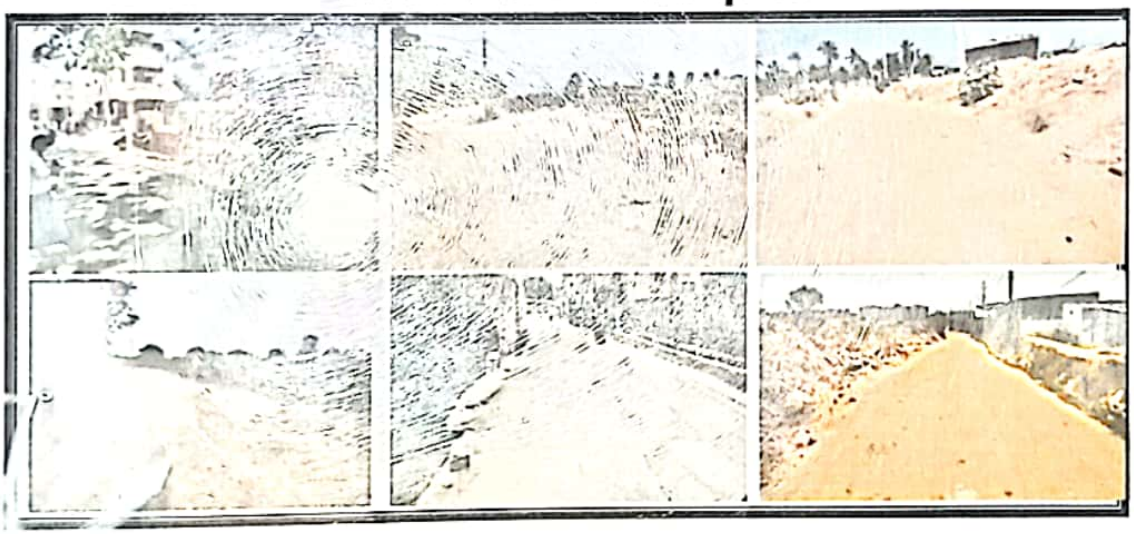
Bruhat Bengaluru MahanagaraPalike

Comprehensive Development and Improvements to the Roads connecting to ITPL Area Whitefield in RI Mahadevapura Division (Package - 02)

Detailed ProjectReport
Volume I – Main Report



Total Estimated Cost is Rs. 30.00 Crores

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Abbreviations/Acronyms

BBD	Benkelman Beam Deflection
BBMP	Bruhat Bengaluru MahanagaraPalike
BESCOM	Bengaluru Electricity Supply Company
BIS	Bureau of Indian Standards
BOQ	Bill of Quantities
BWSSB	Bengaluru Water Supply and Sewerage Board
CBR	California Bearing Ratio
CD	Cross Drainage
CECTC	Civil Experts Consultants and Testing Center
DPR	Detailed Project Report
DTM	Digital Terrain Model
FAR	Floor Area Ratio
GIS	Geographical Information System
GPR	Ground Penetrating Radar
HIP	Horizontal Intersection Point
Ht.	Height
IRC	Indian Road Congress
NMV	Non-Motorized Vehicles
OFC	Optical Fiber Cable
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
ROW	Right of Way
TCA	Typical Contract Agreement

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Chapter 1
Introduction

1.1. Project Background

Bruhat Bengaluru Mahanagara Palike (BBMP) is one of the premier organizations in the state of Karnataka.The Bruhat Bengaluru Mahanagara Palike is the administrative body responsible for the civic and infrastructural assets of the city of Bengaluru, India BBMPisinvolved in providing assistance and support for better planning and implementation of Urban infrastructure in Bengaluru.

Bangalore is growing at a rate, which is significantly higher than that of others. Due to the Growth in Economic Activities, the City is attracting migrants. To serve this Influx of Population, Residential Layouts are being developed. But adequate Transport Infrastructure Facilities such as Roads, Grade Separators, Subways, Mass Transit System, etc. to match this demand are conspicuously absent. The additional demand is to be catered by the already Saturated Road Network. Due to the Inherent Road Network in Bangalore, there are on the average 2 Major and 2 Minor Junctions per kilometer of Road Length. This has resulted in increase in Travel Time due to frequent Bottlenecks and Breakdowns.

The Urban Form of Bangalore is characterized by a Radio -Concentric System structured by Ring Roads, Five Major Radial Roads and Five Secondary Radial Roads. The Five Major Radial Roads are Mysore Road (SH 17) in the South / South West, Old Madras Road (NH 4) in the North / North East, Bellary Road in the North, Hosur Road (NH 7) in the South .East and Tumkur Road in the North West. Similarly, the Five Secondary Radial Roads include Magadi Road (SH 17E) in the West, Kanakapura Road (NH 209) in the South, Bannerghatta Road (SH -87) in the South, Varthur Road and Whitefield Road (SH 35) in the East. The differentiated development of the City based on Geographical Sectors and the Star like Growth Array along the Major Roads, mark the change from a Concentric Spatial Growth to a Sectorial and Linear Radial Development.

The Estimated Population of BBMP's 198 Wards as per the 2011 Census is 84.74 Lakh, up from 45.92 Lakh in 2001 and 24.75 Lakh in 1981. The extent of Developed Area has also increased considerably, in 1971 the Area was 174.7 Sq. km. and today it is about 800 Sq. km. In absence of Adequate Mass Transportation System, the use of personal motor vehicles for intra city travel has increased substantially. This has resulted in growth of motor vehicles, which is eight times the rate of population growth in the last two decades (1.91 Lakh vehicles in 1981 and 38.86 Lakh vehicles in 2011). The Public Transport System (Bus) is overstressed carrying about 50 Lakh Commuters on a daily basis. Congested

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Streets and Longer Route Length due to Urban Sprawl have only served to reduce Bus Frequencies further.

Mahadevapura is a suburban and one of the zones of BBMP in Bangalore district in the Indian state of Karnataka. It was a city municipal council. It is well connected with Outer Ring Road, Whitefield Road and Krishnarajapuram Railway Station is the nearest station to board trains. It is a developing area, which has a high growth potential in terms of residential development. Leading schools, shopping malls, showrooms have come up in the area. Most old residents have either rented out their apartments or sold their flats to developers. For those looking for a long-term investment, Mahadevpura and surrounding areas would be the best places.

The combined effect of all these on the Road Network of Bangalore is Delay and Congestion beyond Tolerable Limits. Vehicular Conflicts at the Intersections are being eliminated by Traffic Signals but at the Expense of Delays and Long Queues. The Peak Hour has spread over a longer period of time, since there are no Perceptible Capacity Augmentation / Conflic1 Reduction Measures. Traffic related Problems have become Regular Phenomena on Bangalore Roads, due to the Vast Developments. This fact is substantiated by the Traffic Study Results, at various Road Networks and Intersections of the City. Most of the Major Junctions of the Core City have crossed the mark of 10000 PCUs in the Peak Hour. Though number of Grade Separators have been constructed and are being constructed, most 'of them are located in the Developed Part of the City and causing a Trigger 0f Congestion at adjacent Junctions. Traffic Management Measures such as One Way Systems, Parking Restrictions, Junctions Improvements, etc. are being implemented to ease the Congested Street Network. But the ever increasing Traffic is fast deteriorating the Limited Improvement in Level of Service these Traffic Management Measures can offer.

As a Comprehensive Development Program for Improvement of Road Network, the Bruhat Bangalore Mahanagara Palike (BBMP) has planned Grade Separated Junction, Widening of Roads, Strengthening of Pavement Base and Sub -Base, Improvement to Pedestrian Facilities, Provision for Car Parking, etc. BBMP has constituted a separate cell to coordinate the Widening of Major Roads in Bangalore City in the face of Land Acquisition Challenges. This Response is the Answer to the severe strain on the Urban Infrastructure, which is inevitable due to the very rapid rate of growth in traffic. Travel Demands of Passengers have increased many folds in the last two decades. Unfortunately, Growth in the Infrastructure is not commensurate with the growing demands of traffic. There is an exigent need to effectively manage the Traffic and Transportation Systems to optimize the Solutions with Short Term and Long Term Measures.

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One of the Practical Steps towards Optimal Solutions that will also give an Immediate Relief to Traffic Scenario is Capacity Augmentation. Capacity Augmentation is not possible without widening the High Density Corridors. Increasing the Capacity of important corridors is inescapable in the long run even if it entails Land Acquisition at high cost. The Land Acquisition is proposed through a Process of Conferring Development Rights (Transfer of Development Rights), by which the owner of the land who has surrendered the part of the land towards infrastructure projects would be allowed to carry out construction based on enhanced Floor Space Index (FSI) conferred by the TDRs.

The existing Road Network System of Bangalore is a major concern, both in terms of Conditions of Roads and the Structure of the Network. The Basic Structure is Radio Concentric with about Ten Major Roads converging on the Centre. The Roads themselves are crowded and their Convergence creates Heavy Congestion. In order to ease the Traffic related Problems, the Bangalore Development Authority (BDA) constructed the Outer Ring Road (ORR) connecting all Major Roads and Highways in and around Bangalore. The newly Developed Areas on the outer side of the Ring Road have caused much increase in Traffic across the Ring Road, which in turn is obstructing Flow of Traffic along the Ring Road and the ORR is currently heading towards a Saturated State of Flow, leading to Planning of New Road Infrastructure Development.

Civil Experts Consultants & Testing Center, Bengaluru have been requested to submit a Detailed Project Report for the selected roads.

1.2. Project Road

The project roads are located in the Bengaluru city. An image showing the proposed project locations is presented in the **Figure 1.1.**

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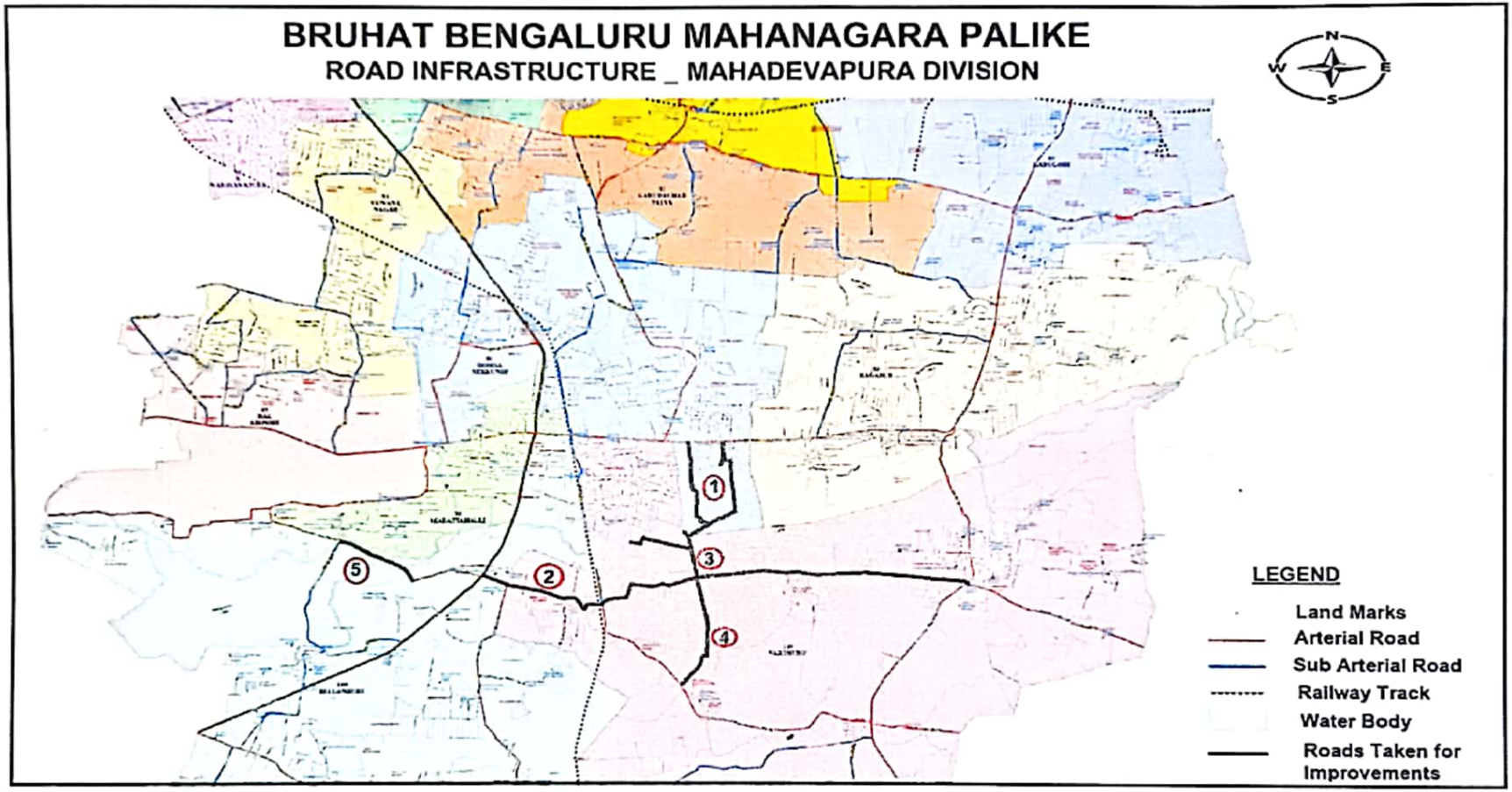

1. Improvements to Road From Varthur Road via Tubarahalli Outer Ring Road and Road from Vibgyaor School via Tubarahalli balagere up to BWSSB Treatment Plant Road (RMP Road)Link Road.
2. Improvements to Road from Varthur to Balagere Gunjur ORR and Kadubisanahalli Road.
3. Improvements to Road from Balagere BWSSB Treatment Paint Road to Munekolala Connecting Road.
4. Improvements to Road from Munekolala sai Layout to Gunjur Palya CDP Road.
5. Improvements of Yamalur Kariyammana Agrahara Road.

Figure 1.1: Project location of Roads

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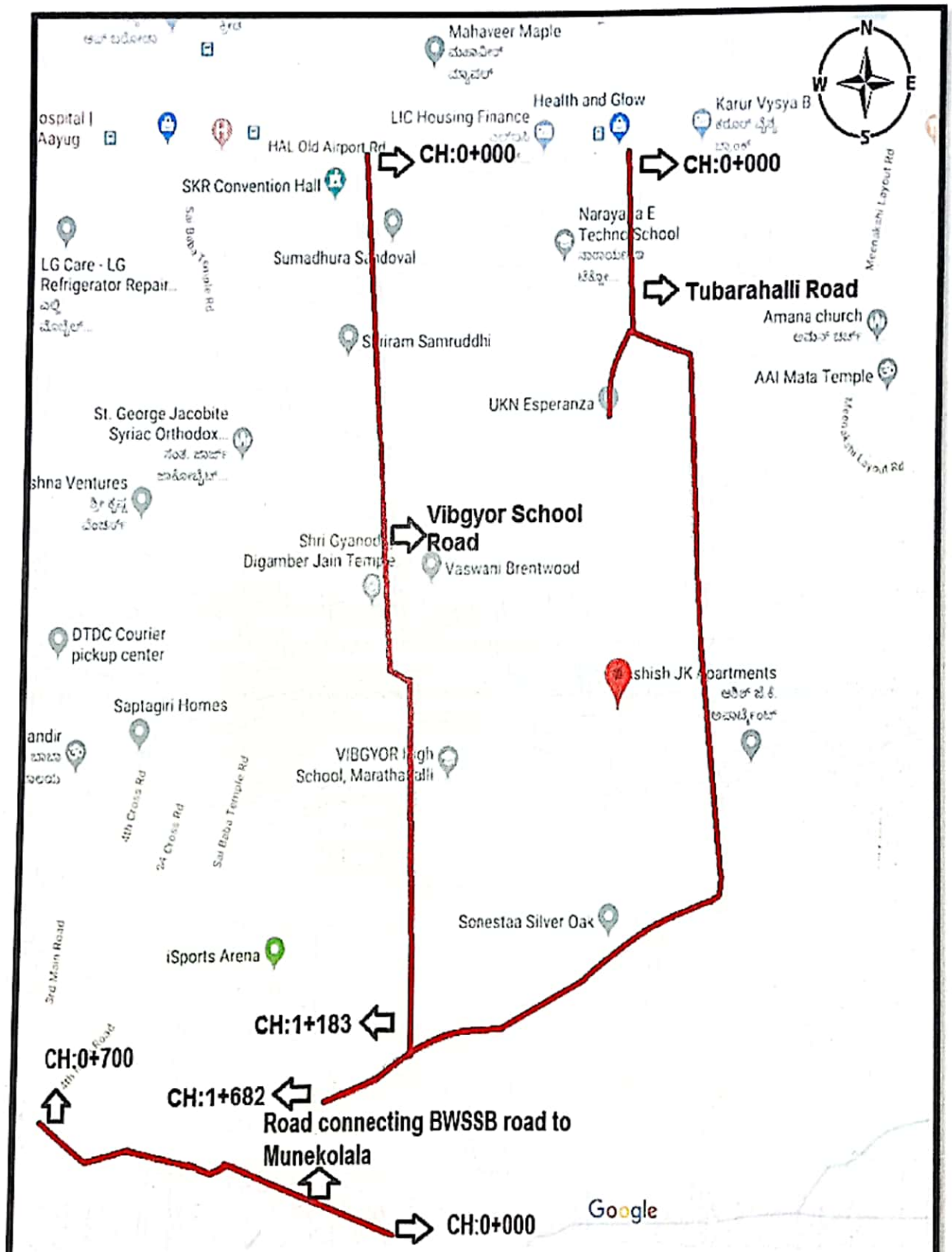

Improvements to Road From Varthur Road via Tubarahalli Outer Ring Road and Road from Vibgyaor School via Tubarahalli balagere up to BWSSB Treatment Plant Road (RMP Road) Link Road.

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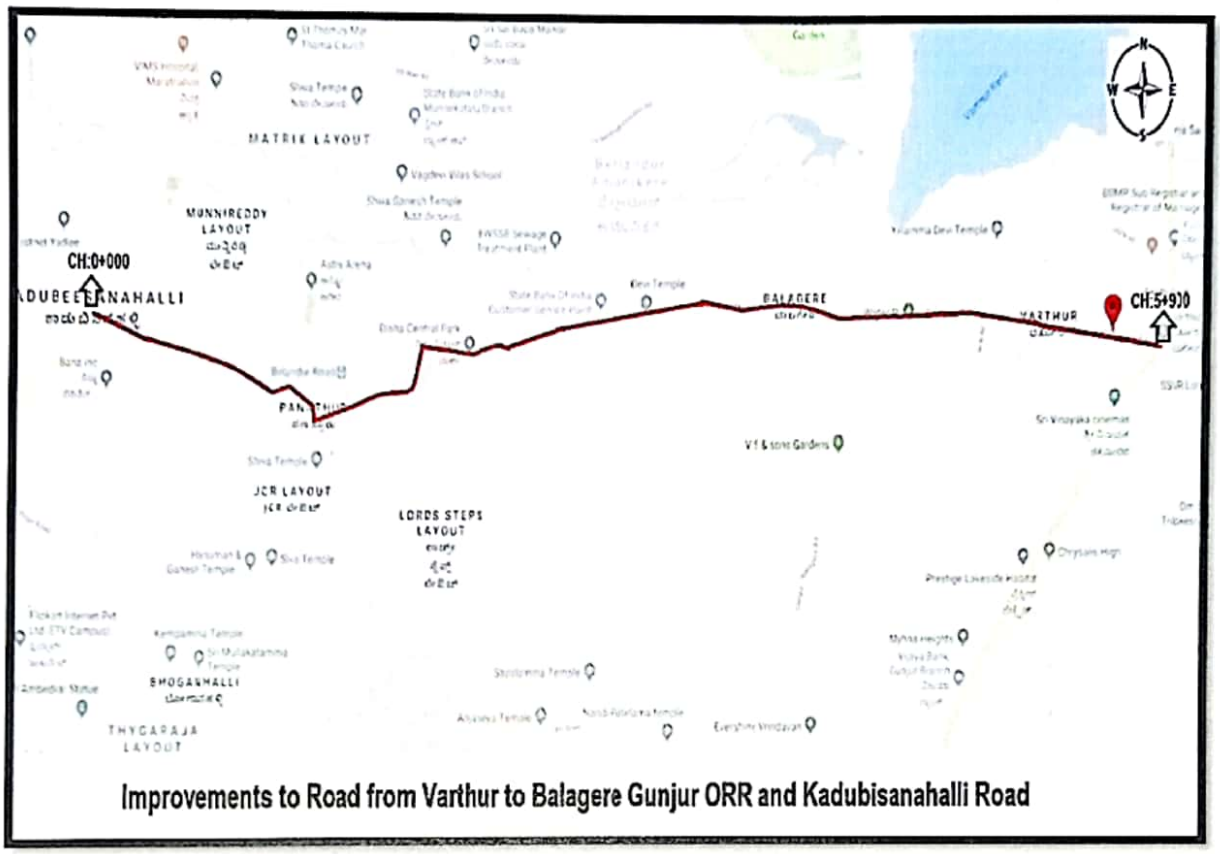
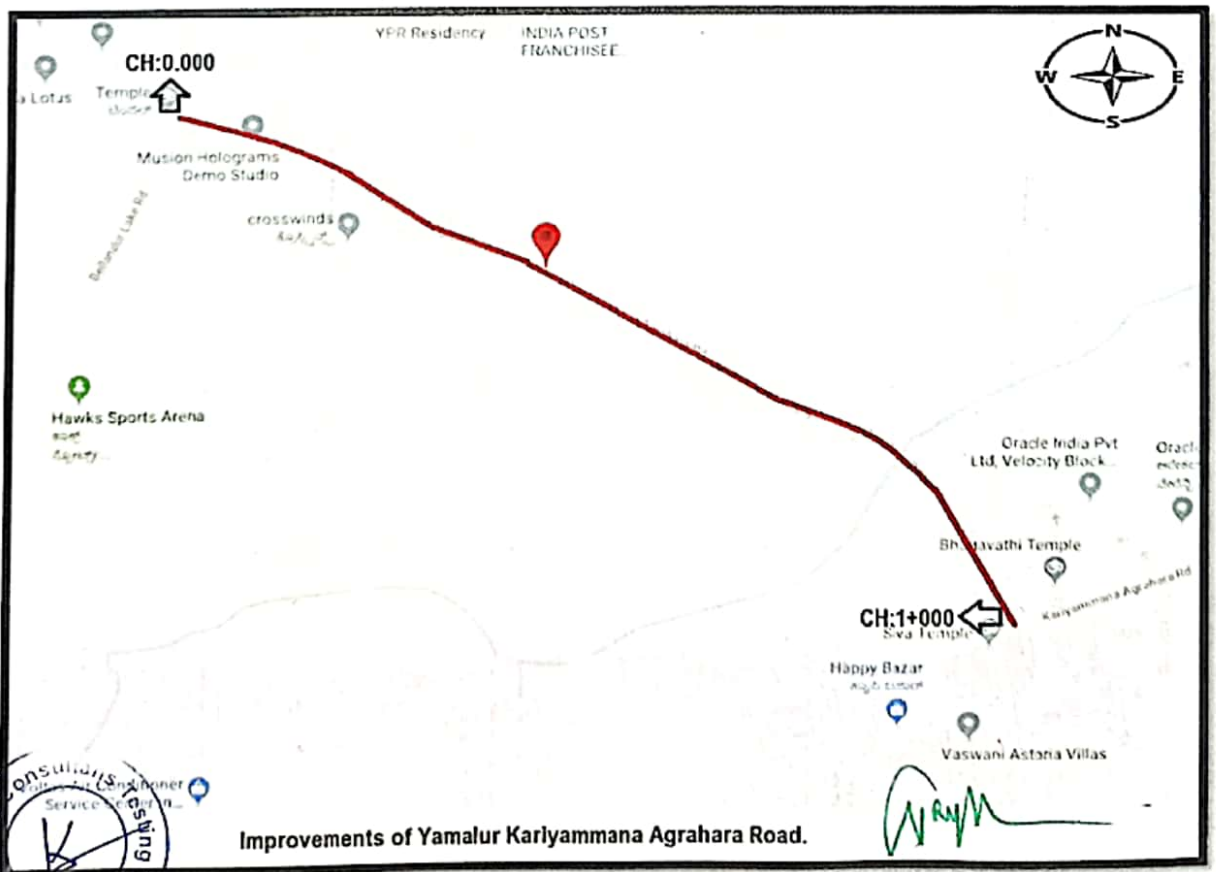


Improvements to Road from Varthur to Balagere Gunjur ORR and Kadubisanahalli Road



Improvements of Yamalur Kariyammana Agrahara Road.

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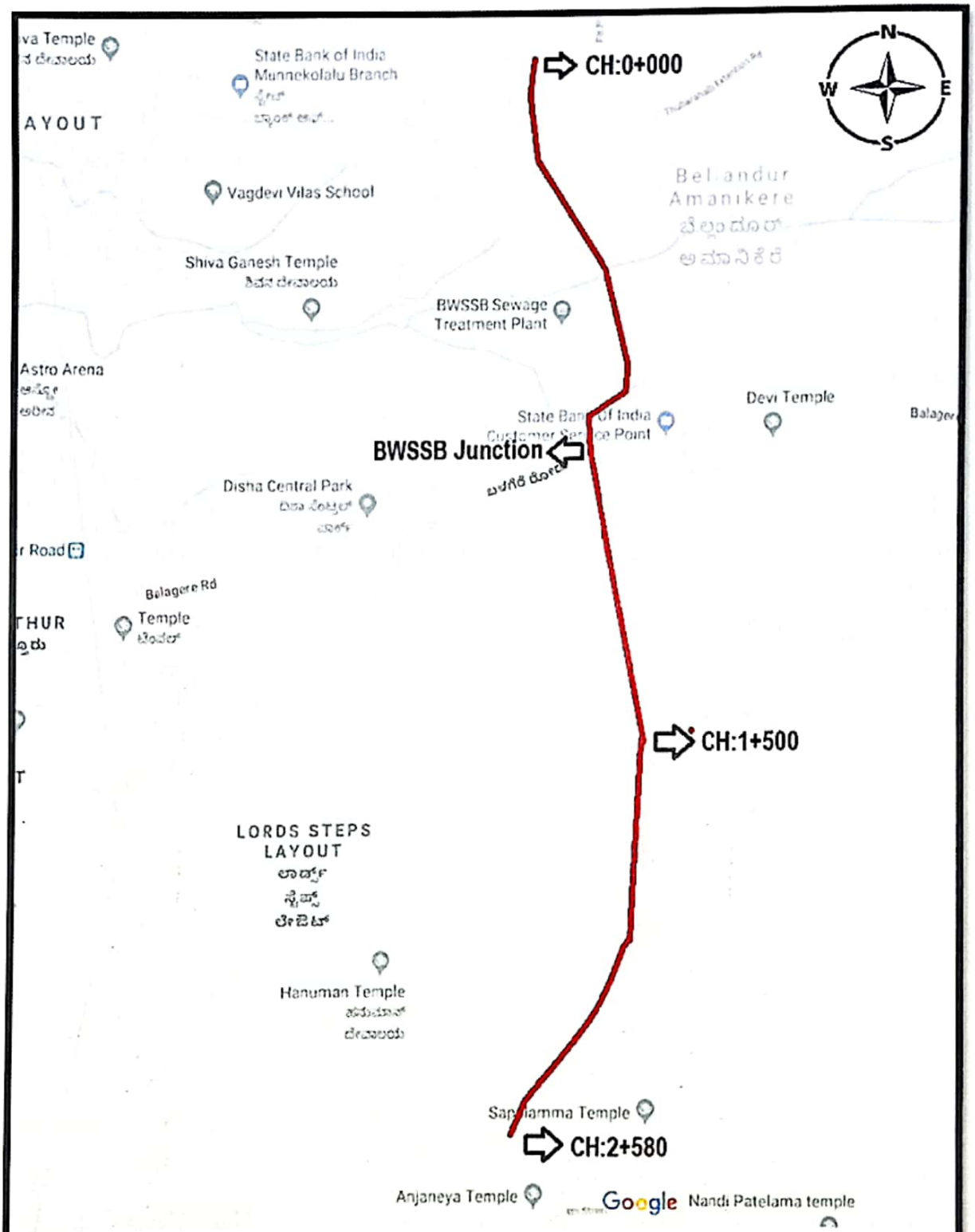

10. Improvements to Road from Balagere BWSSB Treatment Paint Road to Munekolala Connecting Road.

11. Improvements to Road from Munekolala sai Layout to Gunjur Palya CDP Road.

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1.3. Project Objective

The main objectives of the project are as under:

- To conduct necessary surveys, studies, investigations and designs required to prepare Detailed Project Report as per the norms of IRC.
- To prepare BOQ, Cost Estimates and specifications based on the detailed designs
- To prepare tender documents and implementation plan

1.4. Client

The Client for the present assignment is **Bruhat Bengaluru Mahanagara Palike**, represented by the **Executive Engineer**, RI-Mahadevapura, BBMP, Bengaluru.

1.5. Consultant

Civil Experts Consultants and Testing Center(CECTC) with its registered office in Bengaluru has been entrusted the work of preparation of Detailed Project Report, Cost Estimates, Tender documents and Implementation plan for the project roads.

1.6. Document organisation

The document is organized as follows:

Chapter 1 – Introduction

Chapter 2 – Scope of Work

Chapter 3 – Project Appreciation

Chapter 4 – Approach and Methodology

Chapter 5 – Design Standards & Code of Practice

Chapter 6 – Engineering Surveys & Investigation

Chapter 7 – Traffic Survey & Analysis

Chapter 8 – Design Proposal

Chapter9 – Cost Estimate

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Chapter 2
Scope of Work

2.1. Scope of Work

The Scope of the Study to be carried out by the Consultant involves the following.

- Review of Available Data and Reports.
- Topographical Survey of the Corridor.
- Road Inventory and Visual Condition Survey.
- Pavement Condition Survey.
- Test Pit Investigation Survey.
- Benkelman Beam Deflection Survey.
- Basic Engineering Designs along with Detailed Estimate for the Approved Concept.
- Preparation of Tender documents.

Furthermore, if any field activities are to be carried out during the survey it will be taken into consideration purely on need basis

2.2. Deliverables

Following deliverables are planned:

2.2.1. Documents

- Draft Detailed Project Report.
- Final Detailed Project Report

2.2.2. Drawings

- Location Plan
- Strip Plans
- Typical Cross Section of Road
- Miscellaneous Drawings

All deliverables will be submitted in hard (two) sets and soft copy. All soft copy will be in PDF format.

Drawings will be submitted in scale 1:1000, in A3 size.

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Chapter 3
Project Appreciation

3.1. General

As a part of project appreciation, the Consultant's engineers had a discussion with the Client's representative at the office of the Chief Engineer, BBMP, Bengaluru. The meeting was followed by a preliminary reconnaissance survey of the project site, to access the actual ground conditions. The findings and observations are enumerated in this chapter.

3.2. Demography

Bengaluru demography features that over 12 million people live in the city. Bengaluruisthe third densely populated city of India. According to the data of 2017, the population of Bengaluru is estimated to be around 12,300,000.Bengaluru demography also features that the growth rate of population is 4.1% per year. The density of population in Bengaluru is 17,000 per square kilometer.

3.3. Geography

Bengaluru lies in the southeast of Karnataka. It is in the heart of the Mysore Plateau (a region of the larger Precambrian Deccan Plateau) at an average elevation of 1010 m (3,448 ft) from the MSL. It is positioned at 12.97°N 77.56°Eand covers an area of 1741 km² (672.2 mi²).

3.4. Climate

Bengaluru always experiences a very soothing weather with warm summers and cold winters. But neither the summers are very hot, nor the winters are very cold. The maximum temperature level at the summer time can rise to 36°C whereas those during winter can even go below 17°C. The weather becomes foggy in the early mornings of October to February which is the maximum in the months of December and January. The climatic condition in Bengaluru is very much influenced by the low cloud during the months of June to September. The weather in Bengaluru is neither too humid nor too dry.

3.5. Rainfall

The average annual rainfall in Bengaluru is 859 mm.

3.6. Topography

The general terrain along the project road is predominantly plain.

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3.7. Land Use Pattern

Major section of the project roads traverses through Agricultural land, Residential and commercial establishments.

