

Enhancing Public Transport Accessibility for Differently-abled Communities: A Case of Nagpur City

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Declaration

I **Akash Soni**, Scholar No. **2022MTPLM006** hereby declare that the thesis titled **“Enhancing Public Transport Accessibility for Differently-Abled Communities: A Case of Nagpur City”** submitted by me in partial fulfilment for the award of Master of Planning, at School of Planning and Architecture, Bhopal, India, is a record of bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

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This is to certify that the declaration of **Akash Soni** is true to the best of my knowledge and that the student has worked under my guidance in preparing this thesis.

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Abstract

In India, differently-abled faces difficulties when traveling on public transport, be it road infrastructure or traveling in buses or trains, and metro systems. Though several measures have been taken, like the Rights of Persons with Disabilities Act, 2016, and Accessible India, the lack of accessible public places and transport facilities persists. Mostly, trains and buses are unprepared for wheelchair users to travel. Since most of them lack these facilities, they find it tough to travel. In such a scenario, the visually challenged are faced with commuters Braille inaccessible signage. Other barriers include the non-availability of convenient road infrastructure and inaccessible first-mile and last-mile connectivity. An effective study of the methods of public transportation found that fewer than 6% of the 1.45 lakh public transport buses in India have adequate facilities that make them wheelchair friendly. Of these, only 29% are partially accessible.

This research aims to assess, evaluate, and recommend improvements in the accessibility of public transport for differently-abled communities, covering a comprehensive study of infrastructure, road conditions, and first and last-mile connectivity.

In this regard, the purpose of this study begins with a comprehensive literature review, where the state of public transport accessibility of differing capabilities within Indian cities is analyzed. Issues and barriers are identified in the process. However, the central part of the research is through the baseline survey with in-depth interviews, focus group discussions, and other participatory methods to collect direct insights from differing capabilities regarding their experience and problems with public transport. Subsequently, primary and secondary data will be analyzed to identify certain problems with tools like the Public Transport Accessibility Levels for Differently abled people and a Road infrastructure assessment to gain an understanding of broader factors influencing accessibility. The final result is the proposals for improving accessibility, which will include a wide range of strategies from technological innovations to policy recommendations tailored for the provision of a more inclusive public transport system.

The result of the analysis of making public transport accessible for the differently-abled community is based on three parameters: destination, functionality, and safety. For the destination parameter, walking distance layers to various Points of Interest from network analysis. Functionality was based on road infrastructure; Safety was based on the slope function to derive the slope.

As part of the process to improve public transport accessibility for the differently-abled community, recommendations will be based on road infrastructure and first and last-mile connectivity. An accessibility level map will be generated based on high and low-accessible areas, and provisions will be prioritized in low-accessible areas first.

This research contributes to the broader discourse on inclusive urban transport systems by detailing a pragmatic approach to serve the differently-abled better in their public transportation.

सारांश

भारत में, दिव्यांगजन को सार्वजनिक परिवहन में यात्रा करते समय कई चुनौतियों का सामना करना पड़ता है, चाहे वह सड़क के ढांचे में हो, या बसों, ट्रेनों, और मेट्रो प्रणालियों में। हालांकि कई उपाय किए गए हैं, जैसे कि 2016 का "दिव्यांग अधिकार अधिनियम" और "सुगम्य भारत अभियान," फिर भी सार्वजनिक स्थानों और परिवहन सुविधाओं की सुलभता की कमी बनी हुई है। अधिकांश ट्रेनों और बसों में व्हीलचेयर उपयोगकर्ताओं के लिए यात्रा की सुविधाएं नहीं होती हैं, जिससे उन्हें यात्रा करना मुश्किल हो जाता है। इसी तरह, दृष्टिबाधित लोग ब्रेल-सुलभ संकेतों की कमी का सामना करते हैं। अन्य बाधाओं में सुविधाजनक सड़क ढांचे की अनुपलब्धता और पहले और आखिरी मील की संयोजकता का अभाव शामिल है। सार्वजनिक परिवहन के तरीकों के अध्ययन से पता चला है कि भारत में 1.45 लाख सार्वजनिक परिवहन बसों में से केवल 6% के पास व्हीलचेयर के अनुकूल सुविधाएं हैं। इनमें से केवल 29% आंशिक रूप से सुलभ हैं।

यह शोध दिव्यांगजन के लिए सार्वजनिक परिवहन की सुलभता में सुधार करने के लिए मूल्यांकन और सिफारिशें देने के उद्देश्य से है, जिसमें ढांचे, सड़क की स्थिति, और पहले और आखिरी मील की संयोजकता का अध्ययन शामिल है।

इस अध्ययन का उद्देश्य एक साहित्य समीक्षा से शुरू होता है, जहां भारतीय शहरों में सार्वजनिक परिवहन की सुलभता की स्थिति का विश्लेषण किया जाता है। इस प्रक्रिया में समस्याएं और बाधाओं की पहचान की जाती है। हालांकि, शोध का मुख्य भाग गहन साक्षात्कार, केंद्र समूह चर्चाओं, और अन्य सहभागी विधियों के साथ बेसलाइन सर्वेक्षण के माध्यम से होता है, ताकि सार्वजनिक परिवहन के साथ उनके अनुभवों और समस्याओं के बारे में सीधे जानकारी प्राप्त की जा सके। इसके बाद, प्राथमिक और द्वितीयक डेटा का विश्लेषण किया जाएगा ताकि कुछ समस्याओं की पहचान की जा सके, जैसे कि "दिव्यांग सार्वजनिक परिवहन सुलभता स्तर" और सड़क ढांचे का मूल्यांकन, जिससे सुलभता को प्रभावित करने वाले व्यापक कारकों को समझा जा सके। अंतिम परिणाम सुलभता में सुधार के लिए प्रस्ताव होंगे, जिसमें तकनीकी नवाचारों से लेकर अधिक समावेशी सार्वजनिक परिवहन प्रणाली के लिए नीतिगत सिफारिशें शामिल होंगी।

दिव्यांगजन के लिए सार्वजनिक परिवहन को सुलभ बनाने के विश्लेषण का परिणाम तीन मापदंडों पर आधारित है: गंतव्य, कार्यक्षमता, और सुरक्षा। गंतव्य मापदंड के लिए, विभिन्न

स्थानों से रुचि के विभिन्न बिंदुओं के लिए चलने की दूरी का विश्लेषण किया जाता है। कार्यक्षमता सड़क ढांचे पर आधारित होती है; सुरक्षा ढाल के आधार पर होती है।

सार्वजनिक परिवहन की सुलभता में सुधार करने की प्रक्रिया के हिस्से के रूप में, सिफारिशें सड़क ढांचे और पहले और आखिरी मील की संयोजकता पर आधारित होंगी। एक सुलभता स्तर का नक्शा उच्च और निम्न-सुलभ क्षेत्रों के आधार पर बनाया जाएगा, और निम्न-सुलभ क्षेत्रों में पहले सुधारों को प्राथमिकता दी जाएगी।

यह शोध समावेशी शहरी परिवहन प्रणालियों पर व्यापक चर्चा में योगदान देता है, दिव्यांगजन को सार्वजनिक परिवहन में बेहतर सेवा प्रदान करने के लिए एक व्यावहारिक दृष्टिकोण को प्रस्तुत करता है।

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Abbreviations

PwD - Persons with Disabilities

RPwD - Rights of Persons with Disabilities

TOD - Transit-Oriented Development

BRTS - Bus Rapid Transit System

MRTS - Mass Rapid Transit System

URDPFI - Urban and Regional Development Plans Formulation and Implementation

NMC – Nagpur Municipal Corporation

NMA - Nagpur Metropolitan Area

GMC -Government Medical College

SuMA - sustainable mobility accords

ICT - Information and Communication Technology

AIC – Accessible Indian Campaign

SIPDA - Scheme for Implementation of the Rights of Persons with Disabilities Act

FGD - Focus Group Discussion

NGO - Non-Governmental Organization

LOS - Level of Service

CHAPTER 1: INTRODUCTION

1.1 Background

Globally, around 1.3 billion people are Differently abled with a substantial portion residing in developing countries like India. For the 26.8 million Indians living with disabilities, lack of accessible transportation not only limits their mobility but also restricts access to education, healthcare, and economic opportunities. Estimates of the disabled population in India vary, with figures ranging from 4-5% according to the disability sector and 5% recognized by the Planning Commission, to 4-8% as stated in a World Bank report.

Despite efforts such as the Rights of Persons with Disabilities Act, 2016, and the Accessible India campaign, there remains a significant deficit in accessible public places and transportation options. Trains and buses often lack wheelchair facilities, posing challenges for individuals with mobility issues. Visually impaired individuals also encounter difficulties due to the absence of services such as accessible signage.

The struggle to reach transit stops and stations due to inadequate first-mile and last-mile connectivity, as well as inaccessible road infrastructure. A recent report from the Parliamentary Standing Committee on Social Justice and Empowerment revealed that only 6% of the 1.45 lakh public transport buses nationwide are fully accessible to individuals with disabilities, with an additional 29% being partially accessible.

1.2 Historical overview of disability in India: Census 2011 Insights

The disaggregated view of the size of the disabled population and its detailed demographic profile, including gender, types of disabilities, age distributions, education, and urban-rural disparities, has been given by India's Census 2011. A significant proportion of the disabled population, being predominantly male, 1.5 crore, or 56%, and women, 1.18 crore or 44%. A majority of the disabled population lives in rural areas; the proportion is 69%, which is akin to population distributions.

The types of disabilities are also varied. The census data reveal that 20% of the disabled population has a movement-related disability, followed by visual and auditory impairments at 19% each. The census data also show that the age

1.3 Disparities in Education and Employment among Disabled Persons: Census 2011

The Census 2011 highlights significant disparities in education and employment among India's disabled population, with noticeable gaps between rural and urban areas, as well as between males and females. These patterns reveal the challenges that disabled individuals face in accessing education and securing employment.

Education levels among disabled persons are generally higher in urban areas compared to rural areas. In urban regions, 67% of the disabled population are literate, whereas in rural regions, only 49% are literate. This urban-rural divide extends to higher education, with 20% of disabled individuals in urban areas having matric/secondary-level education (below graduate) and 10% being graduates and above. In rural areas, these figures are markedly lower, at 10% and 2%, respectively.

Further analysis shows that among literate disabled persons, the proportion of those who are graduates is also higher in urban areas. In urban regions, 15% of literate disabled individuals are graduates, compared to just 5% in rural regions. This disparity underscores the limited access to advanced education for disabled persons in rural areas, which can have cascading effects on their employment opportunities and overall quality of life.

Employment statistics for disabled persons reflect a similar pattern of disparity. At the national level, only 36% of the total disabled population are employed. Gender disparities are evident, with 47% of disabled males working, while only 23% of disabled females are employed. The gap is even more pronounced in urban areas, where just 16% of disabled females are employed, compared to 25% in rural areas.

Among disabled workers, a significant proportion (31%) are engaged in agricultural labor, highlighting the reliance on traditional forms of employment in rural areas. This reliance on agriculture can limit career growth and opportunities for social mobility among the disabled population, further perpetuating existing inequalities.

The table below shows the metrics comprises of literacy rate, educational level, graduates, employment rate and occupation among disabled workers according to 2011 census (Refer Table no. 1)

Metric	Total Disabled Population	Rural Disabled Population	Urban Disabled Population
Literacy Rate (%)	Overall	55%	67%
	Male	62%	-
	Female	45%	-
Educational Level (% among total disabled)	Matric/Secondary but below Graduate	13%	20%
	Graduate and Above	5%	10%
Graduates among Literate Disabled Persons (%)	Overall	-	15%
	Overall	36%	-
Employment Rate (%)	Male	47%	-
	Female	23%	-
	Female (Rural)	-	25%
	Female (Urban)	-	16%
	Overall	-	-
Occupation among Disabled Workers (%)	Agricultural Laborers	31%	-

Table No. 1: comprehensive overview of the disparities in literacy, education, and employment among disabled persons in India

Source: (census_2011)

1.4 Differently abled Non-Workers: Census 2011 Analysis

The Census 2011 considered the demographic composition and socioeconomic dynamics of disabled non-workers in India, revealing nuanced patterns of dependency, education, and engagement. Among the 1.7 crore disabled non-workers, 46% are males, while 54% are females, indicating a slightly higher representation of females in this category.

The age distribution among disabled non-workers shows that 46% fall in the 15-59 years age group, 31% in the 0-14 years group, and 23% are aged 60 and above. Notably, while the majority of disabled non-workers are concentrated in the 15-59 years age bracket, there is a significant proportion in the 0-14 years group, particularly among females.

Dependency on family support is a prevalent theme, with one in every two disabled non-workers relying on their families. Interestingly, among male non-workers, 33% are students, indicating a pursuit of education despite disability-related challenges. In contrast, 22% of female non-workers are students, suggesting potential disparities in educational opportunities.

Analysis by disability type reveals varying degrees of dependency and engagement. For instance, among those with disabilities in seeing, a significant 42.7% are dependents, while 28% are students. Similarly, individuals with disabilities in hearing exhibit a comparable pattern, with 38.7% being dependents and 32.5% being students.

Further examination unveils that among those with disabilities in movement, dependency is notably higher, with 49.8% being dependents and 19.7% being students. This trend persists across different disability types, with mental retardation and mental illness showing substantial dependency rates, indicating challenges in independent living and employment opportunities for these individuals.

The table shows the demographic distribution and dependency patterns among disabled non-workers, providing a clear overview of the significant trends and insights from the Census 2011 data. (Refer Table no.2)

Category	Percentage/Count
Total Disabled Non-Workers	1.7 crore
Males	46%
Females	54%
Age Distribution (%)	
0-14 years	31%
15-59 years	46%
60 and above	23%
Dependency by Disability Type (%)	
Seeing	42.70%
Hearing	38.70%
Movement	49.80%
Mental Retardation	57.70%
Mental Illness	66.60%
Speech	33.50%
Multiple Disabilities	65.90%

Table No. 2: Percentage of total differently abled Non-Workers's age with Disability type

Source: (census_2011)

1.5 Present Indian scenario of Public transport

In the Indian perspective, transit-oriented development (TOD) efforts aim at overcoming identified gaps and improving public transport accessibility. In the Ahmedabad city, a gradual and progressive bus-based TOD approach is found necessary to address incomplete end-to-end connectivity besides reducing financial strain on poor households. The study shows that it is vital to improve Bus Rapid Transit (BRT) corridor accessibility and adopt user-centric design principles.

Transportation and regional transformation interventions in Delhi also bring out the issue of last-mile connectivity concerning major public modes where few

feeder services are provided for selected metro stations. Here, findings indicate a lack of attention towards pedestrians as well as non-motorized transport (NMT), thus signalling better infrastructure investments coupled with enhanced accessibility within the system.

Furthermore, different Indian cities have conducted studies on metro access which recommend basing last-mile planning on spatial demography around stations to ensure effectiveness in connectivity. Moreover; evaluation reports done on some BRT projects have indicated that such schemes should aim at being inclusive by addressing entry/exit problems faced by all categories of users while using them.

Besides this, the World Bank has advised that while planning for public transportation in India, there should be compartments with lower handlebars and wider gangways on buses so as to meet different requirements; they also suggested having ramps which will help people who use wheelchairs move easily into or out of them among other things. Furthermore, storage facilities need to be provided as well emergency buttons along with CCTV cameras which will help improve security too. These findings thus underscore the need for integrated strategies in transport planning and infrastructure development across India, thereby guaranteeing inclusivity and accessibility of public transport systems for all.

1.6 Challenges, Economic Impact for Inclusive Transportation for Differently abled.

The various challenges that travellers with disabilities face range from many things which prevent them from being able to move and receive necessary services. These problems involve not being able to flag down cars because of unclear directions for the entrance and walking on blind tracks over broken or uneven ground, among other things that might obstruct walking. Also, when bus schedules are hard to get in time it often results in missing out on opportunities for transportation; likewise, without any information about arrivals, there could be missed drop-off points too. Moving between different levels within a building is difficult due to problems with entrances themselves as well as going up or down floors which affects both workplace convenience and general daily life activities.

Additionally, the lack of traffic situation updates makes people who have visual impairments struggle more during travel planning so much so that they may never know what lies ahead until they reach it. Stores and public spaces cannot be accessed because of limited movement ability while intersections pose great danger when crossing roads especially if one has little time left. Infrastructure also becomes unfriendly when boarding or alighting from buses becomes too hard due to rudeness displayed by passengers towards each other; this coupled with such ignorance may lead to greater social discomfort among these groups thus widening the gap between them further apart. Sidewalks may become impassable through wheelchair use given their state of disrepair together with other surfaces being rough and uneven making it impossible for those using wheelchairs to move around freely within their environment; additionally, stairs make physical.

The barriers to access do not stand limited only at the physical infrastructure level; it is manifested in digital platforms, services, and social attitudes. According to the Ola Mobility Institute's report on the urban travel experiences of PwDs, the breakdown of any link of the trip-chain renders travel inaccessible to these individuals, in turn impacting productivity and autonomy. These challenges therefore result in PwDs spending additional time to come up with these barriers. Barriers related to physical infrastructure include access to bus stops, train stations, and sidewalks, which makes it very difficult for PwDs to reach the transit point. Public transport vehicles rarely have essential features such as ramps or designated seating areas. In the digital world, the transportation-related apps and websites do not support assistive technologies, which make it tough for PwDs to access information or even book services. Social barriers can take the form of a lack of disability awareness on the part of the transport operators and staff. Such lack of knowledge results in discriminatory behaviour or neglect in providing services to PwDs. The travel restrictions and shortages of services brought upon by the COVID-19 pandemic further extended such exclusion.

These exclusion costs PwDs not only economically but also socially. According to the International Labour Organisation (ILO), this exclusion can cost a country as much as 7% of its GDP. At the 2021-22 forecasted GDP of approximately \$2.8 trillion for India, this means a loss of nearly \$232 billion in potential economic

output. Beyond the social justice driver of inclusive transportation, it is also an economic driver.

1.7 Need of the Study

Making public transport accessible in India is crucial because there are more than 6% of the population living with disabilities. Unfortunately, there's a lack of understanding about disabilities, and many staff members in public transport aren't sensitized to the needs of disabled individuals. This means that people with disabilities face significant difficulties in using public transport, limiting their freedom and opportunities to participate fully in society.

Improving accessibility in public transport means making changes to infrastructure and ensuring that staff are trained to assist disabled passengers. This could involve adding features like ramps and designated seating areas and providing training programs to educate staff about disability awareness and how to support disabled passengers effectively. These changes can create a more inclusive society where everyone, regardless of their abilities, can access transportation easily and participate fully in community life.

1.8 Research Gaps

The identified research gaps relate to broad aspects of policy implementation, inclusiveness, technology, and the cost implications of disability. The gaps are outlined as follows:

- **Assessment Gap:** A gap exists within existing research regarding policy implementation that aims to enrich accessibility and inclusivity in public transport and other sectors for disabled individuals. It is vital to know whether policies are implemented and practiced, how policies work and what needs to be improved.
- **Inclusivity and Tech Gap:** More research should be conducted on the interface of inclusion and technology to improve accessibility for the disabled. More needs to be addressed; we must study the efficiency of technological solutions, such as mobile applications, assistive devices, or

digital platforms, to improve access to transportation, information, and services for those with disabilities.

- **Cost of Disability:** Although research pertaining to associated financial implications and economic burden linked to disability as it pertains to transportation accessibility is lacking. The need to conduct research on both direct and indirect costs faced by persons with disabilities and their families, including transportation, assistive technologies, healthcare, and lost opportunity costs for employment and education.
- **Lack of End-to-End Connectivity:** The study points out how the implementation of seamless end-to-end connectivity in transportation systems is incomplete for the disabled. It identifies challenges that face disabled passengers in different phases during their journey, starting from access to the hubs and reaching the end destination. Bridging the gaps in connectivity ensures that transportation is well-inclusive and accessible to all.

1.9 Problem Statement

Developing a Public transportation system which can help in achieving universal accessibility and achieving last mile connectivity.

1.10 Aim and Objective

Aim:

To assess, evaluate, and improve the transportation challenges for differently able communities, focuses on accessibility in a transport system.

Objectives:

1. To study the current public transportation accessibility in Indian cities for differently-abled communities.
2. To conduct a baseline study of socio-economic, and transportation accessibility aspects of the study area.
3. To identify the problems and potential areas with accessibility parameters in the study area.

4. To provide strategies and proposals for improving public transport accessibility.

1.11 Scope and Limitations

Scope:

Universal accessibility for Differently abled people improves infrastructure with technology integration.

Limitations:

The sample size of the research will be limited.

This research will only focus on the 5 locations and 3 stretches because of the time constraints.

CHAPTER 2: Study Area

The chapter look into the Nagpur urban transport system, the third-largest city in Maharashtra, serving as the winter capital of the state and lying geographically in the center of India. The chapter discusses connectivity of the city via rail and road, its radial street arrangement, and major highways meeting this central hub. The chapter encompasses operation of the metro system and some of the proposed extensions including last-mile connectivity and its significance for the ever-growing commuters. The chapter discusses the challenges faced by Nagpur in providing people with accessible transport, particularly for PwDs, including infrastructure of the transport system, operations of public transport, and the progress of development work so far. This is followed by key landmarks, NGOs, and hospitals catering to the differently-abled population, further explores the issue of inclusive development, emphasizing key facilities such as the Anubhuti Inclusive Park, a space first of its kind to provide space for PwDs.

2.1 City Profile:

Nagpur is a winter capital of Maharashtra state. This city lies within central India. In fact, it is a geographical centre of India. The city is the third largest one in Maharashtra state following Mumbai and Pune. The population of the city was found to be 23,98,165 according to census 2011. The city is located between 78°30" to 79°30"E and 20°30" to 21°45"N latitude, which is at the exact geographical centre of India and has lowland features.

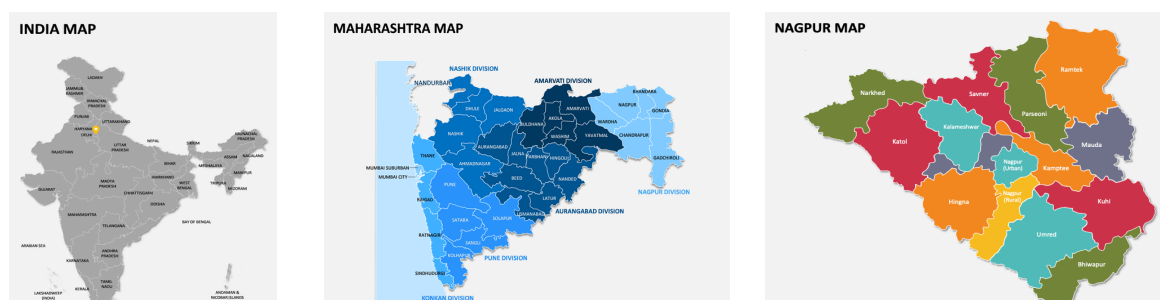


Figure 2: Hierarchy of study area

2.2 Connectivity:

The city's railway history began with the opening of the Bombay-Bhusaval Nagpur line in 1867. It was in 1881 that the city used to have its first train service

to Calcutta, hence the city began its development as a major railway junction. The Nagpur railway station has developed itself into an important node in India's railway system, as it is a stop for 260 trains each day, in addition to acting as a connecting link for the major trunk routes. Electrified broad gauge railway tracks for Nagpur connect the city with four leading metropolitan cities.

On the roads front, the strategic location of Nagpur places it at the nexus of several important national highways. National Highway 7 runs all the way from Kanyakumari to Varanasi, while National Highway 6 links Hajira to Kolkata. And there is Highway 69 linking Nagpur to Obaidullaganj near Bhopal. Its importance is not limited to these factors; Nagpur is a junction point in the Asian Highway Network as well. This junction is the point where AH 43 passes through, which connects Agra to Matara in Sri Lanka, and AH 46, which links Kharagpur to Dhule in India.

Nagpur has a distinct radial pattern and has two ring roads. The total length of the roads is about 1,907 km. The city is also the junction of some important roadways, and the city intersects with some prominent national highways like NH 7 which links Kanyakumari with Varanasi, NH 6 which links Mumbai with Kolkata with a stop in Sambalpur and NH 69 which links Nagpur with Obaidullaganj near Bhopal.

The metro consists of two routes: Automotive Square, Kamptee to MIHAN Metro depot and Prajapati Nagar, East Wardhaman Nagar to Lokmanya Nagar, Hingna. Phase I is 38.215 km operational, and Phase II is 43.8 km proposed. The proposed routes for Nagpur Metro are Nagpur – Wardha – Yavatmal, Nagpur – Wardha – Amravati, Nagpur – Wardha – Chandrapur, Nagpur – Bhandara, Nagpur – Ramtek, and Nagpur – Narkhed. Interchanges have been proposed at Khapri, Nagpur Railway Station, and Ajni with Phase 1 of the Nagpur Metro

2.3 Land and Transport characteristics:

Nagpur covers an area of 227 square kilometres and has seen much development and expansion over the years. In 1984, only 80% of the land of Nagpur was considered developable, whereas the same was considered as 100% by 2011. Currently, 150 square kilometres or 69% of Nagpur's total area is

developed as against 50 square kilometres or 33% of the city's total land area developed in 1984. Present land-use pattern in Nagpur indicates that residential land use dominates at 45%, whereas commercial and industrial land use accounts for 6%. Public use occupies 41% of the land, and parks and gardens take up 8%. The design conforms to the URDPFI guidelines, especially on the land proportions allocated to residential, commercial, and public use. NMC is devising a new revision of the development plan covering 227 square kilometres. Out of which, 217.56 square kilometres come in NMC's jurisdiction, and a newly formed census town of 7.25 square kilometres. In addition, an area of 17.65 square kilometres has been reserved for sewage and drainage disposal projects. NMC has segmented the city into seven planning units for the new revised development plan.

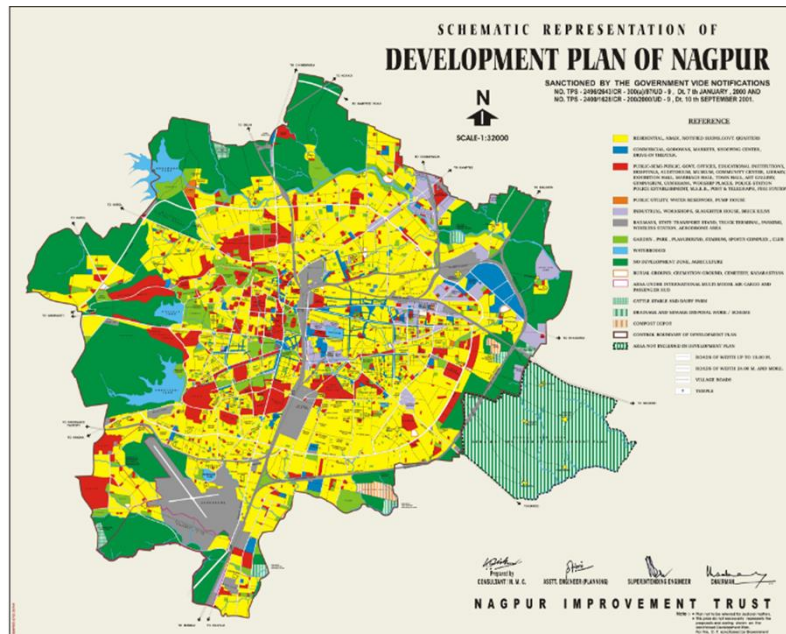


Figure 3: Development Plan of Nagpur
Source: (Nagpur Improvement Trust)

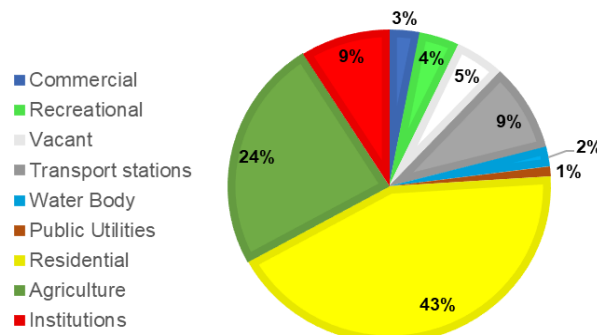


Figure 4: Percentage of Land use
Source: (Nagpur Improvement Trust)

Public transport in Nagpur is managed by the Nagpur Mahanagar Parivahan Limited, a special purpose vehicle of the NMC. The city bus service has 254 operational buses at its disposal with 36 routes out of 183 registered routes of the city. This complete network of public transport is the reason why Nagpur has its strategic importance as the centre for transportation in central India. (Refer Fig No.5)

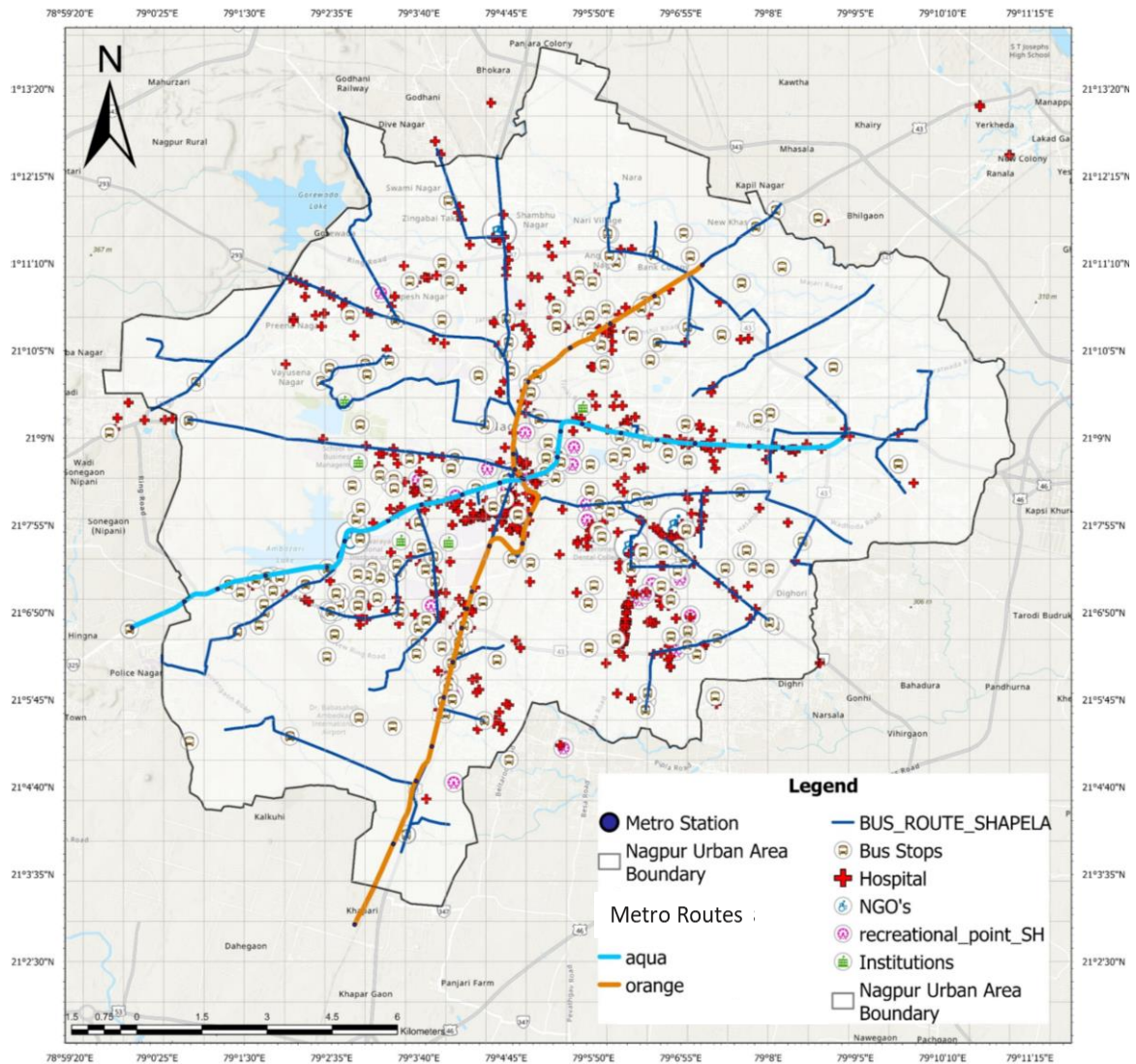


Figure 5: Public transport Map and amenities in Nagpur
 Source: (Author)

2.4 Differently abled Community Profile:

According to the 2011 census, about 0.42% of the disabled population in India resides in Nagpur, Maharashtra. Studies show a rise in the overall disabled population from 2.67% in 2011 to potentially 6% presently. According to The

[SURVEY OF PERSONS WITH DISABILITIES](#) In Nagpur, around 61.7% of people with disabilities use public transport, and about 49.4% can access public buildings.

The general profile about the prevalence of various types of disabilities and their distribution between the genders. Among the surveyed individuals, vision disabilities are the most outstanding category with 22,386 persons affected, comprised of 11,753 males and 10,633 females. Hearing disabilities are also of substantial importance, with 18,651 persons affected, comprised of 10,362 males and 8,289 females. Speech disabilities affect 16,235 persons, comprised of 8,874 males and 7,361 females that have difficulty. Mobility-related disabilities affect 17,727 persons, comprised of 11,471 males and 6,256 females that have difficulties in movement. Mental retardation affects 7,367 persons, comprised of 4,157 males and 3,210 females affected. Mental illness affects 3,036 persons, comprised of 1,748 males and 1,288 females affected by such conditions. Moreover, 22,015 persons report disabilities categorized as "Any Other," comprised of 11,990 males and 10,025 females. Lastly, 6,524 persons have more than one disability, comprised of 3,602 males and 2,922 females. This dataset gives a general profile of different disabilities present among the surveyed population and their gender distribution. (Refer Fig No. 6)

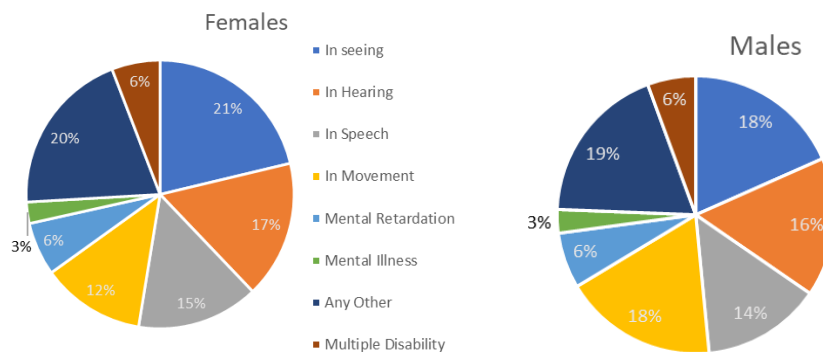


Figure 6: Distribution of Disability among genders
 Source: (Census_2011)

2.4.1 Last-Mile Connectivity Challenges in Nagpur: Insights from Improving Metro Access in India:

Among the challenges presented in the context of the report on the improvement of metro access in India based on evidence in three cities, an important one is represented by last-mile access. Indeed, there is evidence that of the 70-plus per

cent of Nagpur metro commuters who walk or cycle their last mile, there is a preference for sustainable transport modes. This preference points toward effective solutions against the last-mile connectivity challenge.

Recognizing this, the present study brings out its relevant insights in planning metro last-mile access. It underlines the importance of last-mile services that efficiently address the various needs of commuters, especially in the case of walking and cycling as primary modes of transport, as in Nagpur. The latter underscores the need for prioritizing the development of accessible and convenient last-mile solutions in the form of pedestrian pathways, cycling lanes, and feeder services, making metro systems more integrated with existing means of transport and accessibility to commuters.

2.5 Selected Site Details:

Nagpur has five NGOs of which only two works on the skills and education (Aatmadeepam and Matru Sewa Sangh), others are the only institute and rehabilitation facilities. The major hospital is the Governmental Medical College, Nagpur provides health care and employment in the Differently abled section of the hospital responsible for providing Unique Disability Identification (UDID) cards used for promoting the inclusion and well-being of persons with disabilities by providing them with official recognition and facilitating access to essential services and opportunities for socio-economic advancement. The main commercial centre hub of Nagpur is Sitabuldi a major interchange metro station. The world's largest and unique Divyang Park – Anubhuti Inclusive Park in Nagpur, the first ever inclusive park for differently abled community Shri Nitin Gadkari lays the Foundation. The majority of the land in Nagpur is developed for residential purposes (45%), followed by the land under public use (41%), as of 2011. Commercial and industrial developments occupy 6% of the city's land; 8% is under parks and gardens.

2.6 Parameters of selection of site area

Region wise distribution of differently-abled people shows considerable variation in terms of the numbers of such persons, thus pointing at varying population densities and other factors playing a role. The sum total of differently-abled persons in the regions is 11,352, which can be used as a measure to study their proportion in the total population. Looking at the regional distribution, one can see that the highest counts are in Kamptee, 1,575; Mouda, 1,270; and Katol, 1,132. It can be assumed that these regions are more densely populated or are local hubs that have better health facilities and social support.

The lowest counts are in Nagpur Rural Fetari, 740; Kalmeshwar, 811; and Umred, 814. The regions can be assumed to be possibly of low-density population or have a more rural character. Among the regions in the 800-1,100 range, that is Hingna, Narkhed, Parseoni, Ramtek, and Saoner, one can assume that there are some similarities in infrastructure or community support. This varied distribution can be a good guide to the local governments and public transport authorities in planning transport services in accordance with the needs of the differently-abled population, taking into consideration accessibility and equitable deployment of resources. (Refer Table No.3)

NMA	Total No. of Differently-abled Person
Hingna	1014
Kalmeshwar	811
Kamptee	1575
Katol	1132
Mouda	1270
Nagour Rural Fetari	740
Narkhed	1035
Parseoni	812
Ramtek	1036
Saoner	1113
Umred	814
TOTAL	11352

Table No.3: Region wise Differently- abled people
Source: (Census_2011)

2.6.2 Diverse Public Transport Infrastructure and Existing Accessibility Challenges in the Nagpur:

Nagpur has a varied public transport infrastructure, including buses, a metro system, and auto-rickshaws. This diversity allows for a comprehensive assessment of different transport modes and their accessibility.

