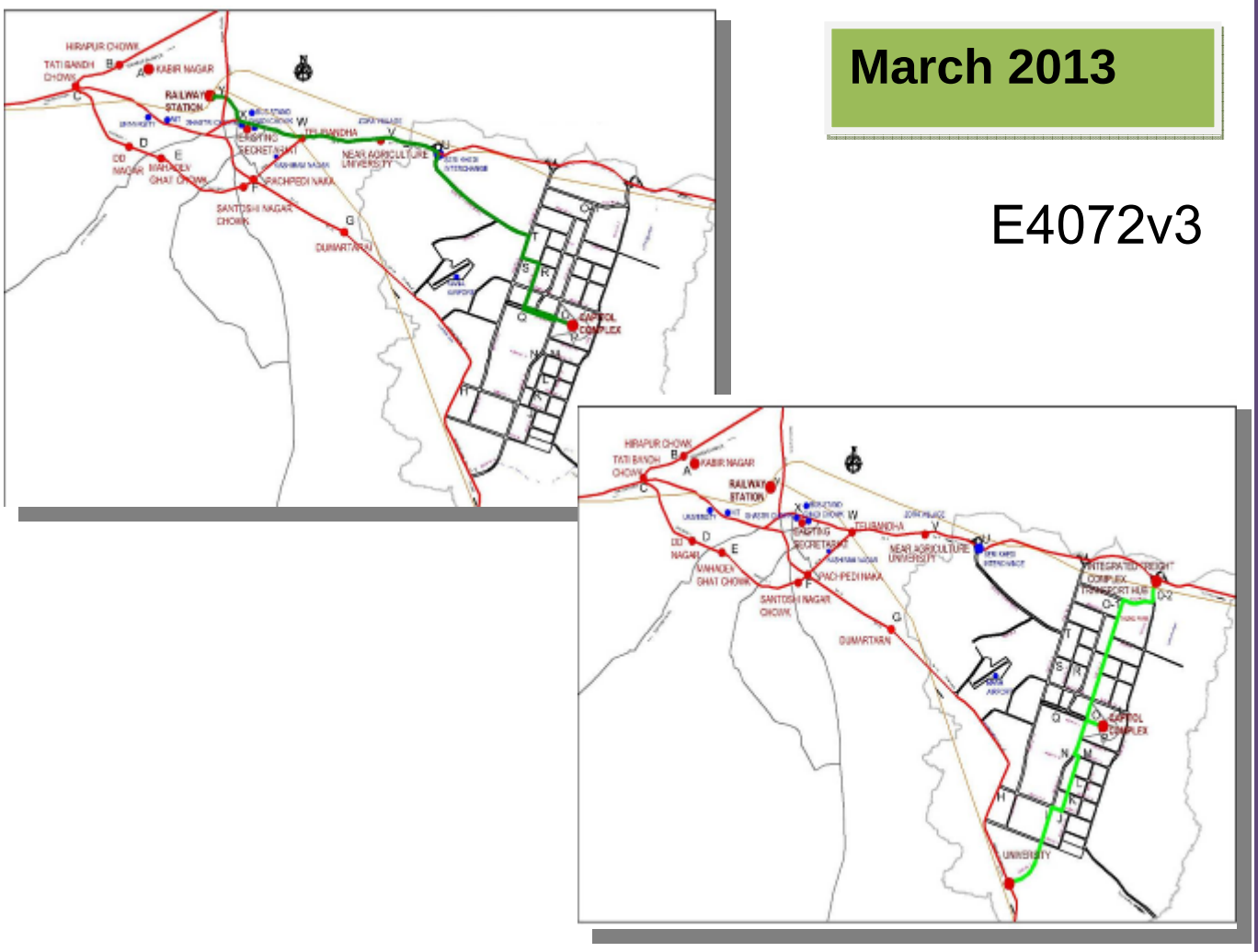


March 2013

E4072v3

ENVIRONMENTAL IMPACT ASSESSMENT FOR BUS RAPID TRANSIT SYSTEM IN NAYA RAIPUR, CHHATTISGARH

Naya Raipur Development Authority
Near Mahanadi Dwar of Mantralaya Raipur – 492 001 Chhattisgarh, INDIA
Tel: +91 0771 4066011 Fax: +91 771 4066188
Website: www.nayaraipur.com

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

BUS RAPID TRANSIT SYSTEM

IN

NAYA RAIPUR, CHHATTISGARH

TABLE OF CONTENTS

CHAPTER NO.		PARTICULAR	PAGE NO.
1.0		Introduction	
	1.1	Need of the project	1-2
	1.2	Project background	3-5
	1.3	Scope of study	6
	1.4	Structure of EIA report	7
2.0		Project description	
	2.1	Naya Raipur	8
	2.2	Road transport system	8-9
	2.3	Project benefits	9
	2.4	Proposed BRT system	10-11
	2.5	BRTS components	11-20
	2.6	Relocation of Utilities	20
	2.7	Salient Features of BRTS	20
	2.7.1	Alignment of Bus Lanes for BRT system in Naya Raipur	20
	2.7.2	Open and Closed System for BRT operation	21
	2.7.3	Proposed service system for Naya Raipur	21
	2.7.4	Pedestrian and cycle tracks	21
	2.7.5	Proposed buses	21-22
	2.7.6	Frequency of operation	22
	2.7.7	Fleet size	22
	2.7.8	Feeder services	22
3.0		Review of environmental regulatory framework	
	3.1	Environmental clearance	23-25
	3.2	Road policy of Chhattisgarh	25
	3.3	State environment policy	25-26
	3.4	Strategies	26
	3.4.1	Environmental resource planning	26
	3.4.2	Collaborative governance and market based mechanism	26
	3.4.3	Positive intervention through public participation	26-27
	3.5	State forest policy	27
	3.5.1	Forest	27
	3.6	Regulation for the village settlement areas	27-28
	3.7	Regulation for the agriculture and other area outside the rural settlement	28-29
	3.8	General regulation	29-31

CHAPTER NO.		PARTICULAR	PAGE NO.
	3.9	NRDA policy on environment and conservation of water body	31
	3.9.1	Green belt	31
	3.9.2	Surface Water	31-32
	3.9.3	Ground water	32
	3.9.4	Sewerage	32
	3.9.5	Drainage	32
	3.9.6	Solid waste	32-33
	3.9.7	Air pollution	33
	3.9.8	Noise	33
	3.9.9	Energy conservation	33-34
	3.9.10	Environmental policy and legal issues	34
	3.10	Environmental clearance	34-35
	3.11	Applicable policies and norms	35
	3.11.1	Application of the environmental social management framework	35
	3.11.2	Rehabilitation policy of the government of Chhattisgarh	36
	3.11.3	NRDA policy on environment and conservation of water body	36
4.0		Analysis of alternatives	
	4.1	Without project	37
	4.1.1	Bus transportation system	37-38
	4.2	With project	39
	4.3	Project component alternatives	39
	4.3.1	Route/corridor alternative	40-47
	4.3.2	Selection of appropriate BRT corridor	48-52
	4.3.3	Bus depot and night parking facilities	52-54
	4.4	Control Centre	54
5.0		Baseline environmental status	
	5.1	Methodology of conducting baseline study	55-56
	5.2	Location of the study area	56
	5.3	Climate and meteorology	56-58
	5.4	Environmental attributes	59
	5.4.1	Air	59-63
	5.4.2	Noise environment	63-64
	5.4.3	Water environment	64-73
	5.5	Land environment	73-74
	5.6	Soil	75-76
	5.7	Ecological environment	76-77
	5.7.1	Forest area and terrestrial ecology	77-79
	5.7.2	Aquatic ecology	80-81

CHAPTER NO.		PARTICULAR	PAGE NO.
	5.8	Faunal Profile	82-84
	5.9	Socio Economic Environment	85
	5.9.1	Socio demographic profile	85-87
	5.9.2	Social Profile	87-88
6.0		Public consultations	
	6.1	Objective	89
	6.1.1	Approach	89
	6.2	Methodology	89
	6.3	Consultations outcome	90
	6.3.1	Women commuters	90
	6.3.2	Consultation with students from university, colleges and schools	90
	6.3.3	Residents near terminal at agriculture institute on NH-53	90
	6.3.4	Residents near Pachpedinaka -Doomar Tarai terminal on NH-30	90
	6.3.5	Commuters in Raipur city	91
	6.3.6	Consultation with conductors, drivers and owners of private buses in Raipur and Naya Raipur	91
7.0		Assessment of potential impacts and mitigation measures	92
	7.1	Pollution Sources	92-93
	7.2	Identification of impacts	94-95
	7.3	Air environment	96
	7.4	Noise	97
	7.5	Impact on water resources	97-98
	7.6	Impacts on land environment	98-99
	7.7	Waste disposal	99
	7.8	Biological environment	99-104
	7.9	Socio-economic environment	104-105
	7.10	Summary of impacts	105-107
8.0		Environmental management plan	108
	8.1	Broad Frame: Environment Management	109
	8.1.1	Air Environment	109-111
	8.1.2	Noise environment	111
	8.1.3	Impact on water resources	111-113
	8.1.4	Impacts on land environment	113-114
	8.1.5	Biological environment	114-115
	8.1.6	Religious and cultural structures affecting in the BRT route	116
	8.2	Environment Management Plan	116-124
	8.3	Environmental management system & monitoring plan	125-128

CHAPTER NO.	PARTICULAR	PAGE NO.
8.4	Budget provision for EMP	131-133
9.0	Summary & conclusions	134
ANNEXURE – I	Environmental Clearance for Naya Raipur	135-150
ANNEXURE – II	Climatological summary for IMD station at Raipur	151-152
ANNEXURE – III	Traffic monitoring data	153-157
ANNEXURE – IV	Types of soil in Chhattisgarh	158-159
ANNEXURE – V	Proceedings of the public consultation	160-164
ANNEXURE – VI	Comments of world bank	165-168
ANNEXURE VII	Road network constructed in Naya Raipur Travel demand analysis Traffic assignment Transportation system	169-174
ANNEXURE VIII	Location of pick up point at secretariat building	175
ANNEXURE IX	Plantation along road side	176-182

LIST OF TABLES

Table No.	Particular
Table 1-1	Phases of Development – Naya Raipur
Table 1-2	Details of the road network for Stage-I in Naya Raipur
Table 1-3	Roads Constructed as SUTP Component
Table 2-1	Origin and Destination of Corridors
Table2.2	Scoring of Alternative Sites
Table2.3	Pick up Points in Corridor I
Table 2-4	Bus Shelters In Naya Raipur
Table 3-1	A list of applicable legislations
Table 3-2	Sitting Criteria Delineated by MOEF
Table 4-1	Vehicular growth in Raipur in last 5 years
Table 4-2	Details on public bus transport system in Raipur
Table 4-3	Route/Corridor Alternative
Table 4-4	Origin and Destination of the selected corridors
Table 5-1	Climatological Summary for Raipur (2009)
Table 5-2	Monitoring Locations
Table 5-3	Monitoring Program Results – AQ1
Table 5-4	Monitoring Program Results – AQ2
Table 5-5	Monitoring Program Results – AQ3
Table 5-6	Monitoring Program Results – AQ4
Table 5-7	Monitoring Program Results – AQ5
Table 5-8	Monitoring Program Results – AQ6
Table 5-9	Ambient Noise Monitoring Stations
Table 5-10	Monitoring Program Results – Noise
Table 5-11	Groundwater Quality Monitoring Locations
Table 5-12	Surface water Quality Monitoring Locations
Table 5-13	Ground Water Test Results as per IS: 10500
Table 5-14	Surface Water Quality within Study Area
Table 5-15	Soil Sampling Locations
Table 5-16	Soil Characteristics of the study area
Table 5-17	list of wild animals reported in study area

Table No.	Particular
Table 5-18	list of common avifauna recorded during survey
Table 5-19	Population Growth of Raipur Urban Agglomeration
Table 5-20	Sex Ratio and Literacy Rate of Raipur Urban Agglomeration
Table 5-21	Work Participation Rate
Table 7-1	Pollutant Sources & Characteristics
Table 7-2	Identification of Impacts (Construction & Functional Phase)
Table 7.3	Summary Matrix of Predicted Impacts Due to Proposed Project
Table 8-1	Fugitive Dust Control Measurers
Table 8-2	Plantation Plan For 1500 R.M.
Table 8-3	Environment management Plan
Table 8-4	Suggested Monitoring Program during Construction Phase
Table 8-5	Table 8.5: Suggested Monitoring Program during Operation Phase
Table 8-6	Record Keeping Requirements
Table 8.7	Budget Estimation
Annexure – I	ENVIRONMENTAL CLEARANCE FOR NAYA RAIPUR
Table 1	Climatological Summary for IMD Station at Raipur (1951-1980)
Table 2	Climatological summary for IMD Station at Raipur (1993-2002)
Annexure – III	Traffic Monitoring Data
Table 1	Traffic Movement at NH-30 – Weekday
Table 2	Traffic Movement at NH-30 – Weekend
Table 3	Traffic Movement at NH-53 – Weekday
Table 4	Traffic Movement at NH-53 – Weekend
Annexure – VI	Comments of World Bank
Table 1	Compliance of the World Bank Comments (13th Sept 2010)
Table 2	Compliance of the PMCs Comments (15th Sept 2010)
Table 3	Compliance of PMC Comments (16th3November 2010)
Annexure – VII	Road Network Constructed in Naya Raipur
Table 1	details of the road network Naya Raipur
Table 2	estimated bus passenger traffic demand along major corridors
Table 3	Details of Bus Routes and Network Corridor

Table No.	Particular
Table 4	Travel Demand For Naya Raipur (Daily Trips)
Table 5	Details Of Development Of BRT Lanes
Table 6	Guidelines of MOUD
	ANNEXURE IX
Table 1	List of species proposed in road side landscape

LIST OF FIGURES

Figure No.	Particular
Figure 1-1	Location map of the Naya Raipur
Figure 1-2	Road Network –Naya Raipur
Figure 2-1	BRT Corridor
Figure 2.2	Terminal / Interchange Point on Corridor I (Source: EMBARQ (India)
Figure 2.3	Proposed Site for Bus Depot at Naya Raipur
Figure 2.4	Location of Bus Shelters in Naya Raipur
Figure 2.5	Vehicles guidance system for docking at bus shelter in naya raipur
Figure 2.6	Proposed NMT Corridor in Naya Raipur
Figure 4.1	Proposed Site for Bus Depot at Naya Raipur
Figure 5.1	Wind Rose Raipur (Annual For 2009)
Figure 5.2	Air Monitoring Stations
Figure 5.3	Water Sampling Locations
Figure 5.4	Seismic Map of Area
Figure 5.5	Location of Quadrant Sampling Point (Sample Plot) Along Proposed Brt Corridor With Their Photograph
Figure 5.6	Showing Lotic & Lentic Water Bodies Along The Proposed Corridor
Figure 5.7	Population Distribution In Various Categories
Figure 5.8	Main Workers: Engagement In Different Sectors
Figure 5.9	Marginal workers : engagement in different sectors
Figure 8.1	New Shitala MaTa Temple Beside Navangaon Pond
Figure 1	Traffic Density – NH-30- Weekday
Figure 2	Traffic Density – NH-30- Weekend
Figure 3	Traffic Density – NH-53- Weekday
Figure 4	Traffic Density – NH-53- Weekend
Figure 5	Soil Types in Raipur (Chhattisgarh)
Figure 6	Modal share in inter-city passenger trips
Figure 7	Modal share in intra-city passenger trips
Figure 8	Location of Pick up Point at Secretariat Building

LIST OF PHOTOS

Picture No	Particular
Photo 5-1	Trees on Agricultural Field Bunds along No. 2
Photo 5-2	Village plantation along Road No. 4
Photo 5-3	Sendh Lake from Road No. 7
Photo 5-4	Hanuman Temple Near Telibandha Junction
Photo 5-5	National Highway near Pachipadanaka Junction

ABBREVIATIONS

AAQSRN	:	Ambient Air Quality Standards In Respect of Noise
AC	:	Alternating Current
AH	:	Amp Hour
BDL	:	Below Detectable Limit
BOD	:	Biological Oxygen Demand
BP	:	Bank Procedures
BRT	:	Bus Rapid Transit
BS	:	Bharat Stage
CDP	:	City Development Plan
CEC	:	Cation Exchange Capacity
CECB		Chhattisgarh Environment Conservation Board
CGWB	:	Central Ground Water Board
CNG	:	Compressed Natural Gas
CO	:	Carbon Monoxide
COD	:	Chemical Oxygen Demand
CPCB	:	Central Pollution Control Board
CTTS	:	Comprehensive Traffic and Transportation Study
dB	:	Decibel
DC	:	District Collector
DC	:	Direct Current
DDP	:	Desert Development Program
DG	:	Diesel Generator
EA	:	Environmental Assessment
EC	:	Environmental Clearance
EC	:	Electrical Conductivity
EIA	:	Environment Impact Assessment
EMP	:	Environment Management Plan

EPC	:	Engineering Procurement Construction
ESMF	:	Environmental and Social Management Framework
EU	:	Euro
FY	:	Financial Year
g/cc	:	Gram per cubic centimeter
GEF	:	Global Environment Fund
GHG	:	Green House Gas
GIS	:	Geographical Information System
GoC	:	Government of Chhattisgarh
GoI	:	Government of India
GPRS	:	Global Positioning Response System
GPS	:	Global Positioning System
GW	:	Ground Water
ha	:	Hectare
HMV	:	Heavy Motor Vehicles
IMD	:	Indian Meteorological Department
INR	:	Indian Rupees
IPT	:	Intermediated Public Transport
IRC	:	Indian Roads Congress
IS	:	Indian Standard
ISC3	:	Industrial Source Complex Version 3
ITS	:	Intelligent Transport System
IUCN	:	International Union for Conservation of Nature
IVI	:	Intelligent Vehicle Initiatives
JNNURM	:	Jawaharlal Nehru National Urban Renewal Mission
KW	:	Kilo Watt
mbgl	:	Meters below ground level
mg/l	:	Milligram per liter
MNC	:	Multi National Companies

MoEF	:	Ministry of Environment and Forest
MoRT&H	:	Ministry of Road Transport & Highways
MoUD	:	Ministry of Urban Development
MPN	:	Most Probable Number
NAAQS	:	National Ambient Air Quality Standards
NAMP	:	National Ambient Monitoring Programme
NCR	:	National Capital Region
ND	:	Not Detectable
NH	:	National Highway
Nm	:	Newton Meter
NMT	:	Non Motorized Transport
NOx	:	Oxides of Nitrogen
NR	:	No Relaxation
NRDA	:	Naya Raipur Development Authority
NTU	:	Nephlometric Turbidity Unit
OP	:	Operational Policy
PCB	:	Pollution Control Board
PHPDT	:	Passengers per hour per direction of traffic flow
PM	:	Particulate Matter
PPP	:	Public Private Partnership
PWD	:	Public Works Department
RDA	:	Raipur Development Authority
RMC	:	Raipur Municipal Authority
RoW	:	Right of Way
RSPM	:	Respirable Suspended Particulate Matter
SAR	:	Sodium Absorption Ratio
SC	:	Schedule Caste
SO2	:	Sulphur Dioxide
SPCB	:	State Pollution Control Board

SPL	:	Sound Pressure Level
SPM	:	Suspended Particulate Matter
ST	:	Schedule Tribes
SUTP	:	Sustainable Urban Transport Projects
SW	:	Surface Water
TAZ	:	Traffic Area Zones
TDS	:	Total Dissolved Solids
US EPA	:	United States Environmental Protection Agency

CHAPTER: I

INTRODUCTION

The State of Chhattisgarh was carved out of erstwhile Madhya Pradesh on November 1st, 2000 in deference to its distinctive historical social background and natural resources. The new state is located in the south eastern part of Madhya Pradesh. Raipur city serves as the capital of the state. To decongest the existing Raipur and create a world class city the 'Naya Raipur' is being developed in close proximity to the existing airport of Raipur and beside the Raipur-Vishakhapatnam rail line in a planned manner, with state of the art physical, social and economic infrastructure.

Naya Raipur Development Authority (NRDA), the nodal agency for development and administration of Naya Raipur, has proposed a Bus Rapid Transit (BRT) system for the main routes with dedicated bus lanes and feeder bus service on all other arterial and sub arterial roads.

The Ministry of Urban Development (MoUD) Government of India would also provide assistance to NRDA for Implementation of BRTS (For Phase 2), Rolling Stock & On -Board ITS and loan for Implementation of BRTS (For Phase 2) assistance from the World Bank, if desired by NRDA. Under GEF is giving debt to NRDA for TA for Transit Oriented Development, Training for Capacity Building components. The proposed scheme is eligible to get financial assistance under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for eligible components. The components not eligible under JNNURM funding will be funded by Global Environment Fund (GEF).

1.1 NEED OF THE PROJECT

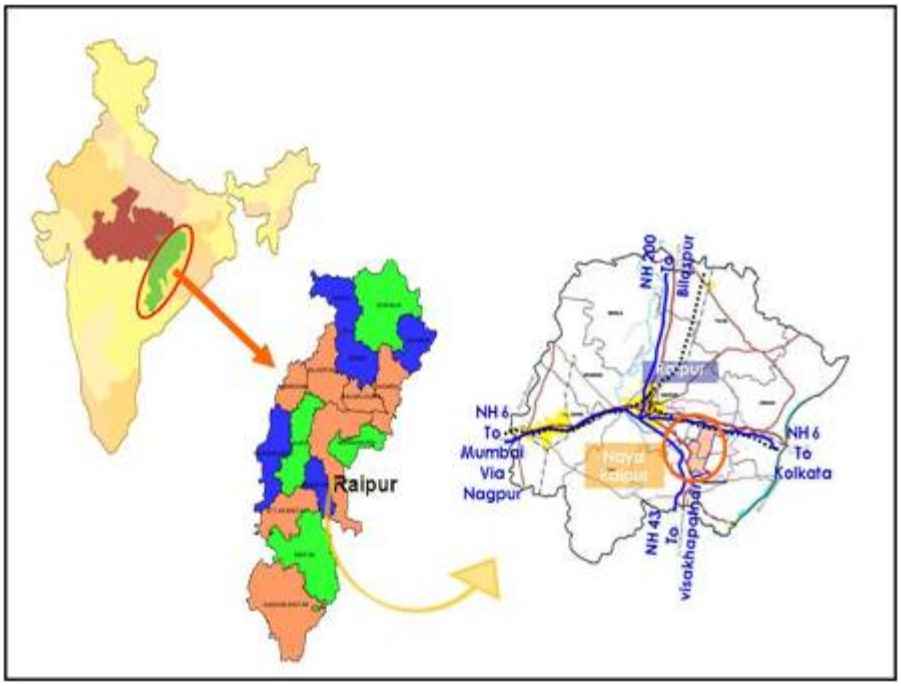
- Connectivity of New satellite city Naya Raipur and Raipur. Whereas there is no planned public transport system.
- Sustainable mode of transport system, economic to local commuters, less polluting and socially accepted.
- To save the time of commuter.
- To decongest the existing Raipur city transport system

- Naya Raipur will have latest public facility like hospital, sports infrastructure, business hub, recreation, schools. The BRT will provide connectivity to this infrastructure to the dwellers of Raipur.

Naya Raipur is being planned as an agent of economic change, social transformation, efficient engine of growth - prosperity, servicing hub of trade - hospitality, hub of cultural services, hub of high quality medical services, hub of quality education facilities and as a knowledge base, thus planning an effective environment and people friendly mass rapid transit system is essential from the very beginning. The major intention of NRDA is to provide a safe, sustainable and economically efficient transportation system. Therefore, a BRT System is proposed in Naya Raipur, which would connect Raipur with Naya Raipur and will run through the main corridors of Naya Raipur too.

As Naya Raipur is a new development area, the existing transport infrastructure in Raipur is taken as a base and projected for Naya Raipur. The advent of BRT system expects to bring about new technologies which would focus on “cleaner technologies” wherein the PM emissions will be much lower. Thus the proposed project will provide an environment friendly and effective transportation system.

FIGURE 1.1: LOCATION MAP OF THE NAYA RAIPUR



1.2 Project Background

Naya Raipur is planned as a satellite town and will serve as the capital of Chhattisgarh. The development of the city is proposed to be carried out in a phased manner; spread over a period of 25 years. The details of phasing are presented in Table .

TABLE 1.1 : PHASES OF DEVELOPMENT – NAYA RAIPUR

Phase	Horizon Year	Cumulative Population	Area (Ha)
Phase I	2011	1,50,000	3057.46
Phase II	2021	3,65,000	3733.56
Phase III	2031	5,60,00	1222.16
Total developed area at the end of Phase III			**8013.10**

Source: Naya Raipur Development Plan 2031

In the first phase NRDA has already constructed 70 km major city roads having 100m and 60m ROW. 27.87 km will be utilized for BRTS. In addition to it 5.75 km. road is constructed as a BRT component. The details of roads constructed are given in the Table No. 1-2.

Table 1.2: Details of the road network for Stage-I in Naya Raipur

Road Number	Description	Length (Kilometers)	Number of Lanes	BRT Corridor Length
1	100m wide Expressway joining NH-53 (including interchange) to entry point of Naya Raipur.	8.5 (6.3+ 2.2 km	4 lanes with median	Yes 7.236 km.
2	100 m wide road joining NH-53 to NH-30 via Capital complex	17.3	6 lanes with median	Yes 9.923+4.482 = 14.405 km.
3	100 m wide road joining 60 m wide road to the South of Transport Hub to Expressway	2.4	4 lanes with median	No
4	100 m wide road joining Expressway and Capital complex	10.1 (5.7 + 4.4)	4 lanes with median	Yes 1.076 km On 100 m. ROW + 1.520 km On 200 m ROW =

Road Number	Description	Length (Kilometers)	Number of Lanes	BRT Corridor Length
				2.596 km.
5	100 m wide road near Muktangan connecting NH-30 and North South 100 m wide road	2.9	4 lanes with median	Yes 3.433 km.
6	60 m wide road North of light Service Industries	2.4	4 lanes with median	No
7	60 m wide road additional link from North South road around Sendh Lake	4.1	4 lanes with median	No
8	60 m wide road joining Expressway & Airport	3.3	4 lanes with median	No
9A	60 m wide road starting from West side 100 m wide road , going around capital complex and joining to the North of Commercial Complex joining 100 m wide N-S road.	5.9	4 lanes with median	No
9B	60 m wide road starting from west side 100 m wide road , going around capital complex and joining to the North of Commercial Complex joining 100 m wide N-S road	2.3	4 lanes with median	No
10	60 m wide road joining South of Capital Complex and N-S 100m wide road	4.2 (3.1 +1.1)	4 lanes with median	Yes 0.204 km.
11	60 m wide road surrounding educational complex/ commercial Complex near health complex on South	3.6	4 lanes with median	No
	Peripheral link roads	3.0		No
	Total length of the roads	70.0		27.87

Source: DPR For BRTS in Naya Raipur

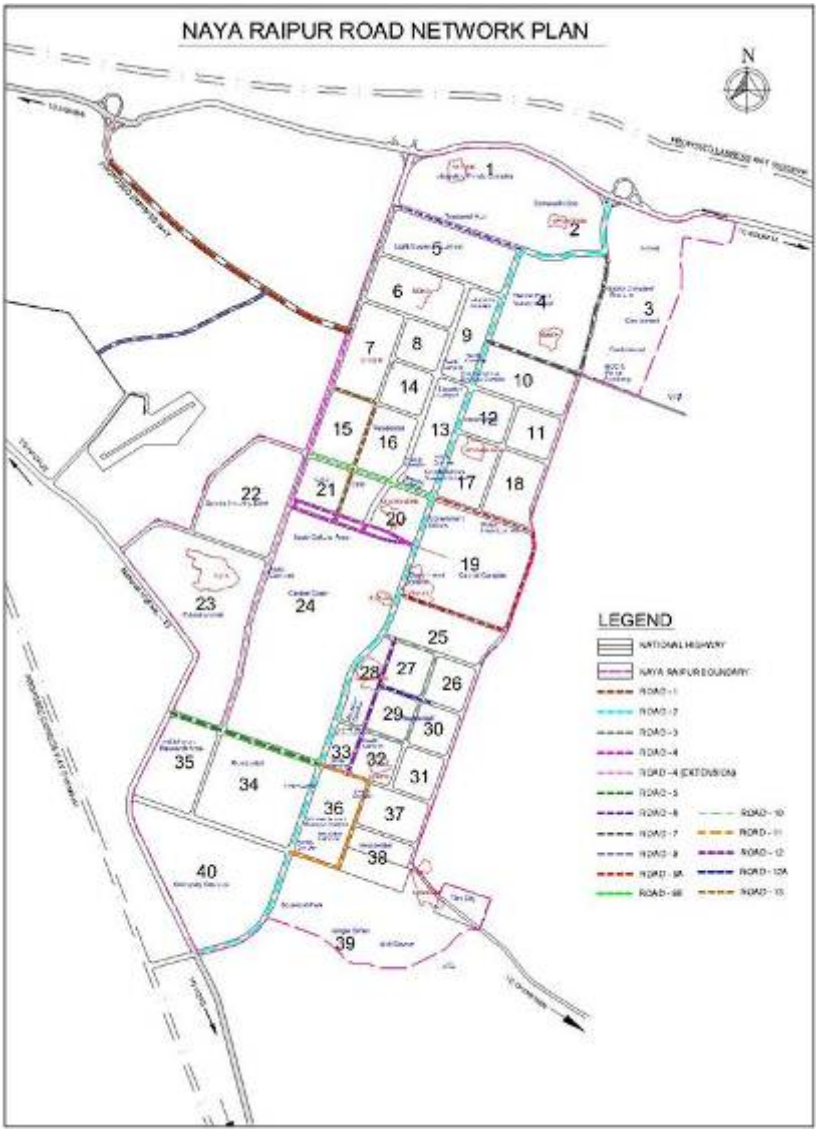
Table 1.3: Roads Constructed as SUTP Component

New Roads Constructed as SUTP component for BRTS				
Road No.	Road Section	Length	Existing Lane	RoW / Proposed RoW
12 and 12 A	Sector-27 link Road	3.43	2 lanes	60/60 meter
13	In between Sector No, 7-15, 15-16 and 20-21	3.165	2 lanes	60/60 meter
Total New BRT Road		6.595		

Source: NRDA Records

In terms of land use, 'transportation' accounts for 12.55 % (1005.77 Ha) of the gross area of Naya Raipur. The major road network in Naya Raipur extends over a total length of 117.86 km and accounts for 843.97 ha of land. The hierarchy of roads in Naya Raipur by right of way is as under:

FIGURE 1.2: ROAD NETWORK –NAYA RAIPUR



1.3 SCOPE OF STUDY

This Environment Impact Assessment (EIA) study for the proposed project is being carried out to cater to the needs of the Environmental and Social Management Framework (ESMF) prepared for GEF-SUTP.

Two corridors have been identified for the study.

Corridor -1 – Raipur Railway Station to Capitol Complex at Naya Raipur (24.7)

Corridor -3 – NH-53 to NH-30 within Naya Raipur (17.8)

The Environment Impact Assessment study will focus on identifying the likely impacts associated with the construction and operation of the proposed BRT corridor in Naya Raipur and pickup points in Raipur and mitigate them through a detailed environment management plan. The study will also design an environmental monitoring plan and an implementation mechanism and a reporting system to assess compliance with the Environment Management Plan.

The base line studies have been conducted in line with the Government of India / Government of Chhattisgarh and Environmental and Social Management Frame Work. The purpose of preparing Environment Impact Assessment report is:

- Identify and estimate full range of potential project impacts, both negative and positive.
- Recommend measures for avoiding or mitigating negative impacts, and for enhancing positive effects, wherever feasible.
- Ensure consideration of impacts in the context of project alternatives, and
- Prepare plans that achieve mitigation, monitoring, and management objectives of an environmental impact assessment**.**

1.4 STRUCTURE OF EIA REPORT

The Environmental Impact Assessment report will discuss the following points.

Chapter 1 : Introduction.
Chapter 2 : Project Description
Chapter 3 : Review of Environmental Regulatory Framework
Chapter 4 : Analysis of Alternative
Chapter 5 : Baseline Environmental status
Chapter 6 : Public Consultation

Chapter 7 : Assessment of Potential Impact and Mitigation Measures
Chapter 8 : Environmental Management Plan
Chapter 9 : Summary & Conclusions

Chapter-II

PROJECT DESCRIPTION

2.1 NAYA RAIPUR

The proposed project of constructing Bus Rapid Transit System (BRT) in the city is aimed at providing access to high speed intercity travel between the Raipur and Naya Raipur. Naya Raipur being a new city designed to decongest the existing city, which is congested due to unplanned road network infested with heterogeneous traffic conditions. The project intervention is thus aimed at introducing exclusive bus lanes on all major arterial roads.

For GEF-SUTP project it is proposed to initiate BRT System to cover the central spine of the Naya Raipur city. Proposed sub-components in the project include Bus Lanes, Bus Terminals / Shelters, procurement of Bus Fleet and also a technical assistance study on Transit Oriented Development.

Project outlay for the city is estimated at INR 138.5 Crores and is to be implemented in the Phase I of the project.

2.2 ROAD TRANSPORT SYSTEM

Two National Highways namely NH-53 and NH-30 flank the Naya Raipur and these are the busiest highways of the state. Most of the goods traffic within the state moves on these highways. With the formation and full functioning of the Naya Raipur, the traffic flow of Raipur is expected to divert towards Naya Raipur up to some extent.

Public transport system occupies less road space, causes less pollution and offer economical travel costs. Prior to 2009, there was no organized public transportation system present in Raipur. In consideration of these facts, an initiative was taken by the District Administration, Raipur Municipal Corporation (RMC) and Raipur Development Authority to form and register under the Indian Companies Act, 1956; a Special Purpose Company namely “Raipur City Bus Limited (RCBL)” for the purpose of providing City Bus Service. Currently, the RCBL is operating 36 city buses in 9 routes.

At present people are using Route No. 5 to reach nearby Naya Raipur i.e. Mandir Hasoud, from here they take services of Auto Rikhsa or small four wheelers i.e. Tata Magic, ACE etc. Naya Raipur is also approachable by NH-30. The people get down from Raipur – Jagadalpur buses near Radiant Public School and use local transport facilities to reach up to Naya Raipur.

2.3 PROJECT BENEFITS

The proposed BRT system will have Techno economic, Social environmental benefits. Reduction in time of travel, Equitable access throughout the city;

Apart from above, following subsidiary benefits would emerge introducing the BRT system in Naya Raipur. These are;

i. Economic benefits

a) Avoiding gridlock, time savings, money savings both for individual as well as economy of the state as a whole

b) Optimizing investments into urban infrastructure

c) Encouraging shifting of future personalized vehicle trips to Transit and pedestrian modes, thus reducing the need for large capital expenditures on roads, and reducing congestion as the transit network is expanded

d) Technological efficiency and enhancement in quality of life would attract investments in the city thus increasing the competitiveness of Naya Raipur in the global world

ii. Social Benefits

a) Affordable public transport favours social equity and accessibility

b) Reduced vehicles promote safety

c) Reduced emissions and short walking/ biking trips promote public health

d) Walkable spaces make vibrant cities

iii. Environmental benefits

a) Reduces travel by personalised vehicles i.e. (VKT)

b) Maintains high standards of air quality in our cities

c) Protects the environment

2.4 PROPOSED BRT SYSTEM

The concept of the BRT System in India is naive and displays potential to replace other forms of public bus transportation system. The policy matters in terms of design standards and principles exclusively for BRT System are not in practice in India, so the guidelines prepared by the Indian Roads Congress (IRC) or Ministry of Road Transport & Highways (MoRT&H) do not reflect it. Since the geometric designs for the BRT System is primarily a part of the road (urban /semi urban sections) cross sectional component either with exclusiveness or mixed condition, the design guidelines adopted for roads or highways (IRC 86:1983 Geometric Design Standards for Urban Roads in Plains) will be applied for the BRT System corridors.

Proposed BRT comprises of various components like Terminals, Depot, Pick up Points, Bus Shelters, Night Parking facilities, Bus Stops, Cycle Track and Pedestrian Walkways. Total BRT corridor length is 67km, out of which 40km is within Naya Raipur, 6km in Raipur and remaining on NH-53 and NH-30. Only 6.595 km road is constructed in Naya Raipur under the upcoming BRT project.

The BRTS corridors linking Naya Raipur with Raipur and within planning area of Naya Raipur is shown in the following map. This map also displays the utilization of existing road network in BRTS.

FIGURE 2.1: BRTS CORRIDORS

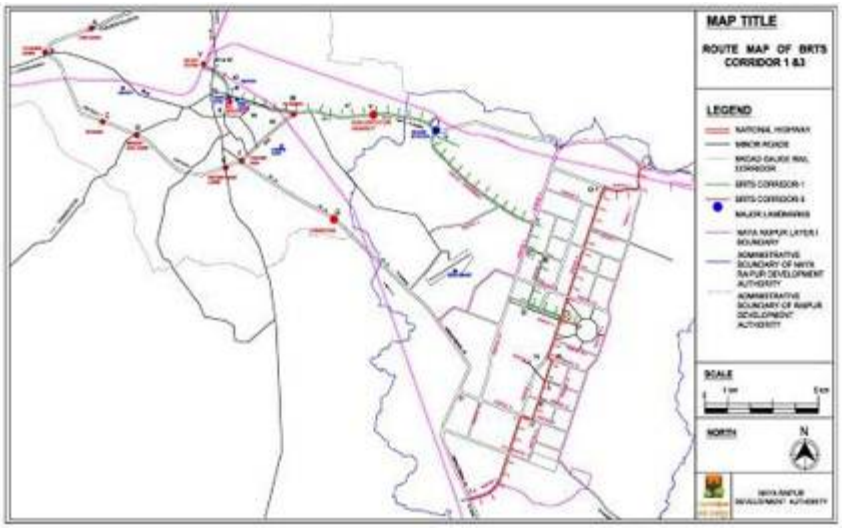


Table 2.1: Origin and Destination of Corridors

Bus Route	Corridor Length (km)	Origin (in Raipur)	Via	Destination (in Naya Raipur)	Linking Roads
Corridor 1	25 km	Railway Station	Old Secretariat, Telibandha, Seri Khedi interchange	Capitol Complex	NH-53-Expressway
Corridor 3	17.8	--	--	Within Naya Raipur	Road No. 2

2.5 BRTS COMPONENTS

A good bus transport system is that which provides reliable, fast, safe, comfortable and affordable means of transport. Bus infrastructures play an important role in making the system fast, safe and comfortable, which are most important attributes for the success of a BRT system. The components of the bus infrastructure broadly include Bus Depot/s, Night Shelter/s for buses, transfer station/s (Station/s) and Bus Stops.

2.5.1 BRT CORRIDORS

Naya Raipur BRTS (Phase I) shall covert transit demand nodes within Raipur and Naya Raipur. The description of the corridors and bus infrastructure along them are given below

Corridor I :

The route in this corridor connects Raipur Railway Station and Capitol Complex in Naya Raipur via present Secretariat at Raipur. Two terminal points in Raipur - (1) Railway Station, (2) Existing Secretariat are proposed on this route. The night halt for buses on this route will be in the parking area of existing Secretariat since the buses will commence service from this point in the morning and terminate service at this point in the night. Maintenance of buses will be done during off-peak period in the bus depot located in Naya Raipur.

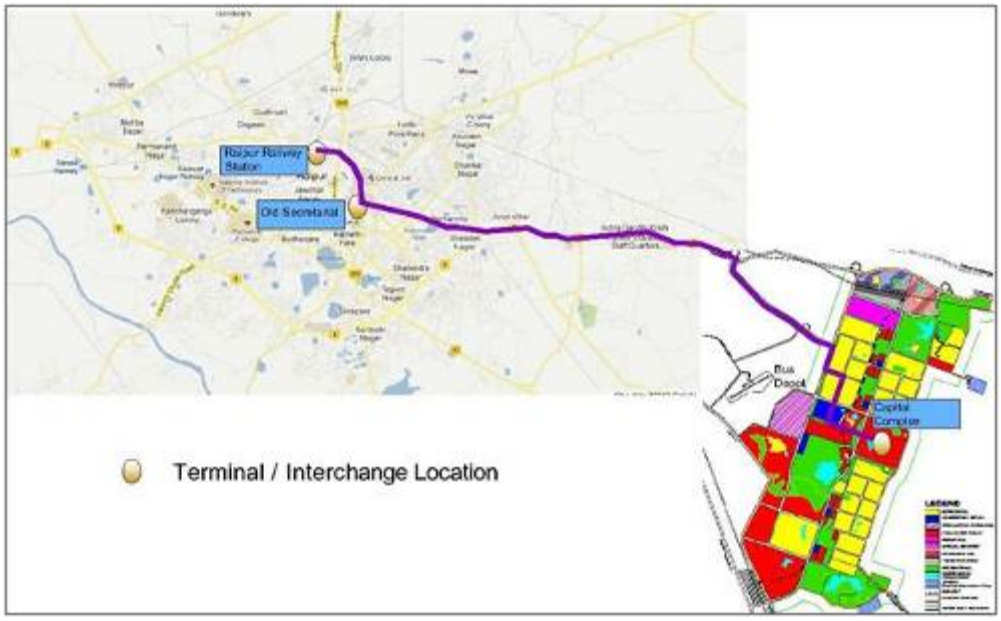


Figure 2.2 : Terminal / Interchange Point on Corridor I (Source: EMBARQ (India)

2.5.2 BUS DEPOT

The depots generally have servicing and maintenance-workshop facilities, fuelling and night parking facilities. Three possible locations for the bus depot have been analyzed and rated as given below -

i. Site (1): Near SIRD approach road junction at NH 30
ii. Site (2): Amanaka depot at Raipur
iii. Site (3): Near junction of Road no 1 & Road no 3 in Naya Raipur

The rating of the three sites mentioned above based on comparative advantages and disadvantages are described in the table below.

