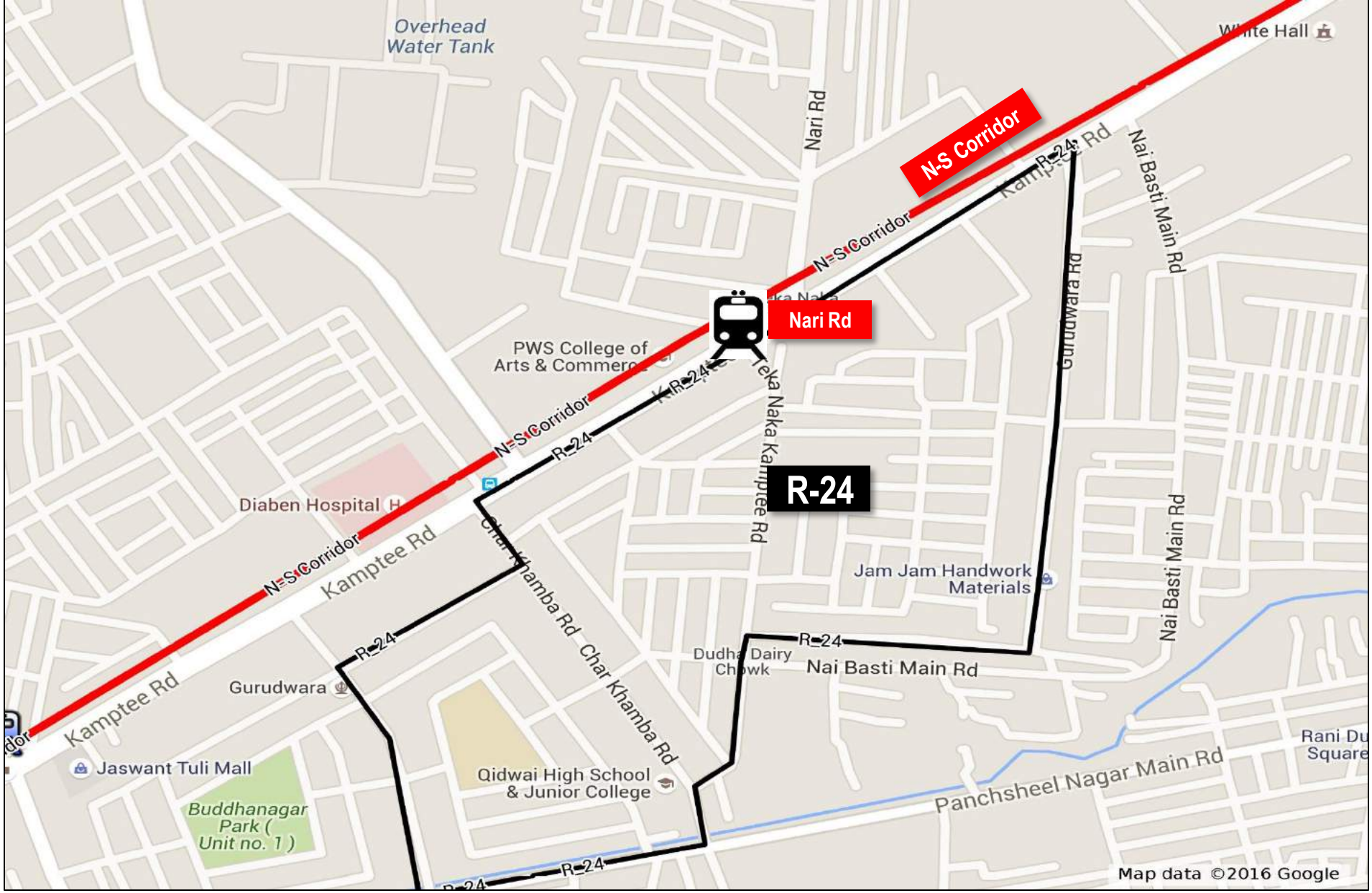
Nari Rd
BABA DEEP NAGAR
NARI VILLAGE
SUGAT NAGAR
GURU TEG BAHADUR NAGAR
DIXIT NAGAR
KAPIL NAGAR
SAHAYOG NAGAR
ANGULIMAL NAGAR
CHAITANYA NAGAR
Power Grid Tank
Overhead Water Tank
MAHENDRA NAGAR
INDORA
Mohd Rafi Square
Itwari Station Rd
Nai Basti Main Rd
Gurudwara Rd
Kamptee Rd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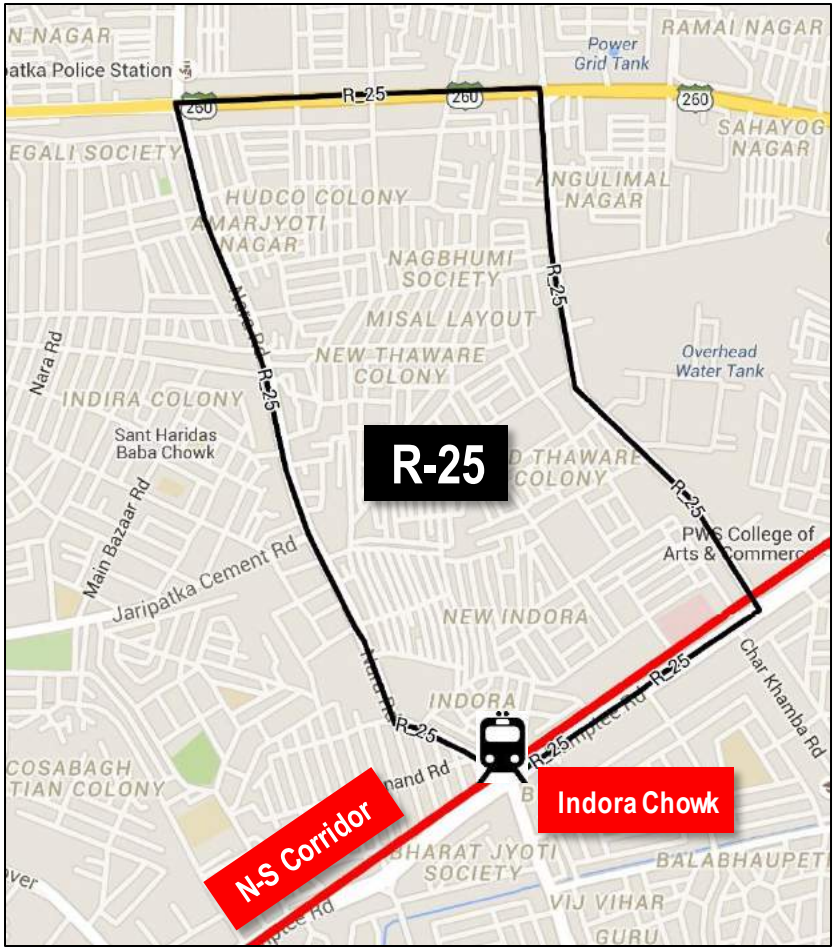
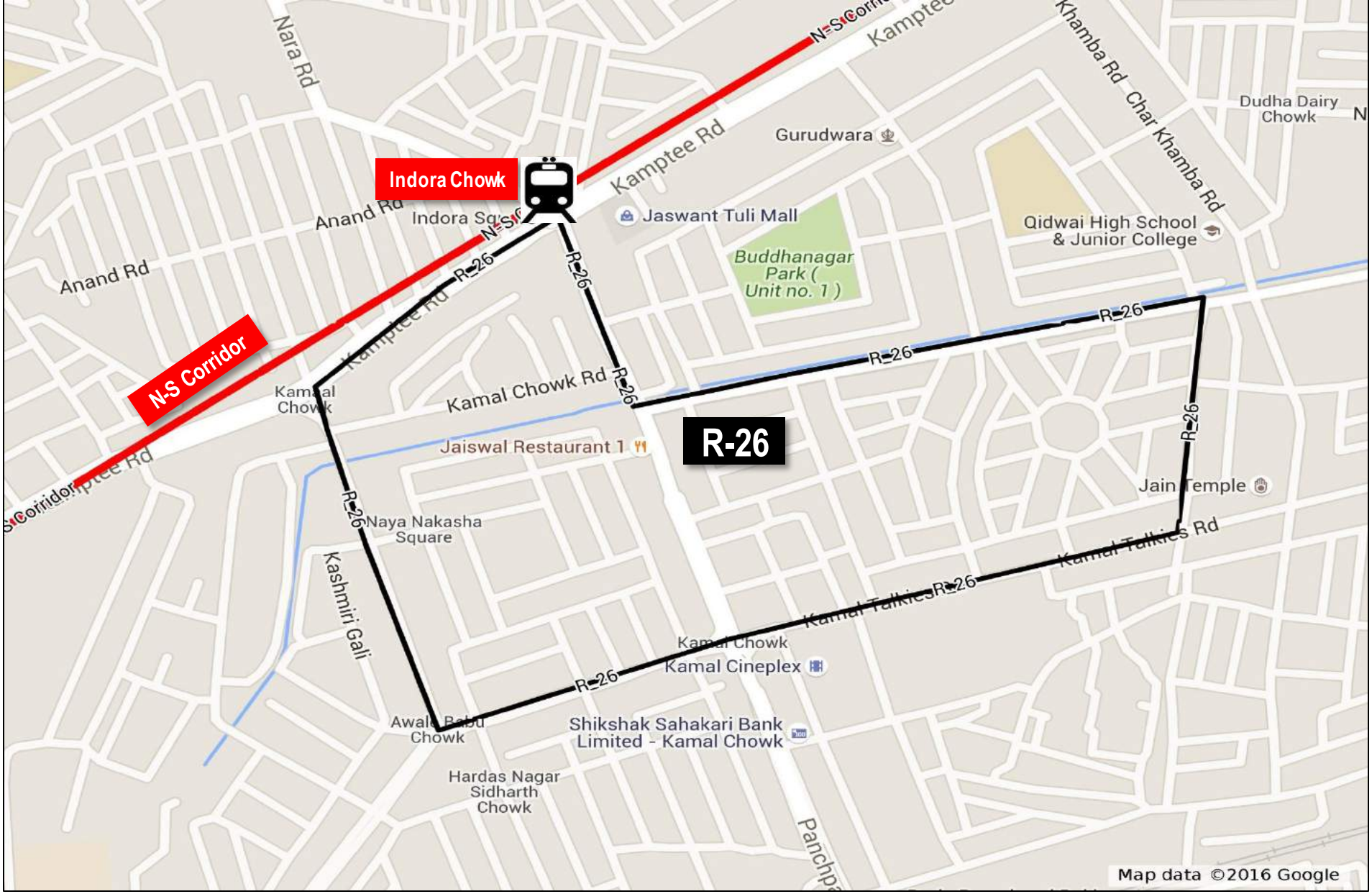
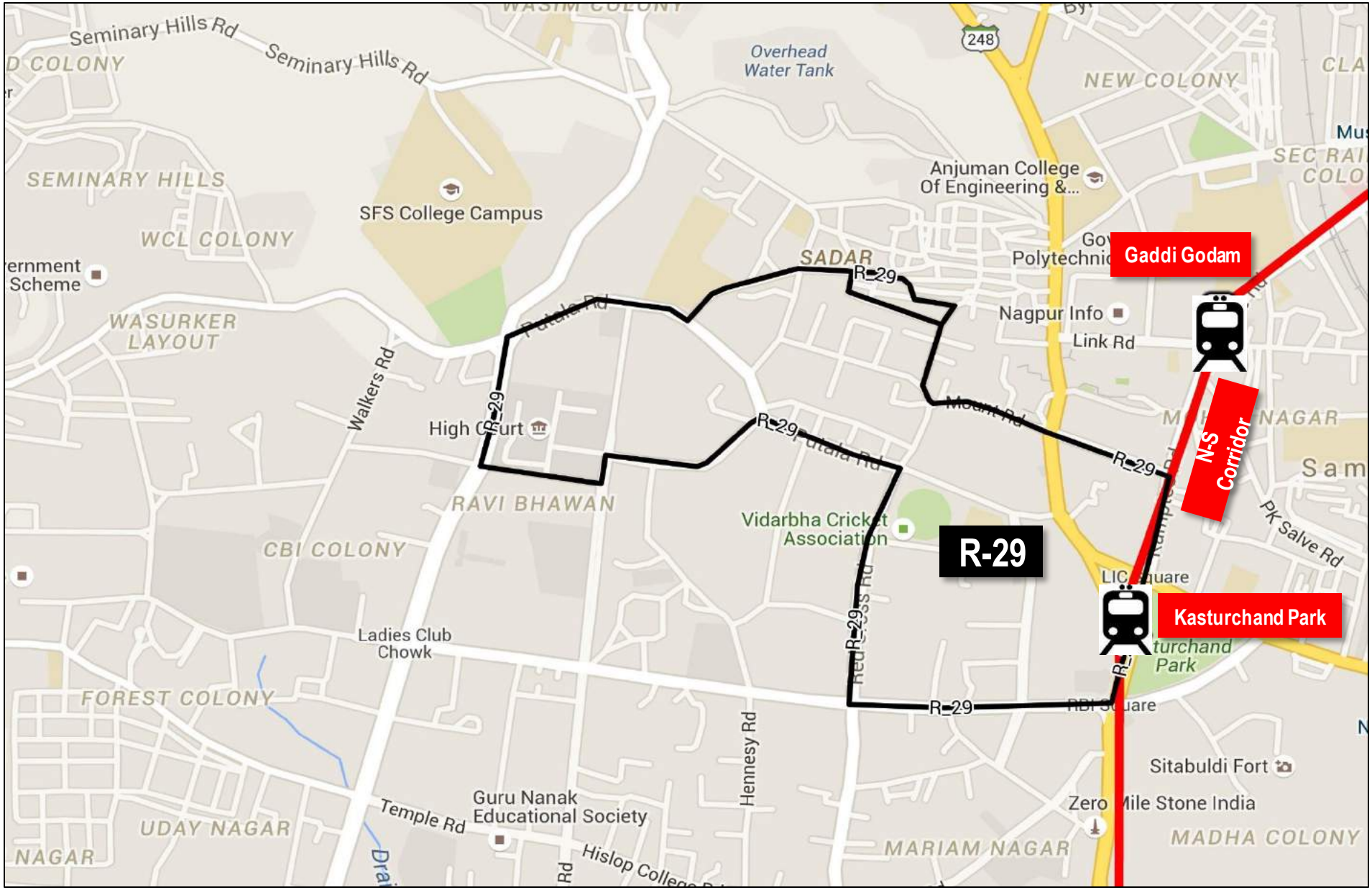
Nari Rd
N-S Corridor
White Hall
Kamptee Rd
Nai Basti Main Rd
Gurudwara Rd
Nari Rd
PWS College of Arts & Commerce
N-S Corridor
R-24
Teka Naka Kamptee Rd
R-24
Diaben Hospital
N-S Corridor
Kamptee Rd
Char Khamba Rd
Jam Jam Handwork Materials
R-24
Dudha Dairy Chowk
Nai Basti Main Rd
Nai Basti Main Rd
R-24
Gurudwara
Char Khamba Rd
Kamptee Rd
Jaswant Tuli Mall
Qidwai High School & Junior College
Buddhanagar Park (Unit no. 1)
Panchsheel Nagar Main Rd
R-24
R-24
Map data ©2016 Google


R-25
N-S Corridor
Indora Chowk
RAMAI NAGAR
Power Grid Tank
SAHAYOG NAGAR
ANGULIMAL NAGAR
HUDCO COLONY
AMARJYOTI NAGAR
NAGBHUMI SOCIETY
MISAL LAYOUT
NEW THAWARE COLONY
Overhead Water Tank
INDIRA COLONY
Sant Haridas Baba Chowk
Nara Rd
Main Bazaar Rd
Jaripatka Cement Rd
NEW INDORA
INDORA
Char Khamba Rd
BHARAT JYOTI SOCIETY
VIJ VIHAR
260
R-25


Indora Chowk
N-S Corridor
R-26
Kamal Chowk Rd
Kamal Chowk
Jaiswal Restaurant 1
Naya Nakasha Square
Kashmiri Gali
Kamal Chowk
Kamal Cineplex
Shikshak Sahakari Bank Limited - Kamal Chowk
Hardas Nagar Sidharth Chowk
Jain Temple
Kamal Talkies Rd
Gurudwara
Jaswant Tuli Mall
Buddhanagar Park (Unit no. 1)
Qidwai High School & Junior College
Dudha Dairy Chowk
Char Khamba Rd
Khamba Rd
Kamptee Rd
Anand Rd
Nara Rd
Map data ©2016 Google


R-27
N-S Corridor
Kadbi Chowk
Jaripatka Police Station
Ring Rd
260
69
248
Bypass Rd
Bank Colony Rd
Nara Rd
Main Bazaar Rd
Chhindwara Rd
Byramji Town Rd
Anand Rd
Overhead Water Tank
NEW MANKAPUR
BEGALI SOCIETY
HUDCO COLONY
AMARJYOTI NAGAR
JARIPATKA
INDIRA COLONY
CHITNAVIS NAGAR
BYRAMJI TOWN
MECOSABAGH CHRISTIAN COLONY
NEW COLONY
CLARK TOWN
Anjuman College Of Engineering &...


R-28
Gaddi Godam
N-S Corridor
Police Talaw T Junction
SIAL LAYOUT
RAMNAGAR
DALAL COMPOUND
VENUKA ASIM COLONY
Overhead Water Tank
BYRAMJI TOWN
Mecosabagh Flyover
Byramji Town Rd
NEW COLONY
Anjuman College Of Engineering
Government Polytechnic, Nagpur
SADAR
Nagpur Info
Mount Rd
Putala Rd
Vidarbha Cricket Association
Sampriti
P.K. Salve Rd
R-28


Gaddi Godam
N-S Corridor
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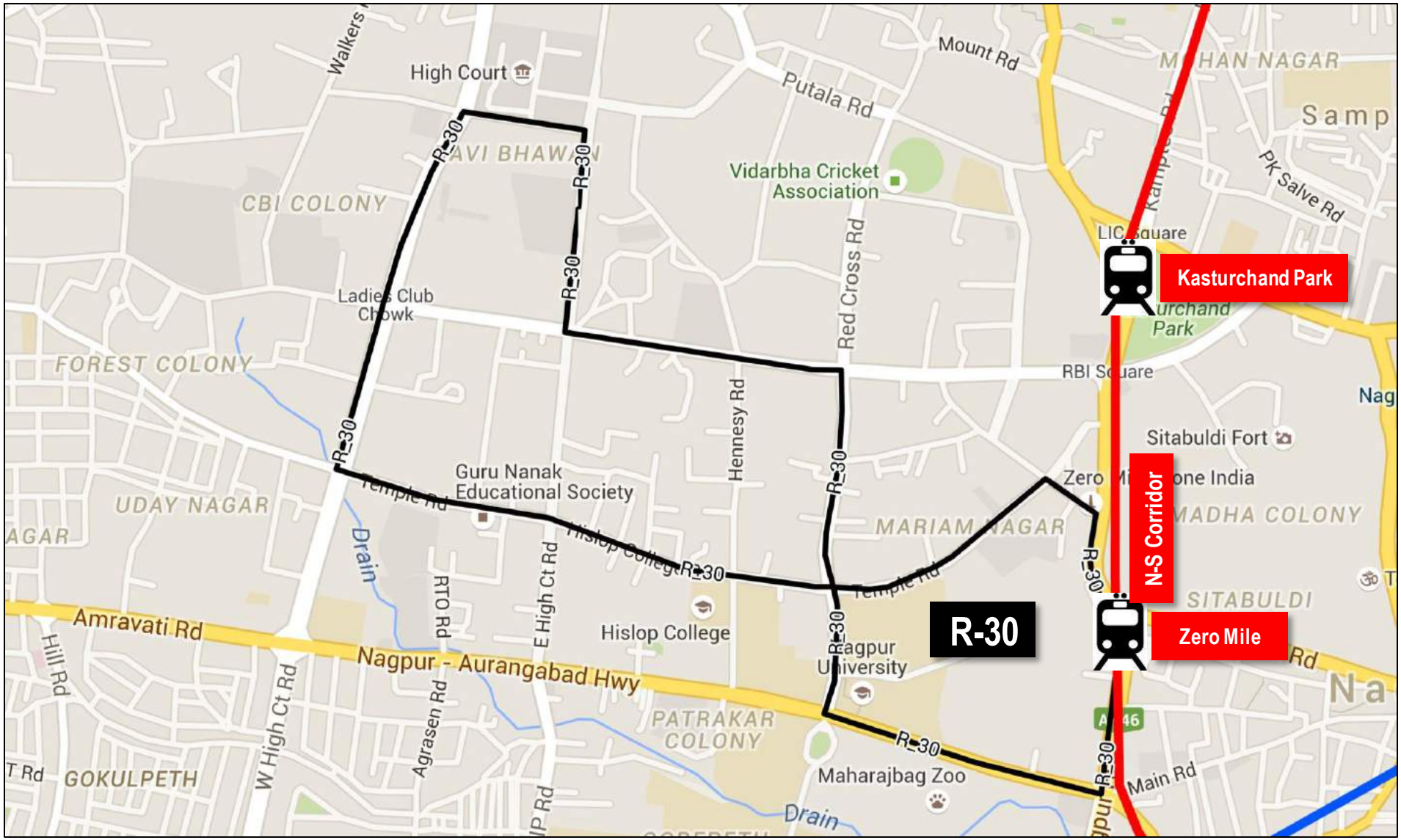
Kasturchand Park
Seminary Hills Rd
Overhead Water Tank
NEW COLONY
SEMINARY HILLS
SFS College Campus
Anjuman College Of Engineering &...
WCL COLONY
SADAR
Nagpur Info
Link Rd
WASURKER LAYOUT
Walkers Rd
Mount Rd
High Court
RAVI BHAWAN
Vidarbha Cricket Association
CBI COLONY
Ladies Club Chowk
FOREST COLONY
Hennesy Rd
Sitabuldi Fort
Zero Mile Stone India
Guru Nanak Educational Society
Temple Rd
UDAY NAGAR
MARIAM NAGAR
MADHA COLONY
PK Salve Rd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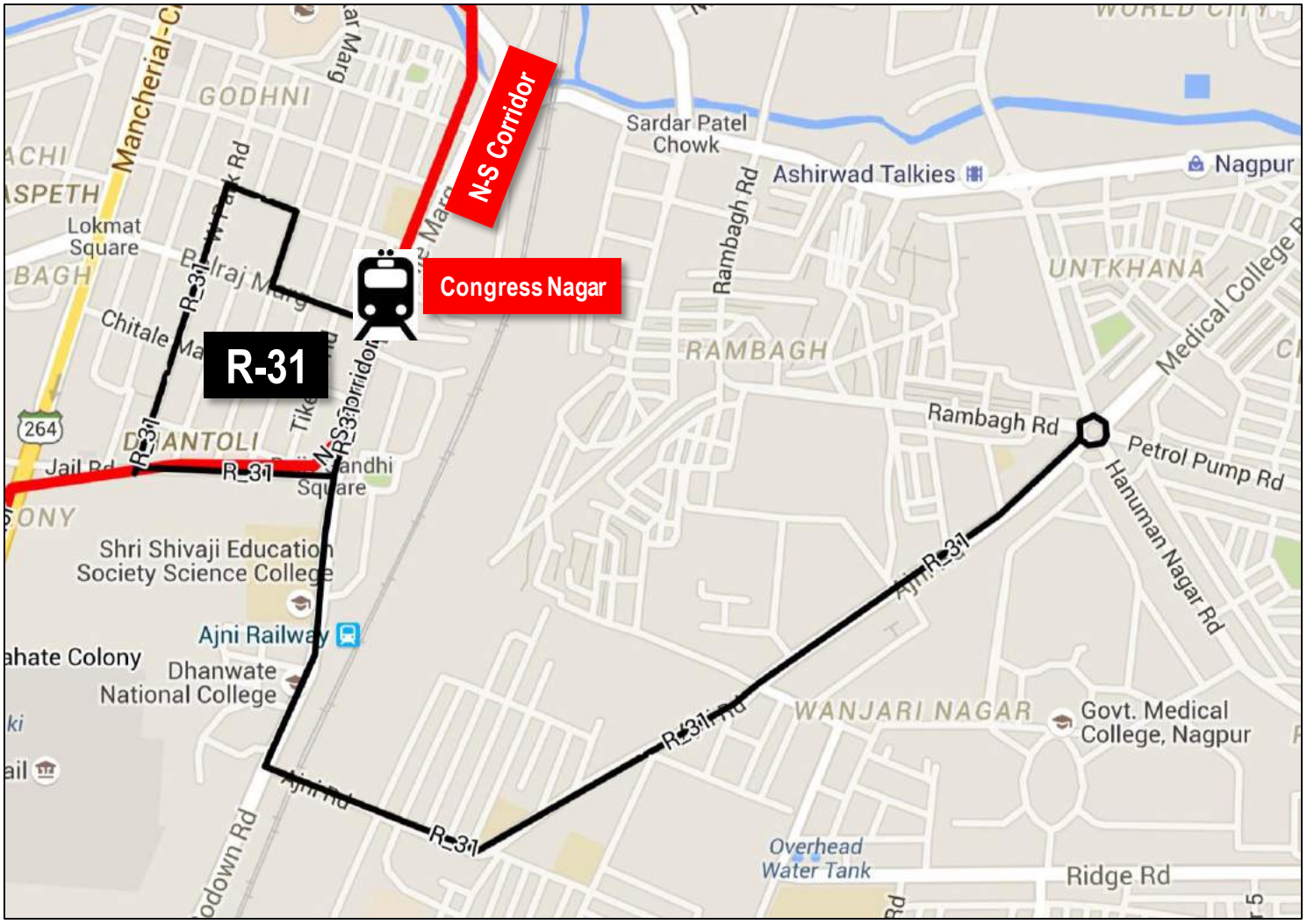
N-S Corridor
Kasturchand Park
Zero Mile
High Court
Mount Rd
Putala Rd
Vidarbha Cricket Association
CBI COLONY
Ladies Club Chowk
Red Cross Rd
PK Salve Rd
FOREST COLONY
RBI Square
Sitabuldi Fort
Hennesy Rd
Guru Nanak Educational Society
UDAY NAGAR
MARIAM NAGAR
SITABULDI
Temple Rd
Hislop College Rd
Drain
RTO Rd
E High Ct Rd
Hislop College
Amravati Rd
Nagpur - Aurangabad Hwy
Nagpur University
PATRAKAR COLONY
Maharajbag Zoo
GOKULPETH
W High Ct Rd
Agrasen Rd
Hill Rd
Main Rd


N-S Corridor
Congress Nagar
R-31
GODHNI
Lokmat Square
Chitale Ma
Sardar Patel Chowk
Ashirwad Talkies
Nagpur
Rambagh Rd
UNTKHANA
RAMBAGH
Medical College
Rambagh Rd
Petrol Pump Rd
Hanuman Nagar Rd
Jail Rd
Gandhi Square
Shri Shivaji Education Society Science College
Ajni Railway
Dhanwate National College
WANJARI NAGAR
Govt. Medical College, Nagpur
Overhead Water Tank
Ridge Rd
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New Airport
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N-S Corridor
N-S Corridor
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R-32
R-32
R-32
R-32
R-32
R-32
R-32
State Bank of India
ATM- Wardha Road...
HP Gas - Sanjana
Gas Agency
Delhi Darbar
Sahara India Parivar
Girikunj Row Houses
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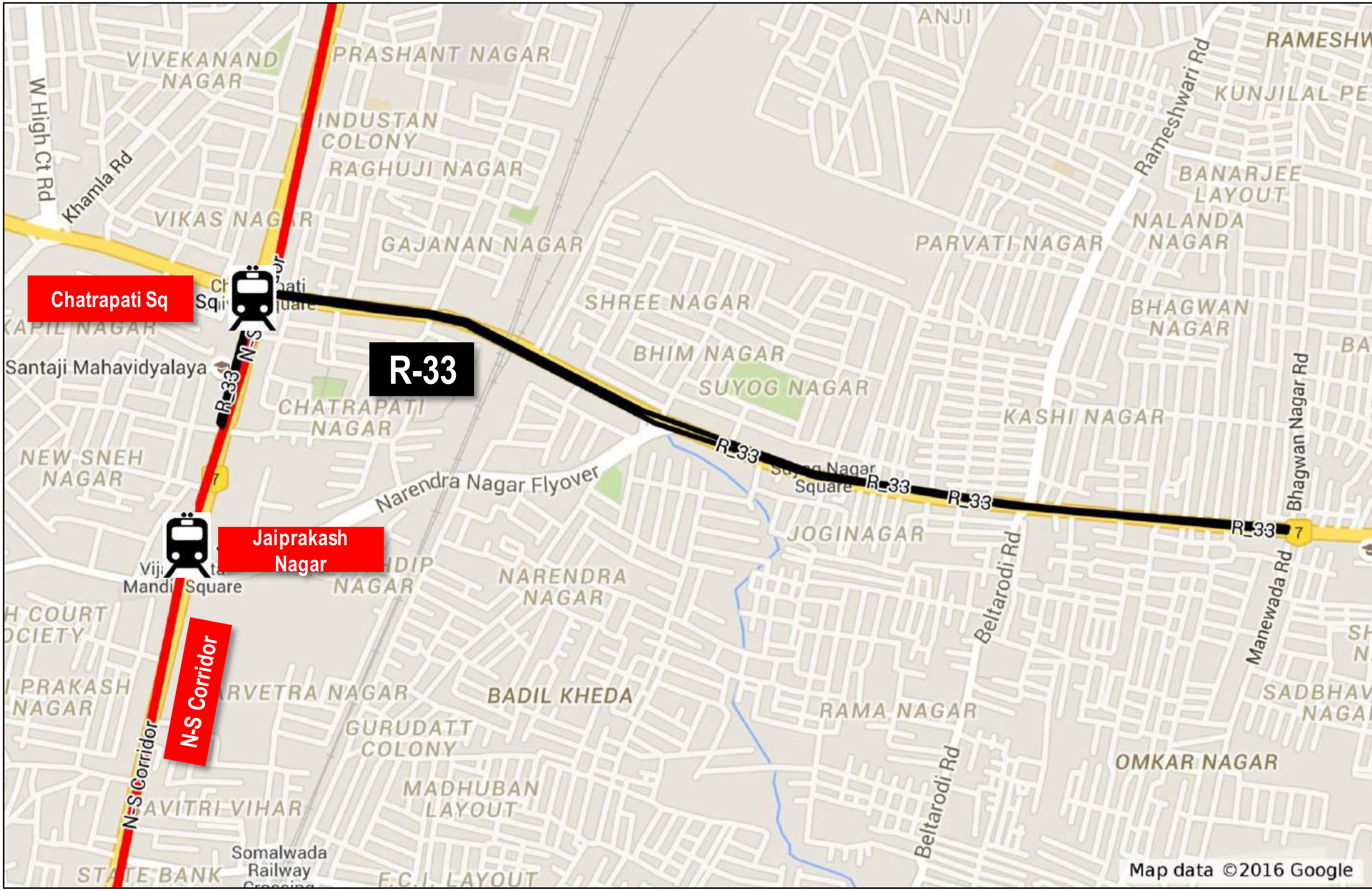
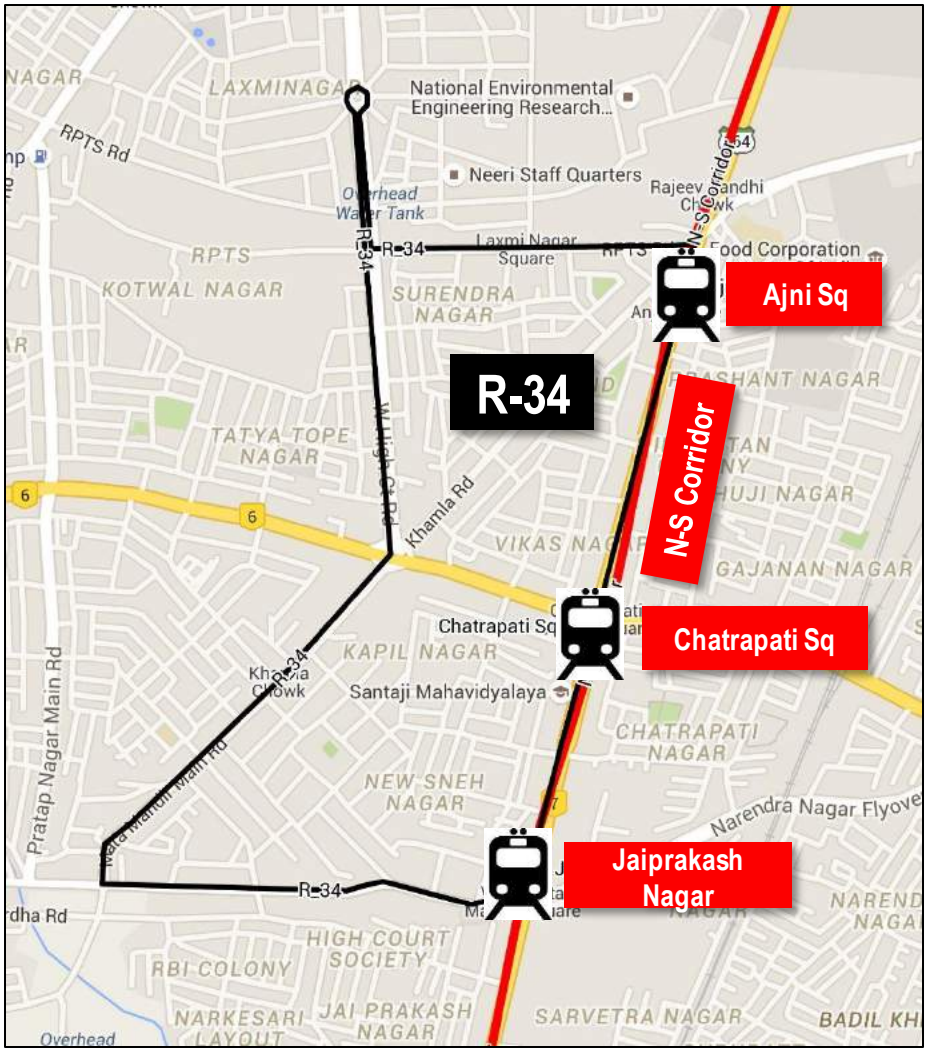


Chatrapati Sq
R-33
Jaiprakash Nagar
N-S Corridor
VIVEKANAND NAGAR
PRASHANT NAGAR
INDUSTAN COLONY
RAGHUJI NAGAR
VIKAS NAGAR
GAJANAN NAGAR
SHREE NAGAR
BHIM NAGAR
SUYOG NAGAR
KASHI NAGAR
PARVATI NAGAR
NALANDA NAGAR
BANARJEE LAYOUT
BHAGWAN NAGAR
KUNJILAL PET
RAMESHW
Rameshwari Rd
Bhagwan Nagar Rd
Manewada Rd
Beltarodi Rd
JOGINAGAR
NARENDRA NAGAR
Narendra Nagar Flyover
CHATRAPATI NAGAR
NEW SNEH NAGAR
Santaji Mahavidyalaya
W High Ct Rd
Khamla Rd
KAPIL NAGAR
BADIL KHEDA
RAMA NAGAR
OMKAR NAGAR
SADBHAV NAGAR
GURUDATT COLONY
MADHUBAN LAYOUT
SAVITRI VIHAR
STATE BANK
Somalwada Railway
F.C.I. LAYOUT
Mandi Square
R_33
Map data ©2016 Google


R-34
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Jaiprakash Nagar
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Neeri Staff Quarters
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Laxmi Nagar Square
Rajeev Gandhi Chowk
Food Corporation
LAXMINAGAR
RPTS Rd
RPTS
KOTWAL NAGAR
SURENDRA NAGAR
TATYA TOPE NAGAR
Khamla Rd
VIKAS NAGAR
GAJANAN NAGAR
PRASHANT NAGAR
KAPIL NAGAR
Santaji Mahavidyalaya
CHATRAPATI NAGAR
NEW SNEH NAGAR
Narendra Nagar Flyover
Pratap Nagar Main Rd
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NARKESARI LAYOUT
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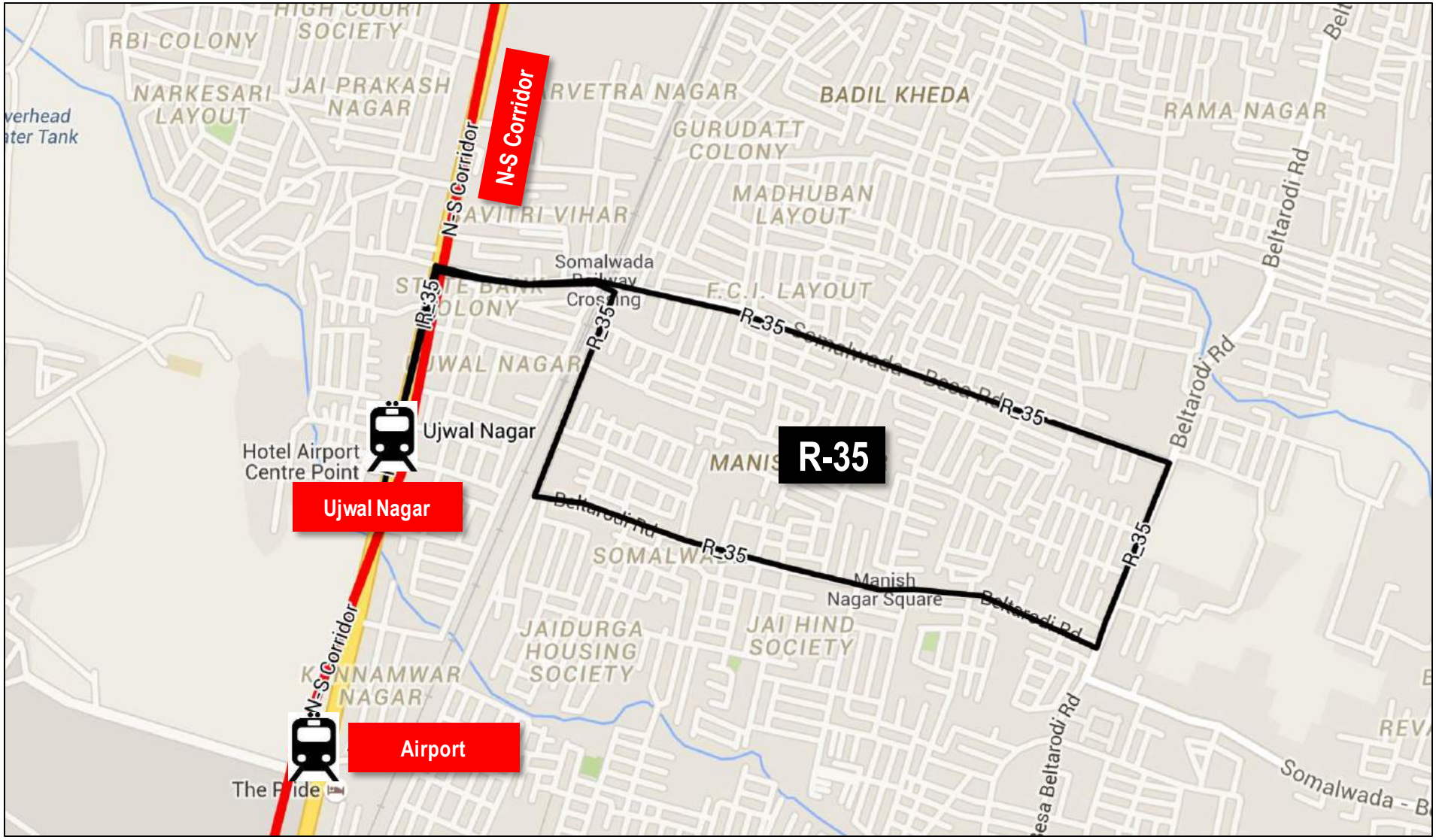
SARVETRA NAGAR
BADIL KH
Overhead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R-35
Ujwal Nagar
Hotel Airport
Centre Point
Ujwal Nagar
Airport
Somalwada
Crossing
Manish
Nagar Square
Beltarodi Rd
BADIL KHEDA
RAMA NAGAR
GURUDATT
COLONY
MADHUBAN
LAYOUT
F.C.I. LAYOUT
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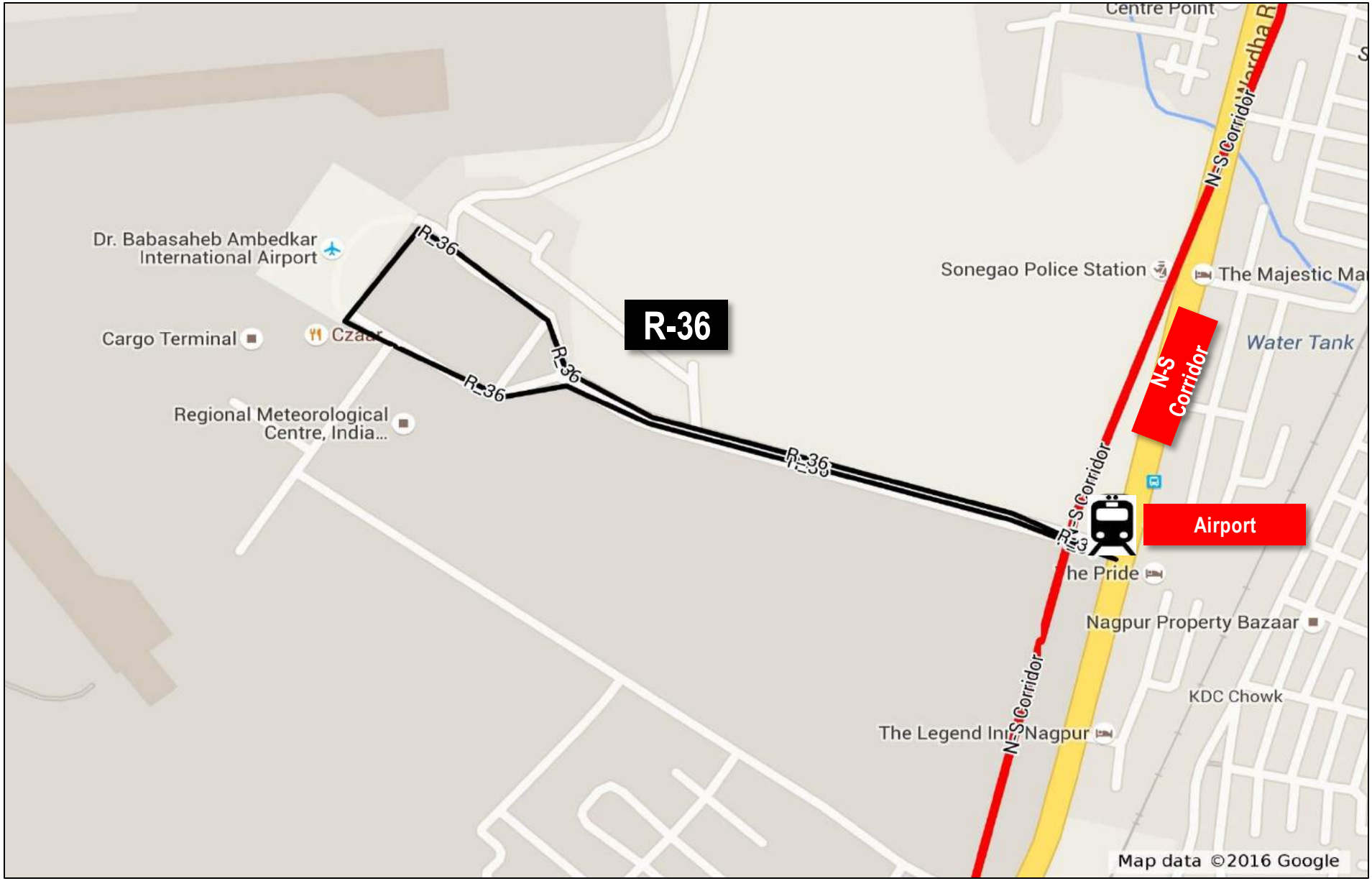
HOUSING
SOCIETY
JAI HIND
SOCIETY
NARKESARI
LAYOUT
RBI COLONY


R-36
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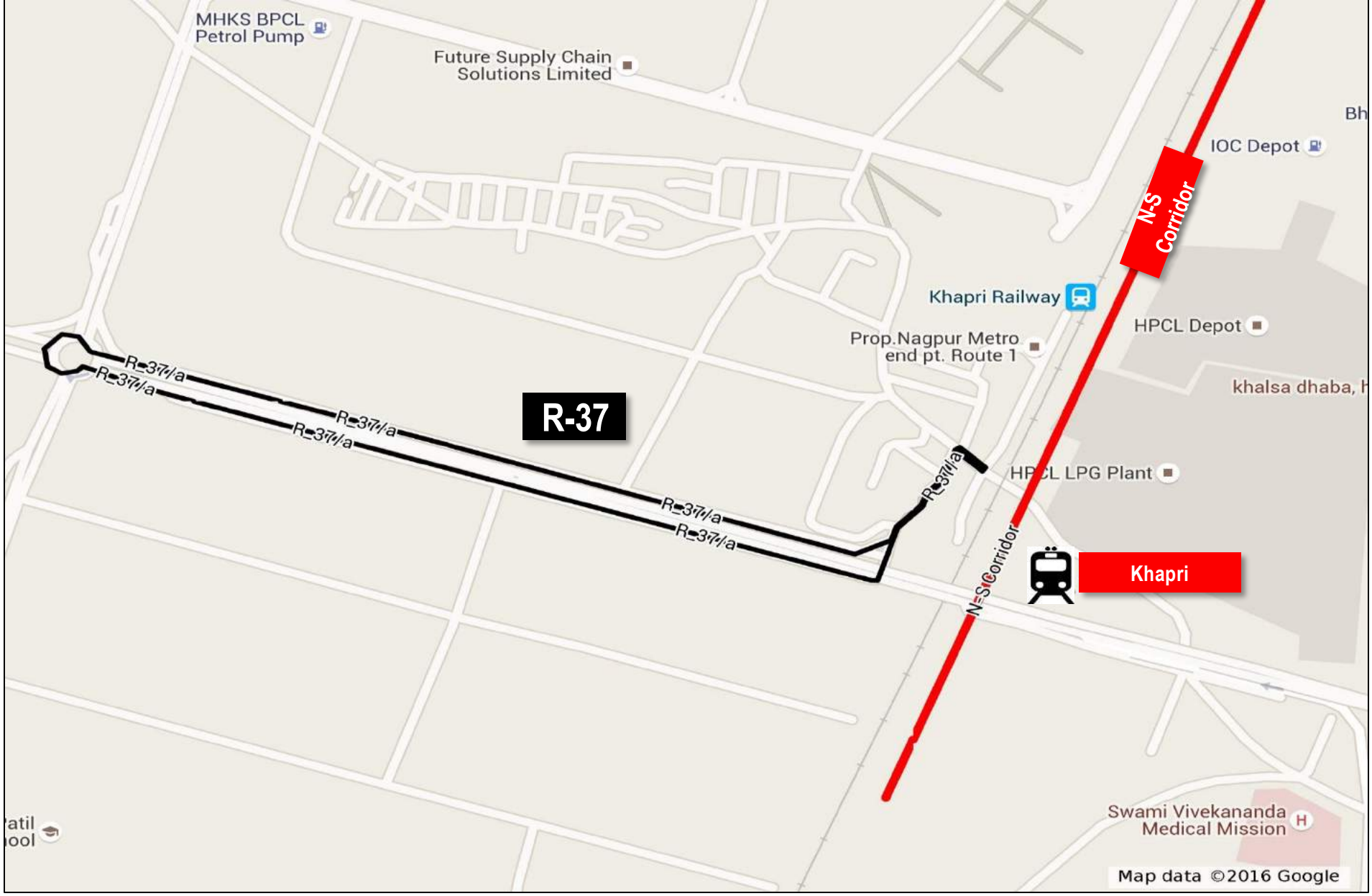
N-S Corridor
Dr. Babasaheb Ambedkar International Airport
Cargo Terminal
Regional Meteorological Centre, India...
Sonegao Police Station
Water Tank
Nagpur Property Bazaar
KDC Chowk
Map data ©2016 Google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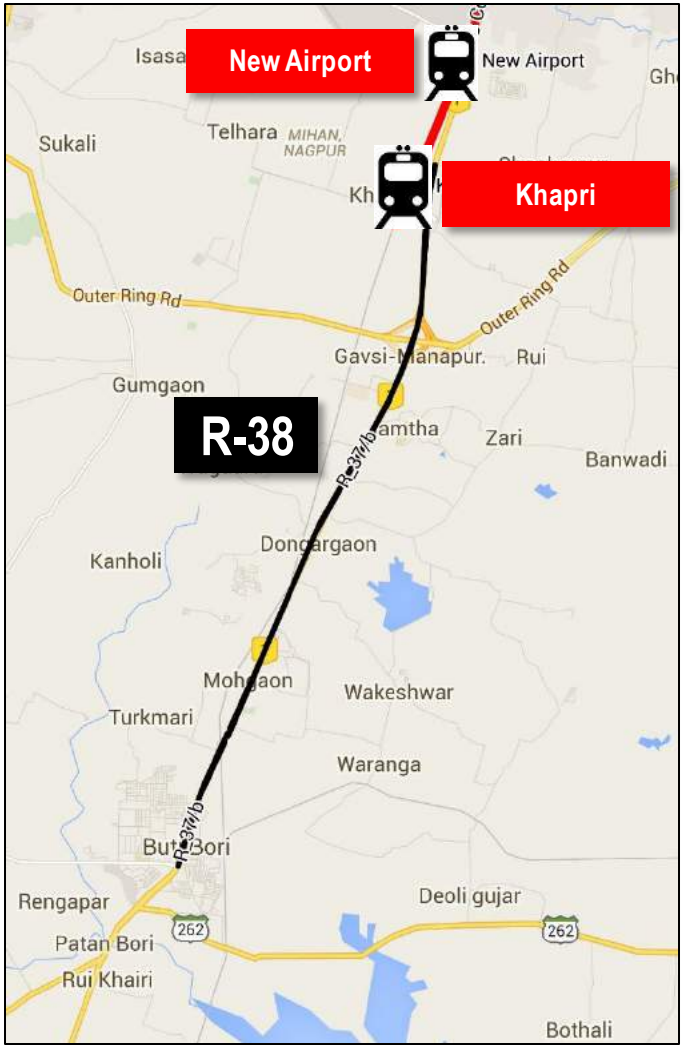
Future Supply Chain
Solutions Limited
IOC Depot
N-S
Corridor
Khapri Railway
Prop.Nagpur Metro
end pt. Route 1
HPCL Depot
khalsa dhaba,
R-37
R-37/a
HPCL LPG Plant
N-S Corridor
Khapri
Swami Vivekananda
Medical Mission
Map data ©2016 Google


New Airport
New Airport
Khapri
Isasa
Telhara
MIHAN, NAGPUR
Sukali
Outer Ring Rd
Outer Ring Rd
Gavsi-Manapur.
Rui
Gumgaon
R-38
Zari
Banwadi
Kanholi
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APPENDIX 6 – STATION AREA PROPOSALS

This section comprises proposals for all station areas of Nagpur Metro. The strategies provided are based on assessment1 of infrastructure requirements for Multi-Modal Integration (MMI) around all metro stations and are in the form of proposals for improved access-egress, pick and drop locations and long term parking requirements etc.

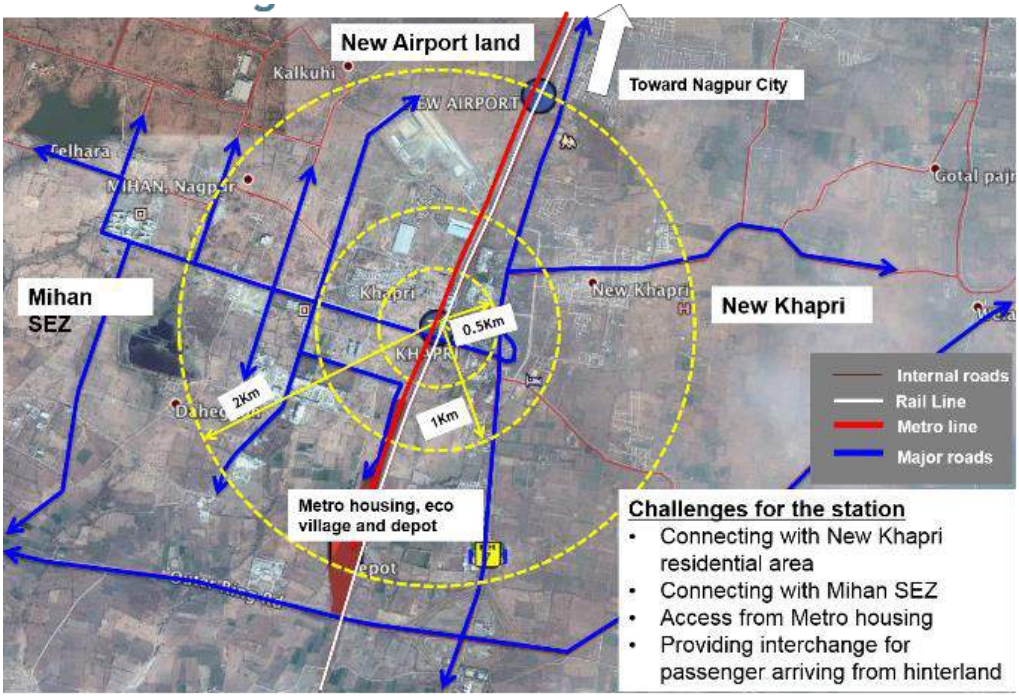
A.1 PROPOSALS FOR REACH-1 STATIONS

This section contains proposals for all stations of Reach-1 of Nagpur Metro:

A.1.1 KHAPRI STATION

This is the last station on the southern end of Reach-1 of Nagpur metro alignment and will be located between the existing Khapri village and Khapri Railway Station. It is about 500m away from the existing highway, separated by the landholdings of ONGC, HPCL and Khapri Railway Station and can be accessed only through "Multi-Modal International Hub Airport at Nagpur" (MIHAN) SEZ (Refer). The location of the station is foreseen to boost the development the MIHAN SEZ area into a prime destination after the Metro services are operational.

FIGURE A- 1: AREAS AROUND KHAPRI METRO STATION



[1] The assessment is based on conceptual diagrams for pick and drop locations, access-egress plans etc. for all stations. Stations, for which the drawings were provided by the client, were analyzed as per actual requirements. Stations, for which the drawings were not available, the requirements were based on thumb rules and typical conditions. The same will be updated as and when the drawings for the stations are made available to the consultant.

A.1.1.1 SURROUNDING LAND USE AND ITS POTENTIAL TO GENERATE NMT TRIPS

A. MIHAN

The MIHAN project area covers 4,360 Ha and comprises the New Airport (1,360 Ha), SEZ (2,000 Ha) and area outside SEZ comprising of R&R, PAP, Residential, Commercial and others related facility (1,000 Ha). This area at present generates 6,000 direct and indirect employment which is expected to rise up to 1,20,000 direct jobs and 2,40,000 indirect jobs by 2030.

B. KHAPRI AND NEW KHAPRI VILLAGES

Mihan SEZ includes the area covered by existing Khapri village (1,040 residents as per 2011 Census). The residents of the latter will be relocated to the New Khapri whose adjoining areas will host upcoming development projects of city expansion.

FIGURE A- 2: MAP SHOWING LANDUSE AROUND KHAPRI METRO STATION

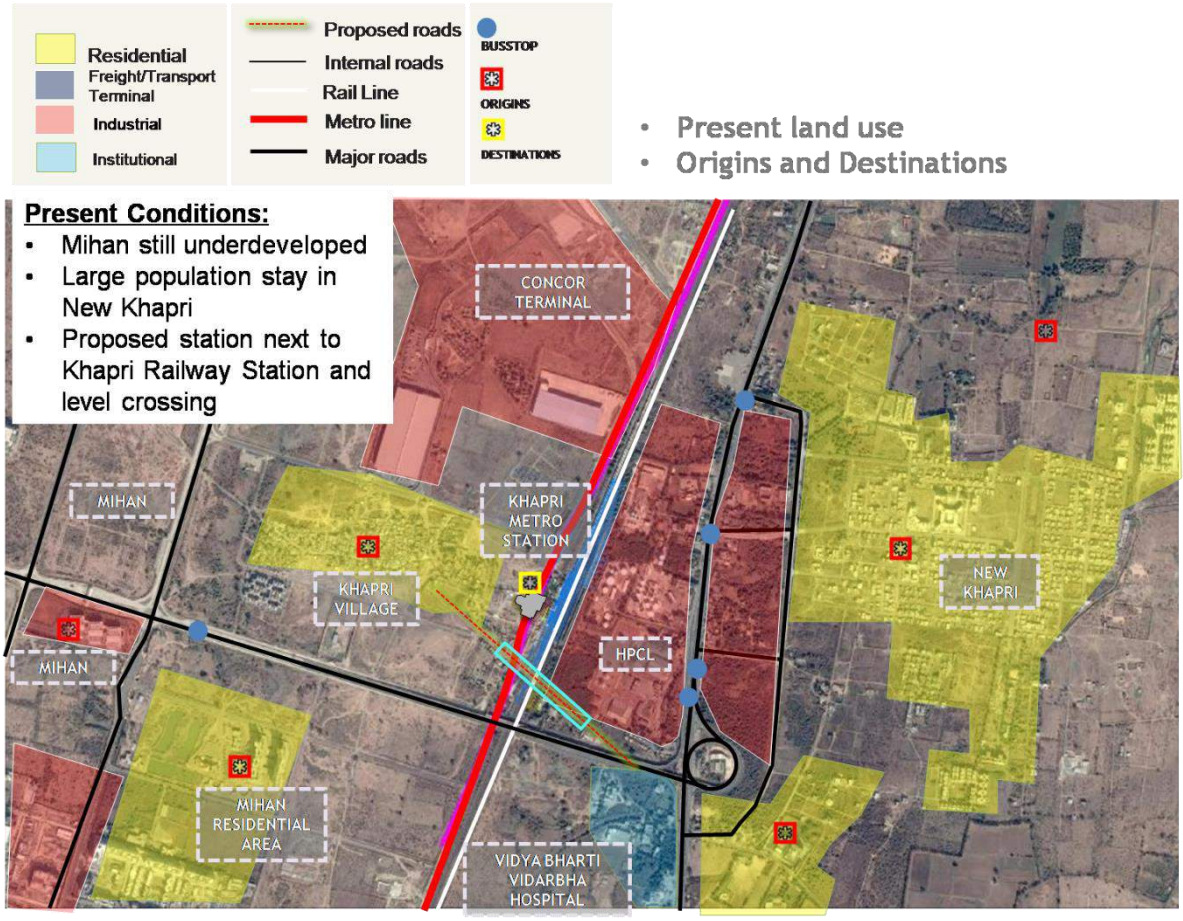
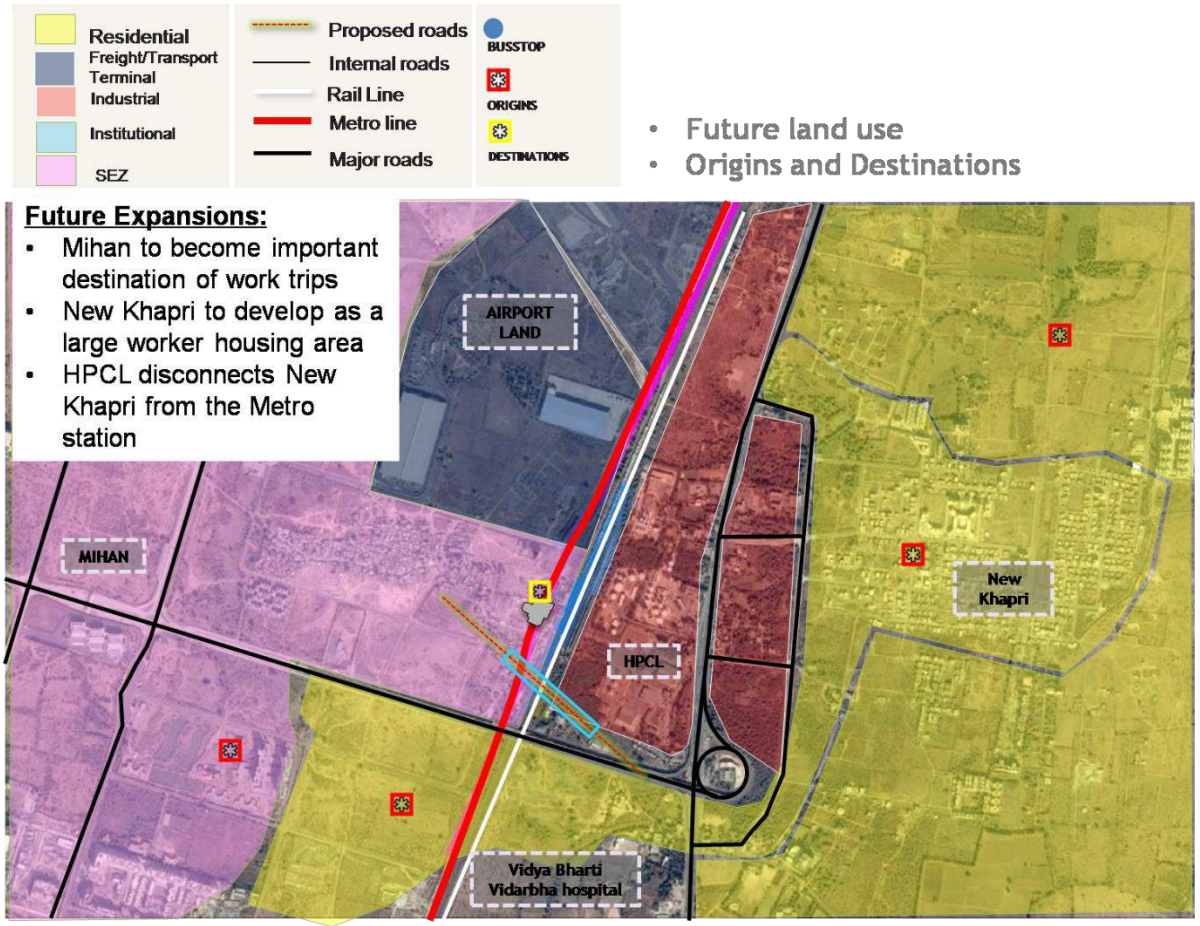


FIGURE A- 3: MAP SHOWING SURROUNDING AREAS OF KHAPRI METRO STATION



A.1.1.2 ISSUES OF CONNECTIVITY

Though the station is physically located within the layout of MIHAN SEZ, it is not integrated with the sector layout. The residents of New Khapri have to access the station after crossing HPCL commercial area and then the National Highway. Refer Figure A- ***4***. This will affect ease of access and may require a modal change to reach the station. To resolve this, a comprehensive network of minor roads has to be laid in all parts of the MIHAN SEZ to facilitate comfortable access/ egress to the Khapri Metro Station from residential areas.

As the MIHAN SEZ may receive footfall from different parts of Nagpur, it would be an opportunity to initiate a Pilot Public Bicycle Sharing Scheme distances below 500 meters. This will require retrofitting the National Highway to accommodate dedicated infrastructure. Refer Figure A- ***5***. Metro Feeder bus services will be operated to connect areas beyond 500 meters and across the National Highway.

The proposed Metro station and Railway Station of Khapri are adjacent to each-other and its tracks near the station would be running at-grade and parallel to each other. This will require closing the existing level-crossing near the railway station.

FIGURE A- 4 : IMMEDIATE CATCHMENT OF KHAPRI METRO STATION WHICH WILL NEED ACCESS TO THE STATION.

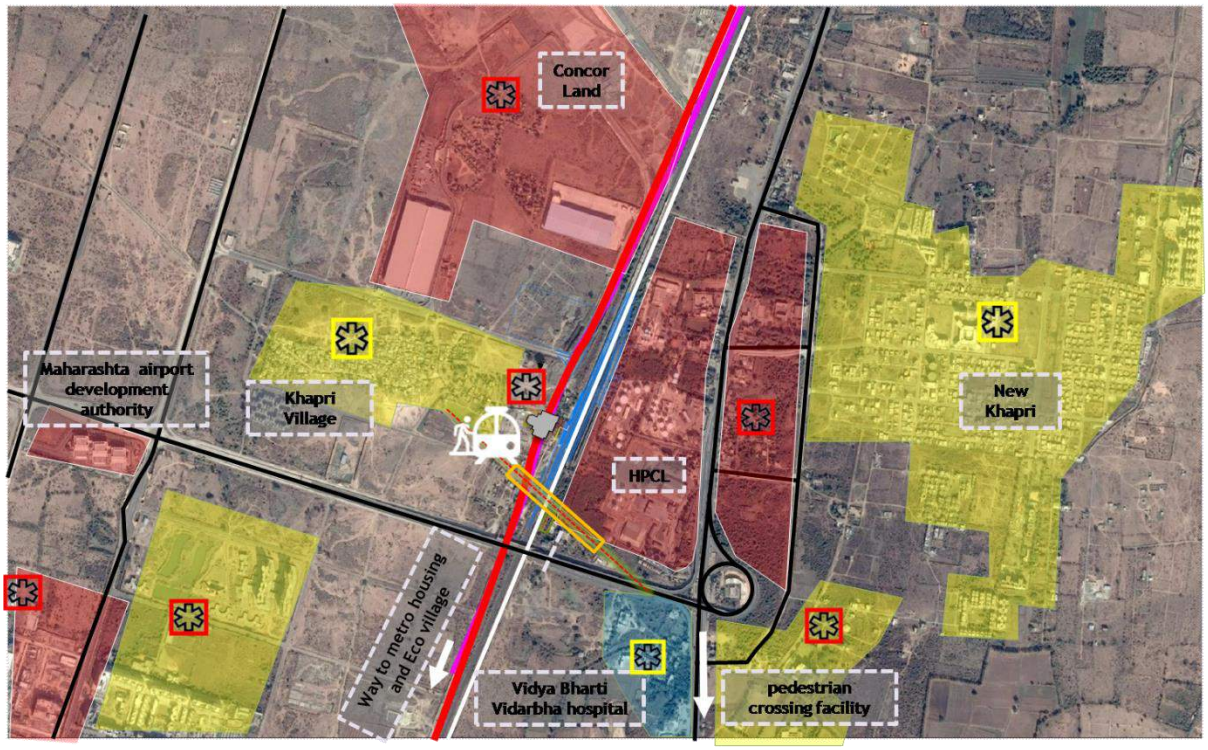


FIGURE A- 5 : ROAD CONDITION NEAR KHAPRI METRO STATION

A.1.1.3 PARKING AND DROP OFF REQUIREMENTS

TABLE A- 1: PARKING, PICK & DROP BAYS REQUIRED NEAR KHAPRI STATION

Passengers (boarding – alighting)			Parking, Pick & Drop Bays Requirement							
			Mode	Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	16409	1804	Car	5	103	166	4	6	25	25
2041	26406	2903	TW	8	769	1237	10	15	50	50
			Auto/ Mini Van	12	357	575	7	11	-	-
			Mini Bus	53	197	317	5	8	-	-

A.1.1.4 ACTIONS TO BE TAKEN

1) A strategy for encouraging use of metro services has to start parallel to its initial phase of operation.
2) Access to metro station from the National Highway requires to be planned
3) Feeder bus connecting New Khapri Area to metro station is necessary
4) MIHAN area has potential to support a pilot Public Bicycle Sharing Scheme
5) It is necessary to replace the existing level crossing with a subway near metro station
6) Facilitation of physical interchange between metro and railway stations is required for easy transfer
7) Re-laying of the road network in the sector with Khapri village and metro station is necessary to ensure satisfactory integration

A.1.1.5 STRATEGIES FOR ENCOURAGING METRO RIDERSHIP FOR THE INITIAL OPERATIONS BETWEEN AIRPORT AND KHAPRI

- **Fair incentives**
  - Option-1- Promotional fares may be allowed for initial period
  - Option-2- Free membership to Metro club with incentives for metro-usage in the form of redeemable points for future use within or outside metro systems.
  - Option-3- Household membership may be encouraged, i.e. metro use by the head of the household may award free rides to be used by dependents.
  - Option-4- Free use of feeder and PBS in initial phases
- **Encourage alternate usage**
  - Option-1- The coaches/ platforms may be used for hosting interactive sessions for kids during off-peak hours on weekends
  - Option-2- The coaches/ platform may be used for exhibitions, advertising etc during off-peak hours
  - Option-3- Points awarded for metro use may be redeemed in other transport facilities.

A.1.1.6 MULTIMODAL INTEGRATION REQUIREMENTS

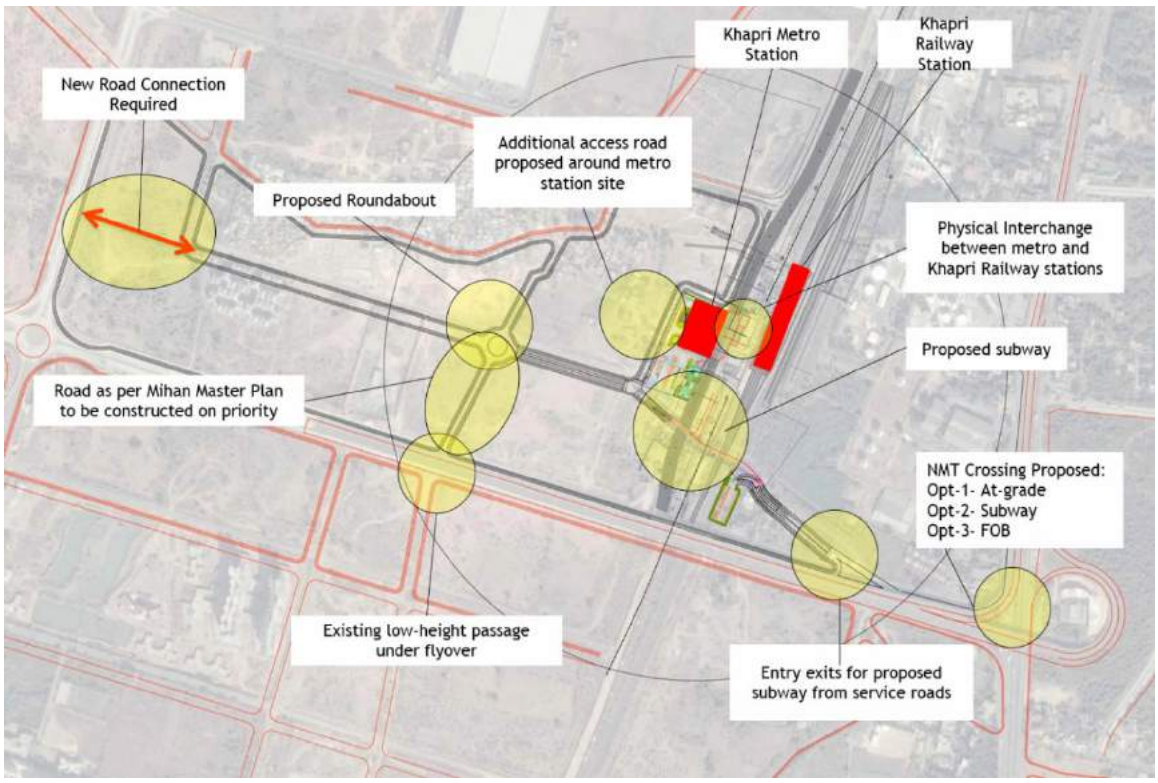
A. CONNECTIVITY IMPROVEMENTS:

Connectivity improvements required for comfortable access to metro station (Refer Figure A- ***6***) are as follows:

1. Replacing existing railway level crossing with a vehicular subway with NMT provisions
2. Provision of a junction of subway lanes with service lanes under existing flyover
3. Provision of additional access road that is integrated with the sector layout of MIHAN along the western edge of Metro Station site.
4. Provision of points of physical interchange between Khapri Metro and Railway Stations
5. Linking of the divided carriageway lanes of the subway with the proposed round-about near MIHAN (Refer Figure A- ***6***)
6. Construction of road following MIHAN sector plan near the aforementioned roundabout. This includes construction of additional roads and up-gradation of existing network connecting Khapri Village to metro station
7. Allocation of crossing points for pedestrians and cyclists across National Highway under existing cloverleaf by means of the following enlisted in decreasing order of priority:
    a. AT-Grade signalized crossing with traffic calming
    b. Subway
    c. Foot Over Bridge

The agreed option is to be implemented in consultation with users.

FIGURE A- 6 : CONNECTIVITY REQUIEMENTS AROUND KHAPRI METRO STATION



B. VEHICULAR MOVEMENT IN AND AROUND KHAPRI AS PER PROPOSED CONNECTIVITY IMPROVEMENTS

Figure A- 7,

FIGURE A- 9 & Figure A- ***10***, demonstrate options of how Khapri Metro station can be accessed from surrounding areas. These access corridors need improvement/retrofitting/ up-gradation considering projected footfall.