3.8. Project Roads

Details of the project roads are presented in **Table 3.1.**

Table 3.1: Details of project roads

No.	Chainage Start and End(Km)	Length (m)	Description
1. Improvements to Road From Varthur Road via Tubarahalli Outer Ring Road and Road from Vibgyaor School via Tubarahallibalagere up to BWSSB Treatment Plant Road (RMP Road)Link Road.			
Tubarahalli Road			
1.	0.000	1682	**Start of Project road**–HAL old Airport Road
2.	1.682		**End of Project road** – BWSSB Plant Road
Vibgyor Road			
1.	0.000	1183	**Start of Project road**–HAL Old Airport Road
2.	1.183		**End of Project road** – Dead End
Road Connecting BWSSB to Munekolala			
1.	0.000	700	**Start of Project road**– BWSSB Plant road
2.	0.700		**End of Project road** – 4th Main road
2. Improvements to Road from Varthur to BalagereGunjur ORR and Kadubisanahalli Road			
Balagere Road			
1.	0.000	5900	**Start of Project road** – Kadubisanahalli Bridge
2.	5.900		**End of Project road** – Varthuru Road

No.	Chainage Start and End(Km)	Length (m)	Description
3. Improvements to Road from Balagere BWSSB Treatment Palnt Road to Munekolala Connecting Road.			
1.	0.000	1500	**Start of Project road** –Sai Baba Temple Road
2.	1.500		**End of Project road** – till CH:1.500
4. Improvements to Road from Munekolala sai Layout to GunjurPalya CDP Road.			
1.	1.500	1080	**Start of Project road** – From Ch:1.500
2.	2.580		**End of Project road** – Panathuru Main road
5. Improvements of Yamalur – Kariyammana Agrahara Road.			
1.	0.000	1000	**Start of Project road** – Bellanduru Lake Road
2.	1.000		**End of Project road** – Dead end Kariyammana Agrahara Road

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Chapter 4
Approach and Methodology

4.1. Design Approach

The design approach followed by Consultant is illustrated in **Figure 4.1.**

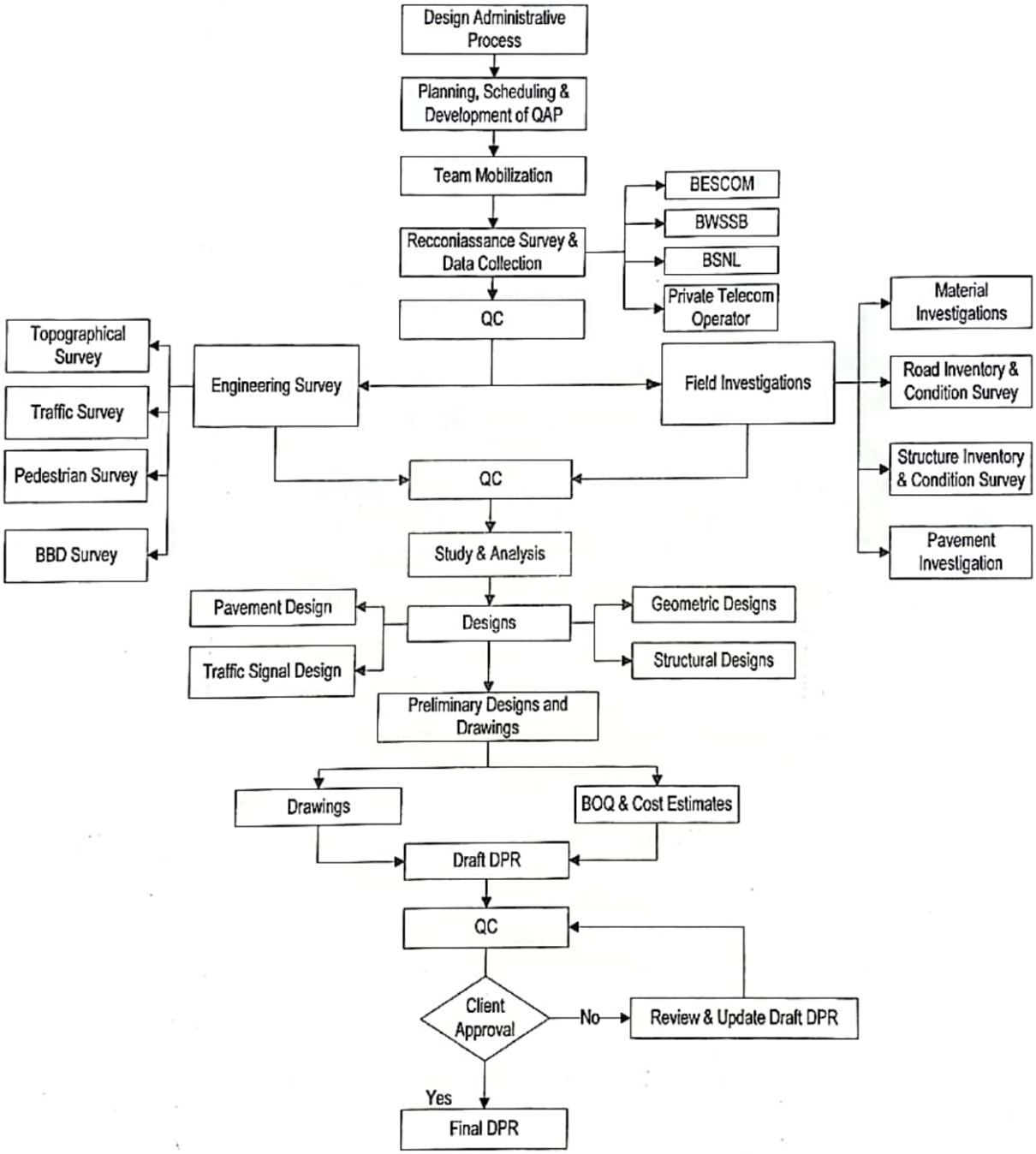

Figure 4.1: Design Administrative Process

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4.2. Methodology

Designing & Developing a Geo Database involves the following tasks:

- Reconnaissance Survey
- Engineering Survey
- Inventory and Field Investigation
- Existing RoW mapping – Cross section detailing and strip plan with entry exit mapping
- Pavement Design
- Geometric Design
- Road side storm water drains design
- Detailed design of junctions with plan, level, drainage, islands, marking, etc.,
- Cost Estimation and Bill of Quantities
- Power point presentation, meetings and discussions on the project at various levels
- Preparation of technical specifications and tender documents

The methodologies adopted by the consultant for the various tasks mentioned above aredetailed in the following sections.

4.2.1. Reconnaissance

The Reconnaissance of the project road has been undertaken to assess the following:

- Condition of the existing road
- Condition of existing structures if any.
- Conditions of existing pavement by conducting Pavement investigations at selected locations
- Existing RoW
- Provision for Pedestrian.
- Inventory of the existing utilities.
- Inventory and condition of existing CD structures if any.
- Inventory of existing signage
- Inventory of existing drainage system

The primary tasks to be accomplished during the reconnaissance surveys include:

- Topographical features of the area
- Typical features along the existing alignment within RoW
- Traffic pattern and preliminary identification of traffic homogeneous links

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- Sections through congested areas
- Critical areas requiring detailed investigations and requirements for carrying out supplementary investigations
- Type and extent of existing utility services along the alignment (within Row)

4.2.2. Engineering Survey

4.2.2.1. Topographic Survey

Detailed Topographical Survey has been carried out on the project roads. The survey was based on horizontal and vertical controls established using high precision Total station. It is also proposed to utilize high end precision survey equipment to gather all the existing features along the project roads. This was in addition to all the roads and topographical features such as existing carriage way, utilities, Right of Way, Trees, Structures and other ground features which are being surveyed covering the entire built up section. In addition, all the Cross Drainage structures if any will also be surveyed and shown. The detailed topographic survey has been taken up after the completion of reconnaissance survey.

The detailed field survey will essentially include the following:

- Topographic survey along the existing RoW: A continuous open traverse has been run along the existing road, wherever required. All cardinal points such as horizontal intersection points (HIP), centre points, transit points etc. has been fixed and the same was referenced with a pair of reference pillars fixed on either side of the centre-line at safe places within the RoW.
- Details of all features such as structures (bridges, culverts, etc.), utilities, existing roads, electric and telephone installations (both O/H as well as underground), buildings, fencing and trees (with girth greater than 0.3 m) oil and gas lines etc. falling within the RoW or building to building has been collected.

The topographical survey for longitudinal and cross sections werecovering the following:

- Longitudinal section levels along final center-line at every 30 m interval, at the locations of curve points, intersections and at the locations of change in elevation.
- Longitudinal section for cross roads for length adequate for design and quantity estimation purposes. (Minimum 50 m).

Details of all important physical features along the alignment have been collected during the topographic survey. These features was include buildings and structures, monuments, burial grounds, cremation grounds, places of worship, railway lines, stream/river/canal, water mains, sewers, gas/oil pipes,

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crossings, trees, plantations, utility services such as electric and telephone lines (O/H & U/G) and poles, OFCs etc. The survey would cover the entire RoW of the road on the adequate allowance for possible shifting of the central lines at some of the intersection locations.

The data collected has been shown on a strip plan so that the proposed improvements can be appreciated and utility removals of each type etc. assessed and suitable actions can be initiated. Separate strip plan for each of the services involved will be prepared for submission/coordination with the concerned agency.

The data from the topographic survey has been in x, y, z format for use in the Digital Terrain Model (DTM).

4.2.2.2. Traffic studies

All traffic surveys and studies required for the project road has been carried out as per the relevant IRC specifications.

- Classified volume counts of vehicles has been conducted for trucks, multi axle trucks (rigid and articulated separate), buses, cars, LCV (jeeps and vans), autos, two wheelers, cycles (two and three wheels separately) and carts.
- Duration for traffic survey:
  - For mid-block section, volume counts (straight counts) have been conducted for 1 day 16 hours in both the direction.
  - For junctions, volume counts (straight counts) have been conducted for 1 day 16 hours in both the directions.
  - Split volume count has been every 15 minutes.
  - Traffic survey at mid-block locations has been simultaneously started in both the directions.
  - The volume count has been recorded in the prescribed format.

4.2.3. Inventory and Field Investigation

4.2.3.1. Road Inventory

Preliminary inventory of the project road has been carried out covering but not limited to the following points:

- Existing RoW
- Abutting land use pattern
- Existing number of lanes and lane width

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- Type, width and condition of carriageway, shoulders, footpath, median and roadside drains
- Existing Trees, Lighting and Road Furniture.
- Condition of Sign Boards and Road Markings
- Details about existing type of parking
- Details of encroachment on footpath, shoulders
- Details of cross roads

4.2.3.2. Pavement Condition Survey

- The objective of the road and pavement condition survey has been to identify defects and sections with similar characteristics. All defects shall be systematically referenced, recorded and quantified for the purpose of determining the mode of rehabilitation.
- The pavement condition surveys have been carried out using visual means. Supplemented by actual measurements and in accordance with IRC 82, 37 and relevant codes.
- The shoulder and embankment conditions has been evaluated by visual means and the existence of distress modes (cuts, erosion marks, failure, drops) and extent (none, moderate, frequent and very frequent) of such distress manifestations will be recorded.
- For sections with severe distresses, additional investigations as appropriate have been carried out to determine the cause of such distress.

Detailed field studies have been carried out to collect road and pavement surface conditions. The data will cover the following:

- Pavement composition: The data concerning the pavement composition has been ascertained by trial pits. At each test, test pit reference (identification number, location), pavement composition (material type and thickness), subgrade type (textural classification) and condition (dry, wet) was recorded.
- Detailed field studies have been carried out to cover the pavement distress type such as cracking, raveling, potholing, edge break, rut depth and the extent of the same will be recorded.
- Shoulder condition details like: paved, unpaved(material loss, rut depth and corrugation) and edge drop will be recorded.

4.2.3.3. Benkelman Beam Deflection

Benkelman Beam Deflection (BBD) survey has been carried out in accordance with IRC: 81-1997, test points to be at 100m interval excluding in stretches where more readings are required.

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- Survey should be conducted for 100 m of intervals for each 3.5 m carriageway
- Temperature reading of pavement for every one hour of interval of time
- Soil sample collection for every 1 km intervals staggered

The BBD survey was not been carried out on badly damaged sections; instead test pits will be dug on each section not exceeding 100 m length to a depth of minimum 500 mm below subgrade level. The pavement layer types and thickness has been recorded and tests were made on samples taken from the bottom of the pit. Regular test pits as required by the BBD survey has been dug at the edge of the road, so as to record layer types and thickness in both carriageway and shoulder. Such test pits were located next to a BBD test location. The interval of such test pits were 1 km as specified by IRC: 81, which was include:

- Atterberg's limits and Grain size
- In situ density and Moisture content

4.2.4. Sub Soil Investigationslimited to selected locations

Detailed field studies have been conducted. Test pits were dug along road sections, which require widening. The minimum distance within such sections was 500 m, closer intervals were used where swelling soils and other unsuitable soils appear to be present. Test pits have been 1.0 m X 1.0 m and were dug to 1.5 m depth. The soil strata were recorded and samples taken at 1.0 m depth have been tested for Atterberg's Limits and Grain Size.

4.2.5. Traffic network flow mapping and existing signal timings

The traffic signal timing during peak and off peak hours are noted and signal timings optimized based on the traffic flow. At junctions where signals do not exist the need for traffic signals were ascertained based on the flow of traffic.

4.2.6. Existing RoW mapping – Cross section detailing and strip plan with entry exit mapping

The data from the topographic survey and the typical cross section developed for the project road is used as the input for mapping existing RoW, preparation of strip plan with entry exit mapping and cross section detailing.

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4.2.7. Identification of existing utility lines on survey drawing

Existing utilities along the project road such as electric poles, transformers, lighting, etc. has been identified during the topographical survey. The details of sub surface utilities were collected from concerned department and same has been superimposed on the alignment plan.

4.2.8. Detailed Design of Road and Pavements, drainage and traffic furniture

Detailed designs have been done and working drawings were prepared for the following:

- Design of pavement, paved shoulders, medians, sidewalk
- Preparation of alignment plans, longitudinal sections and cross sections at 50 m intervals
- Designs for road furniture and road safety/traffic control features
- Drainage design showing location of road side drawings, inlets, kerbs, etc.
- Cross drainage structures plan with drawings if changes required as per the investigation conducted.
- Pavement design has been carried out as per standards

4.2.9. Geometric Design

- Project road have uniform lanes and cross section features. Hence the design of geometric elements were therefore, taken into account the essential requirements of such facilities.
- Based on the data collected from reconnaissance and topographic surveys, the sections with geometric deficiencies, if any, would be identified and suitable measures for improvement would be suggested for implementation
- Major junctions were designed and provided with channelizing islands, storage lanes, free left turns, proper cross fall, drainage, etc.
- The provision of appropriate markings and signs were made wherever the existing site conditions do not permit the adherence to the sight distance requirements as per the standard norms.

4.3. Data Collection from Client and other Departments

The Consultant has been collect all available relevant data and information concerning the road i.e., past traffic data, existing utilities within the Right of Way, social and environment data.

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The departments / organizations from which the data is proposed to be collected are given in **Table** 4.1.

Table 4.1: Data collection

No.	Description	Authority	Contact Address
A.	**Meteorological department**		
1.	Rainfall data	Assistant director	Meteorological department, Bengaluru
2.	Temperature		
B.	**Water supply department**		
3.	Details of Water supply utilities along the project road.	Executive Engineer,	BWSSB, Bengaluru

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Chapter 5
Design Standards & Code of Practice

5.1. General

Planning and Designing of Roads and CD Structures, Pedestrian Facilities and Street Furniture are essentially based on the IRC Standards and Mort&H Specifications. Wherever the Codes/Standards are silent on some of the Aspects, the same has been planned/designed based on the Sound Engineering Practices. Design Standards relevant to the Project Road along with the Broad List of Design Parameters and the relevant IRC Codes/ Specifications have been detailed in **Table 5.1** Design Standards.

Table 5.1: Design Standards

Sl. No	Design Parameters	Reference Code
1.	Geometric Design Standards • Carriageway Width • Shoulder • Footpath • Median • Camber • Super Elevation • Horizontal Alignment • Vertical Alignment	As per IRC: 38, IRC: 86 and IRC: SP: 23
2.	Parking Facilities	As per IRC: SP:12
3.	Road Furniture • Road Delineators • Road Markings • Road Signs	As per IRC: 79 As per IRC: 35 As per IRC: 67
4.	Pedestrian Facilities	As per IRC: 103
5.	Road Capacity	As per IRC: 106
6.	Design of Flexible Pavement	As per IRC: 37
7.	Overlay Design	As per IRC: 81
8.	Road Drainage	As per IRC: SP: 42 and IRC: SP:50
9.	Culverts	As per Relevant IRC Codes and MoRT&H Specifications
10.	Bridges	

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The Project Road Section passes through Plain Terrain. Design Standards (as Appropriate) have been further elaborated under the following heads.

- Geometric Design
- Pavement Design
- Drainage
- Road Furniture and Appurtenances.
- Bridges and CD Structure.

National Standards have been studied and based on that suggested Standards for City Roads of Bangalore have been recommended for Approval and for Designing of Roads, Road Intersections, etc. Accordingly.

5.2. Design Standards Related to Geometric Design

Design Standards related to Road Geometric along with the suggested Design Values/ Standards and Recommended Values based on Site Conditions and Data Analysis are detailed in **Table 5.2** Geometric **Design Standards.**

Table 5.2: Geometric Design Standards

Sl. No.	Design Parameters	Design Values*
1.	Design Speed • Arterial Road • Sub Arterial Road • Collector Street • Local Street	 80kmph 60kmph 50kmph 30kmph
2.	Geometric Design Standards	
	• Carriageway Width	Single lane without kerb – 3.5m Two lane without kerb - 7m Two lane with kerb - 7.5m Three lane with or without kerb - 10.5/11m Four lane with or without kerb - 14m Six lane with or without kerb - 21m
	• Land Width	Arterial Road - 50-60m Sub Arterial Road - 30-40m Collector Street - 20-30m Local Street - 10-20m

	• Median	Absolute Minimum Width – 1.2m Desirable Minimum Width – 5.0m
	• Footpath	Minimum Width – 1.5m
	• Camber	1.7-3.0% for paved Carriageway
	• Kerb	Barrier/ Semi Barrier / Mountable (Semi Barrier type recommended)
	• Super Elevation	Limited to 4% on Urban Section
	• Minimum Radius of Horizontal Curve	40m for a Speed of 30kmph 105m for a Speed of 5kmph
	• Extra Widening at Curves	Nil for Radius above 300m
	• Gradient	Maximum Gradient – 4%(1in 25) Minimum Gradient for Drainage – 0.5% (desirable Minimum) and 0.3& (Absolute Minimum)

(Reference Code: IRC: 86 "Geometric Design Standards for Urban Roads in Plains")

5.3. Design Standards Related to Pavement Design

Design Standards related to Pavement Design are essentially based on the Guidelines given in IRC: 37 "Guidelines for Design of Flexible Pavements", IRC: 58 "Guidelines for Design of Rigid Pavements for Highways" and Overlay Design are essentially based on IRC: 81 "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam deflection Technique". The suggested Design Values / Standards and Recommended Values based on Site Conditions and Data Analysis are detailed in **Table 5.3** Pavement / Overlay Design Standards. The same have been adopted for the Design.

Table 5.3: Pavement / Overlay Design Standards

Sl. No.	Design Parameters	Reference Code / Design Values
1.	• Pavement Design	IRC: 37 "Guidelines for Design of Flexible Pavements" IRC: 58 "Guidelines for Design of Plain Jointed Rigid Pavements for Highways"
	• Traffic Growth Rate	Estimated Annual Growth Rate
	• Design Life	15-20 years for Arterial and Sub Arterial Road 10-15 years for Local and Collector Streets
	• Vehicle Damage Factor	As per IRC: 37

	• Lane Distribution Factor	As per IRC: 37
	• Minimum Thickness	Sub Grade – 500mm Sub Base – 150/200mm(<10msa/>10msa) Base – 225/250mm (<2msa/>2msa) Bituminous Surfacing – Desirably 40mm thick, to prevent Ingress of Water through surface
2.	• Overlay Design	IRC: 81 "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique"
	• Design Life	At least 10 years
	• Correction Factors	Temperature Correction Factor. Correction for Seasonal Variation (inclusive of Correction for Moisture Content, Soil type and Rainfall)
	• Minimum Thickness	From Structural Considerations, the recommended Minimum Bituminous Overlay 40mm Bituminous Concrete (BC).
3.	Wearing Course Material	Bituminous Concrete with Plastic Waste

5.4. Design Standards Related to Road Drainage

Drainage of Water from Pavement Surface is of paramount importance as far as preserving the Road Assets created by investing huge funds in addition to maintenance of Structural Soundness and Functional Efficiency of the Road. Design Standards related to Road Drainage are essentially based on the Guidelines given in IRC: SP: 42 "Guidelines on Road Drainage" and in IRC: SP; 50 "Guidelines on Urban Drainage". The suggested Design Values / Standards are detailed in **Table 5.4** Design Standards Related to Road Drainage.

Table 5.4: Design Standards Related to Road Drainage

SL. No.	Design Parameters	Design Values
1.	• Camber	1.7-3.0%(bi directional) for Carriageway
	• Longitudinal Gradient	Minimum 0.3% for satisfactory Drainage
	• Drain Type	RCC Box Drain with Precast RCC Cover Slab.

r/Road, opp: mini vidhana souda, Yadagiri.

5.5. Design Standards Related to Road Furniture and Appurtenances

Utility and Importance of the Road are greatly enhanced by installing Road Furniture and Appurtenances at Appropriate Locations along the Project Road, which ensures Improved Road Safety. Planning and Designing of Road Furniture and Appurtenances are as per the Guidelines stipulated in IRC. Detailing of each of these Components has been done so that to integrate the same with the Road Improvement Scheme. The suggested Design Values / Standards are detailed in **Table 5.5** Design Standards Related to Road Furniture and Appurtenances.

Table 5.5: Design Standards Related to Road Furniture and Appurtenances

SL. No.	Design Parameters	Reference Code / Design Values
1.	Road Markings	IRC: 35 "Code for Practice for Road Markings".
2.	Road Signs	IRC: 67 "Code of Practice for Road Signs".
3.	Road Delineators	IRC: 79 "Recommended Practice for Road Delineators".
4.	Pedestrian Facilities	IRC: 103 "guidelines for Pedestrian Facilities".

In addition to the above Measures, various other Integral Road Components have been planned so that to achieve the Maximum and Optimal use of the Carriageway with no / least Interference to Traffic Flow and at the same time ensuring Adequate Facilities to other Road Users especially Pedestrians. All the Encroachments, if any shall be cleared within the ROW.

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Chapter 6
Engineering Surveys & Investigation

6.1. General

Various Surveys and Investigations that are essential Inputs for Detailed Engineering Design are detailed in this chapter. All the relevant Maps / Data / Details available with the Concerned Departments have been collected, compiles and reviewed. Particular Attention has been given to Past / Historical Data / Reports. A Review of the Past data available in the various studies has been listed out and such Available Data has been made use of, after updating / augmenting the Data wherever necessary. The data as collected have been made use of Analysis, Design, Formulation of the Improvement Proposals and Costing. The activities have been performed on several fronts fully complying with Requirements. The activities that have been carried out are succinctly brought out hereunder.

The Various Engineering Surveys / Investigations of the Road Sections include:

- Reconnaissance Survey.
- Topographical Survey.
- Benkelman Beam Deflection Survey.
- Test Pit Investigation Survey.

6.2. Reconnaissance Survey

Reconnaissance Survey of the Project Corridors, considered for Improvements for a total length of 12.9 Km, has been carried out to identify the General Condition of Roads, drains, Culverts and Bridges for further Surveys / Investigations, to understand the Kind Establishments along the Project Stretch. Making use of the Observations / Data Collected during Reconnaissance Survey, Detailed Schedule for Surveys / Investigations required for the project hasbeen finalised.

6.3. Topographical Survey

Topographical Survey has been carried out using Total Station based on the Requirements initiated in the Reconnaissance Survey. A Comprehensive Topographic Survey has been conducted all along the Corridor using Total Station Equipment to accurately map the area and obtain the Present Information on Road Width, Adjoining Land Use, building offsets and Levelling Data using Auto Level. The Profiles and Levels of the Road Network within the Study Area have been also captured by taking Longitudinal

and Cross Sectional Levels. The Extent of Survey has been limited to 100m beyond the Battery Limit on Both sides of the Project Corridors. The Details have been Captured adequately for Planning and Designing of proposed Corridor Development Scheme. The Data Captured is in 3D Format which have been directly downloaded to Computers and is compatible for Modern Design Softwares. Topographical Map is given in **Volume III- Drawings.**

6.4. Road Inventory and Condition Survey

A Detailed Inventory and Condition Survey of Road Sections have been carried out by making use of well structured Inventory Data Format. Various Data collected during the Road Inventory broadly include

- Road Length and Number of Lane.
- Surface Type and Condition.
- Shoulder, Median, Drain (Tertiary/Shoulder), Footpath- Type and Width.
- Right of Way.
- Cross Drainage and Bridge Structures.
- Land use type.
- Road Furniture.
- Illumination.
- Salient Buildings and Structures.
- Utility Data.
- Trees.
- Details of Major Junctions.
- Bus/ Auto Stops.
- On street Parking.

All the above Information have been compiled and presented (Chainage wise) in the form of tables for easy understanding. The data captured with respect to Road Geometry have been made use of to identify the Scope for Improvement in Road Geometry and Width of Carriageway.

The Details of Road Inventory and Condition Survey in tabular form are given in **Table 6.1**

Table 6.1: Details of Road Inventory

Name of Project : Improvements to Road from Varthur Road Via Tubarahalli Outer Ring Road and Road from Vibgyor School Via Tubarahalli balagere up to BWSSB Treatment Plant Road (RMP Road) Link Road
Road Name : Tubarahalli road
Location :
Direction :
Road Classification :
Date : 26-03-2019
Time :

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
			Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]		Location/ Chainage	Left/ Right	Width	Type[1]	Condition[2]	Condition[2]	Width	Condition[2]	Condition[2]	Width	Condition[2]	Type	Width	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	No's	Condition[2]	Number of tree	girth size	
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)		(G/P)	(No's)	Dia (m)	
	0.000	0.030	BT	7.8	P																									RCC	0.9	P	1.2	P					
	0.030	0.060	BT	7.8	P								0.013	R	3	CC	P	P/ER	1.2											RCC	0.9	P	1.2	P					
	0.060	0.090	BT	7.8	P								0.013	R	3	CC	P	P/ER	1.2											RCC	0.9	P	1.2	P					
	0.090	0.120	BT	7.8	P								0.013	R	3	CC	P	P/ER	1.2											RCC	0.9	P	1.2	P					
	0.120	0.143	BT	7.8	P								0.013	R	3	CC	P	P/ER	1.2											RCC	0.9	P	1.2	P					
	0.143	0.163	BT	6	P								0.013	R	3	CC	P	P/ER	1.2											RCC	0.9	P	1.2	P					
	0.163	0.190	BT	9	P																																		already WMM laid in some reaches
	0.190	0.220	BT	9	P																																		already WMM laid in some reaches
	0.220	0.230	BT	9	P																																		already WMM laid in some reaches
	0.230	0.250	BT	8	P																																		already WMM laid in some reaches
	0.250	0.280	ER	9	P																																		Provide New culvert and Juction improvement
	0.280	0.310	ER	9	P																																		
	0.310	0.340	ER	9	P																																		
	0.340	0.370	ER	9	P																																		
	0.370	0.400	ER	9	P																																		
	0.400	0.430	ER	9	P																																2	0.3	
	0.430	0.450	ER	9	P																																		
	0.450	0.500	ER	9	P																																		
	0.500	0.530	BT	7	P																																		
	0.530	0.560	BT	7	P																																		
	0.560	0.590	BT	7	P																																		
	0.590	0.620	BT	7	P																																9	0.3	
	0.620	0.660	BT	7	P																																		LS Farm land
																																						LS Farm land
																																						LS Farm land

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No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general Information)
						Left			Right								Left			Right																					
			Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]		Location/ Chainage	Left/ Right	Width	Type[1]	Condition[2]	Condition[1]	Width	Condition[2]	Condition[2]	Width	Condition[2]	Type	Width	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	No's	Condition[2]	Number of trees	garth size	
	(km)	(km)	(BT/ CC/ GR/ ER)	(m)	(G/ P)	(BT/ CC/ GR/ ER)	(m)	(G/ P)	(BT/ CC/ GR/ ER)	(m)	(G/ P)		(km)		(m)	(BT/ CC/ GR/ ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/ P/)	P/K	(m)	(RCC /BS/S SM/S B)	(m)	(P/DS /BS)	(m)	(G/ P)	(RCC /BS/S SM)	(m)	(P/DS /BS)	(m)	(G/ P)		(G/P)	(No' s)	Dia (m)	
	0.680	0.710	BT	3.75	P																																		WMM already laid in some reaches
	0.710	0.740	BT	3.75	P																																		WMM already laid in some reaches
	0.740	0.770	BT	3.75	P																																		
	0.770	0.800	BT	3.75	P																																		WMM already laid in some reaches
	0.800	0.830	BT	3.75	P																																		WMM already laid in some reaches
	0.830	0.860	BT	3.75	P																																		WMM already laid in some reaches
	0.860	0.890	BT	3.75	P																																		WMM already laid in some reaches
	0.890	0.920	BT	3.75	P																																		WMM already laid in some reaches
	0.920	0.950	BT	3.75	P																																		
	0.950	1.000	ER	7	P																																		
	1.000	1.668	ER	7	P																																		
	1.668	1.030	ER	7	P																																		
	1.030	1.060	ER	7	P																																		
	1.060	1.090	ER	7	P																																		
	1.090	1.120	ER	7	P																																		
	1.120	1.150	ER	7	P																																		
	1.150	1.180	ER	7	P																																		
	1.180	1.210	ER	7	P																																		
	1.210	1.240	ER	7	P																																		

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
			Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]		Location/ Chainage	Left/ Right	Width	Type[1]	Condition[2]	Condition[2]	Width	Condition[2]	Condition[2]	Width	Condition[2]	Type	Width	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	No's	Condition[2]	Number of tree	garth size	
						Left			Right								Left			Right																			
	(km)	(km)	(BT/ CC/ GR/ ER)	(m)	(G/ P)	(BT/ CC/ GR/ ER)	(m)	(G/ P)	(BT/ CC/ GR/ ER)	(m)	(G/ P)		(km)		(m)	(BT/ CC/ GR/ ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/ P/)	P/K	(m)	(RCC /BS/S SM/S B)	(m)	(P/DS /BS)	(m)	(G/ P)	(RCC /BS/S SM)	(m)	(P/DS /BS)	(m)	(G/ P)		(G/P)	(No' s)	Dia (m)	
	1.240	1.270	ER	7	P																																		
	1.270	1.300	ER	7	P																																		
	1.300	1.330	ER	7	P																																		
	1.330	1.360	ER	7	P																																		
	1.360	1.390	ER	7	P																																		
	1.390	1.410	ER	7	P																																		
	1.410	1.440	ER	7	P																																		
	1.440	1.470	ER	7	P																																		
	1.470	1.500	ER	7	P																																		
	1.500	1.530	ER	7	P																																		
	1.530	1.560	ER	7	P																																		
	1.560	1.590	ER	7	P																																		
	1.590	1.620	ER	7	P																																		
	1.620	1.650	ER	7	P																																		
	1.650	1.668	ER	7	P																																		
	Towards Esperanza Appartment																																						
	0.000	103.000	BT	(7+8+9)/3	P																																		

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BBMP, Bangalore

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Road Name : Vibgyor Road

Road Classification :

Location :

Direction :

Date : 26-03-2019

Time :

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
			Type[1]	Width	Condition[2]	Left Type[1]	Left Width	Left Condition[2]	Right Type[1]	Right Width	Right Condition[2]		Location/ Chainage	Left/Right	Width	Type[1]	Left Condition[2]	Left Condition[2]	Left Width	Right Condition[2]	Right Condition[2]	Right Width	Condition[2]	Type	Width	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	No's	Condition[2]	Number of trees	garth size	
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P/)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)	(G/P)		(No's)	Dia (m)	
	0.000	0.030	BT	8.0	VP																																		
	0.030	0.030	BT	8.0	VP																																		
	0.030	0.060	BT	8.0	VP																																		
	0.060	0.088	BT	8.0	VP																																		
	0.088	0.110	BT	8.0	VP												P			P					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.110	0.120	BT	8.0	VP												P			P					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.120	0.150	BT	8.0	VP												P			P					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.150	0.188	BT	8.0	VP												P			P					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.188	0.217	BT	8.0	VP								0.188	L/R	20/20	G														RCC	0.9	P	1.2	P					
	0.217	0.300	BT	8.0	P																									RCC	0.9	P	1.2	P					
	0.300	0.250	BT	8.0	P																									RCC	0.9	P	1.2	P					
	0.250	0.280	BT	8.0	P																									RCC	0.9	P	1.2	P					
	0.280	0.300	BT	8.0	P																									RCC	0.9	P	1.2	P					
	0.300	0.330	BT	8.0	P																				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.330	0.360	BT	8.0	P																				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.360	0.386	BT	8.0	P																				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.386	0.410	BT	9.0	P								0.418	R	4	G														RCC	0.9	P	1.2	P					existing Building tiles
	0.410	0.442																																					
	0.442	0.471	BT	8.0	P								0.442	R	8	G														RCC	0.9	P	1.2	P					
	0.471	0.709	BT	8.0	G																																		CH:0.557-R/S Samantra Rainbow MTB

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No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
			Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]	Type[1]	Width	Condition[2]		Location/ Chainage	Left/Right	Width	Type[1]	Condition[2]	Condition[2]	Width	Condition[2]	Condition[2]	Width	Condition[2]	Type	Width	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	No's	Condition[2]	Number of trees	garth size	
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P/)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)		(G/P)	(No's)	Dia (m)	
	0.709	0.500	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.500	0.530	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.530	0.560	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.560	0.590	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.590	0.610	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.610	0.640	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.640	0.670	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.670	0.709	BT	8.0	G																									RCC	0.9	P	1.2	P					
	0.709	0.753	BT	8.0	G																									RCC	0.9	P	1.2	P					CH:0.753-L/S Vibgyor School
	0.753	0.800	BT	4.5	P	ER	5	P																		RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.800	0.900	BT	4.5	P	ER	5	P									P			P						RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.900	0.830	BT	4.5	P	ER	5	P									P			P						RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.830	0.860	BT	4.5	P	ER	5	P									P			P						RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.860	0.900	BT	4.5	P	ER	5	P									P			P						RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.900	1.068	BT	9.0	G																									SM	0.9	-	-	P					

Executive Engineer,
Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

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Name of Project: Improvements to Road from Varthur to Balagere Gunjur ORR and Kadubisanahalli Road

Road Name : Balagere Road

Road Classification :

Location :

Date : 24-04-2019

Direction :

Time :

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																			
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)		(G/P)	(No's)	Dia (m)	
	0.000	0.040	BT	10.8	P												P/CC	P/Cob	2.5							RCC	0.9	P	1.2	P										L/S 3m Cutting Portion
	0.040	0.070	BT	10.8	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P										L/S 3m Cutting Portion
	0.070	0.100	BT	10.8	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P										L/S 3m Cutting Portion
	0.100	0.132	BT	10.8	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P										L/S 3m Cutting Portion
	0.132	0.160	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P										L/S 3m Cutting Portion
	0.160	0.190	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P										L/S 3m Cutting Portion
	0.190	0.220	BT	9.0	P																					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P				L/S 3m Cutting Portion
	0.220	0.250	BT	9.0	P																					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P				
	0.250	0.265	BT	9.0	P																					RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P				
	0.265	0.290	BT	8.5	P								0.265	R	25	BT	P/CC	P/Cob	2.5	P/CC	P/Cob	2.5																		Cobbles and kerbs are missed
	0.290	0.320	BT	8.5	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5																		Cobbles and kerbs are missed
	0.320	0.354	BT	8.5	P	-			-								P/CC	P/Cob	2.5	P/CC	P/Cob	2.5																		Cobbles and kerbs are missed
	0.354	0.380	BT	8.8	P								0.354	L	6	BT	P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P				
	0.380	0.400	BT	8.8	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P				
	0.400	0.430	BT	9.5	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P				L/S WMM 2m existing

