Feasibility Study and preparation of Detailed Project Report for Construction & up-gradation of the newly declared NH-127 B (Assam portion) starting from Srirampur on NH-27(old NH-31 C) at Chainage 0.00 km to the immediate approach of proposed bridge over river Brahmaputra near Dhubri at chainage 55.700 km to NH standard

NH-127B

Final Detailed Project Report

Volume-IV-B:
EIA REPORT(WITH EMP)

Submitted To
National Highways & Infrastructure Development Corporation Ltd.
4, Parliament Street,
New Delhi-110001

Consultant
C. E. Testing Company Pvt. Ltd.
124-A, NSC Bose Road, Kolkata 700092

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Abbreviations

AAQ	Ambient Air Quality
BIS	Bureau of Indian Standards
BOD	Biological Oxygen Demand
CD	Cross Drainage
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COI	Corridor of Impact
CPCB	Central Pollution Control Board
CPR	Common Property Resource
CL	Centre Line
CSC	Construction Supervision Consultant
CW	Carriageway
CTE	Consent to Establish
CTO	Consent to Operate
dB	Decibel
DPR	Detailed Project Report
EC	Environmental Clearance
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EROW	Existing Right of Way
GW	Ground Water
IE	Independent Engineer
IMD	Indian Meteorological Department
IRC	Indian Road Congress
IS	Indian Standard
IUCN	International Union for Conservation of Nature,
LHS	Left Hand Side
MoRTH	Ministry of Road Transport & Highways
MoEF & CC	Ministry of Environment, Forests & Climate Change
NABL	National Accreditation Board for Testing and Calibration Laboratories
NAAQS	National Ambient Air Quality Standards
NH	National Highway
NOC	No Objection Certificate
NOx	Oxides of Nitrogen
NQ	Noise Quality
OHT	Over Head Tank
PIA	Project Influence Area
PF	Protected Forest
PROW	Proposed Right of Way
PM	Particulate Matter

RAP	Resettlement Action Plan
RF	Reserved Forest
ROB	Railway Over Bridge
RUB	Railway under Bridge
RHS	Right Hand Side
ROW	Right of Way
SH	State Highway
SQ	Soil Quality
SO_X	Sulphur oxide
SPCB	State Pollution Control Board
TNPCB	Assam State Pollution Control Board
TDS	Total Dissolved Solids
WPA	Wildlife Protection Act
WQ	Water Quality

CHAPTER-1

(INTRODUCTION)

1. INTRODUCTION

The President of India acting through the Ministry of Road Transport and Highways, Government of India, and represented by Assam PWD NH Works is the employer and executing agency for the consultancy services and the standards of output required from the appointed consultants are of international level both in terms of quality and adherence to the agreed time schedule.

Assam PWD, NH Works appointed C.E. Testing Company Pvt. Ltd. (CETEST) as consultant to prepare the Detailed Project Report for the proposed improvement and up-gradation of the roadway vide Letter of Acceptance No. vide Assam PWD, NH Works's letter no. NHR.9/2012/Pt/25 dated 03.11.2015.

Assam PWD NH Works acting as an executing agency of MoRT&H, New Delhi has decided to implement the work of Consultancy Services for Feasibility Study and preparation of Detailed Project Report for Construction & up-gradation of the newly declared NH-127 B (Assam portion) starting from Srirampur on NH-27(old NH-31 C) at Chainage 0.00 km to the immediate approach of proposed bridge over river Brahmaputra near Dhubri at chainage 55.700 km (as per TOR) to NH standard.

Pursuant to Clause of the Terms of Reference, this Environmental Impact Assessment Report is prepared and being submitted and forming separate part/volume of DPR .

The proposed road project is to provide NH standard connectivity to the immediate approach of proposed bridge over river Brahmaputra near Dhubri at chainage 54.230 km (As per design chainage) from Srirampur on NH-27(old NH-31 C) at Chainage 0.00. The total length of the road is about 54.230 km (as per Design length).

1.1 BENEFITS OF THE PROJECT

The project will have multiple benefits as it will provide all weather high speed National Highway. The road is a key artery connecting with shortest distance for commuter travelling between Srirampur and Dhubri. As the area (Dhubri) is bounded by international border of Bangladesh the project road has strategic importance too. This road will provide connectivity to proposed bridge to be constructed on Rive Brahmaputra. The project road is of significant importance as the road connecting two National Highways (NH31C and NH-31), one proposed bridge over river Brahmaputra and connects to important nearby villages Srirampur,Jakobpur,Kambilpur,Malkapur,Kathalguri,Grampur,Bashantipur,Auxiguri,Uzanpetla, MudhaPetla, Alokjhari,MadhaPetla, BhatiPetla, Satsaura, Kachakana,Pgla Hat, BarunDanga, Morterjhar, Baniyamari,Balajan, Dhepdheoi,DebduttaHazdaha 1, Kachari Hat,DebduttaHazdaha 2, Raja Katli,KachuaKash,ChandaKhol, Ada Bari.

More specifically, the benefits of the project will be as follow:

- Enhance the road condition and users ability of the state trunk roads including linked connectivity to NH.
- Increase travel speeds, and reduce travel time, accidents, and vehicle emissions.
- Ensure more efficient road asset development and management, and higher quality of construction and maintenance, resulting in decreased recurrent costs over the medium and long term.
- Accelerate the social and economic development in the state through improves access to socio-economic services, increase employment opportunities and improve transport services.
- Reduction in accidents and pollution
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits, vegetables and dairy products.
- Better connectivity during flood as area is in flood zone of Brahmaputra and almost every ears experience flood.

1.2 THE DESCRIPTION OF THE PROJECT ROAD

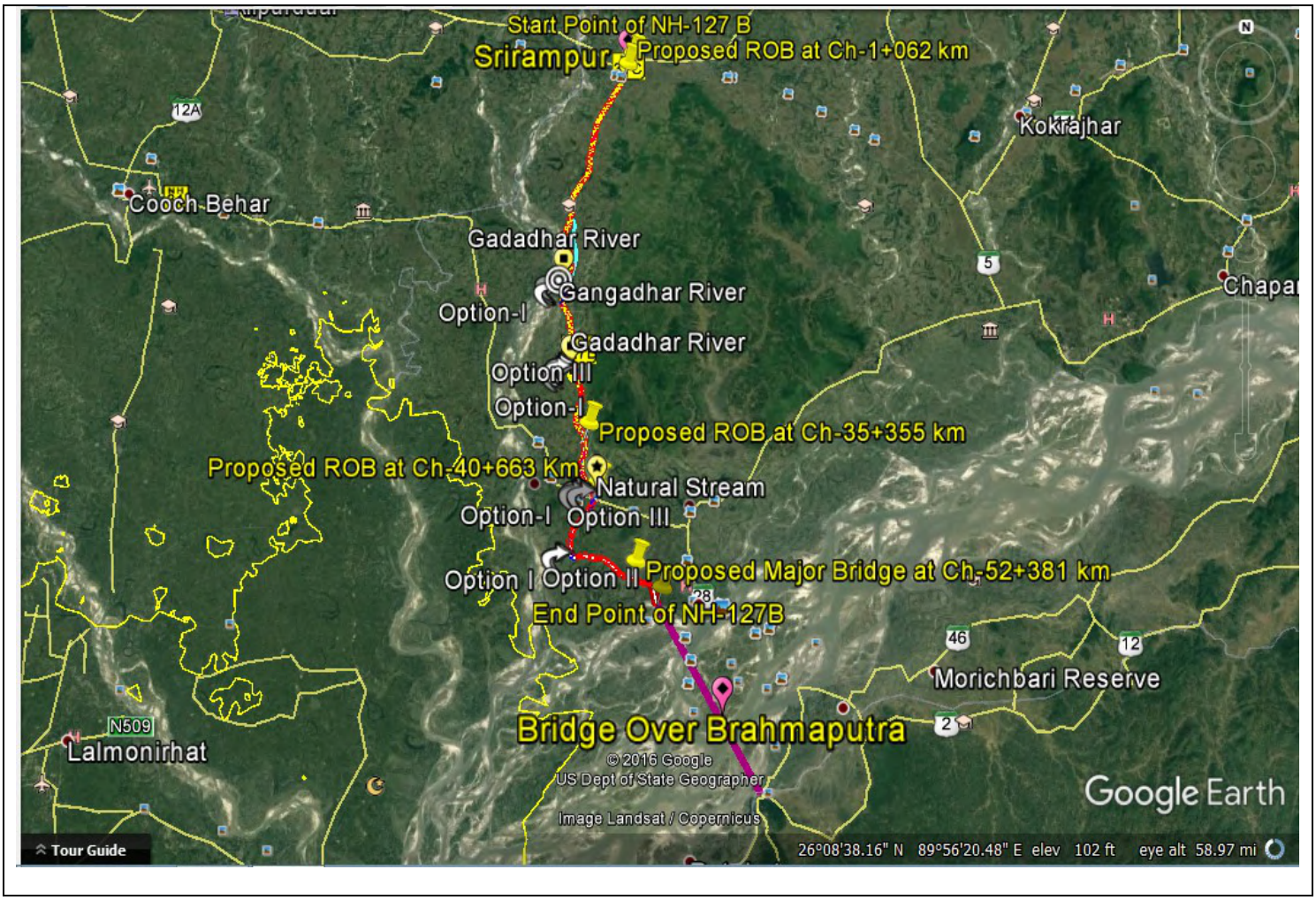
The project road corridor Srirampur- Dhubri is currently a single lane/ Intermediate road. The road starts from Srirampur on NH-27(old NH-31 C)and ends to the immediate approach of proposed bridge over river Brahmaputra near Dhubri, covering a distance of 53.616 km. The entire road stretch passes through Plain terrain and located in Kokrajhar and Dhubri district in state of Assam.

The project road alignment runs through five Police Stations namely, Srirampur, Tamarhat, Dhubri, Gouripur and Gossaigaon Police Station. Project Road traverse through mainly semi-urban and rural settlements. From start chainage it passes through Jakobpur, Kambilpur, Malkapur, Kathalguri, Grampur, Bashantipur, Auxiguri, Uzanpetla, MudhaPetla, Alokjhari, MadhaPetla, BhatiPetla, Satsaura, Kachakana, Pgla Hat, BarunDanga, Morterjhar, Baniyamari, Balajan, Dhepdheoi, DebduttaHazdaha 1, Kachari Hat, DebduttaHazdaha 2, Raja Katli,KachuaKash,ChandaKhol, Ada Bari and ends at immediate approach of proposed bridge over river Brahmaputra near Dhubri.

The existing road is with number of geometric deficiencies as the existing road is of MDR standard and towns & villages are only connected with road facility without proper geometrics. For the improvement of existing alignment number of realignments & bypasses are required with land acquisition at large extent.

The high embankment sections are at approaches to Major/Minor Bridges. However, as the most part of project road is in Brahmaputra River flood zone, significantly road embankment required to be kept high.

Figure 1.1: Key Map of Project Road Alignments



1.3 ENVIRONMENTAL IMPACT ASSESSMENT IN THE PROJECT

1.3.1 Objective and Need of Environmental Impact Assessment

The objective of environmental impact assessment study is to identify the adverse and positive impacts due to project implementation, suggest avoidance, mitigation and enhancements measures in project design and to prepare Environmental Management Plan (EMP) for pre-construction, construction and operation phases of the project.

The EIA notification 14th September 2006 amended, vide notification S.O.2559(E), dated 22nd of August 2013 which reads "*Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on re-alignments or by-passes*." In purview of this amendment in EIA notification it is established that the proposed project does not attract Environmental Clearance (EC) from MoEFCC.

As stated above, Environmental Clearance is NOT required. However EIA report for the project road is necessitated and requisite mitigation measures are to be built in the project design so that impacts are minimized during project execution/operation. The EIA report also required to be prepared so as to meet the requirements of the ToR of Competitive Authority.

1.3.2 Scope of EIA Report

The scope of study is as per ToR provided by MoRTH/ Assam PWD; model ToR for EIA of Highway project provided by MoEFCC and Environmental Impact Assessment Guidance Manual for Highways prepared by Administrative Staff College of India, Hyderabad (in February 2010).

1.4 ENVIRONMENTAL REGULATORY FRAME WORK

The Environmental Regulatory Frame Work in India is being controlled by "The Environment (Protection) Act, 1986. Under this Act, Environmental Impact Assessment (EIA) Notification -2006 has been issued by the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. According to the latest amendment (notification S.O.3067(E), dated 1st December 2009 and S.O. 2559 (E) dated 22 August 2013) of EIA notification 2006 as stated in above, project neither categorized as category A nor category B and it does not attract Environmental Clearance (EC).

1.4.1 Country's Policy Framework

The National policy framework has been developed to complement the legislative provisions. Besides, there are a number of social and transport sector policies in the country which has been isolated in approach for individual modes such as roads, airways, railways and inland waterways. Only relevant national environmental and social policies which are applicable to the project have been captured in the section as listed in **Table 1.2**.

Table 1:1: Relevant National Environmental and Social Policy Framework

S No	Policy	Coordinating Agency	Principal Focus of the Policy
1.	National Environment Policy (NEP) 2004	MoEFCC	Conservation of Critical Environmental Resources, Intra-generational Equity: Livelihood Security for the Poor, Inter-generational Equity, Integration of Environmental Concerns in Economic and Social Development.
2.	National Water Policy, 2002	National Water Board	To develop, conserve, utilize and manage Water Resources of the Country in sustainable manner,
3.	National Forest Policy, 1988	MoEFCC	Increase productivity &quality of forests and bring all degraded and denuded lands under afforestation programs.
4.	Policy Statement for abatement of Pollution 1992	MoEFCC	Integrates environmental considerations into decision making. Protection on critically polluted areas and river stretches; and involve the community in decision-making.
5.	Environment Action Program in 1993.	MoEFCC	The program aims at improving the environmental services in India and facilitating integration of environmental considerations in developmental programs across

S No	Policy	Coordinating Agency	Principal Focus of the Policy
			different sectors.
6.	Wild Life conservation strategy 2002	MoEFCC	Assigns priority sector to wildlife and forests and outlines measures for protecting wild life and enhancing the quality of forest areas in the country
7.	The National Conservation Strategy and Policy Statement on Environment and Development	MoEFCC	Includes guidelines for integrating environmental considerations into India's process of development. Stipulates that projects of certain category must be implemented after prior environmental clearance.
8.	National Environment Policy (NEP) 2004	MoEFCC	Conservation of Critical Environmental Resources, Intra-generational Equity: Livelihood Security for the Poor, Inter-generational Equity, Integration of Environmental Concerns in Economic and Social Development.

1.4.2 Country's Legal Framework and Regulatory Requirements

The legal framework of the country consists of several acts, notifications, rules and regulations to protect environment and wildlife. Indian legal system has been critically reviewed to identify its applicability to the proposed project. A list of all required clearances/ permissions related to environment has been summarised in **Table 1.3**.