FIGURE A- 7 : VEHICULAR MOVEMENT AFTER SUGGESTED IMPROVEMENTS TO REACH METRO STATION

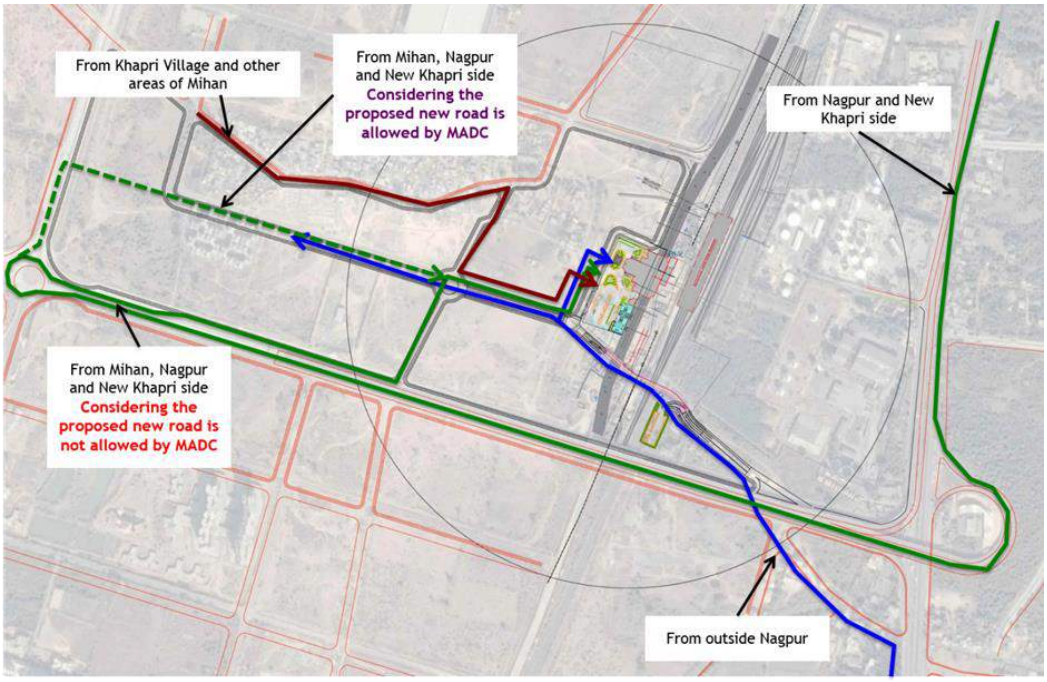


FIGURE A- 8 : VEHICULAR MOVEMENT AFTER SUGGESTED IMPROVEMENTS TO EXIT METRO STATION

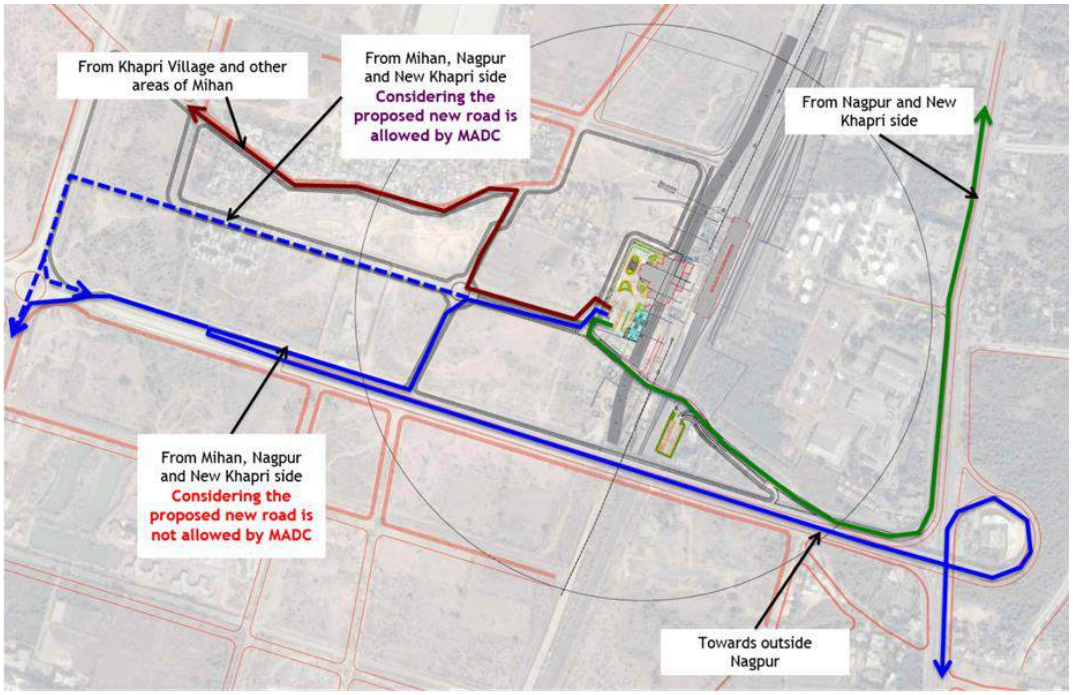


FIGURE A- 9 : VEHICULAR MOVEMENT AFTER SUGGESTED IMPROVEMENTS TO REACH RAILWAY STATION

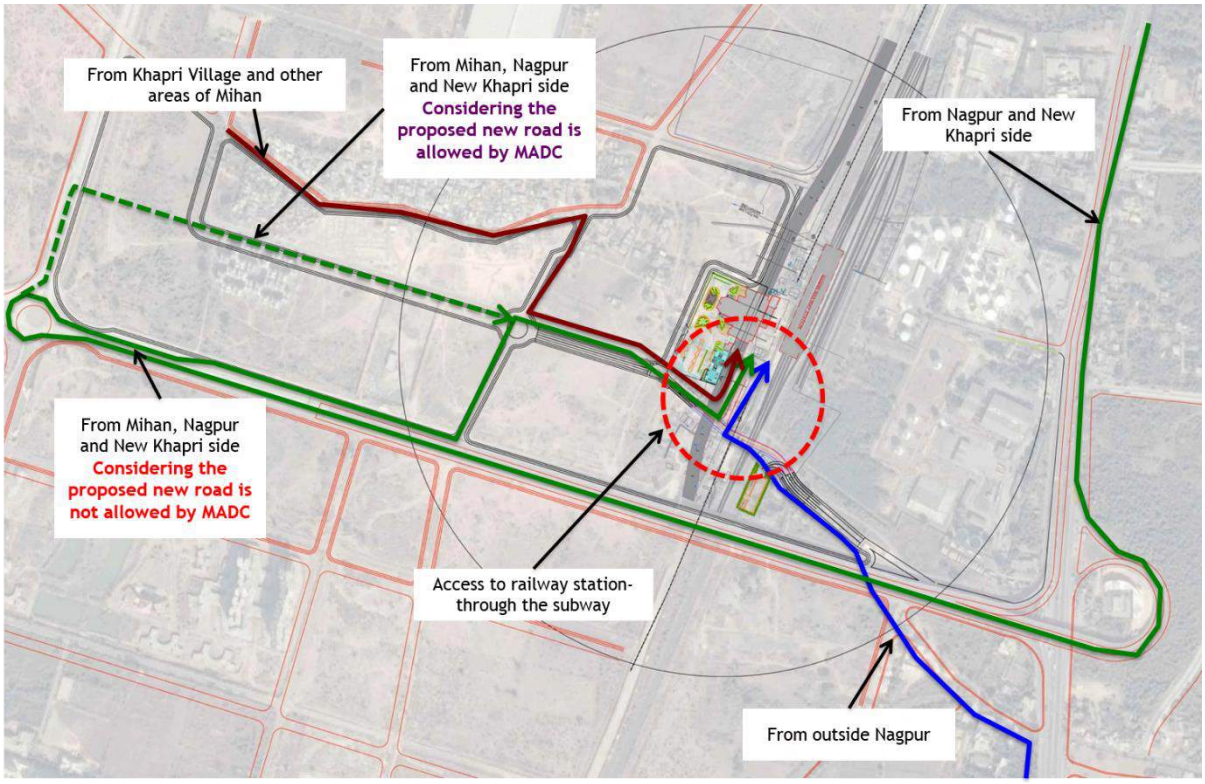
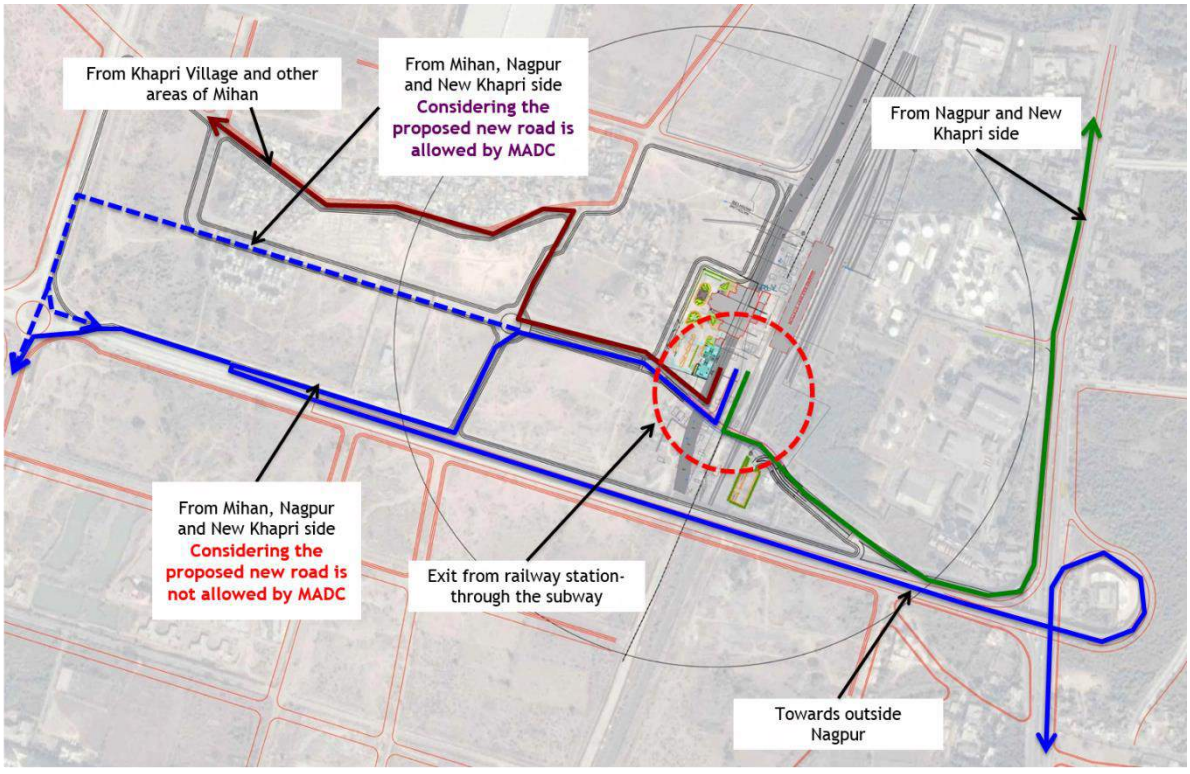


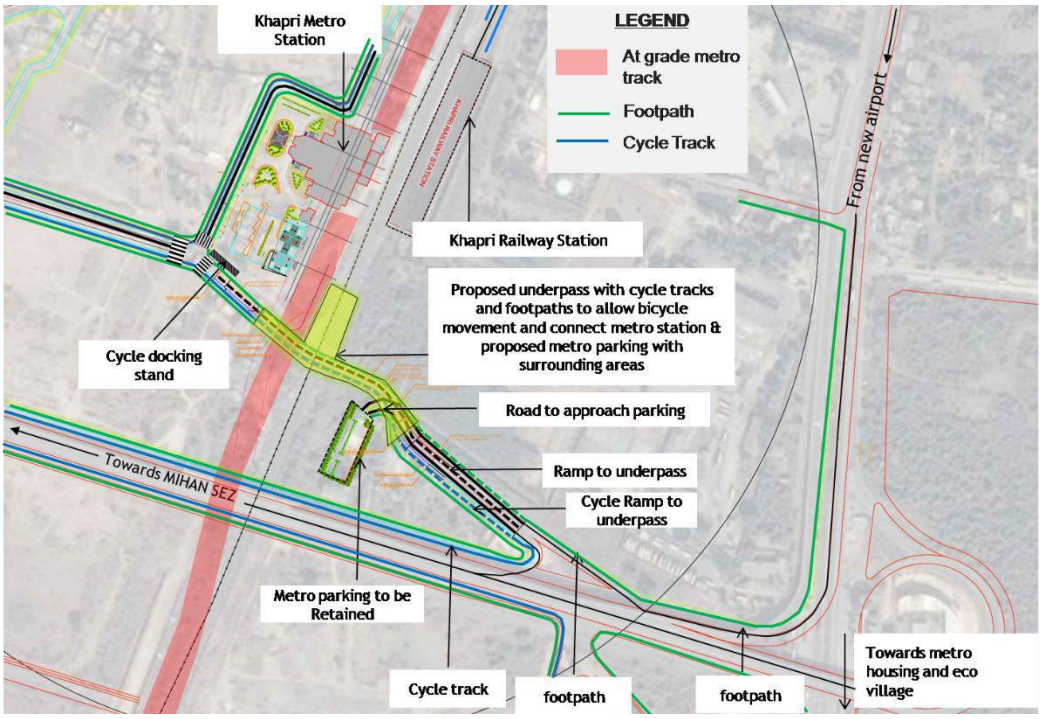
FIGURE A- 10 : VEHICULAR MOVEMENT AFTER SUGGESTED IMPROVEMENTS TO EXIT RAILWAY STATION



C. INTEGRATION AROUND PROPOSED SUBWAY

A vehicular subway is proposed to replace the level crossing of railway to access the metro and railway stations and these with the parking lot of NMRCL seamlessly. It will have dedicated carriageway for vehicles and infrastructure for pedestrians and bicyclists flanking either sides of the road. Refer Figure A- 11.

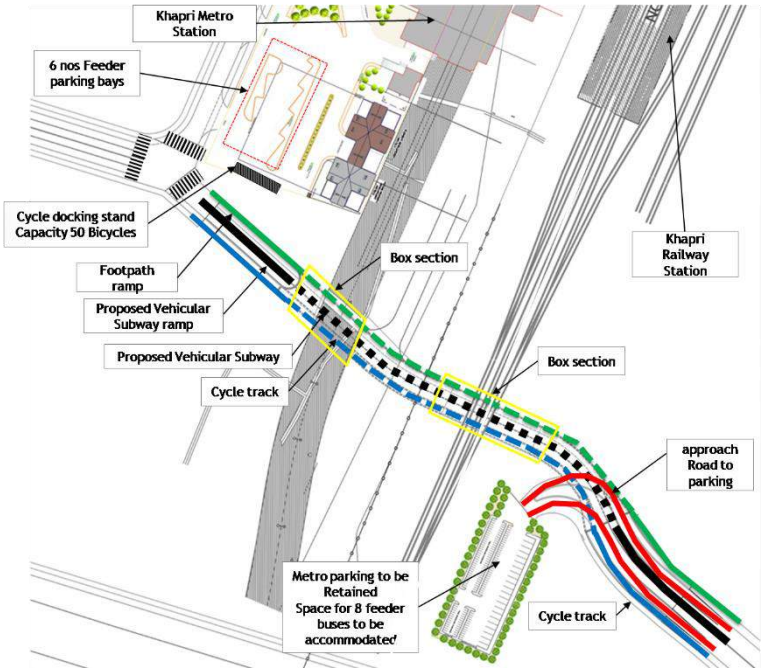
FIGURE A- 11 : MULTI MODAL INTEGRATION AROUND THE PROPOSED SUBWAY



The major roads of MIHAN and other sectors are proposed to allocate with integrated cycle tracks and a bicycle docking station is proposed near the metro station. Refer Figure A- *12*

FIGURE A- 12 : NMT CROSSING ACROSS RAILWAY LINE

D.



D. METRO STATION AREA- CIRCULATION

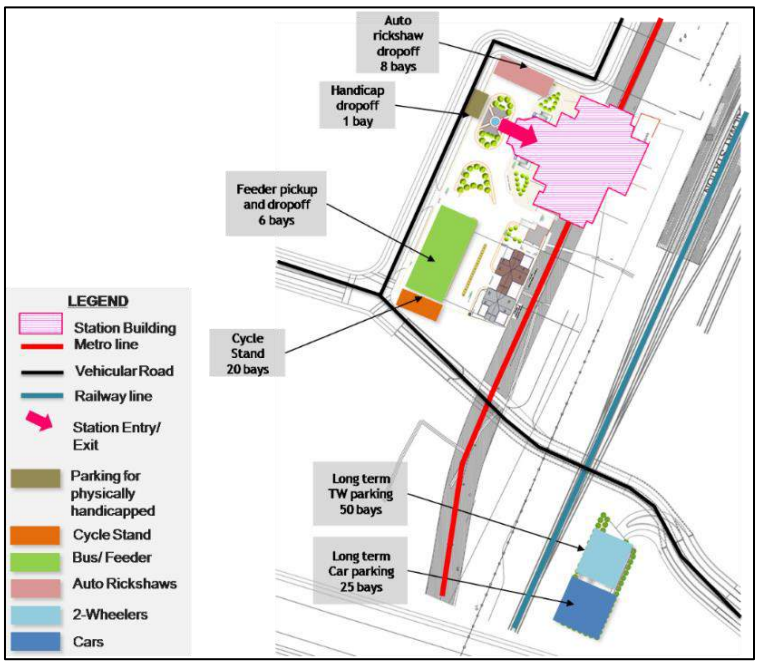
The points of entry/ exit of the metro station are proposed to be from the new road located between Metro station and Khapri Village. It is free from vehicular traffic and is accessible from the proposed subway. Refer Figure A-***13***.

FIGURE A- 13 : PROPOSED ENTRY/ EXIT TO METRO STATION

E. METRO STATION AREA MULTI MODAL INTEGRATION

The location of pick-and-drop facilities and parking lots around Khapri Metro Station is based on MMI planning and design priorities. Refer Figure A- 14.

FIGURE A- 14 : MULTI MODAL INTEGRATION SCHEME AROUND KHAPRI METRO STATION



A.1.1.7 PROPOSED PILOT PUBLIC BICYCLE SHARING SCHEME

Further details of the PBS system are mentioned in Volume 2c of this report.

A.1.1.8 WAY FORWARD

- It is necessary to organize a Metro Samwad with residents of Khapri, New Khapri and its adjoining areas to secure feedback and gain consensus before implementing proposed initiatives.
- Approaching Mihan SEZ Authority for construction of proposed roads with integrated bicycling corridors and round-a-bouts.
- Engineering design of the subway must incorporate established MMI requirements.
- Discussion with MADC to finalize the alignment of proposed road towards the western edge of the Metro Station. The site plan is to be updated based on it prior to implementation.
- Station architect to be approached to design the physical interchange between metro station building and railway station.
- Preparation of GADs for street improvement to be commissioned by MMRCL.

A.1.2 NEW AIRPORT STATION

A.1.2.1 CONTEXT OF THE METRO STATION

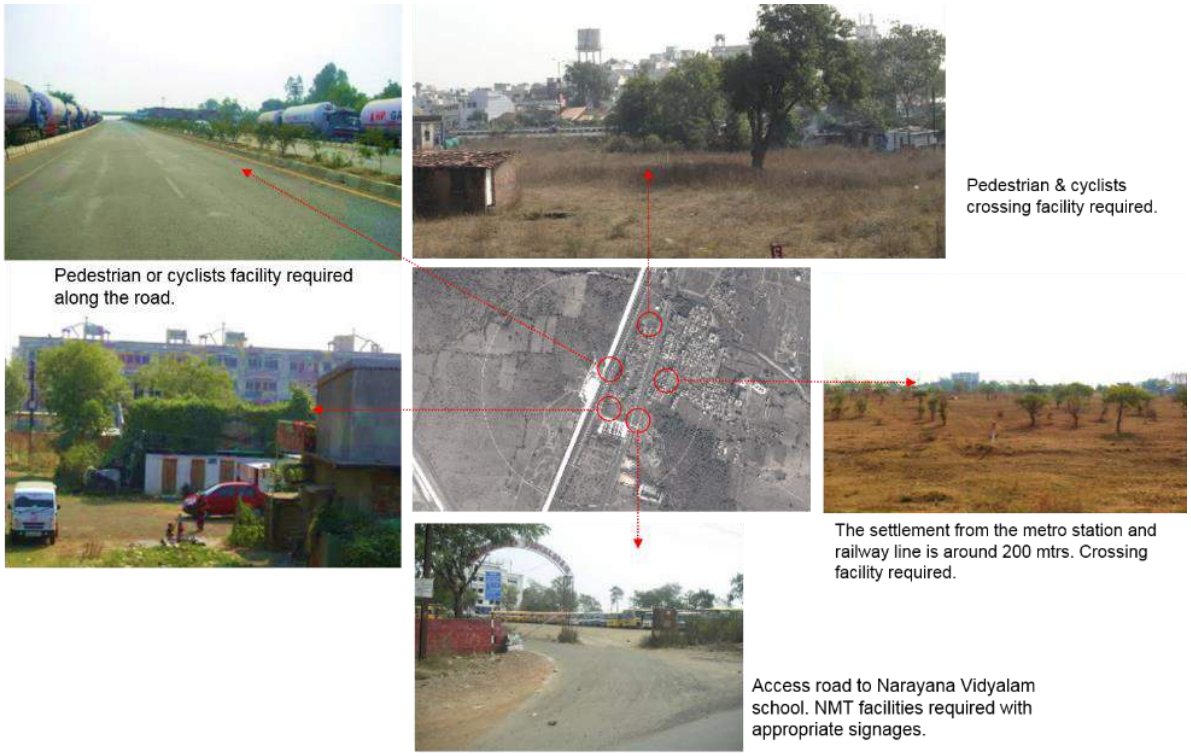
A. MIHAN- NEW AIRPORT

MADC has proposed the construction of a new airport in Nagpur.as a part of the MIHAN scheme between the existing Airport and the MIHAN SEZ. It is projected to cater to an estimated 14 million passengers and 0.87 million tons of cargo. With adequate planning it can significantly increase Metro ridership.

B. SOMALWADA, CHEENJ BHAWAN AND SHREE NAGAR AREAS

It is expected that residents of Chinch Bhawan, Somalwada and Shree Nagar would be the potential users of the New Airport. Though these areas are as of now, under developed, with functioning of the metro station and improved connectivity its densification is expected.

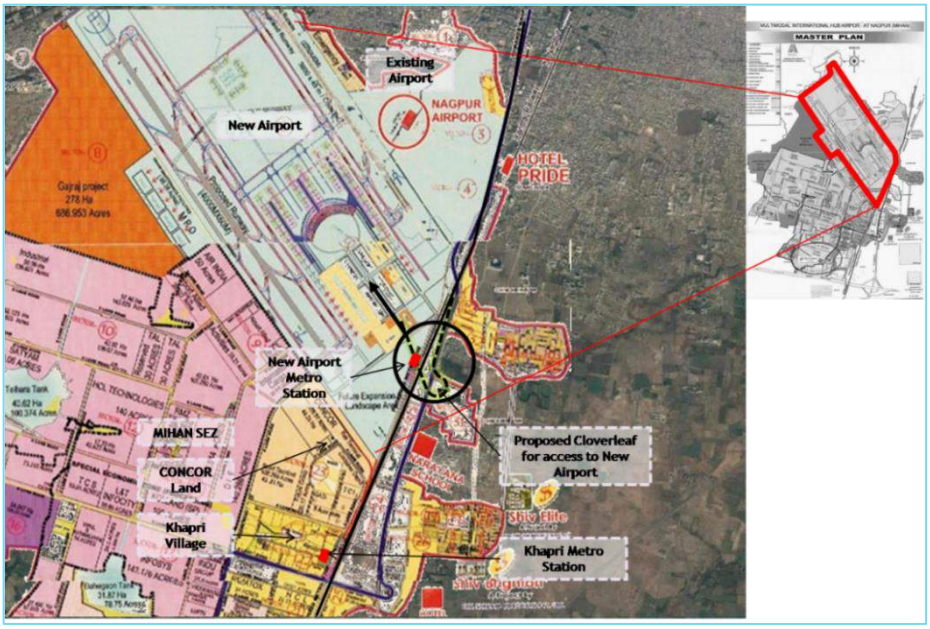
FIGURE A- 15 : NEW AIRPORT- SURROUNDING AREAS



A.1.2.2 CONNECTIVITY

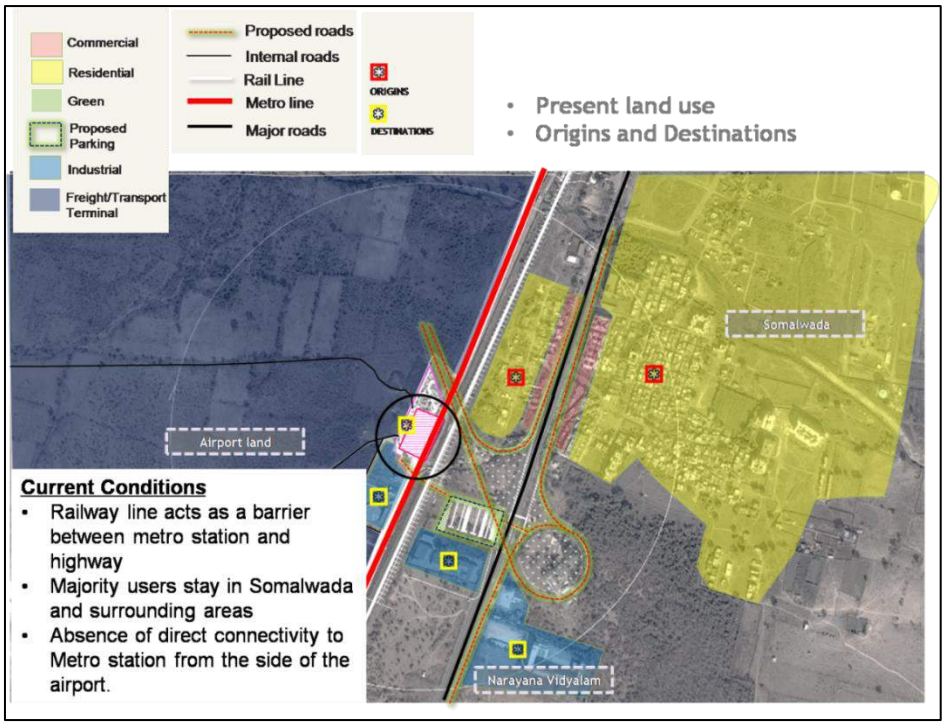
The land for the proposed airport is on the western side of the National Highway and across the railway tracks. The airport structure would be accessed by a flyover extending from the proposed cloverleaf, which originates from the National Highway (Refer Figure A- ***16***). Its integrated metro station would be 800m away from the entry.

FIGURE A- 16 : PLAN FOR THE PROPOSED NEW AIRPORT



The new airport metro station is located on western side of the Railway line. The main entry to the station through the metro parking land is located on the eastern side of the railway line and is connected with the station through a subway under the tracks. The parking site on the eastern side of the railway line is directly connected to the National Highway and its contiguous residential areas (Somalwada and Shree nagar). The latter is a large catchment of metro riders and with the New Airport; ridership is expected to rise exponentially. For it to materialize, the present layout of Airport has to be revised to render access to the metro station (now under construction). Refer Figure A- ***17***.

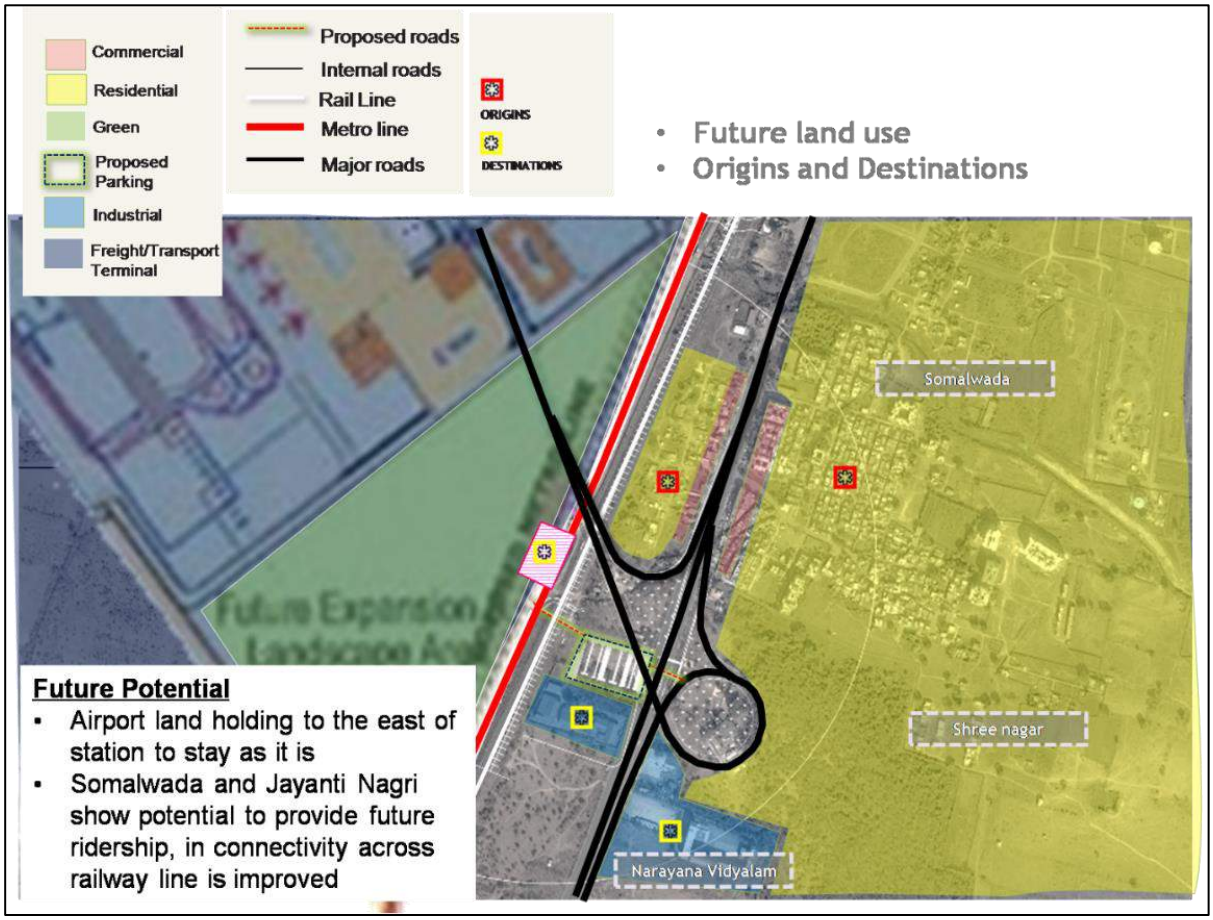
FIGURE A- 17 : CONTEXT OF THE PROPOSED NEW AIRPORT METRO STATION



Somalwada and its surrounding areas urbanized after MIHAN SEZ was established. It also resettled those villagers who were displaced when MIHAN was established. Planning is needed to ensure that the residents of Somalwada can access the New Airport Metro (nearest; now under construction) seamlessly.

Both Cheenj Bhawan and Somalwada are connected to Nagpur by the National Highway. Few buses ply on this corridor and at peak hours its travel-time is time consuming. With the operationalization of Nagpur metro, it is expected that the travel time between Cheenj Bhawan, Somalwada and other areas to its surrounding will decrease and which would subsequently encourage further development.

FIGURE A- 18 : FUTURE DEVELOPMENT POTENTIAL AROUND THE STATION



The area between existing Railway line and National Highway is divided into large land parcels, some of which are encroached by residents. With construction of the Metro Station and New Airport, this land parcel and its surrounding area would become prime area. It is expected that this area would have a high demand for commercial and hospitality complexes and will benefit from the TOD Policy of Nagpur.

The New Airport metro station is surrounded by land parcels identified for 'Future Expansion, Landscape Area' in the Master Plan of MIHAN. At present, there is no road (existing or proposed) connecting it to the National Highway or the Airport and requires to be planned keeping connectivity from Somalwada and Shreenagar in focus.

A.1.2.3 PARKING AND DROP OFF REQUIREMENTS

TABLE A- 2: PARKING, PICK & DROP BAYS REQUIRED NEAR NEW AIRPORT STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement					
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	5474	602	Car	5	34.3	40.1	2	3	16	25
2041	9614	1057	TW	8	256.4	299.5	4	6	25	44
			Auto/ Mini Van	12	119.2	139.2	3	5	-	-
			Mini Bus	53	65.6	76.6	3	4	-	-

A.1.2.4 SUMMARY OF ISSUES

1. Lack of direct connection between proposed metro station and surrounding residential areas due to existing Railway line for that accessing station on-foot or by vehicle. Parking facilities are planned adjoining the National Highway and not near the metro station.
2. Metro Station lacks road connectivity.
3. Lack of planned access of proposed New Airport from its metro station.
4. Lack of planned pedestrian crossing facility across the national highway for residents of Cheenj Bhawan, Somalwada and Shree Nagar area.
5. Lack of structured plan to encourage use of metro feeder, walking and cycling facilities to access the metro station instead of private vehicles

A.1.2.5 PROPOSALS

A. CONNECTIVITY PROPOSALS

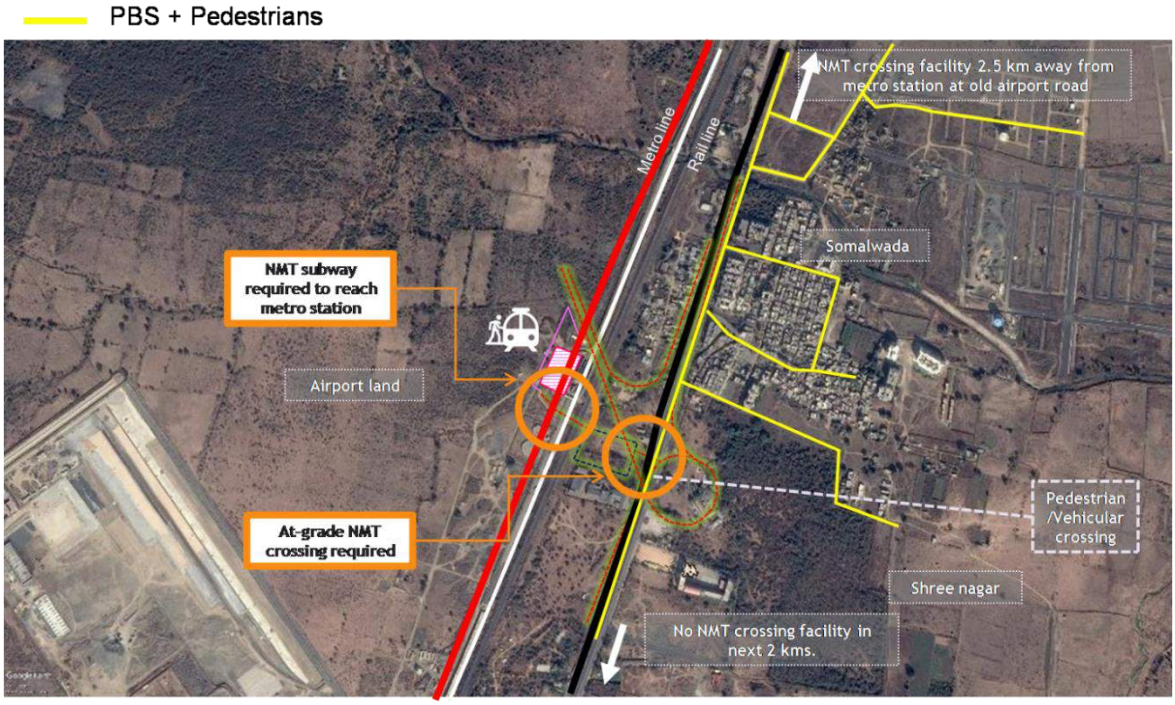
The station and area connectivity proposals are categorized into those that are NMT based and those for Vehicular connections.

Proposed NMT Connectivity

Following two NMT connectivity is required (Refer Figure A- ***19***):

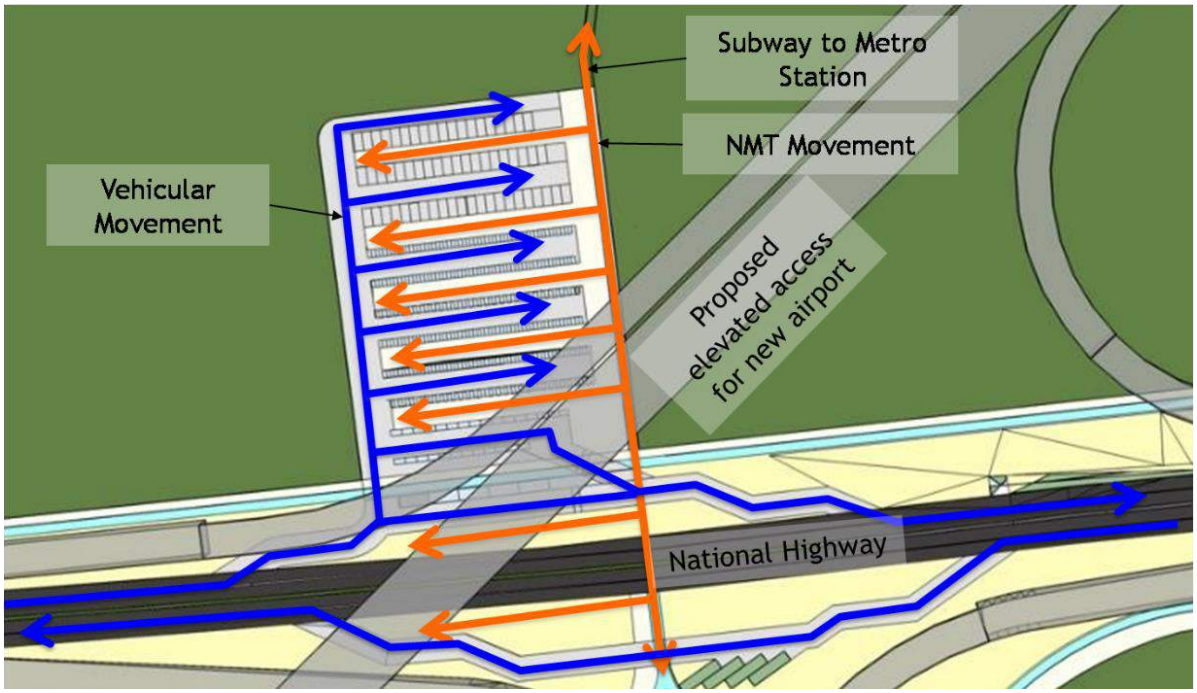
1. NMT at-grade crossing facility near the national Highway.
2. NMT subway across the existing railway station and the at-grade metro tracks to reach the metro station.

FIGURE A- 19: PROPOSED NMT CONNECTIVITY TO THE NEW AIRPORT STATION



The connection between National Highway, proposed parking, and metro station must give pedestrians priority. To avert conflict between pedestrian and vehicles at the parking area, vehicular and NMT movement have been segregated into separate spines. Refer Figure A- *20* for the proposed conceptual NMT and vehicular movement pattern around metro parking facility.

FIGURE A- 20 : CONCEPTUAL NMT AND VEHICULAR MOVEMENT AROUND METRO PARKING



<u>Proposed Vehicular access to the Metro Station</u>

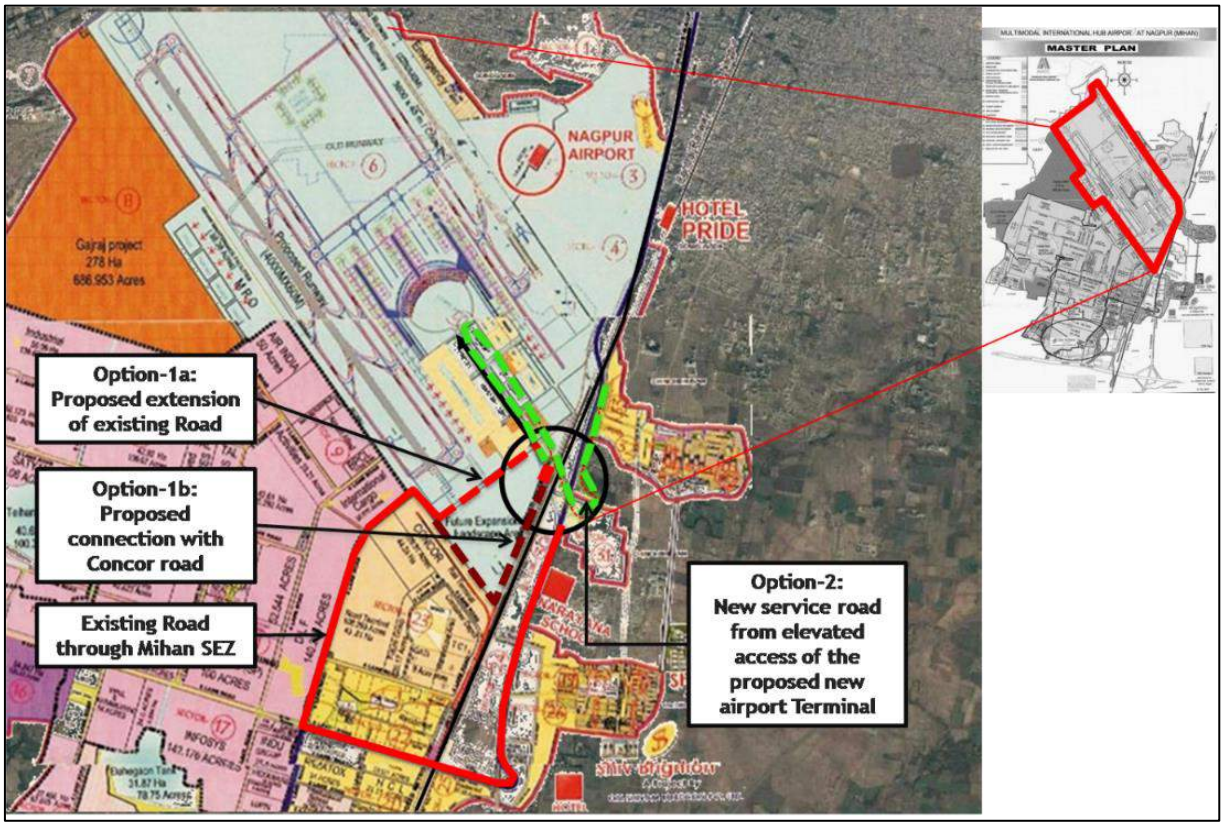
Following four options for Road connectivity to the Metro Station are proposed (refer Figure A- ***21***):

1a. Extension of the existing road from MIHAN SEZ.

1b. Extension of the Concor road along the side of Metro Track

2. New Service Road to be accessed from the proposed elevated access to the New Airport

FIGURE A- 21 : PROPOSED OPTIONS FOR ROAD CONNECTIVITY TO NEW AIRPORT METRO STATION

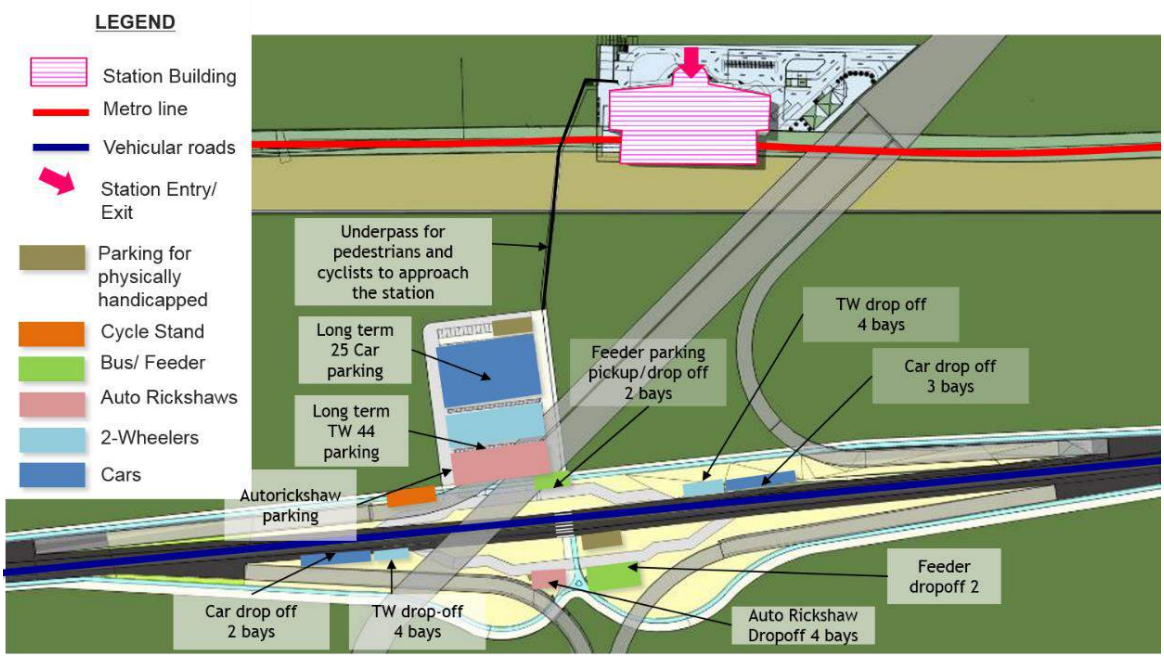


B. CONCEPT LOCATION OF PICK & DROP, PARKING FACILITIES

Proposed parking, pick-and-drop facility for the metro station is planned considering the mode-wise priority for access to the station. The parking bays for vehicles for the disabled are located closest to the entry point of the NMT subway whereas, feeder parking, bicycle docking stations/ parking and autorickshaw parking are located closer to the National Highway. The long-term 2-wheeler and 4-wheeler parking facilities are located away from the National Highway.

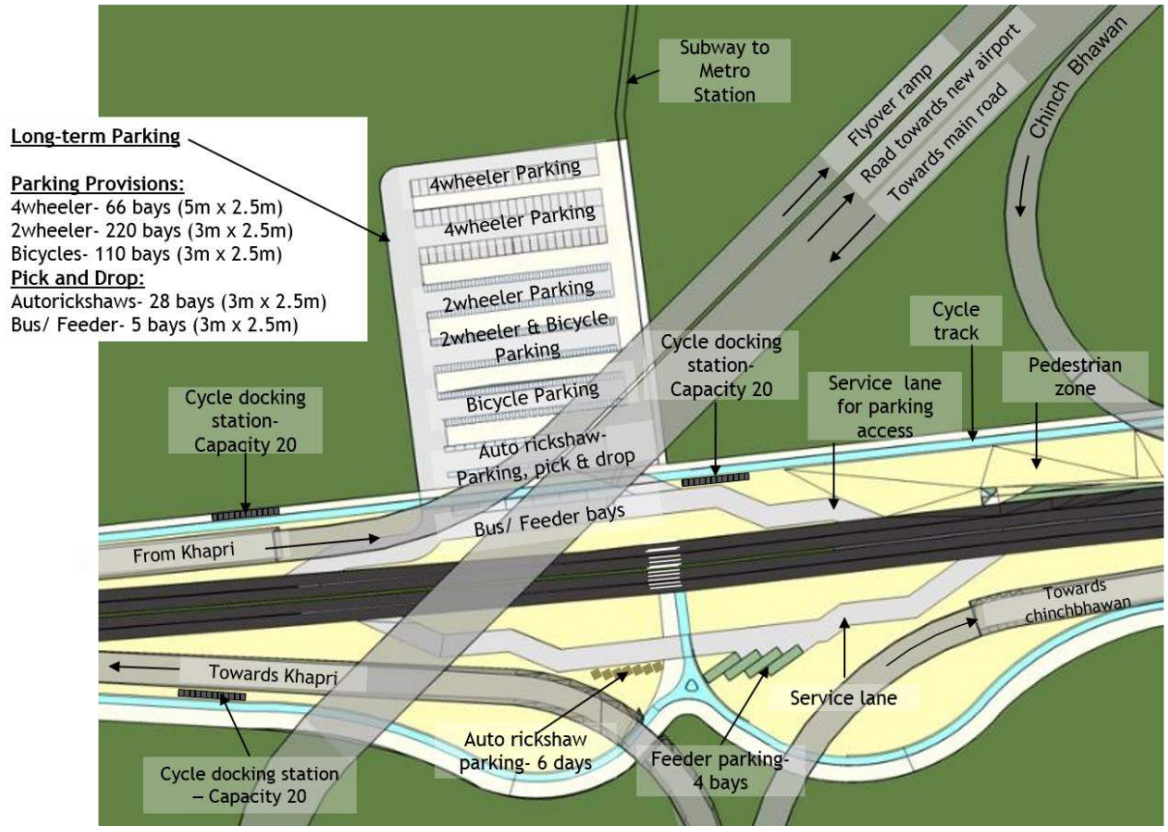
The proposed locations of parking facilities and pick-and-drop bays for proposed New Airport station is shown in Figure A- **22**.

FIGURE A- 22 : CONCEPTUAL LOCATION OF PICK & DROP, PARKING FACILITIES



The details of parking pick and drop facility for the metro station is shown in Figure A- *23* below.

FIGURE A- 23 : CONCEPT LOCATION OF PICK AND DROP FACILITIES



A.1.2.6 SUGGESTED WAY FORWARD

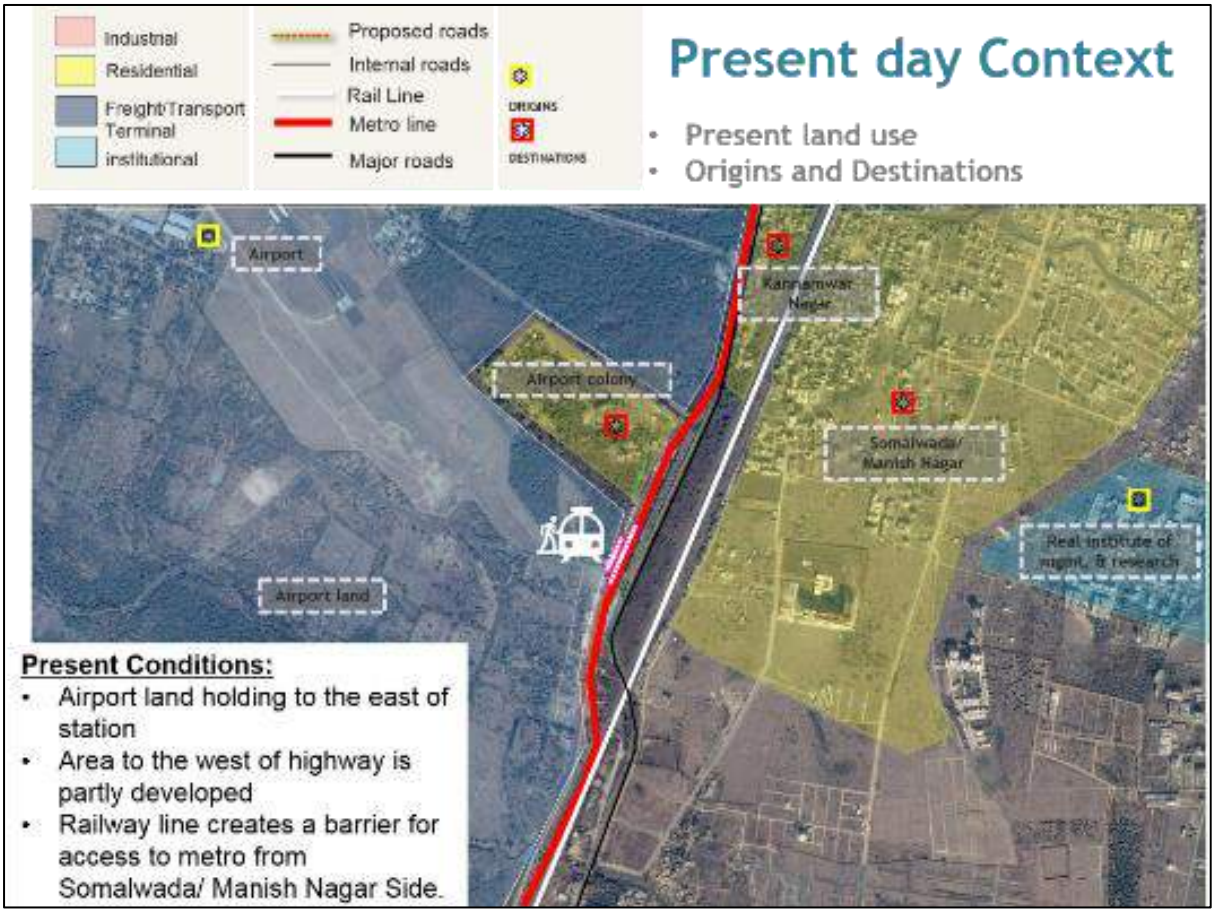
- The proposed plan for Metro Parking area is to be revised to incorporate MMI principles.
- Discussion with MADC to finalize proposals for alternate road connectivity to metro station from the New Airport.
- Discussion with MADC, Traffic Police and Nagpur Municipal Corporation to finalize the proposal for signalized interchange nodes across National Highway along
- Initiation of Metro Samwaad with schools like Narayanan Vidyalam and residents of the area.

A.1.3 SOUTH AIRPORT STATION

A.1.3.1 SITE CONTEXT

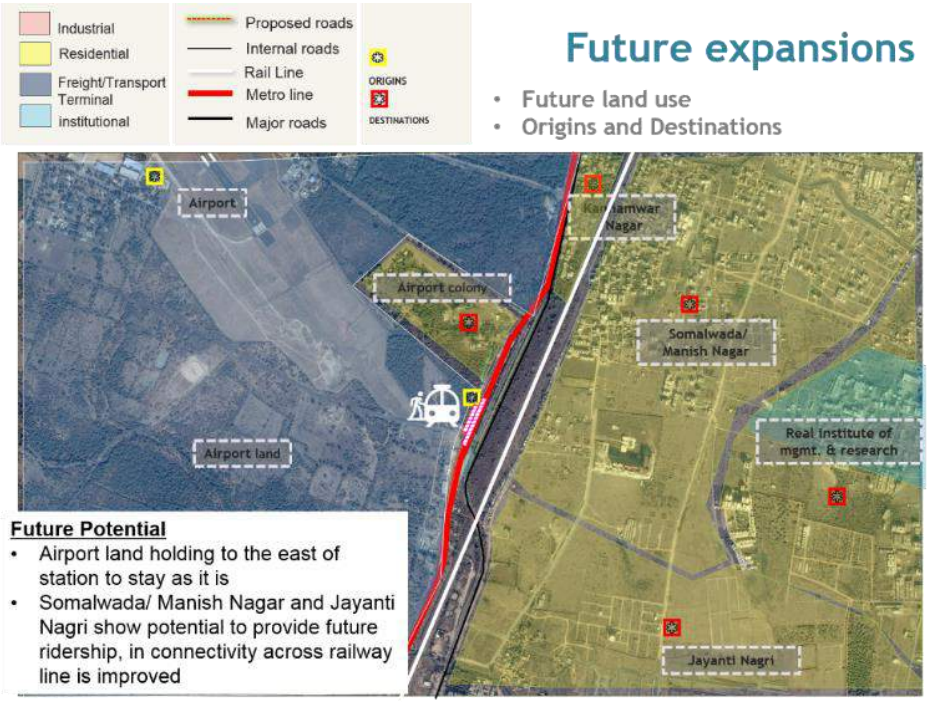
The South Airport Station is at the northern end of Cheenj Bhawan Flyover and to the south of the Airport Station. It is adjoining the National Highway near an uninhabited land parcel owned by Airport Authority. On the eastern side of the station and across the railway line are Somalwada, Manish Nagar and Jayanti Nagri that will provide future ridership. Refer Figure A- ***24***.

FIGURE A- 24 : SOUTH AIRPORT STATION IMMEDIATE CONTEXT



The areas of Somalwada, Manish Nagar and Jagriti Nagar are at present under-developed and are not connected with the South Airport Station. If directly connected with the metro station these areas and its surrounding have potential to develop exponentially. This would require providing a shorter access to the metro station across the railway line.

FIGURE A- 25 : SOUTH AIRPORT STATION FUTURE DEVELOPMENT POTENTIAL

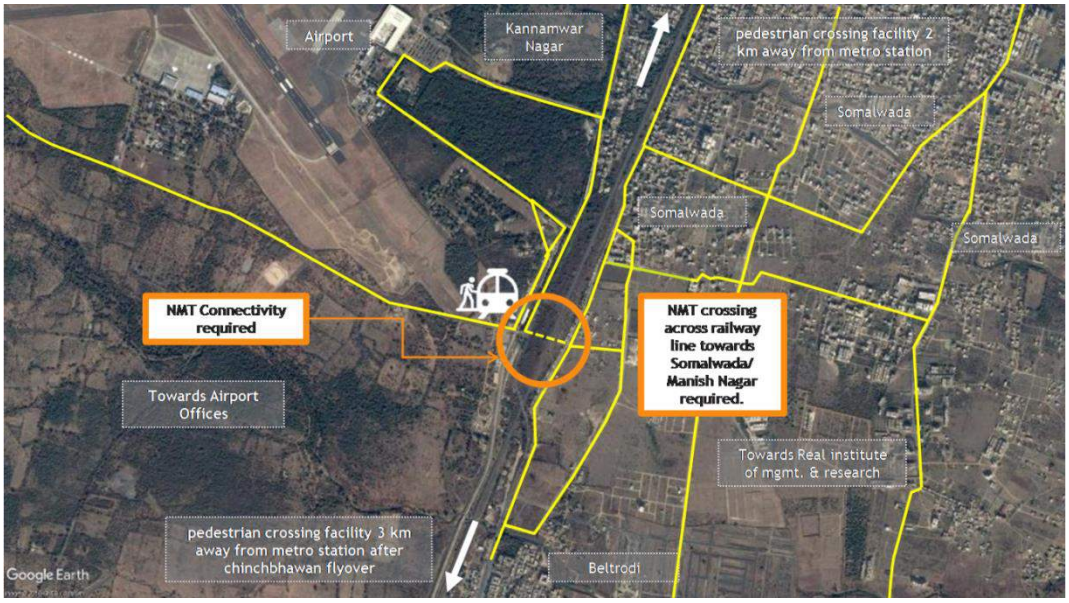


A.1.3.2 CONNECTIVITY ISSUES

A. NMT CONNECTIVITY

The areas of Somalwada, Manish Nagar and Jagriti Nagar are accessible from either Ujwal Nagar ROB or from the southern access of the metro station near Cheenj Bhawan, which are more than a kilometer away from South Metro Station. This distance can be covered by feeders but unviable for NMT users. To encourage use of NMT, a shorter route cross the railway line needs to be provided to access the metro station. Refer Figure A- ***26***.

FIGURE A- 26 : CONNECTIVITY ISSUES AROUND THE METRO STATION



The metro track of South Airport Station would decent from the Cargo Terminal Road to the Station. At the station and till the new Airport Metro station, the tracks will run at-grade, parallel to the railway line. This will block the Alternate Rood to MIHAN SEZ which meets National Highway near Cheenj Bhawan. In lieu of it, a bye-pass road will connect the Cargo Terminal Road and the Alternate road to MIHAN and restore its connectivity with the National Highway.

Another flyover parallel to Cheenj Bhawan flyover is under construction to provide additional lanes to the latter Refer . The same will affect the available space in front of the metro station necessitating re-alignment of road geometry and the median.

FIGURE A- 27 : PROPOSED PARALLEL FLYOVER NEAR CHEENJ BHAWAN FLYOVER

A.1.3.3 PICK & DROP, PARKING REQUIREMENT

The Metro boarding alighting figures for South Airport station is not available, as the station was conceptualized after the preparation of DPR for Nagpur Metro. In lieu of a comprehensive study, boarding/ alighting information for the Station, the pick and drop, parking requirements for the station have been generated by aggregating and considering the average values of Airport Station and New Airport Station.

TABLE A- 3: PARKING, PICK & DROP BAYS REQUIRED NEAR SOUTH AIRPORT STATION

Mode	Parking, Pick & Drop Bays Requirement			
	Drop off requirement		Parking Requirement	
	2016	2041	2016	2041
Car	2	3	16	25
TW	4	6	25	44
Auto/ Mini Van	3	5	-	-
Mini Bus	3	4	-	-

A.1.3.4 ROAD CONDITION

The footpaths on either side of the station are either unavailable or unusable. The condition will require the road space to be designed ensuring enhanced accessibility for users coming from Somalwada and Ujwal Nagar. Refer Figure A- ***28***

FIGURE A- 28 : CONDITION OF ROADS AROUND SOUTH AIRPORT METRO STATION

Pride hotel square. Entry to airport, dedicated lanes for cyclists and pedestrians required.

Encroachment of footpath by cars

Street edges need to be designed. Road space need to be organised

No Crossing available within 2 km from airport

A.1.3.5 SUMMARY OF ISSUES

1. Lack of and hindered NMT connectivity across the Railway line towards Somalwada/ Manish Nagar.
2. Absence of at-grade signalized crossing in front of the metro station to facilitate NMT crossover.

A.1.3.6 PROPOSALS

The proposals for connectivity improvements around South Airport Station are (Refer Figure A- ***29*** & Figure A- ***30***):

1. It is proposed that only NMT (pedestrian and cyclist) connectivity can be availed to the station from Somalwada/ Manish Nagar. It has three parts:
    a. At-grade crossing infront of the metro station.
    b. Walkway and cycle track through the railway's land upto the proposed underground subway across the railway line
    c. Subway across the railway line with NMT interchange facilities on either side.
2. In order to ensure that the NMT connectivity across the railway's land is safe and accessible, public space (with parks, plazas, temporary exhibition space, vending kiosks, etc) is proposed.

FIGURE A- 29 : PROPOSALS FOR CONNECTIVITY IMPROVEMENTS AROUND SOUTH AIRPORT STATION

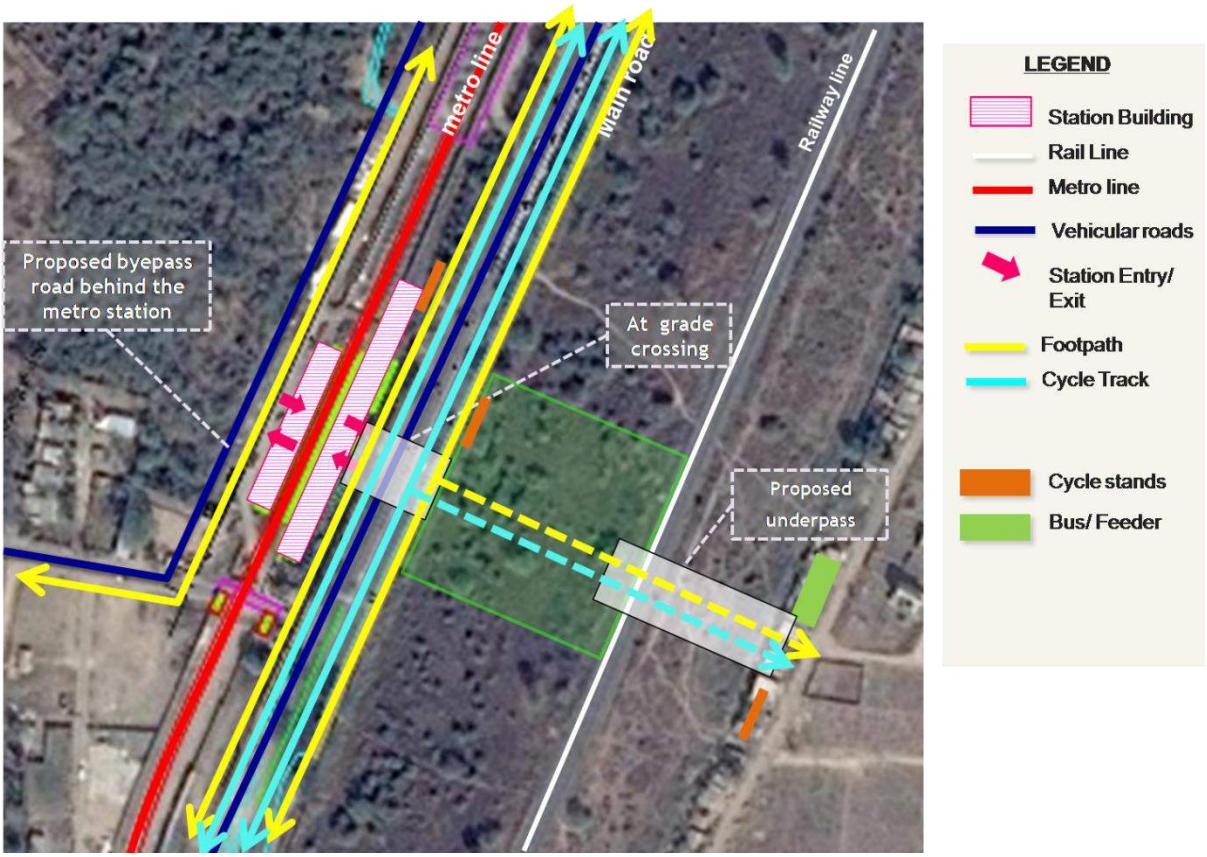
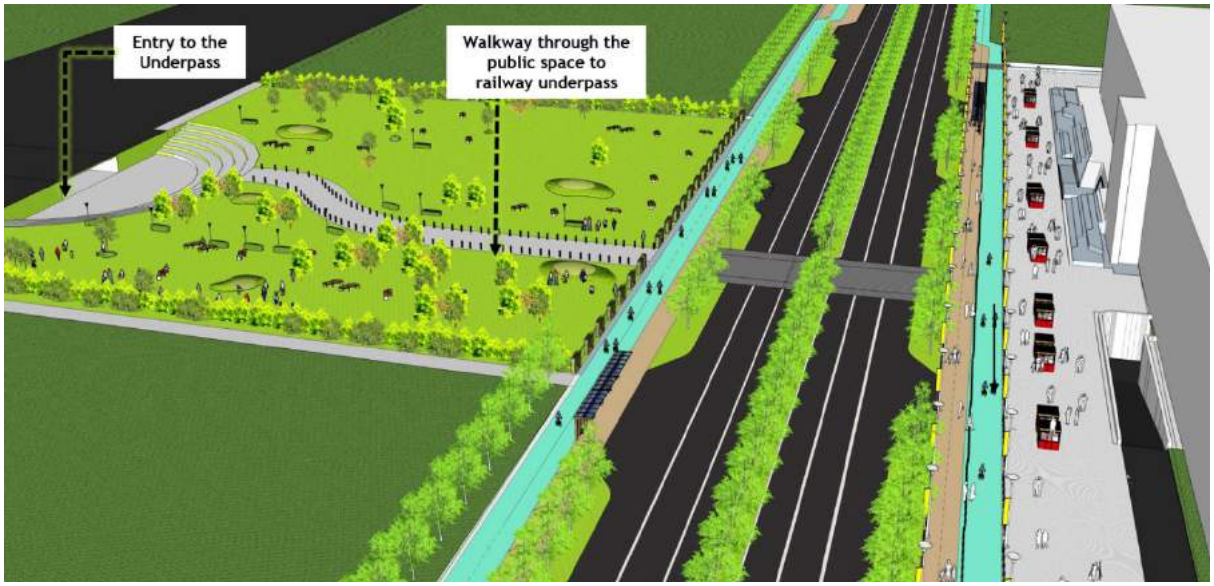


FIGURE A- 30 : GRAPHICAL ILLUSTRATION FOR IMPROVING CONNECTIVITY



The edges of National Highway near the metro station area are to be designed to accommodate short-term pick and drop facilities, footpaths, cycle tracks, proposed public space, proposed NMT connection and the NT subway to connect Somalwada/ Manish Nagar. Figure A- ***31*** shows the Concept proposal for same.

FIGURE A- 31 : CONCEPT PROPOSAL FOR MULTI MODAL INTEGRATION AROUND METRO STATION AREA

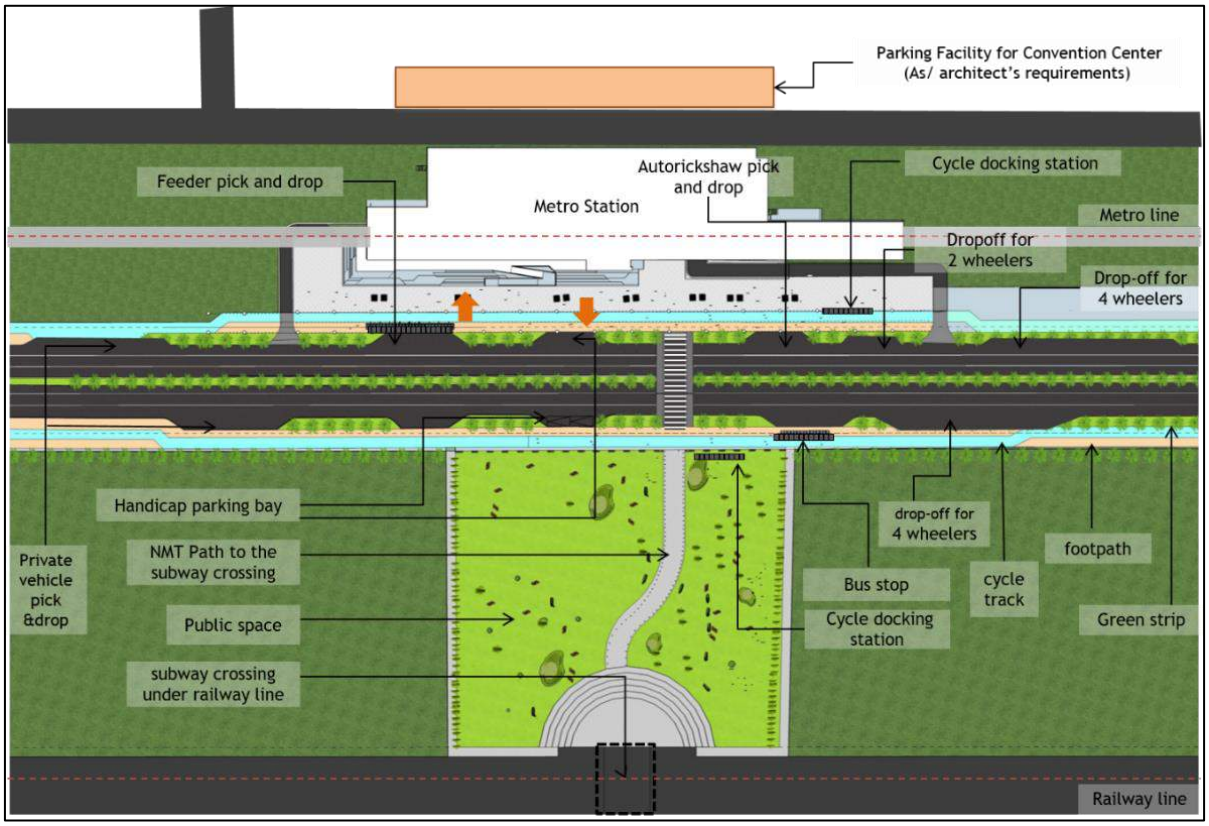
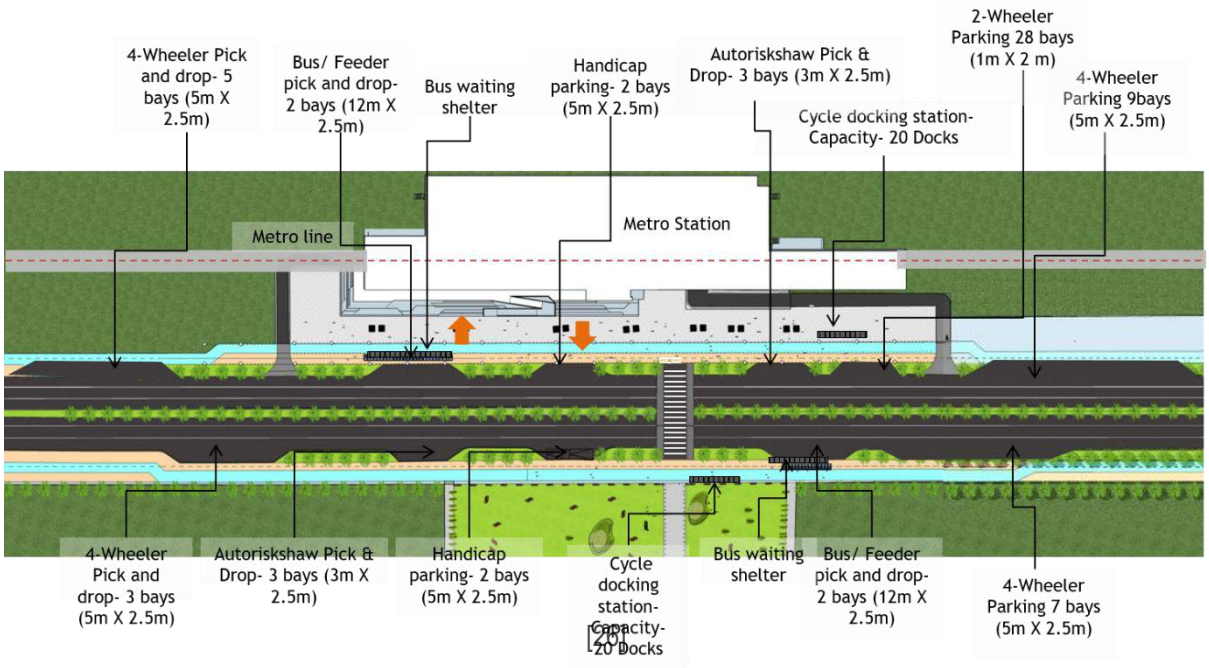


Figure A- ***32*** shows the detailed proposal for locating pick and drop facilities around South Station. An additional space of 792 Sqm is required for long term parking of 25 cars and 44 two wheelers.

FIGURE A- 32 : DETAILED REQURIEMENTS FOR PICK AND DROP FACILTIES



The proposed public space across the metro station can be taken up as a pilot area for place making. Following are the broad principles for place making:

1. The Public space must instill a sense of pride in the residents of Somalwada and Manish Nagar and encourage use of Metro, PT and NMT.
2. Creation of active zones in the form of exhibition/ trade grounds with food plazas, etc. to create an active and safe public space.
3. Opportunity for creation of landmark entry to Somalwada and Manish Nagar, thereby encouraging development in the area, which in-turn would boost metro ridership.
4. Create opportunity of revenue generation for NMRCL, NMC and Railways.

A.1.3.7 WAY FORWARD

The proposals for Multi Modal Integration and Place making is categorized into two zones. Refer Figure A- ***33***

Zone 1:

- The MMI suggestions is to be incorporated in the Site Plans of the Metro Stations
- Conceptual Design Drawings to be shared with the architects for detailing and preparation of implementation drawings

Zone 2:

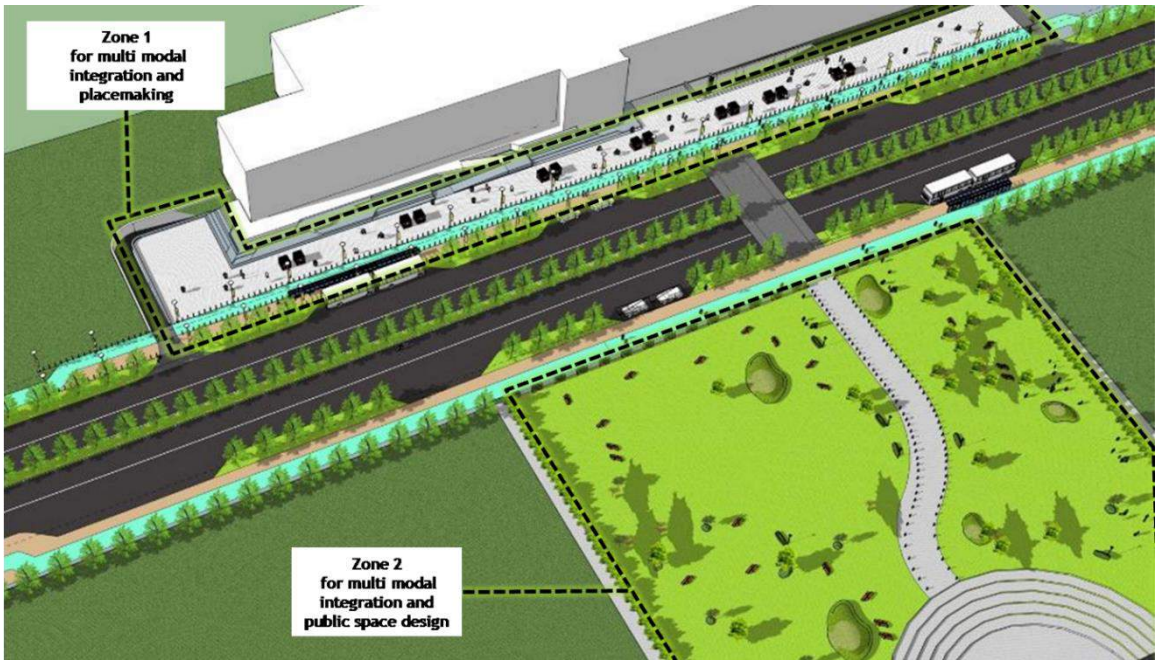
Step-1

- The Nagpur Municipal Corporation and railways to be approached for participation.
- Land for Public Park to be shared by the railways.
- The underpass to be constructed by Nagpur Municipal Corporation
- The public space (exhibition ground/ activity zone) to be developed by NMRCL and maintained by NMC.
- Metro Samwad to be conducted with residents of Somalwada/ Manish Nagar

Step-2

- Consultant to be appointed for preparation of detail design and implementation drawings.

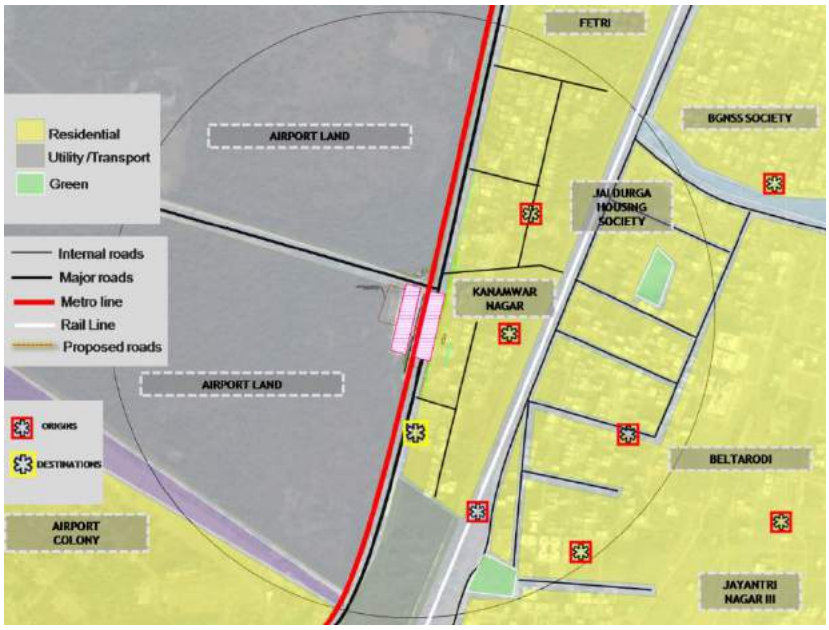
FIGURE A- 33 : MULTI MODAL INTEGRATION AND PLACE MAKING PACKAGES



A.1.4 AIRPORT STATION

Airport station lies between South Airport and Ujwal Nagar metro stations and is to be used to access the existing airport of Nagpur. It is surrounded by residential areas on either side of the metro alignment.