Table 2.2: Scoring of Alternative Sites

Parameters	Scoring of alternative sites for different parameters		
	Site (1)	Site (2)	Site (3)
Land availability	Low	Low	High
Land Procurement	Low	Low	High
Facilitation for management	High	Low	High
Suitability in terms of congestion and habitation	Medium	Low	High
Suitability in terms of dead haulage	Low	High	Medium

Site No. 3 seems to be more suitable for development of the bus depot. A land area of about 37 Ha has been earmarked near the intersection of the Express way (Road no. 1) and Road No. 3 in Naya Raipur for development of a Bus Depot in the Naya Raipur Development Plan 2031. However, for the present need, Bus Depot for 71 buses is proposed to be developed in a part of the land, in an area of 37270 sq m. The land is owned by NRDA. It is a tabled land having gentle slope. Sufficient land is available for future expansion. The site plan is given below:

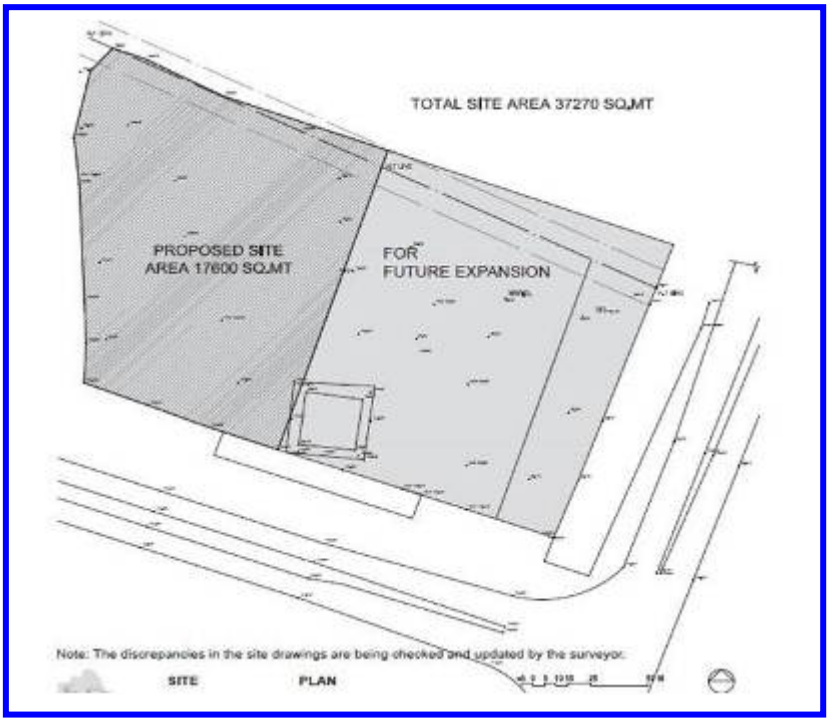


Figure 2.3 : Proposed Site for Bus Depot at Naya Raipur

(Source : M/s Arya Architects)

The depot, besides bus parking facilities shall provide bus washing facilities, minor repairing shed, refueling facilities, workers facilities such as waiting and resting areas, cleaning and changing rooms, lockers, dining facilities and Administration area for the Bus operator.

2.5.3 CONTROL CENTRE

The control centre of Intelligent Transport System application to monitor the operations and information management of BRTS shall be located in Bus depot at Naya Raipur.

2.5.4 Night Parking Facilities in Raipur

The parking space, in front of gate no. 4 of the existing Secretariat Building in Raipur, shall be used for night parking of buses of Corridor I.

Till the time the above parking lot is developed, existing Amanaka bus depot that is presently being used for Raipur City buses shall also be used for night parking of BRT / Interim Service buses.

2.5.5 BUS STOPS ON THE BRT CORRIDOR

The BRT Lite Buses would comprise of High Floor (900mm) buses which would have doors on both sides. On the left, the door shall have steps to operate in mixed traffic.

The buses would operate in median side dedicated "bus only" lanes in Naya Raipur and in mixed traffic beyond Naya Raipur. The Bus Stops in mixed traffic are planned on the kerb side, one in each direction, at a given location. These are termed as "Pick up points". The left side of bus shall have steps to facilitate boarding and alighting at these pick up points. The bus stops in Naya Raipur are planned to be located on the medians and are termed as "Bus Shelter". The right side of the bus shall not have any step and would be used for level boarding and alighting through the high level median Bus Shelters by way of docking.

The Bus stops in Raipur (Pick-up Points) and in Naya Raipur (Bus Shelters) have been identified on the major traffic generating nodes.

2.5.6 PICK-UP POINTS IN RAIPUR

Pickup points have been identified within Raipur city at major passenger demand points so as to operate direct services from such identified points to enable efficient transit service for the employees working in the capital complex in the peak hours. In the initial years, the demand for the BRT System would be primarily

to establish efficient linkages between the employee housing colonies and the residential areas in Raipur. In view of the same, following pickup points have been identified and the details of the same are set out in the table below.

A brief description of the location of the pick points is given below –

Table 2.3: Pick up Points in Corridor I

Sl.No	Pick-Up Points	Distance (km)
1	Railway Station	-
2	Existing Secretariat	2
3	Capitol Complex	26

1) Raipur Railway Station

This is the starting point for Corridor I.

BRTS will have to cater to large passenger loads throughout the day. The central location of railway station in Raipur city provides connectivity to Naya Raipur for the people of the city in addition to those of nearby towns. There is a complex movement of vehicles resulting due to drop off and pick up for passengers traveling by train via public and private transport, pick up of employees in buses of private companies as well as parking of cars and two wheelers.

A suitable site in the railway land has been identified in consultation with the railway officers and a concept plan has been developed by the consultant.

Since this location is not final, the assessment and its mitigative measures will be done in separate report.

2) Existing Secretariat

This site will provide easy access for employees, especially those, living in private houses in Raipur and also those commuting from other towns and visitors for transit to Naya Raipur. It will also be used for night parking of BRTS buses. The site is presently used for parking of vehicles of employees working in the secretariat. The existing plinths and landscape will be incorporated in the design or altered accordingly.

The pick-up points will have ramp at one side (at the side of the street junction) with checkered tiles which will make the Pick-up points disable friendly. The pick-up points will have electronic display boards, showing real time information of bus movements for passengers.

2.5.7 BUS SHELTERS IN NAYA RAIPUR

Bus shelters in Naya Raipur are proposed at median. Two types of shelters based on the width of the median (6m and 20m) shall be developed.

Bus shelters will be high level (900mm) with docking facility, to offer facility for level boarding and alighting to the users. The shelter will have ramp at one side (at the side of the street junction) with checkered tiles which will make the shelters disable friendly. The Bus shelters will have electronic display boards, showing real time information of bus movements for passengers. The shelters will also have provision of off-board ticketing system. This component will be designed as semi-open and an energy efficient structure. The shelter shall be developed before January 2014. In the first phase 2 shelters near Sector 21 and 20 shall be provided, while the terminal shall be in the Capitol Complex.

Table 2.4: Bus Shelters in Naya Raipur

CORRIDOR	BUS SHELTER
Corridor I	At NH 53 and R.N. 1 Junction
	At Junction R.N. 13 and R.N. 4, 200m ROW
Corridor III	At Near Cricket Satadium, R.N. 2, At Junction of R.N.2 and 9B, and at R.N. 12

All locations of Proposed Bus Shelters have been shown in the map given below;

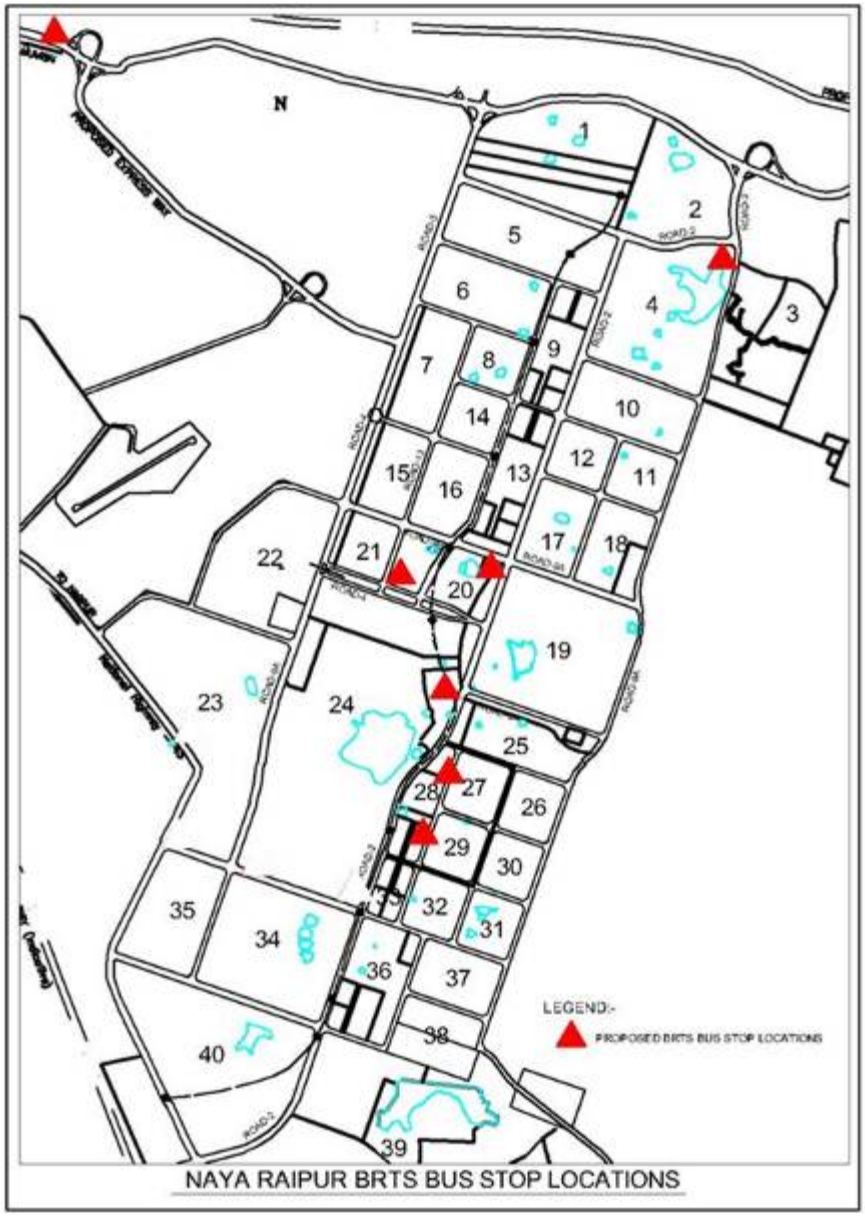
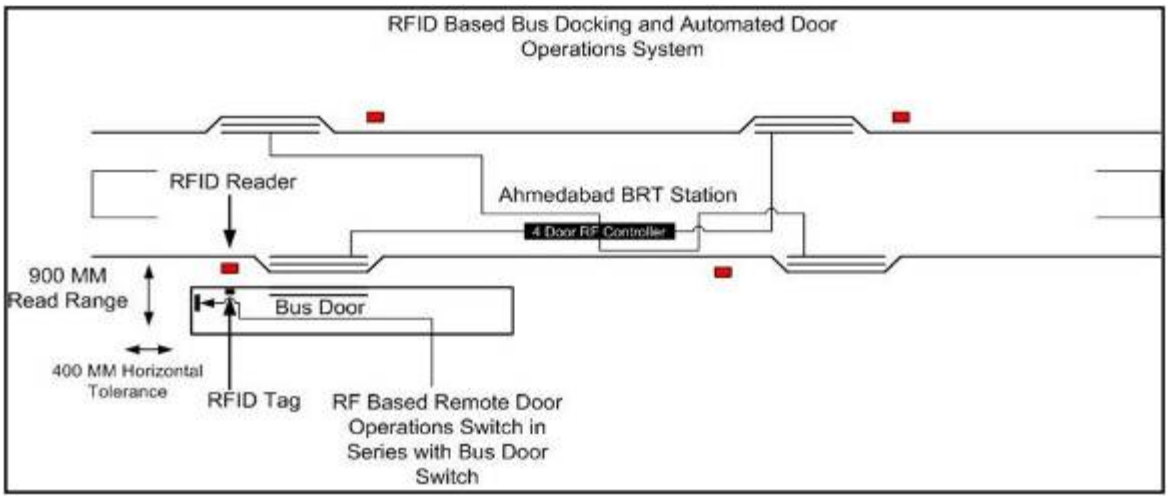


Figure 2.4 : Location of Bus Shelters in Naya Raipur

2.5.8 Vehicle guidance system for docking

Vehicle (Bus) guidance system shall be provided in the shelters for precise longitudinal and lateral placement of the bus door with the station doors for faster, safer and convenient boarding & alighting of the passengers. Operation of sliding doors of the buses as well as of the shelters shall be with the bus driver to ensure synchronization of operation. The system shall concept of RFID Reader at Doors, TAG on the Bus Side Glass near driver, RF wireless Transmitter on the bus driver for Open/Close. Following diagram shows typical plan of operation for Ahmedabad BRT, principle of which will be same in Naya Raipur -



Source of Diagram: Courtesy CEPT University, Ahmedabad

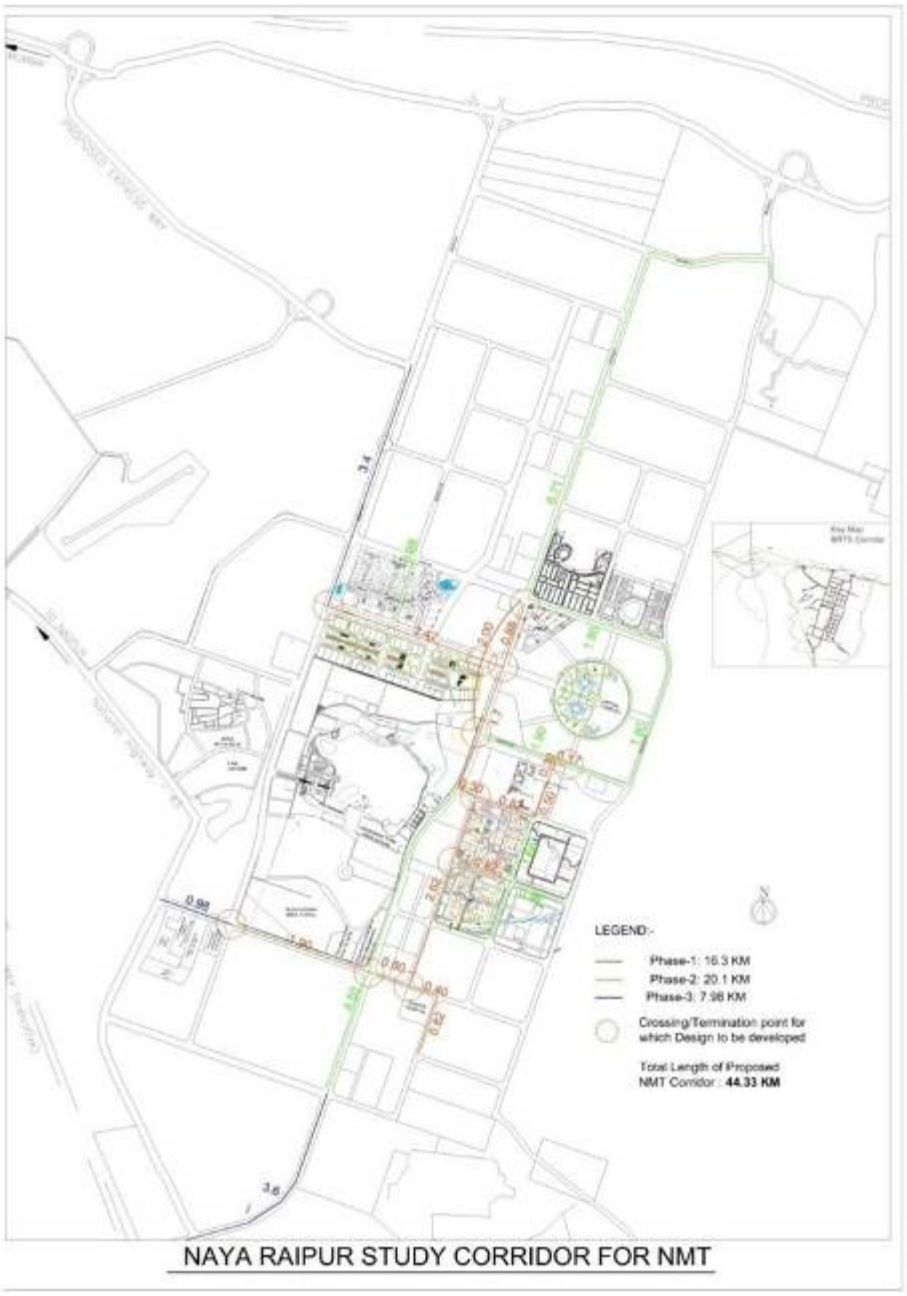
Figure 2.5: Vehicle guidance system for docking at Bus Shelters in Naya Raipur

2.5.9 PEDESTRIAN AND NMV FACILITIES

Walk and cycle are two most environment friendly modes of travel. In Naya Raipur a majority of population will have shorter trip lengths for many of their daily travel needs. The region already has a significant usage of cycles as a travel mode and providing suitable facilities at Naya Raipur will help sustain the usage of cycles. Provision of safe and comfortable facilities for the pedestrians and cyclists will result in encouraging the use of walk and cycle as an alternative to motorized transport. Naya Raipur has been planned taking into account these aspects to provide an enabling environment to encourage walk and cycle modes. All the roads in Naya Raipur are planned with sufficient space allocation for building the pedestrian walkways and cycle tracks. A network of 70 km of major roads has already been developed. Good avenue plantation and landscaping has been proposed for the smooth and safe movement of pedestrians in Naya Raipur along with other pedestrian facilities such as foot-paths and zebra crossings, traffic signals, parking for cycles etc. The funding plan under the project includes Development of approximately 36 km Cycle Tracks and Pedestrian walkways.

The NMT facilities shall be developed in phases. In the first phase, it is proposed to develop corridor of length 16.3 km within the project cost of INR 377 million. The alignment of NMT Corridor and phasing has been shown in the map given below; Proposed NMT Corridor in Naya Raipur

Figure 2.6 : Proposed NMT Corridor in Naya Raipur



2.5.10 **STREET LIGHTING, FURNITURE**

The provisions have been made for the street lighting for important corridors based on the requirements.

Street lighting design of the proposed BRT corridor assumes special significance as it has to cater to various lighting requirement such as BRT buses plying on BRT lane, other motorized traffic on mixed lane, slow moving and motorized traffic on

service lanes and pedestrian on footpath. These aspects would be considered at in detail design stage.

2.6 RELOCATION OF UTILITIES

As Naya Raipur is a new area being developed, the utilities have been planned taking into consideration implementation of mass transit systems and separate space / area has been made available for development / setting up of other utilities / facilities. In light of the above, there is no requirement for relocation of utilities.

In the Raipur City section of Corridor I, Raipur Municipal Corporation has recently widened the roads by shifting the utilities. Divided carriage ways are in place. Shifting of utilities for development of Bus infrastructure shall not be required.

Remaining portion of corridor II is NH 53 and a major portion of corridor II are being developed as a 4 lane road with service road on either side by NHAI under BoT contract, shifting of utilities for constriction of pick points shall not be required.

2.7 SALIENT FEATURES OF BRTS

2.7.1 Alignment of Bus Lanes for BRT system in Naya Raipur

The curb lane operations of BRT buses are proposed for Naya Raipur for reasons given below:

- The inter-city and intra-city public transport system envisaged for Naya Raipur focuses on the need/requirement of a public mass transportation system, that is efficient and cuts down, the usage of personalized modes of transport systems and hence would avoid reduction in the speed of the BRT buses at the intersections.
- The average width of the roads in Naya Raipur is 40 meter (single direction). To provide easier accessibility to passengers from the footpaths, a curb lane system is proposed.

- 2.7.2 **Open and Closed System for BRT operation**

In Naya Raipur, mix of open and closed system is being proposed, as the BRT buses would operate on both mixed and segregated lanes respectively.

BRT will have dedicated lanes with mix of grade separators, demarcated by paint and physical barrier.

2.7.3 *Proposed Service System for Naya Raipur*

A direct service with identified points in Raipur connected to BRT System corridors is proposed for Naya Raipur. The public bus transportation system would connect the other areas to the identified points, wherein the BRT buses would pick up passengers from identified points and transfer them to Naya Raipur.

2.7.4 *Pedestrian and Cycle Tracks*

It is proposed to provide comfortable and safe facilities for pedestrians (minimum 2.0 m wide footpath, pedestrian corridors and plazas) and cyclists (Minimum 3.0 m wide cycle tracks) along the BRT corridors. The road constructed in Naya Raipur already incorporates pedestrian footpaths for about 7.5 km. The 36 km of roadway will be provided with pedestrian footpaths and exclusive cycle tracks, as part of the BRT system.

2.7.5 *Proposed Buses*

The Buses shall be Front diesel engine operated bus of 900 mm floor height with 2 doors. Right side door shall be 2 meter wide with no stairs to facilitate level boarding operation in median side dedicated lane. The left side door shall have 1.65 meter width with stairs to operate in mixed traffic at kerb side pick up points.

A fleet size of 23 standard Buses (capacity 70) is required during the Peak hours (8 am - 9 am & 5 pm - 6 pm) for the interim period. The spare fleet required works out to be 3 buses. During the off peak period services, at headway of 30 minutes and lay over time 10 minutes, 10 Buses shall be required.

The peak hour rider ship in each of the Corridor I and II for the year 2014, 2015 and 2016 are 1790, 1829 and 1867. The peak hour rider ship for Corridor III for the corresponding years are 271, 311 and 344. The service shall be operated with policy headway of 20 minutes. The commercial speed of the buses shall be 30 kmph on Corridor I and 25 kmph on Corridor II.

2.7.6 *Frequency of Operation*

The frequency of trips will be maintained high, with a minimum headway of five minutes between 7 am and 9 pm and before 7 am and after 9 pm headway can be slowly increased..

2.7.7 *Fleet Size*

As per estimates, Naya Raipur will be provided with an operational fleet of 63 buses in Phase I by the BRT project.

2.7.8 *Feeder Services*

Naya Raipur BRTS will act as a Direct Service System. The Feeder services will be provided by mini-buses running in mixed traffic conditions with other private vehicles. A small fleet of mini buses is suggested for the internal transit as feeder services from the adjoining villages to the main terminals within Naya Raipur.

Chapter-III

REVIEW OF ENVIRONMENTAL REGULATORY FRAMEWORK

3.1 Environmental Clearance

Several environmental standards specified by Ministry of Environment and Forest (MoEF) and other ministries may be applicable to the proposed project of Naya Raipur roads. Project and project area will be under the purview of water (Prevention and Control of Pollution) Act 1974; Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act 1986 via Chhattisgarh Environment Conservation Board (CECB) i.e. State Pollution Control Board established for Chhattisgarh to implement and enforce the national standards for effluents, water quality, ambient air quality and ambient noise level. Further, the project will be under the purview of the guidelines of CECB formulated for municipal waste generation as Municipal waste (Management and Handling) Rules 1998.

A detail list of applicable legislations is given in Table 3.1 and sitting criteria for developmental projects specified by MoEF is given in Table 3.2

Table 3.1: A list of applicable legislations

Applicable GOI Policies & Regulations	Year	Objectives	Applicability
Environmental (protection) Act	1986	To protect and improve overall environment	Environment in general
Environmental Impact Assessment (EIA) notification: 1994	2002	Requirement of Environmental Impact Assessment	Direct
Air (prevention and control of pollution) Act	1974	To control air pollution by controlling emission and air pollutants according to prescribed standards	Air pollution
Water (Prevention and Control of Pollution) Act and Cess Act of 1977	1974	To control water pollution by controlling emission & water pollutants as per the prescribed standards	Water pollution
Forest Conservation Act	1980	Regulation of Forest Land and	Forests

Applicable GOI Policies & Regulations	Year	Objectives	Applicability
		Tree felling	
The Wildlife (protection) Act	1972	Protection of wildlife	Wildlife
The Land Acquisition Act	1894 & 1989	Set out rule for acquisition of land by Government	Land Acquisition
Noise Pollution (Regulation and Control) rules 2000	2001	Noise pollution regulation and controls	Control of noise pollution
EIA notification 2006	2006	For impact assessment of infrastructural project	Environmental clearance
International Environmental regulation in which India is a signatory		International environmental issues such as emission of green house gases	Global environmental issues

Table 3.2: Sitting Criteria Delineated by MOEF

I. **As far as possible prime agricultural land/forest land may not be converted into an industrial site**

II. **Land acquired should be minimum but sufficient to provide for a green belt wherein the treated wastewater, if possible/suitable, could be utilized from wastewater treatment systems**

III. **Enough space may be provided for storing solid wastes. The space and the waste can be made available for possible reuse in future**

IV. **Layout and form of the project must conform to the landscape of the area without unduly affecting the scenic features of that place**

V. **Associated township of the project if any to be created must provide for space for phyto- graphic barrier between the project and the township and should take into account predominant wind direction**

VI. Coastal Areas: at least 1/2 km from the high tide line (within 0.5 km of High Tide Line (HTL), specified activities as per CRZ notification, 1991 are permitted)(The HTL is to be delineated by the authorized agency only.)

VII. Estuaries: At least 200 meters from the estuary boundaries

VIII. Flood Plains of the Riverine systems: at least 500 meters from flood plain or modified floodplain or by flood control systems

IX. Transport/Communication System: at least 500 meters from highway and railway

X. Major Settlements (3,00,000 population) at least 25 km from the projected growth boundary of the settlement

The proposed project is located in the rural area near Raipur where no reserved forest or ecologically sensitive water bodies exists. The road alignment selected is not expected to pass through environmentally sensitive locations. In Phase I the 70 km. of roads are constructed and environment clearance has already been taken along with the clearance for development of Naya Raipur a new city, under the category B of EIA notification 2006 of MoEF.

3.2 ROAD POLICY OF CHHATTISGARH

The important objectives of the State Road Policy of Chhattisgarh:

- Ensure good road connectivity in rural areas with particular emphasis on access to districts and block headquarters, healthcare centres, educational institutions, agricultural markets, tourism locations and cultural heritage sites.
- Promote two north-south and four east-west high speed corridors to develop Chhattisgarh into a regional logistics and transhipment hub.
- Facilitate social and economic development by strengthening the road network around industrial areas and growth centres.
- Improve connectivity between industrial / cluster areas. Convert all national highways into two lane roads and convert three of the busiest national highways.

Four broad strategies were laid down to meet the above-mentioned objectives:

- Integrated road development and management
- Private sector participation
- Dedicated funding
- Capacity building of State institutions

3.3 STATE ENVIRONMENT POLICY

Given the need to balance the benefits of development with the need to maintain and improve the environment, the State has prepared its Environmental Policy that is aimed at:

- Ensuring sustainable development with an emphasis on social and intergenerational equity
- Enhancing environmental performance as a means of competitive advantage for the State
- Improving the quality of life of citizens

3.4 STRATEGIES

The State's Environmental Policy has been developed within the basic framework of economic and social priorities with the objective of ensuring environmental conservation without impeding any development imperatives.

The Government of Chhattisgarh has decided on three broad strategies:

3.4.1 ENVIRONMENTAL RESOURCE PLANNING

The government will focus on sustainable management of essential ecological processes and life support systems. This would ensure sustainable and rational utilisation, conservation and integrated environmental management, within all areas viz. land, air, water, forests, biodiversity, minerals, industry, agriculture, as well as urban planning and transport.

3.4.2 COLLABORATIVE GOVERNANCE AND MARKET BASED MECHANISM

Through collaborative efforts, impact of actions of developmental projects on all affected biophysical and social elements would be considered. As the implementation of the Environmental Policy is the responsibility of various Departments, the requirements of the environmental policy would be integrated with the policies of Water Resources, Forest, Road, Transport, Housing, Industry & Mining departments. Measures will be undertaken wherever reasonable and practical, and with due regard to public interest, to ensure that the costs of environmental degradation are borne by the person(s) responsible for the degradation.

3.4.3 POSITIVE INTERVENTION THROUGH PUBLIC PARTICIPATION

Public awareness and participative decision making is essential for effective, long-term environmental protection and equitable utilisation of natural resources. The commitment and participation of people to this process and to matters of

environment that directly and indirectly concern them would hold the key to sustained prevention of environmental pollution and degradation.

3.5 STATE FOREST POLICY

The State of Chhattisgarh has about 44 percent of its geographical area under forests and is the catchment area to at least four main river systems, i.e. Mahanadi, Godavari, Narmada and Ganga. Major rivers of the state are Mahanadi, Indravati, Hasdeo, Sheonath, Arpa and Ibb. Tropical moist deciduous and tropical dry deciduous are the 2 categories of forests in this State. The State Forest Policy has the following basic objectives from the environmental point of view.

- Maintenance of environmental stability through preservation and, where necessary, restoration of ecological balance;
- Preventing denudation of forests and soil erosion in the river catchment areas and reservoirs in order to bring about soil and water conservation;
- Increasing the forest cover in forest deficient districts through afforestation and agro-forestry/farm forestry programmes

3.5.1 FOREST

Forest resources are of vital importance in maintaining the ecosystem and also influencing the climatic pattern of the region. Forest promotes biological diversity and better habitat for several species. But the area in question does not have any legal forest cover.

3.6 REGULATION FOR THE VILLAGE SETTLEMENT AREAS

1. These areas to be considered as residential use zone, all residential and incidental public and semi public facilities and utilities shall permit therein. Public and semi public facilities to be allowed within 0.5 km of the settlement.
2. In case of Central Village, a rural centre could be developed to provide middle level facilities such as education, health, recreation facilities and other facilities to serve a population in the surrounding 8-10 villages.

3. Similarly in case of Rural Growth Centre a rural centre could be developed in for higher education, health, commercial and recreation facilities to serve the growth centre and the adjoining village. (Population up to 35,000)

Source: Draft NCR Plan

3.7 REGULATION FOR THE AGRICULTURE AND OTHER AREA OUTSIDE THE RURAL SETTLEMENT

The area includes mainly the vast agricultural land, forests. This zone agricultural land is being threatened by the spotted industrial/urban encroachments especially along the National Highways. The cheap cost of land in the rural areas, have accelerated the development along the roadsides. The following major landuse to be designated in the rural lands.

1. Intensive agriculture and allied activities with the focus on horticulture and cash crops
2. Social forestry/ afforestation especially on the barren lands
3. Dairy and poultry farming including milk chilling station and pasteurisation plant
4. Regional recreational facilities such as regional parks, wild life sanctuary. Recreational / tourist facilities not more than 4.5 m heights FAR not exceeding 5 percent of the plot area
5. Cemeteries, schools, institutions, like hospitals may be permitted. However, the proposed development should not involve the use of high yielding agricultural land nor should it adversely affect a site of special scenic beauty or ecological interest.
6. Existing village *mandi*s and agriculture markets
7. Rural industries which are non-polluting in nature with focus on agro-based industries.
8. Bus shelters
9. Quarrying as per the environmental guidelines and approved site
10. Sanitary landfill, compost processing plant and other such activity sites with adequate protected belt as prescribed in the CPHEEO Manual of the Ministry of Urban Development and Poverty Alleviation and the notifications issued by the Ministry of Environment and Forests from time to time.
11. Fuel filing stations, service stations and repair workshops

12. Power plant / sub-station / water works / treatment plants and other utility services

Source: Draft NCR Plan

3.8 GENERAL REGULATION

1) Construction along road right of way (r/w)

The right of ways (R/Ws) is for different types of roads are as follows;

1. Expressway 100 m R/W
2. National Highways 100 m R/W
3. State Highways 60 m R/W
4. District Roads 45 m R/W
5. Rural Roads as per the norms applied by the Competent Authority

2) Construction of building not to encroach upon an area set upon for means of access.

A. The highway corridor zone will be notified as controlled area / development area.
B. No building shall be constructed which in any way encroaches upon or diminishes the area set apart as means of access required under this regulation.
C. No Construction other than highways amenities like petrol pump and bus stand shall be permitted on both sides of National Highways and State Highways on both sides up to a depth of 100m.

3) Trunk Services

A. Processed water, Power, Sewerage treatment plant and solid waste management may be established. Environmental clearance from the competent authority is required especially in the arrangements for disposal of solid and liquid wastes.
B. Solid waste and development of landfill site should be according to the provisions of MSW 2000

4) Water Bodies

All the water bodies should be protected and conserved. It can be taken up for development of recreational facilities. It should not be filled to develop any kind of building.

A. These shall not be filled and also be protected from discharge of wastewater

B. Mahanadi River shall be protected providing buffer of green belt of 500 m. These should be acquired as part of the development schemes and afforested under the control of the forest department.

5) Parks, Parking, Circulation and utilities

Parks, parking and circulation, and utilities are permitted in the village settlement areas while agriculture and other area are outside the rural settlements.

6) Natural Conservation Zone and Regional Recreation Zone

Recreation as an amenity has to meet certain competing types of demand such as the one from the urban population of the Region using countryside as an amenity; from a wide urban population coming to the agricultural community and also from the balanced physical development of the Region itself. The landuse policy on recreational area will meet the demand in the following way:

A. In the Natural Conservation Zone the following activities are permitted:
    i) Agriculture and horticulture
    ii) Pisiculture
    iii) Social Forestry / plantation including afforestation
    iv) Regional recreational activities with no construction exceeding 0.5 percent of the area with the permission of the competent authority
B. Areas of general level amenity as regional park in the proximity of the big urban centres,
C. River fronts `as recreational areas' by developing them and making them more accessible for such use,
D. Historical monuments as Tourist attractions

E. Parks in rural areas noted for their landscape and scenic beauty which could be used as picnic spots, and
F. National park in the vicinity of the Region

Source: Draft NCR Plan

7) Forests and Green Buffers

A. Forests (reserved, protected and open forests) to be avoided to bring under different uses.
B. Afforestation measures to be implemented on barren lands
C. Green buffers to be created along all roads, rivers, industrial units and mining areas.

3.9 NRDA Policy on Environment and Conservation of water body

Any new development has some or the other impact on the environment. Naya Raipur will grow with time and the increasing population will create pressure on the natural resources. Conservation of natural resources in the settlement is of utmost importance to make it sustainable. Therefore the concept of environmental management is incorporated in the planning process from the very beginning. In brief following policy decision have been incorporated in the Naya Raipur Development Plan 2031.

3.9.1 Green Belt

A 500-meter wide belt all along the city has been marked as green belt. This shall remain in agricultural use. In due course of time, the resources permitting, the area could be afforested.

3.9.2 Surface Water

Naya Raipur is dotted with a large number of water bodies. The total area under natural water bodies is 233.71 Ha. As a part of the conservation policy, the major water bodies and other environmentally sensitive areas in the city shall be conserved. Following points should be taken care of:

- A minimum buffer of 20 meters on either side of the canals and streams and 50 m around the water bodies shall be a no development zone in order to prevent pollution and conserve the natural water shed of the water body.
- 100 meters area all along the Mahanadi canal shall be reserved as green without allowing any development or construction activity.

- No untreated water should be let out in the water bodies.

3.9.3 Ground water

The depth of ground water table varies from 5 to 12.5 m bgl in the area. Following measures should be taken to maintain the quality and quantity of ground water.

- Construction of wells, bore wells, tube wells, etc. should be restricted with permission from the concerned agency.
- Water harvesting to be practiced on a large scale to maintain the level of ground water.
- Effluent should be properly treated before letting the same on vacant land to avoid seepage and contamination.

3.9.4 Sewerage

Sewage would be treated to the standards as prescribed by the Central/State Water Pollution Control Boards. Efforts would be made for re-use of water for irrigation.

3.9.5 Drainage

- Roadside drains to be provided and the same to be managed in clean condition.
- The water from these drains should be recycled and reused.
- The major natural drainage channels not to be disturbed.

3.9.6 Solid Waste

An effective solid waste management system is necessary for maintaining the health and hygiene within a city. The important points to be considered are as under

- Waste segregation should be practiced at household and community level.
- Dustbins should be provided at appropriate locations.
- Regular collection should be done by the competent authority
- The site for waste disposal should be properly and scientifically selected so that no contaminants percolate into the ground water, river or lake.
- Hazardous waste and bio-medical waste should be disposed off separately.
- Waste disposal areas should be planned down-wind of villages and townships.
- The pattern of filling disposal site should be planned to create better landscape and be approved by appropriate agency and the appropriately pre-treated solid wastes should be disposed according to the approved

plan.

- Intensive programs of tree plantation on disposal areas should be undertaken.

3.9.7 Air Pollution

The setting up of Naya Raipur in the rural settings of the Raipur district is bound to have an impact on the air quality during the implementation phase as well as in the post implementation phase of the project. The construction activity results in a high concentration of SPM in the air. The vehicular emission in a city results in the concentration of NO_x, CO, SO_2, HC. The environmental policy of the city aims towards maintaining the air quality at the lowest possible levels through following steps:

- Minimizing the vehicular traffic through the introduction of integrated multi-modal transport system.
- Green buffers to attenuate the pollution effects.
- Mass transit system has been proposed for the new city in order to reduce the vehicular emissions to a large extent.
- The city wide pedestrian paths that have been incorporated in the design would also help discourage the use of vehicles over short distances.
- Controlling fuel quality (including switching to cleaner fuels and improving the quality of fuels to reduce emissions).

3.9.8 Noise

The major sources of noise are -

- Road traffic;
- Aircraft;
- Industry

To reduce the noise level, the arterial roads are designed to have 2 to 3 rows of plantation and also there could be additional rows of plantation as part of the development.

3.9.9 Energy Conservation

The physical planning policy aims at achieving a sustainable growth through energy conservation and optimum utilization of the natural energy resources.

- Energy conservation shall be encouraged through community and site planning, design, and the use of energy-efficient materials and landscaping.

When development applications are reviewed, consideration shall be given to energy conservation measures such as the solar orientation of buildings, use of landscaping and building materials.

- Energy conservation and efficiency shall be encouraged in all facilities owned and operated by the City.
- Renewable sources of energy shall be promoted to reduce pressure from the conventional sources of power.
- Solar energy to meet some of its energy requirements. Electrically run vehicles could be introduced within the sectors. The road signals could run through solar energy.

3.9.10 Environmental Policy and Legal Issues

Project and project area will be under the purview of water (Prevention and Control of Pollution) Act 1974; Air (Prevention and control of Pollution) Act 1981, the Environment (projection) Act 1986 via Chhattisgarh Environment Conservation Board (CECB) i.e. State Pollution Control Board established for Chattisgarh to implement and enforce the national standards for effluents, water quality, ambient air quality and ambient noise level. Further, the project will be under the purview of the guidelines of CECB formulated for municipal waste generation as Municipal waste (Management and Handling) Rules 1999; Hospital Waste Generation as Bio-medical Waste (Management & Handling) Rules 1998.

Source: Naya Raipur Development Plan – 2031

3.10 ENVIRONMENTAL CLEARANCE

This project comes under the preview of Notification issued by MoEF on September 14, 2006. In this notification, projects are categorized as A category and B category based on the type of industry/development, pollution load and size of the project. The A category projects are appraised at the Central level whereas the category B projects are appraised at the State level.

State level environment impact assessment authority, Chhattisgarh had given environment clearance stating that these road developments are neither National Highways nor State Highway. The roads designed and included in the master plan are treated as a part and parcel of Satellite Town – Naya Raipur. Hence this project is covered in serial no: ‘8(b) Townships and Area Development Project’ of

EIA Notification, 2006. BRT system is being planned on the same area and does not differ with the road planning given in the Development Plan – 2031 for Naya Raipur. Henceforth separate Environment Clearance is not required. The Environmental Clearance for Naya Raipur is attached as **Annexure – I**.

3.11 APPLICABLE POLICIES AND NORMS

The environmental and social safeguards policies shall be applied to all projects to be taken up under GEF-SUTP. Adoption of this framework shall ensure that the projects meet the national and state level environmental and social safeguards and are also consistent with the applicable safeguards policies and provisions of the World Bank.

3.11.1 Application of the Environmental Social Management Framework

Projects triggering significant environmental / social impacts, i.e. projects with potential to trigger impacts on environmental sensitive areas, or large scale resettlement activities are not envisaged under GEF-SUTP. However, in the event of such projects, being critical to the GEF priorities, the projects shall be included after undertaking the necessary environmental and social assessments, as mandated by the GoI / state governments and conforming to the safeguard policies of the World Bank.

National Resettlement and Rehabilitation Policy, 2007 and the Land Acquisition Act 1894 (as amended in 1984) are the applicable legislations at the centre and these would be applicable for all components of the project. While at the state level, respective state governments have formulated a resettlement policy for various multilaterally funded projects being undertaken in the states and these would be applicable.

3.11.2 REHABILITATION POLICY OF THE GOVERNMENT OF CHHATTISGARH

Naya Raipur Development Authority (NRDA) has prepared a Rehabilitation Scheme based on the Rehabilitation Policy of the Government of Chhattisgarh, wherein it is emphasized in the Rehabilitation Plan[1] that agricultural land for development is purchased from farmers by mutual consent and that the Land Acquisition Act will not be used as far as possible. The rates worked out for compensation are:

1. Land-
    a. Rs 11 Lakh per hectare for irrigated land
    b. Rs. 10.00 Lakh per hectare for un-irrigated land.
2. Additional Compensation – Rs 1 Lakh per hectare for irrigated and un-irrigated land
3. Compensation in lieu of special rehabilitation benefits- Rs. 2.75 Lakh per hectare.
4. Families, which need to be relocated, would be provided new houses in a residential colony developed by NRDA within 5Kms distance from their existing homes. Special benefits are also provided to the project affected landless labourers.
5. The provision of houses will be done as per the type of house presently owned by the affected families.

    The above rate are again revised with the consultation of PAPs and above breakups from 1 to 3 is merged. It is divided in to 2 types of rates for purchasing as under;

    a. Irrigated Land: Rs. 25 lakh/ha.

    b. Un-irrigated Land: Rs. 23.75 lakh/ha.

3.11.3 NRDA Policy on Environment and Conservation of water body

The policy as stated in 3.9 above is a part and parcel of Naya Raipur Development Plan 2031. The development plan is approved by the Government of Chhattisgarh wide gazette notification no. 1504/2382/32/07 dated 24-7-2008 published on Chhattisgarh Gazette dated 8-8-2008. This is applicable on all

[1] NRDA Rehabilitation Plan for Naya Raipur Project

activities being carried for and in the development of Naya Raipur, within the provisions of Naya Raipur Development Plan 2031.

Chapter-IV

ANALYSIS OF ALTERNATIVES

4.1 WITHOUT PROJECT

Most of the public movement in the city of existing Raipur is through two wheelers, auto rickshaws, cycle rickshaws and private mini buses. Due to the mixed traffic there are traffic congestions on all the major arterial and sub arterial roads. Lack of organized parking spaces further aggravates the situation, resulting in delays and pollution of the environment.

The yearly number of vehicles registered in Raipur was approximately 0.2 lakh in FY02 and has increased two fold to approximately 0.5 lakh in FY06. Two-wheelers constitute more than 81% of total vehicular population resulting rapid increase in the number of vehicles registered. The total number of registered vehicles in Raipur was approximately 4 lakh as of 2006. The annual growth rate of vehicle registration observed is about 12 %. The breakdown of number of vehicles registered in each year from 2006 to 2010 is set out in the table below

Table 4.1: Vehicular growth in Raipur in last 5 years

Year	Passenger Car	2 Wheeler	3 Wheeler (Auto Rickshaw)	Bus	Mini Bus	Trucks H Goods Vehicle	LGV	LGV 3-Wheeler	Total
2005-06	3190	35901	535	11	665	2855	3996	289	47442
2006-07	3804	40889	750	18	559	3429	6192	337	55978
2007-08	4909	43589	727	33	710	4944	5027	403	60342
2008-09	5558	57292	578	115	600	3750	5307	327	73527
2009-10	6793	54857	667	137	562	2839	5528	236	71619
TOTAL	24254	232528	3257	314	3096	17817	26050	1592	308908

Source: Office of the Regional Transport Officer, Raipur

4.1.1 Bus Transportation System

Public transport system occupies less road space, causes less pollution and offer economical travel costs. Prior to 2009, there was no organized public transportation system present in Raipur. In consideration of these facts, an initiative was taken by the District Administration, Raipur Municipal Corporation (RMC) and Raipur Development Authority to form and register under the Indian Companies Act, 1956; a Special Purpose Company namely "Raipur City Bus Limited (RCBL)" for the purpose of providing City Bus Service. Currently, the RCBL is operating 36 city buses in 9 routes, on Public Private Partnership frame work in which the operators are responsible for procuring Buses, operation and maintenance. Exclusive rights have been awarded to the operators on the given routes. The operator collects the revenue and shares it with RCBL. The details of the routes in Raipur are given below.