The ongoing expansion of Nagpur Metro provides an opportunity to assess new public transport initiatives for accessibility.

The Nagpur Metro Rail Project, as a result of its intentions, has several issues of design and implementation when it comes to making it accessible for the differently-abled. The tactile paving, ramps, and elevators, which are supposed to ensure easy movements along the stations, are often poorly maintained or non-functional. This inconsistency can prove fatal for someone with a mobility issue. Besides, the public dealing counters and the automated kiosks, designed for easy use, are often at heights which are not able to accommodate wheelchair users and cause accessibility issues.

Differently-abled passengers report difficulties in boarding trains from lack of adequate staff support or congestion created by narrow doorways and crowded platforms. In addition, while the railway cars claim to have spaces and safety provisions for differently-abled travellers, these areas are often not sufficiently secure, making them unstable while in transit. Information systems, designed to accommodate both visually and hearing-impaired passengers, often are inconsistent and do not deliver information as clear or not functional, leading to confusion and missed information.

2.6.3 Government Initiatives and Policies

Nagpur, being in Maharashtra, benefits from state-level policies aimed at improving public transport and promoting accessibility for the differently-abled.

Although the noble intentions in the Nagpur's Comprehensive Mobility Plan are admirable, the guidelines and regulations for ensuring public transport accessibility for persons with disability run into serious voids. While the plan emphasizes universal accessibility standards, which seek to make the environment barrier-free, implementation often falls short because of inconsistent

implementation and weak enforcement. While the plan calls for all streets to be at least at the minimum government standards, much of Nagpur remains characterized by uneven pavements, poorly maintained pathways, and obstructed footpaths, which pose a severe barrier for people with reduced mobility, visual impairments, and hearing impairments.

Furthermore, pedestrian infrastructure guidelines are often bypassed, such as recommending at least 75% of the length of arterial streets with non-obstructed footpaths, which are often encroached upon by street vendors, parking vehicles, or construction debris, creating no space for pedestrians, let alone people with disabilities. Footpaths are recommended by the guidelines to have at-grade crossings, which are supposed to be available at regular intervals for safety and accessibility but are often not provided or marked poorly, forcing pedestrians to use hazardous traffic patterns. Such a failure in the provision of public transport and pedestrian infrastructure shows a disconnect between the guidelines and their implementation, defeating the purpose of creating an inclusive and accessible environment for all persons, especially for those with disabilities.

The Anubhuti Inclusive Park in Nagpur, Maharashtra, is one such revolutionary stride towards inclusive facilities for persons with disabilities. Initiated by Union Minister Nitin Gadkari, the park—also referred to as the Divyang Park—is a recreational and skill development center where persons with disabilities can live healthy lives fitted to their capacities and requirements. The state government allocated a budget of Rs 40 crore to make the park a world of entertainment, education, and therapy under a single roof where all the differently-abled people could flourish.

However, this positive development must be seen against the backdrop of accessibility issues to public transport and pedestrian infrastructure in Nagpur. Although the Anubhuti Inclusive Park is a commendable step forward, issues of poorly maintained footpaths, inconsistent pedestrian crossings, and encroachments on pedestrian spaces continue to haunt the broader city environment. Without addressing these issues, initiatives like the Anubhuti Inclusive Park cannot fully realize their promise of creating a barrier-free and inclusive environment for all differently-abled individuals in Nagpur.

2.6.4 Present State of Public Transport for Differently-Abled Individuals in Nagpur

Nagpur's public transport system, in its current state, reveals significant challenges in providing adequate services to differently-abled individuals. The city bus services are notably limited, with only 9 buses per lakh population, a figure that is considerably lower than in other comparable cities. This scarcity is reflected in the modal share of public transport, which hovers between 8 to 10%, a stark contrast to the desirable range of 60-70% for cities with populations between 20 to 50 lakhs. The bus system's "Destination Oriented Services" model leads to fewer buses per route (6 to 7 buses) and lower frequency (average 30-minute intervals), making it difficult for differently-abled individuals to rely on public transport for regular travel.

Compounding this issue, a significant portion of Nagpur's bus services overlaps with the proposed metro corridor. Of the 263 buses operating on 38 routes, 175 buses and 29 routes, representing 66% of the city's bus services, overlap with the metro corridor. This overlap indicates inefficiencies in route planning and suggests a lack of alternative routes for differently-abled individuals who may find the metro less accessible. The reliance on infrequent and overlapping bus services creates additional barriers for those requiring accessible and reliable public transport.

Despite these challenges, Nagpur Municipal Corporation (NMC) is taking steps to enhance public transport accessibility for differently-abled individuals. A proposed scheme by the NMC aims to provide free travel for physically challenged and specially-abled individuals on Aapli Bus services, with the cost of free tickets covered by social welfare funds. Additionally, the NMC already offers concessions, including a 75% discount for handicapped passengers on Red buses and a 50% discount for their companions. The 100% concession for students of NMC-run schools, along with discounts for elderly citizens and other students, further exemplifies NMC's commitment to promoting inclusive transport.

Nagpur has a combination of challenges and opportunities for the differently-abled people in its public transport infrastructure. Overcrowded bus services

public transport in Nagpur has only 9 buses per lakh population poorly maintained pedestrian pathways, and the overlapping transport routes create many barriers to accessibility. However, the Anubhuti Inclusive Park, a dedicated recreational and therapy center for people of differing ability, and NMC's free travel policy for the differently-abled individuals availing Aapli Bus services are steps of improvement in accessibility. Government policies for universal accessibility standards intend to make public transport infrastructure and pedestrian infrastructure more inclusive. However, their implementation seldom lives up to the mark due to a lack of consistent enforcement. The dynamic environment of Nagpur, being a transportation hub and a city rapidly expanding its metro system, makes for a compelling environment for the study on accessibility.

CHAPTER 3: Literature Review

Accessibility for the differently-abled person is a complex and multi-layered challenge within all the sectors of public transport, infrastructure, communication, and information technology. It becomes a matter of inclusive growth and equal opportunities in the urban environment as their share in the population grows and diversifies. This chapter reviews key definitions, case studies, policies, and recommendations within the present state of accessibility issues that arise in India, focusing on the transport systems, public places, and impact of information and communication technology. This chapter identifies the gaps in the present framework and gives a few insights into creating a barrier-free environment to cater to the differently-abled persons. By giving a comprehensive review of real-world examples, this chapter illuminates the challenges and proposes actionable solutions that make India's public spaces and transport systems more accessible and inclusive for all.

3.1 Definitions

Persons with Disabilities: Persons with Disabilities or PWD refers to all those who have long-term physical, mental, intellectual, or sensory impairments. These impairments, in interaction with various barriers, may hinder their full and effective participation on an equal basis with others in society.

Accessible Transport: Accessible transport is the transportation systems, vehicles, infrastructure, and services that have been designed, operated, and maintained in a manner that they can be used by people with disabilities. Features may consist of ramps, lifts, tactile paving, audible announcements, and others that can allow mobility of people with disabilities.

Barrier-Free Environment: A barrier-free environment ensures that people with disabilities can access and use transportation facilities and services without incurring any physical, informational, or communication barriers. This, therefore, includes features such as wide and step-free entrances, accessible ticketing counters, and signage in accessible formats.

Accessible Public Transport: Accessible public transport includes buses, trains, metro systems, ferries, and the like that are equipped with all features and

amenities to accommodate the needs of their passengers. Such features may include wheelchair ramps, priority seats, provision for mobility aids, and staff being trained in the assistant role to passengers with disabilities.

Universal Design: Universal design aims to make products, environments, and systems that are usable by all people to the greatest extent possible without the need for adaptation or specialized design in the context of public transport. Such universal design principles can help ensure that transportation facilities and services are accessible and inclusive for people with diverse abilities and needs.

Rights of Persons with Disabilities Act, 2016: This legislation in India has laid down measures to ensure accessibility and non-discrimination for persons with disabilities in several areas, of which transportation is one. It provides for provisions related to accessible infrastructure, public facilities, and transportation services that are to improve the mobility and independence of individuals with disabilities.

Accessible India Campaign or Sugamya Bharat Abhiyan: It is an initiative by the Government of India. This campaign seeks to bring along public infrastructure and transportation systems for the rights of the people with disabilities. The campaign focuses on barrier-free environments and offering accessibility standards in all sectors, especially transportation.

Bus Rapid Transit System: BRTS is a high-quality bus-based transit system that seeks to match the efficiency and reliability of rail transit with the flexibility and cost-effectiveness of bus services. BRTS typically consists of dedicated bus lanes, priority at intersections, rapid boarding processes, and modern stations complete with amenities such as passenger information displays, vending machines, and station-level platforms. Accessibility features incorporated into BRTS can include low-floor buses complete with wheelchair ramps, priority seating, and other types of passenger information announcements as well as tactile indicators at the stations.

Mass Rapid Transit System: MRTS refers to urban rail systems designed for transit efficiency and rapid movement. The network is usually comprised of underground, elevated, or at-grade railways connecting prime destinations in urban areas. MRTS accessibility is crucial to make sure the persons with disability can enter the stations, platforms, trains, and other facilities

independently. Features of MRTS include step-free access due to elevators and ramps, the indication of route to guide passengers, audio signals, wide passage gates, as well as space allocation for wheelchairs and other mobility aids on the trains.

Level Boarding: Level boarding means that there is seamless, non-obstacle-free access between the vehicle floor and station platform. This accessibility measure eliminates the use of steps or falls within the vehicle, allowing passengers to enter the station without moving up or down the stairs. Therefore, level boarding in a BRTS and MRTS system can be understood as a measure to ensure the accessibility of passengers with impaired mobility, such as wheelchair users or passengers who have trouble going up or down the stairs.

Priority Seating: Priority seating areas are reserved for passengers with disabilities, elderly passengers, those pregnant, those with trouble with stairs, or others who may need preferential seating due to mobility disabilities or other special needs. Priority seating in both public transport vehicles and stations ensures that those with disabilities have the facility to access seating that meets their requirement regarding comfort, stability, and safety.

Transport hubs: The point of interconnection between various modes of transport, like bus, train, and metro systems, with the intention of providing seamless connectivity and transfer for passengers, is an integrated transport hub. Universal design principles, wayfinding signage, tactile maps, accessible toilets, and customer service facilities able to help people with disabilities is the best way of providing accessibility at transport hubs.

Accessible Information and Communication: Information and communication are indispensable for ensuring that passengers with disabilities are able to move through public transport systems in an independent and safe manner. Accessible forms of information, such as real-time travel information in braille, large print, audio announcements, and electronic displays that adjust contrast and font size, are a key contribution.

Pedestrian Facilities: Sidewalks, footpaths, and pedestrian crossings must be laid out such that users with different forms of mobility, including wheelchair users, people with visual impairments, and those using mobility aids are accommodated. Some of the key features include

Sidewalk Width and Surface: The sidewalk shall be wide enough to accommodate pedestrians; it shall be levelled, slip-resistant, and free from hazards and obstructions.

Curb Ramps: Curb ramps, also called curb cuts or tactile ramps, provide effective means of providing accessible transitions between sidewalks and roadways for wheelchair users and those with mobility impairments. The curb ramps shall be provided with appropriate grades, tactile markings for orientation, and sufficient width to provide safe passage.

Pedestrian Crossings: Crosswalks shall be clearly marked and provided with audible signals, tactile indicators, and positive visual signals for pedestrians with disabilities to cross the road safely. Accessible pedestrian signals APS are signals with auditory and tactile information on crossing phases and timing of signals

Accessible Parking: Accessible parking space shall be provided near any key destination, such as public buildings, commercial areas, or transportation hubs. Accessible parking space shall have appropriate size, signage, and access aisles that accept vehicles with wheelchair lifts or ramps.

Traffic Signals and Signage: Traffic signals and road signs shall be designed and placed such that they are perceptible and comprehensible by all road users, which includes people with visual impairments or cognitive disabilities. This is achieved by using high-contrast markings, large fonts, and tactile features that make it easier to read traffic signals and signage.

Shared Streets and Shared Spaces: Shared streets, also known as shared spaces or woonerfs, are urban forms that emphasize the use of pedestrians and bicycles over motorized traffic. A shared street combines slow-moving motorized traffic, wide sidewalks, and shared-use zones that allow all forms of transport to be used safely and easily accessible to all users.

Wayfinding and Navigation: Public urban environments should be designed with pedestrian wayfinding in mind, including those who are partially sighted. This could include installing tactile maps, audible cues, braille signage, and clear directional information.

Maintenance and Repair: Regular maintenance and repair ensure that pedestrian facilities, curb ramps, crosswalks, and other components of the built

environment remain accessible and safe. Prompt repairs and regular maintenance prevent hazards, ensuring that road infrastructure is accessible to all.

3.2 Case Studies:

Two case studies reviewed for the public transportation challenges for the differently abled community.

3.2.1 Directorate of Urban Land Transport (DULT) SUSTAINABLE MOBILITY ACCORDS (SuMA)

Implementing Sustainable Urban Mobility through Design in Bangalore: Case Study of DULT

DULT, the directorate in Bangalore, commenced its SuMA program to rectify something that seemed to result in an inability in its pedestrian-friendly environment. It has pinpointed major challenges to sustainable mobility, which include poor footpath design, high-speed vehicles, poor crossing facilities, high bus floor levels, and no wheelchair access.

Issues:

5. Poor footpaths: The footpaths in the city of Bangalore are poorly designed, with uneven surfaces, obstructions, and encroachments that pose health hazards and safety problems for pedestrians.
6. High-Speed Vehicles: High-speed vehicles run at high speeds on the urban roads in Bangalore, thereby introducing safety risks to pedestrians, especially at the crossroads where the pedestrian facility may be poor.
7. Unsuitable Pedestrian Crossing Facilities: The intersections in Bangalore lack the basic facilities required for pedestrians, such as zebra stripes, signal lights, and pedestrian refuge islands, and this makes it tough for pedestrians to cross busy intersections safely.
8. High Bus Floor Level: The public buses with high floor levels are inaccessible for the people using wheelchairs and other mobility devices, thereby making it difficult for them to get into and get out of the bus safely.

9. Lack of Wheelchair Access: The city lacks wheelchair-accessible facilities, such as curb ramps and developed walkways, that seriously restrict the mobility and independence of people using wheelchairs and other mobility devices.

Recommendations:

- Transform the Footpath in Universal Design: Redesign the footpaths as per universal design criteria so as to ensure a straight, smooth, and level surface, without obstructions, to ensure access for all pedestrians, including those with disabilities. Place tactile paving and curb ramps to bring about greater ease of movement.
- Improve Signage and Markings: Provide clear signage, directional signs, and maps in braille at all important places to help pedestrians, especially people with visual impairments, to navigate better. Ensure that pedestrian crossings are provided at the intersections along with signal lights to provide better safety and ease of movement.

3.2.2 Evaluating Accessibility for Transport Planning Victoria Transport Policy Institute

Victoria Transport Policy Institute carried a paper towards assessment of accessibility issues concerning user groups and their disadvantages and gave relevant recommendations for them.

Issues:

- Accessibility to Medical Clinics of Medical Managers and Recreation Centers: One of the important problems found is that the accessibility of individuals to essential services, such as medical clinics and recreation centers, may be a problem due to inadequate transport means or built environmental barriers.
- Traffic Speed and Congestion: High traffic speed and congestion were shown to be major accessibility problems. Such factors do not only involve inefficient working transport systems but also compromise the safety of pedestrians and vulnerable users of the road.

- **Infrastructure:** Access to the transport infrastructure, such as sidewalk or ways, was considered very important to provide mobility, particularly to physically impaired persons. However, this may create a barrier to accessibility due to the absence of such infrastructure.
- **Equipment and Skill Requirement:** Accessible transport means may require specific equipment or skill to operate efficiently, and may create problems for individuals who may not have the infrastructure, resources, or may not have the competence to operate such equipment and facilities.

Recommendations:

- **Elimination of Obstructions for Wheelchair Users and Person with Impaired Senses:** The paper proposes the elimination of steps and other physical barriers that cause difficulty for wheelchair users or persons with impaired vision and hearing. This would also help ensure that the public space and other transport facilities are universally accessible.
- **Creation of Information Signs:** To improve the accessibility of wheelchair users and persons with impaired vision and hearing, the paper recommends the erection of easy-to-read information signs. Information signs in a particular sign should provide easy directions and instructions, which will be made available using universal symbols and formats that are accessible to all.

3.3 Policies/Schemes/Acts:

National Policy for Persons with Disabilities 2006 The National Policy for Persons with Disabilities 2006 is targeted to further an environment in which equal opportunities, protection of rights, and full participation in society for persons with disabilities are made possible. Under the policy framework, a few schemes and initiatives are launched to achieve the following objectives:

Scheme for Implementation of the Rights of Persons with Disabilities Act, 2016 (SIPDA): This scheme is focused on the implementation of the provisions of the Rights of Persons with Disabilities Act, 2016, to protect the rights and dignity of persons with disabilities.

Accessible India Campaign (AIC): It is a campaign aimed at creating a barrier-free environment so that persons with disabilities can participate effectively in various domains, including infrastructure, transportation, and public facilities.

National Action Plan for Skill Development of Persons with Disabilities (NAP-SDP): This action plan strives to provide skill development opportunities and vocational training for empowering persons with disabilities to become employed and thus reduce their challenges.

Unique Disability ID (UDID): The UDID program issues a unique identification number to persons with disabilities to facilitate their access to government schemes, benefits, and services.

Awareness Generation and Publicity (AGP) & In-Service Training: It aims at creating awareness of disability issues and providing training to its stakeholders, which include government officials, service providers, and other people, so that disability issues get due regard and sensitivity.

Research on Disability Related Technology Product and Issues & Development: It supports research and development activities aimed at addressing disability related technology needs and challenges and promoting innovation in assistive devices and technologies.

ASIC Scheme: It provides financial support to spinal injuries centers for better medical care and rehabilitation services to persons who have been injured in their spinal cord.

Cross-Disability Early Intervention Centre: It provides early intervention services to children with disabilities in a timely manner for a proper and complete development of the child.

Projects under SIPDA: There are a lot of projects running under SIPDA that cater to the needs and challenges of people with disabilities, such as infrastructure development, accessibility measures, and capacity-building projects.

CPMU cum Data Strategy Unit: This handles the implementation of SIPDA projects and the data management and analysis, which provides the data for informed policy-making and monitoring of disability-related projects.

3.3.1 Gaps in Policies

The policy framework, particularly the Scheme for Implementation of the Rights of Persons with Disabilities Act 2016, has significant gaps in its framework that hinder the effective implementation and realization of the objectives:

Slow Achievements in Accessibility: Although 50 percent of government websites are targeted to be made accessible by the Accessible India Campaign, the pace of achievement has been sluggish. As of 2021, out of the identified 1,72,000 buildings, 29.7 percent have been made accessible since 2015, and out of the identified 2,67,674 websites, 64.61 percent have been made accessible. It reveals a considerable gap in the achievement of the accessibility goals in the given period.

Limited Beneficiaries: While schemes such as the Deendayal Divyangjan Rehabilitation Scheme, among others, have disbursed finances to hundreds of thousands of projects, and some more than 3.18 lakh persons from 2014 to 2022, still, a wide population of persons with disabilities may not have benefited from such an initiative or had their comprehensive needs addressed in full measure. The scope may not be wide enough to cater to the different needs of all persons with disabilities.

Issues with Access to Assistive Devices: The Assistance to Disabled Persons for Purchase/Fitting of Aids/Appliances has facilitated assistance and provision of assistive devices to more than 24.37 lakh people between 2014 and 2022. However, challenges may lie in access to such devices, particularly in rural or marginalized segments of society. There is also need for further specialized services, as indicated by 5323 cochlear implant surgeries that have been provided.

Inequality in Distribution of Scholarships: Between 2022-23, the Meritorious Scholarship for Students with Disabilities has awarded scholarships to 2.28 lakh students, totaling Rs 699.95 crore. Still, scholarship funds are unevenly distributed, leaving perhaps qualified students or marginal groups without access to education.

Appropriateness of infrastructure and service gaps: Even though provisions under the SIPDA scheme include creating disabled-friendly websites, early diagnostic and intervention centers, and district disability rehabilitation centers, the availability and quality of such facilities could be inequitable in different

regions. This may result in disparate access to essential services and support for persons with disabilities. This may further exacerbate existing disparities.

3.4 COVID-19 Pandemic: An Additional Struggle for differently abled:

The COVID-19 pandemic exposed and increased existing disparities in the accessibility of essential services and information for differently abled persons. The national and state-wide lockdowns across India led to a fall of challenges, significantly impacting those with physical, visual, auditory, and cognitive disabilities. Despite the legal framework provided by the Rights of Persons with Disabilities (RPwD) Act of 2016, the Guidelines for Indian Government Websites (GIGW) 2.0, and the Disability Inclusive Disaster Risk Reduction (DIDRR) Framework 2019, many governmental agencies failed to implement accessible communication and service delivery methods, resulting in severe consequences for this vulnerable population.

Access to critical information regarding COVID-19, safety measures, and government policies was hindered due to the inaccessibility of various formats, including websites, apps, and traditional communication channels. For instance, key COVID-related apps such as “Aarogya Setu” were designed without considering accessibility, making them unusable for those with visual impairments. Government notifications and advisories were often circulated as inaccessible scanned images or infographics without alternative text or accessible formats like Braille or audio. The lack of captioning in audio-visual content further isolated those with hearing disabilities from crucial information. This communication barrier not only impeded access to services but also posted significant risks to health and safety.

The lockdowns and movement restrictions also created significant obstacles for caregivers and support networks. Many caregivers were unable or unwilling to fulfill their roles due to the pandemic, leaving differently abled persons without the necessary assistance for daily living activities. Those requiring regular medical check-ups or ongoing treatment for chronic conditions found it increasingly difficult to access healthcare services. Travel restrictions and logistical challenges

further compounded these issues, leaving many people homebound and unable to access even basic necessities.

The lack of accessible infrastructure and technology significantly impacted the ability of differently abled persons to access financial assistance, healthcare, and essential services. ATMs and banking apps, which are typically inaccessible to those with visual impairments, made it challenging to withdraw cash or conduct financial transactions. Additionally, the process of obtaining government-allocated rations and cooked food became cumbersome, particularly for those with physical and mental disabilities who faced travel restrictions, infrastructure limitations, and additional costs.

Education for children with disabilities also suffered during the pandemic. As schools transitioned to online platforms, many differently abled students found themselves excluded due to the inaccessibility of digital resources and poor internet connectivity, especially in rural areas. The burden of creating accessible educational materials fell on civil society organizations, which were already struggling with limited funding and an increased demand for their services due to the pandemic.

The compounded challenges faced by differently abled persons during the COVID-19 pandemic underscore the urgent need for inclusive policies and practices. Ensuring accessible communication, infrastructure, and technology is essential for providing equitable support to all individuals, especially during times of crisis. Addressing these systemic issues requires concerted efforts from governmental agencies, civil society organizations, and the broader community to create a more inclusive and supportive environment for differently abled persons.

3.5 Information and Communication Technology (ICT) Accessibility in India for Persons with Disabilities

ICT accessibility in India is an intrinsic condition in digital inclusion, especially as far as persons with disabilities are concerned. Ensuring that all sites and applications, especially government sites and applications, are made with accessibility in mind would go a long way in developing a more inclusive society. Therefore, a multi-sectoral type of approach incorporating government and

industry players is required to address the challenges and make remarkable strides on the issue.

MeitY (Ministry of Electronics and Information Technology) has taken the initiative to further promote ICT accessibility. Declarations such as the National Policy of Universal Accessibility in 2013 are critical in laying the foundation for accessibility but there is a need for continued implementation and enforcement. Key areas of improvement include accessible procurement, inclusive smart cities, and a close matching of both with big government campaigns such as Digital India and Make in India.

The Manual of Procurement of Works prescribes that procuring authorities shall consider accessibility for persons with disabilities. However, due to the lack of a clear standard of procurement for accessible ICT, accessibility has not been widely adopted on many government projects and initiatives. In this regard, the committee studying ICT standards needs to come up with their work and make clear guidelines so that comprehensive accessibility compliance is seen in the procurement process.

One of the major challenges faced by persons with disabilities in India is the lack of compatibility between the devices and the assistive technologies these individuals use. This often forces them to seek devices from international markets, which are costlier and therefore less accessible due to language barriers and other factors. These persons need indigenous solutions for India's linguistic diversity and socio-economic conditions. The affordability and wide adoption of technology are in order, with low-cost devices designed to support assistive technology features. Such is crucial to empower individuals with disabilities, as well as elderly persons.

The Telecommunications Engineering Center is a sub-division of the Department of Telecommunications. It works toward developing and adopting standards for telecom products and services in India. Its responsibility in certifying the telecom manufacturers that meet accessibility standards is of immense importance. The June 2020 mandate of TEC requiring all telecom equipment and products to be tested in-country in TEC-certified laboratories and get the certification (MTCTE) ensures that telecom products meet specific standards. The directive—part of the

Indian Telegraph Act (Amendment) Rules, 2017—will potentially improve accessibility across all ranges of telecom services.

3.6 Summary of Reviewed literature paper

Following are the summary of literature paper study during the research period .

3.6.1 GIS based Multi-Criteria Decision Analysis for analyzing accessibility of the disabled in the Greater Irbid Municipality

The methodology described in the paper involves transforming major factors into measures based on accessibility standards for individuals with disabilities. Geographic Information System (GIS) techniques were then used to analyze these influencing factors, resulting in the creation of 10 separate analytical layers. Finally, GIS-based Multi-Criteria Decision Analysis (MCDA) was employed to generate a final map of disabled access to relevant services, facilitating the identification of areas where accessibility improvements are needed.

3.6.2 Assessing accessibility to ASFs from bus stops using distance measures: Case of two Indian cities

The methodology is to evaluate spatial interactive measures specifically, looking at the maximum potential of minimum walking distance as gleaned from the literature. The model takes into consideration both the straight-line distance (Euclidean) and the network distance measure in comparing distances at the whole city level and between cities to all Accessible Service Facilities (ASFs) of public transport (PT). The purpose of this study is to enlighten the various types of distance measures to ASFs from PT while cost considerations are deliberately disregarded so as not to introduce complexity in the comparison of cities. The study utilizes secondary data sourced from several state and local government agencies.

3.6.3 Evaluation of disable friendliness of road transport Facility in Ludhiana city of Punjab (India).

The primary goal of the study was to assess the extent to which road transport facilities in Ludhiana are barrier-free for people with disabilities (PWDs)

The study on Ludhiana's road transport facilities reveals the serious accessibility issues for PWDs. The outer environment of ISBT included no specific parking for PWDs, no proper pedestrian crossing, and manholes that are most dangerous for visually impaired people. Inside ISBT, accessibility challenges were equally daunting: no automatic doors at the entrance, no ramps to help a wheelchair user, and elevators that did not have handrails. Besides, the accessibility features in case of toilets were insufficient as those toilets did not even have grab bars and emergency alarms. Due to the absence of signs, the visually impaired person found it hard to move around. Other elements, like public telephones and reception counters, were not accessible to PWDs.

Transport modes were also equally challenging. Local and long-route buses were not provided retractable ramps or "kneeling suspension" to help wheelchair users board. The priority seating provided for the disabled and elderly was often taken by other passengers, and the drivers had no intention to enforce the seating policy. In most cases, bus drivers did not have proper training about disability-related issues and were less sympathetic to PWDs. Taxis and auto-rickshaws, which are widely used for transport, were totally unsuitable for wheelchair users. These are caused by narrow doorways and high steps. Bus stops were also poorly managed with inadequate information, guiding blocks, and shelters.

This overall environment was rated at a score of 61.15 out of 200. This is equivalent to classifying Ludhiana's transport system as "poor." This puts significant restrictions on the abilities of PWDs in accessing employment, education, healthcare, and social events. These restrictions lead to social exclusion. It also indicates a wider systemic problem in public transport and urban planning for disability.

These issues have been dealt with by the study in terms of a comprehensive approach. First, it calls for redesigning public transport and built environments with universal accessibility, providing the staff transport with extensive training on

disability issues, and finally putting in place policies that increasingly improve accessibility. More campaigns meant for public awareness would help, aside from promoting an accessible travel option, increase sensitivity towards challenges faced by PWDs. It needs commitments from government agencies, transport operators, and other members of the broader public to ensure that the transport system in Ludhiana turns into a barrier-free one.

3.6.4 Accessibility for All; A Case Study of Pune City in India

The first phase conducted a detailed needs analysis study to assess accessibility in each country, including a review of existing practices in other regions like Europe, the USA, and Latin America.

The second phase involved small-scale demonstration projects in the countries of study, and the third phase drafted a compendium of guidelines to promote universal accessibility.

The Pune Demonstration Project would enhance the accessibility of people with disabilities by modifying bus stands on route number five of the Pune Municipal Transport (PMT) that link the Pune railway station and Swargate bus terminal. Among the modifications made were benches at heights that suit people with mobility impairments, route information boards that have clear text for hearing-impaired passengers, new signs that show bus route numbers and pictograms, removing obstructions on pavements, colour contrast on pillars to improve visibility, and tactile guideways for visually impaired passengers. The project introduced new buses with wider entrances, lowered first steps, grab rails, and other features to make room for passengers with disabilities. The PMT also conducted a disability awareness training program for drivers and conductors to improve service.

Passenger surveys before and after the modifications indicated that passengers used bus stands more often, with positive feedback on benches and route information boards. However, problems existed, such as buses stopping far from shelters and the need for better driver training. Surveys of passengers with disabilities pointed to improved boarding and alighting from buses, although significant challenges remained, especially for those with hearing impairments

and mobility problems. Visually impaired volunteers particularly appreciated the tactile guideways and colour contrasts, while passengers with mobility impairment reported problems with high bus stands and inattentive conductors.

Conclusion and recommendation from the demonstration project indicate that even small-scale modifications can significantly improve accessibility and benefit all passengers rather than just those with disabilities. The project pointed out that all stakeholders should be involved right from the beginning and that ongoing disability awareness training for drivers and conductors was mandatory. Altogether, the findings point to incremental improvements toward achieving universal accessibility and further work is needed to address issues that remain.

3.6.5 Accessibility to the built environment in Delhi, India: understanding the experience of disablement through the intersectionality paradigm

To point out the barriers that faced disabled women of low and middle-income backgrounds toward education, employment, healthcare, and public transportation in Delhi-NCR, India. The study identified the fact that a combination of factors significantly restricted the women's access. Disability in the nature and degree of the impairment, gender, social class, and lack of family support, including poor support from their husbands, significantly intersected with the existing infrastructural and attitudinal barriers. These barriers resulted in quite unique forms of exclusion from mainstream society, as the case study has shown.

The barriers greatly impacted the mobility of these women and damaged their mental well-being. Many women internalized negative societal attitudes regarding their impairments, resulting in self-imposed restrictions on mobility by avoiding social interaction. Although many women found relief from stigma and judgment by others, most women mentioned deep sorrow about not being able to participate in community life.

The paper underlines that the factors of accessibility, as pointed out in the ICF, are multidimensional, coming from several factors that would be recognized within the ICF, including health condition, personal factors, and the environment.

The case study takes a position that the barriers to accessibility are even further constrained by a multiplicity of personal-specific factors, often at the individual level, that seldom receives discourse in the accessibility discourse.

Moving toward a solution, it is therefore necessary to have a more comprehensive understanding of accessibility that touches upon the complex interplay of personal and environmental factors. The solutions need to consider not only the physical adaptation needed for the built environment but also the social support systems and attitudinal changes required to build a truly inclusive society.

In conclusion of this chapter, the process of achieving a fully accessible and inclusive environment for people with disabilities in India is still at a long way but not a vulture chase. Where the “Accessible India Campaign” and the “Rights of Persons with Disabilities Act, 2016”, have brought improvements to the realm, many gaps remain with respect to infrastructure, transportation, and information and communication technologies. The COVID-19 pandemic has only hastened this need to have holistic policies and practices enacted to ensure equal access and participation for all. This would be achieved by prioritizing universal design principles, improving staff training, and increasing public awareness.

CHAPTER 4: Research Design

The Chapter outlines the methodology adopted to investigate the public transport accessibility issues. The chapter begins with a review of the literature to outline the background understanding of public transport accessibility. The chapter then takes a closer look at a detailed field study, including surveys, discussion in focus groups, and interviews with the differently-abled community. Primary and secondary data sources will be used to derive a comprehensive view of the situation. The methodology explains the journey experience associated with challenges to navigate the public transport system.

4.1 Methodology:

The study is to examine public transportation accessibility for differently-abled individuals in Nagpur city. The methodology incorporates qualitative and quantitative data collection techniques to gain a comprehensive understanding of the current state of accessibility, the challenges faced by the differently-abled community, and the potential solutions to enhance inclusivity in public transportation systems. The following outlines the four key objectives guiding this research and the methodological approaches used to achieve them.

Objective 1: To study the current public transportation accessibility in Indian cities for differently-abled communities.

Initiating with a comprehensive literature review of the present state of public transportation accessibility for the differently-abled in the Indian cities. The literature review has gathered not only the current state of public transportation but also explored the principles of the inclusive urban transport system. With that, the review will have the ability to identify lapses and challenges faced by the differently-abled community when accessing public transportation. By specifically narrowing down on the needs of this demographic, the literature review will end up defining the aim, objectives, and research questions that will steer the subsequent phases of the study.

Objective 2: To conduct a baseline study of socio-economic, and transportation accessibility aspects of the study area.

Following the literature review, a baseline survey is conducted to collect primary data from the differently-abled community. This phase involves direct engagement with the target demographic through qualitative methods such as interviews, focus group discussions (FGDs), and other participatory techniques. The survey focuses on evaluating the first and last-mile connectivity aspects and overall accessibility of existing public transportation systems. This direct interaction with differently-abled individuals allows for the collection of comprehensive and nuanced data, capturing their personal experiences, perspectives, and challenges encountered while navigating urban transportation networks.

Objective 3: To identify the problems and potential areas with accessibility parameters in the study area.

is focused on a detailed analysis of the problems and challenges identified through the collection of primary and secondary data. In the analysis of primary data, the social and economic assessment is included alongside the usage of tools such as the Public Transport Accessibility Level for differently abled designed to provide a variety of data on accessibility for the differently-abled population. In addition, the journey mapping method will offer a understanding of the daily mobility experience and the challenges the Differently abled population goes through. Under this, secondary data analysis of sources such as census data, transportation service records, and urban development plans will allow for a more overarching understanding of the contextual factors influencing transportation accessibility. The outcome of this objective will be a comprehensive identification of problems and challenges supported by empirical evidence and real-world experience.

Objective 4 To provide strategies and proposals for improving public transport accessibility. It is part of the process of analysis to action, emphasizing practical and effective solutions to the problems identified. Through diverse tools and techniques, ranging from technological innovations to policy recommendations, the solutions are tailored to target the needs of the differently-abled community. Technological solutions may include the development of accessible

transportation applications or assistive devices integrated into available infrastructure. Policy suggestions could include making regulatory changes or allocating resources in order to improve accessibility standards, this objective will empower policymakers, urban planners, and other stakeholders to take meaningful action towards more inclusive public transportation systems for all, regardless of ability. (Refer Fig No.8)

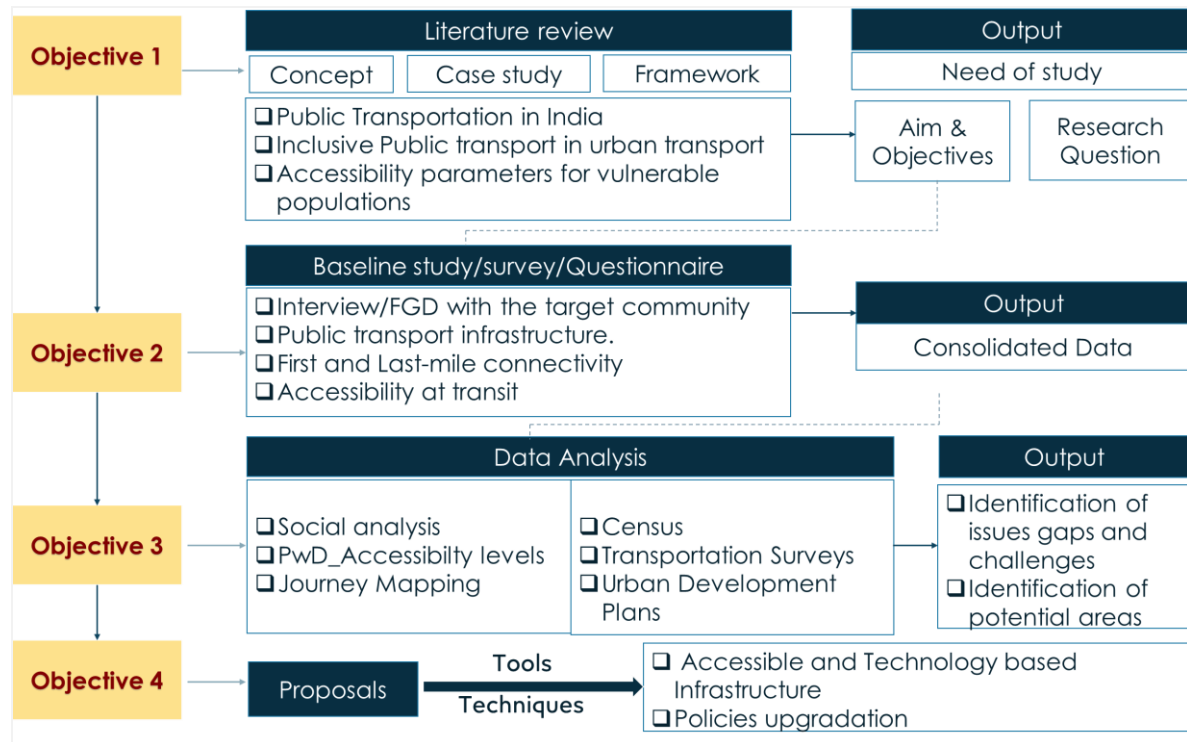


Figure 8: Detail Methodology

Source: (Author)

4.2 Data Checklist:

Data sources are identified as both primary and secondary. Primary data is obtained directly from the major sources, whereas secondary data is gathered from other organizations, government agencies, or independent research institutions. The sampling method used was non-probability sampling, with 305 samples obtained from focus group discussion (FGD), Questionnaire, Expert Interviews from which Qualitative and quantitative data were collected.