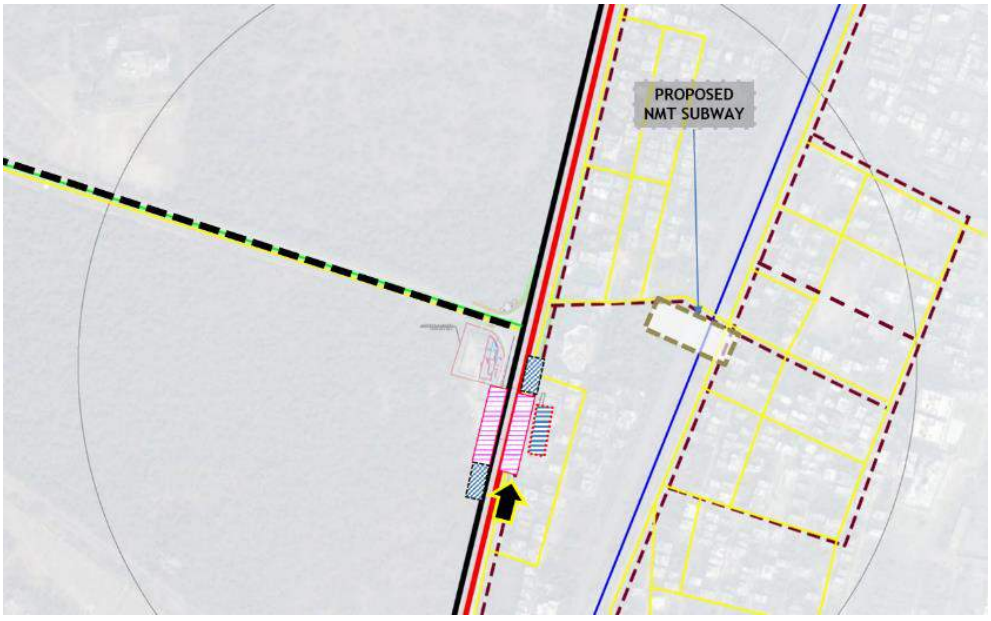
FIGURE A- 34 : AIRPORT METRO STATION CONTEXT



A.1.4.1 CONNECTIVITY REQUIREMENTS

Near Airport station, NMT connectivity is required from Kannamwar nagar towards the metro station. This will require construction of an underground subway to cross the railway line.

FIGURE A- 35 : NMT CONNECTIVITY REQUIRED



A.1.4.2 PICK AND DROP, PARKING REQUIREMENTS

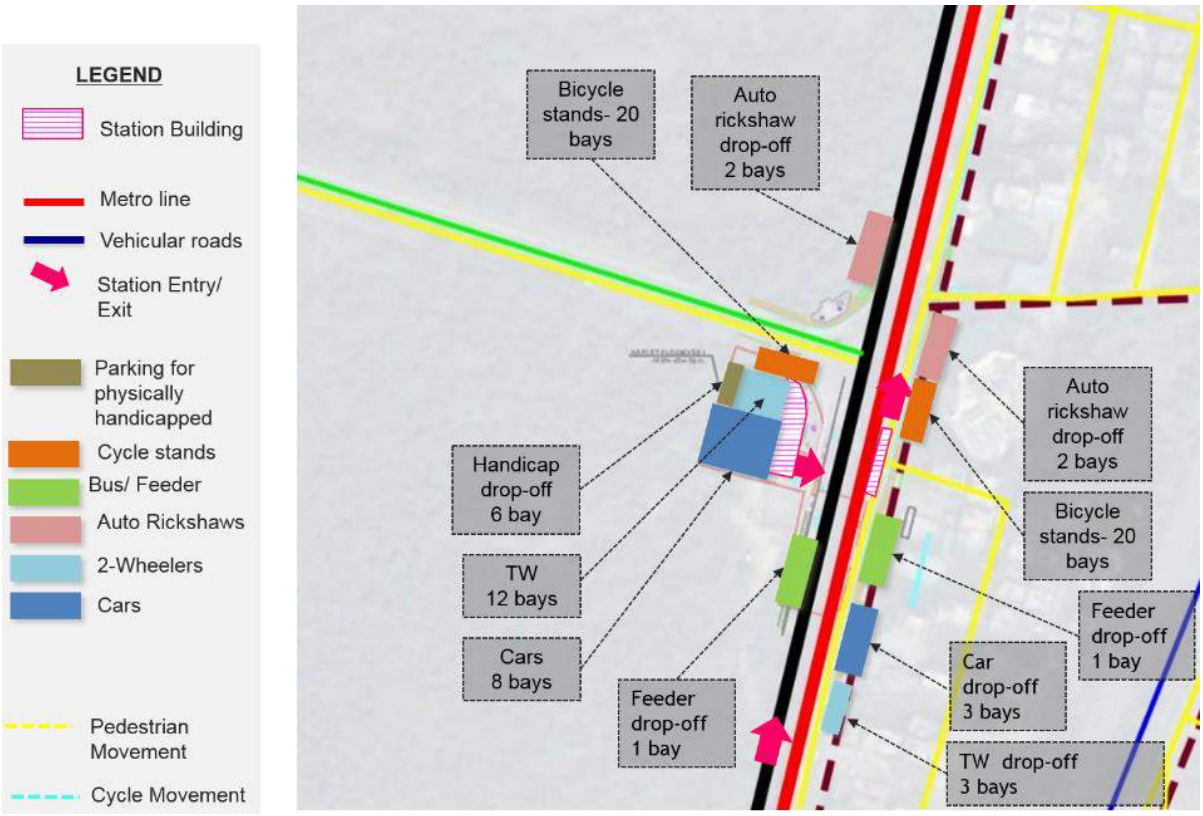
TABLE A- 4: PARKING, PICK & DROP BAYS REQUIRED NEAR AIRPORT STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	1700	185	Car	5	9	15	2	3	5	8
2041	2634	287	TW	8	15	23	3	3	8	12
			Auto/ Mini Van	12	22	34	2	2	-	-
			Mini Bus	53	98	152	2	2	-	-

A.1.4.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

The Conceptual location for pick-and-drop facilities and long term parking around airport station as per Conceptual plan is shown in Figure A- ***36***.

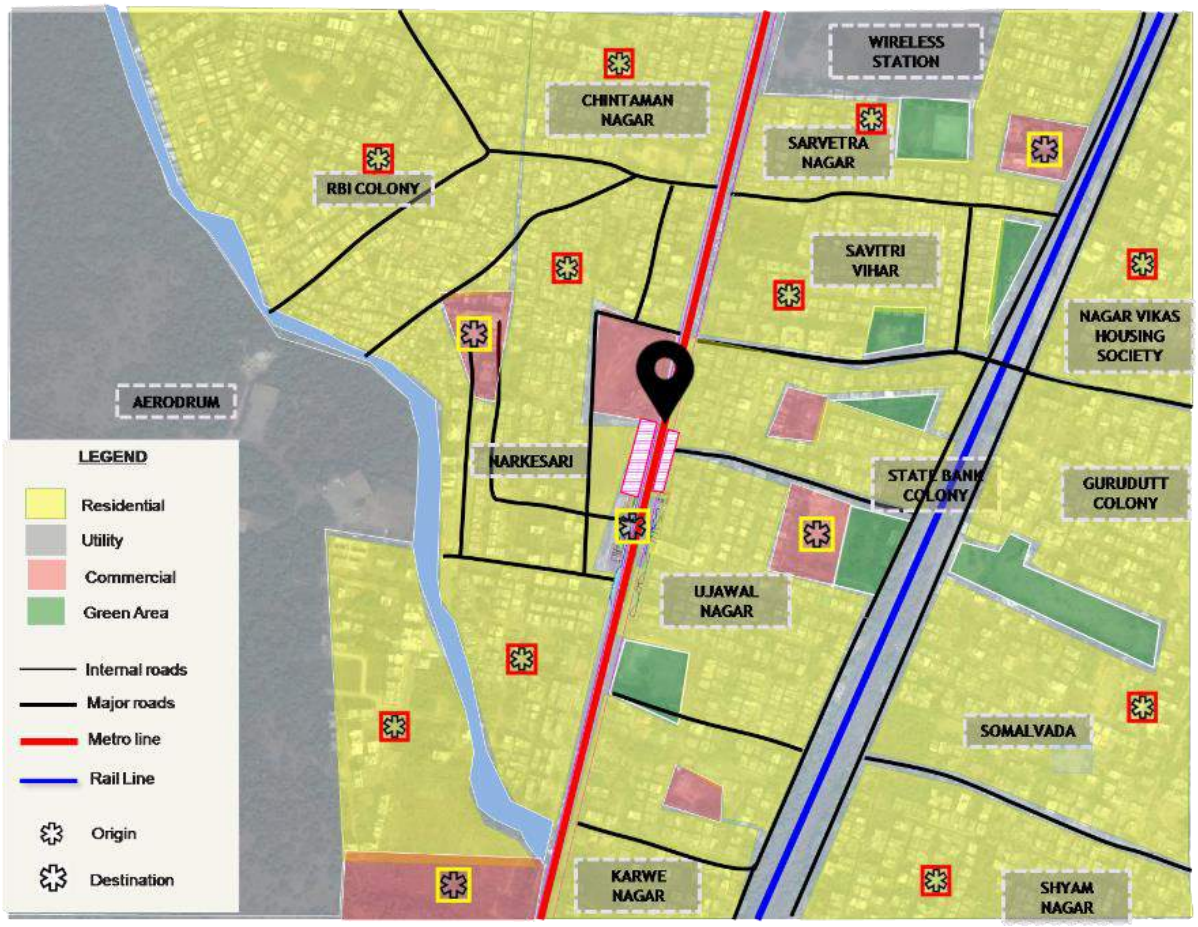
FIGURE A- 36 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND AIRPORT STATION



A.1.5 UJWAL NAGAR

The principle land use around Ujwal nagar metro station is residential with mixed use street frontages. Refer

FIGURE A- 37 : CONTEXT FOR UJWAL NAGAR METRO STATION

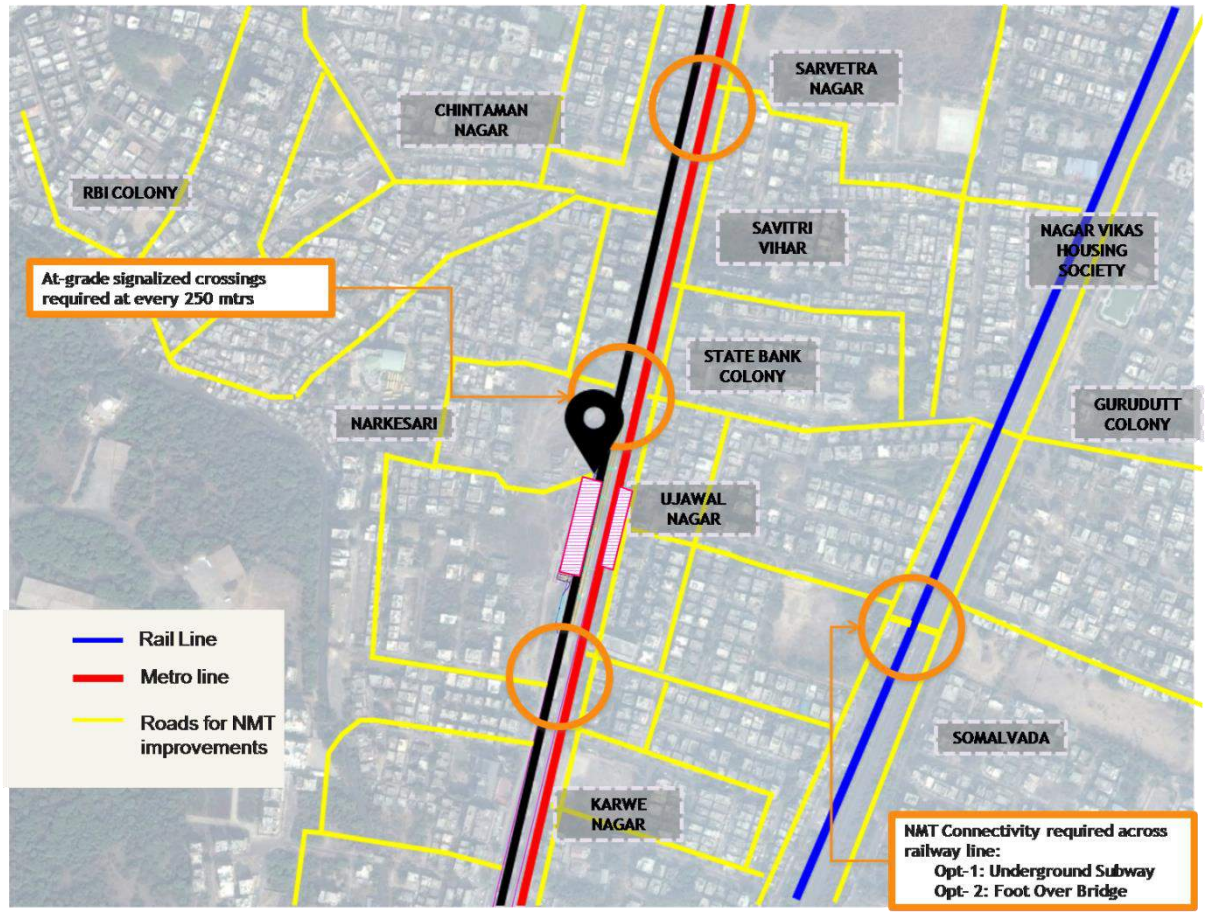


A.1.5.1 CONNECTIVITY ISSUES

The access road for Somalwada/ Manish Nagar meets the main metro corridor at a distance of approximately 100m north of the station. While residents of Savitri Vihar, Sarvetra Nagar, Ujwal Nagar etc. can directly access the Metro corridor, those from Manish Nagar have to use the railway level-crossing near Nagar Vikas Housing Society.

To facilitate NMT connectivity, a signalized junction with NMT priority needs to be provided on the road connecting Somalwada to the existing Airport. Additionally a NMT-only crossing is also required to connect Ujwal Nagar to Somalwada to reduce walking and cycling distance for residents of Somalwada/ Manish Nagar. Refer Figure A- ***38***

FIGURE A- 38 : NMT CONNECTIVITY PROPOSALS FOR UJWAL NAGAR



A.1.5.2 PICK AND DROP, PARKING REQUIREMENTS

TABLE A- 5: PARKING, PICK & DROP BAYS REQUIRED NEAR UJWAL NAGAR STATION

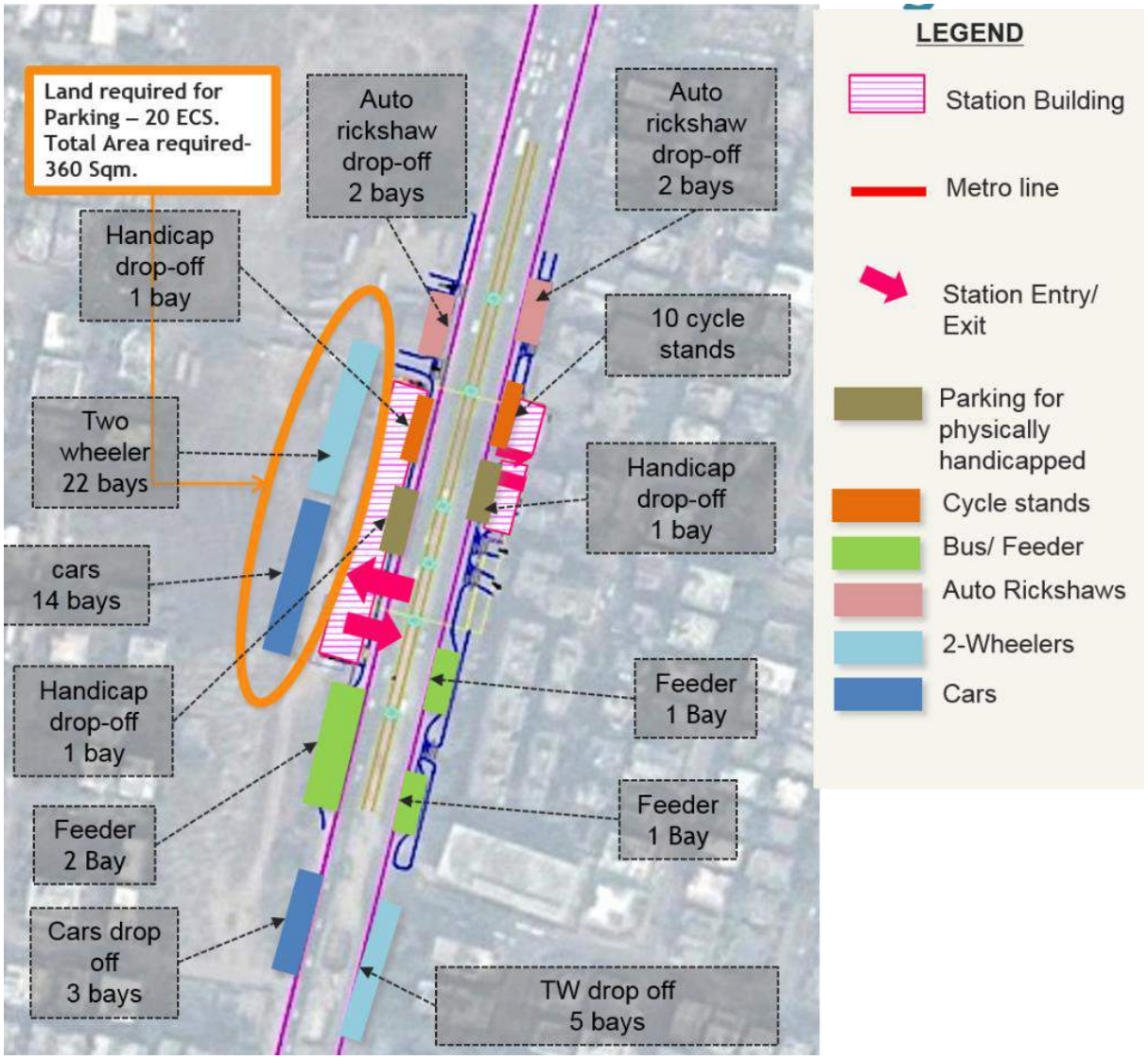
Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	3041	332	Car	5	152	239	3	3	9	14
2041	4761	519	TW	8	243	381	3	5	14	22
			Auto/ Mini Van	12	365	571	2	3	-	-
			Mini Bus	53	1612	2523	2	2	-	-

A.1.5.3 CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING FACILITIES

Figure A- *39* show a number of pick-and-drop points for different modes of transport at the metro stations. The existing road space along the main metro corridor will be managed to accommodate bays for all modes. Over

and above it, additional space (360 Sqm) is necessary for long term parking of 22 two-wheelers and 14-four wheelers is required near the Metro station.

FIGURE A- 39 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITIES AROUND UJWAL NAGAR STATION

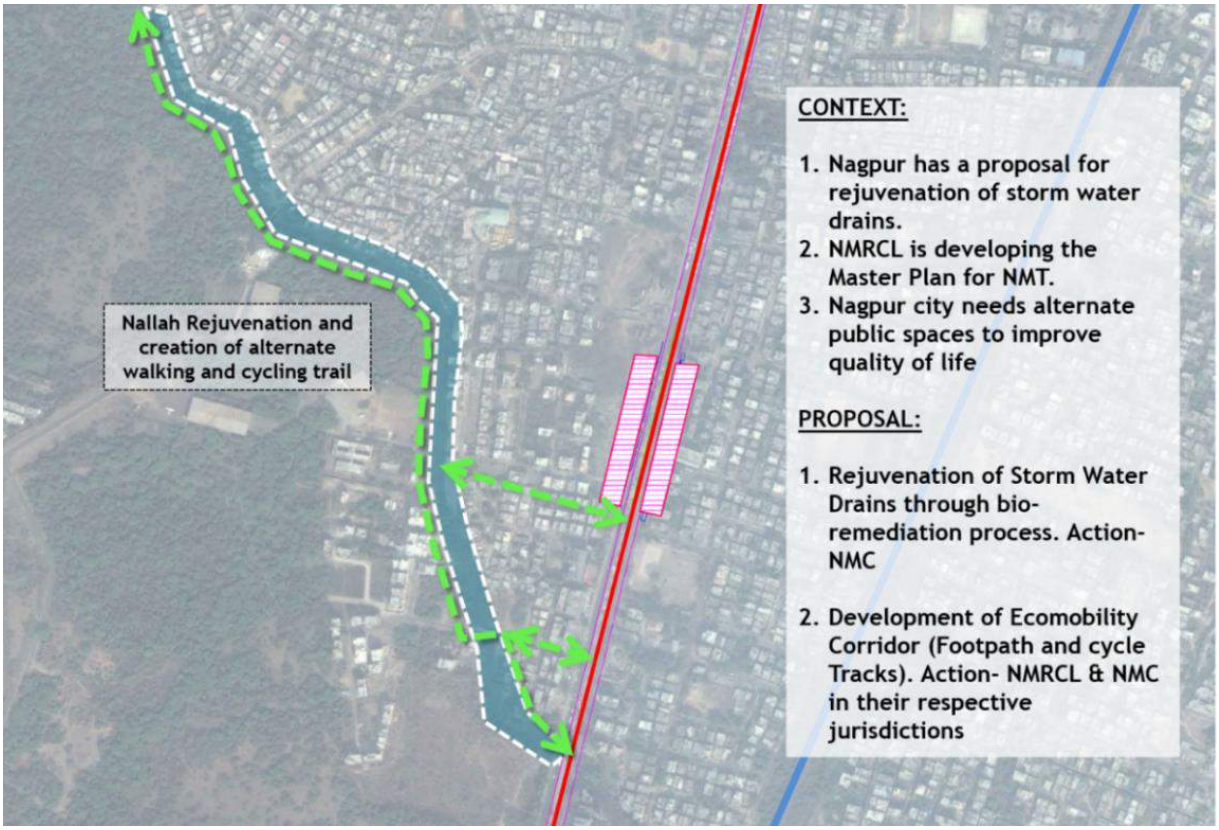


A.1.5.4 CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING FACILITIES

The canal along the west of the metro corridor of the airport land is has potential for creating an alternative stretch for walking and bicycling. It is proposed for a pilot case for urban Place Making. Refer Figure A- ***40***.

The scheme for urban place making is in Appendix-B.

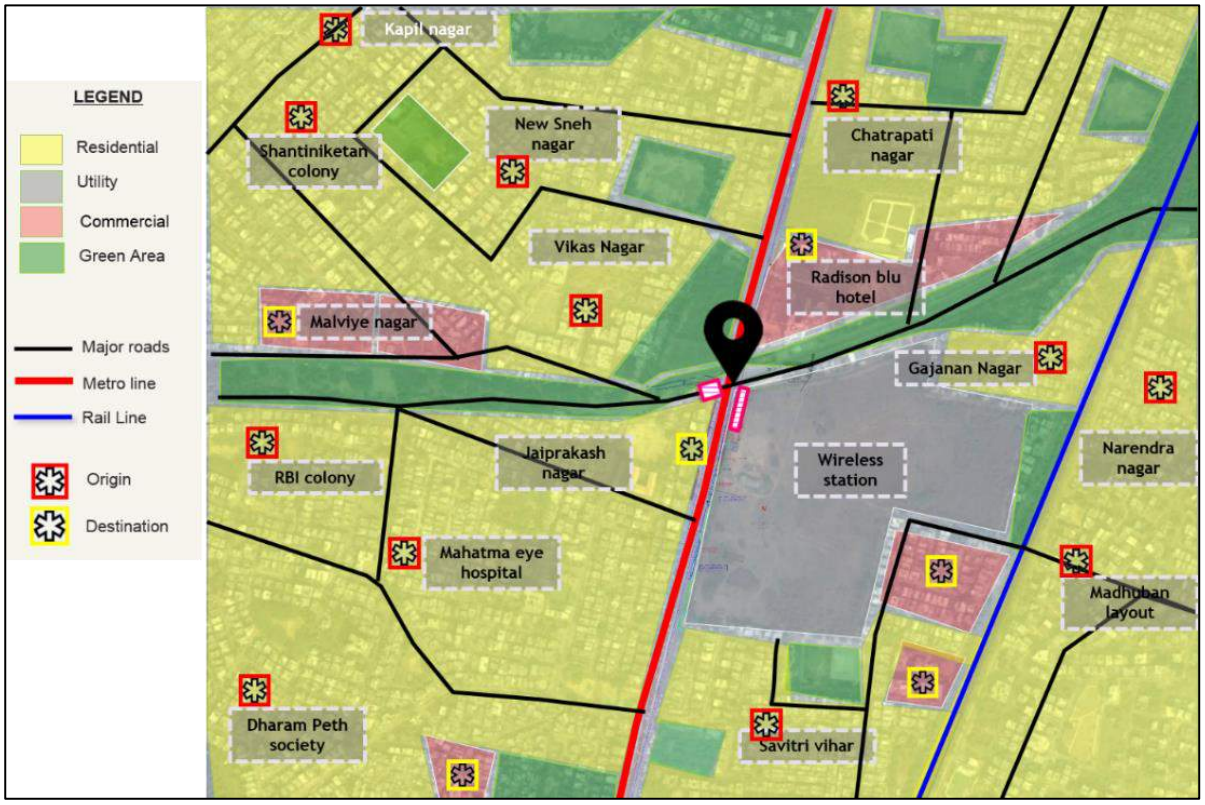
FIGURE A- 40 : PROPOSED AREA FOR URBAN PLACE MAKING NEAR UJWAL NAGAR METRO STATION



A.1.6 JAIPRAKASH NAGAR

Jaiprakash nagar metro station is located in a predominantly residential area like Jaiprakash nagar, Gajanan Nagar, Vikas Nagar. The metro station on the eastern side of the Wardha Road is on the land owned by Airport Authority for a wireless station while that of the western exit is a part of a defunct railway line and on railway property. Both the exits are close to the Radisson Hotel junction.

FIGURE A- 41 : CONTEXT OF THE JAIPRAKASH NAGAR STATION



A.1.6.1 CONNECTIVITY REQUIREMENTS

The street grid near Jaiprakash nagar connects Wardha Road at regular intervals of about 200-250m. These junctions are proposed to be retained, signalized and provided with traffic calming measures. Refer Figure A- ***42***

FIGURE A- 42 : CONNECTIVITY IMPROVEMENTS NEAR JAIPRAKASH NAGAR

A.1.6.2 PICK AND DROP, PARKING REQUIREMENTS

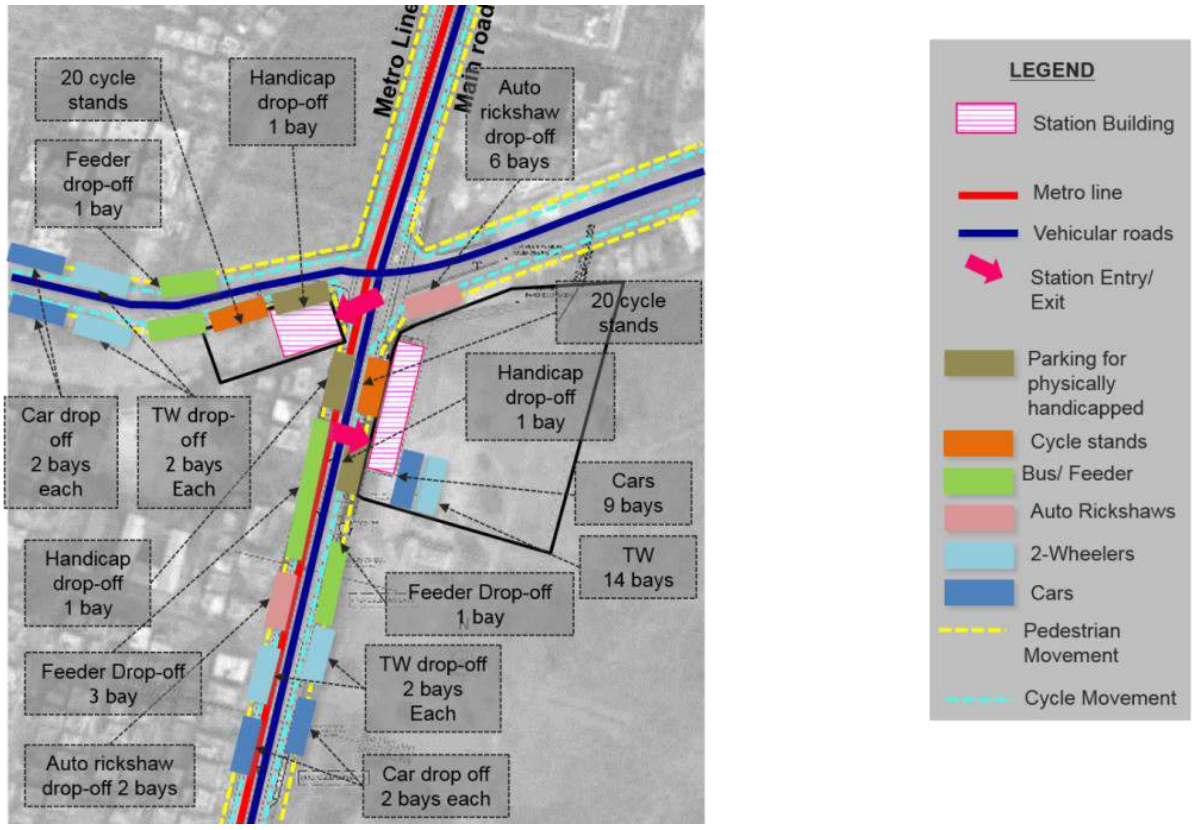
TABLE A- 6: PARKING, PICK & DROP BAYS REQUIRED NEAR JAIPRAKASH NAGAR STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement					
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	2028	221	Car	5	101	158	2	3	6	9
2041	3158	344	TW	8	162	253	3	4	9	14
			Auto/ Mini Van	12	243	379	2	2	-	-
			Mini Bus	53	1075	1674	2	2	-	-

A.1.6.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Figure A- ***43*** shows the locations for parking and drop-off facilities for different modes of transport as in the Conceptual plan at the metro station area.

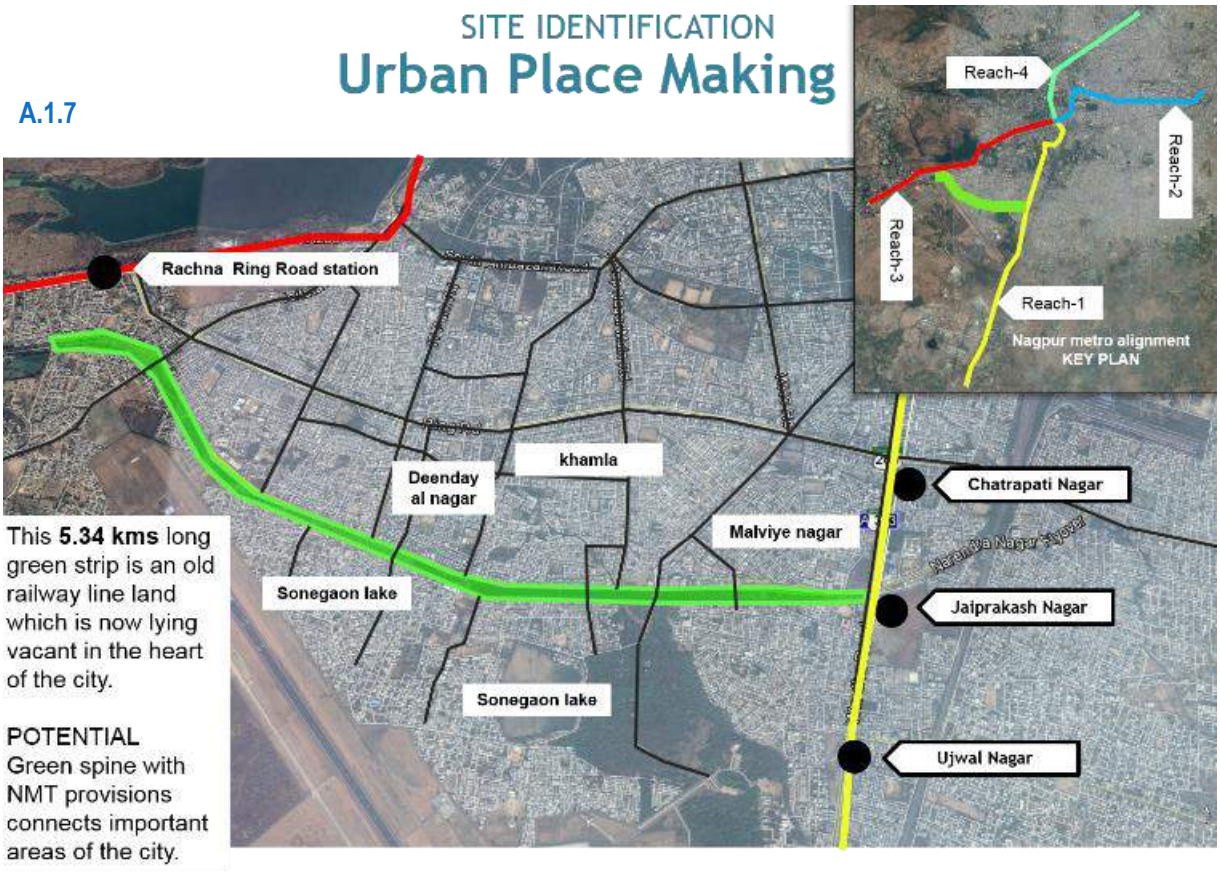
FIGURE A- 43 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITIES AROUND JAIPRAKASH NAGAR STATION



A.1.6.4 URBAN PLACE MAKING

There is a 5.34 kms oblong vacant green area in the heart of the city and was where the old railway tracks were laid. This area has varying characteristics across its length and is a potential area for either a public place or for a dedicated NMT corridor to connect Reach-1 and Reach-3 of Nagpur metro. Further, this tract can also provide NMT connectivity to adjoining areas. Refer Figure A- ***44***

FIGURE A- 44 : POTENTIAL AREA FOR URBAN PLACE MAKING NEAR JAIPRAKASH NAGAR METRO STATION

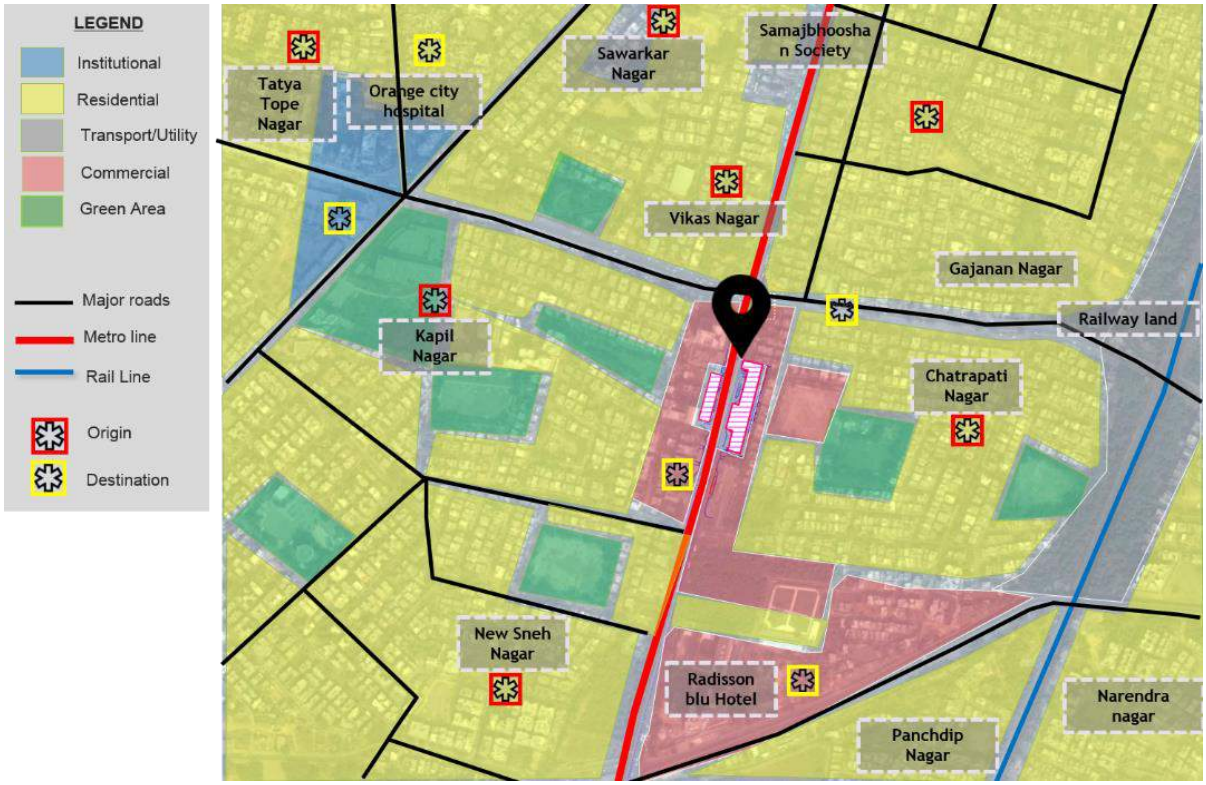


A.1.7 CHATRAPATI NAGAR STATION

Chatrapati Nagar Station is located amidst the Chatrapati Shivaji Chowk, a commercial area beyond which is residential areas like Sneh nagar, Gajanan Nagar and Vikas Nagar. In combination, the area provides a potential user-base. Refer Figure A- ***45***.

Along the south-eastern side of the station is a plot owned and managed by a private entity that is used for long term parking facility. This is also a prominent junction where a large number of intercity buses stop.

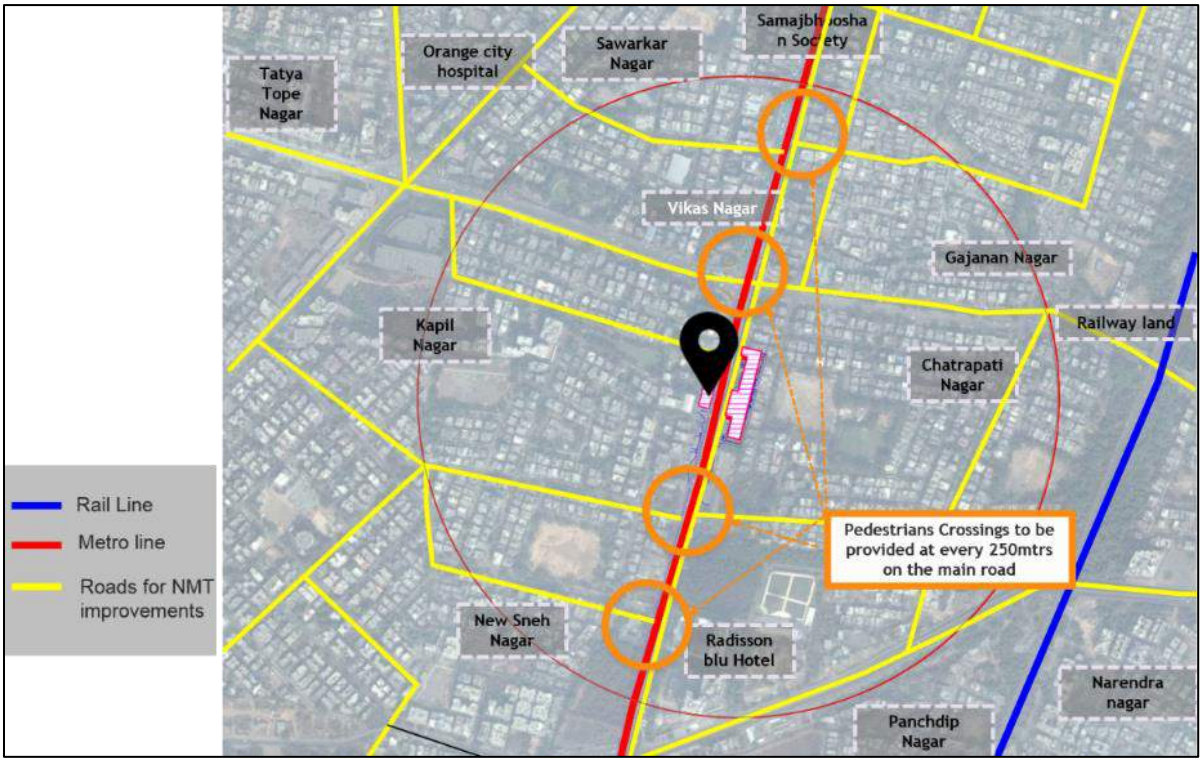
FIGURE A- 45 : CONTEXT OF CHATRAPATI METRO STATON



A.1.7.1 CONNECTIVITY REQUIREMENTS

As the metro corridor follows the road alignment, signalized junctions are required every 250 mtrs and at critical junctions. Refer Figure A- ***46***.

FIGURE A- 46 : CONNECTIVITY IMPROVEMENTS AROUND CHATRAPATI METRO STATION



A.1.7.2 PICK AND DROP, PARKING REQUIREMENTS

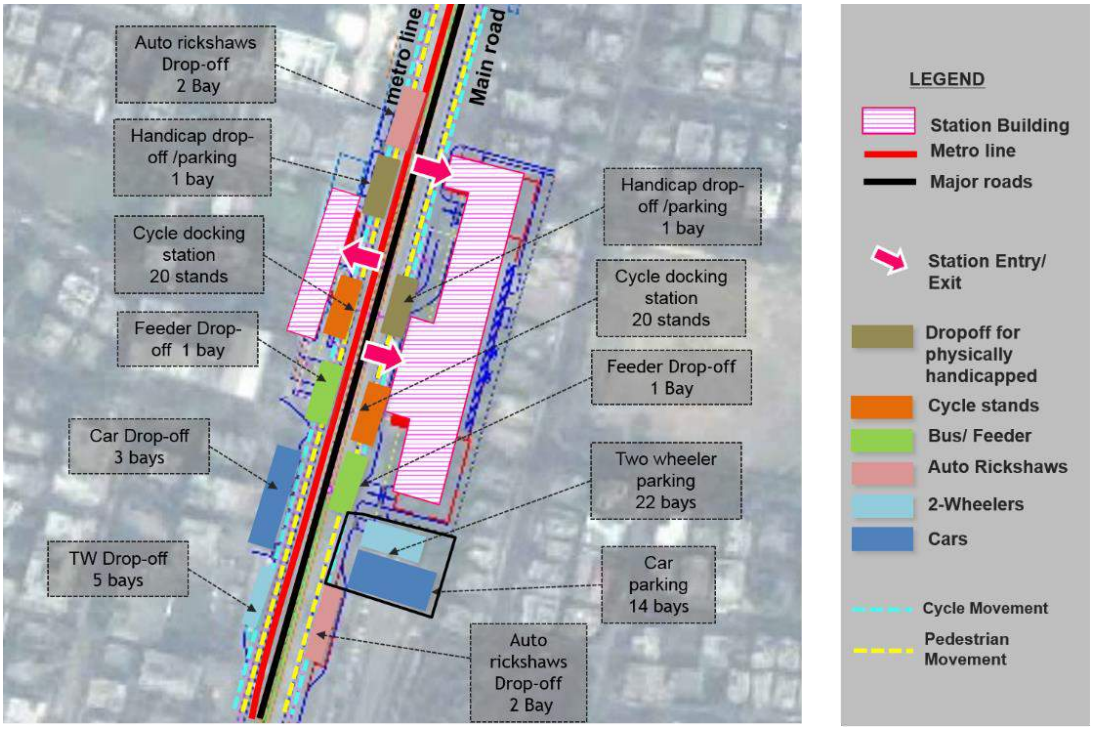
TABLE A- 7: PARKING, PICK & DROP BAYS REQUIRED NEAR CHATRAPATI STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	3123	240	Car	5	157	237	3	3	9	14
2041	4733	516	TW	8	250	379	3	5	14	22
			Auto/ Mini Van	12	375	568	2	3	-	-
			Mini Bus	53	1654	2507	2	2	-	-

A.1.7.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Figure A- *47* shows the locations for pick-and-drop bays and parking facilities required for different modes of transport at the metro station area in a Conceptual plan.

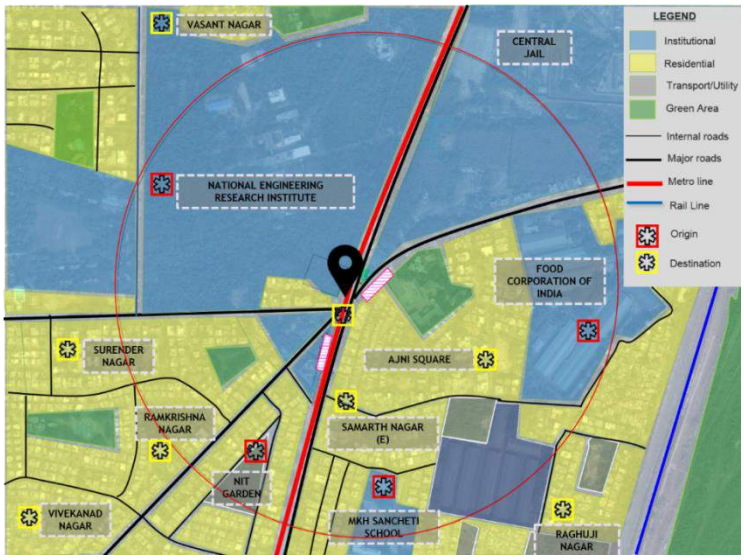
FIGURE A- 47 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.1.8 AJNI SQUARE STATION

Ajni Square Station is located on the 5-armed junction of Ajni Square and has residential areas like Sneh Nagar, Gajanan Nagar, Vikas Nagar to its south and institutional areas like NEERI, FCI and Central Jail towards to its north. Refer Figure A- *48*. The junction requires adequate geometric design and NMT improvements.

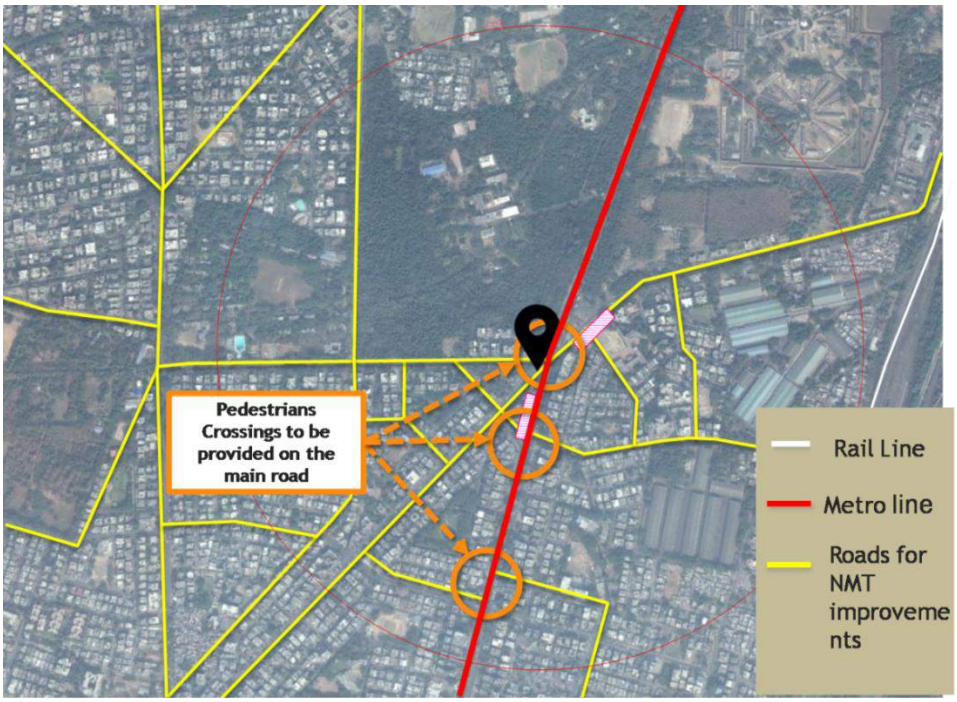
FIGURE A- 48 : CONTEXT OF AJNI METRO STATION



A.1.8.1 CONNECTIVITY REQUIREMENTS

As metro corridor follows the road alignment, signalized junctions are required every 250 mtrs and at critical junctions.

FIGURE A- 49 : CONNECTIVITY IMPROVEMENTS AROUND AJNI METRO STATION



A.1.8.2 PICK AND DROP, PARKING REQUIREMENTS

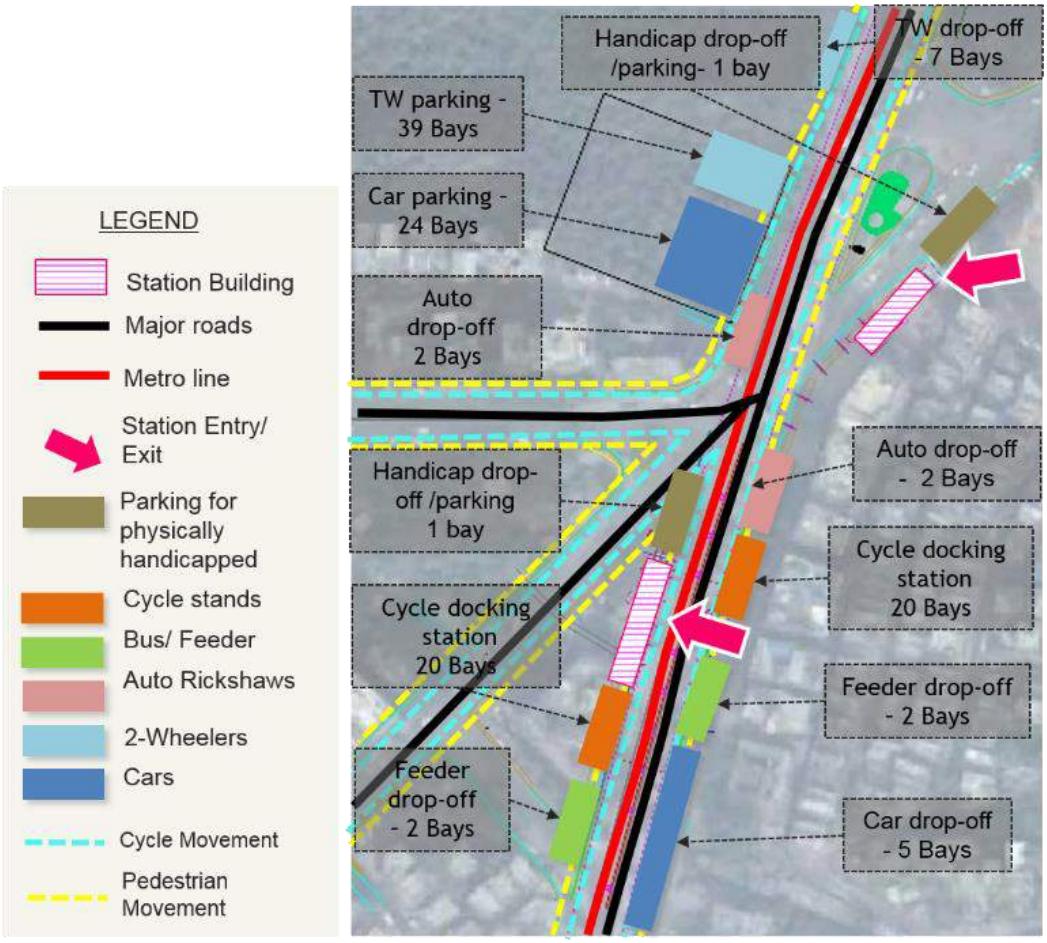
TABLE A- 8: PARKING, PICK & DROP BAYS REQUIRED NEAR AJNI STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	5228	570	Car	5	261	421	4	5	15	24
2041	8426	918	TW	8	418	674	5	7	24	39
			Auto/ Mini Van	12	627	1011	3	4	-	-
			Mini Bus	53	2771	4466	2	3	-	-

A.1.8.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

FIGURE A- 50 shows the locations for pick-and-drop bays and parking facility required for different modes of transport at the metro station area on a Conceptual plan.

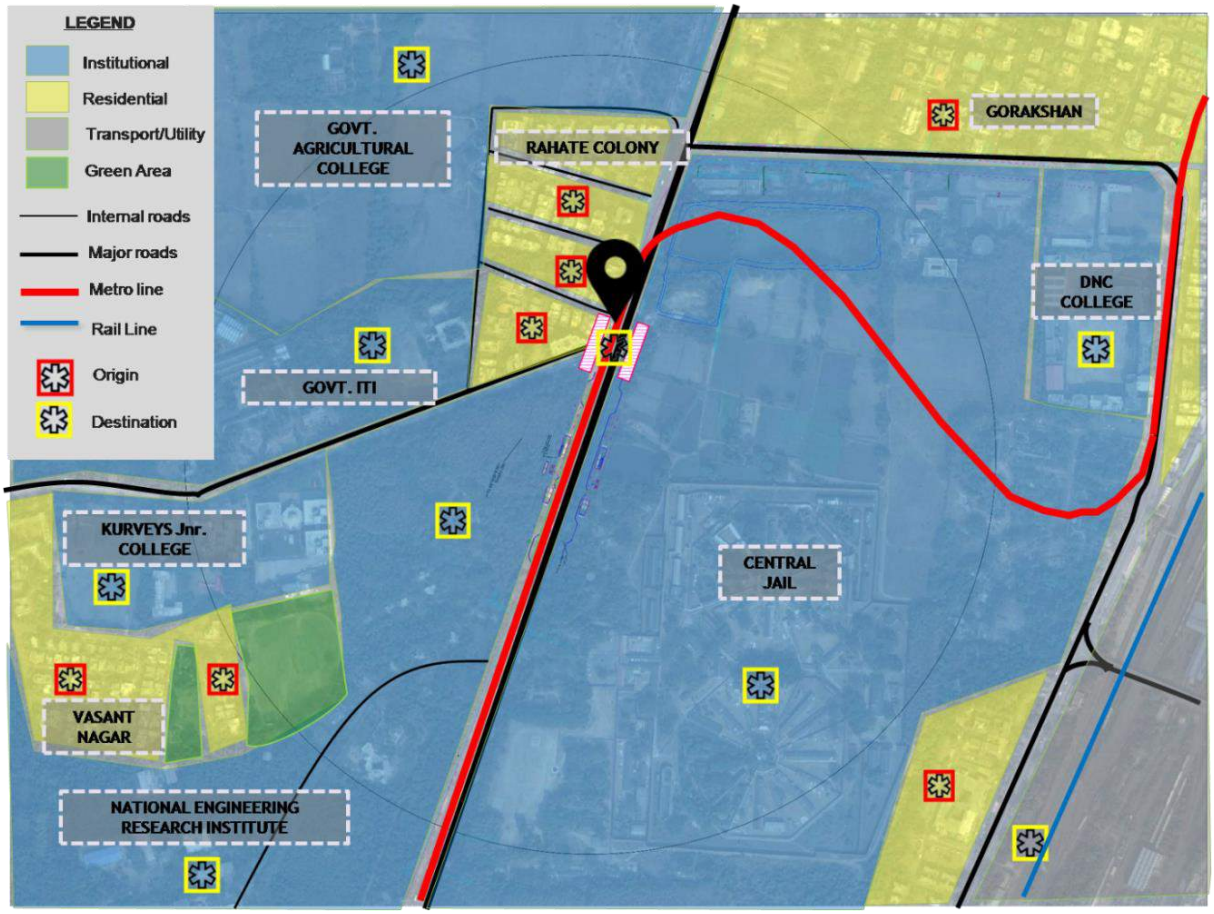
FIGURE A- 50 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.1.9 RAHATE COLONY STATION

Rahate Colony Station is surrounded by institutions like Govt. College of agriculture, Kurveys Junior College, NEERI, Central Jail, and a smaller residential area, the Rahate Colony to the north.

FIGURE A- 51: RAHATE COLONY METRO STATION CONTEXT

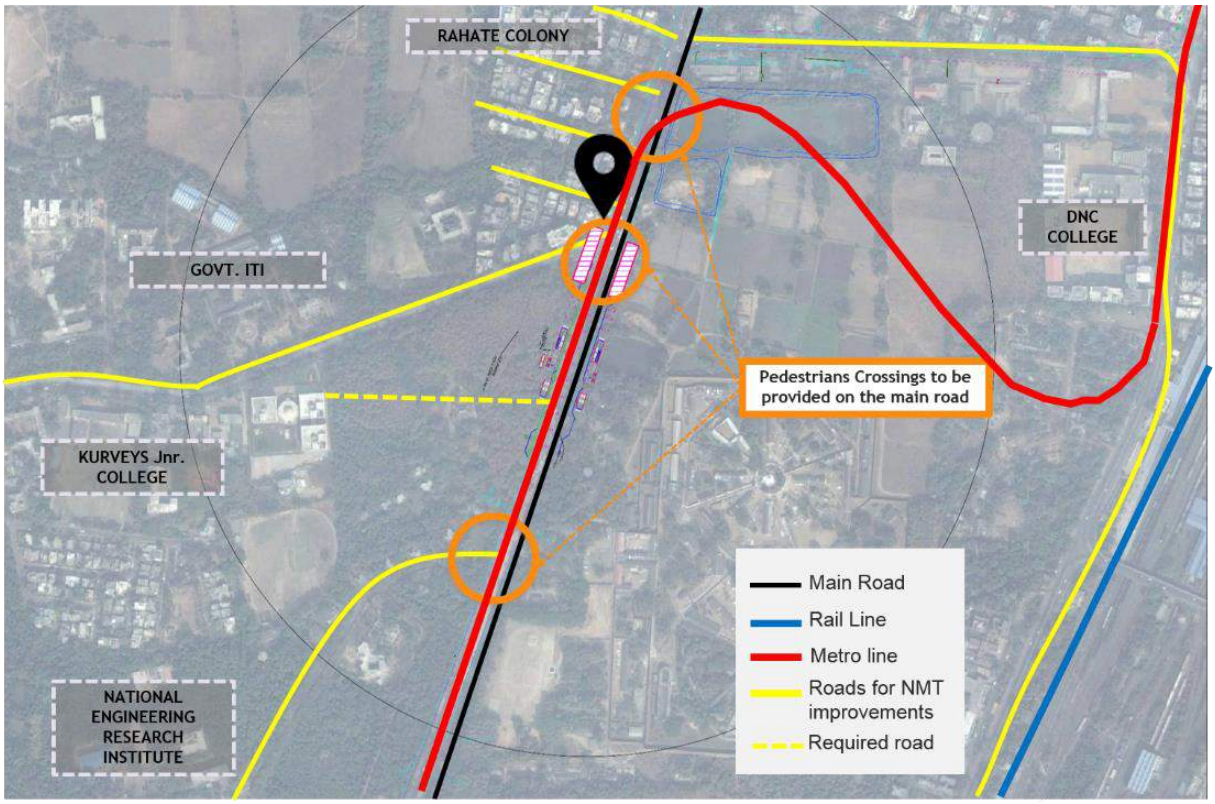


A.1.9.1 CONNECTIVITY REQUIREMENTS

The residential area has necessary density of street-grid to facilitate access to the Station by walking and cycling. Refer Figure A- ***52***. In order to improve NMT connectivity following strategies are proposed:

1. Public participation involving institutions close to the stations is necessary to facilitate operation of shorter NMT paths and its parking closer to the entry/ exit point of Metro. Simultaneously, the footpaths along all public roads will be upgraded by Maha- Metro/ NMC
2. A PBS Scheme can be initiated in the area.

FIGURE A- 52 : NMT IMPPROVEMENTS AROUND RAHATE COLONY METRO STATION



A.1.9.2 PICK AND DROP, PARKING REQUIREMENTS

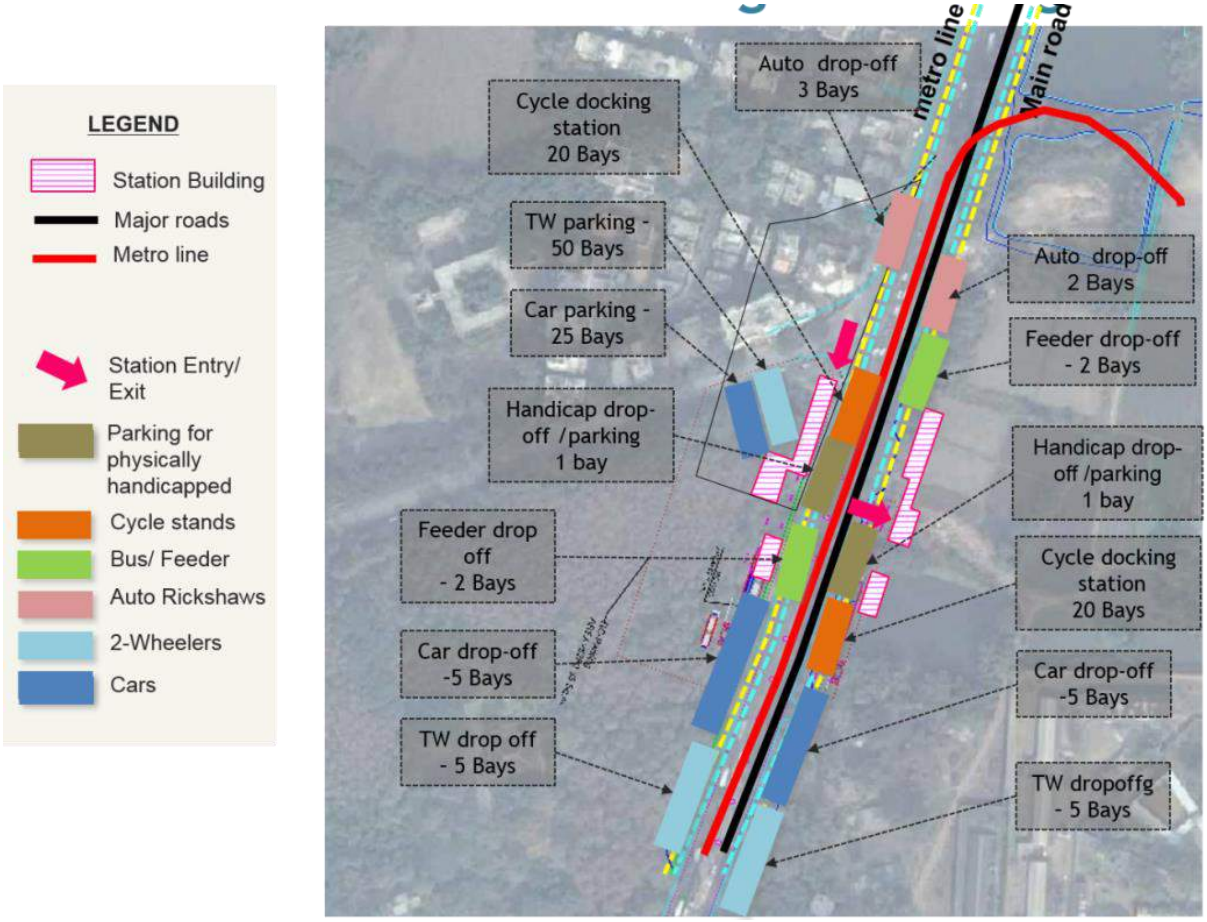
TABLE A- 9: PARKING, PICK & DROP BAYS REQUIRED NEAR RAHATE COLONY STATION

Passengers (boarding – alighting)			Mode	Mode split (2041)	Parking, Pick & Drop Bays Requirement					
					Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	8119	885	Car	5	405	675	5	7	23	25
2041	13499	1471	TW	8	649	1080	7	10	37	50
			Auto/ Mini Van	12	974	1620	4	5	-	-
			Mini Bus	53	4303	7154	3	4	-	-

A.1.9.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Figure A- *53* shows the locations for pick-and-drop bays and parking facility required for different modes of transport at the metro station exits.

FIGURE A- 53 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.1.10 CONGRESS NAGAR STATION

Congress Nagar Station abuts Ajni Railway Station and is surrounded on the north, west and east by residential areas like Congress Nagar, Medical Colony Dhantoli, Gulmohar colony. On the west and southwest are institutional areas like Central jail and DNS College. Refer Figure A- ***54***.

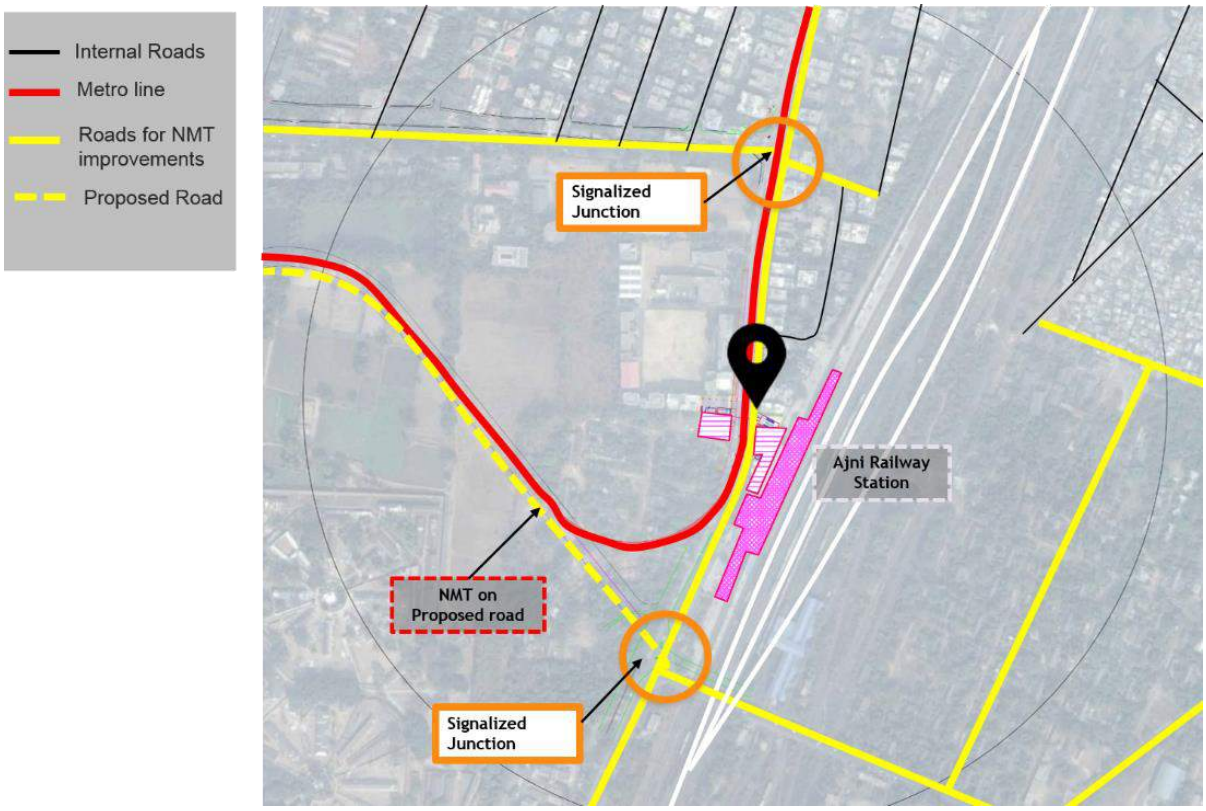
FIGURE A- 54 : CONGRESS NAGAR METRO STATION CONTEXT

A.1.10.1 CONNECTIVITY REQUIREMENTS

The metro station will be physically integrated with the existing Ajni Railway Station where the space for parking and pick-and-drop will be mutually shared.

The alignment of the metro corridor detours from the existing and follows a new road through the green area north of the Central Jail from the Congress Nagar station. This new road can facilitate accessing the station through NMT and Maha-metro's improvement of footpaths around the station will encourage pedestrian access. Further, the existing and proposed junctions of Congress Nagar Station require improvements in-terms of station area planning and designed to prioritize NMT usage. Refer Figure A- ***55***.

FIGURE A- 55 : NMT IMPROVEMENTS AROUND CONGRESS NAGAR STATION



A.1.10.2 PICK AND DROP, PARKING REQUIREMENTS

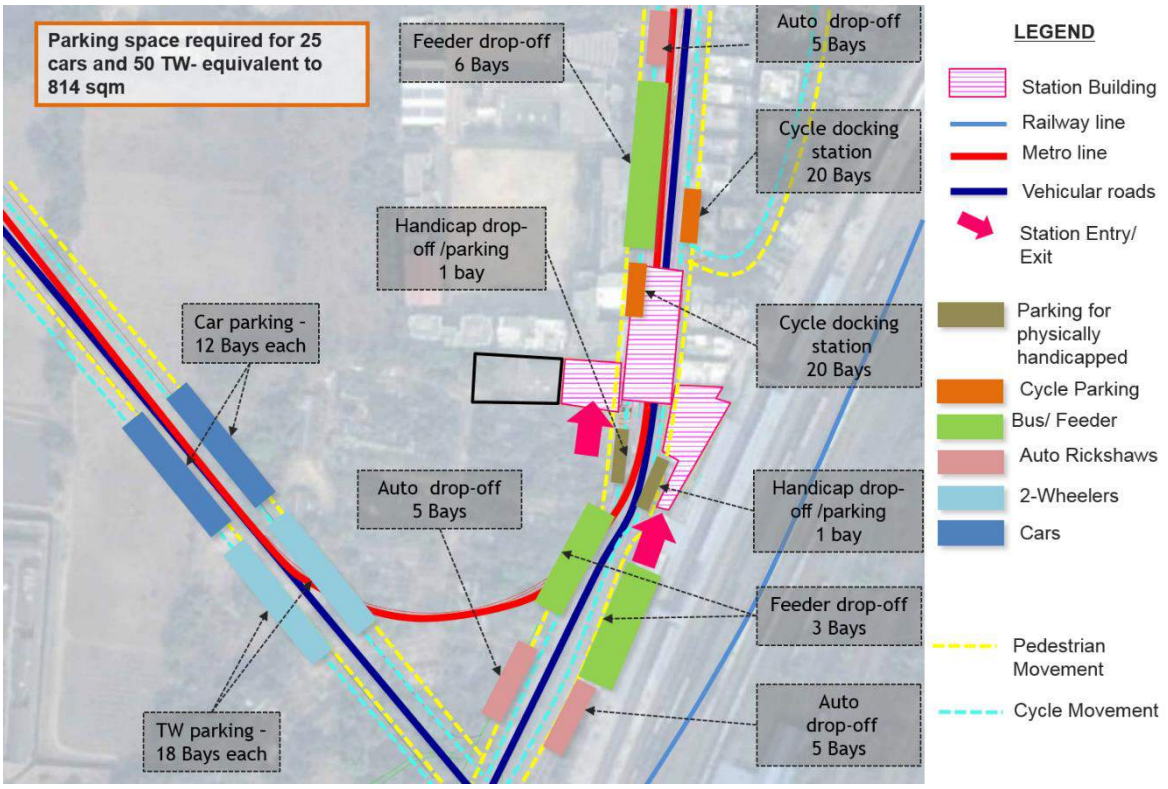
TABLE A- 10: PARKING, PICK & DROP BAYS REQUIRED NEAR RAHATE COLONY STATION

Passengers (boarding – alighting)			Mode	Mode split (2041)	Parking, Pick & Drop Bays Requirement					
					Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	35551	3875	Car	5	221	291	16	23	25	25
2041	53355	5815	TW	8	1651	465	24	36	50	50
			Auto/ Mini Van	12	767	698	11	15	-	-
			Mini Bus	53	422	3082	8	11	-	-

A.1.10.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Figure A- ***56*** shows the locations for pick-and-drop bays and parking facility required for different modes of transport at the metro station and will be shared between the proposed metro and existing railway stations.

FIGURE A- 56 : CONCEPT LOCATION OF PICK AND DROP, PARKING FACILITY



Additional space of 814 Sqm is necessary to park 25 cars and 50 two wheelers for metro users and will be allocated by Maha Metro.

A.2 PROPOSALS FOR REACH-2 STATIONS

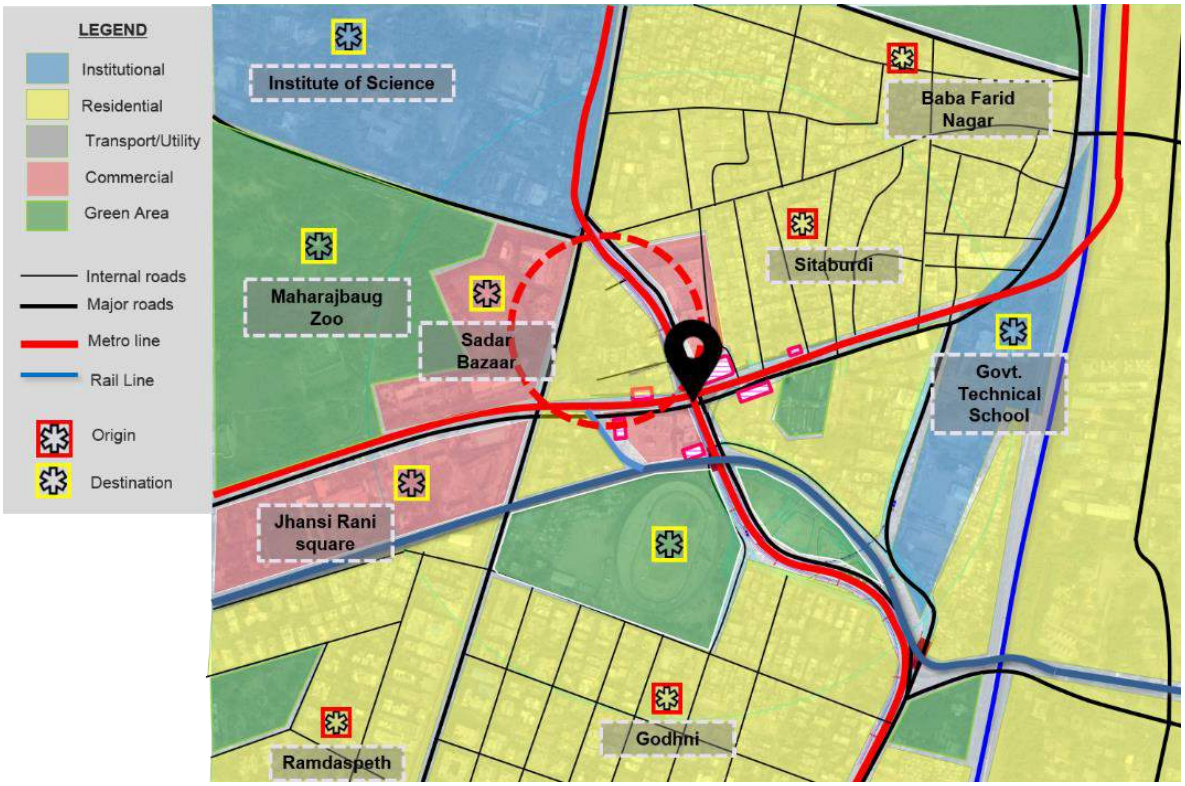
This section contains proposals for all stations of Reach-2 of Nagpur Metro.

A.2.1 SITABULDI (MUNJHE CHOWK) STATION

A.2.1.1 SITE CONTEXT

Sitabuldi is the main commercial hub, densest, largest wholesale market[2] of Nagpur where the Sitabuldi Main Road is the principle shopping streets and Munjhe Chowk a critical junction. Here, the North-South and East-West lines of NMR intersect at an elevated plane at the station. The latter has a number of commercial floors which continues onto the commercial spine that is flanked by a number of banks, shops and a school. The facility has the potential to boost revenue generation.

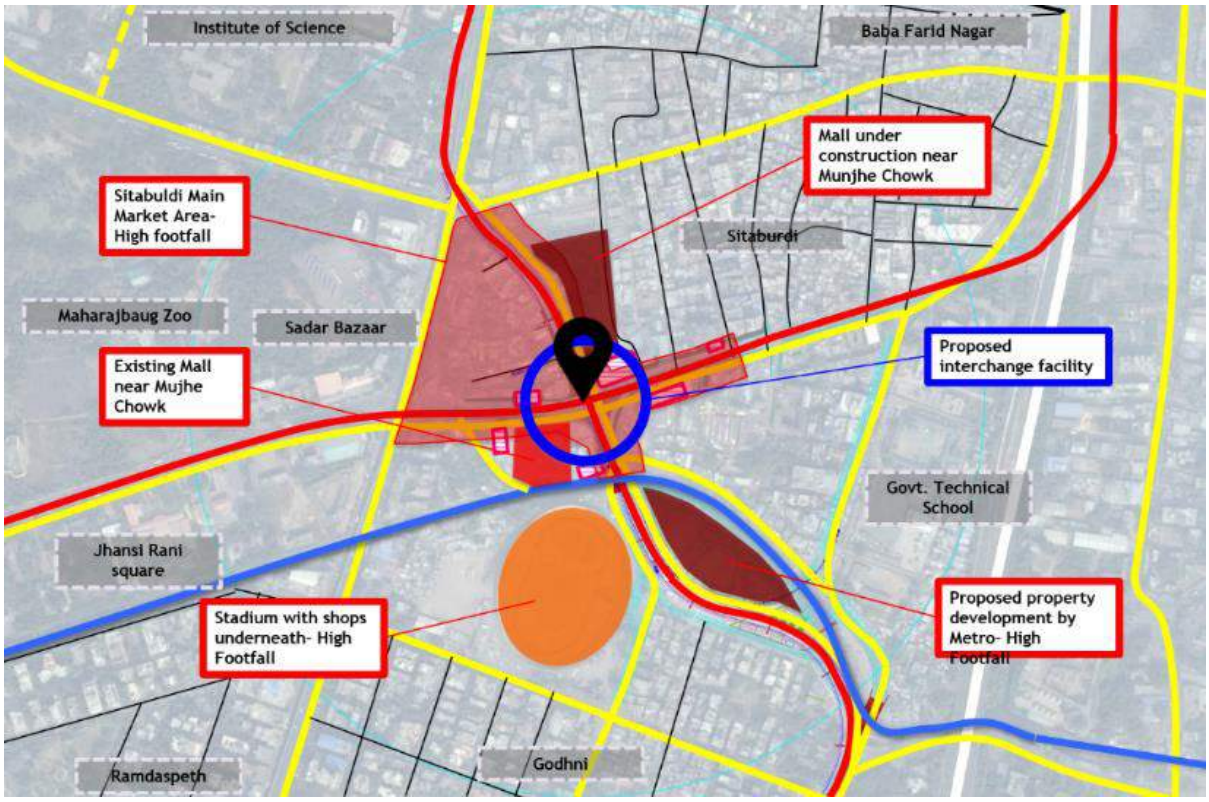
FIGURE A- 57 : LANDUSE CHARACTERISTICS AROUND MUNJHE CHOWK AS PER MASTER PLAN



There are 2 Malls, one built on the western-leg and another proposed on the northern leg of Munjhe Chowk. To its south, the TTMC site is an additional land for commercial exploitation by NMRC. It is also expected that Metro services will trigger up-gradation of low-end retail shops under Yashwantrao Chavan Stadium into high-end establishments. While the aforementioned will boost footfall in the area, it may simultaneously breach the carrying capacity and congest the existing right of way or cause a surge in private vehicle movement.