Table 1:2: Permissions/Clearances Required for the Sub-Project

SL	Clearances	Acts/Rules/Notifications/ Guidelines	Concerned Agency	Responsibility
A. Pre-construction Stage				
1.	No Objection Certificate	Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981	Assam State Pollution Control Board	MoRTH ,PWD /Consultant
2.	Environmental Clearance	New EIA Notification, 2006 promulgated under Environment Protection Act 1986 and subsequent amendment	MoEFCC	Not required/ Only EIA and EMP need to be prepared by DPR consultant
3.	Permission for felling of trees	Forest Conservation Act (1980) Procedural Guidelines developed by the Department of Environment, under the orders of the Hon'ble High Court; Tree removal will be guided as per state government rules.	MoEFCC after recommendation from state Forest Department	PWD /DPR Consultant
B. Implementation Stage				
4.	Permission for Withdrawal of	Environment Protection Act 1986	Central Ground Water Authority	Contractor

SL	Clearances	Acts/Rules/Notifications/ Guidelines	Concerned Agency	Responsibility
	Ground Water			
5.	Permission for Withdrawal of Surface Water from River/ Irrigation Canals	-----	Irrigation Authorities for use of water from Irrigation Canal. River Board / Authorities for withdrawal of water from Rivers	Contractor To the Extent Possible Ground Water will be used.
6.	Permission for Sand Mining from river bed	Mines and Minerals (Regulation and Development) Act, 1957 as amended in 1972	River Board Authorities/ Department of Mining Govt. of Assam	Contractor
7.	Permission for Opening of New Quarry		Department of Mining Govt. of Assam and Assam State Pollution Control Board	Contractor
8.	Hot mix plant, Crushers, Batching Plant	Air (Prevention and Control of Pollution) Act 1981	State Pollution Control Board	Contractor
9.	Storage of Hazardous Chemicals	Hazardous Waste (Management and Handling) Rules 1989 and Manufacturing Storage and Import of Hazardous Chemicals Rules 1989	State Pollution Control Board	Contractor
10	Disposal of Hazardous Waste	Hazardous Waste (Management and Handling) Rules 1989	State Pollution Control Board	Contractor
11	Disposal of Construction Waste & liquid effluent from Labour camps	Water (Prevention and Control of Pollution) Act 1974	State Pollution Control Board	Contractor
12	Use of Fly ash within 100 kms around Thermal Power plants.	Fly Ash Notification, 1999 as amended upto 2009:	MoEFCC	Contractor
13	Pollution Under Control Certificate	Central Motor and Vehicle Act 1988	Department of Transport, Govt. of Assam	Contractor
14	Employing Labour/workers	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	District Labour Commissioner	Contractor

1.4.3 Cross-Sectoral Coordination and Other Permissions

In addition to above permissions and clearances, the cross-sectoral coordination with various departments need to be taken up prior to actual implementation of the project and obtain necessary permissions/clearances from

- Electricity Board and Telephone Department
- REO and other Road development agencies for Road Crossing
- Other utility organizations e.g. oil pipelines etc.

1.4.4 Relevant Guidelines/Specifications

- Guidelines for Environmental Impact Assessment of Highway Projects, IRC: 104-1988
- Recommended Practice for Treatment of Embankment slopes for erosion control, IRC: 36-1974
- Recommended Practice for Borrow pits for Road Embankment for Road manual operation, IRC: 10-1961
- Recommended Practice for the construction of Earth Embankments for Road Works, IRC: 36-1970
- Highway Safety Code, IRC, special publication no. 44
- Guidelines on Bulk Bitumen Transportation and Storage Equipment, IRC, special publication 39
- Recommended Practice for Tools Equipment and Appliances for Concrete Pavement Construction, IRC: 43-1972
- Recommended Practice for use and Upkeep of Equipment, Tools and Appliances for Bituminous Pavement Construction, IRC: 72-1978.Road Accident Forms A-1 and 4, IRC: 33-1982
- The factories act 1956 for hygiene and safety requirements of construction workers
- Other relevant codes of Bureau of Indian Standard (BIS) and National Building Codes
- Manual of Specifications and Standards for four laning of National Highways by Department of Road Transport & Highways (MoRTH)

1.4.5 Administrative Structure and the Interactive framework

The Government through specific legislations regulates the environmental management system in India. The MoEFCC and the Pollution Control Boards (CPCB i.e. Central Pollution Control Board and SPCBs i.e. State Pollution Control Boards) together form the regulatory and administrative core of the part. Other Ministries/Statutory Bodies/departments responsible for ensuring environmental compliance and granting various clearances includes state ministry /dept. of environment, regional offices of MoEFCC and state forests/wildlife departments.

1.4.6 Ministry of Environment and Forests (MoEFCC)

The primary responsibility for administration and implementation of the Government of India's policy with respect to environmental management, conservation, ecologically sustainable

development and pollution control rests with the Ministry of Environment, Forests and Climate Change (MoEFCC). Established in 1983, MoEFCC is the agency primarily responsible for the review and approval of EIA pursuant to GOI legislation. However, in this project review and approval shall be made by MoRTH itself as project road does not attract Environmental Clearance from MoEFCC.

1.4.7 MoEFCC Regional Offices

The Ministry of Environment and Forests has set up regional offices, in the six regions of the country. The regional office for the present project is located at Hyderabad. This office is responsible for collection and furnishing of state information relating to EIA of projects, pollution control measures, status of compliance of various conditions in projects cleared by MoEFCC, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, and other biological reserves.

1.4.8 Central Pollution Control Board (CPCB)

CPCB is a statutory authority attached to the MoEFCC and located in New Delhi. The main responsibilities of CPCB include inter alia the following

- Plan and implement water and air pollution monitoring programs;
- Advise the Central Government on water and air pollution monitoring programs;
- Set air and water standards; and
- Co-ordinate with the State Pollution Control Boards.

1.4.9 State Pollution Control Boards (SPCB)

The Assam State Pollution Control Board (ASPCB) will be the government agency responsible for ensuring the compliance with the relevant standards related to discharge of pollutant into the environment. The following activities of the ASPCB will be relevant to the project Planning and executing state level air and water quality initiatives;

- Planning and executing state level air and water quality initiatives;
- Advising state government on air, water and industry issues;
- Establishing standards based on National Minimum standards;
- Enforcing monitoring of all activities within the state under The Air Act, The Water Act and the Cess Act etc.; and
- Issuing No Objection Certificate (NOC) for various developmental projects.

1.4.10 Assam Forest Department

The Assam Forest Department is responsible for the management and administration of forest resource in the state. There are some linear plantations along the existing alignment, which need to be cut during construction stage. Hence, permission from state forest department has to be obtained for cutting of trees and forest land diversion. Compensatory afforestation work will be undertaken in lieu of tree cutting from the designated protected forests area.

1.5 STRUCTURE OF THE EIA REPORT

This EIA report has been presented keeping in view of EIA Guidance Manual for Highway version 1.0 (2010) and model TOR prepared by Administrative Staff College of India, Hyderabad, Model ToR provided by MoEFCC and as per requirements of ToR provided by MoRTH/PWD Assam.

Chapter - 1: Introduction: The present chapter deals with the purpose of the report, identifying the project and project components, giving brief description of nature, size and location of the project and its importance to the country, region and scope of work.

Chapter - 2: Project Description: This chapter briefly describes the scope of work and proposal for improvement the project.

Chapter - 3: Description of the Environment This chapter describes the study area and meteorological baseline existing environmental scenario in detail. The sections on Meteorological baseline, components of the biophysical and natural environments, cultural properties along the corridor and quality of life which give a comprehensive picture of the existing environment along the project road and its area of influence.

Chapter - 4: Anticipated Environmental Impacts and Mitigation Measures: This chapter details out environmental impacts, mitigation, avoidance and enhancement measures including Environmental Management Plan. In addition to the avoidance and mitigation measures for the biophysical and natural environmental components, this chapter discusses various environmental enhancements suggested by the project including the enhancement of common property resources such as community water bodies and cultural resources along the project road.

Chapter - 5: Analysis of Alternatives: This chapter covers various alternatives considered in finalisation of project road alignment and with and without project scenario.

Chapter - 6: Stakeholder Consultations: This chapter gives an overview of the Community Consultation carried out during the project preparation stage. It also provides an insight into the processes involved, its importance to project design and methods adopted to document the entire exercise.

Chapter - 7: Environmental Monitoring Programme: This Chapter gives the Environmental Monitoring Plan for Pre Construction, Construction and Operation phases to check the efficacy of EMP.

Chapter - 8: Environmental Management Plan (EMP): This chapter suggests institutional requirements for ease of implementation of the environmental component of the project. It goes on to describe the set-up required, a reporting system and Environmental management Plan. The environmental monitoring plan has also been described.

CHATER-2 (PROJECT DESCRIPTION)

2.5 GENERAL

Project Corridor Sirirampur- Dhubri under study is a part of National Highway No. 127B. The total length of the project highway is 53.616 km. The study stretch starts from km. 0.000 (Srirampur), X Junction with old NH-31 and ends at Dhubri km. 53.616 (at proposed Bridge at Brahmaputra). The topographic survey is carried out along the existing and part of new alignment between Srirampur-Dhubri starts from km 0.000 and ends at km 53.616, thus the existing project road is 53.616.

2.2 PRESENT CHARACTERISTICS

The project road is traverses in plain terrain passing through rural areas as well as few intermittent semi-urban and urban settlements. In rural areas the land use on both sides is agricultural land/open spaces interspersed with small structures. The abutting land use in the built-up areas is predominantly residential and semi-commercial. Few Educational institutions and worship places exist along the roads in some of the villages and semi-urban sections. It is observed that the vertical alignment of the road is quite flat except at few bridge and culvert locations. The existing formation height of the project road varies from 2m to 5 m and even more at approaches to bridges, where it is higher. In some stretches it is flushing with GL resulting in serious drainage problems.

Traffic signs are missing at many locations on the project road. No warning signs exist before the approach of the junction and approach of curves. Directional signs exist at few locations.

2.4.1 Major Village/town on Project Road:

The project road alignment traverse and connects five Police Stations namely, Srirampur, Tamarhat, Dhubri, Gouripur and Gossaigaon Police Station. Project Road traverse through mainly semi-urban and rural settlements.

From start chainage it passes through Jakobpur, Kambilpur, Malkapur, Kathalguri, Grampur, Bashantipur, Auxiguri, Uzanpetla, MudhaPetla, Alokjhari, MadhaPetla, BhatiPetla, Satsaura, Kachakana, Pgla Hat, BarunDanga, Morterjhar, Baniyamari, Balajan, Dhepdheoi, DebduttaHazdaha 1, Kachari Hat, DebduttaHazdaha 2, Raja Katli,KachuaKash,ChandaKhol, Ada Bari and ends at immediate approach of proposed bridge over river Brahmaputra near Dhubri

2.4.2 Traffic Volume

Two homogeneous section has been identified for traffic study.

(a) Homogeneous section-1

From the traffic projection it is seen that the PCU of project road from Km 0+000 to Km 38+990 (homogeneous section 1) is within 18000 upto the year 2034, so as per IRC:SP 73-2015 two lane with paved shoulder is sufficient up to 2034, but 4 Lane cross section has been adopted as per instruction received from NHIDCL vide Minutes of 56th meeting of executive committee Dated: 27.08.2018. The road is designed for 15 years design life as per IRC-37 2012.

(b) Homogeneous section-2

From the traffic projection it is seen that the PCU of the project road for homogeneous section-2 (from Km 38+990 to Km 54+523) reaches 18000 PCU in the year 2028 which is 8 years after the opening of traffic on the project road. So that portion of the project road i.e from Km 38+990 to Km 54+523 is proposed to construct as 4-lane with paved shoulder.

In 53.6 km long project road traffic survey has been done at 5 below mentioned locations. Classified traffic volume count has been detailed in below mentioned table 2.2.

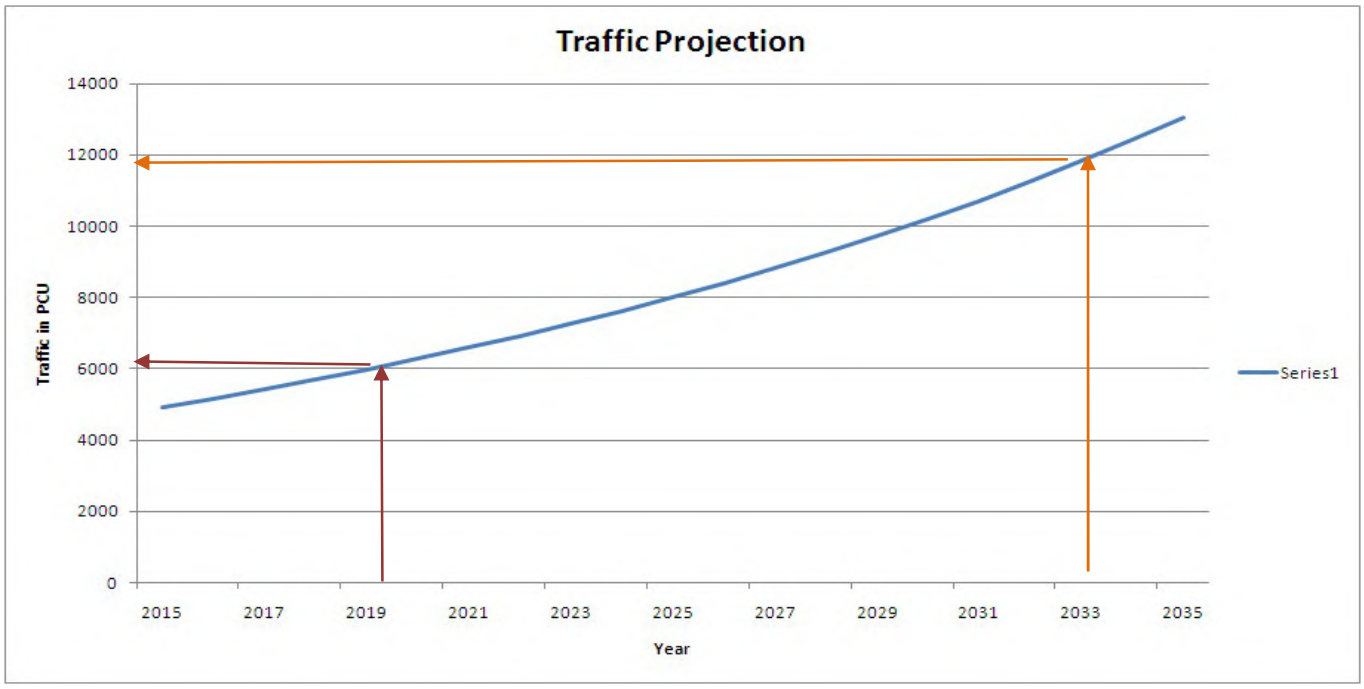
Table 2:1: Classified Traffic Volume Count

Vehicle Type	ON NH-127B (Near Chowmore)	ON NH-31	Probable diverted traffic from NH 31 to NH-127B	ON NH-31C	Probable diverted traffic from NH 31C to NH-127B	Expected traffic on NH-127B after completion
Two Wheeler	1535	1477	0	1545	0	1535
Car/Jeep/Van/Taxi/Auto	1070	2344	703	1976	99	1872
Mini Bus	0	121	93	75	7	101
Standard Bus	4	145	112	116	12	127
LCV	42	52	396	115	0	42
2-Axle Truck	41	671	531	329	39	476
3-Axle Truck	1	932	441	322	10	542
Multi-Axle	0	658	0	767	23	464
Tractor With Trailer	41	106	0	11	0	41
Tractor Without Trailer	13	22	0	2	0	13
Cycle	1374	533	0	631	0	1374
Cycle Rickshaw	116	89	0	100	0	116
Hand Cart	6	5	0	15	0	6
Bullock Cart	0	1	0	1	0	0
Horse Cart	0	5	0	1	0	0
Total Motorized Vehicles (Number)	**2747**	**6529**	**2277**	**5257**	**190**	**5214**
Total Non Motorized Vehicles (Number)	**1497**	**633**	**0**	**747**	**0**	**1497**
Total Commercial Vehicle per day	**142**	**2708**	**1574**	**1737**	**91**	**1807**
Total PCU per day	**3181**	**11429**	**5946**	**8625**	**396**	**9523**

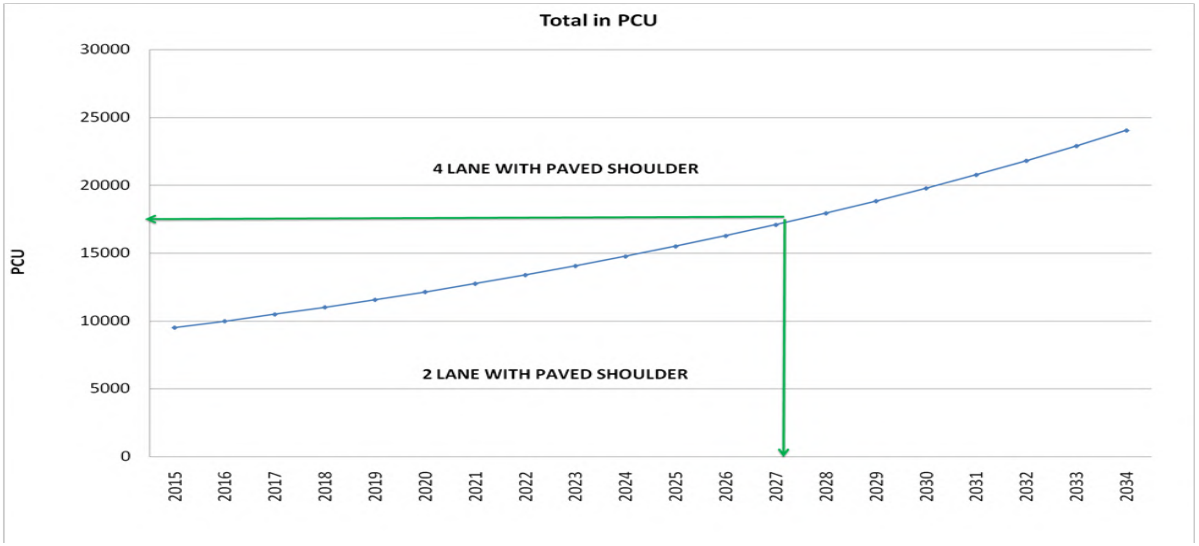
2.4.3 Projected Traffic & Capacity analysis

The future traffic generation is carried out based on IRC: 37-2012, 5% growth of traffic is considered for homogeneous section 1 and homogeneous section 2.