Table 4.2: Details on public bus transport system in Raipur

Sl No.	Route No.	Particulars	No. of buses
1	1	Railway Station to Banjaridham	5
2	2	Tatibandh to Banjaridham	9
3	3	Ghadi Chowk to Sezbahar	4
4	4	Shastri Chowk to Vidhan Sabha	2
5	5	Ghadi Chowk to Mandir Hasaud	2
6	6	Ghadi Chowk to Shailendra Nagar, Pachpedi Naka	2
7	7	Ghadi Chowk to Telibandha, Amlidih	2
8	8	Amleshwar to Ghadi Chowk via Purani Basti, Shyam Takies	4
9	9	Railway Station to Airport via Mana Basti	6
Total			36

Source: Raipur City Bus Limited

Without BRT system the same above existing system will be extended to Naya Raipur. In the absence of the proposed BRT project, both the cities (Raipur &

Naya Raipur) will also find it difficult to have good transportation. This will also lead to Increased air pollution, due to slow moving traffic and congestion & Noise levels will rise. Traffic congestion, pollution, lengthy travel time, behavioral aspects of the transport personnel will persists.

4.2 WITH PROJECT

Bus Rapid Transit Systems have important benefits in terms of travel time savings, increased ridership, land development impacts, and improved safety. Travel time reductions resulting from the introduction of BRT services may exceed 40%.

Bus Rapid Transit Systems have achieved important benefits in terms of travel time savings, increased ridership, land development impacts, and improved safety. Travel time reduction resulting from the introduction of BRT services may go up to 40%.

The travel time savings associated with buses operating on their own rights-of-way will also achieve operating costs and safety and environmentally benefits. It will reduce fatalities, drop in pollutants & less fuel consumption per capita for transportation.

It is a green field project hence the BRT system is being easily amalgamated with the Land Use Planning Policies. This act increases chances of success in all respects.

The commercial activity will be getting a good boost due to proposed BRT roads and will give rise to employment potential for people in and around these places.

Therefore, the ‘project with’ scenario, with its minor impacts is more acceptable than the “without” project scenario, which would mean slow down development. Hence, implementation of the project will be a definite advantage in order to achieve all-round development of its economy and progress for its people.

4.3 PROJECT COMPONENT ALTERNATIVES

In this project, project alternatives in terms of location, option are very limited, as the BRT project is coming on the existing road network, which is already constructed.

4.3.1 Route/corridor alternative

The alternatives have been worked out identifying possible routes covering the traffic generation nodes given in the table above from Raipur and leading to the capitol complex in Naya Raipur.

The alternatives considered are described below :

Table 4.3: Route/corridor alternative

Alternative	Origin	Destination	Via	Total Route Length
1	Raipur Railway Station	Capitol Complex, Naya Raipur	Old Secretariat, Telibandha, Agriculture University, Seri Khedi Interchange,	24.7
2	Kabir Nagar	Capitol Complex, Naya Raipur	Hirapur Chowk, Tatibandh Chowk, DD Nagar, Mahadev Ghat Chowk, Santoshi Nagar Chowk, Pachpedi Naka, Dumartarai.	37.6
3	Kabir Nagar	Capitol Complex, Naya Raipur	Hirapur Chowk, Tatibandh Chowk,Railway Station, Old Secretariat, Telibandha, Agriculture University, Seri Khedi Interchange,	37.1
4	Kabir Nagar	Capitol Complex, Naya Raipur	Hirapur Chowk, Tatibandh Chowk,, University, NIT, Pachpedi Naka, Dumartarai,	37.1
5	Kabir Nagar	Capitol Complex, Naya Raipur	Railway Station, Existing Secretariat, Teibandha, Agriculture University, Seri Khedi Interchange,	31.6

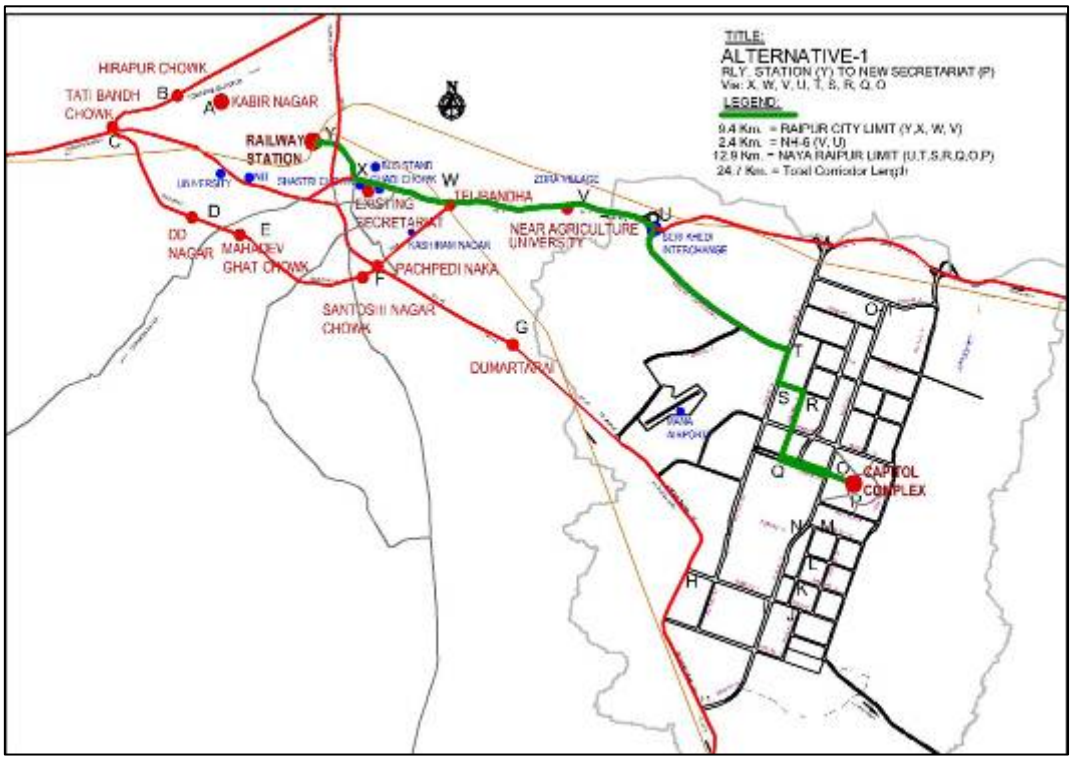
Each alternative is discussed below:

a. Alternative 1

The route connects Raipur Railway Station to Capitol Complex in Naya Raipur through NH-53 covering Raipur Railway Station; Inter State Bus Station, Existing Secretariat, Telibandha intersection which are important traffic generation nodes. Route Characteristics are as follows:

a	Origin:	Railway Station Chowk, Raipur
b	Destination:	Capitol Complex, Naya Raipur
c	Via:	Existing Secretariat, Telibandha, Sherikhedi interchange.
d	Route Length	24.7 km

Sections of Route	Length
Raipur City limit:	9.4 km
N.H Limit	2.4 km
NRDA Limit	12.9 km
Total	**24.7 km**



Map: Alternative Route I

i. Advantages :

1. It provides connectivity to the intercity passengers to Naya Raipur, as many of the government employees as well as visitors from all over the state will be visiting the capitol complex.
2. This route serves the CBD area of Naya Raipur.
3. Institutional areas in the east Raipur are also served.

4. The road way has sufficient width, controlled road crossings so that the desired level of service can be maintained at this route.

ii. Disadvantages :

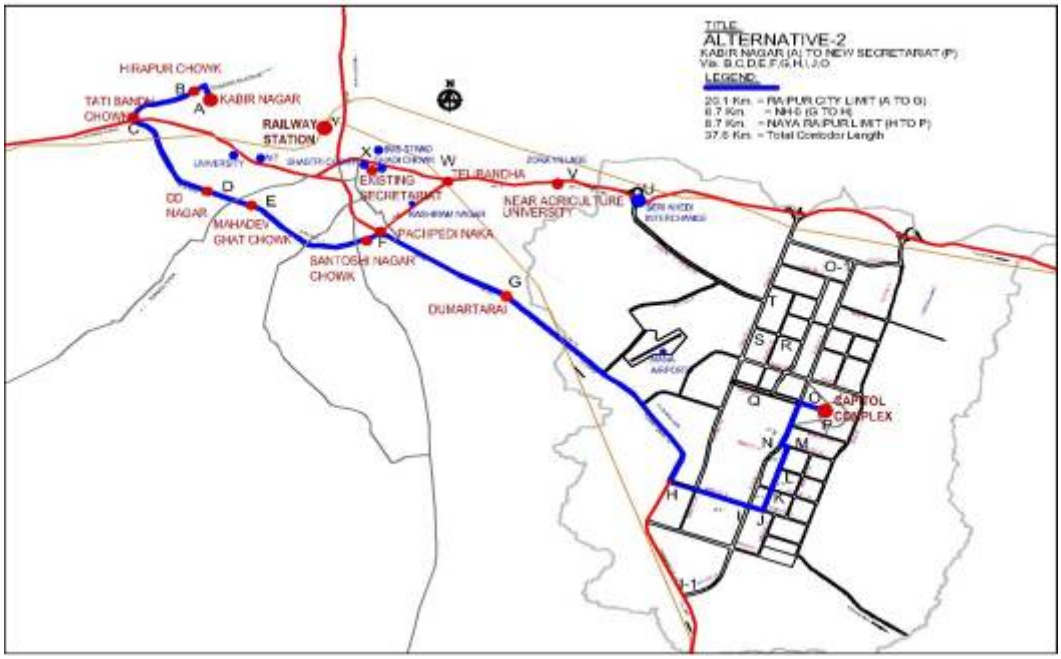
1. Demand nodes for government employees, like Kabir Nagar, Tatibandh housing colony, Deen Dayal Upadhyay Nagar, Santoshi Nagar, Pachpedi Naka and Kashiram nagar are not covered.
2. Demand nodes for the visitors coming from all over from the southern part of the state (Dumartarai and Pachpedi Naka) are not served.

b. Alternative 2

The route connects Kabir Nagar in Raipur to Capitol Complex in Naya Raipur through NH-30.The route covers government employees residential areas such as Kabir Nagar, Hirapur Tatibandh, Deen Dayal Upadhyay Nagar, Mahadeo Ghat area, Santoshi Nagar, Kashiram Nagar etc. and visitors coming from Durg, Bhilai (Tatibandh) and Southern part of state (pachpedi Naka and Dumar Tarai). Route Characteristics are as follows:

a	Origin:	Kabir Nagar, Raipur
b	Destination	Capitol Complex, Naya Raipur
c	Via:	Tatibandh Chowk, Deen Dayal Upadhyay Nagar, Santoshi Nagar, Pachpedi Naka.
d	Route Length	37.6 km

Sections of Route	Length
Raipur City limit:	20.1 km
N.H Limit	8.7 km
NRDA Limit	8.7 km
Total	**37.5 km**



Map : Alternative Route 2

The route has the following advantages and disadvantages

i. Advantages

It provides direct connectivity to the residential zones of the government employees like Kabir Nagar, Tatibandh Housing Colony, Deen dayal Upadhyay Nagar, Santoshi Nagar and Pachpedi Naka.

1. This alternative also provides connectivity to the employees commuting from other cities at Tatibandh Chowk.
2. The route has Comparatively less congestion as it runs through the Ring Road and NH-53.

ii. Disadvantages

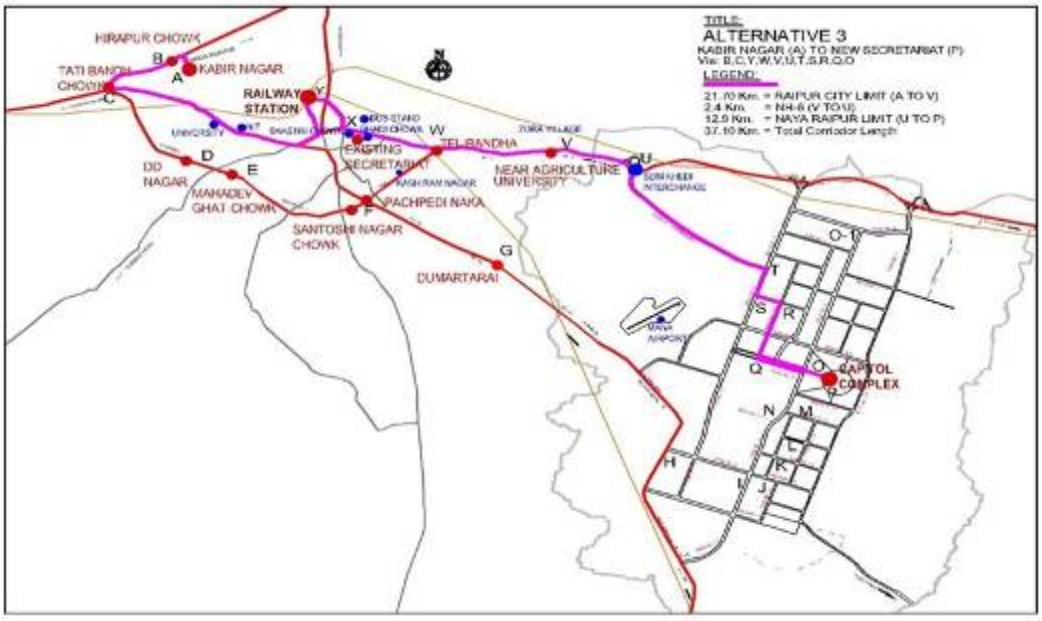
1. The intercity passenger demand is not served in this route as it does not connect to the railway station and it does not cover Inter State Bus Station.
2. It does not cover existing Secretariat demand where most of employees residing within city from are expected to use the BRTS buses.

c. Alternative 3

This alternative route serves the Kabir nagar area as well as Raipur railway station and connects Naya Raipur through the inner city Road of Raipur and NH-53. The Route Characteristics are as follow:

a	Origin	Kabir Nagar, Raipur
b	Destination	Capitol Complex, Naya Raipur
c	Via	Tatibandh, NIT Raipur, Railway Station, existing Secretariat, Telibandha, Seri Khedi Interchange.
d	Route Length	37.1 km

Sections of Route	Length
Raipur City limit	21.7 km
N.H Limit	2.4 km
NRDA Limit	12.9 km
Total	37.0 km



Map : Alternative Route 3

i. Advantages

1. It covers employees residential zone at Kabir nagar Tatibandh, Some portion of Deen Dayal Nagar, residential areas of inner city,

2. It covers existing secretariat and intercity traffic at Tatibandh and Raipur railway station.

ii. Disadvantages

1. The major disadvantage is that the level of service may reduce due to heavy demand at Kabir nagar and at railway station. The already occupied buses may get overloaded to crush capacity due to substantial amount of passengers boarding at Railway Station.

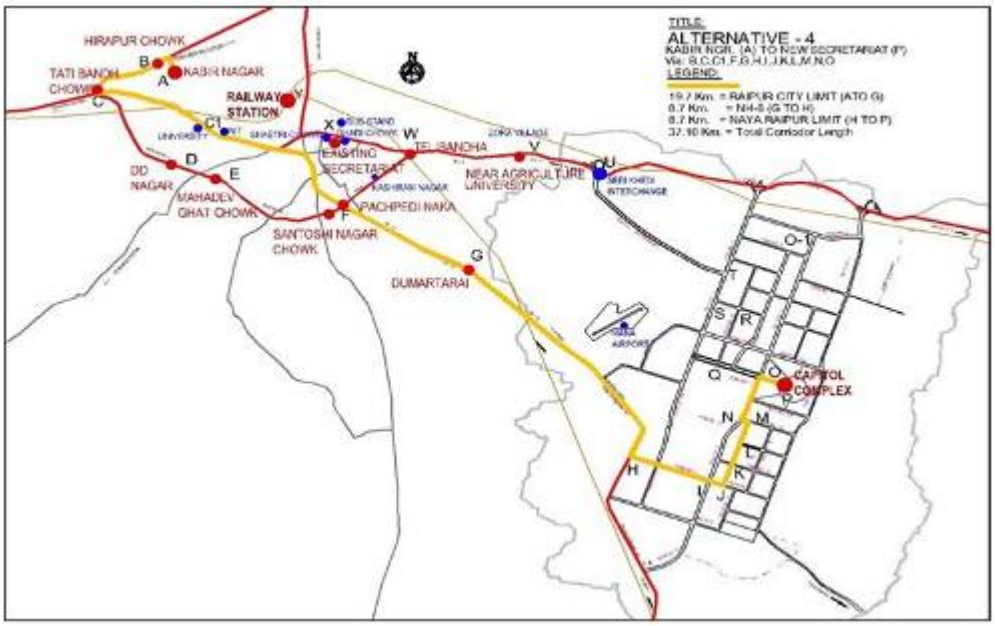
2. The route is characterised by highly heterogeneous traffic which will reduce the bus speed and cause further congestion.

d. Alternative 4

The route connects Kabir nagar area with the Capitol complex in Naya Raipur through NH-53 . Route Characteristics are as follow:

a	Origin	Kabir Nagar, Raipur
b	Destination	Capitol Complex, Naya Raipur
c	Via	Tatibandh, NIT Raipur, Sadar Bazar, Pachpedi naka, Dumratarai,
d	Route Length	37.1 km

Sections of Route	**Length**
Raipur City limit	19.7 km
N.H Limit	8.7 km
NRDA Limit	8.7 km
Total	37.1 km



Map : Alternative Route 4

The comparative advantages and disadvantages of this route are discussed below –

i. Advantages

1. The alternative serves the employees residential zone, institutional zones i.e., NIT Raipur and, University in Raipur
2. It covers inner city area.

ii. Disadvantages

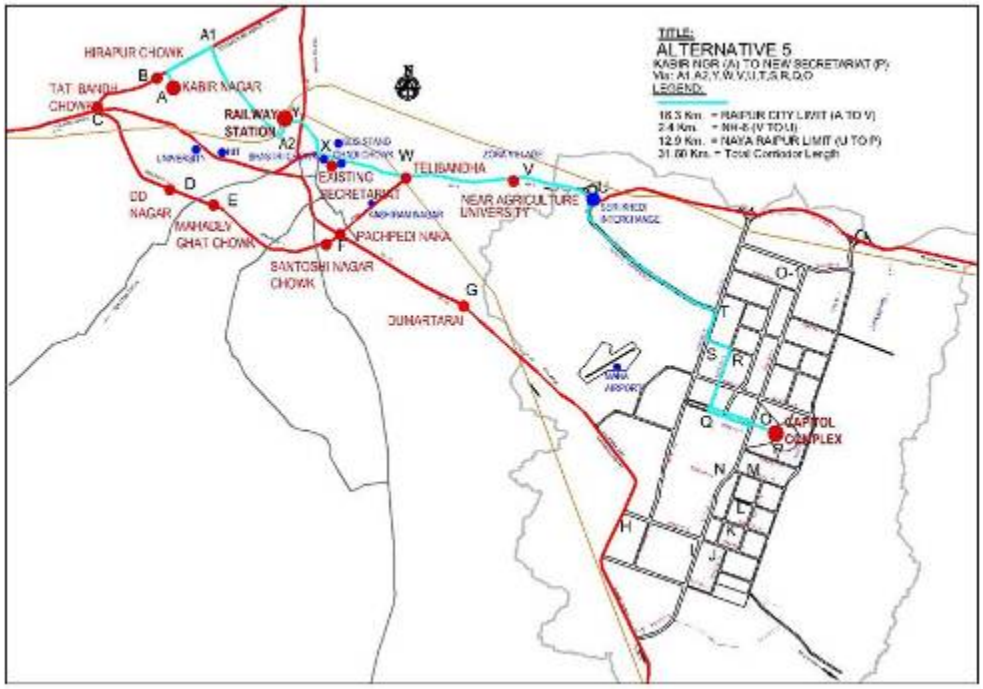
1. It does not cover major residential areas within Raipur such as Deen Dayal Upadhyay Nagar, Santoshi Nagar, Kanshiram Nagar.
2. The route passes through congested commercial areas
3. The route is characterised by mixed traffic

e. Alternative 5

This alternative connects Kabir nagar area with the Capitol complex in Naya Raipur through NH-53 . Route Characteristics are as follow:

a	Origin	Kabir Nagar, Raipur
b	Destination	Capitol Complex, Naya Raipur
c	Via	Railway Station, Telibandha, Near Agriculture University, Seri Khedi Interchange
d	Route Length	31.6 km

Sections of Route	**Length**
Raipur City limit	16.3 km
N.H Limit	2.4 km
NRDA Limit	12.9 km
Total	



Map : Alternative Route 5

The advantage and disadvantage of the route are given below

i. Advantages

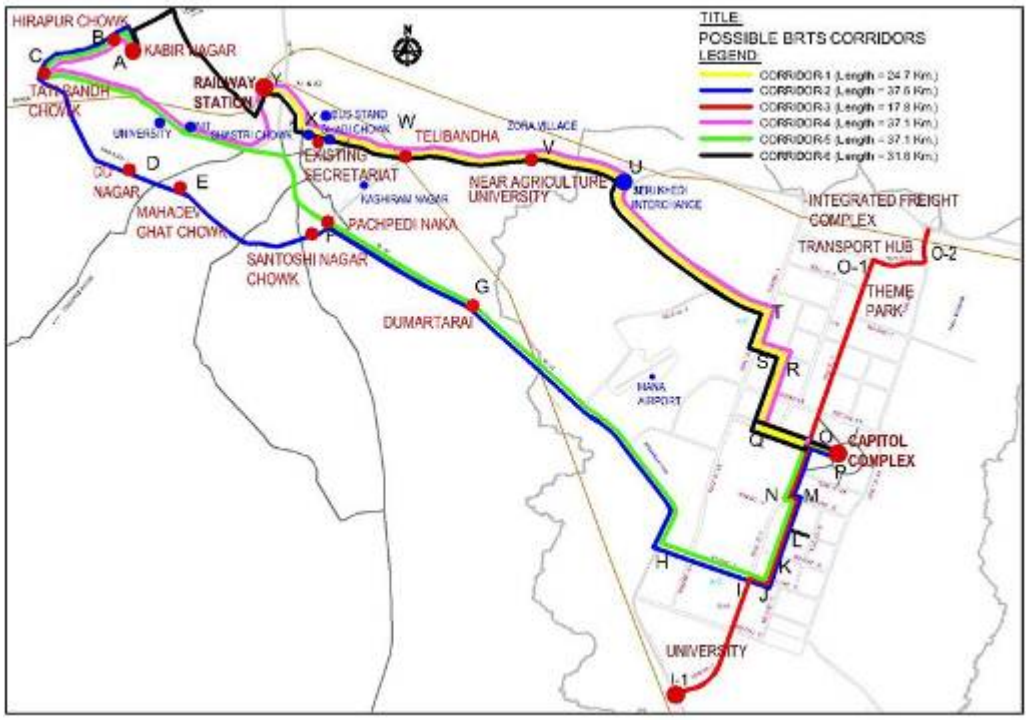
Major traffic generation like Kabir Nagar, existing Secretariat, Railway Station are served by a single route.

ii. Disadvantages

Existing ROW has varying width and is dominated by mixed traffic which may cause delay and congestions from Kabir Nagar to Railway Station.

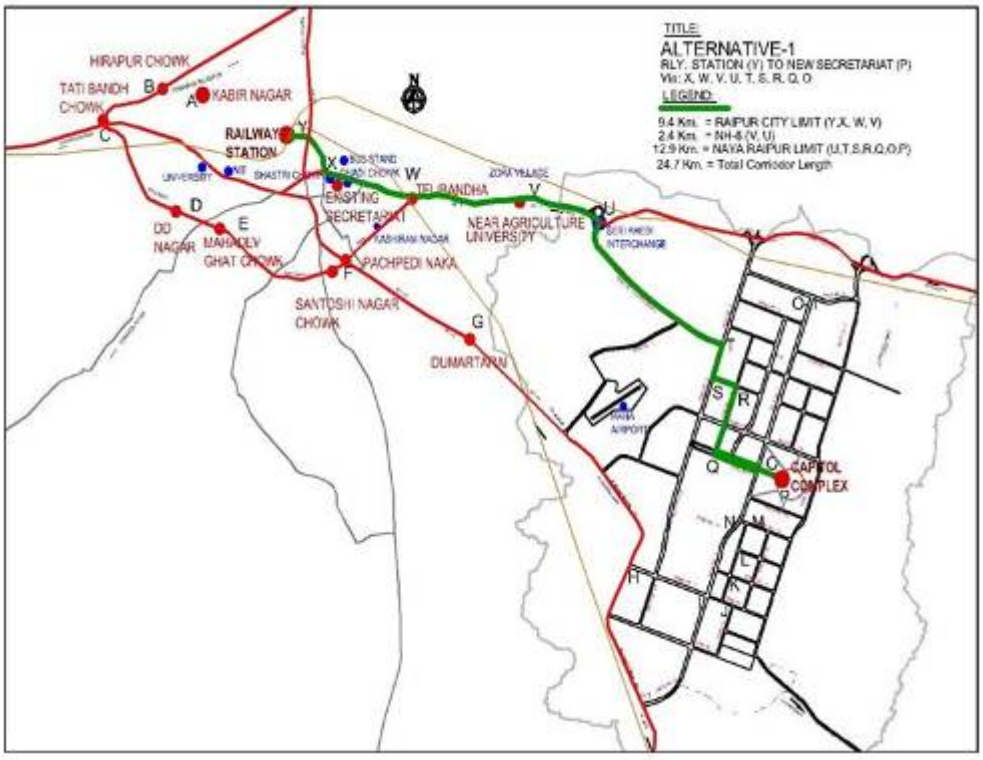
4.3.2 SELECTION OF APPROPRIATE BRT CORRIDOR:

The various options worked out are shown in the following map:

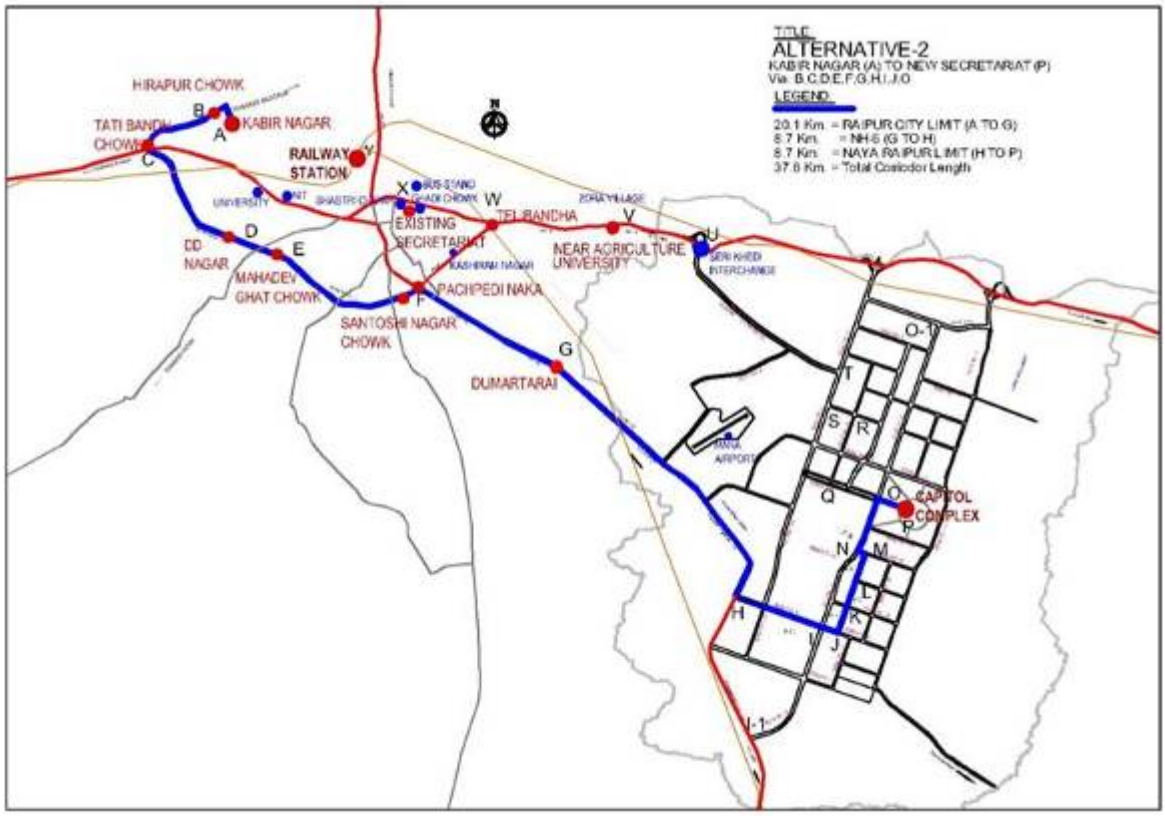


The purpose is to select route (s) which provides efficient connectivity by serving the demand between Raipur and Naya Raipur along with demand within the Naya Raipur which will arise in the subsequent years. However any single route is not able to cover all of demand nodes. In view of this, Out of the 5 options discussed, 2 Corridors have been selected based on their comparative advantages and disadvantages to serve the demand providing connectivity between Raipur and Naya Raipur with equity as well as to make the system sustainable. The selected Corridors are as follows:

A. **Corridor I:** The corridor can serve the regional level traffic by having its origin at railway station and Interstate Bus Station providing the connectivity to the daily commuters from the neighbouring cities. The reason for selecting this corridor above the others is that it is the only corridor which can be used to serve the demand of intercity passengers while maintaining the level of service. The selection of a complementary corridor takes care of the disadvantages off this corridor. The corridor length is 24.7 km (rounded of to 25 km).



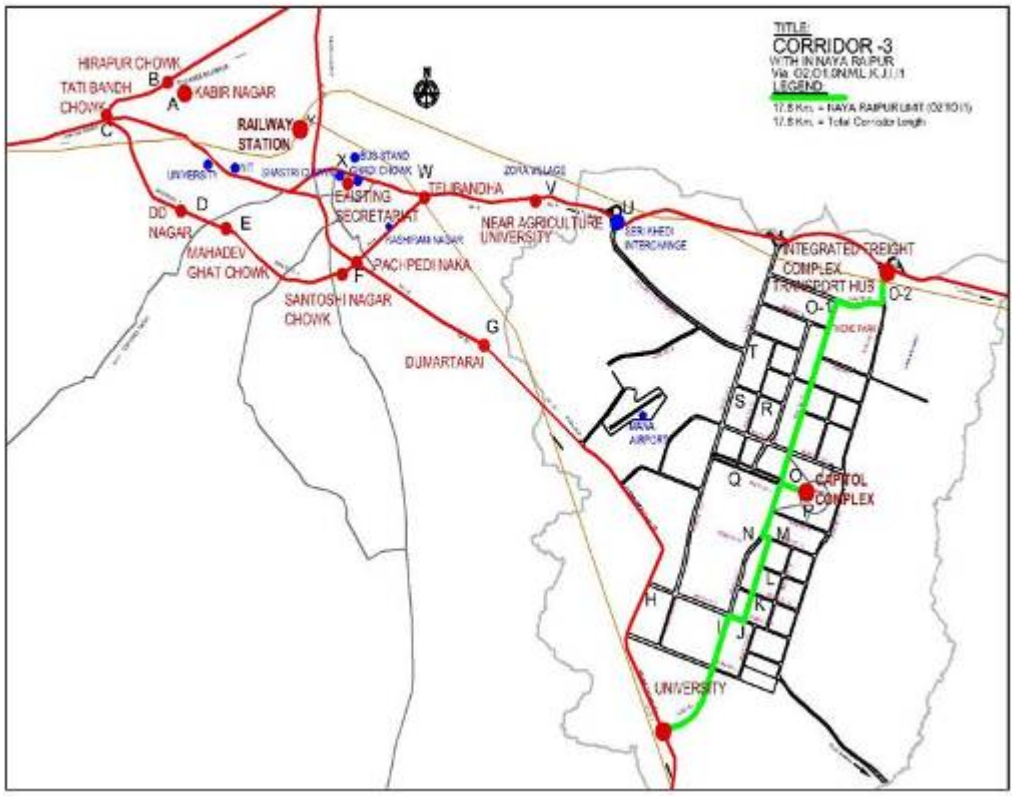
B. Corridor II: The second corridor selected is having the route length of 37.6 km (rounded off to 38 km) and covers the residential zones, majorly those in which the government employees reside. The corridor passes through the ring road, covers almost half periphery of the Raipur city. The disadvantages of this corridor are reduced by the selection of corridor I along with this corridor.



C. Corridor III: The Corridor III is selected keeping in view the future demand within Naya Raipur. Development of the residential zones in Naya Raipur will raise the demand in near future. This route serves the North-South the mobility covering the major points in Naya Raipur.

The Route Characteristics are as follow:

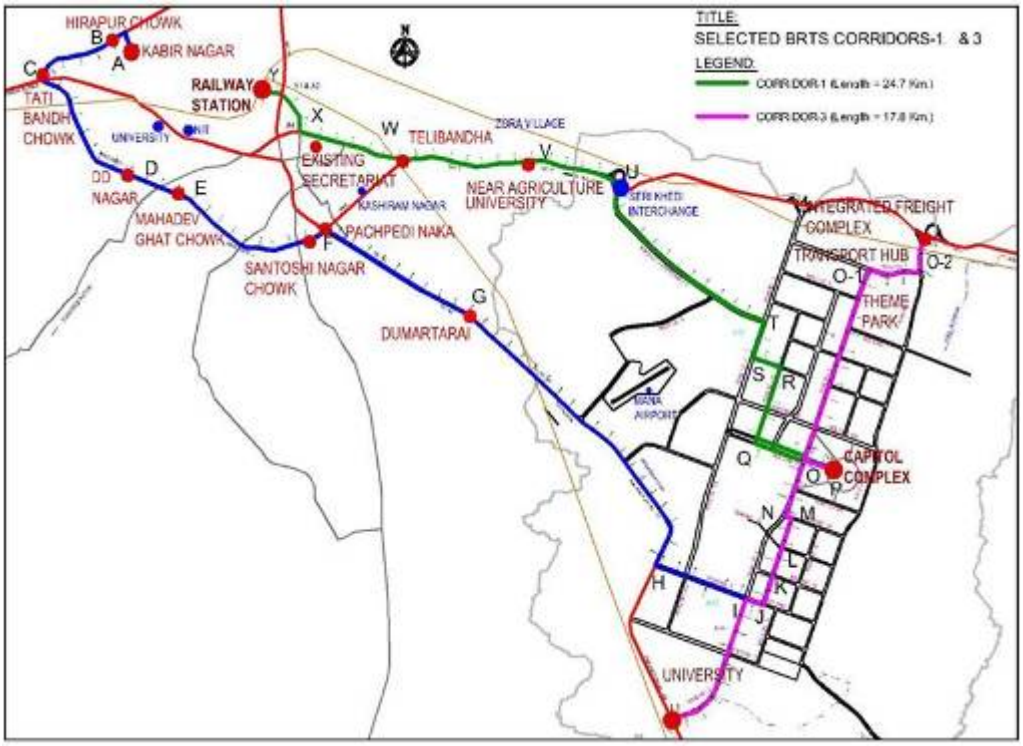
a	Origin	Within Naya Raipur
b	Destination	Within Naya Raipur
c	Via	Sports complex, Theme park, Community open spaces Residential zones, capitol complex, Botanical Park, University.
d	Route Length	17.8 km



Map : BRT Route in Naya Raipur

DISCRIPTION OF SELECTED CORRIDOR

The selected corridors are shown in the map below:



A. Origin Destination: The Origin and Destination of the selected corridors are shown below:

Table 4-4: Origin and Destination of the selected corridors

Bus Route	Corridor Length (km)	Origin (in Raipur)	Via	Destination (in Naya Raipur)	Linking Roads
Corridor I	25 km	Railway Station	Old Secretariat, Telibandha, Seri Khedi interchange	Capitol Complex	NH-53-Expressway
Corridor III	17.8	--	--	Within Naya Raipur	Road No. 2

4.3.3 BUS DEPOT AND NIGHT PARKING FACILITIES

A. Bus Depot

The depots generally have servicing and maintenance-workshop facilities, fuelling and night parking facilities. Three possible locations for the bus depot have been analyzed and rated as given below -

iv. Site (1): Near SIRD approach road junction at NH-30
v. Site (2): Amanaka depot at Raipur
vi. Site (3): Near junction of Road no 1 & Road no 3 in Naya Raipur

The rating of the three sites mentioned above based on comparative advantages and disadvantages are described in the table below.

Parameters	Scoring of alternative sites for different parameters		
	Site (1)	Site (2)	Site (3)
Land availability	Low	Low	High
Land Procurement	Low	Low	High
Facilitation for management	High	Low	High
Suitability in terms of congestion and habitation	Medium	Low	High
Suitability in terms of dead haulage	Low	High	Medium

Site No. 3 seems to be more suitable for development of the bus depot. A land area of about 37 Ha has been earmarked near the intersection of the Express way (Road no. 1) and Road No. 3 in Naya Raipur for development of a Bus Depot in

the Naya Raipur Development Plan 2031. However, for the present need, Bus Depot for 71 buses is proposed to be developed in a part of the land, in an area of 37270 sq m. The land is owned by NRDA. It is a tabled land having gentle slope. Sufficient land is available for future expansion. The site plan is given below:

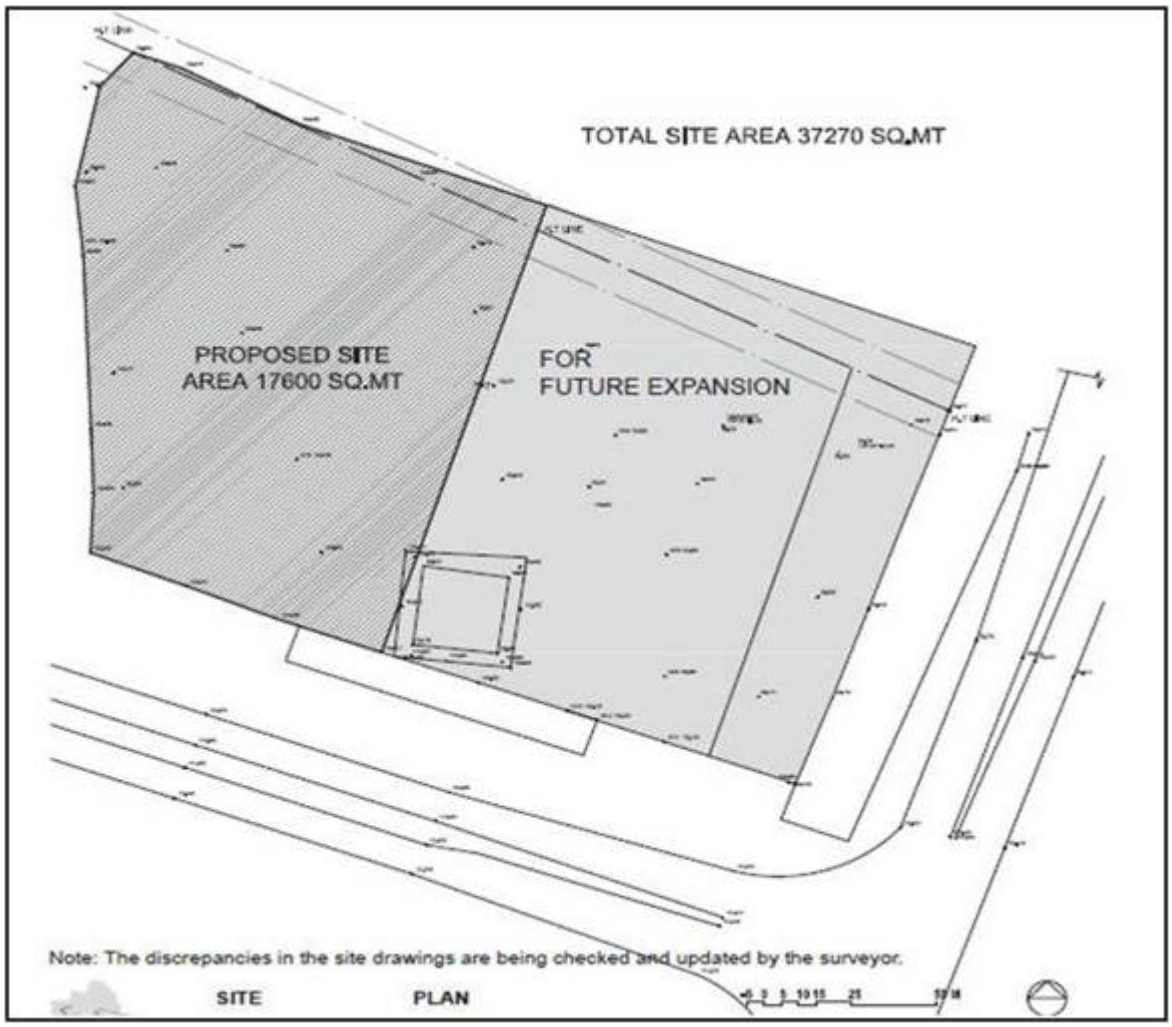


Figure: 4.1 Proposed Site for Bus Depot at Naya Raipur (Source : M/s Arya Architects)

The depot will be beneficial for night halt once population shifts to Naya Raipur, however initially it will be used for maintenance and repair workshop. In the initial phases since the buses will start from Raipur and night parking will be provided in Raipur itself. This depot should be sufficient for both corridors for the present plan, it may further be enlarged when the demand grown in future.

The depot, besides bus parking facilities shall provide bus washing facilities, minor repairing shed, refueling facilities, workers facilities such as waiting and resting areas, cleaning and changing rooms, lockers, dining facilities and Administration area for the Bus operator. NRDA shall construct the Bus depot and equip it with

maintenance facilities. It will be handed over to the selected Private bus operator for operation and maintenance during the concession period.

B. Night Parking Facilities in Raipur

In order to reduce dead haulage, existing Amanaka bus depot, presently being used for Raipur City buses shall be used for night parking of buses of Corridor II.

The parking space, in front of gate no. 4 of the existing Secretariat Building in Raipur, shall be used for night parking of buses of Corridor I.

4.4 CONTROL CENTRE

Basic application of Intelligent Transport System shall be used to achieve operational and managerial efficiency. Components of ITS shall include a GPS and GPRS/GSM Based Fleet Monitoring System, RFID for Flap Doors Passenger Information System at pick up points, Bus Shelters and on Buses and on web portal. A centralized Control Center at Bus Depot in Naya Raipur shall be established. A system integrator to operate and maintain the control center shall be selected through competitive bidding process.

Chapter-V

BASELINE ENVIRONMENTAL STATUS

To characterize existing baseline environmental and socio-economic conditions including establishing prevailing conditions primary monitoring, undertaking surveys, collection of secondary information from various published sources are adopted. This included the physical environment, biological environment and socio-economic environment.