[2] As per observations in the Nagpur Master Plan 20xx, the density of commercial activity at Sitabuldi exceeds permissible capacity.

FIGURE A- 58 : INTENSE COMMERCIAL LANDUSE IN AND AROUND MUNJHE CHOWK



A. NMT VOLUMES

The NMT volume surveys conducted in May-June, 2017 show a very high volume of existing NMT users in and around the area. It is expected that the NMT ridership will increase when the area transforms post operation of the Nagpur Metro, development of Metro Property Development Site and functioning of the under construction mall near Munjhe Chowk.

TABLE A- 11: NMT VOLUME COUNTS IN 2017

Leg of the Junction	Pedestrian Counts (2017)				Cyclist Counts (2017)			
	16hr total Count	Peak Hour	PH Count	PH %	16hr total Count	Peak Hour	PH Count	PH %
A	2679	18.15-19.15	239	8.9%	7948	18.00-19.00	845	10.6%
B	2298	09.30-10.30	222	9.7%	3321	12.00-13.00	375	11.3%
C	2501	10.45-11.45	207	8.3%	1156	09.30-10.30	101	8.7%
D	2934	18.15-19.15	249	8.5%	2188	19.15-20.15	309	14.1%
Total	10412	09.45-10.45	824	7.9%	14613	18.00-19.00	1392	9.5%

As per the NMT Demand Assessment for 2041, Nagpur would witness minimum annual growth of pedestrian trips at the rate of 1.29% per annum and a total of 22.13% upto the Horizon year. At the same time, the cycling trips would grow at the rate of 1.63% per annum and a total of 32.08% upto the Horizon year. Considering minimum projected growth, the volumes for Horizon Year would be as per Table A-12.

TABLE A- 12 : PROJECTED NMT VOLUME COUNTS FOR 2041

Leg of the Junction	Pedestrian Counts (2017)		Pedestrian Counts (2041)		Cyclist Counts (2017)		Cyclist Counts (2041)	
	16hr total Count	PH Count	16hr total Count	PH Count	16hr total Count	PH Count	16hr total Count	PH Count
A	2679	239	3271	291	7948	845	10497	1116
B	2298	222	2806	271	3321	375	4386	495
C	2501	207	3054	252	1156	101	1526	133
D	2934	249	3583	304	2188	309	2889	408
Total	10412	824	12716	1006	14613	1392	19300	1838

The table above establishes the demand for dedicated NMT space around Munjhe Chowk. The requirements for Dedicated NMT space has been outlined in Table A-13.

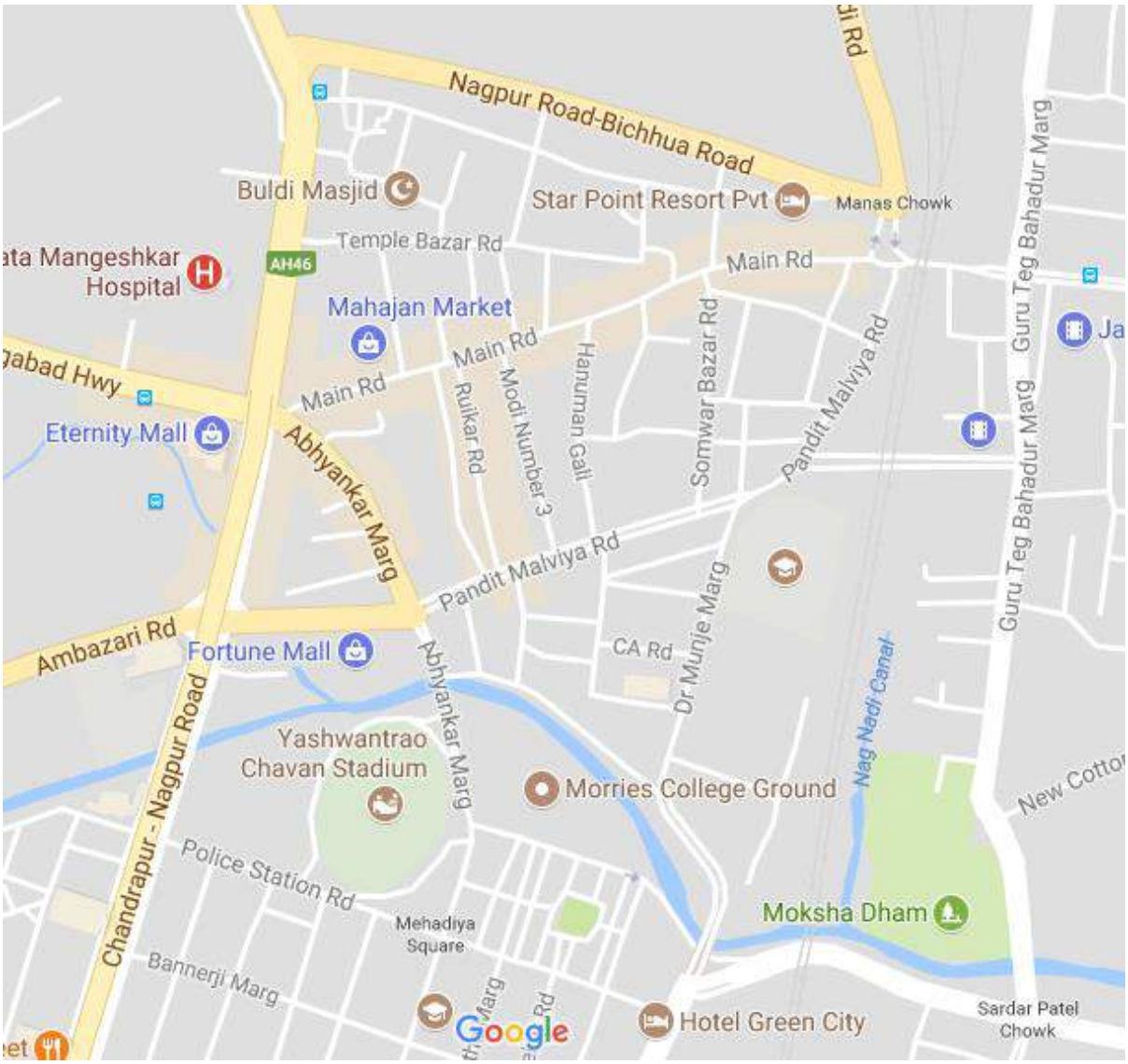
TABLE A- 13 : REQUIREMENT OF DEDICATED NMT SPACE AS PER IRC CODES

Leg of the Junction	Pedestrian Counts (2017)	Footpath Width	Pedestrian Counts (2041)	Footpath Width	Cyclist Counts (2041)	Cycle Track Requirement	Cyclist Counts (2041)	Cycle Track Requirement
A	2679	2.5m +2.5m	3271	3.5m +3.5m	7948	4 Lane- 2 way	10497	4 Lane- 2 way
B	2298	2.5m +2.5m	2806	3m +3m	3321	3 Lane- 2 way	4386	3 Lane- 2 way
C	2501	2.5m +2.5m	3054	3m +3m	1156	2 Lane- 2 way	1526	2 Lane- 2 way
D	2934	3m +3m	3583	3.5m +3.5m	2188	3 Lane- 2 way	2889	3 Lane- 2 way
The above is as per IRC-103- 2012- Guidelines for Pedestrian Facilities. The Guidelines also recommend that High Intensity Commercial Areas should have atleast 4m wide footpaths along both sides					The above is as per IRC-11- 1962- Recommended practice for the design and layout of cycle tracks. As per the guidelines, the minimum width of cycling lane should be 2m (per lane).			

A.2.1.2 ISSUES RELATED TO CONNECTIVITY AND ACCESS TO THE AREA

Sitabuldi has a comprehensive network connecting different parts of Nagpur. This is achieved through an inner and an out loop that is interconnected by internal roads. The inner loop for vehicular movement comprises the Chandrapur-Nagpur road, Ambazari road and Abhyankar Marg while the outer has Chandrapur-Nagpur road, Police Station road, Dr. Munjhe Marg, Pandit malviya road and Nagpur-Bichhua road. Refer Figure A- ***59***.

FIGURE A- 59 : SITABULDI ROAD NETWORK



Roughly, the footfall in and around Munjhe Chowk is about 2 Lakhs to 3 Lakhs people a day. Of this, the existing mall draws a footfall of 0.5-1 Lakhs and that proposed is projected to be 1 Lakh. With the operationalization of metro services and contiguous commercial establishments, the area is likely to receive a footfall of 3.5- 4 Lakh people per day. Operation of the metro services will also discourage use of private cars to access Munjhe Chowk, and in-turn secure additional space. However, considering the existing density and that proposed, allocation of additional space for pedestrians, resting and recreation will be necessary. To do so, curbing use of private vehicles and encouraging usage of metro is the first step even if parking facilities may be provided in the TTMC property.

A.2.1.3 PICK & DROP, PARKING REQUIREMENTS FOR THE METRO USERS

TABLE A- 14 : PARKING, PICK & DROP BAYS REQUIRED NEAR NEW AIRPORT STATION

Passengers (boarding – alighting)			Mode	Mode split (2041)	Parking, Pick & Drop Bays Requirement					
					Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	29382	3203	Car	5	1469	2357	12	19	25	25
2041	47138	5138	TW	8	2351	3771	19	30	50	50
			Auto/ Mini Van	12	3526	5657	8	12	-	-
			Mini Bus	53	15573	24983	5	8	-	-

A.2.1.4 SUMMARY OF ISSUES

1. Increasing density and congestion
2. Disorganized surface parking along the four arms of Munjhe Chowk constrict road-section and limit movement of vehicles
3. Due to the lack of space, a crowd management plan will be necessary to distribute passengers away from the metro station. This may be achieved through the proposed plan identifying entry/exit points closest to the tentative destination.

A.2.1.5 PROPOSALS

Considering the existing and projected future footfalls, Munjhe Chowk and its surrounding areas can only be accessed by walking, cycling and public transport and out-of-bound for private motor vehicles. Pedestrianisation of the area can be phased to allow end users to adapt to the modified traffic in the long run reinforce its economic and socio-cultural significance. This can only be initiated through a structured dialogue involving relevant stakeholders to appraise the proposed in a participatory manner.

Following is the phased proposal for pedestrianisation (Refer Figure A- ***60***):

TABLE A- 15 : PHASED PROPOSAL FOR PEDESTRIANISATION OF MUNJHE CHOWK

Steps	Phase-I	Phase-II
1	Limiting access of private vehicules to Ambazari road (from Munjhe Chowk to Rani Jhansi Square), Abhyankar Marg (from bridge over canal to Variety Chowk) and Pandit Malviya road (from Munjhe Chowk to Canara Bank junction) Allocating areas for short-termed high-value parking, pick-and-drop facility near Rani Jhansi Chowk, Variety Chowk, Canara Bank and Site for TTMC- Property Development	Complete pedestrianisation of roads mentioned in Phase-I Ban on on-street parking within 500m from Munjhe Chowk. Long termed parking may be accommodated within TTMC-PD and Zero Mile- PD sites. If need be, an additional facility for long term multi level parking may be constructed at the vacant land near the existing stadium.

		Only off-peak-time bound access will be allowed for service vehicles.
2	Police Station road, Dr. Munjhe Marg, Pandit Malviya road and Nagpur-Bichhua to be developed as a 2-way outer loop for the area.	Continuity of Phase-I
3	Footpaths along the Munjhe Chowk upto Chandrapur-Nagpur road, Police Station road, Dr. Munjhe Marg, Pandit malviya road and Nagpur-Bichhua need to be upgraded with provisions for landscaping, accessibility improvements, etc.	Increased seating and space for recreation in the pedestrianized area.
4	Small feeders, e-rickshaws to be encouraged in the area.	PBS Scheme for the area to be rolled out
5	Improvement of all major junctions and allocation of traffic calming measures at-grade.	

A. POSSIBLE BENEFITS OF PEDESTRIANISATION:

1. Increased footfall and hence instances of commercial interaction in the area due to reduced congestion.
2. Revival of the CBD boosting economic growth in the surrounding areas.
3. Increase in demand of Metro PD floor spaces.
4. Increase in Metro ridership
5. Improved quality of life for the residents and visitors of the area.
6. Reclamation of public space for larger public use

FIGURE A- 60 : PROPOSED ZONE FOR PEDESTRIANIZATION

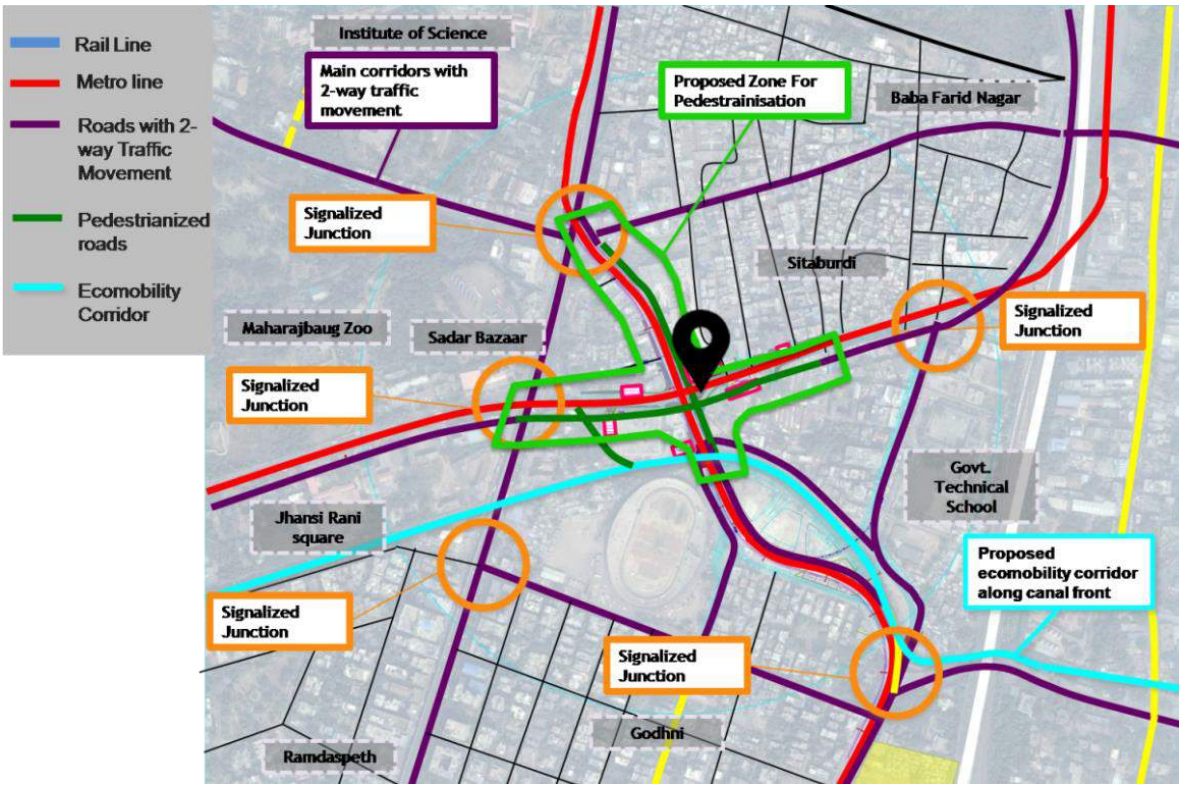
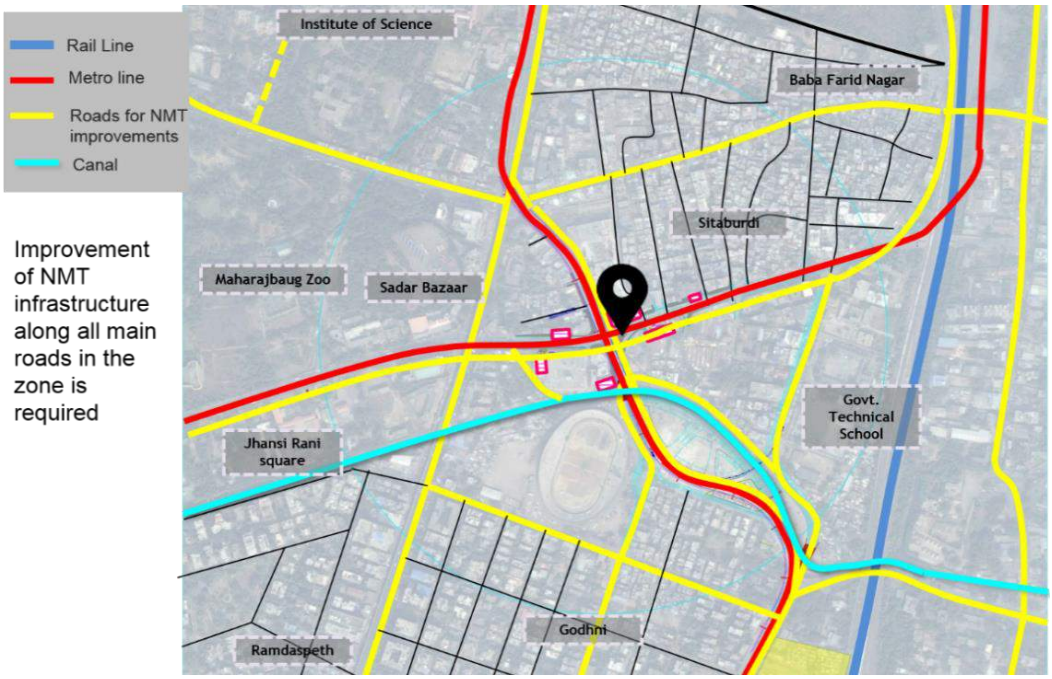


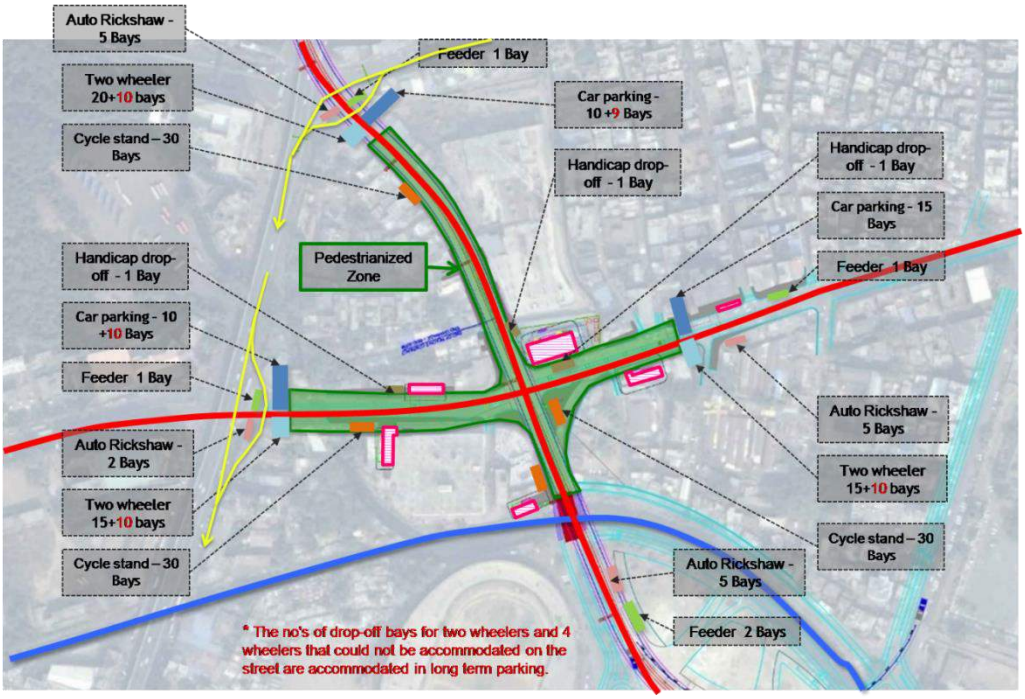
FIGURE A- 61 : MAIN NMT CORRIDORS IN AND AROUND SUTABULDI AREA



A.2.1.6 CONCEPTUAL LOCATIONS FOR PICK & DROP FACILITIES AROUND MUNJHE CHOWK STATION- OPTION -1 (WITH PROPOSED PEDESTRIANISATION)

Considering phased pedestrianisation of the area around Munjhe Chowk, pick-and-drop zones are proposed near Variety Chowk, Rani Jhansi Square, Cana Bank and TTMC site. This facility will be accommodated within its available road spaces, near the junctions, etc. Refer Figure A- **62**.

FIGURE A- 62 : CONCEPT LOCATION FOR PICK & DROP FACILITIES



A.2.1.7 PLACE MAKING PROPOSAL

The area around Munjhe Chowk proposed for pedestrianisation is ideal for place-making through street design interventions. The details of the place making proposal are in Appendix B. It is proposed that an eco-mobility corridor having space for recreation can be an inviting place for residents and can transform the canal flowing along the southern side of Sitaburdi chowk. Refer Figure A- ***60*** above. The convergence of DPR prepared by Nagpur Municipal Corporation for rejuvenation of Nallahs throughout Nagpur and recommendations for integrating footpaths and cycle tracks as per the NMT Master Plan can help develop the canal-front.

A.2.1.8 WAY FORWARD

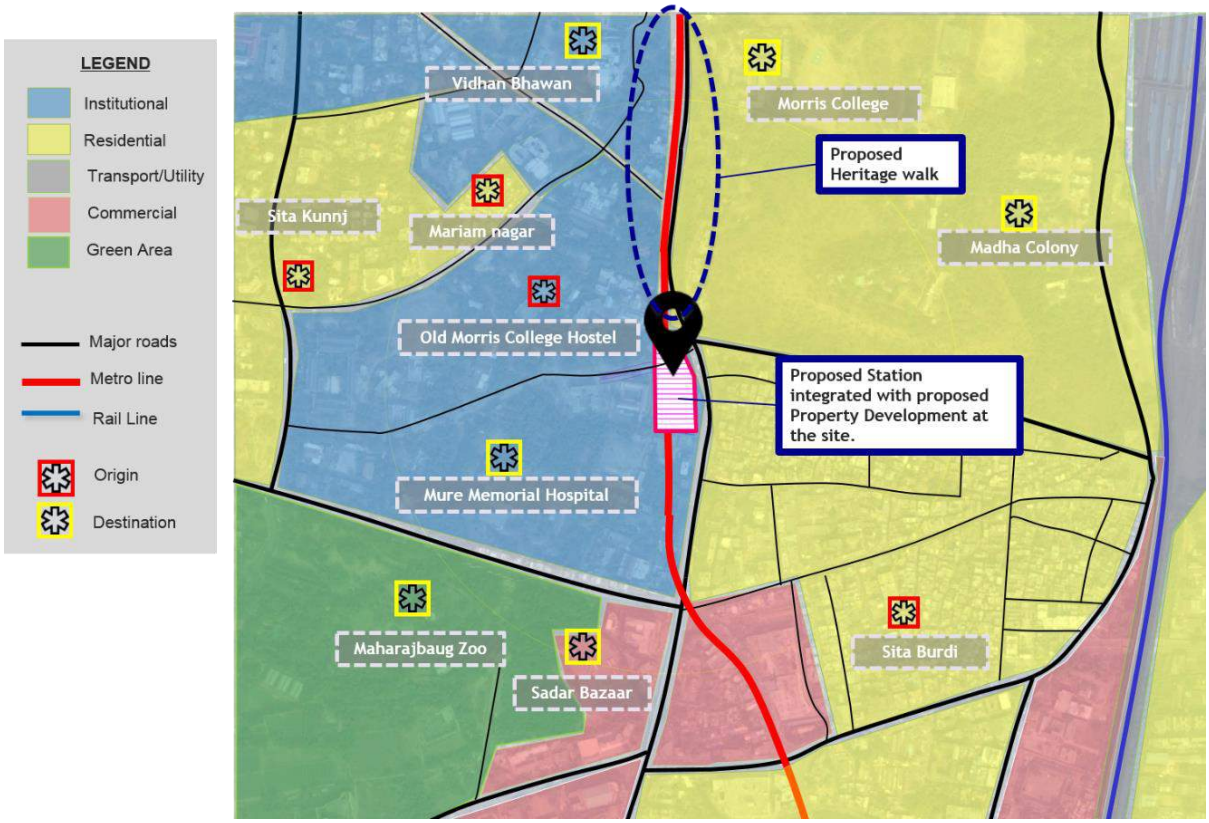
1. A detailed traffic survey for an area of atleast 2km around Munjhe Chowk is to be taken up on priority-basis to finalise the conceptual proposal for pedestrianisation and traffic diversions along the 2-way roads.
2. Finalization and dissemination of proposal for Munjhe Chowk to be done through a participatory mechanism involving relevant stakeholders. This should form the basis for a detailed area design and implementation proposal.

A.2.2 ZERO MILE STATION

A.2.2.1 CONTEXT

This station, near the historic marking stone is named after the Zero mile Stone that was erected by the British. It has residential areas like Madha colony, commercial areas like Sitaburdi, Sadar bazaar on its east and Institutional area like Old Morris College, Vidhan Bhawan, Mure Memorial Hospital on its west. The length of the road northwards from the Station is proposed to be landscaped.

FIGURE A- 63 : LANDUSE AROUND ZERO MILE STATION



A.2.2.2 CONNECTIVITY REQUIREMENTS

Zero mile metro station lies to the west of the Chandrapur-Nagpur road and the road connecting the railway station (see Fig) meets it perpendicularly. It will be connected to the Old Morris College Hospital through a proposed road. Refer Figure A- ***63***.

FIGURE A- 64 : ZERO MILE STATION- AT-GRADE PLAN

Parking is provided at the ground level of Zero Mile Station and building services can be provided from the service lane to its west. The eastern side of the station has staircases and escalators on the continuous footpath leading to the unpaid passenger area on the first floor. Refer Figure A- ***64***. This level has shops, ticketing windows, provides access to the pedestrian-only over-bridge across the highway and leads to the paid area. This would ultimately decongest junction near Zero Mile station as the nearest pedestrian crossing is further ahead on the road leading to the railway station. Refer Figure A- ***65***.

The station abuts National Highway and the flyover leading to Rani Jhansi Square and Variety square junctions terminate near the Station.

FIGURE A- 65 : ZERO MILE STATION FIRST FLOOR PLAN

A.2.2.3 PICK-AND-DROP, PARKING REQUIREMENTS

The requirements for pick-and- drop bays and long term parking exclusively for metro users is mentioned in this section and that for property development will be over and above it and will be planned, located and designed by the architect for the latter.

TABLE A- 16 : PARKING, PICK & DROP BAYS REQUIRED NEAR ZERO MILE STATION

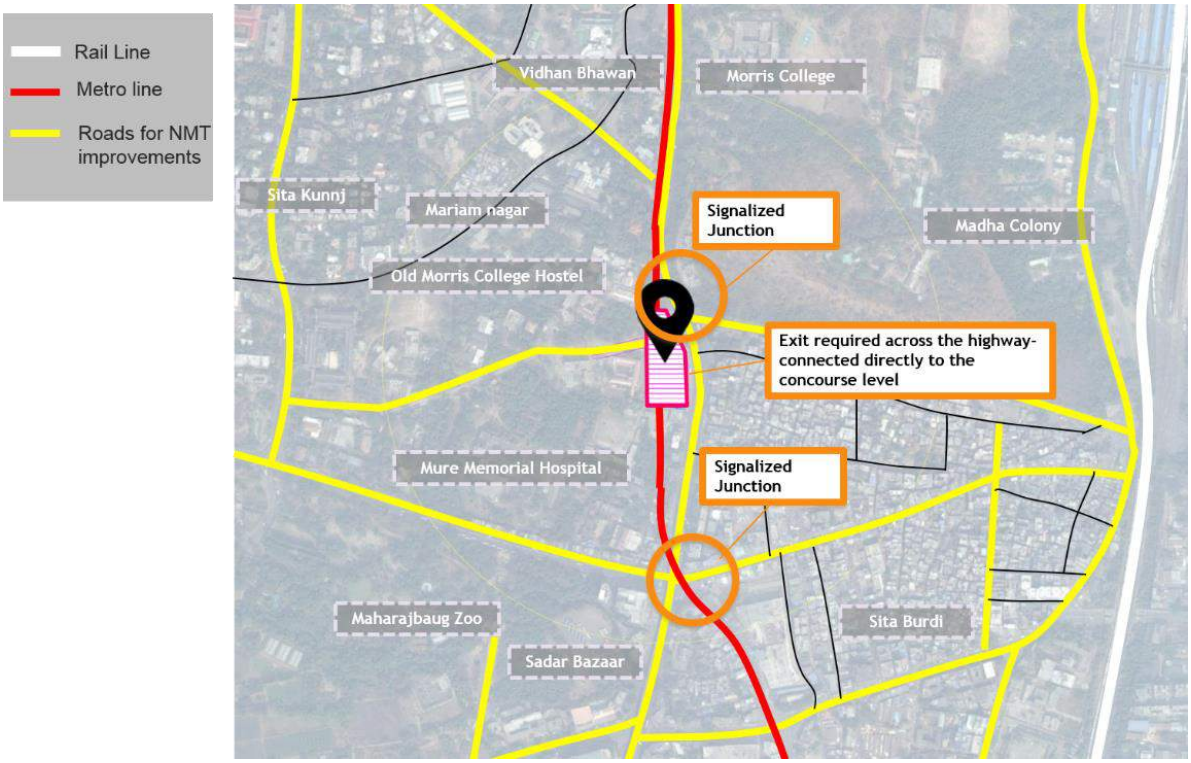
Passengers (boarding – alighting)			Mode	Mode split (2041)	Parking, Pick & Drop Bays Requirement					
					Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	9096	992	Car	5	455	528	4	4	25	25
2041	10556	1150	TW	8	728	844	6	7	42	50
			Auto/ Mini Van	12	1092	1267	2	3	-	-
			Mini Bus	53	4821	5595	2	2	-	-

A.2.2.4 PROPOSALS

A. CONNECTIVITY IMPROVEMENTS

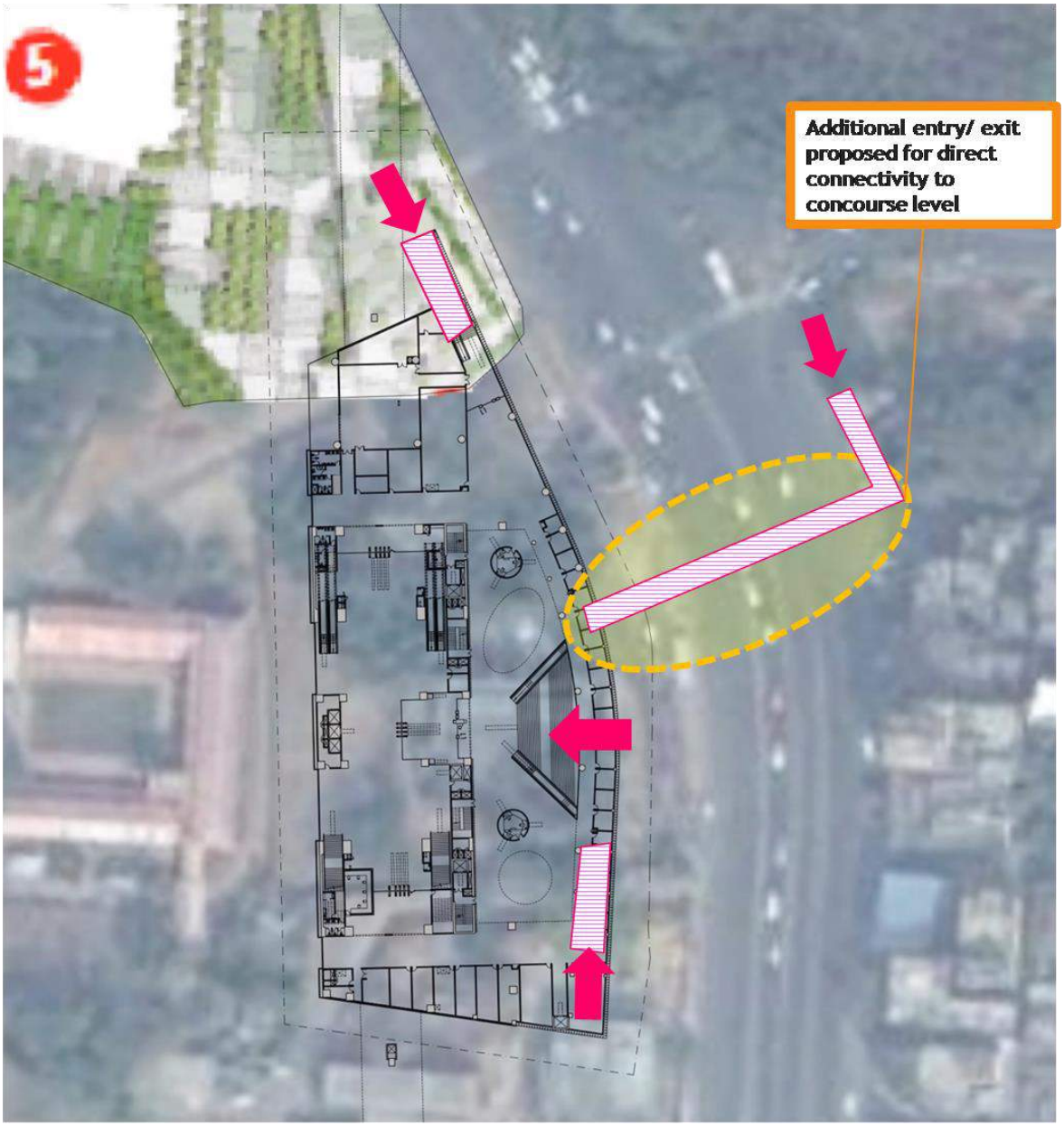
All major roads around the station are to be improved to incorporate NMT infrastructure. Rani Jhansi Square, Variety Chowk and the Zero Mile junctions are to be maintained as signalized junctions with provisions for at-grade NMT crossing and traffic-calming measures. Refer Figure A- ***66***.

FIGURE A- 66 : CONNECTIVITY AROUND ZERO MILE METRO STATION



It is proposed to provide an over-bridge directly connected to the first floor of the metro station spanning across and connecting other side of the Highway. Refer Figure A- ***67***.

FIGURE A- 67 : PROPOSAL FOR ADDITIONAL ENTRY/ EXIT FOR THE STATION

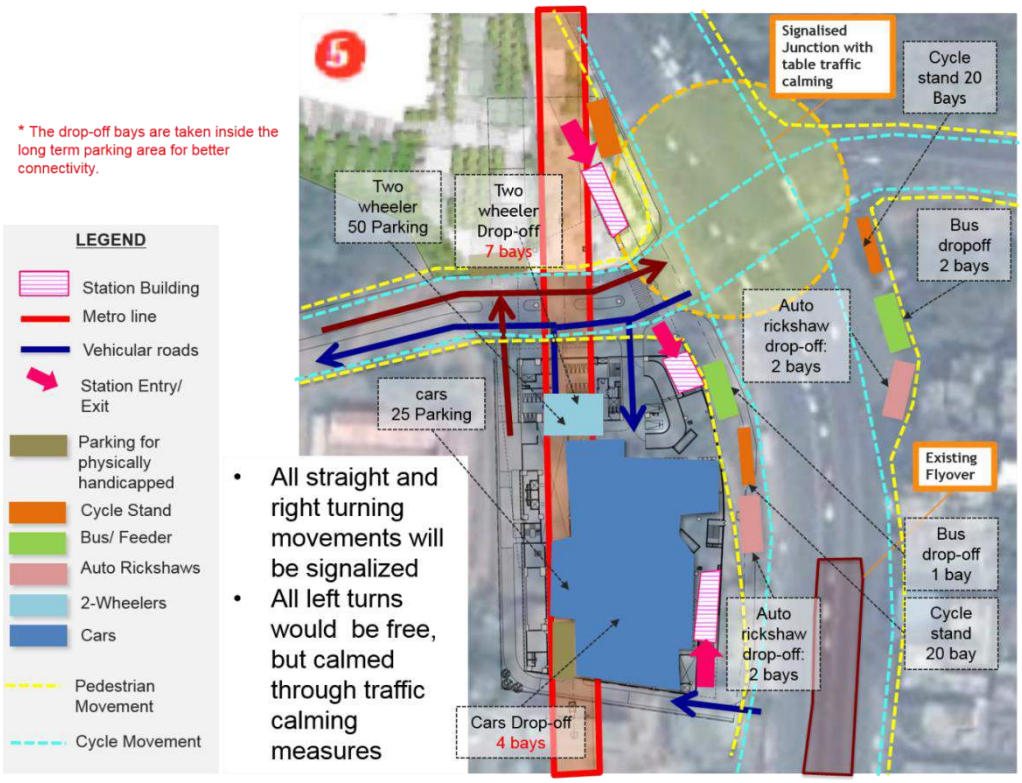


A.2.2.5 CONCEPTUAL LOCATION OF PICK & DROP, PARKING FACILITIES

Pick-and-drop facilities proposed around Zero Mile Station are shown in Figure A- *68* and located along the highway by accommodating bays within the design of footpaths. These would be directly accessible through the slip lanes of the flyover.

The long-term parking required for metro users may be accommodated within the areas planned for property development and accessed through service lanes of the station area.

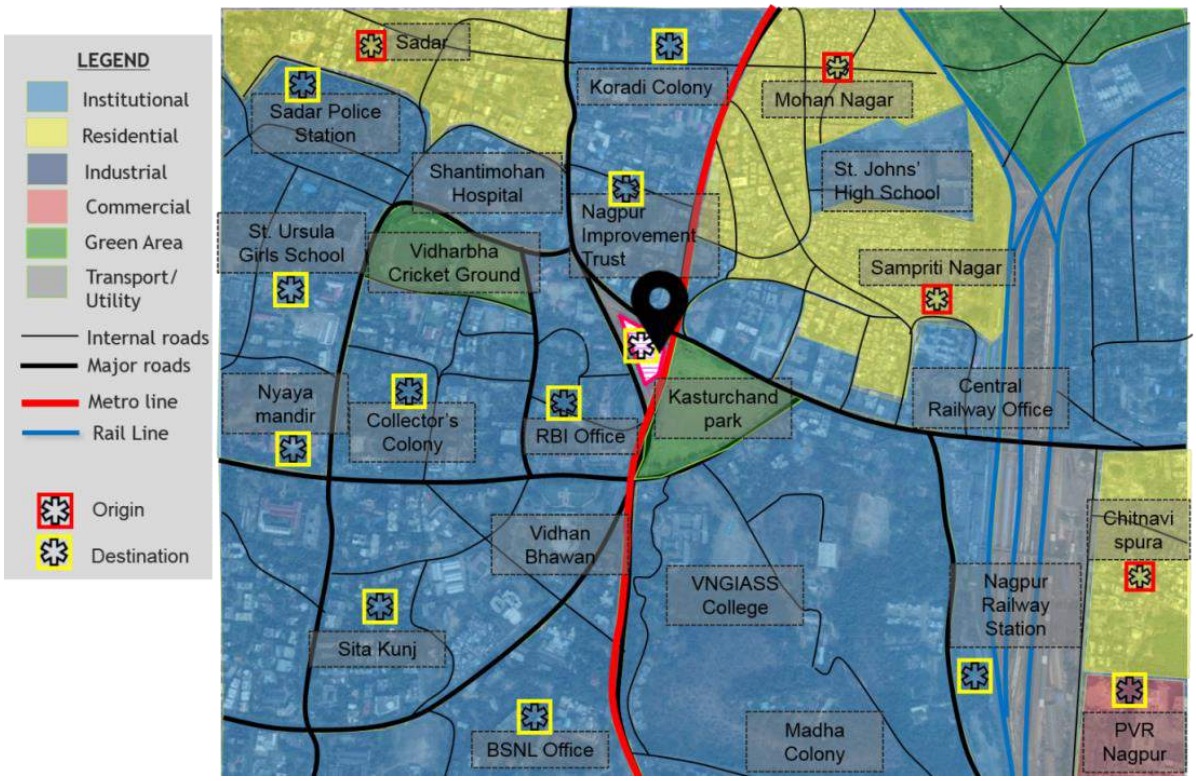
FIGURE A- 68 : CONCEPTUAL LOCATION OF PICK AND DROP FACILITIES



A.2.3 KASTURCHAND PARK STATION

Kasturchand park metro station is located between LIC Square and RBI Square, is surrounded by government offices, Nagpur Railway station, educational institutes and some residential areas. The Kasturchand Park along its eastern edge offers a breathing space to the surrounding. Refer ***FIGURE A- 69***.

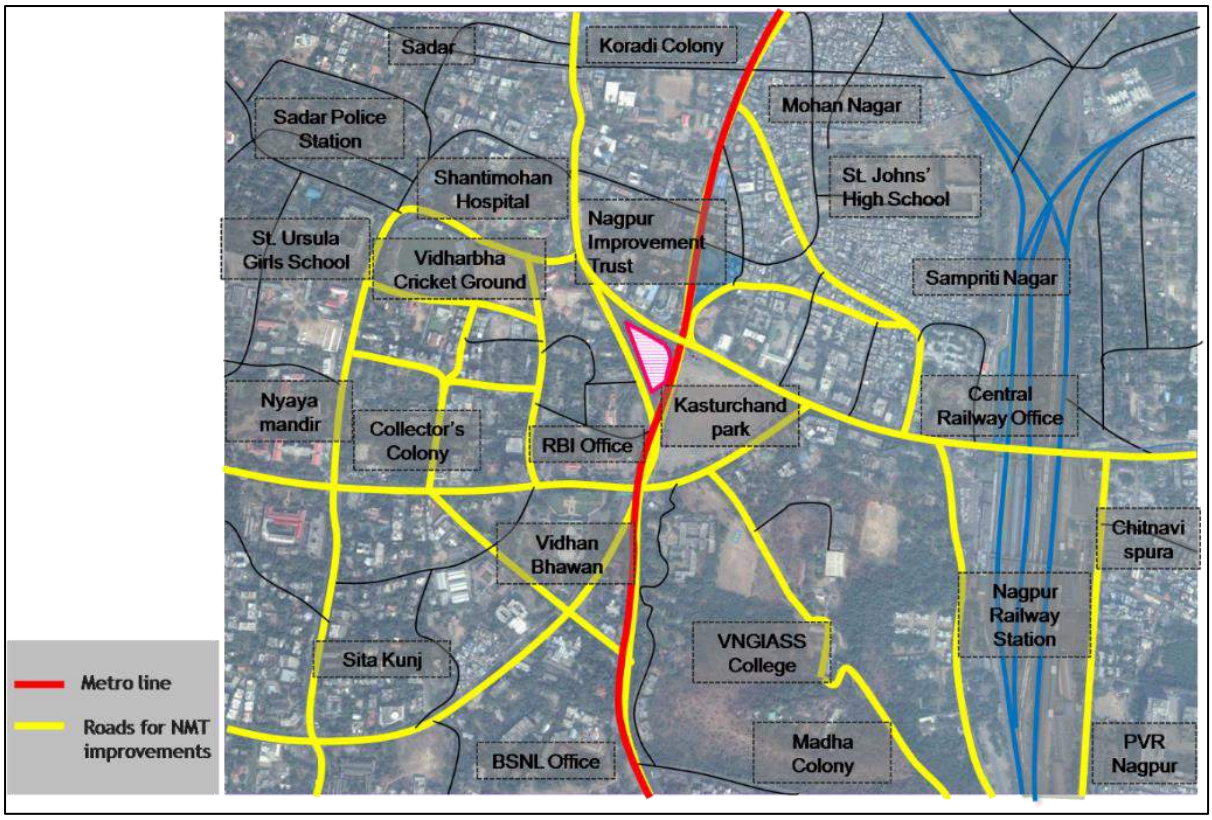
FIGURE A- 69 : KASTURHAND PARK METRO STATION CONTEXT



A.2.3.1 NMT IMPROVEMENTS

The metro service is foreseen to provide improved access to the Kasturchand park which is an opportunity to reorganize its spaces and edges as a public space. This should encourage walking, cycling and use of public transport in the area. Therefore, NMT improvement of all streets and junctions in the vicinity of the station area is indispensable. Refer Figure A- ***70***.

FIGURE A- 70 : NMT IMPROVEMENTS AROUND KASTURCHAND PARK STATION



A.2.3.2 PICK AND DROP, PARKING REQUIREMENTS

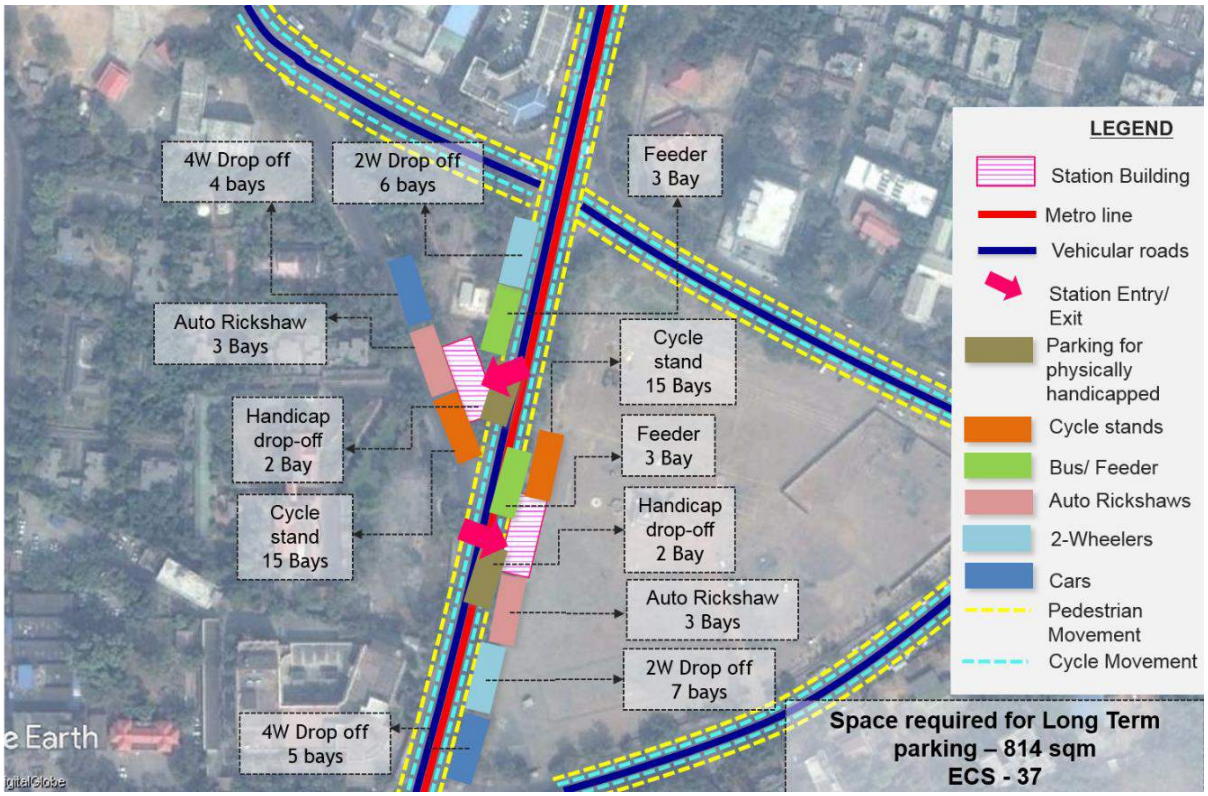
TABLE A- 17 : PARKING, PICK & DROP BAYS REQUIRED NEAR KASTURCHAND PARK STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	10196	1111	Car	5	63	96	6	9	25	25
2041	17698	1929	TW	8	473	154	8	13	47	50
			Auto/ Mini Van	12	220	231	4	6	-	-
			Mini Bus	53	121	1022	3	5	-	-

A.2.3.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Pick-and-drop bays for all modes of transport are to be accommodated around the metro station and within the road RoW. The edge of the park along the footpath will accommodate these bays. An additional 814 Sqm of space is required for long term parking of 25 cars and 50 two wheelers. Refer Figure A- ***71***.

FIGURE A- 71 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



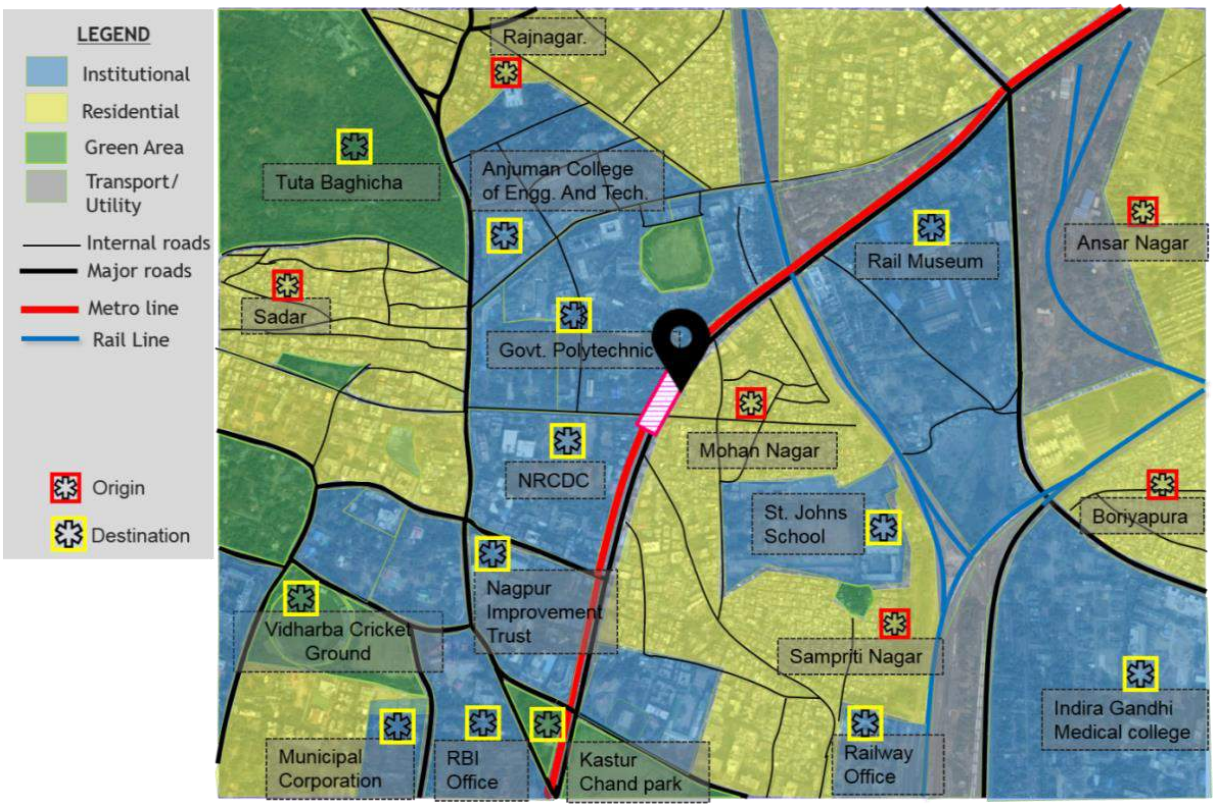
A.2.3.4 PROPOSAL FOR PILOT BICYCLE SHARING SCHEME AND URBAN PLACE MAKING AROUND KASTURCHAND PARK.

The area around Kasturchand Park is suitable for both – a pilot PBS scheme and an Urban Place Making exercise. Details of the PBS Sharing Scheme are part of Volume-III of this report and the pilot Urban Place Making scheme is in Appendix B.

A.2.4 GADDI GODAM SQUARE

Gaddi Godam Square metro station is flanked by institutional areas on its west and residential on its east. The Rail museum is located on the North Eastern side of the station. Refer Figure A- 72

FIGURE A- 72 : GADDI GODAM SQUARE METRO STATION CONTEXT



A.2.4.1 NMT IMPROVEMENTS AROUND GADDI GODAM SQUARE METRO STATION

The Gaddi Godam Square metro station is well connected to its surrounding area and shows possibility of a large user-base. It is therefore proposed that NMT facilities along all roads and junction in the areas be upgraded. Refer Figure A- 73.

FIGURE A- 73: NMT IMPROVEMENTS AROUND GADDI GODAM SQUARE METRO STATION

A.2.4.2 PICK AND DROP, PARKING REQUIREMENTS

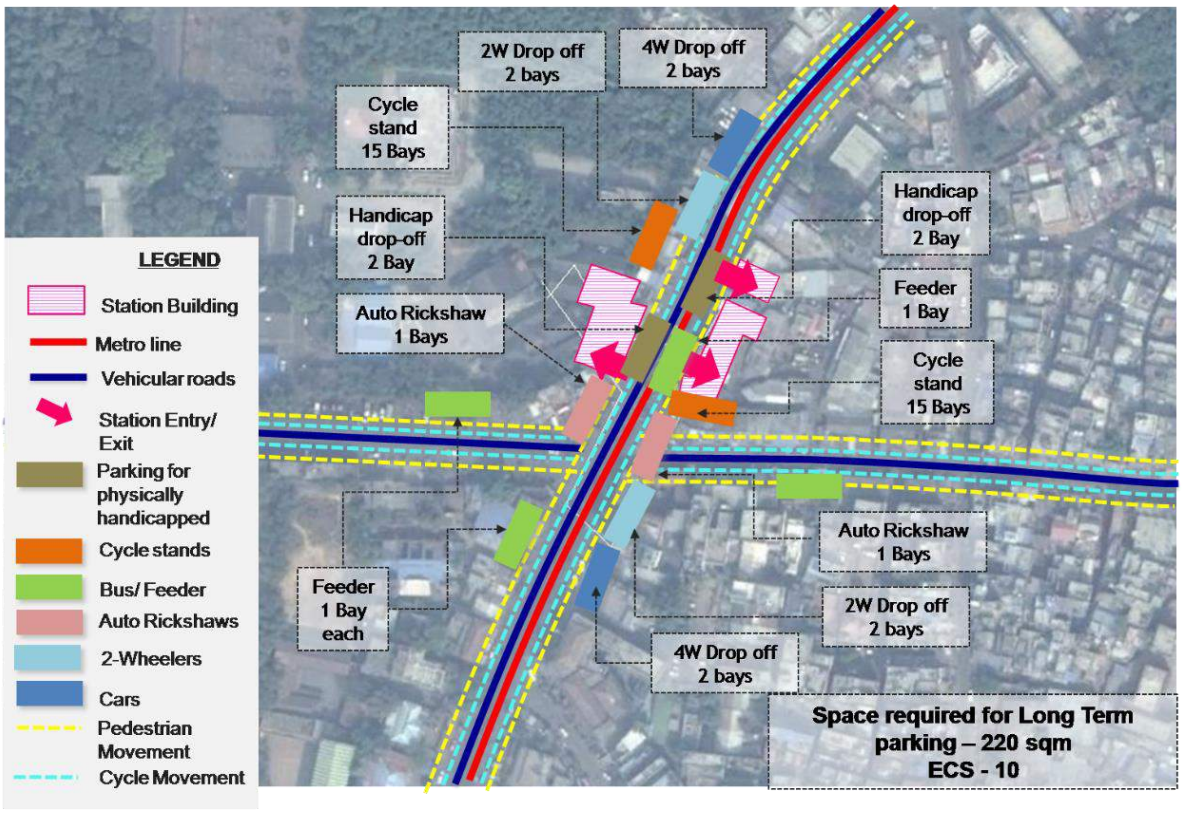
TABLE A- 18 : PARKING, PICK & DROP BAYS REQUIRED NEAR KADVI CHOWK METRO STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	1227	134	Car	5	8	14	2	3	4	7
2041	2562	279	TW	8	57	22	2	3	6	12
			Auto/ Mini Van	12	27	33	2	2	-	-
			Mini Bus	53	15	148	2	2	-	-

A.2.4.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

The station is planned close to Gaddi Godam Junction and the space for pick-and-drop facilities for all modes of transport including feeder services is allocated around the Chowk whereas auto rickshaw stands, bicycle docking facility etc, are proposed closer to the metro station. Refer Figure A- *74*.

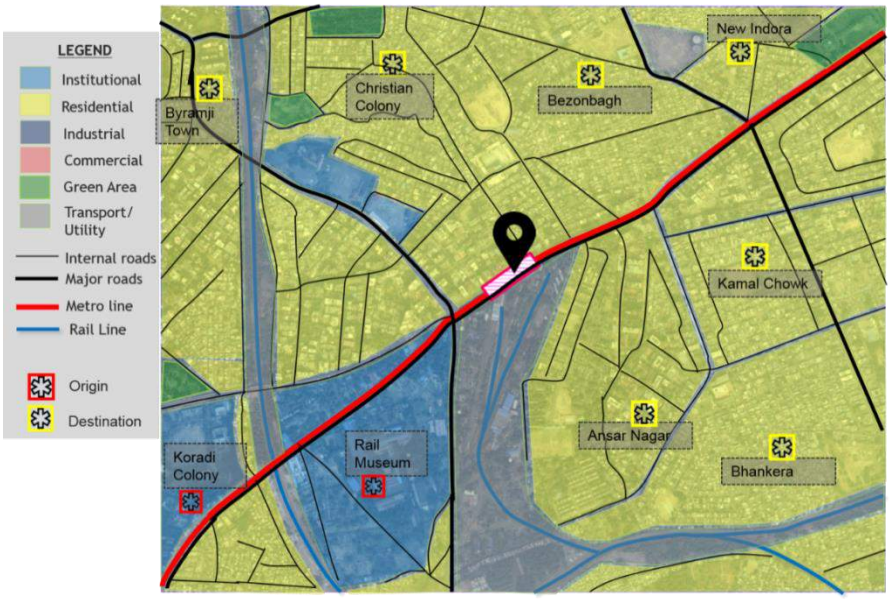
FIGURE A- 74 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.2.5 KADVI CHOWK

Kadvi Chowk metro station is located towards the east of Kadvi Chowk along the Kemptee road. The south and southwestern side of the station has railway land and the Rail Museum respectively. On all other sides are residential areas like Christian Colony, Bezonbagh, Ansal Nagar etc. Refer Figure A- **75**.

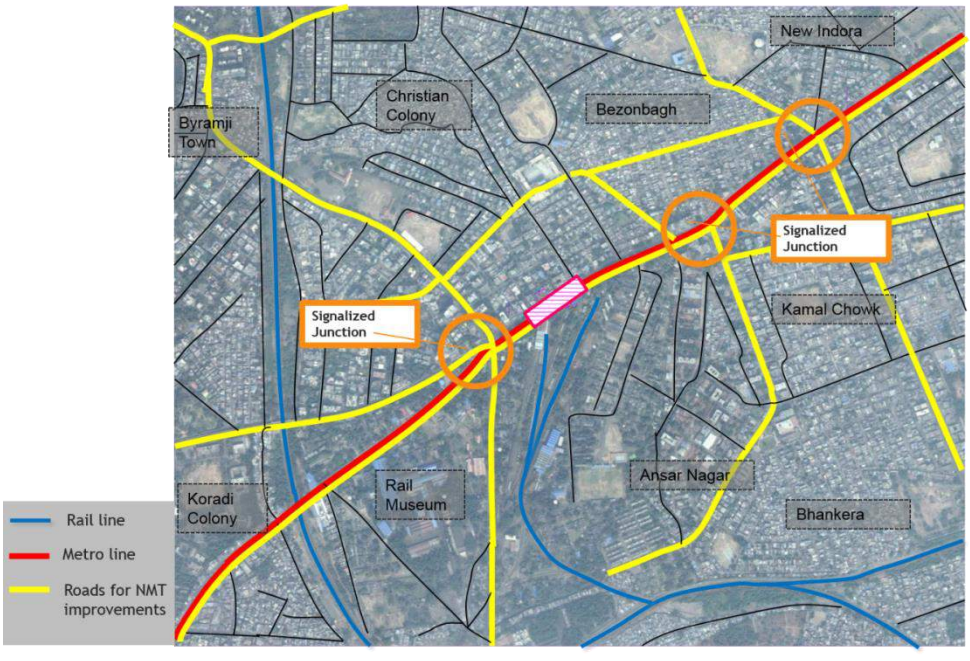
FIGURE A- 75: KADVI CHOWK METRO STATION CONTEXT



A.2.5.1 NMT IMPROVEMENTS REQUIRED AROUND KADVI CHOWK METRO STATION

Along Kemptee road near Kadvi Chowk station, Kadvi Chowk and Dus number Puliya Chowk require improvement of NMT infrastructure, traffic calming and signalized junctions. Refer Figure A- **76**.

FIGURE A- 76 : NMT IMPROVEMENTS REQUIRED AROUND KAVI CHOWK METRO STATION



A.2.5.2 PICK AND DROP, PARKING REQUIREMENTS

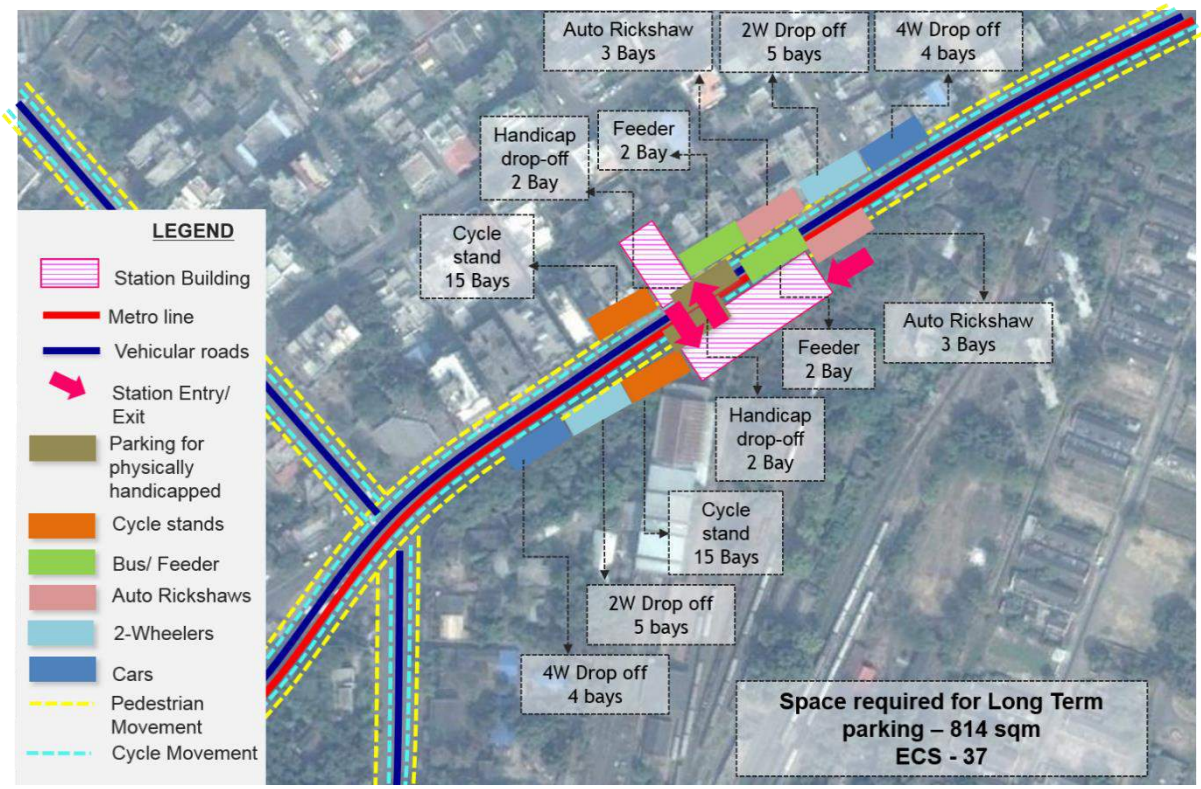
TABLE A- 19 : PARKING, PICK & DROP BAYS REQUIRED NEAR KADVI CHOWK METRO STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	8031	761	Car	5	50	73	5	7	23	25
2041	13355	1456	TW	8	373	116	7	10	37	50
			Auto/ Mini Van	12	173	175	4	5	-	-
			Mini Bus	53	95	772	3	4	-	-

A.2.5.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

The bus bays, auto rickshaw stands and bicycle-docking stations are to be integrated along the road. An additional space of 814 Sqm is necessary to accommodate long-term parking for 25 Cars and 50 two wheelers is required. Refer Figure A- 77

FIGURE A- 77 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.2.6 INDORA CHOWK:

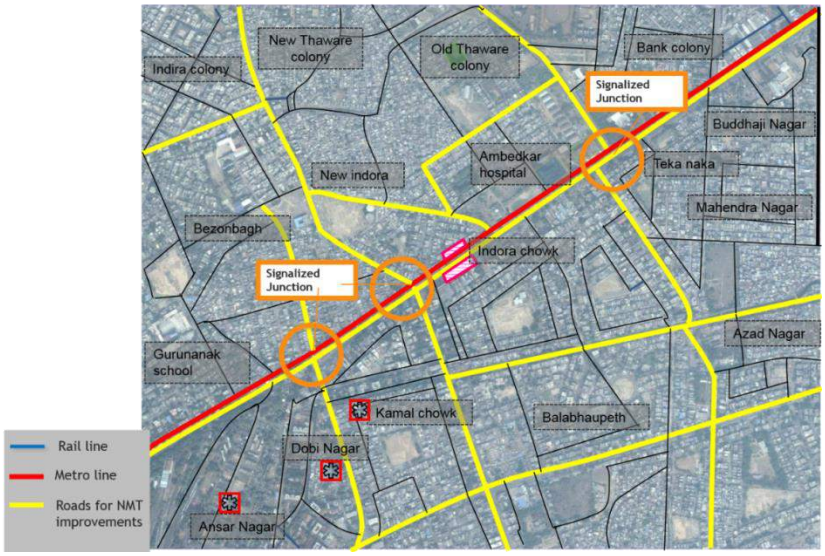
This metro station close to Indora Chowk is set amidst residential areas like New Indora, Balabhaupeth, Dobi Nagar etc. Ambedkar hospital is located to the northeast of the proposed station. Refer Figure A- *78*

FIGURE A- 78 : INDORA CHOWK METRO SATTION CONTEXT

A.2.6.1 NMT IMPROVEMENTS AROUND INDORA CHOWK METRO STATION

The area around Indora Chowk is compact where the main access is the Kamptee road. This area would require improvement of NMT infrastructure on the main and internal roads and in the junctions like Dus Puliya Chowk, Indora Chowk and Lal Godam. Refer Figure A- *79*.

FIGURE A- 79 : NMT IMPROVEMENTS AROUND INDORA CHOWK METRO STATION



A.2.6.2 PICK AND DROP, PARKING REQUIREMENTS

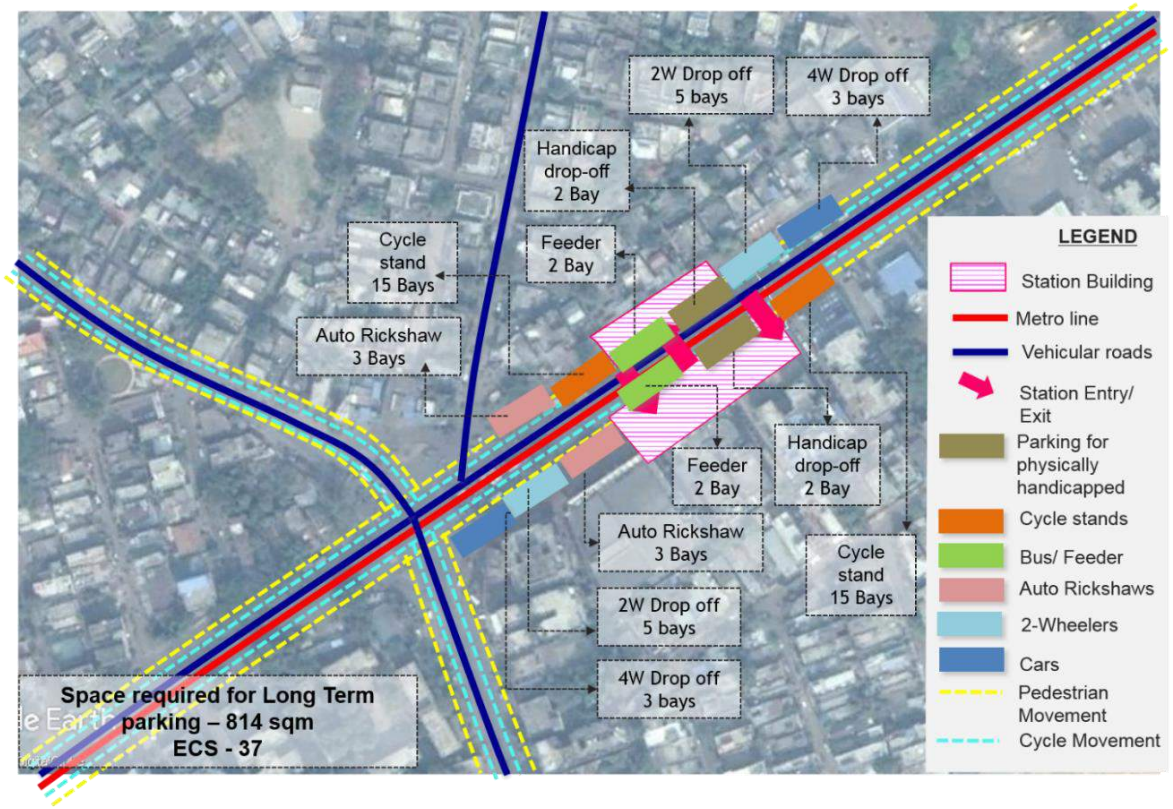
TABLE A- 20 : PARKING, PICK & DROP BAYS REQUIRED NEAR KADVI CHOWK METRO STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	6986	761	Car	5	43	68	4	6	20	25
2041	12417	1353	TW	8	324	108	6	9	32	50
			Auto/ Mini Van	12	151	162	3	5	-	-
			Mini Bus	53	83	717	3	4	-	-

A.2.6.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

The bus bays, auto rickshaw stands and bicycle-docking stations are proposed to be integrated along the road. An additional space of 814 Sqm is necessary if long term parking for 25 Cars and 50 two wheelers are to be accommodated and is to be provided by Maha Metro. Refer Figure A- ***80***.

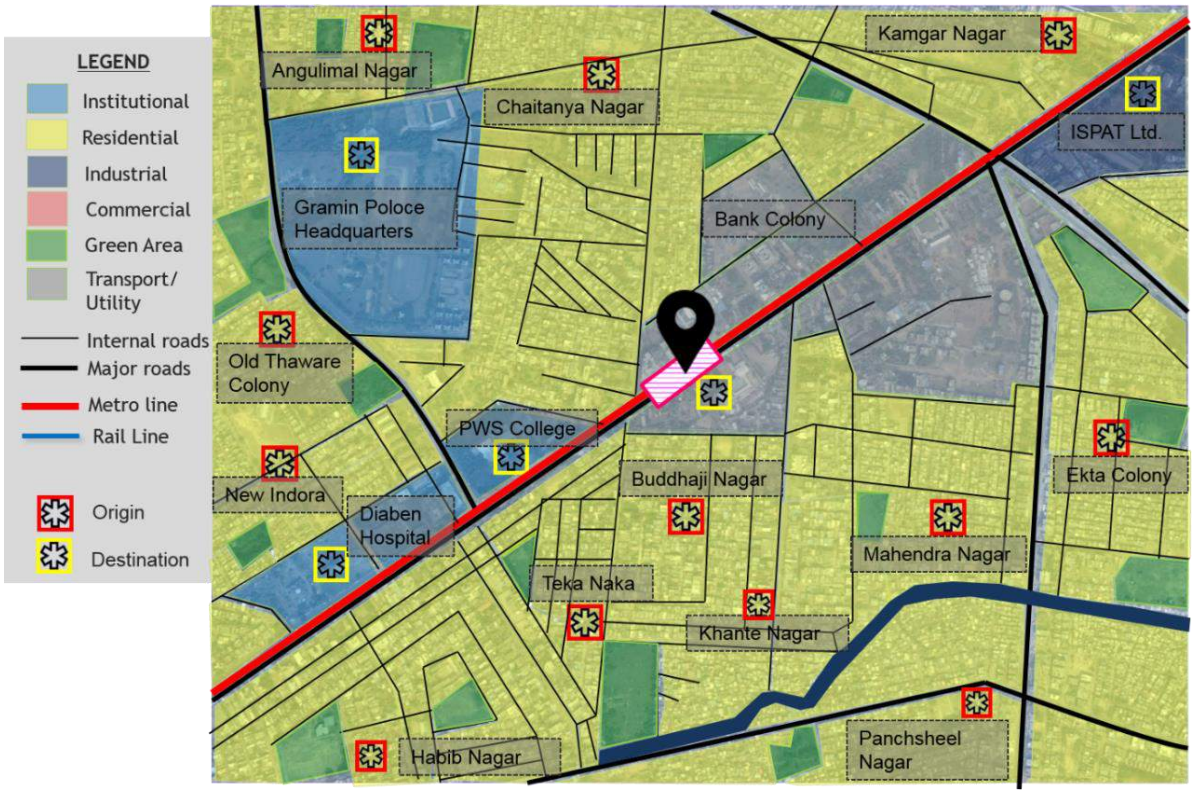
FIGURE A- 80 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.2.7 NARI ROAD STATION

Nari road metro station is located near the intersection of Nari with Kemptee road. It is surrounded by the residential area of Chaitanya Nagar, Old Thaware Colony, Bank Colony, Budhaji Nagar, Khante Nagar, Mahendra Nagar and Ekta Colony. Towards its northeast and along Kemptee road are some small-scale industrial units and on its southeast, along Kamptee road is the PWS College and Diaben Hospital. Refer Figure A- ***81***

FIGURE A- 81 : NARI ROAD METRO STATION CONTEXT

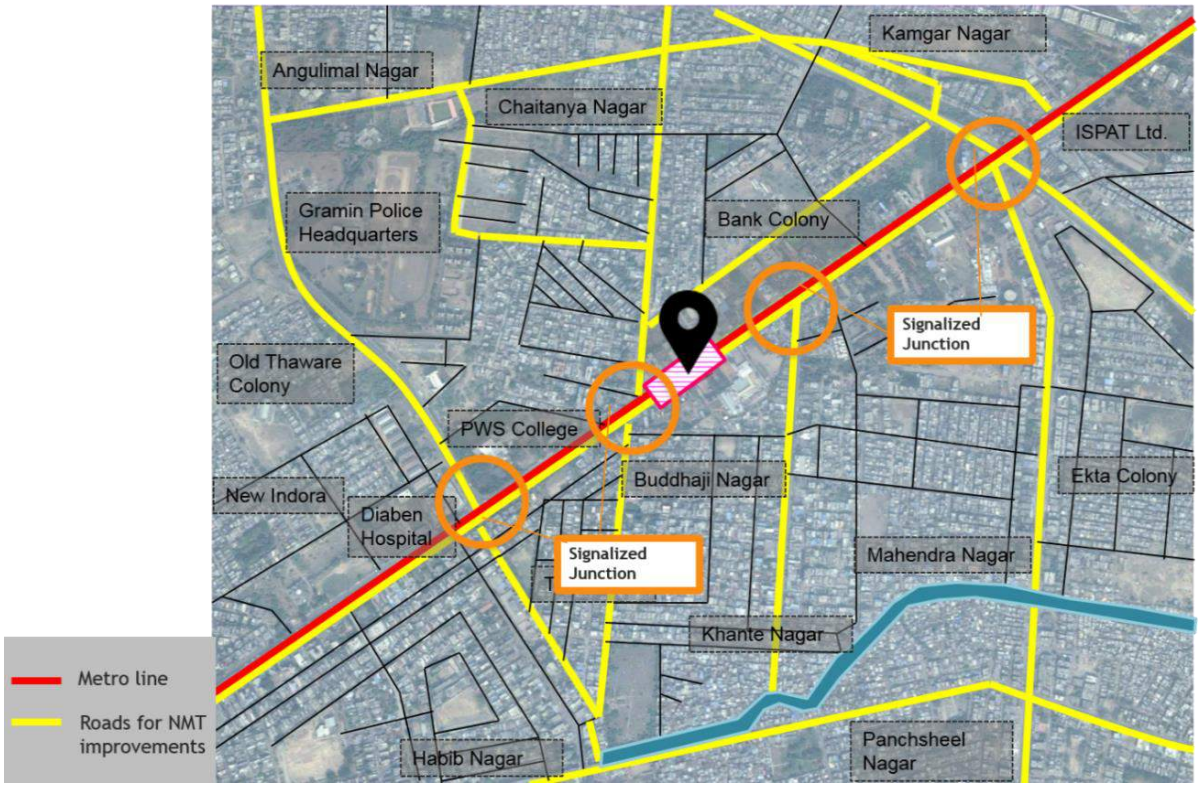


A.2.7.1 NMT IMPROVEMENTS REQUIRED AROUND NARI ROAD STATION

The areas around the station have institutional and industrial uses, necessitating access to residential areas through the junctions of Lal Godam, Rani Durgawati Chowk, Teka Naka, Gurudwara Road and Sharda Chowk. This is both inconvenient and adds to the travel distance and time. To resolve the same, the junctions are to be provided with NMT priority.