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No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general Information)
						Left			Right								Left			Right																				
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)		(G/P)	(No's)	Dia (m)	
	0.430	0.460	BT	9.5	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					L/S WMM 2m existing
	0.460	0.490	BT	9.5	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					L/S WMM 2m existing
	0.490	0.520	BT	9.5	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					L/S WMM 2m existing
	0.520	0.550	BT	9.5	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					L/S WMM 2m existing
	0.550	0.583	BT	9.5	P								0.583	R	7	BT	P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					L/S WMM 2m existing
	0.583	0.610	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.610	0.640	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.640	0.670	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.670	0.700	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.700	0.730	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.730	0.753	BT	9.0	P								0.753	L	7	BT	P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.753	0.780	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					Drain Footpath Missed
	0.780	0.810	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					Drain Footpath Missed
	0.810	0.840	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					Drain Footpath Missed
	0.840	0.856	BT	9.0	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					Drain Footpath Missed
	0.856	0.880	BT	8.8	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.880	0.910	BT	8.8	P												P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.910	0.952	BT	8.8	P								0.952	R	7	BT	P/CC	P/Cob	2.5	P/CC	P/Cob	2.5				RCC	0.9	P	1.2	P	RCC	0.9	P	1.2	P					
	0.952	0.986	BT	7.0	P																					RCC	0.9	BS	1.2	P	RCC	0.9	BS	1.2	P					
	0.986	1.030	BT	7.0	P																					RCC	0.9	BS	1.2	P	RCC	0.9	BS	1.2	P					
	1.030	1.060	BT	4.5	P								1.030	L	7	BT																								Drains are missed
	1.060	1.090	BT	4.5	P																																		Drains are missed
	1.090	1.120	BT	4.5	P																																		Drains are missed

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No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P)/(CC/SS)	(G/P)/(CC/ER/T)	(m)	(G/P)/(CC/SS)	(G/P)/(CC/ER/T)	(m)	(G/P)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)		(G/P)	(No's)	Dia (m)	
	1.120	1.150	BT	4.5	P																																		Drains are missed
	1.150	1.187	BT	4.5	P																																		Drains are missed
	1.187	1.210	BT	5.0	P																									BS	0.6	BS	0.9	P					
	1.210	1.243	BT	5.0	P																									BS	0.6	BS	0.9	P					
	1.243	1.270	BT	5.5	P																				BS	0.6	BS	0.9	P	BS	0.6	BS	0.9	P					
	1.270	1.300	BT	5.5	P																				BS	0.6	BS	0.9	P	BS	0.6	BS	0.9	P					
	1.300	1.330	BT	5.5	P																				BS	0.6	BS	0.9	P	BS	0.6	BS	0.9	P					
	1.330	1.360	BT	5.5	P																				BS	0.6	BS	0.9	P	BS	0.6	BS	0.9	P					
	1.360	1.388	BT	5.5	P																				BS	0.6	BS	0.9	P	BS	0.6	BS	0.9	P					
	1.388	1.410	BT	7.0	P							9																		ER	0.6	-	-	P					CH:1.388- railway Bridge
	1.410	1.440	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.440	1.470	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.470	1.500	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.500	1.530	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.530	1.560	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.560	1.590	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.590	1.620	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.620	1.650	BT	7.0	P							9																		ER	0.6	-	-	P					
	1.650	1.680	BT	9.0	P							11													SSM	0.6	BS	0.8	P	ER	0.6	-	-	P					Electric Poles-29
	1.680	1.710	BT	9.0	P							11													SSM	0.6	BS	0.8	P	ER	0.6	-	-	P					
	1.710	1.740	BT	9.0	P							11													SSM	0.6	BS	0.8	P	ER	0.6	-	-	P					
	1.740	1.770	BT	9.0	P							11													SSM	0.6	BS	0.8	P	ER	0.6	-	-	P					
	1.770	1.805	BT	9.0	P							11													SSM	0.6	BS	0.8	P	ER	0.6	-	-	P					
	1.805	1.830	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	1.830	1.860	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	1.860	1.890	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	1.890	1.920	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	1.920	1.950	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	1.950	1.980	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	1.980	2.000	BT	8.5	P																									SSM	0.6	BS	0.8	P					
	2.000	2.030	BT	7.5	P																				ER	0.6	-	-	P	ER	0.6	-	-	P					

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No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
	(km)	(km)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)		Location/ Chainage (km)	Left/ Right	Width (m)	Type[1] (BT/CC/GR/ER)	Condition[2] (G/P)/(CC/SS)	Condition[2] (G/P)/(CC/ER/T)	Width (m)	Condition[2] (G/P)/(CC/SS)	Condition[2] (G/P)/(CC/ER/T)	Width (m)	Condition[2] (G/P)	Type P/K	Width (m)	Drain Type[4] (RCC/BS/SSM/SB)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	Drain Type[4] (RCC/BS/SSM)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	No's	Condition[2] (G/P)	Number of tree (No's)	garth size Dia (m)	
	2.030	2.060	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.060	2.090	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.090	2.120	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.120	2.147	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.147	2.170	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.170	2.200	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.200	2.230	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.230	2.252	BT	7.5	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.252	2.280	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.280	2.310	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.310	2.340	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.340	2.370	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.370	2.400	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.400	2.430	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.430	2.460	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.460	2.490	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.490	2.520	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.520	2.562	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.562	2.647	BT	7.0	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.647	2.670	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.670	2.700	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.700	2.730	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.730	2.760	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.760	2.790	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.790	2.820	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.820	2.850	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.850	2.880	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.880	2.910	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.910	2.940	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.940	2.970	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	2.970	3.000	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.000	3.030	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.030	3.060	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.060	3.094	BT	5.8	P																						ER	0.6	-	-	P	ER	0.6	-	-	P					

Civil Experts Consultants Testing Center

Executive Engineer
Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																			
	(km)	(km)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)		Location/ Chainage (km)	Left/ Right	Width (m)	Type[1] (BT/CC/GR/ER)	Condition[2] (G/P) (CC/SS)	Condition[2] (G/P) (CC/ER/T)	Width (m)	Condition[2] (G/P) (CC/SS)	Condition[2] (G/P) (CC/ER/T)	Width (m)	Condition[2] (G/P)	Type P/K	Width (m)	Drain Type[4] (RCC/BS/SSM/SB)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	Drain Type[4] (RCC/BS/SSM)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	No's	Condition[2] (G/P)	Number of tree (No's)	garth size Dia (m)	
	3.094	3.120	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					CH:3.094-SWD crossing
	3.120	3.150	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.150	3.180	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.180	3.210	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.210	3.240	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.240	3.270	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.270	3.300	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.300	3.330	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.330	3.360	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.360	3.390	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.390	3.420	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.420	3.450	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.450	3.480	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.480	3.500	BT	4.5	P																					ER	0.6	-	-	P	ER	0.6	-	-	P					
	3.500	3.530	BT	5.0	P																										ER	0.6	-	-	P					
	3.530	3.560	BT	5.0	P																										ER	0.6	-	-	P					
	3.560	3.590	BT	5.0	P																										ER	0.6	-	-	P					
	3.590	3.620	BT	5.0	P																										ER	0.6	-	-	P					
	3.620	3.650	BT	5.0	P																										ER	0.6	-	-	P					
	3.650	3.680	BT	5.0	P																										ER	0.6	-	-	P					
	3.680	3.710	BT	5.0	P																										ER	0.6	-	-	P					
	3.710	3.740	BT	5.0	P																										ER	0.6	-	-	P					
	3.740	3.770	BT	5.0	P																										ER	0.6	-	-	P					
	3.770	3.800	BT	5.0	P																										ER	0.6	-	-	P					
	3.800	3.814	BT	5.0	P																										ER	0.6	-	-	P					
	3.814	3.850	BT	4.8	P																					ER	0.6	-	-	P	RCC	0.6	-	-	G					
	3.850	3.880	BT	4.8	P																					ER	0.6	-	-	P	RCC	0.6	-	-	G					
	3.880	3.910	BT	4.8	P																					ER	0.6	-	-	P	RCC	0.6	-	-	G					
	3.910	3.940	BT	4.8	P																					ER	0.6	-	-	P	RCC	0.6	-	-	G					
	3.940	3.978	BT	4.8	P																					ER	0.6	-	-	P	RCC	0.6	-	-	G					
	3.978	4.000	BT	4.8	P																										RCC	0.6	-	-	P					
	4.000	4.030	BT	4.8	P																										RCC	0.6	-	-	P					
	4.030	4.060	BT	4.8	P																										RCC	0.6	-	-	P					
	4.060	4.090	BT	4.8	P																										RCC	0.6	-	-	P					
	4.090	4.120	BT	4.8	P																										RCC	0.6	-	-	P					

Executive Engineer,
Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
	(km)	(km)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)		Location/ Chainage (km)	Left/ Right	Width (m)	Type[1] (BT/CC/GR/ER)	Condition[2] (G/P/) (CC/SS)	Condition[2] (G/P/) (CC/ER/T)	Width (m)	Condition[2] (G/P/) (CC/SS)	Condition[2] (G/P) (CC/ER/T)	Width (m)	Condition[2] (G/P/)	Type P/K	Width (m)	Drain Type[4] (RCC/BS/SSM/SB)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	Drain Type[4] (RCC/BS/SSM)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	No's	Condition[2] (G/P)	Number of trees (No's)	girth size Dia (m)	
	4.120	4.156	BT	4.8	P																																		
	4.156	4.180	BT	5.0	P				ER	3	P																				RCC	0.6	-	-	P					
	4.180	4.210	BT	5.0	P				ER	3	P																												
	4.210	4.245	BT	5.0	P				ER	3	P																												
	4.245	4.270	BT	5.0	P																																		
	4.270	4.300	BT	5.0	P																																		
	4.300	4.330	BT	5.0	P																																		
	4.330	4.358	BT	5.0	P																																		
	4.358	4.380	BT	5.2	P																																		
	4.380	4.410	BT	5.6	P																																		Electric Poles-50
	4.410	4.440	BT	5.6	P																																		
	4.440	4.470	BT	5.6	P																																		
	4.470	4.500	BT	5.6	P																																		
	4.500	4.530	BT	5.6	P																																		
	4.530	4.560	BT	5.6	P																																		
	4.560	4.590	BT	5.6	P																																		
	4.590	4.620	BT	5.6	P																																		
	4.620	4.650	BT	5.6	P																																		
	4.650	4.680	BT	5.6	P																																		
	4.680	4.710	BT	5.6	P																																		
	4.710	4.740	BT	5.6	P																																		
	4.740	4.770	BT	5.6	P																																		
	4.770	4.800	BT	5.6	P																																		
	4.800	4.830	BT	5.6	P																																		
	4.830	4.860	BT	5.6	P																																		
	4.860	4.890	BT	5.6	P																																		
	4.890	4.920	BT	5.6	P																																		
	4.920	4.950	BT	5.6	P																																		
	4.950	4.980	BT	5.6	P																																		
	4.980	5.010	BT	5.6	P																																		
	5.010	5.040	BT	5.6	P																																		
	5.040	5.070	BT	5.6	P																																		
	5.070	5.100	BT	5.6	P																																		
	5.100	5.130	BT	5.6	P																																		

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Executive Engineer,
Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P/)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)	No's	(G/P)	(No's)	Dia (m)	
	5.130	5.160	BT	5.6	P																																		
	5.160	5.190	BT	5.6	P																																		
	5.190	5.220	BT	5.6	P																																		
	5.220	5.250	BT	5.6	P																																		
	5.250	5.280	BT	5.6	P																																		
	5.280	5.310	BT	5.6	P																																		
	5.310	5.340	BT	5.6	P																																		
	5.340	5.367	BT	5.6	P																																		
	5.367	5.390	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					Trees-20
	5.390	5.420	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.420	5.450	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.450	5.480	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.480	5.510	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.510	5.540	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.540	5.570	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.570	5.600	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.600	5.630	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.630	5.660	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.660	5.690	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.690	5.710	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.710	5.740	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.740	5.770	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.770	5.800	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.800	5.830	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.830	5.860	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.860	5.890	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					
	5.890	5.901	BT	3.5	P																					RCC	0.6	-	-	P	SSM	0.6	BS	1.2	P					Trees-20

Civil Experts Consultants Testing Center

Executive Engineer,
Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

Name of Project : Improvements to Road from Balagere BWSSB Treatment Paint Road to Munekolala Connecting Road.

Road Name : Balagere BWSSB plant road to Munekolala

Road Classification :

Location :

Date : 12-04-2019

Direction :

Time :

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath	Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																		
	(km)	(km)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)	Type[1] (BT/CC/GR/ER)	Width (m)	Condition[2] (G/P)		Location/ Chainage (km)	Left/Right	Width (m)	Type[1] (BT/CC/GR/ER)	Condition[2] (G/P/) (CC/SS)	Condition[2] (G/P/) (CC/ER/T)	Width (m)	Condition[2] (G/P/) (CC/SS)	Condition[2] (G/P) (CC/ER/T)	Width (m)	Condition[2] (G/P/)	Type P/K	Width (m)	Drain Type[4] (RCC/BS/SSM/SB)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	Drain Type[4] (RCC/BS/SSM)	Vent size(WxD) (m)	Cover slab (P/DS/BS)	Width (m)	Condition[2] (G/P)	No's	Condition[2] (G/P)	Number of trees (No's)	Dia (m)	
	0.000	0.030	ER	16.0	P								0.020	L	8	ER																						Electric poles-5
	0.030	0.060	ER	16.0	P																																
	0.060	0.090	ER	16.0	P																																
	0.090	0.103	ER	16.0	P																																
	0.103	0.130	ER	6.2	P																						ER	0.3	-	-	P	ER	0.3	-	-	P					
	0.130	0.160	ER	6.2	P																						ER	0.3	-	-	P	ER	0.3	-	-	P					
	0.160	0.198	ER	6.2	P																						ER	0.3	-	-	P	ER	0.3	-	-	P					
	0.198	0.220	ER	5.5	P																																		Electric poles-3
	0.220	0.250	ER	5.5	P																																		
	0.250	0.290	ER	5.5	P																																		
	0.290	0.320	ER	9.8	P																										ER	0.3	-	-	P					Electric poles-7
	0.320	0.350	ER	9.8	P																										ER	0.3	-	-	P					
	0.350	0.380	ER	9.8	P																										ER	0.3	-	-	P					
	0.380	0.410	ER	9.8	P																										ER	0.3	-	-	P					
	0.410	0.440	ER	9.8	P																										ER	0.3	-	-	P					
	0.440	0.470	ER	9.8	P								0.494	R	6	ER															ER	0.3	-	-	P					
	0.470	0.494	ER	9.8	P																										ER	0.3	-	-	P					
	0.494	0.520	ER	9.0	P							20																											
	0.520	0.550	ER	9.0	P							20																											
	0.550	0.580	ER	9.0	P							20																											
	0.580	0.610	ER	9.0	P							20																											
	0.610	0.640	ER	9.0	P							20																											
	0.640	0.662	ER	9.0	P							20																											
	0.662	0.690	ER	5.5	P							16																											CH:0.986 L/S Temple
	0.690	0.706	ER	5.5	P							16																											
	0.706	0.730	ER	5.5	P							25	0.706	R	5	ER																							Trees-28

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Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general Information)
						Left			Right								Left			Right																				
			Type[1]	Width	Condition[2]	Type[1]	Width	Corrosion[2]	Type[1]	Width	Corrosion[2]		Location/ Chainage	Left/Right	Width	Type[1]	Condition[2]	Condition[2]	Width	Condition[2]	Condition[2]	Width	Condition[2]	Type	Width	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	Drain Type[4]	Vent size(WxD)	Cover slab	Width	Condition[2]	No's	Condition[2]	Number of trees	garth size	
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/) (CC/SS)	(G/P/) (CC/ER/T)	(m)	(G/P/) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P/)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)		(G/P)	(No's)	Dia (m)	
	0.730	0.760	ER	5.5	P							25																											
	0.760	0.790	ER	5.5	P							25																											
	0.790	0.820	ER	5.5	P							25																											
	0.820	0.840	ER	5.5	P							25																											
	0.840	0.870	ER	12.0	P																																	
	0.870	0.900	ER	12.0	P																																	
	0.900	0.930	ER	12.0	P																																	
	0.930	0.960	ER	12.0	P																																	
	0.960	0.990	ER	12.0	P																																	
	0.990	1.055	ER	12.0	P																																	
	1.055	1.080	ER	10.0	P																																	
	1.080	1.110	ER	10.0	P																																	
	1.110	1.140	ER	10.0	P																																	
	1.140	1.170	ER	10.0	P																																	
	1.170	1.200	ER	10.0	P																																	
	1.200	1.230	ER	10.0	P																																	
	1.230	1.260	ER	10.0	P																																	
	1.260	1.290	ER	10.0	P																																	
	1.290	1.320	ER	10.0	P																																	
	1.320	1.350	ER	10.0	P																																	
	1.350	1.380	ER	5.0	P																																	Trees-10
	1.380	1.410	ER	5.0	P																																	
	1.410	1.440	ER	5.0	P																																	
	1.440	1.470	ER	5.0	P																																	
	1.470	1.490	ER	5.0	P																																	
	1.490	1.567	ER	5.5	P																						ER	0.3	-	-	P								CH:1.567-Junction
	1.567	1.590	ER	7.0	P																																	
	1.590	1.620	ER	7.0	P																																	
	1.620	1.650	ER	7.0	P																																	

Civil Experts Consultants Testing Center

Executive Engineer
Road Infrastructure, Mahadevapura Division
BBMP, Bangalore

No.	From	To	Carriageway			Shoulder						ROW (m)	Details of cross roads				Kerb	Footpath		Kerb	Footpath		Median			Road Side Drain(LHS)					Road Side Drain(RHS)					Lighting		Tree		Remarks (Junctions, town names, other general information)
						Left			Right								Left			Right																				
	(km)	(km)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)	(BT/CC/GR/ER)	(m)	(G/P)		(km)		(m)	(BT/CC/GR/ER)	(G/P/I) (CC/SS)	(G/P/I) (CC/ER/T)	(m)	(G/P/I) (CC/SS)	(G/P) (CC/ER/T)	(m)	(G/P/)	P/K	(m)	(RCC/BS/SSM/SB)	(m)	(P/DS/BS)	(m)	(G/P)	(RCC/BS/SSM)	(m)	(P/DS/BS)	(m)	(G/P)	No's	(G/P)	(No's)	Dia (m)	
	1.650	1.680	ER	7.0	P																																	
	1.680	1.710	ER	15.0	P																									RCC	0.9X1	-	-	G					
	1.710	1.740	ER	15.0	P																									RCC	0.9X1	-	-	G					
	1.740	1.770	ER	15.0	P																									RCC	0.9X1	-	-	G					
	1.770	1.787	ER	15.0	P								1.787	R	6	ER														RCC	0.9X1	-	-	G					
	1.787	1.810	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.810	1.840	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.840	1.870	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.870	1.900	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.900	1.930	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.930	1.960	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.960	1.990	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	1.990	2.037	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	2.037	2.070	ER	10.0	P																																	11 vent Pipe Culvert
	2.070	2.100	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	2.100	2.130	ER	30.0	P								2.180	L	9	ER										RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	2.130	2.160	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	2.160	2.180	ER	30.0	P																					RCC	0.9X1	-	-	G	RCC	0.9X1	-	-	G					
	2.180	2.210	ER	25.0	P																																	
	2.210	2.240	ER	25.0	P																																	
	2.240	2.270	ER	25.0	P																																	
	2.270	2.300	ER	25.0	P																																	
	2.300	2.326	ER	25.0	P								2.326	R	12	ER																							
	2.326	2.350	ER	6.0	P																									RCC	0.9X1	-	-	G					
	2.350	2.380	ER	6.0	P																									RCC	0.9X1	-	-	G					
	2.380	2.410	ER	6.0	P																									RCC	0.9X1	-	-	G					
	2.410	2.442	ER	6.0	P																									RCC	0.9X1	-	-	G					
	2.442	2.470	ER	4.5	P																									RCC	0.9X1	-	-	G					
	2.470	2.500	ER	4.5	P																									RCC	0.9X1	-	-	G					
	2.500	2.530	ER	4.5	P																									RCC	0.9X1	-	-	G					
	2.530	2.560	ER	4.5	P																									RCC	0.9X1	-	-	G					
	2.560	2.578	ER	4.5	P																									RCC	0.9X1	-	-	G					

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6.5. Pavement Condition Survey

The Pavement Condition Survey has been carried out in accordance with IRC Guidelines.All Surveys and Investigations have been carried out with the following Objectives.

- To have an up to date record of Road Assets.
- To have a clear understanding of Road Side Feature including Land Use, Drainage Characteristics, etc. and
- To assess the Condition and Strength Data for Developing Improvement Proposals and related Designs.

6.5.1. Visual Condition Survey

Visual Condition Survey of the Road Sections has been carried out by travelling along the Project Road and noting down the Pavement Conditions such as Extent of Cracking, Patching, Rutting, Potholes, Edge Breaking, etc. by visual observations in a well structured Data Format. During the Inspection of the Road, is has been found that the Pavement Surface seems to be fair to Good by Visual Observations for some of the Road Sections whereas in other Sections the Road has been found to be deteriorated. The Data so collected has been compiled and presented(Chainage wise) in the form of tables for easy understanding. These Data have been used to assess the Pavement Condition.

The Details of Road Inventory and Condition Survey in tabular form are given in **Table 6.1**

6.5.2. Benkelman Beam Deflection Survey

Benkelman Beam Deflection Survey of the Road Sections has been carried out in accordance with the Procedure given in IRC: 81-1997 "Tentative Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique" in the Month of October 2012 in order to assess the Pavement Strength and related Parameters. During the Survey, Pavement Temperature has been measured for correcting the Deflection Values to the Standard Temperature. Seasonal Factor has also been determined from the Type and Moisture Content of Sub Grade Soil.

The Deflection Data have been analysed for each homogeneous section and the Analysed Data are presented in Annexure A.3.2. The Data so analysed form a Useful Input to estimate the Extent of Overlay required for Strengthening. The Structural Evaluation especially with regard to the Adequacy/ Inadequacy of the Road Sections improved earlier in Various Schemes has also been assessed so that not to duplicate the same in the Upgradation Proposals.

Table 6.2 Benkelman Beam Deflection Survey for Road Sections

BBD Analysis for Over lay Design					
Benkelman Beam Deflection studies as per guidelines of IRC 81-1997 has been conducted on the Flexible pavements, the Analysis are tabulated here below					
Name of the Road Section	**Length in mts**	**Design msa Considered**	**Characteristic Deflection, mm**	**Overlays in terms of BM mm**	**Recommended Overlays**
Improvements to Road From Varthur Road via Tubarahalli Outer Ring Road and Road from Vibgyaor School via Tubarahalli balagere up to BWSSB Treatment Plant Road (RMP Road)Link Road.					
Tubarahalli Road					
Ch:0+000 to Ch:0+950	950	10	1.45 mm	115 mm	DBM-50mm & BC-30mm
Cross Road					
Ch:0+000 to Ch:0+103	103	5	1.81 mm	113 mm	DBM-50mm & BC-30mm
Vibgyor Road					
Ch:0+000 to Ch:1+068	1068	10	1.43 mm	112.5 mm	DBM-50mm & BC-30mm
Improvements to Road from Varthur to Balagere Gunjur ORR and Kadubisanahalli Road					
Balagere Road					
Ch:0+000 to Ch:1+030	1030	10	1.41 mm	111.5 mm	DBM-50mm & BC-30mm
Ch:1+390 to Ch:5+900	4510	10	1.40 mm	110 mm	DBM-50mm & BC-30mm

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6.5.3. Test Pit Investigation Survey

Test Pit Investigation Survey of the Road Sections has been done as required. Testing has been carried out so that to match the Locations of the CBR Test in that Road Section. Soil Samples have been collected and tested in Laboratory for

- Field Moisture Content.
- Grain Size Analysis.
- Atterberg's Limits.
- Classification of Soil.
- Maximum Dry Density – Optimum Moisture Content Test.
- California Bearing Ratio (CBR) on 4 days Soaked Samples.

Sub Grade Characteristics and Strength Parameters so determined are required in respect of

- Existing Sub Grade to design Widening of Existing Roads and to check Strengthening Requirements of Existing Pavements by the CBR Method, and
- Prospective Borrow Material for use as Sub Grade in case of New Alignment, Reconstruction and Widening.

6.6. Secondary Data

Details of any Ongoing Developmental Works along the Project Roads such as Road Improvements, Junction Improvements, Grade Seperation Schemes, Footpath Improvement Schemes, NICE Corridor Scheme, Metro Rail Alignment, White Topping, Signal Free Corridor etc. have been collected so that to integrate the same with the Improvement Proposals suggested and also to avoid Duplication which will have a direct bearing on the Project Cost.

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Chapter 7
Design Proposal

7.1. General

Improvement proposals for an existing road cross section essentially consist of two components, geometric and structural improvements. The geometric improvements mainly involve, cross sectional elements such as carriageway, shoulders etc. The structural component deals with the pavement design aspects, i.e., the ability of the roads to adequately carry and support the vehicle / wheel loads over the design period. Improvements to geometry are based on relevant IRC standards. Safety, speed, efficiency, economy and comfort in traffic movement to a large extent are governed by adequacy of design standards used for a specific road facility. The present chapter illustrates the design proposals for the project road.

7.2. Improvement Proposals

7.2.1. Geometric design

Geometric design of roadways deals with the positioning of the physical elements of the roadway according to standards and constraints. The basic objective in geometric design is to provide a smooth-flowing, crash-free facility. Geometric design comprises of improvements in horizontal and vertical geometrics of the existing road. The geometric design is optimized within the frame work of contract and approving authority.

7.2.2. Terrain and Land Use

The Geometric design of the project Road is influenced significantly by terrain condition. Economy dictates choice of different standards for different type of terrain. Terrain is classified by the general slope of the country across the project alignment, for which the criteria given in **Table 7.1**are followed. Short isolated stretches of varying terrain are not taken into consideration.

Table 7.1 General Guidelines for Terrain Classification

Terrain Classification	Percent Cross Slope
Plain	**0 - 10**
Rolling	10 – 25
Mountainous	25 – 60
Steep Terrain	Greater than 60

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Since the percentage cross slope along the alignment is predominantly ranging between 0 - 10%, the project road is classified as **Plain terrain.**

7.2.3. Cross sectional element

The present project envisages 2 - 4 lane traffic movements, with divided and undivided carriageway configuration. Topographical survey and road inventory has confirmed the availability of RoW varying all the roads. The details of cross sectional element as indicated in**Table 7.2.**

Table 7.2Details of cross sectional element

No.	Description	Dimensions
Tubrahalli Road		
1.	Existing Carriageway width	7.75 m to 9.1 m
2.	Right of Way width	9.75 m to 12.00m
3.	Both side Covered RCC drain	1m
VibgyorRoad		
1.	Existing Carriageway width	4.5 m to 9.0 m
2.	Right of Way width	6 m to 15m
3.	Both side Covered RCC drain	1m
BalagereRoad		
1.	Existing Carriageway width	3.5 m to 10.8 m
2.	Right of Way width	6 m to 12m
3.	Both side Covered RCC drain	1m
BWSSB Treatment Plant Road		
1.	Proposed Carriageway width	2 way 7.0 m
2.	Right of Way width	30m
3.	Both side RCC drain	1m
Yamalur–KariyammanaAgrahara Road		
1.	Proposed Carriageway width	2 way 7.0 m
2.	Right of Way width	30m
3.	Both side RCC drain	1m

Based on the above mentioned standard cross sectional elements, typical cross sections are finalized to suit the site conditions and are explained in brief below.

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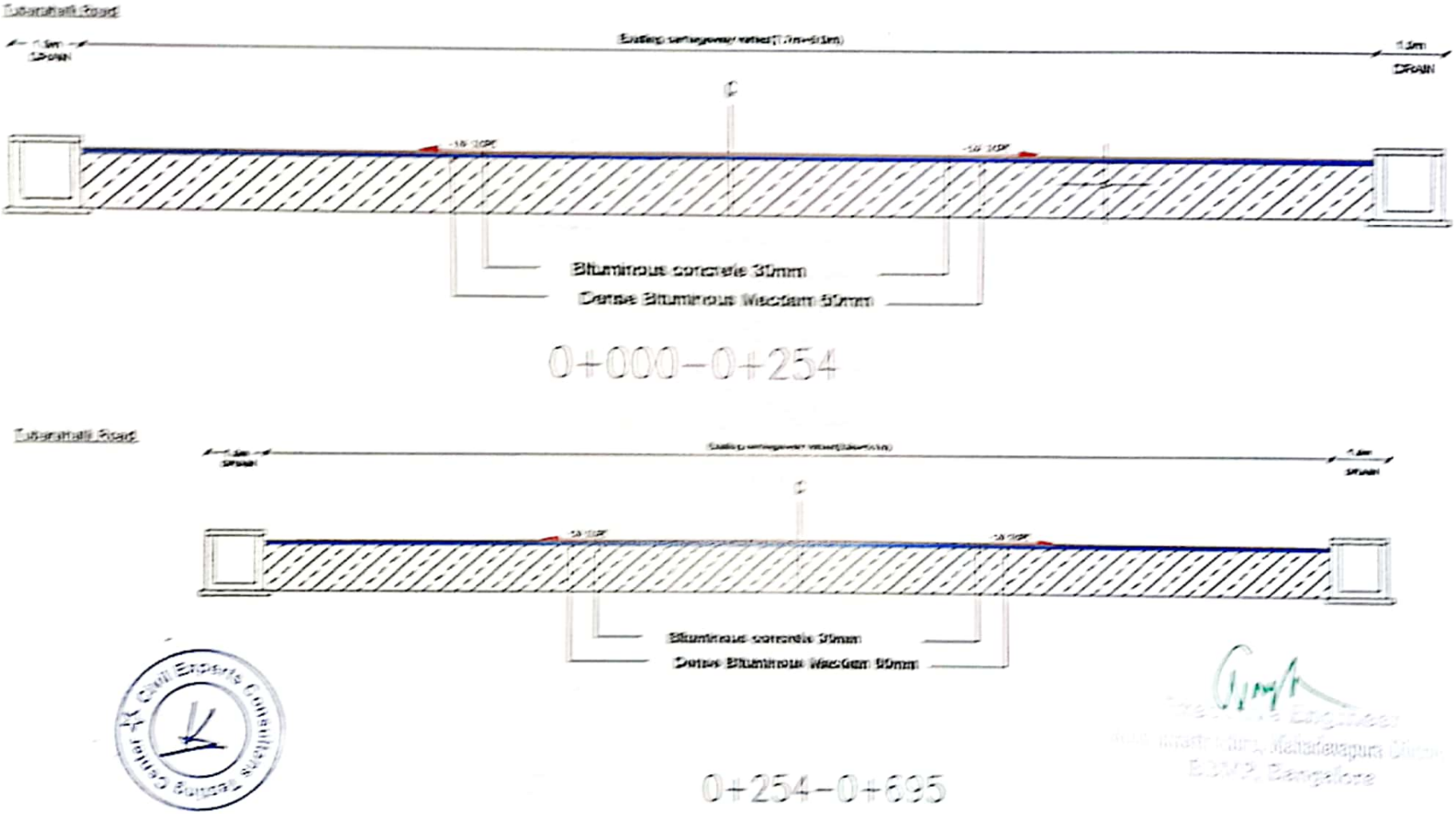
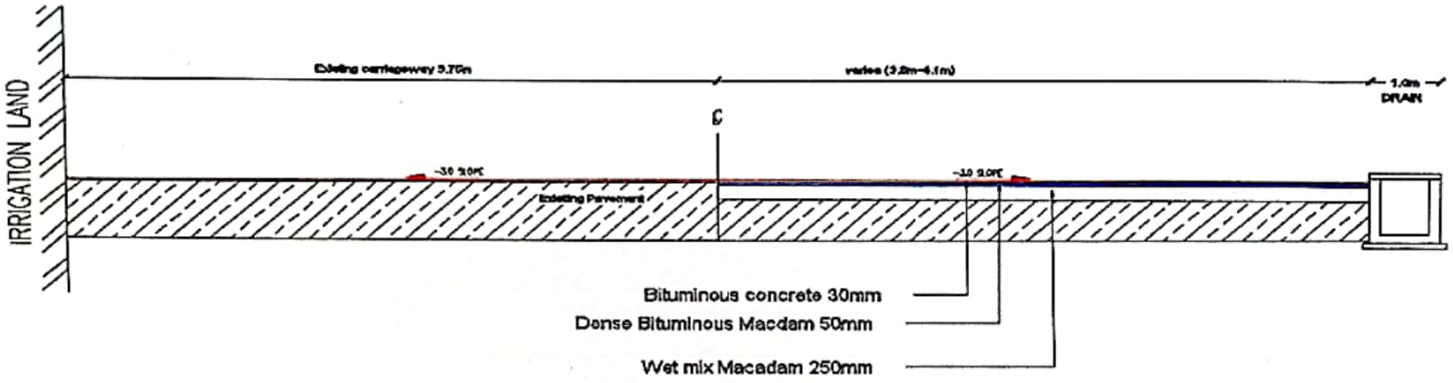
Figure 7.1.Proposed typical cross sections of the Tubarahalli Road