4.2.1 Secondary Data:

To understand the accessibility of public transportation for the differently-abled in Nagpur, this study uses a range of secondary data. Nagpur Zila Parishad

provides the demographic data, which gives an indication of how the population of the differently-abled is distributed across Nagpur's rural areas.

- Nagpur Municipal Corporation (NMC) deals with the urban area and provides lists of the differently-abled residing in the city. That data is used for locating places where services for accessibility will be most needed.
- Government Medical College & Hospital (GMC) provides the backdrop information regarding the healthcare context of the differently-abled population in Nagpur, and indeed, the physical barrier and the problem of mobility.
- Town Planning Department, Nagpur provides the City Development Plan for Nagpur, 2041. This is a long-term structure of urban development for Nagpur and includes transport projects. Therefore, the document is used to examine the long-run impact on accessibility.
- Nagpur Bus Stands, Ganesh Peth, and Mor Bhawan; provide information about bus routes and schedules that are important for assessment of first- and last-mile connectivity.
- Nagpur Aatmadeepam Society, and Matru Sewa Sangh Institute of Social Work conduct FGDs and interviews with the differently-abled population. Those qualitative sources provide personal insights and on-the-ground experiences on transport accessibility issues.

Location	Data collected
Nagpur Zila Parishad	List of disabled people in Nagpur (Rural + Urban)
Atmapeedan Society Nagpur	FGD/ Interview
Matru Sewa Sangh Institute of Social Work	FGD/ Interview
Nagpur Municipal Corporation	List of disabled people in Nagpur (Urban)
Government Medical College & Hospital (GMC)	Interview
Town Planning Department	City Development Plan for Nagpur, 2041
Nagpur Bus stands (Ganesh Peth and Mor Bhawan)	Bus Routes
MAHA Metro, Nagpur	Routes, Updated Fares

Table No.4: Secondary Data List

Source: (Author)

4.2.2 Primary Data:

The primary data-gathering process would involve a multi-dimensional approach to the acquisition of comprehensive insights into accessibility features in public transport, the availability of infrastructure, and trip patterns. This would involve, on-site surveys and inspections of the actual accessibility features present in public transportation facilities, such as ramps, elevators, and barrier-free footpaths. Focus Group Discussions (FGDs) are held with participants with visual, locomotor, and speech/language disabilities, gathering shared experiences on transportation challenges. Interviews with experts, doctors, NGO heads, and local residents offer specialized insights into accessibility issues. Questionnaires, using a purposive sampling method, target 80 respondents to gain a broad understanding of public transportation use among differently-abled individuals. Telephonic surveys reach a wider audience with 134 participants. (Refer Table No.5)

Primary survey					No.
Focus Group Discussion (FGD)	Age	Disability			
	10-35	All visual differently-abled			18
	18-50	locomotor differently-abled			21
	18-50	Speech and Language differently-abled			05
Interview	Experts	Locals	Doctors	NGO's head	47
	02	45	05	03	
Questionnaire	Sample technique- Non-probability sampling (Purposive sampling)				80
Telephonic Survey	According to the format				134
Observation Survey	Activity near areas of bus stops, metro stations, and terminals				
Road Inventory	Footpaths, signages, ramps, Elevator, sidewalks etc				
Total sample					305

Table No.5: Primary Data List

Source: (Author)

CHAPTER 5: Data Collection

The data collection framework for studying public transportation accessibility for differently-abled individuals includes several key parameters: social profile, trip profile, mode choice, what helps to move freely, and road infrastructure. The social profile identifies the demographic characteristics of the differently-abled community, such as age, gender, education, employment status, and types of disability. Knowing these demographics will help identify specific needs and challenges faced by differently-abled people. Trip profile considers the patterns and characteristics of trips taken by this community, such as frequency, destinations, and purposes: work, education, healthcare, or recreation. Mode choice examines transportation modes preferred by the differently-abled and why: buses, metros, taxis, and others. "What helps to move freely" looks at factors that allow or prevent mobility: ramps, elevators, and assistive technologies. Assessment of the road infrastructure considers the level of accessibility of the physical environment—from footpaths and crossings to the layout of transportation stops.

5.1 Primary Data Collection Framework:

The parameters to be studied are measured in terms of both qualitative and quantitative data-gathering. Qualitative measures like focus group discussions, interviews, and observation surveys are rich, narrative-based. This enables the researcher to get a holistic and first-person view of experiences and perceptions of a differently-abled person. These are the most important methods for capturing personal stories and understanding the unique challenges faced by this community. Quantitative measures like questionnaires, telephonic surveys, and data from government reports and census records provide numerical data that can be statistically analysed to identify trends and patterns. The research is designed to have a holistic understanding of the current state of public transportation accessibility for differently-abled people in Nagpur by integrating both the qualitative and quantitative data.

The derived outcomes from the parameters and measurements yield critical insights into the accessibility of public transportation and guide areas of

improvement. For the social profile, it's a concept that attempts to understand the demographics and characteristics of the differently-abled community and guide tailor-made transportation solutions. The trip profile outcome reveals typical travel behaviours and needs, hence guiding the development of transportation services that best address them. Outcomes for mode choice help determine the best and most preferred transportation modes, hence representing areas that need accessibility improvements. The results from the "what helps to move freely" parameter help determine which factors and aids are best for mobility, guiding efforts to improve on this front. Finally, the outcomes for road infrastructure assess the accessibility and safety of road-related elements and help suggest improvements for urban planning and transportation policies. The focus on these outcomes develops actionable recommendations to improve public transportation accessibility for the differently-abled community in Nagpur. (Refer Fig No.9)

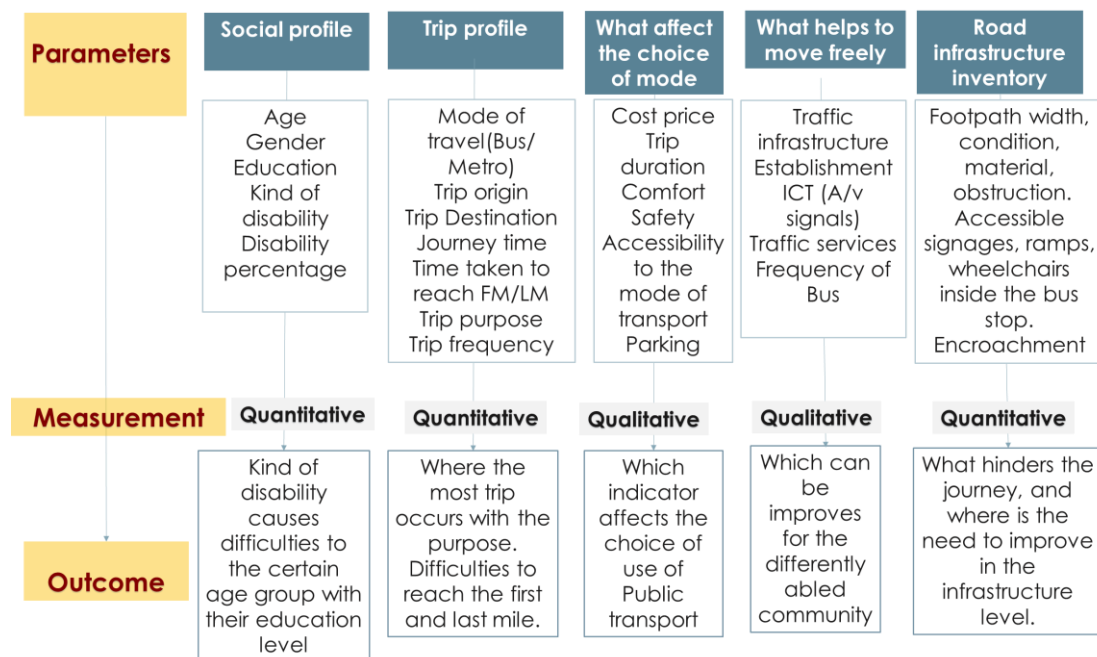


Figure 9: Primary Data collection Framework
Source: (Author)

5.2 Community and Trip profile:

A comprehensive data collection process has been carried out, comprising 305 samples. Significant patterns in the distribution of disabilities and literacy rates were found by analyzing this set of data. Locomotor disabilities were found to be the most prevalent among the population sampled, followed by multiple

disabilities and blindness. Regarding literacy, the data indicated that 47% of the persons in the sample had completed graduate-level education, while 33% did not have any formal education. These results highlight the significance of comprehending and meeting the various needs of people with disabilities. (Refer Fig No.10)

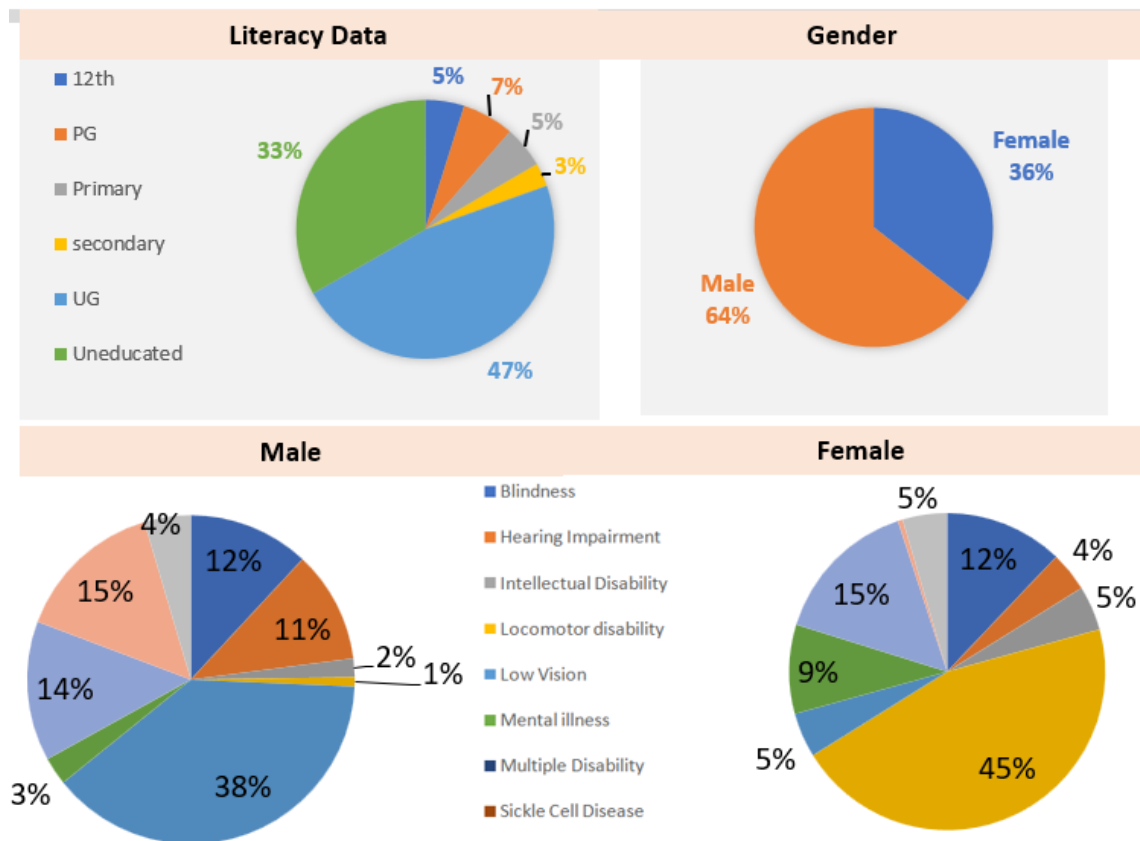


Figure 10: literacy Data with gender wise disability
Source: (Author)

A data shows, a large number of individuals with locomotor disabilities rely on public transportation, with the majority being male and undergraduates. This demographic indicates that differently-abled individuals, particularly those with mobility challenges, have a strong need for accessible public transport to participate in economic activities, education, and social engagement.

The data collected on journey modes provides a trip profile of users and objectives. 82% of respondents, most of them, prefer buses as their main form of transportation, showing their reliance on the infrastructure of public

transportation. It's interesting to note that although bus use is common among both genders, there are significant differences in the reasons for trips. Women are more likely to travel for commercial reasons (36%) and for educational purposes (24%), indicating their involvement in both learning and financial activities. On the other hand, men's distribution is balanced in terms of business use (30%), education (30%), and leisure (26%), indicating a wide range of activities and interests. (Refer Fig No.11 & 12)

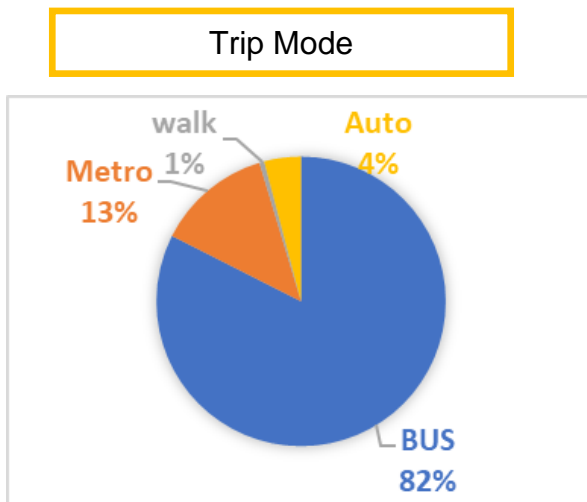


Figure 11: Trip Mode data
Source: (Author)

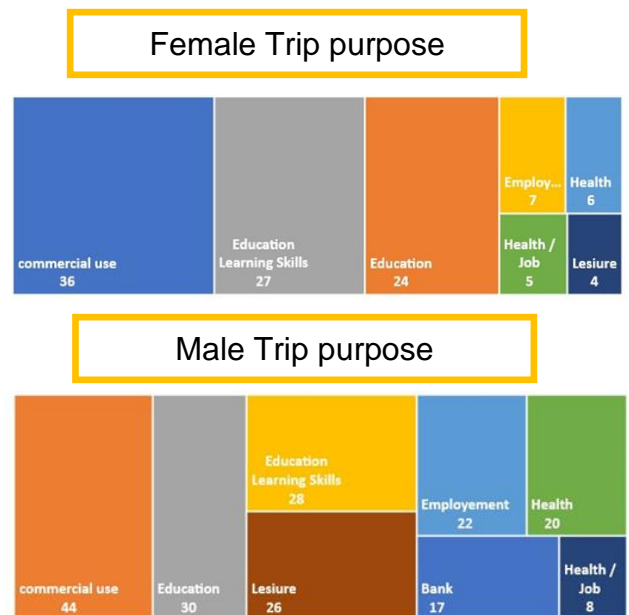


Figure 12: Trip Purpose data
Source: (Author)

Particularly, places like Sadar, Dharam Peth, Itwari, and Sitabuldi become hubs for trip incidents, highlighting their importance in the city

5.3 Identified stretches:

Identified location where most trips occur: Main centers upon which residents depend. (As per the primary survey and land use)

Point of Interest

Public transportation accessibility for the differently-abled in urban settings should also focus on some areas. Transportation stops, whether bus or metro stations, should have ramps, elevators, tactile paving, and designated seating to make it easy for them to use. Healthcare facilities should be incorporated into the transit

routes for their easy access to medical care, and similarly, educational and institutional facilities need accessible transportation for the benefit of the differently-abled students. Commercial centres, which are the shopping malls and the business districts, should be served with an inclusive transit to also facilitate economic participation and social integration. Recreational areas, such as parks and auditoriums, also require transportation that is inclusive to be able to enjoy quality of life and community participation. Lastly, disability associations and NGOs must be reachable by public transit, so the differently-abled can avail support services and advocacy networks. All these put together create an inclusive transportation system, able to foster greater independence and participation among the differently-abled community.

The greatest number of trips occurred at Sitabuldi, NGOs and many destinations are shown below

5.3.1 Identified Stretches for Journey Mapping

The process of identifying problems within the journey for differently-abled individuals encompasses a three-part framework that includes 'the first mile,' 'during the journey,' and 'the last mile.' During the 'first mile,' the problems people face include the inability to find their way to bus stops or metro stations because sidewalks are inaccessible, there is no tactile paving, or the signage is inappropriate. These problems easily prevent the differently-abled from reaching transit stations safely and efficiently. 'During the journey' and traveling on such public transit systems, the problems involved inaccessible boarding platforms, overcrowding, or lack of seating arrangements. These problems, apart from making them physically unable to reach, are responsible for the sense of discomfort and insecurity in their journey. The 'last mile' involves problems at the final destination station or stop in terms of inaccessible exits, uneven terrain, or inadequate connectivity to the final destination. Breaking down the journey into three separate phases makes it possible to point at the areas where accessibility and infrastructure need to be improved if the differently-abled are to be provided with a better travel experience.

Stretch 1 – From Sitabuldi to Aatmedeepam NGO

The approximately 5-kilometer stretch primarily serves education and skill development needs, with a significant dependence on bus and metro service. It positively affects communities and encourages development by supporting education, skill-building, and community empowerment. There have been 31 trips ending in Aatmedeepam. (Refer Fig No.13)



Figure 13: From Sitabuldi to Aatmedeepam NGO

Source: (Author)

Stretch 1 – Identified Problem

Pedestrian Crossing: Inadequate or poorly marked pedestrian crossings increase the risk of accidents and pose safety hazards for pedestrians trying to cross the road, especially in high-traffic areas.

Trees Located in Footpath Obstructing View:

Trees planted on footpaths obstruct visibility for pedestrians and drivers, potentially leading to accidents and making the footpath less safe and accessible.

U-turn Makes a Walk Lengthy: Lengthy detours caused by U-turns or poorly planned road layouts inconvenience pedestrians, increase walking distances, and discourage foot traffic, impacting overall accessibility and mobility.

Finding a Bus: Lack of clear signage or designated bus stops makes it challenging for passengers to locate and access bus services, leading to confusion and inconvenience.

Accessibility in Bus: Inadequate accessibility features within buses, such as ramps or designated spaces for wheelchairs, restrict access for individuals with disabilities, violating their rights to equitable transportation services.

Bus Stand Not Accessible for Wheelchairs: Inaccessible bus stands to prevent individuals using wheelchairs or mobility aids from safely accessing public transportation, limiting their mobility and independence.

No Wheelchair Space under Bus Shelter: The absence of designated wheelchair spaces under bus shelters fails to provide adequate protection from the elements

for individuals with disabilities, compromising their comfort and safety while waiting for buses.

Display Not Functioning: Non-functional displays at bus stops fail to provide essential information to passengers, causing confusion and uncertainty about bus schedules and routes.

Stretch 2 – From Sitabuldi to Mihan

The approximately 16-kilometer stretch primarily serves employment development needs, with a significant dependence on metro service. It positively affects communities and encourages development by supporting employment, no bus services are frequently available. Mihan is on the peri-urban side of the city. (Refer Fig No.14)

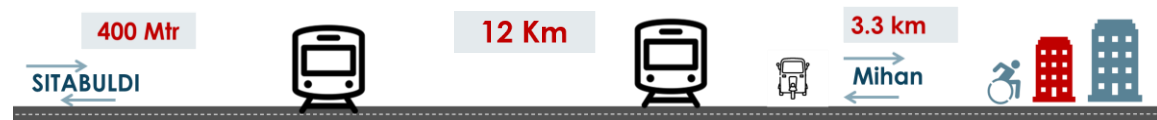


Figure 14: From Sitabuldi to Mihan

Source: (Author)

Stretch 2 – Identified Problem

Crossing the Road: Pedestrians face challenges in safely crossing the road due to inadequate pedestrian crossings, poor visibility, and high traffic volume, increasing the risk of accidents.

Finding a Bus: Lack of clear signage or designated bus stops makes it difficult for passengers to locate and access bus services, leading to confusion and inconvenience.

Monitoring Inside the Metro Station: Inadequate monitoring and surveillance inside metro stations may compromise passenger safety and security, increasing the risk of unauthorized activities or emergencies going unnoticed.

Bus not Stopped for Differently Abled Person: Failure of bus drivers to stop or assist differently-abled passengers boarding or alighting the bus poses barriers to accessibility and violates their rights to equitable transportation services.

Wrong Direction of the Vehicle: Buses traveling in the wrong direction or deviating from their designated routes cause delays, confusion, and inconvenience for passengers, disrupting the efficiency of public transportation services.

U-turn Makes a Walk Lengthy: Poor urban planning, such as lengthy detours caused by U-turns or inadequate pedestrian infrastructure, increases walking distances and discourages pedestrian activity, impacting mobility and accessibility

Stretch 3 – From Sitabuldi to Government Medical College

The approximately 04-kilometer stretch primarily serves health care and employment development needs, with a significant dependence on bus and IPT. This stretch is important as 45 no. of trips ends there for health, providing UDID card, and employment. (Refer Fig No.15)



Figure 15: From Sitabuldi to Government Medical College

Source: (Author)

Stretch 3 – Identified Problem

Bus stop not operational: the nearby bus stop is not in working condition for two years from the local source as the distance increased by 100 m for the next bus stop.

Footpath Condition: The condition of footpaths is often poor, with uneven surfaces, cracks, and potholes, posing hazards to pedestrians.

Improper Signage: Lack of proper signage on footpaths contributes to confusion and may lead to pedestrians getting lost or facing difficulties in navigating the area.

Width of the Footpath: Many footpaths have Insufficient width makes it challenging for pedestrians, especially those with mobility aids or strollers, to navigate safely.

Obstructions: Footpaths are often obstructed by various objects such as garbage bins, street vendors, or illegally parked vehicles, impeding pedestrian movement.

Manholes: Uncovered or poorly maintained manholes pose a significant safety risk to pedestrians, especially during low-light conditions.

Pedestrian Crossing: Inadequate or poorly marked pedestrian crossings contribute to road safety hazards, increasing the risk of accidents involving pedestrians.

Encroachment: Encroachment by shops, stalls, or construction materials onto footpaths limits pedestrian space and obstructs safe passage.

Accessibility in Bus: Bus stops often lack accessibility features such as ramps or designated spaces for wheelchairs, making it challenging for people with disabilities to use public transportation.

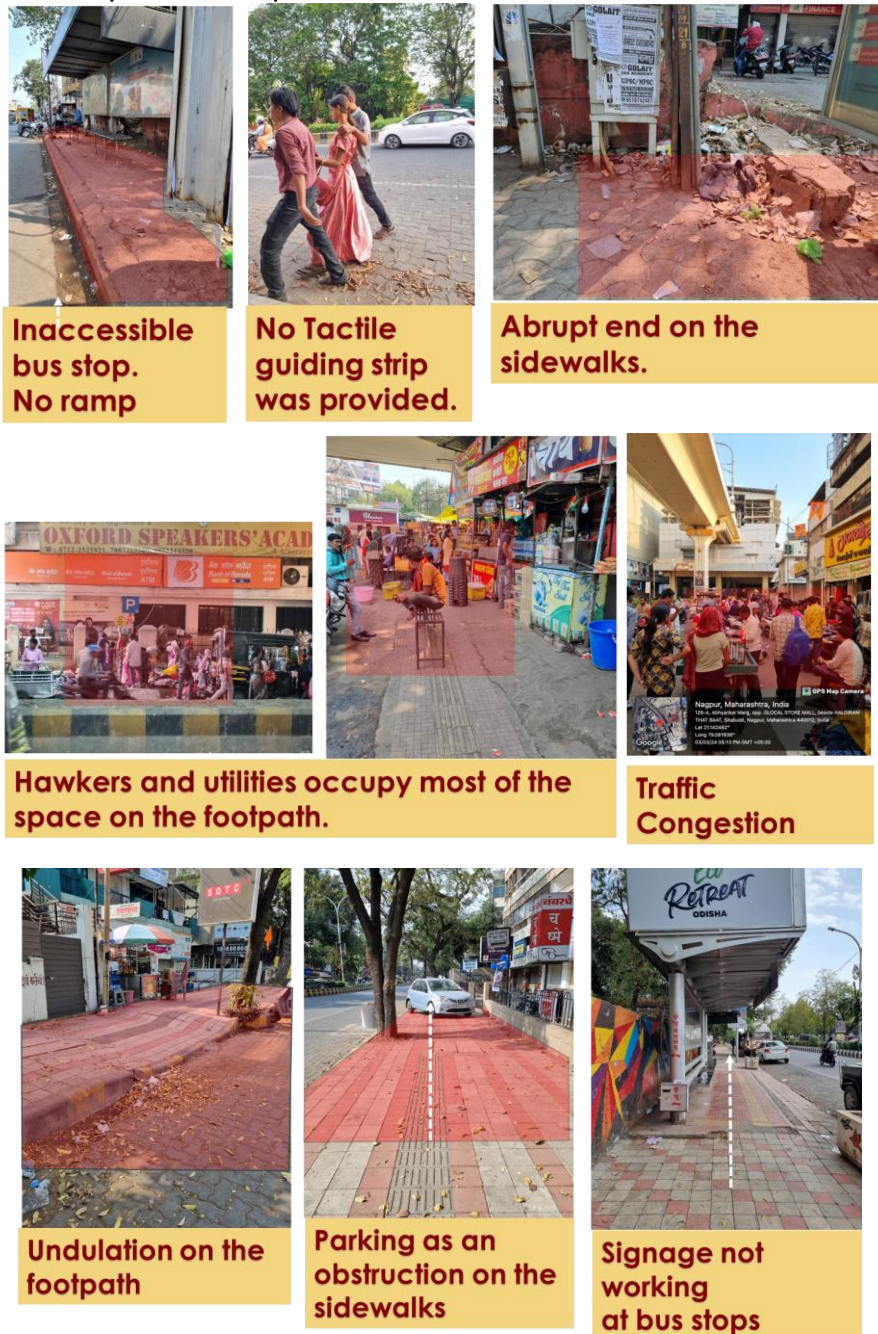


Figure 16: Problems captured during the survey

CHAPTER 6: Data Analysis

Data Analysis is done with the help of primary and secondary data. Transformation of factors to measurable parameters. Data is been processed and divided into three aspects, first one is Destinations another one is functionality and third one is safety, (Refer Fig No.17)

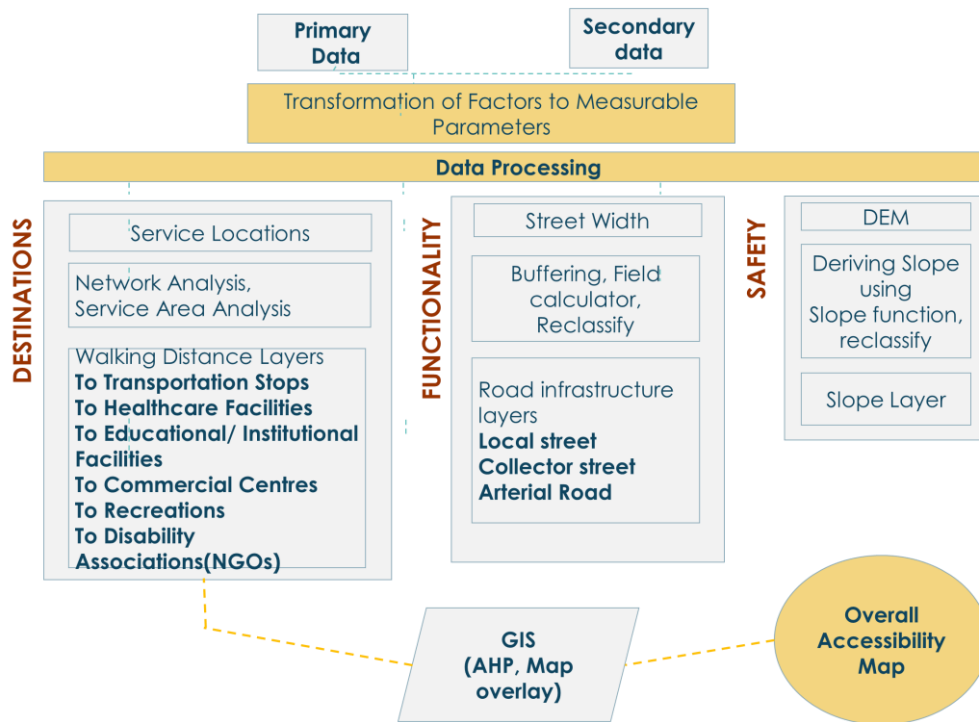


Figure 17: Data Analysis Framework

Source: (Author)

6.1 Main Destinations:

In this aspect, the parameter analysis of destinations involved the comprehensive assessment of the accessibility of different ally people to the important service categories. This was done through the use of GIS application software, by the network analysis walking distance layers from major transportation hubs, health facilities, learning/institutional facilities, business centres, recreational zones, and differently able NGOs. are calculated. These were converted into a raster format for further analysis.

The overlays are performed with these layers using raster-weighted overlay analysis to produce a comprehensive output raster of the current accessibility situation for differently abled populations concerning relevant services. After

reclassification to a common measurement scale of 1 to 4, scores are derived for accessibility, where scores will determine the level of accessibility. The scores suggest the locations and proximity of services to transportation hubs, where the summation of accessibility scores is more readily accessible to people with differently-abled.

The analysis emphasizes the weight assignment as a vital factor in the effective use of public urban space frequented by the differently abled, considering how valuable the public's attention toward the environment should be. Planning based on spaces frequented by the differently abled community will highlight to experts concerned with urban planning the areas that need rehabilitation and improvement.

6.1.1 Walking Distance to Bus Stop:

The accessibility map suggests unequal levels of accessibility for bus stops in different specified places. Sitabuldi, Aatmadeepam NGO, and Hudkeshwar show relatively high accessibility levels, which means that bus stops are easily accessible for people using this mode of transport. However, Mihan and Pardi illustrate low accessibility levels due to the scarcity of buses in these places. In the Mihan and Pardi places, the deficiency in buses causes significantly low accessibility in the region. (Refer Fig No.18)

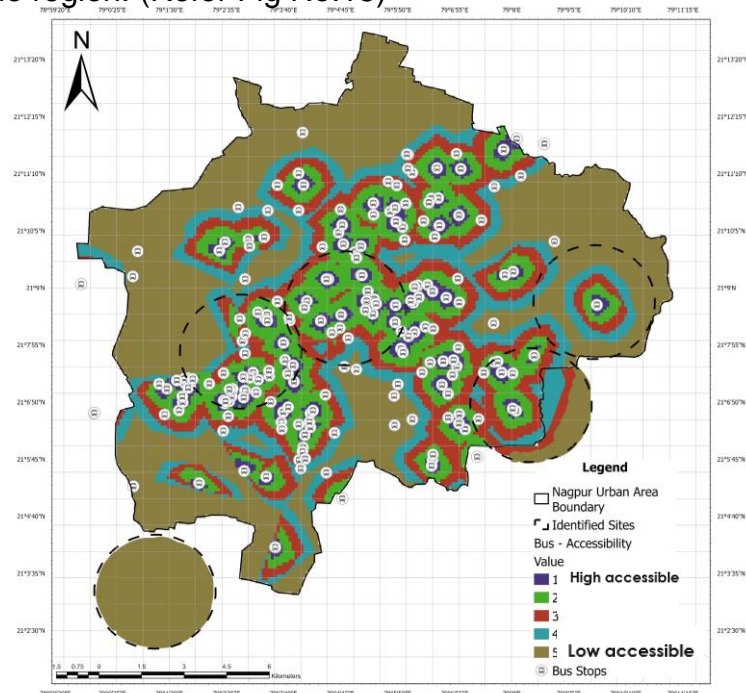


Figure 18: Walking Distance to Bus Stop Map

Source: (Author)

6.1.2 Walking Distance to Disability Association

The analysis has outlined the problem faced in accessing these two NGOs, Matru Sewa Sangh and Aatmadeepam NGOs, especially from Hudkeshwar and Pardi places. The accessibility to these NGOs is even further affected by the Mihan region. This reflects the general problem of non-availability and non-accessibility of bus services in these places, which makes it tough to access important community resources, such as NGOs, in these places. (Refer Fig No.19)

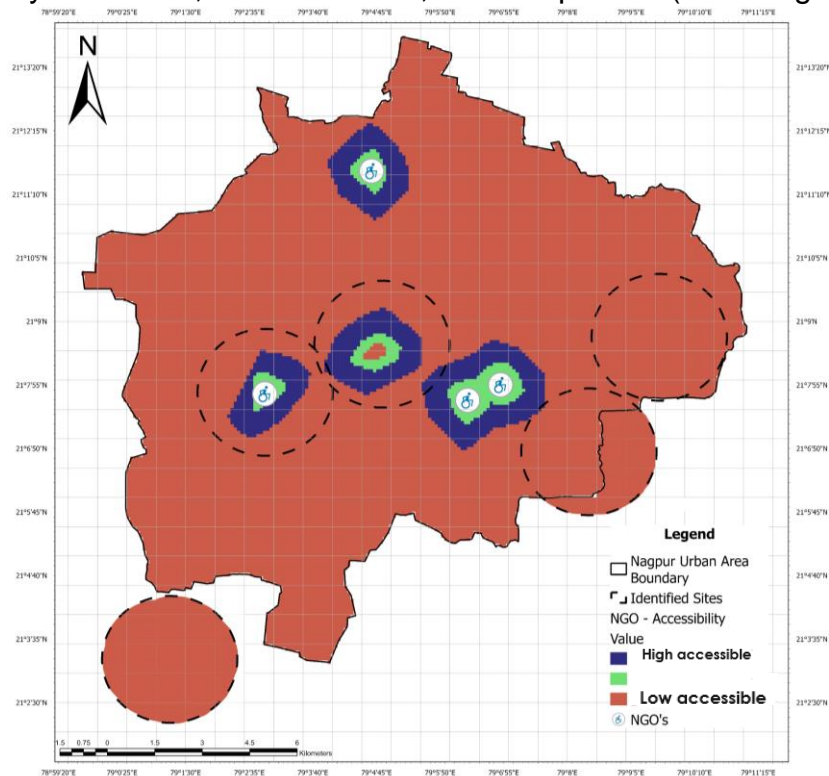


Figure 19: Walking Distance to Disability Association Map
Source: (Author)

6.1.3 Walking Distance to Recreational Facilities

The significant challenge of accessibility to the recreational centers located around Sitabuldi and Itwari for people living in localities like Pardi, Hudkeshwar, and around the NGOs. These localities face the inability to access recreational places because transportation is low-frequency based, mostly via low-frequency buses.

A new accessibility challenge for the proposed Anubhuti inclusive park located on the campus of Pardi presents itself as well. Located on the eastern side of Nagpur, access to the park becomes highly challenging for people living in the

vicinity of Pardi, Hudkeshwar, and nearby NGOs. The limited transportation infrastructure based on buses to Pardi acts as a barrier to the people to access the park and enjoy the recreational facilities. (Refer Fig No. 20)

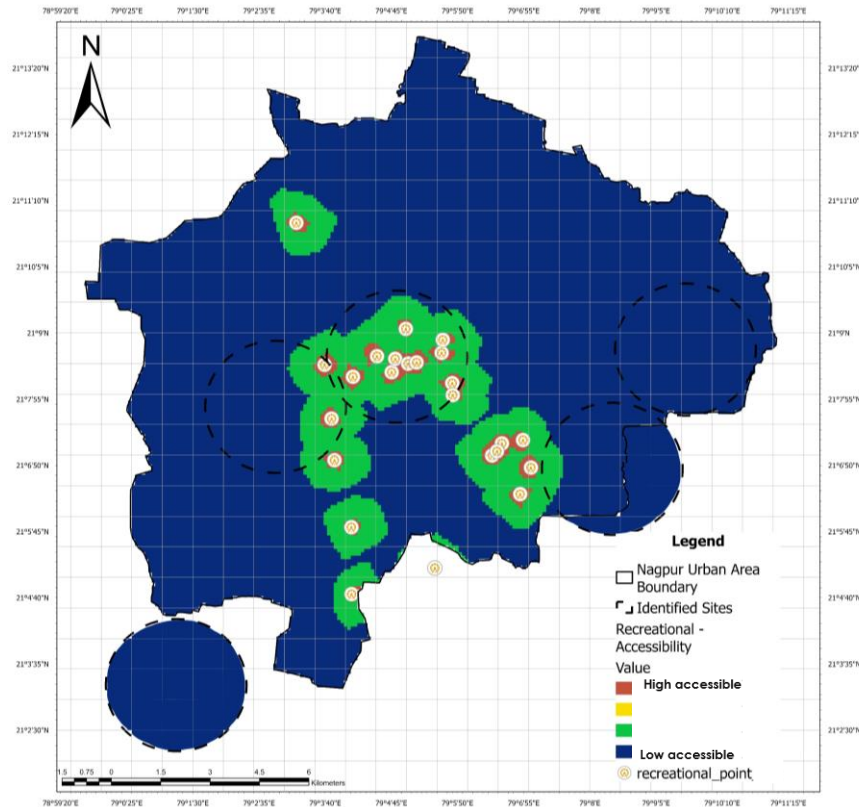


Figure 20: Walking Distance to Recreational Facilities Map
 Source: (Author)

6.1.4 Walking Distance to Metro Stations

The metro line covers two routes: the first route starts from Automotive Square in Kamptee and reaches the MIHAN Metro depot; the second route starts from Prajapati Nagar in East Wardhaman Nagar and reaches Lokmanya Nagar in Hingna. Phase I covers 38.215 kilometres and is in operation, connecting various parts of the city. Moreover, Phase II covers 43.8 kilometers and is yet to be implemented, aiming to cater to more residents and extend connectivity over the city. The problem seen is that the metro services have not been operational in the chosen Hudkeshwar region. The absence of metro services in the Hudkeshwar region creates a gap in the transportation system, possibly limiting the ability of the residents in this locality to reach effective and fast transit options. (Refer Fig No.21)

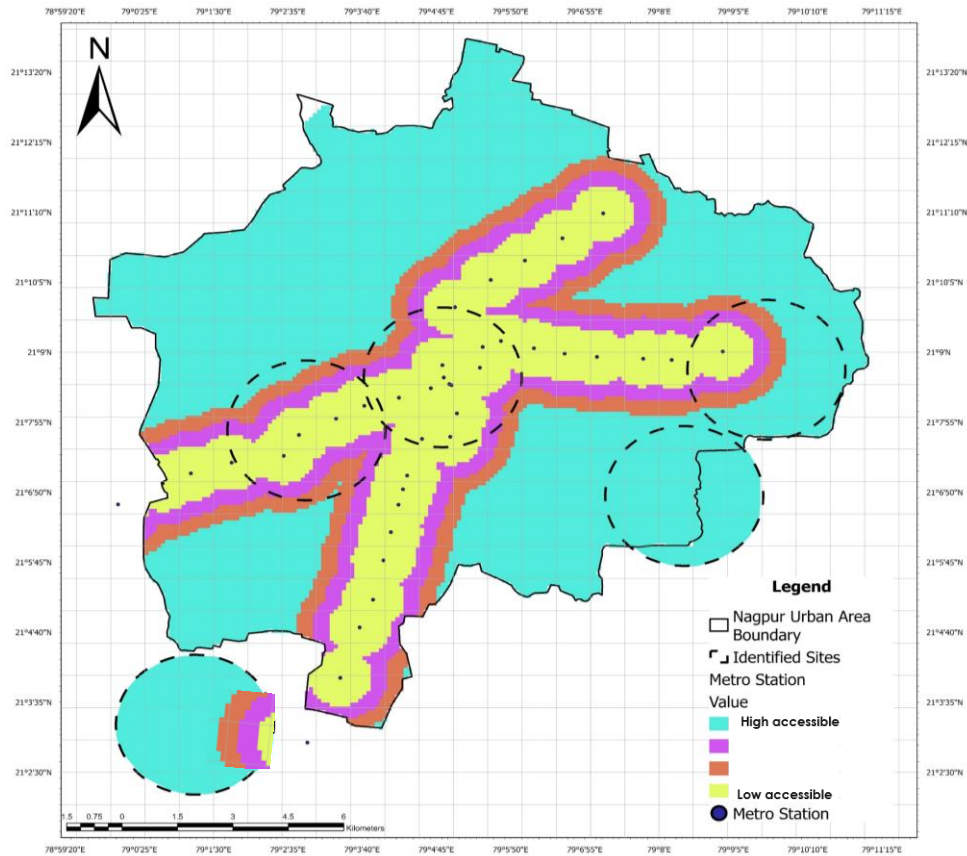


Figure 21: Walking Distance to Metro Stations Map
 Source: (Author)

6.1.5 Walking Distance to Institutional Buildings

This is one of the major issues that need to be addressed for Nagpur to ensure that the disabled do have not enough institutions serving their needs. Such institutions play a crucial role in availing essential services, support, and resources to many differently-abled people with physical and cognitive impairments.