The junction of Rani Durgawati Chowk is in close proximity to Teka Naka Chowk and their improvements are to be done simultaneously based on a comprehensive scheme. Refer Figure A- ***82***.

FIGURE A- 82 : NMT IMPROVEMENTS REQUIRED AROUND NARI ROAD STATION



A.2.7.2 PICK AND DROP, PARKING REQUIREMENTS

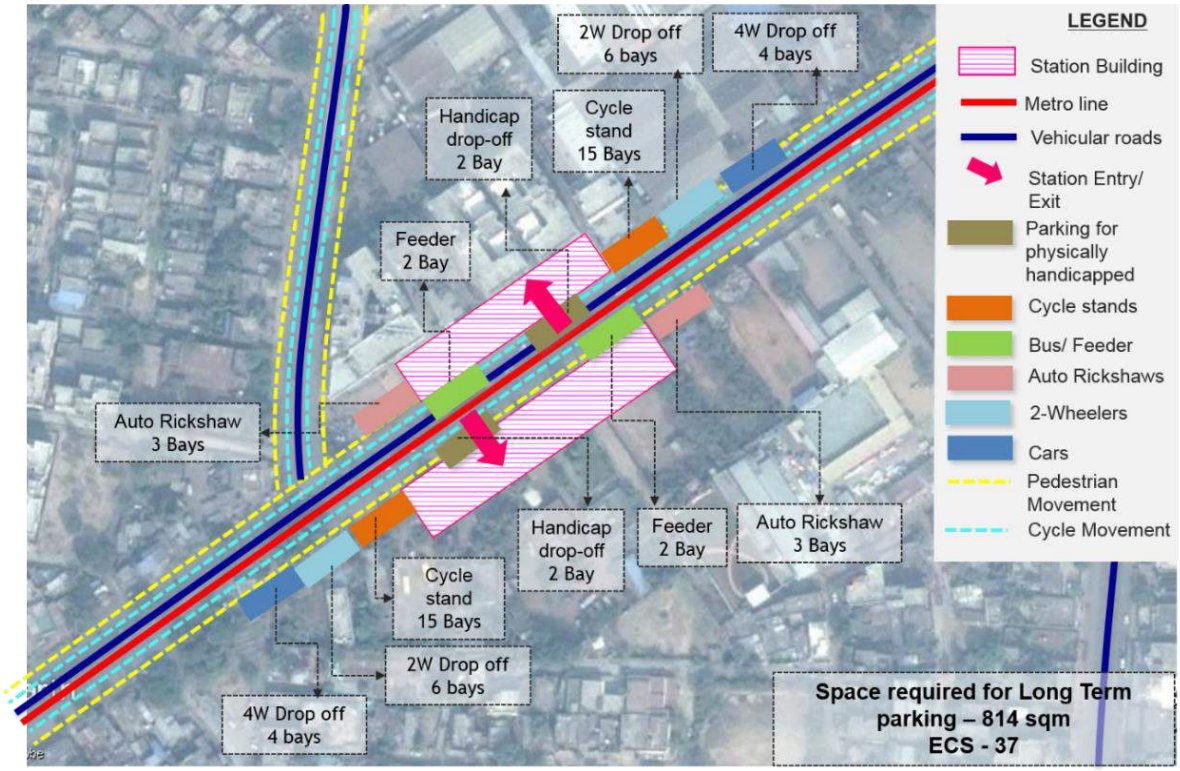
TABLE A- 21 : PARKING, PICK & DROP BAYS REQUIRED NEAR NARI ROAD STATION

Year	Passengers (boarding – alighting)		Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	7241	789	Car	5	45	84	4	8	21	25
2041	15415	1680	TW	8	336	134	6	11	33	50
			Auto/ Mini Van	12	156	202	3	6	-	-
			Mini Bus	53	86	890	3	4	-	-

A.2.7.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

The bus bays, auto rickshaw stands and bicycle-docking stations are to be integrated along the road. An additional space of 814 Sqm is necessary to provide long-term parking for 25 four-wheelers and 50 two-wheelers and may be provided by Maha Metro. Refer Figure A- ***83***

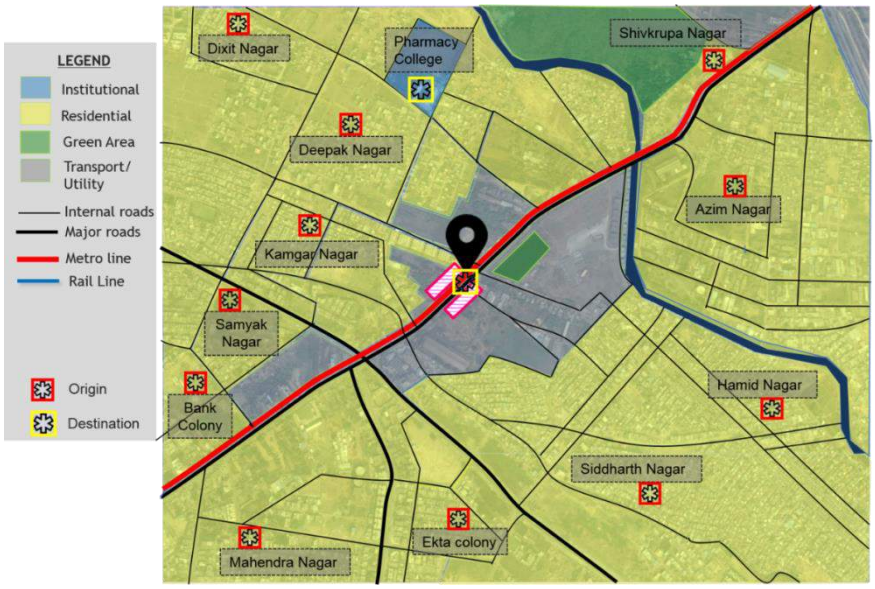
FIGURE A- 83 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.2.8 AUTOMOTIVE SQUARE

Automotive Square metro station is the last station on Reach-2. The surrounding area is flanked by industrial and beyond which is residential areas of Siddharth Nagar, Samyak Nagar, Ekta Colony, Kamgar Nagar, Deepak Nagar, Azim Nagar, etc. Refer Figure A- ***84***.

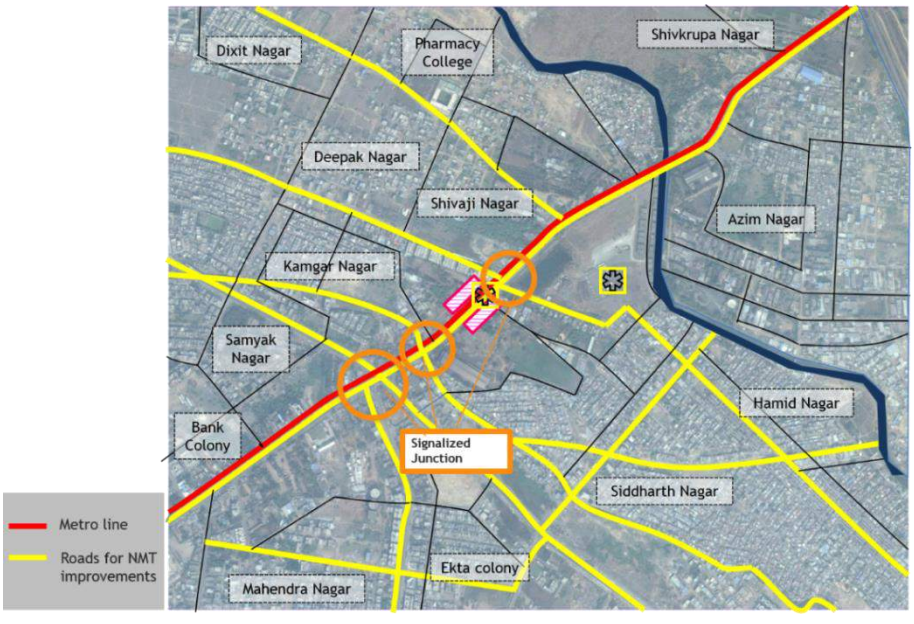
FIGURE A- 84 : AUTOMOTIVE SQUARE METRO STATION CONTEXT



A.2.8.1 NMT IMPROVEMENTS AROUND AUTOMOTIVE SQUARE METRO STATION

All major junctions around the station and road network require improvement of NMT infrastructure as per NMT Master Plan. Refer Figure A- ***85***.

FIGURE A- 85 : NMT IMPROVEMENTS AROUND AUTOMOTIVE SQUARE METRO STATION



A.2.8.2 PICK AND DROP, PARKING REQUIREMENTS

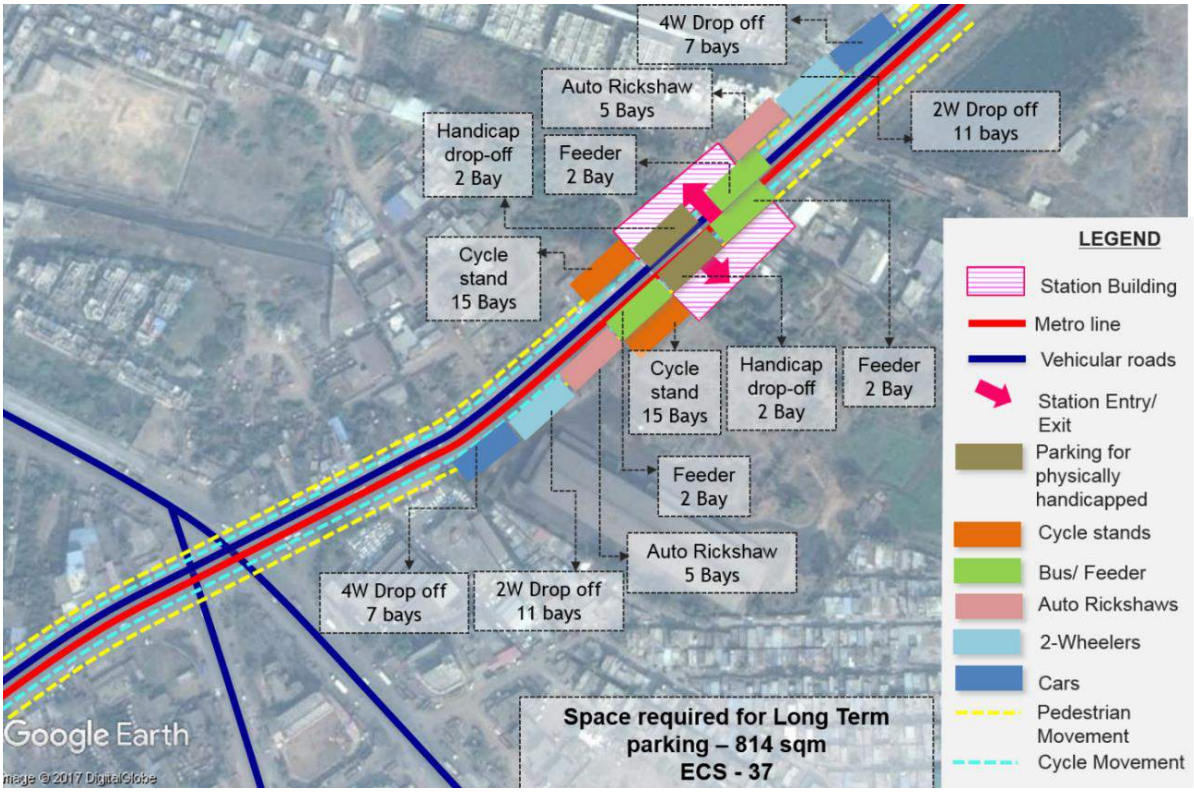
TABLE A- 22 : PARKING, PICK & DROP BAYS REQUIRED NEAR AUTOMOTIVE SQUARE STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement					
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	15529	1693	Car	5	97	174	8	14	25	25
2041	31977	3485	TW	8	721	279	11	22	50	50
			Auto/ Mini Van	12	335	418	16	10	-	-
			Mini Bus	53	185	1847	4	7	-	-

A.2.8.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

The bus bays, auto rickshaw stands and bicycle docking stations are proposed to be integrated along the road. Additional space of 814 Sqm to accommodate long term parking for 25 Cars and 50 two wheelers is to be provided by Maha Metro. Refer Figure A- ***86***

FIGURE A- 86 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



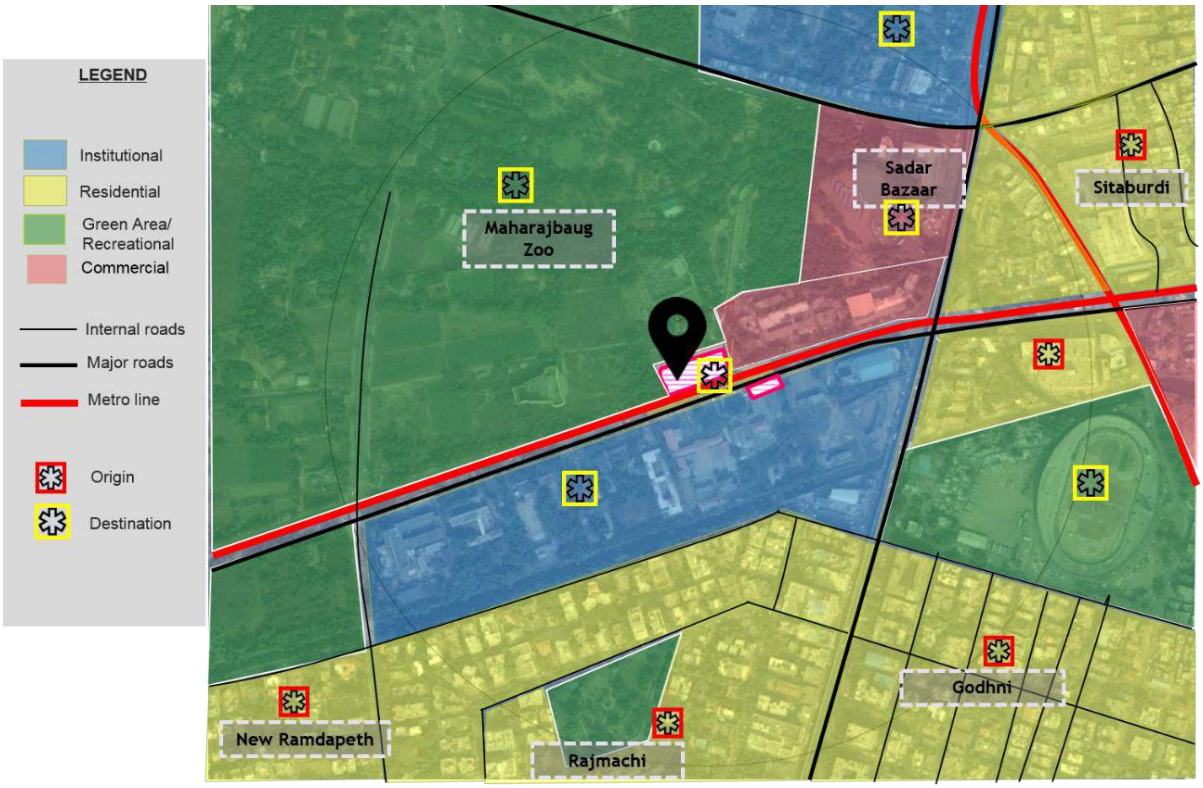
A.3 PROPOSALS FOR REACH-3 STATIONS

This section contains proposals for all stations of Reach-3 of Nagpur Metro.

A.3.1 JHANSI RANI STATION

Jhansi Rani Station, near Rani Jhansi Square is located near the Maharajbagh Zoo,institutions like Seva Sadan High school and Andhra bhawan and is connected by private and state transport buses. The station lies further west of the road that borders the western fringe of Sitabuldi and connects residential areas like New Ramdaspeth, Rajmachi,Godhni and Sadar Bazar. Refer Figure A- ***87***

FIGURE A- 87 : JHANSI RANI METRO STATION CONTEXT



A.3.1.1 CONNECTIVITY REQUIREMENTS

Together with Variety Junction, the Rani Jhansi is connected to Munjhe Chowk and planned pedestrianization will allow deeper penetration into Sitabuldi and surrounding areas. To ensure seamless access, any plan (for Eg to pedestrianize the area) and its implementation for the section connecting Munjhe and Rani Jhansi Chowks with Sitabuldi, must be done as a single unit.

To ensure safe passage across critical junctions along the road network, signalized cross over points are necessary. This includes, a pedestrian crossing under the station for metro users to access areas across over the road. Refer Figure A- ***88***

FIGURE A- 88 : NMT IMPROVEMENTS AROUND RANI JHANSI METRO STATION

A.3.1.2 PICK AND DROP, PARKING REQUIREMENTS

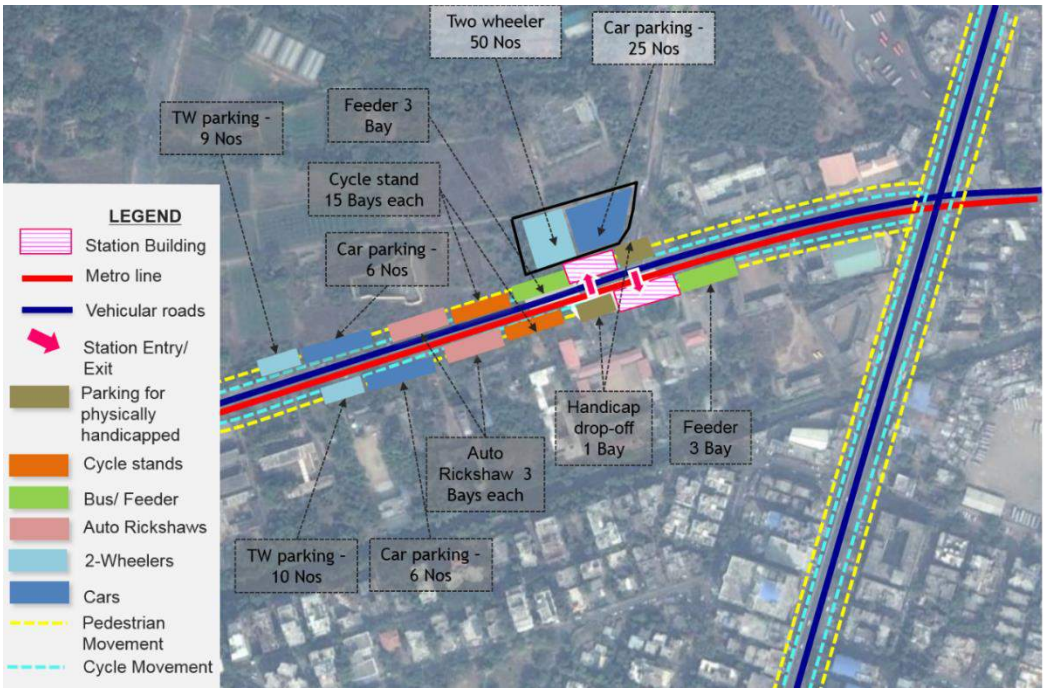
TABLE A- 23 : PARKING, PICK & DROP BAYS REQUIRED NEAR RANI JHANSI STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement					
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	17031	1856	Car	5	93	168	8	12	25	25
2041	26991	2942	TW	8	149	1253	12	19	50	50
			Auto/ Mini Van	12	12	583	6	9	-	-
			Mini Bus	53	954	321	4	6	-	-

A.3.1.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stand and bicycle-docking stations are to be integrated along the road while that to park two and four wheelers is allocated to the north of the metro station by NMRCL.

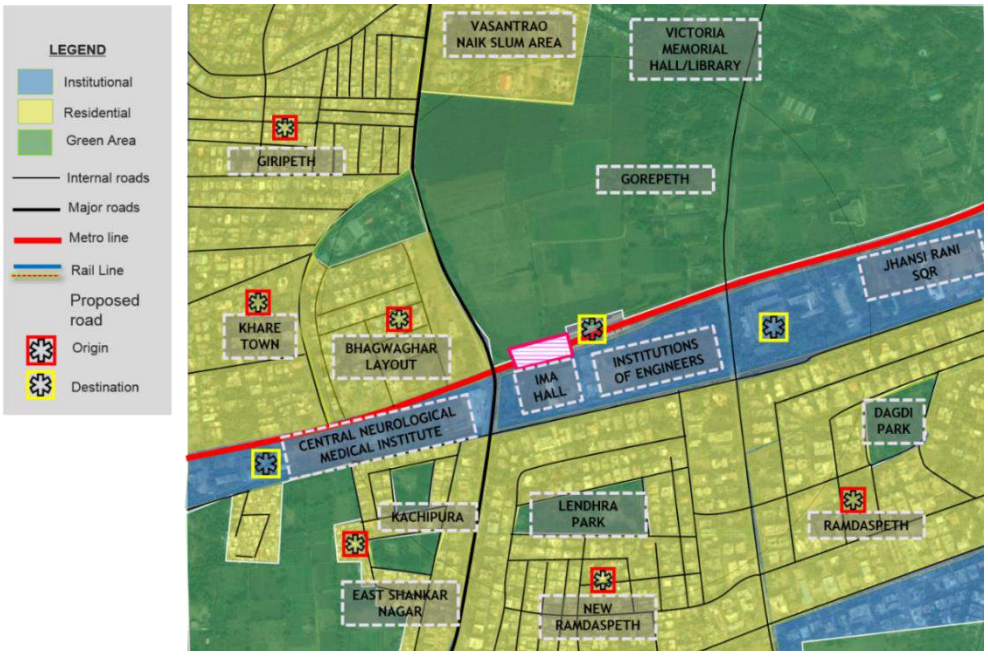
FIGURE A- 89 : CONCEPTUAL CONCEPTUALLOCATION OF PICK AND DROP, PARKING FACILITY



A.3.2 INSTITUTE OF ENGINEER'S STATION

This station is located between Senpati bapat and Alankar Chowks and surrounded by institutional and residential areas. On its northwest is residential areas like Khare Town, Bhagwaghar Layout while on the northeast is Gorepeth. Immediately to the south of the station is an institutional area comprising Central Neurological Medical Institute, IMA Hall and Victoria Memorial Library. Further south to it is the residential areas of Ramdaspeth and New Shankar Nagar. Refer Figure A- ***90***.

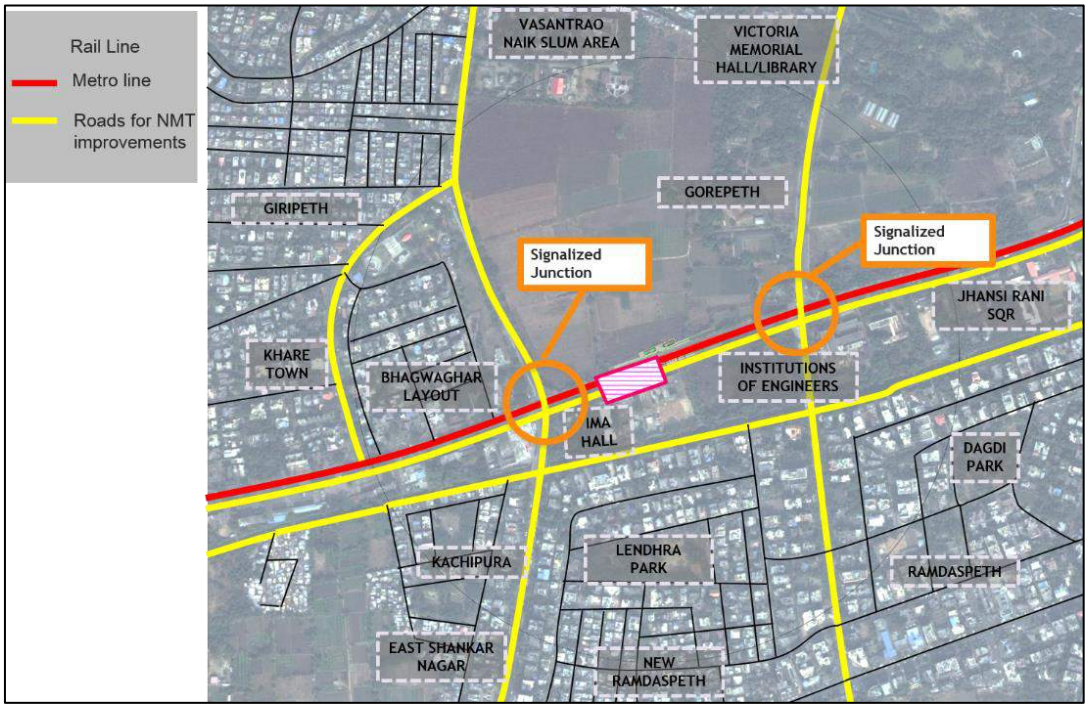
FIGURE A- 90 INSTITUTE OF ENGINEERS METRO STATION CONTEXT



A.3.2.1 CONNECTIVITY IMPROVEMENTS:

The area and access leading to Senpati bapat Chowk and Alankar Chowk requires improvement of NMT infrastructure. Refer Figure A- ***91***.

FIGURE A- 91 : NMT IMPROVEMENTS AROUND IOC METRO STATION



A.3.2.2 PICK AND DROP, PARKING REQUIREMENTS

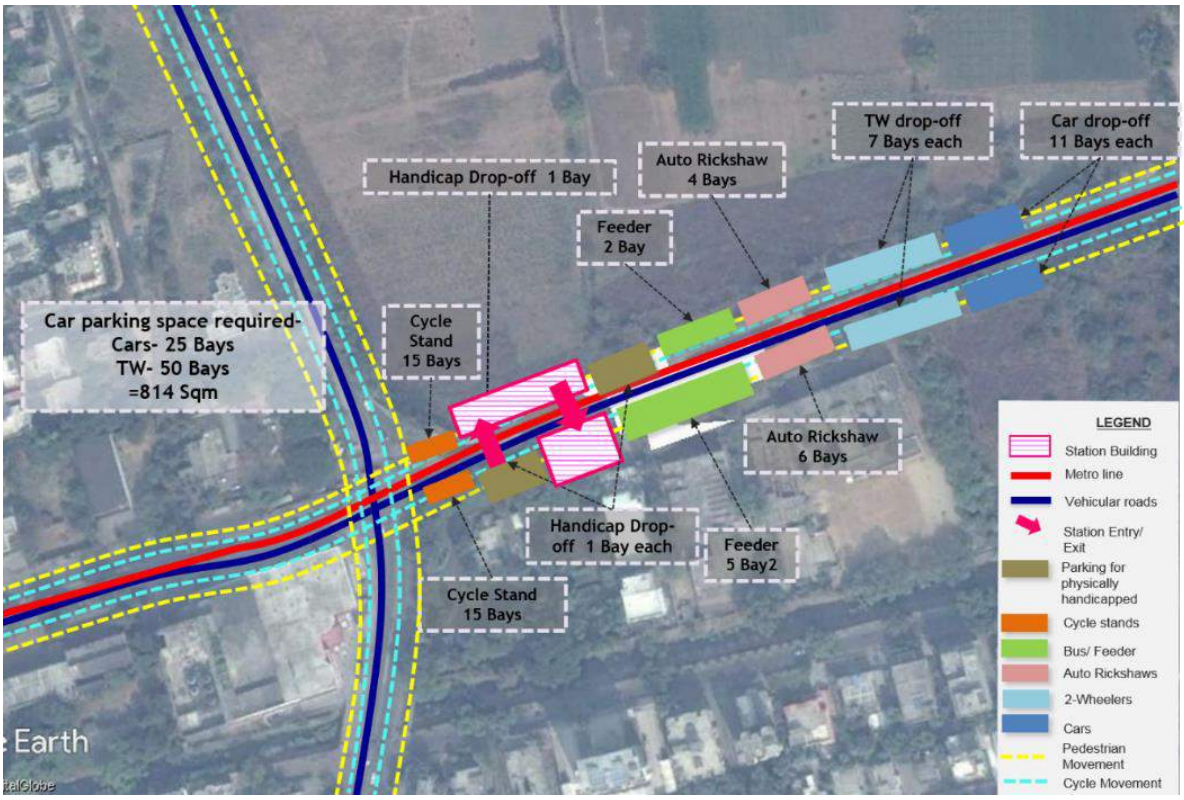
TABLE A- 24 : PARKING, PICK & DROP BAYS REQUIRED NEAR RANI JHANSI STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement					
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	23662	2579	Car	5	129	173	11	14	25	25
2041	31749	3461	TW	8	206	277	17	22	50	50
			Auto/ Mini Van	12	310	415	8	10	-	-
			Mini Bus	53	1367	1834	6	7	-	-

A.3.2.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stand and bicycle-docking stations are to be integrated along the road. An additional space of 814 Sqm is necessary for long term parking of 25 four and 50 two wheelers and may be provided by Maha Metro where needed.

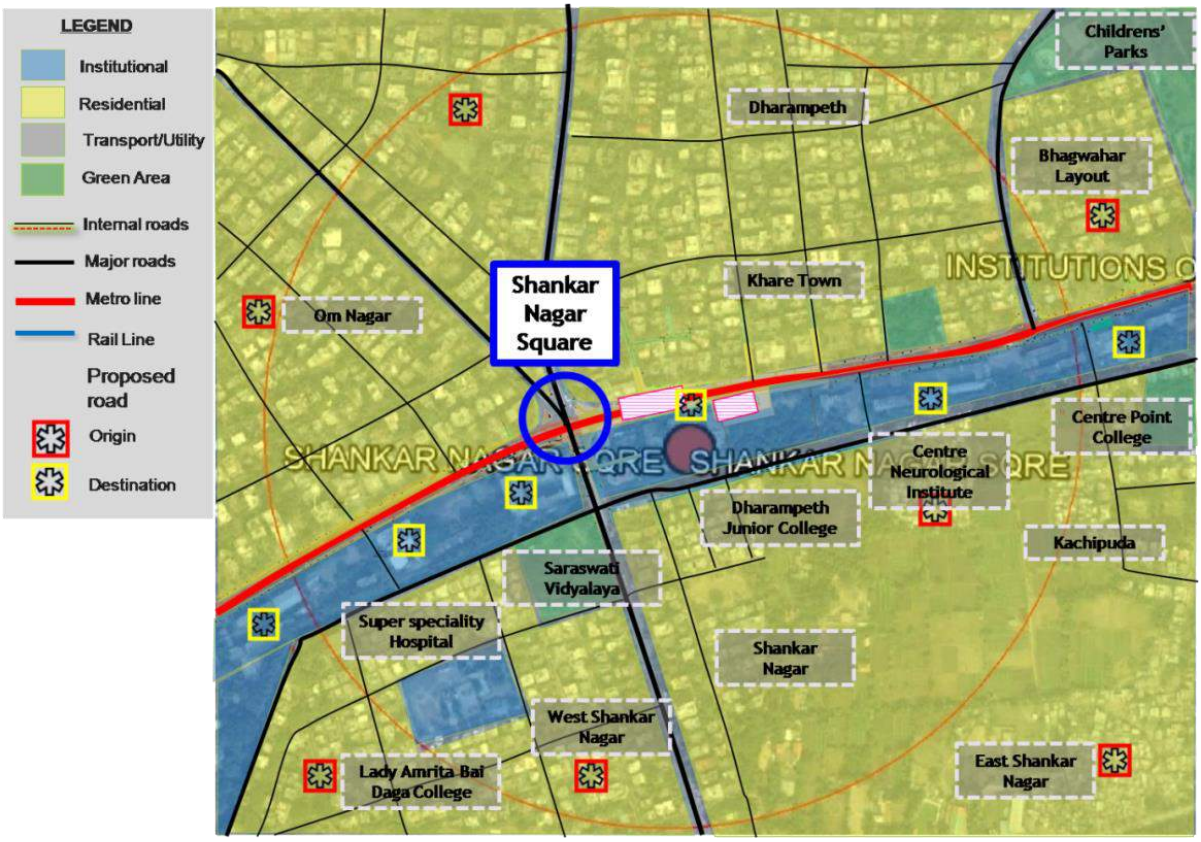
FIGURE A- 92 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.3.3 SHANKAR NAGAR STATION

This station is located along the Ambazari Road and is near the junction between the latter and West High Court Road. The area to the north of the station and Ambazari road is predominantly residential whereas to the south, a row of institutional plots separates it from residential areas further south. Refer Figure A- *93*

FIGURE A- 93 : LANDUSE AROUND SHANKAR NAGAR SQUARE STATION



A.3.3.1 CONNECTIVITY ISSUES

Perpendicular to the metro corridor (aligned along Ambazari Road) are feeder roads at every 200-250m. This provides the necessary connectivity between the metro and surrounding catchment area and increased options of walking and bicycling routes.

Shankar Nagar Square is the most important junction to the west of station. It would require improved geometric design to streamline traffic and ensure NMT priority.

A.3.3.2 PARKING REQUIREMENT

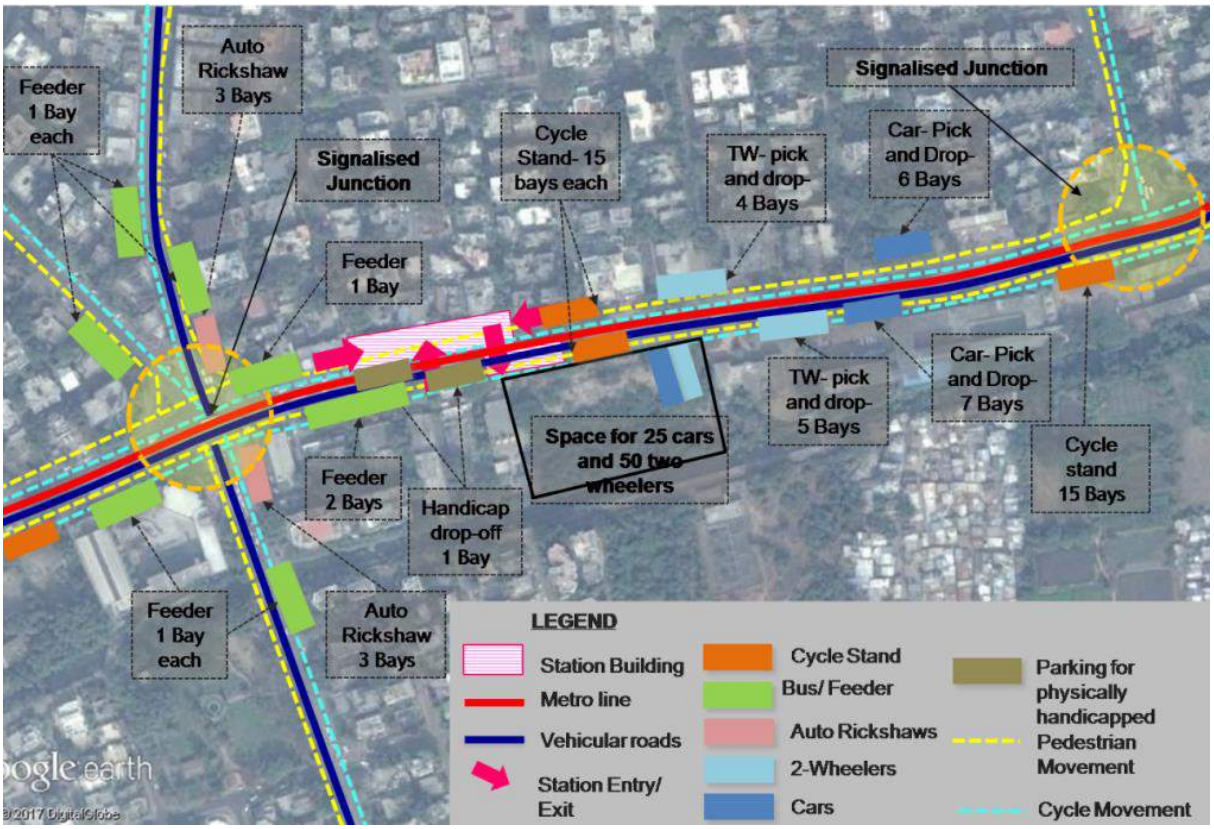
TABLE A- 25 : PARKING, PICK & DROP BAYS REQUIRED NEAR SHANKAR NAGAR SQUARE STATION

Passengers (boarding – alighting)			Mode	Mode split (2041)	Parking, Pick & Drop Bays Requirement					
					Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	13584	1481	Car	5	74	101	7	9	25	25
2041	18443	2010	TW	8	118	161	10	13	50	50
			Auto/ Mini Van	12	178	241	5	6	-	-
			Mini Bus	53	785	1065	4	5	-	-

A.3.3.3 CONCEPTUAL LOCATIONS OF PICK AND DROP, PARKING FACILITIES

The Shankar Nagar Square is a busy 5-arm intersection where locating feeder routes are along its four arms and pick-and-drop bays for other modes is a major concern. The Figure A- ***94*** shows the proposed locations of bus bays, auto rickshaw stands, bicycle docking stations pick-anddrop points for private vehicles. These are integrated with the road while the long-term 50 two and 25 four-wheeler parking will be allocated by Maha Metro. The latter requires 814 sqm. space for surface parking.

FIGURE A- 94 : CONCEPTUAL LOCATION OF PICK AND DROP AROUND SHANKAR NAGAR STATION



A.3.4 LAD CHOWK STATION

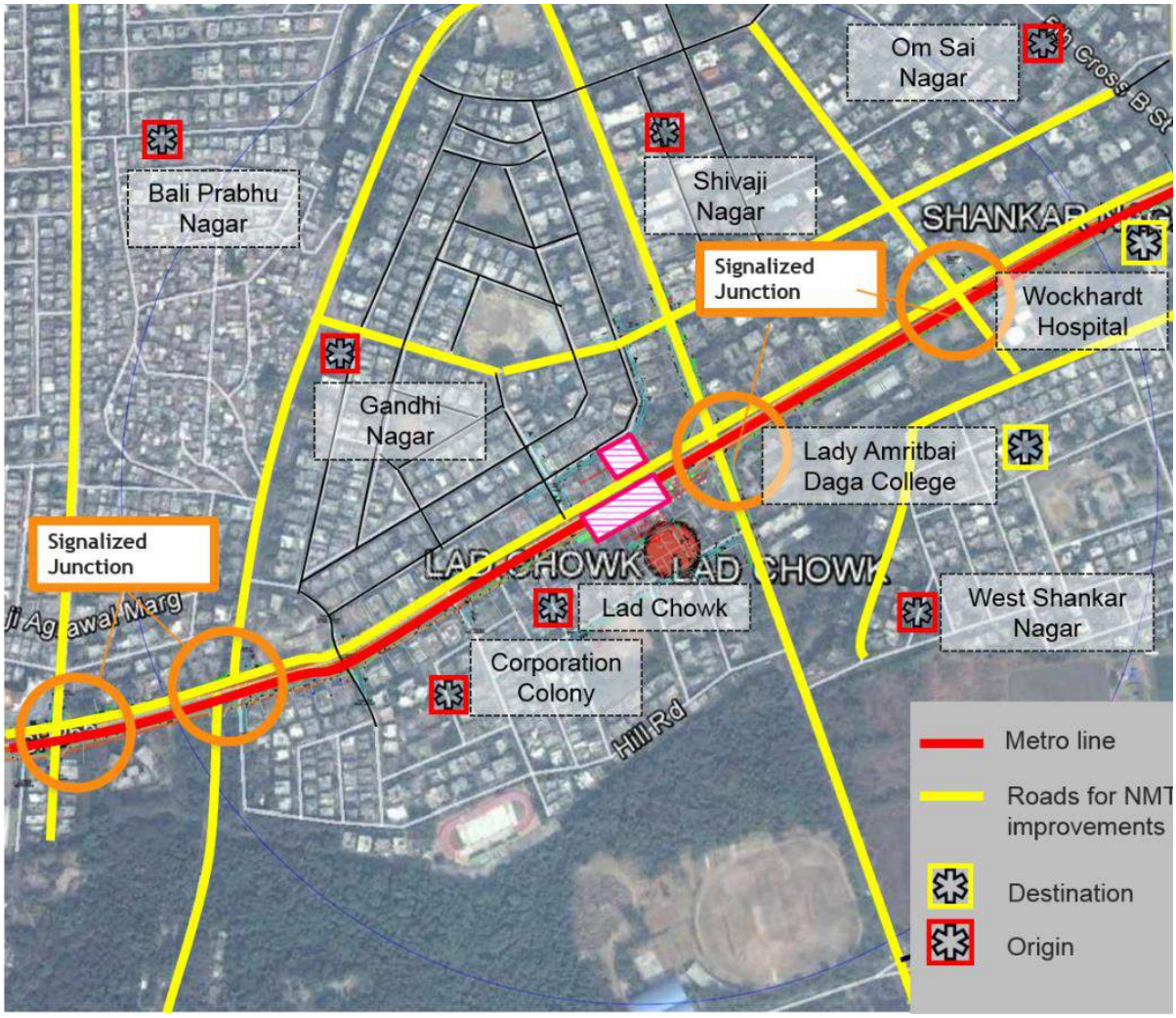
This station is located along Ambazari Road and to the west of Lady Amritbai Daga College and is set amidst residential areas of Gandhi Nagar, Bali Prabhu Nagar, Shivaji Nagar, Vasant Shankar Nagar and Corporation Colony. The VNIT ground is 200m to the south of the station. Refer Figure A- ***95***

FIGURE A- 95 : LAD CHOWK METRO STATION CONTEXT

A.3.4.1 CONNECTIVITY IMPROVEMENTS

The dense networks routes of Gandhi Nagar Square, Shivaji Nagar Junction, Hill road-Ambazri road junction and Bali Prabhu Nagar junction require signalized intersections and relevant improvements to NMT infrastructure. This will encourage walking and bicycling to the Metro Station and maximize outdoor experience. Refer Figure A- ***96***.

FIGURE A- 96 : NMT IMPROVEMENTS AROUND LAD CHOWK STATION



A.3.4.2 PICK-AND-DROP, PARKING REQUIREMENTS

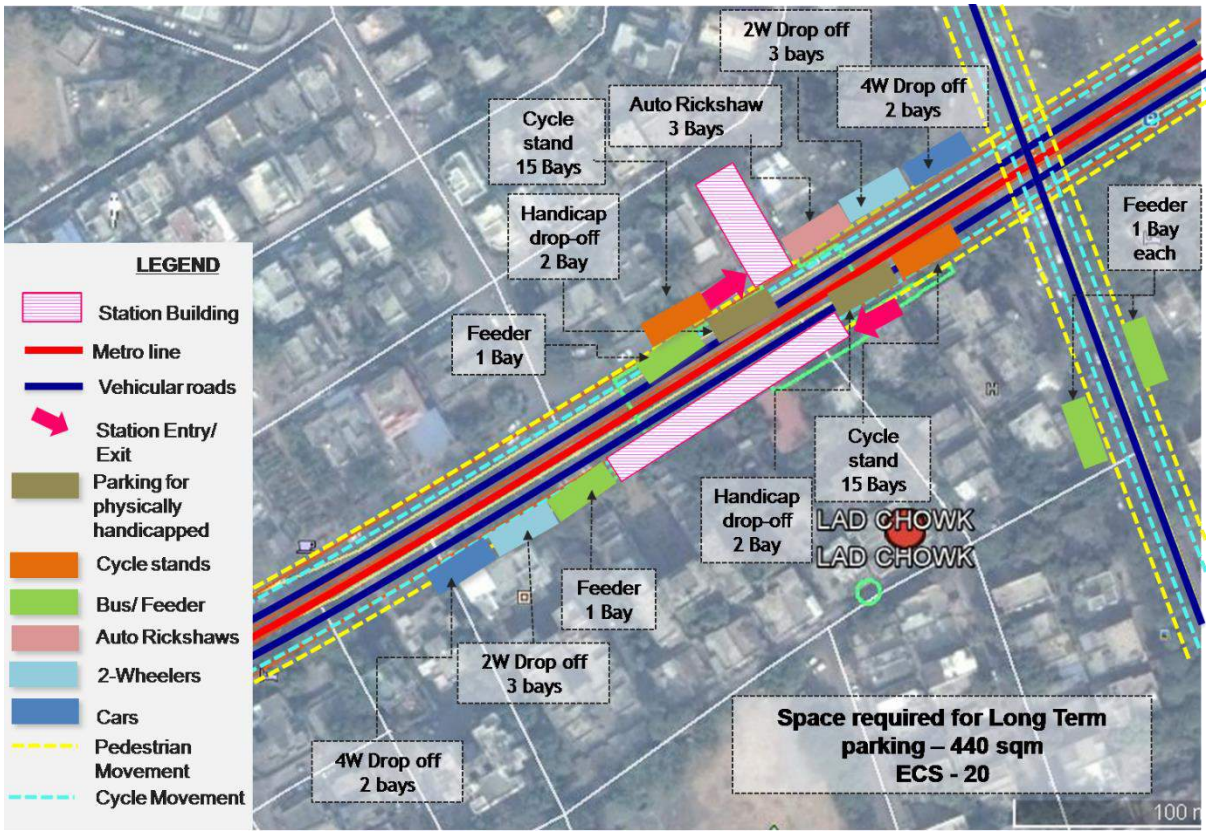
TABLE A- 26 : PARKING, PICK-&-DROP BAYS REQUIRED NEAR LAD CHOWK STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	3506	382	Car	5	19	28	3	4	10	15
2041	5136	560	TW	8	31	45	5	6	16	23
			Auto/ Mini Van	12	46	67	3	3	-	-
			Mini Bus	53	203	297	2	3	-	-

A.3.4.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for Bus bays, auto rickshaw stand and bicycle-docking stations are to be integrated with the road space while that for two and four wheeler parking will be allocated by Maha Metro. An additional space of 440 Sqm. for long-term parking of 15 four and 23 two wheelers may be provided by Maha Metro.

FIGURE A- 97 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

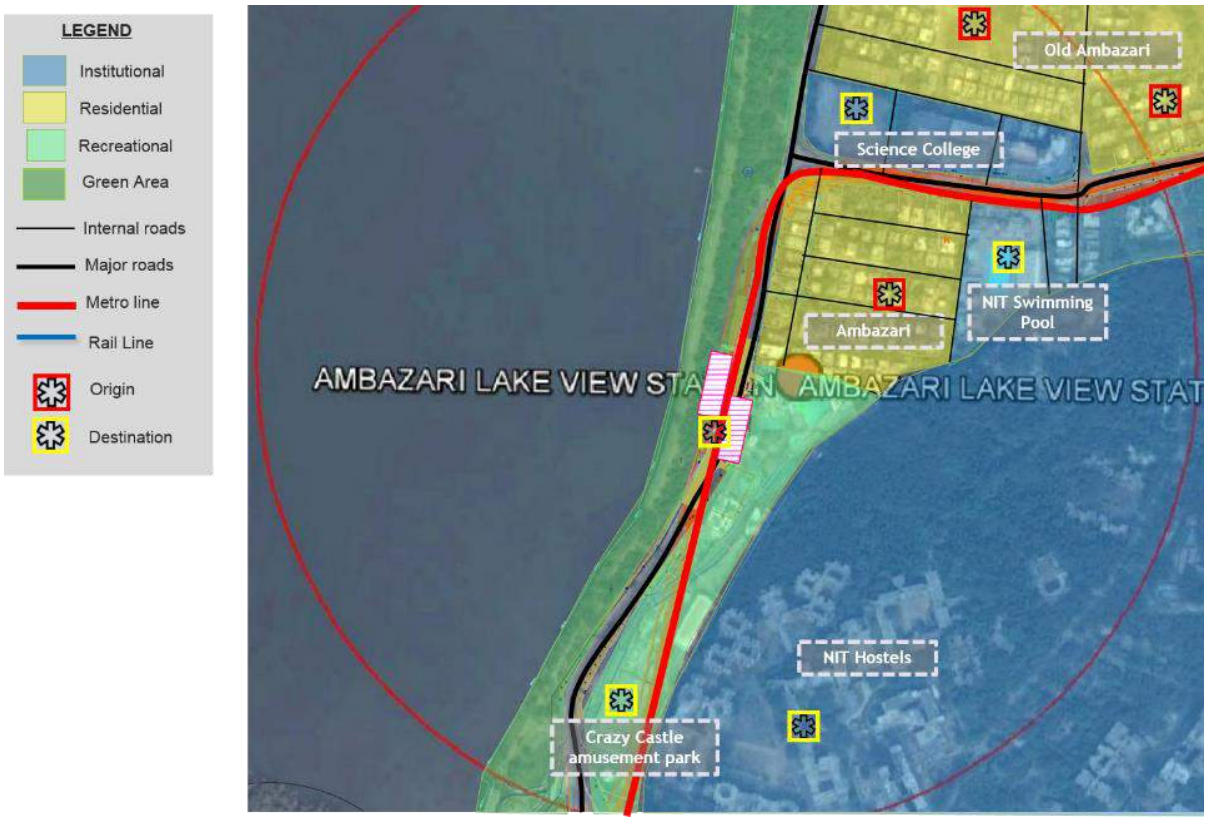


A.3.5 AMBAZARI LAKE/ DHARAMPETH STATION

A.3.5.1 CONTEXT

This station flanked by green areas, is to the west of Ambazari Lake and is north of Crazy Castle Entertainment Park. Beyond the green area and to its southeast are the hostels of VNIT Institute, Science College. To its northeast are the residential areas of new Ambazari and further beyond is Old Ambazari. Refer Figure A- ***98***. These are expected to provide both weekend/holiday and daily footfall of prospective riders to metro.

FIGURE A- 98: USE AROUND DHARAMPETH STATION



A.3.5.2 SUMMARY OF ACCESSIBILITY ISSUES

1. Absence of defined entry/ exit to the lakefront
2. Lack of a footpath with requisite width connecting metro entry/ exit to Crazy Castle

A.3.5.3 PICK AND DROP, PARKING FACILITY REQUIRED

TABLE A- 27 : PARKING, PICK & DROP BAYS REQUIRED NEAR DHARAMPETH STATION

Passengers (boarding – alighting)	Parking, Pick & Drop Bays Requirement				
	Mode	Mode split (2041)	Total passengers	Drop off requirement	Parking Requirement

Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	2711	295	Car	5	15	22	3	3	8	11
2041	4002	436	TW	8	24	35	3	4	12	18
			Auto/ Mini Van	12	35	52	2	3	-	-
			Mini Bus	53	156	231	2	2	-	-

A.3.5.4 PROPOSALS

A. CONNECTIVITY IMPROVEMENTS

Considering proposed landuse direct entry/ exit from the metro station to the Lake front is necessary and a continuous footpath of requisite width connecting it to Crazy Castle is essential. The former is necessary to support Urban Place making schemes along the lake-edge. For the latter, the space occupied by parking can be reclaimed to construct footpaths with cycle tracks.

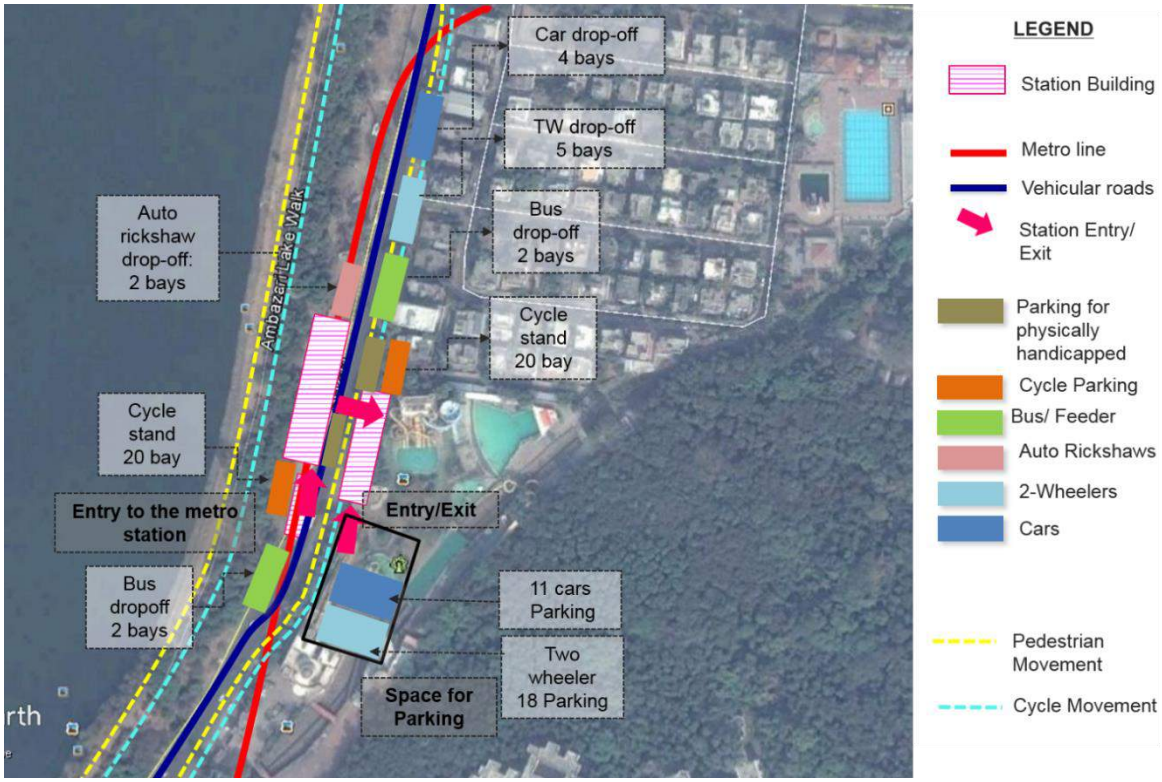
An additional entry/ exit is essential near the existing junction that is in front of the Science College and is flanked by Old and New Ambazari.

FIGURE A- 99 : PROPOSED ADDITIONAL ENTRY/ EXITS

A.3.5.5 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITIES

This station will be serving the proposed the improved lakefront and is expected to see a surge in footfall. Space for bus bays, parking-and-drop-off, auto rickshaw stands and bicycle-docking stations need to be integrated along the road and additional space for two and four wheeler parking to be allocated by NMRCL. Space for additional long-term parking can be accommodated under footprint of the elevated station.

FIGURE A- 100 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



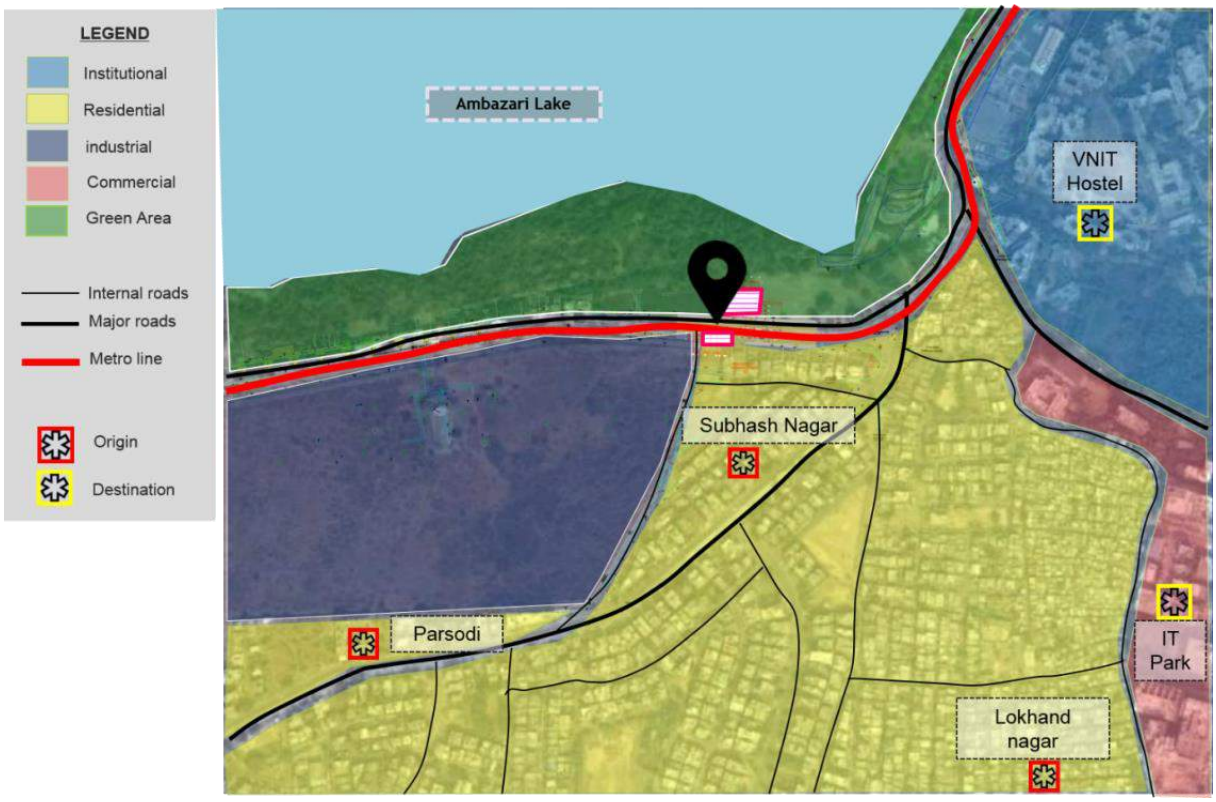
A.3.5.6 PLACE MAKING PROPOSAL

The edge of the Ambazari Lake has the potential for public-place-making to add value to the area. In support of the same, it is proposed to develop its access corridors with NMT priority. The proposal is part of Appendix-B.

A.3.6 SUBHASH NAGAR STATION

This station is near Subhash Chandra Bose Chowk and is to the south of the green area bordering Ambazari Lake where the Ambazari Lake walkway terminates. To the south of the station are residential areas of Subhash Nagar, Lokand nagar and Shastri Nagar. The station stands in close proximity to Subhash Nagar and Netaji Subhash Chandra Chowks. Refer Figure A- ***101***.

FIGURE A- 101 : CONTEXT OF SUBHASH NAGAR STATION



A.3.6.1 CONNECTIVITY IMPROVEMENTS

Ambazari- Hingna road, South Ambazari Road, Jaitala road and Kadu road are the main access roads to the Station. Subhash Nagar and Netaji Subhash Chandra Chowks are important junctions leading to the metro station. The aforementioned roads and junctions require improvements of NMT-based infrastructure and to ensure its priority.

To reduce travel distance and time to Subhash Nagar and Shastri Nagar Layout from the Station an additional road needs to be constructed to connect it with Jaitala road. This can be done by acquiring the vacant land to the southwest of the station to widen existing road. All details of the aforementioned road will follow the NMT Master Plan in Volume-I of this report.

FIGURE A- 102 : NMT IMPROVEMENTS AROUND SUBHASH NAGAR STATION

A.3.6.2 PICK AND DROP, PARKING REQUIREMENTS

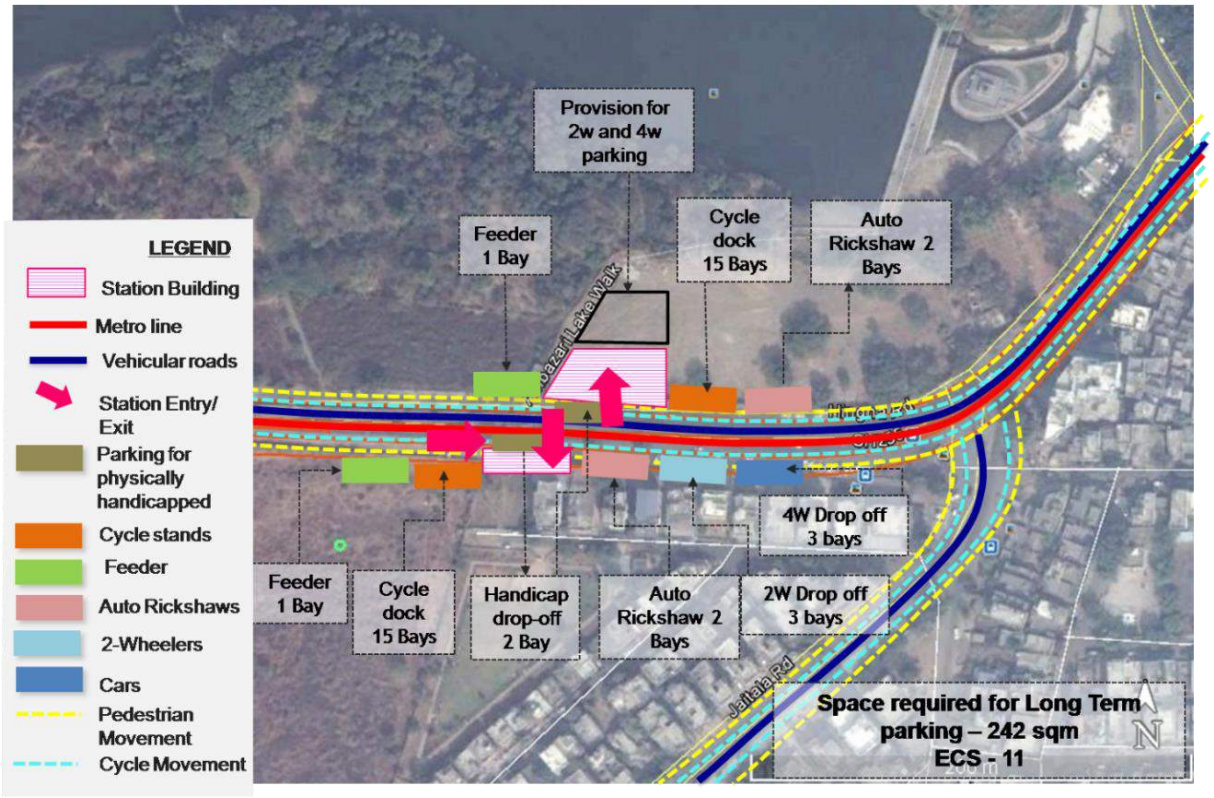
TABLE A- 28 : PARKING, PICK & DROP BAYS REQUIRED NEAR SUBHASH NAGAR STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	1916	209	Car	5	11	18	2	3	5	8
2041	2868	313	TW	8	17	133	3	3	9	13
			Auto/ Mini Van	12	25	62	2	2	-	-
			Mini Bus	53	111	34	2	2	-	-

A.3.6.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stand and bicycle-docking stations are to be integrated into the road space, while two and four wheeler parking is to be allocated by Maha Metro. An additional space of 242 Sqm. is required for long-term parking of 8 four and 13 two wheelers and may be provided by Maha Metro

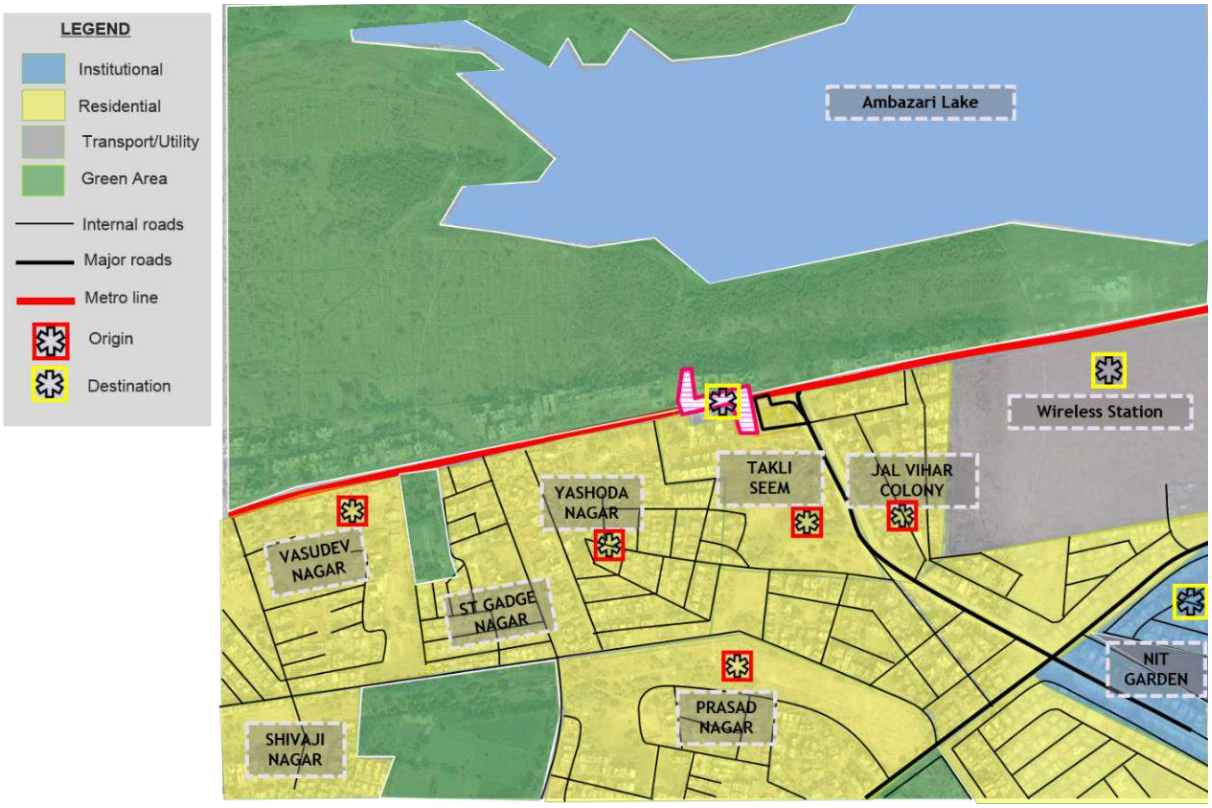
FIGURE A- 103 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.3.7 RACHNA RING ROAD STATION

This station is planned near the junction of Hingna and Ring roads and is flanked by a row of mixed use buildings to its south, beyond which are the residential areas of Jal Vihar Colony, Taakli Seem, Yashoda Nagar, Prasad Nagar etc. On the north is the green area defining the Ambazari Lake. Refer Figure A- ***104***

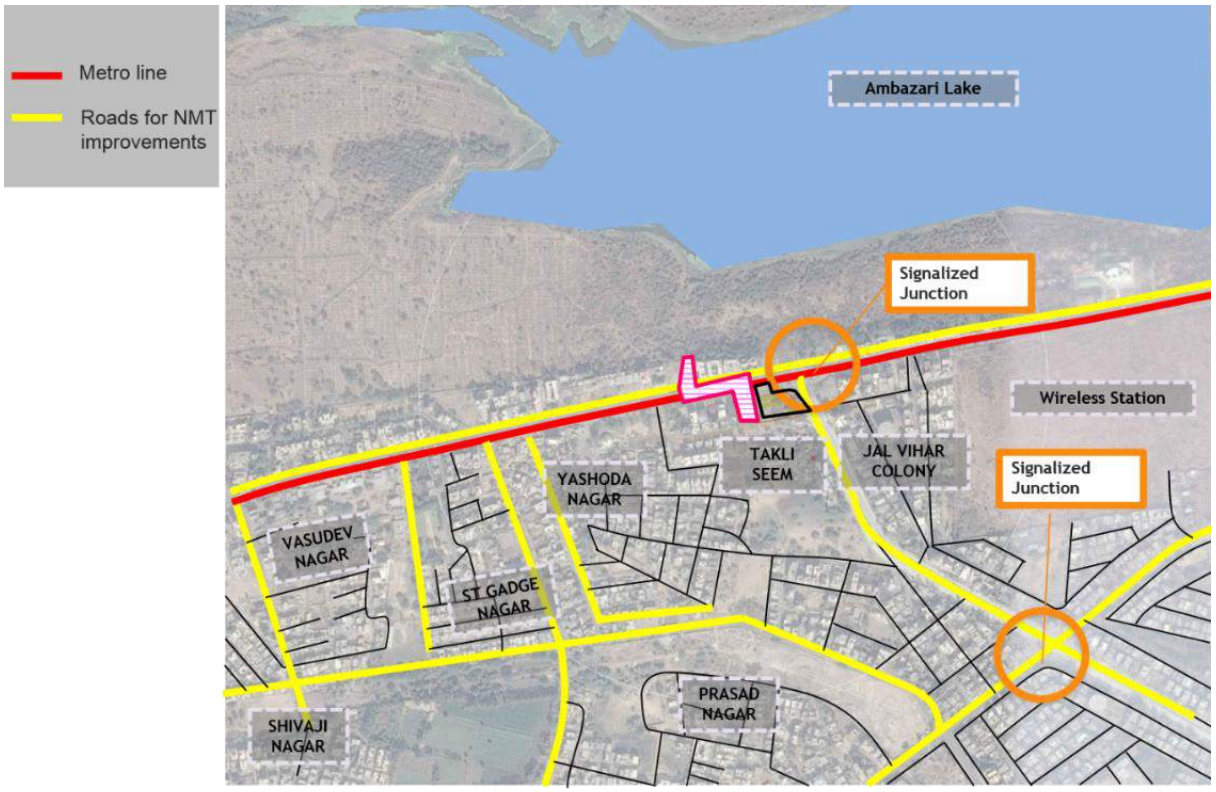
FIGURE A- 104 RACHNA RING ROAD STATION CONTEXT



A.3.7.1 CONNECTIVITY IMPROVEMENTS

The junction of Hingna and Ring road require NMT-based improvement. Refer Figure A- ***105***. All Junctions within two kilometers radii from the ring road need signal synchronization, NMT improvements and traffic calming measures. This will check the speed of traffic at the Rachna Ring road junction and disperse packets to decongestion at the Ring Road junction.

FIGURE A- 105 : NMT IMPROVEMENTS AT JUCNTIONS NEAR RACHNA RING ROAD



A.3.7.2 PICK AND DROP, PARKING REQUIREMENTS

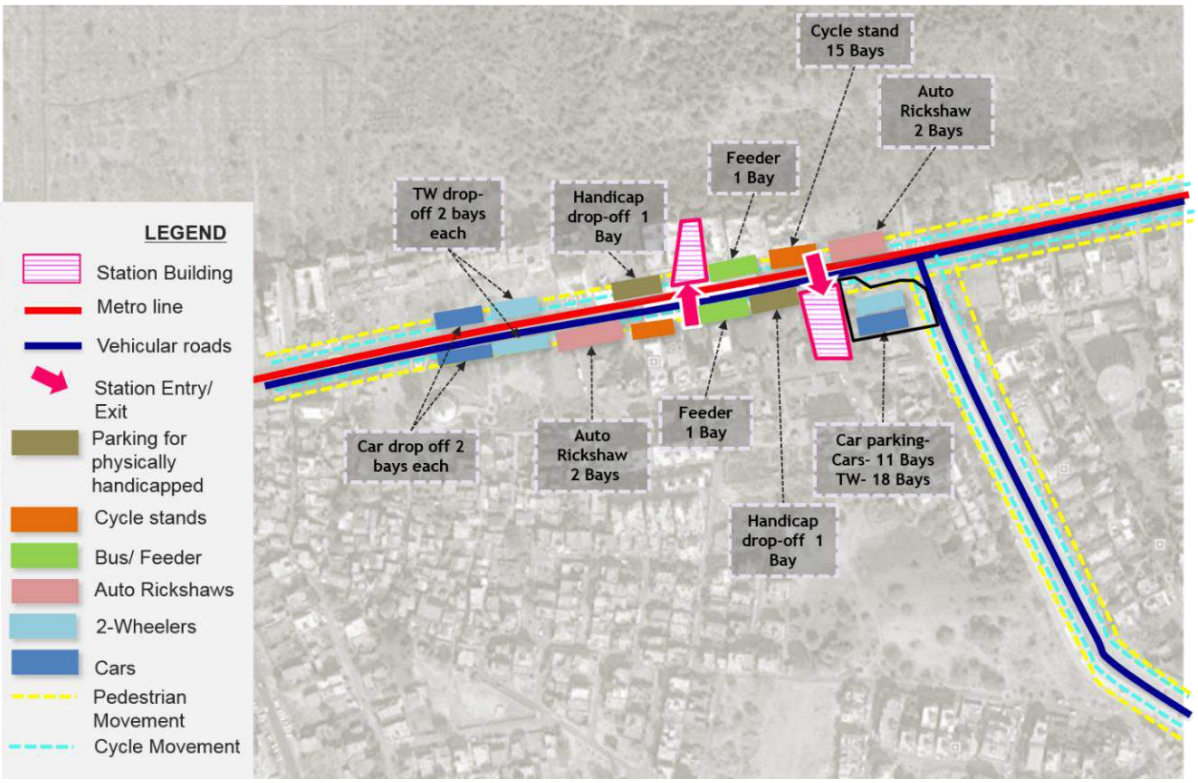
TABLE A- 29 : PARKING, PICK & DROP BAYS REQUIRED NEAR RACHNA RING ROAD STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	2711	296	Car	5	14	21	2	3	6	11
2041	3844	419	TW	8	101	34	3	4	10	18
			Auto/ Mini Van	12	47	50	2	3	-	-
			Mini Bus	53	26	222	2	2	-	-

A.3.7.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stand and bicycle-docking stations are to be integrated into the road, while two and four wheeler parking may be provided by Maha Metro. Requirements of long-term parking for 11 four and 18 two wheelers can be accommodated within metro-land holding near Rachna ring road junction. Refer Figure A- ***106***.

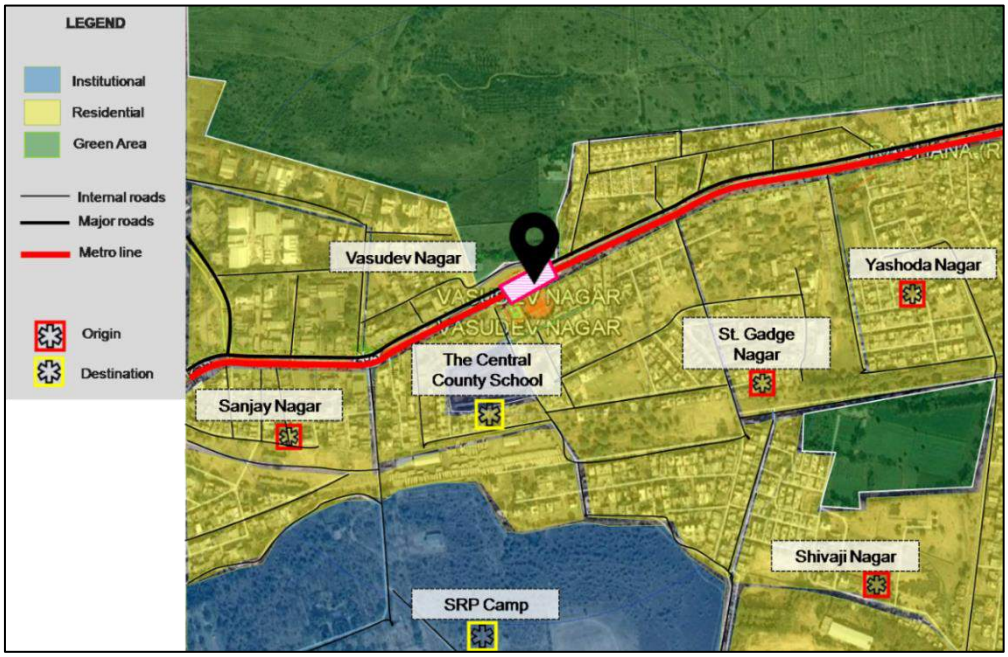
FIGURE A- 106 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.3.8 VASUDEV NAGAR STATION

This station serves a large residential area of Vasudeva nagar, Yashoda nagar, Sanjay nagar, Shivaji Nagar and the industrial area of SRP camp. Refer Figure A- ***107***.