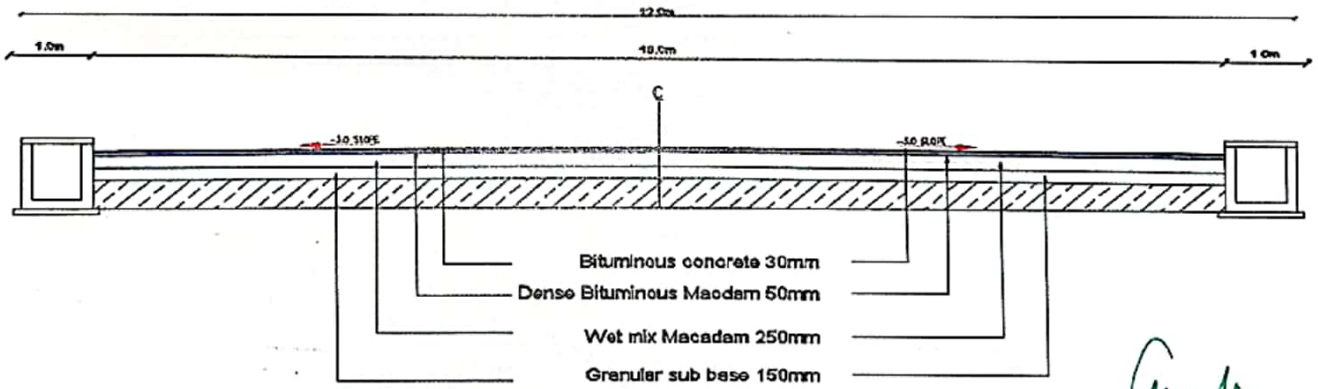


Tubarahalli Road



0+695–0+950

Tubarahalli Road



0+950–1+668

Typical cross section of Tubarahalli Road Shown in **Figure 7.1**

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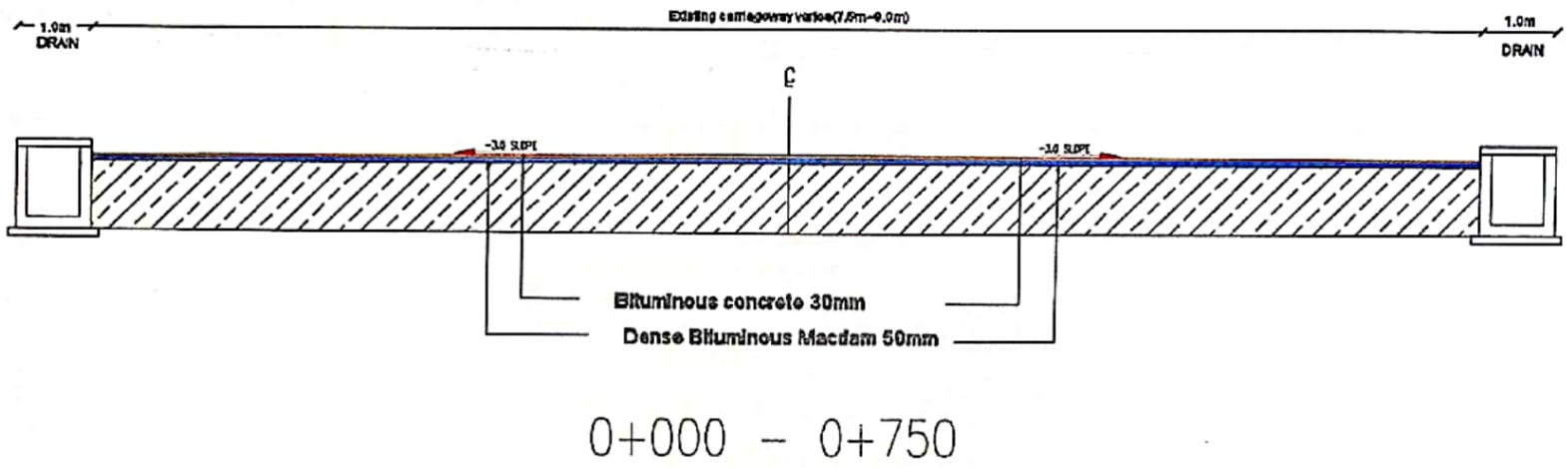
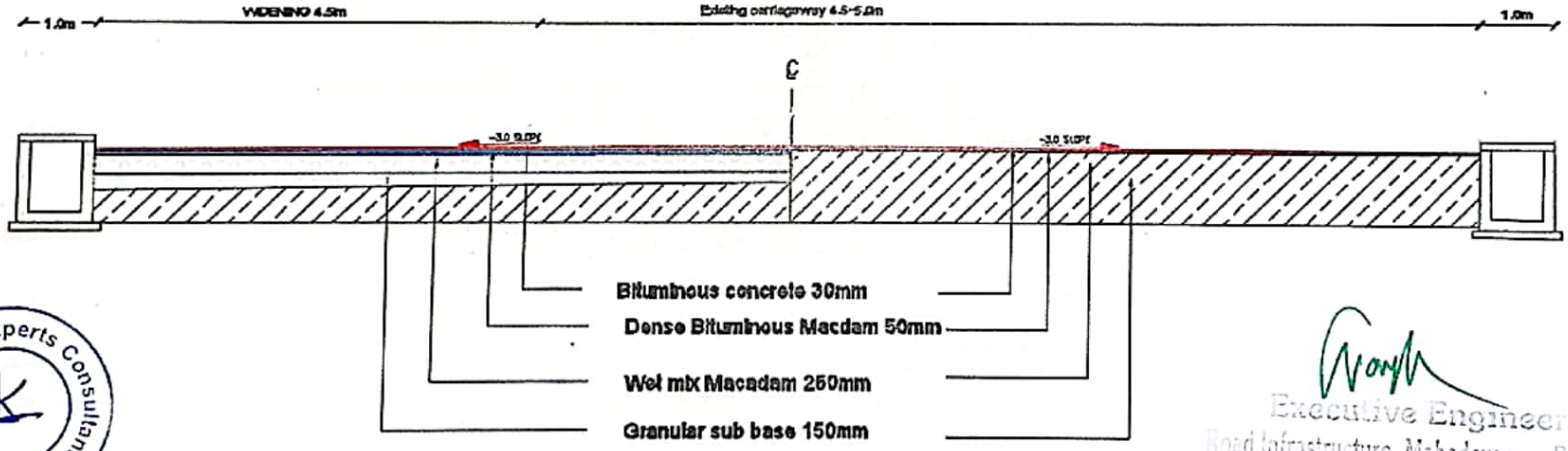
Figue 7.2 Proposed typical cross section of Vibgyor Road

Vibgyor Road



0+000 – 0+750

Vibgyor Road



0+750 – 0+900

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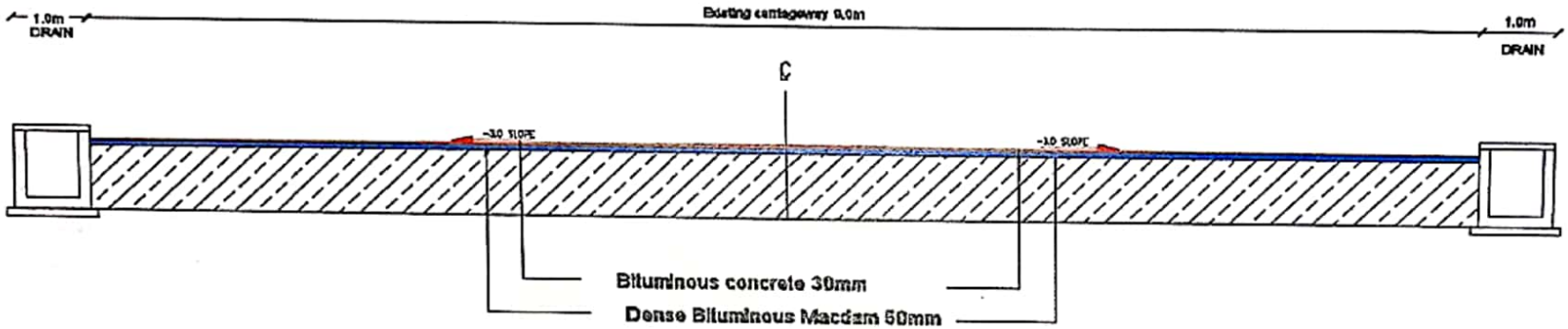
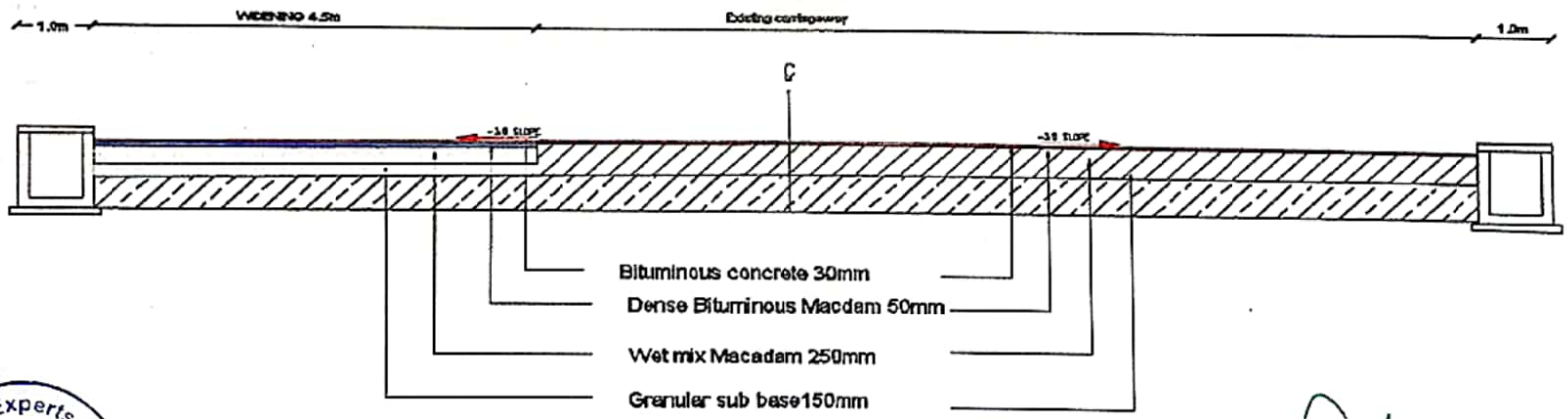
VIBGYOR Road



0+900 – 1+068

VIBGYOR Road



1+068– 1+170

Typical cross section of Vibgyor Road is shown in **Figure 7.2**

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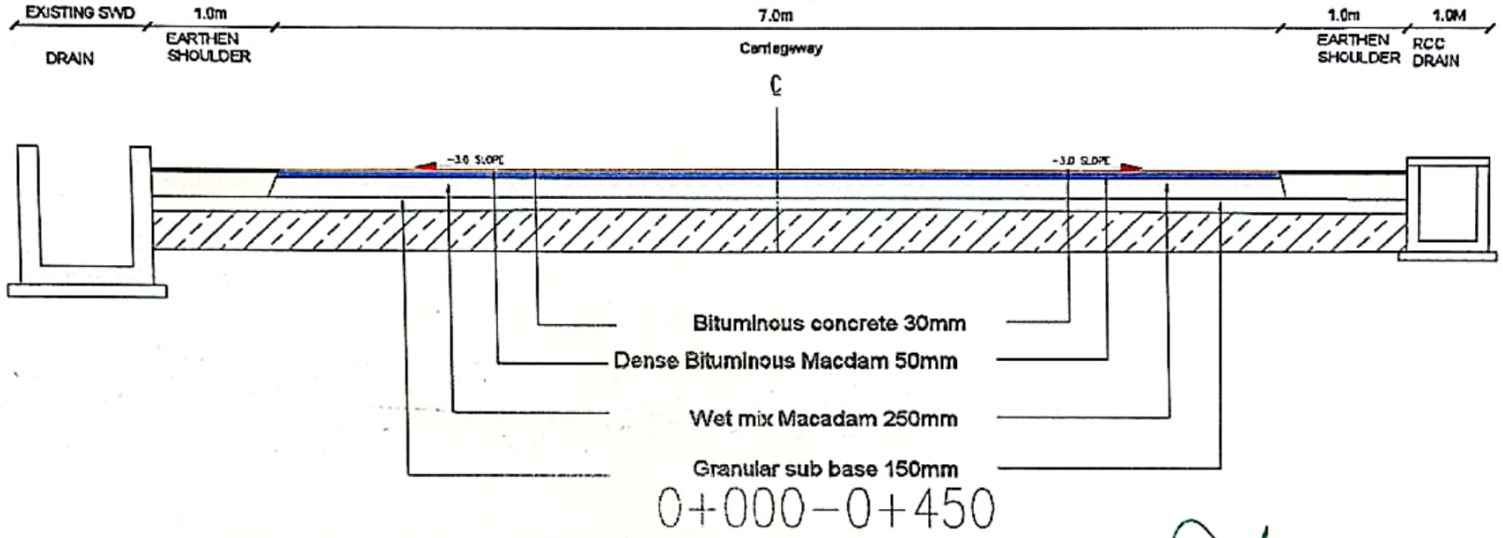
Figure 7.3 Proposed typical cross of Road Connecting BWSSB to Munekolala

Road connecting BWSSB road to Munekolala



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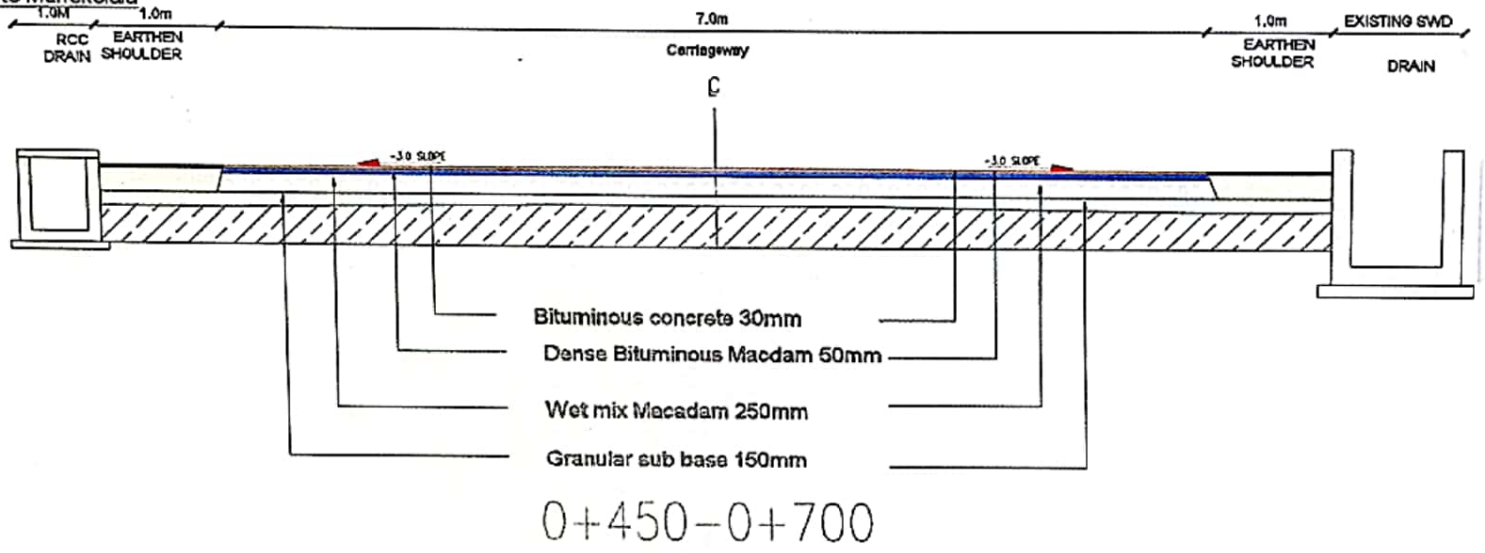
Road connecting BWSSB road to Munekolala



Typical cross section of Road Connecting BWSSB to Munekolalais shown in **Figure 7.3**

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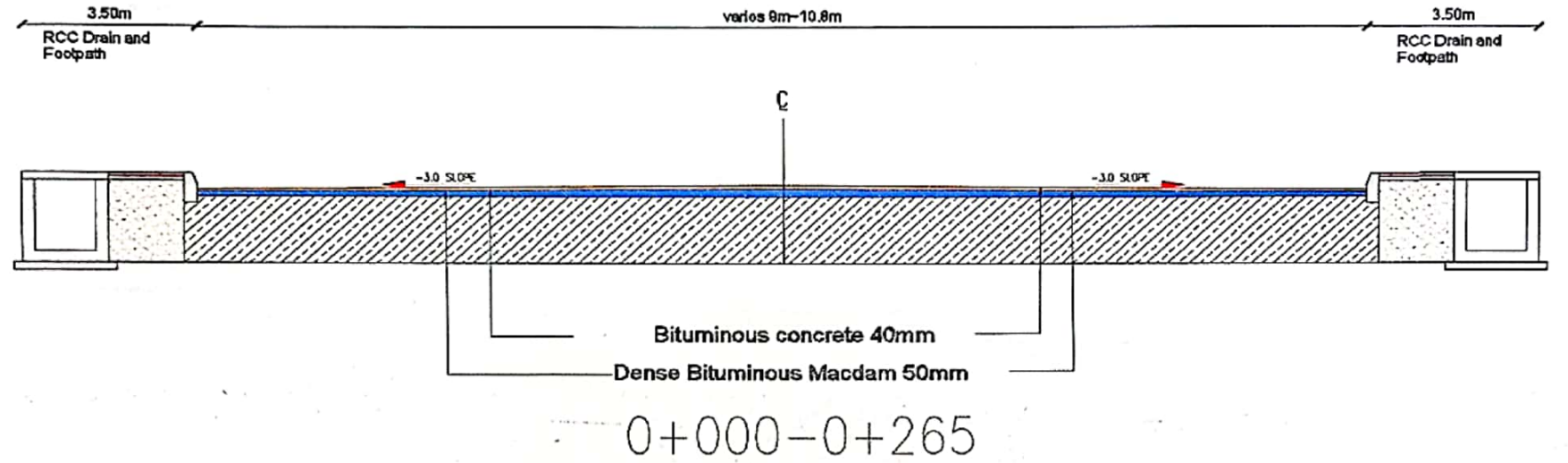
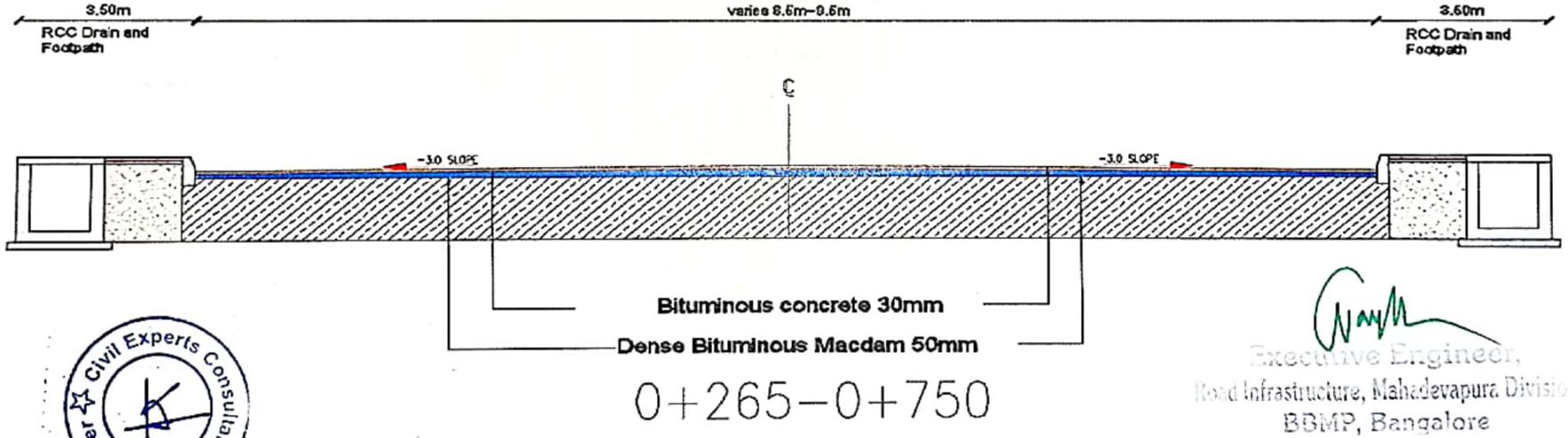
Figure 7.4: Proposed typical cross section of Balagere Road





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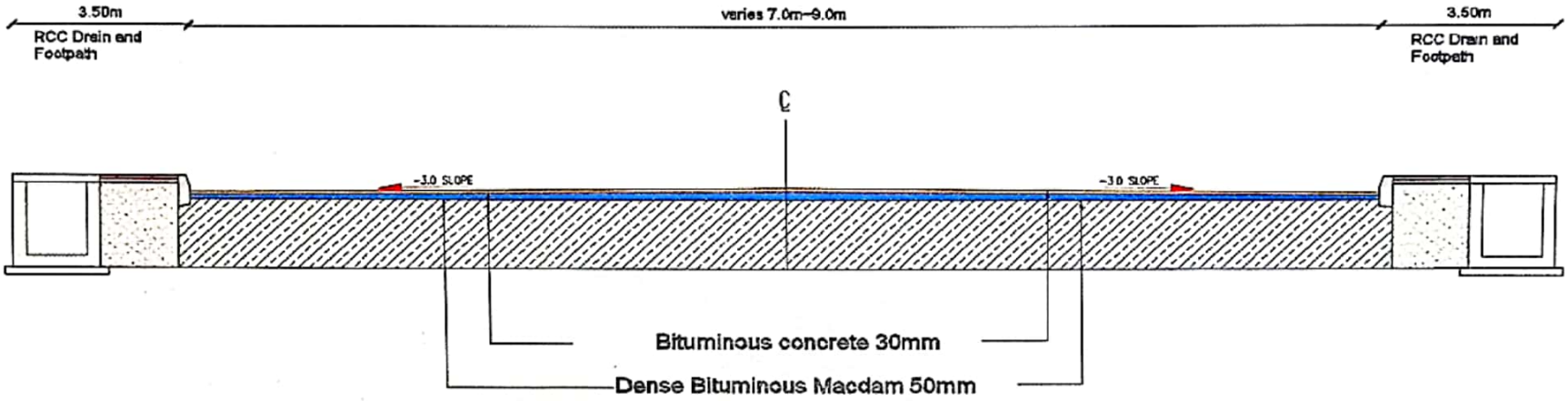

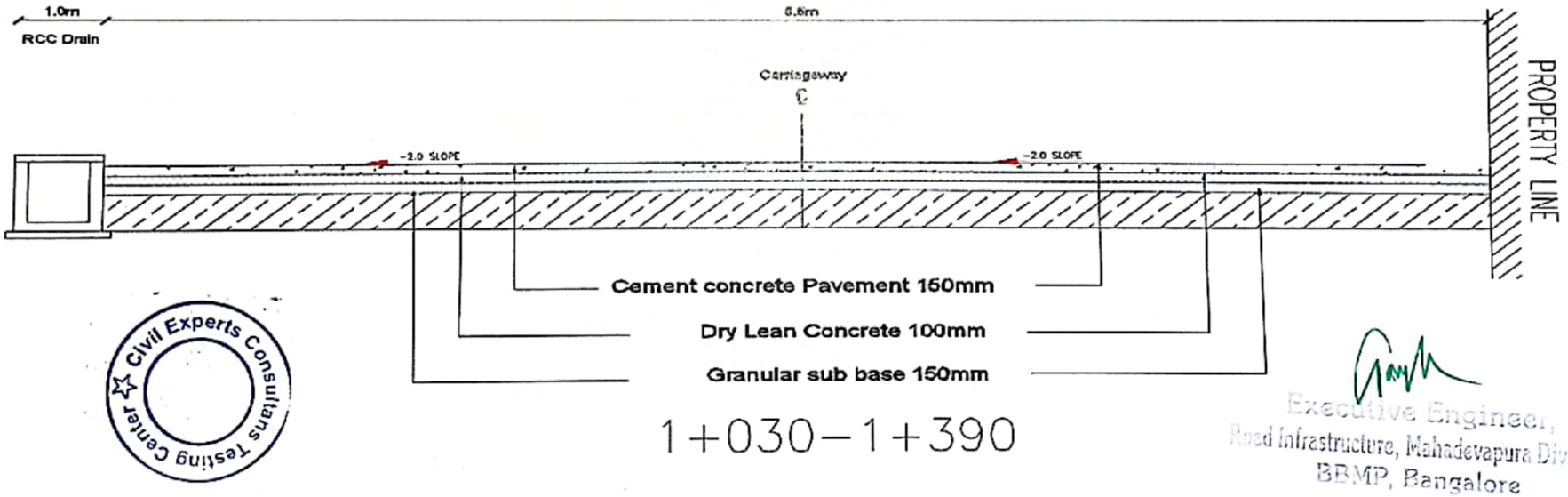

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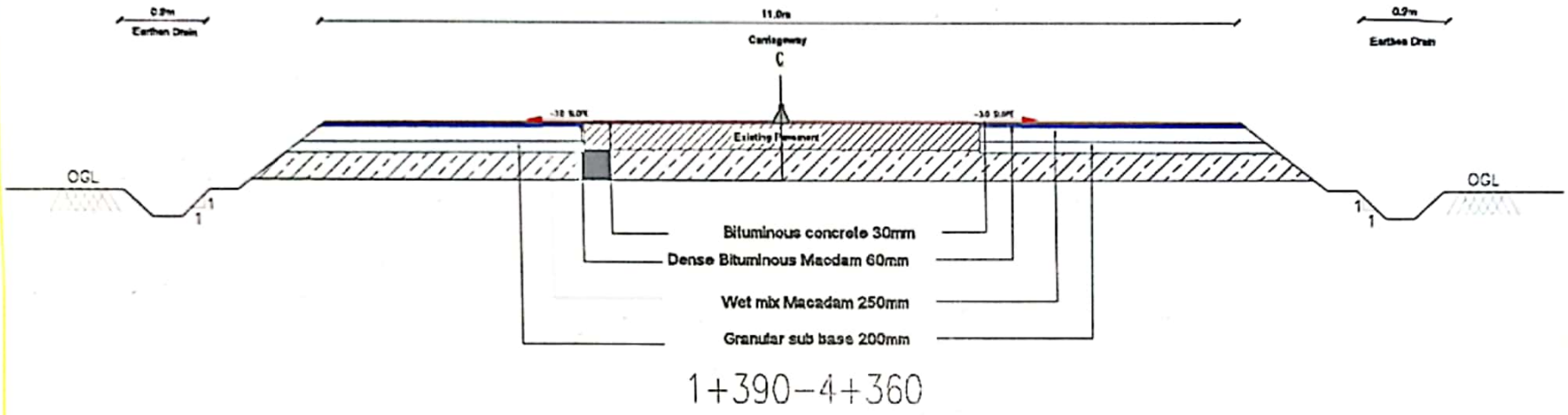
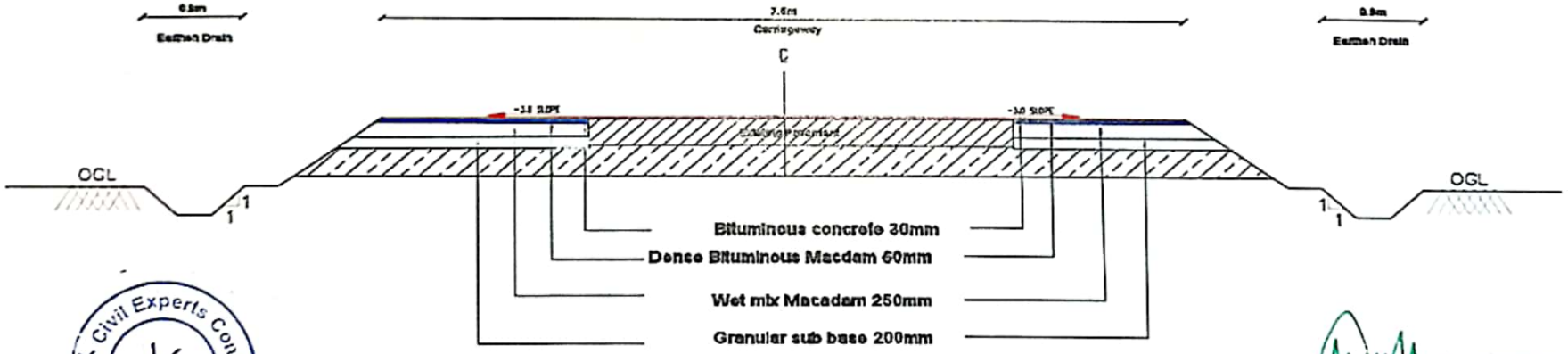


1+390–4+360



4+360–5+370

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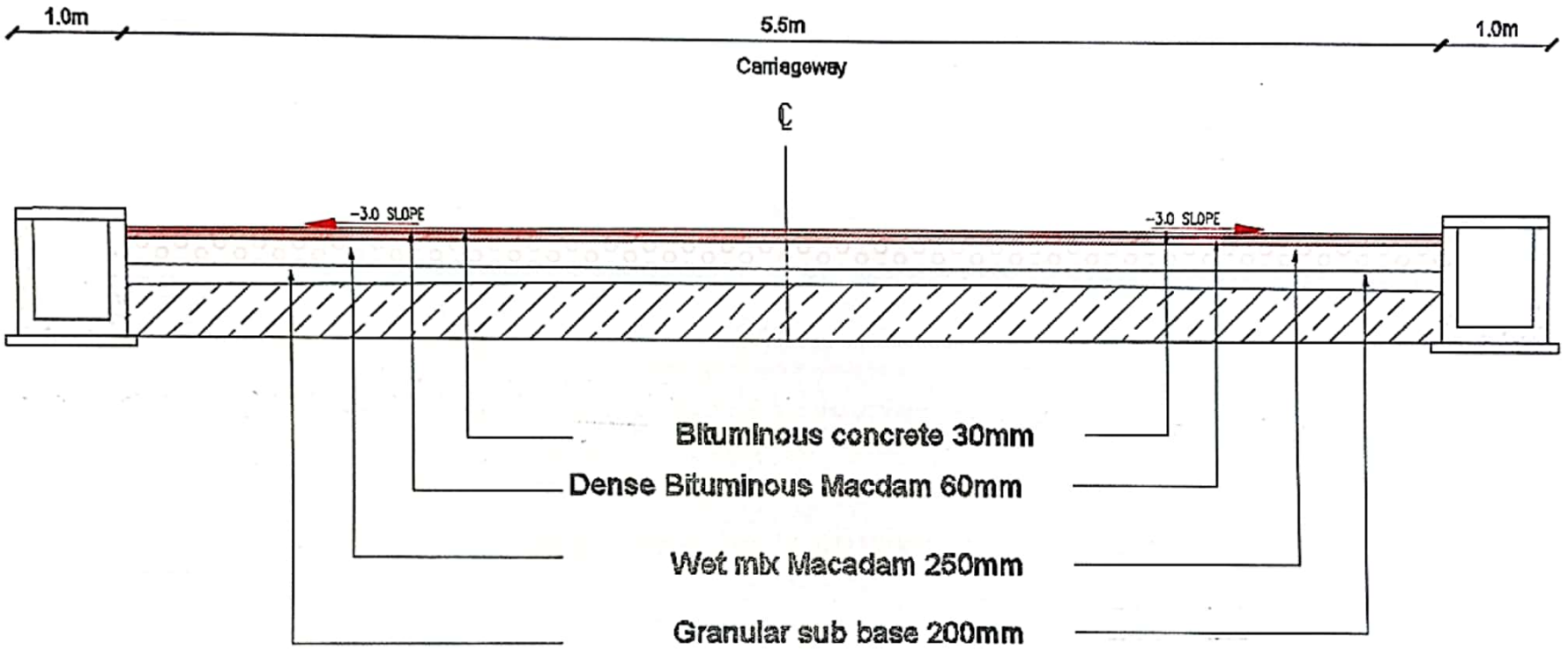

5+370–5+900

Typical cross section of Balagere Road is shown in **Figure 7.4**

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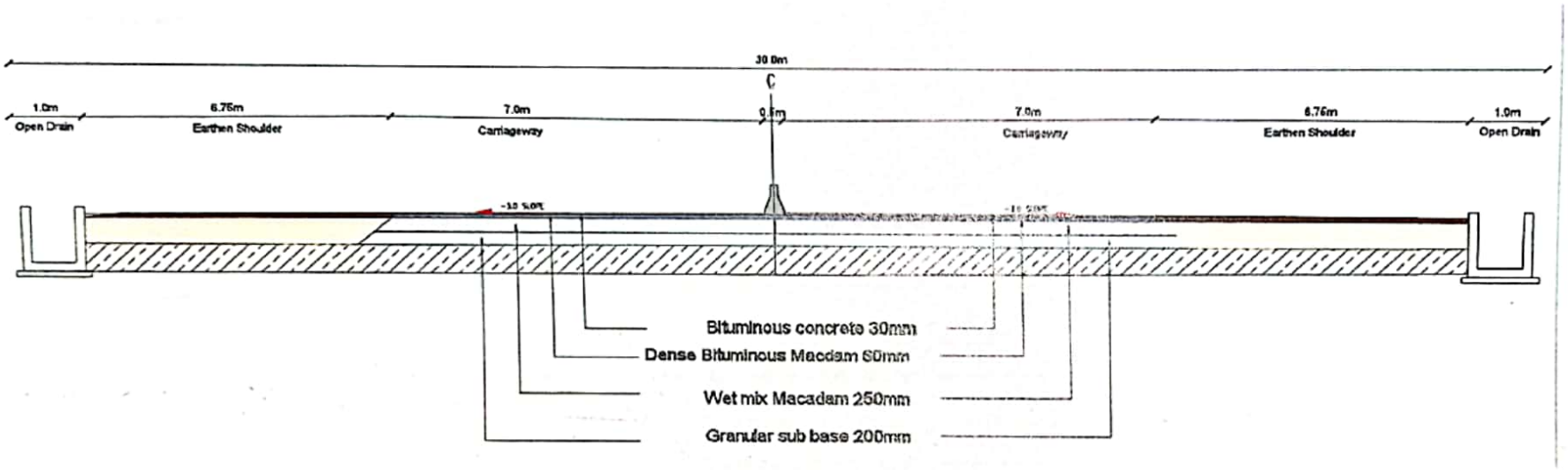
Figure 7.5: Proposed typical cross section of Balagere BWSSB Treatment Plant Road to Munekolala Connecting Road



Typical cross section of Balagere BWSSB Treatment Plant Road to Munekolala Connecting Roadis shown in **Figure 7.5**

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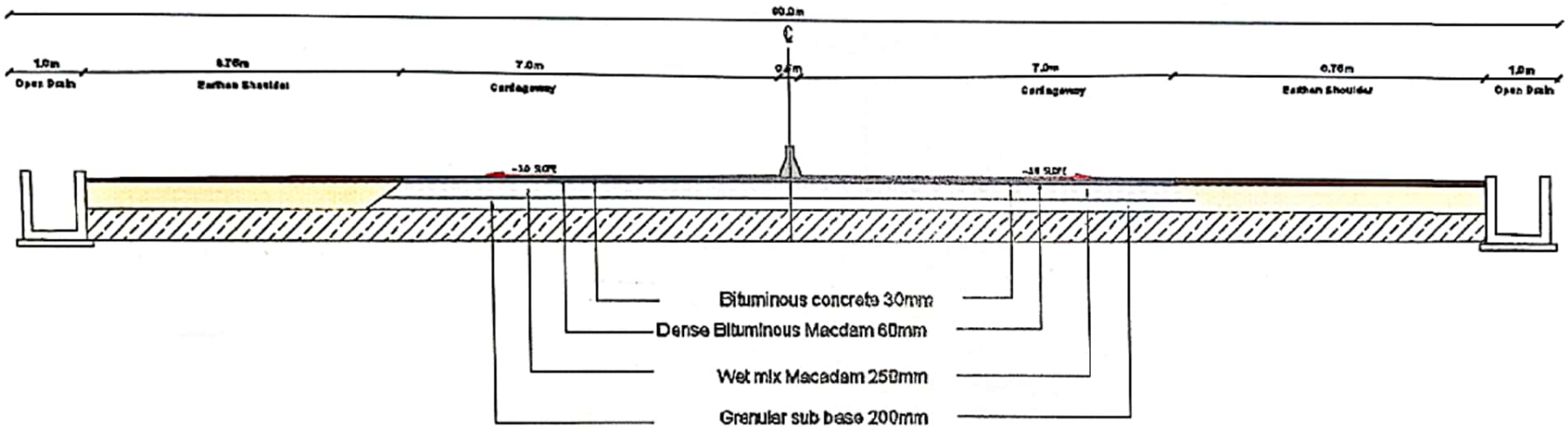
Figure 7.6: Proposed typical cross section of Balagere BWSSB Treatment Plant Road to Munekolala Connecting Road



Typical cross section of Balagere BWSSB Treatment Plant Road to Munekolala Connecting Roadis shown in **Figure 7.6**

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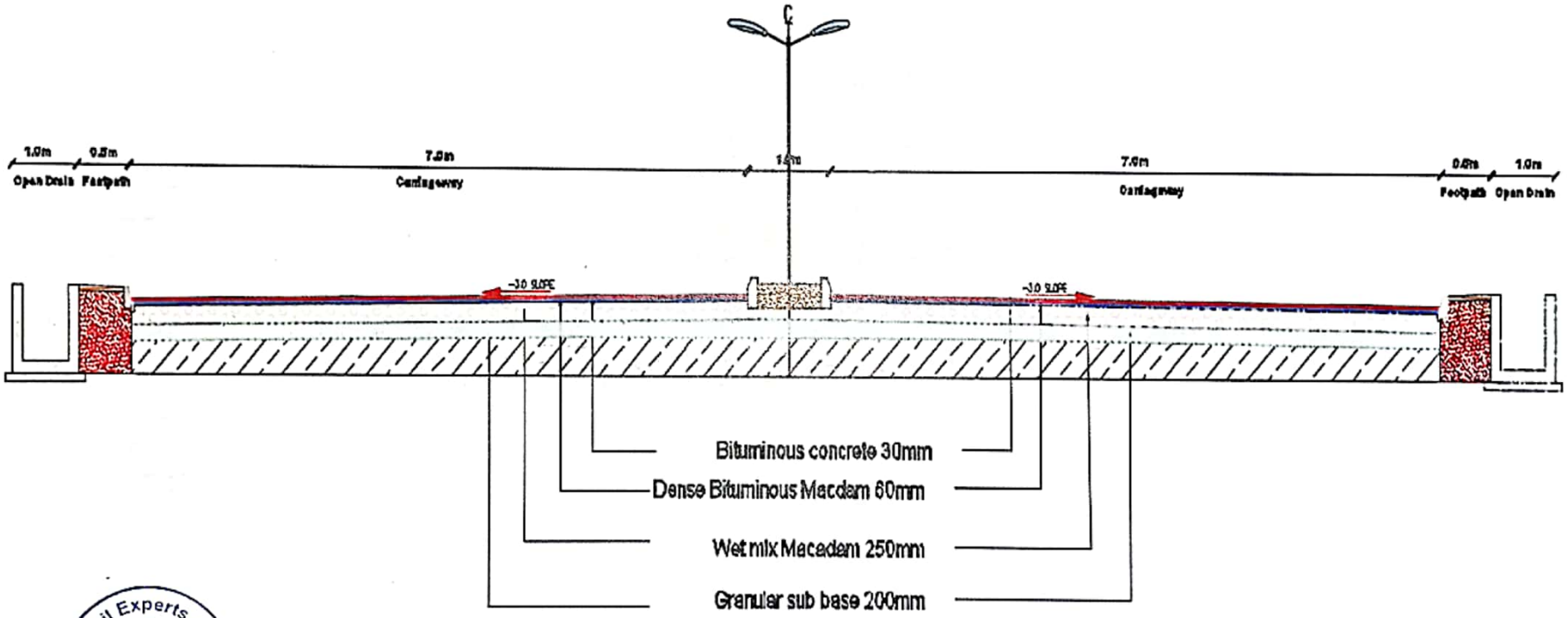
Figure 7.7: Proposed typical cross section of Kariyammana Agrahara Road



Typical cross section of Kariyammana Agrahara Road is shown in **Figure 7.7**

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7.2.4. Horizontal Geometry

In road alignment, design changes in direction are often necessary due to restriction imposed by topography, environment, restriction in roadway, presence of monuments, places of worship, existing structures, built up area and other considerations such as available land. For convenient, safe and pleasant travel on road, changes in directions have to be accomplished by introducing horizontal and transition curves in the alignment.