- Understanding the assessment of environmental characteristics of the project area
- Assessing existing environmental attributes, as well as the environmental impact of future development;
- Identification of environmental c and developing mitigation measures.

5.1 METHODOLOGY OF CONDUCTING BASELINE STUDY

Components of physical environment like water, ecology, soil, air, socio-economic and noise quality in the surrounding areas were assessed primarily through field studies, and by undertaking monitoring and analysis of samples collected from the field. The potential impacts/mitigation measures for the attributes – Air, Noise, Water (surface & ground), Soil, Trees, Urban Ecosystems & Landscapes, Social Issues & Urban Infrastructure, Religious & Cultural Structures and Solid/Liquid Waste affecting the BRT route are discussed in detail in Chapter 5 & 6.

With interdisciplinary team discussions and professional judgment, the scoping and extent of data generation was formulated. The study area for undertaking baseline studies is taken as 10 km on either side of the road alignment.

Information about geology, hydrology, prevailing natural hazards like earthquakes, etc. is collected from literature reviews and authenticated information made available by government departments. Extensive surveys were carried out to understand and record the biological environment prevailing in the area and the

same was verified against published information and literature. The socioeconomic environment is studied through extensive consultations with various stakeholders with a strong focus on neighboring villages.

5.2 LOCATION OF THE STUDY AREA

Naya Raipur is located near the centre of large fertile plains of Chhattisgarh region and is situated between $21^0$12'6.108"N, $81^0$52'37.141"E to $21^0$13'56.718"N, $81^0$46'31.296"E and $21^0$03'13.481"N, $81^0$48'59.611"E to $21^0$06'57.204"N, $81^0$41'39.609"E. The proposed Naya Raipur City is situated in Raipur district of Chhattisgarh and occupies the South-Eastern part of upper Mahanadi basin. Raipur district is bounded on the North by Bilaspur & Janjgir Champa districts, on the South by Koraput district of Orissa state, on the East by Mahasamund, Raigarh and Orissa; and by Durg, Dhamtari, Kabirdham and Kanker on the West. Kharun River in the West forms the Western boundary of the district and Seonath & Mahanadi mark the Northern boundary with Bilaspur and Janjgir Champa districts.

5.3 CLIMATE AND METEOROLOGY

Primary data was collected for the summer season to understand the air quality of the region and to assess the impact on air environment. Air quality sampling was carried out at six locations in the study area, namely Dumar Tarai village, Serikheri village, Capital Complex, Nawagaon village, Palaud village and Uparwara village.

Raipur falls in the sub-tropical climatic region. The climate of the area is moderate and tropical, characterized by a hot summer from March to mid June, a humid monsoon or rainy season stretching from mid June to September, a short pleasant post-monsoon during October and November, and a cool winter spanning between December and February. Climatologically there are four seasons i.e. summer (pre-monsoon), monsoon, post-monsoon and winter.

A) Meteorological Data

Table 5 shows climatological summary for Raipur.

TABLE 5.1 : CLIMATOLOGICAL SUMMARY FOR RAIPUR (2009)

Month	Mean Max. Temperature (°C)	Mean Min. Temperature (°C)	Relative Humidity	Total Rainfall (mm)	Mean Wind Speed (m/s)
January	35.0	14.4	52.4	0.0	0.6
February	37.8	15.4	38.3	0.0	0.8
March	40.0	19.6	32.4	0.0	0.8
April	44.0	21.0	25.1	2.1	1.0
May	45.8	24.6	31.3	4.9	1.7
June	43.8	23.8	45.0	25.8	2.7
July	33.6	24.0	81.6	571.8	3.1
August	34.6	23.4	79.8	246.4	1.9
September	36.2	24.0	75.6	66.4	1.3
October	34.0	16.0	67.7	20.1	0.6
November	33.6	12.8	68.4	10.5	0.8
December	30.4	12.4	62.9	0.3	0.3
Average/ Total	**37.4**	**19.3**	**55.0**	**948.3**	**1.3**

Source: IMD Pune

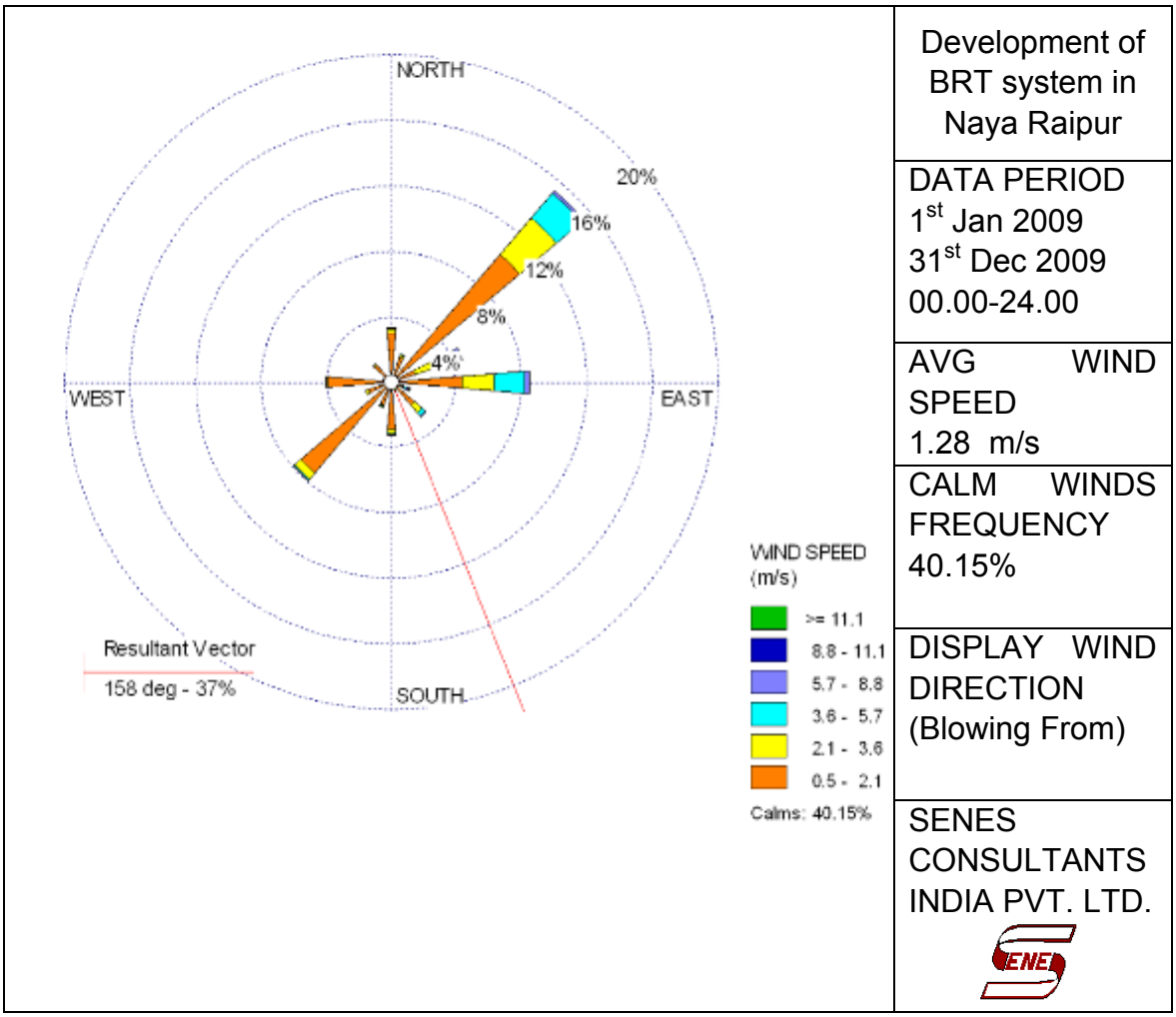
B) Long Term Climate Trends

Long-term climate trend data was obtained for Raipur station from Indian Meteorological Department (IMD). The region is characterized by dry and warm climate. Summers are very hot which commences from March to mid-June. Winter witnesses cold waves between the months of October and February. Monsoon starts mid June and lasts till the end of September. The mean monthly average maximum and minimum temperature in winter i.e. in the month of January is about 27 and 13 °C respectively. Whereas, mean monthly average maximum and minimum temperatures in summer i.e. in the month of May are about 42 and 28 °C respectively. The relative humidity during South-West monsoon season is over 75 % but sometimes it goes to 100 %. During winter season, air is fairly dry. Rain is predominant during July and August. On an average, there are 61 rainy days in a year. The Raipur District receives 87.1 % of the total rainfall from the South-West monsoon during June to September. The winter–rainfall accounts for 9 % of the total rainfall. During the monsoon season, the maximum rainfall occurs during the months of July and August. Over the course of a year, wind usually blows in all directions, with varying frequencies. On an average, over the course of a year, the prevailing winds are from the North and Northeast direction.

The long-term climate trend of secondary data collected for the IMD station located in Raipur over a period of 1951-1980; as well as the decadal trend of secondary data collected from IMD Pune (1993-2002) is provided in **Annexure – II**.

Wind rose summarizes a considerable amount of wind frequency information into a single graphic and is shown in Figure (annual for 2009).

FIGURE 5.1 : WIND ROSE RAIPUR (ANNUAL FOR 2009)



The annual wind rose diagram (IMD Raipur-42875) reveals that wind was blowing predominantly from the Northeast direction. The onsite average wind speed was observed 1.28 m s^{-1} with frequency of calm winds 40.15% during the monitoring period. The annual predominant wind direction is north easterly.

5.4 ENVIRONMENTAL ATTRIBUTES

5.4.1 Air

Site–specific Background Air Quality Monitoring

A site specific background air quality monitoring program was conducted for one season (pre monsoon season). Background data was collected for SPM, RSPM, SO_2, NO_x and CO. The general guidelines for the site selection are provided in the footnote[2] below.

Six sampling stations were located in the study area to provide the surrounding baseline air quality. The details of monitoring locations are specified in Table 5-2 and Figure 5-2.

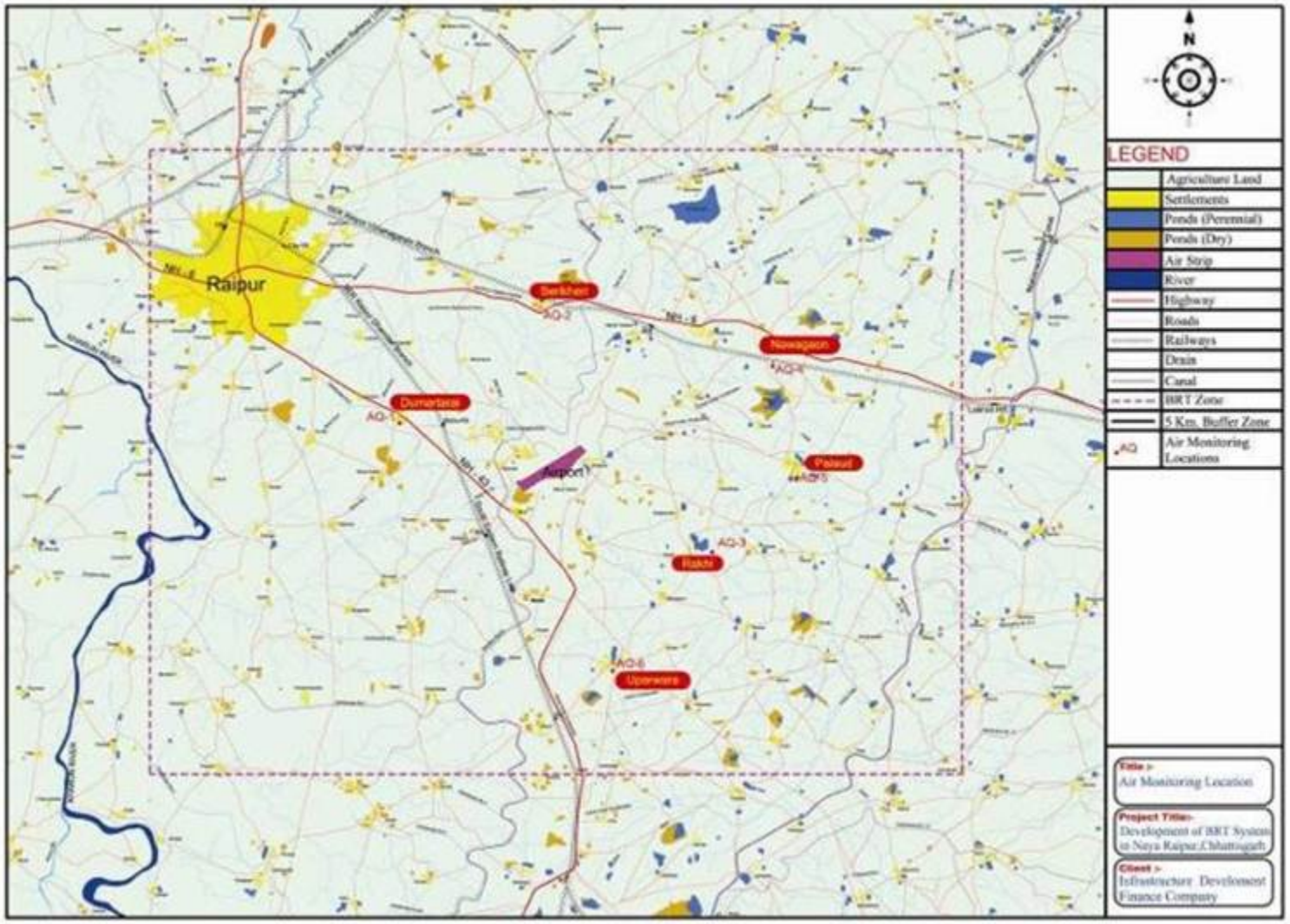
TABLE 5.2 : MONITORING LOCATIONS

Monitor	Description	Land Use
AQ1	Dumar Tarai Village	Residential
AQ2	Serikheri Village	Residential
AQ3	Capital Complex	Institutional
AQ4	Nawagaon Village	Residential
AQ5	Palaud Village	Residential
AQ6	Uparwara Village	Residential

[2] ***General Guidelines for Site Selection***

Siting guidelines refer to the environs surrounding a measurement location, and these differ depending on the zone representation intended for a specific monitoring site. Large nearby buildings and trees extending above the height of the monitor may present barriers or deposition surfaces. Certain trees may also be sources of PM in form of detritus, pollen, or insect parts. These can be avoided by locating samplers by placing them more than 20m from nearby trees, and twice the difference in elevation difference from nearby major buildings or other obstacles. The background monitoring sites should be located at more than 10km from large population centres, and more than 100m from roads and wood burning.

FIGURE 5.2 : AIR MONITORING STATIONS



As per standard methodologies and accepted protocols, as detailed by the MoEF the background-monitoring program was carried out.

Monitoring was conducted in pre-monsoon season of the year 2009. Monitoring results (observed levels and ranges) of SPM, RSPM, SO_2, NO_x and CO are presented in the Table 5-3 to Table 5-8**.**

TABLE 5.3 : MONITORING PROGRAM RESULTS – AQ1

Units: $\mu g/m^3$

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	126.4	114.6	102.8	200
RSPM	30.3	26.3	22.4	100
SO_2	13.9	12.9	11.8	80
NO_x	16.4	15.6	14.8	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 5.4 : MONITORING PROGRAM RESULTS – AQ2

Units: $\mu g/m^3$

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	96.7	92.5	88.3	200
RSPM	21.4	19.9	18.4	100
SO_2	11.8	10.8	9.8	80
NO_x	16.9	15.2	13.6	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 5.5 : MONITORING PROGRAM RESULTS – AQ3

`

Units: $\mu g/m^3$

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	166.4	151.5	136.6	200
RSPM	36.2	31.3	26.4	100
SO_2	14.8	13.5	12.2	80
NO_x	17.2	16.3	15.4	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 5.6 : MONITORING PROGRAM RESULTS – AQ4

Units: $\mu g/m^3$

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	88.3	82.5	76.8	200
RSPM	20.3	19.5	18.8	100
SO_2	11.6	11.0	10.4	80
NO_x	14.4	14.0	13.6	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 5.7 : MONITORING PROGRAM RESULTS – AQ5

Units: $\mu g/m^3$

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	102.4	96.0	89.6	200
RSPM	24.6	22.6	20.6	100
SO_2	13.8	12.7	11.6	80
NO_x	17.4	16.3	15.2	80
CO	< 1.0	< 1.0	< 1.0	2000

TABLE 5.8 : MONITORING PROGRAM RESULTS – AQ6

Units: $\mu g/m^3$

Parameter	Monitoring results			NAAQS
	Maximum	Average	Minimum	
SPM	114.4	102.5	90.6	200
RSPM	25.4	22.9	20.3	100
SO_2	13.2	12.4	11.6	80
NO_x	16.9	16.1	15.3	80
CO	< 1.0	< 1.0	< 1.0	2000

With respect to pollutants, the results of the monitoring program indicate the following:

- The observed SPM and RSPM levels are within the NAAQS at all locations.

- NO_X and SO_2 concentrations are well within the specified standards at all the monitored locations.
- CO concentration is also within the specified standards at all the monitored locations.

5.4.2 Noise Environment

Ambient Noise Quality

Site-Specific Background Noise Quality Monitoring

Noise monitoring was conducted at eight locations within the study area .The background-monitoring program was done in accordance with the requirements of an EIA study. Sound pressure level (SPL) measurements were automatically recorded to give the noise level for every hour continuously for 24 hours in a day.

Accordingly one full day (i.e. 24 hourly values) of data was collected at each of the eight locations. These monitoring locations are set out below**.**

TABLE 5.9 : AMBIENT NOISE MONITORING STATIONS

Monitor	Description	Category
N1	Dumar Tarai	Residential
N2	Serikheri	Residential
N3	Capital Complex	Commercial
N4	Nawagaon Village	Residential
N5	Palaud	Residential
N6	Uparwara	Residential
N7	Mana	Residential
N8	National Highway 43	Commercial

Table 4-10 provides equivalent noise levels viz., L_{eqday} and $L_{eqnight}$, at the noise monitoring locations, alongside noise standards as prescribed by the CPCB. L_{eq} was calculated using the following equation:

$$L_{eq,T} = 10\log\left(1/n\sum_{i=1}^{n}10^{\frac{L_i}{10}}\right)$$

Where L_i = levels observed at n equally spaced times during interval T.

TABLE 5-1 : MONITORING PROGRAM RESULTS – NOISE

Location	Day Time[3]		Night Time[4]	
	Leq (dB (A))	Limit Leq (dB (A))	Leq (dB (A))	Limit Leq (dB (A))
Serikheri	43.3	55	39.0	45
Capital Complex	56.1	65	49.1	55
Navagaon Village	44.0	55	38.6	45
Dumar tarai	46.8	55	41.1	45
Palaud	44.8	55	38.8	45
Uparwara	44.4	55	39.1	45
Mana	46.9	55	40.6	45
NH-30	54.9	65	45.6	55

[2] *Daytime shall mean from 6.00 a.m. to 10.00 p.m.*
[3] *Night time shall mean from 10.00 p.m. to 6.00 a.m*

The results of the monitoring program indicate that both daytime and nighttime levels of noise are within AAQSRN limits at all the 8 locations surveyed.

5.4.3 Water Environment

5.4.3.1 Baseline Water Quality & Sampling Locations

To establish baseline water quality in the project area water sampling and analysis was conducted, following standard guidelines for physical, chemical and bacteriological parameters, though they are not getting affected due to project. Five ground water and surface water samples were evaluated in the study area. Table 5-11 & Table 5-12 give details of the ground water and surface water sampling stations. The sampling locations are also depicted in Figure .

Noise Standards:

Area Code	Category of Area/Zone	Limits in dB (A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

TABLE 5.11 : GROUNDWATER QUALITY MONITORING LOCATIONS

Station No.	Description
GW - 1	Rakhi
GW - 2	Navagaon
GW - 3	DumarTarai
GW - 4	Uparwara
GW - 5	Palaud

TABLE 5.12 : SURFACE WATER QUALITY MONITORING LOCATIONS

Station No.	Description
SW - 1	Rakhi
SW - 2	Navagaon
SW - 3	DumarTarai
SW- 4	Uparwara
SW-5	Palaud

Table 5-13 shows the physicochemical characteristics of composite ground water sampling in the selected areas as compared with the standard (IS 10500: Indian Standards/Specifications for Drinking Water) reference values. Table 5-14 shows the physicochemical characteristics of surface water samples as compared to CPCB Standards for Class “C” water i.e. water to be used for drinking after conventional treatment followed by disinfections.

FIGURE 5.3: WATER SAMPLING LOCATIONS

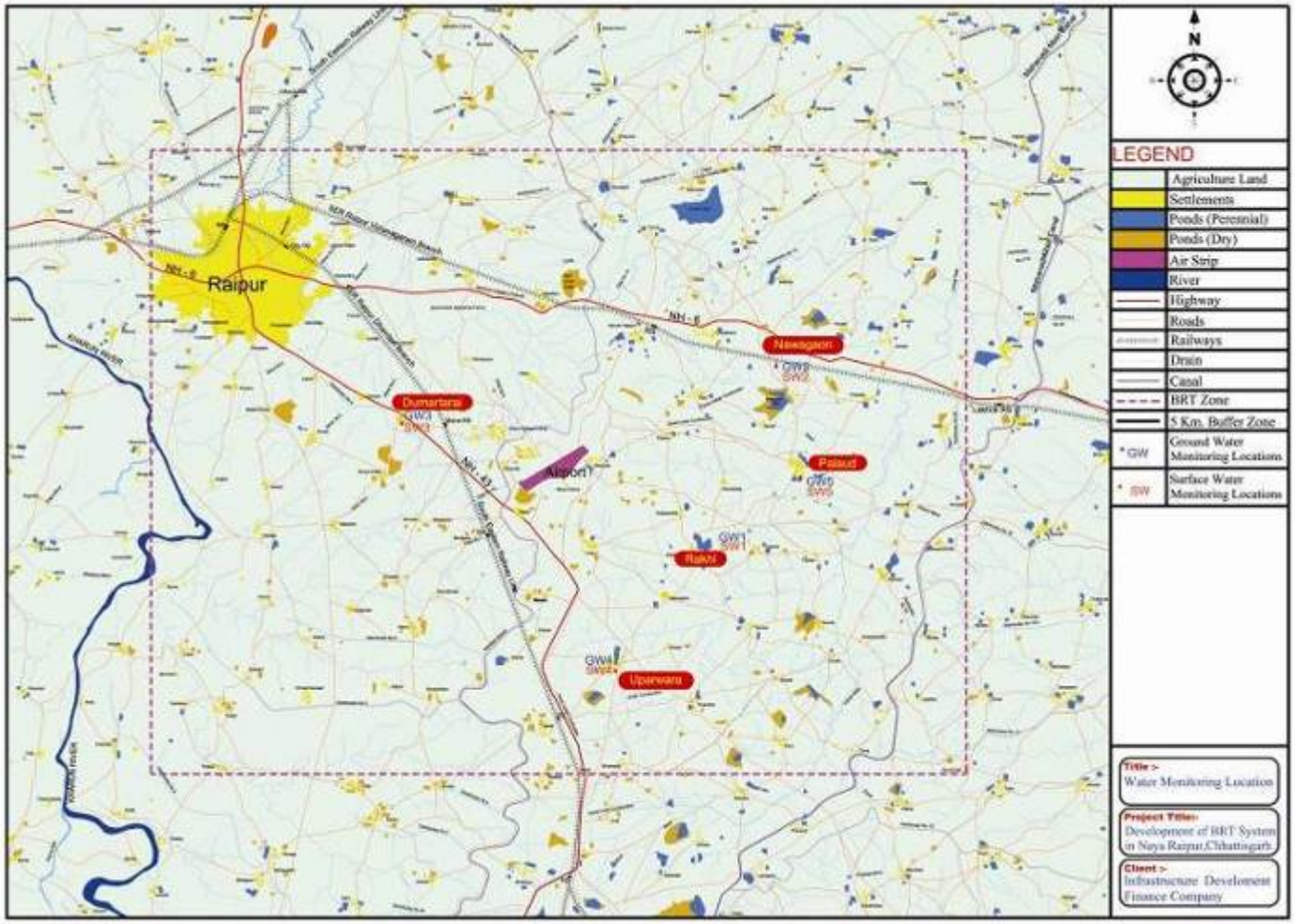


TABLE 5.13 : GROUND WATER TEST RESULTS AS PER IS: 10500

S. N	Parameter	Units	GW-1	GW-2	GW-3	GW-4	GW-5	Desirable Limits as per IS: 10500	Permissible Limits as per IS: 10500
1	pH	-	7.34	7.48	7.22	7.52	7.66	6.5 – 8.5	NR
2	Color	Hazen	04	03	04	03	04	<5	<25
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	-
4	Odor	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	-
5	Conductivity	µs/cm	542	566	1160	488	328	--	--
6	Turbidity (NTU)	NTU	1.60	1.30	2.30	1.30	1.20	<5	<10
7	Total Dissolve solids	mg/L	336	358	738	306	206	<500	<2000
8	Total Hardness as $CaCO_3$	mg/L	216	208	320	184	104	<300	<600
9	Total Alkalinity	mg/L	200	220	360	180	120	<200	<600
10	Calcium as Ca	mg/L	64	64	96	57	26	<75	<200

S. N	Parameter	Units	GW-1	GW-2	GW-3	GW-4	GW-5	Desirable Limits as per IS: 10500	Permissible Limits as per IS: 10500
11	Magnesium as Mg	mg/L	13	12	19	10	09	<30	<100
12	Residual Chlorine	mg/L	Nil	Nil	Nil	Nil	Nil	<0.2	-
13	Boron	mg/L	0.20	0.30	0.60	0.50	0.40	<1.0	<5
14	Chloride as Cl	mg/L	21	25	106	18	21	<250	<1000
15	Sulphate as SO_4	mg/L	27	18	47	28	09	<200	<400
16	Fluorides as F^-	mg/L	0.80	0.50	1.70	0.50	0.40	<1.0	<1.5
17	Nitrates as NO_3	mg/L	06	05	14	06	03	<45	<100
18	Sodium as Na	mg/L	23	32	115	24	25	--	--
19	Potassium as K	mg/L	02	03	06	02	02	--	--
20	Phenolic Compounds	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
21	Cyanides	mg/L	ND	ND	ND	ND	ND	<0.05	NR

S. N	Parameter	Units	GW-1	GW-2	GW-3	GW-4	GW-5	Desirable Limits as per IS: 10500	Permissible Limits as per IS: 10500
22	Anionic Detergents	mg/L	ND	ND	ND	ND	ND	<0.2	<1.0
23	Mineral Oil	mg/L	ND	ND	ND	ND	ND	<0.01	<0.03
24	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	<0.01	NR
25	Arsenic as As	mg/L	ND	ND	ND	ND	ND	<0.01	NR
26	Copper as Cu	mg/L	0.052	0.048	0.059	0.040	0.050	<0.05	<1.5
27	Lead as Pb	mg/L	0.03	0.02	0.04	0.04	0.04	<0.05	NR
28	Manganese as Mn	mg/L	0.10	0.12	0.22	0.18	0.15	<0.1	<0.3
29	Iron as Fe	mg/L	0.12	0.18	0.24	0.26	0.24	<0.3	<1.0
30	Chromium as Cr^{6+}	mg/L	ND	ND	ND	ND	ND	<0.05	NR
31	Zinc as Zn	mg/L	3	2	4	3	2	<5	<15
32	Aluminum as Al	mg/L	ND	ND	ND	ND	ND	<0.03	<0.2

S. N	Parameter	Units	GW-1	GW-2	GW-3	GW-4	GW-5	Desirable Limits as per IS: 10500	Permissible Limits as per IS: 10500
33	Mercury as Hg	mg/L	ND	ND	ND	ND	ND	<0.001	NR
34	Pesticides	mg/L	Absent	Absent	Absent	Absent	Absent	Absent	<0.001
35	E-coli	MPN / 100 ml	Absent	Absent	Absent	Absent	Absent	Absent	--

ND = Not Detectable NR= No Relaxation

TABLE 5.14 : SURFACE WATER QUALITY WITHIN STUDY AREA

S.N	Parameter	Units	SW-1	SW-2	SW-3	SW-4	SW-5	IS:2296 standards
1	pH	-	6.88	7.28	6.98	6.99	6.92	6.5 – 8.5
2	Color	Hazen units	07	09	08	10	09	300
3	Conductivity	μs/cm	469	486	1596	836	848	--
4	Dissolved Oxygen	mg/L	5.10	5.30	4.80	5.30	5.10	> 4.0
5	BOD (3 days at 27^{o}C)	mg/L	06	08	12	10	08	< 3.0
6	Total Dissolved Solids	mg/L	296	308	988	524	536	<1500
7	Total Hardness	mg/L	120	128	520	128	124	--
8	Chloride as Cl	mg/L	35	21	255	85	128	<600
9	Fluorides as F^{-}	mg/L	0.50	0.50	1.90	1.30	1.40	<1.5
10	Sulphate as SO_4^{--}	mg/L	16	36	105	139	72	<400
11	Alkalinity	mg/L	160	160	300	140	160	--
12	Nitrates as NO_3	mg/L	04	06	18	11	05	--
13	Cyanides as CN	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
14	Calcium as Ca	mg/L	29	35	85	32	29	--
15	Magnesium as Mg	mg/L	12	11	18	11	13	--
16	Sodium as Na	mg/L	51	48	167	129	133	--
17	Potassium as K	mg/L	02	03	06	06	06	--
18	Iron as Fe	mg/L	2.1	3.5	4.5	1.8	1.9	<50

S.N	Parameter	Units	SW-1	SW-2	SW-3	SW-4	SW-5	IS:2296 standards
19	Chromium as Cr	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	<0.01
21	Lead as Pb	mg/L	0.06	0.09	0.08	0.08	0.06	<0.1
22	Copper as Cu	mg/L	0.60	0.70	0.80	0.50	0.40	<1.5
23	Arsenic as As	mg/L	ND	ND	ND	ND	ND	<0.2
24	Selenium as Se	mg/L	ND	ND	ND	ND	ND	<0.05
25	Phenolics as C_6H_5OH	mg/L	Nil	0.002	0.004	0.004	0.004	<0.005
26	Zinc as Zn	mg/L	06	08	10	06	08	<15
27	Mercury as Hg	mg/L	ND	ND	ND	ND	ND	--
28	Aluminum as Al	mg/L	0.02	0.03	0.04	0.05	0.04	--
29	Anionic detergents as MBAS	mg/L	0.4	0.5	0.5	0.4	0.3	<1.0
30	Oil and grease	mg/L	0.2	0.6	0.8	0.6	0.2	<0.1
32	Insecticides	mg/L	Absent	Absent	Absent	Absent	Absent	Absent

ND = Not Detectable

Various parameters of ground water and surface waters were tested and the results found are discussed hereunder:

Ground water: At Rakhi village all the parameters are under the desirable limits as per IS:10500, at Navagaon village manganese and Total Alkalinity is found a bit higher than desirable limits as per IS:10500 but it is less than the permissible limits prescribed by IS:10500. Water sample at Dumartarai were found a bit higher in Manganese, TDS, total hardness as $CaCO_3$, Total Alkalinity, Calcium and Fluorides but still these are under the permissible limits prescribed by IS:10500. Uparwara and Palaud were found a bit higher in Manganese yet under the permissible limits prescribed.

Surface water: All the parameters tested at all the five sites, namely Rakhi, Navagaon, Dumartarai, Uparwara and Palaud were found under the permissible standards prescribed by IS: 2296 except for Biochemical Oxygen Demand which was higher at all the five sites, this may be attributed to the Organic substances present in waters though these were also under the standards prescribed by CPCB for disposal of waters into surface water bodies as per the relevant acts.

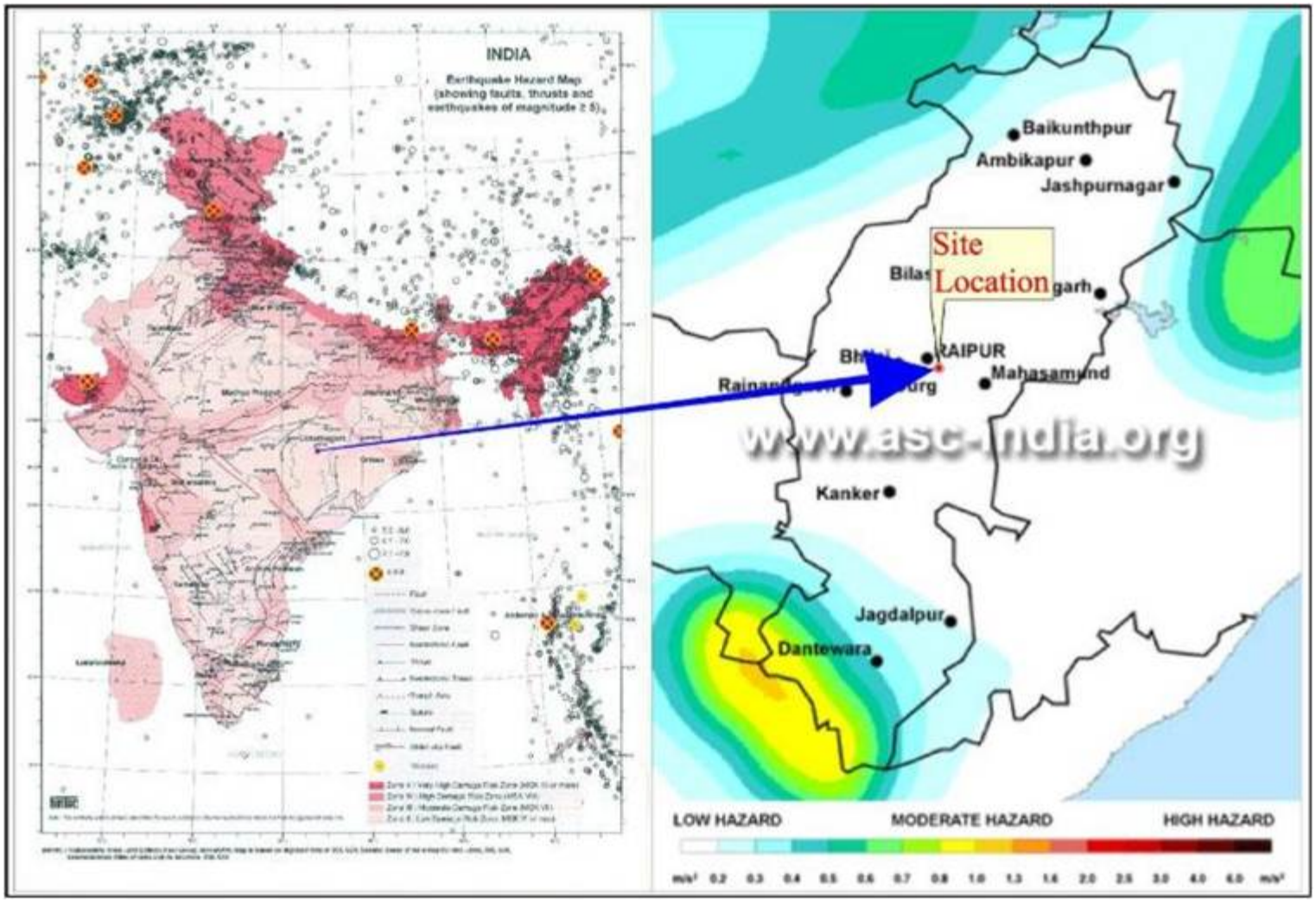
5.5 LAND ENVIRONMENT

5.5.1 Seismo-Tectonic Appraisal of the Area

Chhattisgarh has very low rates of seismic activity. In recent years, tremors from earthquakes in neighboring states are felt, most notably in 1969. Minor seismic activity was recorded in the vicinity of Chiraikund and Muirpur along the border with Madhya Pradesh. A few faults which form the eastern section of the Narmada-Son Fault Zone have shown movement during the Holocene epoch. Another active fault is the Tatapani Fault which trends in an East-West direction in the vicinity of Mainpur in Sarguja district. In the south, the active Godavari fault forms the Northern flank of the Godavari Graben and runs through the southern part of the state.

The project site is located in the central India which is a seismically low region, as depicted in the figure below. Raipur falls under zone II category of seismic zone (i.e. having low seismic intensity) and therefore has a low risk of potential damage due to earthquake.

FIGURE 5.4: SEISMIC MAP OF AREA



5.6 Soil

Soil sampling was done to establish the baseline characteristics and to assess the anticipated impacts due to proposed project. Soil samples are collected using auger from a depth of 60 cm.

Detail about the types of soil in Chhattisgarh state is given in **Annexure – IV**.

TABLE 5.15 : SOIL SAMPLING LOCATIONS

S.No	Station No.	Description
1	S - 1	Capital Complex
2	S - 2	Navagaon

A quantitative assessment of the particle size distribution in the soil was made by wet sieve analysis and sedimentation analysis using hydrometer, as per procedures laid down in IS: 2720 Part IV. The particle sizes[5] were designated according to the scale given in IS: 1498.

The three major type of soil are – (a) sands, which have at least 70% sand and less than 15 % clay (b) clay, which have more than 40 % clay content (c) loam, which is a mixture of sand silt and clay. The soil test results are tabulated below in Table 4-16Table 5.

TABLE 5.16: SOIL CHARACTERISTICS OF THE STUDY AREA

S. N	Parameter	S1	S2
1	Texture	Clay	Clay
a	Sand (%)	18	14

[5] Particle size scale (IS: 1498)

Soil Type	Texture	Particle Size
Gravel	Coarse	20 – 80 mm
	Fine	4.75 – 20 mm
Sand	Coarse	2.0 – 4.75 mm
	Medium	0.425 – 2.0 mm
	Fine	0.075 – 0.425 mm
Silt & Clay	-	Less than 0.075 mm

S. N	Parameter	S1	S2
b	Silt (%)	34	28
c	Clay (%)	48	58
2	pH	7.50	7.24
3	EC (us/cm)	224	212
4	Bulk Density (g/cc)	1.12	1.08
5	SAR	1.30	1.22
6	Available Nitrogen (kg/ha)	198	166
7	Available P as PO_4 (kg/ha)	36	28
8	Available K (kg/ha)	148	180
9	Exchangeable Ca (meq/100g)	2.60	2.90
10	Exchangeable Mg (meq/100g)	1.20	1.40
11	Exchangeable Na (meq/100g)	3.40	2.90
12	Organic Carbon (%)	0.80	1.10
13	Manganese (meq/100g)	0.10	0.18
14	Zinc (meq/100g)	5.10	5.50
15	Boron (meq/100g)	0.20	0.28

Clayey soils are found in the area with bulk density of two samples as 1.08 and 1.12 g/cc respectively. Soil of the area is neutral to slightly alkaline with pH ranging from 7.2 to 7.5. Most crops grow best if the soil pH range is 6.0 to 7.5. Soluble salts expressed in terms of electrical conductivity of saturation extract of the different soil (ECe) samples are 224 and 212 µmhos/cm respectively. The Organic carbon percentages of the two samples are found to be 0.80 and 1.10 respectively. The analysis of the sample shows that SAR of the two soil samples studied is 1.30 and 1.22 milliequivalent /Kg respectively.

5.7 ECOLOGICAL ENVIRONMENT

The ecological survey is done to establish the baseline ecological conditions within study area to assess the potential ecological impacts of the proposed project on ecology, to develop adequate and feasible mitigation measures (via inputs to project design and layout, working practices, or compensate where appropriate) to keep ecological impacts within acceptable limits, and to prepare comprehensive management plan.

The proposed capitol complex and BRT construction is located in plain rural areas, where the agricultural ecosystem predominate in the regional ecological structure. The aquatic biodiversity is very less in the region.

The project is a linear green field project and does not passes through any sensitive Ecological Environment. Most of the area passes through barren and agricultural land. Trees falling in the corridor are actual counted and marked, recorded by the Forest Department and other ecological parameters are occulariliy adjudged being insignificant in the area of interest.

5.7.1 Forest Area and Terrestrial Ecology

There is no legal forest area involved in the area of interest of the BRTS Project. The forest area is at about 40 km. aerial distance from the project site. The trees in plantation done by the private person and naturally growing trees on the bunds of agricultural fields falls in the project area. These are actually counted by the Forest Department and Recorded in the Marking Book. Only 478 trees are found and recorded in BRTS corridor.

Identification of flora falling within the indirect impact i.e. within 10 km. radius, was conducted based on sample plot method along the proposed BRTS corridor, villages, and open field (agricultural field and waste land) in the study area. There is uniformity in patterns of distribution and growth. Majority of the species reported are common type, with growth along bunds, waste land and very less in agricultural field. Extensive growths of aquatic weeds are noticed where water logging or moisture are present. The overall biodiversity in study area is low due to barren land, similarity in species distribution and poor growth.

Floral Profile along Existing National Highway

The floral profile of the existing highway witness growth of weeds like *Aristida purpurea, Erianthus munja* and *Lantana camara.* These weeds had permanently replaced grasses covering lower strata. Dried twigs of *Paranthenium hysterophorus*, *Heteropogon contortus*, *Datura stramonium, Chenchrus cilitaris* etc. are also noticed in agricultural waste land or uncultivated land adjacent to National Highway. Among trees recorded, higher frequency of *Albizzia Lebback*, *Euclyptus sp., Dalbergia sissoo, Acacia catechu, Azadirachta indica,* Bamboo

(*Dendrocalamus strictus*), (Bambuaa aroumdinacea), wild dates (*Phoenix sylvestris*) *etc.* are noticed.

Agricultural Field

Trees within agricultural field bunds and in small patches up to 0.1 hector in area are considered as farm forest. Majority of species reported in farm forest are naturally grown and few are planted. The planted species recorded in farm forest are Sagwan (*Tectona grandis*), Eucalyptus (*Eucalyptus sp*), Drum stick (*Moringa oleifera*), Neem (*Azadirachta indica*), Mahua (*Madhuca indica*), Ambla (*Emblica officinalis*), Cashew nut (*Anacardium occidentale*), Mango (*Mangifera indica*), The naturally growing species are Jamun (*Syzygium cumini*), Peepal (*Ficus religiosa*), Bargad(*Ficus bengalensis*), Bair (*Zizypus maurutiana*), Babul (Acacia nilotica), Wild dates (*Phoenix sylvestris*), *Prosopis sp.*, Bail (*Aegle marmelose),* Arjun (*Terminalia arjuna*), Jharber (*Zizyphus numularia*), Gamhar (*Gmelina arborea*) etc

Photo 5-1 : Trees on Agricultural Field Bunds along Road No. 2

Weeds recorded in the agricultural field bunds are Calotropis (*Calotropis procera*), Lantana (*Lantana camara*), Bahia (*Ipomea carnea*), *Cenchrus ciliaris, Saceharim spontaneum, Saccharum munja, Aristida depressa, Heteropogon contortus, Parthenium hysterophorous,* etc

Village Plantation

Natural and planted trees on community or private land are considered as Village Woodlot. During the 70s and 80s decades, government land and private lands are brought under the USAID project and Social Forestry project. Under these projects, Eucalyptus (*Eucalyptus sp*.), Ambla (*Emblica officinalis*) are planted. Mango (*Mangifera indica*), Bamboo (*Dendrocalamus strictus*), (Bambuaa aroumdinacea),

Peepal (*Ficus religiosa*), Neem (*Azadirachta indica*), Banyan tree (*Ficus bengalensis*), Sissoo (*Dalbergia sissoo*), Teak (*Tectona grandis*), Mahua (*Madhua indica*) bamboo sp, Jamun (*Syzygium cumini*), etc are either naturally grown or planted a few.