From the traffic projection of Homogeneous section-1, it is seen that the PCU of project road from Km 0+000 to Km 38+990 (homogeneous section 1) is within 18000 upto the year 2034, so as per IRC:SP 73-2015 two lane with paved shoulder is sufficient up to 2034, but 4 Lane cross section has been adopted as per instruction received from NHIDCL vide Minutes of 56th meeting of executive committee Dated: 27.08.2018. The road is designed for 15 years design life as per IRC-37 2012.



Similarly, from the traffic projection of homogenous section-1, it is seen that the PCU of the project road for homogeneous section-2 (from Km 38+990 to Km 54+523) reaches 18000 PCU in the year 2028 which is 8 years after the opening of traffic on the project road. So that portion of the project road i.e from Km 38+990 to Km 54+523 is proposed to construct as 4-lane with paved shoulder.



Also as per the MoRT&H Circular No. RW/NH-33044/28/2015/S&R (R) dt. 29th June 2015 the guidelines regarding upgradation of the existing 2 lane highways with paved shoulders shall be started before the end of design life, so that by the time threshold capacity of road reached the 4 lane highway shall be constructed. The upgradations of road to 4lane road are specified, 4 Lane improvements shall be proposed for traffic of 15000 PCU (Plain terrain). As per these guidelines 4 Lane + PS is proposed for HS 1 & HS 3 is proposed with 2 Lane + PS road configuration.

Accordingly the improvement proposals are prepared for two different sections:

Package	Proposed Chainage		Length(m)	TCS	TCS Details
	From	*To*			
I	0	420	420	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (With New Sub-Grade)
	420	1780	1360	TCS-5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road
	1780	10900	9120	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
II	10900	12700	1800	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	12700	14650	1950	TCS-1A	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (dismantling upto Existing GSB Layer)
	14650	15550	900	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade

Package	Proposed Chainage		Length(m)	TCS	TCS Details
	From	*To*			
	15550	17000	1450	TCS-4A	Reconstruction of 4-Lane carriageway Rigid Pavement with both side Drain (dismantling upto Existing GSB Layer)
	17000	20300	3300	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	20300	23050	2750	TCS - 3	New Construction of 4-Lane Carriageway for flexible Pavement
	23050	23200	150	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	23200	23550	350	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (with New Sub-Grade)
	23550	26705	3155	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	26705	27226	521	TCS-4B	Reconstruction of 4-Lane carriageway Rigid Pavement with both side Drain (with New Sub-Grade)
	27226	27650	424	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
III	27650	27870	220	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (with New Sub-Grade)
	27870	28450	580	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	28450	30350	1900	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	30350	34300	3950	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	34300	34450	150	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (with New Sub-Grade)
	34450	34645	195	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	34645	36070	1425	TCS-5A	4-Lane Carriageway for flexible pavement with Both side RE Wall

Package	Proposed Chainage		Length(m)	TCS	TCS Details
	From	*To*			
					&Service Road
	36070	36500	430	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
IV	36500	36900	400	TCS-1A	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (dismantling upto Existing GSB Layer)
	36900	39150	2250	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	39150	39370	220	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	39370	40700	1330	TCS-5B	4-Lane Carriageway for flexible pavement with Both Side RE Wall
	40700	41250	550	TCS-5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road
	41250	42550	1300	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	42550	43300	750	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
V	43300	45650	2350	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	45650	46350	700	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	46350	47750	1400	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	47750	48400	650	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	48400	49400	1000	TCS-5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road
	49400	51590	2190	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	51590	52000	410	TCS-7	New construction of 4-Lane carriageway for flexible Pavement with High Embankment

Package	Proposed Chainage		Length(m)	TCS	TCS Details
	From	*To*			
	52000	53550	1550	TCS-6	New construction of 4-Lane carriageway for flexible Pavement with Both Side Service Road & Retaining Wall.
	53550	54154	604	TCS-7	New construction of 4-Lane carriageway for flexible Pavement with High Embankment

2.4.4 Right-of-Way

The existing ROW of project road has been observed to be around 20m to 30m. However, the existing ROW does not cater to the codal provision of 60m ROW for plain road and hence land is required to be acquired to adhere to the codal provision. The project road doesn't have sufficient RoW for proposed upgradation and widening. The actual additional land requirements can be assessed when the design philosophy, necessity and locations of bypasses are decided and. The additional land requirement and land actuation related details are provided separately in Land Acquisition Plan (LAP)

The concept of development improvement & construction of the project highway to Two/Four Lane with Paved Shoulders is for reduction in transport cost, enhanced safety & Level of Service for road users, with superior operation & maintenance enabling enhanced operation efficiency, minimal adverse impact on the local population, minimal adverse impact on environment, minimal land acquisition by appropriate engineering solutions. The preliminary designs of the major components are carried out for the alternative alignment options of project road.

2.4.5 ROB, RUB & Railway Crossings

There is no existing manned railway crossing (LC)/ROB in the existing project road stretch. However, 3nos. ROB is proposed at the following location mentioned below.

Sl. No.	Design Chainage (km)	Type of Structure	Span Arrangement (No. x Span)m
1	1.044	ROB	3 x 36m RDSO + 1 x 72m BOWSTRING + 3 x 36m RDSO
2	35.355	ROB	1X24 T-BEAM+(1X24+1X36+1X24) COMPOSITE+1X24 T-BEAM
3	40.637	ROB	1X21_TBEAM+1X72.M_BOWSTRING+(2X36) COMPOSITE+1X24_T BEAM

2.4.6 Major Bridges, Minor Bridges & Cross Drainage works

The inventory of all existing structures (bridges, cross drainage structures) is prepared as per provisions of IRC:SP:35-1990 and also the required parameters are collected which will help in adopting a technical approach for retention/repair & rehabilitation/reconstruction/new construction of existing structures & listed below.

There are 9 Nos. of bridges in the project stretch out of which 1 no minor bridge locations has been omitted due to realignment. 3 nos of existing minor bridges(Including 2nos wooden bridges) have been proposed for reconstruction, while widening with new 2 lane bridge 5 Nos.(4 nos. Minor Bridge+1 no. Major Bridge) has been proposed. Additional 4 no new minor bridges has been included in the project road. Considering smooth traffic flow & safety issue, 1no VUP, & 3 nos. ROB is also proposed.

Table 0:2List of omitted bridges due to realignment

Sl No.	Existing Chainage (km)	Existing		
		Type of Water Way	Type of Structures (Bridge)	Span Arrangement (No x Span) (m)
1	29.200	Nala	RCC Slab Bridge	2 x 12m

Table 0:3Details of Minor bridges with additional two lane: 4 Nos.

Sl No.	Survey Chainage (km)	Proposed Chainage (km)	Existing			Proposal	
			Type of Water Way	Type of Structures (Bridge)	Span Arrangement (No x Span) (m)	Type of Structures (Bridge)	Span Arrangement (No.xSpan) m
1	7+300	7+241	Open Land	Bridge(RCC Box)	4x4m	Minor Bridge	4mx4.066m x 4cell
2	24+400	23+999	Nala	RCC Slab Bridge	2 nos. x 12m span	Minor Bridge	2x 12m (Integral Slab)
3	31+500	30+408	Nala	Bridge (T-Beam Girder)	1 x 19.6m	Minor Bridge	1x 21m (T-Beam)
2	45+800	44+645	Water Logged	Bridge (PSC T-Beam Girder)	40.80m	Minor Bridge	1x 41m (PSC)

Table 0:4Details of Minor bridges New Construction: 4 Nos.

Sl No.	Survey Chainage (km)	Proposed Chainage (km)	Existing			Proposal	
			Type of WaterWay	Type of Structures (Bridge)	Span Arrangement (No.xSpan) (m)	Type of Structures (Bridge)	Span Arrangement (No.xSpan) m
1		21+140	Gadadhar Rvier			Minor Bridge	2x 18m (T-Beam)
2		21+871	Gadadhar Rvier			Minor Bridge	2x 18m (T-Beam)
3		28+974	Gadadhar Rvier			Minor Bridge	2x 24m (T-Beam)
4		30+050	Gadadhar Rvier			Minor Bridge	3x 18m (T-Beam)

Table 0:5Minor Bridges Reconstruction as 4lane: 3 Nos.

Sl No.	Survey Chainage (km)	Proposed Chainage (km)	Existing			Proposal	
			Type of WaterWay	Type of Structures (Bridge)	Span Arrangement (No x Span) (m)	Type of Structures (Bridge)	Span Arrangement (No.xSpan) m
1	44+000	43+100	Open Land	(RCC Box)	4.0X3.0X2.0	Minor Bridge	Box Bridge 4mx3m x 2cell
2	48+750	47+286	Water Logged	Wooden Bridge		Minor Bridge	1x 24m (T-Beam)
3	49+700	48+167	Water Logged	Wooden Bridge		Minor Bridge	1x 24m (T-Beam)

Table 0:6Details of Major bridges with additional 2 lane: 1 No.

Sl No.	Proposed Chainage (km)	Existing			Proposal	
		Type of Water Way	Type of Structures (Bridge)	Span Arrangement (No x Span) (m)	Type of Structures (Bridge)	Span Arrangement (No x Span) m
1	51+553	Redundant part of River	(T-Beam Girder)	2 span 42m	Major Bridge	2x 41m (PSC)

2.4.7 Vehicular Underpass

3 Vehicular Underpass and 1 Light Vehicular Underpasses is proposed at the following location mentioned below.

Table 8.9Location of Vehicular Underpass (VUP)

Sl. No.	Design Chainage (km)	Type of Structure	Span Arrangement (No. x Span)m
1	39.700	VUP	1x15m(Integral Slab)
2	48.810	VUP	1x15m(Integral Slab)
3	52.353	VUP	1x15m(Integral Slab)
4	53.191	LVUP	1x15m(Integral Slab)

2.4.8 Relocation of Utilities

Both LT and HT lines run along / across the road at a number of places. At few stretches, telephone lines and water pipes also exist. Telephone, LT lines need relocation in consultation with local electricity authorities. OFC lines are also to be realigned. Strip plans showing relocation of utilities have been prepared and submitted with DPR. Provisions have been made in the cross-section for accommodating Utilities at both over as well as underground as the case may be and a 2.0 m wide strip of land at the extreme of ROW as prescribed in MANUAL are kept for accommodating Utility Services. Provisions contained in IRC: 98 have been followed to accommodate Utility Services for Project Highway in built up area.

2.4.9 Existing Road Geometric

The formation width of the existing road is 4.70m to 9.00m throughout the road section. The carriageway width is generally 3.70m to 6.00m. The geometric of existing alignment was reviewed based on survey drawing and data showing the existing road alignment and it is revealed that horizontal alignment and vertical profile at most of the places are deficient in geometrics. Deficient

horizontal curves have been revised to ruling 100kmph and minimum of 80kmph as per codal provisions. In some cases the speed is reduced to 65kmph.

Vertical profile has been designed keeping the sub grade formation as per codal provision. Deficient vertical curves have been smoothened out at the intersections of different grades to ease off changes in gradients for the fast moving vehicles. Horizontal curves as exist are found are not as per IRC Code at many locations, in the provision of required transition length for design speed of 100 Km/hr and hence some curves are to be modified accordingly. For widening the road embracing the existing alignment, as there is need for correction of curves at some places.

2.4.10 Existing Pavement

The existing bituminous road surface has been classified into poor, and failed on visual inspection and BBD test. Pavement has been found to poor with absolutely cracking, raveling, rutting and potholes almost the full stretch and some proportion DBM and WBM layer fully exposed. Existing pavement thickness has been found to vary from 60 mm to 1000 mm.

2.4.11 Land Use

Land use is the human modification of natural environment into built environment such as fields, pastures, and settlements. It can also be defined as "the total of arrangements, activities, and inputs that people undertake in a certain land cover type".
The land adjacent to the road is predominantly agricultural, low lying pastures and sparse settlements having rural and semi-urban character.

2.5 NEED OF PROJECT

The project achieves its significance due to a large number of reasons. Important among them have been described below.

- The project road is of significant importance as the road connecting two National Highways (NH31C and NH-31), one proposed bridge over river Brahmaputra and connects to important nearby villages and semi-urban settlements.
- The project will have multiple benefits as it will provide all weather high speed National Highway.
- Other than this project road also benefit in below mentioned way;-
- Fast and safe connectivity resulting in savings of fuel, travel time and total transportation cost to the society
- Employment opportunity to people
- Development of local industry, agriculture and handicrafts
- Transporting, processing and marketing of agricultural products
- Reduction in accidents
- Reduction in pollution
- Opening up of opportunities for new occupations
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products
- Improved quality of life for people.

2.5 TYPE OF PROJECT

The improvement proposal consist of improvement to existing carriageway by reconstruction/new construction/ widening to Two/Four Lane with Paved Shoulders. The improvement proposal includes improvement to geometrically deficient curves and grades to meet the geometrical standards, Proposed New Bypasses and Realignments. All existing minor and major bridges proposed for reconstruction / widening / new construction as per standards of MoRT&H. It is also proposed reconstruction / widening / new construction of Hume Pipe Culverts / Slab drains to meet the National Highway standards.

As per latest amendment of EIA notification 2006 of MoEFCC (notification S.O.3067(E), dated 1st December 2009 and S.O. 2559 (E) dated 22 August 2013) as stated in above section project neither categorized as category A nor category B and it does not attract Environmental Clearance (EC).

2.4.1 Deficiencies and Issues

The following major deficiencies in existing highway in the project stretches have been identified and addressed for proposed widening in terms of traffic operation and safety, road conditions and maintenance.