However in case of urban roads the horizontal alignment is maintained as per existing without subjecting it to widening, as land acquisition is prohibited.

7.2.5. Vertical Geometry

The vertical alignment of a road consists of gradients (straight lines in a vertical plane) and vertical curves. In determining the type and length of the vertical curve, the design considerations are comfort and security of the driver, and the appearance of the profile alignment. Among these, sight distance requirements for the safety are most important on summit and valley curves. The stopping sight distance or absolute minimum sight distance is considered in case of summit curves and headlight sight distance is considered for valley curves. When a fast moving vehicle travels along a summit curve, there is less discomfort to the passengers. This is because the centrifugal force will be acting upwards while the vehicle negotiates a summit curve which is against the gravity and hence a part of the tyre pressure is relieved. Also if the curve is provided with adequate sight distance, the length would be sufficient to ease the shock due to change in gradient. Circular summit curves are identical since the radius remains same throughout and hence the sight distance. From this point of view, transition curves are not desirable since it has varying radius and so the sight distance will also vary. The deviation angle provided on summit curves for highways is very large, and so the simple parabola is almost congruent to a circular arc, between the same tangent points. Parabolic curves are easy for computation and also it had been found out that it provides good riding comfort to the drivers. It is also easy for field implementation. Due to all these reasons, a simple parabolic curve is preferred as summit curve.

Improvements to vertical alignment are taken into consideration by providing profile corrective course in addition to the overlay proposed as per BBD studies. **Table 7.3**indicates the overlay proposed to Roads

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Table 7.3: Overlay proposed to Roads

Chainage (km)	Road Name	Proposed Overlay thickness (mm)
Ch:0.000 to Ch:0.950	Tubarahalli Road	80 mm
Ch:0.000 to Ch:0.103	Cross Road	80mm
Ch:0.000 to Ch:1.068	Vibgyor Road	80mm
Ch:0.000 to Ch:1.030	Balagere Road	80mm
Ch:1.390 to Ch:5.900	Balagere Road	80mm

Table 7.4 shows the design pavement thickness proposed for reconstruction

Table 7.4: Design Pavement thickness proposed

Chainage (km)	Road Name	Pavement thickness (mm)			
		BC	DBM	WMM	GSB
Ch:0.950 to Ch:1.668	Tubarahalli Road	30	50	250	150
Ch:1.068 to Ch:1.170	Vibgyor Road	30	50	250	150
Ch:0.630 to Ch:2.209	Road Connecting BWSSB to Munekolala	30	50	250	150
		PQC		DLC	GSB
Ch:1.030 to Ch:1.390	Balagere Road	150		100	150
		BC	DBM	WMM	GSB
Ch:0.000 to Ch:1.500	Road From Balagere BWSSB Treatment Plant road to Munekolala Connecting Road	30	60	250	200
Ch:1.500 to Ch:2.580	Road from Munekolala Sai Layout to Gunjur Palya CDP Road	30	60	250	200
Ch:0.000 to Ch:1.000	Tamaluru Kariyammana Agrahara Road	30	60	250	200

7.2.6. Intersections/junction improvement

Junction improvement aims at improving the capacity of junctions by improving their geometrics like making them bell shaped, creating channelizing islands, proper footpaths and proper markings etc.

There are major junctions along the project road. All major junctions are 4 way junctions. The list of major junctions and the proposed improvements are summarized in **Table 7.5.**

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Table 7.5 : List of junctions and proposed improvements

No.	Location (km)	Type of Intersection	Proposed Geometric Improvements
Improvements to Road From Varthur Road via Tubarahalli Outer Ring Road and Road from Vibgyaor School via Tubarahalli balagere up to BWSSB Treatment Plant Road (RMP Road)Link Road.			
1.	Intersection of Panathuru Main Road and Road towards Munekolala.	T - Junction	Providing Minimum turning radius
Improvements to Road from Balagere BWSSB Treatment Plant Road to Munekolala Connecting Road.			
1.	Intersection of BWSSB Treatment Plant Road and Tubarahalli Road	T - Junction	Providing Minimum turning radius
2.	Intersection of BWSSB Treatment Plant Road and Balagere Road	Four Arm Junction	Providing Minimum turning radius
3.	Intersection of BWSSB Treatment Plant Road and Panathur Main Road	T - Junction	Providing Minimum turning radius

7.2.7. Storm Water Drain

Storm Water Drain along the project roads observed are of SSM/RCC type. Covered/Uncovered SSM and RCC drain exists predominantly along the project roads. Further, the revised cross section proposal consists of RCC Storm water drainis proposed along the kerb edge.

7.2.8. Road furniture

7.2.8.1. Traffic Signs and Pavement Markings

Pavement markings will include lane marking. road studs, directional arrow, stop name and zebra crossing along the project roads. The design and marking for the Project Roads will be as per the IRC guidelines.

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Chapter 8
Cost Estimate

8.1. General

Cost estimation for the project roads has been prepared based on the design proposals. The cost estimate is prepared for overlay of existing pavement, cross drainage, longitudinal drains, junction improvements, road furniture, etc., of the project which covers about 18.40 Km.

8.2. Rate analysis

Unit rates are adopted for the items of project based on the schedule of rates PWP & IWT department SR 2018-2019 Bangalore circle. Since the project road falls in Bhruhat Bengaluru Mahanagara Palike limits for roads and bridges area weightage of 6% above basic rates is considered.

8.3. Project costing

The abstract of estimated cost for Flexible Pavement for each location per Km, According to Schedule of Rates 2018-2019 (PWP & IWTD, Bangalore).

Data rate for 250mm thick precast slabs and Data rate for medium rise medians is attached with the estimate.

8.3.1. Road Furniture

Road furniture such as crash barriers/guard-rails, pavement markings,road studs, sign boards etc. have a provision in the cost estimate.

8.3.2. Estimated project cost

The cost estimate is prepared by working out the quantities of each item based on the improvement proposal, by using the relevant drawings developed. The estimated cost of construction is Rs 30.00 crores.

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The Bill of Quantity of cost estimates is as shown in

Table 8.1.

Table 8.1: Bill Quantity of cost estimates

BRUHAT BENGALURU MAHANAGARA PALIKE					
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Bill of Quantity					
Comprehensive Development and Improvements to the Roads connecting to ITPL Area Whitefield in RI Mahadevapura Division (Package - 02)					
Sl. No	**Discription of Item**	**Unit**	**Total Qty**	**Rate in Rs.**	**Amount in Rs.**
1	Removing & Refixing stone slabs of drains and pointing in CM(1:3).	Sqm	1299.38	111.30	144620.99
2	Removing B.S slab of drain and stacking	Sqm	387.00	104.94	40611.78
3	KSRRB M200-15.2. Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts complete as per specifications. iii) Dismantling Stone Masonry. Rubble stone masonry in cement mortar. MORTH Specification No. 202	Cum	153.00	413.40	63250.20
4	KSRRB M200-12.1. Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts complete as per specifications. By Mechanical Means. A. Cement Concrete Grade M-15 & M-20. MORTH Specification No. 202	Cum	880.20	454.74	400262.15
5	KSRRB 300-1. Earthwork excavation by manual means for roads, drains & similar works in ordinary soil excavated surface leveled and sides neatly dressed, the disposed earth to be leveled neatly after breaking of clods complete as per specifications. MORTH / Chapter 3	Cum	613.88	238.92	146670.67
6	KSRRB M300-14. Excavation for roadwork in all types of soil by mechanical means including cutting and loading to tippers, trimming bottom and side slopes, in accordance with requirements of lines, grades and cross sections, and transportation with a lead of 1.00 km and complete as per specifications. MORTH Specification No.301.	Cum	30633.23	84.16	2578215.17

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7	KSRRB M2900-1. Plain cement concrete M10 mix with crushed stone aggregate 40mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing including cost of materials, labor, HOM complete as per specifications. MORTH Specification No. 408	Cum	2484.86	4479.56	11131079.46
8	Providing and laying plain/reinforced cement concrete for side drains using M20 nominal mix concrete with OPC at 300 kgs. with 20mm and down size granite metal coarse aggregates at 0.69 cum and fine aggregates at 0.43 cum machine mixed, well compacted for walls and bottom including centering, shuttering, cost of materials, HOM of machinery, curing etc., complete excluding cost of steel as per MORTH specification No. 1500, 1700, 2200. Including cost of materials, labour, HOM complete as per specifications. Wall& bottom thickness 10cm	Cum	5013.76	7273.72	36468686.39
9	KSRRB M2200-5.9. Providing and laying Design mix M20 with OPC @ 320kgs, with 20mm and down size graded granite metal coarse aggregates @0.69cum and fine aggregates @ 0.46cum, with superplastisiser @3lts confirming to IS9103-1999 Reaffirmed-2008 including cost of materials, labour, HOM curing, form works, scaffolding and centering complete as per specifications. - i) Upto 5 m height.	Cum	527.21	5483.38	2890892.77
10	Providing and laying reinforced cement concrete pipe NP3 for culverts including pointing ends, and fixing collars with cement mortar 1:2 including cost of all materials, labour, curing, including cost of materials, labour, HOM complete as per specifications. Specifications. No. KSRB 1000, 2300 MOST Specification No.1000 / 2300 (900mm dia).	M	15.00	5832.12	87481.80
11	KSRRB M2200-6. Providing T.M.T. steel reinforcement for R.C.C. work including straightening, cutting, bending, hooking, placing in position, lapping and/or welding wherever required, tying with binding wire and anchoring to the adjoining members wherever necessary complete as per design (laps, hooks and wastage shall not be measured and paid) cost of materials, labour, HOM complete as per specification. MORTH Specification No.1600 & 2200.TMT Bars Fe 500.	Tonne	377.21	72326.98	27282460.13
12	Providing and laying 100mm thick pre-cast cover slabs over drains of width not exceeding 800 mm using M20 concrete reinforced with steel @ 6.00 kg/Sqm, slabs jointed in CM 1:3 proportion and nicely finished including providing holes in the Cover slabs wherever necessary for easy drainage of surface water including of labour, materials, HOM of machineries, curing, lead and lift charges etc, Complete as per MORTH specifications No. 1500, 1700 (1 m Width Slab)	Sqm	7088.13	1145.86	8122004.64
13	Providing precast slab of 250 mm thick including cost of all materials, labour, curing, transportation, loading and unloading etc, complete and as per the direction of	Sqm	1058.40	3640.00	3852576.00

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	Engineer In Charge - Data rate				
14	Providing Precast RCC Medium size medians of 2.0 m length, 0.1m top width, 0.4 m bottom width and 0.6 m Height of M-30 grade including loading at casting yard, Transportation to site, Lowering, Hoisting and Erecting to line including all labour charges, taxes etc., complete as per the direction of Engineer in charge.(Data Rate)	Rm	1104.00	6300.00	6955200.00
15	Removing and resetting of available heavy duty cobble stones 60mm thick interlock pavers, using cement and course sand for manufacture of block of approved size, shape and colour with a minimum compressive strength of 281 kg per sqm over 50mm thick sand bed (average thickness) and compacting with plate vibrator having 3 tons compaction force thereby forcing part of sand underneath to come up in between joints, final compaction of paver surface joints into its final level, including cost of materials, labour and HOM of machineries complete as per specification. (for available cobble stones)	No	1575.00	548.87	864470.25
16	KSRB 14.6-1: Providing and laying heavy duty cobble stones 60mm thick interlock pavers, using cement and course sand for manufacture of blocks of approved size, shape and colour with a minimum compressive strength of 281 kg per sqm over 50mm thick sand bed (average thickness) and compacting with plate vibrator having 3 tons compaction force thereby forcing part of sand underneath to come up in between joints, final compaction of paver surface joints into its final level, including cost of materials, labour and HOM complete as per specifications. Specification No. KBS)	Sqm	1249.00	1116.18	1394108.82
17	Providing and laying reinforced cement concrete pipe NP2 for culverts including pointing ends, and fixing collars with cement mortar 1:2 including cost of materials, labour, HOM complete as per specifications, curing complete as per specifications. Specifications. No. KSRB 1000, 2300 MOST Specification No.1000 / 2300 - 300mm dia	m	205.05	1119.36	229524.77
18	KSRRB M300-19. Removal of unserviceable soil including excavation, loading and disposal but excluding replacement by suitable soil which shall be paid separately as per clause 300.5 complete as per specifications. MORTH Specification No. 301	Cum	4687.20	65.96	309167.71
19	Providing and fixing pre cast solid cement concrete kerb stones made out of C.C. 1:2:4 with top and bottom width 114 and 165 mm respectively, 400mm high and 450mm in length finished with CM 1:3 plastering and finishing cutting, including form work, curing, including cost of all materials, labour, hire charges of machinery, loading, unloading, lead and lift, transportation etc., complete	No	17955.00	432.48	7765178.40

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20	KSRRB M2300-3.1. Providing and Placing Reinforced / Prestressed cement concrete in super-structure as per drawing and Technical Specification complete as per specifications. B. RCC with OPC design mix M25 @ 340kgs, with 20mm and down size graded granite metal coarse aggregates @0.7cum and fine aggregates @ 0.47cum, with superplastisiser @3lts confirming to IS9103-1999 Reaffirmed-2008, including cost of materials, labour, HOM, curing, form works, scaffolding and centering complete as per specifications. MORTH Specification No. 1500,1600, 1700 & 2300 IS 456 Height upto 5 m	Cum	206.27	6803.08	1403271.31
21	KSRRB M2200- Providing Weep Holes KSRRB M2200-8. Providing weep holes in Brick masonry / Plain / Reinforced concrete abutment, wing wall / return wall with 100 mm dia AC pipe, extending through the full width of the structure with slope of 1V :20H towards drawing face. Complete as per drawing and Technical Specifications complete as per specifications MORTH Specification No.2706 & 2200	Rm	33.88	155.82	5279.18
22	KSRRB M2700-5. Drainage Spouts using 100mm class 'B' GI pipe as per drawing and Technical specification including clamps and nuts etc., including cost of materials, labour, HOM complete as per specifications. MORTH Specification No. 2705	Each	4.00	1645.12	6580.48
23	KSRRB M2700-7. Reinforced cement concrete M30 approach slab including reinforcement @ 70 kg/cum and formwork complete as per drawing and Technical specification including cost of materials, labour, HOM complete as per specifications. MORTH Specification No. 1500, 1600, 1700 & 2704	Cum	50.40	10558.66	532156.46
24	Providing and laying Filter material as per table 300-3 underneath pitching in slopes complete as per drawing, including cost of all materials, labour, loading, unloading, lead, lift transporting etc., complete. complete As per MoRT&H Technical Specification Clause 2504 .	Cum	37.98	2482.52	94286.11
25	Providing and laying Pitching on Slopes laid over existing prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing, including cost of all materials, labour, loading, unloading, lead and lift, transporting etc., complete in accordance with MoRT&H Technical Specification Clause 2504. A) Stone/Boulder.	Cum	37.98	1709.78	64937.44
26	KSRRB M2500-1.1. Providing and laying boulders apron on river bed for protection against scour with stone boulders weighing not less than 40 kg each complete as per drawing and Technical specification including cost of materials, labour, HOM complete as per specifications. A. Boulder Laid Dry Without Wire Crates MORTH Specification No. 2503	Cum	11.94	1709.78	20414.77

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27	KSRRB M200-10.1. Clearing and grubbing road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, including removal and disposal of top organic soil not exceeding 150 mm in thickness complete as per specifications. I. By Manual Means: A. In area of light jungle. MORTH Specification No. 201	Ha	0.13	82105.48	10552.20
28	KSRRB 300-46. Scarifying by mechanical means stone metal crust 50mm to 100mm thick by along with 20mm premix carpet / surface dressing and stacking of old serviceable materials including cost of all labour charges, HOM complete as per specifications. MORTH / Chapter 3	Sqm	1795.00	41.34	74205.30
29	KSRRB M300-53. Construction of embankment with approved material Gravel/Murrum with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement Table 300-2 complete as per specifications, including cost of gravel / murrum, watering charges & compaction by vibratory roller to 95% of modified proctors density. MORTH Specification No. 305.	Cum	30635.44	344.50	10553909.08
30	Construction of granular sub-base Grading-V as Sub-base and drainage layer by providing coarse graded crushed stone aggregates of granite/ trap/basalt material,mixing by mix in place method with rotavator at OMC, spreading in uniform layers with motor grader on prepared surface and compacting with vibratory power roller to achieve the 98 % proctor density, complete as per specifications. Clause 401 of MORTH V Revision.	Cum	13333.41	1855.00	24733475.55
31	KSRRB M600-1.Providing and Constructing dry lean cement concrete mix CC 1:5:10 base with OPC 25mm and down size graded granite metal coarse aggregate at 0.86cum and fine aggregates @0.58cum over a prepared sub-base, coarse and fine aggregate conforming to IS: 383-2016,aggregate cement ratio not to exceed 15:1, Aggregate gradation after blending to be as per Table 600-1,optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, laid with a paver, compacting with 8-10 tones vibratory roller, finishing and curing complete as per specifications. Clause 601of MORTH V Revision and IS 456 Table-5 with OPC at 150 kg/cum and coarse aggregate 0.86cum, fine aggregate 0.58cum using Concrete Batch mix Plant at 75 cum/hr capacity with Slip form paver with electronic sensor.	Cum	198.00	3800.10	752419.80

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32	Constructing un-reinforced, plain cement concrete for pavements using Grade concrete M30 over a prepared base with OPC coarse aggregate at 0.69 cum, fine aggregates at 0.46 cum,Coarse and fine aggregate conforming to IS:383-2016, with Superplastizer at 3 lts conforming to IS 9103-2008. mixed in a concrete mixer of not less than 0.6 cum capacity and appropriate weigh batcher as per approved mix design, laid in approved fixed side form work (steel channel, laying and fixing of 125 micron thick polythene film, wedges, steel plates including leveling the form work as per drawing). & Spreading the concrete with shovels, rackers compacted using needle, screed and plate vibrator and finished with floaters in a continuous operation including provision of contraction, expansion, construction and longitudinal joints,including groove cutting charges, joint filler, separation membrane of impermeable plastic sheet of 125 micron, sealant primer, joint sealant, admixtures as approved, curing compound, finishing to lines and grades, textured with texturing machine, and curing including cost of all materials, labour,hire charges of machineries, all lead & lift charges etc., complete as per specifications. With OPC at 360 kg/cum and coarse aggregate 0.69cum, fine aggregate 0.46cum.	Cum	297.00	5210.96	1547655.12
33	KSRRB M400-17. Providing, laying, spreading and compacting crushed stone aggregates of granite / trap / basalt to wet mix macadam specifications including pre mixing the material with water at OMC in mechanical mix plant carriage of mixed materials by tipper to site, laying in uniform layers with paver in sub-base/base course on well prepared surface and compacting with vibratory roller to achieve the desired density complete as per specifications. MORTH Specification No. 406	Cum	17348.96	2001.28	34720126.67
34	KSRRB M500-6. Providing and applying primer coat with S.S. bitumen emulsion on prepared surface of granular base such as WMM including cleaning of road surface and spraying primer at the rate of 0.60 kg / sqm using mechanical means complete as per specifications. Clause 502 of MORTH V revision	Sqm	67980.25	29.68	2017653.82
35	KSRRB 500-2. Cleaning the existing black topped surface with brooms, soft brushes and finally dusting with old gunny bags and / or compressed air to receive bituminous treatment including cost of all materials, labour, HOM complete as per specifications. Clause 501 of MORTH V revision	Sqm	51277.00	5.30	271768.10
36	KSRRB 500-7. Providing and applying tack coat using 80/100 grade bitumen(VG10) on the prepared black topped surfaces at 2.5 kg per 10 sqm, heating bitumen in boiler fitted with spray set (excluding cleaning of road surface) including cost of all materials, labour, HOM complete as per specifications. Clause 503 of MORTH V revision	Sqm	116618.83	12.72	1483391.52

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37	KSRRB M500-17. Providing and laying dense graded bituminous macadam using crushed aggregates of specified grading, premixed with VG30 grade bituminous binder and, transporting the hot mix to work site, laying to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction in all respects complete as per specifications. Clause 505 of MORTH V revision - using 40/60 TPH capacity H.M.P. with Mechanical paver Gr-II (50 mm to 75 mm) with 4.5 % VG-30 Bitumen	Cum	5938.81	6858.20	40729546.74
38	Providing and laying bituminous concrete 40mm thick with hot mix plant, using crushed aggregates of specified grading, premixed with bituminous binder and filler, transporting the hot mix to work site, laying with a paver finisher to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction in all respects complete as per specifications.Clause 507 of MORTH V revision as per IRC SP-53-2015.– using 40-60 TPH capacity HMP with mechanical paver grading II (30-45mm) with 5.4 % of modified bituminus binder consisting of 4.97% of VG-30 bitumen (60/70 grade) and 0.43% of plastomeric thermoplastics (waste plastic)	Cum	3498.57	8049.64	28162229.01
39	KSRRB M800-13.Road Marking with Hot Applied Thermoplastic Compound with Reflectrising Glass Beads on Bituminous Surface/ Concrete Surface: Providing and laying of hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads at 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC:35 standards specified. The finished surface to be level, uniform and free from streaks and holes complete as per specifications. MORTH Specification No. 803.	Sqm	5965.71	454.74	2712846.97
40	KSRRB M800-35. Supply and Installtion of Moulded Shank Raised Pavement Markers made of polycarbonate and ABS(Acrylonitrile Butadiene Styrene) moulded body and reflective panels with micro prismatic lens capable of providing total internal reflection of the light entering the lens face and shall support a load of 16000 kg tested in accordance to Specifications of Category A of MORTH Circular No RW/ NH/33023/10-97 – DO III Dt 11.06. 1997. The height, width and length shall not exceed 50 mm, 100 mm and 102 mm and with minimum reflective area of 13 Sqcm on each side and the slope to the base shall be 35 degree. The strength of detachment of the integrated cylindrical shanks, (of diameter not less than 19 mm and height not less than 30 mm) from the body is to be a minimum value of 500 Kg. Fixing will be by drilling holes on the road for the shanks to go inside, without nails and using epoxy resin based adhesive as per manufacturer's recommendation and complete as directed by the engineer.	No	5733.00	357.22	2047942.26

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41	Retro-Reflectorized Traffic Signs Providing and fixing of retro - reflectorized cautionary, mandatory and informatory sign as per IRC:67 made of high intensity grade sheeting vide Clause 801.3, fixed over aluminum sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing. 600 MM Equilateral triangle - TYPE XI	No	42.00	2642.58	110988.36
42	Retro-Reflectorized Traffic Signs Providing and fixing of retro - reflectorized cautionary, mandatory and informatory sign as per IRC:67 made of high intensity grade sheeting vide Clause 801.3, fixed over aluminum sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing. 600 MM Circle - TYPE XI	No	18.00	3309.32	59567.76
43	Retro-Reflectorized Traffic Signs Providing and fixing of retro - reflectorized cautionary, mandatory and informatory sign as per IRC:67 made of high intensity grade sheeting vide Clause 801.3, fixed over aluminum sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing. 900 MM Octagon Stop Board - TYPE XI	No	47.00	5349.82	251441.54
44	Manufacturing, Supply and installation of Retro-reflective Hazard Marker signboards made out of cube corner micro prismatic grade sheeting confirming to Type XI standards of IRC:67:2012& ASTM D 4956-09 specification & fixed over 4 mm thick Aluminum Composite Panel sheet having minimum 0.30 mm thick aluminum skin on both sides & fixed over back support frame of 25x25x 3mm MS angle frame. Supported on round pipe post of 1.5 Meters height and grouted 60 cm below ground level. The sign post should be painted with one coat of red oxide paint and two coats of synthetic enamel paint of black and firmly fixed to the ground by means of foundation with M 20 grade cement, concrete foundation size of 45 cm x 45 cm x 60 cm including cost & conveyance of all materials, equipment, machinery&Labour with all leads and lifts, Loading charges necessary for satisfactory completion of the work as directed by engineer incharge.	Sqm	12.96	4948.08	64127.12

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45	Supply and fixing of Retro Reflective Single Arrow Road Name Signboard of size 1600mm x 900mm made out of retro reflective sheeting conforming to Type XI standards of ASTM D 4956 - 09 & as per IRC 67-2012 for full back ground of blue colour& white letters and fixed over 4 mm thick Aluminum Composite Material sheet having minimum 0.5 mm thick Aluminum skin on both sides with back side painted grey colour and fixed over back support frame SS angle of 15mm x 20mm x 1.2mm, supported by 38mm OD stainless steel pipe all round in 304 grade and 2 nos of vertical posts of 50 mm OD stainless steel pipe of 202 grade firmly fixed to the ground by means of properly designed foundation of size 450mm x 450mm x 600mm in 1:1.5:3 ratio cement concrete. The background shall be blue in color with letters and border in white, the item includes earthwork excavation, cost of all materials, loading, unloading, lead, lift, transportation etc., complete. as per direction of engineer incharge of work clause 6.9 of IRC 67-2012 for Type XI retro reflective sheeting from the sheeting manufacturer & a certified copy of test reports from an independent test laboratory conforming to clause 6.7 of IRC 67-2012 including outdoor weather exposure report for the retro reflective sheeting offered shall be submitted by the contractor for technical qualification in the tender.	Sqm	21.60	14094.82	304448.11

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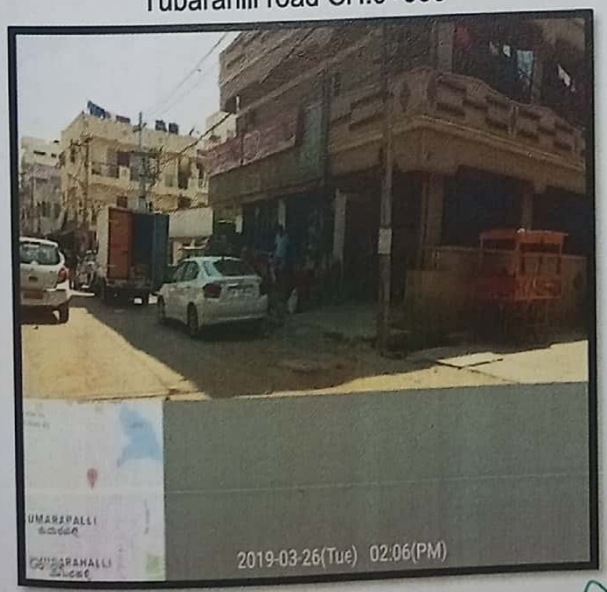
Chapter 9
Photos

9.1. Existing Site Photos

Improvements to Road From Varthur Road via Tubarahalli Outer Ring Road and Road from Vibgyaor School via Tubarahallibalagere up to BWSSB Treatment Plant Road (RMP Road)Link Road.