They offer, besides specialized education and vocational training, rehabilitation services and assistive technologies to help the differently abled and improve their quality of life. In addition, they serve as community centers offering advocacy, counselling, and recreational facilities attuned to their individual needs.

In this regard, the absence of such institutions in Nagpur worsens the condition of the differently abled, who are deprived of opportunities for education, employment, and social inclusion. Also, the burden is excessively borne by

families and caregivers, who can hardly provide the necessary support and resources without institutional support. (Refer Fig No.22)

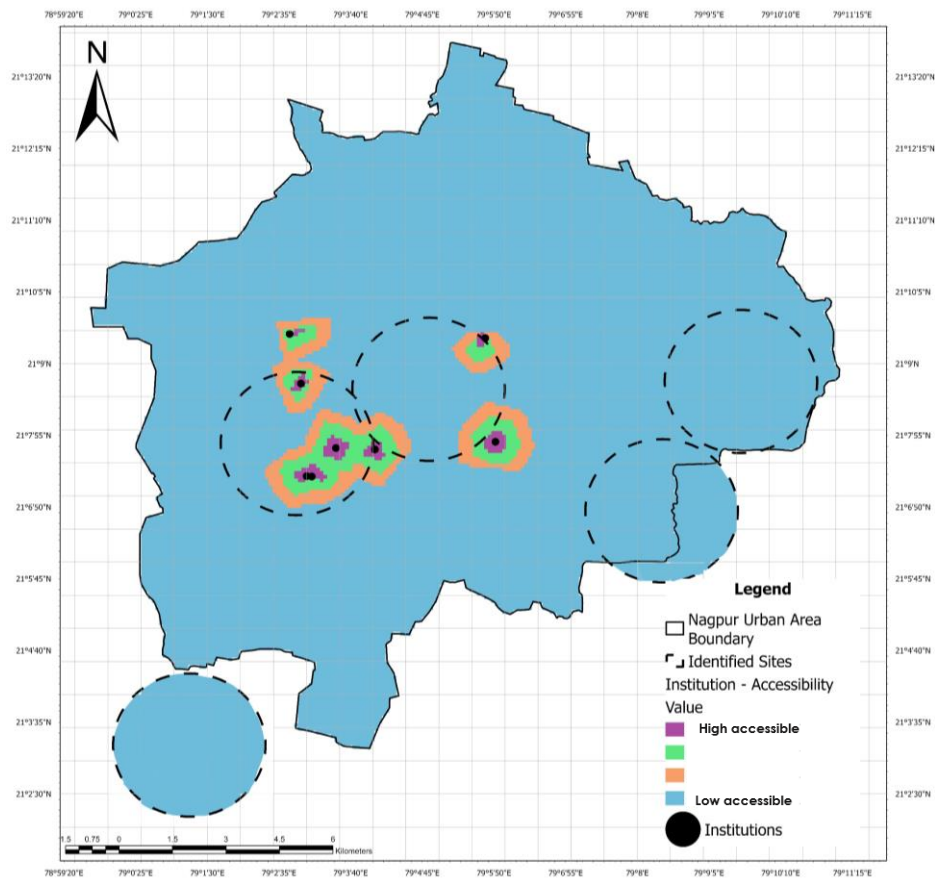


Figure 22: Walking Distance to Institutional Buildings Map
Source: (Author)

6.1.6 Walking Distance to Healthcare Facilities:

Nagpur has both complete healthcare infrastructure and hospitals, clinics, and specialist medical centers. However, peri-urban areas on the fringes or outskirts of the city are facing significant challenges about infrastructure development, which itself incurs many challenges in accessing healthcare services.

People in such peri-urban areas find many difficulties in accessing healthcare facilities due to insufficient transportation infrastructure, unequal distribution of medical facilities, and sparse medical centres. People also find it difficult to access essential medical services and care because they often face a delay in accessing healthcare services from the city centre.

Besides, peri-urban areas may lack adequate healthcare infrastructure, such as hospitals, clinics, and specialized medical centres. Disparities in healthcare

access due to a lack of healthcare infrastructure can lead to health inequalities between urban and peri-urban areas. Poor access to healthcare through gaps in healthcare infrastructure can contribute to poorer health outcomes among the residents of peri-urban areas. (Refer Fig No.23)

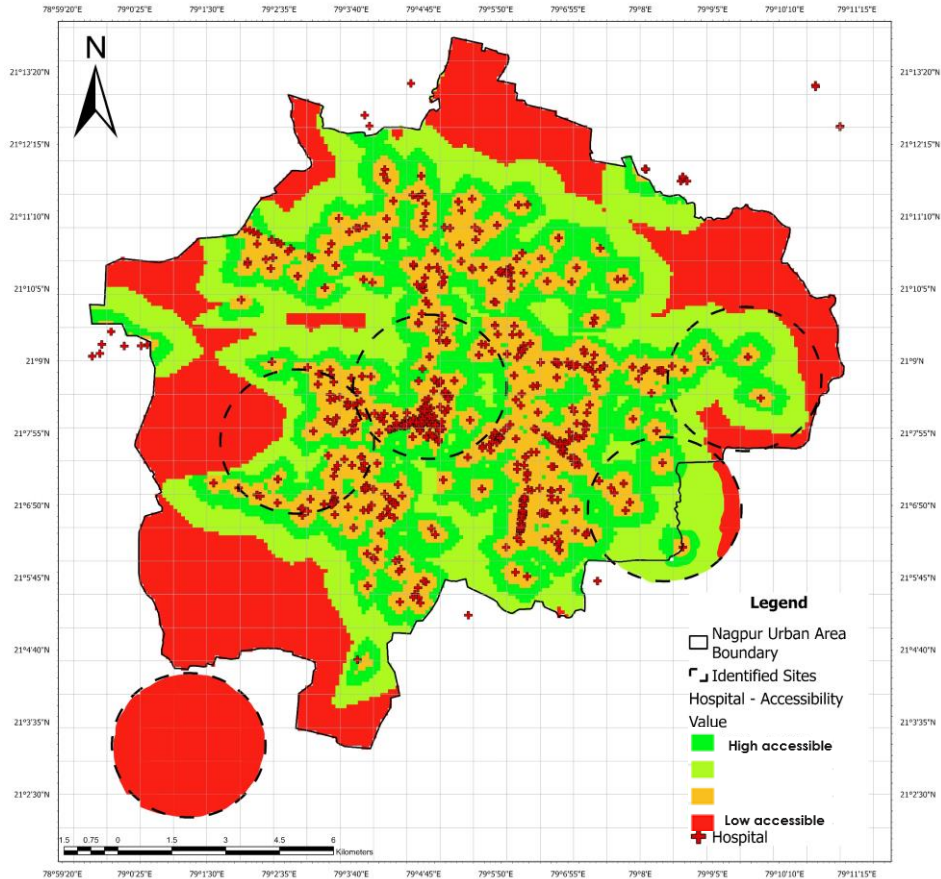


Figure 23: Walking Distance to Healthcare Facilities Map
 Source: (Author)

6.2 Functionality:

The assessment of road infrastructure functionality, and sidewalk width is a critical measure of pedestrian access and safety. The ranges of widths recorded from the primary survey are categorized into: less than 900mm, worst case; 900-1200mm, bad; 1200-1800mm, better; and above 1800mm, best. This categorization reflects the level of ease and comfort of pedestrian movement, making wider sidewalks provide smoother and safer passage for pedestrians, including those with walking aids or disabilities.

In the consideration of accessibility in road infrastructure, all the factors that affect the mobility of the differently-abled are assessed. Assessment of such factors looks at the state of the road considering the quality of the road surface and its

absence of potholes and considers such alternative modes of transport, such as the dedicated traffic lanes for bikes or the pedestrian zone, that will give value to further the option for mobility.

The great importance, in this case, is the status of the footpaths and sidewalks. This should be clear of obstructions such as cars or encroachments. The obstruction on footpaths and sidewalks can be a big hindrance to movement for the differently-abled, particularly those using wheelchairs or other assistive devices. Street lights are another aspect that is essential for safety, especially during the nighttime when all users should safely manoeuvre the streets.

The key factors include accessible signage, which gives clear and understandable information for all users, including users with visual impairments. Accessible bus stops are assessed concerning different aspects, such as rampage, tactile paving, and areas designated for wheelchair users, to ensure that all kinds of different disabilities are being taken care of. The existence of tactile paving is considered in assisting the user who has issues with their vision to walk in the environment.

All of these elements are reduced into one variable, that is said to encapsulate the overall state regarding road infrastructure accessibility. Calculating LOS or Level of Service represents the quality and performance of infrastructure when it comes to the accessibility factor. This translates to a high LOS, for instance, when the infrastructure is fully compatible with the needs of the differently-abled, and a low LOS would imply significant room for improvement. This analysis forms the basis upon which improvements and changes are recommended in order to render the road infrastructure more accessible and inclusive. (Refer Table No.6)

Variable	Indicators	Statement	Rate in Scale 1- 3					
				Hudkeshwar	Mihaan	Atmadeepam	Anubhuti Park	Sitabuldi
Road Infrastructure Assessment	Road Condition	The roads to / from where I live are in good condition	1-Strongly Disagree 3-Strongly agree	2	2	3	1	3
	Alternative modes availability	There are alternatives of transportation modes to support my daily activities		1	1	2	2	3
	Tactile Pavement	Tactile pavement is present in my area		1	1	1	2	2
	Foothpath Condition	Footh path condition is good in my area		1	2	2	2	3
	Obstruction at Foothpath	No obstruction is their in foothpath in my area		1	1	3	1	2
	Availability of signages	Signages are available at my area.		1	1	1	1	2
	Street Light	Street light are available at my area.		3	3	3	2	3
	Accessible Signages	Access Signages are available at my area.		1	1	1	1	1
	Accessible Bus Stops	Accessible bus stops are available at my area.		1	2	1	1	1
	Wheel Chair inside Bus Stop	Wheel chair are accessible at bus stop in my area.		1	1	1	1	1
	Parking	Parking Facilities are available at Public Transportation Facilities at my area.		1	3	1	1	2
	Level of Service				14	18	19	15

Table No.6: Road Infrastructure assessment analysis

Source: (Author)

The functional assessment of the road infrastructure of Nagpur reveals some critical observations that impact the accessibility and transportation options in the areas.

- First, the conspicuous difference in road conditions between Hudkeshwar and MIHAN areas, which were observed in poor condition, and Sitabuldi, where roads were found in good condition, evidences the importance of infrastructure maintenance and development that ensures smooth and safe movement of the residents.
- Secondly, the availability of alternative transportation modes such as buses, the metro, and auto stands, mainly concentrated in the Sitabuldi area, much more than in other areas, heavily influences transportation accessibility. This difference in transport modes can limit the scope of mobility options for the residents living in the area with limited alternative modes of transport.
- The availability of tactile pavements in Sitabuldi areas, which are in non-walkable condition, shows the efforts to improve accessibility for visually impaired persons. The absence of such tactile pavements in other areas shows that there is a need for full-scale infrastructure improvement to involve the needs of differently-abled persons.
- The Hawking Vending has emerged as the most significant hurdle in Sitabuldi as it is a city centre. This shows that effective urban management strategies must be adopted to harmonize economic activities with pedestrian accessibility and safety.
- The lack of signage outside the area of Sitabuldi, wayfinding is quite difficult, so accessibility issues are still furthered for the residents and visitors alike.
- Most bus stops are inaccessible to disabled persons and wheelchair provisions are not put up at all in all the areas. This is the reason that disabled persons have to pay their way with private vehicles, increasing congestion and air pollution in the city, while also restricting their mobility options.

6.2.1 Sidewalk Width

In the assessment of sidewalk, width is measured about the street widths. Sidewalks are Worst when the width of streets varies between 0-900mm. This type classifies as inadequate conditions for pedestrians due to a restricted space with potential hazards. Streets having widths of sidewalks between 900mm and 1200mm are classified as Bad. The condition is partially improved but with some inadequacies. Better sidewalks are between 1200mm and 1800mm. This category is improved and has less failure for pedestrians, with more pedestrian space. Best sidewalks, more than 1800mm. In this category, the condition for pedestrian safety and comfort is better, as it is easily moved and accessibility is not restricted.

This system of categorization will prove to be a very useful tool for determining the appropriateness of sidewalks and for drawing attention to the dominant local needs required for the infrastructure of sidewalks, helping to establish pedestrian safety and accessibility. The improvement and maintenance of the sidewalks in the better and best categories are indispensable for developing more pedestrian-friendly environments of active transportation and overall enhancement of urban livelihood. (Refer Fig No.24)

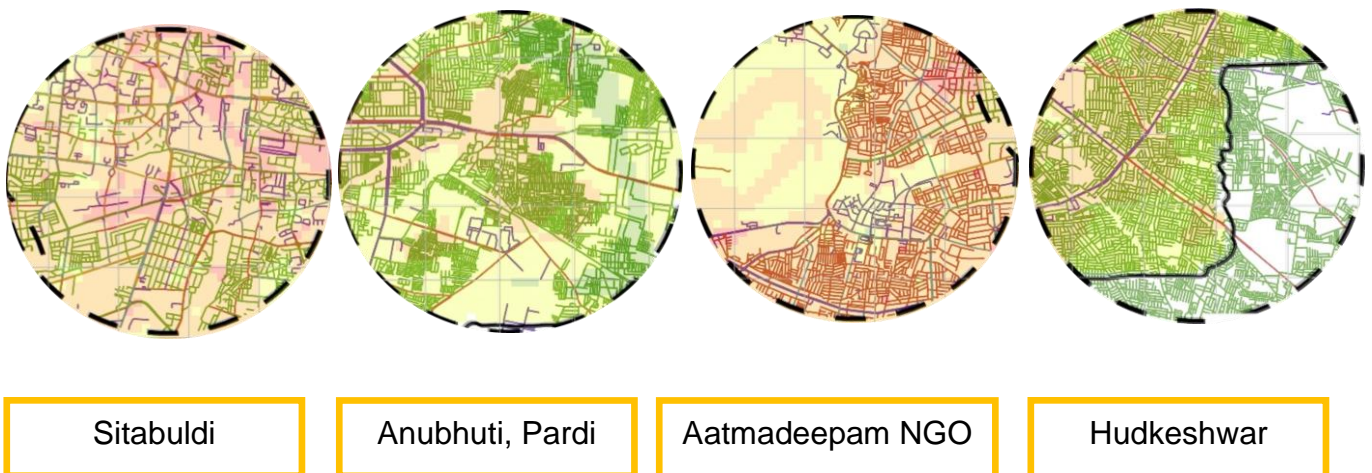


Figure 24: Sidewalk Width

Source: (Author)

For the assessment of sidewalk width in Nagpur, roads are typically categorized into arterial, sub-arterial, collector, and local streets. Here's a brief overview of each classification:

Arterial Roads: Arterial roads are major thoroughfares designed to accommodate high volumes of traffic, providing primary routes for through-traffic movement within the city and connecting major destinations. These roads often have multiple lanes, higher speed limits, and limited access, facilitating efficient movement between different areas of the city. Examples include main highways, major boulevards, and expressways.

Sub-Arterial Roads: Sub-arterial roads serve as secondary routes within the urban road network, connecting arterial roads to local streets and providing access to neighbourhoods, commercial areas, and institutions. These roads typically have moderate traffic volumes and may feature fewer lanes compared to arterial roads. Sub-arterial roads play a crucial role in distributing traffic within the city and improving connectivity between different areas.

Collector Roads: Collector roads function as intermediate-level roads that collect traffic from local streets and feed it into the higher-order arterial and sub-arterial roads. These roads serve as important connectors within neighborhoods, providing access to local amenities, residential areas, and smaller commercial establishments. Collector roads often have lower traffic volumes compared to arterial and sub-arterial roads but are essential for maintaining overall traffic flow and accessibility.

Local Streets: Local streets form the backbone of the urban road network, serving primarily as access routes to individual properties, residential areas, and small-scale businesses. These streets typically have low traffic volumes, reduced speed limits, and frequent intersections, prioritizing pedestrian and cyclist safety.

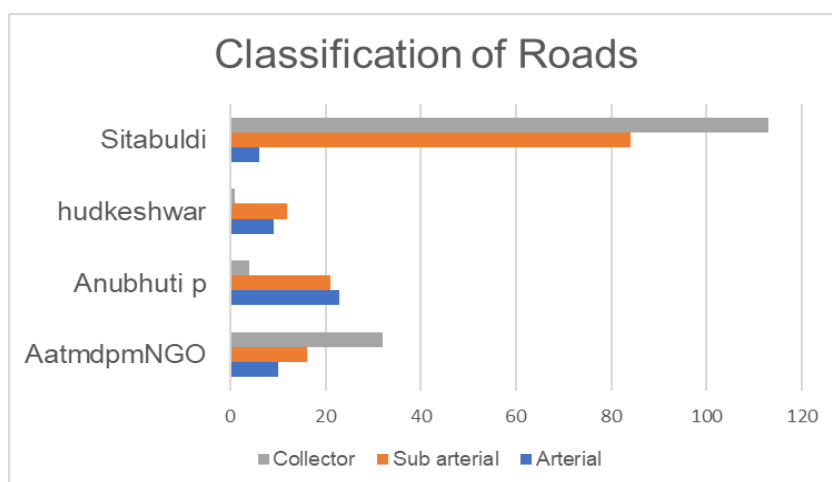


Figure 25: Classification of Roads

Source: (Author)

6.3 Safety :

The slope map generated from the Digital Elevation Model (DEM) in ArcGIS Pro DEM slope map shows the local land slope and its characteristics. Terrains with slopes between 0-2% are considered more accessible because they provide relatively flat terrain suitable for all activities and human transport conditions. Slopes above 5% are considered less accessible due to the steepness of slopes that may become difficult for movement or navigation, especially for pedestrians, cyclists, and people with mobility impairments.

Slope distribution across the landscape is an important consideration for planning, infrastructure, and land use management. Assessing the accessible and inaccessible areas by their gradients will enable policymakers and planners to make informed decisions regarding the location of infrastructure, design of transportation networks, and resource allocation for universal access and mobility for all residents. Additionally, slope considerations in planning cities may induce more inclusive and equitable spaces that consider universal access and the possibility of active transportation. (Refer Fig No.26)

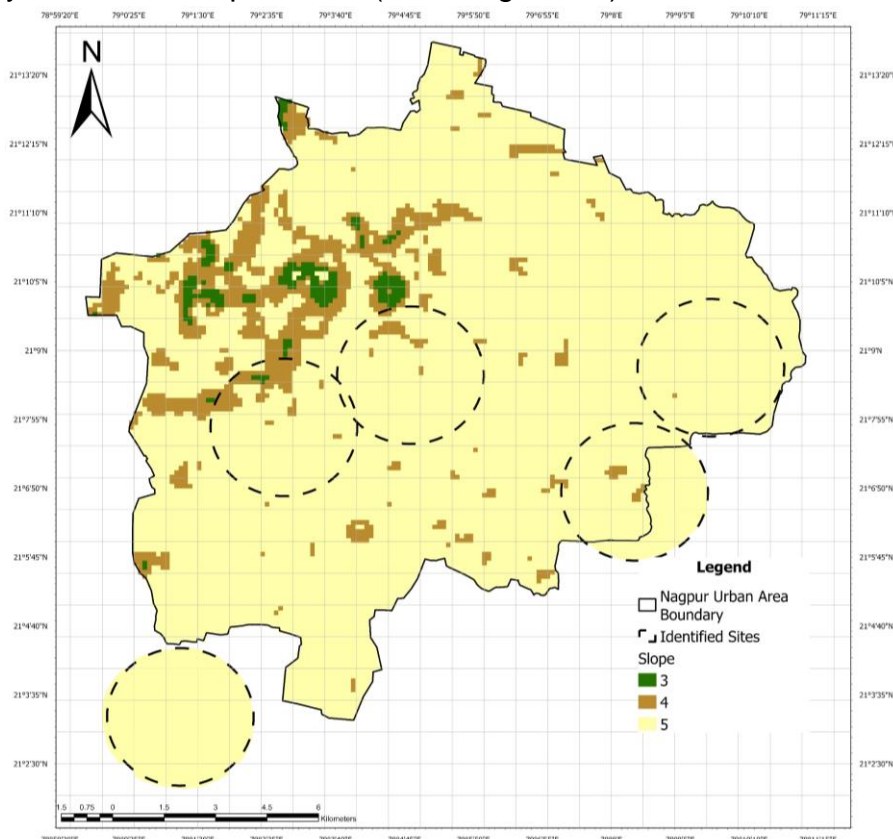


Figure 26: Slope Map
Source: (Author)

6.4 Overall Accessibility Levels:

An overall accessibility map created using GIS application software and network analysis techniques gives insights into the accessibility landscape for the differently able in Nagpur. The walking distance layers of key service categories, like transportation hubs, healthcare facilities, educational institutions, commercial centers, recreational zones, and NGOs catering to the differently able, map out areas with varying degrees of accessibility.

The findings point out that nearly 3.89% of Nagpur's streets do not provide sufficient accessibility for the differently able, and around half of them do not provide adequate access to essential services. In particular, the areas of Pardi and Hudkeshwar are areas of higher vulnerability and call for specific attention from the planner and policy-maker.

An overall finding from the map is the clustering of primary services in the city centre, thus affecting the accessibility of disabled people living in peripheral suburbs unduly. It therefore stresses the need for strategic distribution of services to make all residents' access equitable.

To address these problems of accessibility, planners and policymakers need to consider aspects such as the distribution of services, low-cost transportation options, and urban design. A redistribution of services to the underserved areas and better infrastructure for transportation will go a long way in improving the lives of the differently able.

The public transportation accessibility study was carried out for the differently-abled community in Nagpur City. The selected parameters for this study are: accessibility to the stops of the public transportation, disability associations, recreational facilities, institutional buildings, and health care. The parameters have been made essential to ensure that the transportation system caters to the diverse needs of the community.

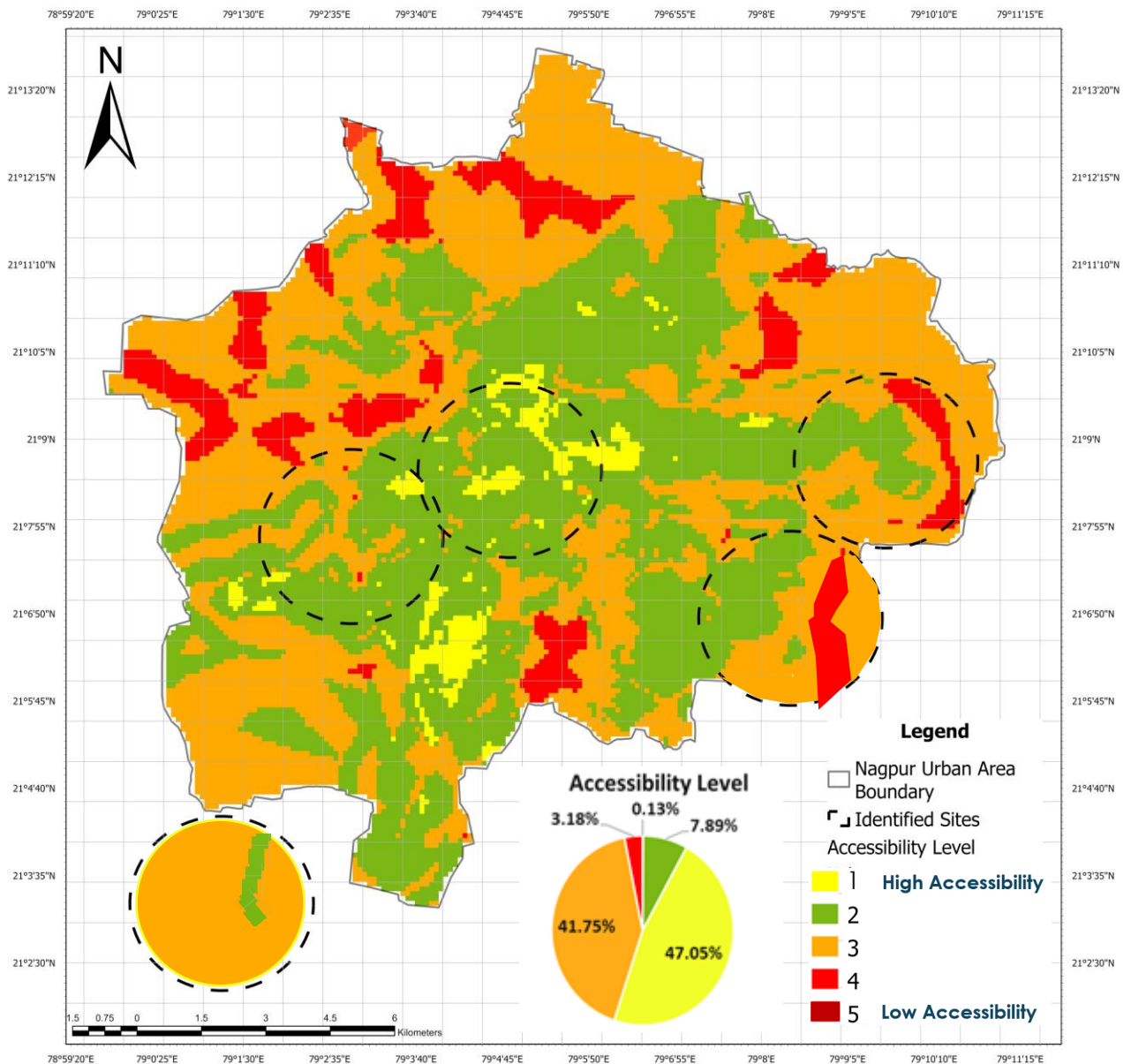


Figure 27: Overall Accessibility Levels Map
 Source: (Author)

The selected parameters have been weighed through a literature review and the primary survey. The purpose of trips, as observed in the dataset, is related to healthcare facilities and disability associations, making up 40% of all trips. It is important that the facilities, therefore, are easily accessible to the differently-abled.

The analysis is being carried out through network analysis to analyze the accessibility of these major facilities. Accessibility to the facilities within 400

meters is considered very accessible, and accessibility above 1600 meters is considered low accessibility. This analysis would help gain insight into how well it is now accessible in Nagpur City and pinpoint areas that need improvement.

CHAPTER 7: Conclusion

7.1 location specific Recommendations

i. Sitabuldi

The key issues in Sitabuldi stem from encroachment and the conflict between pedestrians and vehicles. Encroachment from hawkers and vendors leads to narrow pedestrian pathways, increasing the risk of accidents and limiting accessibility for differently-abled individuals. This congestion creates a conflict with fast-moving traffic, posing safety risks, especially for people with vision impairments. Objects placed within the path of travel that aren't detectable by visually impaired individuals add to these hazards

To address these issues, designated vending zones should be established away from pedestrian pathways and roadways, reducing encroachment and ensuring safer walking spaces. The installation of tactile pavements along pathways is recommended to alert visually impaired individuals to potential obstacles and guide them safely. These changes will help maintain clear pedestrian pathways and reduce conflicts with vehicular traffic.

ii. Government Medical College

The problems at Government Medical College's vicinity include inadequate signage and accessibility at bus stops. There's a lack of clear and legible signs with contrasting colors, making it difficult for differently-abled individuals to navigate. The bus stop isn't accessible from the adjacent footpath and road due to the absence of kerb ramps. Moreover, a nearby bus stop hasn't been operational for two years, forcing commuters to travel further distances to find transportation.

To resolve these issues, it's recommended to make the nearby bus stop operational again, reducing walking distances for commuters and providing better access to public transportation. Additionally, clear and legible signage with contrasting colors should be installed to improve accessibility. Kerbs and kerb ramps need to be added to ensure safe transitions between the road, footpath, and bus stop, enhancing accessibility for all users.

iii. Aatmdeepam NGO

The main challenges around Aatmdeepam NGO involve a lack of accessible signages and long walking distances due to inconvenient U-turns. There's no use of graphic or pictorial symbols, nor Braille, in existing signage. The lengthy U-turn creates a longer and potentially unsafe walk from the NGO to the bus stop. Additionally, the NGO's accessibility is limited due to its location, making it challenging to reach from various parts of the city, affecting travel training programs and community engagement. The level of road infrastructure service in Pardi, where the NGO is located, is notably low, with inadequate footpaths, signage, and parking.

To improve accessibility and safety, pedestrian crossings or cuts in the road should be implemented, allowing safer passage for pedestrians. Accessible signages with graphic/pictorial symbols and Braille should be installed to guide people to the NGO. The footpath infrastructure needs improvement, including better width, material quality, and parking regulations, to enhance accessibility in the Pardi area. These recommendations will help create a more accessible environment for the differently-abled community and support the NGO's mission to provide education and training.

7.2 General Recommendations

- I. Improving pedestrian infrastructure and accessibility in Nagpur will contribute to a safe, inclusive, and convenient environment for all people with disabilities or reduced mobility. The most pressing issues that have to be addressed involve encroachment from hawkers and vendors, inadequate signage, information on the location of bus stops, inadequate functioning bus stops, the distance between important points, and poorly functioning road infrastructure services. There should be a series of targeted recommendations to resolve these issues.

- II. The prime concern of Nagpur is the encroachment by hawkers and vendors, which often blocks the pathways of pedestrians and poses a threat to their safety, especially to the visually impaired people. Pedestrian pathways and roadways need to be demarcated, and vending zones

should be created. Such vending zones would give a decent place to the vendor where the encroachment in the pathways would reduce, and the pedestrians would find their pathways to be safer and more accessible.

- III. Second, the installation of tactile pavements could assist visually challenged individuals in identifying whether there is a step, or any other obstacle that lies in the pathways. These are textured surfaces that can be felt using the feet or a cane, providing a crucial indication of changes in the environment, such as a step or a hazard.
- IV. A critical issue is the lack of clear and legible signage and information of the bus stops. This will ensure that public transportation becomes more accessible. Improvement in signage and making sure that the bus stops become accessible through the adjacent footpaths and roads will tremendously enhance the accessibility of the people. Clearing, graphic/pictorial signs, and Braille will help the people to effortlessly move around the city for all.
- V. Operationalizing nearby bus stops that have been inactive for a long time is also necessary. An example is the bus stop that is close to the college and has been inactive for two years. This makes pedestrians walk longer distances. Operationalizing such bus stops will save pedestrians significant time and effort, especially those traveling to and from the college.
- VI. Another focus will be on road infrastructure where the level of service is low. An example is the road infrastructure in Pardi, which needs to be upgraded including the footpaths that meet accessibility standards, widening where necessary, and the proper installation of signages and signals. Such kinds of improvements will substantially improve the safety of pedestrians and accessibility, hence making it easier for people to walk around the city.

- VII. Another aspect is making the accessibility of NGOs across the city more substantial. Currently, there are only five NGOs, and they are not accessible from every part of the city. It is hard to access education, development, and travel training programs. A proposal for another NGO in the GMC area will fill this gap and make those services more accessible to a greater population.
- VIII. For people with reduced mobility who are unable to walk across roads in one go due to tiredness, central medians and pedestrian refuge islands with pedestrian-friendly crossing can provide a safe and barrier-free means of crossing roads. Aspects like uniformity in crossing distances and providing real-time information on expected waiting times or service changes can further help pedestrians feel secure and comfortable.
- IX. Smooth and safe rides for persons with disabilities necessitate driving operators to take a more optimum approach to their driving. This begins by the gradual acceleration and deceleration so that persons with mobility impairments or those using walking aids will not be jolted from the seats. With smoother driving, transit operators are able to reduce the potential for falls and accidents, thus offering a safer ride for all passengers, especially those with physical impairments. Such an adjustment of the driving style leads to a more pleasant and accessible ride.
- X. The safety of the pedestrian is a special consideration, especially for persons with disabilities who have to take more time to cross the street and need assistance in doing so. The designation of pedestrian refuges and central medians creates pedestrian zones in which pedestrians can linger in their crossing while traversing an extensive length of street. Such pedestrian refuge zones are essential in reducing risks and the risk of falling across busy streets since the pedestrian can cross in steps while not being subjected to the pressure of a heavy stream of traffic. Added to this is the implementation of consistent crossing distance, which gives consistency to other roadways and creates a predictable route for persons

with mobility impairments. Pedestrian refuges not only increase safety but also enhance accessibility in urban design.

- XI. Audible announcements on the public transportation system play a significant role in assisting the visually impaired in navigating public transportation. Audible announcements for significant stops, transfer points, and end-of-line stops ensure the confidence of visually impaired individuals in traveling through the transit system. Such announcements should be loud enough in the bus and especially at the front, where the area of most seating is reserved for the disabled. This measure increases accessibility through the provision of the essential information in an audible format, reducing dependence on visual information, and increases an inclusive ride on public transportation.

- XII. Transport operators should be at the frontline of ensuring that those with disabilities have positive time while traveling. A training program that can emphasize the use of ramps, give them a helping hand, and even create awareness about peculiar needs for people with disabilities are very essential. This type of training should create an empathetic environment, patronize customer service, and give practical skills so the operators can effectively help such people with their disabilities. A culture of awareness and support of transit systems will make public transportation more accessible and welcoming to people with disabilities.

- XIII. Empowering people with disabilities through education and mobility training enhances independence and confidence when using public transport. Training on travel training, safe navigation of streets, and use of assistive devices is an example of such a program. These programs tend to enable people with disabilities to gain the skills they need and be part of a greater inclusion in a community. Such programmes give access to training and help one grow in personal development and enable the physical movement of a person and his or her community without difficulties.

- XIV. A key point of an inclusive public transportation system that accessible information has to be available in multiple accessible formats, including Braille, large print, and digital formats that can be read with screen readers. This is such that people with disabilities can access information that will enable them to plan their travels and move comfortably on public transportation. These information resources help break the barriers and enable people to participate fully in public transportation by all the people from a given community.
- XV. When it comes to effective public transportation systems, reliability and timely information are very crucial, especially when it involves the use of differently-abled passengers, who would be given additional time or assistance during their journey. Accurate, timely updates to the passengers on the expected waiting time, service changes, or even delays would help them plan their journeys very effectively and reduce the level of uncertainty. Real-time information helps differently-abled individuals to make alternative arrangements where necessary and provides more flexibility and control over their choice of transport. This improvement in accessibility and more confidence among the differently-abled passengers can be achieved through the transit system.

7.3 Way forward

The insights from the current study call for a broader, more inclusive approach to improving accessibility within public transportation networks. As we look to move forward, key strategies to expand the scope of intervention include broadening the geographic base, economic barriers, and sequential changes. This comprehensive strategy would allow gaining a profound insight into the varied challenges met by differently-abled people and allowing targeted interventions to make transportation systems more user-friendly. With careful planning and inclusive policies, we can thus pave the way toward a more accessible and equitable transportation future.

7.3.1 Expand Geographic Coverage

One limitation of current studies is the focus on only three specific stretches or five key locations. To obtain a more comprehensive understanding of accessibility challenges, it's crucial to expand the geographic scope. This expansion can include additional trip destinations and a broader range of transportation hubs, such as bus stops, metro stations, and other points of interest. By encompassing a wider area, the study will capture more diverse patterns of transportation use and accessibility needs, leading to more holistic solutions.

7.3.2 Address Economic Barriers

While accessibility is a primary focus, economic factors play a significant role in public transportation use among differently-abled individuals. Consideration must be given to the affordability of public transportation, including fare structures, discounted passes, and subsidies for differently-abled users. Addressing economic barriers ensures that transportation remains accessible to all, regardless of financial status. Further analysis into the economic aspects of transportation can identify where cost may be a limiting factor and propose targeted solutions to reduce financial burdens.