Photo 5-2 : Village plantation along Road No. 4

Road Side Plantation

Based on sample plot methods trees, shrubs, bushes and weeds are recorded along the proposed BRTS corridor. Among trees Arjun (*Terminalia arjuna*), Nilgri (*Eucalyptus globulus*), Wild dates (*Phoenix sylvestris*), Babul (*Acacia nilotica*), Prospic sp. Bail (*Aegle marmelose*), (*Terminalia Balerica*), Mahua (Madhuca Indica), Neem (*Azadirachta indica),* Kamhar *(Gmelia arborea), Imali* (*Tamarindus indica*), Jharber *(Zizyphus numularia),* Bair *(Ziziphus Mauritiana),* Burgad *(Ficus bengalensis) etc.* are recorded along the proposed site.

Undergrowth plant like shrubs, herbs and grasses are noticed in scattered manner. The undergrowth species recorded along the proposed BRTs corridor are mostly weeds and bushes. Weeds recorded along the road sides are Calotropis (*Calotropis procera*), Lantana (*Lantana camara*), *Cenchrus ciliaris, Saceharim spontaneum, Saccharum munja, Aristida depressa, Heteropogon contortus, Parthenium hysterophorous,* etc. Where soil is moist or along the edge of ponds growth of Bahia (*Ipomea carnea*) was noticed.

Quadrant sampling method (Plot Sample) was used to calculate floral type and their distribution along the proposed BRTs Corridor. Location of sample plot is shown in Figure 5-5 and Table 5-18 gives the list of species recorded, with their frequency, density and abundance of distribution along the proposed BRTs Corridor.

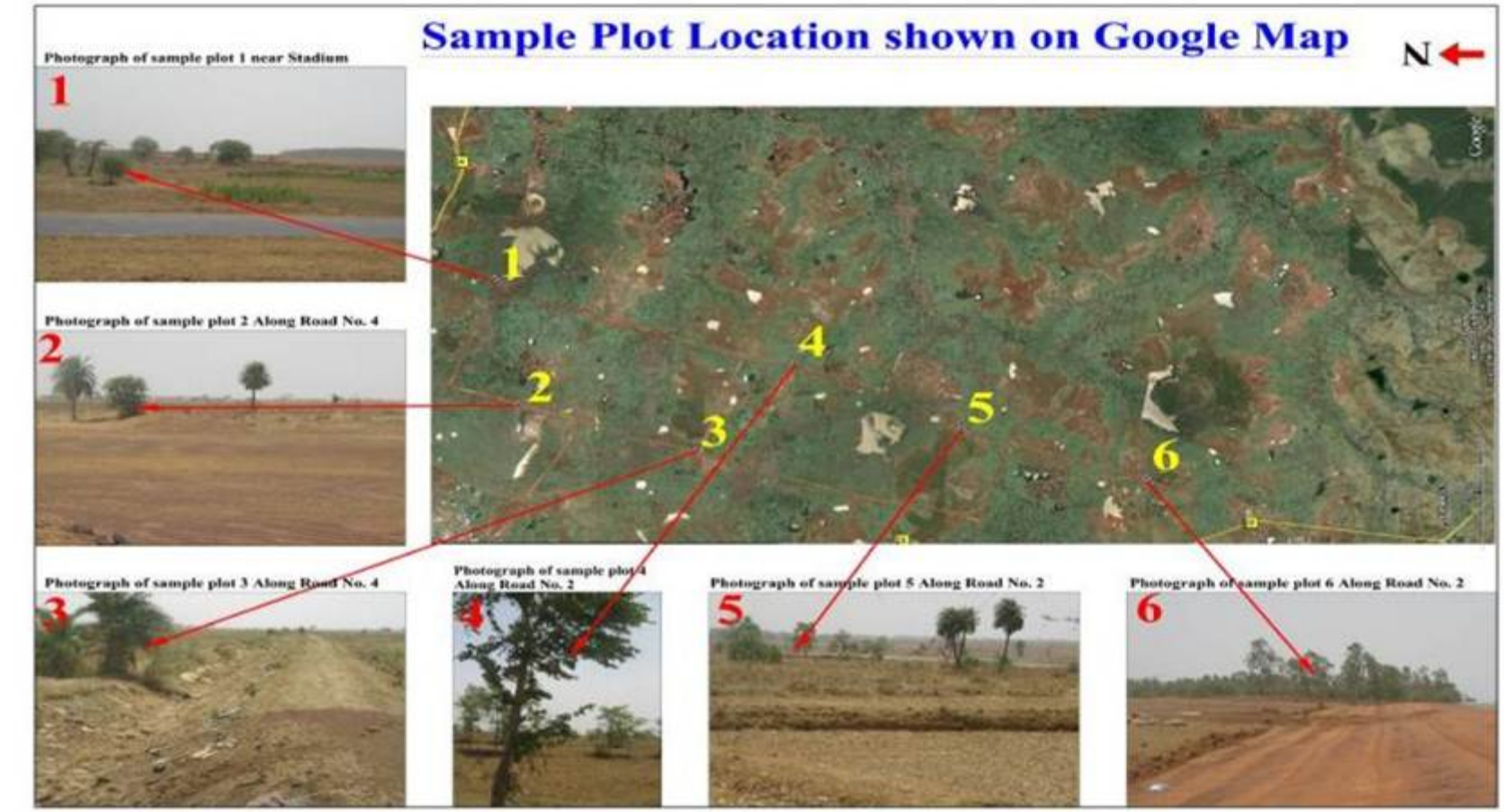
5.7.2 Aquatic Ecology

Along the proposed BRTs corridor a few large and small ponds are reported in adjacent or within 100 m away. Natural drainage are crossing Road no. 2 but they are seasonal in natural. Flora recorded along the flows of natural stream and nalas are weeds, reeds and bushes of Bahia (*Ipomea carnea*). At some locations, scattered growth of wild dates (Phoenix sylvestris) is noticed.

Photo 5-2 : Sendh Lake from Road No. 7

The nearest river reported is Kharum River, which is about 5 km away. All these streams finally drain into Kharum River. Lentic water bodies reported along the proposed BRTs corridor are man-made ponds. No natural pond is noticed in the study area. Man made ponds are mostly perennial and are rain fed. These ponds are main source of water for the villagers, for drinking, bathing, irrigation, feeding animals and other anthropogenic activities. Along the edge of these ponds growth of hydrophytes like *Ipomea carnea, Marsilea villosa,* Cenchrus cilitaris are noticed. Pisciculture practices are commonly noticed in these ponds.

FIGURE 5.5 : LOCATION OF QUADRANT SAMPLING POINT (SAMPLE PLOT) ALONG PROPOSED BRT CORRIDOR WITH THEIR PHOTOGRAPH



5.8 Faunal Profile

Mammals

No wild mammals are sited in the proposed project site and study area. Domesticated mammals like buffalo, cow, goat etc are commonly noticed grazing in open field. Small mammals like field mouse (vermin), five stripped squirrels and wild mammals like Hyaena (*Hyaena hyaena*), rabbits (*Lepus nigricollis*), Monkey (Macaca Mulata) Fox (Vulpes bengalensis), mongoose (*Herpestes auropunctatus*) and Jackal (Canis aureus) are reported by the villagers. Table 5-18 gives list of animals reported during site visit.

TABLE 5.17 : LIST OF WILD ANIMALS REPORTED IN STUDY AREA

S.No	Local Name	Scientific Name	RED LIST (IUCN)
1	Hyaena	*Hyaena hyena*	Near Threatened-2009
2	Rabbit	*Lepus nigricollis*	Least Concern - 2010
3	Monkey	*Macaca Mulata*	Least Concern -2009
4	Fox	*Vulpes bengalensis*	Least Concern -2010
5	Mongoose	*Herpestes auropunctatus*	Least Concern - 2009
6	Jackal	*Canis aureus*	Least Concern - 2010

(Source: Villagers & Forest department)

Avifauna

Sampling of avifauna was carried out between the hours 6:30 to 8: 00 A.M. This survey was based on a “Walk/Drive Though” survey. A point count sampling method was adopted to list the bird species seen or heard. Only listing of species is done.

The Area lack rich diversity of avifauna. During the time of survey common birds like Common crow, Pigeon, Pariah kite, Jungle babbler, Ring dove, Spotted dove, Indian parakeet, Indian roller, Drango, White breasted king fisher, Common myna, Pond heron, Sparrow, Coot, etc are recorded.

TABLE 5.18 : LIST OF COMMON AVIFAUNA RECORDED DURING SURVEY

S. No.	Scientific Name	Common Name	Source	Wildlife Schedule
1.	*Acridotheres tristis*	Common Myna	Sited	IV
2.	*Athene brama*	Spotted Owlet	Villagers	IV
3.	*Columba livia*	Blue Rock Pigeon	Sited	IV

S. No.	Scientific Name	Common Name	Source	Wildlife Schedule
4.	*Corvus splendens*	House Crow	Sited	V
5.	*Cuculus canorus*	Cuckoo	Villagers	IV
6.	*Cutornix cutornix*	Quail	Villagers	IV
7.	*Dicrurous adsimilis*	Drango	Sited	IV
8.	*Milvus migrans*	Pariah Kite	Sited	IV
9.	*Passer domesticus*	House Sparrow	Sited	IV
10.	*Psittacula krameri*	Roseringed Parakeet	Sited	IV
11.	*Pycnonotus cafer*	Red vented Bulbul	Villagers	IV
12.	*Turdoides caudata*	Common Babbler	Sited	IV
13.	*Bubulcus ibis*	Cattle Egret	Sited	IV
14.	*Halcyon smyrensis*	white throated kingfisher	Villagers	IV
15.	*Ceryle rudis*	Pied kingfisher	Villagers	IV
16.	*Ardeola grayii*	Pond Heron	Sited	IV
17.	*Fulica atra*	Coot	Sited	IV

(Source: recorded during site visit and interaction with villagers)

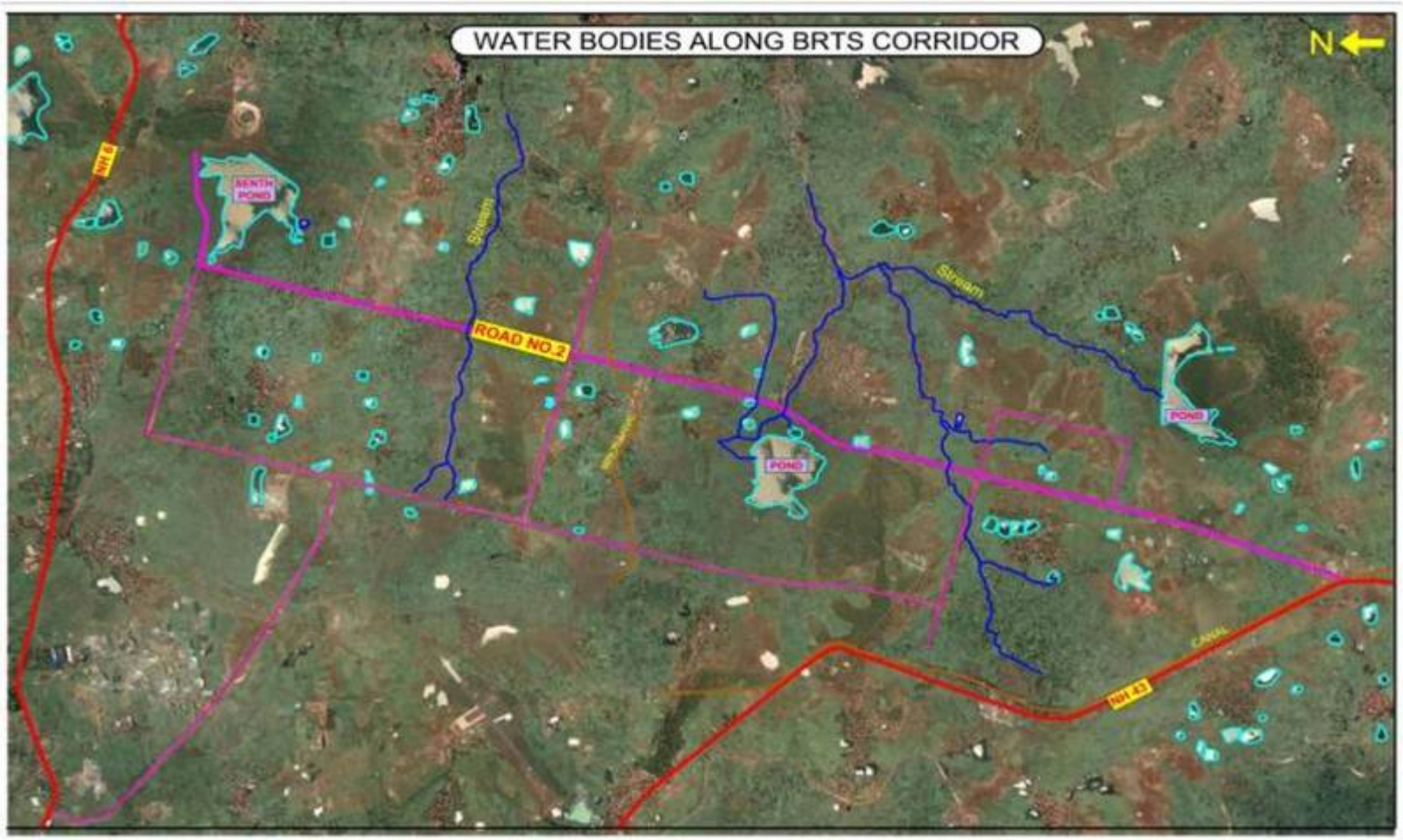
Amphibians

Amphibians are recorded in ponds along the proposed project site and nearby settlements. The commonly reported amphibians are Bull frog, Indian skipper frog and Indian cricket frog. Only species are identified on ocular basis.

Reptiles

During survey no reptilian species are noticed. The villagers mention the presence Agama (*Agama tuberculata*), lizard (*Calotes sp*.) and skink (*Scincilla sp*.) in field, bushes along the road site and waste land. Among Snakes Dhaman *(Ptyas mucosa)* are commonly encounter by the farmers. Poisons snakes like Cobra (*Naja naja)*, Banded Krait (*Bungarus multicinctus*), Russel viper (*Vipera ruselii*), are rarely encounter by the farmers in the field. Scorpions are commonly noticed by the villagers in the study area.

FIGURE 5-6: SHOWING LOTIC & LENTIC WATER BODIES ALONG THE PROPOSED CORRIDOR



5.9 SOCIO ECONOMIC ENVIRONMENT

The areas of discussion in this chapter are demographic structure, economic activity, education, literacy profile, land use and infrastructure resources. The assessment attempts to predict and evaluate the anticipated impacts of project upon people, their physical, psychological health and wellbeing, their economic facilities, cultural heritage, lifestyle and their value system.

5.9.1 Socio Demographic Profile

Population

Raipur is the capital of Chhattisgarh State with a population of 30,16,930 as per census 2001. The Raipur city population is 6,70,042; the projected population at the decadal growth rate of 34.8% would house a population of 10.64 lakh in 2011 and 14.98 lakh in 2021[6].

The demographic details of Raipur urban agglomeration is given in Table 5-20.

TABLE 5.19 : POPULATION GROWTH OF RAIPUR URBAN AGGLOMERATION

Year	Population in Lakhs	Growth Rate (%)
1951	0.89	--
1961	1.39	56.18
1971	2.06	48.2
1981	3.38	64.08
1991	4.61	36.39
2001	6.69	45.12

Source :Census of India

The decadal growth rate of Raipur increased from 36.39% in 1981-1991 to 45.12% in 1991-2001. The decadal growth rate of the district at the same time was 30.14% and 18.97%. This means higher urban growth rate in comparison to the overall population growth. The sex ratio, and literacy rate of Raipur is given in Table 5-21.

TABLE 5.20 : SEX RATIO AND LITERACY RATE OF RAIPUR URBAN AGGLOMERATION

Area	Sex Ratio	Literacy Rate (%)
Raipur District	980	68.5

[6] CDP, Raipur

Area	Sex Ratio	Literacy Rate (%)
Raipur City	923	81.1

Source: Census of India 2001

The population composition of Raipur District is depicted in

Figure 5 which clearly shows the sizable percentage of SC and ST population.

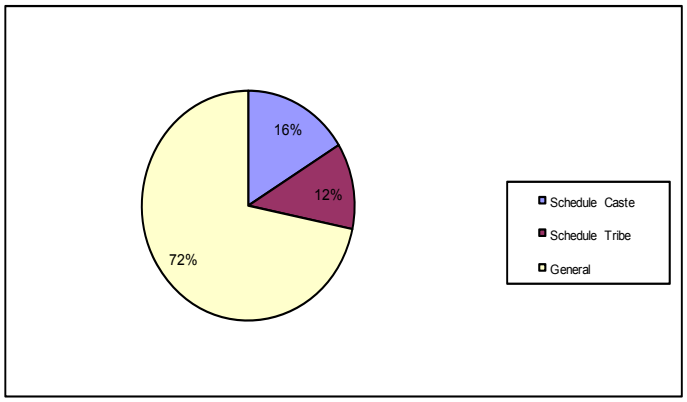


FIGURE 5.7 : POPULATION DISTRIBUTION IN VARIOUS CATEGORIES

Work Participation

The workforce participation rate of Raipur district is 41.9% and Raipur city is 32.4%, as per census 2001.The involvement in different sectors is given in Table 5-22.

TABLE 5.21 WORK PARTICIPATION RATE

Area	Total Workforce (%)	Main Workers (%)	Marginal Workers (%)
Raipur District	41.92	76.03	23.97
Raipur City	32.48	91.57	8.43

Census of India 2001

The employment pattern in the district is given in

Figure **5** and Figure 5.

FIGURE 5.8 : MAIN WORKERS: ENGAGEMENT IN DIFFERENT SECTORS

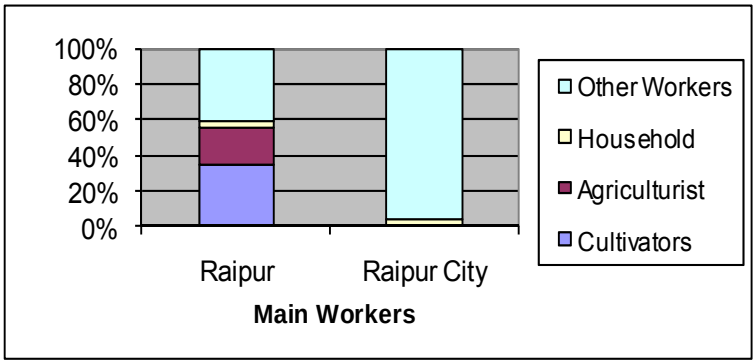
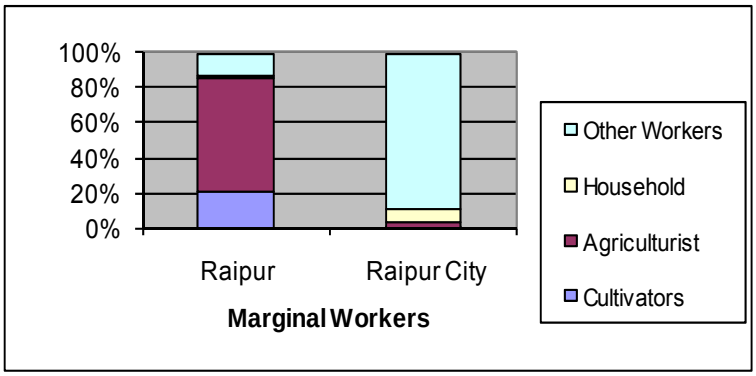


FIGURE 5.9: MARGINAL WORKERS : ENGAGEMENT IN DIFFERENT SECTORS



The figures above signify the dependency of urban population on other categories of employment. This means that for sustainable growth, investment in the industrial sector and provision of necessary infrastructure is the need of the day.

Population of Naya Raipur

Naya Raipur will take functions from Raipur city; also it will attract population from other parts of Chhattisgarh and from other states of India. The population of Naya Raipur is planned as 150,000 in 2011 to 560,000 in 2031. (*Source: Naya Raipur Development Plan-2031)* The population estimates for Naya Raipur are related to and dependent on the development of various economic activities and other socio-economic and physical conditions.

5.9.2 Social Profile

A project development entails a host of social concerns, which need to be identified for sustainable growth in the area. To identify project related social concerns, a series of consultations were carried out with the villagers who will be affected by the proposed project.

The villages covered in this process were Rakhi, Palaud, Nawagaon, Uparwara, Mana, Dumar Tarai, and Serikheri.

The baseline information of these villages is summarized in the section given below:

Social Amenities

The amenities in the villages include electricity, water supply, telephone and sewerage. Power supply in the villages is available but there are power cuts.

Water is available through hand pumps and a large portion of the population uses this source of water for domestic use. Community ponds are also used by animals and for washing.

Livestock

Animal husbandry is a major economic activity of villagers, which includes poultry farming and livestock. The goats, sheep, cows, pigs and backyard poultry are the most valuable species of livestock to all groups of farmers as it fulfills their own daily needs as well as is a important source of income.

Religious and Cultural Sites

There are three small religious structures very close to the proposed corridor:

1. Sitalla mata temple located in Nawagaon village
2. Bhasurur temple in Nawagaon Village
3. Hanuman temple near Telebandha Junction.

Photo 5-3 : Hanuman Temple Near Telibandha Junction

Culture and Tradition

The local language used is “Chhattisgarhi”. Traditional medical practitioners are more acceptable to the rural folk. Festivals celebrated in the area are Gouri-Goura, Surti, Hareli, Pola and Teeja, which are celebrated in the month of 'Shravan'. The villagers follow a traditional life style.

Photo 5-4 : National Highway near Pachipadanaka Junction

Chapter-VI

PUBLIC CONSULTATIONS

Public consultations with women commuter, students, employees of Agricultural University, general commuter of Raipur city, conductors, driver and bus owner and government employee were carried out during 14th to 16th April 2010. are given as **Annexure – V**.

6.1 OBJECTIVE

To know the opinion of stake holders, consultations were held to identify impacts of the project, their concerns and issues relating to the BRTS and developing grievance redressal mechanism. Grievance redressal mechanism is given environmental management plan.

6.1.1 APPROACH

Efforts were made to include vulnerable sections in order to voice their concerns. The groups that were consulted on the services were women, students from university and colleges, residents of proposed transfer station, commuters in Raipur city and conductors, drivers and owners of auto rickshaws and buses both private and public (plying under contract with government on select routes).

6.2 METHODOLOGY

The consultations were conducted based on a random method during the site visits undertaken. The locations were decided on the basis on the BRTS routes, category (different groups women, students from university and colleges, residents of proposed transfer station, commuters in Raipur city and conductors, drivers and owners of auto rickshaws and buses both private and public). Groups were formed on the basis of availability, willingness of participants and expected use or impact by BRTS service. During visits to specific sites to meet specific individuals prior arrangements were made for suitability of time and the location to ensure boarder/specific participant groups.

6.3 CONSULTATIONS OUTCOME

6.3.1 Women commuters

Women are comfortable with the bus service as some seats are reserved for them, so they do not face major problems and issues. They are of the opinion that BRT system should have more frequency of buses. Currently they find the services are limited and during specific times the frequency is very less. For long journey air conditioned buses should be introduced considering the weather conditions in Raipur as the commuters face hardship due to the extreme heat, making the journey both uncomfortable and difficult. Overall opinion of the women for the BRT system can be summarized as largely good.

6.3.2 Consultation with students from university, colleges and schools

Students in the university and colleges are of the view that more BRTS bus services should be provided during the morning and evening hours. University Specials should be introduced. Students should be issued concessional monthly passes for the BRTS.

Parents of school going children feel that the school administration will operate their own buses if required in the near future for Naya Raipur and so do not have much stake in the BRTS service.

6.3.3 Residents near Terminal at Agriculture Institute on NH-53

Most of the BRT buses on NH-53 will ply from the terminal which is planned to be developed on land owned by Indira Gandhi Agriculture University. Passengers from city buses will de-board at this point and then board buses plying under BRT system to Naya Raipur. The identified land has staff quarters. The discussion with residents of the identified location gives an idea that most of the residents are working in university either on daily wages or as class IV employees. They are of the view that wherever university administration will shift them they are ready for it. Discussion with University authorities reveals on the same line that after formal intimation for land requirement from NRDA they will plan for dismantling and resettlement of the occupants.

6.3.4 Residents near Pachpedinaka -Doomar Tarai Terminal on NH-30

The plot to be developed as terminal on NH-30 is vacant land with no settlements. There are not any surface features needed to be resettled.

6.3.5 Commuters in Raipur city

Discussions were held with commuters travelling on different routes of the BRTS. Fare charges based on the distance are more affordable. Contradictory to the flat rate decided arbitrarily by the Auto rickshaw drivers, this is much higher than the BRTS rate. The commuters on BRTS routes are of the view that the frequency of existing city bus service is not enough. Commuters are of the opinion that traffic congestion can be decreased by banning some type of vehicles especially rickshaws on particular roads. Some passengers feel that A/c bus service should be introduced and that bus service should run on schedule.

6.3.6 Consultation with conductors, drivers and owners of private buses in Raipur and Naya Raipur

At present the bus services are limited only to the identified routes. The government has selected the operators through a process of tendering. It is expected by bus owners and employees that for the new routes, operators will be selected by the same procedure. Existing routes should not be given to new operators as this will result in a loss for the current operators and their employees.

Chapter-VII

ASSESSMENT OF POTENTIAL IMPACTS AND MITIGATION MEASURES

This chapter identifies sources of pollution from proposed Bus–based Road Transit system and evaluation of various impacts on environmental attributes in the study area. BRTS Naya Raipur is a Greenfield project. Potential environmental impacts are impacts on land, water, air, noise and ecology. These impacts can be classified in to construction phase and operation phase.

"Environmental Impact" can be defined as any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration.

Generally, the environmental impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributed directly by the project, secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed action.

The impacts have been predicted for the proposed BRTS assuming that the pollution due to the existing activities has already been covered under baseline environmental monitoring.

Impact on various environmental parameters can be categorized into two phases, namely:

- The construction phase: Impact during this phase may be regarded as temporary or short term; and
- The functional phase: Impact during this phase shall have long term effects.

Various impacts during these two phases have been studied and are discussed in the subsequent sections.

7.1 POLLUTION SOURCES

Pollutants generated in the proposed development of BRTS during both the construction and functional phases are solid, liquid and gaseous in nature. Also the generation of pollution could be continuous, periodic or accidental. Sources of pollutants and their characteristics during the construction and functional phase are given below in Table 7.1

Table 7.1: Pollutant Sources & Characteristics

Sr. No	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
CONSTRUCTION PHASE				
1.	Site Preparation	Air emissions – SPM, PM10, CO, NOx, SO2	Dust from construction activities and excavation. Particulates, NOx and CO from vehicle exhaust	Temporary during construction phase only bulk of the emissions are expected from ground working and leveling activities.
		Earth / solid waste / excavation	Solid waste from construction activity and excavation.	Periodic.
		Noise	Noise generated from construction equipment and machinery	Temporary during initial construction phase.
2	Labour Camps	Sewage	Waste generated from temporary labour camps on site	Temporary – during the initial construction phase
		Solid Waste	Solid Waste generated from temporary labour camps on site	Temporary – during the initial construction phase
FUNCTIONAL PHASE				
1.	Vehicular movement	Air emissions	Vehicle exhaust emissions	Continuous / Periodic
		Noise	Vehicular movement	Continuous/ Periodic
		Water	Presence of Oil & Grease, SS during rainy season Oil Spillage	Periodic
2	Bus Depot/ workshop Near junction of Road No. 1 & 3 Naya Raipur	Exhaust Emission from tuning and testing of vehicles Solvent Emission Emission from DG Sets Storage of Hazardous Sustance like motor oil, degreaser, brake fluid, petrol, solvent coolant, waste oil	**Hydrocarbon and CO** **CO, HC and NOx**	**Temporary**

Sr. No	Activity / Area	Pollutant	Pollutant Characteristics	Frequency
		Waste generated from oil trap		
3.	Night Parking in Raipur			
4.	Safety of Raod users	Pedestrian crossings at bus shelters and bus stops at At NH 53 and R.N. 1 Junction At Junction R.N. 13 and R.N. 4, 200m ROW At Near Cricket Satadium, R.N. 2, At Junction of R.N.2 and 9B, and at R.N. 12		
5	Pick up points – Raipur Railway station Existing Secretariat			

7.2 IDENTIFICATION OF IMPACTS

The potential impacts due to proposed project have been identified in the following table..

Table 7.2 : Identification of Impacts (Construction & Functional Phase)

Sr. No	Environmental Attributes	Aspect	Potential Impact
CONSTRUCTION PHASE			
1	Ambient Air Quality	Dust emissions from site preparation excavation, material handling & other construction activities at site.	Minor negative impact within site premises. No negative impact outside site premises. Short term
2	Noise	Noise generated from construction activities, operation of construction equipment and their movement	Minor negative impact near noise generation sources within site. No significant impact on ambient noise levels outside site. Short term
3	Water quality	Surface runoff from project site Oil/fuel & waste spills. Improper debris disposal Discharge of sewage from labour camp.	No significant negative impact. Short term
4	Land use	Excavation	Minor negative impact

Sr. No	Environmental Attributes	Aspect	Potential Impact
5	Topography & Geology	Site development	No significant impacts
6	Soils	Construction and excavation activity leading to topsoil removal & erosion.	Minor negative impacts
7	Ecology Flora & Fauna	Habitat disturbance during construction activity	Minor negative impacts Short term
8	Socio-economy	Increased job opportunity for locals. Economy related to material supply etc. expected to boom.	Overall positive impact
9	Traffic Pattern	Vehicle movement and possibility of traffic congestions on the road.	Minor negative impact
FUNCTIONAL PHASE			
1	Ambient Air Quality	Particulate and gaseous emissions from increased vehicular movement	Minor Negative impact alongside the route. No negative impacts beyond 200 m from the road
2	Noise	Noise from vehicle movement	Minor negative impact to the receptors alongside the roads especially at junctions and crossings.
3.	Water Quality	Oil/fuel & waste spills. Discharge of contaminated storm water	Minor negative impact
4	Soils	Fuel and material spills	No negative impact
5.	Ecology Flora & Fauna	Land use change, cutting of trees coming along the route	Minor negative impact
6.	Social & Economic	Resettlement and rehabilitation Improvement in Public Transportation	Minor Positive Impact
7	Traffic Pattern	Changes to Traffic, Parking and Access Separate route for Public Buses	Positive

These impacts are discussed phase wise in subsequent sections.

7.3 IMPACT ON AIR ENVIRONMENT

7.3.1 Construction Phase

During this phase, dust is expected to be the main pollutant associated with site development, stockpiles and material handling. Pollution emission sources will be

distributed throughout construction site of work shop, bus depots, terminal stations, control centre, night parking area, pick point and bus shelters. This involves excavation, leveling etc and can cause dust generation. The impact will be confined within the project boundary and is expected to be negligible outside the project boundaries.

7.3.1.1 Emission from construction machinery

The emissions from construction machinery would contain particulates, SOx, NOX, CO. However, the quantity of these pollutants is expected to be extremely low due to low fuel requirement and use of cleaner fuel like diesel. It is expected that the machinery will consume merely 20 to 30 L of diesel. The resultant emissions, therefore, are not expected to affect ambient air quality.

7.3.2 Operation Phase

During operation phase of project major pollutants expected from the vehicular movement and operation of workshop and maintenance area of the buses. The main pollutant will be SO_2 ,NOx, particulate matter of $PM_{10,}$ $PM_{2.5,}$ Carbon Monooxide, Benzene etc from vehicular operation and operation work shop. The diesel generator of work shop are the source of pollutant. The location of the above pollutant will be at the following locations.

- Workshop and depots
- Parking area
- Bus pick up point and terminal.

7.4 IMPACT ON NOISE ENVIRONMENT

7.4.1 Construction Phase

During the construction phase of work shop, bus depots, terminal stations, control centre, night parking area, pick point and bus shelters, the movement of construction vehicles, excavation of foundation will generate noise.

7.4.2 Operation Phase

The operation of buses of BRTS and maintenance of workshop will generate noise. The maintenance buses will be limited to the work shop and will not have impact outside the workshop.

7.5 IMPACT ON WATER ENVIRONMENT

Construction Phase

Construction activities for the proposed development can have minor impact on hydrology and ground water quality of the area in case the construction chemicals leaches into ground. minor impact on the surface water is expected. Potential impacts on the hydrology and ground water quality have been discussed with respect to the following:

- Soil runoff from the site leading to off-site contamination (particularly during the rainy season).
- Improper disposal of construction debris leading to off-site contamination of water resources.
- Unaccounted disposal of domestic wastewater from temporary labour camps.
- Spillage of oil and grease from the vehicles and wastewater stream generated from on- site activities such as vehicles washing, workshop etc.

Construction & Development of site

Development of the proposed site could lead to stockpiling and excavation activity on site, thereby causing erosion of base soil. The run off from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season.

The impact also envisaged from the construction practices and the type of material used. Construction waste is likely to create significant impact. This type of waste would be stock piled and disposed off properly.

Workshop

The repair and maintenance of equipments/vehicles on site would generate waste containing oil and grease. The wastewater stream would also be generated from vehicle washing. The impact can be mitigated to a great extent by installing oil and grease traps.

Labour Camp

During construction phase, sewage will be generated from labour colony. High levels of BOD, SS, Nitrogen and E. coli would characterize the same. Significant water quality impact will occur, if the sewage is disposed without any prior treatment. Temporary soak pits and septic tanks shall be constructed on the site during construction phase to mitigate the impact.

Operation Phase

Contamination of surface & ground water may be possible due to accidental spillage of oil, grease and diesel from the vehicles during operation phase of project. Other emissions from work shop and maintenance are as follows.

- Solvent Emission,
- Waste oil,
- Brake fluid,
- Coolant,
- Solvent,
- Wash down waters from floor,
- Detergents,
- Degreaser,
- Storm water from maintenance area.

7.6 IMPACTS ON LAND ENVIRONMENT

Land Use & Aesthetics

The proposed project will built on existing road and comes under NRDA limit. Land required for proposed project is in possession with NRDA. There is minor change in land use pattern of the area and the land use will remain viz-a-viz to Naya Raipur Development Plan 2031.

Topography & Geology

The proposed activity during the construction phase would involve excavation work and minor leveling of site. Overall geology or topography of the region is not expected to change due to the project. No additional stresses will be imposed by the project on these parameters and hence no significant impacts are expected.

Soil

Construction Phase

Impact on soil owing to the project construction activity includes soil erosion, compaction, physical and chemical desegregations. Erosion of soil may occur due to

removal of vegetation and excavation activity. Site selected for the project has almost no vegetation; hence impact owing to removal of vegetation would be minimal, however construction and associated activities would expedite erosion if not managed properly. Other factors contributing to soil erosion is increased runoff and decrease in permeability of the soil. Since proposed site is fairly leveled, excavation is expected to be minimal.

Use of heavy machinery and storage of materials results in compaction of the soil. Compaction of the soil as well as mixing of construction material with soil would also lead to reduced infiltration of water, decrease in permeability and increased runoff.

Several environmental management measures will be implemented to minimize the soil erosion and other impacts such as removal and use of topsoil from construction activity for future plantation, etc. Impact on account of soil erosion is expected to be minimal.

Operation Phase

During the operation phase, carefully designed tree plantation and landscaped areas along sides of the roads will be maintained. No significant adverse impact is expected on the soils and areas around the site. The following management measures are proposed:

- Storm water will be used to recharge the aquifer.
- The area of work shop/bus depot will be sufficiently paved leading no leaching of any substances in case of spills

Hence, no negative impact on soil quality is expected due to the project activities.

7.7 WASTE DISPOSAL

Construction Phase

During the construction phase, solid waste generated will include vegetation/biomass from land clearing activities, waste from the labour camp and construction waste. Construction activities would generate solid wastes that need to be disposed; these are sand, concrete, gravel, stone, bricks, plastic, paper, wood, metal, glass etc. Exact estimation of these construction wastes is not practicable.

Potential pollution problems during construction activities include dumping of construction debris into or near by low-lying areas. Proposed mitigation measures will suggest maximum reuse of construction waste on site or removal of waste from the site and proper disposal, which would reduce adverse the impact, if any, significantly.

Operation Phase

During operation phase the solid waste from workshop and maintenance area will be generated. Solid waste on bus terminals will also be generated from the passengers. This will be municipal solid waste.

Waste Product	Source	How Disposed
Liquids		
Waste Oil	Workshop – maintenance of buses and equipments	Recycled
Brake Fluid	Workshop – replace ment of brake oil	Recycled
Coolant	Workshop – maintenance of buses and equipments	Evaporation/Trade Waste/ ETP
Solvents	Workshop – cleaning area	Recycled/ETP
Wash Down Waters (floor)	Floor and bush wash	Trade Waste/ ETP
Detergent	Workshop – maintenance of buses and equipments	Trade Waste/ETP
Degreaser	Workshop – maintenance of buses and equipments	Trade Waste/ETP
Solids		
Cardboard	Workshop – maintenance of buses and equipments	Recycled
Plastic	Workshop – maintenance of buses and equipments	Recycled
Glass	Workshop – maintenance of buses and equipments	Recycled
Aluminium	Workshop – maintenance of buses and equipments	Recycled
Lunchroom Waste	Workshop – maintenance of buses and equipments	Disposal
Oil Filters	Workshop – maintenance of buses and equipments	Recycled (Metal)
Steel	Workshop – maintenance of buses and equipments	Recycled (Metal)
Fan Belts, Hoses etc	Workshop – maintenance of	Disposed

Waste Product	Source	How Disposed
	buses and equipments	
Paper	Workshop – maintenance of buses and equipments	Recycled
Rags	Workshop – maintenance of buses and equipments	Disposed
Absorptive Material	Workshop – maintenance of buses and equipments	Bagged & Disposed
Other		Disposed

7.8 IMPACT ON ECOLOGICAL ENVIRONMENT

Impacts on trees

Trees at Road Number 13 – This road 478 trees felling was done for the construction of Road No. 13 of BRTS with due permission from the competent authority which is Collector Raipur. The compensatory afforestation was also been completed against this felling.

Site Development*:*

During construction, the vegetation on the land will be destroyed, and the local ecosystem at micro level may get changed. In addition, the destruction and fragmentation effect of the construction may diminish the habitats for some of the animal species, so that there may not be enough roosting places any more for them to survive. The development of the proposed site may cause direct impacts and loss of habitats and their associated flora & fauna. Only 478 trees have been cut for the BRTS and do not have significant value as more than 3 lacs saplings have been planted which will support more forms of life than the flora, fauna at the construction site, capable of strengthening the existing micro and macro level eco-system of the area.

Air, noise and visual disturbance may be observed during the site development. The surrounding project site area is devoid of any major flora and fauna hence negative impacts are not envisaged.

Aquatic ecology

During construction phase the project will be confined to the site boundaries only and no aquatic body is involves. Hence, impacts on aquatic ecology cannot be expected.

Operation Phase

Potential impacts of this phase on terrestrial ecology include long term air and noise pollution and disturbance generated by area lighting and traffic. However, as mentioned in earlier sections, the impact due to increased traffic is minimum. Also, the study area supports common species of fauna & flora. Hence, potential impacts from these sources are expected to be minimal and can be reduced considerably adopting adequate mitigation measures.

7.9 Safety

Occupational Safety

HOUSEKEEPING

To provide a first line of difference against accident and injuries the working environment shall be cleared of all unnecessary waste. General Housekeeping shall be carried out by the contractor and ensured at all times at Work Site, Construction Depot, Batching Plant, Labour Camp, Stores, Offices and toilets/urinals. Full height fence, barriers, barricades etc. be erected around the site in order to prevent the surrounding area from excavated soil, rubbish etc, The barricade/fence especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Employer. These shall be maintained in one line and level.

WORKING AT HEIGHT

The places designed above ground level for performing specific task shall be protected by fence of at least 1.2 m. height and if temporary working is to be done from a high place then net below the working place shall be suitably placed to protect the working person from any personal injury. Slipping, Tripping, Cutting, Drowning and Falling Hazards

a) All places should be free from dust, debris or similar materials.

b) Sharp projections or any protruding nails or similar objects shall be suitably guarded or shall even be avoided to make the place safe to work.

Contractor shall not allow workmen to work or use platforms, scaffolds/passageways or any walkways, which has water, or oil or similar substances spilt and has a slipping hazard, unless it is cleaned off or covered or sanded or saw dusted or make it safe with any suitable material.

CONSTRUCTION MACHINERY

Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers piling rigs, vibro hammers, rail welding equipments, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc. These machineries shall be operated by a trained licence holder skilled person. All safety precautions shall be taken as per the manual of the specific machinery.

SITE ELECTRICITY

The contractor shall employ qualified and competent electrical personnel

- The contractor shall assess the size and location of the electrical loads and the manner in which they vary with time during the currency of the contract.

- The contractor shall elaborate as to how the total supply is to be obtained / generated. The details of the source of electricity, earthing requirement, substation / panel boards, distribution system shall be prepared and necessary approval from Employer /competent authority shall be obtained before proceeding of the execution of the job.

- The Contractor shall take into consideration the requirements of the sub / petty contractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators.

- As the sub / petty contractors' small capacity generators create more noise and safety hazard, no small capacity diesel generators shall be allowed for whatsoever the type of job to be executed under this contract.

If any unsafe noise making small capacity diesel generators are found used by sub / petty contractors the main contractor shall only be penalised.

TRAFFIC MANAGEMENT AT THE CONSTRUCTION SITE

The objective of traffic management is to ensure the safe and efficient movement of traffic near the construction site as well as to ensure the safety of workmen and the road users.

The construction of bus shelters and bus stop will have intervention in the traffic and may pose potential accident to the road users. This shall be mitigated by providing proper Traffic Management Plan as per the EMP.

7.10 SOCIO-ECONOMIC ENVIRONMENT

Job Opportunity

The local people would also get the job opportunities closer to their places of stay. Expenditure incurred by those employed at the project will boost local economy. Jobs would be created for unskilled, semi-skilled as well as skilled labour category, for which local population would be given preference. Thus, the project is expected to contribute to the over all development of the area.

Improvement of Infrastructure Facilities

The development of project will also create the services like road and communication, thereby improving the life of local populace.

Wider Economic Growth

The proposed project will increase the economic activities around the area, creating avenues for direct/indirect employment in the post project period. There would be a wider economic impact in terms of generating opportunities for other business like transportation, marketing, repair and maintenance tasks, etc.

Transportation

During functional phase, the vehicular movement would mainly comprise passenger cars and buses, two wheelers, cycles and light commercial vehicles. The impact would be mitigated by the suggested measures like better upkeep of vehicles and maintaining good road network.

Transient Labour Population

Construction activity may lead to influx of construction labours. Though majority of work force would be recruited locally, labours with specific skills, may be from outside. However, such labours would be limited in number. The camp shall be provided with all basic amenities like water supply, public toilet etc. Therefore no significant pressure on local infrastructure is envisaged.