Tubarahlli road CH:0+000

Tubarahlli road CH:0+100



Tubarahlli road CH:0+200

Tubarahlli road CH:0+240

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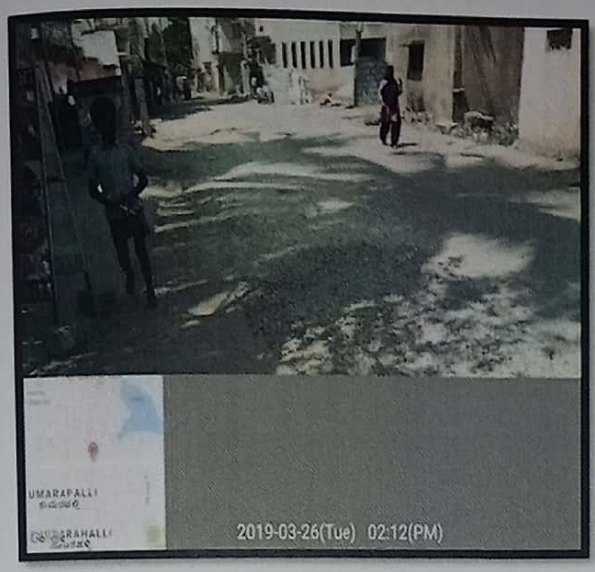
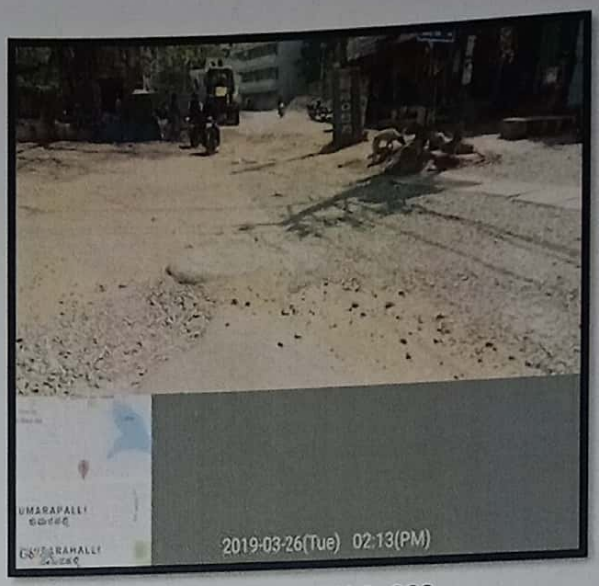


Tubarahlli road CH:0+250



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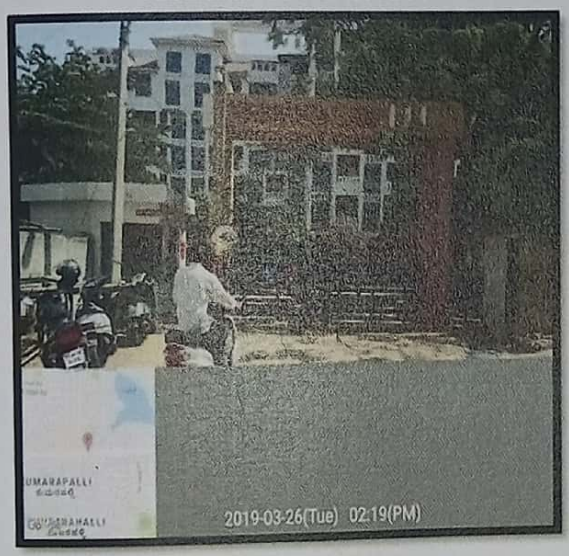
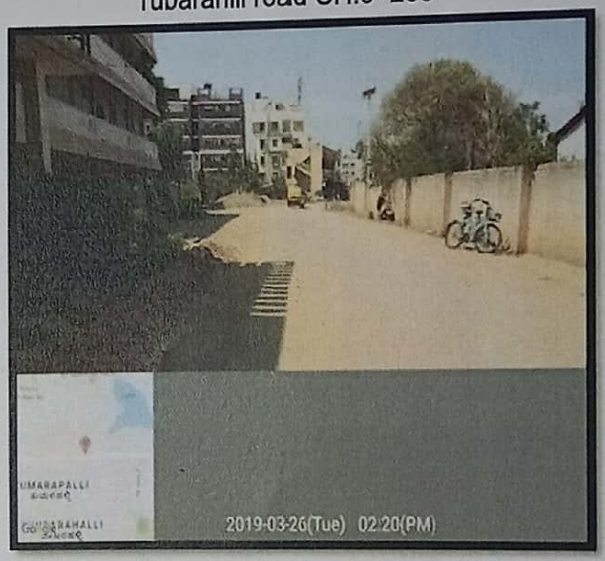
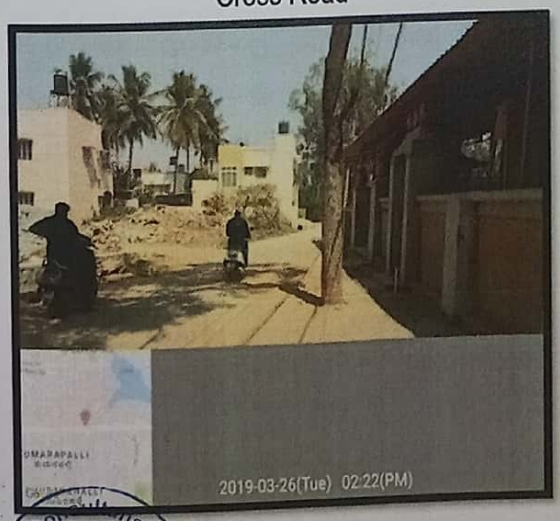


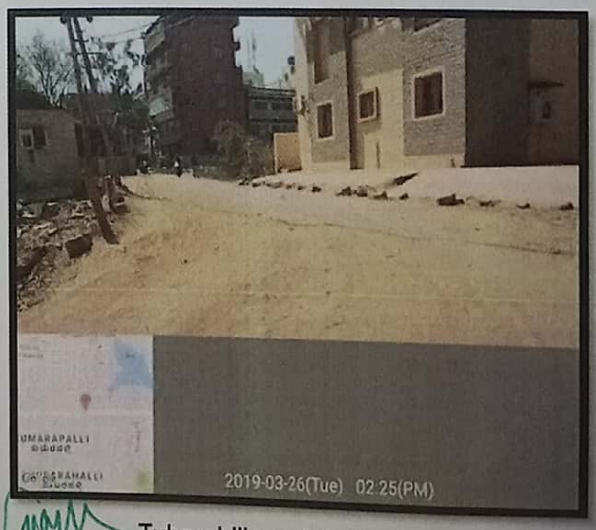
Cross Road



Cross Road



Tubarahlli road CH:0+270



Tubarahlli road CH:0+350

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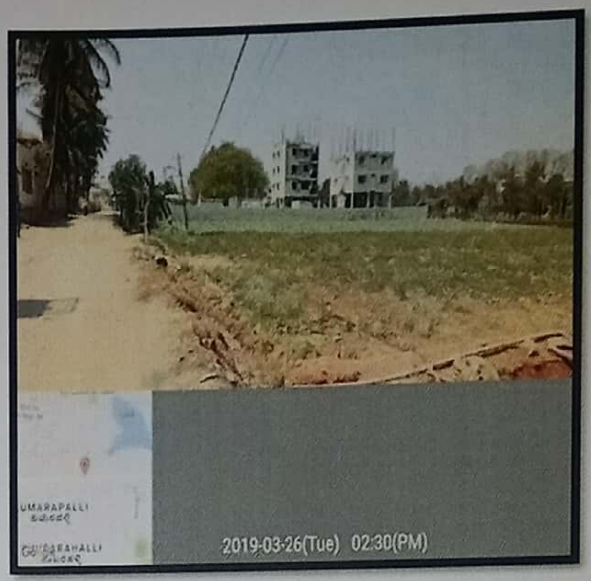
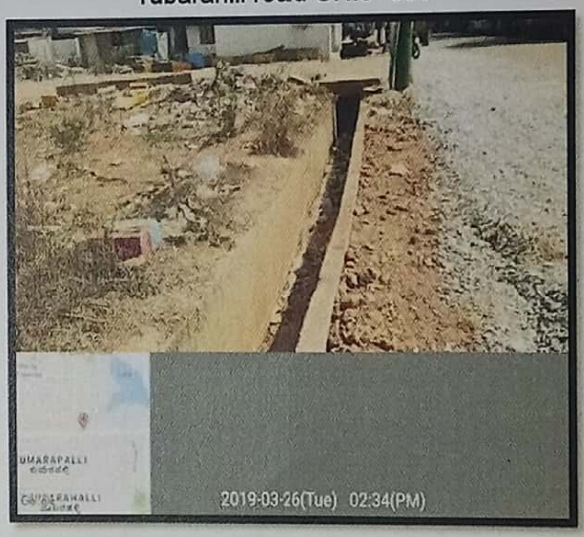
Tubarahlli road CH:0+600



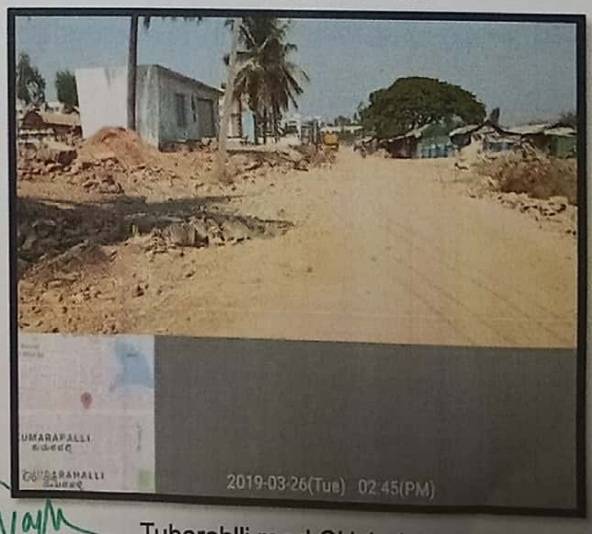
Tubarahlli road CH:0+650

Tubarahlli road CH:0+800



Tubarahlli road CH:0+900

Tubarahlli road CH:1+020



Tubarahlli road CH:1+150

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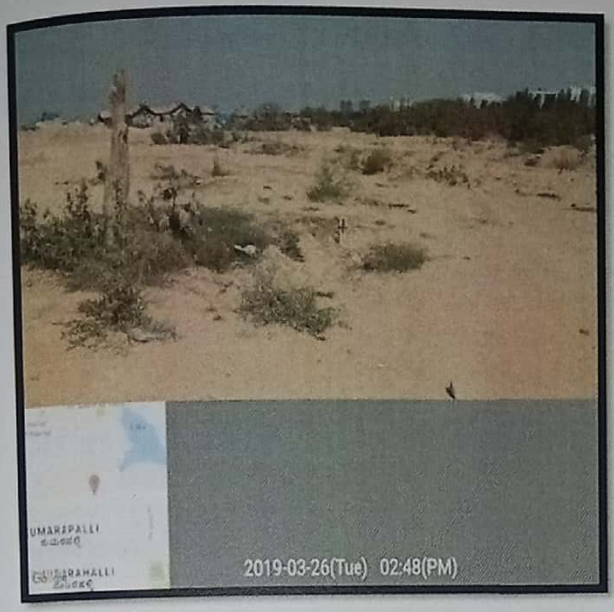
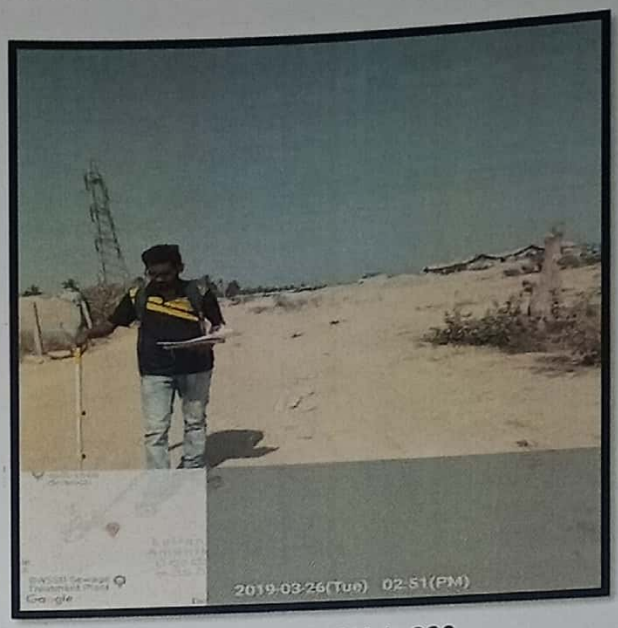
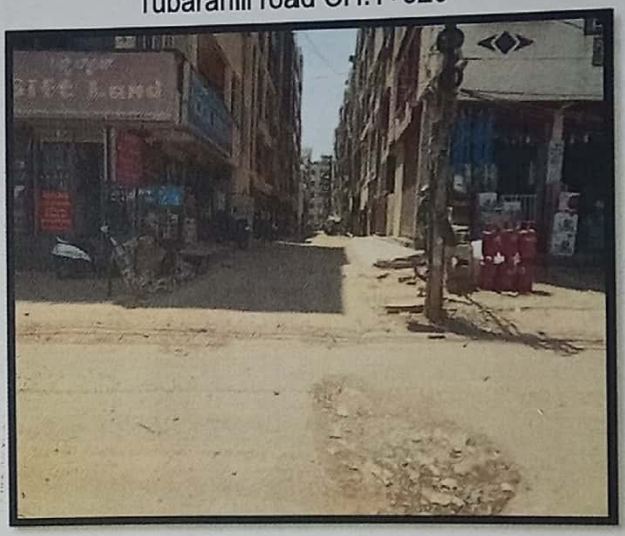


Tubarahlli road CH:1+600

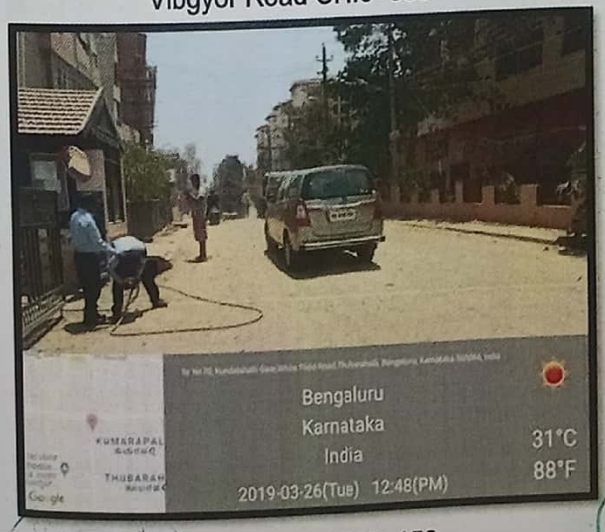


Tubarahlli road CH:1+620

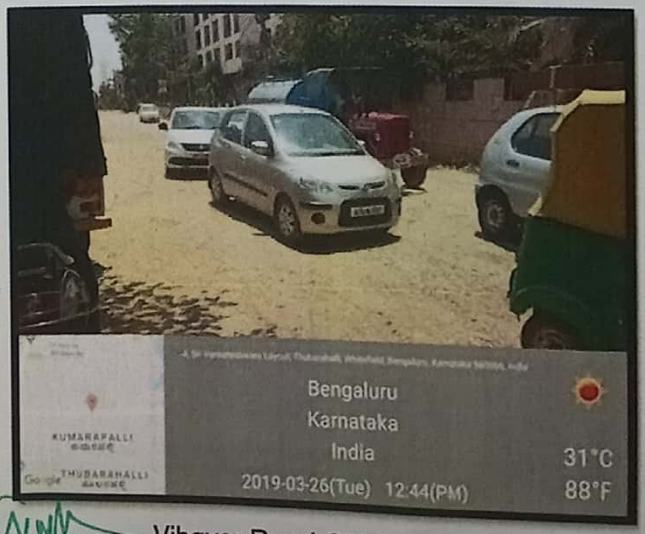
Vibgyor Road CH:0+050



Vibgyor Road CH:0+100



Vibgyor Road CH:0+150



Vibgyor Road CH:0+200

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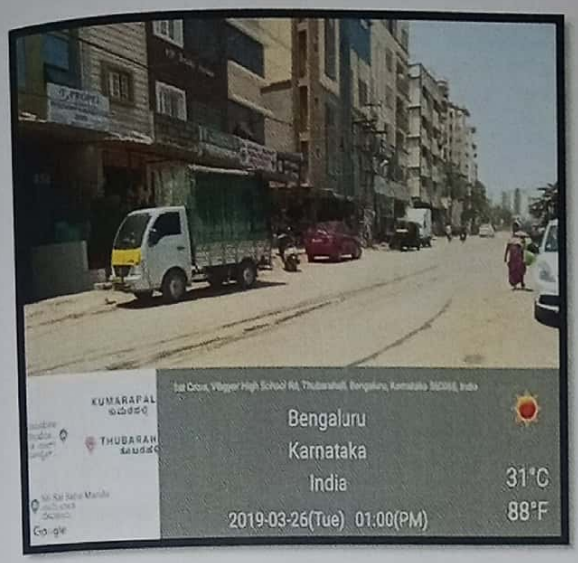
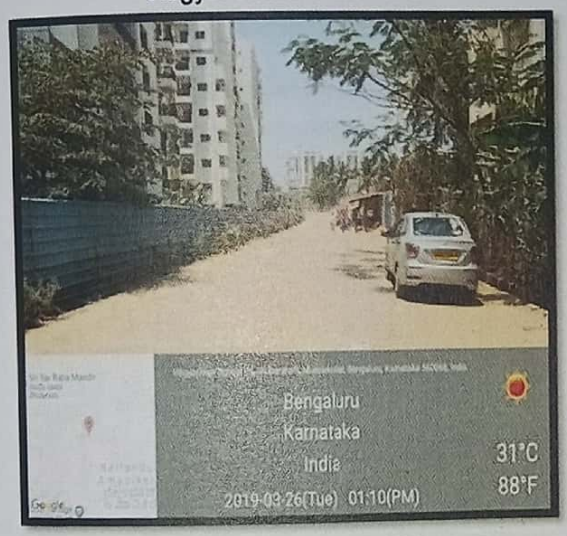


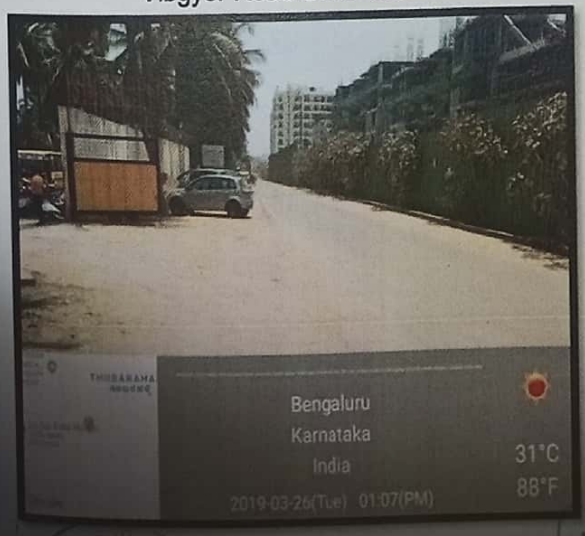
Vibgyor Road CH:0+400

Vibgyor Road CH:0+450



Vibgyor Road CH:0+650

Vibgyor Road CH:0+700



Vibgyor Road CH:0+850

Vibgyor Road CH:0+860

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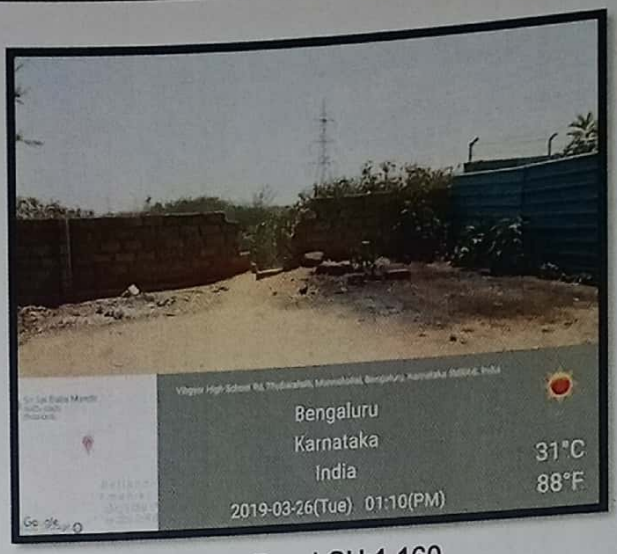
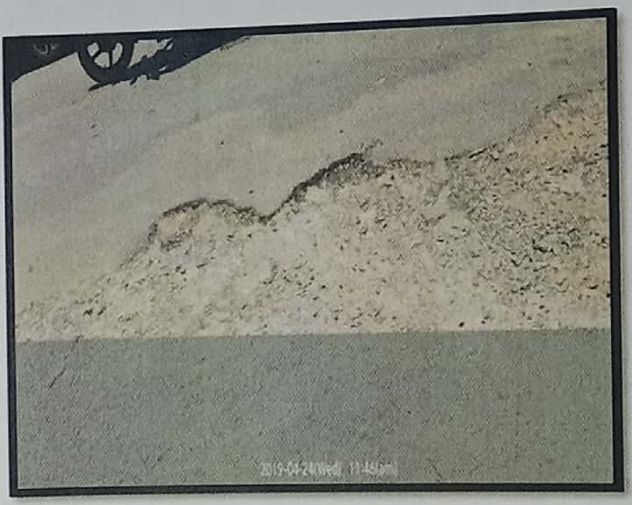
Vibgyor Road CH:0+900



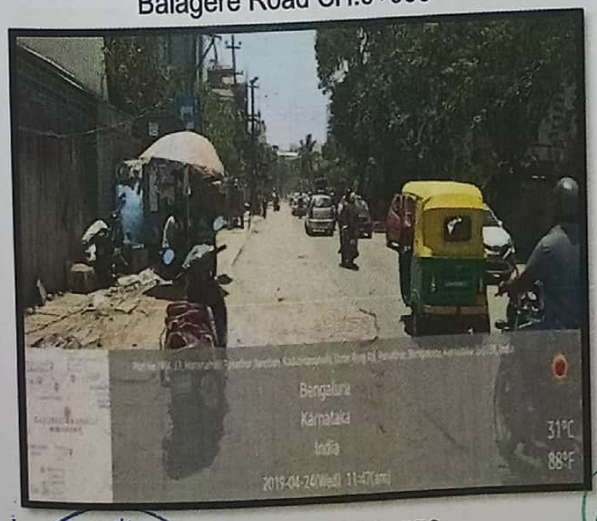
Vibgyor Road CH:1.160

Improvements to Road from Varthur to Balagere Gunjur ORR and Kadubisanahalli Road

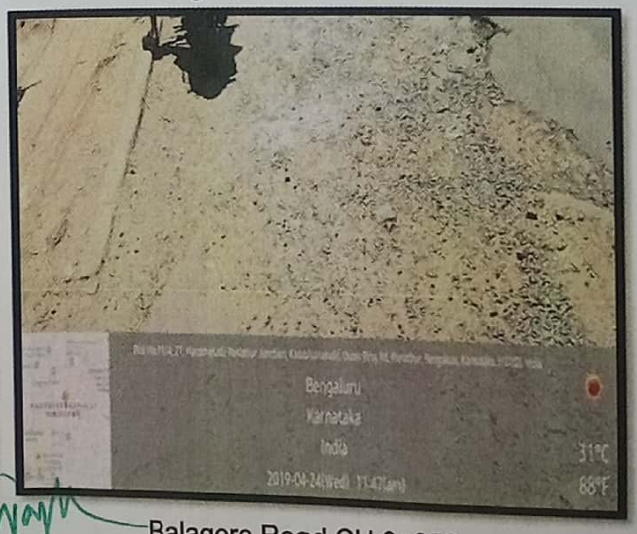
Balagere Road CH:0+000



Balagere Road CH:0+020



Balagere Road CH:0+050



Balagere Road CH:0+050

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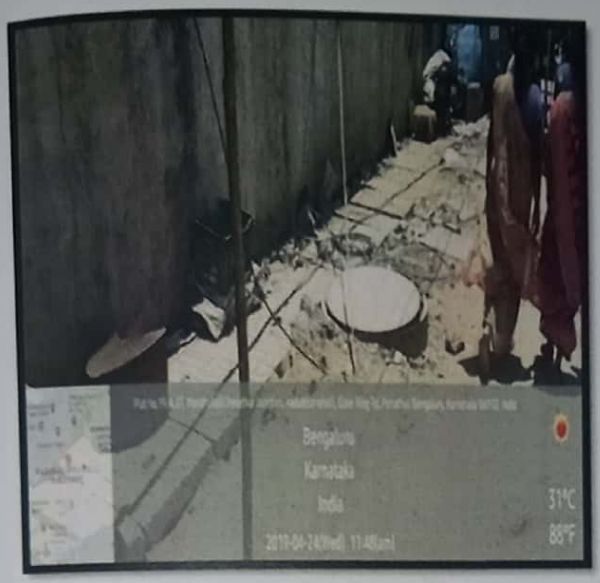
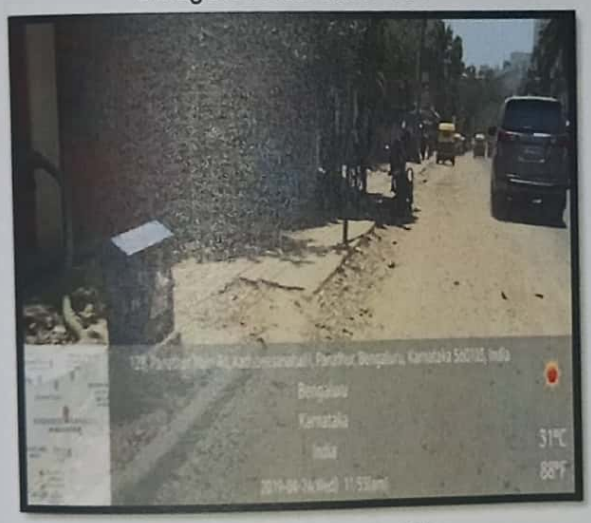
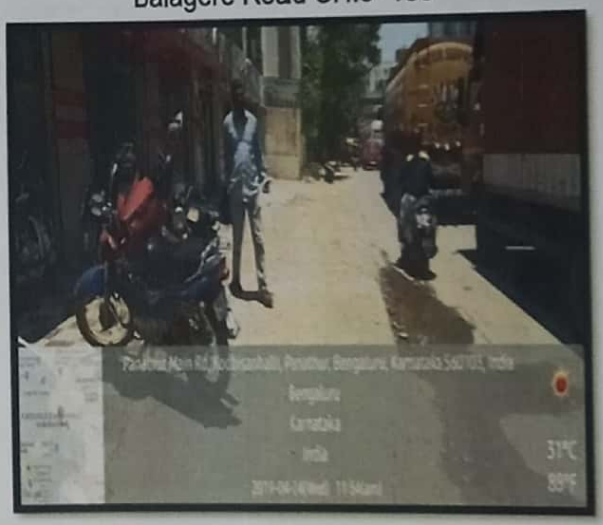


Balagere Road CH:0+100

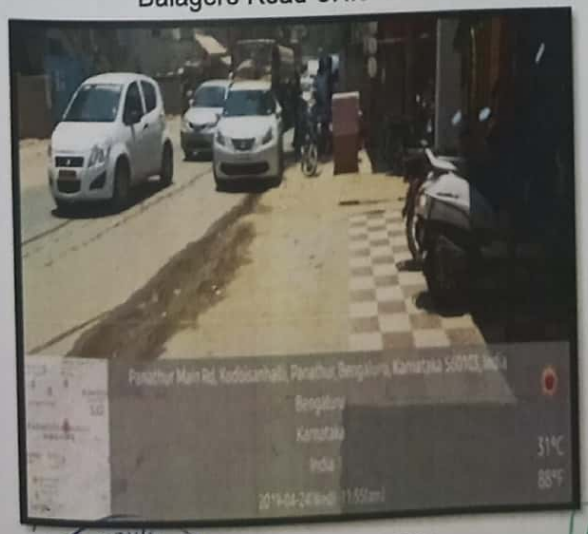
Balagere Road CH:0+150



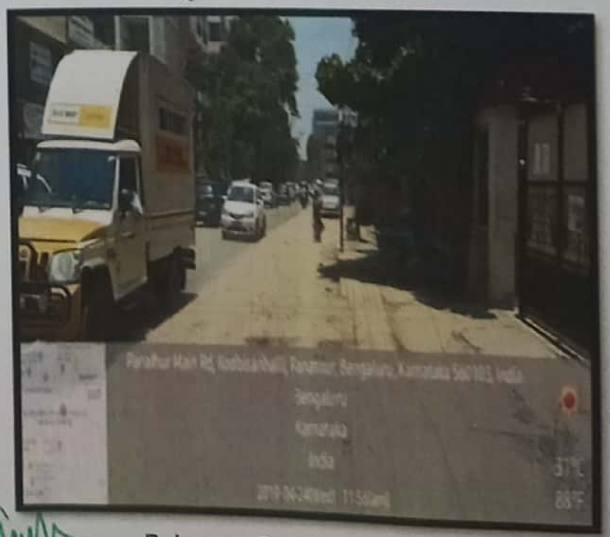
Balagere Road CH:0+220



Balagere Road CH:0+300



Balagere Road CH:0+320



Balagere Road CH:0+340

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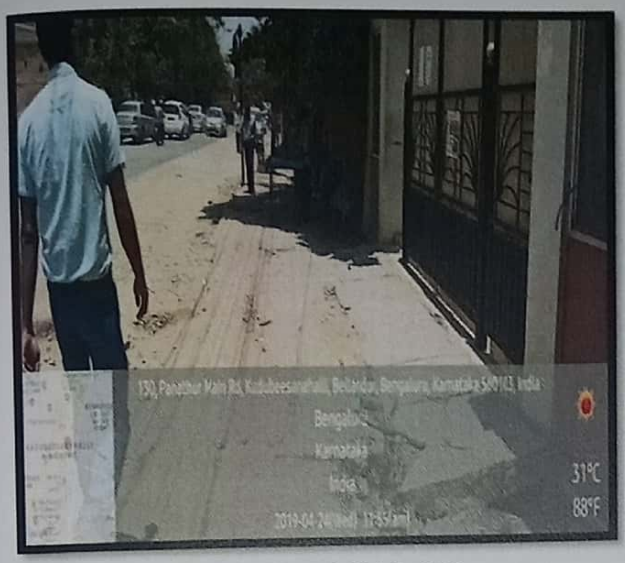
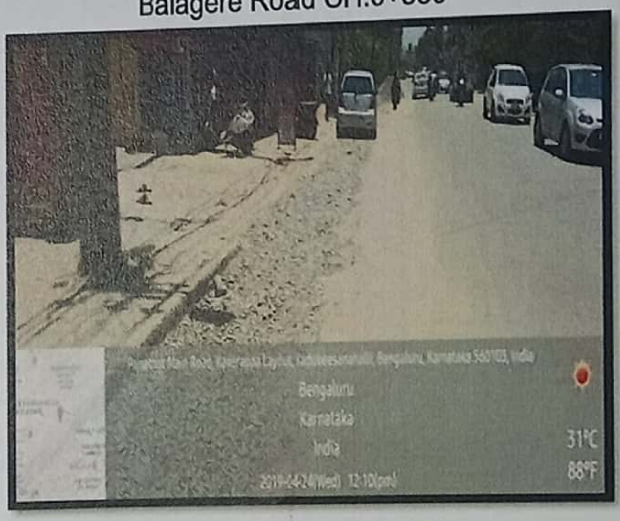


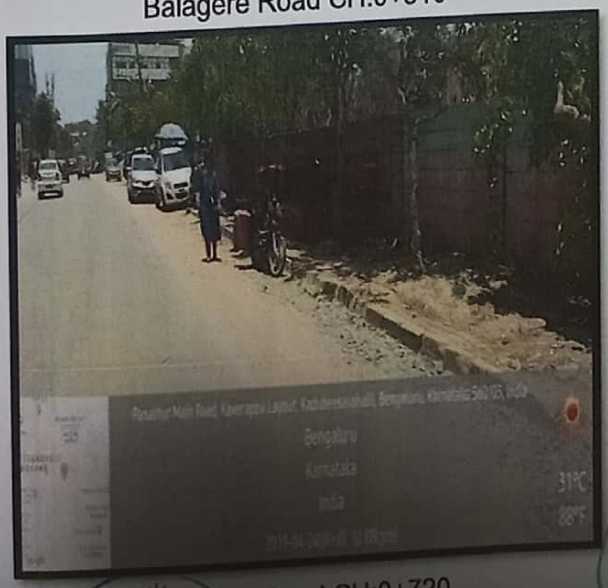
Balagere Road CH:0+340

Balagere Road CH:0+380

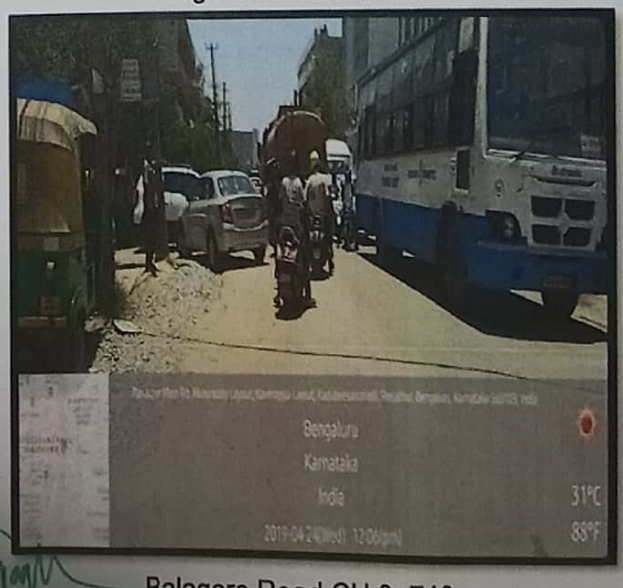
Balagere Road CH:0+510



Balagere Road CH:0+600



Balagere Road CH:0+720



Balagere Road CH:0+740

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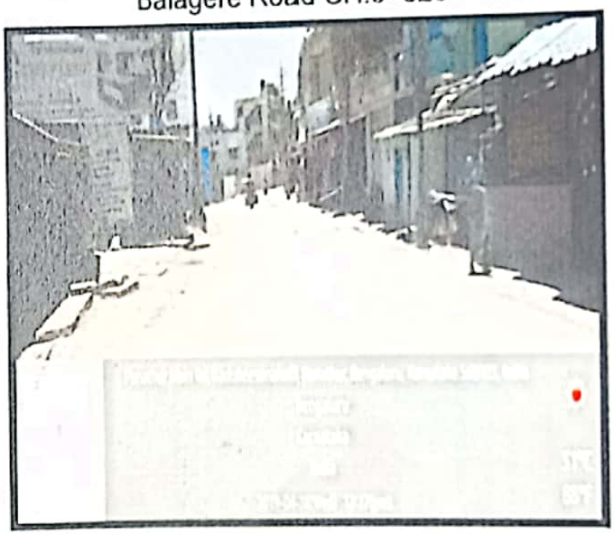
Balagere Road CH:0+800