Operation

- Road capacity augmentation
- Congestion and delays through built-up areas
- Vehicle competing with slow moving vehicle for the pavement space
- Deficient road surface conditions (roughness)
- Pedestrian crossing on the road
- Pavement edge markings
- Uncontrolled roadside developments and encroachments

Safety

- Exposed roadside hazards.
- No pavement markings
- Inadequate or NO traffic signs
- Conflict with pedestrians, cattle, slow vehicles.

Road

- The existing bituminous road surface has been classified into poor, and failed on visual inspection and BBD test. Pavement has been found to poor with absolutely cracking, raveling, rutting and potholes almost the full stretch and some proportion DBM and WBM layer fully exposed. Existing pavement thickness has been found to vary from 60 mm to 1000 mm.
- The pavement condition of main carriageway varies poor to bad and there is structural inadequacy.
- Shoulder functionally is inadequate to NIL.

A few other issues which contribute to operational deficiencies and safety concerns and which prevent the optimum utilization of the highway capacity to a desirable level of service, e.g. driving discipline and compliance, traffic surveillance, corridor security and management, level of regular road maintenance, truck overloading, etc. have been dealt as per Manual for Specification and Standards for 2/4 laning of Highways.

2.4.2 Pavement Composition

Flexible pavement is proposed with reconstruction/new construction of the existing road for entire road except congested build up area. Rigid pavement is designed for design period of 30 (Thirty) years and adopted CBR of subgrade is 10% (Minimum).

Flexible pavement is proposed for Service road locations existing cross Junction roads, Bus Byes. Flexible pavement is designed for design period of 15 (Thirty) years and adopted effective CBR of subgrade is 8% (Minimum).

2.4.3 Widening/Improvement Proposal

The **Table 2.8** showing below is the proposed project length after geometric improvement of the project road.

Table 0:7: Widening/Improvement Proposal

Package	Proposed Chainage		Length (m)	TCS	TCS Details
	From	*To*			
I	0	420	420	TCS -1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (With New Sub-Grade)
	420	1780	1360	TCS - 5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road
	1780	10900	9120	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
II	10900	12700	1800	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	12700	14650	1950	TCS-1A	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (dismantling upto Existing GSB Layer)
	14650	15550	900	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	15550	17000	1450	TCS-4A	Reconstruction of 4-Lane carriageway Rigid Pavement with both side Drain (dismantling upto Existing GSB Layer)

Package	Proposed Chainage		Length (m)	TCS	TCS Details
	From	*To*			
	17000	20300	3300	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	20300	23050	2750	TCS - 3	New Construction of 4-Lane Carriageway for flexible Pavement
	23050	23200	150	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	23200	23550	350	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (with New Sub-Grade)
	23550	26705	3155	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	26705	27226	521	TCS-4B	Reconstruction of 4-Lane carriageway Rigid Pavement with both side Drain (with New Sub-Grade)
	27226	27650	424	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
III	27650	27870	220	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (with New Sub-Grade)
	27870	28450	580	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	28450	30350	1900	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	30350	34300	3950	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	34300	34450	150	TCS-1B	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (with New Sub-Grade)
	34450	34645	195	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	34645	36070	1425	TCS - 5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road

Package	Proposed Chainage		Length (m)	TCS	TCS Details
	From	*To*			
	36070	36500	430	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
IV	36500	36900	400	TCS-1A	Re-Construction of 4-Lane Carriageway for flexible pavement with Both side drain (dismantling upto Existing GSB Layer)
	36900	39150	2250	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	39150	39370	220	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	39370	40700	1330	TCS-5B	4-Lane Carriageway for flexible pavement with Both Side RE Wall
	40700	41250	550	TCS - 5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road
	41250	42550	1300	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	42550	43300	750	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
V	43300	45650	2350	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	45650	46350	700	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	46350	47750	1400	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade
	47750	48400	650	TCS-3	New Construction of 4-Lane Carriageway for flexible Pavement
	48400	49400	1000	TCS - 5A	4-Lane Carriageway for flexible pavement with Both side RE Wall & Service Road
	49400	51590	2190	TCS - 2B	Re-Construction of 4-Lane Carriageway for flexible pavement with New Sub-Grade

Package	Proposed Chainage		Length (m)	TCS	TCS Details
	From	*To*			
	51590	52000	410	TCS-7	New construction of 4-Lane carriageway for flexible Pavement with High Embankment
	52000	53550	1550	TCS-6	New construction of 4-Lane carriageway for flexible Pavement with Both Side Service Road & Retaining Wall.
	53550	54154	604	TCS-7	New construction of 4-Lane carriageway for flexible Pavement with High Embankment

2.4.4 Slope Protection/Protection work

Fillings in slopes have been involved in widening the road to 2/4-lane configuration including the high-embankment in bridge approaches. Predominant nature of the soil in the slopes is to be grader-trimmed machined earth of ordinary/heavy type available in the locality. A natural slope of 1:1.5 and flatter, found stable with adequate factor of safety, has been proposed. Protection of the cut and fill slopes will be provided with turfs grown by mulching and seeding.

Protection works in the major bridge will be provided matching the protection work used in the existing bridges. IRC-89-1997 will be followed in detailing the protection works.

i) Return walls of required length will be provided in all bridges and culverts to stop the spilling of earth into the waterway,
ii) Flooring will be provided over both side of the base raft of culverts to guard against deterioration of the base raft
iii) Perimetral cut-off walls around the base raft of culverts and boulder apron on both upstream and downstream sides will be provided to reduce the scouring,
iv) The perimetral cut-off walls will also increase the effective depth of foundation in addition to their protective functions.

2.4.5 Miscellaneous Work

Provision of signs and road markings proposed to ensure road safety- Retro reflective road signs shall be provided at all locations necessitating informatory, Cautionary and Mandatory signs as per guidelines given in IRC : 35 – 1997 and IRC : 67 – 2001 for road markings, painting and signage systems. In addition to this proper safely signs and marking shall be provided at all busy crossings for safety of traffic and pedestrians. For visibility at night times all road sections passing through built up areas shall be provided with lighting system as per standards and specifications.

Metal Beam Crash Barriers (MBCB) - Metal Beam Crash Barriers are proposed on both edges of road embankments where the height is more than 3.00 m on both sides of main carriageway.

The metal Beam Crash Barrier shall consist of W – Beam fixed on posts (15 MB150) placed at 5.0 m apart c/c with spacers (also 15 MB – 150). Reflectors shall be fixed on the Metal Beams @ 3m c/c for proper delineation of barrier line.

Guard Posts- Standard Guard Posts made of M-20 grade concrete fixed with M-20 grade concrete foundation proposed to be provided on inner and outer edges of road with sharp curves, road on hill side at 1.50 m intervals and 2.00 m from the edge of carriageway with reflectors fixed on it.

200 m, Kilometre and 5th km. stones- These stones shall be fixed as per guidelines of IRC : 8 and IRC : 26 with lettering and numbering as per code provisions. These shall be fixed on LHS for each direction of travel.

Delineators-Delineators are provided for visual assistance to drivers to follow and negotiate the alignment of road ahead and provide warning about hazards particularly at night times. Various types in use are:-

- Clustered Red Reflectors on triangular nodes as object markers are provided at the edge of median and directional islands.
- Circular red reflectors on face / top of islands and medians.
- Circular white Reflectors on Guard Posts.

Boundary Stones- Road Boundary stones shall be fixed on both sides of the road to demarcate the boundary of new ROW. These shall be fixed with proper founding concrete and dowel bars to guard against tampering.

Traffic Signals- All at grade junctions in built up areas shall be provided with traffic signals. These shall be provided as per safety manual.

Lighting System- All road stretch passing through built up area shall be provided with lighting system erected on poles with adequate height and 30 m c/c., such that it shall provide uniform illumination of 40 lux minimum at all places.

Landscaping and Arboriculture - The environment along the proposed corridor shall be enhanced using various techniques of soft landscapes, principally through plantation of various types of shade and ornamental trees along with shrubs. Landscaping strategy has been developed to enhance the visual quality of the project road. Tree plantations have manifold benefits. They may help in reducing the air pollution levels, especially Suspended Particulate Matter (SPM) in the surrounding area. A marginal decrease of 3 to 4 dB (A) in noise levels may also be expected due to the plantation used for landscaping.

Tree plantation is proposed along project highway at 10-15 m c/c on both sides parallel to the road. Set back distance of trees in different situation shall be as per IRC:SP:21 and IRC : 66. The nearest edge of tree trunk shall be at 2.00 m minimum from road edge or kerb edge.

The scheme of Landscaping shall be part of overall Environmental Mitigation Plan (EMP). The planting shall be such that it does not obstruct the visibility of traffic from any side and shall be pleasing in appearance.

Avenue plantation is proposed to be planted in entire project road length. 1% of the Total Project Cost is set apart for Highway plantation and its Maintenance as per circular F.No.RW/NH-33044/49/2015/S&R (R) Dated 28th August 2015.

2.5 Cost Estimate

The estimated cost for widening and strengthening into 4 laning with paved shoulder with all structure, road furniture in all respect is Rs. 1471.02Crores. The package cost wise breakup is as follow:

S No	Description	Amount (Crore)
1	Total Civil Cost	886.66
2	Civil Cost with Centages	1379.79
3	Departmental Cost	333.43
3.A	Land acquisition and R& R Cost	328.28
3.B	Utility Shifting	3.38
3.C	Environmental Cost	1.76
Total Project Cost		1471.02 (27.16Cr/km)

CHAPTER-3

(DESCRIPTION OF ENVIRONMENT)

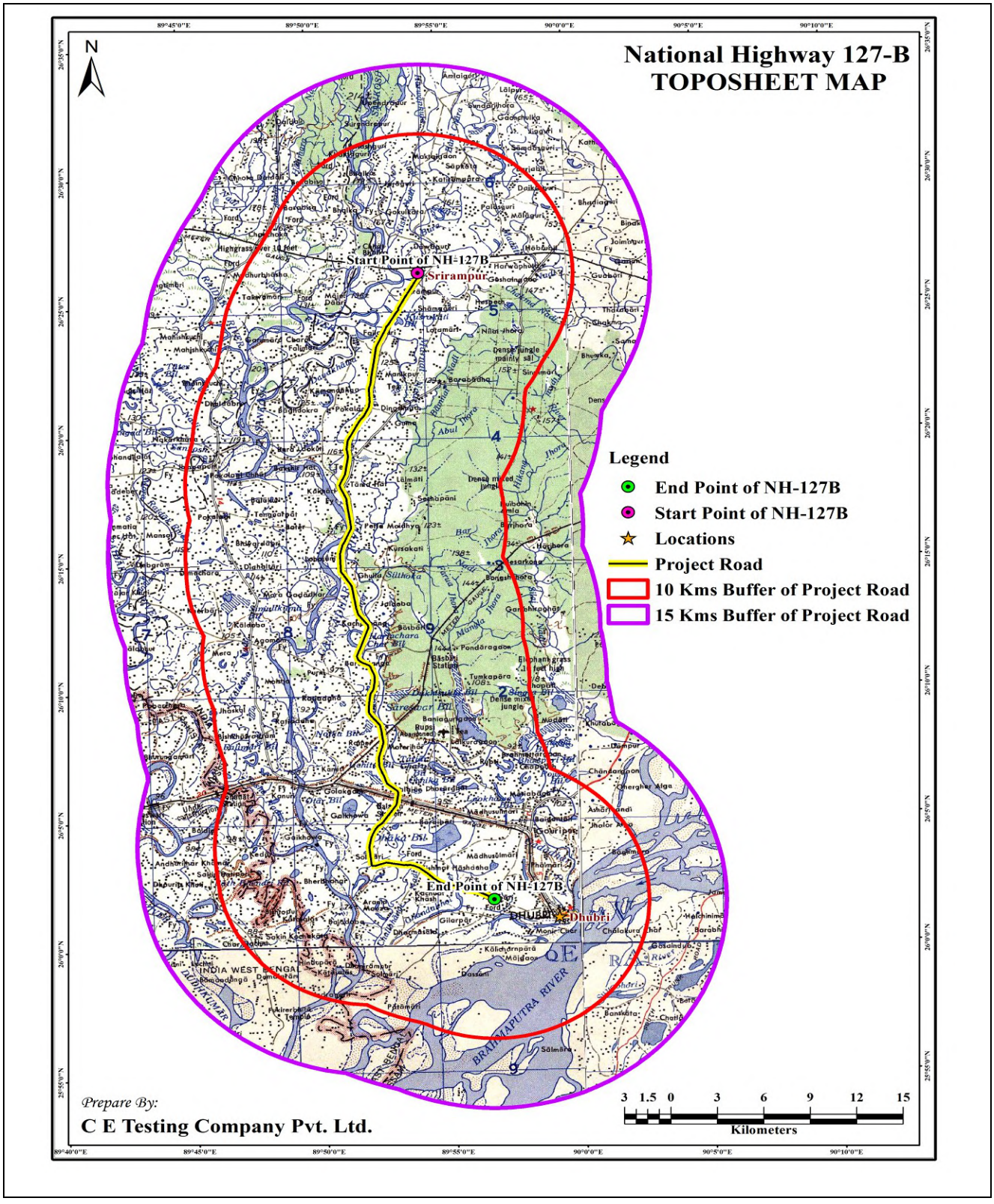
3. DESCRIPTION OF THE ENVIRONMENT

As stated in previous chapter, study stretch starts is currently a single lane/ Intermediate road and it starts from Srirampur on NH-27(old NH-31 C)and ends to the immediate approach of proposed bridge over river Brahmaputra near Dhubri, covering a distance of 53.616 km. The entire road stretch passes through Plain terrain. The project road stretch passes through Kokrajhar (approx 10 Km) and Dhubri (approx. 44 km) district of Assam. The road project is to provide NH standard connectivity to the immediate approach of proposed bridge over river Brahmaputra near Dhubri at chainage 54.230 km (As per design chainage) from Srirampur on NH-27(old NH-31 C) at Chainage 0.00. The total length of the road is about 54.230 km (as per Design length).

The proposed project road traverses predominantly through open area and rural/semi-urban settlements. Both side of project road alignment is generally low-lying area of flood plain of Brahmaputra River.

The study area map of the proposed project has been presented in **Figure 3.01**.

Figure 3.0 1: Study Area Map of the Project Road



3.1 PHYSICAL ENVIRONMENT

3.1.1 Physiography

Physiographically, the district constitutes the vast alluvial plains of Brahmaputra River system. The monotony of the flat alluvial tract is interrupted by the presence of Archaean inliers in the form of disconnected hillocks referred to as inselbergs and these occur specially in the eastern and southern parts of the district. These hillocks are joined by the offshoots of Shillong plateau and are found on the north bank near Diple beel, Sitdanga beel and east of Bilasipara and on the south bank of the foothill portion of Garo Hills along the district boundary. The level difference between the valley and the peaks of the inselbergs ranges from 25 to 455 m. These hillocks are covered by a thick lateritic mante and are occupied by evergreen mixed forest. Terraced alluvial deposits occupy 80% of the district with conspicuous occurrence of buried channels, back swamps, etc. Soils in greater part of the district are sandy and silty loam, or clayey loam. It is found to be highly acidic to slightly alkaline in nature and is moderately permeable and characterised by the presence of low organic carbon and low soluble salts. Soils restricted to inselberg areas are more clayey, lateritic and less permeable and are highly acidic in nature. From agriculture point of view, the soils in major part of the area are suitable for all sorts of crops cultivation.

3.1.2 Elevation

The elevation of the project road and project influence area has been presented in **Figure 3.02**.

As shown in the elevation map, the elevation of the project road start point is lower than end point. The general slope of the project road and project influence area is south to north. The elevation of the project road at its start point (Srirampur) is in the range of 30-40m while near Dhubri, it is in the range of 20-30m while its lesser at the project road end point.