Resettlement & Rehabilitation Issues

A separate Resettlement & Rehabilitation plan has been prepared by the NRDA and under this Resettlement & Rehabilitation of the affected person will be done.

7.11 SUMMARY OF IMPACTS

A summary of likely impacts due to proposed project is depicted in **Table 7.4**.

Table 7.3: Summary Matrix of Predicted Impacts Due to Proposed Project

Sr. No	Components	Activities	Predicted impacts	Extent of Impacts
CONSTRUCTION PHASE				
1.	Ambient air quality	**-Dust emissions from site preparation, excavation, material handling and other construction activities at Site.**	Minor Negative impact inside project premises. No negative impact outside premises of site.	Impacts are temporary during construction phase. Impacts will be confined to short distances, as coarse particles will settle within the short distance from activities.
2.	Noise	Noise generated from construction activities and operation of construction equipment.	Minor negative impact near noise generation sources inside premises. No significant impact on ambient noise levels outside premises.	Temporary impacts during construction phase. No blasting or other high intensity noise activities envisaged. Baseline noise is within the standards. Contribution of noise will be confined in time and space.
3.	Water quality	**-Surface runoff from project site** **-Oil/fuel and waste spills.** **-Improper debris disposal** **-Discharge of sewage from labour camp**	Minimal due to effective mitigation measures.	Impact will be temporary. Local labour will be employed to reduce size of labour camps. No perennial surface water resource adjacent to site. Labour colonies shall be provided potable water for drinking and toilet facility.
4	Land use & aesthetics	-Land development	Permanent positive impact	There will not be change in local land use pattern. The proposed development has also planned for landscaping areas, lawns, and open spaces. This will enhance the visual appeal of the area.
5.	Topography & geology	-Existing site is fairly levelled	No Significant Impacts	Region is flat and hence no impacts on topography. No deposits of minerals on site leading to loss of

Sr. No	Components	Activities	Predicted impacts	Extent of Impacts
				revenue. Development is planned as per IS standards for earthquake protection.
6.	Soils	-Construction activity leading to topsoil removal and erosion.	Minor negative impact	Site is fairly levelled and will need minimum cutting and filling. Also adequate mitigation measures will reduce the same.
7.	Ecology, Flora & fauna	-Habitat disturbance during construction activity	Minor negative impact	The site and adjacent areas do not have any significant flora and fauna diversity and density. No endangered species recorded in study area. Development is planned in notified industrial area.
8.	Socioeconomics	Economy related to commercial real estate development, material supply etc. expected to boom.	Overall positive impact	Ancillary developments in the service sector is expected
9.	Traffic pattern	Decongestion of Existing Raipur Traffic and Haul movement and possibility of traffic congestion on NH 53 and NH30 at peak hours	Minor negative Impact	Location specific.
OPERATION PHASE				
1.	Ambient air quality	-Particulate and gaseous emissions from vehicle movement	Minor negative impact	Limited along side the routes
2.	Noise	-Noise from vehicle movement	Minor negative impact	New generation vehicles will be plying on the roads, which generate less noise.
3.	Water quality	-Oil/fuel and waste spills. -Discharge of sewage. -Discharge of contaminated storm water	No significant adverse impact	No wastewater discharge outside the premises to the nearby water source.
4.	Water availability		No impact	--
5	Soils	- Accidental Fuel and material spills	No negative impact	Excavated topsoil from the area will be preserved and reused for horticulture purpose.
6.	Ecology, flora &	-Land use change	Minor negative	--

Sr. No	Components	Activities	Predicted impacts	Extent of Impacts
	fauna		impact	
7.	Socio-economy	-Increased job opportunity -Better social infrastructure	Overall positive impact	Socio-economic status of the region will be improved.
8.	Traffic pattern	Improved roads without any obstruction	Positive Impact	-

Chapter VIII

ENVIRONMENTAL MANAGEMENT PLAN

It has been evaluated that the study area will not be adversely affected significantly and impacts are mainly exposed to be confined to the proposed corridors. Mitigation measures at the source level and an overall Management Plan are elicited to improve the supportive capacity and also to preserve the assimilative capacity of the receiving bodies. The Management Action Plan aims at controlling pollution at the source level to the maximum possible extent with the available and affordable technology followed by treatment measures.

The Environmental Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental risks arising from the proposed project and take appropriate actions. EMP also ensures that the project implementation is carried out in accordance with the design and by taking appropriate mitigative actions to reduce adverse environmental impacts during its life cycle.

Developmental works along BRTS routes to a certain extent, create inevitable impacts mainly during construction phase, but these are temporary and rather marginal and can be reduced significantly with the help of effective EMP. The potential environmental impacts, which need to regulate are mentioned below:

- Air pollution due to the emission of Particulate Matter and gaseous pollutants;
- Noise pollution due to various noise generating equipment as well as vehicular movement;
- Wastewater generation from sanitary/domestic activities; and
- Solid waste disposal.

8.1 BROAD FRAME : ENVIRONMENT MANAGEMENT

8.1.1 AIR ENVIRONMENT

A. Construction Phase

To mitigate the impact of SPM/dust during the construction phase of the proposed project, the following measures are recommended:

- A Fugitive dust control.
- Procedural changes to construction activities.

A1. **Fugitive Dust Control**

Source wise Fugitive dust control measures are tabulated below:

Table 8.1: Fugitive Dust Control Measurers

Source	Control Measures
Earth moving	**- For any earth moving which are more than 30m from site boundary, conduct watering as necessary to prevent visible dust emissions.**
Disturbed surface areas	- Apply dust suppression measures frequently to maintain a stabilized surface; - Areas, which cannot be stabilized, as evidenced by wind driven dust, must have an application of water at least twice per day.

Source	Control Measures
Inactive disturbed surface areas	- Apply dust suppressants in sufficient quantity and frequency to maintain a stabilized surface.
Unpaved roads	- Water all roads used for any vehicular traffic at least twice per day of active operations; OR - Water all roads used for any vehicular traffic once daily and restrict vehicle speed to 20 kmph, which will reduce dust emission.
Open storage piles	- Apply water to at least 80 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust; OR - Install an enclosure all along the storage piles.
Track-out control	- Downwash of construction vehicles (especially tyres) prior to departure from site.

The most cost-effective dust suppressant is water. Water can be sprinkled by the handheld sprays or with the help of automatic sprinkler systems as the situation would demand. The incoming loads of dusty materials could be covered to avoid spreading of dust. Besides; loss of material in transport, especially if material is transported off-site, can very well be minimized.

A2. **Procedural Changes in Construction Activities**

- **Material Production** - The transport of materials such as concrete, asphalt, etc. to construction sites generate significant amounts of road dust, especially for sites that are relatively far off from the material manufacturers. Setting up the temporary portable concrete plants and/or asphalt plants at construction sites can eliminate haulage of these materials.
- **Idling Time Reduction** - Construction equipment is generally left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Existing idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention of the operators.
- **Improved Maintenance** - Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors could be asked to provide maintenance records for their fleet at regular intervals as a part of the contract awarded to them. A monetary incentive/disincentive provision could be made to encourage contractors to comply with the regular maintenance requirements.

- **Reduction of on-site construction time** - Rapid on-site construction could reduce the duration of traffic interference and therefore, reduce emissions from traffic delay.

B. Functional Phase

To mitigate the impact of pollutants from vehicular traffic during the operational phase of the site, the following measures are recommended for implementation:

- Vehicle emission controls; and
- Greenbelt development.

B1. Vehicle Emission Controls

Vehicles (Cars, Buses, Two-Three wheelers and Light Commercial Vehicles) to be used should be confirmed to BS-IV norms, which are in force. Regular maintenance of the vehicle should be mandatory. Restriction of speed is also helpful in the reducing the emission rate. Instead of petrol, the fuels like CNG/LPG could be encouraged.

B2. Greenbelt Development

Increasing vegetation in the form of greenbelt is one of the preferred methods to mitigate air pollution. Plants generate oxygen, serve as a sink for pollutants, reduce the flow of dust and reduce the noise pollution too along side the BRTS routes.

8.1.2 NOISE ENVIRONMENT

A. Construction Phase

To mitigate the impact of noise from construction equipment, the following measures are suggested:

- Noise prone activities could be restricted to the extent possible during night.
- Workers employed in high noise areas would be rotated. Earplugs/muffs, or other hearing protective devices could be provided to those working very close to the noise generating machinery.

B. Functional Phase

To mitigate the impact of noise from Vehicular movement the following measures are recommended for implementation:

B1. Greenbelt Development:

Noise attenuating / breaking species is being planted and proposed to be planted in a greenbelt, especially surrounding the noise generating sources.

B2. Vehicles loaded with latest technology:

The buses will be loaded with latest technology especially the less noise generating engine and silencer fitted with turbo jet.

8.1.3 IMPACT ON WATER RESOURCES

A. Construction Phase

To prevent degradation and maintain the quality of the water, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water into any nearby water body, stream, etc. Following management measures are suggested to protect the water quality during this phase.

- Avoid excavation during monsoon season.
- Care should be taken to avoid soil erosion.
- Pit latrines and community toilets with temporary soak pits and septic tanks should be constructed on the site during construction phase to prevent the wastewater from entering into the water bodies.
- To prevent surface and ground water contamination on account of oil/grease, etc. leak proof containers should be used for storage and transportation of oil/grease. The floors of oil/grease handling area should be kept effectively impervious. Any wash off from the oil/grease handling area or workshop should be drained through impervious drains and effluent should be treated appropriately before releasing it.
- Construction activities generate disturbed soil, concrete fines, oils and other wastes. On-site collection and settling of storm water, prohibition of equipment wash downs, toxic releases from the construction site, etc. are some of the essential measures which prove helpful in minimising water pollution.

B. Functional Phase

The water for plantation will be used in minimum quantity applying the drip irrigation system or similar technology all along the BRTS routes.

- **Storm Water Management:**

  Most of the storm water produced along the BRTS routes will be channeled to the well laid out storm water network devised alongside of both the corridors and it will recharge the aquifer through sand filter.

- **Rainwater harvesting:**

  Rainwater harvesting can serve as a solution to the water problem in the water crises area by capturing the runoff. Rain water harvesting helps in utilizing the primary source of water and prevent the runoff from going into sewer, thereby serving dual purpose: Making water available for future use and reducing the load on treatment plants. Recharging the water aquifers help in improving the quality of existing groundwater through dilution.

  Rainwater harvesting comprises of two components

  - Storing Rainwater in ground water reservoirs for beneficial use in future.
  - Rain water harvesting for artificial recharge of ground water.

  In proposed BRTS collected rain water will recharge in ground water through recharge pit.

8.1.4 IMPACTS ON LAND ENVIRONMENT

A. Construction Phase

Waste generated from construction activity includes construction debris, biomass from land clearing activities, waste from the labour camp, etc. Following section discusses management for each type of waste.

A1. Construction Debris

Construction debris is bulky and heavy and re-utilization and recycling is an important strategy for management of such waste. As concrete and masonry constitute the majority of waste generated, recycling of this waste by conversion to aggregate can offer benefits of reduced landfill space and reduced extraction of raw material for new construction activity.

Recycled aggregate could be used for filler application, and as a sub base for road and paved surface construction.

Construction contractors would be asked to remove metal scrap from structural steel, piping, concrete reinforcement and sheet metal work from the site. A significant portion of wood scrap can be reused on site. Recyclable wastes such as plastics, glass fibre insulation, roofing etc shall be sold to recyclers. NRDA has demarcated the construction debris landfill site within its limits.

A2. Waste from labour camp & Biomass:

Waste generated from labour camps will mainly comprise the household domestic waste, which would be collected and composted on site along with the biomass from the land clearing activities. The non-compostable and non-recyclable portion of the waste shall be collected and transported to the nearest identified landfill site.

A3. Topsoil Management

To minimize disruption of soil and for conservation of topsoil, the contractor shall take the topsoil out separately and stockpile it. After the construction activity is over, topsoil shall be utilized for landscaping activity. Other measures, which would be followed to prevent soil erosion and contamination include:

- Maximize use of organic fertilizer for landscaping and green belt development.
- To prevent soil contamination by oil/grease, leak proof containers could be used for storage and transportation of oil/grease and wash off from the oil/grease handling area shall be drained through impervious drains and treated appropriately before disposal.
- Removal minimum flora, as far as possible during the development, and re-vegetation of blank areas during and after the project.
- Working in a small area at a point of time (phase wise construction).

B. Functional Phase

- Solid waste generation is not anticipated during operation phase.

8.1.5 ECOLOGICAL ENVIRONMENT

A. Construction Phase

Cutting, uprooting, coppicing of trees or small trees present in and around labour camps for cooking, burning or heating purposes will be prohibited and suitable alternatives for this purpose will be provided.

After completion of major construction work, the green belt will be developed.

B. Functional Phase

Extensive plantation and landscaping is proposed to mitigate any impacts during this phase.

- **Plantation & Landscaping**

Road side Landscape plan is prepared. There are 10 plantation/landscape models of 150 m. different for each road, based on road speed design, ROW, and need of the adjacent area inherited from land use. Within the project area, around 215 Ha of land will be planted. Average 8000 trees will be planted in 1 Km. road i.e. 32000 in whole BRTS corridor within Naya Raipur. The details of the green area designed for development along the roads for 10 models i.e. 1500 Rm. Is given in the following Table no. 8.2

TABLE 8.2 : PLANTATION PLAN FOR 1500 R.M.

S.N.	Component	Number of Plants	Type of Plants
1	**Drain**	1650	Ground Cover / Shrub
2	**Utility Corridor**	23500	Ground Cover / Shrub
3	**Slope**	287	Ground Cover / Shrub
4	**Greenery**	357	Tree species
6	**Foot Path / Drain**	528	Tree species
7	**Bus By Lane**	1205	Ground Cover / Shrub
8	**Median**	740	Short Height Tree, Ground Cover / Shrub
	Total	**28267**	

Selected plants have mix of following characteristics.

i. The species are fast growing and providing optimum penetrability.

ii. The species are wind-firm and deep rooted.

iii. The species forms a dense canopy.

iv. The species are indigenous and locally available

v. Species tolerant to air pollutants like SPM, SO2 & NOx are preferred.

vi. The species are permeable to help create air turbulence and mixing within the belt.

viii. Trees species have high foliage density, leaves with larger leaf area and hairy on both the surfaces.

ix. Species have ability to withstand conditions like inundation and drought.

x. Species are soil improving (Nitrogen fixing, rapidly decomposable leaf litter).

xi. Sustainable green cover with minimal maintenance.

8.1.6 RELIGIOUS AND CULTURAL STRUCTURES AFFECTING IN THE BRT ROUTE

A temple of Shitala Mata near Navagaon which was coming in the BRT corridor is affected and shifted in the opposite direction, beside the Navagaon pond. Construction of this new temple is almost over. This is constructed with acceptance of Navagaon people. No other religious structures come in the BRT corridor.

: OLD SHITALA MATA TEMPLE LOCATED ON & SHIFTED FROM THE BRT CORRIDOR

FIGURE 8.1: NEW SHITALA MATA TEMPLE BESIDE NAVAGAON POND

8.2 ENVIRONMENT MANAGEMENT PLAN

To ensure better environment in & around the project site as well as the neighboring population, an effective EMP is developed for construction and operational phase as per the following table;

Table 8.3 Environment Management Plan

Environmental Aspect	Mitigation/Enhancement measures taken	Location	Time frame	Implementing Organization	Supervising/Monitoring
Design Stage/ Pre-Construction Stage					
Rain Water Harvesting	Provision of rainwater harvesting structure to recharge the ground water in the Work Shop and Depot	Near the Junction of Road NO. 1 and 4 village Reko	In the design phase	Contractor	NRDA
Oil separator	Provision of oil separator	Near the Junction of Road NO. 1 and 4 village Reko	In the design phase	Contractor	NRDA
Management of Liquid waste from the Workshop/Depot	Provision of Effluent Treatment Plant to treat the discharge from work shop containing oil, solvent, grease or detergent	Workshop/ depot	In the design	Contractor	NRDA

Environmental Aspect	Mitigation/Enhancement measures taken	Location	Time frame	Implementing Organization	Supervising/Monitoring
External Influence of construction campsites	Selection of camp site which should not have intervention with the local community.	Site of the labour camp.	During Design	Contractor	NRDA
Clearances, Approvals and Permits	Obtain all necessary clearances and approvals including Environmental Clearance, Forest Clearance, and Consent to establish and consent to operate under the Air (Prevention and Control of Pollution) Act, 1981 and Water (Prevention and Control of Pollution Act) 1974 and for felling of trees prior to commencing any road works	All project component and whole area	Before start of the construction	Contractor	NRDA
	Obtain written permission from private landholders to conduct activities on their land prior to commencing			Contractor	NRDA
	Adhere to all clearance terms and conditions			Contractor	NRDA
Construction Stage					
Environmental Management and Monitoring Facility for EMP	This will include institutional requirements, training, environmental management and monitoring. Provision for purchasing required equipment.	For the project	In the initial stage of the construction	Contractor	NRDA
Ambient Air Environment					
Emission from construction vehicle	All vehicles and machineries shall obtain and maintain the Pollution under Control Certificate (PUC). These vehicles will be maintained so that emissions conform to the standards prescribed in the certificate.	Project area	Project period	Contractor	NRDA
Emission from Diesel Generator	The relevant NoC will be obtained from the State Pollution Control Board. The Exhaust will be released at the height prescribed by the CECB and so that it does not affect the near by populations.	Project Area	Before start of work and whole project period	Contractor	NRDA
Dust	The construction site of work shop, depot and terminal station and bus shelter will be cordon off and boundary will be	Project area	Project period	Contractor	NRDA

Environmental Aspect	Mitigation/Enhancement measures taken	Location	Time frame	Implementing Organization	Supervising/Monitoring
	sealed. Water sprinkling will be done at the source of dust. All internal roads and parking areas are to be sealed in either concrete or bitumen				
Noise					
Noise of Diesel Generator	Use of Silent DG set. In case of non silent DG set , these DG sets will be place in acoustic rooms. The relevant NoC will be obtained from the CECB and maintain the noise level according to the prescribed level. The location of the DG set will be selected such way that it does not affect the local population.	Project area	Project period	Contractor	NRDA
Noise and vibration of Machineries and Vehicles	Machinery and vehicles will be maintained to keep their noise to a minimum.	Project area	Project period	Contractor	NRDA
Equipment Selection maintenance and operation	Construction plant and equipment will meet recognised international standards for emissions and will be maintained and operated in a manner that ensures that relevant air, noise, and discharge regulations are met	Project area	Project period	Contractor	NRDA
Noise and vibration at Construction Site	The working house will be maintained. In the residential area night time construction activity will be avoided while in commercial area the day time construction activity will be avoided. The working hour will be defined and disclosed for workers as well as local people.	Project area	Project period	Contractor	NRDA
Water					
Flood Impacts and Drainage at the workshop and depot	Provision of drains to collect the runoff from the workshop/ depot, bus shelters, terminal station to the main drain or the stream. The runoff is not allowed to mix with the oil, grease, solvents. Since these wastes will be treat in the ETP. All drains in the workshop will be lined drains to avoid	Workshop/ depots/ terminal station/ bus stops/ bus shelters	Project period	Contractor	NRDA

Environmental Aspect	Mitigation/Enhancement measures taken	Location	Time frame	Implementing Organization	Supervising/Monitoring
	any leaching of solvents caused due to accidental spillage.				
Alteration of drainage	Any alteration of drainage on the to be restored.	Project area	Project period	Contractor	NRDA
Drainage for Bus Stop	Drainage from the bus stop to be connected to the main drain.	Bus stops/ Bus Shelter	Project period	Contractor	NRDA
Sanitation at the Raipur Terminal Station	Provision of STP at Raipur Terminal Station	Raipur Terminal Station	Project period	Contractor	NRDA
Contamination from fuel and lubricants	Vehicle maintenance and refuelling will be confined to areas in construction camps designed to contain spilled lubricants and fuels. Waste petroleum and lubricants must be collected and taken to approved disposal sites, according to GOI laws.	Project area	Project period	Contractor	NRDA
Sanitation and Waste Disposal in Construction Camps	Sufficient measures will be taken in the construction camps, i.e. provision of rubbish receptacles and sanitation facilities. Waste in septic tanks will be cleared periodically as necessary. Drinking water will meet Indian National Standards. Rubbish will be collected and disposed of frequently. Special attention shall be paid to the sanitary condition of camps. Camps will be located at a minimum distance of 200 m from water sources.	Project area	Project period	Contractor	NRDA
Sanitation at Terminal Station at Naya Raipur		Project area	Project period	Contractor	NRDA
Health and Safety					
Worker's Health and Safety	Provision of Personnel Protective Equipment (PPE) - The assessment of the requirement of PPE before the mobilization of worker at site and provision of the same. Training of the worker before mobilization to the site and refresher training provided to the worker.	Project area	Project period	Contractor	NRDA
Loss of Access	Temporary access should be maintained throughout the course of the work unless the contractors make agreements with any affected frontages or legitimate user.	Project area	Project period	Contractor	NRDA

Environmental Aspect	Mitigation/Enhancement measures taken	Location	Time frame	Implementing Organization	Supervising/Monitoring
Traffic Jams and congestion	If there is traffic congestion during construction of bus shelter/ stops, measures should be taken to relieve it as far as possible with the co-operation of the traffic police.	Project area	Project period	Contractor	NRDA
Operation Stage					
Air					
Exhaust Emissions	Tuning and testing are the point source of air pollution. These activities should be conducted inside the building.	Project area	Project period	Contractor	NRDA
Washing facility for Bus	The discharge from washing of buses will be treated then discharge into the drain or stream.	Project area	Project period	Contractor	NRDA
Air-Conditioning Gas Recovery/Recycling	All work done on air-conditioners will follow the Industry Code of Practice for automotive air-conditioning. Approved refrigerant gas recycling and storage equipment shall be used in these circumstances.	Project area	Project period	Contractor	NRDA
Fire Protection	Fire extinguishers should be located at suitable location.	Project area	Project period	Contractor	NRDA
Staff Training	All staff are trained in accordance with the provisions of this Environmental Management Plan. In particular staff are regularly briefed on : • correct position of equipment; • relevant environmental issues; • proper waste disposal methods.	Project area	Project period	Contractor	NRDA
Spill Management	The liquids should be stored undercover within the building. A spill kit comprising of rags, absorptive material, broom, shovel are kept in close proximity to the storage area. All large containers should be frequently checked as they are repeatedly used. All	Project area	Project period	Contractor	NRDA

Environmental Aspect	Mitigation/Enhancement measures taken	Location	Time frame	Implementing Organization	Supervising/Monitoring
	liquid are stored in a constructed tray to contain any accidental spillage both for environmental protection reasons and workplace health and safety.				
Minor Spills	The container is up-righted/checked and if required drained and the area spot cleaned with either absorptive material or rags.	Project area	Project period	Contractor	NRDA
Major Spills	Where the unlikely event of a major spill occurs (>20 litres) the level in the interceptor is checked and if required <licence waste removalist's name> contacted to empty the triple interceptor.	Project area	Project period	Contractor	NRDA
Storage of Hazardous Substances	Motor Oil, Various Activities, Degreaser, Petrol, Brake Fluid, Solvent, Coolant, Waste Oil will be stored in the container as per the norms of CECB	Project area	Project period	Contractor	NRDA

1.4 TRAFFIC MANAGEMENT

The basic objective of the following guidelines is to lay down procedures to be adopted by contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen at construction sites.

a) All construction workers should be provided with high visibility jackets with reflective tapes as most of viaduct /tunnelling and station works or either above or under right-of-way. The conspicuity of workmen at all times shall be increased so as to protect from speeding vehicular traffic.

b) The guiding principles to be adopted for safety in construction zone are;

- Warn the road user clearly and sufficiently in advance.
- Provide safe and clearly marked lanes for guiding road users.
- Provide safe and clearly marked buffer and work zones
- Provide adequate measures that control driver behaviour through construction zones.

c) Legal permission

- In all cases, the contractor shall employ proper precautions. Wherever operations undertaken are likely to interfere with public traffic, specific traffic management plans shall be drawn up and implemented by the contractor in consultation with the approval of local police authorities and/or the concerned metropolitan/civil authorities as the case may be.

- Such traffic management plans shall include provision for traffic diversion and selection of alternative routes for transport of equipment. If necessary, the contractor shall carry out road widening before commencement of works to accommodate the extra load

d) The primary traffic control devices used in work zones shall include signs, delineators, barricades, cones, pylons, pavement markings and flashing lights.

e) The road construction and maintenance signs which fall into the same three major categories as do other traffic signs, that are Regulatory Signs, Warning Signs and Direction (or guidelines) Signs shall only be used. The IRC: 67 (Code of Practice for Road Signs) provide a list of traffic signs. The size, colours and placement of sign shall confirm to IRC: 67.

f) Regulatory signs

Regulatory signs impose legal restriction on all traffic. It is essential, therefore, that they are used only after consulting the local police and traffic authorities.

g) Warning signs

- Warning signs in the traffic control zone shall be utilised to warn the drivers of specific hazards that may be encountered.

- The contractor shall place detour signage at strategic locations and install appropriate warning signs. In order to minimize disruption of access to residences and business, the contractor shall maintain at least one entrance to a property where multiple entrances exist.

- A warning sign as per IRC SP 55 shall be installed an at all secondary road which merges with the primary road where the construction work is in progress at sufficient distance before it merges with the primary road so as to alert the road users regarding the ‘Work in Progress’.

- Materials hanging over / protruded from the chassis / body of any vehicle especially during material handling shall be indicated by red indicator (red light/flag) to indicate the caution to the road users.

h) Delineators

The delineators are the elements of a total system of traffic control and have two distinct purposes:

- To delineate and guide the driver to and along a safe path

- As a taper to move traffic from one lane to another.

- These channelising devices such as cones, traffic cylinders, tapes and drums shall be placed in or adjacent to the roadway to control the flow of traffic. These should normally be retro-reflectors complying to IRC: 79 - Recommended Practice for Road Delineators.

- Traffic cones and cylinders

  Traffic cones of 500mm, 750mm and 1000mm high and 300mm to 500mm in diameter or in square shape at base and are often made of plastic or rubber and normally have retro-reflectorised red and white band shall be used wherever required.

- Drums

  Drums about 800mm to 1000mm high and 300mm in diameter can be used either as channelising or warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers.

- Barricades

  - Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. Same the way barricades protect the road users from the danger due to construction equipment and other temporary structures.

  - The structure dimension of the barricade, material and composition, its colour scheme, Logo and other details shall be in accordance with specifications laid down in tender document.

  - All barricades shall be erected as per the design requirements of the Employer, numbered, painted and maintained in good condition and also Barricade in-charge maintains a barricade register in site.

  - All barricades shall be conspicuously visible at night. This shall be ensured by affixing retro reflective stripes of required size and shape at appropriate angle at the bottom and middle portion of the barricade at a minimum gap of 1000mm. In addition minimum one red light or red light blinker should be placed at the top of each barricade.

- The contractor shall ensure that all his construction vehicles plying on public roads (like dump trucks, trailers, etc.) have proper license to ply on public roads from the State Transport Authority. Drivers holding proper valid license as per the requirements of Motor Vehicles Act shall drive these vehicles

- The contractor shall not undertake loading and unloading at carriageways obstructing the free flow of vehicular traffic and encroachment of existing roads by the contractor applying the excuse of work execution.

- Tow away vehicle

The contractor shall make arrangements keeping tow away van / manpower to tow away any breakdown vehicle in the traffic flow without losing any time at his cost.

- Cleaning of roads

The contractor shall avoid impact on the cleanliness of public roads and footpaths due to his works, by deploying proper manpower for sweeping, cleaning, washing, including proper disposal of dust and debris arising.

8.3 ENVIRONMENTAL MANAGEMENT SYSTEM & MONITORING PLAN

For the effective implementation of EMP, an Environmental Management System (EMS) should be established at the site. The EMS should include the following:

- An environmental management cell.
- Environmental Monitoring.
- Personnel Training.
- Regular Environmental Audits & Corrective Action.
- Documentation – Standard operating procedures

8.3.1. Environmental Management Cell

A Cell for Environmental Management within NRDA at the project level, will take the overall responsibility for co-ordination of the actions required for environmental management and mitigation, and for monitoring the progress of the proposed management plans and actions to be taken for the project. The Cell will be headed by a qualified Environmental Engineer and the other members of the cell that will include an Environmental Field Officers, Scientist, Chemists and Operators. The cell will report to Chief Executive Officer NRDA for regular compliances.

The EMC will prepare a formal report on environmental management at six-monthly intervals. Reports on any urgent or significant issues may be prepared at shorter intervals.

Apart from responsibilities listed above, the EMC will have the responsibility of the following:

To implement the environmental management plan,

- To assure regulatory compliance with all relevant rules and regulations,
- To minimize environmental impacts as by strict adherence to the EMP,
- To initiate environmental monitoring as per approved schedule.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference.
- Maintain environmental related records.
- Coordination with regulatory agencies, external consultants, monitoring laboratories.
- All the Environment related aspects will be handled by a dedicated group and will be responsible for the compliance to all the issues
- To manage post project-monitoring plan as per approved EIA & EMP.
- To develop & maintain green belt
- To work for continuous & regular improvement in environmental engineering

8.3.2. Environmental Monitoring

The purpose of environmental monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse affects are detected and timely action can be taken.

In consultation with CECB, the NRDA will monitor ambient air quality, noise levels, groundwater quality and quantity, soil quality and solid wastes in accordance with an approved monitoring schedule. The monitoring protocol and location selection will have to be done carefully. The monitoring and sampling program should be discussed and approved. A suggested monitoring protocol, based on the predicted impacts, is given in **Table 8.4**.

Table 8.4: Suggested Monitoring Program during Construction Phase

Sr. No	Environmental attribute	No. Of Locations	Parameters	Period and Frequency

	Ambient Air Quality	Five stations per corridor	Criteria Pollutants: SO2, N0x, SPM, PM10, CO	• 24-hr average sampling except for CO, which will be 8-hr sampling. – • Twice a week
	Ambient Noise	Five stations per corridor	dB(A) levels	Hourly day and night time Leq levels every quarter during construction phase
	Water Quality	Five Samples per corridor	Drinking water parameters as per IS 10500.	Quarterly
	Soil quality	Five Samples per corridor	Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal. Alkalinity, Acidity.	Quarterly
	Inventory of flora			Once a two year
	Socio-economic condition of local population		Physical Survey	Once in two year

Table 8.5: Suggested Monitoring Program during Operation Phase

Sr. No	**Environmental attribute**	**No. Of Locations**	**Parameters**	**Period and Frequency**
	Ambient Air Quality	Three stations per corridor	Criteria Pollutants: SO2, N0x, SPM, PM10, CO	• 24-hr average sampling except for CO, which will be 8-hr sampling. – Quarterly
	Ambient Noise	Five stations per corridor	dB(A) levels	Hourly day and night time Leq levels • Twice a year
	Water Quality	Four Samples per corridor	Drinking water parameters as per IS 10500.	Twice a year
	Soil quality	four Samples per corridor	Organic matter, C, H, N,	Twice a year

			Alkalinity, Acidity, heavy metals and trace metal. Alkalinity, Acidity.	
	Inventory of flora			Once a year
	Socio-economic condition of local population		Physical Survey	Once in two year

Monitoring will be carried out externally through respective reputed agencies/laboratory. NRDA will depute its Environmental Engineers for regular checking of monitoring programme in accordance with the suggested monitoring programme.

8.3.3 Personnel Awareness & Training

Training and human resource development is an important link to achieve sustainable operation of the facility and environmental management. For successful functioning of the project, relevant EMP should be communicated both during constructional and functional phases to all concerned staff and contractors.

8.3.4. Environmental Audits & Corrective Action Plans

To assess whether the implemented EMP is adequate, periodic environmental audits will be conducted by Environment Cell. These audits will be followed by Corrective Action Plans (CAP) to correct various issues identified during the audits.

8.3.5. Documentation – Standard operating procedures

Record keeping and reporting of performance is an important management tool. Records should be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements is summarized in **Table 8.6**.

Parameter	Particulars
Solid Waste Handling &Disposal	• Daily quantity of waste received • Daily quantity treated and recycled • Daily quantity sold
Regulatory Licenses (Environmental)	• Environmental Permits / Consents from CECB / MoEF (if required) • Copy of Waste manifests as per requirement
Monitoring & Survey	• Records of all monitoring carried out as per the finalized monitoring protocol.
Other	• Log book of compliance • Employee environmental, health and safety records • Equipment inspection & calibration records, where applicable • Vehicle maintenance and inspection records

Table 8.6: Record Keeping Requirements

8.4 BUDGET PROVISION FOR EMP

It is necessary to include the environmental cost as a part of the budgetary cost component. The activity essential for the Environment Management is listed below in the table and its financial bearing is estimated.

Sr. No	Environmental attribute	No. of Locations/ Quantity	Costs covered in DPR In INR	Cost to be covered in EMP in INR
1.	Provision of Rain water harvesting structure to recharge the Ground water in the workshop and Depot	• Near The Junction of Road no. 1 and 4 village Reko	1,243,231	
2.	Oil Separator	• Near The Junction of Road no. 1 and 4 village Reko	225,000	
3.	Supply, installation, testing & commissioning of waste water DEWATA / SOIL SCAPE SYSTEM Treatment Plant with collection tank.	• Work Shop	650,000	
4.	Dust suppression	• The construction site of workshop, Depot and terminal station and bus shelter will be cordon off and boundary will be sealed. Water sprinkling will be done at the source of Dust. All internal roads and parking areas are to be sealed in either concrete or bitumen.		1,350,000
5.	Washing facility for bus		17,537,776	
6.	Ambient Air Quality Monitoring of all parameters of NAAQS,	• Five stations per corridor • 104 sample per		5,720,000

	2009	year per location.		
7.	Meteorological Monitoring of Wind speed, Wind direction, Humidity and temperature	• 2 location – One in Raipur and other in Naya Raipur • 104 days in a year.		1,664,000
8.	Ambient Noise level monitoring	• Five stations per corridor • 104 samples in a year		780,000
9.	Water Quality monitoring Drinking water parameters as per IS 10500.	• Five Samples per corridor. • 3 seasons in year		160,000
10.	Soil quality monitoring Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal. Alkalinity, Acidity.	• 10 locations. • Twice a year		160,000
11.	Inventory of flora	• Once in a year		50,000
12.	Socio-economic condition of local population Physical Survey	• Once in a year		2,00,000
13.	Environmental Training (Annual Training)	• Once in a year		1,000,000
Total			**19,656,007**	**4,436,000**
Operation Stage				
14.	Ambient Air Quality Monitoring of all parameters of NAAQS, 2009	• Three stations per corridor • 104 sample per year per location.		3,432,000
15.	Ambient Noise	• Five stations per corridor • 104 samples in year		936,000
16.	Water Quality Drinking water parameters as per IS 10500.	• Four Samples per corridor • Twice in a year		64,000
17.	Soil quality Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal. Alkalinity,	• four Samples per corridor • Twice in year		64,000

	Acidity.			
18.	Inventory of flora	• Once in a year		50,000
19.	Socio-economic condition of local population-Physical Survey	• Once in a year		2,00,000
20.	Staff Training	• Once in a year		1,000,000
Total				**5,746,000**

Chapter IX

Summary & Conclusions

The proposed BRT is essential for the future development of Naya Raipur. The project addresses the sustainable urban development through its road network implementation and traffic management system. It will provide a key premise for the district's sustainable development. By sharing the city functions with the existing urban centre, district development will contribute to the sustainable development of the entire Raipur city. The project includes two components for urban traffic sustainability: 1) development of the BRT, 2) utility facilities. The EIA revealed that the BRT System at Naya Raipur will have not much environmental impacts on soil, air, water, urban and rural ecosystems, economic activities, communities and society.

The EMP will reduce environmental impacts to acceptable levels. It includes environmental protection measures for all potential environmental impacts and a monitoring plan. It also designates relevant organization's environmental responsibilities. The EMP ensures implementation of the environmental mitigation measures during construction and operation. Therefore, the BRT project will be implemented in an environmentally sound manner and will effectively contribute to the sustainable urban development of Chhattisgarh and the future development of Naya Raipur.

ANNEXURE – I ENVIRONMENTAL CLEARANCE FOR NAYA RAIPUR

STATE LEVEL ENVIRONMENT IMPACT ASSESSMENT AUTHORITY
CHHATTISGARH
Government of India
Ministry of Environment and Forests

1-Tilak Nagar,
Shiv Mandir Chowk,
Main Road Avanti Vihar,
Raipur (C.G.)
E-mail: seiaacg@gmail.com
Website: www. seiaacg.org

No. 303 /SEIAA-CG/EC/T&AD/RYP/1/08 Raipur, Dated 8/12/2008

To,

Chief Executive Officer
Naya Raipur Development Authority
Near Mantralaya,
Raipur (Chhattisgarh).

Sub: - Conditions to be complied with for according Environmental clearance for PLANNING & DESIGNING OF NAYA RAIPUR SATELLITE CITY OF CHHATTISGARH, NRDA, RAIPUR – Regarding.

Ref: -
1. Your letter no. 382/EIA & EMP Naya Raipur/NRDA/07 Raipur, dated 11/02/2008
2. Your letter no. 1036/3-92/EIA & EMP Road/NRDA/07 Raipur, dated 25/04/2008
3. Your letter no. 1037/EIA & EMP Naya Raipur/NRDA/07 Raipur, dated 25/04/2008
4. This office letter no. 99/SEIAA-CG/T&AD/RYP/1/08 Raipur, dated 03/07/2008.
5. This office letter no. 138/SEIAA-CG/T&AD/RYP/1/08 Raipur, dated 04/08/2008.
6. Your letter no. 3067/NRDA/08 Raipur, dated 21/08/2008.

---::000::---

The application submitted by Naya Raipur Development Authority for Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" was considered in second meeting of SEAC, Chhattisgarh held on 5th April 2008. Initially NRDA, Raipur has submitted two separate applications for "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" and "Construction of Express Way of 100 meter ROW, Roads with 100 meter ROW and 60 meter ROW at Naya Raipur". These two applications were considered in the second meeting of SEAC, Chhattisgarh held on 5th April 2008. The proposed expressway and roads at Naya Raipur are neither a National Highway nor a State

4690 15/12/08

Highway. The National Highways and State Highways (new or expansion) only are covered in the schedule of EIA Notification, 2006, therefore the SEAC, Chhattisgarh decided that the construction of Express Way of 100 meter ROW, Roads with 100 meter ROW and 60 meter ROW at Naya Raipur project should be a part of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur and it should not be treated separately. Accordingly, NRDA, Raipur submitted the revised Form-I, Form-I 'A' including the express way and roads in the Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur project. The SEAC, Chhattisgarh considered this application. As per decision taken in second meeting of SEAC, Chhattisgarh, project proponent along-with consultant made the presentation before SEAC, Chhattisgarh on 26th April 2008. This project is covered in serial no. '8(b) Townships and Area Development Project' of EIA Notification, 2006.

The Government of Chhattisgarh has envisaged creation of a new capital city by the name of 'Naya. Government of Chhattisgarh has constituted the 'Naya Raipur Development Authority' as a Special Area Development Authority to plan, implement and administer Naya Raipur.

The Naya Raipur city mainly includes the following:

- Government complexes to include Secretariat, Assembly, Government Offices, and Police Head-quarters area.
- Cultural center to include Museum, Art Gallery, Library, Theatres, Convention center and International Center.
- City Center to include city level shopping malls, commercial offices, restaurants, multiplexes and other areas of recreation.
- University including research and institutional complexes.
- Software technology park, exhibition and business centers.
- Central City Park around an existing vast water body. Park and Sports Center in the North end to include urban forest, theme park and sports complex. City Park South to include Theme Park, Jungle Safari, Golf Course and Film City.
- Transport and integrated freight complex to service the city and its industrial area.
- Living areas with medium density development.
- Express way / roads etc.

As per Ministry of Environment and Forests, Government of India circular No.23/3/2007-IA.III, dated - 05/02/2008, the State Level Expert Appraisal Committee, Chhattisgarh recommended for issue of provisional Environmental Clearance (Conditions to be complied with for according Environment Clearance) as per the provision of Environmental Impact Assessment Notification, 2006 and the subsequent amendments.

II

The application submitted by Naya Raipur Development Authority for "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" and recommendation of State Level Expert Appraisal Committee, Chhattisgarh was considered in the third and fourth meeting of SEIAA, Chhattisgarh held on 16th June 2008 and 30th September 2008 respectively. After detailed deliberations SEIAA, Chhattisgarh accepted the recommendation of SEAC, Chhattisgarh and decided to issue the Provisional Environmental Clearance (conditions to be complied with for according Environment Clearance) as per Ministry of Environment and Forests, Government of India circular No.23/3/2007-IA.III, dated 05/02/2008) for Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur.

In pursuant to above Provisional Environmental Clearance (conditions to be complied with for according Environment Clearance) as per Ministry of Environment and Forests, Government of India circular No.23/3/2007-IA.III, dated 05/02/2008) for "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" is hereby accorded subject to strict compliance of the terms and conditions mentioned below:-

PART A – SPECIFIC CONDITIONS

I. Construction Phase

Facility of Labourers during Construction: -

i) Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project. Construction camp and temporary labour sheds shall be located away from the construction site. Construction camps shall be provided for construction personnel to avoid indiscriminate settlement of construction workers and labourers.

ii) Provision of drinking water, wastewater disposal, solid wastes management and primary health facilities shall be ensured for labour camps. Proper sanitation facilities shall be provided at the construction site to prevent health related problem. Domestic as well as sanitary wastes from construction camps shall be cleared regularly.

iii) Water usage during construction shall be optimised to avoid any wastage.

iv) Ground water shall not be used for construction works during construction phase.

v) Adequate safely measures shall be adopted to the construction workers.

vi) All the labourers to be engaged for construction works shall be screened for health and adequately treated before issue of work permits. The contractor shall ensure periodic health check-up of construction workers.

vii) Provision shall be made for the supply of kerosene or cooking gas /pressure cooker to the labourers during construction phase.