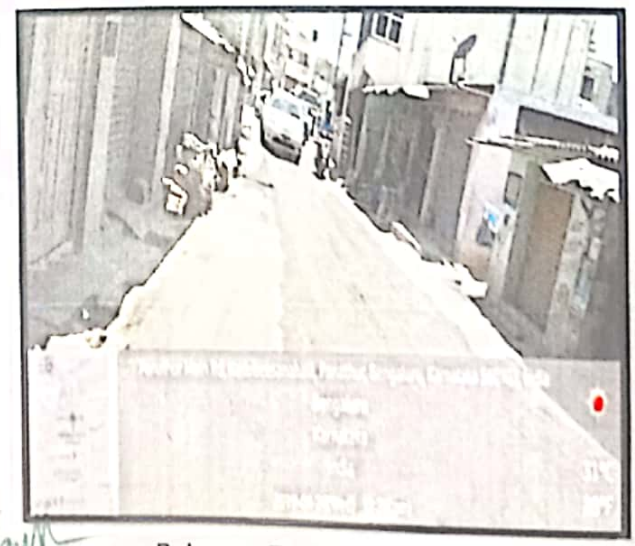
Balagere Road CH:0+820

Balagere Road CH:0+950



Balagere Road CH:0+980

Balagere Road CH:1+100



Balagere Road CH:1+150

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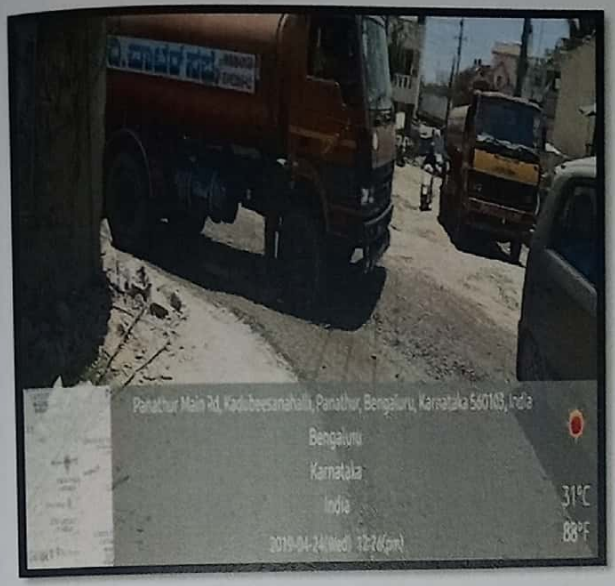
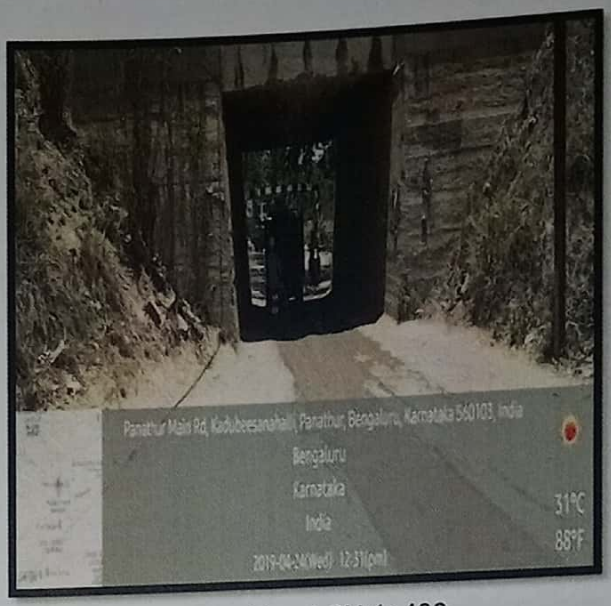
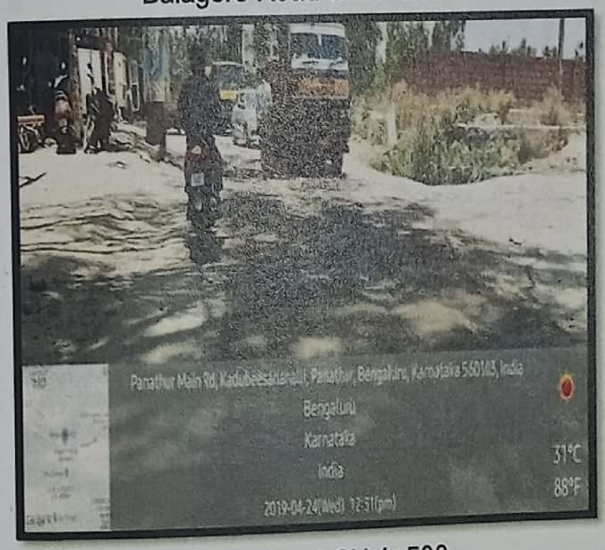


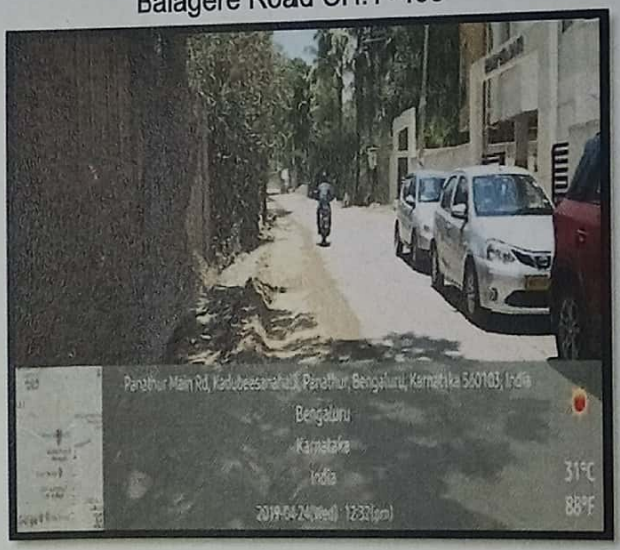
Balagere Road CH:1+200



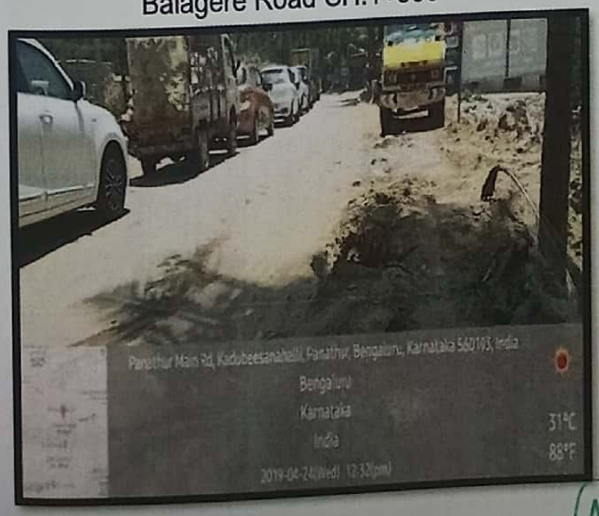
Balagere Road CH:1+400



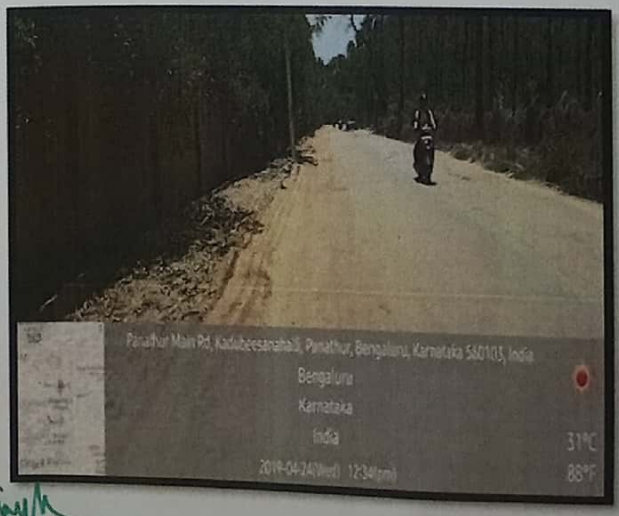
Balagere Road CH:1+500



Balagere Road CH:1+650



Balagere Road CH:1+680



Balagere Road CH:1+790

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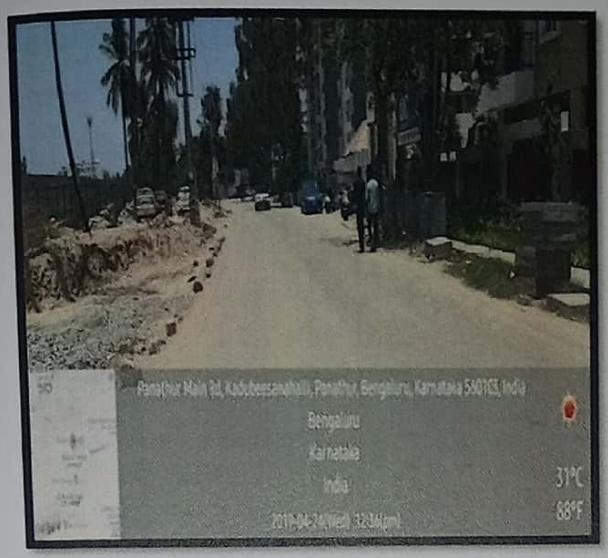
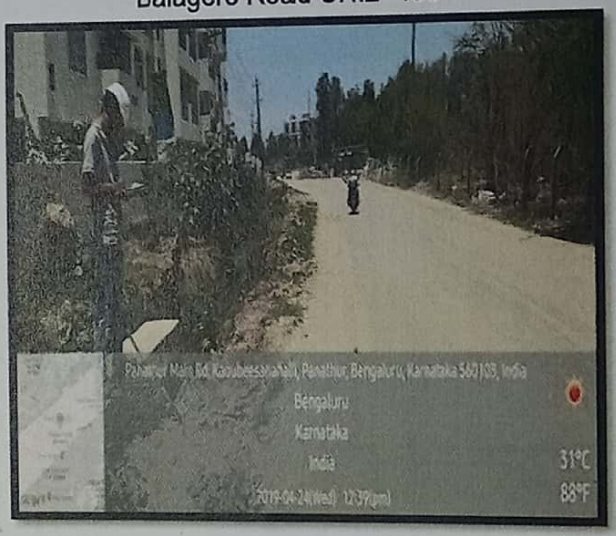
BBMP, Bangalore



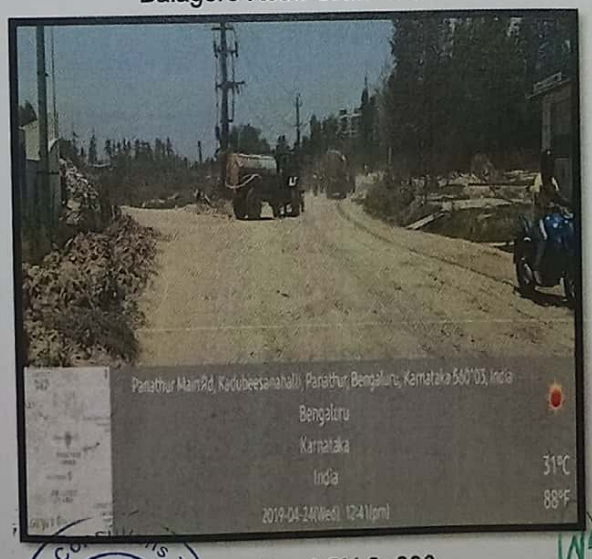
Balagere Road CH:2+200

Balagere Road CH:2+400

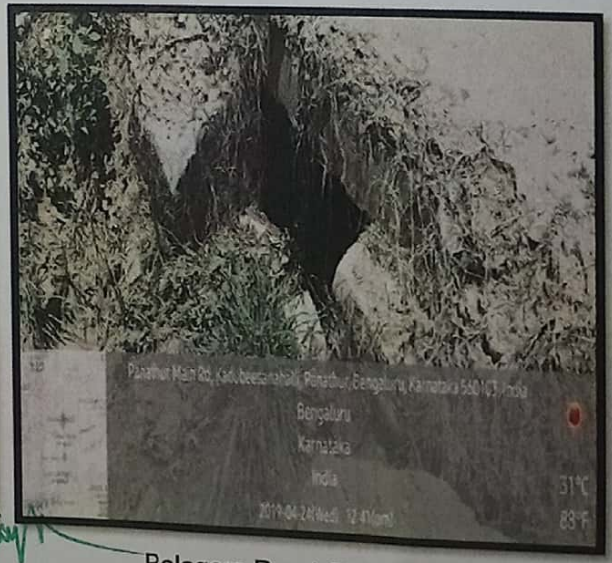
Balagere Road CH:2+400



Balagere Road CH:2+400



Balagere Road CH:2+600



Balagere Road CH:2+600

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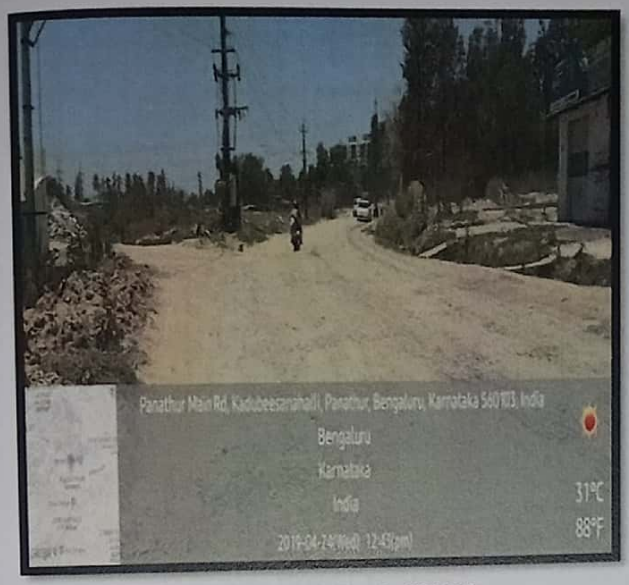
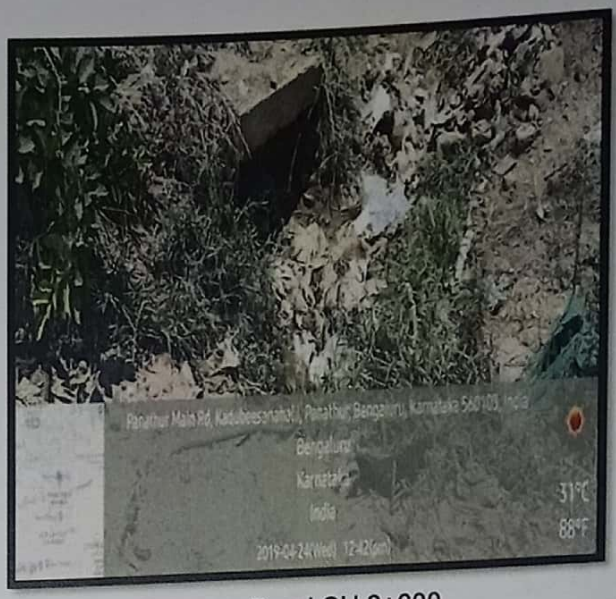
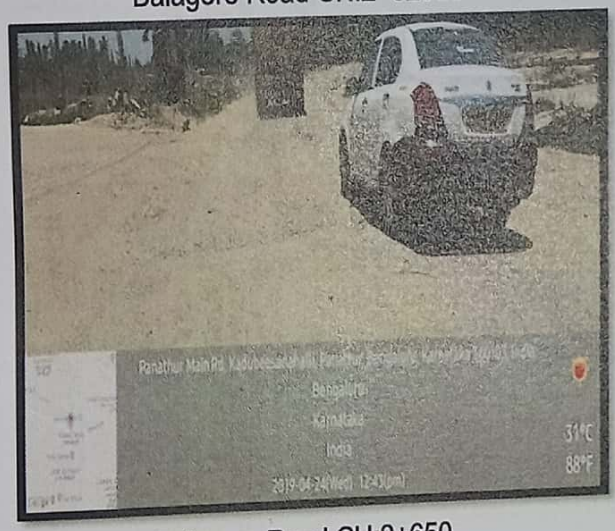


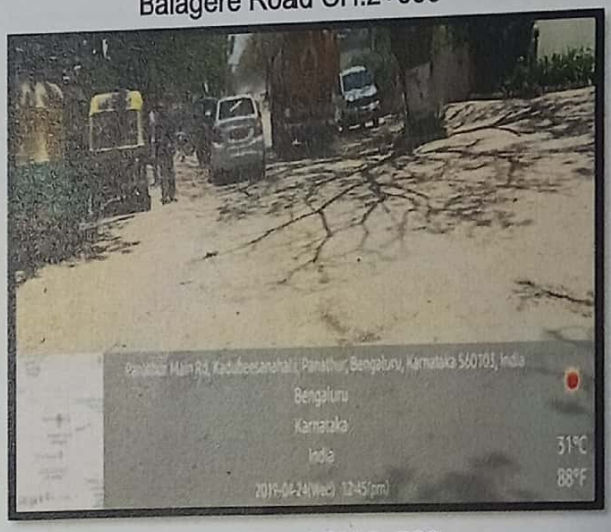
Balagere Road CH:2+62000



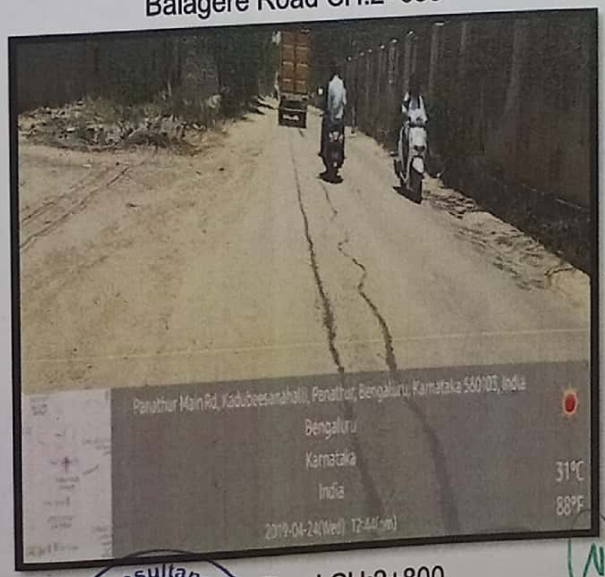
Balagere Road CH:2+600



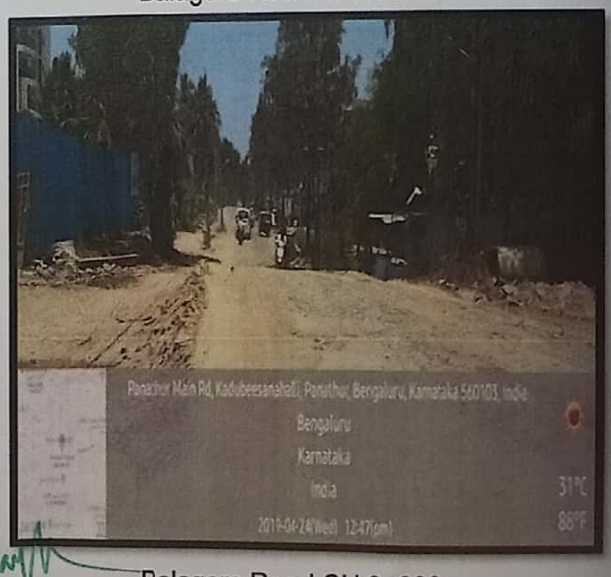
Balagere Road CH:2+650



Balagere Road CH:2+200



Balagere Road CH:2+800



Balagere Road CH:3+000

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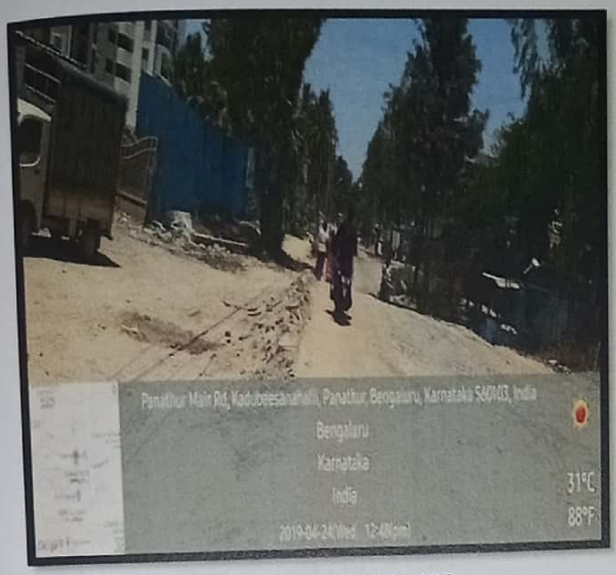
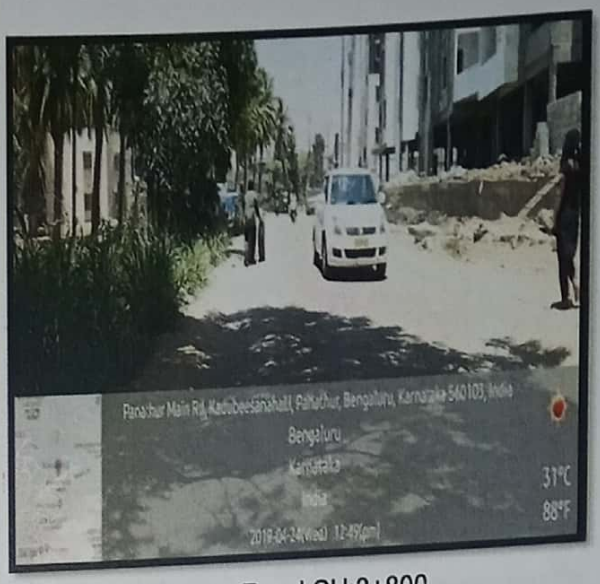
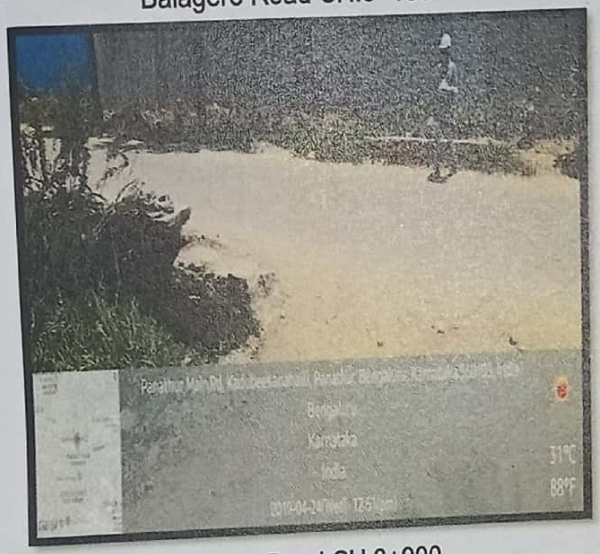


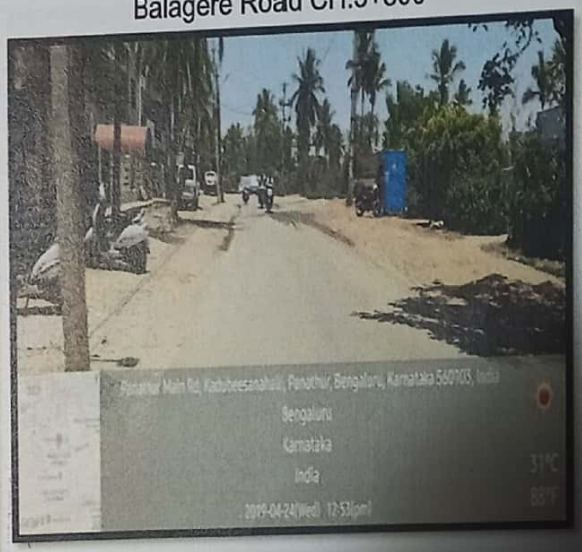
Balagere Road CH:3+100



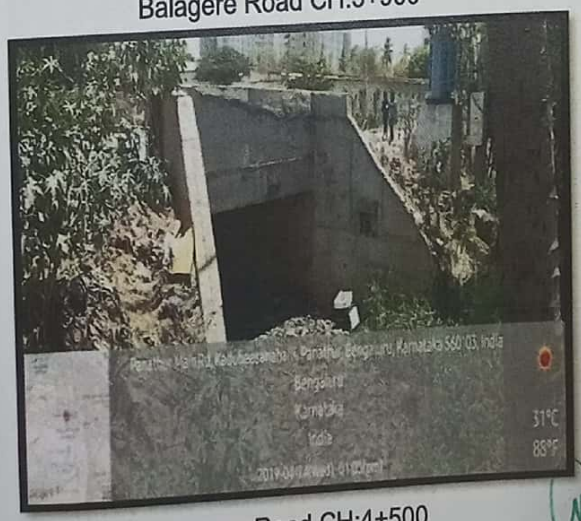
Balagere Road CH:3+800



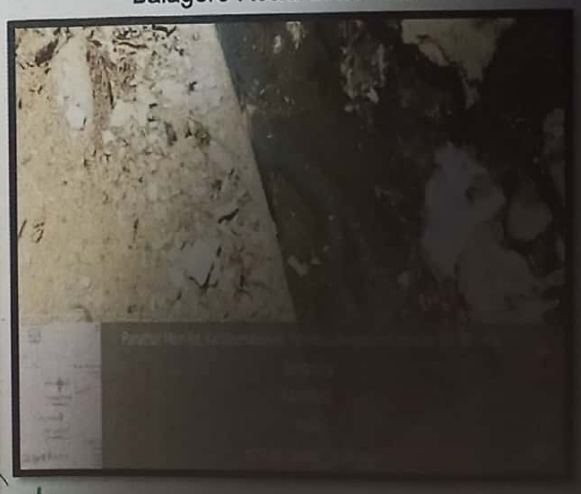
Balagere Road CH:3+900



Balagere Road CH:4+000



Balagere Road CH:4+500



Balagere Road CH:4+500

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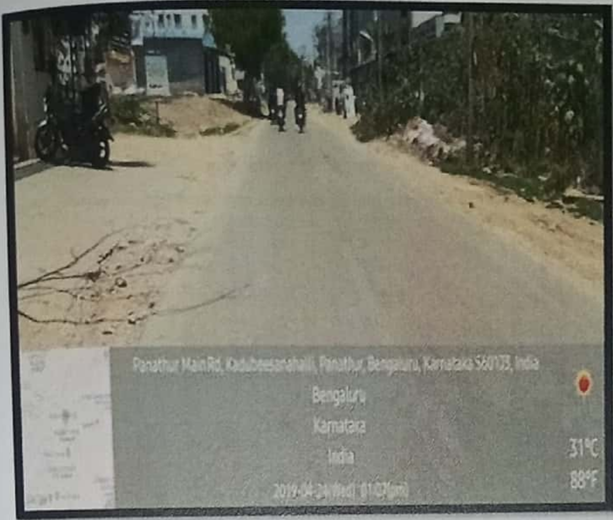
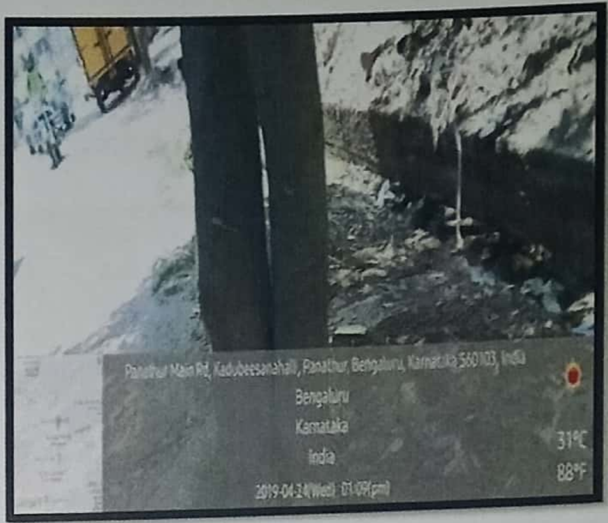
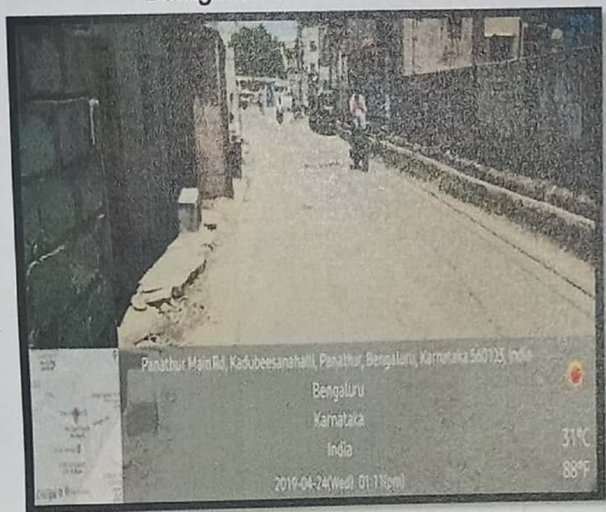


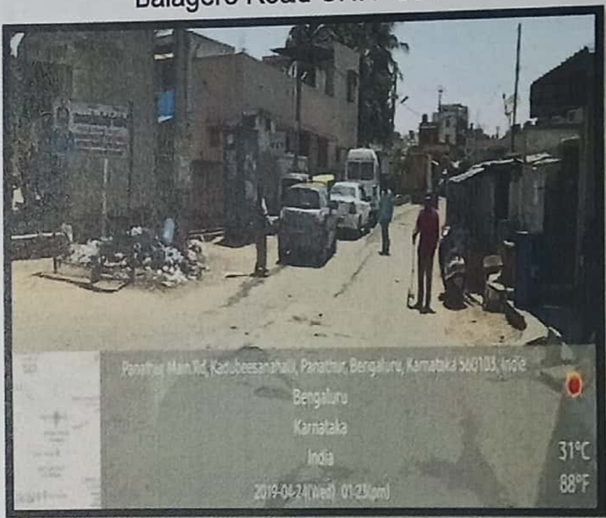
Balagere Road CH:4+800



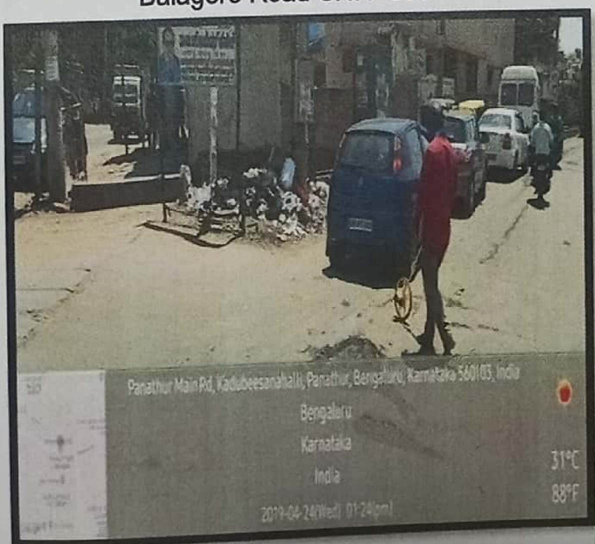
Balagere Road CH:4+900



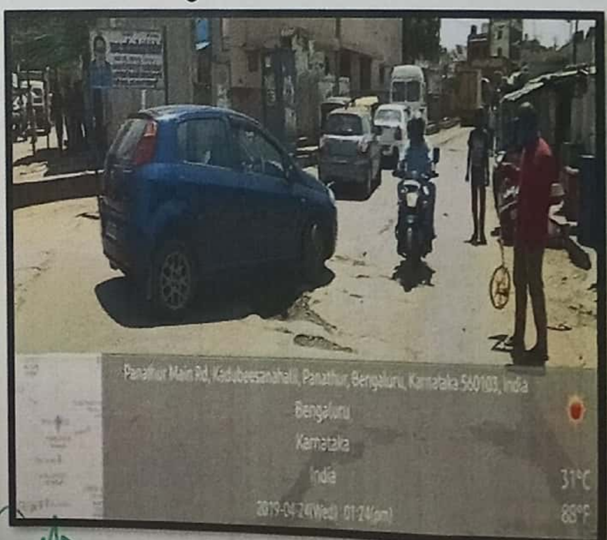
Balagere Road CH:4+980



Balagere Road CH:5+900



Balagere Road CH:5+900



Balagere Road CH:5+900

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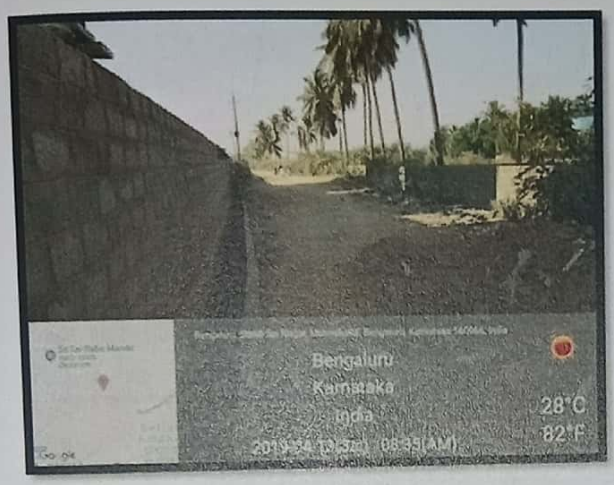
Civil Experts Consultants Testing Center

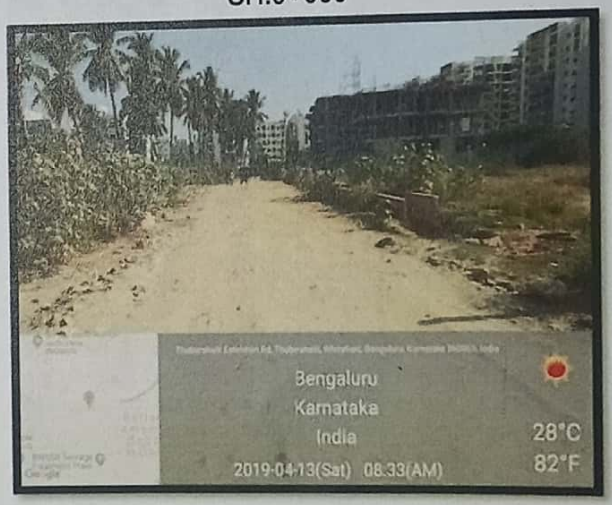
Improvements to Road from Balagere BWSSB Treatment Palnt Road to Munekolala Connecting Road.
&
Improvements to Road from Munekolalasai Layout to GunjurPalya CDP Road.