7.3.3 Develop a Phase-Wise Implementation Plan

Implementing accessibility measures requires a strategic approach, especially when addressing complex transportation systems. A phase-wise implementation plan allows for gradual improvements, minimizing disruptions and providing time for proper resource allocation.

7.4 Conclusion

The study on public transportation accessibility for differently-abled individuals in Nagpur City highlights significant challenges in terms of infrastructure, accessibility, and safety. Through a comprehensive analysis involving focus group discussions, expert interviews, surveys, and GIS-based mapping, it became clear that certain areas of the city, especially in peri-urban regions, suffer

from poor road conditions, encroachment, and lack of accessible pathways. Key issues such as inadequate signage, non-functional bus stops, inaccessible pedestrian crossings, and insufficient transportation modes were identified. Recommendations were made to address these challenges, including the creation of designated vending zones, the installation of tactile pavements, operationalization of inactive bus stops, and improved training for transportation operators. Additionally, there's a need for broader geographic coverage and addressing economic barriers to create a more inclusive transportation system. By implementing these solutions, Nagpur can work towards a more accessible and equitable public transportation network that accommodates the needs of differently-abled individuals.



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Annexures

Annexure 1: Household survey Questionnaire:

		HOUSEHOLD SURVEY			DEPARTMENT OF TRANSPORT PLANNING AND LOGISTICS MANAGEMENT			
Settler/ City Area		Questionnaire No.						
		City NAGPUR						
		DATE						
1	Gender	Male		Female				
2	Age							
3	Highest degree							
4	Occupation				5	Employed		Unemployed
6	Current status	Preschooler						
		Primary /secondary						
		University student						
7	No. of household members			Member older than 6				
8	Is your Apartment	Family's Property						
		Rented						
		Other						
9	Kind of disability							
10	Kind of Aid							
11	Are You Independent when making trips/moving? (with or without aid) If not, state who is your most frequent companion?							
	1 Yes				2. NO, I most often make trips with			
12	Do you have a Permanent work address (Work/Organizations/Institution/School)							
13	If you have an additional job (which you travel every day, please Provide an address)							
14	If you are a Housemaker, unemployed, or retired but travel daily on a certain route , please indicate which one ?							
	1. Yes					2. NO		
15	Do you have a Driver's License ?			1. Yes	2. NO			
16	No. of vehicles own		2-WHEELER:	3-WHEELER:	4-WHEELER:	OTHER:		
17	Are Your activities or work related to frequent(more than 2 times a day)use of passenger car?							
	1 Yes		2 No					
18	what affects your choice of mode of transport ?							
	1 cost price	2 Trip duration	3 comfort	4 safety	5 Accessibility to mode of transport	6 Parking	Others	
19	Do you use public Transport? If yes which one							
	BUS	METRO		NO				
20	Nearest Bus stop/ Metro station					Time taken to reach		
21	Cost of Trip	Trip Length		Trip Time				
	Trip purpose			Trip frequency				
22	Trip origin		Origin station		Destination station			
23	What would help you move/travel more during the day?(Rank the offered answers in order importance)							
	Traffic infrastructure (footpaths, intersections and means of transport, etc.)							
	Establishments (restaurants, shops; educational, sports and cultural establishments)							
	Information and communication in traffic (auditory, visual, tactile)							
	Traffic services (specialized transport services, GPS, smartphone applications, reservation or ticket payment systems_ etc.)							
Others. Please state								

प्रश्नावली :

शहर: नागपुर

तारीख:

1. **लिंग:** पुरुष या महिला
2. **आयु:**
3. **सबसे अधिक डिग्री:**
4. **व्यापार:**
5. **रोजगार स्थिति:** रोजगारी बेरोजगार
6. **वर्तमान स्थिति:** प्रीस्कूलर, प्राथमिक/माध्यमिक, विश्वविद्यालय के छात्र
7. **परिवार के सदस्यों की संख्या:**
8. **6 वर्षों से अधिक आयु वर्ग के सदस्य:**
9. **क्या आपका अपार्टमेंट है:**
 - परिवार की संपत्ति
 - किराए पर
 - अन्य
10. **विकलांग का प्रकार:**
11. **सहायता का प्रकार:**
12. **क्या आप यात्राएँ/चलने में स्वतंत्र हैं?**
 1. हा
 2. नहीं, मैं अक्सर यात्राएँ करता हूँ के साथ:
13. **अगर आपका एक अतिरिक्त काम है (जिसमें आप रोज़ाना यात्रा करते हैं), तो कृपया पता प्रदान करें:**
14. **अगर आप घरेलू, बेरोजगार हैं या सेवानिवृत्त हैं लेकिन रोज़ाना किसी विशिष्ट मार्ग पर यात्रा करते हैं, तो कृपया इसे सूचित करें:**
 1. हाँ
 2. नहीं
15. **क्या आपके पास ड्राइविंग लाइसेंस है?**

1. हाँ
2. नहीं

16. वाहनों की संख्या:

- 2-व्हीलर:
- 3-व्हीलर:
- 4-व्हीलर:
- अन्य:

17. आपके परिवहन के चयन को कैसे प्रभावित करता है?

- मूल्य
- यात्रा की अवधि
- आराम
- सुरक्षा
- पार्किंग

18. क्या आप सार्वजनिक परिवहन का उपयोग करते हैं? अगर हाँ, तो कौन सा:

19. सबसे निकट बस स्टॉप / मेट्रो स्टेशन:

- यात्रा का लागत
- यात्रा की लंबाई
- यात्रा का समय
- यात्रा का उद्देश्य
- यात्रा का गंतव्य

20. दिनभर आपको और अधिक चलने/यात्रा करने में कैसे मदद करेगा? (प्रदान की गई उत्तरों को महत्व के क्रम में रैंक करें):

- यातायात बुनियादी (फुटपाथ, चौराहे, परिवहन के साधन, आदि)
- स्थान (रेस्टोरेंट, दुकानें; शैक्षिक, खेल, और सांस्कृतिक स्थानों)
- यातायात में सूचना और संचार (श्रव्य, दृष्टिगत, स्पर्शगत)
- यातायात सेवाएँ (विशेषज्ञ परिवहन सेवाएँ, जीपीएस, स्मार्टफोन एप्लिकेशन, आरक्षण या टिकट भुगतान प्रणाली, ___ अन्य

Annexure 2: Road Infrastructure survey**Checklist for regarding universal accessibility on urban roads and streets**

location:

list of roads audited:

date of survey:

no.	item	yes/no	comments
1	Walking Path Modal conflict		
	Any conflict with heavy and fast vehicles which prevents walking?		
	Is there a high risk of accident?		
	Any conflict with other slow moving NMT modes?		
2	Availability of walking Paths Whether footpath exists		
	What is the condition of footpath?		
	What is the width of footpath?		
	Is the footpath clear of all obstructions?		
	Is the footpath clear of steps and stairs?		
	Is the surface level, smooth and non-slippery?		
	Does the footpath have a different color and texture from the adjacent surface?		
	Are all manholes placed outside the pedestrian path of travel?		
	If there are gratings, are the openings narrow, not more than 12 mm?		
	Are the gratings perpendicular to the direction/path of travel?		
	Is the kerb height 150 mm or less?		
3	Availability of crossing Points		
	What is the average vehicular speed on the road		
	Pedestrian Crossings		
	Are there Pedestrian Crossings at all intersections?		
	What is the distance between pedestrian crossings?		
	Is there any traffic calming treatment that starts 25 m before zebra-crossing?		
	Mid-Block Crossings		
	Is there a mid-block crossing near transit/bus-stop locations, shopping areas, schools and/or community centers?		
	Do the mid-block crossings include signage visible from min. 100 m distance?		
	Is there a pelican crossing- pedestrian-initiated traffic light at the mid-block crossing?		

no.	item	yes/no	comments
	Table Top Crossings		
	Are raised, table top crossings, level with pavement located at i. Slip roads? ii. Where high volume streets intersect with low volume streets? iii. At mid-block crossings?		
	Are there raised driveways in front of buildings for level crossing to enter the property?		
	Foot Over Bridges		
	If there is a foot over bridge/subway, for streets with high-speed transit corridors like BRT etc., does it have a combination of either staircase + ramp or stair-case + elevator?		
	Does the foot bridge ramp have a slope of 1:12 max with min 1500 x 1500 mm clear landing after every 9.0 m run (1:20 preferable)?		
	Are handrails at 760-900 mm height from the walking surface provided on either side of the ramp?		
	Is a tactile warning band provided 300 mm from the top & bottom of the flight of steps, 300 mm width min?		
	Are elevator/lifts provided at both entrance/exits with minimum clear internal dimension of 1500 mm X 1500 mm?		
	Do they have Braille buttons & Audio announcement systems?		
4	Quality of crossing Points		
	Are the crossing points manned or signalized?		
	Is the road surface even and slip resistant at pedestrian crossings?		
	Are pedestrian traffic lights installed?		
	Is the crossing point grade separated without escalator/elevator?		
	Do traffic lights have both audible and visual signals?		
	Do traffic islands/median refuges at pedestrian crossings have street-level footpaths cut through them with a minimum width of 1500 mm? (Clear width 1200 mm without bollards)		
	Are tactile warnings provided on the refuge areas?		
	Is the crossing time adequate (more than 15 seconds for two lanes and 30 seconds for four lanes)?		
	Kerb Cuts		
	Are kerb ramps provided when there is level difference, between the road carriageway and footpath level: a) Pedestrian crossings? b) Accessible parking space? c) Building entrances?		
	Are kerb ramps located at each corner of street intersections?		
	Is every kerb ramp faced by another kerb ramp on the opposite side of the street?		

no.	item	yes/no	comments
	Is the slope of the kerb ramp no less than 1:12 with flared sides of 1:10 min slope?		
	Is the width of kerb ramp 1.2 m min?		
	Is there 1.2 m min landing for waiting before the kerb ramp?		
	Are warning tactile pavers provided before and after the kerb ramp?		
5	Amenities		
	Parking		
	Is there any accessible parking reserved for people with disabilities?		
	Are a number of parking slots adequate (required ratio 1:20)?		
	Is the accessible parking within 30 meters of the entrance of transit station/building?		
	Is the international symbol of access, imprinted on the ground of the parking bay?		
	Is there a vertical, visible signboard indicating that the lot is for use by a disabled driver only?		
	Do kerb ramps connect accessible parking spaces with the side kerbs?		
	Are there pre-cast wheel stoppers or bollards to separate footpath from the parking?		
	Is the size of the parking 3600 mm x 5000 mm?		
	Is the drop off area marked by signage and kerb ramp?		
	Does the drop off area have warning signs for persons with vision impairment?		
	Lighting		
	Does the street lighting provide even lighting for clear visibility of footpath and obstacles?		
	Are the street lights in working condition?		
	Signage		
	Is there clear and legible signage and accessible route information at bus stops, with contrasting colours?		
	Are there clear and legible orientation signage and/or orientation maps?		
	Are there signs about availability of Public Transit and traffic signs?		
	Are there signs for public conveniences: - public toilets etc.?		
	Are graphic/pictorial symbols/Braille used in signage?		
	Are legible fonts and bright colour contrast used in signage?		
	Bus Stop		
	Is it accessible from the adjacent footpath and road? (Preferably should not interfere with 1.8 m clear walking zone)		
	If there is a kerb at the bus stand, then is there a kerb ramp leading to the footpath?		
	Is there wheelchair space under bus shelter?		

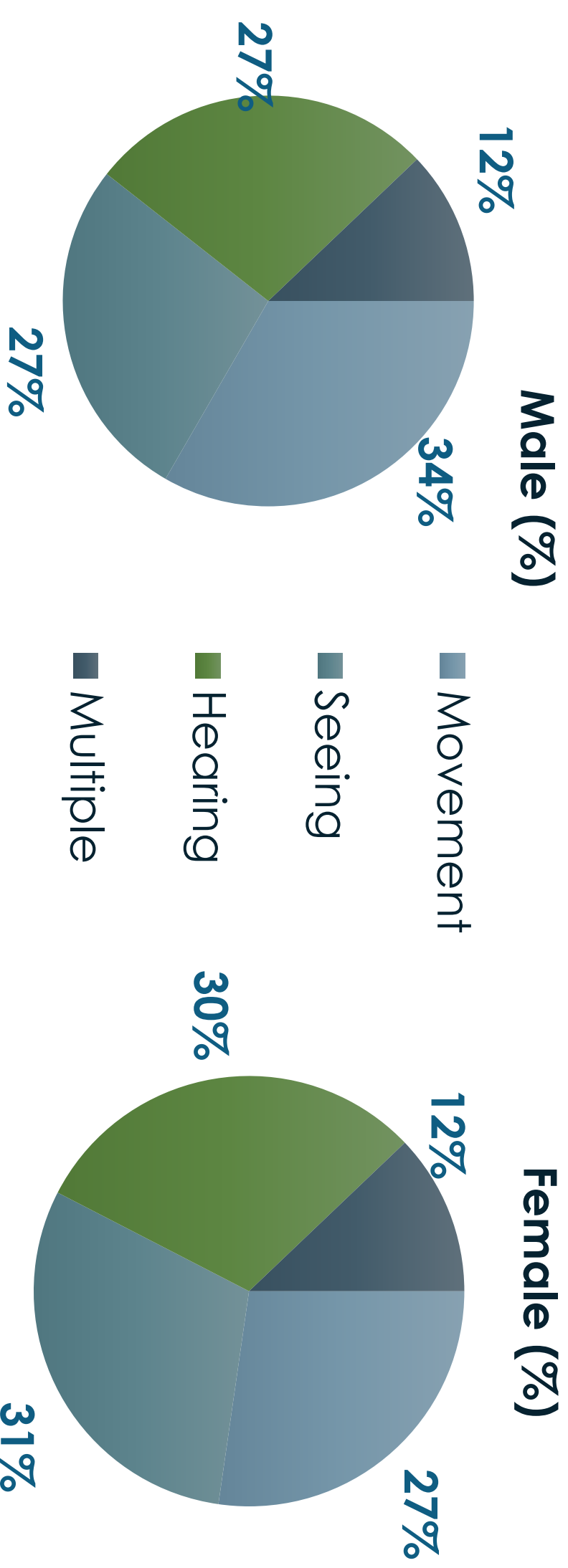
no.	item	yes/no	comments
	What all facilities are provided for benefit of persons with reduced mobility?		
	Trees		
	Are there trees that provide shade cover?		
	Are they located in the footpath/obstruct views to signage/traffic?		
	Site Furniture		
	Are there rest areas - benches available at 100 m intervals and these are in good condition?		
	Are there dustbins, located near bus stops and intersections to avoid littering?		
	Signs, lights and shade available but can be improved with better placement and alignment?		
	Public Toilets		
	Are there public toilets- for men and women, located near the bus stops/markets?		
	Is the entry to Ladies and Gents toilet opposite (facing each other) or parallel? (Parallel toilets are preferred as it reduces women/girls abuse possibilities)		
	Are there open urinals with ramps and doors 900 mm min.?		
	Are there unisex accessible toilets?		
	Are these toilets wheelchair friendly?		
6	accessible infrastructure		
	Do traffic lights have both audible and visual signals?		
	Are Zebra crossings embossed (3D) to be detected by persons with vision impairments?		
	Tactile pavers		
	Is there a tactile paving band 300 mm wide min with 5mm raised blisters/rails for persons with vision impairment to detect?		
	Is there a tactile warning band with raised blisters/domes, 300 mm away from top and bottom of all kerb ramp/steps/footpath and along all hazards provided?		
	Is a continuous tactile guiding strip provided at a distance of 600-800 mm from the edge of footpath/Boundary Wall/any obstruction?		
	Is the tactile paving band of contrasting colour with surrounding surface? (Canary yellow preferred colour)		
	Is warm white light (not yellow light) provided for tactile pavers to stand out in darkness?		
7	security		
	Is it a busy street/active/unused- what is the activity levels?		
	Is there adequate and even lighting with no dark spots?		

no.	item	yes/no	comments
	Are there high walls, setbacks of buildings, tinted windows of commercial spaces, high compound walls or inactive edges?		
	Do the buildings open onto the street, active edges, low walls?		
	Are there hawkers?		
	Are there any recessed doorways, alleys, demolished or unfinished buildings that could be unsafe?		
	Is there a dead width/width of frontage provided? i. 1m wide space provided in shopping areas ii. 0.5 m next to buildings and fences iii. In busy areas like bus stops, transit stations, recreational areas, etc. width suitably increased to account for accumulation of pedestrians?		
	What is the condition of vacant/unused land? Are there overgrown bushes and hedges?		
8	Motorists' behavior		
	Do motorists disrespect pedestrians and encroach on pedestrian space?		
	Do they yield to pedestrians?		
9	obstructions		
	Are there any protruding objects within the path of travel, not detectable by a person with vision impairment with white cane- For e.g., Culverts, transformers, junction boxes, trees, light poles, sign boards, property entry exists, fences etc.?		
	Are the protruding objects, marked with tactile warning at least 300 mm beyond the projection area of the obstruction?		
	Are all overhanging obstructions with the path of travel marked with contrasting colour?		
	Do hawkers or utilities occupy most of the space leaving very little space to walk?		
	Do parked vehicles block the footpath (temporary)?		
10	any other		
	Metro/BRT Stations		
	Are there way finding signage for the stations		
	Is the approach to the station free of any obstruction and hazards guarded?		
	Is the entry to the Metro station accessible?		
	Are there equal risers and treads for steps?		
	Are the handrails provided on both the sides of steps and at two levels?		
	Is there a tactile warning band with raised blisters/domes, 300 mm away from top and bottom of ramp/steps/escalators provided?		



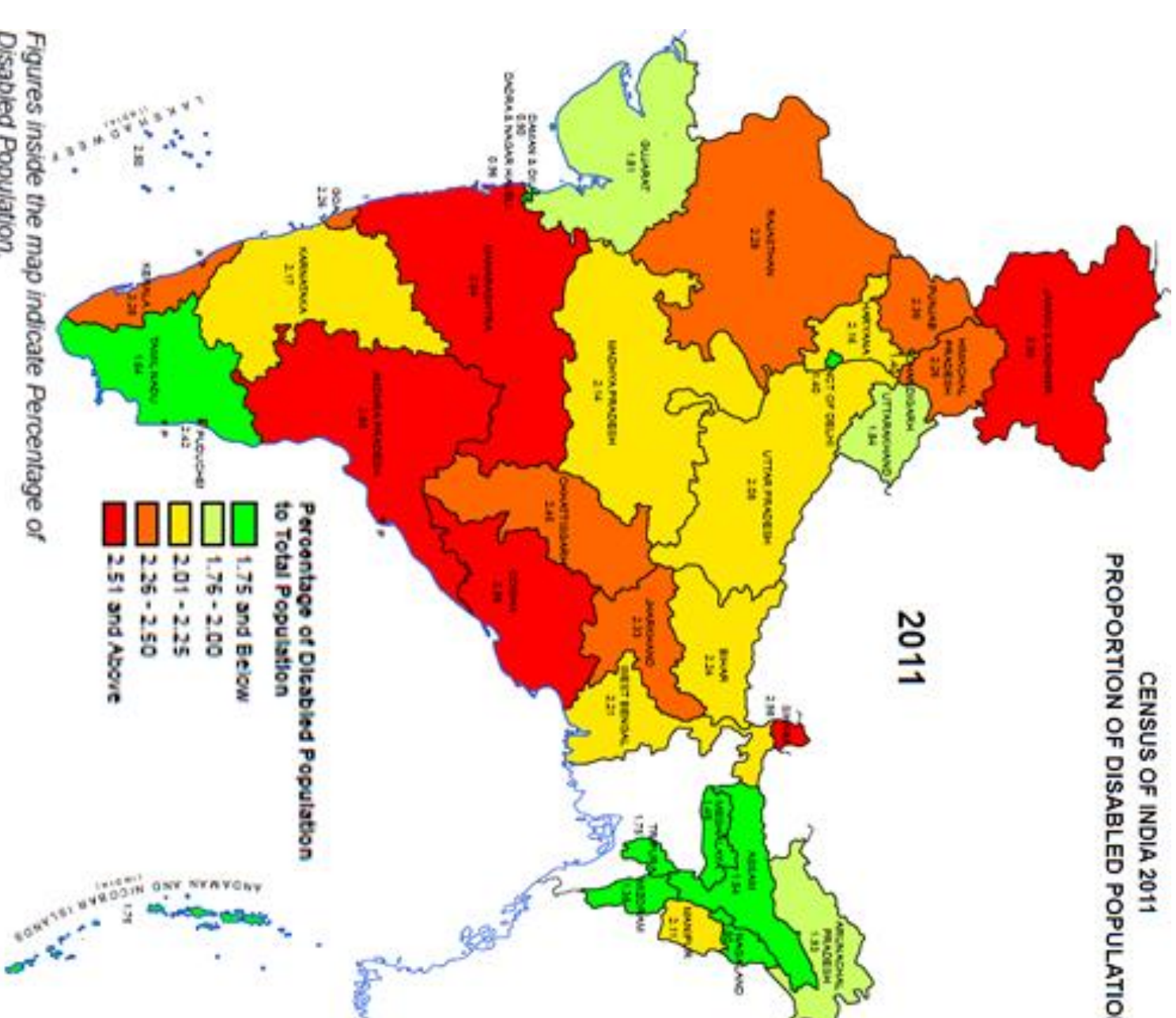
Introduction

Globally, around 1.3 billion people live with disabilities, with a substantial portion residing in developing countries like India. For the 26.8 million Indians living with disabilities, **lack of accessible transportation** not only limits their mobility, but also access to education, healthcare, and economic opportunities. The disability sector in India in general estimates that 4-5% of the population is disabled. The Planning Commission recognizes this figure as 5%. The World Bank report states that persons with disability constitute between 4-8% of India's population.

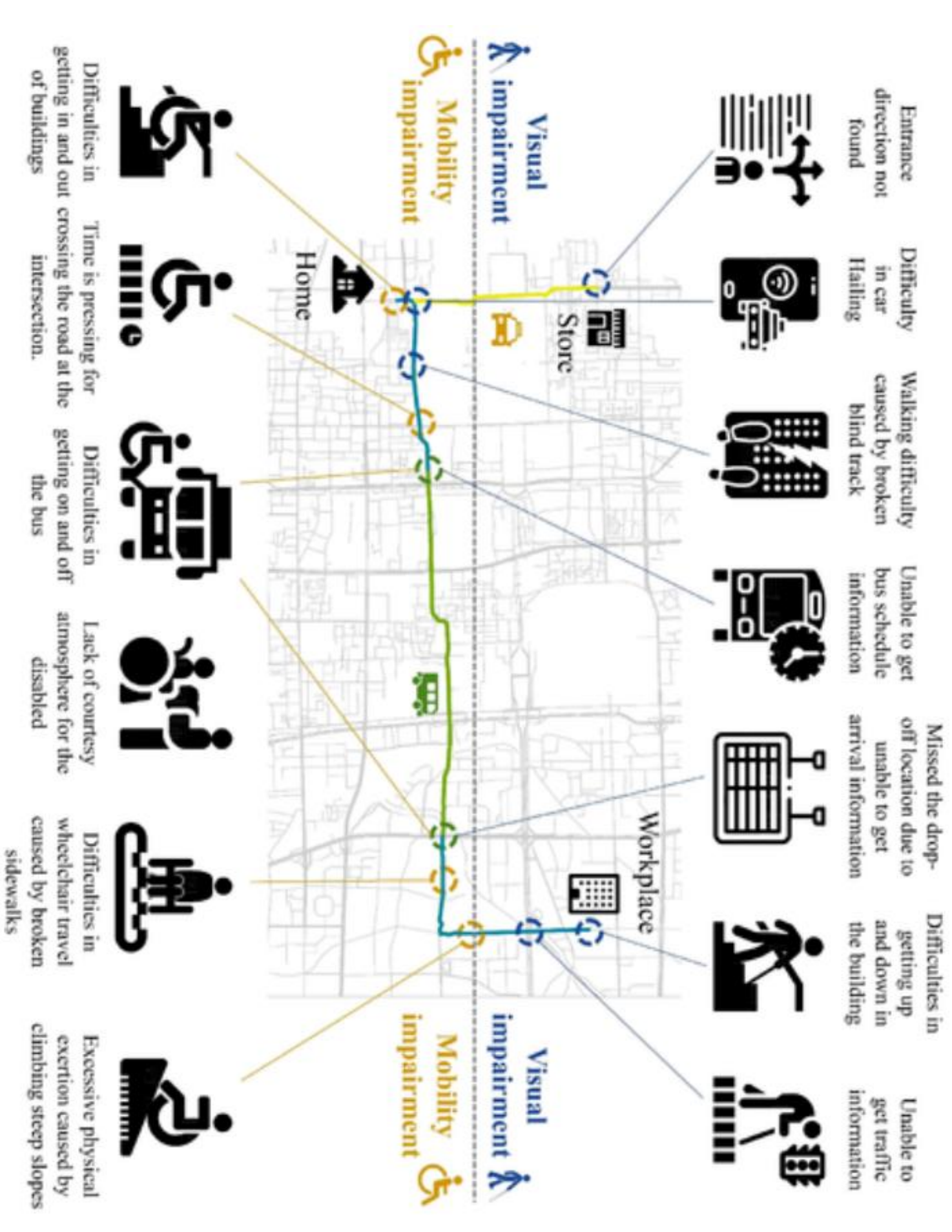


Literature Study

Keywords - Accessibility, public transit network, amenities, distance metrics, Social acceptability.



Challenges to travelers with visual and mobility impairment.



Key Takeaways

S.no	Title of literature	Year	Key Takeaways
1	Transit Oriented Development For Indian Smart Cities National Institute of Urban Affairs Ahmedabad: An incremental and progressive approach to bus based TOD	2017	GAP • Incomplete End-to-End Connectivity • financial burden on low-income households. FINDINGS • Enhanced BRT Corridor Accessibility • User-Centric Design
2	National Institute of Urban Affairs Delhi: Transportation and regional transformation	2017	GAP • At some places, last mile connectivity to major public modes is poor. • Metro feeder services are available only at selected stations. FINDINGS • Pedestrians and the NMT are amongst the most neglected ones
3	Improving metro access in India: Evidence from three cities	2023	FINDINGS Base last-mile planning on the spatial demography around stations
4	Centre for Urban Equity (CUE) CEPT University BRT projects in Indian cities as inclusive transport systems? An assessment	2023	GAP BRT is not integrated at all with the existing municipal bus services, in terms of • access and egress • ticketing and fare collection • Very low Affordability and hence pricing to be more inclusive. FINDINGS BRT systems not to be treated as an exclusive system. Need to integrate existing systems with the new systems in terms of physical access, ticketing and governance mechanisms.
5	World Bank, Designing Public Transport in India That Works for All.	2023	NEED Bus design can include lower handbars, wider gangways, space for strollers, access ramps, storage space, as well as emergency buttons and even closed-circuit television cameras (CCTVs)

Research Gap

Policy Implementation Assessment Gap
Inclusivity and Tech Gap
Cost of Disability
Incomplete End-to-End Connectivity

Need Of The Study

The need for accessible public transport in India is crucial due to the large population of disabled individuals, which constitutes over 6% of the total population. Lack of awareness about disabilities and insufficient sensitization among staff in public transport systems further hinder accessibility.

Problem Statement

Developing a Public transportation system which can helps in achieving universal accessibility and achieving last mile connectivity.

1 Akash Soni
2022MPTPLM006

M.PLAN THESIS
2023-24

Enhancing Public Transport Accessibility for Differently
Abled Community A Case of Nagpur City

Seal & Sign

DEPARTMENT OF
TRANSPORT PLANNING

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Aim

To assess, evaluate, and improve the transportation challenges for differently able communities, focuses on accessibility in a transport system.



Objective

- To study the current public transportation accessibility in Indian cities for differently-abled communities.
- To conduct a baseline study of socio-economic, and transportation accessibility aspects of the study area.
- To identify the problems and potential areas with accessibility parameters in the study area.
- To provide strategies and proposals for improving Public transport accessibility.

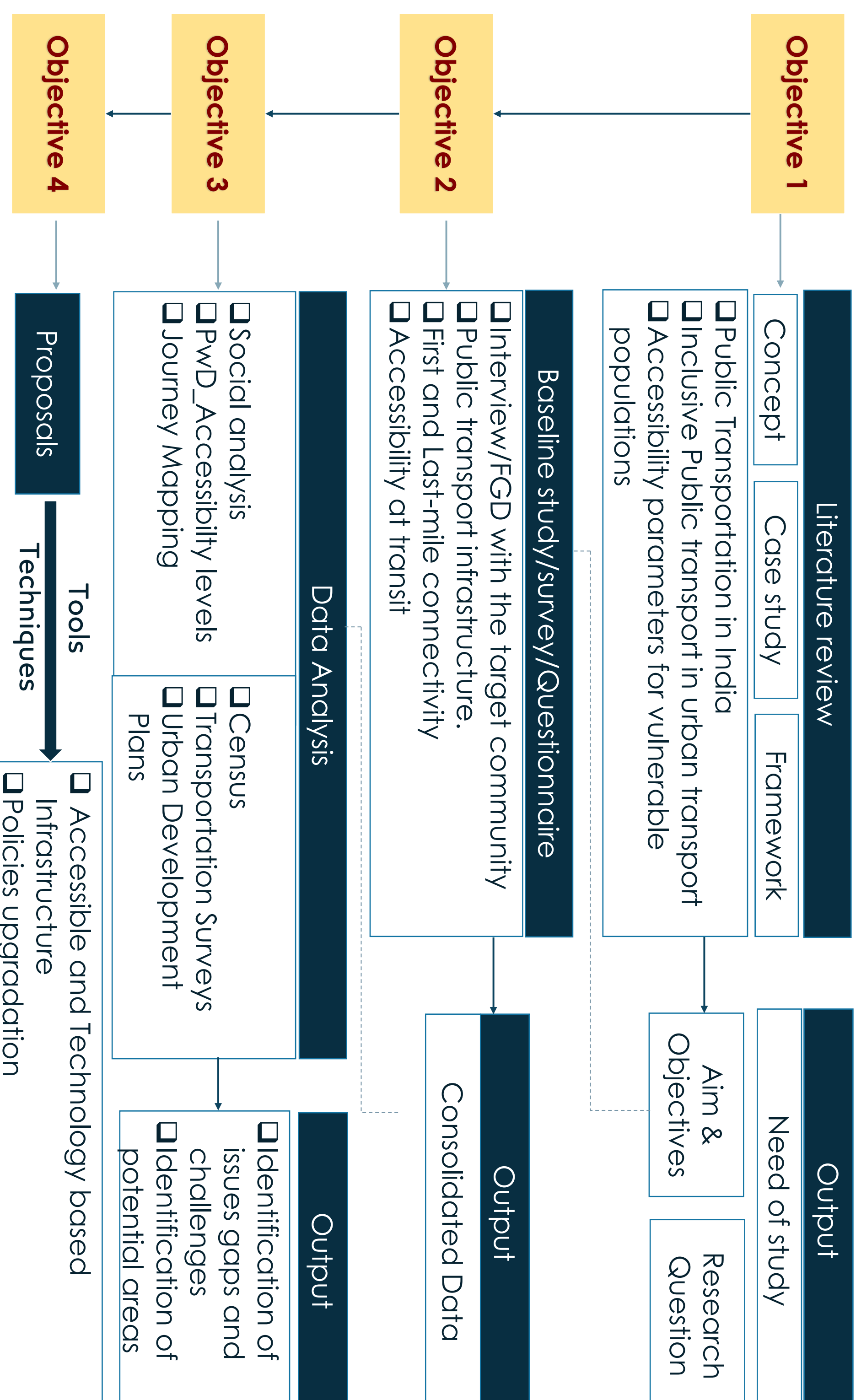
Scope

- Universal accessibility for Differently abled people improves infrastructure with technology integration.
- Same solutions can be implemented in areas having similar problems.

Limitations

- The sample size of the research will be limited.
- This research will only focus on the 5 locations and 3 stretches because of the time constraints.

Methodology



Literature Review

1. Case Study

Directorate of Urban Land Transport (DULT) SUSTAINABLE MOBILITY ACCORDS (SUMA)

Scale **Ward level at Bangalore**

Issues found

- Poor Footpath Design
- High-Speed Vehicles
- Inadequate Crossing Facilities
- High Bus Floor Level
- Lack of Wheelchair Access

Recommendations

- Improve footpaths and streets based on universal design principles.
- Provide clear signage and markings to aid navigation, including maps in braille where necessary.

2. Case Study

Evaluating Accessibility for Transport Planning
Victoria Transport Policy Institute

Scale **Oklahoma City**

Issues found

- Difficulty to reach medical clinics and recreation centers
- Traffic speeds, congestion.
- Requires sidewalk or path.
- Requires equipment and skill

Recommendations

- Removing steps for wheelchair users, persons with visual and hearing impairments, etc.
- Installation of easy-to-understand information signage for wheelchair users and persons with visual and hearing impairments

Policies/Schemes/Acts

National Policy for Persons with Disabilities 2006

To create an environment that provides them equal opportunities, protection of their rights, and full participation in society.



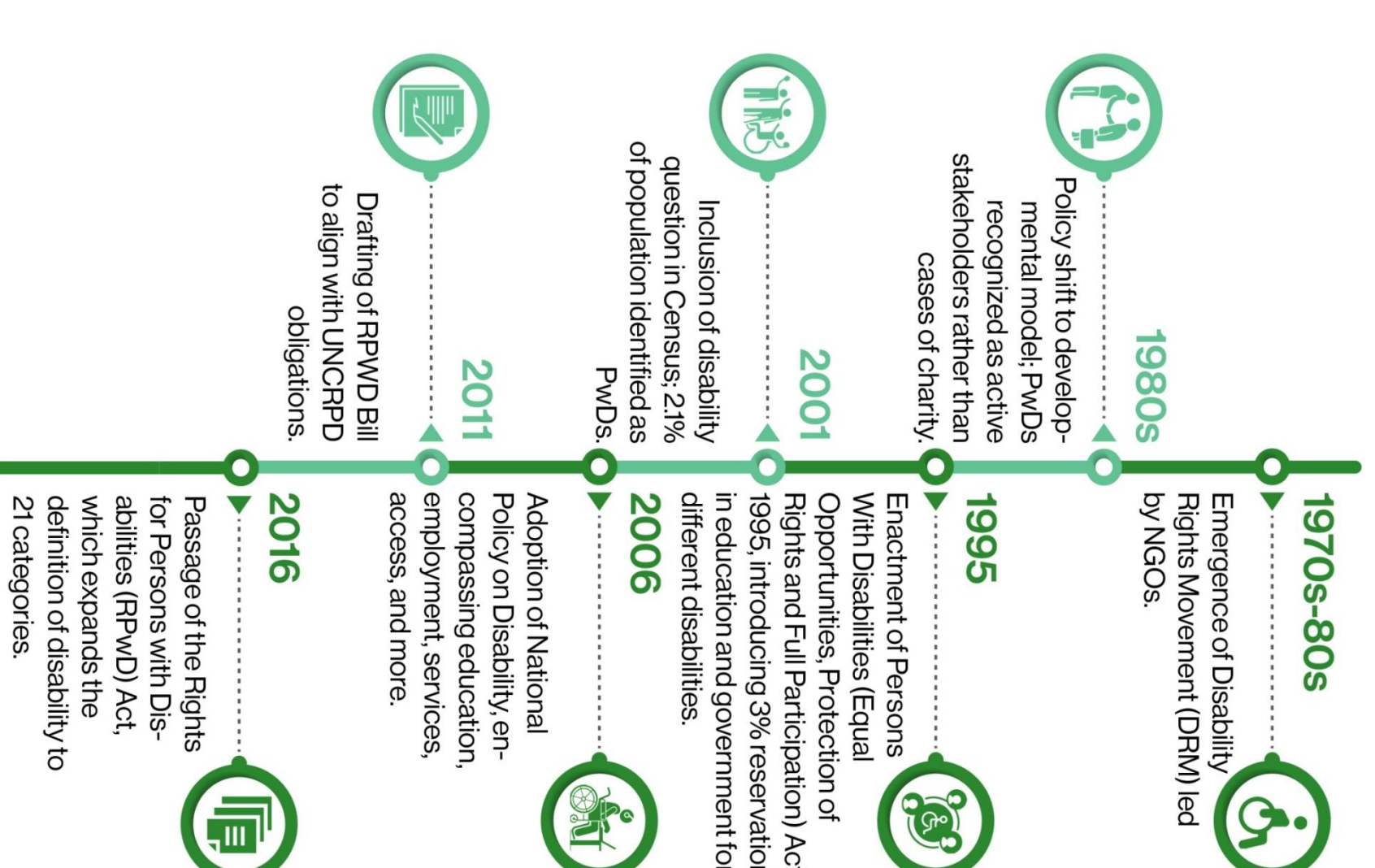
Schemes

Scheme for Implementation of the Rights of Persons with Disabilities Act, 2016 (SIPDA)

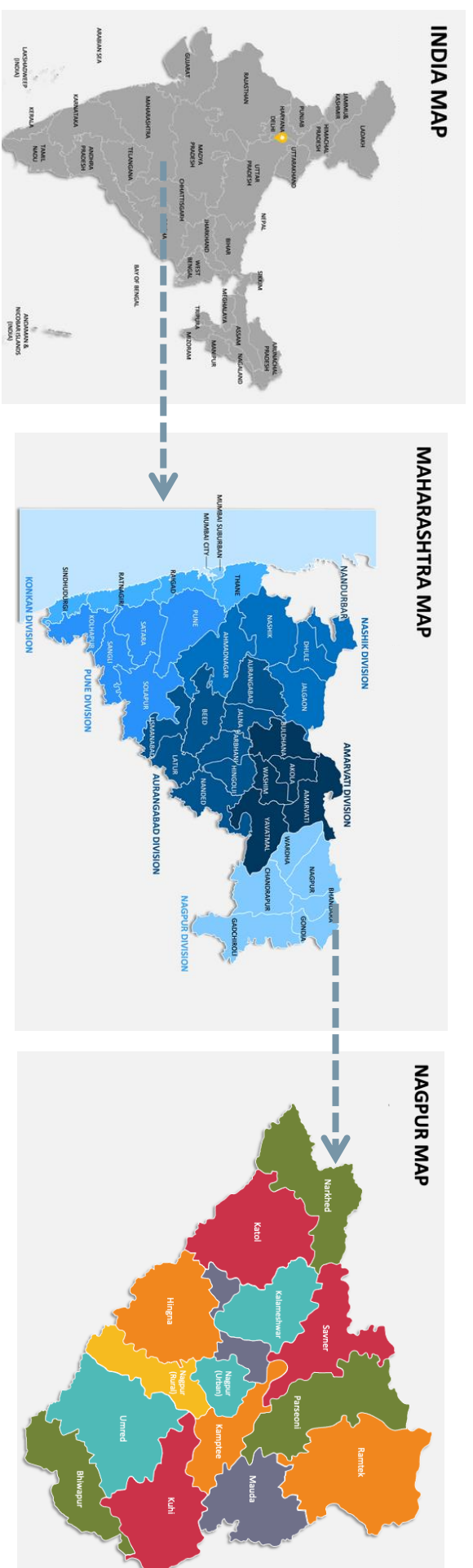
- ❑ **Creation of Barrier Free Environment Accessible India Campaign (AIC)**
- ❑ National Action Plan for Skill Development of Persons with Disabilities (NAP-SDP)
- ❑ Unique Disability ID (UDID)
- ❑ Awareness Generation and Publicity (AGP) & In Service Training

- ❑ **Research on Disability Related Technology Product and Issues & Development**
- ❑ Financial Assistance to Spinal Injuries Centers (ASIC Scheme)
- ❑ Cross-Disability Early Intervention Centre
- ❑ Projects under SIPDA
- ❑ CPMU cum Data Strategy unit

TIMELINE



Study Area



According to the 2011 census, about **0.42%** of the disabled population in India resides in Nagpur, Maharashtra. Studies show a rise in the overall disabled population from **2.67%** in 2011 to potentially **6%** presently.