III

Environmental Management during Construction: -

i) Some of the existing buildings/houses/structures within project site are proposed to be demolished. Re-use of debris at existing site as far as practicable is recommended with a special care for handling and disposal of asbestos waste, if any. Rest of waste is to be disposed at the sanitary landfill disposal site at Naya Raipur City.

ii) The asbestos waste, from demolition debris, if any, shall separated and shall be disposed at proposed Common Hazardous Wastes, Treatment and Disposal Facility of Naya Raipur City.

iii) Appropriate measure like adequate drainage, embankment consolidation and slope stabilization shall be taken along the city road to avoid soil erosion. Top soils (20 cm) of the borrow pit sites shall be conserved and restored after completion of excavation. All the topsoil excavated during construction activities shall be stored for use in horticulture/landscape development within the project site. Proper erosion control and sediment control measures shall be adopted.

iv) Earth material generated from excavation shall be reuse to the maximum possible extent as filling material during site development. The construction debris and surplus excavated material shall be disposed off by mechanical transport in suitable pre-identified dumping areas to avoid land degradation and water logging due to indiscriminate dumping. Dumping areas shall be biologically reclaimed through topsoil cover and plantation.

v) A soil erosion and sedimentation control plan shall be prepared prior to construction. The soil erosion, sediment control and storm water practices mentioned in this document shall be incorporated depending upon the site characteristics to control soil erosion and loss of top soil during construction.

vi) Disposal of muck including excavated material during construction phase shall not create any adverse effects on the neighbouring communities and disposed off taking the necessary precautions for general safety and health aspects.

vii) Low sulphur diesel type diesel generator sets should be used during construction phase. Diesel generator sets during construction phase shall have acoustic enclosures and shall conform to Environment (Protection) Rules, 1986 prescribed for air and noise emission standards.

viii) All Vehicles/equipments deployed during construction phase shall be ensure in good working condition and shall conform to applicable air and noise emission standards. These shall be operated only during non-peaking hours.

ix) Ambient noise levels shall conform to residential standards both during day and night. Fortnightly monitoring of ambient air quality (RPM, SPM, SO_2 and NOx). Equivalent noise levels shall be ensured during construction phase and closely monitored during construction phase.

x) The protective equipments such as earplugs etc. shall be provided to construction personnel exposed to high noise levels. Stationary construction

equipments generating noise shall be placed at-least 125 m away from inhabited areas and at-least 200 m away from the silence zones. Construction activities carried out near residential area shall be scheduled to daytime only. Only limited necessary construction shall be done during nighttime. No unloading of construction materials shall be done at night. Vehicular noise and use of horns shall be controlled through enforcement of laws and public awareness. Use of pressure horns shall be strictly prohibited. Appropriate noise barriers at silence zones shall be provided. To reduce noise level, the arterial roads shall be designed to have 2 to 3 rows of plantation.

xi) The separation of housing from traffic noise by interposing buffer zones, and the protection of schools and hospitals and other sensitive areas by green belts, public gardens, etc. should be ensured. To overcome the problem caused by aircraft noise, noise exposure forecast (NEF) criterion should be adopted. No residential development shall be allowed beyond NEF 35 level. For very critical buildings such as buildings necessary for maintaining and supplementing the airport services, and for commercial development, such as hotels, provide sealed windows and to centrally air-condition the entire building. Local housing roads shall not provide short cuts for heavy traffic zones through residential areas. Trees with heavy foliage shall be planted on both sides of carriageway. Highway noise barriers shall be also used for reducing traffic noise around residential areas.

xii) Construction spoils, including bituminous material and other hazardous materials including oil from construction equipments must not be allowed to contaminate watercourses and the dumpsites for such material must be secured so that they shall not leach into the ground water. If necessary, oil trap shall be installed where heavy machineries are deployed.

xiii) Proper and prior planning, sequencing and scheduling of all major construction activities shall be done. Construction material shall be stored in covered godowns/sheds. Truck carrying soil, sand and other construction materials shall be duly covered to prevent spilling and dust emission. Adequate dust suppression measures shall be undertaken to control fugitive dust emission. Regular water sprinkling for dust suppression shall be ensured. Mass transit system shall propose for the new city in order to reduce the vehicular emission.

xiv) Use of Ready-Mix concrete is recommended for this project.

xv) Accumulation/stagnation of water shall avoid ensuring vector control.

xvi) Regular supervision of the above and other measures shall be in place all through the construction phase so as to avoid disturbance to the surroundings.

Selection of Materials for Better Energy Efficiency: -

i) Use of energy efficient construction materials shall be ensured to achieve the desired thermal comfort.

ii) Use of fly ash based bricks/blocks/tiles/products shall be explored to the maximum extent possible. Blended cement with fly ash shall be used (not less than 17%). The provisions of Ministry of Environment and Forests, Government of India Notification No. 763(E) dated 14/09/1999 [amended notification no. SO 979 (E) dated 27/08/2003] regarding use of Fly Ash must be complied with. Appropriate usage of other industrial wastes shall also be explored. Soil borrow area should be filled up with ash with proper compaction and covered with top soil kept separately. Fly ash/pond ash should be used for low- lying areas filling. In embankments / fly over / road construction etc. ash should be utilized as per guidelines of Ministry of Environment and Forests, Government of India/ Central Pollution Control Board/ Indian Road Congress etc. concerning authorities. The use of perforated brick / hollow blocks / fly ash based lightweight aerated concrete etc. should also be explored so as to reduce load on natural resources.

iii) Construction shall conform to the requirements of local seismic regulations. The project proponent shall obtain permission for the plans and designs including structural design, standard and specifications of all construction works from concerned authority.

iv) Reduce the use of glazed surface as per National Building Code 2005. Use of glass in various complexes may be reduced up to 40% to reduce the electricity consumption and load on air-conditioning. If necessary, use of high quality double glass with special reflective coating in windows. Roof of the various complexes should meet prescriptive requirement as per Energy Conservation Building Code by using appropriate thermal insulation material to fulfil requirement. Opaque wall should meet prescriptive requirement as per Energy Conservation Building Code which is proposed to be mandatory for all air conditioned spaces while it is inspirational for non-air-conditioned spaces by use of appropriate thermal insulation material to fulfil requirement.

v) Use of energy efficient construction materials to achieve the desired thermal comfort shall be incorporated. The desired level of roof assembling 'U' factor and insulation 'R' value must be achieved. Roof assembling 'U' factor for the top roof shall not exceed 0.4 Watt/sq.m/degree centigrade with appropriate modifications of specifications and building technologies. The provisions of National Building Code 2005 shall be strictly followed.

vi) Modern electrical power transmission & distribution system shall be installed. Power supply for up to 33 kV shall be supplied through underground distribution system. Power supply at 132 kV or above shall be supplied through overhead system. The main receiving stations (Grid stations) shall have the SCADA (Supervisory Control and Data Acquisition) facility to ensure online monitoring & control of power supply.

vii) Street lighting shall be energy efficient. The High Pressure Sodium Vapour (HPSV) Lamps & Compact Fluorescent Lamps (CFL) along city network system shall be provided. High intensity, high mast lights to be installed at intersections, bus stops, stadium, transport hubs and major pedestrian

movement areas as per the specifications and guidelines prescribed by the Bureau of Indian Standards. Solar energy may be used for outdoor lighting.

viii) Extensive network of cellular phones and landlines shall be provided. Fibre optic cables shall be used. The telephone and electric cables shall be laid in the same corridor. Adequate vertical and horizontal separation between telephone and electric cable shall be maintained.

ix) Guidelines to the household shall include usage efficiency measures such as energy efficient lighting and rainwater harvesting system.

x) Reduce hard paving-onsite (open area surrounding building premises) and/or provide shade on hard paved surfaces to minimize heat island effect and imperviousness of the site.

xi) Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, Expressways, City Arial Roads, Sector Peripheral and Intra-Sectoral Roads etc. are proposed to come up in the earmarked area. All proposed air-conditioned buildings should follow the norms proposed in the ECBC regulations framed by the Bureau of Energy Efficiency. Use of chillers shall be CFC & HCFC free.

Water Body Conservation: -

i) No water body shall be lined or no embankment shall be cemented. The water bodies shall be kept in natural conditions without disturbing the ecological habitat.

ii) Improvement or rehabilitation of existing natural streams, channels / nallas shall be carried out without disturbing the ecological habitat.

iii) No untreated wastewater shall be discharge in the any water bodies under any circumstances.

iv) All the construction and preparatory activities shall be carried out during dry seasons only.

Water Supply: -

i) Proposed Annicut on Mahanadi River shall be source of water supply for first phase, whereas, for second and third phases, new barrage near Rajim shall be the source of water supply.

ii) The water supply norms based on manual of Central Public Health and Environmental Engineering Organization (CPHEEO) and master plan for Delhi 2001 shall be adopted for Naya Raipur City.

iii) The water treatment plant shall be provided for treatment of water. The treatment shall include screening, sedimentation, filtration and disinfections. The Water Treatment Plant shall be constructed in different modules.

iv) Appropriate arrangement shall be made for treatment and reuse of backwash water of filtration plant.

v) Project proponent shall provide adequate measuring arrangement at the inlet point of water uptake and at the discharge point for the measurement of water utilized in different categories to monitor the daily water consumption. Measuring arrangement for effluent generated shall also be provided.

vi) Water saving practices such as usage of water saving devices / fixtures, low flow flushing systems, sensor based fixtures, auto control walls, pressure reducing devices etc. should be adopted.

Greening Programme: -

i) Lay out of proposed Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, Expressways, City Arial Roads, Sector Peripheral and Intra-Sectoral Roads etc. shall be made in such a way that it shall cause minimum disturbance to existing flora and fauna. Appropriate green belt shall be developed to compensate the habitat loss of trees for site clearing. The project proponent must obtain permission for tree cutting from competent authority as per prevailing Act/Rules. The exotic species existing within the planning area, if any, shall be protected. The greening programme shall include plantation of exotic and indigenous species.

ii) A buffer of 20m on either side of canals & streams, 50m around water bodies and 100m along Mahanadi canal shall be reserved as greenbelt without allowing any development. Plantation along the side of the roads and in the open spaces shall be developed to act as sinks of air pollutants.

iii) Adequate plantation programme along the city level road and open spaces shall be planned. The plantation of trees shall be completed in the construction stage. The plantation programme shall be drawn to conform the natural climate conditions. The plantations shall consist of mixture of available indigenous, fast growing and sturdy species of trees, shrubs and herbs. Preferential plantation of flowering trees with less timber and fruit value shall be carried out. To compensate the habitat loss of any fauna, about five hundred wide greenbelt all around the Naya Raipur City shall be developed.

iv) Green belt shall be comprised of specific plant species as per Central Pollution Control Board's guidelines depending up on the type/nature of pollution. The pollutants wise plant species shall be provided.

Sewage Management: -

i) As per the proposal submitted by project proponent, the project area shall be divided into two drainage zones – southern zone & northern zone. Southern zone shall cater about 60% and Northern zone about 40% of the total sewage. Two Sewage Treatment Plants of total 96 MLD (minimum) capacities shall be constructed. STP should be developed in phases. As single modular Sewage Treatment Plant is energy efficient, hence, the possibility of single modular Sewage Treatment Plant of adequate capacity should also be explored for treatment of sewage generated from Naya Raipur city in order to conserve the

energy. Treatment based on primary settling followed by activated sludge process and dis-infection shall be adopted. Sewerage system of adequate capacity to carry the sewage during peak hours shall be laid to collect and convey the sewage from various complexes. Three sewage-pumping stations of adequate capacity shall be constructed for sewerage system at southern zone, northern zone & intermediate pumping station. The augmentation of Sewerage System, Sewage- Pumping Stations and Sewage Treatment Plants shall be ensured before the operation phase starts.

Rain Water Harvesting Scheme: -

i) Rainwater from open spaces shall be collected and reuse for landscaping and other purposes. Rooftop rainwater harvesting shall be adopted for Naya Raipur City. Every government/private buildings, shopping malls & residential apartments shall have rainwater-harvesting facilities. The storm water flowing in roadside drains shall also be recycled and reused to maintain the vegetation and discharged into natural water bodies. Before recharging the surface runoff, pre treatment must be done to remove suspended matter and oil & grease.

ii) Net imperviousness of the site should not exceed the imperviousness factor as prescribed by the National Building Code of India, Bureau of Indian Standards, 2005.

Transport Management: -

i) Dedicated cycle tracks and pedestrian paths shall be provided along the major roads. Appropriate access shall be provided for physically challenged people in the pedestrian paths.

ii) The design of service roads and the entry and exit from the housing complexes shall conform to the norms & standards prescribed by the National Highways Authority of India/ State Public Works Department.

iii) All the villages shall be connected by an all-weather village road to a higher order road either directly or through another village settlement. Naya Raipur City Transport System shall not cover more than 12.55% (10055.77 Ha) of the gross area of Naya Raipur. Naya Raipur City Transport System shall comprise of City Arial Roads (ROW-100 m), Sector Peripheral (ROW-60 m) and Intra-Sectoral Roads (ROW-24m /18m /12m).

iv) The road system shall have the road cross sections for general traffic, exclusive ways for public mass transport (bus) system, pedestrian paths and ways, cycle tracks, utility corridors and green strip. The major roads shall be free of service lanes to check direct access of abutting property / activity from the main road. An internal road system linked to the main roads at defined locations shall be provided for access to all the activities.

v) In the initial period, flexible pavement (as per IRC guidelines for the design of flexible pavement IRC: 37-2001) shall be constructed to allow the consolidation and settling of base. Cement concrete pavement shall be

constructed in the later phases. Permeable (porous) paving in the parking areas, and walkways & patio areas should be used to control surface water runoff by allowing storm water to infiltrate the soil and return to ground water.

vi) All intersections shall be designed and developed as roundabouts. The diameter of the central rotary shall be more than the carriageway widths of links meeting at the intersections. Roundabouts shall be landscaped with wide variety of flora and fauna of Chhattisgarh. Geometric designs of Links and Nodes shall be based on manuals and guidelines and in conformity with standards and specifications prescribed by concerned authorities.

vii) All utility lines (electricity, telephone, cable, water supply, sewerage, drainage, etc.) shall be laid below ground level. Ducts shall be provided along and across the roads to lay the utility lines. Major trunk (water/sewerage) lines are to be laid along the utility corridor.

viii) The road drainage shall be designed to enable quick runoff of surface water and prevent water logging. The road level shall be kept at least 0.5 to 1.0 meter above the observed high flood level. The guidelines on Urban Drainage, IRC: SP-50 shall be followed. Fencing along the outer edge of the road right off way shall be carried out to prevent unauthorized ribbon development. The pedestrian shall be given priority attention in the transport system, which includes footpaths, pedestrian ways (along the ROW of the major roads 100 m / 60m) and pedestrian corridor, pedestrian plazas and other facilities. On the both sides of all roads, well –lit and smooth surfaced footpaths, of minimum 2.0 m width shall be provided. Cycle Tracks, of minimum 3m width shall be provided along the green and pedestrian corridors and ways. The hoardings shall be strictly prohibited along the roads.

ix) The public mass transport of Naya Raipur shall include (a) Bus System [Common Carrier] (b) Intermediate Public Transport modes and (c) Rail based Light Rail Transit.

x) Adequate provision shall be made to cater the parking needs. Parking spaces standards as given in 'Manual on Norms and Standards for Environmental Clearance of Large Construction Projects' issued by Ministry of Environment & Forests, Government of India shall be adapted.

Others: -

i) All mandatory approvals and permissions as required from Airport Authority, Director of explosives and Fire Department etc. shall be obtained.

ii) Unskilled construction labourers shall be recruited from the local areas. Construction materials shall be procured locally as far as possible.

iii) Provision shall be made in layout plan for distribution of convenient shops and Nursery Schools as per planning norms and minimum walking distance from the households.

x

iv) Provisions shall be made for the integration of solar water heating system. Provision for the use of biomass as a source of energy generation may be explored.

v) Provision of vermi-composting for the biodegradable solid wastes generated from the Government Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, Housing Complexes as well as the large amount of biomass that shall be available from the tree plantation shall be made.

vi) Information regarding hydrogeology and ground water regime shall be incorporated. Surface water analysis regarding quality and the availability of sufficient quantity of water supply to the various complexes shall be ensured. Periodical monitoring of ground water table and quality shall also be carried out. Construction of tube wells, bore wells shall be strictly regulated. The ground water shall not be abstracted without prior permission from the competent authority in the project area. Permission to draw ground water shall be obtained from the competent authority prior to construction / operation of the project.

vii) The Strom water management plan shall be designed in such a manner that the storm water is discharged though an existing dedicated Storm water outfall only. The design shall confirm the existing drainage scheme of the surrounding locality. Storm water control and its re-use as per CGWB and BIS standards for various applications should be followed.

viii) Adequate roadside drains shall be provided along the city road to facilitate its better maintenance and increase in the life of the carriageway, which shall avoid soil erosion and land degradation due to water stagnation. The roadside drains shall be provided on both sides of the road. Longitudinal and cross drainage system shall be regularly maintained. Adequate new drainage works and cross drainage structures shall be provided for smooth passage of runoff. Filling of existing natural drainage courses shall be strictly avoided. Suitable drainage at construction site and camp shall be provided to eliminate the formation of stagnant water pools.

II. Operation Phase

Sewage Treatment Plant: -

i) Project proponent shall operate and maintain the sewerage system, sewerage pumping system and sewage treatment system regularly to ensure the treated effluent quality within the standards prescribed by Ministry of Environment and Forests, Government of India or prescribed by Chhattisgarh Environment Conservation Board (which ever stringent). All the effluent treatment system shall be kept in good running conditions all the time and failure (if any), shall be immediately rectified without delay, otherwise, some alternate arrangement shall be made for storage of untreated sewage until the control measures are rectified to achieve the desired efficiency. Project proponent shall install separate electric metering arrangement with time totalizer for the running of

pollution control systems. The record (logbook) of power & chemical consumption for running the pollution control systems shall be maintained.

ii) Properly treated and disinfected (Ultra Violet) sewage shall be utilized in pisciculture, forestry, fire fighting, in Government buildings, shopping malls and private & government apartments for cooling purpose, to develop and maintain the greenbelt along the city road, expressway and in open spaces etc. As far as possible discharge of treated sewage into watercourses / water bodies shall be avoided. Only treated sewage confirming the norms of effluent standards prescribed by Ministry of Environment and Forests, Government of India or prescribed by Chhattisgarh Environment Conservation Board (which ever stringent) shall be allowed to discharge into those watercourses / water bodies, which is not use for source of drinking water supply or use for bathing purpose in downstream, depending upon the assimilative capacity of the watercourse / water body.

iii) Open defecation within the Naya Raipur city shall be strictly controlled.

iv) Non-mixing of fecal matter with the municipal solid wastes shall be strictly ensured.

v) Non-mixing of sewage/sullage with rainwater shall be strictly ensured.

Emission of Diesel Generator Set: -

i) Noise barriers shall be provided at appropriate locations so as to ensure that the noise levels do not exceed the prescribed standards. DG sets shall be provided with necessary acoustic enclosures as per Central Pollution Control Board norms.

Ensure Energy Efficiency: -

i) Back up supply as well as public transportation system proposed for project shall be based on Natural Gas/cleaner fuel subject to their availability.

ii) The project proponent shall resort to solar energy at least for street lighting and water heating for Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions, gardens / park areas.

iii) During maintenance, energy efficient electric light fittings & lamps – low power ballasts, low consumption high power luminaries, lux level limiters & timers for street lighting shall be provided.

iv) A report on the energy conservation measures confirming to energy conservation norms finalized by Bureau of Energy Efficiency should be prepared incorporating details about building materials & technology, 'R' value & 'U' factors etc.

Municipal Solid Waste/ Other Wastes: -

i) Municipal solid wastes generated in the Naya Raipur City area shall be managed and handled in accordance with the compliance criteria and

procedure laid down in Schedule – II of the Municipal Wastes (Management and Handling Rules,2000 (As amended).

ii) The specification of the landfill sites shall be in accordance with the compliance criteria and procedure laid down in Schedule – III of the Municipal Wastes (Management and Handling Rules, 2000 (As amended).Similarly, the standard for composting, treated leachates & Incineration (if any) as mentioned in Schedule – IV of the Municipal Wastes (Management and Handling Rules, 2000 (As amended) shall be followed.

iii) Two-chambered container (one for recyclable wastes and other for all organic and compostable wastes) shall be placed at 500 m distance on the roadside. Covered dustbins / garbage collector in convenient places to collect the municipal solid wastes shall be provided. Coordination with government and semi government agencies, railways, industrial establishment and institutions for finalizing a programme for efficient removal and reduction of solid wastes from roadsides and drains shall be ensured. Modern trucks capable of using hydraulic lifting as well as safe covered garbage containers shall be provided for transportation.

iv) The project proponent must specify whether bio composting or vermi composting of municipal solid wastes should be carried out? The technical details of bio composting or vermi composting of municipal solid wastes shall be submitted.

v) Proper composting/vermi composting of municipal solid wastes shall be carried out. The proponent must develop the Solid Wastes Segregation, Collection, Handling, Transportation and Disposal Scheme ensuring safe and scientific segregation, collection, handling, transportation and disposal of organic and inorganic portion. The organic waste is to be composted/vermi composted at the compost plant within the project site. All municipal solid wastes shall be segregated, collected, transported, treated and disposed as per provisions of the Municipal Solid Wastes (Management and Handling) Rules, 2000 (As amended).

vi) Public awareness programmes of benefit of living a clean and healthy life by proper management of solid wastes shall be organized regularly.

vii) Hazardous wastes and bio-medical wastes shall be disposed off separately. Centralized common facility for segregation, collection, transportation, treatment and disposal including incinerator (fitted with adequate air pollution control equipment and stack of adequate height) for management of all bio-medical wastes shall be established. All bio-medical wastes shall be segregated, collected, transported, treated and disposed as per provisions of the Bio-Medical Wastes (Management and Handling) Rules, 1998 (As amended).

viii) Centralized common facility for segregation, collection, transportation, treatment and disposal for management of all hazardous wastes shall be established. All hazardous wastes shall be segregated, collected, transported,

treated and disposed as per provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 (As amended).

ix) The use of hand gloves, shoes and safety dress for all waste collectors and sorters shall be enforced.

x) Recycling of all recyclable wastes such as; newspaper, aluminium cans, glass bottles, iron scrap and plastics etc. shall be encouraged through private participation. Project proponent shall take appropriate action to ensure minimum utilization of plastics carry bags and plastics small containers etc. within the Naya Raipur city. 100% collection and recycling of plastics used within the Naya Raipur city shall be ensured.

xi) Intensive program of tree plantation on the disposal areas shall be carried out after the site is filled up.

PART B – GENERAL CONDITIONS

i) Project proponent should submit the details of animal population & its management and management of wastes (liquid and solid both) generated from animal husbandry within the Naya Raipur city area and rehabilitated population area.

ii) Details of project-affected people (PAPs) being rehabilitated/relocated shall be provided. A special rehabilitation scheme to ensure a reasonable compensation package to project affected persons in NRDA area shall be implemented as per R & R policy of Government of Chhattisgarh. Rehabilitation scheme to ensure most favorable compensation package to project-affected people (PAPs) in Naya Raipur Development Area shall be adopted. New houses shall be provided in a residential area to families, which need to be relocated on account of development works within 5 kms. Relocated families shall be given plots of either 1500 sq.ft. area or 2400 sq.ft. area.

iii) Minimal dislocation of human settlement on account of the project shall be ensured. In addition to payment of compensation also make available land for horticulture / floriculture or utility shops, Gumties or residential plot, free of cost in and around existing Abadi land of the villages to the project affected people. Families of any village, which needs to be relocated on account of development works, shall be provided new houses in a residential colony within 5 kms distance from their existing homes. The rehabilitation colony shall have adequate number of school buildings, Angan Wadis and common facility centres. The residential colony shall also accommodate families who need to be rehabilitating from other villages.

iv) Demarcation of the total area being given compensation to project-affected people (PAPs) on the location map along with resettlement plan shall be provided.

v) Rest room facilities shall be provided for service population.

vi) The environmental safeguards and mitigation measures contained in the EIA Report shall be implemented in letter and spirit.

vii) All the conditions, liabilities and legal provisions contained in the Environmental Clearance shall be equally applicable to the successor management of the project in the event of the project proponent transferring the ownership, maintenance of management of the project to any other entity.

viii) The project proponent shall make financial provision in the total budget of the project for implementation of the above-mentioned conditions and for suggested environmental safeguard measures. The funds earmarked for the environmental protection measures shall not be diverted for other purposes.

ix) Six monthly monitoring reports shall be submitted to the Chhattisgarh Environment Conservation Board, Raipur, who shall be monitoring the implementation of environmental safeguards shall be given full cooperation, facilities and documents / data by the project proponents during their inspection. A complete set of all the documents shall submit to State Level Environmental Impact Assessment Authority, Chhattisgarh.

x) The responsibility of implementation of environmental safeguards rests fully on the project proponent. Project proponent shall establish an environmental management cell to carryout functions relating to environmental management under the supervision of senior executive, directly reporting to the head of organization.

xi) In the case of any change(s) in the scope of the project, the project shall require a fresh appraisal by the SEIAA. As the details for the Government Complexes, Housing Complexes, Cultural Centres, Industrial / IT Park, Commercial Complexes, Education Institutions etc. have not been submitted with respect to built-up area, excavation, water consumption, sewage generation, solid wastes generation, power requirement, pollution control arrangements, environmental safeguards, construction material etc. for construction and operation phases, therefore, the respective project proponents shall obtain separate Environmental Clearance for those construction projects which falls under the schedule of Environment Impact Assessment Notification, 2006 from State Level Environmental Impact Assessment Authority, Chhattisgarh as per provisions of Environment Impact Assessment Notification, 2006.

xii) The issuance of this letter does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Central, State or Local laws or regulations.

xiii) Risk Assessment study along-with Disaster Management Plan (DMP) shall be prepared. The mitigative measures for disaster prevention and control shall be prepared and get approved from competent authority. All other statutory clearances from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponent. Project proponent shall obtain statutory clearances / licenses/ permissions from concerned Central Government/State Government Departments, Boards, Bodies and Corporations etc. for development of Naya

Raipur City. Project proponent shall follow direction issued by Central Government/ State Government, Central Pollution Control Board/Chhattisgarh Environment Conservation Board from time to time regarding control of water & air pollution and for environmental conservation.

xiv) The State Level Environmental Impact Assessment Authority, Chhattisgarh reserves the right to amend the above conditions and add additional safeguard measures subsequently, if found necessary, and to take action including revoking of the environment clearance under the provisions of the Environmental (Protection) Act. 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

After submission of sanctioned Development Plan of Naya Raipur City – 2031 by competent authority and compliance/ incorporation for fulfilment of above terms and conditions in the "Planning & Designing of Naya Raipur Satellite City of Chhattisgarh, NRDA, Raipur" project, the final Environmental Clearance shall be accorded by State Level Environmental Impact Assessment Authority, Chhattisgarh after consideration and recommendation of it by State Level Expert Appraisal Committee.

Please acknowledge the receipt of this letter.

For & on behalf of
State Level Environment Impact Assessment
Authority, Chhattisgarh

Member Secretary
State EIA Authority, Chhattisgarh
Raipur (C.G.)

Copy to:-

1. The Secretary, Department of Environment, Mantralaya Chhattisgarh, Raipur-492001
2. The Chairman, Chhattisgarh Environment Conservation Board, 1-Tilak Nagar, Shiv Mandir Chowk, Main Road Avanti Vihar, Raipur (C.G.)
3. The Chief Conservator of Forests (C) Regional Office (WZ), Ministry of Environment & Forests, Kendriya Paryavaran Bhawan, Link Road No.-3, E-5, Arera Colony, Bhopal.

Member Secretary
State EIA Authority, Chhattisgarh
Raipur (C.G.)

XVI

ANNEXURE – II CLIMATOLOGICAL SUMMARY FOR IMD STATION AT RAIPUR

Table 1 discusses the long-term climate trend of secondary data collected for the IMD station located in Raipur, over the period of 1951-1980.
Table 2 discusses the decadal trend of secondary data collected from IMD Pune, over a period of 1993-2002.

TABLE 1: CLIMATOLOGICAL SUMMARY FOR IMD STATION AT RAIPUR (1951-1980)

Month	Mean Max. Temperature (°C)	Mean Min. Temperature (°C)	Relative Humidity	Total Rainfall (mm)	Mean Wind Speed (m/s)	Predominant Wind direction
January	27.5	13.3	50	6.7	1.1	N
February	31.1	16.5	41	12.3	1.4	N
March	35.5	20.8	33	24.6	1.7	N
April	39.6	25.3	31	15.7	2.2	W
May	42.0	28.3	31	18.8	2.6	W
June	37.4	26.5	58	189.8	3.0	SW
July	30.8	24.0	81	381.0	3.0	SW
August	30.2	23.9	83	344.7	2.6	W
September	31.3	23.9	77	230.2	2.0	W
October	31.6	21.5	64	53.9	1.4	NE
November	29.6	16.5	54	7.4	1.1	NE
December	27.3	13.2	52	3.7	0.9	NE
Average/ Total	**32.8**	**21.1**	**55**	**1288.8**	**1.9**	

Source: Climatological Table, IMD

TABLE 2: CLIMATOLOGICAL SUMMARY FOR IMD STATION AT RAIPUR (1993-2002)

Month	Mean Max. Temperature (°C)	Mean Min. Temperature (°C)	Relative Humidity	Total Rainfall (mm)
January	27.6	13.0	59.1	10.2
February	30.6	16.3	54.1	19.1
March	35.4	20.2	39.3	15.6
April	40.0	24.7	36.2	13.5
May	41.9	27.5	39.2	19.6
June	37.1	26.0	64.0	176.9
July	31.7	24.3	82.3	347.5
August	30.0	23.9	86.7	379.9
September	31.0	23.6	83.0	195.1
October	31.7	21.4	73.9	60.5
November	29.9	16.2	63.3	13.1
December	28.0	12.7	57.5	1.8
Average/ Total	**32.9**	**20.8**	**61.5**	**1252.7**

Source: IMD Pune

ANNEXURE – III TRAFFIC MONITORING DATA

TABLE 1: TRAFFIC MOVEMENT AT NH-30 – WEEKDAY

Average Number of Vehicles							
Time	**Two Wheelers**	**Three Wheelers**	**Cars and vans**	**Busses & Lorries**	**HMV**	**Cycles**	**Cycle Rikshaw**
0100	17	5	21	17	17	1	0
0200	14	6	19	28	28	2	1
0300	22	14	28	28	33	1	0
0400	25	24	35	59	47	2	0
0500	39	35	61	68	40	3	0
0600	59	34	78	105	60	1	1
0700	108	60	110	120	44	0	0
0800	109	48	127	147	41	0	1
0900	134	34	166	151	48	4	0
1000	152	43	159	164	52	0	0
1100	164	37	181	170	41	0	0
1200	170	28	187	173	54	2	1
1300	167	22	197	145	43	4	2
1400	153	21	168	128	52	0	2
1500	130	26	165	114	37	0	0
1600	143	34	157	94	34	2	0
1700	156	42	131	107	35	0	0
1800	153	53	116	98	33	0	1
1900	125	35	105	69	41	0	0
2000	115	43	96	56	45	0	0
2100	98	29	78	43	47	0	0
2200	73	22	52	35	31	0	0
2300	42	17	34	26	23	1	1
2400	21	6	13	12	16	1	1

FIGURE 1: TRAFFIC DENSITY – NH-30- WEEKDAY

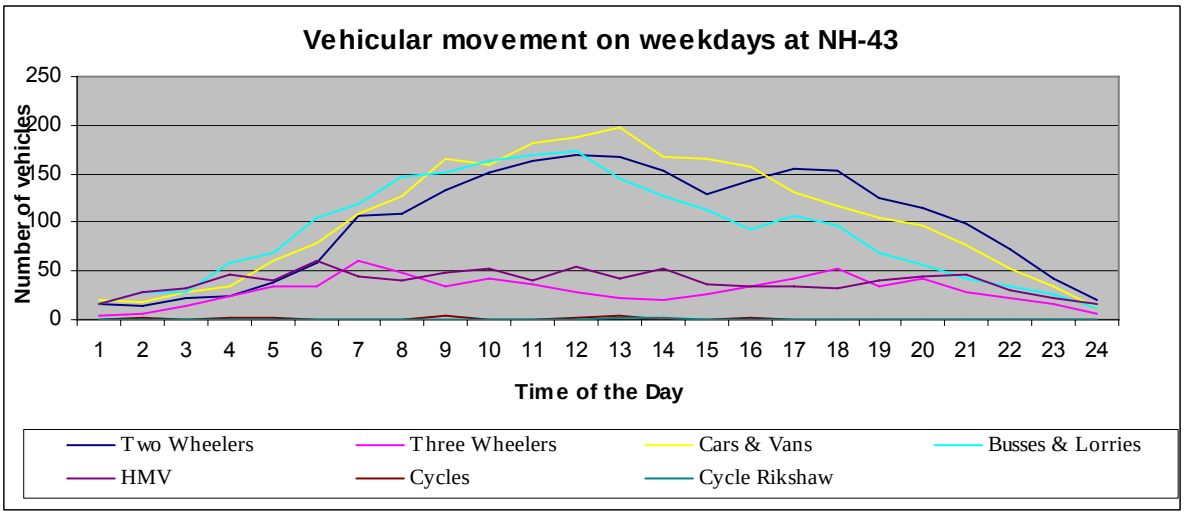


TABLE 2: TRAFFIC MOVEMENT AT NH-30 – WEEKEND

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
0100	9.0	7.0	15.0	11.0	14.0	0.0	0.0
0200	5.0	9.0	13.0	15.0	29.0	2.0	1.0
0300	15.0	10.0	23.0	16.0	36.0	1.0	1.0
0400	13.0	24.0	23.0	26.0	39.0	1.0	0.0
0500	28.0	28.0	36.0	50.0	35.0	0.0	0.0
0600	38.0	26.0	40.0	65.0	39.0	0.0	0.0
0700	26.0	37.0	48.0	71.0	41.0	0.0	0.0
0800	61.0	50.0	76.0	84.0	36.0	0.0	0.0
0900	64.0	42.0	104.0	97.0	36.0	1.0	0.0
1000	76.0	34.0	80.0	135.0	38.0	2.0	0.0
1100	67.0	40.0	132.0	123.0	34.0	0.0	1.0
1200	100.0	30.0	124.0	154.0	30.0	1.0	0.0
1300	78.0	23.0	131.0	128.0	36.0	2.0	0.0
1400	59.0	19.0	126.0	91.0	35.0	0.0	2.0
1500	68.0	16.0	134.0	85.0	30.0	1.0	0.0
1600	42.0	17.0	112.0	66.0	26.0	0.0	0.0
1700	37.0	28.0	94.0	69.0	26.0	0.0	0.0
1800	28.0	15.0	88.0	56.0	23.0	0.0	0.0
1900	33.0	21.0	86.0	44.0	34.0	0.0	0.0
2000	24.0	9.0	73.0	38.0	27.0	0.0	0.0

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
2100	20.0	13.0	61.0	30.0	27.0	0.0	1.0
2200	26.0	10.0	41.0	24.0	16.0	0.0	0.0
2300	15.0	5.0	31.0	19.0	14.0	0.0	1.0
2400	8.0	5.0	7.0	5.0	11.0	0.0	3.0

FIGURE 2: TRAFFIC DENSITY – NH-30- WEEKEND

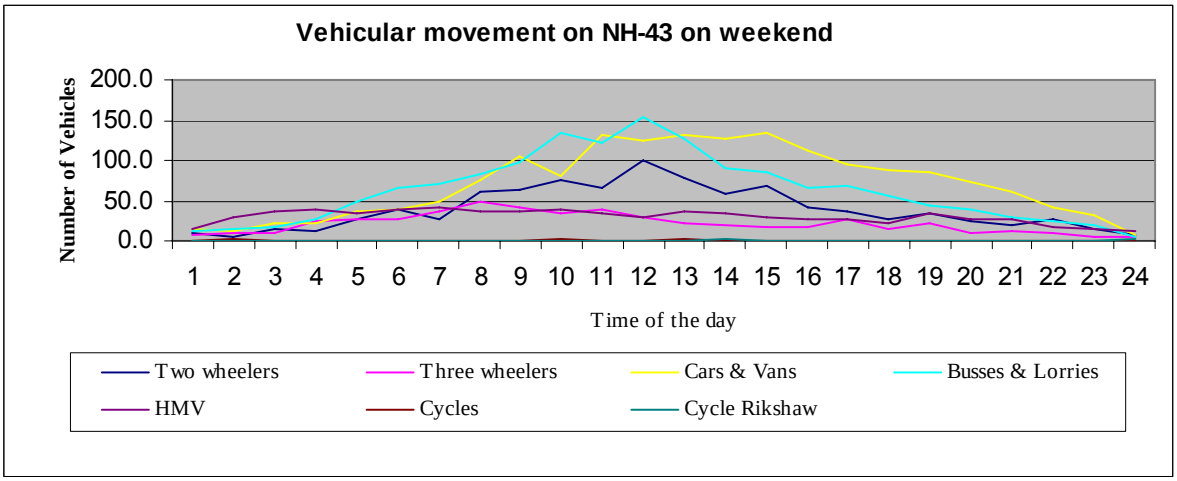


TABLE 3: TRAFFIC MOVEMENT AT NH-53 – WEEKDAY

Average Number of Vehicles							
Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
0100	14	10	24	17	25	2	1
0200	22	12	23	26	25	1	1
0300	23	17	30	35	22	0	0
0400	25	23	38	53	32	1	1
0500	33	33	51	52	34	3	0
0600	36	37	69	81	45	1	2
0700	61	42	90	98	51	0	0
0800	75	56	98	127	46	1	1
0900	86	46	132	133	50	0	1
1000	107	47	146	147	41	0	0
1100	132	40	157	147	50	1	0
1200	131	37	161	159	57	0	0
1300	138	46	176	142	50	1	1

Average Number of Vehicles							
Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
1400	135	31	157	132	42	0	2
1500	121	31	140	106	32	0	0
1600	127	26	123	95	25	1	0
1700	147	31	115	88	39	0	0
1800	125	36	109	80	39	1	1
1900	69	31	100	69	35	0	0
2000	46	25	85	58	38	2	1
2100	31	24	72	46	58	0	1
2200	21	21	50	41	42	0	0
2300	18	15	34	26	32	2	0
2400	10	6	23	16	27	2	0

FIGURE 3: TRAFFIC DENSITY – NH-53- WEEKDAY

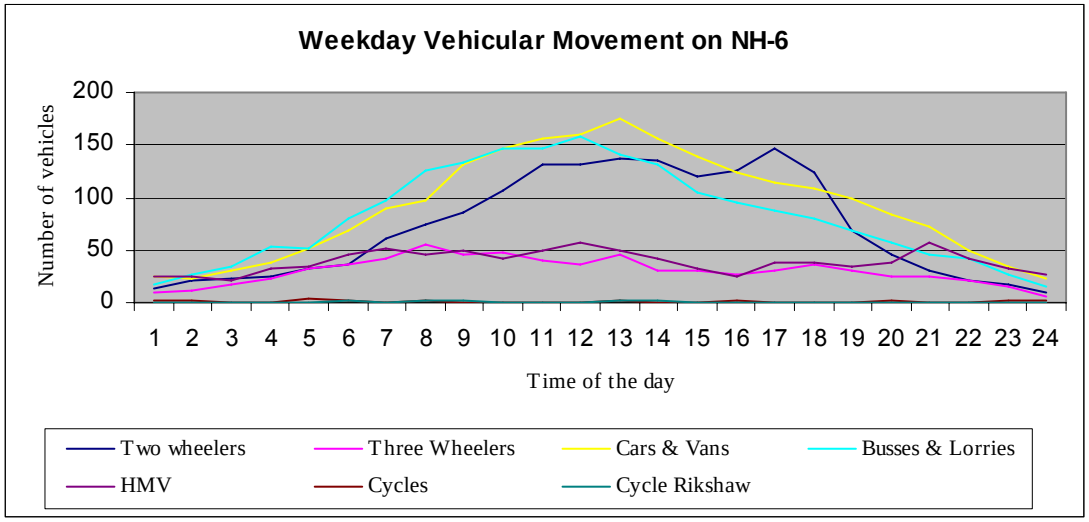
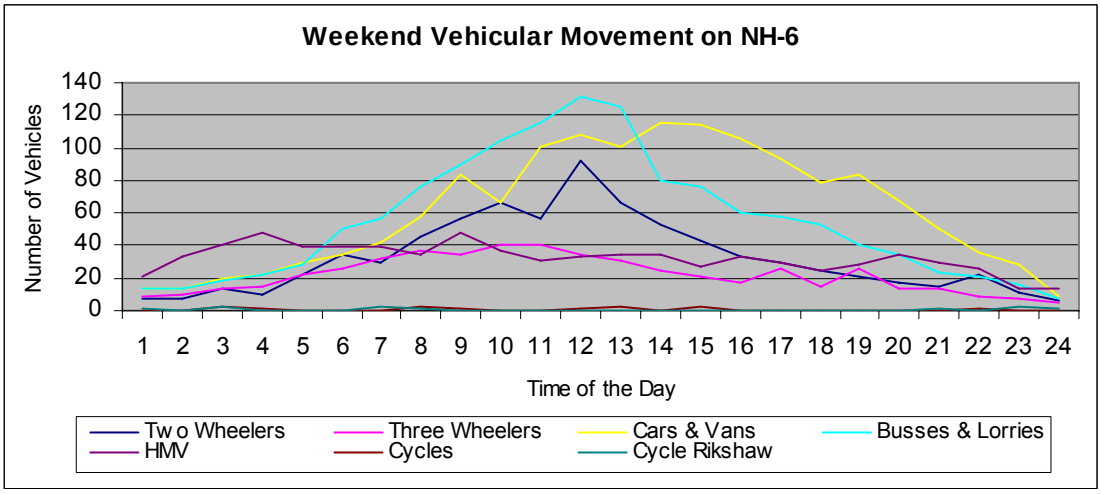


TABLE 4: TRAFFIC MOVEMENT AT NH-53 – WEEKEND

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
0100	7	8	13	13	21	0	1
0200	7	10	13	13	33	0	0
0300	13	13	20	19	40	2	2
0400	10	15	22	22	48	1	0
0500	22	22	30	28	39	0	0

Time	Two Wheelers	Three Wheelers	Cars and vans	Busses & Lorries	HMV	Cycles	Cycle Rikshaw
0600	34	26	34	50	39	0	0
0700	30	32	42	56	39	0	2
0800	46	37	58	76	35	2	1
0900	56	34	83	90	48	1	0
1000	66	40	66	104	37	0	0
1100	56	40	101	116	31	0	0
1200	92	34	108	131	33	1	0
1300	66	31	101	125	34	3	0
1400	53	24	115	80	34	0	0
1500	43	21	114	76	27	3	0
1600	33	17	106	60	33	0	0
1700	29	26	93	58	29	0	0
1800	24	15	78	53	25	0	0
1900	21	26	83	41	28	0	0
2000	17	14	68	34	34	0	0
2100	15	13	50	23	30	0	1
2200	22	8	36	21	26	1	0
2300	11	7	28	16	14	0	3
2400	6	5	9	7	14	0	1

FIGURE 4: TRAFFIC DENSITY – NH-53- WEEKEND



ANNEXURE – IV TYPES OF SOIL IN CHHATTISGARH

A wide variety of soil types are found in Chhattisgarh.

The soil of the study area is very shallow, yellowish brown to reddish brown, sandy clay loam to clay loam. The agricultural properties and fertility status of the soil of this region are generally poor and not suitable for the growth of the various kinds of crops.

In the study area, there water bodies in the form of lakes, ponds, nallahs and irrigation canals. Land is irrigated using surface water. Rain water is the main source for irrigation.

A variety of factors control soil formation - climate, biotic factors, relief, drainage, parent rock materials and time. The soils in the region are as follows:

Vertisol

A soil in which there is a high content of expansive clay known as montmorillonite that forms deep cracks in drier seasons or years. Typically form from highly basic rocks such as basalt in climates that are seasonally humid or subject to erratic droughts and floods. Depending on the parent material and the climate, they can range from grey or red to the more familiar deep black.