CH:0+000

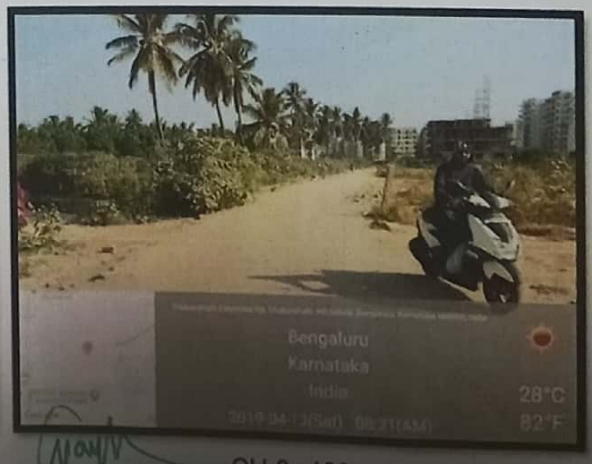
CH:0+000

CH:0+100



CH:0+250

CH:0+300



CH:0+400

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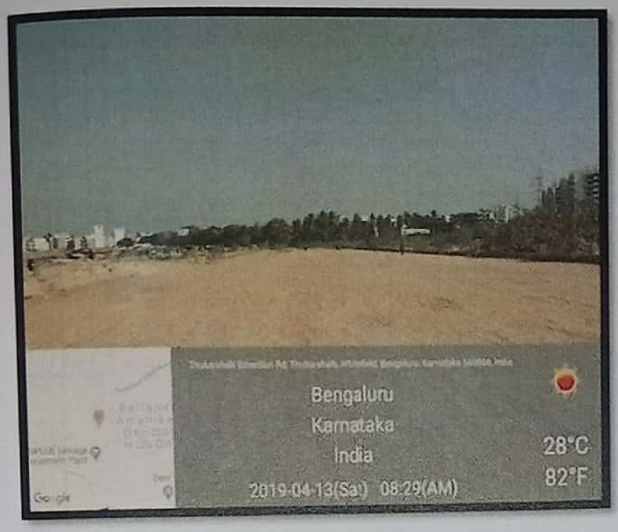
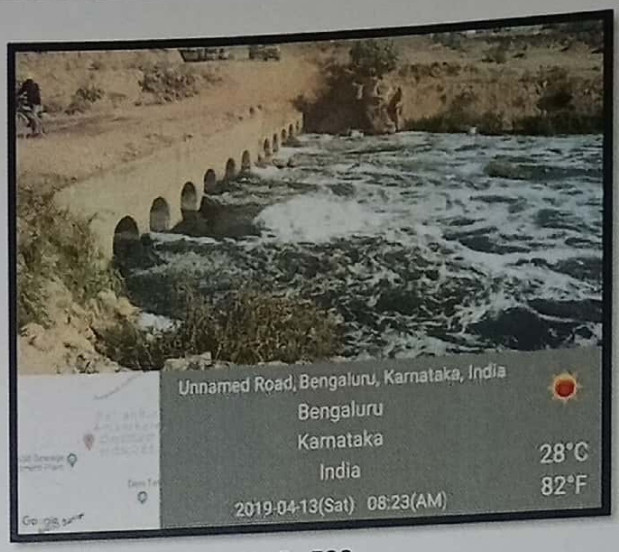


CH:0+450



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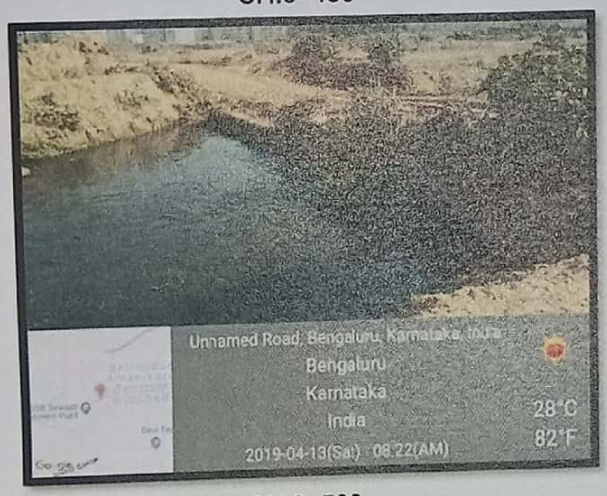

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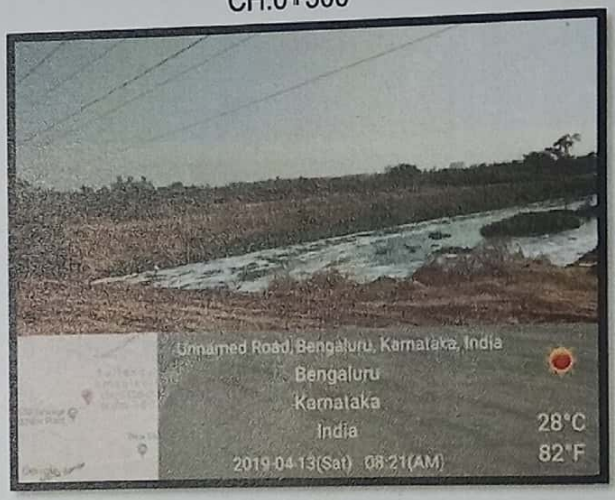

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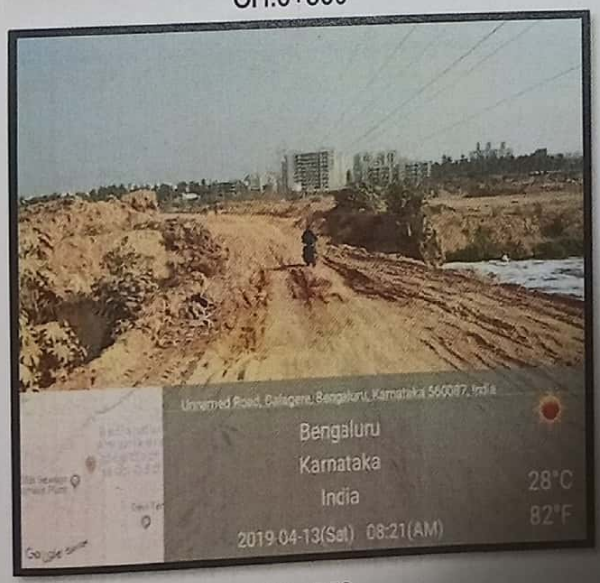

CH:0+550

CH:0+650

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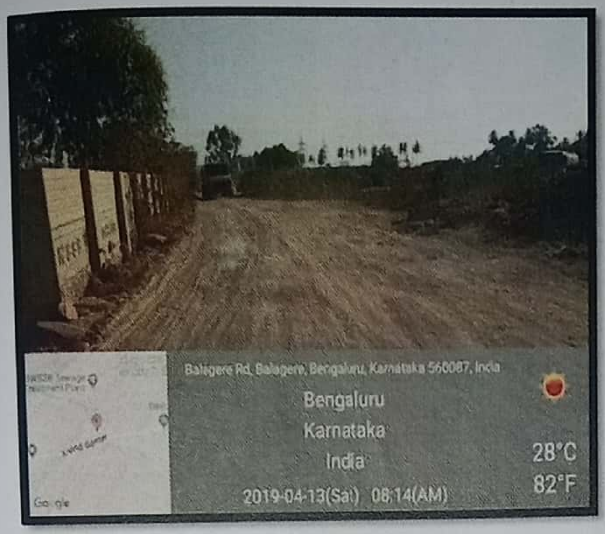
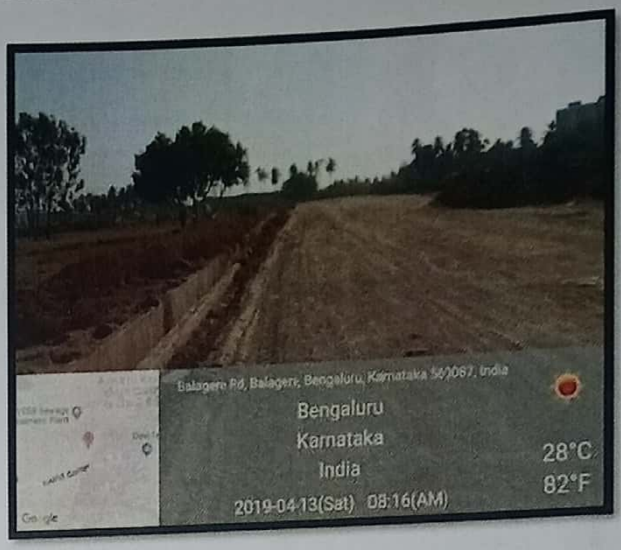
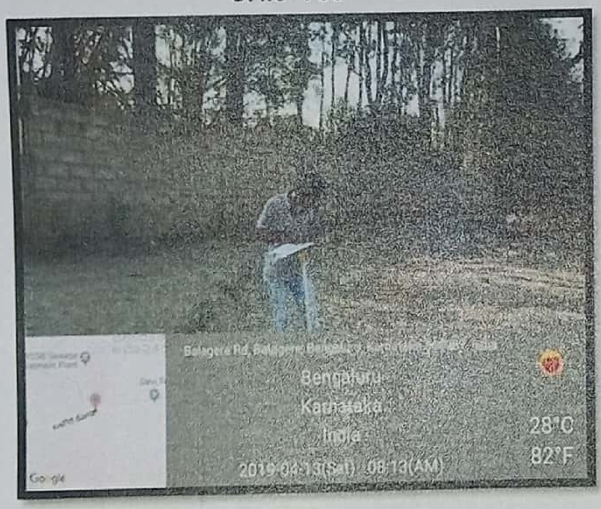


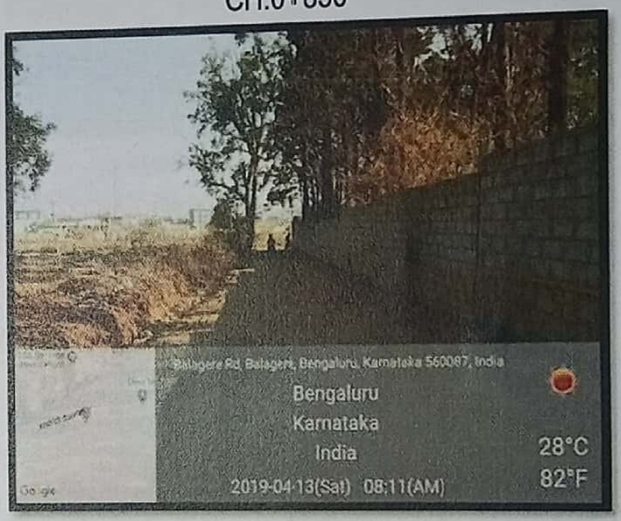
CH:0+700



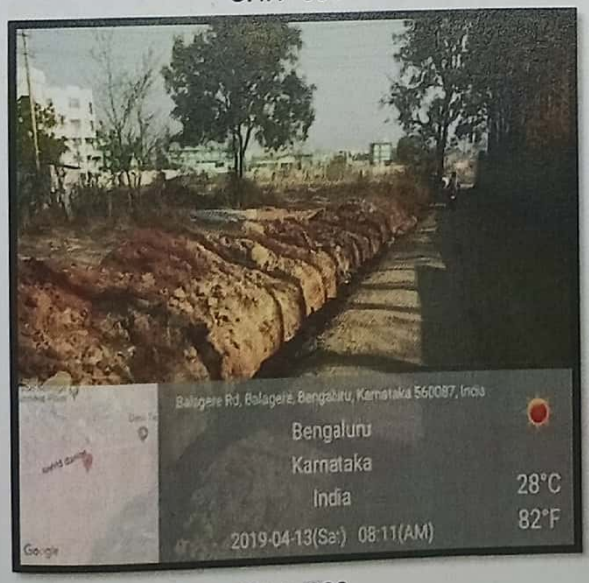
CH:0+850



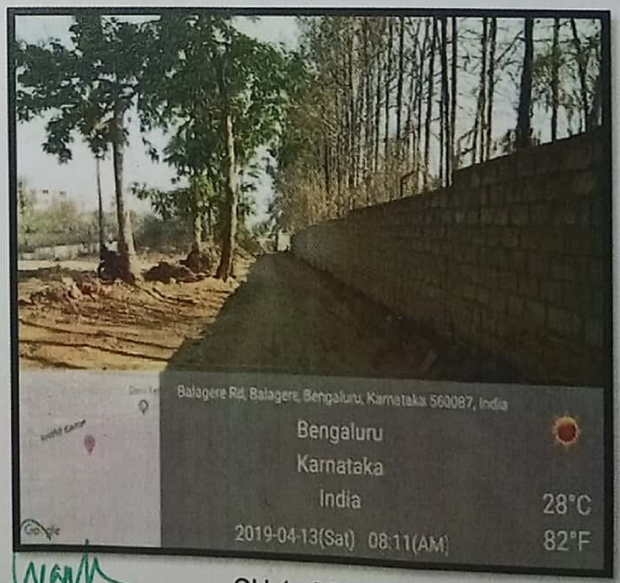
CH:1+000



CH:1+200



CH:1+300



CH:1+350

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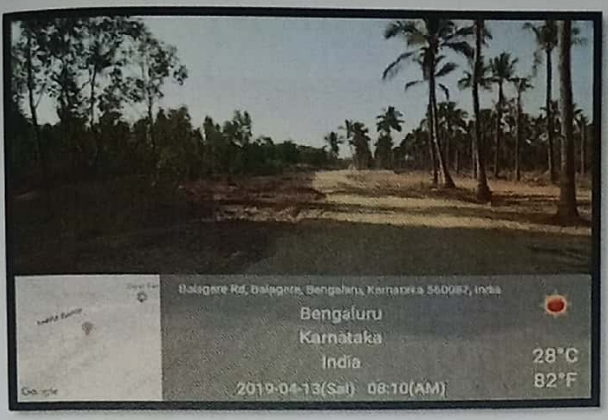
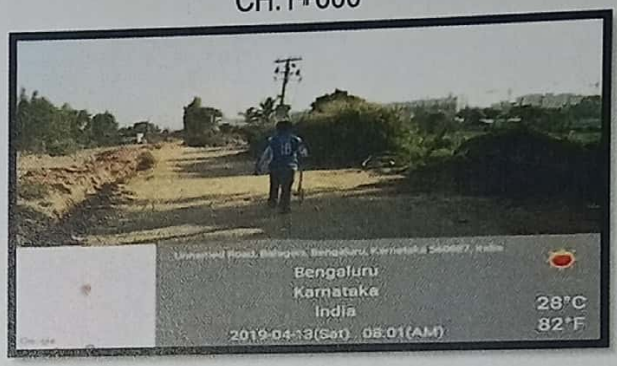


CH:1+500

CH:1+600

CH:1+720



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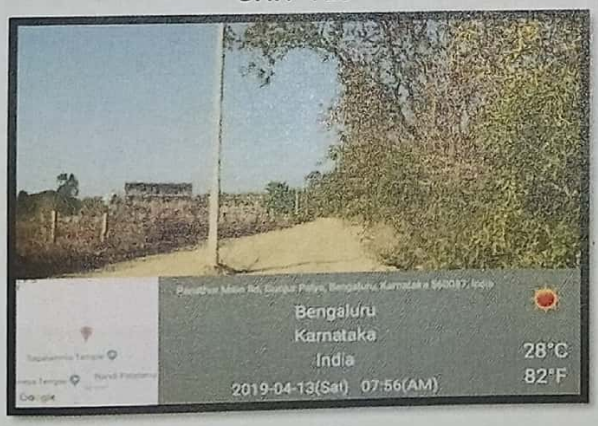
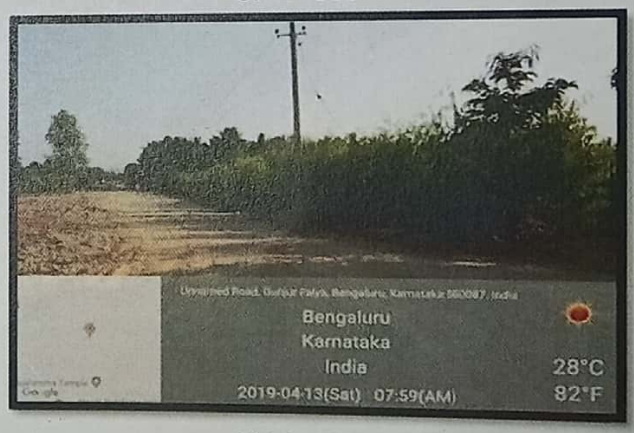


CH:2+000



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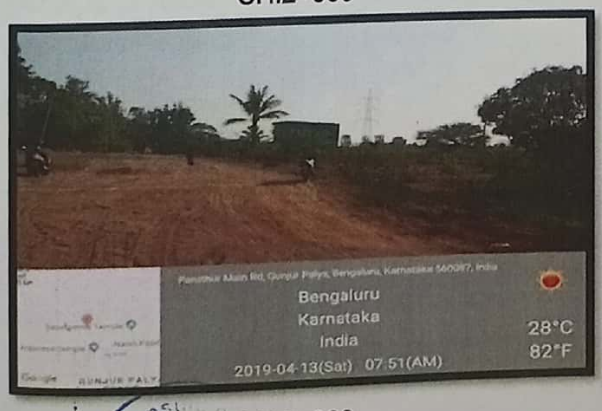
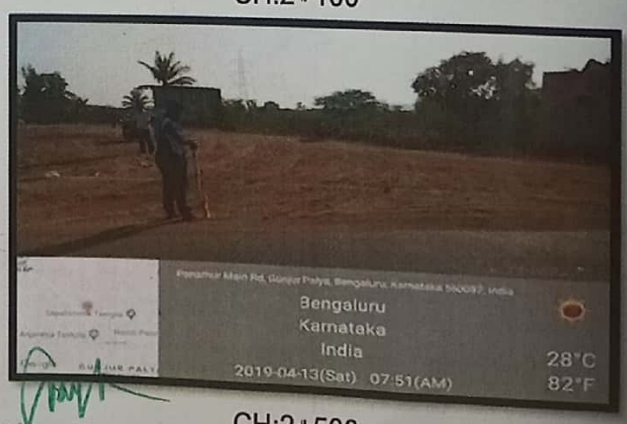


CH:2+300



CH:2+500

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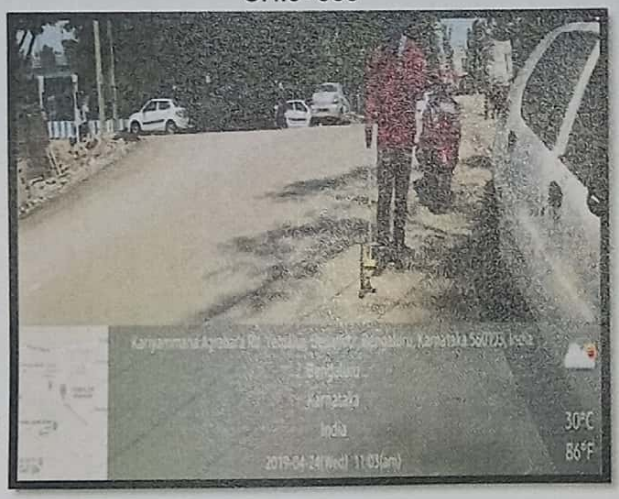
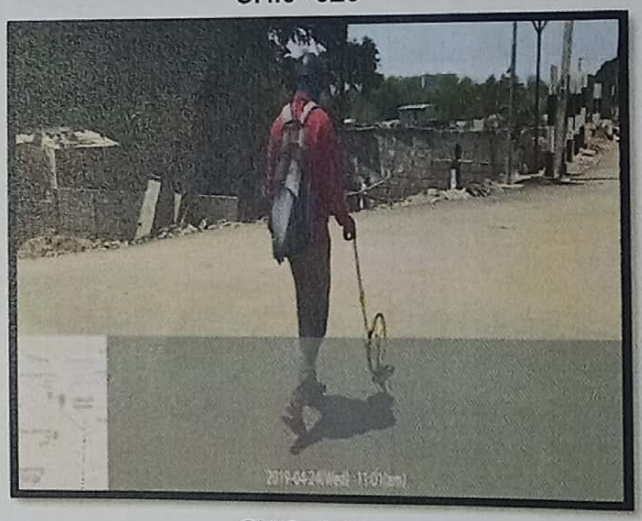
CH:0+000

CH:0+020



CH:0+030



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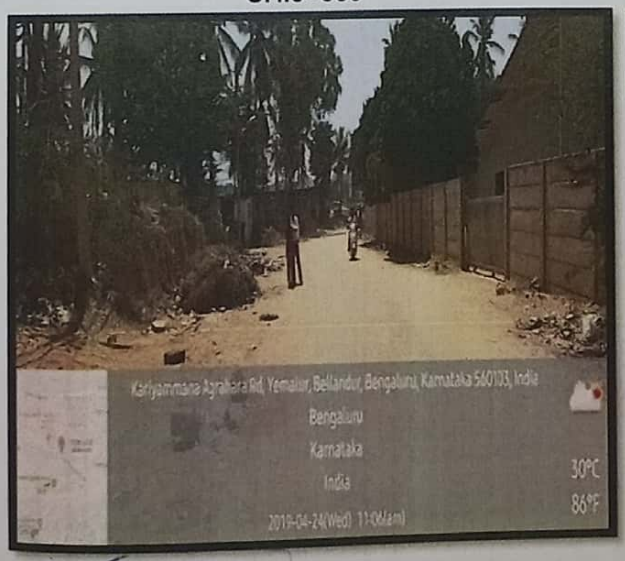

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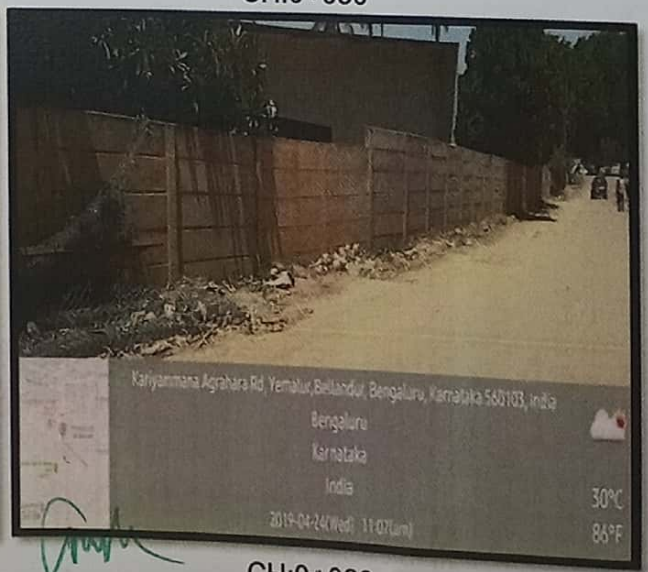

CH:0+080

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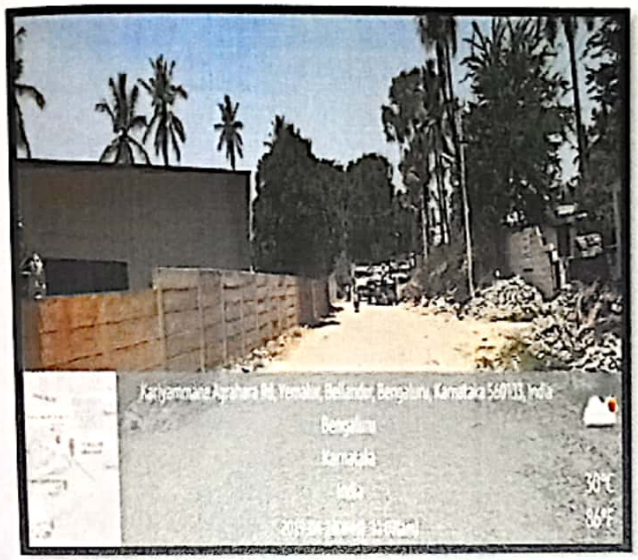
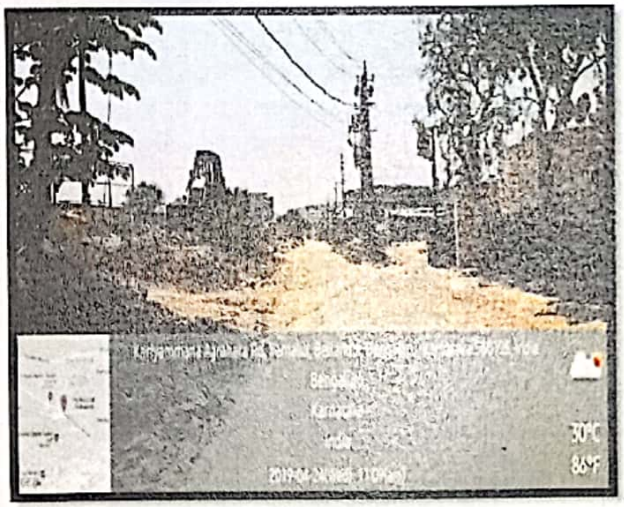
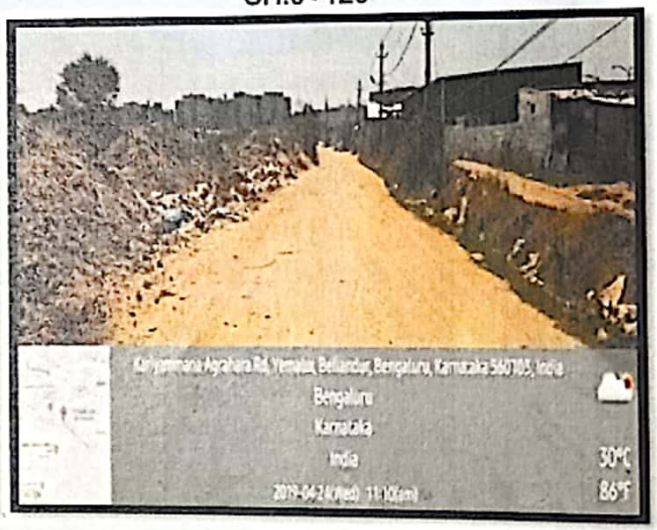


CH:0+100

CH:0+120



CH:0+150



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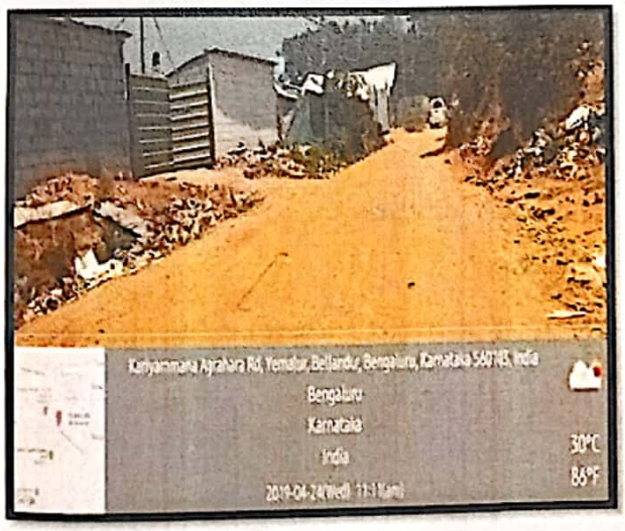

CH:0+350

CH:0+420

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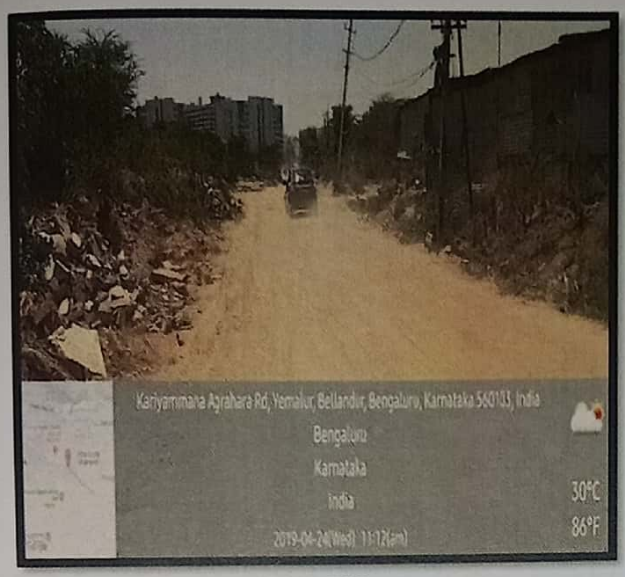

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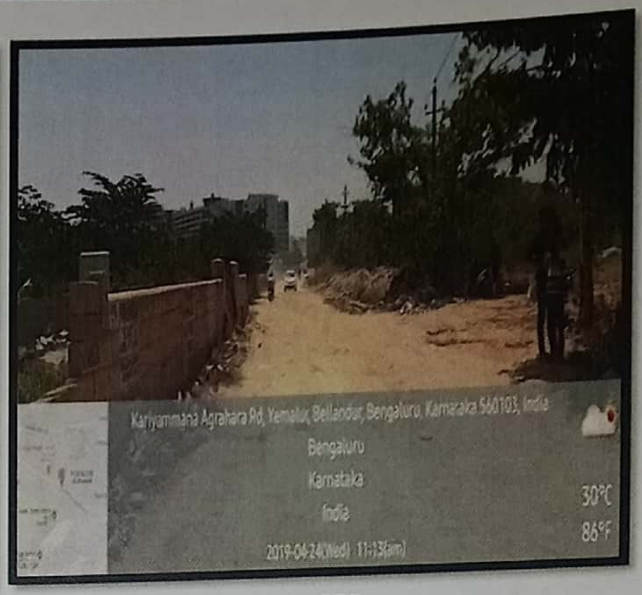
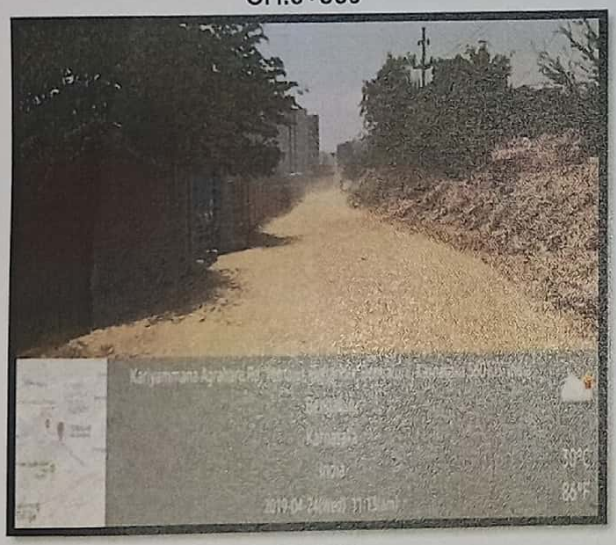


CH:0+650



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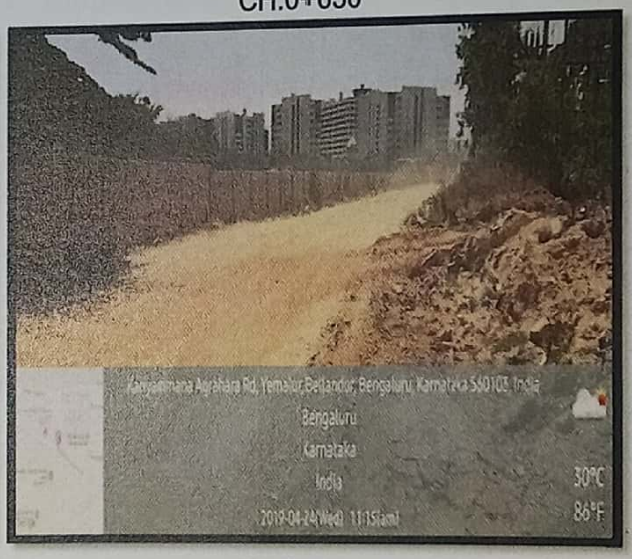

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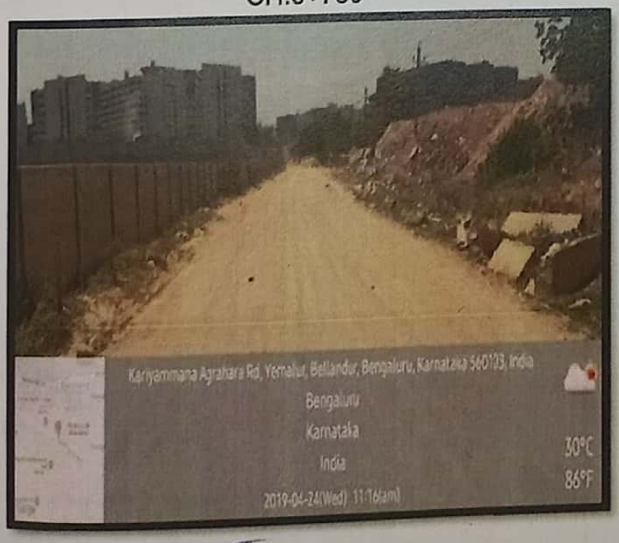

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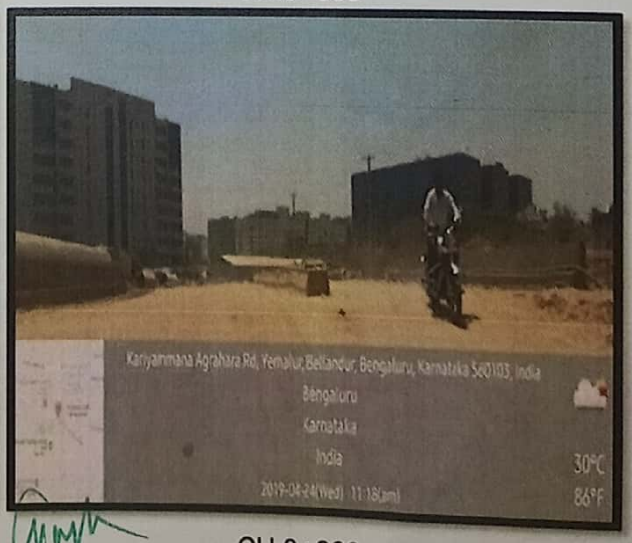

CH:0+900

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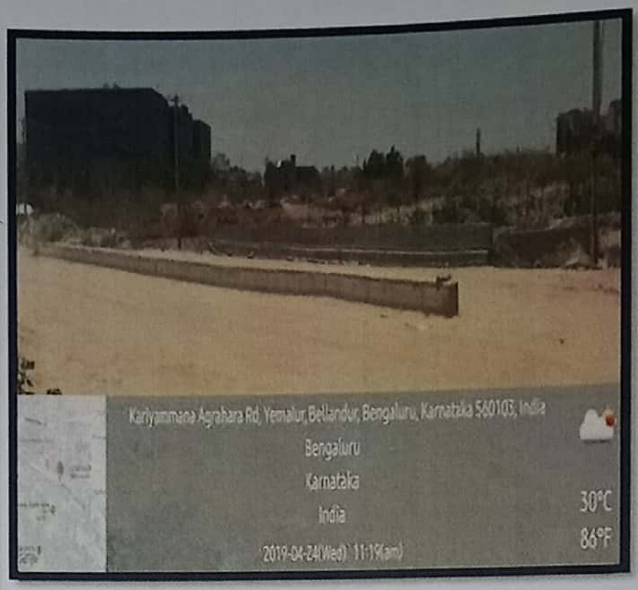
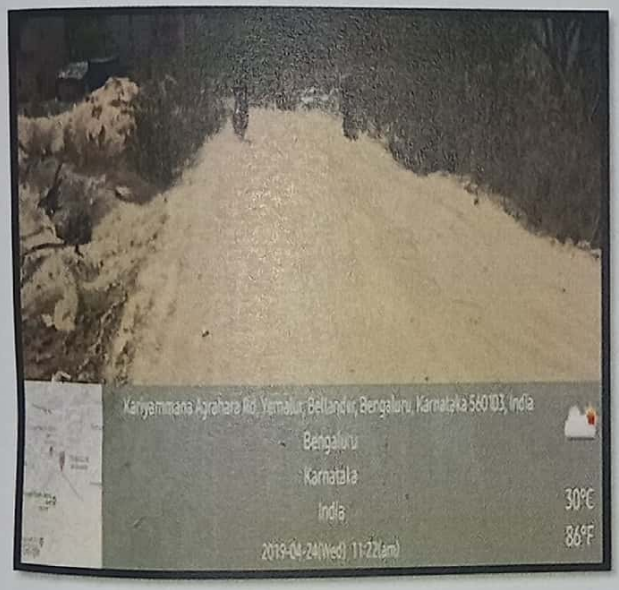
CH:0+920



CH:0+920



CH:0+950

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