According to the **SURVEY OF PERSONS WITH DISABILITIES** in Nagpur, around **61.7%** of people with disabilities use public transport, and about **49.4%** can access public buildings.

Challenges

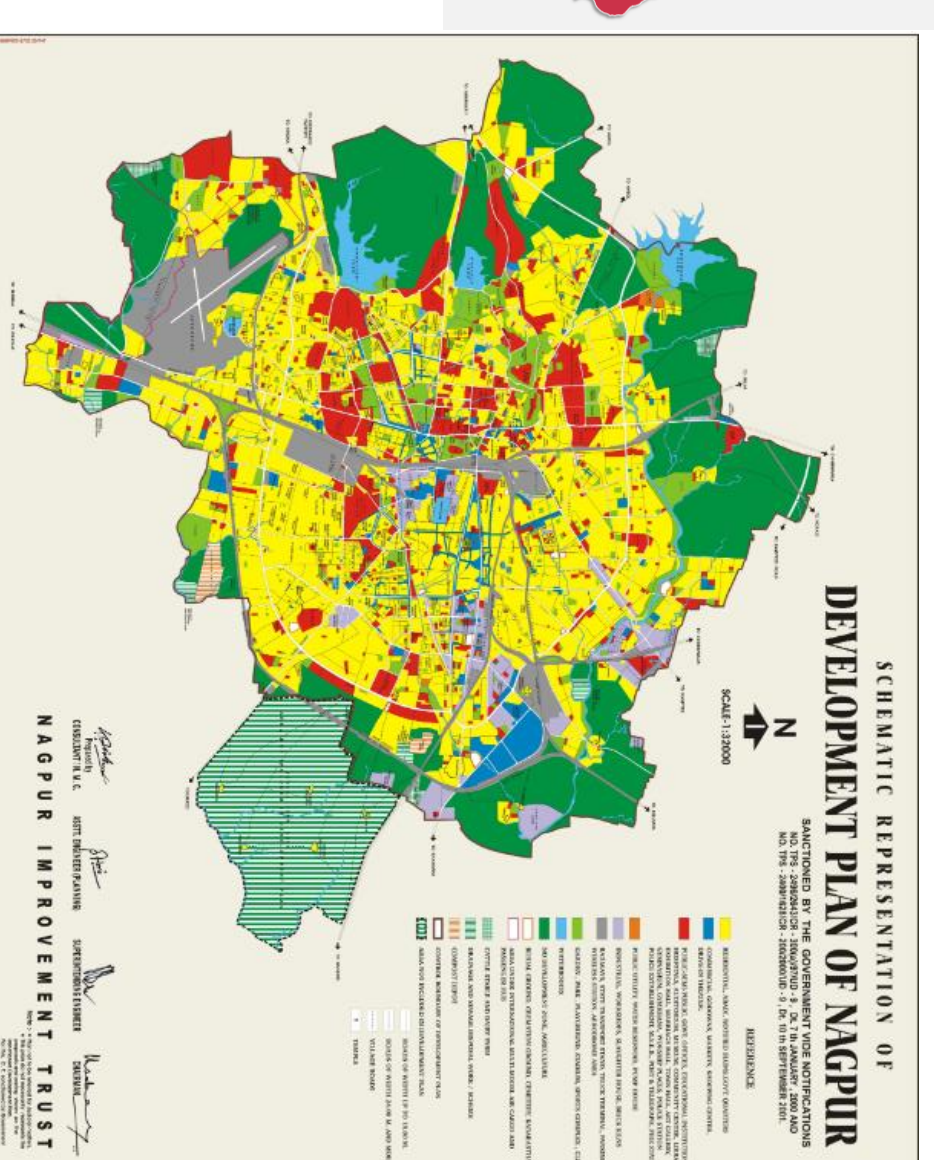
Last-Mile Connectivity Challenge

In Nagpur, over 70% of metro commuters prefer walking or cycling, indicating a preference for sustainable transportation.

Insights for Metro Last-Mile Planning

➤ The study suggests that efficient last-mile services are crucial for meeting commuters' needs, especially in Nagpur where walking and cycling are prevalent.

City Plan Map, Nagpur



Opportunity



Shri Nitin Gadkari lays the Foundation Stone of the world's largest and unique Divyang Park – Anubhuti Inclusive Park in Nagpur,

Nagpur City Profile

Nagpur has a distinct radial pattern and has two ring roads. The total length of the roads is about 1,907 km.

Sources

Population in million (2011)	2,40,566	Census of India
Area (Sq km)	235.2	Data.gov.in
Estimated Population Using the bus in (million)	0.14	Data.gov.in
Average trip length (Km)	7.6	Includes walking
Bus modal share	15.6%	
Identified PT (bus stops)	194	

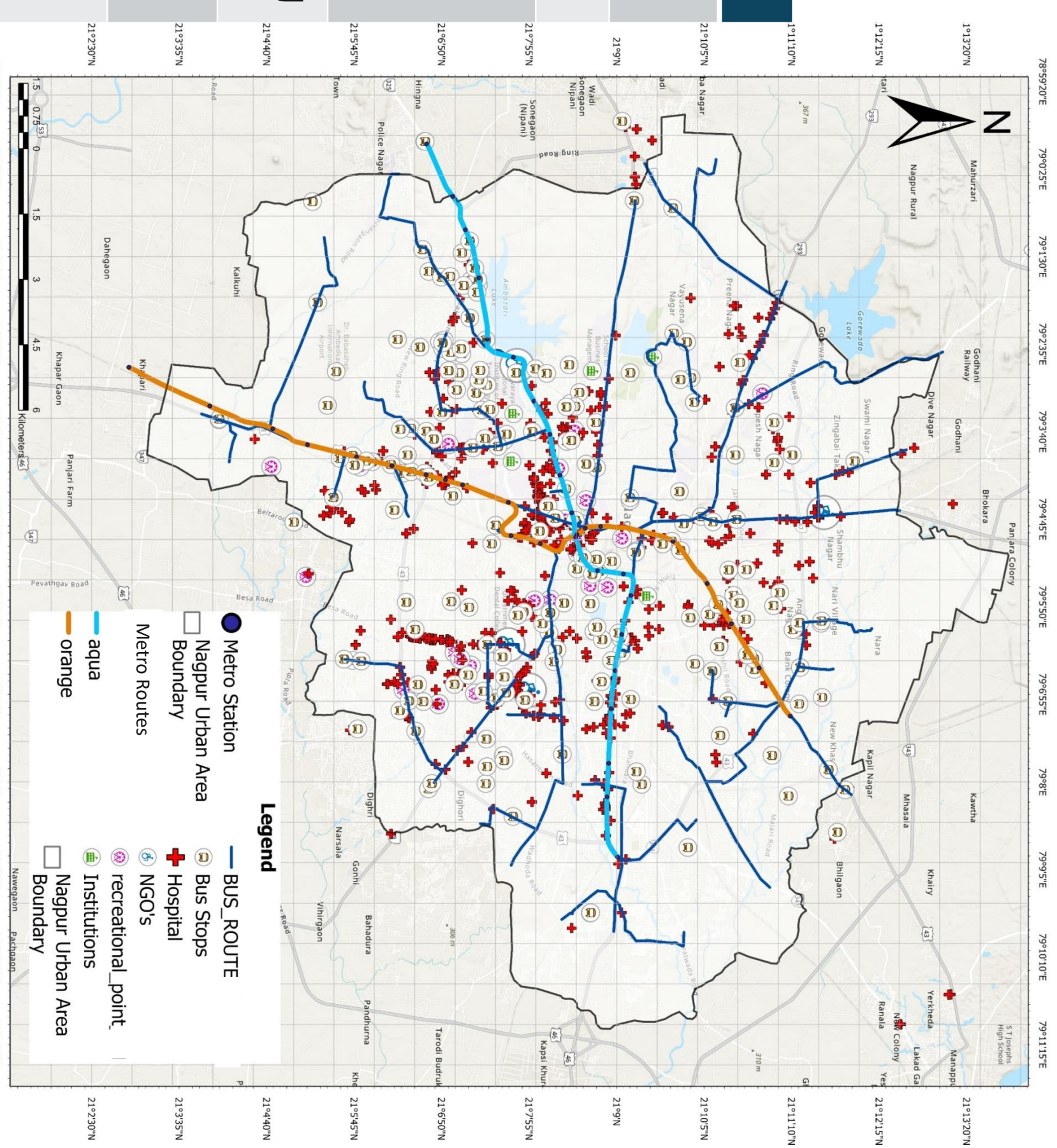
The proposed routes for Nagpur Metro are: Wardha – Yavatmal, Nagpur – Wardha – Amravati, Nagpur – Wardha – Chandrapur, Nagpur – Bhandara, Nagpur – Ramtek, and Nagpur – Narkhed. Interchanges have been proposed at Khapri, Nagpur Railway Station, and Ajni with Phase 1 of the Nagpur Metro

Data Collection Methodology

Primary Data Collection Process

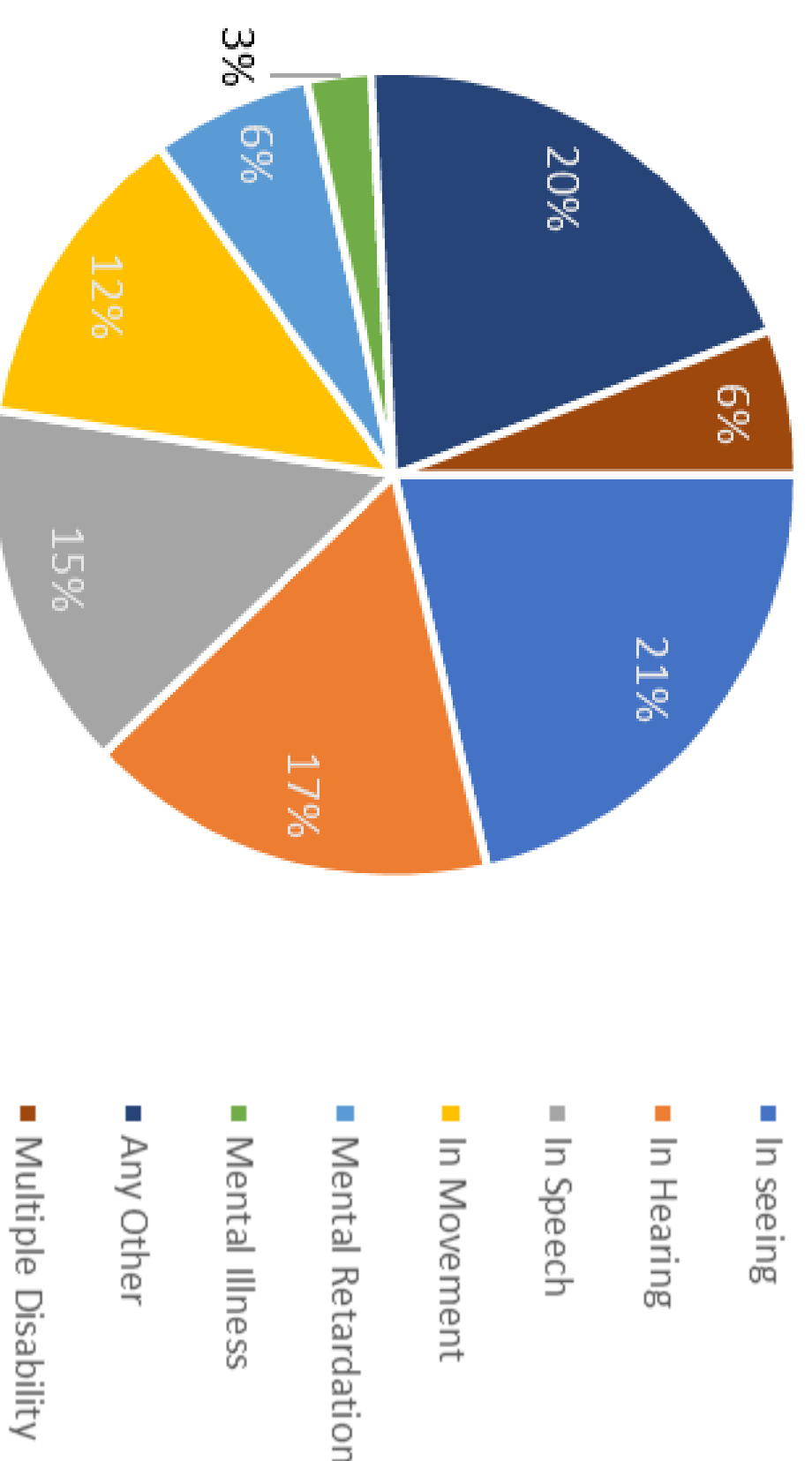
Focus Group	Primary survey			No.
	Age	Disability		
Discussion (FGD)	10-35	All visual disability		18
	18-50	locomotor disability		21
	18-50	Speech and Language Disability		05
Interview	Experts	Locals	Doctors	47
	02	45	05	03
			NGO's head	
Questionnaire	Sample technique- Non-probability sampling (Purposive sampling)			80
Telephonic Survey	According to the format			134
Observation Survey	Activity near areas of bus stops, metro stations, and terminals			
Road Inventory	Footpaths, signages, ramps, Elevator, sidewalks etc			
Total sample				305

-Non-probability sampling is defined as a sampling technique in which the researcher selects samples based on the subjective judgment of the researcher rather than random selection.

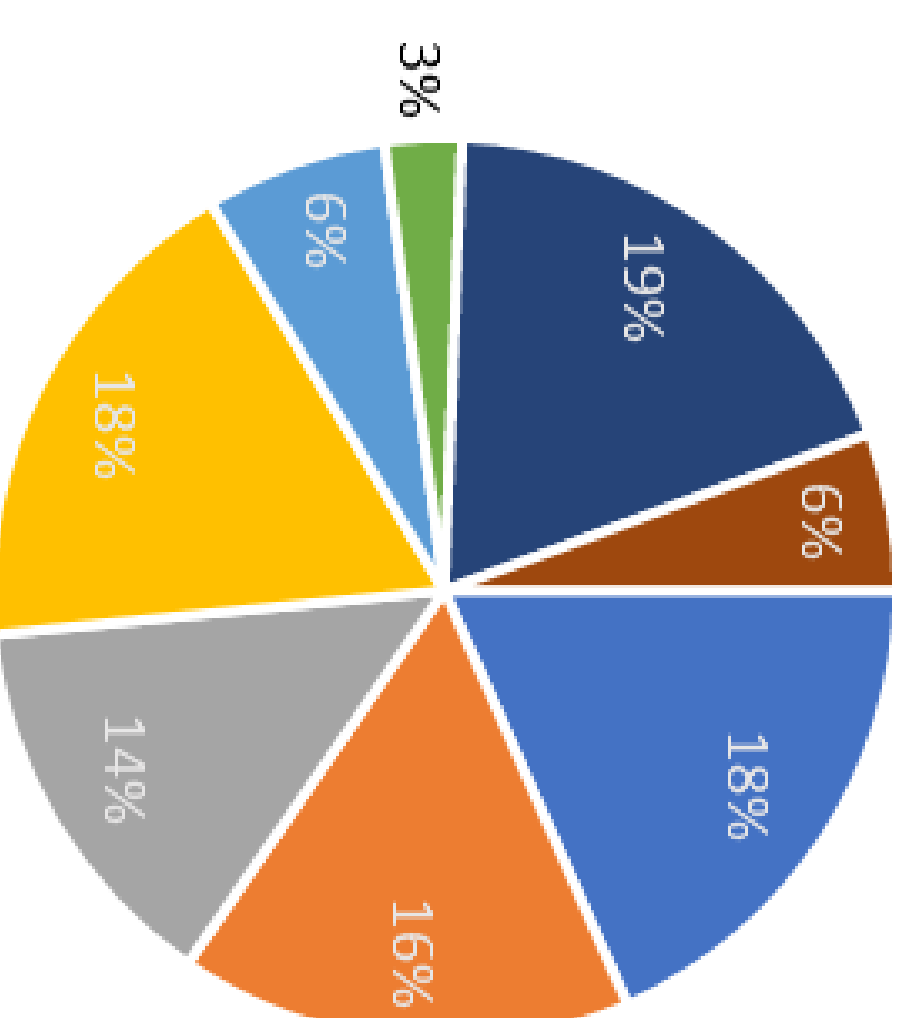


Community Profile

Females

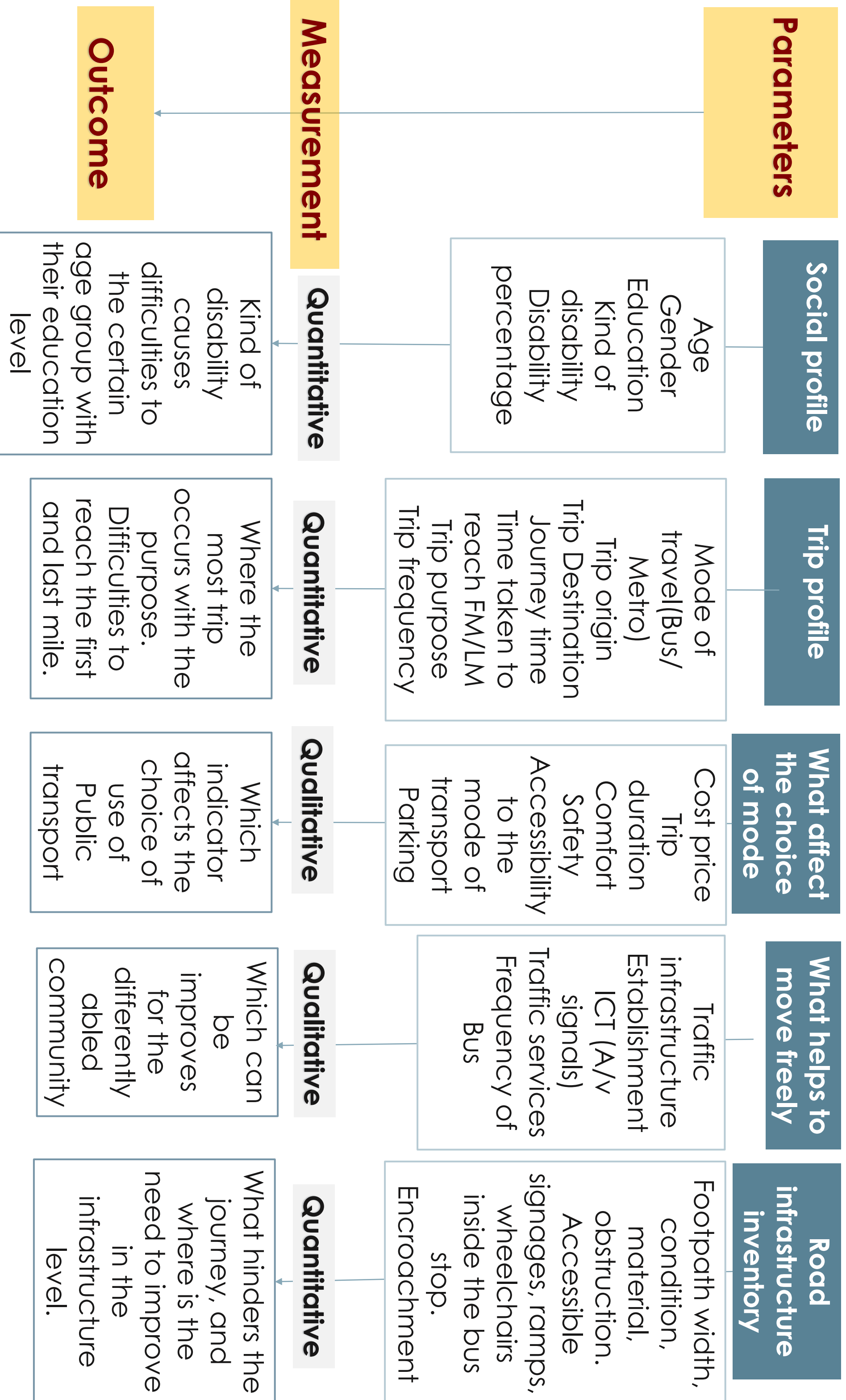


Males

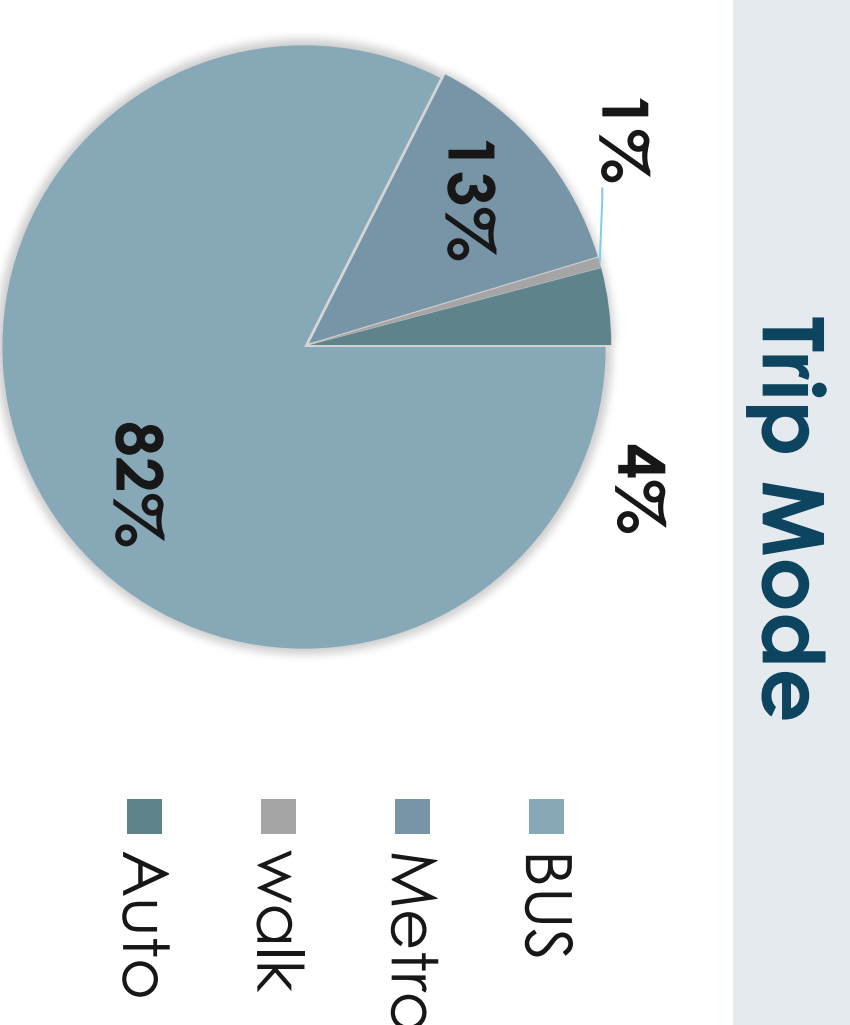


Type of Disability	In seeing	In Hearing	In Speech	In Movement	Mental Retardation	Mental Illness	Any Other	Multiple Disability	TOTAL
Persons	22386	18651	16235	17727	7367	3036	22015	6524	113941.00

Primary Data Collection – Framework

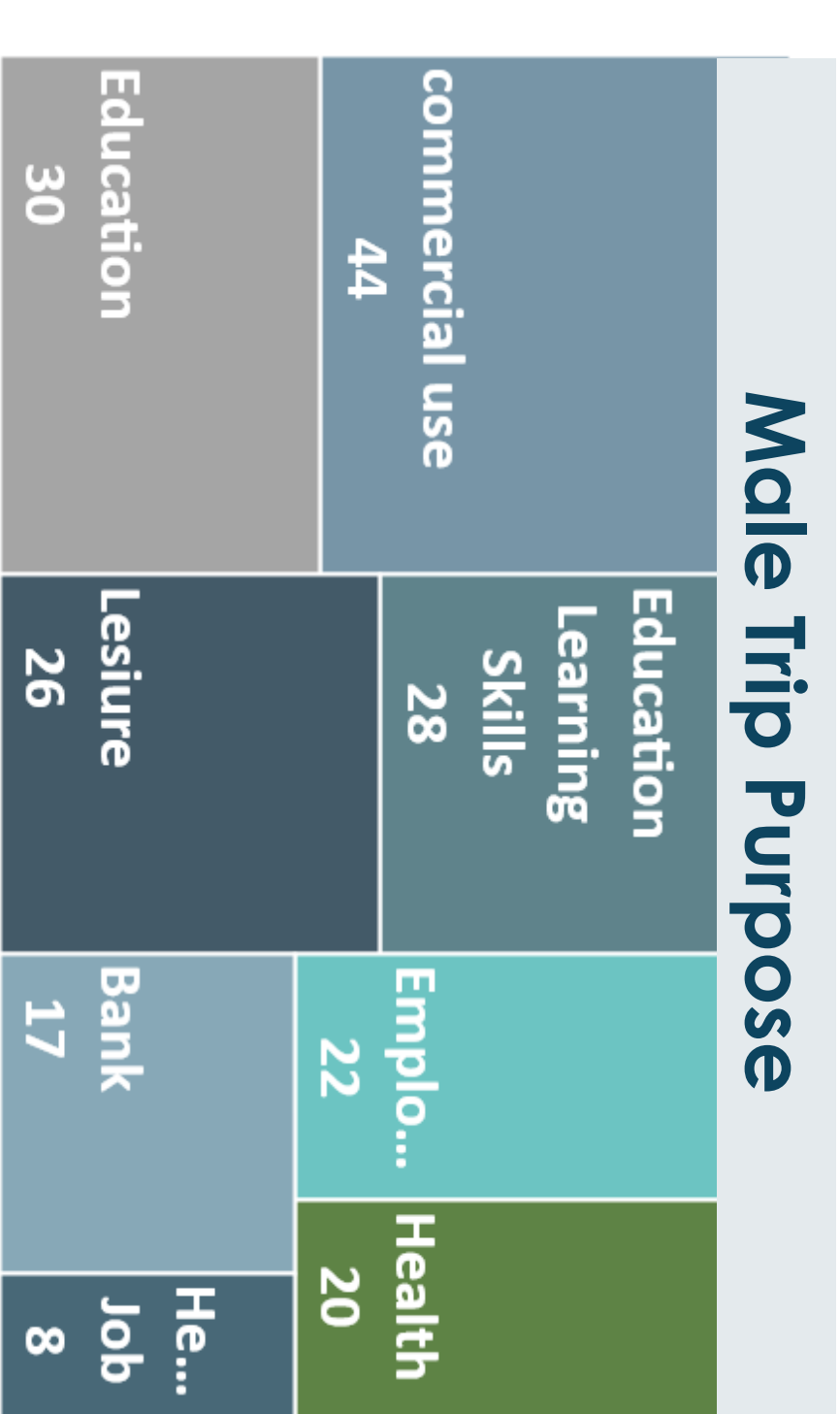
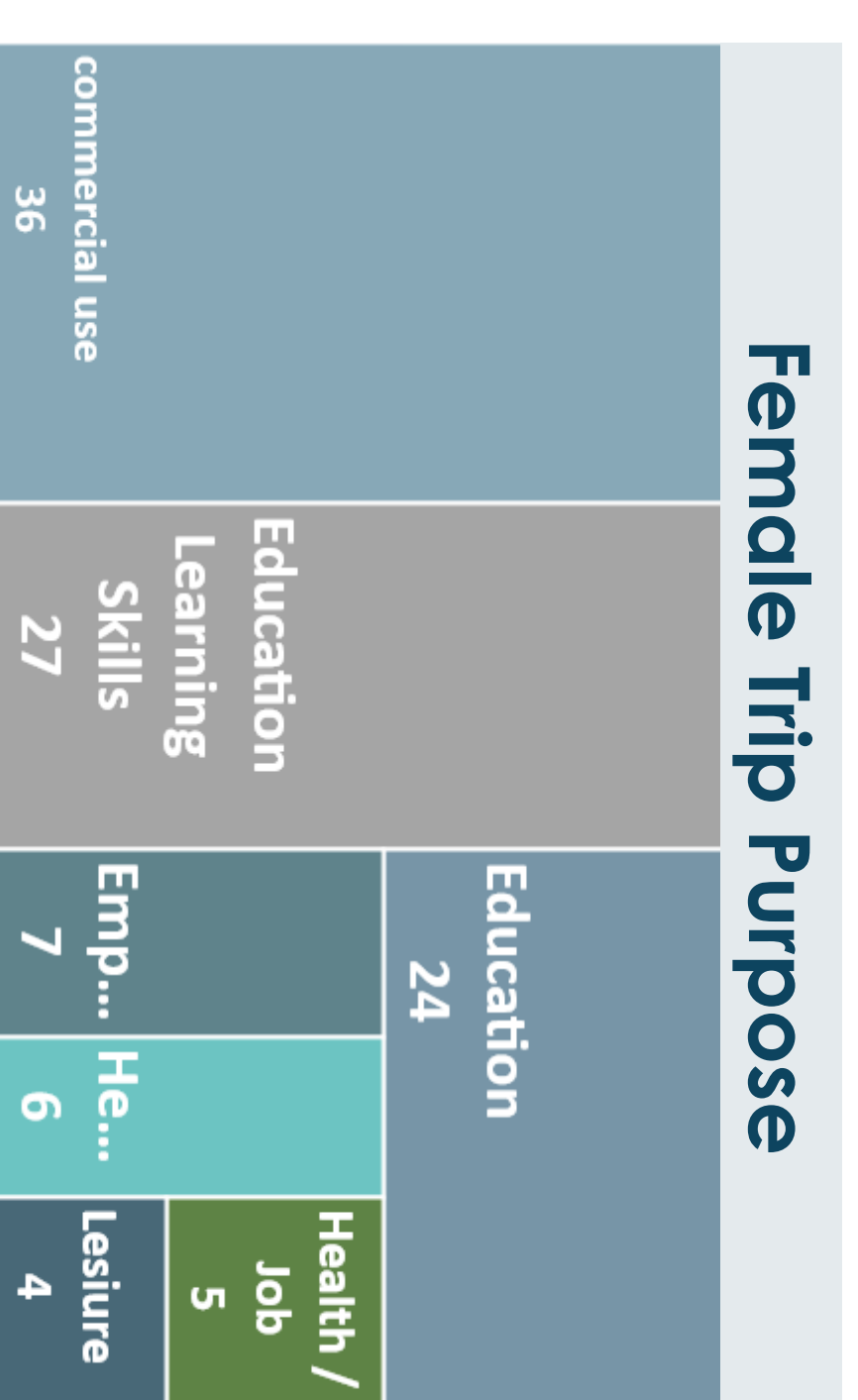


Data Collection



Inference: A larger number of individuals have locomotor disabilities, with males comprising the highest proportion, and a majority of them being undergraduates.

Inference: Maximum trip occurs for commercial use. (Sodar, Dharampath, Itwari, Sitbuldi). The bus is used as the main mode of transportation.