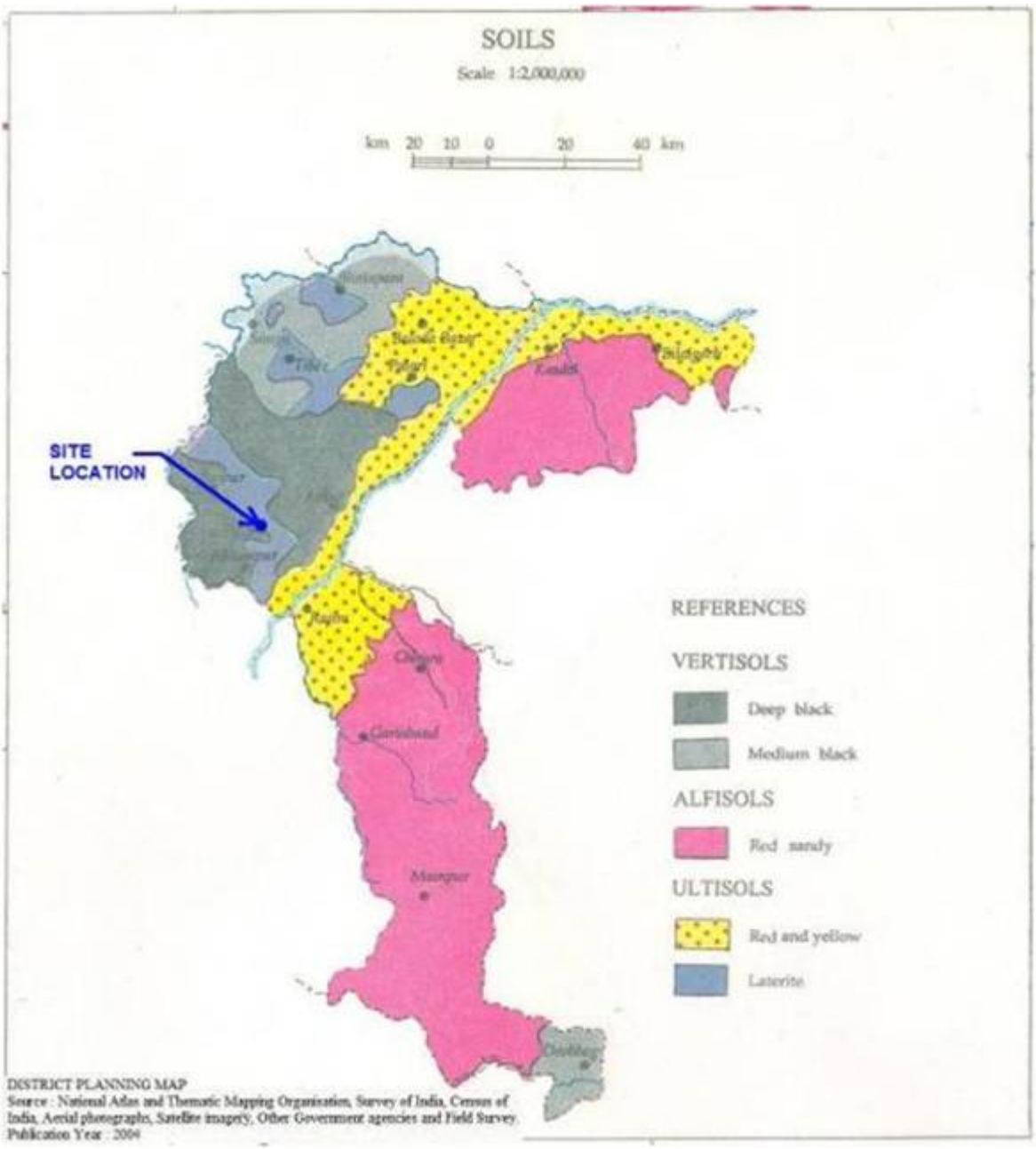
Alfisols

Having clay-enriched subsoil with a relatively high native fertility "Alf" refers to Aluminium (Al) and Iron (Fe). Alfisols have undergone only moderate leaching. By definition, they have at least 35% base saturation, meaning that Calcium, Magnesium, and Potassium are relatively abundant

Ultisols

“Red clay soil", defined as mineral soils containing no calcareous material anywhere within the soil, with less than 10% weatherable minerals in the extreme top layer of soil, and less the 35% base saturation throughout the soil. These are found in Pilari, Baloda Bajar,Bilaigarh and Rajim area and various other parts of the district too.

FIGURE 5: SOIL TYPES IN RAIPUR (CHHATTISGARH)



ANNEXURE – V PROCEEDINGS OF THE PUBLIC CONSULTATION

Different sections of people were explained about the BRT project and were asked to voice their concerns, suggestions and views for the same. The public consultation was carried out from 14th to 16th April 2010 by Mr. Ahsan Najeeb and Ms. Rajani Iyer (SENES Representatives) at varied locations in Raipur city and their consultations are provided below.

1) WOMEN COMMUTERS

Location: Bus stops, Residential Colonies
Date: 14th April, 2010.
Time: 11:00am to 1:30pm

1. Asha Verma --- told that sufficient seats should be reserved for women.
2. Dhanlakshni Jain is of the Opinion that frequency of buses should be increased.
3. Sudha Sahu --- said some ladies special buses should be run in peak hours.
4. Maahi Chaubey --- told that AC buses must run for long distances, as extreme weather makes journey uncomfortable and difficult.
5. Seema Nigam --- feels bus routes are limited and frequency is less BRT buses should reach till major masses and more number of buses provided.
6. Ruchi Srivastav --- told that ladies seats should be reserved in all buses and should be marked properly and maintained strictly.
7. Usharani Dubey --- wants the buses to run on correct time, hence can be relied upon.
8. Bharati Sahay --- told travelling in normal buses makes the journey painful. AC buses with low fares should be started, so that the travel becomes relaxing.
9. Sanjana Goyal --- has odd working hours and so wants frequency of buses to increase.
10. Mahavi Singh --- said that some bus seats be booked for ladies and elderly persons and that ladies entry be from front door and men enter from rear door.

2) CONSULTATION WITH STUDENTS FROM UNIVERSITY, COLLEGES AND SCHOOLS

Location: Bus stops, Near University and college
Date: 15th April, 2010.
Time: 9:00am to 11:30am

1.) Manish Diwan --- Student of Bodhi Satva High school feels number of buses plying during morning and evening hours should be increased.

2.) Dinesh Naidu --- Student of Nac Mit Pt college feels students should be issued monthly passes as it will encourage them travel by bus which in turn will decrease congestion and traffic on road.

3.) Nitin Rai --- Student of Gurukul Institute says special university buses should be introduced for the students of different universities.

4.) Vikas Pali --- Student of RIT has an opinion that concessional seasonal or monthly bus passes should be introduced for students.

5.) Rajan Dahariya --- Student of Agrasen Mahavidhyalaya feels that more number of buses should run during the morning and evening hours, which will make traveling easier for students without congestion in buses.

6.) Aditya Dixit --- Student of RIT feels special university buses should be introduced for the students along with other people.

7.) Seema Lalwani --- Student of Disha Institute of Management & Technology feels more number of buses should ply during morning and evening hours.

8.) Lalit Yadav --- Student of Government Medical college feels more number of buses should be introduced so that traveling will be more comfortable.

9.) Krishna Soni --- Student of Government Medical college feels existing number of buses is not at all sufficient and more number of buses should be introduced.

10.) Kunal Dhawan --- Student of RIT syas bus passes should be issued to the students which will decrease the traffic as more students will be using public transport rather than their own transport.

3) CONSULTATIONS WITH PERMANENT AND TEMPORARY EMPLOYEES OF THE IGAU

Location: Indira Gandhi Agricultural University
Date: 15th April, 2010.
Time: 6.00 pm to 7:30 pm

1. Upadhyaya ---As the family is staying in staff quarters they are willing to move where the university accommodates them.

2. N.L. Shrivastava---both the husband and wife are not keeping good health and therefore he and his family want to be accommodated within the campus to reduce problems they will face if shifted from out of the university campus.

3. Dinesh Bhosale---Working as a peon in one of the departments feels that the university will make the necessary arrangements as the staff quarters they are living in are old and the families of the staff members have made partitions inside to accommodate their enlarging families.

4. S. Yadav ---Felt that as they were working and staying in the houses provided by the university, then even if the land is given for any project the university will shift them to other houses within the campus.

5. R. S.Tiwari---Referred to a road near their houses which is connecting their houses and a residential complex to the highway and mentioned that another road will have to be provided to enable people to go about their activity.

4) COMMUTERS IN RAIPUR CITY

Location: Bus stops, Near Offices
Date: 14th April, 2010.
Time: 3:00pm to 5:30pm

1.) Ratan Sahu --- Government employee, feels number of buses should increase as he finds difficult to reach office once he misses bus.

2.) Ashok Gupta --- Feels A/c buses should be introduced as it will make the journey comfortable.

3.) Rahul Verma --- Says frequency of the buses should be more from one destination to other as it would decrease the load in the bus.

4.) Anil Jain --- A local businessman feels autorickshaws should be banned in some routes as they charge more rates and create kiosk in traffic.

5.) Ved Prakash Banchor --- Private job employee finds it difficult to travel during summer season and recommends A/c buses in different routes.

6.) Ashish Thakur --- Informed about the congestion in the present road and feels autorickshaws and heavy vehicles should be banned on some routes.

7.) Umesh Rawat --- Employee, says frequency of the buses should increase and buses should be more spacious.

8.) Uttam Devangan --- Feels buses should maintain proper timing and also number of buses plying should increase.

9.) Riya Agarwal --- Thinks charges of the bus service is very much affordable and will be good if the buses run on time.

10.) Kripa Soni --- Feels number of buses plying in the city should increase and also proper timing should be maintained.

5) CONSULTATIONS WITH CONDUCTORS, DRIVERS AND OWNERS OF PRIVATE BUSES

Location: Bus stands, Bus Depots
Date: 15th April, 2010.
Time: 3:00pm to 5:30pm

1. Deendayal Sharma --- feels that introducing BRT would be good for city's progress but the existing buses should also be allowed to continue.
2. Babubhai Bhagel --- is of the opinion that existing bus drivers and conductors should be appointed for the new bus services, hence improving their lives.
3. Amit Sahay --- told that BRT buses must run in different routes, so as not to affect their daily income.
4. Mahendra Chandrakar --- (Owner of private bus firm) told that bus operators must be selected by a procedure of tendering, as near the case for appointing existing operators.
5. Raja Kumar --- told that bus lanes and other vehicle lanes should not be mixed anywhere, as it will disturb traffic and affect punctuality/efficiency of buses.
6. Daneshwar Sahu --- told that buses should be stopped only at bus stops and no other places.
7. Rajesh Chandrakar --- feels that the existing routes should not be given to new operators as it will result in loss of current operators and their employees.

6) CONSULTATIONS AT THE SECRETARIAT PICK UP POINT:

SENES representative: Mr. V. V. Subbarao and Ms. Rajani Iyer
Location: NRDA Secretariat, where the new pick-up point is to be located
Date: 27th October 2010
Topic : BRTS – SENES explained about BRTS project and asked the people there about their views / suggestions / problems associated with it.
Time : 6:00 pm to 7:00 pm

1. Ramesh Yadav (Tea stall owner): said he is happy that more people will be coming there, so his daily earnings will increase.

2. Rajeev Nigam (Pan shop owner): will have to move his shop a little but then feels that more income is likely to generate.

3. Umang Jadav (a nearby resident) is of the opinion that the place will become crowded and vehicle traffic and honking will increase.

4. Dilip Mishra (Fruit & Vegetable vendor): he will need to get relocated from his usual place because of upcoming pick up point.

5. Alok Chaobe (Chaiwala): says it will be good for his business if pick up point comes at the Secretariat location.

6. Aakash Pandey (Resident): says it would become easy and convenient for him and his family to board the bus from the so near pick up point.

ANNEXURE – VI COMMENTS OF WORLD BANK

TABLE 1: COMPLIANCE OF THE WORLD BANK COMMENTS (13TH SEPT 2010)

Sr. No.	Comments of World Bank	Clarifications/Arguments
1.	There is no mention of consultations carried out. In that regard, of particular importance are consultations within Raipur city where the new facilities are coming up. Concerns from relevant stakeholders, including local residents, should be documented and the way they are (to be) handled in the project design and implementation should also be clarified.	Public Consultation with the relevant stakeholders like local residents, people residing near the terminals, commuters from Raipur city, women commuters, students, etc. are conducted and presented in the EIA report.
2.	No analysis of alternatives is presented. For instance, I remember we had a location initially considered for the bus stop close to the CM residence where tree cutting would have been an issue which is now changed to a plot outside the city. Such analysis would give the readers who may not be familiar with the site enough confidence that these issues were indeed considered.	According to NRDA, no alternatives other than the current ones were proposed for Bus Terminals, Bus Depots, Bus Stops and Bus Routes.
3.	Some mitigation and enhancement measures that can actually show value that the EIA can bring - provision of oil and grease traps where bus maintenance is to be carried out, public utilities like drinking water spouts, and toilets, provision of water harvesting, etc. seem to have been missed out.	Oil interceptor and wate water treatment facility will be provided at the bus depot, where the oily waste will be sold to local authorized agents and recycled water will be reused for gardening purpose. Bus Terminals will be provided with drinking water spouts and other public amenities. NRDA proposes to develop RWH system along the BRT corridor and Bus Terminals and Depots.
4.	There is no discussion of Safety due to the movement of buses within the colony areas. If it is already clear that this will be handled properly, it would be	Proper signages like entry and exit points of BRT, traffic lights, speed breakers, pedestrian crossings, blow horn sign, speed limit indication, marking BRT corridor on the roads, providing footpaths

Sr. No.	Comments of World Bank	Clarifications/Arguments
	useful to give the steps proposed to be taken for such an influx of buses at fixed hours.	and cycle paths will be provided to improve the safety within the colony area.

TABLE 2: COMPLIANCE OF THE PMCS COMMENTS (15TH SEPT 2010)

Sr. No.	Comments of PMC	Clarifications/Arguments
1.	There is a need to revisit the observations/comments provided earlier and if any doubt prevails then to seek clarification before submitting the report.	The earlier comments are answered appropriately and a compliance report for the same is prepared and attached as appendix in the final EIA report.
2.	The second chapter needs prudent editing.	Done
3.	Analysis of Alternative needs to be worked out as, also, pointed out by W.B's observation and presented in a separate chapter.	According to NRDA, no alternatives other than the current ones were proposed for Bus Terminals, Bus Depots, Bus Stops and Bus Routes.
4.	Public Consultation needs to be presented.	Public Consultation with the relevant stakeholders like local residents, people residing near the terminals, commuters from Raipur city, women commuters, students, etc. is conducted and presented in the EIA report.
5.	Chapter 4 should prudently give rational project specific data rather than starting with definitions of the attributes.	Done
6.	Chapter 5 'Assessment of Potential Impact & Mitigation measures' & Chapter 6 'Environment Management Plan' is weak and needs to be strengthened corresponding to data in chapter 4.	Done
7.	Chapter 7, Summary & Conclusions needs to be updated in light of the above changes.	Done

TABLE 3: COMPLIANCE OF PMC COMMENTS (16TH NOVEMBER 2010)

Sr. No.	Comments of PMC	Clarifications/Arguments
1.	Analysis of alternative has to be developed as discussed i.e., without/with project, trade-off between optional locations of any facility etc., leading to final selection.	Provided Analysis of Alternatives
2.	Public Consultation needs to be supported by necessary documentation.	**Annexure – V** Proceedings of the Public Consultation
3.	The Budget as discussed is erroneous and needs to be brought in line with the desired Envionmental management.	Done
4.	Chapter 1.2, Pg no. 3 Cover facilities within BRT scope at Raipur, also.	Done
5.	Chapter 2.7.1, Pg no. 12 Could we have a map in which various BRT components are clearly shown.	Done
6.	2.7.2 Could you provide the figure in the main text	Done
7.	Chapter 3.0 Could we have short discussion of applicable Environmental legislations	
8.	Chapter 3.1 Do put the Environmental Clearance for Naya Raipur in the Annex.	**Annexure – I** EC for Naya Raipur
9.	Chapter 4.2 Could you provide the Latitude/Longitude of the project area.	Provided
10.	Chapter 4.3 Avoid giving definition.	Done
11.	4.3.1 A Avoid giving definition and keep historical data in Annex.	Done
12.	4.3.2 Avoid giving definition.	Done
13.	4.3.3 Avoid giving definition.	Done
14.	4.3.4 Keep explanations pertaining to the table (bullets etc.) at the bottom of the table.	Done
15.	4.6.4 Are no. of streams crossing BRT corridor. If so, give name of significant ones and chainages (where crossed by BRT corridor)	Done

Sr. No.	Comments of PMC	Clarifications/Arguments
	of others.	
16.	Chapter 5 Could we have the analysis of potential impact/mitigation measures of the attributes covered in the baseline and in the same sequence.	Provided the attributes in the same order as in baseline chapter.
17.	Are you referring to area to be planted in the mitigation? Could you give the identified locations and the numbers too.	Provided

ANNEXURE VII

ROAD NETWORK CONSTRUCTED IN NAYA RAIPUR

Government of Chhattisgarh (GoC) has taken steps to develop Naya Raipur with completely sustainable infrastructure in place. The following road networks are in Phase I. The details of the road network are set out in the table below.

TABLE 1 : DETAILS OF THE ROAD NETWORK NAYA RAIPUR

Road Number	Description	Length (Km)	Number of Lanes
1	100 m wide Expressway joining NH-53 (including interchange) to entry point of Naya Raipur	8.5	4 lanes with median
2	100m wide road joining NH-53 to NH-30 via Capital Complex	17.3	4 lanes with median
3	100m wide road joining 60m wide road to the south of transport hub to Expressway	2.4	4 lanes with median
4	100m wide road joining Expressway and Capital Complex	10.1	4 lanes with median
5	100m wide road near Muktangan connecting NH-30 and North South 100 m wide road	2.9	4 lanes with median
6	60m wide road north of light Service Industries	2.4	4 lanes with median
7	60m wide road additional link from North South road around Sendh Lake	4.1	4 lanes with median
8	60m wide road joining Expressway and Airport	3.3	4 lanes with median
9A	60m wide road starting from Westside 100m wide road, going around Capital Complex and joining to the North of Commercial Complex joining 100m wide N-S road	5.9	4 lanes with median
9B	60m wide road starting from Westside 100m wide road, going	2.3	4 lanes with median

Road Number	Description	Length (Km)	Number of Lanes
	around Capital Complex and joining to the North of Commercial Complex joining 100m wide N-S road		
10	60m wide road joining south of Capital Complex and N-S 100m wide road	4.2	4 lanes with median
11	60m wide road surrounding educational complex/ Commercial Complex near health complex on South	3.6	4 lanes with median
	Total length of roads	**67.0**	

Source: DPR

TRAVEL DEMAND ANALYSIS

In absence of a Comprehensive Traffic and Transportation Study (CTTS) for Naya Raipur, the information collected from various sources such as Development Plan and Regional Plan is analyzed to delineate the traffic flow using transport models. Passenger trips are expected to be generated from the work/business trips, education trips and other/visitor trips. Trip detail is estimated using trip generation rates assumed based on the population, employment and area developed. The basic travel data obtained by assessing the travel characteristics, in this manner is the basis on which BRT System is designed.

As per the development Plan, Naya Raipur is planned for a population size of 5.6 lakh people in 2031 and is estimated to have per-capita trip rate of 1.4. However, for study purpose, the per-capita trips performed by vehicular modes is assumed to be 0.8 (excluding walk and cycle trips). With this assumption, passenger trip is estimated separately by the trip purpose i.e work, education and other purpose trips.

Based on the current assessment of development, the population anticipated in Naya Raipur in FY13 is 70,000 and employment of 31,000 of which the government offices will account for an employment of 7000. Also, about 75% of the projected population and employment targets for 2021 and 2031 will be realized by those timeframe.

Significant trips are expected from the surrounding area to Naya Raipur. Further, significant number of jobs in Naya Raipur would be served by non-resident population.

The area was divided into 51 Traffic Area Zones (TAZs) in Naya Raipur, 34 TAZs in Raipur and 3 other TAZs. Apart from TAZs, various pick up points in Raipur, which will also form a part of the network corridor, are identified. The whole of Naya Raipur area is divided into TAZs as per sectors along with few other major areas of land use such as software Technology Park, integrated freight complex, Capital Complex, universities / institutional areas, industrial areas.

The number of trips generated in each TAZ was assessed using the socio economic parameters of the TAZ. Model share on the basis of past studies and specific recommendations of Naya Raipur have been used.

Modal Share

The key transport service characteristics that influence choice of travel mode are identified and analyzed. In this regard, the modal share on the basis of past studies and specific recommendations of Naya Raipur is used. Modal share predicted amongst different modes in the Development Plan indicate that the share of trips by personalized vehicles and public/ intermediated public transport (IPT) account for 50% each respectively for inter-city trips. Larger modal share for public transit is assumed for intra–city trips also in view of proposed well networked facility. In case of intra-city and inter-city trips, the share of public transit could be 40%. The modal distribution assumed in general in case of inter-city and intra city is shown in the figures below:

FIGURE 6 : MODAL SHARE IN INTER-CITY PASSENGER TRIPS

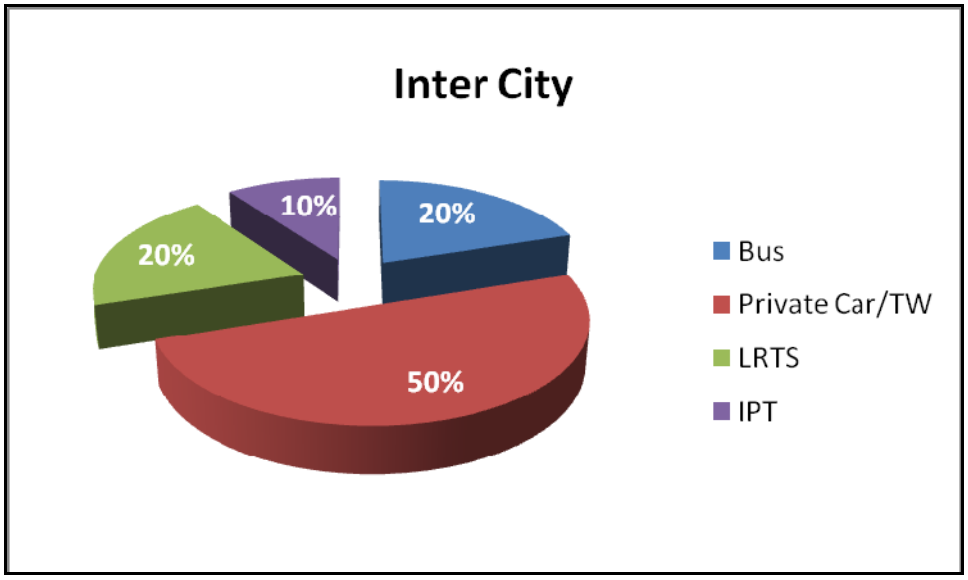
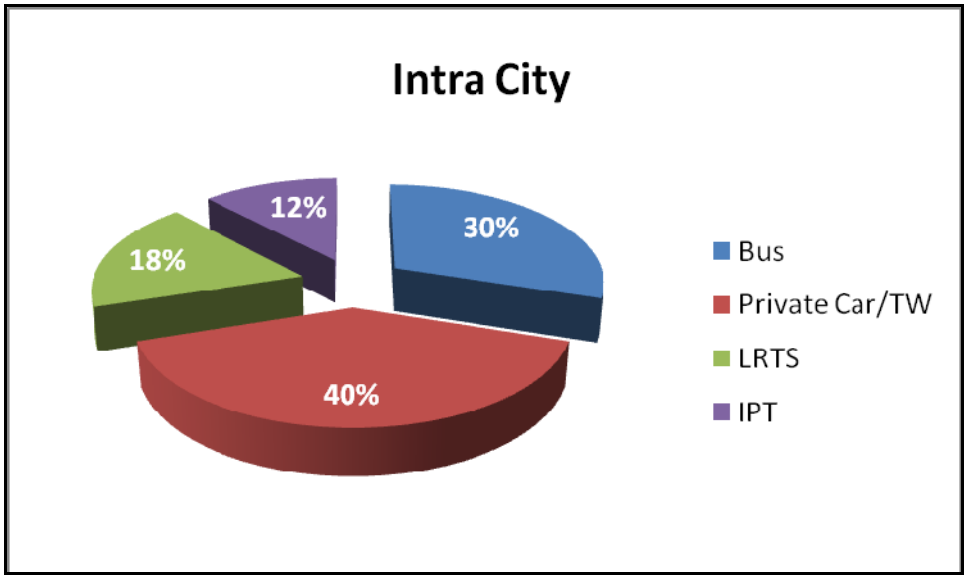


FIGURE 7 : MODAL SHARE IN INTRA-CITY PASSENGER TRIPS



In addition, separate share of public transit system is adopted by purpose and travel pattern. Significant inter-city work trips are expected to be performed by public transit system due to trip lengths involved. Similarly, education trips are expected to be performed by school/college buses.

It is estimated that the mass transit trip generation would be approximately 0.38 lakh trips per day by year FY13 and could grow upto approximately 1.73 lakh trips and 2.5 lakh trips per day by the year 2021 and 2031 respectively.

Moreover, from the studies carried out for the BRT System in Ahmedabad, it is observed that there is a 32% modal shift from private to public transport vehicles in six months.

Keeping in mind the BRT system proposed for the Naya Raipur with modal share of 40 % in the year 2031 the estimated bus passenger traffic demand along major corridors in the Naya Raipur is depicted below:

TABLE 2 ESTIMATED BUS PASSENGER TRAFFIC DEMAND ALONG MAJOR CORRIDORS

S. No.	Year	Passengers Per Hour Per Direction Traffic Flow (PHPDT)
1.	2013	800 – 1500
2.	2021	1650 – 6000
3.	2031	2400 – 7000

Traffic Assignment

The travel pattern and routes are well defined within routes A1, A2, and A3 catering to Raipur and Naya Raipur trips, it is assumed that about 75% of trips

shall use A1 and A3 along NH-53 as NH-53 is being upgraded to 4 lane highway. Road number 2 and expressway via NH-53 are expected to serve majority of trips during the initial development phase. Route details for the corridor and travel demand for Naya Raipur are shown in Table 2-3 and Table 2-4 respectively.

TABLE 3: DETAILS OF BUS ROUTES AND NETWORK CORRIDOR

Bus Route	Corridor Length	Locations in Raipur	Linking Roads	Locations in Naya Raipur
A1	18.0	Telibandh chowk	NH-53 – Expressway	Capital Complex
A2	22.0	Santoshi chowk	NH-30 – Khandwa	Capital Complex
A3	24.0	Government Housing Colony – Telibandh chowk	NH-53	Capital Complex
A4	17.0	N.A	N.A	Nawagaon chowk – Capital Complex – University Complex (NH-30 Junction)
A5	8.0	N.A	N.A	Different sections of Naya Raipur

TABLE 4: TRAVEL DEMAND FOR NAYA RAIPUR (DAILY TRIPS)

Bus route	Corridor Length (Km)	2013		2021		2031	
		Boarding	PHPDT	Boarding	PHPDT	Boarding	PHPDT
A1 & A3	18 & 24	44523	2214	205733	7306	221660	7515
A2	22	14841	738	68578	2435	147773	5010
A4	17	12915	644	42788	1429	78289	1674
A5	8	4305	215	28525	476	52193	1116
Total Boarding's		**76854**		**345624**		**499915**	

PHPDT – Per Hour per Direction Traffic
Source: DPR

To achieve efficient mobility and all round accessibility, primary network of the city would have to have public transit priority. The details of the BRT corridor are shown in Table 2-5.

TABLE 5 DETAILS OF DEVELOPMENT OF BRT LANES

S. No	Corridor Description	Length (km)
1	Additional BRTS lanes along the 4-Lane Road	33.0
2	New Road Construction with Bus Lanes	7.0
	Total length in kilometers	**40.0**

TRANSPORTATION SYSTEM

The estimated bus passenger traffic demand along major corridors in the Naya Raipur ranges between 800 to 1500 Per Hour Per Direction Traffic Flow (PHPDT) in the year 2013 and 1650 and 6000 PHPDT in the year 2021, it is likely to go upto 2400 and 7000 PHPDT in the year 2031. The demand is estimated for the Naya Raipur with modal share of 40% in the year 2031.

The travel demand is estimated based on the envisaged land-use and likely travel pattern assumptions based on experience and the corridors already identified in the Development Plan.

Ministry of Urban Development (MoUD), Government of India suggests that the selection of transport system should be done with respect to the traffic demand and ground constraints. The guideline by MoUD is set out in the table below.

TABLE 6 : GUIDELINES OF MOUD

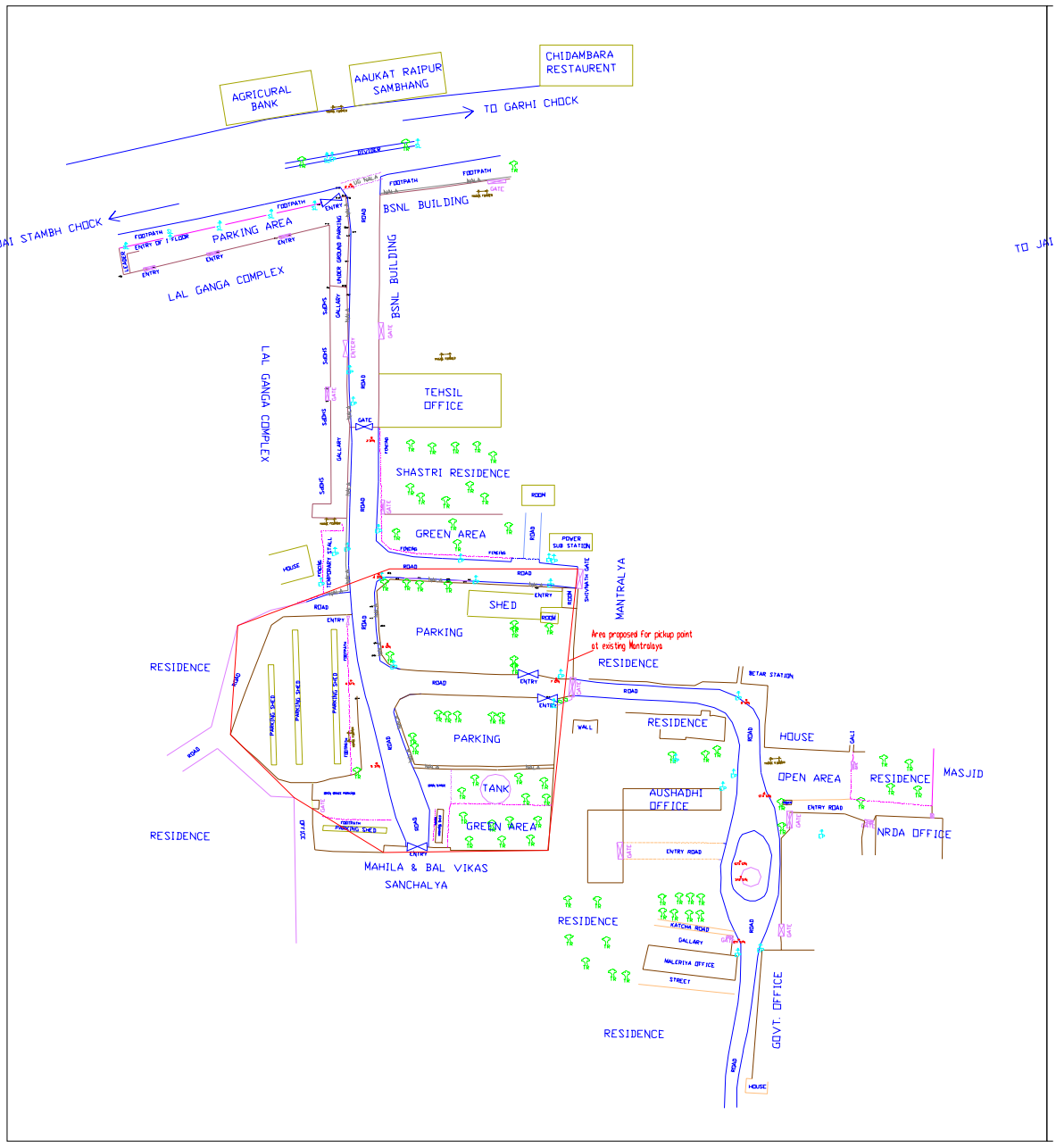
S.N	Typical System Capacity (PHPDT)	
1	Bus System (Mixed RoW)	4000 – 6000
2	Bus System (exclusive right of way)	6000 – 15000
3	Mono Rail	15000 – 25000
4	Light rail transit system	15000 – 30000
5	Heavy rail metro system /Sub Urban system	30000 – 80000
6	Suburban Electrical multiple units	30000 – 60000

The system capacity is planned to meet the traffic demand in Phase I to start with and will be augmented in subsequent phases to meet the development of Naya Raipur. The traffic demand along the major roads in Naya Raipur would be 12000 PHPDT in peak hours once all planned developments are completed. Hence, in terms with MoUD, a BRT System is proposed in Naya Raipur, which would connect Raipur and Naya Raipur and also serve the main corridors within.

ANNEXURE VIII

CHAPTER 2: FIGURES

FIGURE 8: LOCATION OF PICK UP POINT AT SECRETARIAT BUILDING



ANNEXURE IX

PLANTATION ALONG ROAD SIDE

The design of right of way landscape and avenue plantation is done with a view to conserve, enhance and effective display of the urban and rural countryside through which the road passes. It shall improve the aesthetic and functional quality of the roads.

The design has incorporated all types of vegetation suitable and tested in the area in different places, except herbs being short lived and demanding more maintenance. Types of vegetation used in avenue plantation and right of way landscape : Large Tree, Medium Tree, Small Tree, Shrub and Ground Cover.

- Large Tree: A tree species that can attain a mature height of over 12 m. at maturity.
- Medium Tree: A tree species that can attain a mature height of 8 to 12 m at maturity.
- Small Tree: A tree species that can attain a mature height of less than 8 m. at maturity.
- Shrub: A woody, perennial plant species, smaller than a tree, usually with several stems or trunks that can attain a mature height of 1.5 m to 8 m. at matuarity. Some can be grown as small trees if pruned properly.
- Ground Cover: A herbaceous perennial plant species that can attain a mature height of less than 1.5 m. at maturity.

TABLE 1: LIST OF SPECIES PROPOSED IN ROAD SIDE LANDSCAPE

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	**2**	**3**	**4**	**5**
1	Satavar	Satavar	*Withania somnifera*	G.C.
2	Leman Grass	Lemon Grass	*Penisetum pedicellatum*	G.C.
3	Aakash Pushpa	Duranta	*Duranta Repens*	S.H.
4	Rubber Plant	Rubber Plant	*Ficus elastica*	S.H.
5	Pipal	Pipal	*Ficus religiosa*	L.T.
6	Doob	Doob	*Cynodon*	G.C.

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	2	3	4	5
7	Vinca - Rosia	Vinca - Rosia	*Vinca - Rosia sps*	S.H.
8	Pudina	Mentha	*Mentha piperata*	G.C.
9	Ocimum	Ocimum	*Ocimum sps*	G.C.
10	Seeta Ashok	Ashoka	*Saraca indica*	M.T.
11	Amaltas	Amaltas	*Cassia fistula, Spp.*	M.T.
12	Neem	Neem	*Azadirachta indica*	L.T.
13	Vakul Moul Shree	Vakul Moul Shree	*Mimosops elongi*	L.T.
14	Sulphi	Fishtail palm	*Caryota urens*	L.T.
15	Putranjiva	Luck bean tree	*Putranjiva roxburghii*	M.T.
16	Gulmohar	Poinciana	*Delonix regia*	S.T.
17	Spathodia	Fountain tree	*Spathodea Campanulata*	L.T.
18	Euphorbea	Chrismas Flower	*Emphorbea pulcharima*	S.H.
19	Samaniya - Saman		*Cassia samia*	S.H.
20	Queens Flower	Queens Flower	*Lagerstroemia flassigina*	S.H.
21	Imli	Tamarind	*Tamarindus indica*	L.T.
22	Grliricidia	Grliricidia	*Grliricidia masculata*	M.T.
23	Peltophorum	Peltophorum	*Peltophorum enerme*	S.T.
24	Kadamba	Kadamba	*Anthocephalus Kadamba*	M.T.
25	Grevillea Robusta	Silver oak	*Grevillea Robusta*	L.T.
26	Makhan	Ficus krishana	*Ficus krishana*	S.T.

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	2	3	4	5
	Katori/Dona			
27	Colvillea Racemosa	Kilbili	*Colvillea Racemosa*	M.T.
28	Parkiya	Parkiya	*Parkiya biglandulusa*	M.T.
29	Pipal	Ficus sps	*Ficus religeosa*	L.T.
30	Badam	Badam	*Prunus emigdalous*	L.T.
31	Arjun	Terminalia	*Terminalia arjuna*	M.T.
32	Ramkanta Babool	Prosopis	*Prosopis julifera*	S.H.
33	Mitragyna	Mitragyna	*Mitragyna parviflora*	M.T.
35	Amla	Amla	*Phyllanthus emblica*	S.T.
36	Bael	Bael	*Eagle marmelos*	S.T.
37	Harra	Terminalia	*Terminalia chebula*	L.T.
38	Aam	Mango	*Mangifera indica*	L.T.
39	Bargad	Ficus	*Ficus benghalensis*	L.T.
40	Siris	Siris	*Albizia lebbck*	K.T.
42	Baheda	Ficus	*Terminalia bellerica*	L.T.
43	Jamun	Syzigium	*Syzygium cummini*	L.T.
44	Kadamba	Kadamba	*Anthocephallus chinehsis*	L.T.
45	Karanj	Karanj	*Pongamia pinnata*	M.T.
46	Kathal	Jack-fruit	*Atrocarpus heterophyllus*	M.T.

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	2	3	4	5
47	Chatim	Alstonia	*Alstonia scalris*	M.T.
48	Mohua	Madhuca	*Madhuca indica*	M.T.
49	Bhindi Vriksha	Thespesia	*Thespesia populnea*	S.T.
50	Jharul	Lagrestromea	*Lagerstroemia speciosa*	M.T.
51	Spathodea	Fountan tree	*Spathodea campanulata*	L.T.
53	Kusum	Kusum	*Schalicherra trijuga*	M.T.
54	Rukhamani	Ixora	*Ixora sps*	S.H.
55	Yellow Kaner	Narium	*Narium odorum*	S.H.
56	Red Kaner	Narium	*Narium odorum*	S.H.
57	Chandani	Chandani	*Tabernaemontana divaricata*	S.H.
58	Dwarf Kaner	Dwarf Kaner	*Narium sps*	S.H.
59	Dhobi	Dhobi	*Mussaenda ruteola*	S.H.
60	Ratanjot	Jatropha	*Jatropha curcus*	S.H.
61	Gudahal	Hibiscus	*Hibiscus rosasinesis*	S.H.
62	Adusa	Adusa	*Adusa sps*	S.H.
63	Karonda	Karonda	*Carrisa carandus*	S.H.
64	Palm	Royal palm	*Oreodoxa regia*	L.T.
65	Lantana	Lantana	*Lantana cammarra*	S.H.
66	Abuliton	Abuliton	*Abuiton sps*	S.H.
67	Madhu Kumani	Madhu	*Murrya exotica*	S.H.
68	Bougainvillea	Bougainvillea	*Bougainvillea*	S.H.

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	2	3	4	5
			sps	
69	Dikamali	Dikamali	*Dikamali sps*	S.T.
70	Acalypha	Acalypha	*Acalypha sps*	S.H.
71	Pedilanthus	Pedilanthus	*Pedilanthus sps*	S.H.
72	Parijath/ Harsingar	Parijath/ Harsingar	*Parijath/ Harsingar sps*	S.H.
73	Codiam	Codiam	*Codiam sps*	S.H.
74	Manihot	Manihot	*Manihot sps*	S.H.
75	Pentas	Pentas	*Pentas sps*	S.H.
76	Rambans sisal	Agave	*Agave americana*	G.L.
77	Amltash	Amltash	*Cassia*	S.T.
78	Euphorbia	Euphorbia	*E. polychroma*	G.C.
79	Morpankhi	Thuja	*Thuja oxidentalis*	S.H.
80	Mussaenda	Mussaenda	*Mussaenda luteola*	S.H.
81	Cycus	Cycus	*Cycus vanety*	S.H.
82	palm	Date palm	*Cariyola vrens*	S.H.
83	Taberhaemontana	Taberhaemontana	*Taberhaemontana sps*	S.H.
84	Plumeria rubra	Plumeria rubra	*Plumeria rubra*	S.T.
85	Jacaranda	Jacaranda	*Jacaranda mimosifolia*	M.T.
86	Tecoma	Tecoma	*Tecoma sps*	S.H.
87	Gandhraj	Gardenia	*Gardenia sps*	S.T.
88	Bottle brush	Bottle brush	*Callistomen lanceolatus*	S.T.
89	Allamanda	Allamanda	*Allamanda sps*	S.H.
90	Nolina	Nolina	*Nolina sps*	G.C.
91	Cuphea ignea	Cuphea ignea	*Cuphea ignea sps*	S.T.

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	2	3	4	5
92	Phoenix	Phoenix	*Phoenix sps*	S.H.
93	Jangali Jhau	Casuarina	*Casuarina equisetifolia*	M.T.
94	Ashok (Ashupal)	Pendula Ashok	*Polyalthia longifolia*	M.T.
95	Maharukh	The tree of heaven	*Ailanthus excelsa*	L.T.
96	Golden Champak	Golden Champak	*Ochna squarrosa*	S.T.
97	Hari Champa	Hari Champa	*Artabotrys uncinatus*	S.T.
98	Marigold	Marigold	*Tagets erecta/T. patula*	S.T.
99	Larkspur	Larkspur	*Delphinium ajacis*	S.T.
100	Gerbera	Gerbera	*Gerbera jasmesonii*	S.T.
101	Begonia Spp	Begonia Spp	*Begnonia Spp*	S.T.
102	Jacaranda	Jacaranda	*Jacaranda mimosaefolia*	S.H.
103	Champa	Champa	*Michalia champaka*	S.H.
104	Nag kesar	Nag kesar	*Mesua feria*	S.H.
105	Agastaya	Agastaya	*Sesbenia grandifolia*	S.T.
106	Bakayan	Bakayan	*Melia azedarech*	G.C.
107	Kapok	Cotton tree	*Ceiba pentandra*	L.T.
108	Mahandi	Mahandi	*Lawsonia alba*	S.T.
109	Gwarpatha	Aloevera	Aloevera	G.C.
110	Cactus	Cactus	Cactus sps	G.C.
111	Acalypha	Acalypha	Acalypha Hispids	G.C.

S.N.	LOCAL NAME	ENGLISH NAME	BOTANICAL NAME	TYPE OF TREE (SH,ST,MT,LT, GC)
1	**2**	**3**	**4**	**5**
112	Sane	Sane	Allamands eathartica	G.C.