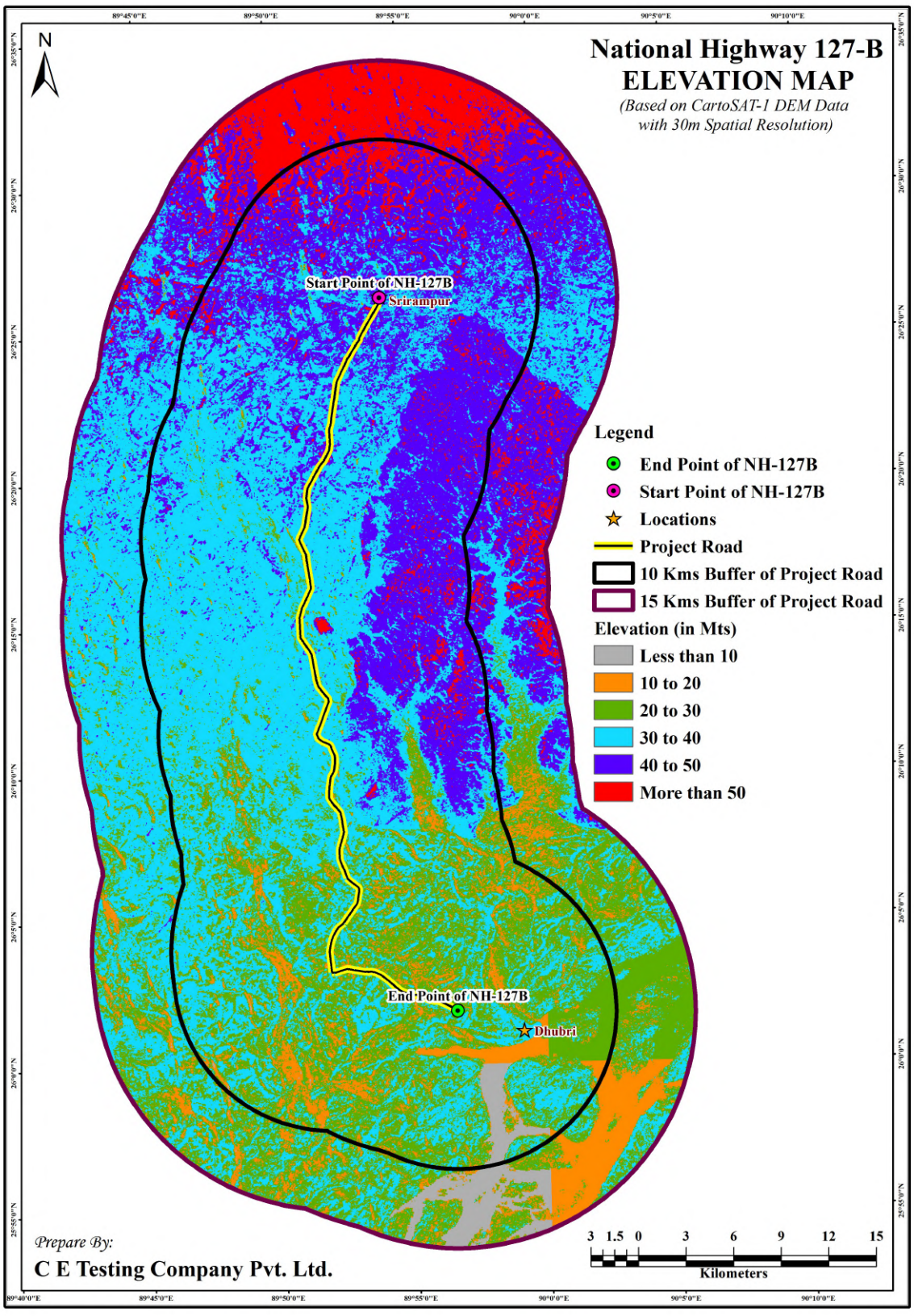


Figure 3.0 2: Elevation Map of the Project Road and Project Influence Area

3.1.3 Soil Characteristics

Soil is a vital natural resource which is formed over hundreds of years from the erosion of the underlying geological strata, decaying organic matter, water and air. It is the home to a wide range of organisms and performs a range of functions essential to the wellbeing of mankind and the natural and built environment.

3.1.4 Soil Quality Monitoring

Surfacial soil samples were collected from the nearby places/river bank of the likely impacted area from the proposed project activities and analysed for various soil parameters to get baseline soil quality status of different project areas. Soil samples were collected from as many as 3 locations along the proposed project road (**Table 3.1**) and further processed and analysed for specified physico-chemical parameters following standard procedures and techniques.

The methodology and the analytical results of measured physico-chemical parameters in soil samples of investigated areas are given in the **Table 3.2 & 3.3**, respectively.

Table 3:1 Details of Soil Sampling Locations

Sl. No.	Location Code	Sampling Location Name	Geographical Locations		Date of Sampling
			Latitude	*Longitude*	
1	SO-1	Shrirampur	$26^0$25′34.04′′	$89^0$53′52.80′′	10/10/2016
2	SO-2	Paglahat	$26^0$12′41.94′′	$89^0$51′53.17′′	10/10/2016
3	SO-3	Moterjhar	$26^0$08′35.19′′	$89^0$52′21.87′′	10/10/2016

Table 3:2: Soil Sampling Analysis Methodology

Sl.	Parameters	Protocol	Instrument Used
1	pH	Method of Soil Analysis-Soil Science Society for America (Part II)	pH meter
2	Electrical conductivity (EC)	Method of Soil Analysis-Soil Science Society for America (Part II)	Conductivity Meter
3	Infiltration rate	Method of Soil Analysis-Soil Science Society for America (Part I)	Ring Infiltrometer
4	Moisture Retention Capacity	Soil Chemical Analysis- M.L. Jackson	Pressure membrane Suction-plate
5	Organic Matter	Method of Soil Analysis-Soil Science society for America (Part II)	Muffle Furness
6	Sand	Soil Chemical Analysis- M.L. Jackson	Sieve Shaker & Weighing balance
7	Silt	Soil Chemical Analysis- M.L. Jackson	-Do-

Sl.	Parameters	Protocol	Instrument Used
8	Clay	Soil Chemical Analysis- M.L. Jackson	-Do-
9	Texture	Soil Chemical Analysis- M.L. Jackson	Computation
10	Moisture	Soil Chemical Analysis- M.L. Jackson	Hot Air Oven
11	Sodium (as Na)	Soil Chemical Analysis- M.L .Jackson	Flame Photometer
12	Potassium (as K)	Soil Chemical Analysis- M.L. Jackson	Flame Photometer
13	Calcium	Soil Chemical Analysis- M.L. Jackson	Flame Photometer
14	Nitrogen	Method of Soil Analysis-Soil Science society for America (Part II)	Spectrophotometer
15	Phosphorus as P	Method of Soil Analysis-Soil Science society for America (Part II)	Spectrophotometer

3.1.5 Soil Quality

The results of measured parameters reflects that the soils of different project areas with pH ranging from 7.2 to 8.0 (mean, 7.7), are neutral to moderately alkaline in nature. Electrical conductivity (EC) varying between 127-197 µs/cm with mean value of 193 µs/cm, indicates moderate concentrations of major elements in soils of investigated project areas. The recorded infiltration rates varied from 29375 mm/yr to 33016 mm/yr with a mean value of 31761 mm/yr. Moisture retention capacity ranged from 30.7% to 45.5% with an average value of 37.1%. The textural estimation of soils indicates that soils of the area are Loamy in nature, except for soils collected near the Sonkosh banks, being Sandy Loam type. Invariably fair fractions of clay & silt were observed in the soils of project area.

The selected alkali & alkaline earth metals were found in moderate levels. Organic content of soils varied from 5.2% to 6.6%, with mean value of 5.6%. Nutrient such as N & P were also measured in representative soil samples and found varying from 5.5 mg/kg to 9.7 mg/kg (mean, 7.4 mg/kg) & 0.26 mg/kg to 0.57 mg/kg (mean, 0.40 mg/kg), respectively.

Table 3:3 : Analysis Results of Soil Quality

Sl. No.	Parameters	Sampling Locations		
		SO-1	SO-2	SO-3
1	pH	7.2	7.5	8
2	Electrical Conductivity at 25^0C (in µs/cm)	183	127	197
3	Infiltration rate (mm/yr)	29375	32519	33016
4	Moisture (%)	13.2	10.5	4.1
5	Organic matter (%)	5.2	6.6	5.2
6	Sand in % (W/W)	20.75	29.32	55.35
7	Silt in % (W/W)	55.06	47.51	25.5
8	Clay in % (W/W)	24.19	23.17	19.15
9	Texture	Loam	Loam	Sandy Loam
10	Moisture Retention Capacity (%)	36.8	45.5	30.7
11	Sodium as Na (mg/kg)	49.5	49.5	65

12	Potassium as K (mg/kg)	38.2	37	22.5
13	Calcium as Ca (mg/kg)	65	56.2	59.2
14	Nitrogen (mg/kg)	6.2	9.7	5.5
15	Phosphorus as P (mg/kg)	0.57	0.35	0.26

Source: Consultants' Environmental Monitoring

3.1.6 Natural Hazards and Vulnerability

An earthquake is a sudden and temporary vibration set up on the earth's surface, ranging from a faint tremor to a wild motion, due to the sudden release of energy stored in the rocks beneath the earth's surface. Earthquake is a form of energy of wave motion which originates in a limited region and then spreads out in all directions from the source of disturbance.

The unique geo-climatic condition of Dhubri District has made it a peculiar compared to other districts of Assam. On the basis of complex geo-physical feature the total demographical area of the district could be divided into three separate parts:

a. Char (riverrine) areas : The area along river Bramhaputra and almost the entire Hatsingimari Sub-Division fall in this category. This part of the district is also most flood/erosion prone.
b. Kaim (permanent) areas : Middle part of the district along the NH31. This part is also flood prone.
c. High land and hilly areas : The Northern part of the district and the area bordering Meghalaya of Mankachar Circle. This part is less flood prone.

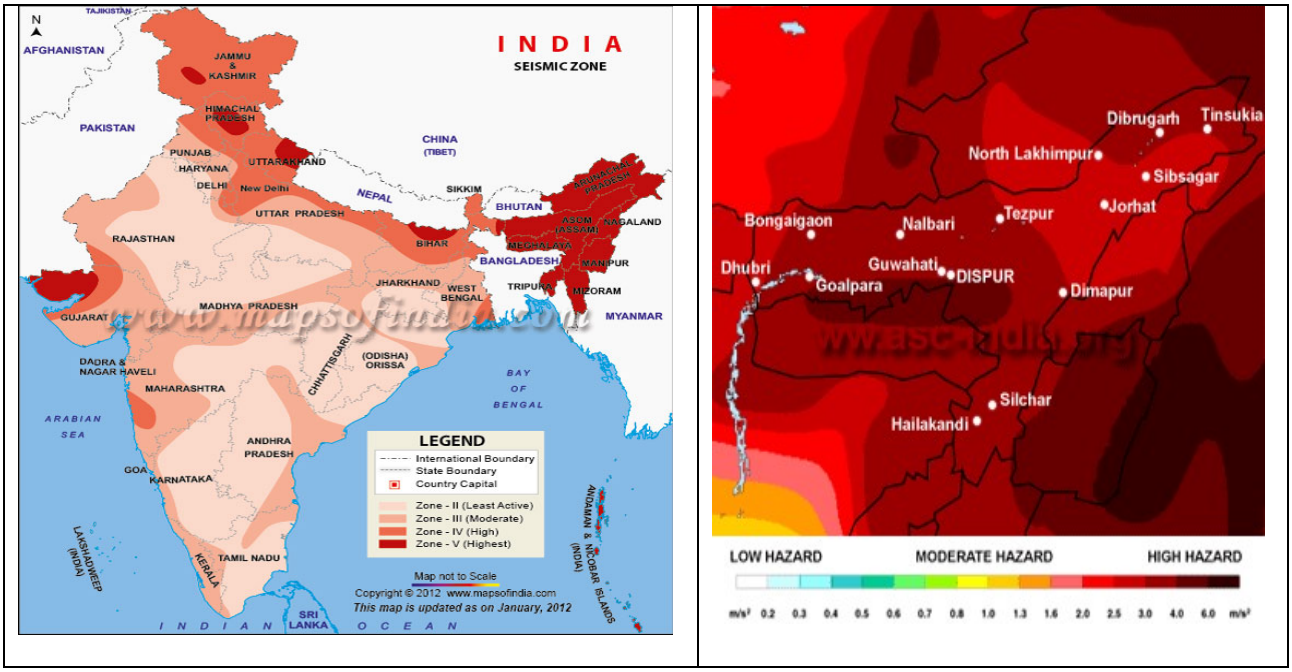
Almost the whole Dhubri district is multi-hazard disaster prone. The history reveals that flood is a recurring disaster of Dhubri but presently along with flood massive erosion is occurring every year. Moreover, cyclone and thunder storms also lead to great losses in this district.

As per the Vulnerability Atlas of India developed by Ministry of Urban Development and Poverty Alleviation and BMTPC, India, the whole Dhubri district is situated in the wind and cyclone high damage risk zone (Vb = 47 m/s). Moreover, some parts in the middle and south corner of the district are in wind and very high cyclone damage risk zone-A (Vb = 53 m/s). In addition to that, the whole district is located in zone V i.e. earthquake very high damage risk zone (MSK-IX or more) and also liable to high flood.

The recurring occurrence of natural disaster almost in every year causes a great havoc and disrupts the normal functioning of the district. It leads to widespread human, material and environmental losses, which exceed the ability of the affected district to cope using its own resources.

According to GSHAP data, the state of Assam lies in a region with high to very high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, this state also falls in Zone V. Historically, parts of this state have experienced seismic activity greater than M6.0.

Figure 3.0 3**: Seismic Zone of India & Assam**



3.1.7 Land use and Holding Pattern

Land use is the human modification of natural environment into built environment such as fields, pastures, and settlements. It can also be defined as "the total of arrangements, activities, and inputs that people undertake in a certain land cover type". The details of land use in project influence area 10 km either side of centreline of project road will be access through satellite map and provided in EIA report.

The project study area is dominated by Agricultural Crop Land (34.74 %) while Agricultural Follow Land is 26.10% which shows that farming is very prevalent in the study area. Vegetation is covered in 19.93 % of the study area while urban and rural settlement is 2.10 %. The landuse classification and its area have been tabulated in **Table 3.4** while the landuse map of the study area has been shown in **Figure 3.04**.