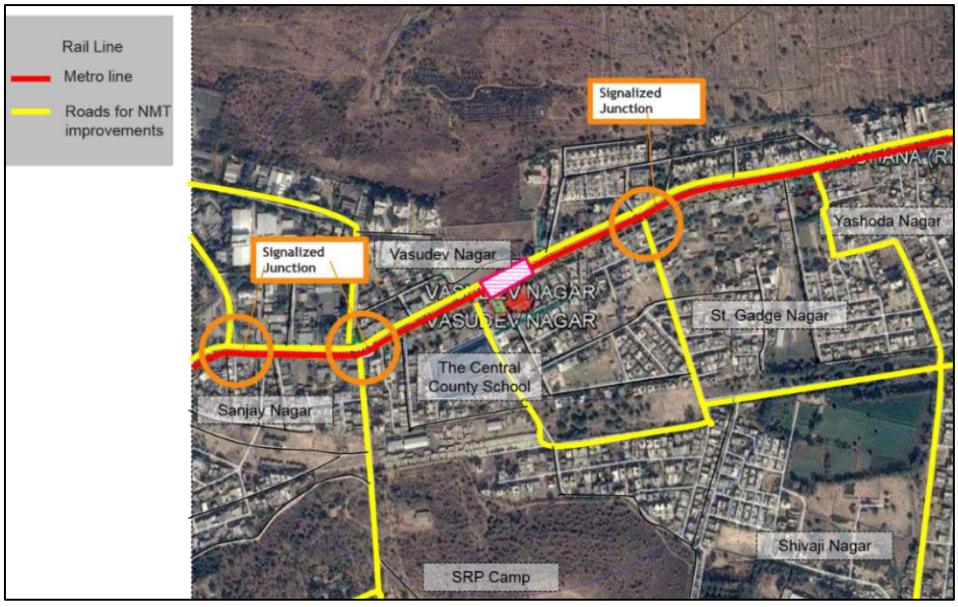
FIGURE A- 107 : VASUDEV NAGAR METRO STATION CONTEXT



A.3.8.1 NMT BASED IMPROVEMENTS

Major junctions along Hingna road require traffic-calming measures and improvements to enable NMT priority. Refer Figure A- ***108***.

FIGURE A- 108 : JUNCTIONS NEAR VASUDEV NAGAR STATION THAT REQUIRE NMT BASED IMPROVEMENTS



A.3.8.2 PICK AND DROP, PARKING REQUIREMENTS

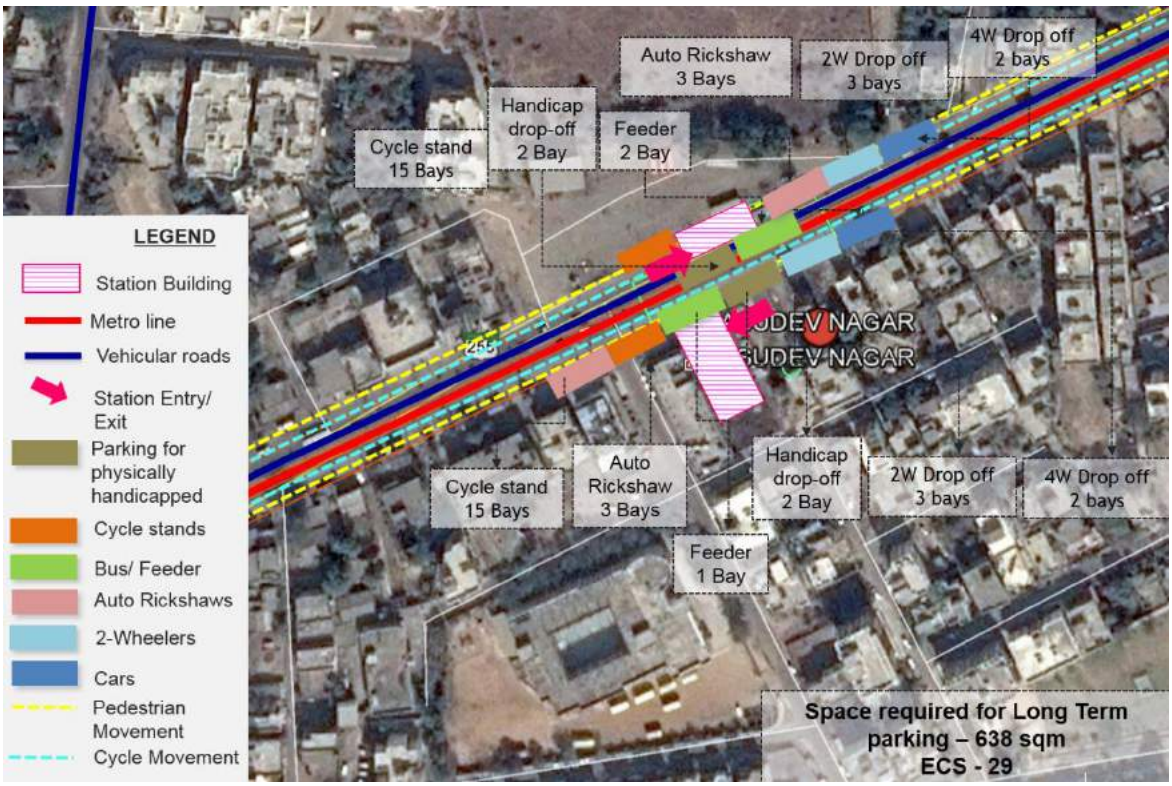
TABLE A- 30 : PARKING, PICK & DROP BAYS REQUIRED NEAR VASUDEV NAGAR STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	26	525	Car	5	30	41	3	4	14	21
2041	7449	812	TW	8	224	65	5	6	22	34
			Auto/ Mini Van	12	104	97	3	3	-	-
			Mini Bus	53	57	430	2	3	-	-

A.3.8.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stand and bicycle-docking stations are to be integrated into the road while two and four wheeler parking can be allocated nearby by Maha Metro. An additional space of 638 Sqm. required for long-term parking of 21 four and 34 two wheelers and may be provided by Maha Metro.

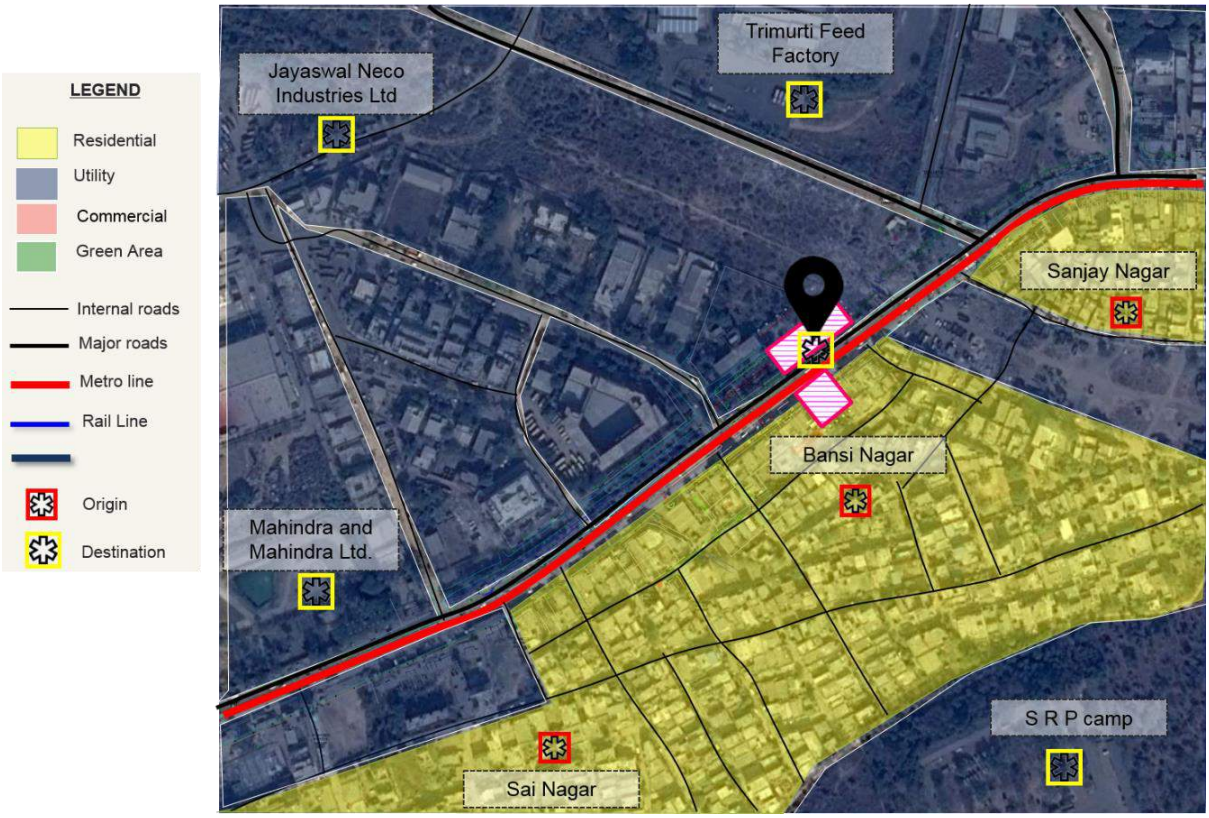
FIGURE A- 109 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



A.3.9 BANSI NAGAR STATION

This station is flanked by Hinga Industrial area to the north and residential areas like Bansi Nagar and Sai Nagar to the south. It is expected that the two would be the source of metro ridership. Refer Figure A- ***110***

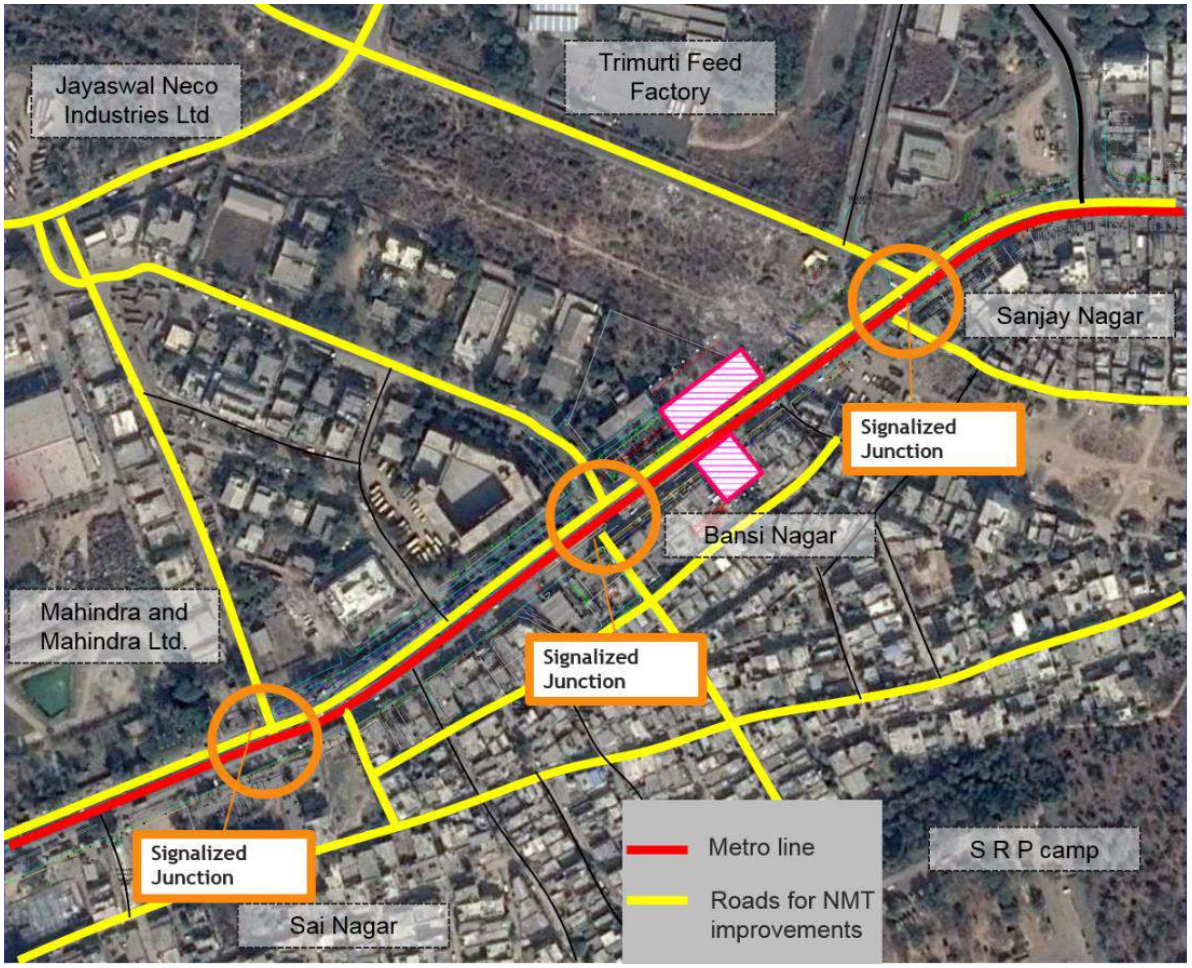
FIGURE A- 110 : BANSI NAGAR METRO STATION CONTEXT



A.3.9.1 NMT IMPROVMENTS IN THE AREA

The area stretching from Bansi Nagar to Lokmanya Nagar has a high proportion of pedestrians and bicyclists. All major roads and junctions in this area would require street design and junction improvements that ensure NMT priority. The area is also suitable for a pilot PBS scheme to encourage people to walk, bicycle and use public transport facilities. Refer Figure A- ***111***.

FIGURE A- 111 : NMT BASED IMPROVEMENTS AROUND BANSI NAGAR METRO STATION



A.3.9.2 PICK AND DROP, PARKING REQUIREMENTS

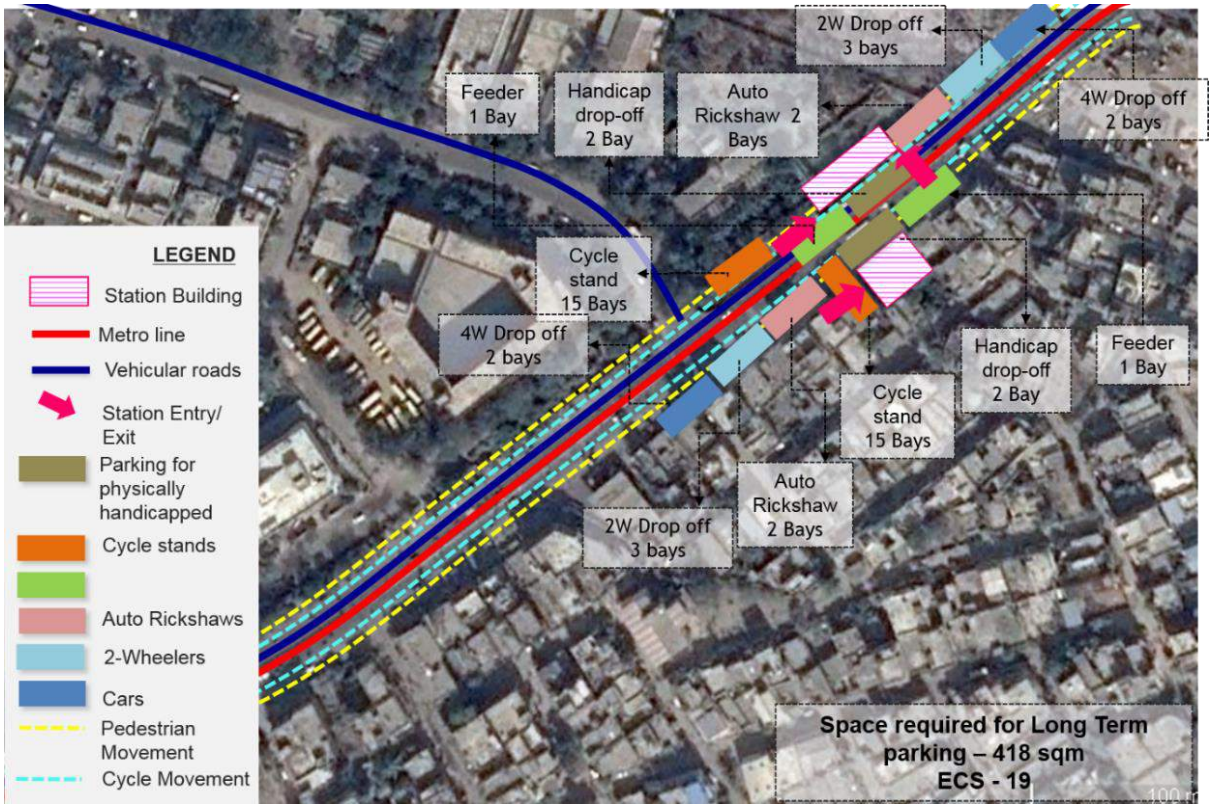
TABLE A- 31 : PARKING, PICK & DROP BAYS REQUIRED NEAR BANSI NAGAR STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement					
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	3083	336	Car	5	19	26	3	3	9	14
2041	4850	529	TW	8	143	42	3	5	14	22
			Auto/ Mini Van	12	67	63	2	3	-	-
			Mini Bus	53	37	280	2	2	-	-

A.3.9.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stand and bicycle-docking stations are integrated into the road, while that for two and four wheeler parking is to be allocated by Maha Metro. An additional space of 418 Sqm. required for long-term parking of 14 four and 22 two wheelers may be provided by Maha Metro. Refer Figure A- ***112***.

FIGURE A- 112 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

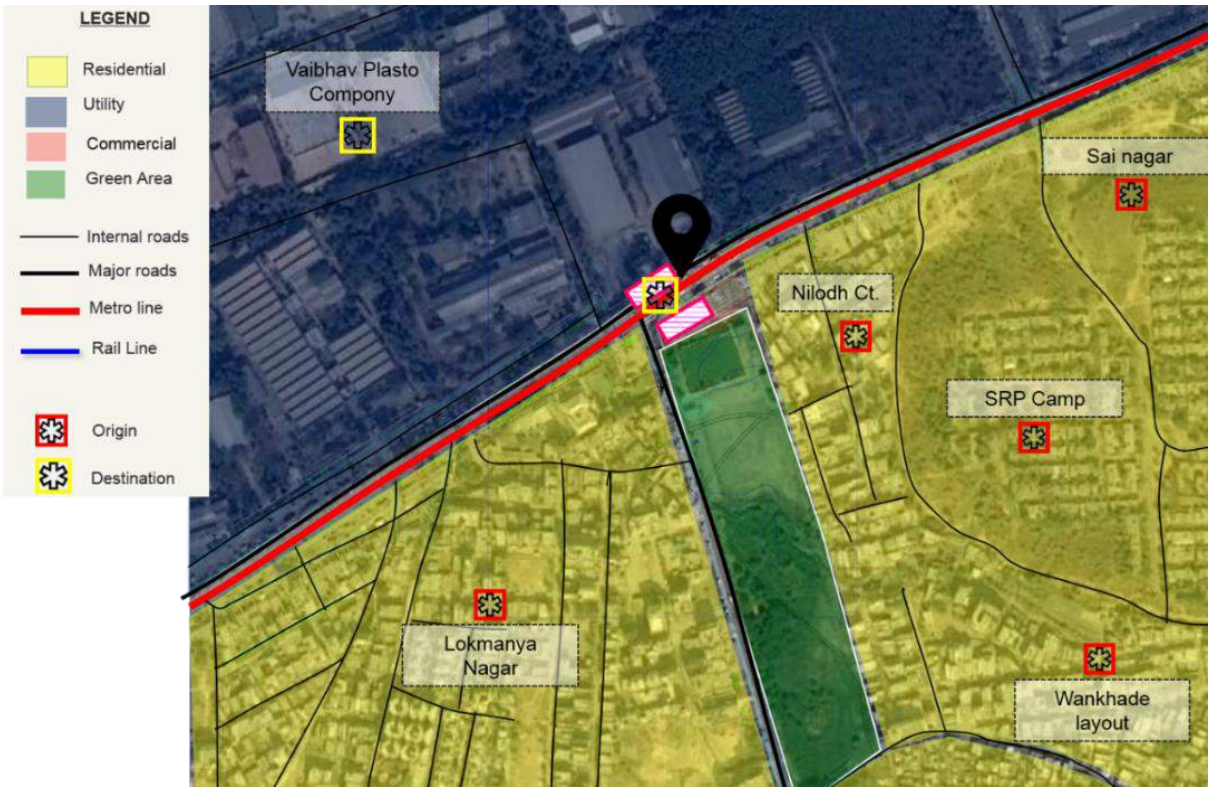


A.3.10 LOKMANYA NAGAR STATION

This is the last station of the Reach-3 and serves the residential areas of Lokmanya Nagar, Nildoh Ct., SRP Camp, Sai Nagar towards its South and Hingna industrial area to its south and industries to its north. Refer Figure A- ***113***

The Southern side of Lokmanya Nagar metro station has a linear green area of land and provides an opportunity to create a public park that is directly accessible by metro.

FIGURE A- 113: LOKMANYA NAGAR METRO STATION CONTEXT



A.3.10.1 NMT IMPROVEMENTS AROUND LOKMANYA NAGAR METRO STATION

The area around this station being partly industrial and partly residential in nature, it can generate a large number pedestrian and bicycle trips. Therefore, provision of NMT infrastructure, prioritizing it across all major roads and improving junction and streets is critical to enhance road-user experience. The area is also suitable to implement a pilot PBS scheme to encourage people to walk, bicycle and use public transport facilities. Refer Figure A- ***114***.

FIGURE A- 114 NMT IMPROVEMENTS REQUIRED AROUND LOKMANYA NAGAR STATION

A.3.10.2 PICK AND DROP, PARKING REQUIREMENTS

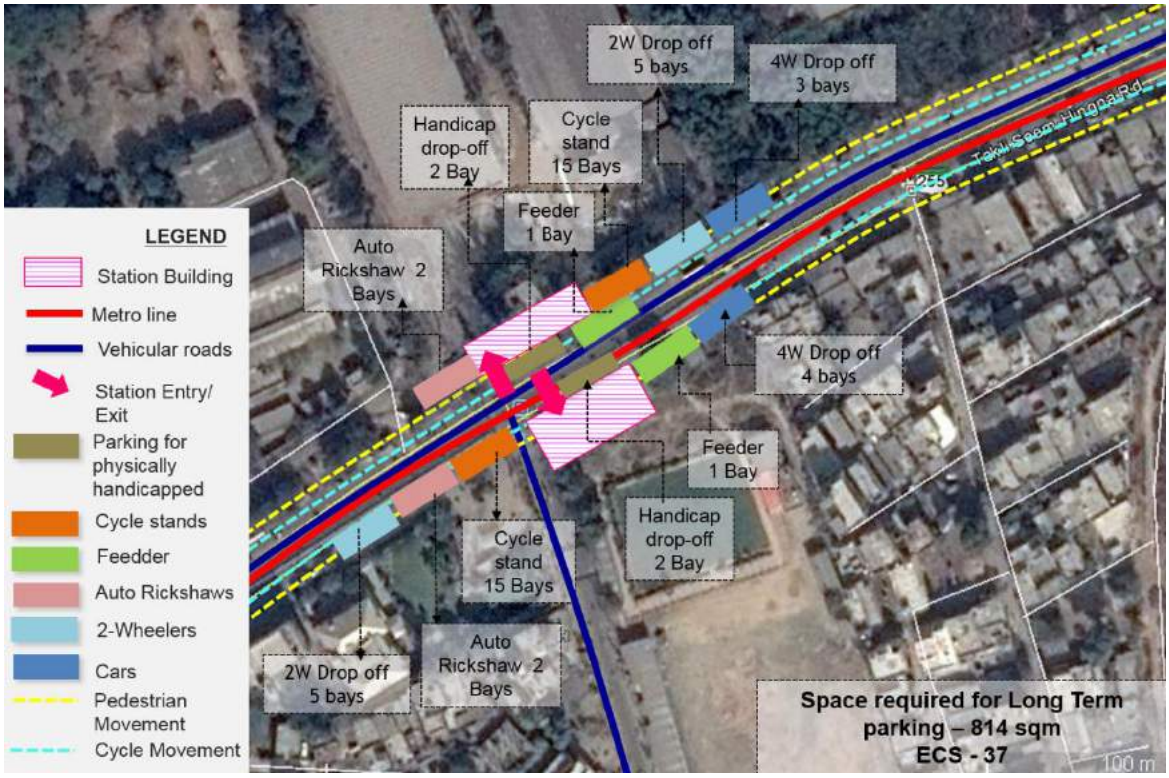
TABLE A- 32 : PARKING, PICK & DROP BAYS REQUIRED NEAR LOKMANYA NAGAR STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	8863	966	Car	5	55	48	5	7	25	25
2041	13754	966	TW	8	412	77	7	10	41	50
			Auto/ Mini Van	12	191	116	4	5	-	-
			Mini Bus	53	105	512	3	4	-	-

A.3.10.3 CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY

Space for bus bays, auto rickshaw stands and bicycle-docking stations are to be integrated into the road, while two and four wheeler parking may be allocated by Maha Metro. An additional space of 814 Sqm. required long term parking of 25 four and 50 two wheelers may be provided by Maha Metro.

FIGURE A- 115 : CONCEPTUAL LOCATION OF PICK AND DROP, PARKING FACILITY



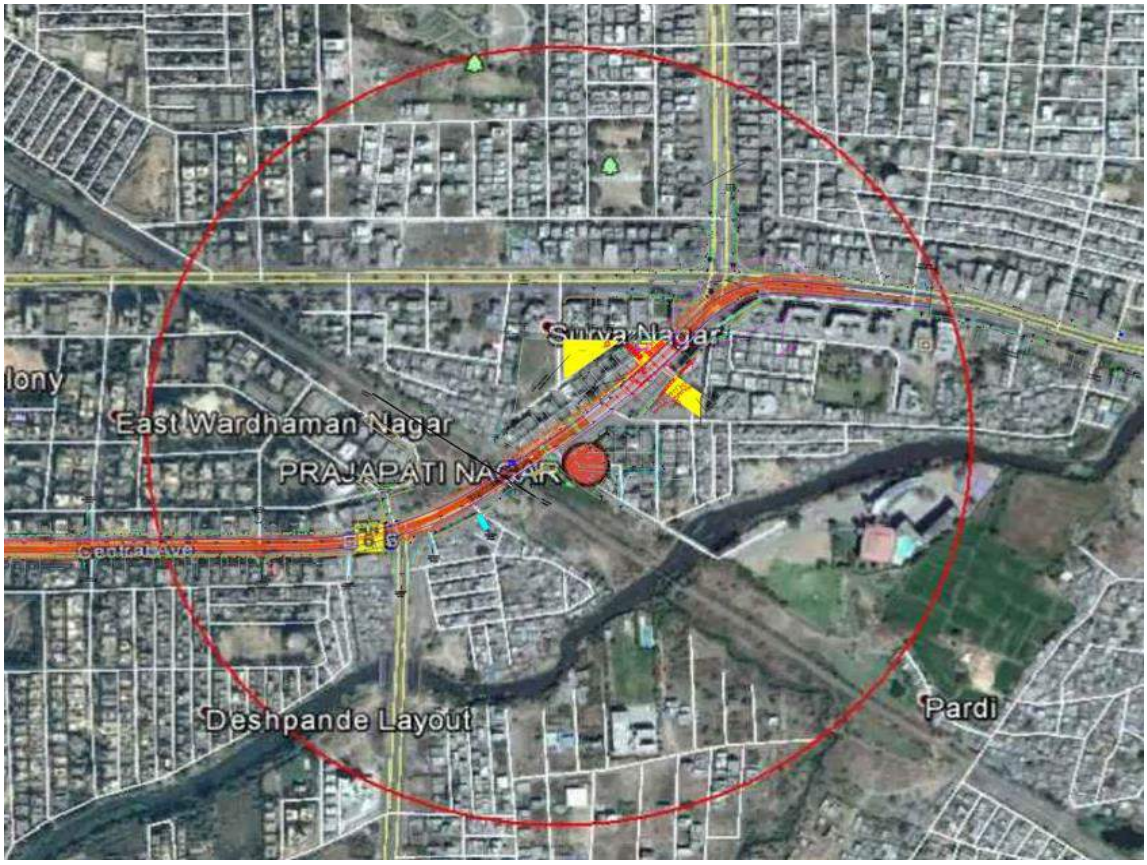
A.4 PROPOSALS FOR REACH-4 STATIONS

In the absence of latest station area drawings, the following Conceptual schemes for stations of Reach-4 of Nagpur Metro is based on old drawings depicting conditions of 2016.

A.4.1 PRAJAPATI SQUARE STATION

This is the terminal station of the Reach 4 alignment and lies on the Ring Road (NH 6). It is surrounded by residential areas such as Surya Nagar to the north, Pardi to the far south and East Wardhman Nagar to the west of the station.

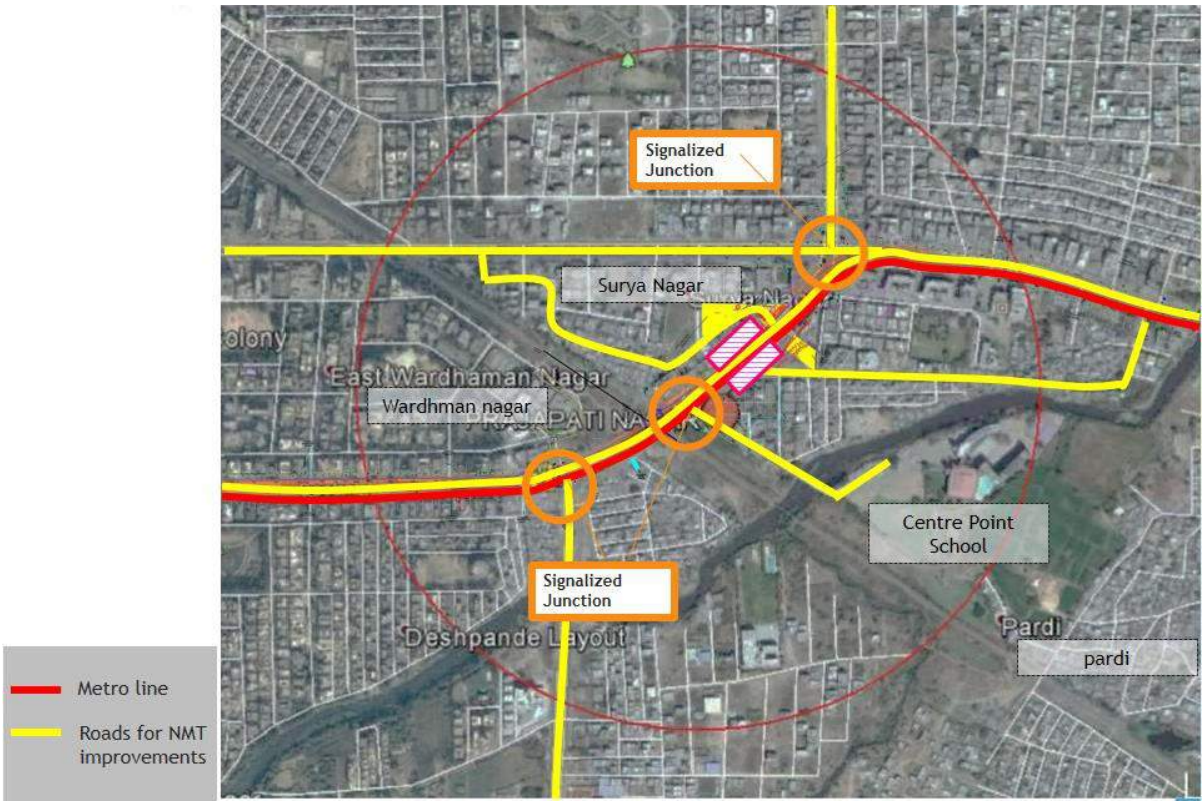
FIGURE A- 116 : PRAJAPTI SQUARE METRO STATION CONTEXT



A.4.1.1 CONNECTIVITY REQUIREMENTS

Improvement of NMT infrastructure is required from Wardhman Nagar via Surya nagar to the metro station and improvement of signalized junctions is required at HB Town Square, Prajapati square and Govardhan Nath square.

FIGURE A- 117 : NMT CONNECTIVITY REQUIRED



A.4.1.2 PICK AND DROP, PARKING REQUIREMENTS

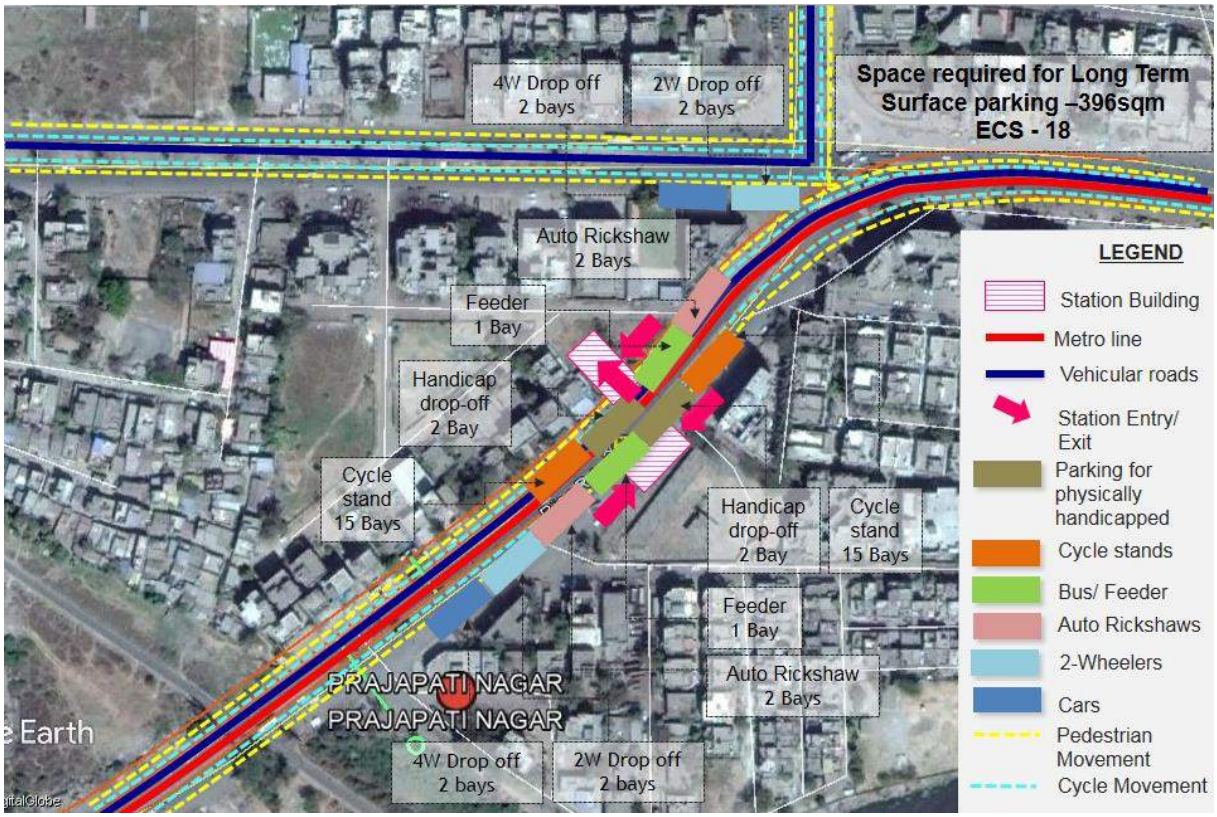
TABLE A- 33 : PARKING, PICK & DROP BAYS REQUIRED NEAR PRAJAPATI STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	3308	361	Car	5	21	25	3	3	9	13
2041	4528	494	TW	8	154	40	4	4	15	21
			Auto/ Mini Van	12	71	59	2	3	-	-
			Mini Bus	53	39	262	2	2	-	-

A.4.1.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

Figure A- *118* show pick-and-drop-off points for different modes of transport at the station area. Spaces for all modes are to be accommodated within the existing road space along the main metro corridor. An additional space equivalent to 396 Sqm is required for long term parking of 21 two and 13 four near the station by Maha Metro.

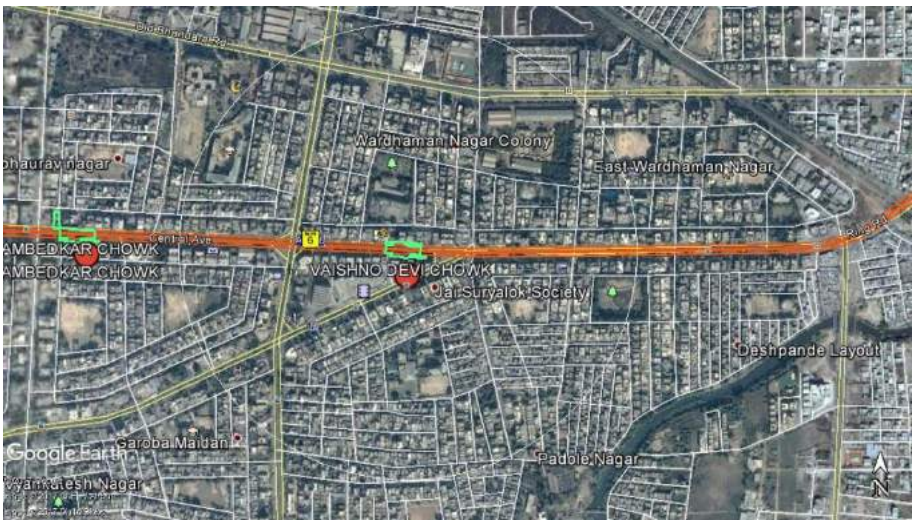
FIGURE A- 118 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND PRAJAPATI SQUARE STATION



A.4.2 VAISHNODEVI SQUARE STATION

This station is on the Ring Road (NH 6) is flanked by mixed landuse along the road and residential areas beyond it.

FIGURE A- 119 : VAISHNODEVI SQUARE METRO STATION CONTEXT



A.4.2.1 CONNECTIVITY REQUIREMENTS

The street grid near the Vaishnodevi square provides a well-connected network of roads that meets Central avenue (NH 6) at a regular interval of roughly 200-250m. These junctions are proposed to be retained, signalized and provided with traffic calming measures.

FIGURE A- 120 : NMT IMPROVEMENTS REQUIRED AROUND VAISHNODEVI SQUARE STATION

A.4.2.2 PICK AND DROP, PARKING REQUIREMENT

TABLE A- 34: PARKING, PICK & DROP BAYS REQUIRED NEAR VAISHNODEVI SQUARE STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	2979	325	Car	5	19	23	3	3	9	12
2041	4163	454	TW	8	138	36	3	4	14	19
			Auto/ Mini Van	12	64	54	2	3	-	-
			Mini Bus	53	35	241	2	2	-	-

A.4.2.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

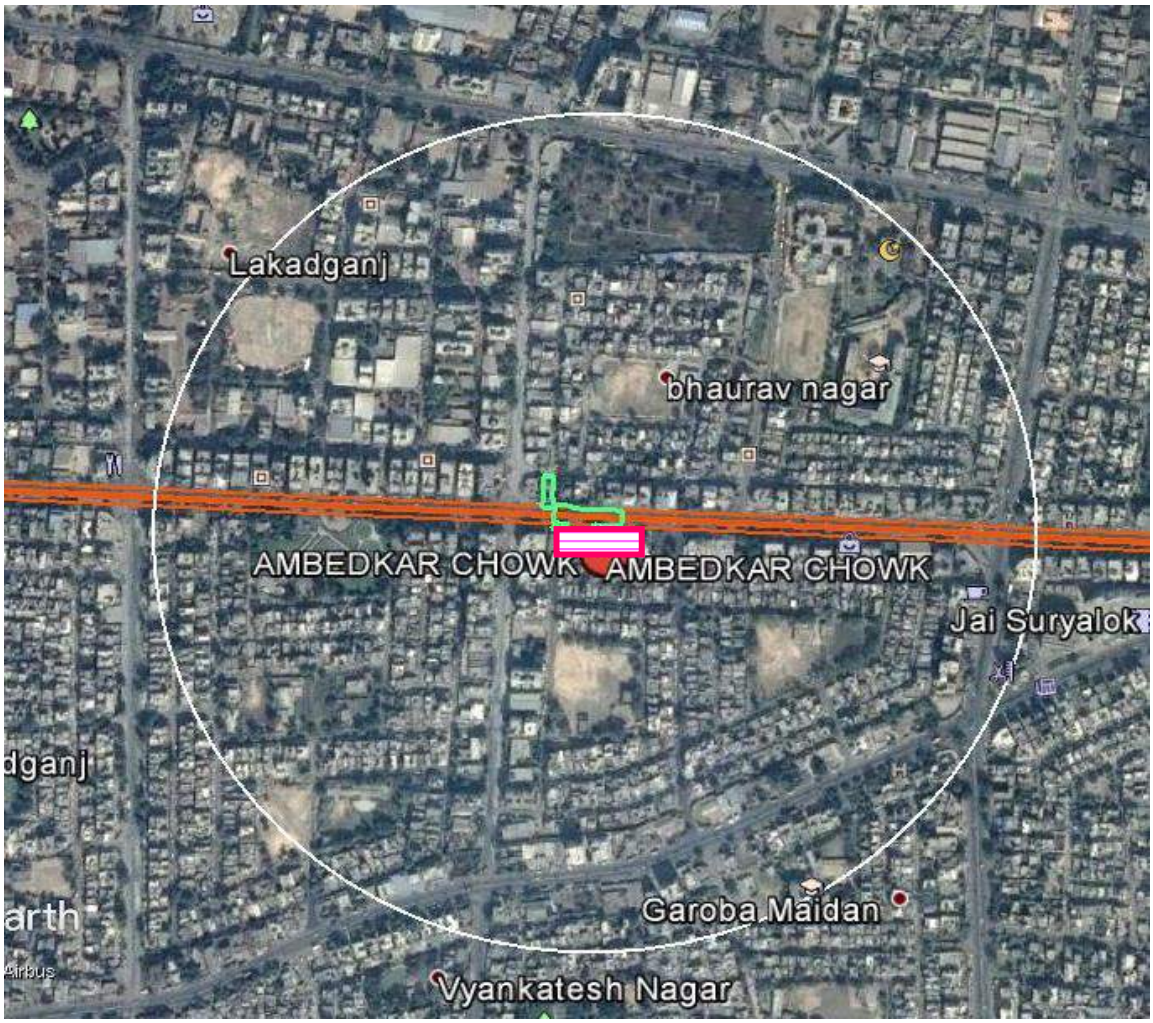
Figure A- *121* shows pick-and-drop-off location for different modes of transport at the station area. Spaces for bays for all modes are to be accommodated within the existing road space along the main metro corridor. An additional space equivalent to 352 Sqm near the Metro station is required to accommodate long-term parking for 19 two and 12 four wheelers.

FIGURE A- 121 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND VAISHNODEVI SQUARE STATION

A.4.3 AMBEDKAR SQUARE STATION

This station lies on the Ring Road (NH 6) and is surrounded by residential areas of Satnami Nagar and Bhaurav Nagar to its north and Shastri Nagar to its south. Refer Figure A- ***122***.

FIGURE A- 122 : AMBEDKAR SQUARE METRO STATION CONTEXT



A.4.3.1 NMT IMPROVEMENTS REQUIRED

The internal roads of the residential areas near Vaishnodevi square provides a well-connected network of roads which meet Central avenue (NH 6) at Wardhman Chowk and Chapru Nagar square that are 400-450m apart. These junctions are proposed to be retained, signalized and provided with traffic calming measure. Refer Figure A- ***123***.

FIGURE A- 123 : NMT IMPROVEMENTS REQUIRED

A.4.3.2 PICK AND DROP, PARKING REQUIREMENTS

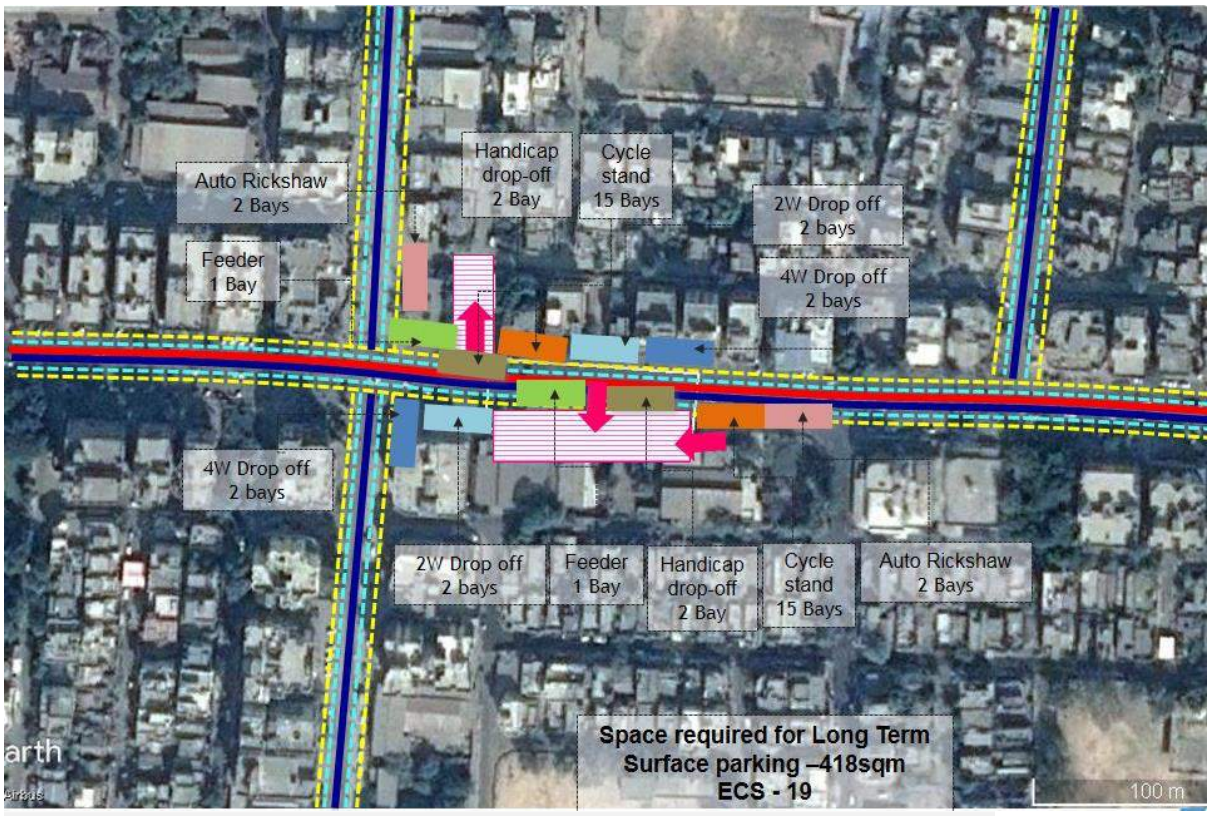
TABLE A- 35: PARKING, PICK & DROP BAYS REQUIRED NEAR AMBEDKAR STATION

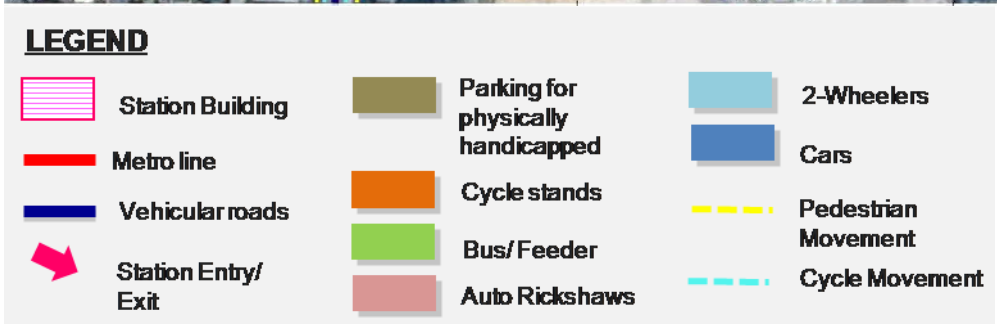
Passengers (boarding – alighting)			Mode	Mode split (2041)	Parking, Pick & Drop Bays Requirement					
					Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	3390	370	Car	5	21	26	3	3	10	14
2041	4731	516	TW	8	158	41	4	5	15	22
			Auto/ Mini Van	12	73	62	2	3	-	-
			Mini Bus	53	40	273	2	2	-	-

A.4.3.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

Figure A- ***124*** shows the pick-and-drop-off points for different modes of transport at the station area. The bays for all modes are to be accommodated within the existing road space along the main metro corridor. An additional space equivalent to 418 Sqm is required near the station to accommodate long term parking for 22 two- and 14 four wheelers.

FIGURE A- 124 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND AMBEDKAR SQUARE STATION



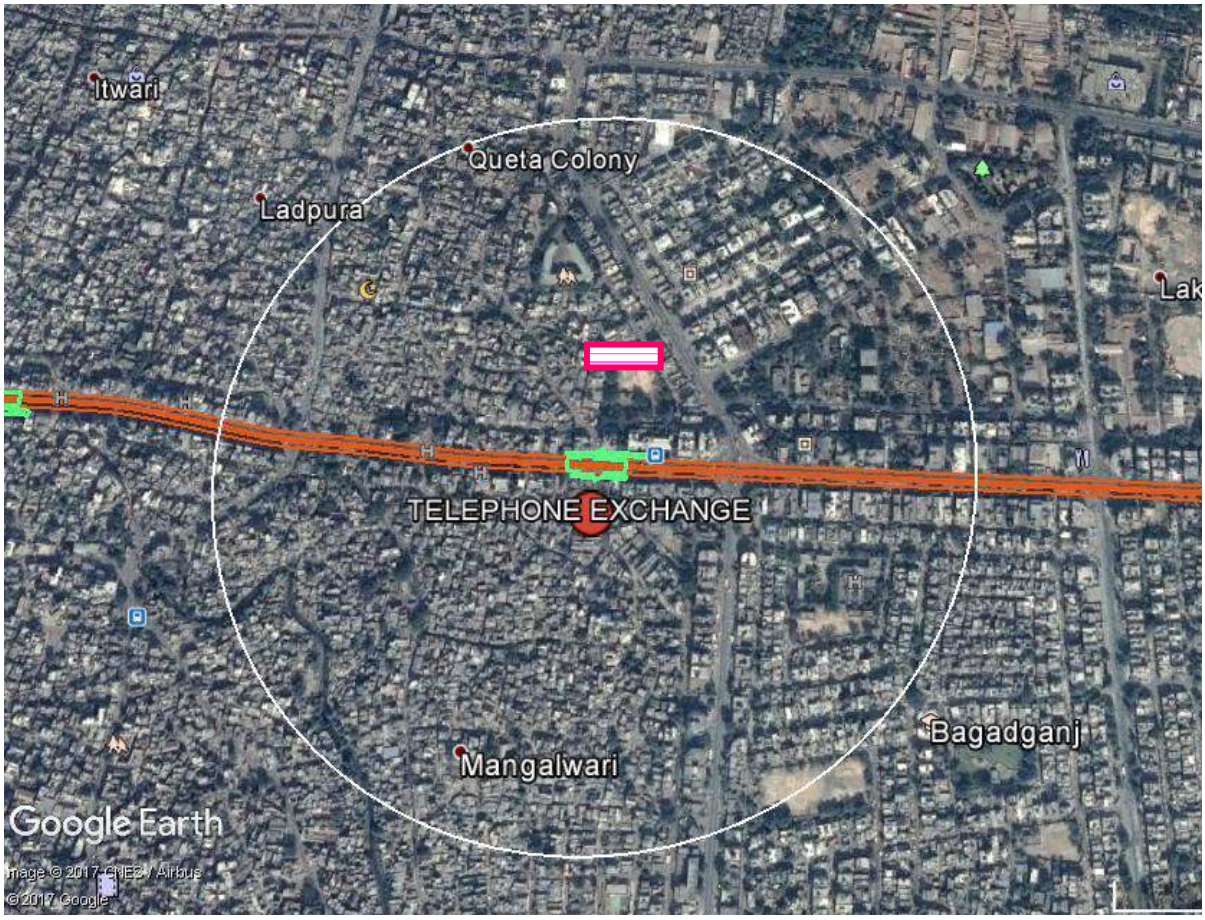


A.4.4

A.4.4 TELEPHONE EXCHANGE STATION

This station is surrounded by residential areas like Queta Colony, Mangalwadi and Chaproo nagarand is flanked by Itawari telephone exchange chowk on its east and Kolbaswami chowk on its west. Refer ***FIGURE A- 125***.

FIGURE A- 125 : TELEPHONE EXCHANGE METRO STATION CONTEXT



A.4.4.1 NMT IMPROVEMENT REQUIRED

The residential areas around the station have a dense network of internal roads and improvement of NMT facilities is necessary. The Gangabai Ghat road and Queta colony road forming an intersection on the east and Mazyrkar marg on the west are potential for such interventions and are to be signalized and provided with traffic calming measures.

FIGURE A- 126 : NMT IMPROVEMENTS REQUIRED

A.4.4.2 PICK AND DROP, PARKING REQUIREMENTS

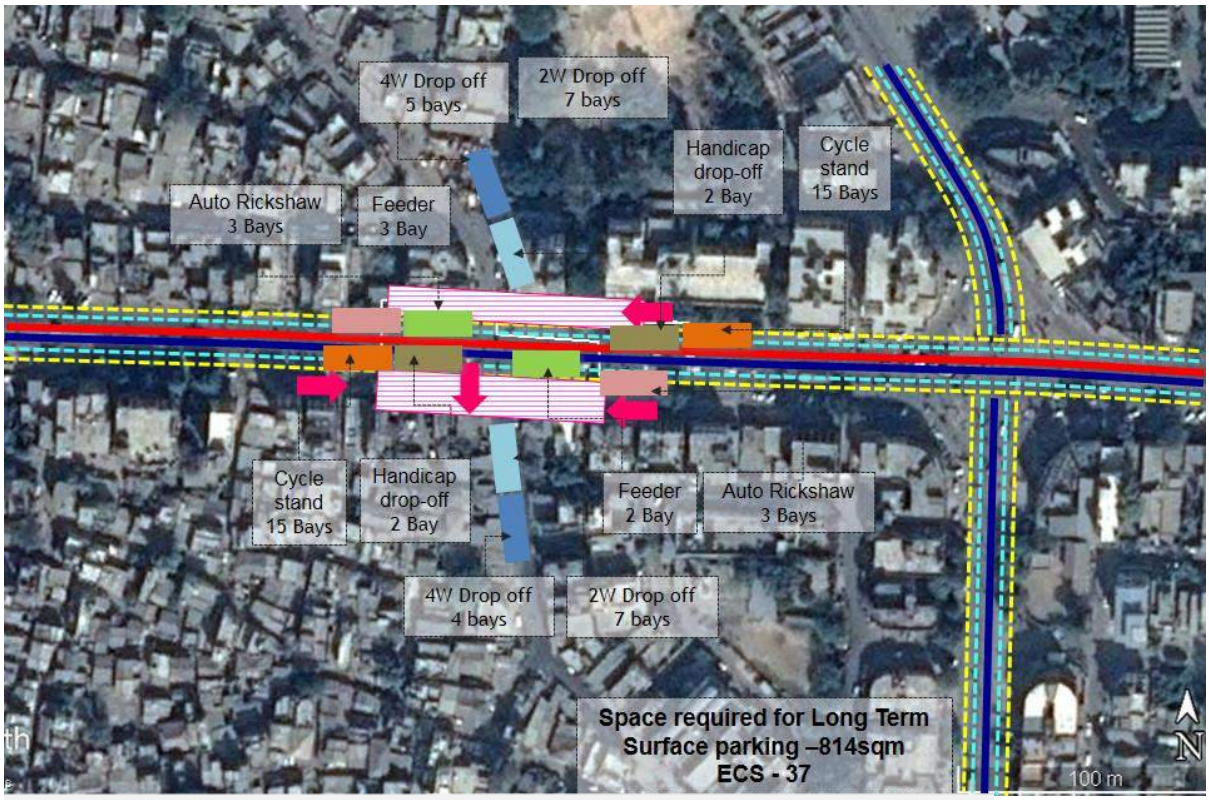
TABLE A- 36: PARKING, PICK & DROP BAYS REQUIRED NEAR TELEPHONE EXCHANGE STATION

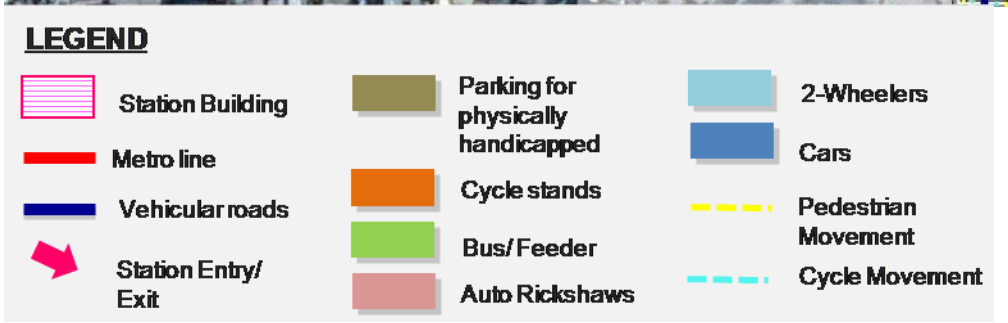
Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	11406	1243	Car	5	71	62	6	9	25	25
2041	18778	1243	TW	8	530	99	9	14	50	50
			Auto/ Mini Van	12	246	149	4	6	-	-
			Mini Bus	53	135	659	3	5	-	-

A.4.4.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

Figure A- ***127*** shows pick-and-drop-off points for different modes of transport at the station area. The bays for all modes are to be accommodated within the existing road space along the main metro corridor. An additional space equivalent to 814 Sqm is required near the metro station to accommodate long-term parking for 50 two and 25 four wheelers and will be provided by Maha Metro Refer Figure A- ***127***

FIGURE A- 127 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND TELEPHONE EXCHANGE STATION





A.4.5 CHITTAROLI SQUARE STATION

This station to the east of Chandra shekhar Azad Chowk is surrounded by residential areas like Ladpura and Itawari while a number of plots adjoining it are put to commercial. Its northern entry/exit leads to the Shaheed chowk and its southern one to the Hanuman Mandir road. Refer Figure A- ***128***.

FIGURE A- 128 : CHITTAROLI SQUARE METRO STATION CONTEXT

A.4.5.1 NMT IMPROVEMENTS REQUIRED

The dense networks of internal roads of the residential areas require improvement of NMT infrastructure. Such improvements are required on Masurkar marg road and old Mangalwadi road which intersects on the east and along the New Itawari road and Jagannath road and its junction to the west. These junctions are to be retained, signalized and provided with traffic calming measures. Refer Figure A- ***129***.

FIGURE A- 129 : NMT IMPROVEMENTS

A.4.5.2 PICK AND DROP, PARKING REQUIREMENTS

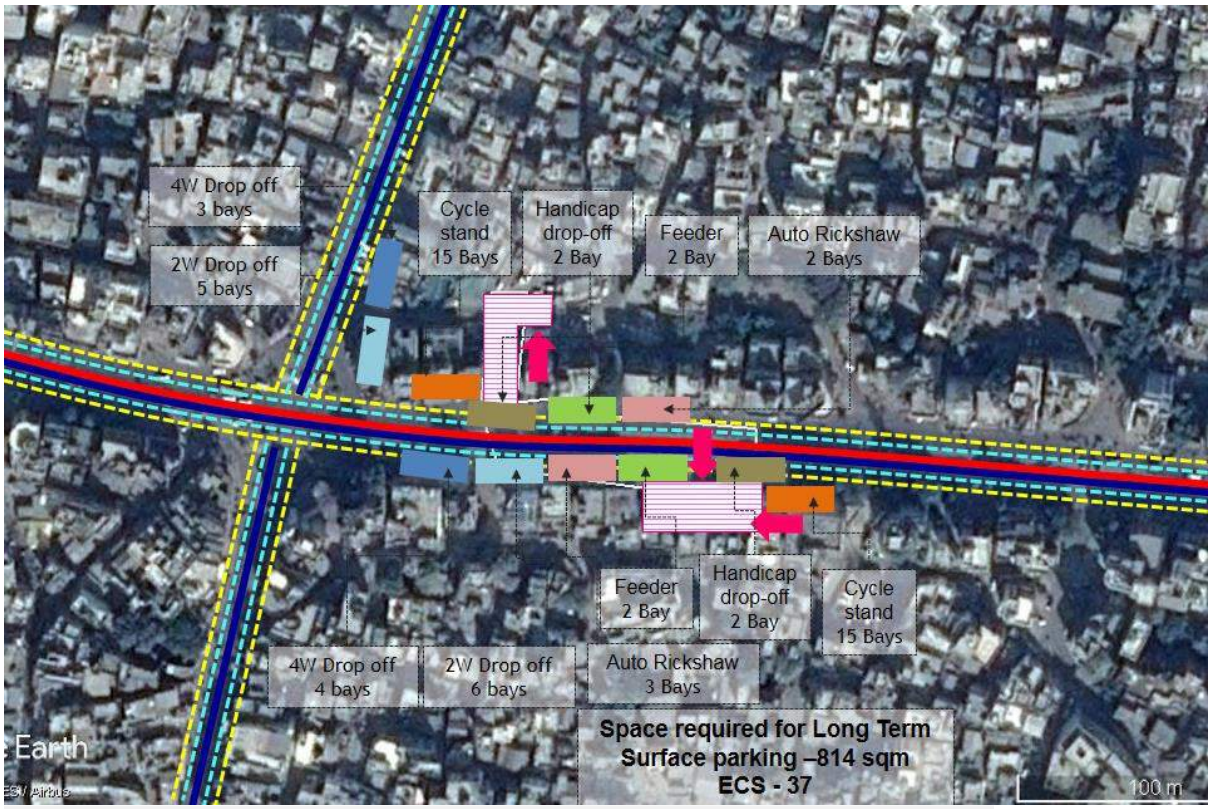
TABLE A- 37: PARKING, PICK & DROP BAYS REQUIRED NEAR CHITTAROLI SQUARE STATION

Passengers (boarding – alighting)			Mode	Parking, Pick & Drop Bays Requirement						
				Mode split (2041)	Total passengers		Drop off requirement		Parking Requirement	
Year	Full Day	Peak Hr		%	2016 (PH)	2041 (PH)	2016	2041	2016	2041
2016	9078	990	Car	5	56	50	5	7	25	25
2041	14646	990	TW	8	422	79	7	11	41	50
			Auto/ Mini Van	12	196	119	4	5	-	-
			Mini Bus	53	108	525	3	4	-	-

A.4.5.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

Figure A- ***130*** shows pick-and-drop-off points for different modes of transport at the station area. The bays for all modes are to be accommodated within the existing road space along the main metro corridor. An additional space equivalent to 814 Sqm is necessary near the station to accommodate long term parking for 50 two and 25 four wheelers by the Maha Metro Refer Figure A- ***130***.

FIGURE A- 130 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND CHITRAKOLI SQUARE STATION

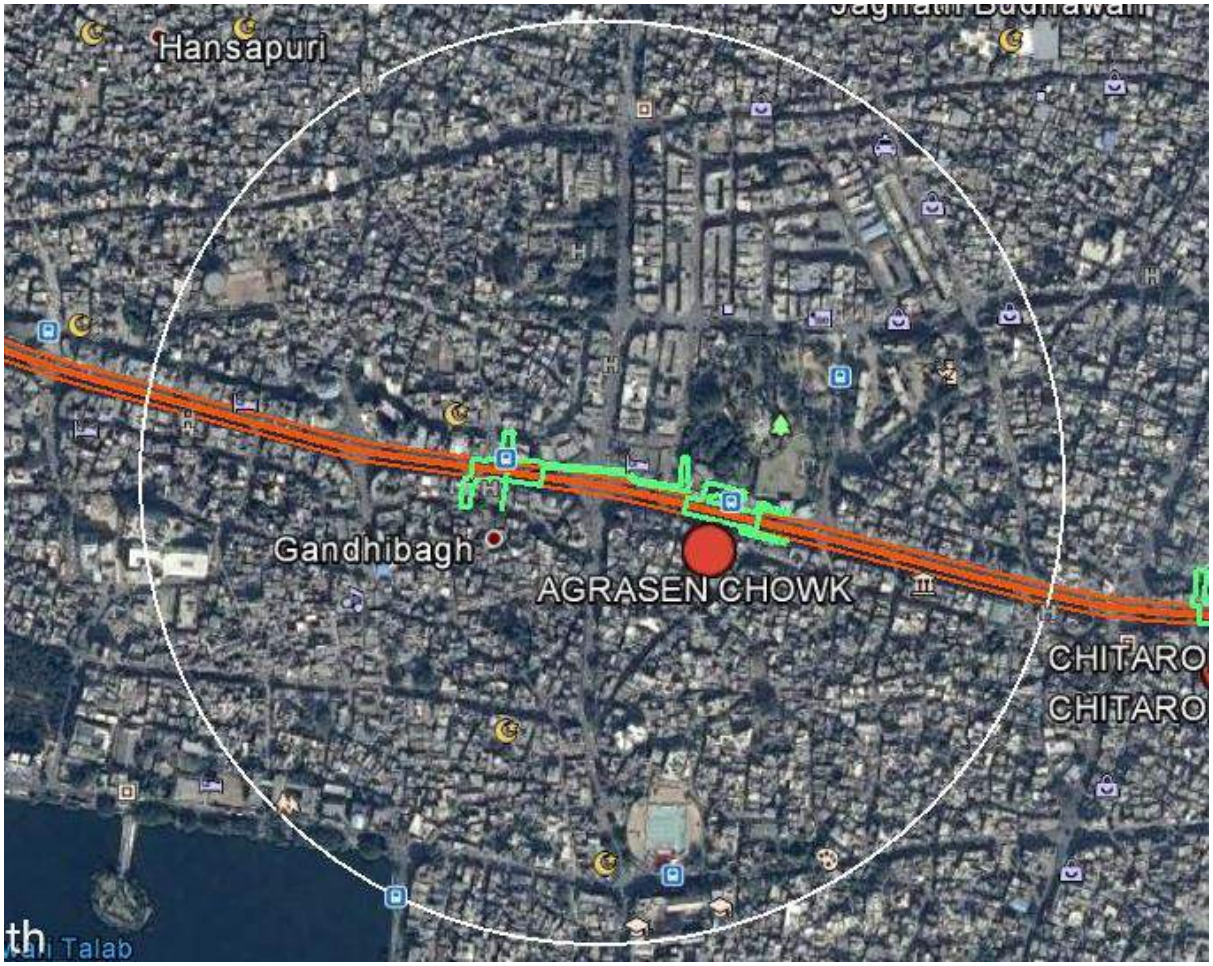


A.4.6

A.4.6 AGRASEN SQUARE STATION

This station to the south of the Gandhi Bagh Park is surrounded by commercial and institutional areas to the north and dense residential to the south with few plots adjoining the metro station with mixed land use. The station building has two blocks; one on the east off Fawwada Chowk and entered from the Hindustan Petrol pump adjoining it. The block on the west is accessed through the Agrasen Chowk.

FIGURE A- 131 : AGRASEN SQUARE METRO STATION CONTEXT



A.4.6.1 NMT IMPROVEMENTS REQUIRED

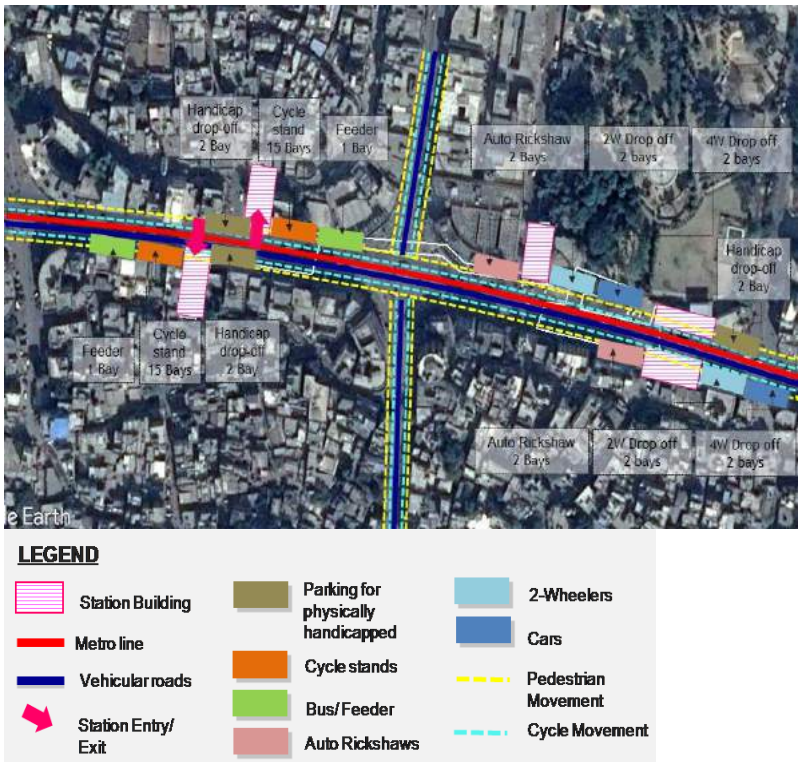
The Armori-Nagpur Highway and the section of Police station road from Imli chowk to Gandhi Bagh Park are important accesses and require improvement in NMT infrastructure. The Fawwada Chowk is proposed to be retained, signalized and provided with traffic calming measures.

FIGURE A- 132 : NMT IMPROVEMENTS

A.4.6.2 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

In the absence of information on station ridership and pick-up, parking facilities for the station, the proposed allocation of parking facilities is done considering typical minimum requirements.

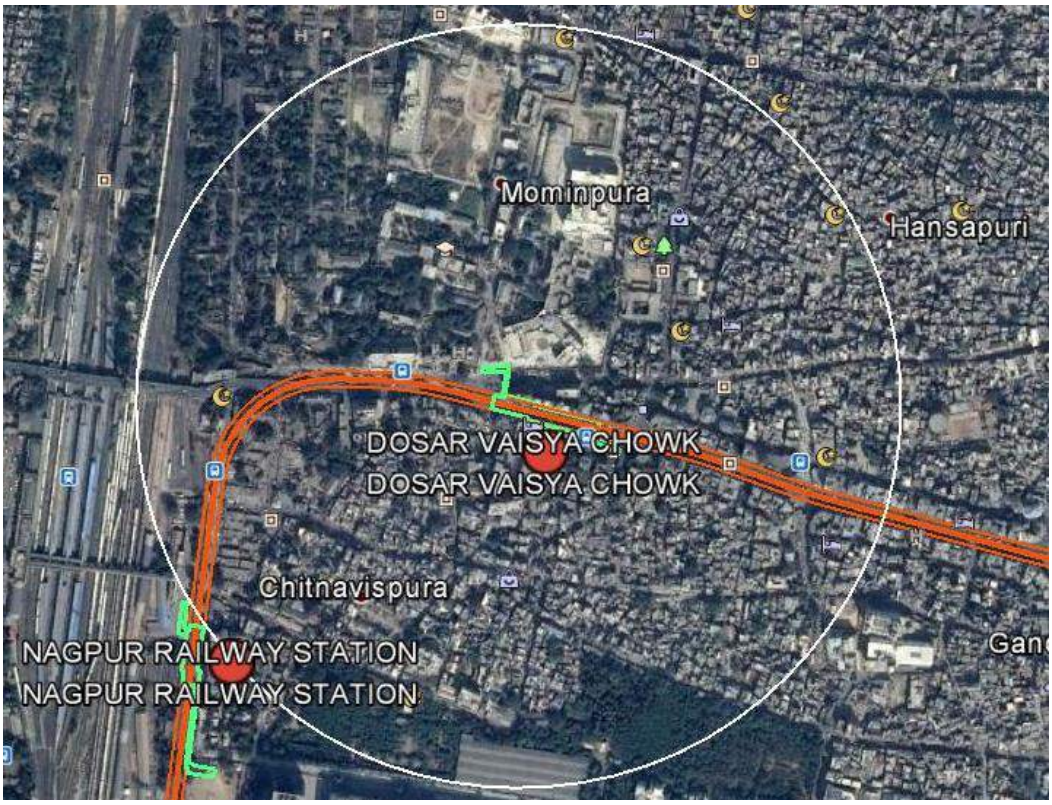
FIGURE A- 133 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND AGRASEN SQUARE STATION



A.4.7 DOSAR VAISYA SQUARE STATION

This station is located south of the Indira Gandhi Government Medical College on the Donargarh-Nagpur Road and to the east of railway freight godown. It has institutional (Indira Gandhi Government Hospital, PWD office, Mayo hospital) areas to its north and a combination of commercial (Kapda market) and residential (Kasabpura and Lodhipura) areas to its south. It is entered from the Mayo Hospital road on the north and Dosar Vaisya chowk from the south.

FIGURE A- 134 : DOSAR VAISYA METRO STATION CONTEXT



A.4.7.1 NMT IMPROVEMENTS REQUIRED

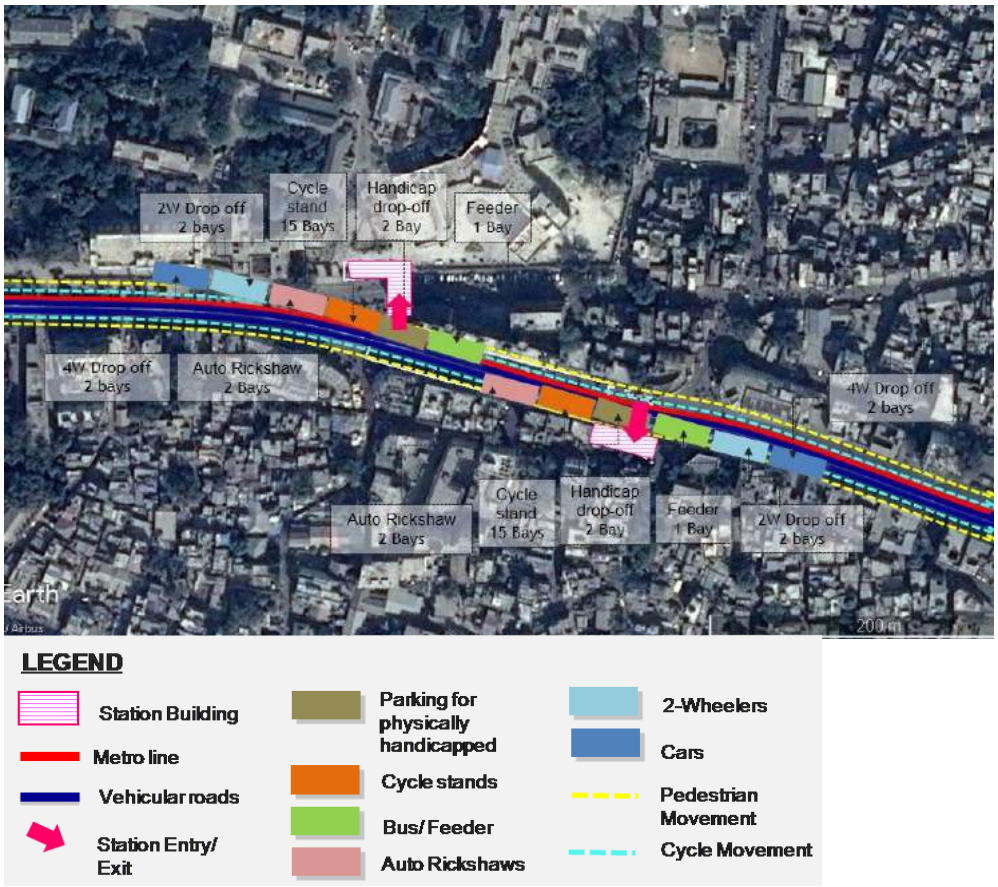
It is important to improve the NMT infrastructure in the institutional areas to the north of the station and the focus will be on Mayo Hospital road which meets Donpura – Nagpura Road for the purpose.

FIGURE A- 135 : NMT IMPROVEMENTS REQUIRED

A.4.7.2 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

In the absence of information related to station ridership, the proposed allocation of the parking facilities has been done considering typical minimum parking requirements.