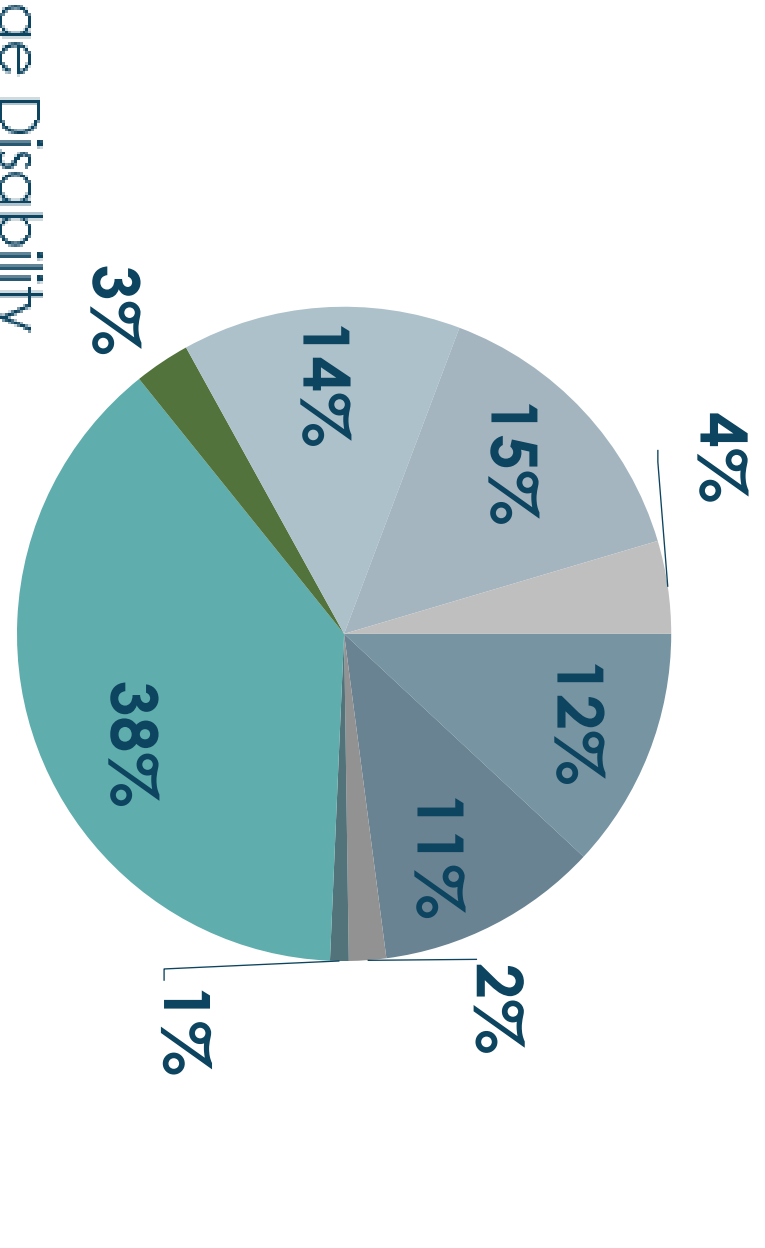
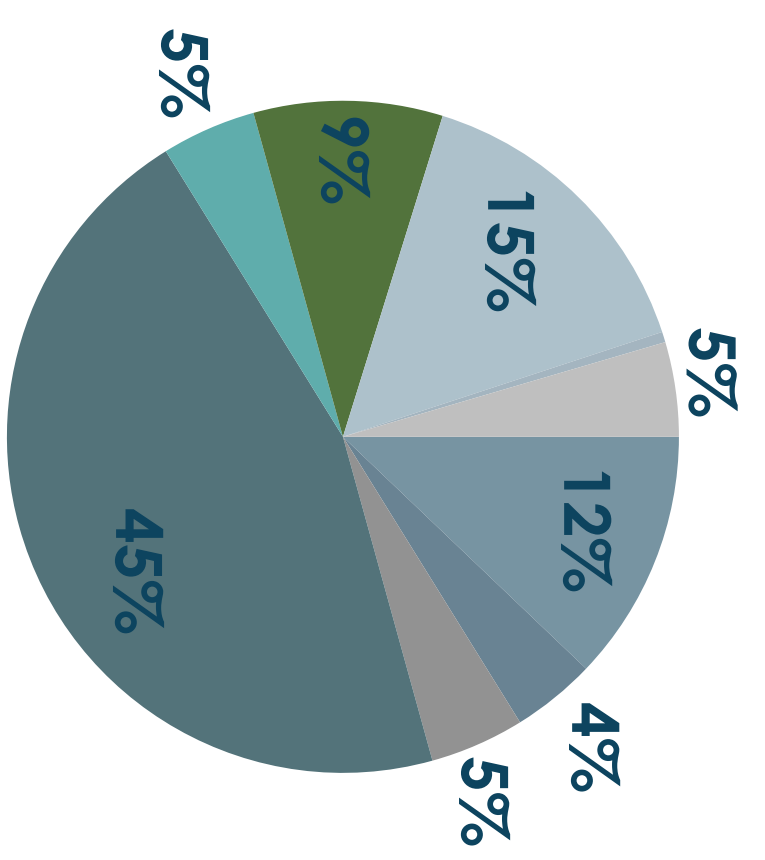
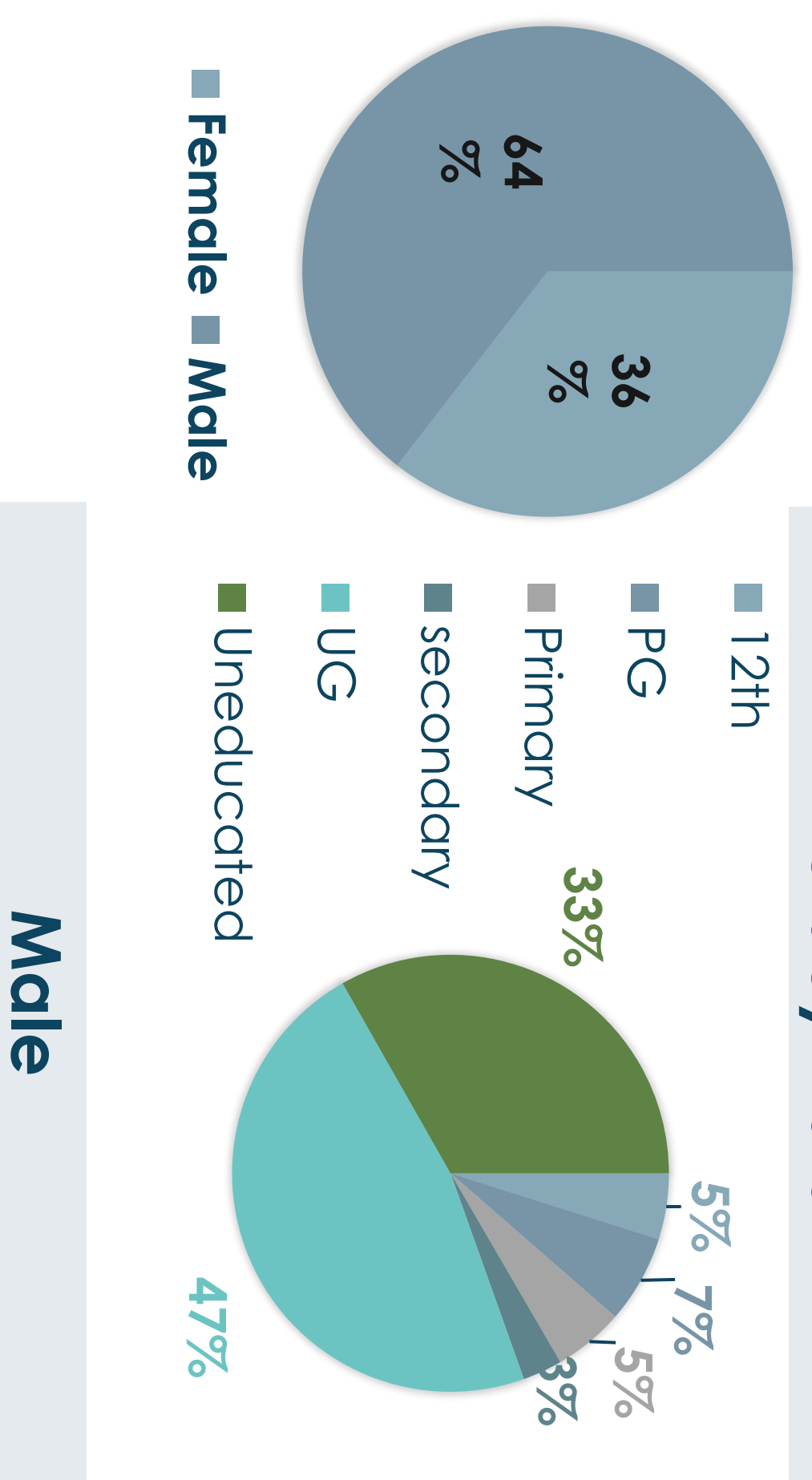


Data Collection

Types of Disability

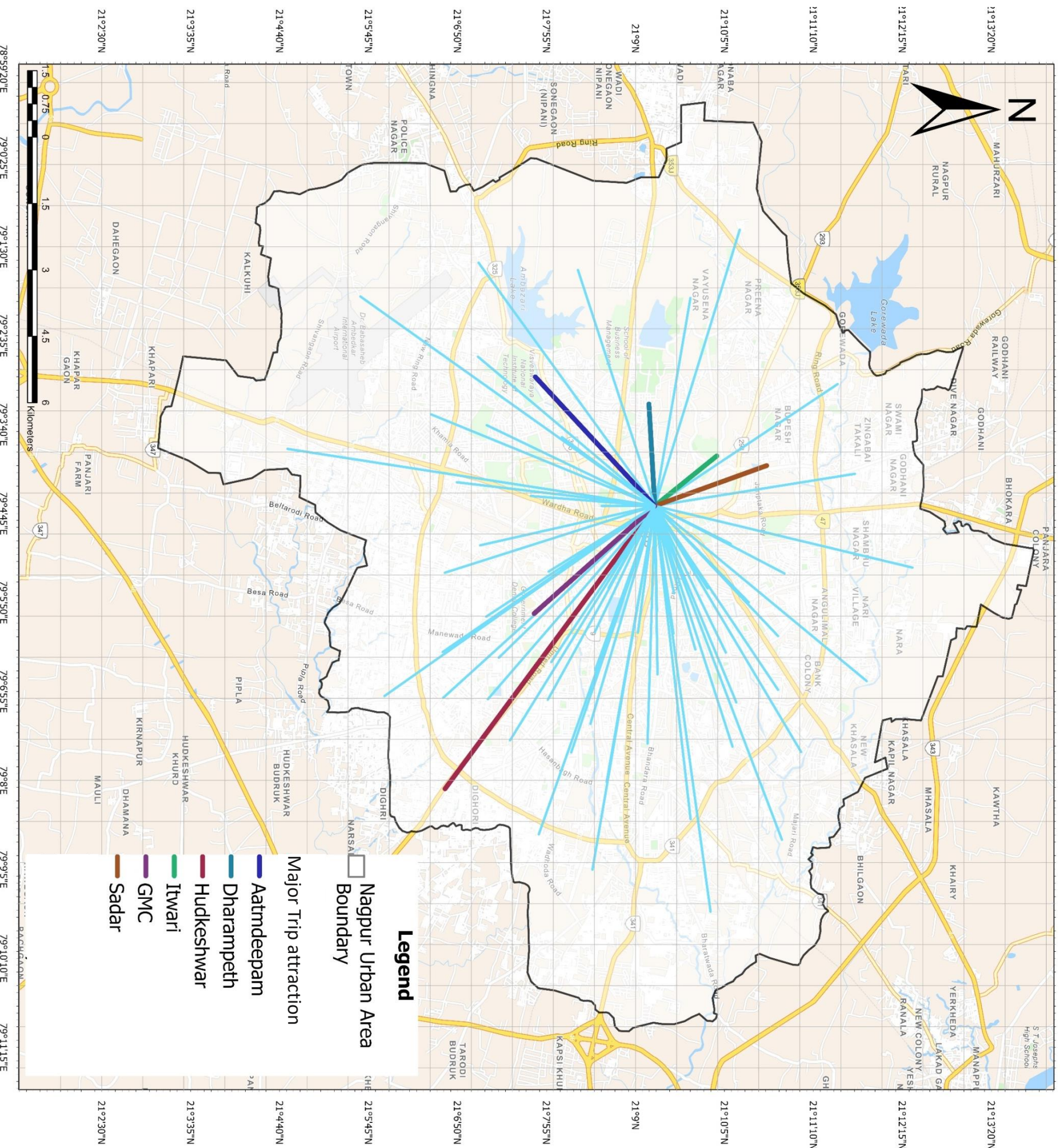
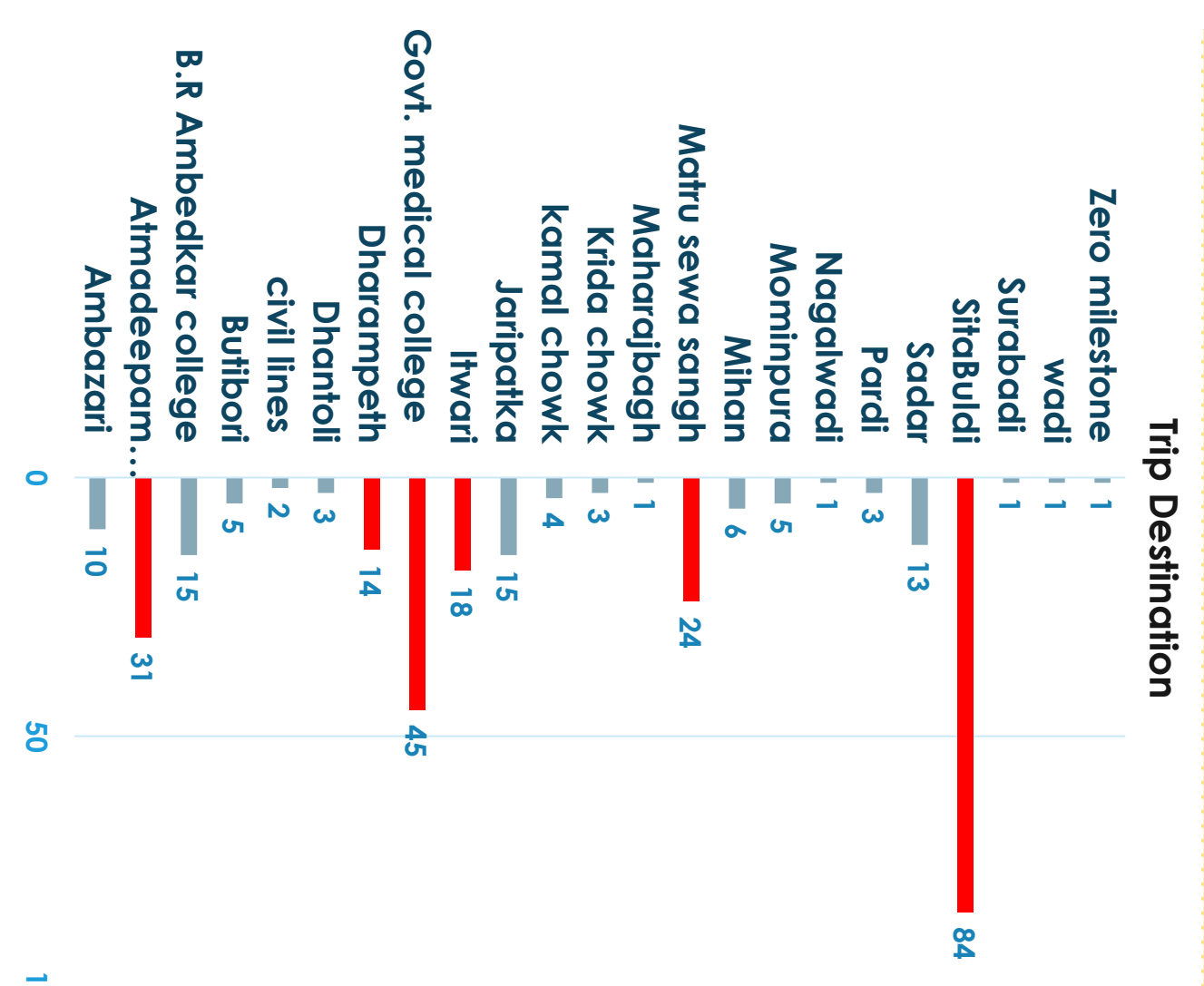
Blindness	37	TOTAL
Hearing Impairment	20	
Intellectual Disability	11	
Learning Disability	1	
Locomotor disability	130	
Low Vision	12	
Mental illness	33	
Multiple Disability	46	
Stickle Cell Disease	1	
Speech and Language Disability	14	
	305	

Literacy Data



Identified Stretches-Identified location where most trips occur: Main centers upon which residents depend. (As per the primary survey and land use)

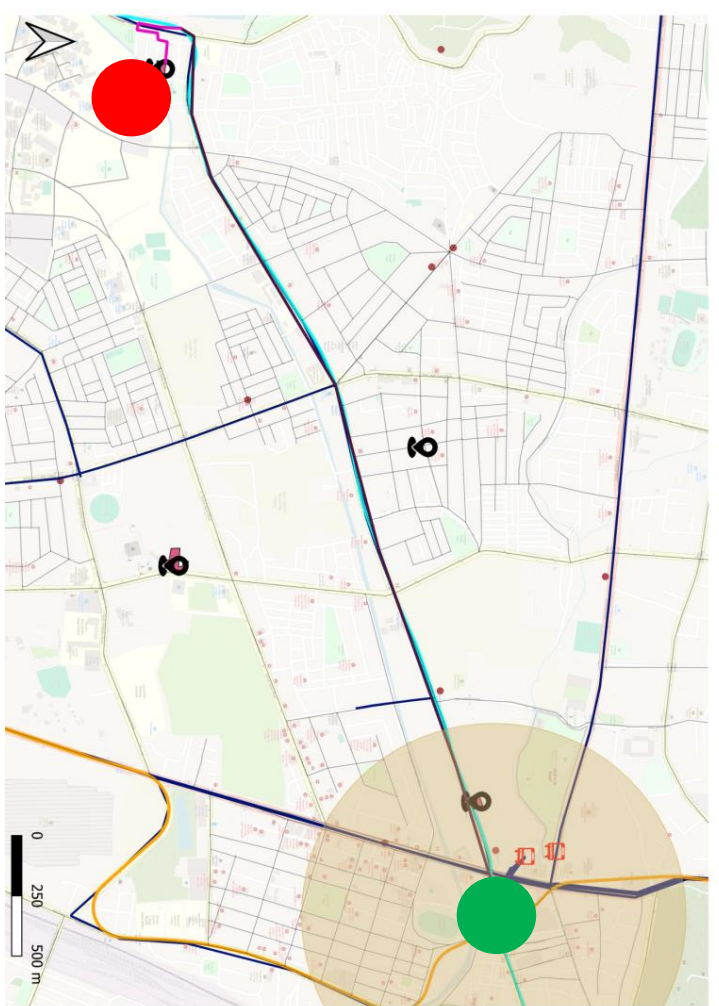
Point of Interest: Public Transportation Stops, Healthcare Facilities Educational/ Institutional Facilities Commercial Centres, Recreations facilities Disability Associations (NGOs)



IDENTIFIED STRETCHES

1 Admadeepam Society NGOs

- Promoting education, skill development, and community empowerment, positively impacting the local society and fostering growth.



Inaccessible bus stop. No ramp



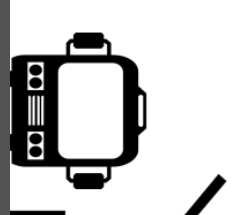
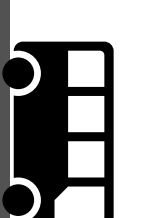
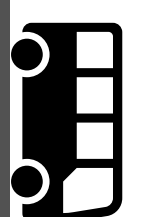
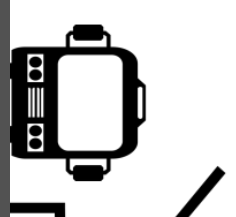
No Tactile guiding strip was provided.



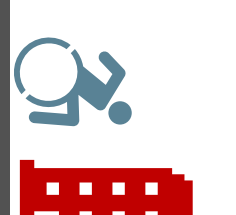
Abrupt end on the sidewalks.

400 Mtr

SITABULDI



Atmadeepam

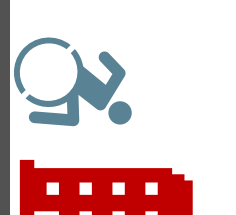


- The bus is not stopped for a differently abled person
- Footpath Condition
- Improper Signage
- Width of the Footpath
- Manholes
- Pedestrian Crossing
- No kerb
- Encroachment

- Accessible steps on the bus
- Bus Stand not accessible for wheelchair
- Audio/video signals are not installed in the bus

415 Mtr

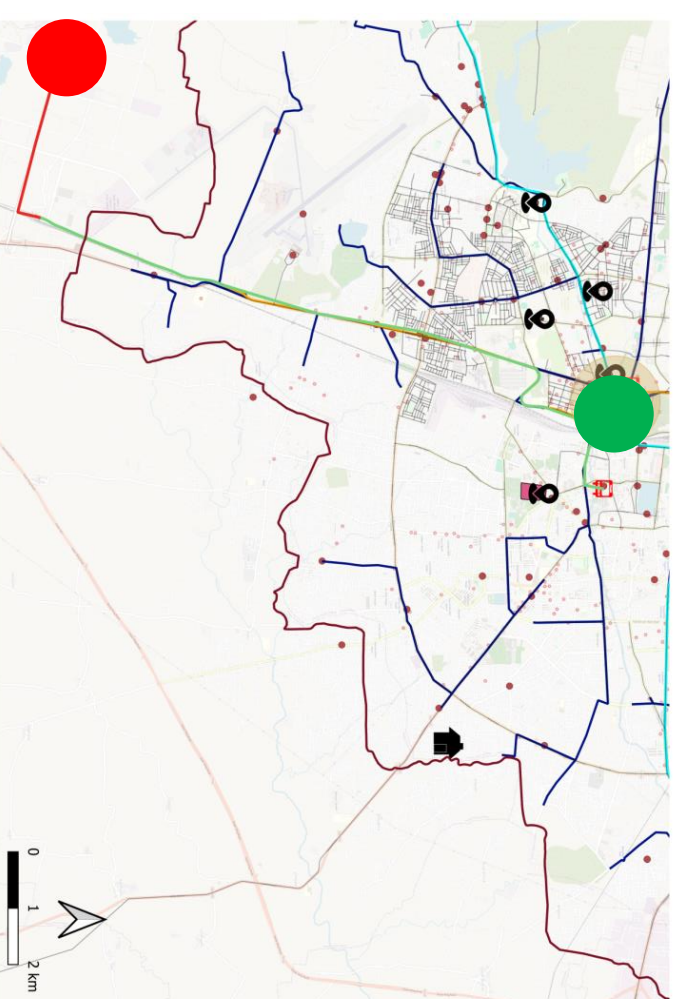
Atmadeepam



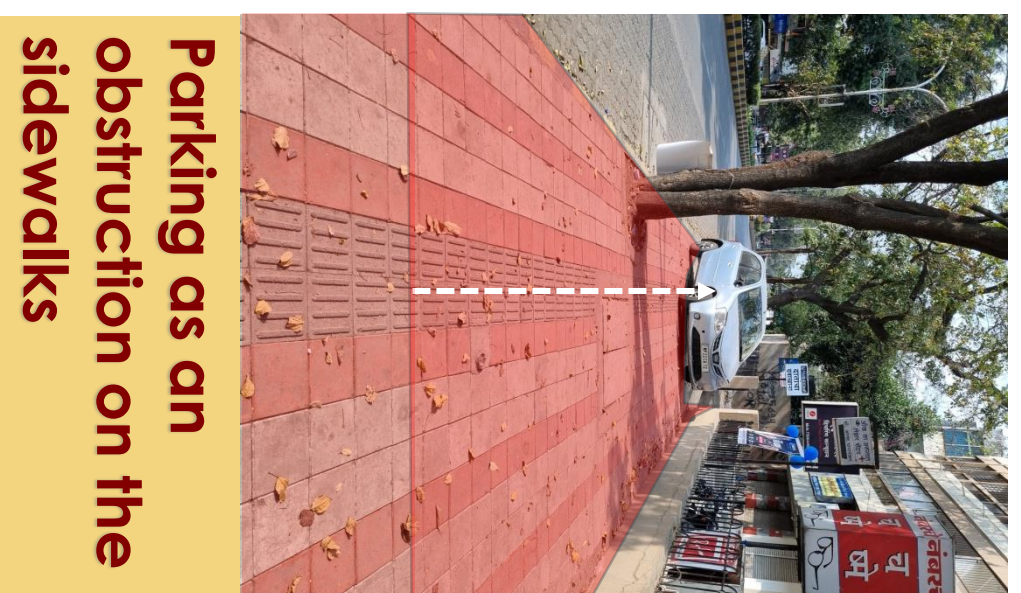
- The bus stop is not accessible
- U-turn makes a walk lengthy
- No accessible signages

2 Mihan

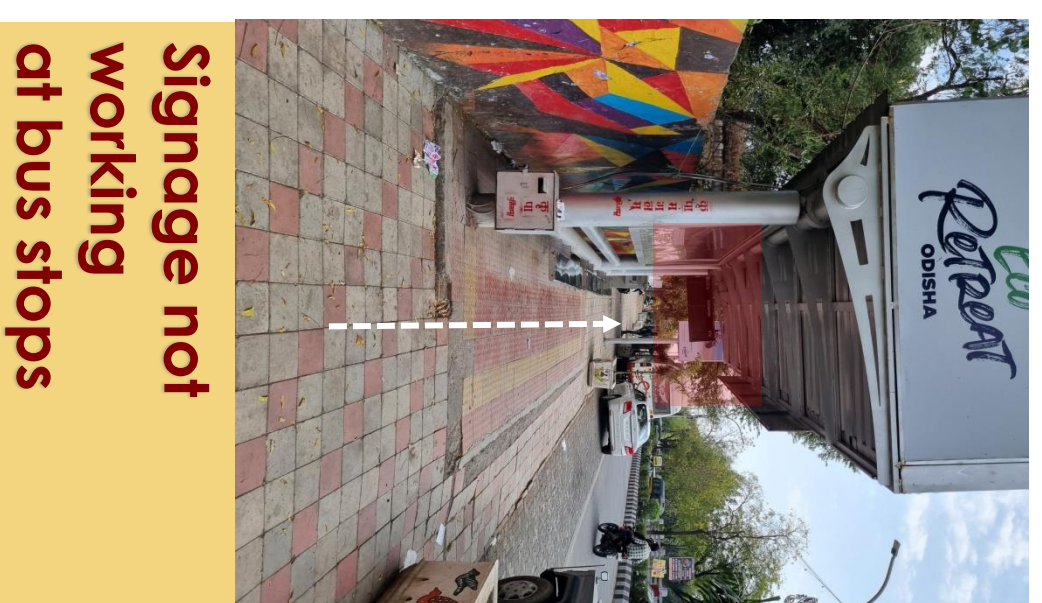
- Promoting economic opportunities



Undulation on the footpath



Parking as an obstruction on the sidewalks



Signage not working at bus stops

400 Mtr

SITABULDI

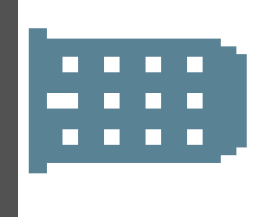


12 Km



3.3 km

Mihan



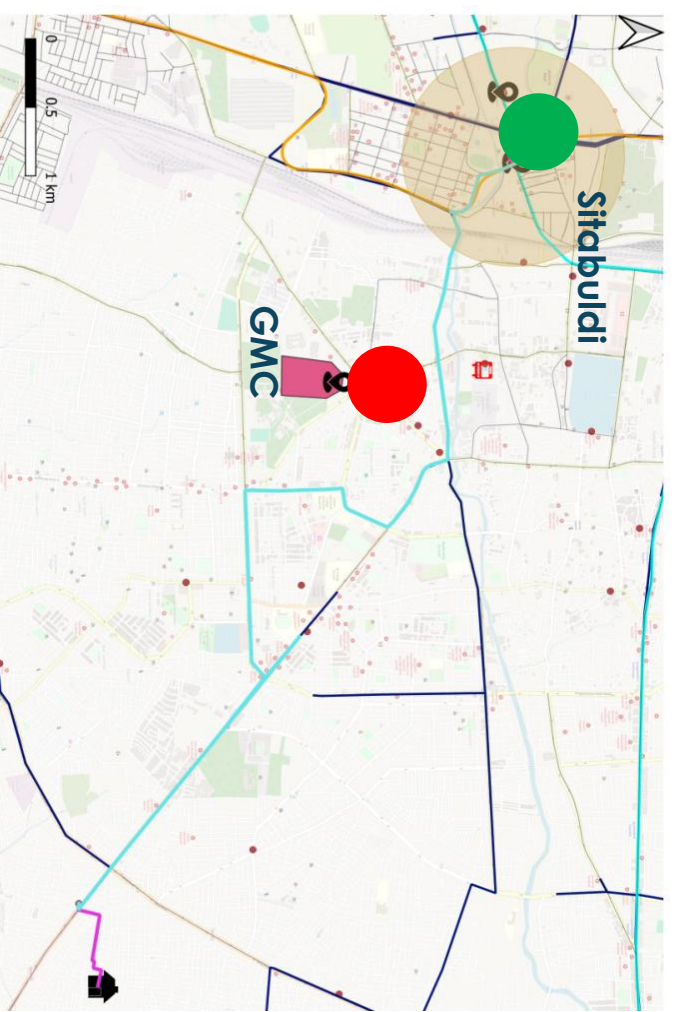
- Improper width of the Footpath
- Obstructions
- Manholes
- Pedestrian Crossing
- No kerb
- Encroachment
- No Wheelchair Space under bus shelter
- Crossing the Road
- Finding a Bus

- Monitoring inside the metro station

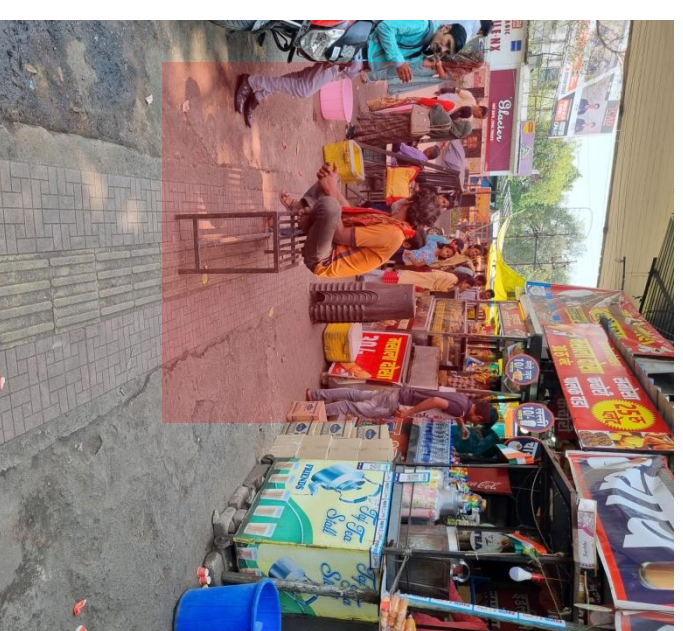
- Pedestrian Crossing
- Obstructions
- Manholes
- Wrong direction of the vehicle

3 Government Medical College (GMC)

- Hub for healthcare facilities and job opportunities.



Hawkers and utilities occupy most of the space on the footpath.



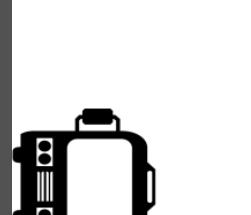
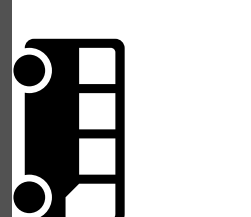
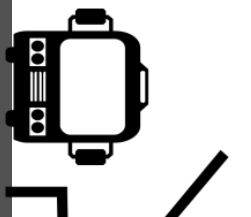
Hawkers and utilities occupy most of the space on the footpath.



Traffic Congestion

400 Mtr

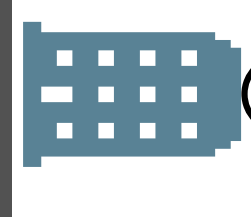
SITABULDI



2 Km

789 Mtr

GMC



- Footpath Condition
- Improper Signage
- Width of the Footpath
- Manholes
- Pedestrian Crossing
- No kerb
- Encroachment

- Accessible steps on the bus
- Bus Stand not accessible for wheelchair
- Audio/video signals are not installed in the bus

- Near Bus stop is not accessible
- Frequency of Bus is slow
- No fixed stop for Bus
- No accessible signage makes chances of accidents.

5

Akash Soni
2022MPTPLM006

M.PLAN THESIS
2023-24

Enhancing Public Transport Accessibility for Differently Abled Community A Case of Nagpur City

Seal & Sign

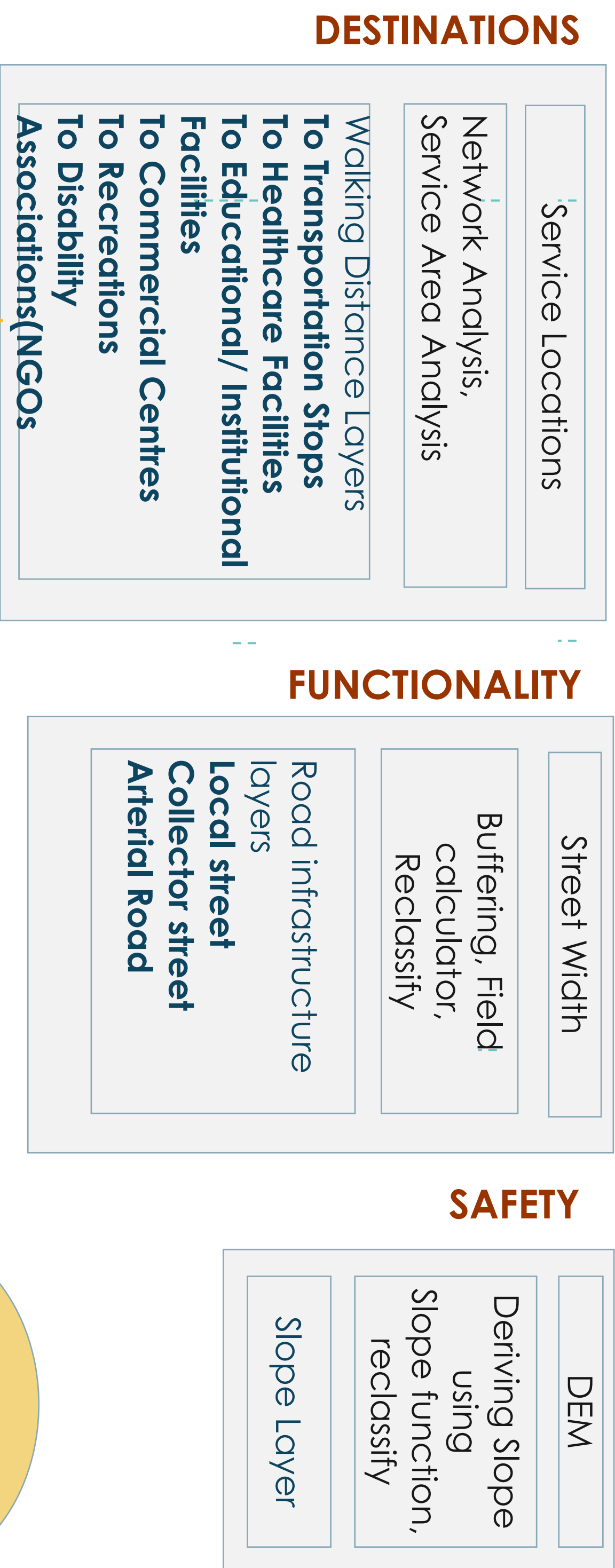
DEPARTMENT OF
TRANSPORT PLANNING

श्रीमान् वल्लभभास्करा विद्यालय, भोपाल
राष्ट्रीय महान् स्तम्भ, राष्ट्रिय महान्, स्तम्भ स्तम्भ
School of Planning and Architecture, Bhopal
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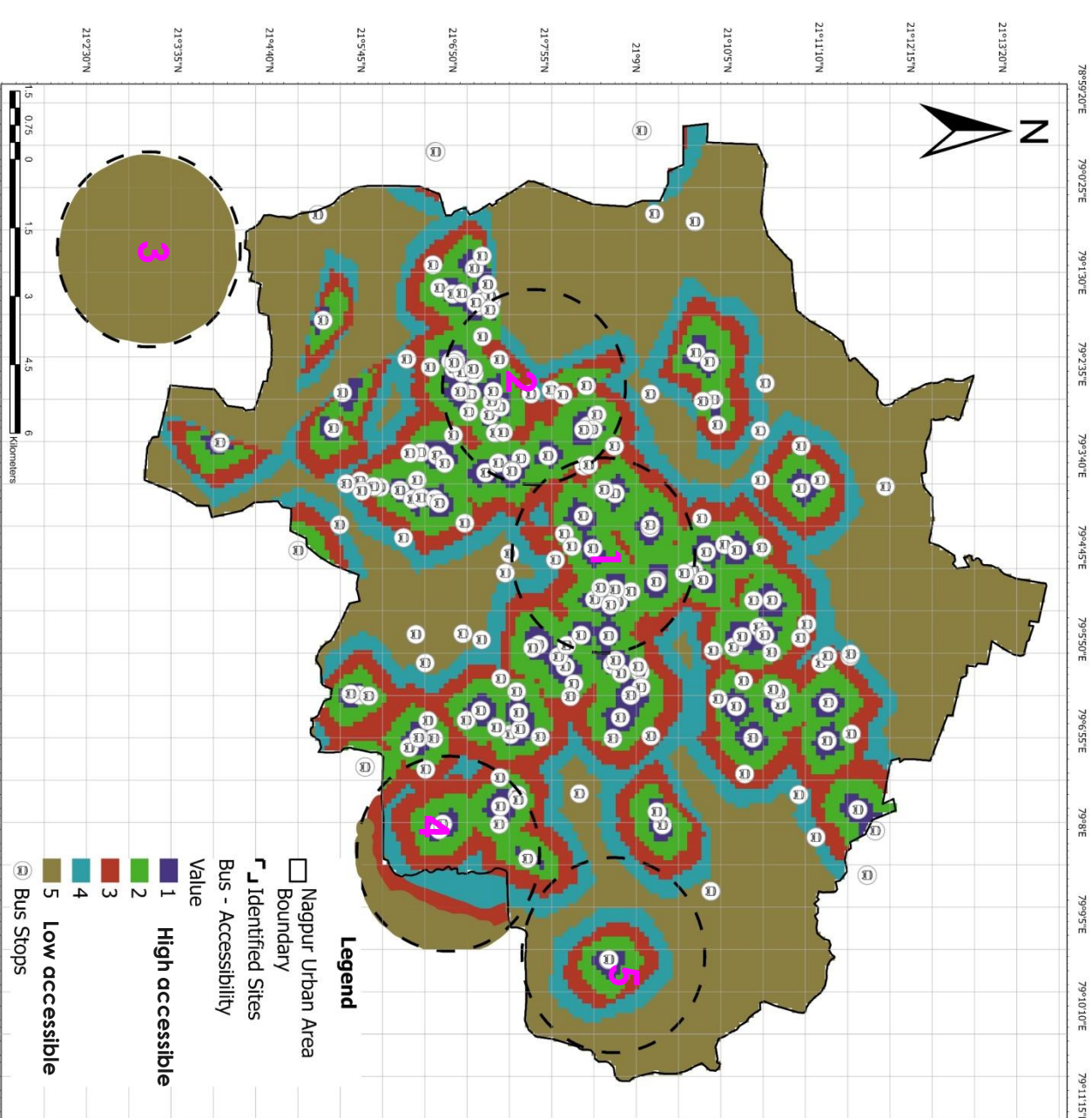
Data Analysis - Framework



Data Processing



Data Analysis (Destinations) - Point of Interest



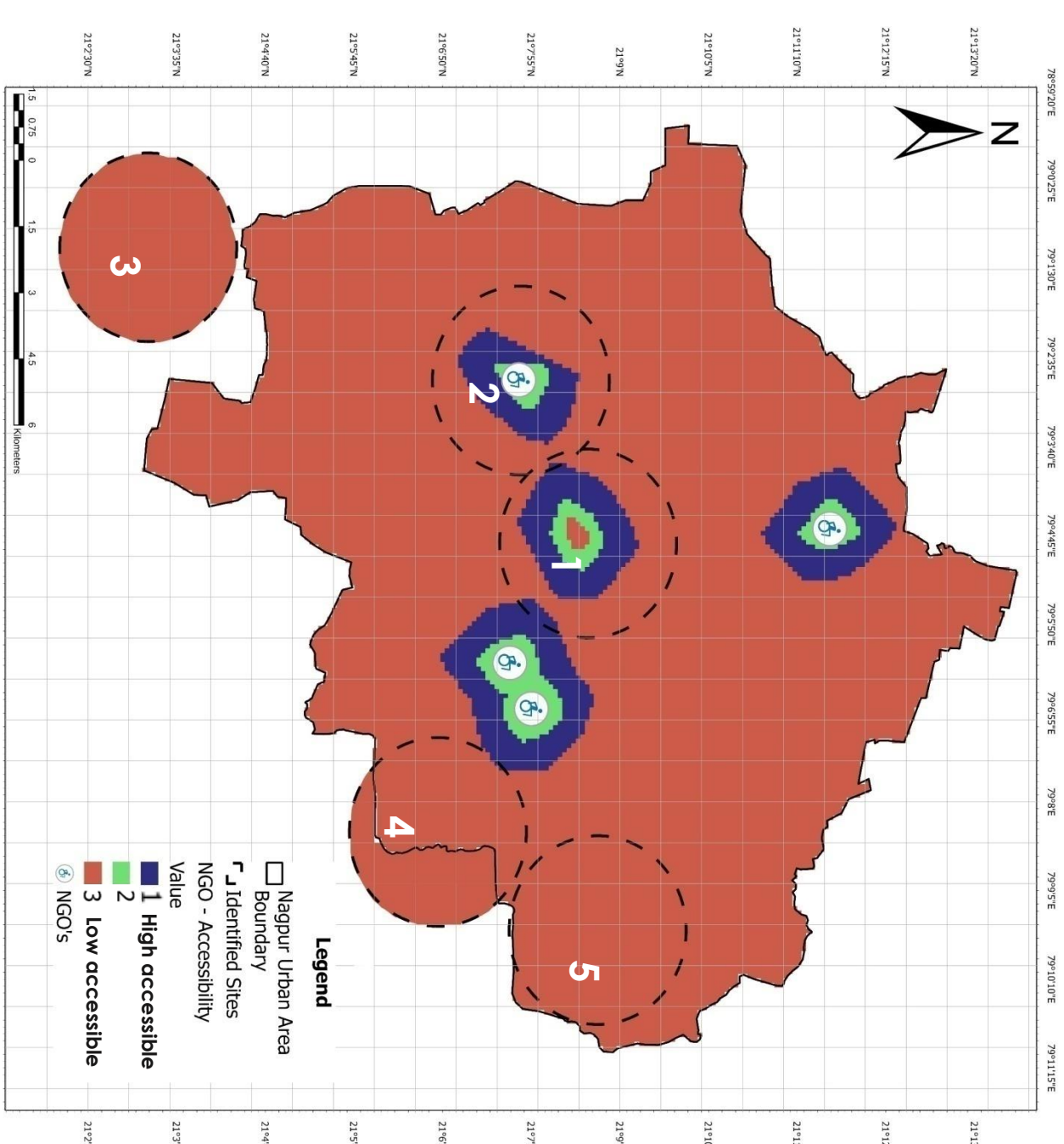
Inference

- The Map shows the accessible levels for Bus stops in the identified areas.
- Stitabuldi, Aatmedeepam NGO, and Hudkeshwar are fairly accessible.
- Mihan and Pardi have low accessibility. The reason for low accessibility in Mihan and Pardi is less Bus availability.