Table 3:4: Landuse classification of the study area

S. No.	LULC Classes	Area (in Sq Kms)	Area (in %)
1	Settlements	47.298	2.10
2	Transportation	3.228	0.14
3	Agricultural Crop Land	783.972	34.74
4	Agricultural Fallow Land	588.889	26.10
5	Barren Land / Waste Land	165.539	7.34
6	Mixed Forest	449.755	19.93
7	River Bed	120.409	5.34
8	River & Water Bodies	97.298	4.31
	TOTAL	**2,256.387**	**100.00**

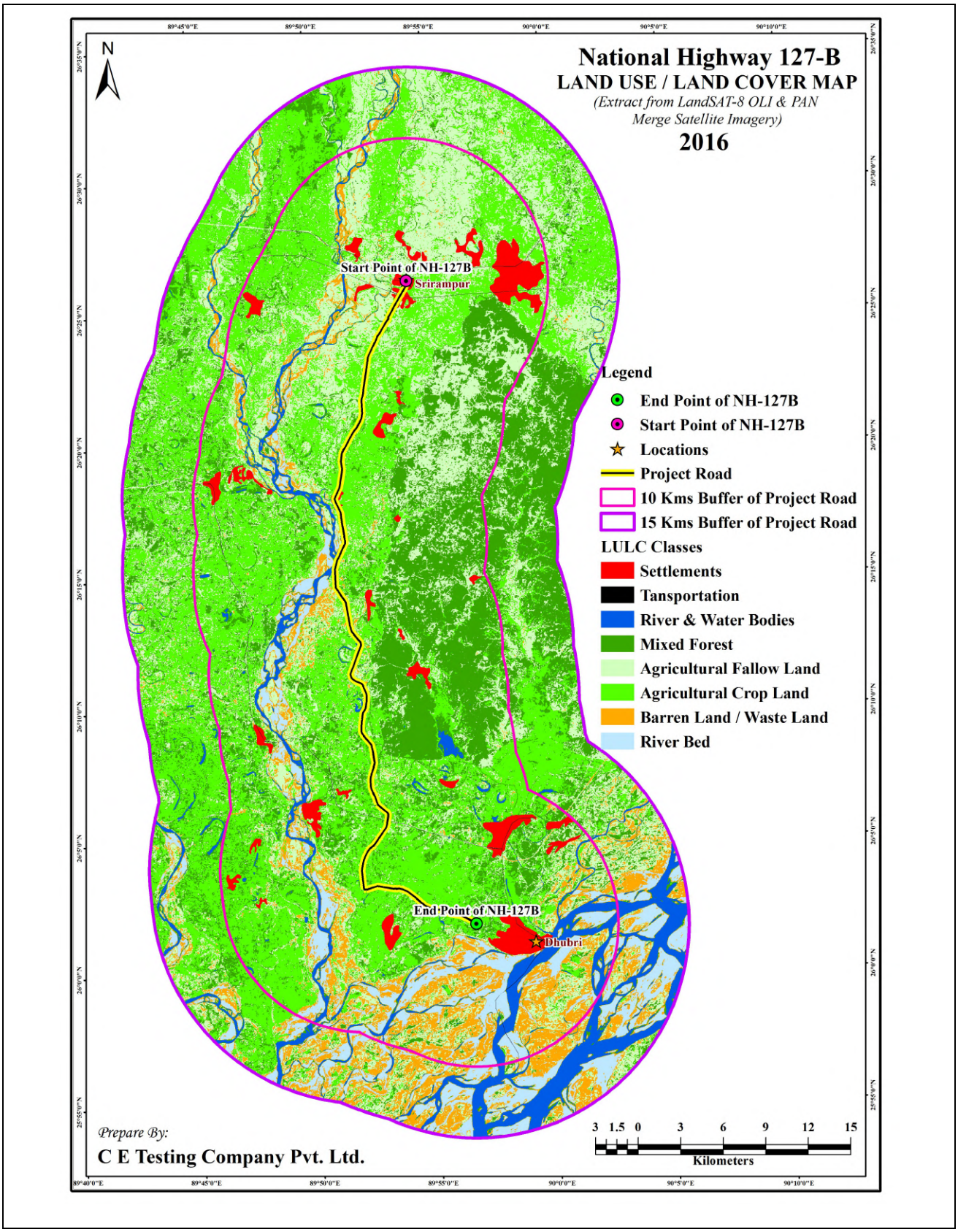

National Highway 127-B
LAND USE / LAND COVER MAP
(Extract from LandSAT-8 OLI & PAN Merge Satellite Imagery)
2016
N
Start Point of NH-127B
Srirampur
End Point of NH-127B
Dhubri
Legend
End Point of NH-127B
Start Point of NH-127B
Locations
Project Road
10 Kms Buffer of Project Road
15 Kms Buffer of Project Road
LULC Classes
Settlements
Tansportation
River & Water Bodies
Mixed Forest
Agricultural Fallow Land
Agricultural Crop Land
Barren Land / Waste Land
River Bed
3 1.5 0 3 6 9 12 15
Kilometers
Prepare By:
C E Testing Company Pvt. Ltd.

Figure 3.0 4: Landuse classification Map of the study area

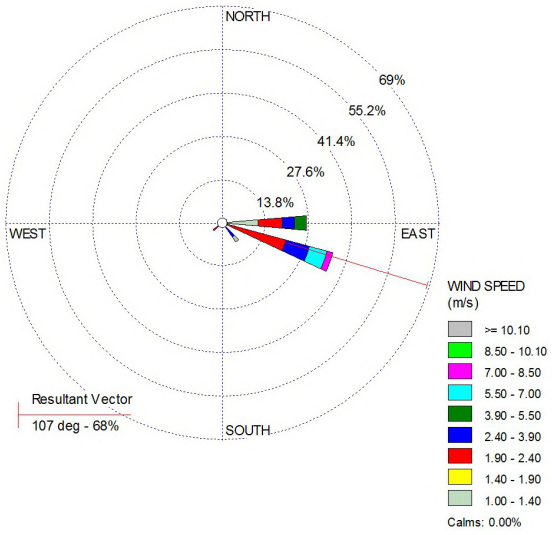
3.1.8 Meteorology

The nearest meteorological data is acquired from Wunderground meteorological website (wunderground.com) and IMD. **Table 3.5** shows the monthly mean Temperature, Humidity, Visibility, Wind Speed and Precipitation at Dhubri/project influence area. The averages were drawn over last 5 years daily average data.

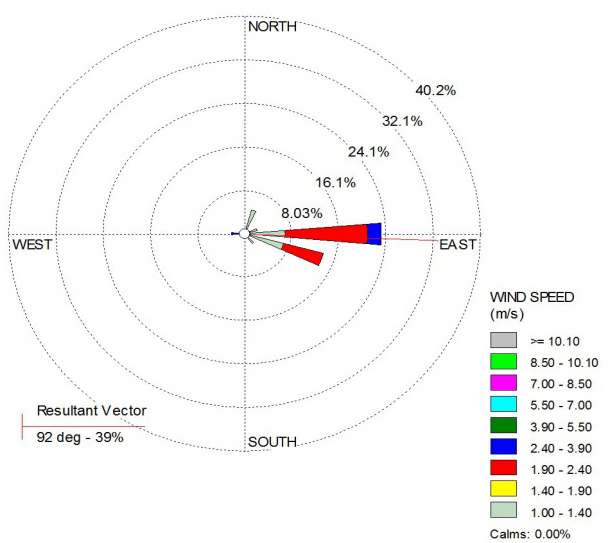
Table 3:5: Monthly mean data for different meteorological variables near the project road

	TemperatureC	Dew PointC	RH (%)	Sea Level PressurehPa	VisibilityKm	Wind SpeedKm/h	WindDirDegrees
1	19.37 ± 2.72	15.26 ± 1.53	71.22 ± 13.00	1,017.37 ± 2.60	3.28 ± 1.18	4.83 ± 3.48	91.67 ± 10.30
2	23.60 ± 3.99	16.79 ± 1.99	59.79 ± 17.10	1,014.30 ± 4.37	3.25 ± 1.07	5.21 ± 3.89	126.00 ± 65.12
3	25.21 ± 2.97	20.37 ± 1.92	69.21 ± 15.63	1,012.05 ± 3.41	3.90 ± 0.45	5.02 ± 3.03	98.00 ± 10.33
4	28.20 ± 4.03	23.10 ± 2.75	68.75 ± 14.18	1,006.05 ± 3.75	4.00 ± 0.00	5.46 ± 4.77	118.24 ± 48.76
5	25.80 ± 2.19	23.65 ± 1.39	83.60 ± 6.00	1,005.30 ± 4.28	3.70 ± 0.73	5.95 ± 4.11	110.00 ± 0.00
6	29.60 ± 2.06	26.45 ± 1.05	78.00 ± 8.29	1,004.85 ± 2.81	3.90 ± 0.45	3.46 ± 1.96	108.57 ± 76.69
7	28.00 ± 1.52	26.80 ± 1.15	92.15 ± 4.58	1,001.95 ± 2.56	3.29 ± 1.33	2.67 ± 0.96	80.00 ± 28.87
8	31.16 ± 2.03	27.58 ± 0.77	77.63 ± 8.91	1,001.74 ± 3.11	3.79 ± 0.63	3.26 ± 1.89	106.25 ± 16.85
9	29.65 ± 1.73	26.75 ± 1.02	79.80 ± 7.34	1,005.90 ± 3.24	4.00 ± 0.00	3.52 ± 1.44	158.89 ± 72.88
10	27.79 ± 2.20	25.21 ± 1.75	82.68 ± 5.79	1,009.16 ± 2.75	4.00 ± 0.00	2.67 ± 0.96	121.43 ± 66.19
11	24.90 ± 2.17	20.30 ± 2.00	69.25 ± 7.48	1,012.80 ± 2.17	4.00 ± 0.00	3.96 ± 2.51	95.00 ± 9.26
12	23.22 ± 2.00	18.17 ± 0.98	67.48 ± 10.48	1,016.70 ± 2.01	4.00 ± 0.00	4.91 ± 3.51	100.00 ± 26.60

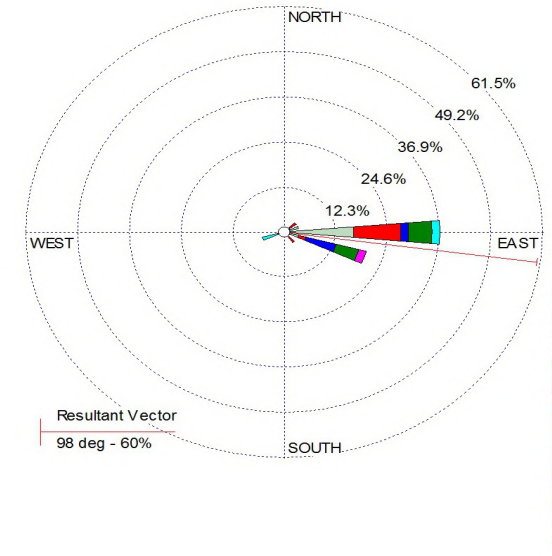
It clearly indicates that August is the warmest month and January is the coolest months of the year having mean temperatures of 31.16±2.03 and 19.37±2.72, respectively. Overall rainfall is minimum during November to February and maximum during June to August. Wind activity is also very high during winter and premonsoon period, especially from December to May. For rest of the year wind activity is minimal. **Figure 3.05** presents the seasonal wind rose plots for the year 2015 – 2016 depicting the predominant wind directions during different seasons of the year.



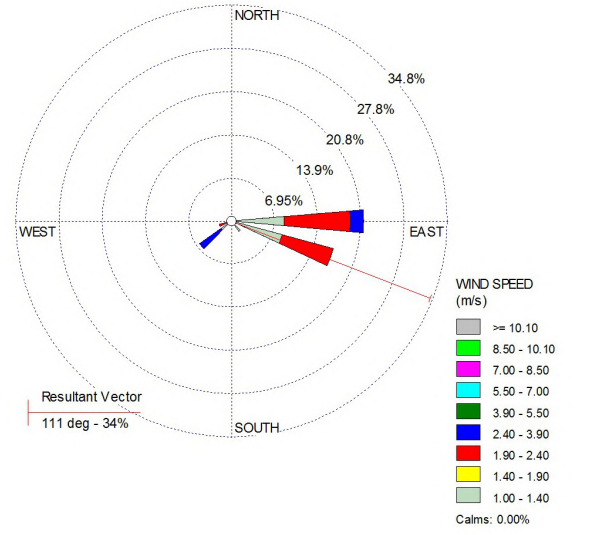
Pre Monsoon



Monsoon



Post Monsoon



Winter

Figure 3.0 5: Seasonal Wind Rose Plots for Dhubri District/Project Influence Area

It is evident from the plots that wind is predominantly easterlies in nature. There are little variations in the wind direction throughout the year at Dhubri/in project influence area.

3.1.9 Climatic Condition

Climatic conditions of study area like that of temperate zone with dry winter and hot summer followed by heavy rains. Annual rainfall is between 200 to 400 cm (annual Average 2244mm). Temperature throughout the year generally varies between 31.16±2.03°C and 19.37±2.7230 °C. Humidity generally observed in range of 60-82% and wind speed between 0-3 km per hour.

3.1.10 Seasons

The climate of area is mainly influenced by its inland position and the prevalence of wind pattern during the major part of the year. Generally, the area experience following four seasons in a year:

Summer	March to July
Monsoon	July to September
Post-monsoon	October and November
Winter	December to February

3.1.11 Air Quality

The ambient air quality was monitored to characterize baseline scenario in the study area and direct project influence area. The project road crosses mostly through rural and semi urban centres along the proposed road segment with few isolated pockets of semi urban markets especially at the start and end points of the road. The sources of air pollution in the region are mainly vehicular traffic; dust arising from unpaved roads, emissions from Household and Private Gensets. The prime objective of the baseline air quality study is to establish the existing ambient air quality along the project road. This will also be useful for impact assessment during the construction and operation phases. In order to establish baseline ambient air quality, monitoring locations were finalized so as to be true representatives of the study area. Further, the locations have also been established with the following considerations:

- Meteorological conditions on synoptic scale;
- Topography/ terrain of the study area;
- Human settlements; and
- Representatives of likely impact areas along the project road

The air quality along the project road has been mostly affected by road traffic emissions and emissions from Household and Private Gensets. The ambient air quality monitoring was carried out at 4 different locations (table 3.7) for 24 hours on two different days. The site has been selected depending upon land use characteristics and prevailing meteorological conditions. Overall PM2.5, PM10, SO2, NOx, CO, O3, NH3 and As concentrations in the ambient air were monitored at all the 4 locations. For PM2.5 and PM10, 24 hour average sampling was carried out. For gaseous pollutants, except O3, 6 samples of 4 hour duration were collected in 24 hour sampling period. For O3, two samples of 4 hour duration were collected for estimating 8 hour average concentrations. The PM2.5 samples were collected using high volume sampler with WINS impactor as per USEPA design. PM10 samples were collected using USEPA approved sampling train similar as PM2.5 sampler but without WINS impactor assembly. Gaseous samples were collected using impingers

filled with absorbent liquids at a flow rate of 500ml/minute. As was estimated from the chemical analysis of PM_{10} samples through ICP-AES.

Table 3:6 : Sampling location for air quality monitoring

Site ID	Sampling Site Location	Longitude	Latitude
AAQ-1	Shrirampur	$26^0$25′ 34.04′′	$89^0$53′ 52.80′′
AAQ-2	Ujanpetla	$26^0$17′ 34.12′′	$89^0$51′ 12 23′′
AAQ-3	Moterjhar	$26^0$08′ 35.19′′	$89^0$52′ 21.87′′
AAQ-4	Adabari	$26^0$01′20.27′′	$89^0$57′ 40.66′′

Sampling Locations for Air, Water, Soil and Noise pollution Monitoring along Road Alignment

The photographs of sampling arrangements are given in Appendix-3.1. The monitoring results are presented in table 3.7. As evident from table 3.7, the PM2.5 concentrations in the vicinity of project road vary from a minimum of 29.6µg/m3 to the maximum of 59.6µg/m3. The minimum concentrations of PM2.5 were observed near Ujanpetla (AAQ-2) and maximum concentrations were observed at Adabari (AAQ-4) near End Point followed by Shrirampur (AAQ-1) near Starting Point. The maximum 98th percentile of PM2.5 concentration was found at Adabari (AAQ-4) and minimum at Ujanpetla (AAQ-2). Similar trend were also observed for PM10 concentrations. PM10 concentrations were found to be maximum (158.5µg/m3) at Adabari (AAQ-4) and minimum

(90.2µg/m3) at Ujanpetla (AAQ-2). The maximum 98th percentiles of the PM10 concentrations also show the similar trend. It is also evident that as we approach towards the city area particulate matter concentrations increases. At Adabari and Srirampur site traffic activities were relatively high which may result into high concentrations at these sites.