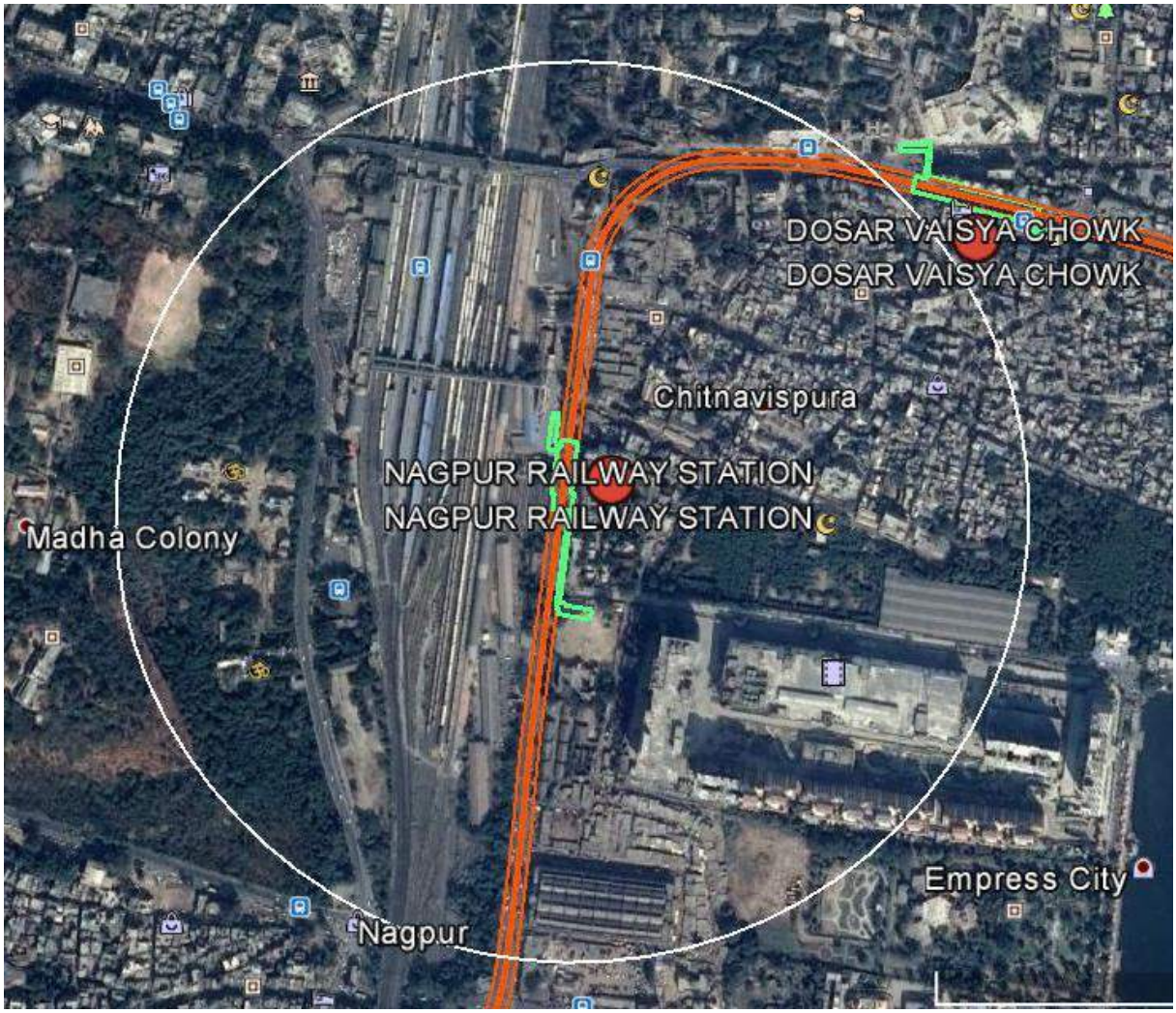
FIGURE A- 136 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND DOSAR VAISYA STATION



A.4.8 NAGPUR RAILWAY STATION

This station on the east of the Nagpur Railway station lies on the Gurutej Bahadur Marg near the Railway freight Yard. Further westwards from the railway station is the Kapda bazaar (Market area) and to the northeast of the metro station is the dense residential area of Chitinavispura.. Refer Figure A- ***137***.

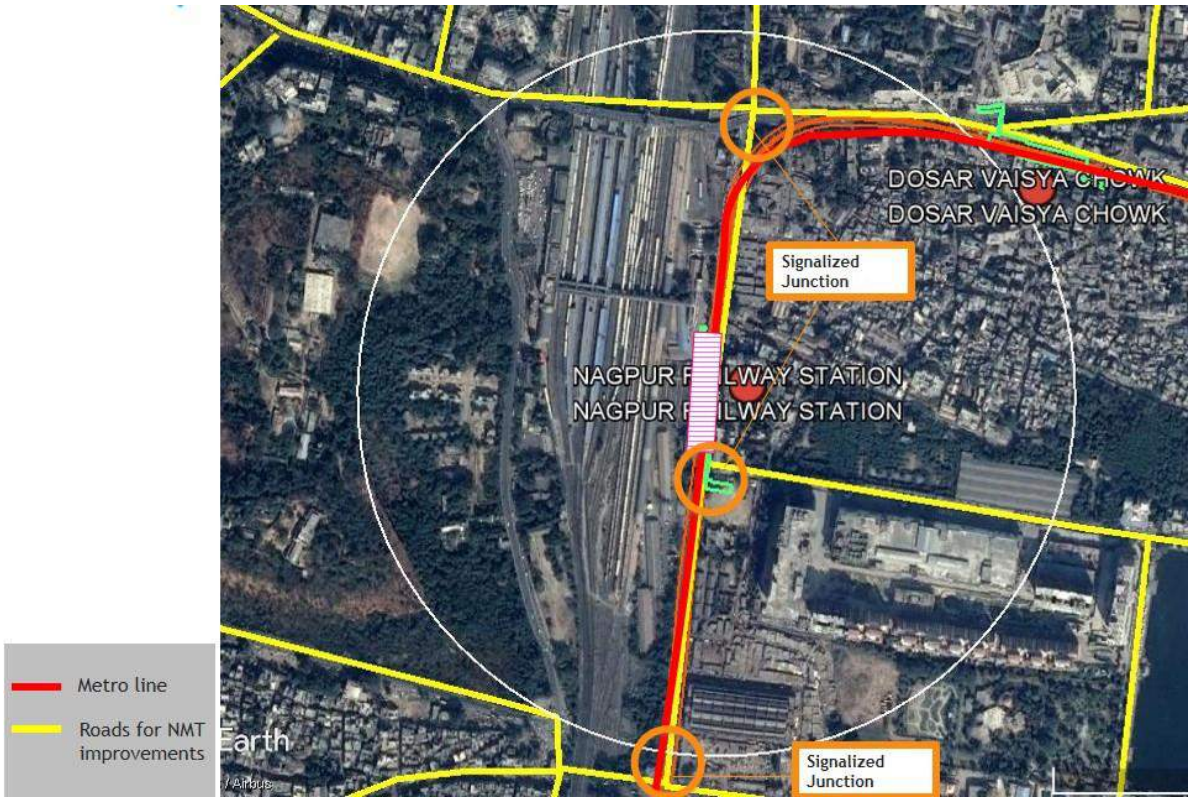
FIGURE A- 137 : NAGPUR RAILWAY STATION METRO STATION CONTEXT



A.4.8.1 NMT IMPROVEMENTS REQUIRED

Located in close proximity to the Railway Station the space between metro and railway stations are to be designed ensuring convenient interchange.

FIGURE A- 138 : NMT IMPROVEMENTS



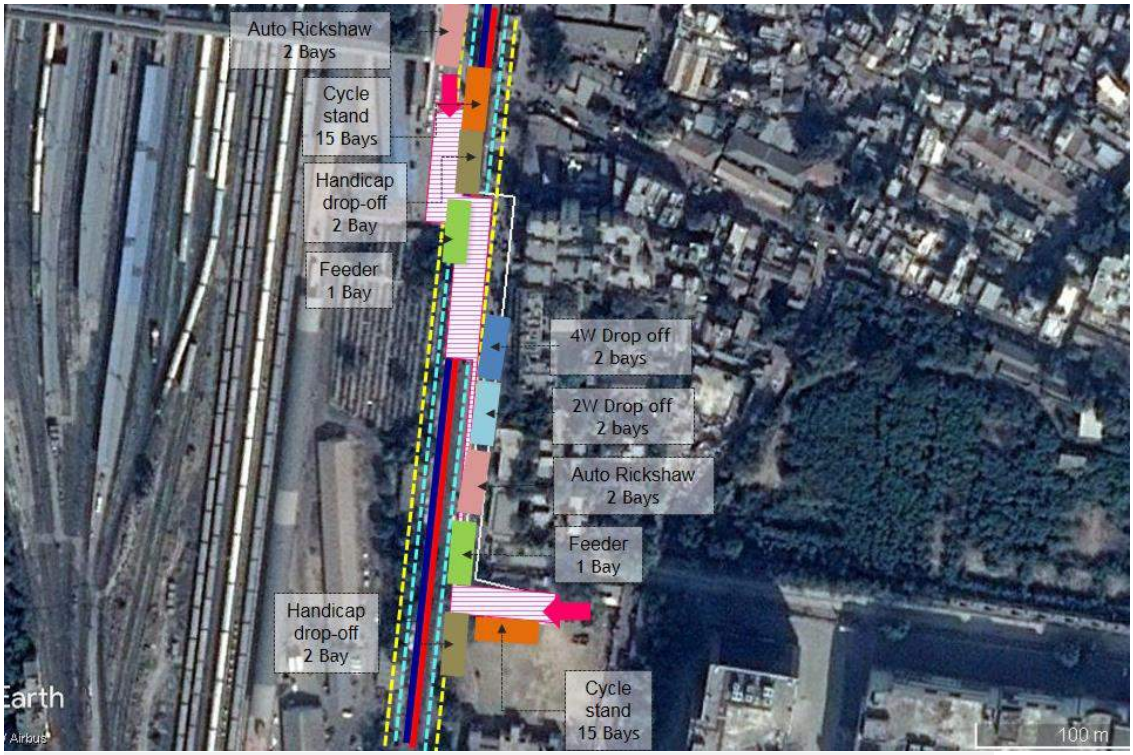
A.4.8.2 PICK AND DROP, PARKING REQUIREMENTS

The information on station ridership for Nagpur Railway Station is not available. In such situations, the requirements for pick and drop, parking facilities for the station area cannot be established.

A.4.8.3 CONCEPTUAL PROPOSAL FOR PICK AND DROP FACILITIES, PARKING REQUIREMENTS

In the absence of information on station ridership, the proposed allocation of the parking facilities has been done considering typical minimum parking requirements.

FIGURE A- 139 : CONCEPTUAL LOCATIONS FOR PICK AND DROP, PARKING AROUND NAGPUR RAILWAY STATION



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APPENDIX B – CONCEPTUAL URBAN PLACE MAKING SCHEME

This section details out the urban place-making proposals identified in the NMT Need Assessment Report for the following locations:

- **PA-1- Public space in front of South Airport Station-** The Concept proposal for Place Making in front of South Airport Station is integrated with the concept proposal for Station Area Improvements for South Airport in Appendix A
- **PA-2- Sitabuldi Pedestrianisation**
- **PA-3- Eco-Mobility corridors near Ujwal Nagar and Jaiprakash Nagar stations**
- **PA-4- Ambazari Lakefront**
- **PA-5- Kastur Chand Park place making**

B.1. PA – 2 – SITABULDI PEDESTRIANIZATION

B.1.1 AREA INTRODUCTION

Sitabuldi is an important commercial area located in the vicinity of Nagpur railway station and bus terminal. Munjhe chowk is Sitabuldi`s most important junction and is where the elevated interchange node of North-South and East-West lines of Nagpur Metro is planned. Refer This is located near the junction of Nagpur-Chandrapur Road, Nagpur-Aurangabad Highway and Ambazari road.

Though predominantly a residential area as per the Nagpur Master Plan 2032, Sitabuldi has commercial activities of varying scale and density of commercial ventures surpassing the sanctioned by in Master Plan Figure B- 2. Apart from a large number of retail, wholesale commercial establishments, hotels and restaurants, a new mall is under constructed on the northern arm of Munjhe Chowk. As part of property development initiatives of Maha-Metro, the station building would also house a hotel and commercial floors over the station which extends upto the TTMC site located opposite the Yashwant Stadium. Refer Figure B- 4. Subsequent increase in commercial floor space around Munjhe Chowk shall inadvertently boost footfall in Sitabuldi.

FIGURE B- 1 : SITABULDI LOCATION MAP

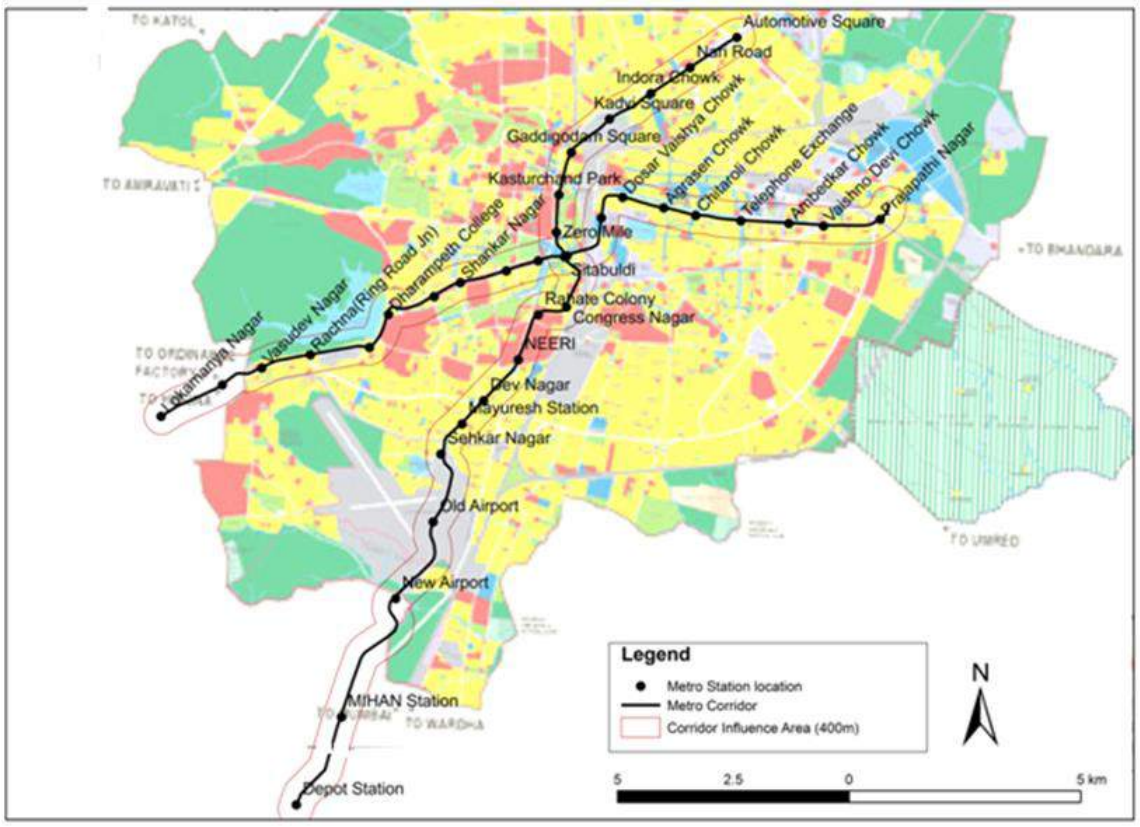
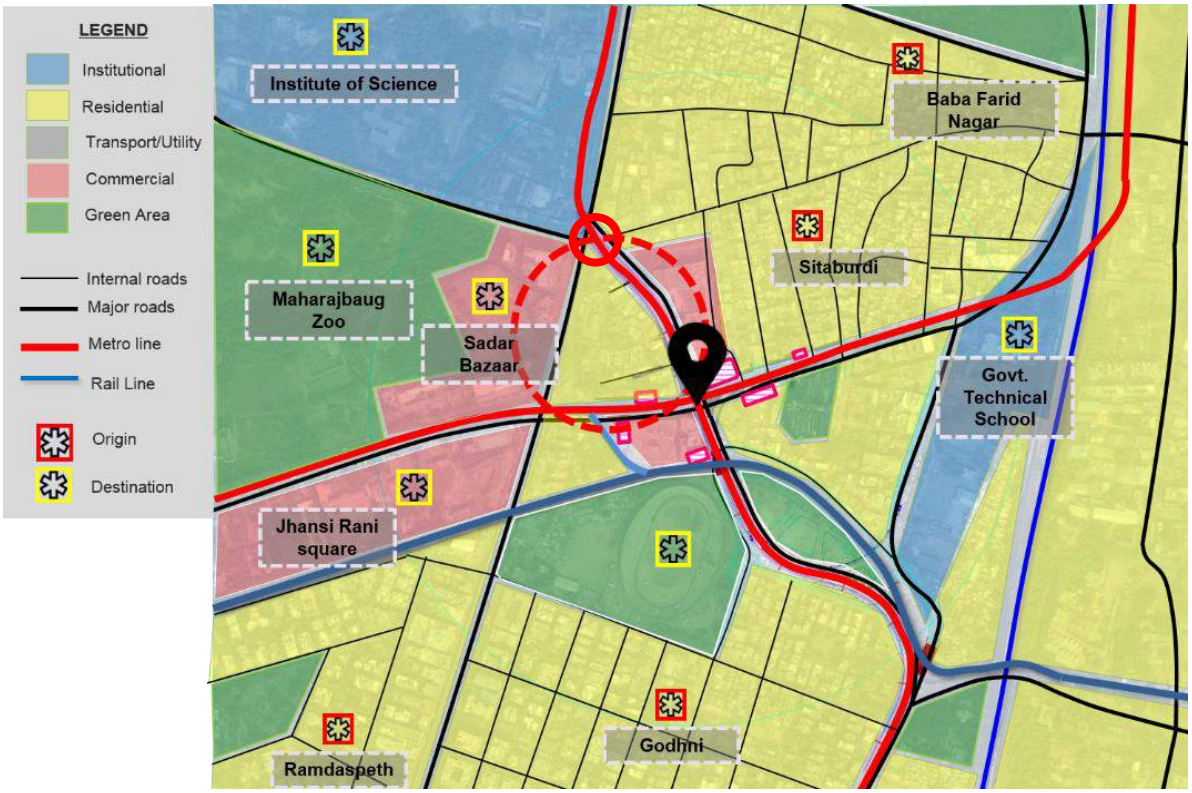


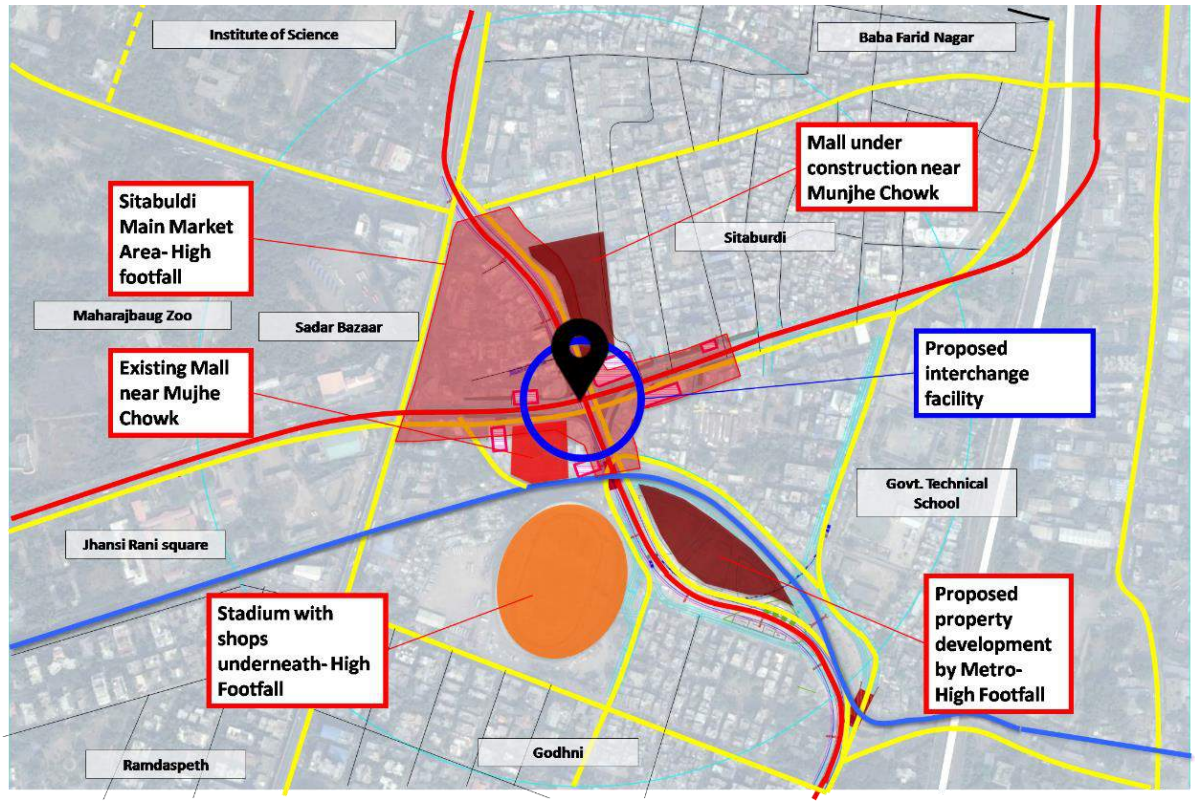
FIGURE B- 2 : SITABULDI LANDUSE



In the absence of organized Public Transport and parking restrictions, the four arms of Munjhe Chowk is perennially congested where only two lanes (out of 4) are available for movement of vehicles. At the same time, pedestrian safety is compromised as people are expected to walk through encroached areas, spillover of commercial establishments and moving vehicles. Refer Figure B- *3*

FIGURE B- 3 : TYPICAL CONDIION OF ROAD SPACE AROUND MUNJHE CHOWK

FIGURE B- 4 : EXISTING AND PROPOSED COMMERCIAL ACTIVITY AROUND MUNJHE CHOWK



B.1.2 NMT VOLUMES

The NMT volume surveys conducted in May-June, 2017 show a very high volume of existing NMT users in and around the area. It is expected that the NMT ridership will increase when the area transforms post operation of the Nagpur Metro, development of Metro Property Development Site and functioning of the under construction mall near Munjhe Chowk.

TABLE B- 1 : NMT VOLUME COUNTS IN 2017

Leg of the Junction	Pedestrian Counts (2017)				Cyclist Counts (2017)			
	16hr total Count	Peak Hour	PH Count	PH %	16hr total Count	Peak Hour	PH Count	PH %
A	2679	18.15-19.15	239	8.9%	7948	18.00-19.00	845	10.6%
B	2298	09.30-10.30	222	9.7%	3321	12.00-13.00	375	11.3%
C	2501	10.45-11.45	207	8.3%	1156	09.30-10.30	101	8.7%
D	2934	18.15-19.15	249	8.5%	2188	19.15-20.15	309	14.1%
Total	10412	09.45-10.45	824	7.9%	14613	18.00-19.00	1392	9.5%

As per the NMT Demand Assessment for 2041, Nagpur would witness minimum annual growth of pedestrian trips at the rate of 1.29% per annum and a total of 22.13% upto the Horizon year. At the same time, the cycling trips would grow at the rate of 1.63% per annum and a total of 32.08% upto the Horizon year. Considering minimum projected growth, the volumes for Horizon Year would be as per Table B- *2*

TABLE B- 2 : PROJECTED NMT VOLUME COUNTS FOR 2041

Leg of the Junction	Pedestrian Counts (2017)		Pedestrian Counts (2041)		Cyclist Counts (2017)		Cyclist Counts (2041)	
	16hr total Count	PH Count	16hr total Count	PH Count	16hr total Count	PH Count	16hr total Count	PH Count
A	2679	239	3271	291	7948	845	10497	1116
B	2298	222	2806	271	3321	375	4386	495
C	2501	207	3054	252	1156	101	1526	133
D	2934	249	3583	304	2188	309	2889	408
Total	10412	824	12716	1006	14613	1392	19300	1838

The table above establishes the demand for dedicated NMT space around Munjhe Chowk. The requirements for Dedicated NMT space has been outlined in Table B- *3*.

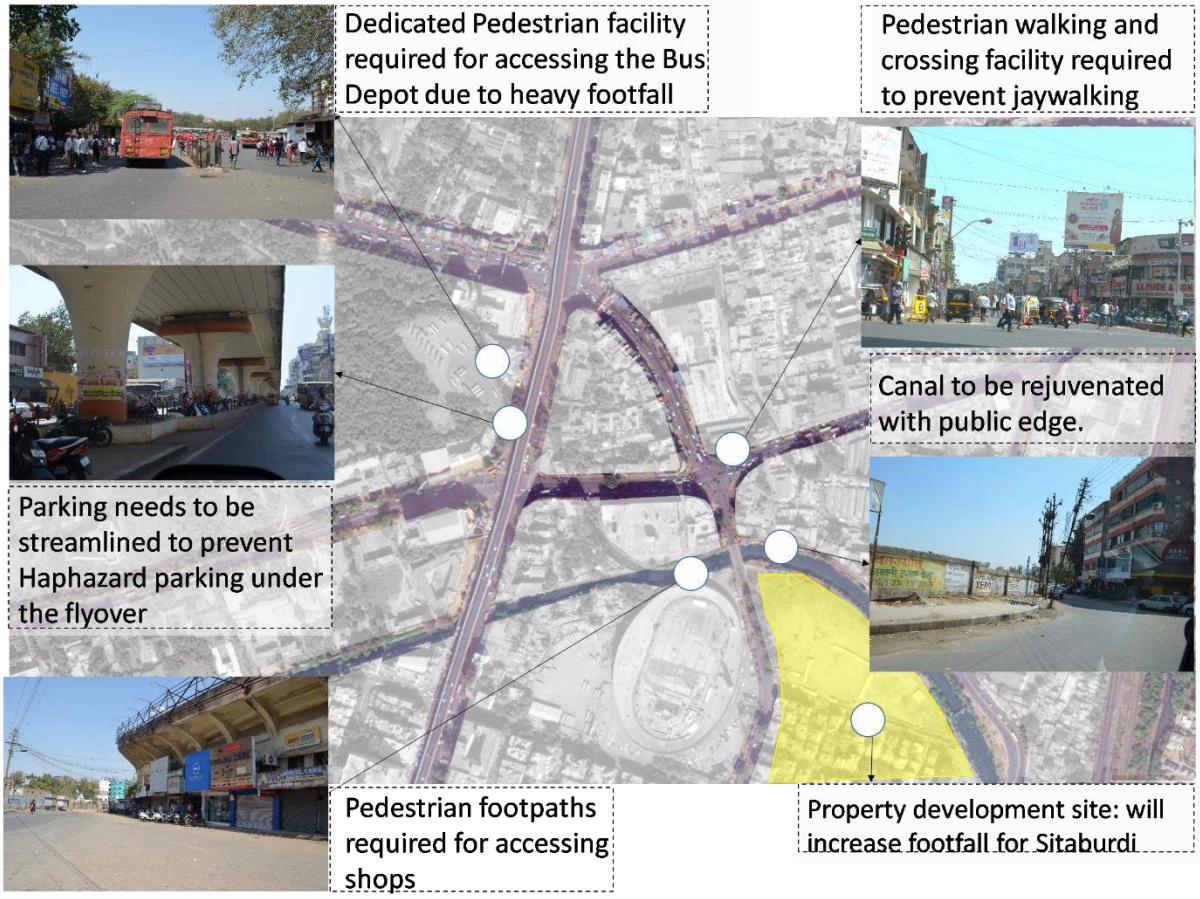
TABLE B- 3 : REQUIREMENT OF DEDICATED NMT SPACE AS PER IRC CODES

Leg of the Junction	Pedestrian Counts (2017)	Footpath Width	Pedestrian Counts (2041)	Footpath Width	Cyclist Counts (2041)	Cycle Track Requirement	Cyclist Counts (2041)	Cycle Track Requirement
A	2679	2.5m +2.5m	3271	3.5m +3.5m	7948	4 Lane- 2 way	10497	4 Lane- 2 way
B	2298	2.5m +2.5m	2806	3m +3m	3321	3 Lane- 2 way	4386	3 Lane- 2 way
C	2501	2.5m +2.5m	3054	3m +3m	1156	2 Lane- 2 way	1526	2 Lane- 2 way
D	2934	3m +3m	3583	3.5m +3.5m	2188	3 Lane- 2 way	2889	3 Lane- 2 way
The above is as per IRC-103- 2012- Guidelines for Pedestrian Facilities. The Guidelines also recommend that High Itensity Commercial Areas should have atleast 4m wide footpaths along both sides					The above is as per IRC-11- 1962- Recommended practice for the design and layout of cycle tracks. As per the guidelines, the minimum width of cycling lane should be 2m (per lane).			

B.1.3 MAPPING OF CONSTRAINS AND OPPORTUNITIES

Broad area wise constraints and opportunities in the area are shown in Figure B- 5.

FIGURE B- 5 : MAPPING BROAD OPPORTUNITIES AND CONSTRAINTS



The elaborate list of opportunities and constraints in and around the area are:

Constraints:

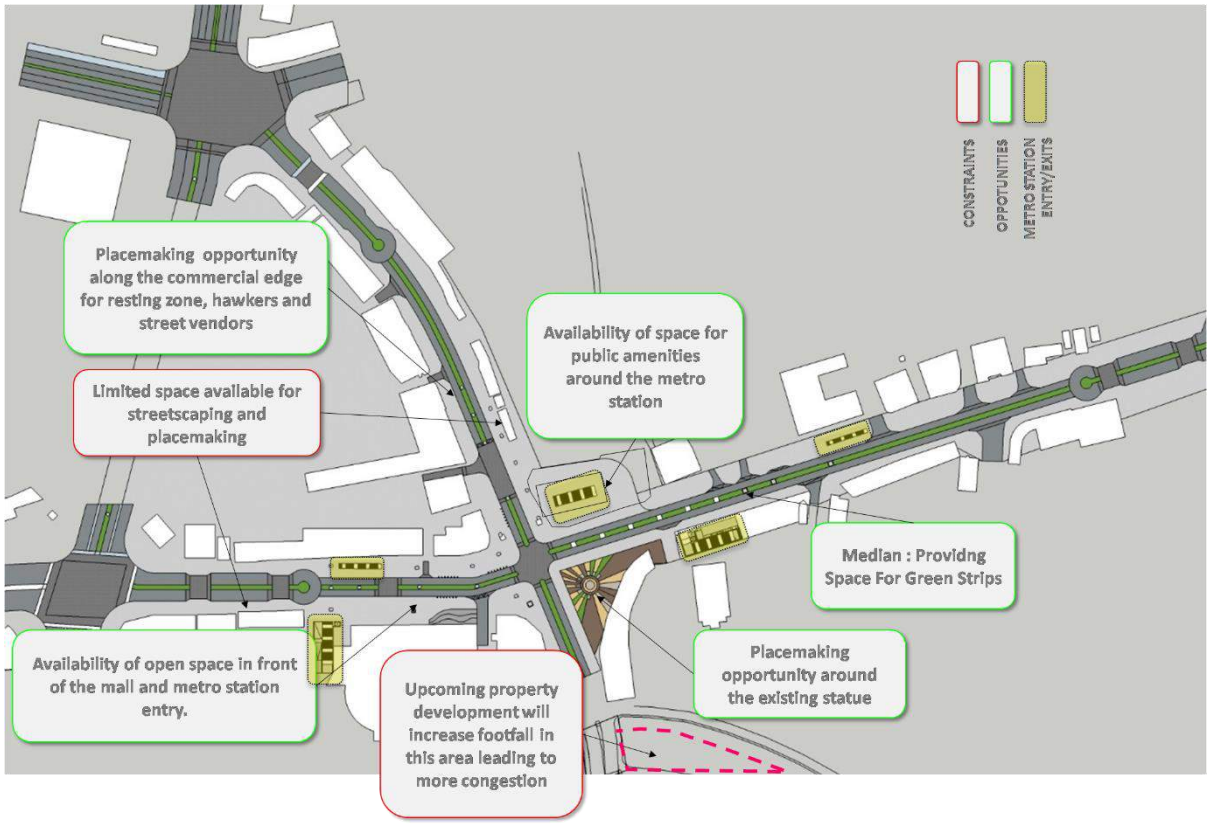
1. Absence of detailed mapping of existing commercial floor space and respective footfalls.
2. Increasing private vehicle use to access the area.
3. Absence of parking restraint measures.
4. Limited RoW of the existing roads in the manner of present use

Opportunities:

1. High footfall of visitors and shopper in the area.
2. Availability of high density of commercial floor space in the area.
3. Planned metro interchange facility at Munjhe Chowk
4. Availability of parking space under existing flyover and within proposed property development can decongest the arms of Munjhe Chowk.
5. Possibility of distributing traffic load into surrounding road network thereby decongests area.

In line with the above, Fig B6 shows the opportunity for various initiatives to decongest the area.

FIGURE B- 6 : AREAS SPECIFIC OPPORTUNITY AND CONSTRAINT MAPPING

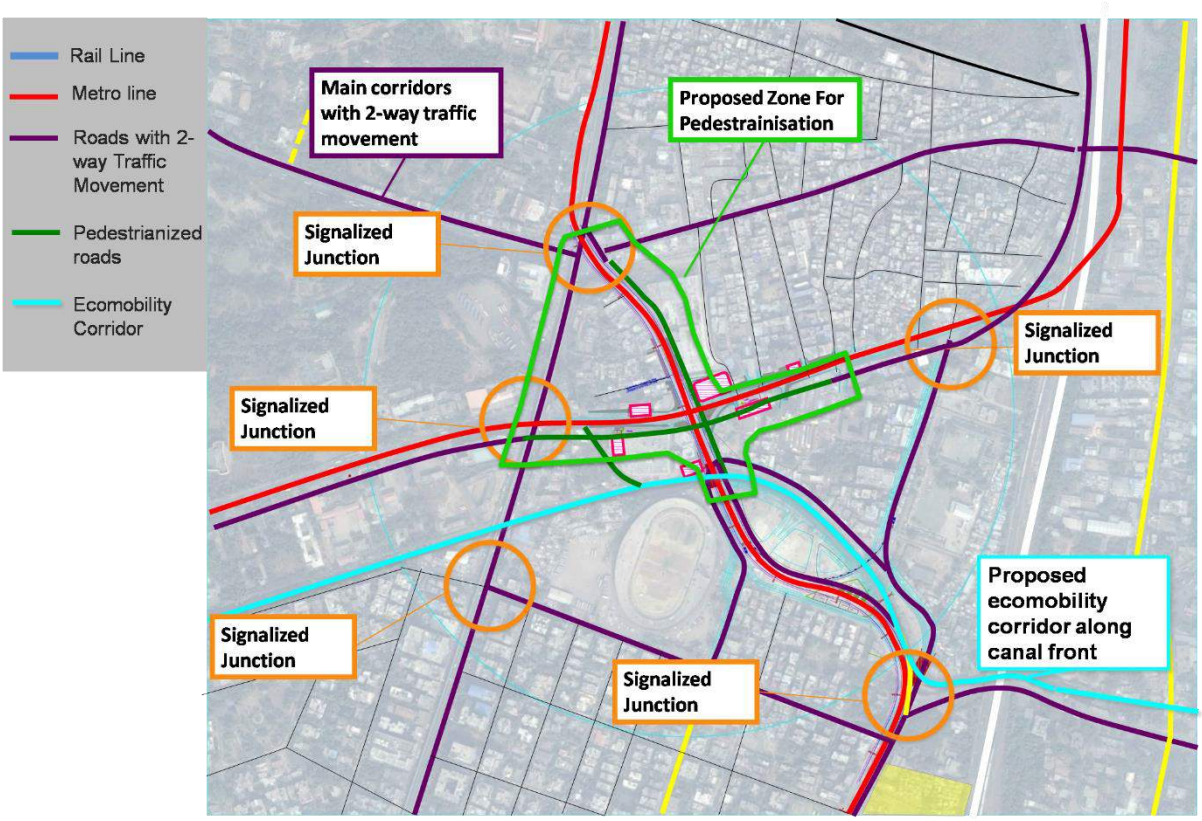


Sitabuldi requires a phased strategy for decrease the use of private motor vehicles and increase parking restriction and thereby reclaim road space for wider NMT use.

B.1.4 PLACE MAKING PROPOSAL

For effective use of roads and spaces in Sitabuldi it is proposed that the four arms of Munjhe Chowk be pedestrianised. This can be followed by diverting vehicular traffic from Abhayankar Marg to Sitabuldi Main road, from Ambazari to Police Station road and from Pandit Malviya marg to Dr Munjhe Marg. Refer Figure B-7 to reroute traffic, a traffic impact assessment study must be commissioned for its identified zone. An alternate walking and bicycling corridor shall be developed along the edge of East-West Stream, to the south of Munjhe Chowk.

FIGURE B- 7 : TRAFFIC DIVERSION AROUND MUNJHE CHOWK



B.1.4.1 AVAILABILITY OF SPACE FOR PEDESTRIANISATION

It can be seen in Figure B- *8* that after leaving space for metro median and a single lane of traffic, a dedicated NMT zone 4.25-5.5m can be accommodated on either sides of the arms extending from Munjhe Chowk.

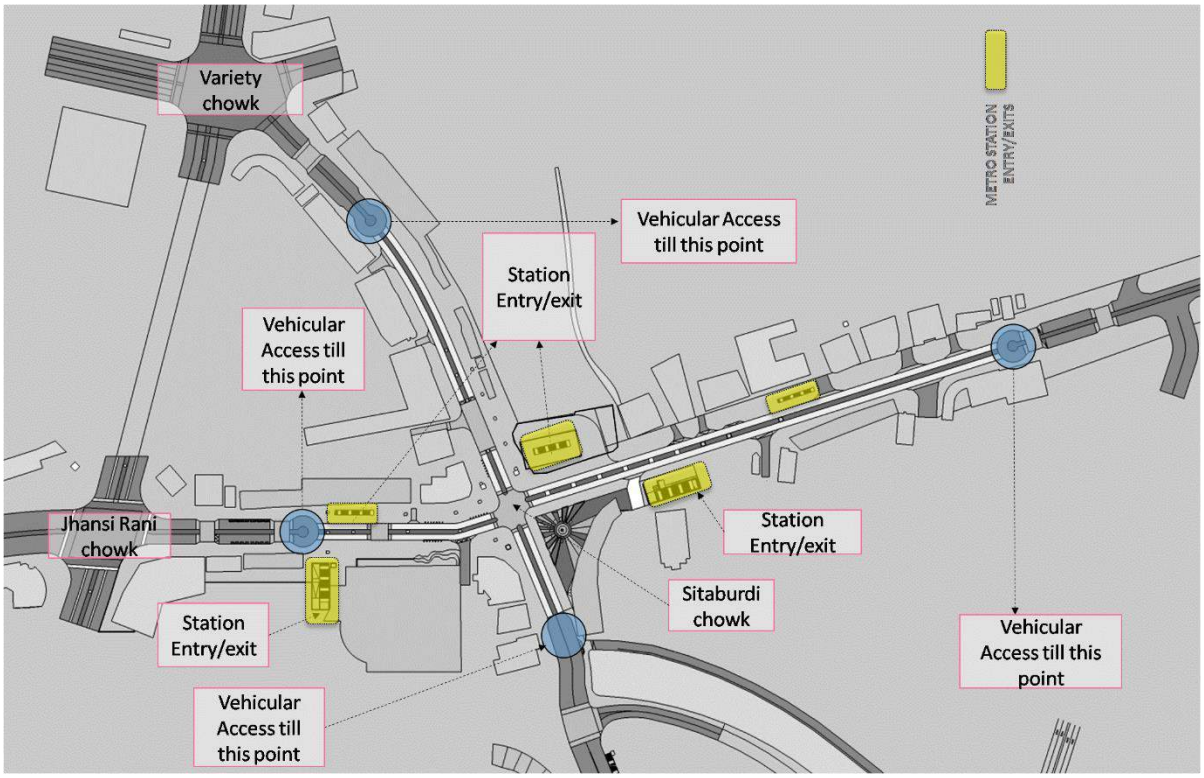
FIGURE B- 8 : RE-ORGANISATION OF ROAD SPACE FOR PEDESTRIANIZATION

FIGURE B- 9 : RE-ORGANISATION OF ROAD SPACE FOR PEDESTRIANIZATION

B.1.4.2 PROPOSED LIMITS FOR VEHICULAR ACCESS AND PEDESTRIANISATION

Four entry points to the core-pedestrianized area around Munjhe Chowk are planned and will be accomplished in two phases. The space between the entry points to the core-pedestrianized area and the nearby junction (Variety Chowk, Rani Jhansi Chowk) will have short-term high-priced pick-and-drop facilities, parking for metro feeder bus etc. The metro station entry/ exits are located within 50m from the entry points to the core-pedestrianized area.

FIGURE B- 10 : LIMITS FOR VEHICULAR ACCESS TO THE PEDESTRIANISED AREA



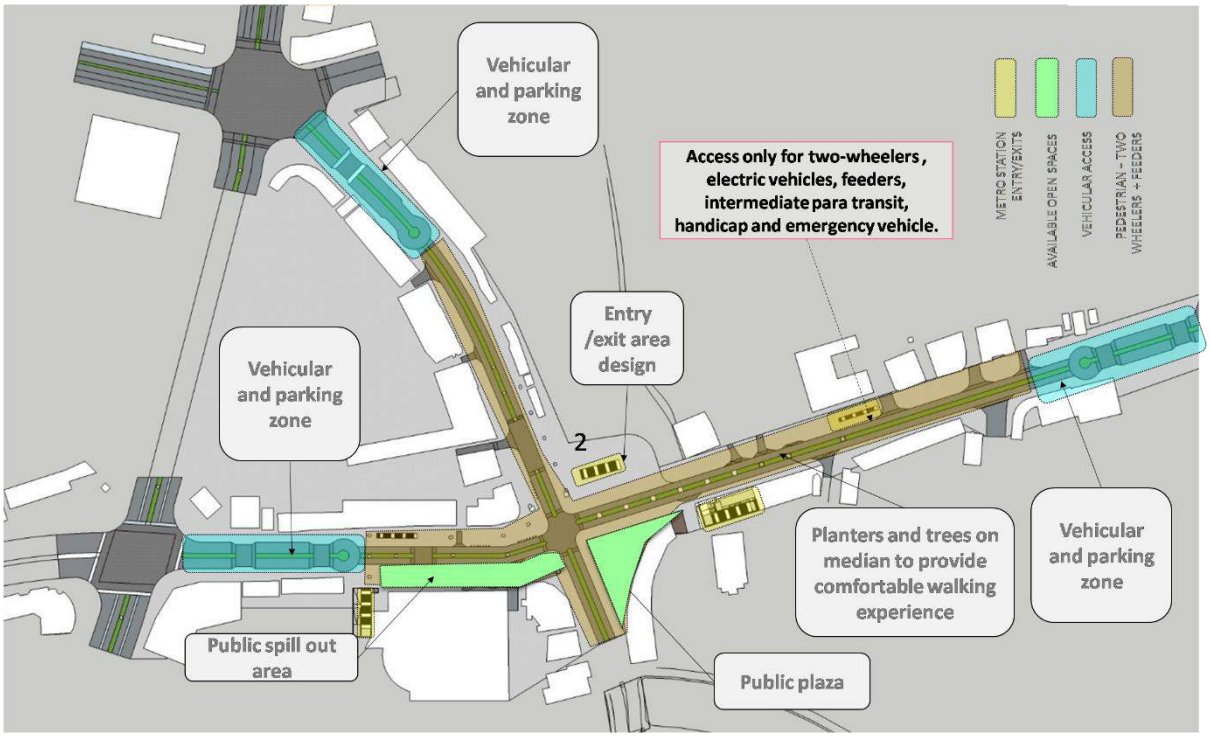
The proposal for pedestrianisation of the four arms of Munjhe Chowk has been planned in following two phases:

1. PROPOSED ZONING- PHASE-1

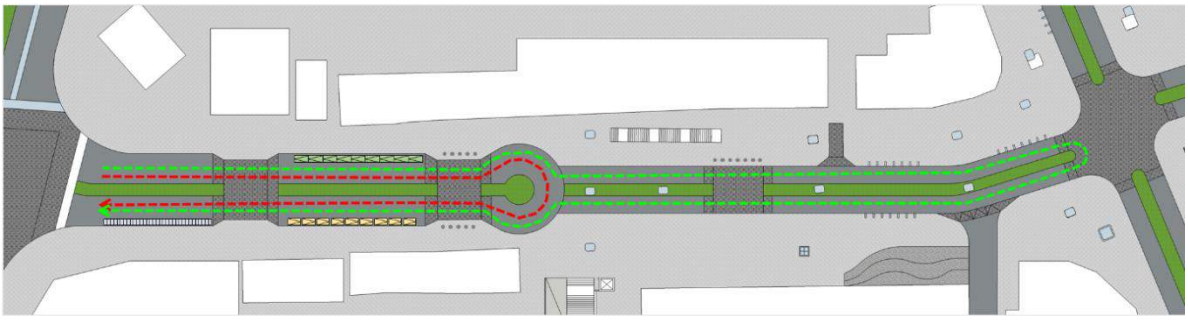
In the first phase, streets around Munjhe Chowk shall be redesigned with more space for NMT and limited vehicular access. Parking restrictions in the form of short-term high priced pick and drop will be imposed in the identified zones near Variety Chowk, Rani Jhansi Chowk and Canara Bank. Simultaneously, limited access will be granted for bicycles, two-wheelers, metro feeder, IPT, handicap and emergency vehicles to the pedestrianized zones. Service vehicles will only be allowed either before or after the peak hours in the morning and evening, respectively.

Long-term parking shall be provided under the Nagpur Chandrapur Flyover and the Property Development opposite Yashwant Statdium. Refer Figure B- ***11***.

FIGURE B- 11 : PROPOSED ZONING FOR PEDESTRIANISATION- PHASE-1



VEHICULAR MOVEMENT PHASE-1



Note: In both phases e-rickshaws, emergency vehicles and handicapped users are allowed to take their vehicles inside the pedestrian only carriageways.

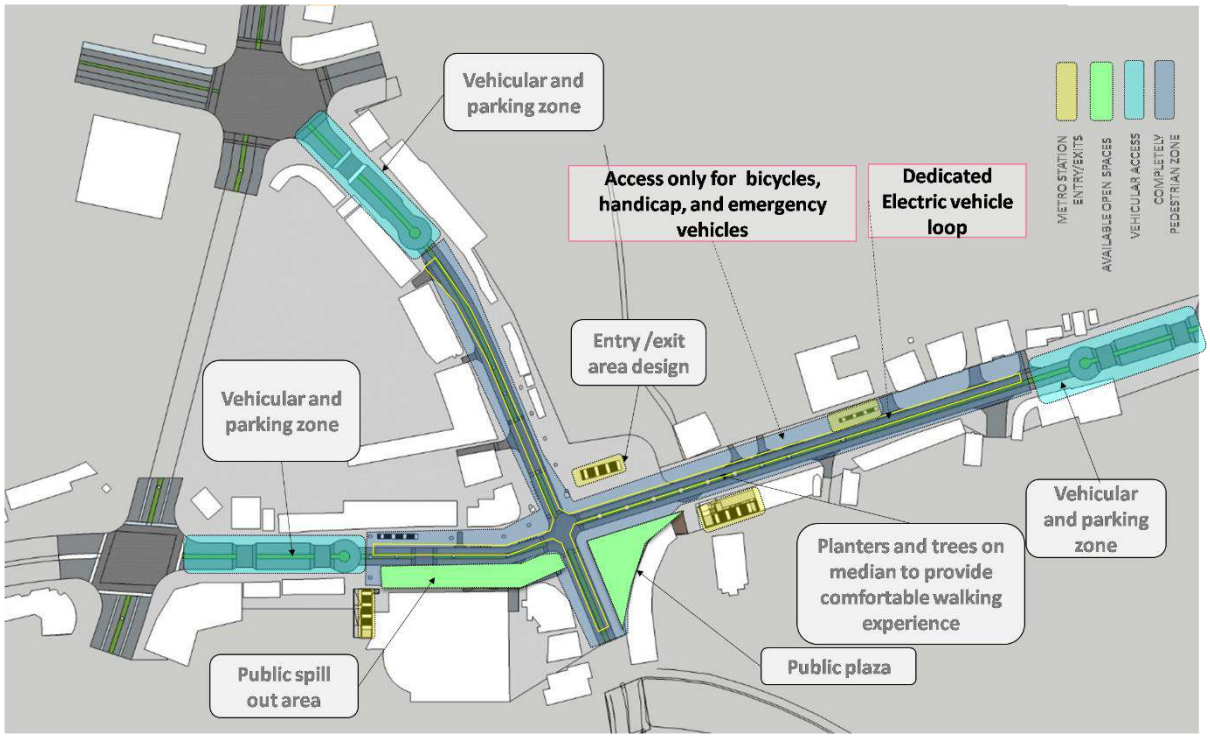
Bicycles, Two wheelers and feeders

Cars

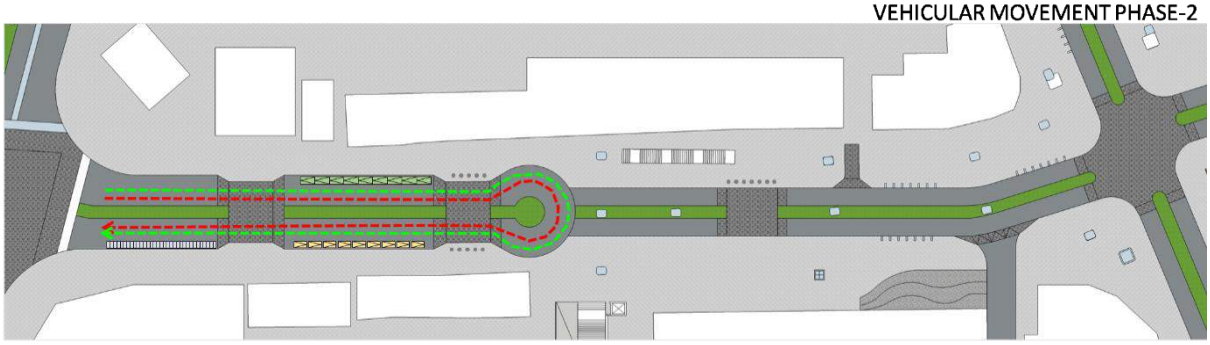
2. PROPOSED ZONING- PHASE-2

In Phase- 2 accesses to all vehicles (except bicycles, those for the disabled and for emergency services) will be restricted in the pedestrianized area Refer Figure B- *12*. For those in need, an electric vehicle running in a defined loop may be allowed within the pedestrianized area.

FIGURE B- 12 : PROPOSED ZONING FOR PEDESTRIANISATION- PHASE-1



VEHICULAR MOVEMENT PHASE-2



Note: In both phases e-rickshaws, emergency vehicles and handicapped users are allowed to take their vehicles inside the pedestrian only carriageways.

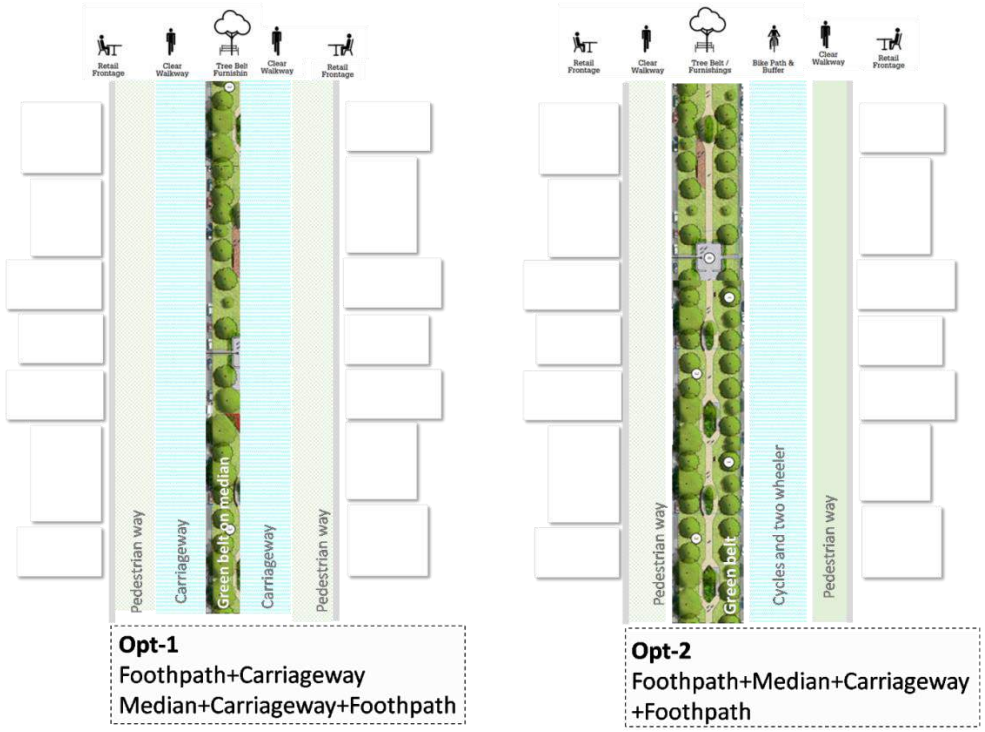
Bicycles, Two wheelers and feeders

Cars

3. RE-ORGANIZING ROAD SPACE AROUND MUNJHE CHOWK

The road space around Munjhe Chowk will need reorganization to reclaim necessary space for NMT usage. Reclamation of space for pedestrians can be done in two ways, i.e. either the lanes for movement of bicycles and selected vehicles can be planned on either side of the median along the metro alignment or along any one side. Refer Figure B- *13*. The first option where the space for movement of selected vehicles is planned on either side of the median along metro alignment has been preferred above option 2 as it allows equitable distribution of NMT space.

FIGURE B- 13 : OPTIONS FOR ORGANISING ROAD SPACE AROUND MUNJHE CHOWK



4. DESIGN OF PEDESTRIANIZED STREET

Typical design for a pedestrianized arm of Munjhe Chowk is shown in Figure B- *14* & Figure B- *15*.

FIGURE B- 14 : TYPICAL STREET DESIGN FOR PEDESTRIANISATION

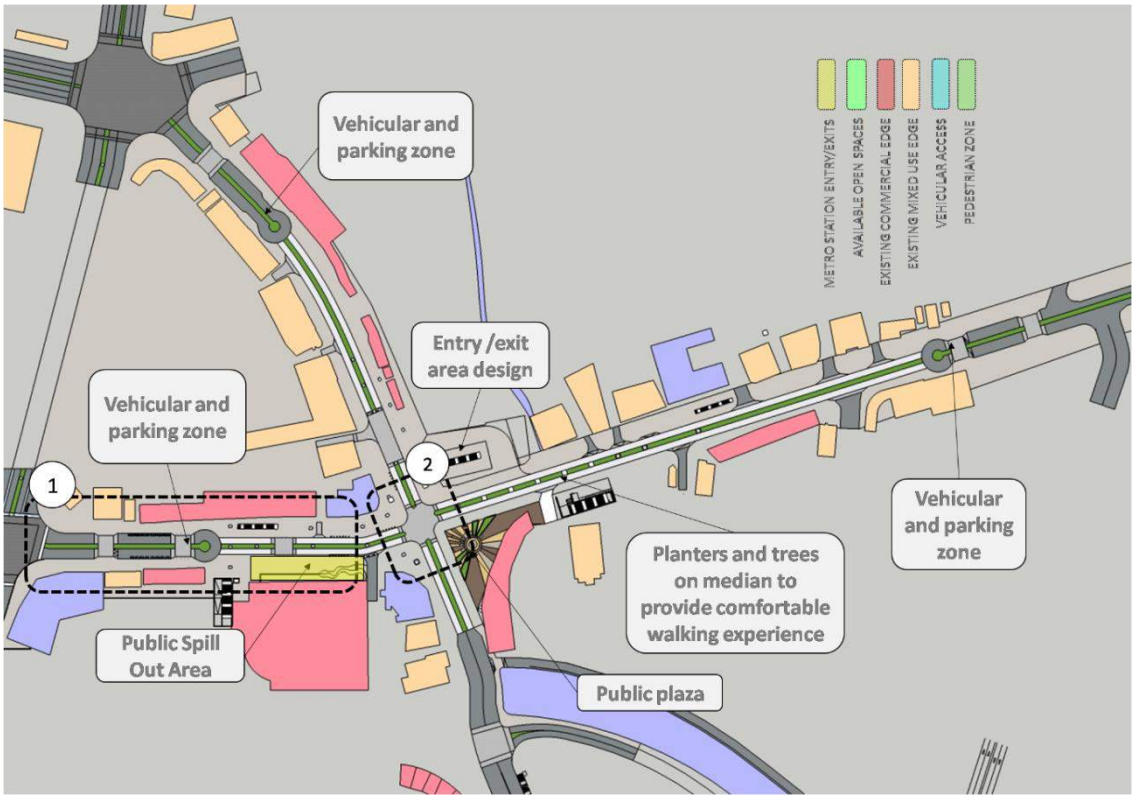
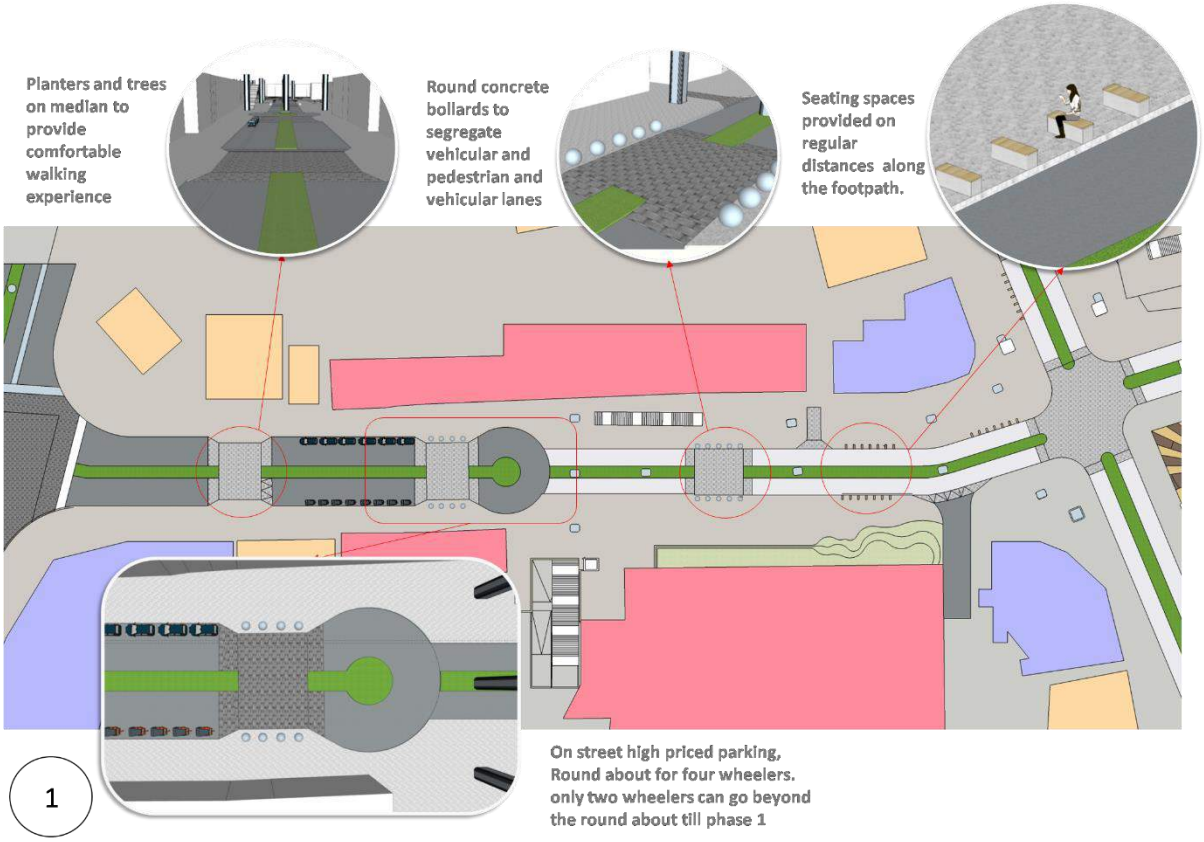


FIGURE B- 15 : STREET DESIGN FEATURES



B.1.5 WAY FORWARD

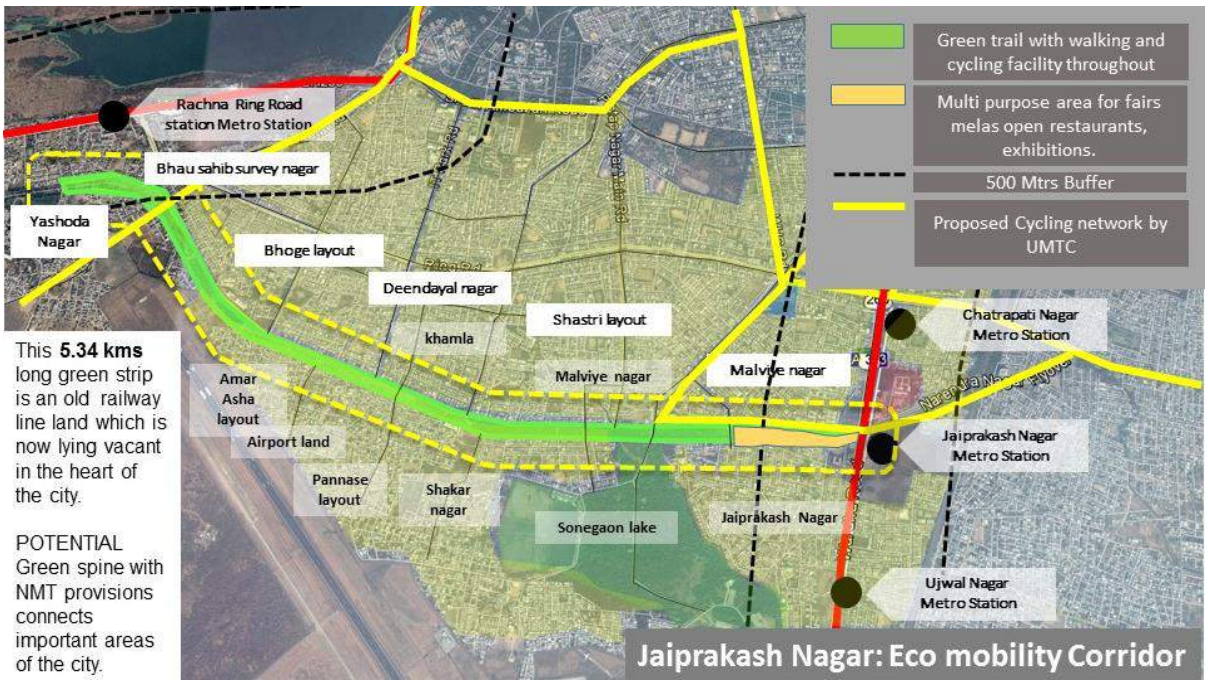
1. A detailed traffic impact assessment for the zone is necessary to finalize/ modify traffic re-routing suggestions.
2. Stakeholder engagement to raise awareness about ill-effects of increased vehicular usage in the area is necessary.
3. Trial runs for traffic rerouting are necessary.

B.2. PA-3- ECO-MOBILITY CORRIDORS NEAR UJWAL NAGAR AND JAIPRAKASH NAGAR STATIONS

B.2.1 AREA INTRODUCTION- JAIPRAKASH NAGAR ECO MOBILITY CORRIDOR

A green patch of land, owned by the railways extends from Jaiprakash Nagar metro station on Reach-1 upto Rachna Ring Road metro station on Reach-3. This land has a defunct track traversing it. Refer Figure B- *16*.

FIGURE B- 16 : JAIPRAKASH NAGAR DEFUNCT RAILWAY LAND



B.2.2 LAND USE- JAIPRAKASH NAGAR ECOMOBILITY CORRIDOR

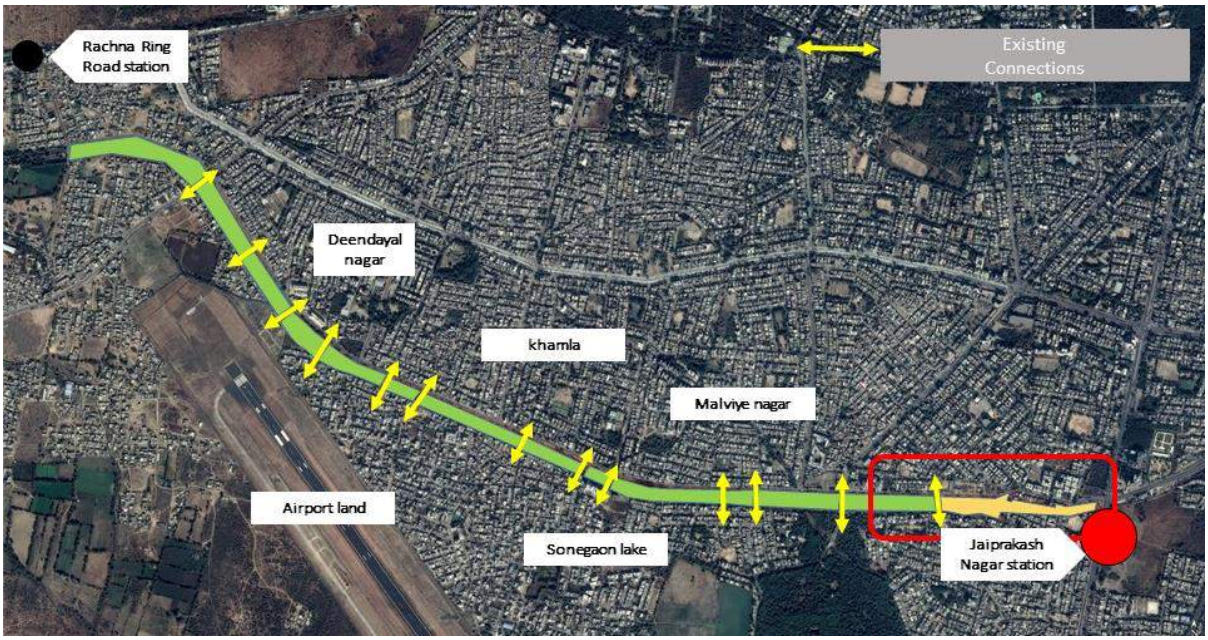
The areas surrounding the identified railway land is predominantly a residential one with some commercial areas and hotels in close proximity. Its edge connects with a dense network of streets (Refer Figure B- 17) and provides a breathing space for surrounding areas. It also bears an opportunity to be developed as an edge with eco-mobility and encourage walking and cycling.

FIGURE B- 17 : LANDUSE AROUND THE IDENTIFIED LAND PLACE MAKING

B.2.3 CONNECTIVITY- JAIPRAKASH NAGAR ECO-MOBILITY CORRIDOR

Areas on either side of railway land are identified for place making through eco-mobility. Refer Figure B- *18*. The proposal allows the green area to be traversed by walking and cycling and at the edge continue onwards to the main traffic network. This allows continuous walking and cycling that links surrounding areas to the Metro Station by adding value (through active use) to the land parcel.

FIGURE B- 18 : CONNECTIVITY BETWEEN THE EDGES OF THE IDENTIFIED LAND FOR PLACE MAKING



B.2.4 CASE STUDIES

B.2.4.1 ROSE FITZGERALD KENNEDY GREENWAY, BOSTON

In 1991, construction began on the “Big Dig" to remove the elevated highways and create a tunnel system below the city. This was done with the aim of enhancing the city`s environment by creating the *Greenway*, a linear series of parks and gardens that would re-connect some of Boston’s oldest, most diverse, and vibrant neighborhoods. Refer Figure B- ***19*** & Figure B- ***20***. This was a joint effort of the Massachusetts Turnpike Authority (MTA), the Commonwealth of Massachusetts, the City of Boston and various civic groups.

FIGURE B- 19 : ELEVATED HIGHWAY BEFORE BIG DIG

FIGURE B- 20 : ROSE FITZGERALD KENNEDY GREENWAY, BOSTON, AFTER BIG DIG

The Greenaway has regenerated the surrounding areas by adding vibrant public spaces with zones for recreation, play, public art, open air exhibitions, public art, etc. in the heart of the city. These spaces are managed and maintained by the Rose Kennedy Greenways Conservation Team.

B.2.5 PLACE MAKING PROPOSAL- JAIPRAKASH NAGAR ECOMOBILITY CORRIDOR

B.2.5.1 VISION

The proposed area provides opportunity to design the edge for better walking and cycling experience. It is recommended that the final use and design of the land should allow unhindered network of footpaths and cycle tracks with necessary crossing facilities and traffic calming. The space, if put to adequate use with public edges and permeable ground plane can initiate regeneration of the surrounding areas and boost the real estate investments in the vicinity. Care must be taken to curb using the area as a thoroughfare.

B.2.5.2 PROPOSAL

The land parcel for place-making extends from Jaiprakash Nagar to Rachna Ring road stations and a large part of it is beyond the study area of this assignment. The place-making proposal under discussion is for the stretch extending 500mt from the station and a typical design for edges.

1. CONCEPTUAL PLACE MAKING PROPOSALS

Irrespective of use, the edges of the Railways land needs to transform to a vibrant public edge with footpaths and cycle tracks through design. Refer Figure B- *21***Error! Reference source not found.**. The space required for footpaths and cycle tracks can be shared between the railway land and public road RoW.

FIGURE B- 21 CONCEPTUAL PROPOSAL FOR PLACE MAKING ALONG THE GREEN STRIP

As part of street improvement to encourage use of NMT, the green area to the west of Station can be developed as an entry zone. The adjoining road and land parcel will be designed as shown in Figure B- 23.

FIGURE B- 22 : TYPICAL DESIGN OF ROAD ADJOINING THE RAILWAYS LAND

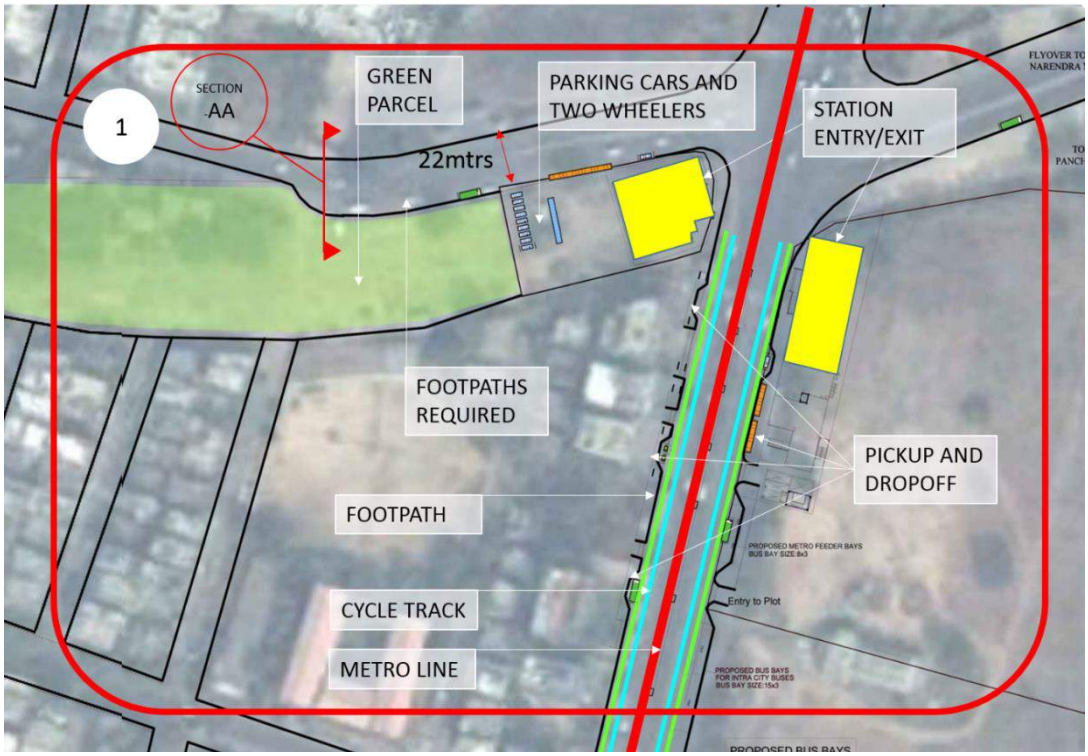
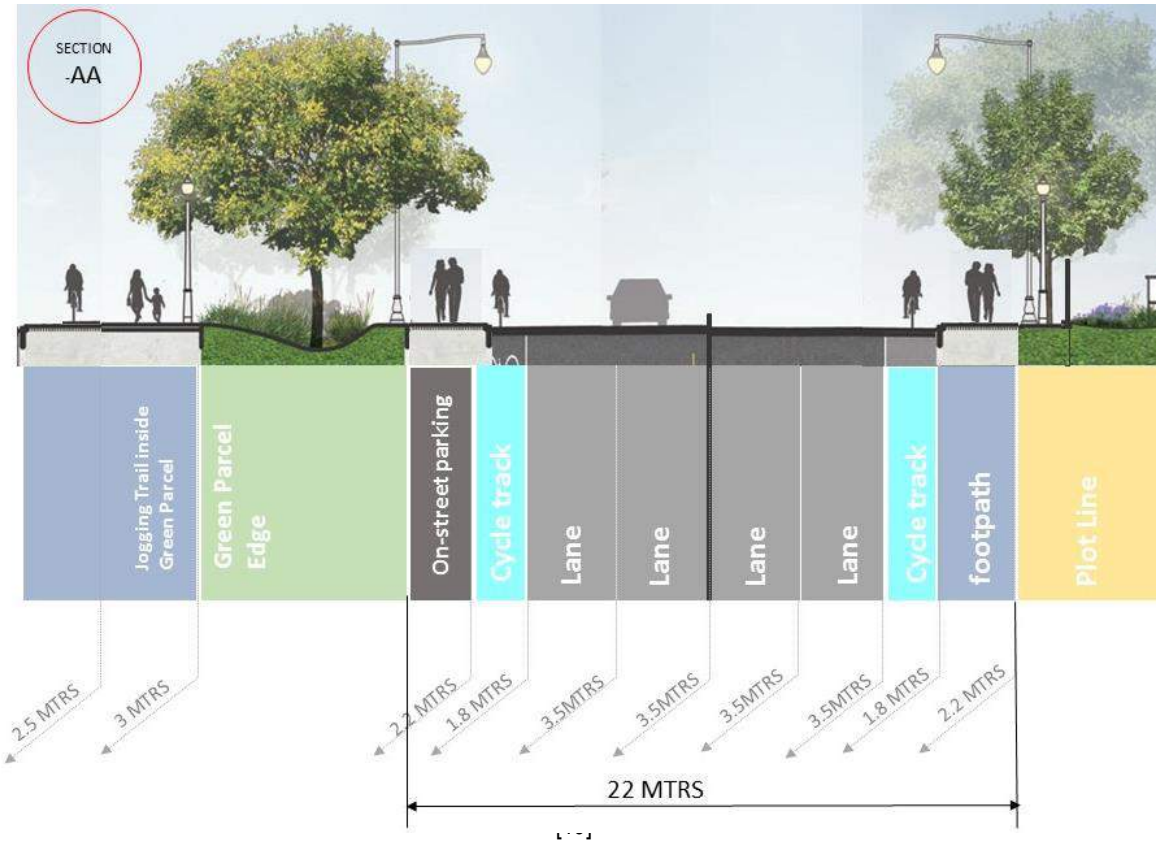


FIGURE B- 23 : TYPICAL DESIGN OF THE ROAD ADJOINING THE LAND PARCEL



B.2.5.3 AREA INTRODUCTION- UJWAL NAGAR ECO-MOBILITY CORRIDOR

This station is surrounded by residential areas where its western edge is separated from land owned by Airport Authority by a water canal. This land parcel extends further

1. SURROUNDING LAND USE AND CONNECTIVITY THROUGH ECO-MOBILITY CORRIDOR

Flanking the eastern and western edge of the canal are residential areas and land owned by the Maharashtra Airport Development Corporation (MADC) respectively. Refer Figure B- ***24***. The edges provide an opportunity to develop an eco-mobility corridor to encourage connecting residential areas of RBI Colony, Narksari Layout, Dharampeth Society and Ganguly Layout with the station area by walking and bicycling. It should result in a sustainable mechanism for improving water quality (of the canal) and maintaining the canal edge simultaneously.