Walking Distance to Disability Association

Inference

- Matru Sewa Sangh and Aatmedeepam NGOs are not accessible from the Hudkeshwar and Pardi further difficult from the Mihan.
- The NGOs are not very accessible from their identified areas themselves.



Walking Distance to Recreational Facilities

Inference

As the city has Recreational centres around the Stitabuldi and Itwari, from the Pardi, Hudkeshwar, and NGOs it is very difficult to access the centres.

The proposed Anubhuti inclusive park is located at the Pardi campus, the park is in the East part of Nagpur makes it challenging to reach with the low frequency of buses to reach Pardi.

Data Analysis – Safety

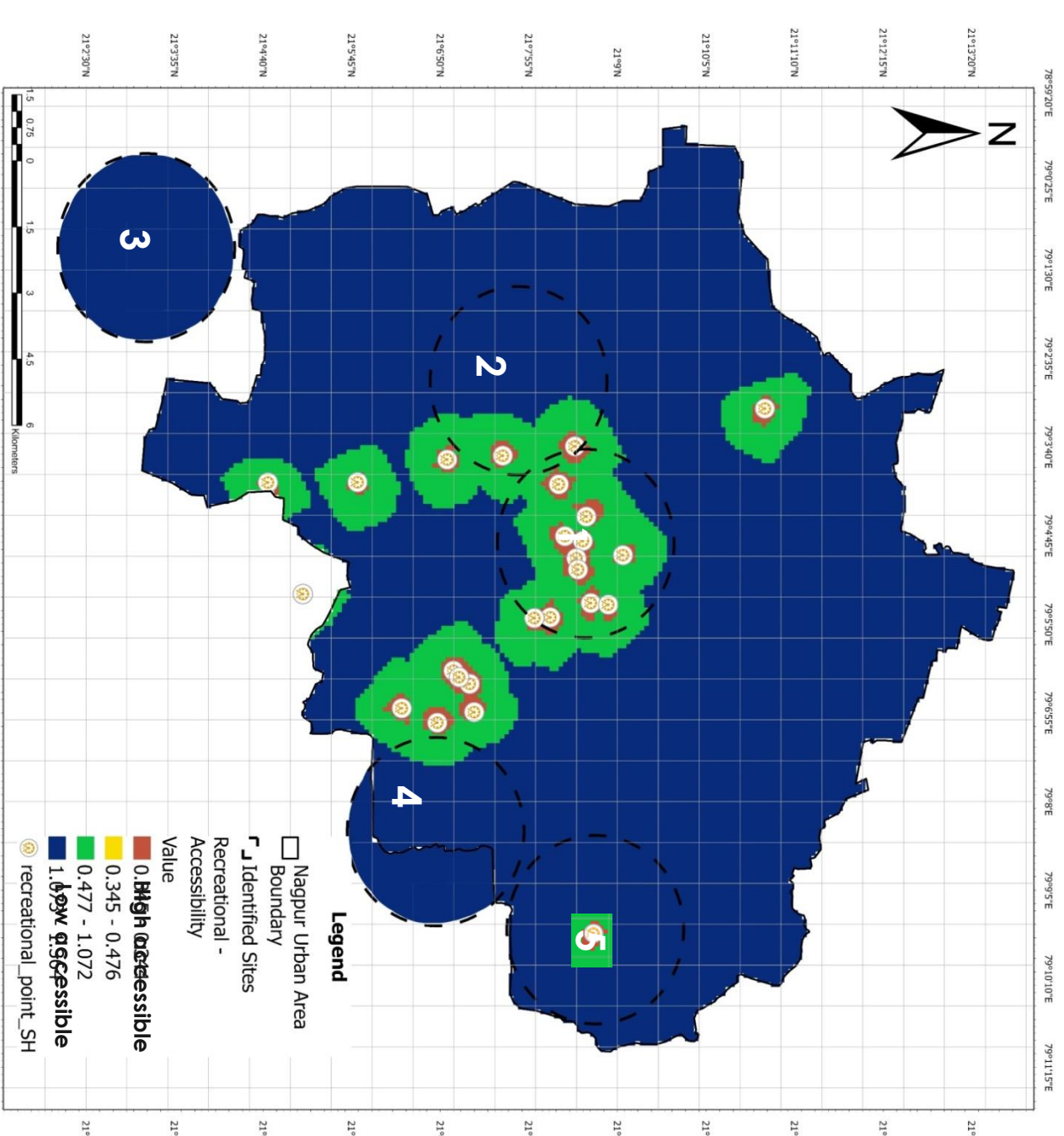
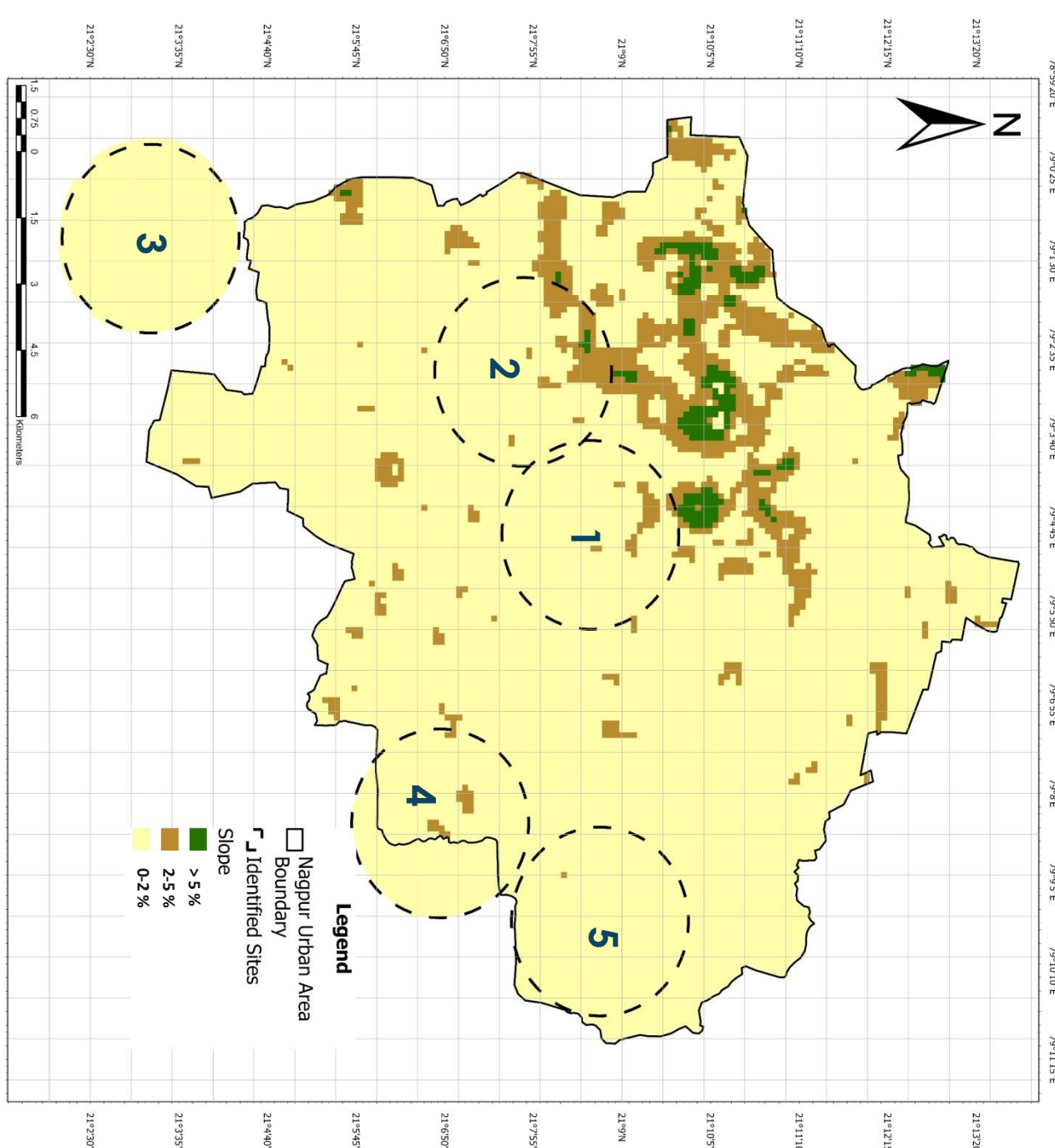
The highest number of trips occur for commercial purposes, followed by those for NGOs, healthcare, institutions, and recreational activities. These areas are selected based on data where the majority of trips occur.

Identified areas

1. Stitabuldi
2. Aatmedeepam NGO
3. Mihan
4. Hudkeshwar
5. Pardi

Slope Map

A slope of no more than 1:20 (5%) is typically recommended for accessible routes for wheelchair users and individuals with mobility impairments.

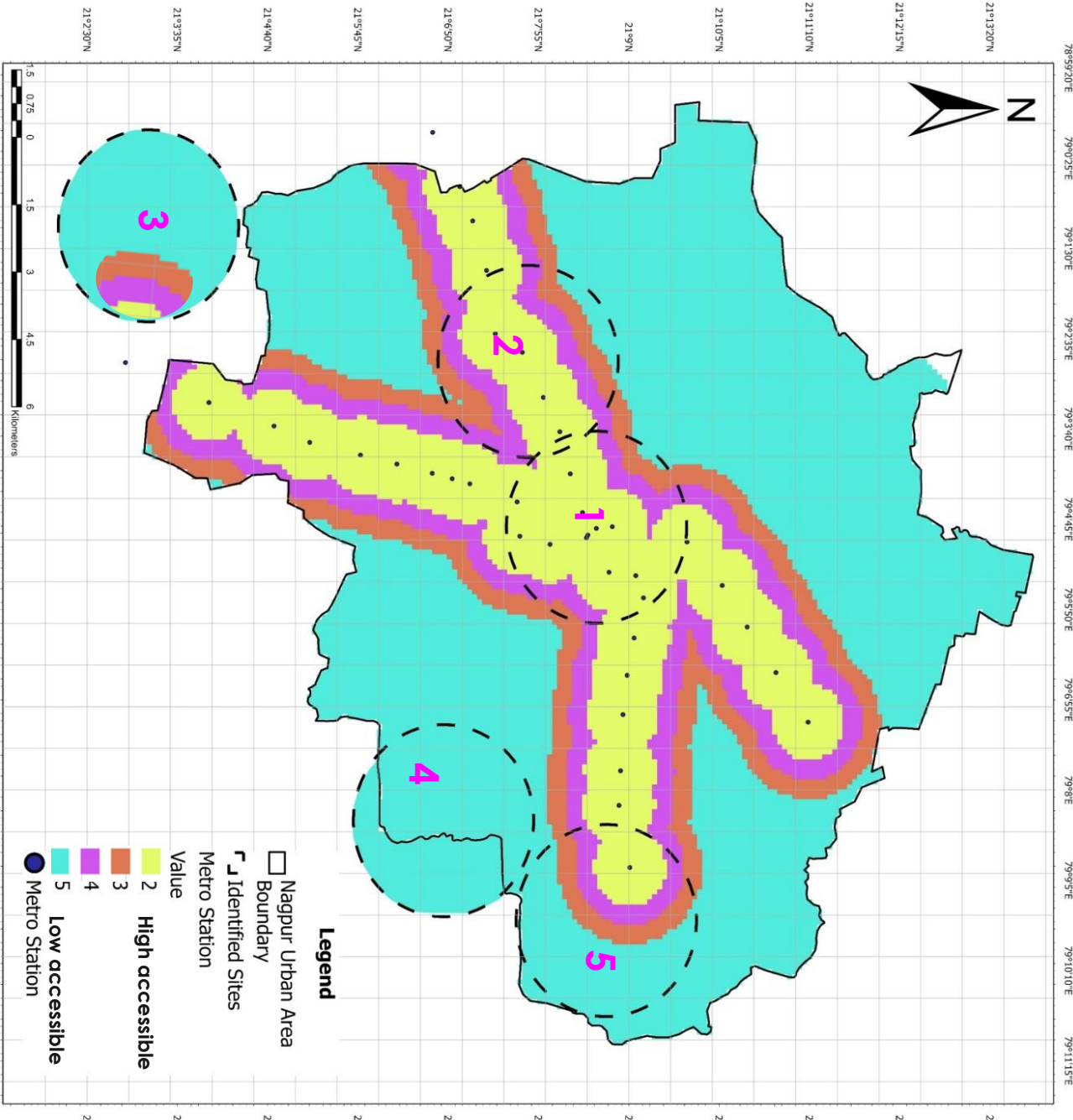


Walking Distance to Metro Stations

Inference

- The metro consists of two routes: Automotive Square, Kamptee to MIHAN Metro depot and Prajapati Nagar, East Wardhaman Nagar to Lokmanya Nagar, Hingna. Phase-I 38.215 km operational, Phase-II 43.8 km proposed

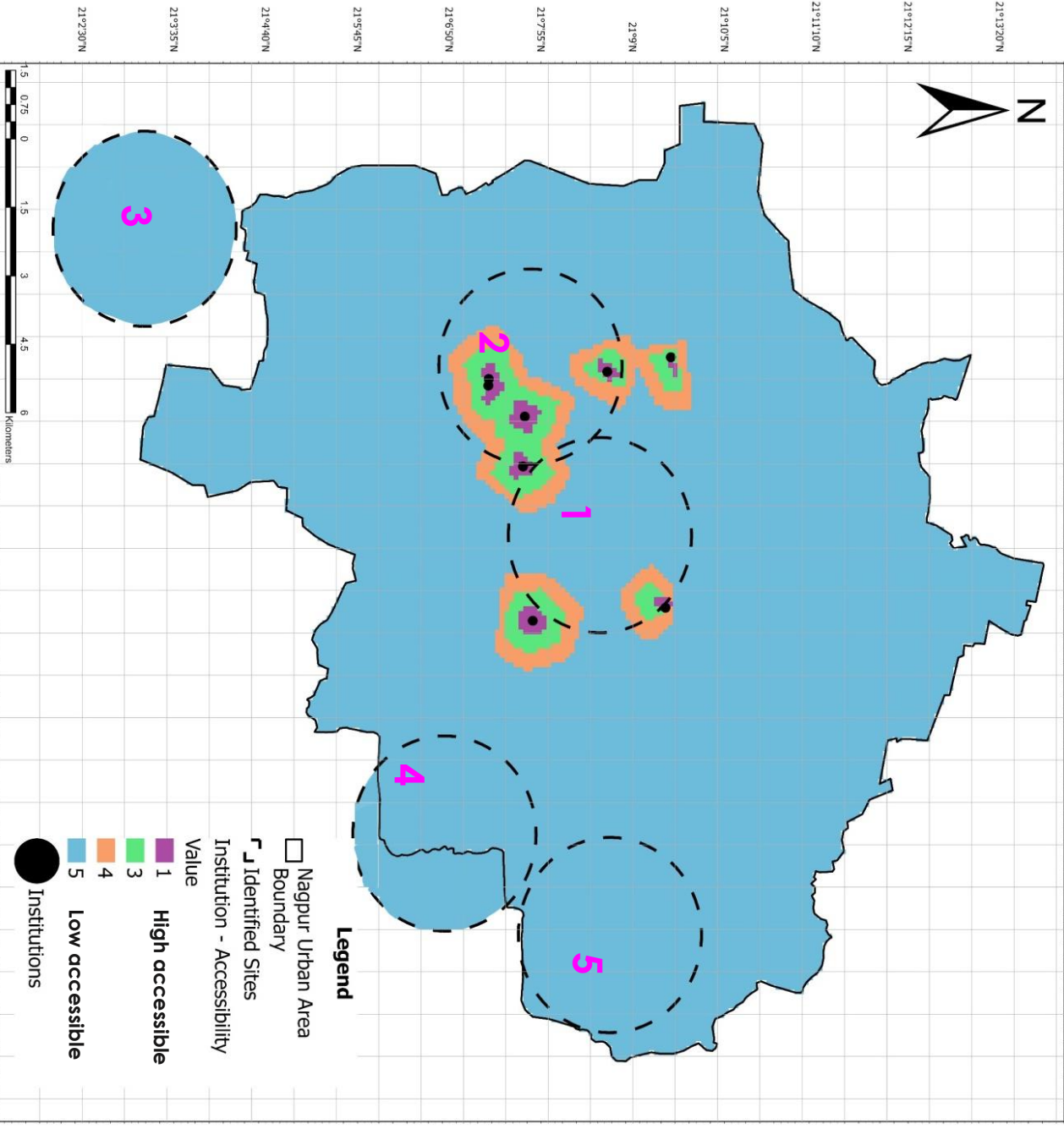
- The metros are not operating in selected Hudkeshwar area



Walking Distance to Institutional Buildings

Inference

- Lack of institutions catering to the needs of the differently abled community in Nagpur is a significant concern.

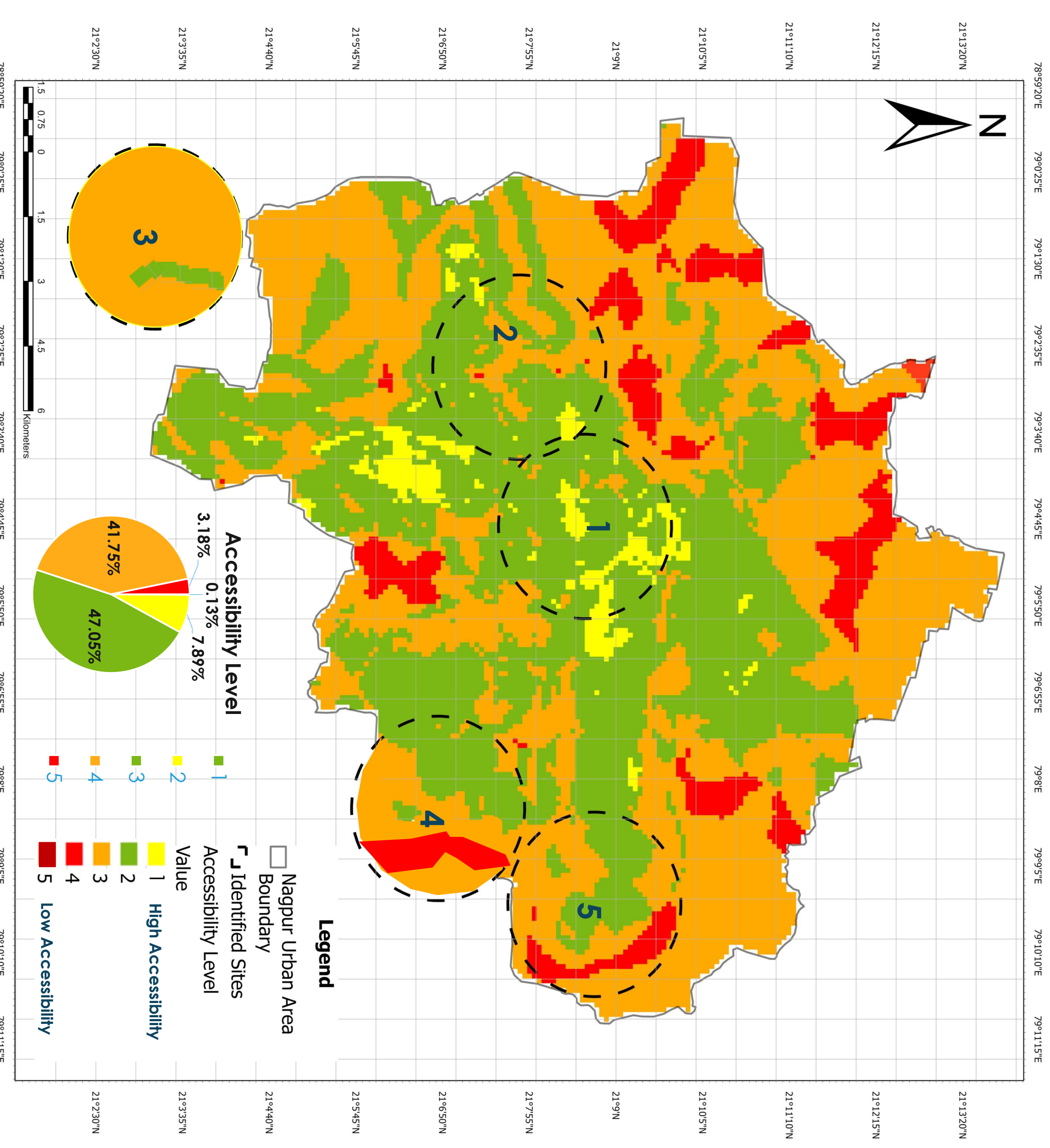
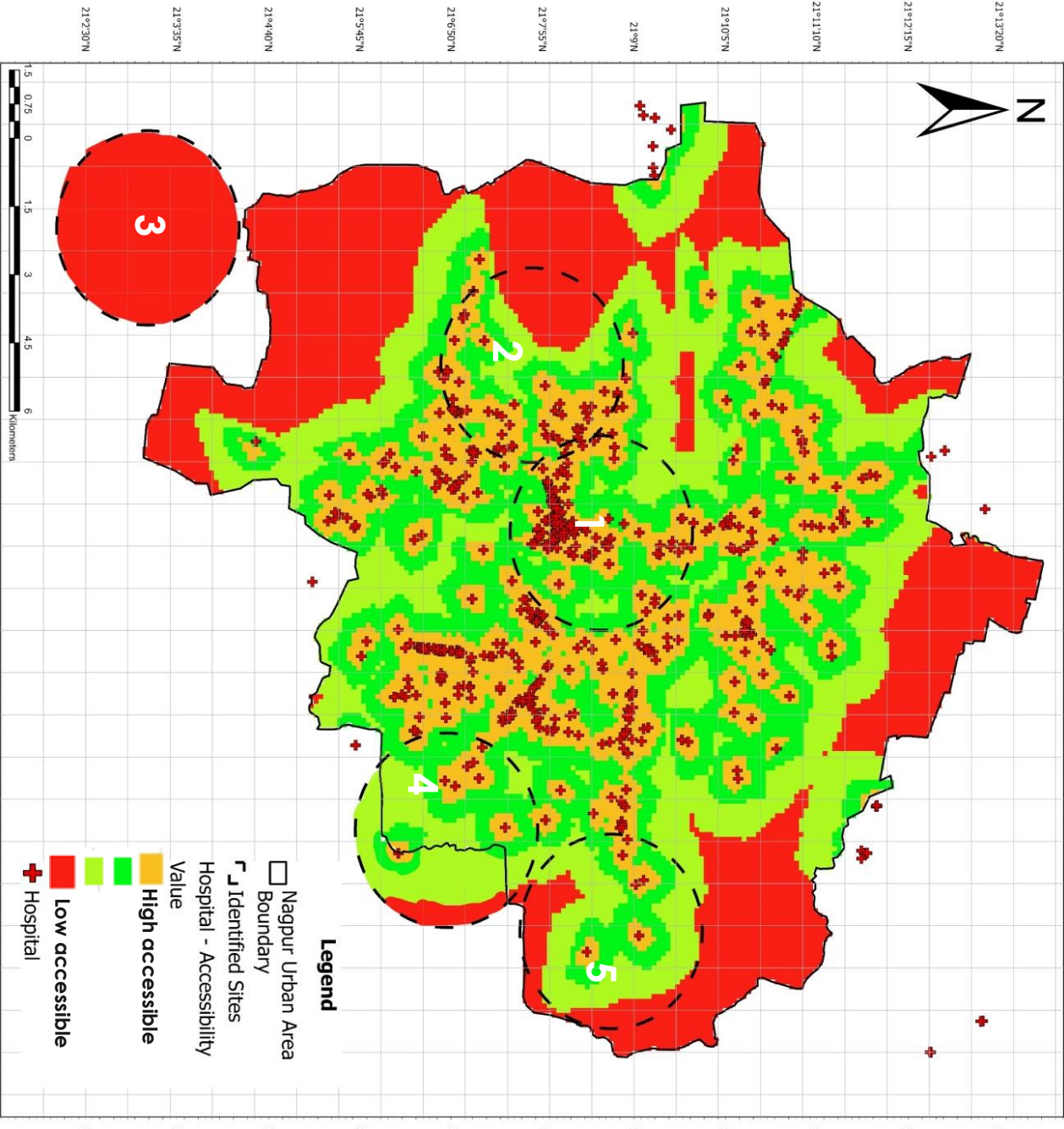


Walking Distance to Healthcare Facilities

Inference

- The city, being a major urban center, is equipped with a range of healthcare services including hospitals, clinics, and specialist medical centers.

- These peri-urban areas, located on the outskirts or fringes of the city, often face challenges in terms of infrastructure development and access to healthcare services



Parameters	Weight	Reasoning	Buffer
Public Transport Stops	15%	Based on the data collected through our primary survey, the weightages have been determined for different purposes of trips that have occurred. The most common purpose for trips in our dataset is healthcare facilities and Disability association which accounts for 40% of all trips	<ul style="list-style-type: none"> < 400 m-High Accessibility 800 m 1200 m 1600 m > 1600m-LowAccessibility
Accessibility To Disability Association	20%		
Accessibility to Recreational Facilities	15%		
Accessibility To Institutional Buildings	15%		
Accessibility To Healthcare	20%		

Source: GIS based Multi Criteria Decision Analysis for analyzing accessibility of the disabled in the Greater Irbid Municipality Area, Irbid, Jordan

Road Infrastructure Assessment

Roads Infrastructure Assessment

1. Road Condition
2. Alternative modes availability
3. Footpath's Condition
4. Footpath's Obstruction
5. Street Light
6. Accessible Signages
7. Accessible Bus Stop
8. Wheelchair Inside Bus Stop
9. Tactile Pavement
10. Parking over Sidewalks

Converted into a Single Variable

Calculated LOS

Sidewalk Width



Sitabuli



Pardi



Atmadeepam NGO



Hudkeshwar

Variable	Indicators	Statement	Rate in Scale 1-3										
Road Infrastructure Assessment	Road Condition	The roads to / from where I live are in good condition		Hudkeshwar	2	Mihaan	2	Atmadeepam	3	Anubhuti Park	1	Sitabuli	3
	Alternative modes availability	There are alternatives of transportation modes to support my daily activities			1		1		2		2		3
	Tactile Pavement	Tactile pavement is present in my area			1		1		1		2		2
	Footpath Condition	Foot path condition is good in my area			1		2		2		2		3
	Obstruction at Footpath	No obstruction is there in footpath in my area			1		1		3		1		2
	Availability of signages	Signages are available at my area.			1		1		1		1		2
	Street Light	Street light are available at my area.			3		3		3		2		3
	Accessible Signages	Access Signages are available at my area.			1		1		1		1		1
	Accessible Bus Stops	Accessible bus stops are available at my area.			1		2		1		1		1
	Wheel Chair inside Bus Stop	Wheel chair are accessible at bus stop in my area.			1		1		1		1		1
Parking	Parking Facilities are available at Public Transportation Facilities at my area.			1		3		1		1		2	
Level of Service					14	18	19	15	23				

Inference

- The road condition in Hudkeshwar and Mihaan area is in the worst condition and the Sitabuli area have roads in good condition.
 - There are several alternative modes of transportation in Sitabuli like bus, metro, and auto stand. Other areas lack in this service.
 - Tactile pavement is present in Anubhuti and Sitabuli but not in good condition
 - Hawking vending is the main obstruction in the sitabuli area as it is a city center.
 - Signage's not available in the area except in Sitabuli
 - Bus stops are not accessible
 - Road conditions in Hudkeshwar and MIHAN are poor, while Sitabuli's roads are in good condition.
 - Sitabuli offers multiple transportation options like buses, the metro, and auto stands, lacking in others.
 - Bus stops are inaccessible, and there are no wheelchair provisions.
 - Parking near public transport is lacking in Hudkeshwar, Mihaan, Atmadeepam, and Anubhuti, leading to a preference for private vehicles
- The inaccessibility of bus stops and the lack of wheelchair provisions are significant obstacles for disabled individuals in all areas. due to which people prefer private vehicles while traveling.

Note

- 0-900 (Worst)
- 900-1200 (Bad)
- 1200-1800 (Better)
- 1800+ (Best)

Recommendations

Location

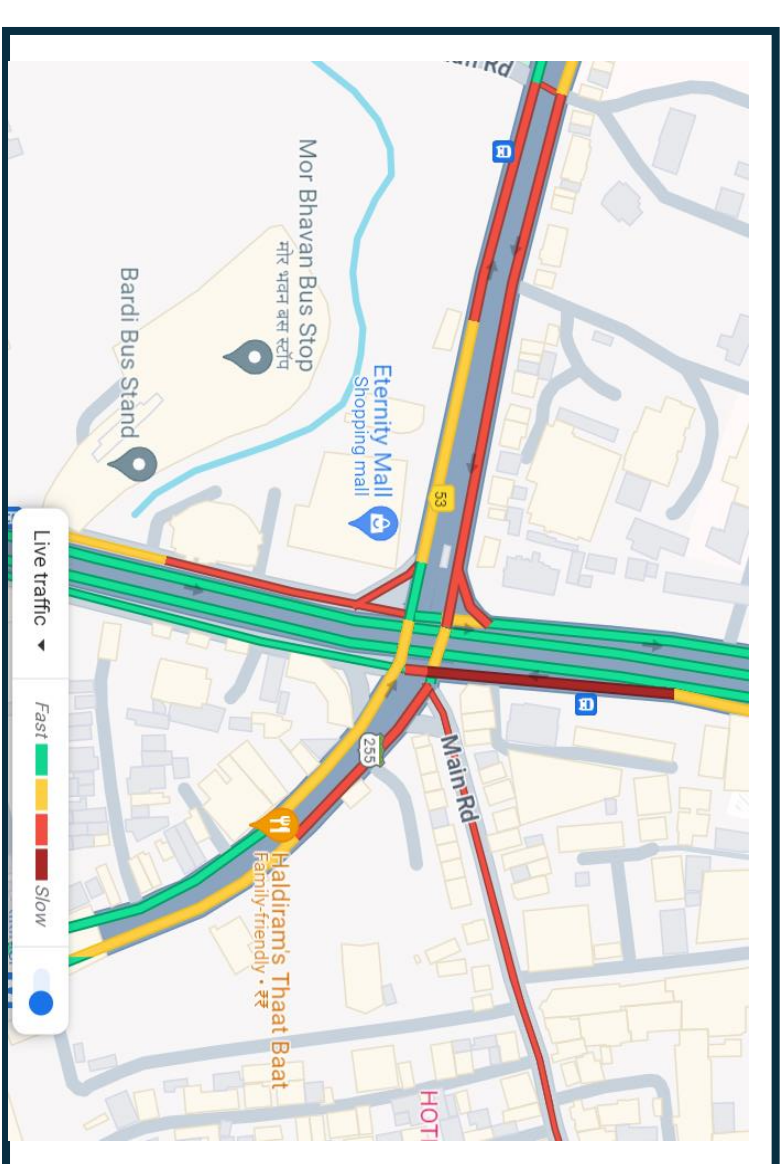
Issues

Area Specific Recommendations

Sitabuldi

Encroachment from the hawkers and vendors Conflict with heavy and fast vehicles with walking objects within the path of travel, not detectable by a person with vision impairment Hawkers or utilities occupy most of the space leaving very little space to walk.

Establishment of designated vending zones away from pedestrian pathways and roadways to reduce encroachment issues near the Sitabuldi Bus stand .



Installation of tactile pavements along pathways to alert visually impaired individuals of potential obstacles

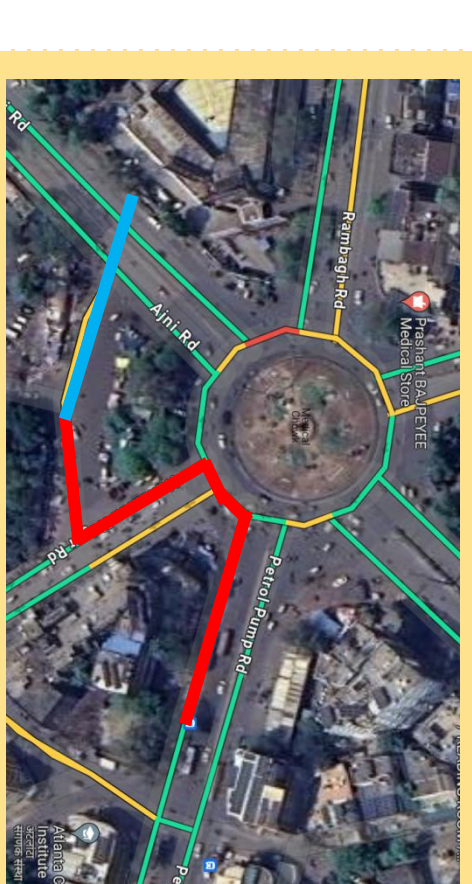
Nearby Bus stop should be again operational as it is closest to the college.

Govt. Medical college

No clear and legible signage and accessible route information at bus stops. The bus stop is not accessible from the adjacent footpath and road. There is no kerb at the bus stop, No ramp leading to the footpath. A Nearby Bus stop has not operational for 2 years from local sources.

Atmadeepam NGO

No graphic/pictorial symbols/Braille used in signage From NGO to Bus stop it's a long distance because of U-turn ,its make a walk lengthy.



Distance from **Red** path - 189 m

Distance from **Blue** path - 75 m

Distance saved - **114 m**

Pedestrian crossing or a cut in the road to make it easier and safer for pedestrians to cross

Installation of accessible signages for guiding to the NGO.

Proposal of skills and training in GMC area

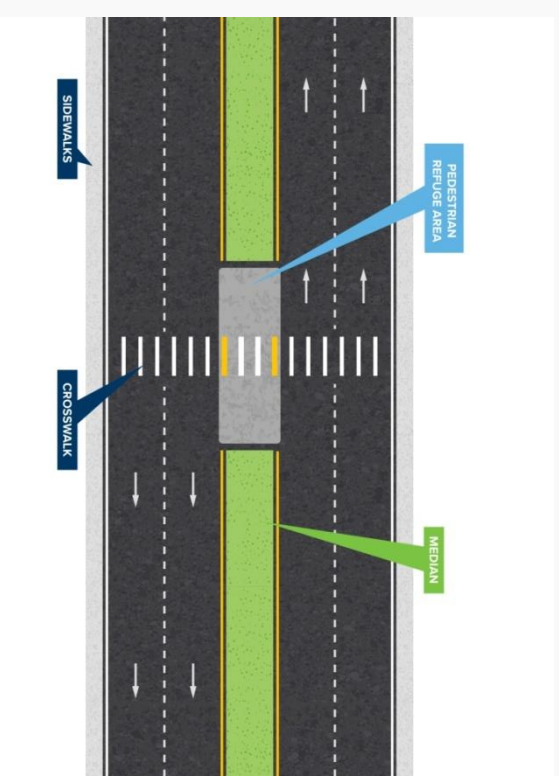
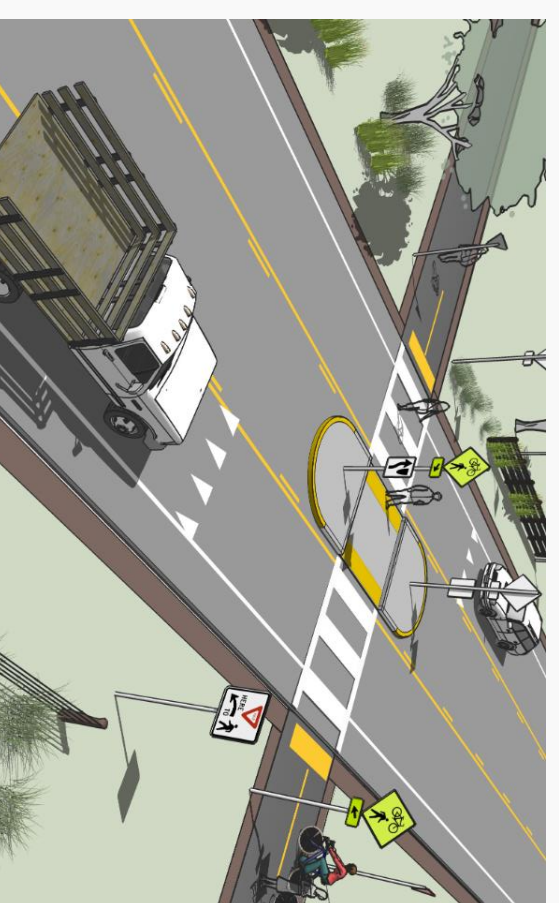
There are only five NGOs, and they are not accessible from every part of the city. This makes it difficult to educate, develop, and implement travel training programs. The level of road infrastructure service in pardi is very low, includes footpath condition, width , material, signages and signals, parking facilities.

General Recommendations

Optimizing driving techniques to prioritize gradual acceleration and deceleration minimizes abrupt movements.

Central medians and refuge : Pedestrian refuge should be required for safe and barrier-free road crossing.

- Uniformity in crossing distance should be maintained.
- It is essential to have pedestrian refuge (islands) in crossing



Implementing consistent auditory announcements for major stops, transfer points, and the end of the line, delivered audibly throughout the bus or prioritized in the front where seating for those with disabilities should be provided, facilities accessibility for passengers with visual impairments

Provide transport operators with complete training on the importance of using ramps and helping differently-abled.

- Empower differently-abled through education and training, focusing on mobility training for using public transport and navigating streets
- Ensure that information about public transit services is easily accessible and understandable for PWD, including route maps, schedules, and fare information

Reliability over time- Timely, real-time information on expected waiting times, service changes or delays enhances their ability to make alternative plans if needed.

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Enhancing Public Transport Accessibility for Differently

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