It is pertinent to mention that PM10 concentrations were found to exceed the minimum prescribed CPCB standards of 100µg/m3 only at two monitoring locations namely Adabari and Shrirampur. PM2.5 concentrations were within the CPCB standards of 60µg/m3 at all the sites. The main sources of PM10 were vehicular emissions and windblown re-suspended dust particles. In case of PM2.5 concentrations, the main sources are vehicular emissions. Since there is no industrial activities in the vicinity of the proposed road alignment, PM2.5 concentrations were primarily due to vehicular emissions and transported dust from the nearby regions.

Table 3:7: Air Quality monitoring data

Parameter	Particulate Matter ($PM_{2.5}$)**				Particulate Matter (PM_{10})**				NOx**				SO2**				CO(mg/m^3)			
Monitoring station and category	No of samples	Range	Mean (24hour)	98percentile	No of samples	Range	Mean (24 hour)	98percentile	No of samples	Range	Mean (24 hour)	98percentile	No of samples	Range	Mean (24 hour)	98percentile	No of samples	Range	Mean (24 hour)	98percentile
AAQ-1	2	39.4 - 54.7	47.1	54.7	2	137.3 - 148.6	143.0	148.6	12	21.5 - 32.9	29.3	32.9	12	20.4 - 38.1	31.3	38.1	12	BDL - 0.8	0.7	0.8
AAQ-2	2	29.6 - 34.1	31.9	34.1	2	90.2 - 110.9	100.6	110.9	12	13.6 - 29.7	22.5	29.7	12	12.7 - 31.6	25.1	31.6	12	BDL - 0.4	0.2	0.4
AAQ-3	2	31.4 - 37.8	34.6	37.8	2	101.4 - 137.9	119.7	137.9	12	19.7 - 28.4	28.2	28.4	12	14.2 - 29.3	25.5	29.3	12	BDL - 0.4	0.1	0.4
AAQ-4	2	41.9 - 59.6	50.8	59.6	2	144.7 - 158.5	151.6	158.5	12	27.6 - 39.1	35.7	39.1	12	26.8 - 42.3	39.0	42.3	12	0.5 - 1.2	0.9	1.2

** Concentration unit (µg/m^3)

Parameter	O_3**Ɨ				NH_3**				As*			
Monitoring station and category	No of samples	Range	Mean(24 hour)	98percentile	No of samples	Range	Mean(24 hour)	98percentile	No of samples	Range	Mean(24 hour)	98percentile
AAQ-1	4	23.3 - 79.4	61.3	79.4	2	42.3 - 86.5	77.2	86.5	2	0.1 - 0.7	0.4	0.7
AAQ-2	4	24.9 - 83.4	73.8	83.4	2	71.6 - 127.3	105.3	127.3	2	0.1 - 1.3	0.7	1.3
AAQ-3	4	27.6 - 80.5	74.6	80.5	2	79.5 - 119.6	98.5	119.6	2	0.2 - 1.8	1.0	1.8
AAQ-4	4	32.8 - 93.2	81.2	93.2	2	57.3 - 81.7	69.3	81.7	2	0.4 - 2.1	1.3	2.1

** Concentration unit (µg/m^3); *Concentration unit (ng/m^3); Ɨ 8 hour average *Source: Consultants' Environmental Monitoring*

The concentrations of most of the gaseous pollutants along with particulate matter associated pollutants were well below the prescribed standards of CPCB at all the sampling locations. The maximum concentrations of NOx were observed at AAQ-4 (39.1 µg/m3) and minimum at AAQ-2 (13.6 µg/m3). In case of SO2, maximum concentration was observed at AAQ-4 (42.3µg/m3) and minimum at AAQ-2 (12.7µg/m3). Similarly CO concentrations also vary from a minimum of BDL (<0.1mg/l) at all the locations except AAQ-4 and maximum at AAQ-4 (1.2mg/m3). In case of As, only annual average ambient concentration level as standards are given from CPCB. The daily average concentrations, recorded along the road at representative sampling locations are found to be lower than the annual average concentrations prescribed by the CPCB.

3.1.12 Air Pollution Impact during Construction

During construction impact was estimated using Road Construction Emission Model (ver 7.1.04) considering 36 months of the construction activity and taking 500 meter on both side of the road as project area. Total emission load per day were estimated and tabulated in Table 3.7&3.8:

The maximum emissions NOx (647.7Kgs/day), CO (201.6Kgs/day) and CO2 (103207.4Kgs/day) was estimated from the construction activities whereas total emission of NOx, CO and CO2 were estimated to be 365.8 Mega Grams, 162.4 Mega Grams and 56336.2 Mega Grams for the entire construction phase considering 8220 hectares as the project area with maximum of 11hectares /day will be disturbed and maximum of 21999 m3 of soil material will be imported or exported from the site. Fugitive dust will be the major source of dust pollution in the area. As far as ROG (Reactive Organic Compounds) is concerned, Grubbing / Land Clearing and Grading/ Excavation cause maximum emission to the air. These two activities will be the major sources of pollutants' load in the near vicinity of the project road.

Table 3:8 : RCEM model output results

Emission Estimates for ->	Srirampur- Dhuburi NH 127B Road			Total	Exhaust	Fugitive Dust	Total	Exhaust	Fugitive Dust	
Project Phases (Metric Units)	**ROG (kgs/day)**	**CO (kgs/day)**	**NOx (kgs/day)**	**PM10 (kgs/day)**	**PM10 (kgs/day)**	**PM10 (kgs/day)**	**PM2.5 (kgs/day)**	**PM2.5 (kgs/day)**	**PM2.5 (kgs/day)**	**CO2 (kgs/day)**
Grubbing/Land Clearing	23.9	101.1	121.0	130.9	7.4	123.6	32.2	6.5	25.7	16,490.8
Grading/Excavation	45.2	201.6	647.7	146.4	22.8	123.6	44.1	18.4	25.7	1,03,207.4
Drainage/Utilities/Sub-Grade	27.7	139.9	177.6	134.2	10.7	123.6	35.3	9.6	25.7	23,732.9
Paving	17.6	96.2	92.5	5.8	5.8	-	5.2	5.2	-	14,875.9
Maximum (kilograms/day)	45.2	201.6	647.7	146.4	22.8	123.6	44.1	18.4	25.7	1,03,207.4
Total (megagrams/construction project)	34.6	162.4	365.8	125.9	15.2	110.6	35.8	12.8	23.0	56,336.2

Notes:

Project Start Year ->	2017
Project Length (months) ->	48
Total Project Area (hectares) ->	8220
Maximum Area Disturbed/Day (hectares) ->	11
Total Soil Imported/Exported (meters^3/day)->	21999

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

3.1.13 Air Pollution Impact during Operation

During the operation phase, vehicular emissions are the main sources of air pollution in the vicinity of the road. Since the road crosses mostly through the rural and periurban locations, the impact of its emissions will be less on the different receptor locations.

Prediction of Impacts – The road alignment were segregated into three sections namely Section – 1(Shrirampur to Paglahat – 24/580 Km), Section – 2 (Paglahat to Debattar Hasdaha Pt2 – 16/100 Km approx) and section 3 (Debattar Hasdaha Pt2 to Adabari – 15/200 Km approx.). For section 1 and 2, three receptor locations within the 100 meter distance were considered whereas for section 3 two receptor locations were considered for evaluating the impact of air pollutants. The total road alignment was taken into consideration for the prediction of impact due to air pollution.

Traffic Density – A detailed study of the traffic density along the project road sections was conducted during 2016. The traffic projections up to the year 2040 as estimated by Assam PWD in 2014 report was considered for making predictions.

Emissions Factors

The emission factors developed by "The Automotive Research Association of India (ARAI)", Pune in its study for "Emission Factor Development for Indian Vehicles" as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies under Air Quality Monitoring Project - Indian Clean Air Programme (ICAP) has been used for the air dispersion modelling study.

Table 3:9 : Emission Factors for Criteria Pollutants[1]

S. No.	Type of Vehicle	Emission Factor (in g/km)				
		CO	HC	NOx	PM	CO_2
1	**Car**	3.01	0.26	0.84	0.19	173
2	**Bus**	3.92	0.16	6.53	0.30	602
3	**LCV**	0.25	0.19	0.67	0.10	256
4	**2-axle Truck**	3.66	1.35	2.12	0.48	401
5	**MAV**	6.00	0.37	9.30	1.24	762

Emission Rate

The emission rate of the pollutants due to the movement of traffic has been calculated based on the traffic density, respective emission factor, length of road section, and average speed of the vehicles. In the present study, only motorized vehicles count and projections have been utilized for prediction of impact on air quality. The emission rates at different road sections have been presented below (Table 3.10):

[1]Table I: Summary of Finalized Emission Factors for Indian Vehicles. Project Rep. No.: AFL/2006-07/IOCL/Emission Factor Project/Final Rep dated August 17, 2007

Table 3:10: Emission Rates due to Traffic at Different Road Sections

Pollutant	Road Section	Emission Rates (g/s)					
		2015	2020	2025	2030	2035	2040
CO	Shrirampur to Paglahat Km 00+000 – Km 24+580	2.77	3.53	4.51	5.75	7.34	9.36
	Paglahat to Debattar Hasdaha Km 24+580 - Km 40+680	2.57	3.28	4.19	5.34	6.82	8.7
	Debattar Hasdaha to Adabari km 40+680 – Km 55+700	0.35	0.45	0.58	0.74	0.94	1.2
NOx	Shrirampur to Paglahat Km 00+000 – Km 24+580	2.37	3.02	3.86	4.92	6.29	8.02
	Paglahat to Debattar Hasdaha Km 24+580 - Km 40+680	2.20	2.81	3.59	4.58	5.84	7.46
	Debattar Hasdaha to Adabari km 40+680 – Km 55+700	0.31	0.39	0.50	0.63	0.81	1.03
PM	Shrirampur to Paglahat Km 00+000 – Km 24+580	0.36	0.45	0.58	0.74	0.94	1.2
	Paglahat to Debattar Hasdaha Km 24+580 - Km 40+680	0.33	0.42	0.54	0.69	0.88	1.10
	Debattar Hasdaha to Adabari km 40+680 – Km 55+700	0.05	0.06	0.07	0.09	0.12	0.15

Meteorological Data

Meteorological factors such as temperature, wind velocity, pressure and relative humidity, cloud cover determine the stability conditions of any area. It also plays a significant role in dispersal and removal of air pollutants. In the present study the meteorological data from Bagdogra Airport (nearest airport) was used.

Receptors

A total of 8 receptor locations were identified along the proposed road taking 3 receptor locations in section 1 and 2 and two locations in road sections 3. It is pertinent to mention that all these receptor locations are within the 100 m distance from the median line of the proposed road.

Predicted GLC due to Traffic on Project Roads

The prediction of maximum ground level concentration on each road section has been carried out with the help of AERMOD Software program. The prediction for CO was conducted for 1-hourly and 8-hourly concentrations, whereas for NOx, and PM, it was conducted for 24 hourly concentrations. The prediction results have been depicted in following tables (Table 3.11,3.12 and 3.13):

Table 3:11: Maximum 1-hourly CO Concentration at different Receptors

	2017	2020	2025	2030	2035	2040
Location	**Maximum 1-Hourly Average Concentration (µg/m^3)**					
R1	4620.0	4389.0	4213.4	4740.1	4929.7	4880.4
R2	5280.0	5016.0	4765.2	5544.0	5876.6	5876.6
R3	4730.0	4493.5	4403.6	4966.5	5115.5	5064.3
R4	4940.0	4693.0	4646.1	5038.8	5089.2	5089.2
R5	1950.0	1852.5	1759.9	2028.0	2129.4	2086.8
R6	2080.0	1976.0	1897.0	2184.0	2271.4	2362.2
R7	1320.0	1254.0	1191.3	1346.4	1359.9	1387.1
R8	2200.0	2090.0	1985.5	2222.0	2355.3	2378.9

Table 3:12: Maximum 24-hourly NOx Concentration at different Receptors

	2017	2020	2025	2030	2035	2040
Location	**Maximum 1-Hourly Average Concentration (µg/m^3)**					
R1	76.1	72.3	70.8	76.6	78.1	79.7
R2	75.7	71.9	68.3	80.2	83.4	85.1
R3	105.1	99.9	95.9	110.4	111.5	112.6
R4	80.2	76.2	73.1	83.4	88.4	91.1
R5	49.7	47.2	45.3	51.7	52.7	52.2
R6	48.1	45.7	44.8	48.6	51.5	51.0
R7	54.8	52.0	50.0	56.4	59.8	59.8
R8	60.6	57.6	57.0	61.2	64.3	64.3

Table 3:13: Maximum 24-hourly $PM_{2.5}$ Concentration at different Receptors

	2017	2020	2025	2030	2035	2040
Location	**Maximum 1-Hourly Average Concentration (µg/m³)**					
R1	83.6	79.4	75.5	84.2	90.1	89.2
R2	57.8	54.9	52.7	60.1	60.7	61.9
R3	74.5	70.8	68.7	74.5	79.7	80.5
R4	65.7	62.4	61.8	65.7	69.0	69.0
R5	76.4	72.6	71.9	78.7	81.9	81.9
R6	52.4	49.8	49.3	53.5	54.5	54.5
R7	89.9	85.4	82.8	92.5	93.5	95.3
R8	71.2	67.7	67.0	74.1	79.3	81.6

Air Quality Results from the proposed project – As evident from the projected air quality concentrations, the values of the different pollutants show less concentrations as per the prescribed norms. The widening of existing highway from two lanes to four lanes will cease the traffic congestions which will result in decrease in concentrations. Over the time, the traffic load will increase as per the traffic projections, may results in increased concentrations of the pollutants. Further, the technology enhancement and alternate fuel use will also reduce the concentrations in long run.

3.1.14 Noise Environment

Since most part of the project road alignment traverse through sparse habitation and no significant commercial /industrial activities the Ambient Noise Quality is generally good and below the prescribed standard. This fact is also supported by Noise Quality Monitoring data. However, during construction phase of the project activity, noise level near construction camp and construction site are expected to be high due movement of heavy vehicle and other construction machinery.

Noise monitoring was carried out at 8 different locations along the project road (Table 3.14). The sampling sites were selected depending upon the landuse type and site category. Noise pollution affects the students, Patients and senior citizens the most. Hence care has been taken to monitor the noise pollution level in the vicinity of school/colleges and commercial places and temples/ Mosque, besides urban and periurban areas. Table 3.14, presents the minimum and maximum Leq values as well as Leq for day and night at all the locations.

Table 3:14: Ambient Noise Levels Measured on the Project Road

S.No.	Location	Latitude	Longitude	Lmax	Lmin	Leq_day	Leq_night	Env. Settings
N-1	Shrirampur	$26^0$25′34.04′′	$89^0$53′52.80′′	69.2	44.6	64.4	41.1#	Resi.+Comm.
N-2	Jacobpur	$26^0$24′39.25′′	$89^0$53′ 19.08′′	59.3	35.1	54.6	31.9#	residential
N-3	Oxiguri	$26^0$19′ 01.35′′	$89^0$51′ 19.27′′	52.1	27.9	47.4	24.3#	Commercial
N-4	Ujanpetla	$26^0$17′34.12′′	$89^0$51′ 12.23′′	45.3	26.3	41.2	22.8#	Resi.+Comm.
N-5	Paglahat	$26^0$12′41.94′′	$89^0$51′ 53.17′′	47.6	23.4	43.2	20.1#	Residential
N-6	Moterjhar	$26^0$08′35.19′′	$89^0$52′21.87′′	44.9	25.1	40.9	21.7#	Sensiotive
N-7	Kechuar Khas	$26^0$02′25.10′′	$89^0$54′ 53.95′′	57.9	33.5	53.8	30.3#	Rural Area
N-8	Adabari	$26^0$01′20.2′′	$89^0$57′ 40.66′′	73.9	49.6	69.2	45.8#	Commercial Area

#Data are lower than the prescribed standards for the given Environmental setting. *Source: Consultants' Environmental Monitoring*

The day time maximum noise pollution levels were found to be less than 70 dBA level at all the places except at N-8, whereas night time noise pollution level is found to be lower than 40dBA level at most of the places with the exception of N-1 and N-8.