FIGURE B- 24 : LANDUSE AROUND THE EXISTING CANAL NEAR UJWAL NAGAR STATION

B.2.5.4 CONSTRAINS AND OPPORTUNITIES

<u>Opportunities</u>

1. The canal provides an opportunity for development of public space along its edge.
2. Convergence of plans of Nagpur Municipal Corporation to rejuvenate storm water drains (nallahs) across Nagpur supports development of the proposed eco-mobility corridor and public spaces along the canals.

3. Convergence of plans by Maha Metro to improve walking and bicycling conditions within a radius of 500m from metro alignment is an opportunity for incorporating all ideas.

Constraints

1. Parts of the edges along the canal are constricted with limited space. This may hinder the seamless provision of walking and bicycling zones/corridors.

B.2.5.5 CASE STUDIES

1. CASE STUDY- NOTTINGHAM CANAL

Since it was built in the 18th cent CE, the area along Nottingham canal transformed continually and impacted its water quality.

The canal edge was first lined with warehouses, maintained by Railway agency and thereafter its surrounding area was restructured successively. In the mid-20th cent CE the Nottingham City council assumed its ownership and was maintained as a public asset. The canal front was reclaimed for public use with active edges and improved water quality Refer Figure B- ***25*** & Figure B- ***26***.

FIGURE B- 25 : NOTTINGHAM CANAL EDGE

FIGURE B- 26 : NOTTINGHAM CANAL EDGE

B.2.5.6 PLACE MAKING PROPOSAL- UJWAL NAGAR ECO-MOBILITY CORRIDOR

1. VISION

It is proposed that the edges of the canal be developed as an eco-mobility corridor, with footpaths, cycle tracks and recreational zones. This pilot exercise is expected to trigger interest and encourage such initiatives across Nagpur.

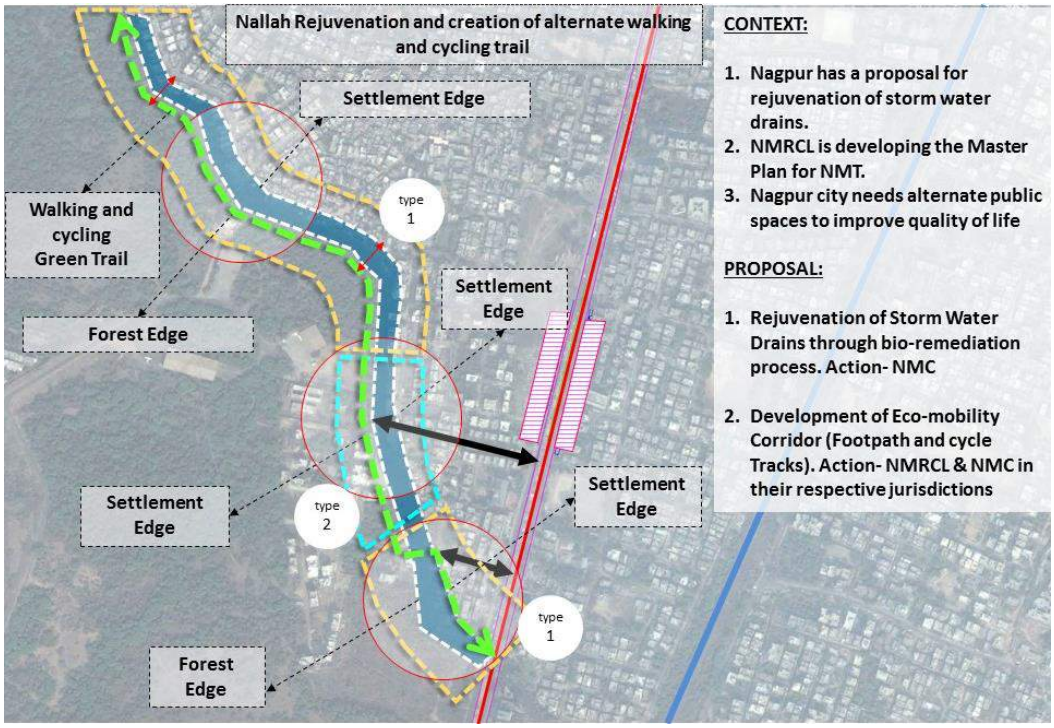
The strategies for improvement of the canal and its adjoining areas are proposed:

1. Rejuvenate of the Nallahs through bio-remediation to improve water quality and maintenance of eco-system
2. Physical transformation and social integration of canal edge through provision of necessary infrastructure supporting mobility (footpaths and bicycle tracks) and active use
3. Educating residents of the surrounding areas to prevent spilling waste and misuse of the area

2. PROPOSED ECO-MOBILITY CORRIDOR

Depending on the width of available space, there are 2 types of proposal for the Eco-mobility zone. Areas with a width of 5 meters or more between the canal and built edge, for example the sections at the Dharampeth Society and the RBI Colony can house both – an NMT zone and space for walking, bicycling and other active use. In sections with less than 5 meters width, the corridor will divert onto and be laid bordering the edge of MADC Land. Refer Figure B- 27.

FIGURE B- 27: NALLAH EDGE CONDITIONS FOR DEVELOPMENT OF ECOMOBILITY CORRIDOR



3. CONCEPTUAL PLACE MAKING PROPOSALS

The conceptual proposals for improving the canal edge through creation of eco-mobility corridors are shown below.

FIGURE B- 28 : EXISTING CONDITION OF THE NALLAH

FIGURE B- 29 : ILLUSTRATIVE EXAMPLE OF TRANFORMATION THROUGH ECOMOBILITY ALONG THE NALLAH

FIGURE B- 30 : TYPICAL ECOMOBILITY CORRIDOR WHERE THERE IS EXISTING SETTLEMENT ONLY ON ONE SIDE OF THE CANAL

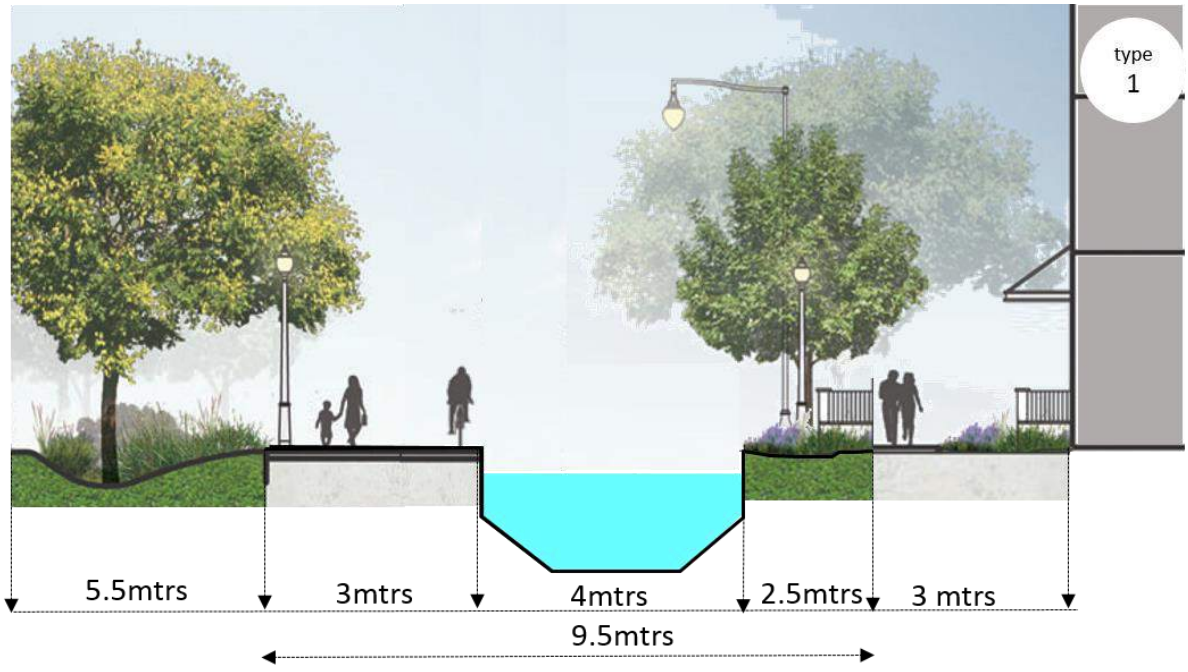
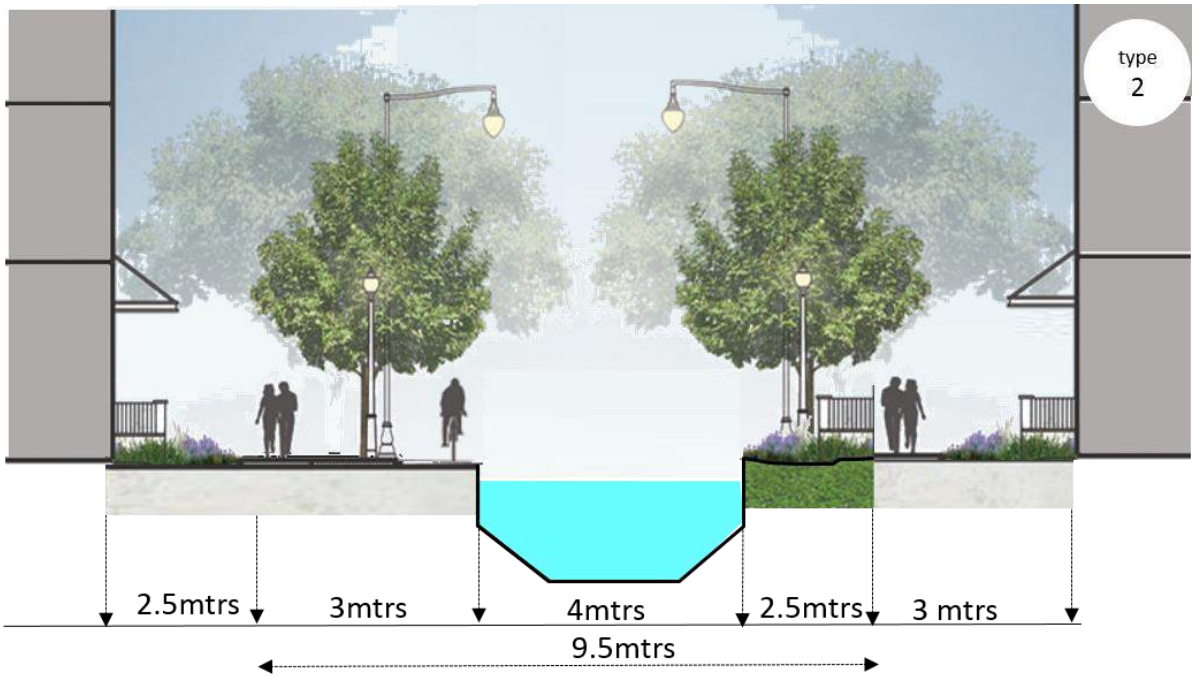


FIGURE B- 31 : TYPICAL ECOMOBILITY CORRIDOR WHERE THERE ARE EXISTING SETTLEMENT ON BOTH SIDES OF THE CANAL



B.2.6 WAY FORWARD

1. It is necessary that a city-wide eco-mobility plan be prepared to rejuvenate all natural water channels and the urban ecosystem. This should improve the pre-conditions (water quality, water-front condition and provide a consistent network) to integrate the entire length of the city
2. With improvements in the-preconditions, the use of eco-mobility corridors for walking and bicycling can be encouraged.
3. It is recommended that the section of the canal to the west of the station be taken-up as a pilot case for urban place-making by Maha Metro on priority basis.

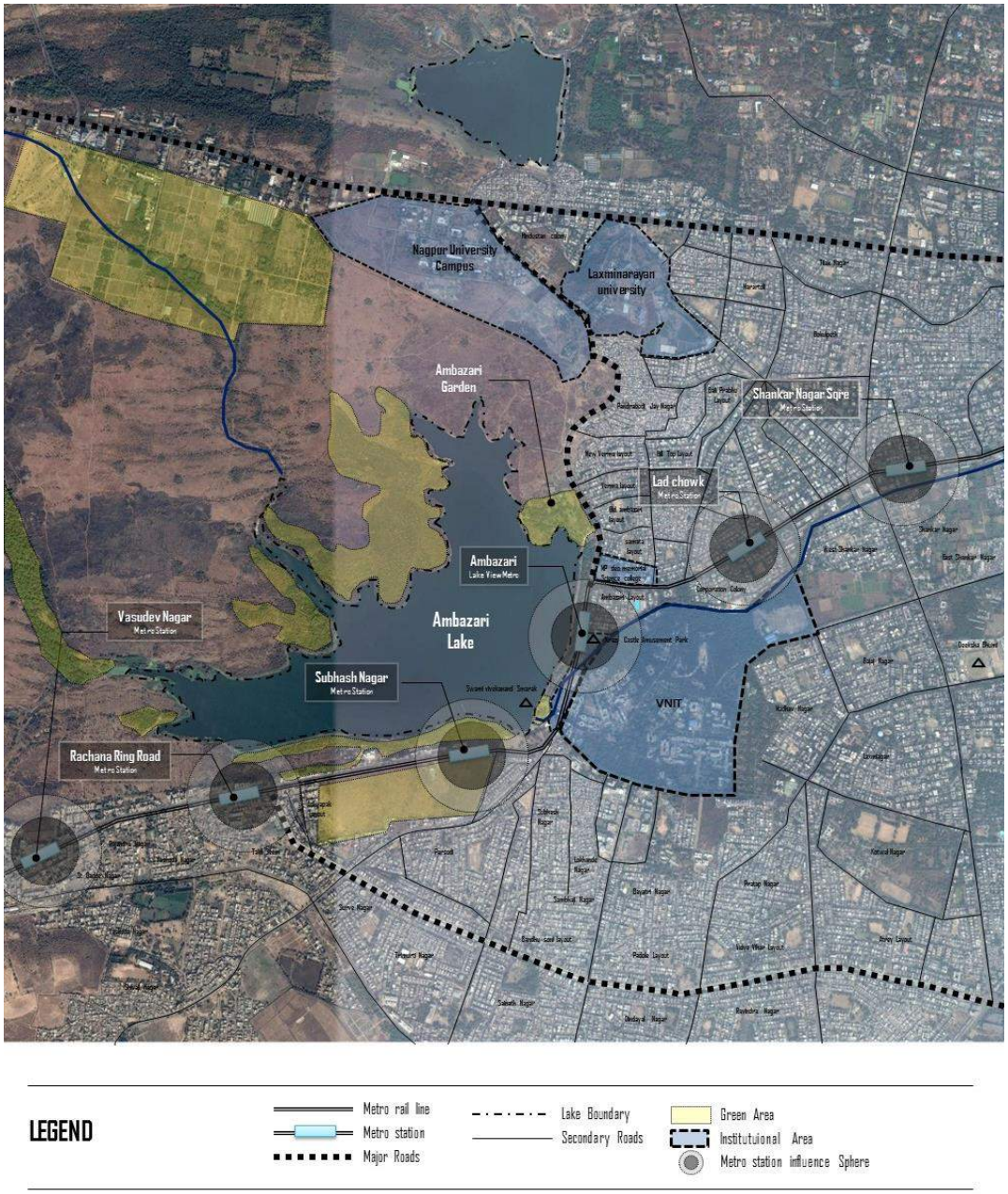
B.3. PA-4- AMBAZARI LAKEFRONT

B.3.1 AREA INTRODUCTION

Ambazari lake bordering Nagpur on its southwest, is the largest among the 11 lakes in the city. Its edges were surrounded by amba or mango trees which lent it the name *Ambazari* and were a source of water for the city since 1870.

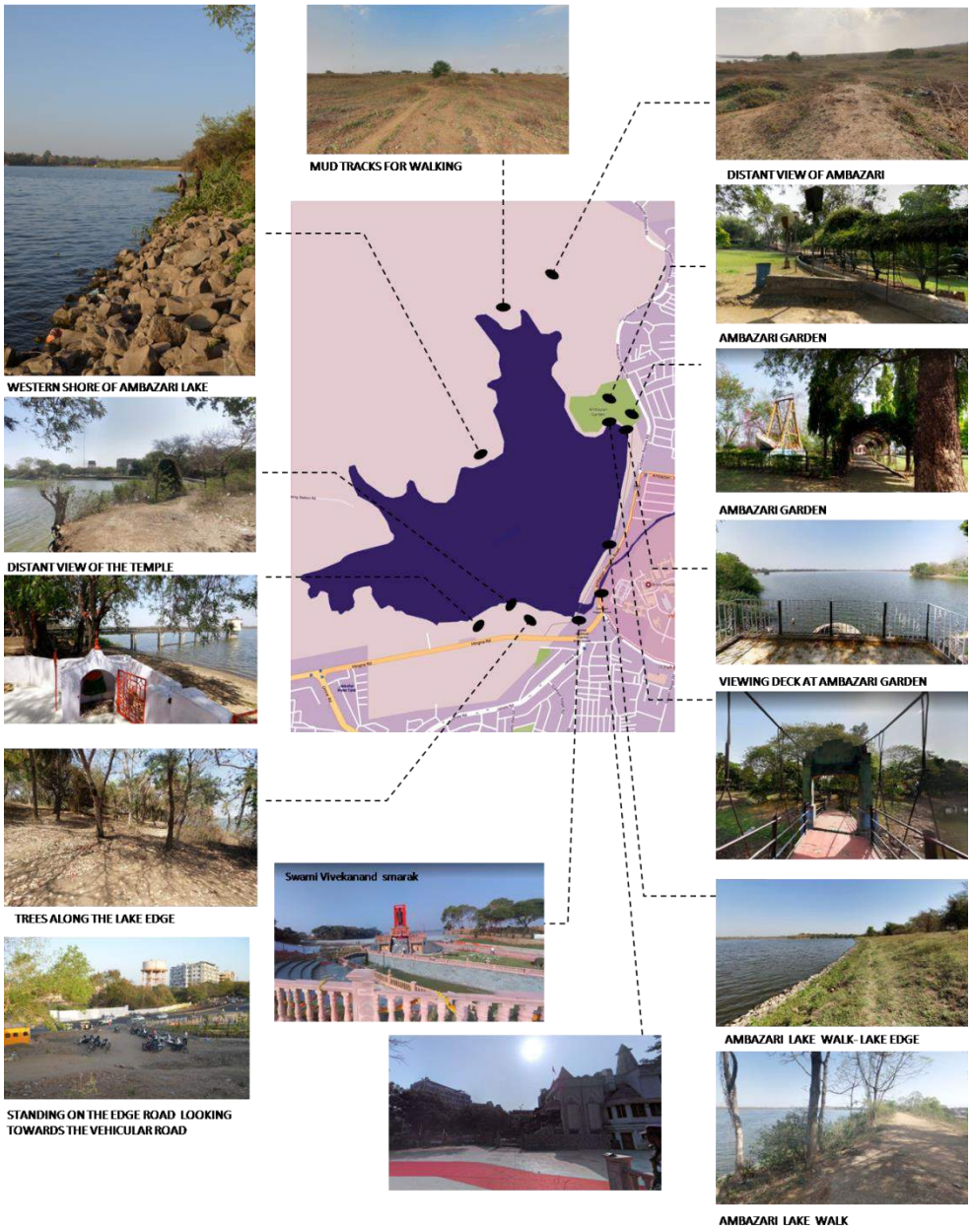
Dharampeth (Ambazari Lake), Subhash Nagar and Rahna Ring road metro stations of Reach-3 and the VNIT hostels are all along the edges of Ambazari Lake. Refer Figure B- 32. This would improve connectivity and provide the necessary footfall/ user-base for whom the edges will be rejuvenated.

FIGURE B- 32 : REACH-3 METRO STATIONS ALONG AMBAZAI LAKE



Along this stretch, only a limited part of the edge is maintained by Nagpur Municipal Corportion as parks, gardens, memorials, viewing decks, leaving a larger portion untended. Refer Figure B- *33*.

FIGURE B- 33 : EXISTING CONDITION OF AMBAZARI LAKE FRONT



B.3.2 PLACE MAKING PROPOSAL

B.3.2.1 VISION

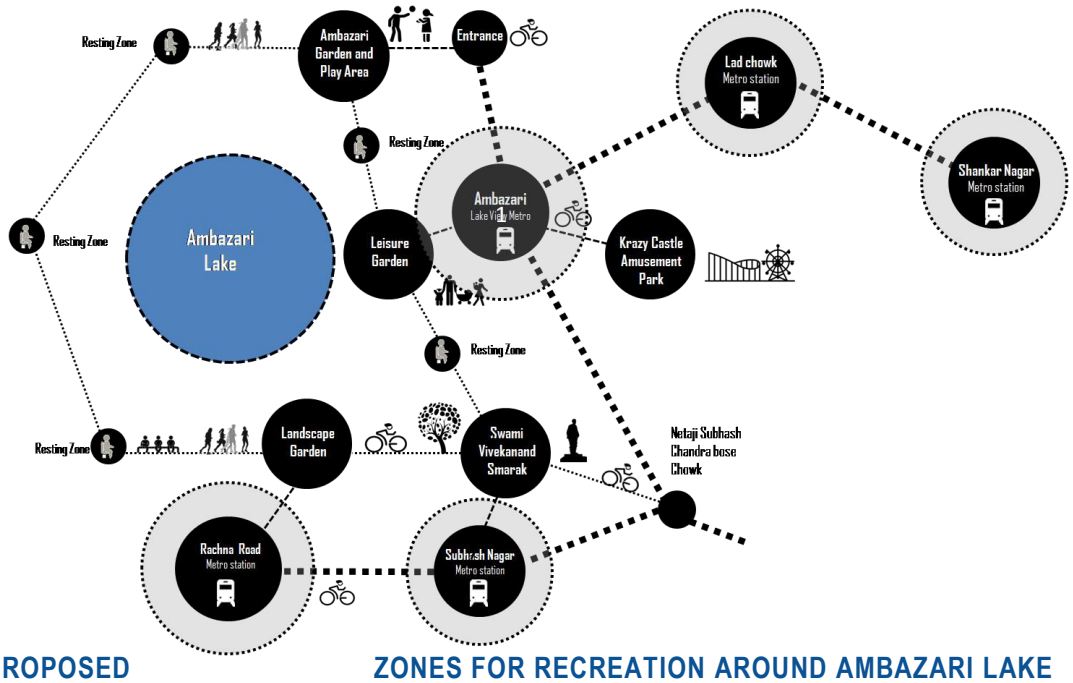
This proposal aims at rejuvenating the along Ambazari Lake into a vibrant public space with provisions for walking, cycling and active use. Through this transformation it is expected that people will be encouraged to travel to Ambazari lake by metro for recreation. Refer Figure B- *34*

FIGURE B- 34 : PROPOSED ACTIVITIES AROUND AMBAZARI LAKE FRONT

B.3.2.2 CONCEPT PROPOSAL

An interconnected network of open spaces, such as plazas, promenades, and greens (like the Ambazari garden) within the neighborhood provides an ideal condition for people to consider the lake as destination. Combined with views to the lake, people would treat the entire journey to the lake as a destination. The natural areas that buffer the lake provide opportunities to provide space for trails and shared paths that can connect to a larger pedestrian and bicycling network. Refer Figure B- ***35***.

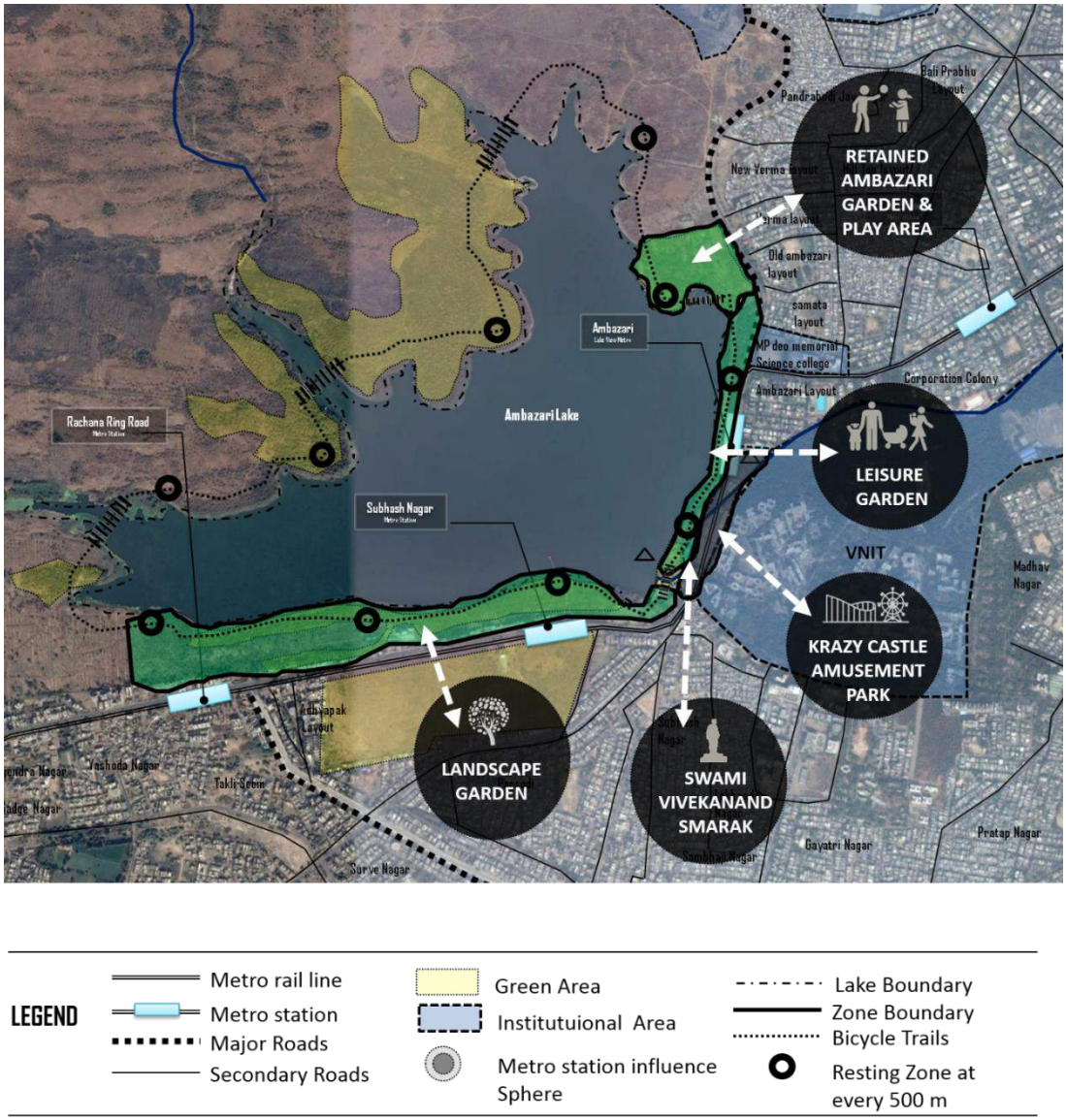
FIGURE B- 35 : AMBAZARI LAKE FRONT CONCEPT PROPOSAL



1. PROPOSED ZONES FOR RECREATION AROUND AMBAZARI LAKE

Ambazari Garden is retained at the same place. A stepped leisure garden it proposed along the edge of Ambazari Lake near Dharampeth Station. Another leisure garden is proposed along the lake front from Subhash Nagar to Rachna Ring road stations. A continuous cycle track is proposed all around the lake connecting all parks, gardens, public spaces and entry exits of the park. The condition of footpaths, NMT facilities and public utility within the park has to be upgraded. Refer Figure B- 36.

FIGURE B- 36 : PROPOSED ZONES FOR RECREATION AROUND AMBAZARI LAKE



B.3.2.3 CONCEPTUAL PLACE MAKING PROPOSALS

All along Ambazari Lake, the treatment of lakefront would vary as per the proposed uses. Figures below illustrate the same.

FIGURE B- 37 : DESIGN OF LAKE SIDE FOOD COURT TO BE INTEGRATED WITH AMBAZARI GARDEN

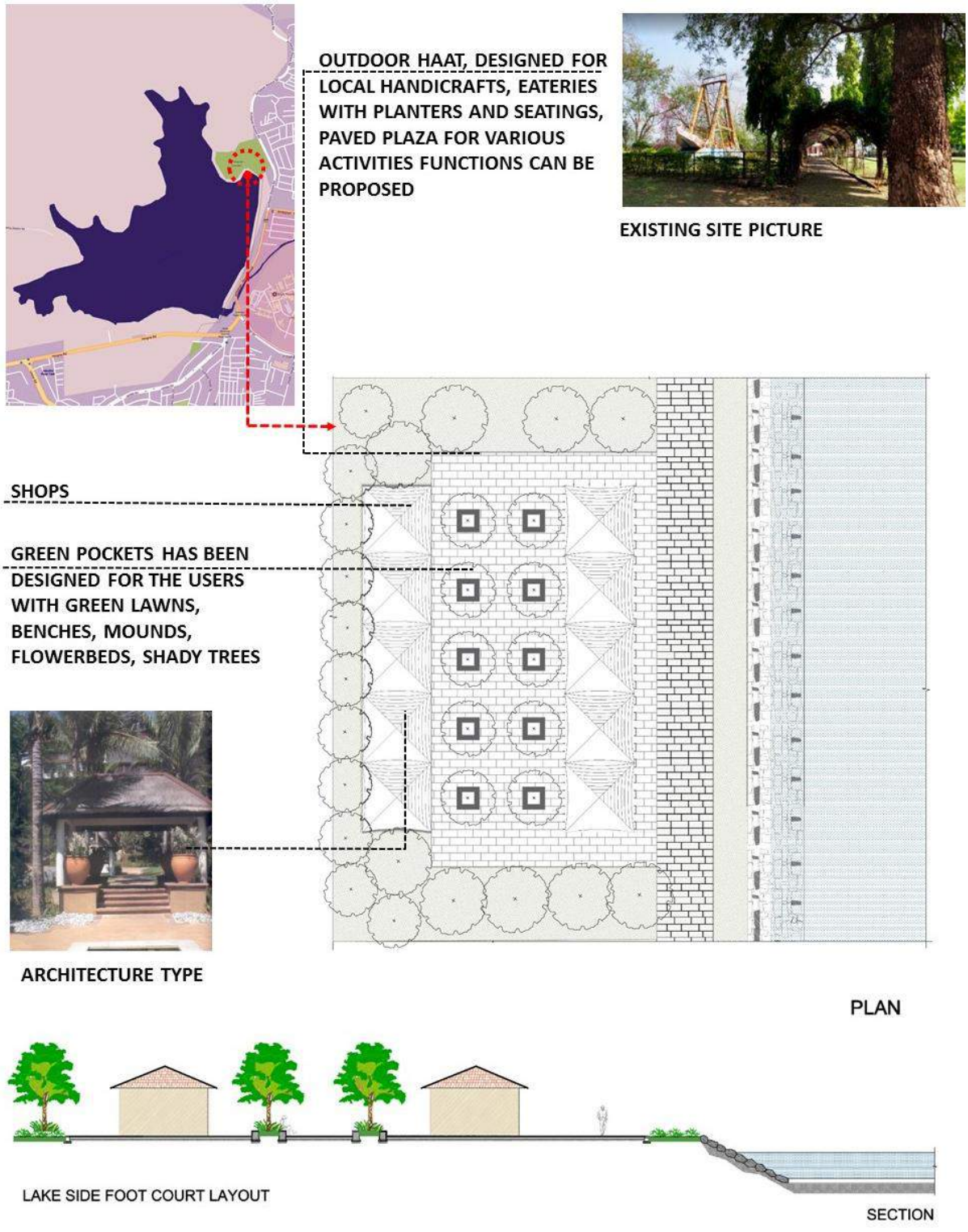
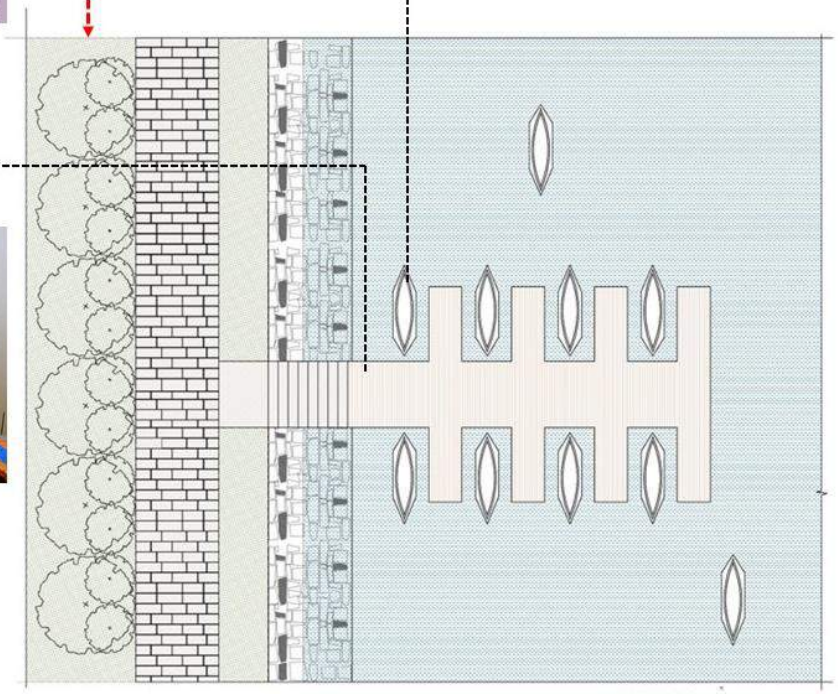


FIGURE B- 38 : DESIGN OF PROPSOED DECK FOR BOATING, EXTENDED FROM THE AMBAZARI GARDEN

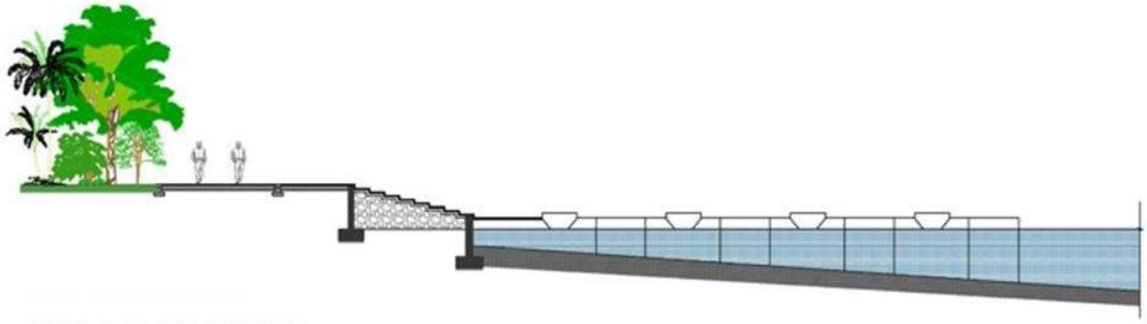
EXISTING SITE PICTURE

BOATING AREA CAN BE INTRODUCED FOR THE USERS

TENTATIVE VIEW



PLAN



LAKE SIDE BOATING

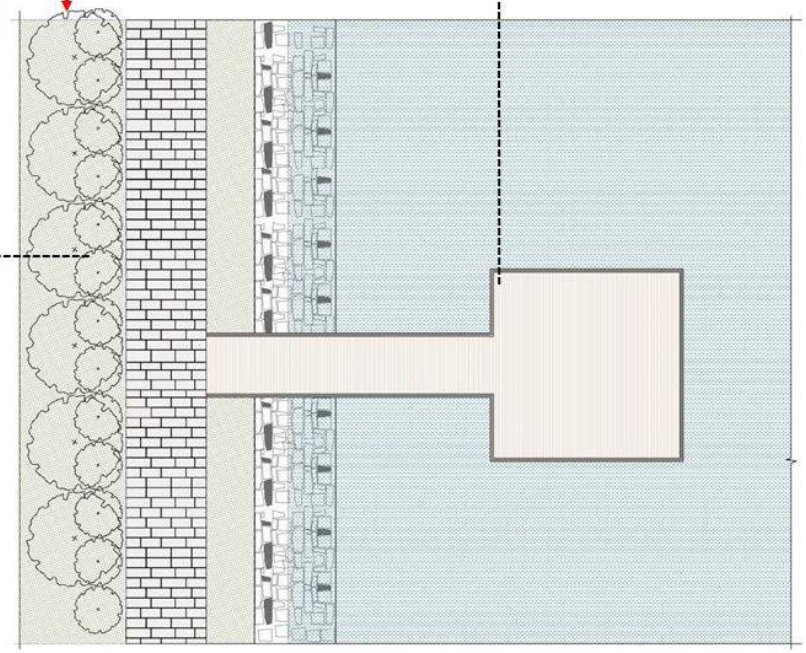
SECTION

FIGURE B- 39 : PROPOSED DESIGN FOR EXTENDED VIEWING DECK FROM AMBAZARI GARDEN

EXISTING SITE PICTURE

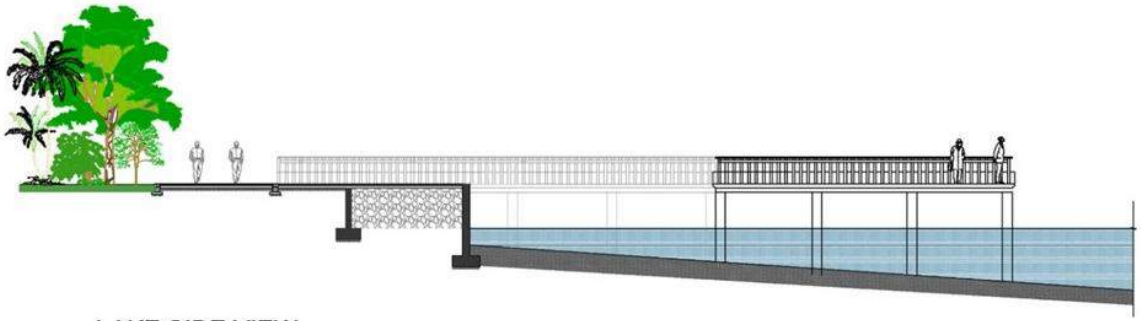
VIEW POINT CAN BE CREATED
AT SOME INTERVAL

EVERGREEN TREES ALONG THE
PROPOSED PATHWAY FOR
SHADE AT SUMMER



TENTATIVE VIEW
OVIEWPOINT OF LAKE

PLAN



LAKE SIDE VIEW
POINTS

SECTION

FIGURE B- 40 : PROPOSED DESIGN OF LEISURE GARDEN NEAR DHARAMPETH STATION

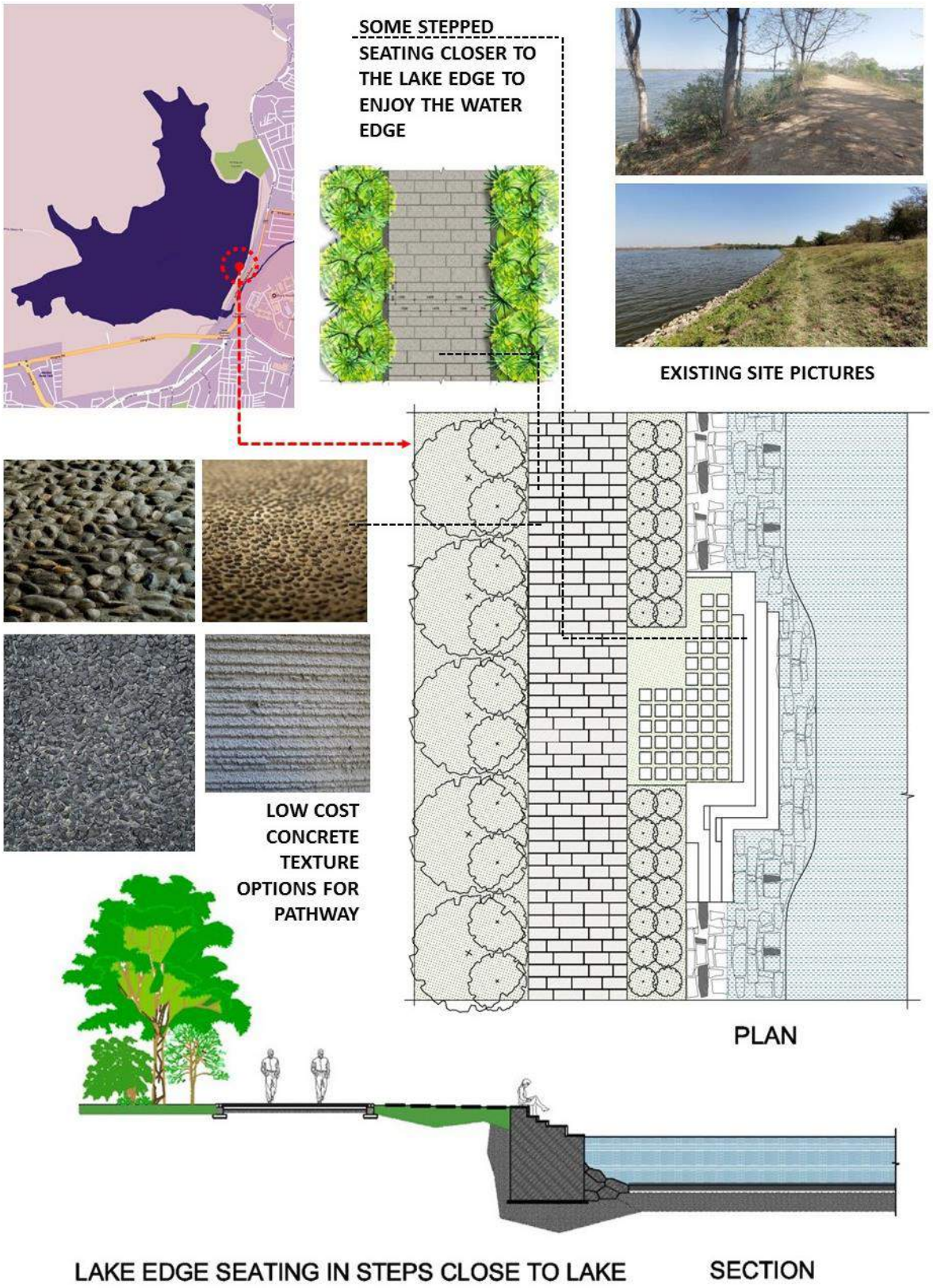
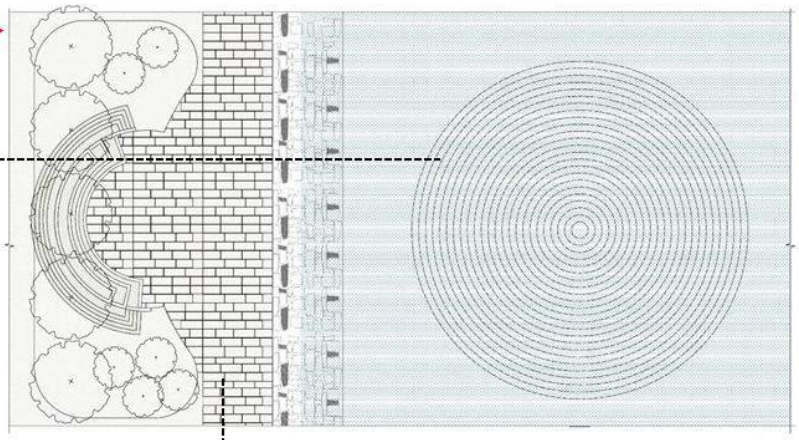


FIGURE B- 41 : PROPOSAL OF MUSICAL FOUNTAIN WITHIN THE ARTEFICIAL WATER BODY IN SWAMI VIVEKANANDA SMARAK

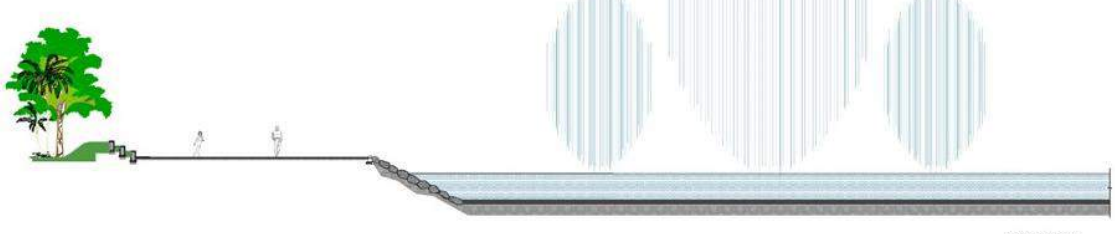
MUSICAL WATER FOUNTAIN TO CREATE WATER EDGE DRAMA .THIS IS THE GOOD WAY TO PURIFY WATER. THIS IS ONE OF THE INTERESTING FEATURES TO ATTRACT TOURIST

EXISTING SITE PICTURE



TENTATIVE VIEW OF MUSICAL WATER FOUNTAIN

PATHWAY TEXTURE OPTIONS



SECTION

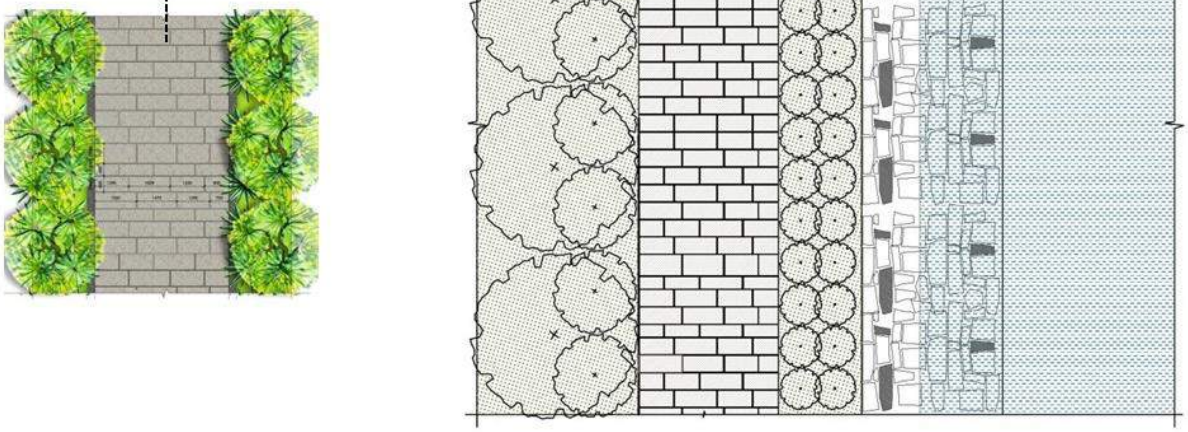
LAKE SIDE MUSICAL WATER FOUNTAIN

FIGURE B- 42 : PROPOSED DESIGN OF LAKE EDGE FURTHER WESTWARDS FROM SUBHASH NAGAR STATION

TRELLIS CAN BE PROVIDED AT REGULAR INTERVAL TO BREAK THE MONOTONY .

EXISTING SITE PICTURE

PATHWAY TEXTURE



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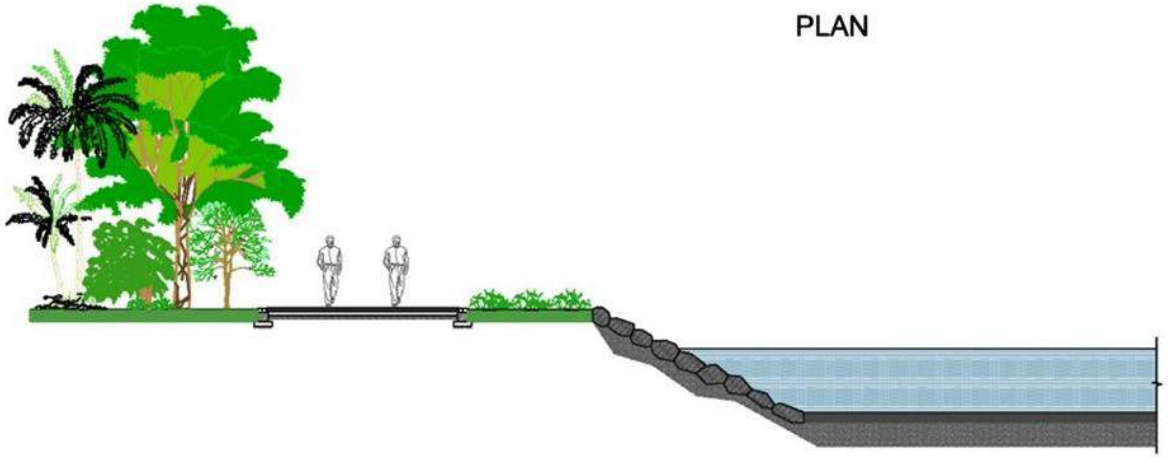


LAKE EDGE DETAIL

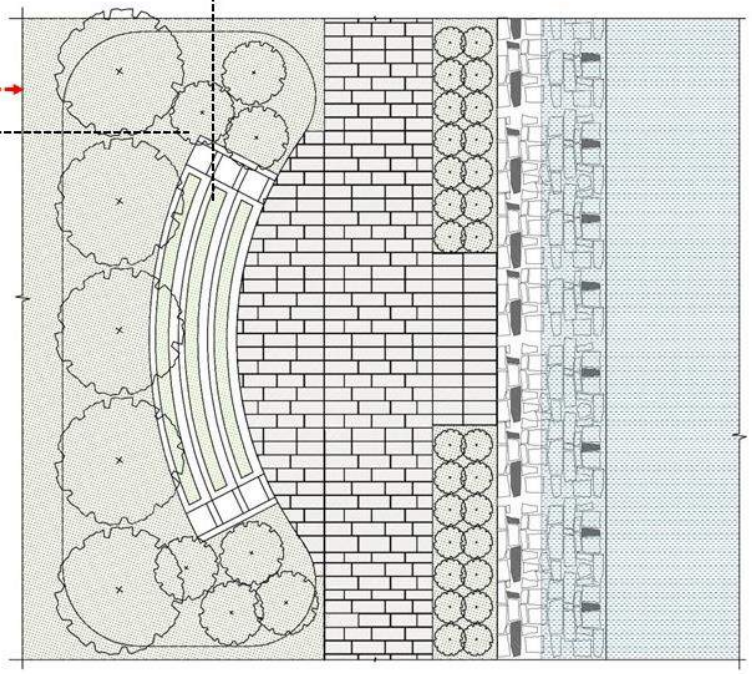
SECTION

FIGURE B- 43 : PROPOSED DESIGN OF AMPHITEATRE FURTHER WESTWARDS FROM SUBHASH NAGAR STATION

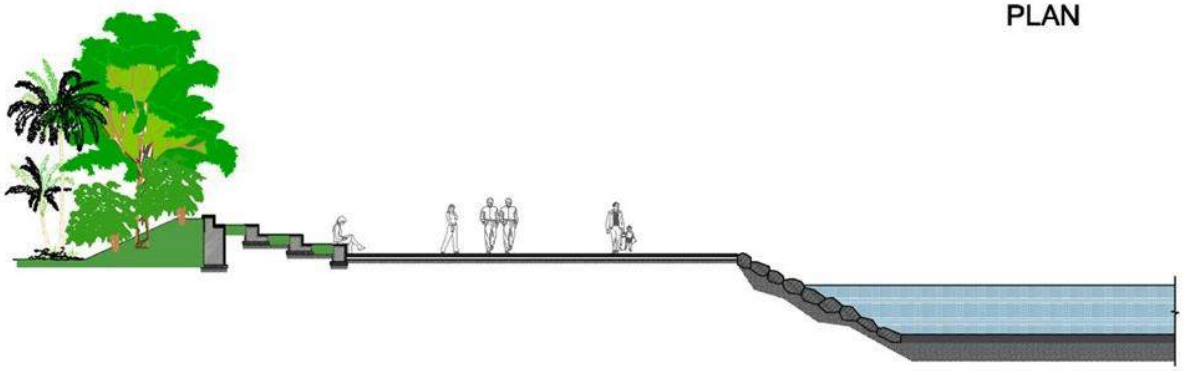
OPEN AIR AMPHITHEATER FOR MULTI-PURPOSE ACTIVITIES

EXISTING SITE PICTURE

OAT OPTIONS



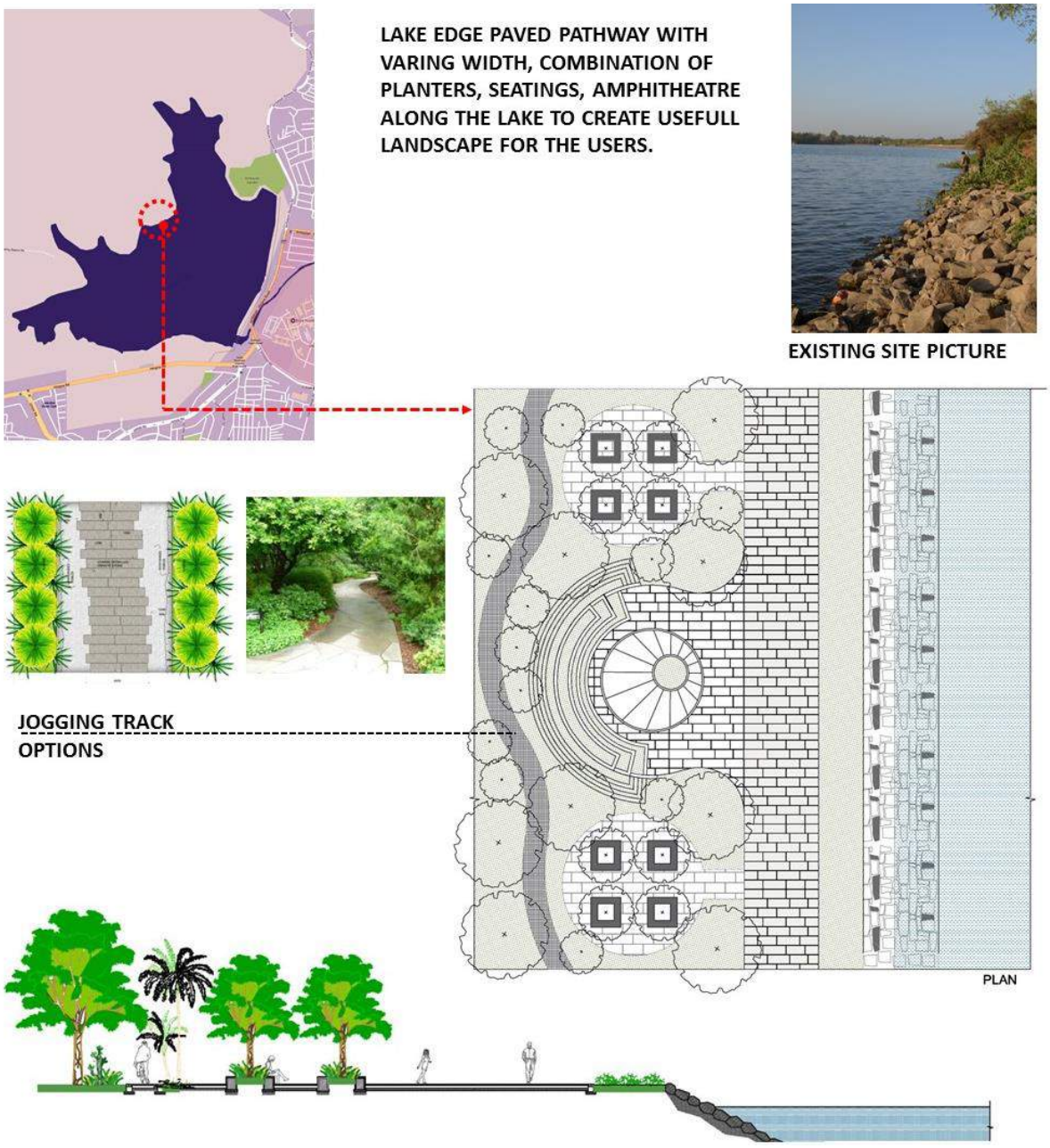
PLAN



LAKE EDGE SEATING IN STEPS

SECTION

FIGURE B- 44 : TYPICAL DESIGN OF RESTING ZONES ALONG THE BICYCLING TRAIL



B.3.3 WAY FORWARD

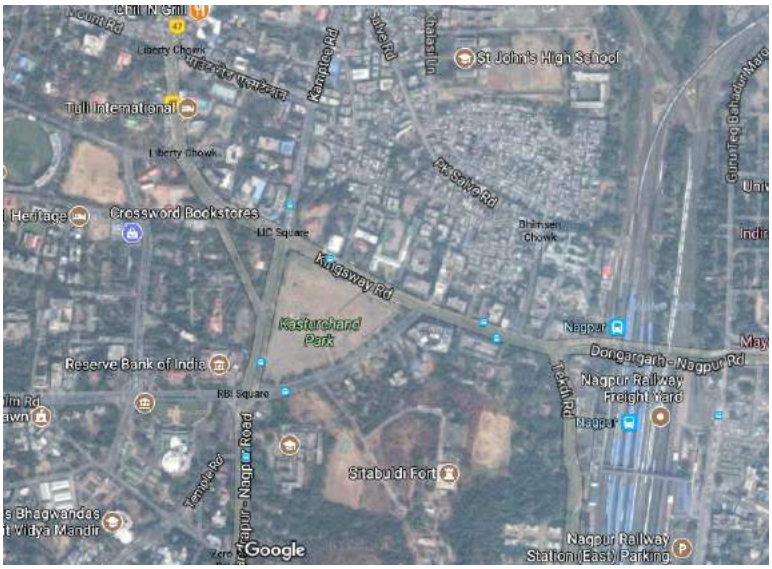
1. Maha Metro and NMC should form a joint action team for detail design and implementation of the concept place making proposal.
2. A detailed scheme along with proposals for water treatment and bio-remediation for the Lake is to be worked out separately.
3. The detailed design for conceptual place making scheme would be required for implementation.

B.4.PA-5- KASTURCHAND PARK PLACE MAKING

B.4.1 AREA INTRODUCTION

Kasturchand Park is an important public space located amidst public institutions, transport interchange nodes, the Nagpur Railway Station and its office apart from monuments of Nagpur. Refer Figure B- 45.

FIGURE B- 45 : LOCATION OF KASTURCHAND PARK

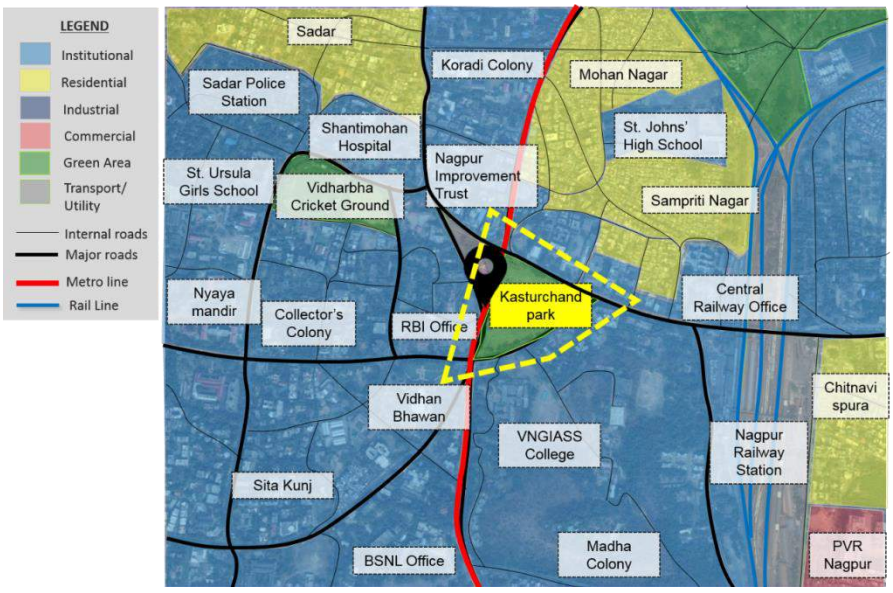


B.4.2 LAND USE

Planned between RBI and LIC squares the metro station and the Kasturchand park abuts institutional land. Refer Figure B- *46*.

FIGURE B- 46 : LANDUSE OF AREAS AROUND KASTURCHAND METRO STATION

B.4.3

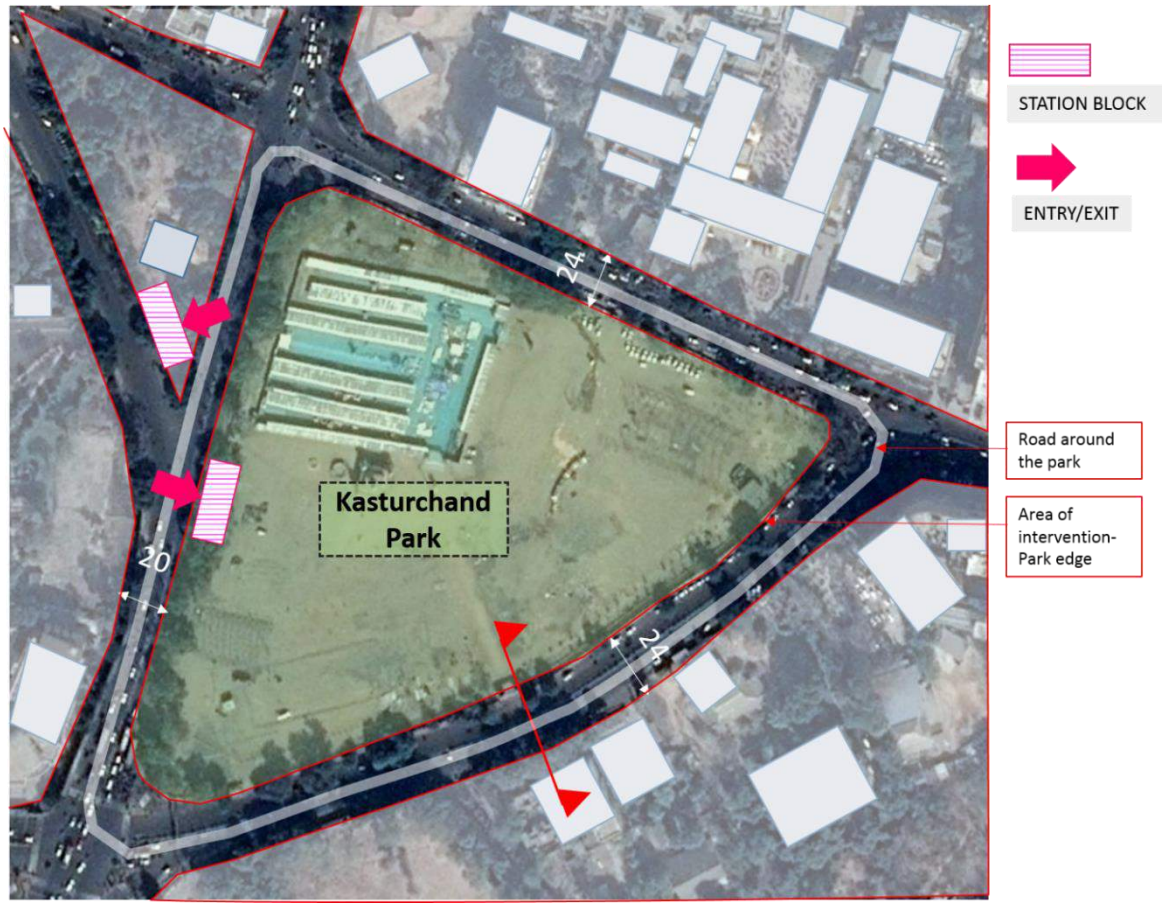


B.4.3 PLACE MAKING PROPOSAL

B.4.3.1 PROPOSED INTERVENTION

The edges of Kasturchand Park are proposed to be redesigned to create wider space for walking and bicycling. Refer Figure B- *47*.

FIGURE B- 47 : KASTURCHAND PARK-INTERVENTION AREA



B.4.3.2 CONCEPTUAL PLACE MAKING PROPOSALS

It is proposed that the edges of Kasturchand Park be rendered porous to encourage active use of the park. Refer Figure B- *48*. For the same, it will be provided with wider footpaths and cycle tracks circumscribing the park. The paths separated by bollards will segregate zones dedicated for walking and cycling. Reclaiming an under-utilized area and transforming it into a community asset is expected to add value to the area.

FIGURE B- 48 : EDGE DESIGN FOR KASTURCHAND PARK

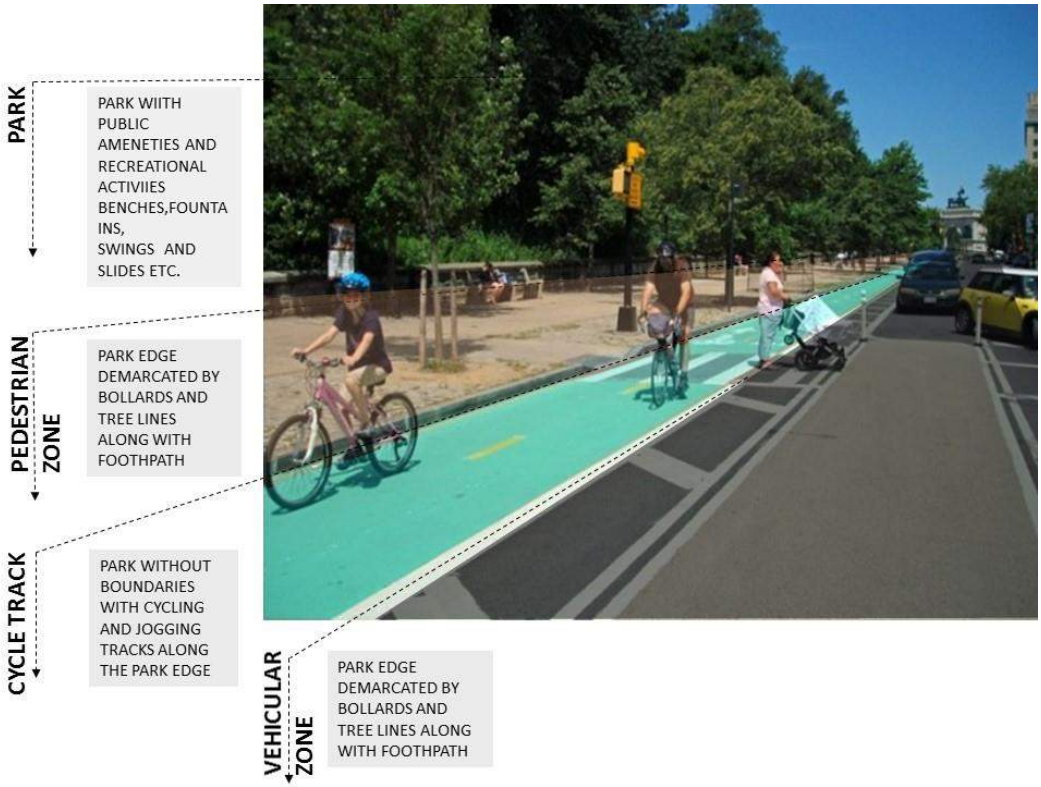


FIGURE B- 49 : PROPOSED DESIGN OF EDGE CONDITION- TYPICAL PLAN

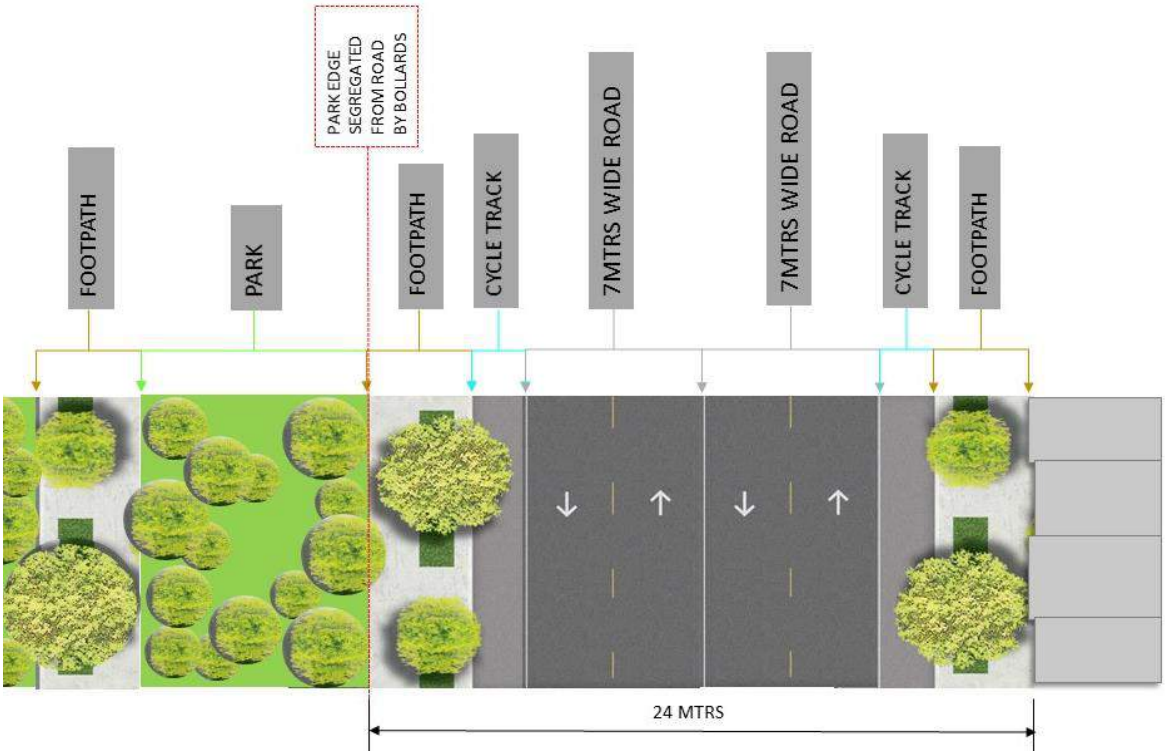
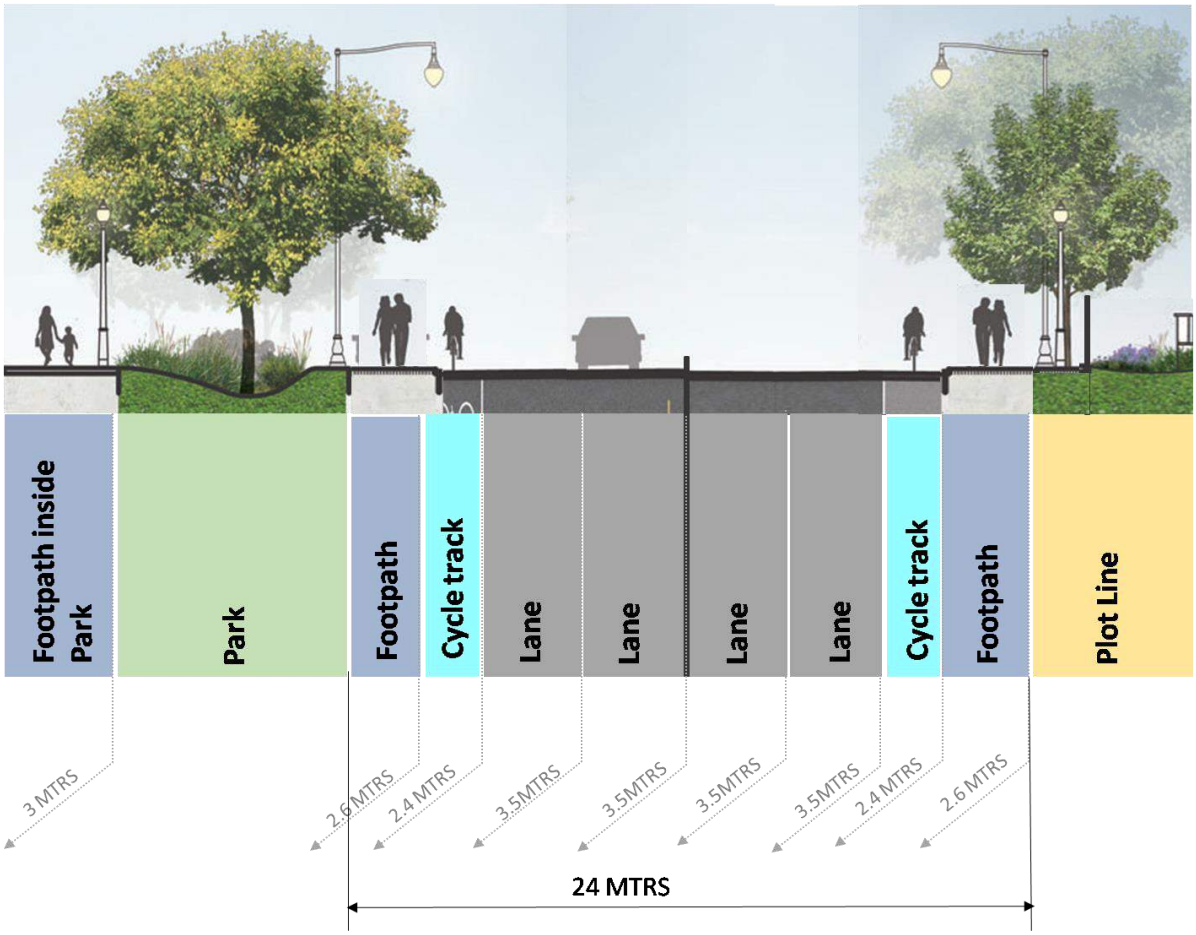


FIGURE B- 50 : PROPOSED DESIGN OF EDGE CONDITION- TYPICAL SECTION



B.4.4 WAY FORWARD

The improvement of edge condition of Kasturchand park must be done simultaneously with development of NMT corridors around the park and in the area.

ANNEXURE 8. PUBLIC BICYLE SHARING MODELS

PBS Model	First Generation	Second generation	Third Generation	Fourth Generation
	Free systems	Coin based systems	ICT based systems	Complex, integrated systems
	1965	1995	1998	2005
Example	White bikes-Amsterdam	Bycyklen-Copenhagen	Velos a la Carte, Rennes	Mol-Bubi, Budapest
Type of Bicycles	Regular bikes with differentiating color	Custom bikes	Custom bikes	Custom bikes
Access	Free	With Coin	Access with user card (user Identification/ registration required)	Access with mobile device(user Identification/ registration required)
Usage	Free	Free	Free (usually in the first 30 minutes)	Free (usually in the first 30 minutes)
Stations	Not fixed	Fixed	Fixed	Real time information provision (e.g. station usage)
Integration	None	None	None	Large scale integration with different systems

ANNEXURE 9. INDICATIVE STAFF REQUIREMENT FOR PBS

	Staff Resource	Roles and Responsibilities	Indicative Staff required based on the System Size Fleet Size 500 Cycles; 50 Stations; 750 Docks		
			Manual	Semi - Automated	Automated
Control Center	Operations Manager	Overall smooth operations and management of the PBS project and customer satisfaction	1	1	1
	Shift In Charge	Shift management for the operations of the PBS with desired service levels	3	3	3
	Control Center Operators	Nodal point of contact for information dissemination; ensure circulation of cycles and monitoring PBS performance	0	5	5
	Customer Service Call Center	Support customers for queries, information and complaint redressal	0	5	5
	Administration	Support routine office administration and project functions	2	2	2
	Human Resources	Recruitment, training, payroll and other HR related functions	3	3	2
	Marketing Manager	Marketing, advertisement and public outreach of PBS	1	1	1
	Accounts	Accounting, cash management and bank transfers	2	2	2
Field Operations	Station Attendent	Support the customers in issuance and receiving of cycles; ensure minimum cycles are maintained in coordination with Control Centre	120	120	0
	Point of Sale Operators	Distribution of smart cards/passes and collection of cash and refunds	0	12	12
	Driver	Driving redistribution vehicles and circulation of cycles	12	12	12
	Helper	Support redistribution vehicle driver in shifting cycles	12	12	12
Support System	IT Support	Maintenance and upkeep of IT and other automated system deployed on the project	0	5	5
	Workshop Mechanics	Maintenance and repair of cycles	5	5	5
	Guard	Security of the premises and material in the workshop, stores and Control Centre	4	4	4
	Cleaner	Regular cleaning of cycles and docking station	11	11	11
Total Staff Required			**176**	**203**	**82**

The other assumptions considered for the staff requirement are as follows;

- No. of Redistribution Vehicles – 5
- No. of Operating Shifts – 2
- Control Center along with workshop space and storage – 1
- Point of Sale Locations – 5
- Relieving Staff – 20%

ANNEXURE 10. SUBSCRIPTION NO'S ASSUMPTIONS FOR PBS

Assumptions for calculating subscription numbers are given below;

Type	Fee (₹)	%age of cycle trips within the project influence area	No. of Cycle Trips - 2017	No. of Cycle trips 2041
One Year Pass	599	5.00%	7469	13403
6 month Pass	299	2.50%	3734	6702
3 month Pass	249	2.50%	3734	6702
1 month Pass	99	2.50%	3734	6702
Non-Members		4.00%	5975	10723
TOTAL			**24646**	**44232**