It is also evident that the day and night time noise levels were higher at market places and near urban areas. It is quite obvious as during the day time, market places in semi urban and rural locations are full of commercial activities whereas, during night time it became very silent. Similarly at semi urban centers and traffic cross sections, traffic movement is although continuous throughout the day and night, but during night time traffic volume significantly reduced thereby reducing the ambient noise level.

3.1.15 Noise Pollution Impact during Construction

During Construction, noise pollution impacts were estimated using Road Construction Noise Model (ver. 1.1).Image 3.06 , presents the snapshot of the model calculation exercise.

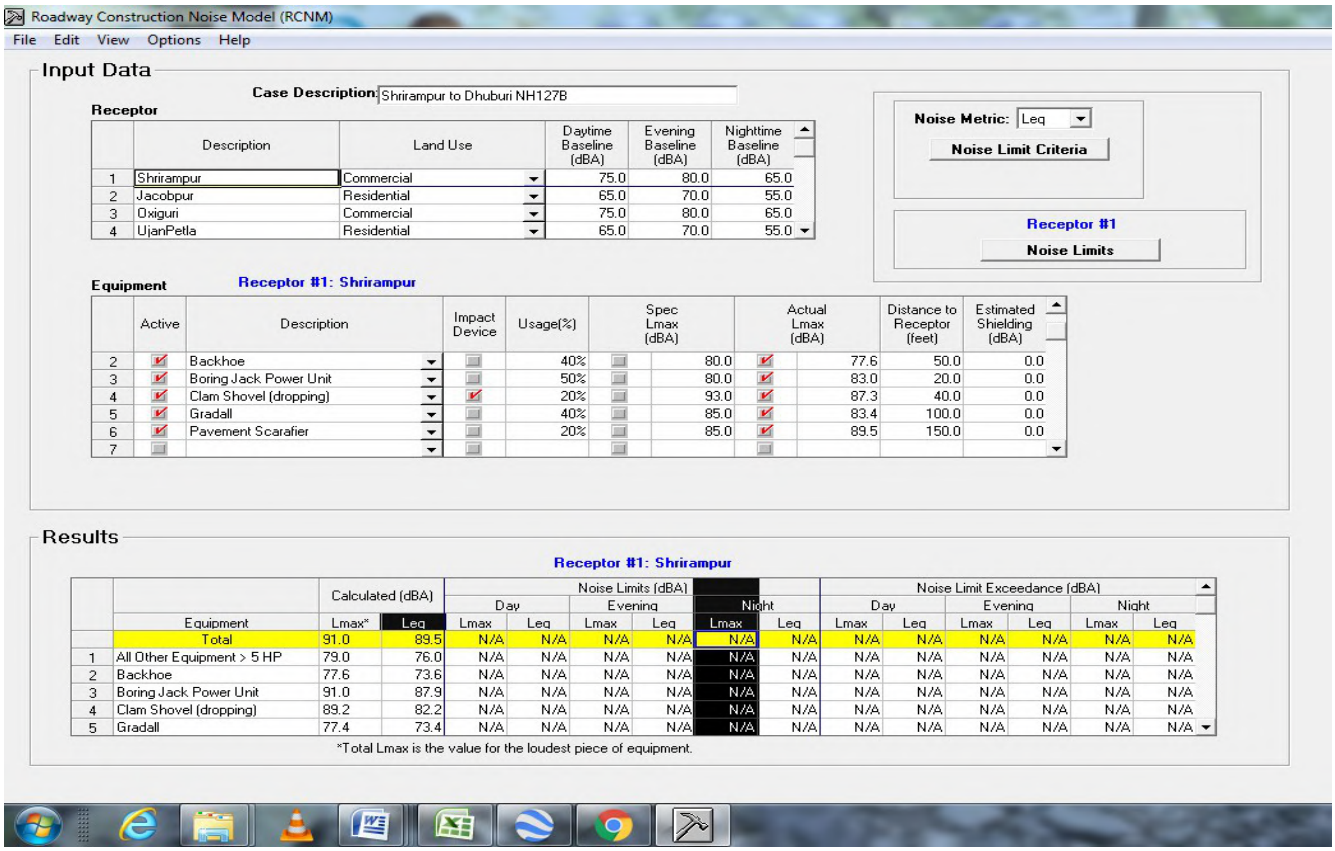


Figure 3.0 6: :Snapshot of the Model run from RCNM model to estimate the impacts at various receptor sites along the project road.

Table 3:15: Receptor description and baseline noise level data as per CPCB norms

Roadway Construction Noise Model (RCNM),Version 1.1				
Report:	**30-11-2016**			
Case Description:	**Srirampur-Dhuburi NH 127B**			
			Baselines (dBA)	
Description		***Land Use***	***Daytime***	***Night***
Shrirampur	---- Receptor #1 ----	Resi.+Comm.	65	55
Jacobpur	---- Receptor #2 ----	residential	55	45
Oxiguri	---- Receptor #3 ----	Commercial	75	70
Ujanpetla	---- Receptor #4 ----	Resi.+Comm.	65	55
Paglahat	---- Receptor #5 ----	Residential	55	45
Moterjhar	---- Receptor #6 ----	Sensiotive	55	45
Kechuar Khas	---- Receptor #7 ----	Rural Area	50	40
Adabari	---- Receptor #8 ----	Commercial Area	75	70

Table 3:16: Noise projection results at three distance ranges across the road at different receptor sites

Noise Projection at three Distance ranges near different receptor sites						
	100m		500m		1000m	
	Leq	Lmax	Leq	Lmax	Leq	Lmax
---- Receptor #1 ----	63.7	67.5	60.9	62.3	53.6	57.9
---- Receptor #2 ----	65.2	69.5	62.1	63.3	55.6	59.2
---- Receptor #3 ----	69.0	72.5	61.2	62.3	54.6	58.4
---- Receptor #4 ----	62.6	63.7	60.1	61.3	55.6	57.8
---- Receptor #5 ----	65.4	69.7	61.0	62.3	53.6	58.3
---- Receptor #6 ----	68.0	71.8	60.4	62.3	54.9	58.8
---- Receptor #7 ----	68.8	71.7	60.3	61.3	59.4	62.8
---- Receptor #8 ----	66.7	68.5	61.1	62.3	54.6	58.1

It is evident from the table 3.16 that the noise levels exceed the CPCB standards for the respective category of the receptor site at all the locations for 100m distance. Except for Receptor sites 3 and 4, which are commercial zones, at all the other locations noise levels will be within the limit at 500 and 1000 meter from the road during construction phase.

3.1.16 Water Quality in Project Influence Area

Monitoring of water quality is an effort to obtain information on physical, chemical and microbiological parameters through representative sampling. The project road runs parallel to river Sonkosh (A tributary of River Brahmaputra). The primary objective of water quality monitoring is to record the response of water regime to the natural and anthropogenic stresses. Groundwater is the important water source for drinking water along the proposed highway. Groundwater samples were collected from commonly used hand pumps installed by the local government along the project road. Surface waters were collected from the Ponds, River Sonkosh and River Gangadhar.

Water quality is an indisputable concern for surface water and the groundwater sources in road construction work. In order to establish baseline quality of surface water and groundwater in different stretches surveyed across the proposed project road of NH network, Five (5 Nos.) surface water and Five (5 Nos.) groundwater samples were collected in pre-sterilized and pre-washed teflon bottles. The sampling locations' details are given in Table 3.10. The samples were processed, preserved and analyzed following standard procedures and techniques. The basic parameters such as pH, EC, TDS, Alkalinity, and DO were measured in-situ and rest of the parameters were analyzed in the laboratory within the preservation period following standard methods (Table 3.18).

Table 3:17: Sampling locations' details for Surface water and Groundwater

Sl. No.	Location Code	Sampling Location Name	Geographic Locations		Date of Sampling
			Latitude	*Longitude*	
SURFACE WATER					
1	SW1	Jacobpur	$26^0$24'47.21''	$89^0$53'20.85''	10/10/2016
2	SW2	Alokjhari	$26^0$15'28.33''	$89^0$50'55.71''	10/10/2016
3	SW3	Paglahat	$26^0$12'41.94''	$89^0$51'53.17''	10/10/2016
4	SW4	Debattar Barundanga	$26^0$08'50.49''	$89^0$52'17.22''	10/10/2016
5	SW5	Choto Bashjani	$26^0$01'32.41''	$89^0$57'01.96''	10/10/2016
GROUNDWATER					
1	GW1	Shrirampur	$26^0$25'34.04''	$89^0$53'52.80''	10/10/2016
2	GW2	Jacobpur	$26^0$24'39.25''	$89^0$53'19.08''	10/10/2016
3	GW3	Ujanpetia	$26^0$17'34.12	$89^0$51'12.23''	10/10/2016
4	GW4	Paglahat	$26^0$12'41.94	$89^0$51'53.17''	10/10/2016
5	GW5	Adabari	$26^0$01'20.27''	$89^0$57'40.66''	10/10/2016

Table 3:18: Analytical Method Details (Water)

Sl. No.	Parameter	Method	Instruments Used
1	pH	Electrometric	pH Meter
2	Electrical Conductivity (EC)	Electrometric	Conductivity Meter
3	Total Dissolved Solids (TDS)	Electrometric	TDS Meter
4	Total Hardness (TH) as CaCO3)	Computation	-
5	Turbidity	-	Nephelometer
6	Total Alkalinity as CaCO3	Titration	-
7	Colour	APHA, 1995	Tinto Meter
8	Odour	APHA, 1995	Static Reference Scale
9	Dissolved Oxygen (DO)	Galvanic sensors	Portable DO Probe
10	Biological Oxygen Demand (BOD)	5 days incubation at 20^oC followed by titration	BOD Incubator
11	Anions (F^-, Cl^-, NO_3^-, PO_4^{3-}, SO_4^{2-})	Ion-exchange method	Ion-Chromatograph (Dionex ICS 90)
12	Boron (B)	Carmine	UV-Vis Spectrophotometer

Sl. No.	Parameter	Method	Instruments Used
13	Aluminium (Al)	Atomic Absorption Spectrophotometry	AAS
14	Sodium (Na)	Atomic Absorption Spectrophotometry	AAS
15	Calcium (Ca)	Atomic Absorption Spectrophotometry	AAS
16	Magnesium (Mg)	Atomic Absorption Spectrophotometry	AAS
17	Phenolic compounds (as C_6H_5OH)	Spectrophotometry	UV-Vis Spectrophotometer
18	Total Arsenic	Atomic Absorption Spectrophotometry	AAS-HG
19	Iron (Fe)	Atomic Absorption Spectrophotometry	AAS
20	Manganese (Mn)	Atomic Absorption Spectrophotometry	AAS
21	Cadmium (Cd)	Atomic Absorption Spectrophotometry	AAS
22	Lead (Pb)	Atomic Absorption Spectrophotometry	AAS
23	Zinc (Zn)	Atomic Absorption Spectrophotometry	AAS
24	Total Chromium (Cr)	Atomic Absorption Spectrophotometry	AAS
Bacteriological Tests			
25	Feacal Coliform	Multiple Tube Fermentation Technique	Bacteriological Incubator

3.1.17 Surface Water Quality

The analytical results of surface water quality are presented in **Table 3.19.** The data show nearly neutral to moderately alkaline nature of surface waters (Rivers & Ponds) across the project areas, with pH ranging from 6.9 to 8.6 with an average value of 7.8. Electrical Conductivity (EC) varied between 253 μScm^{-1}-589 μScm^{-1} (mean 378 μScm^{-1}). The recorded high concentrations of EC in few samples indicate increased concentrations of major ions, which may be attributed to evaporation in the surface water bodies and/or the influence of groundwater during the lean phases of their flow in the summer season. The TDS ranged from 152 to 377 mg/L (mean, 235 mg/l), reflecting dissolved concentrations of major ions in the surface waters in project areas. Alkalinity of surface waters surveyed in the projects area varied from 79 to 215 mg/L (mean, 125 mg/l).

Surface waters were found turbid invariably at all locations with values ranging from 8 to 19 NTU (mean, 14 NTU) and thus exceed the defined standard of 5 NTU. Anions' concentrations in water samples analyzed were found either below or comparable to the respective permissible limits as per IS 10500:1991, except for marginally higher level of nitrate, varying between 14.5-58.5 mg/L (mean, 30.7 mg/l), at one location. Most of selected trace elements measured were found to be either below or comparable to the respective permissible limits as per IS 10500:1991. Elements such as Al, Mn, Pb, Cd and phenolic compounds were observed below detection limits at SW-5.

Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) levels varied between 3.9-5.9 mg/l (mean, 4.96 mg/l) and 3.8-8.5 mg/l (mean, 6.5 mg/l), respectively. The observed DO and BOD concentrations meet the drinking water quality criteria, except at very few locations featuring marginally high BOD.

Faecal coliforms count widely ranged from 715 to 1032 in 100 ml samples and found relatively high in numbers at locations namely SW1 and SW2. However, SAR levels, recorded in surface waters of the area, ranging from 0.2 to 1.4 (mean, 0.4) computed out of analytical database measured, suggest for their agronomic suitability.

Table 3:19 Analytical Results of Surface Water Quality

Sl. No.	Parameter	Unit	Sampling Locations				
			SW-1	SW-2	SW-3	SW-4	SW-5
	Physico-Chemical Parameters						
1	pH	pH unit	8.3	8.6	6.9	7.5	7.7
2	EC	µS/cm	589	589	291	272.7	253
3	TDS	mg/L	377	377	176	164.7	152
4	Total Alkalinity	mg/L	215	215	81	80.1	79
5	Turbidity	NTU	16	16	19	14.1	8
6	TH	mg/L	261	261	142	159	177
7	DO	mg/L	5.7	5.9	3.9	4.9	5.2
8	BOD	mg/L	7.2	7.3	8.5	6.9	3.8
9	SAR	-	0.5	1.4	0.2	1.1	0.4
10	F^-	mg/L	0.9	1.2	0.7	1.0	0.7
11	Cl^-	mg/L	27.3	27.4	19.2	25.0	29.5
	Physico-Chemical Parameters						
12	NO_3^-	mg/L	14.5	15.4	19.1	39.6	58.5
13	PO_4^{3-}	mg/L	0.2	1.2	0.4	1.5	0.6
14	SO_4^{2-}	mg/L	19.4	19.6	11.5	7.2	2.1
15	Phenolic Compounds (asC_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL
16	Na	mg/L	25.3	26.1	11.5	15.8	18.5
17	Ca	mg/L	56.1	56.5	14.9	23.7	32
18	Mg	mg/L	27.5	27.9	8.5	12.4	15.7

Sl. No.	Parameter	Unit	Sampling Locations				
			SW-1	SW-2	SW-3	SW-4	SW-5
19	B	mg/L	0.2	0.5	0.7	0.5	0.1
20	Al	mg/L	0.1	0.1	0.2	1.0	BDL
22	Fe	mg/L	0.1	0.6	0.1	0.8	0.2
23	Mn	mg/L	0.1	0.7	BDL	0.7	BDL
24	Cu	mg/L	0.1	0.3	0.1	0.3	0.4
25	Zn	mg/L	0.1	0.3	0.5	1.3	0.2
26	Pb	mg/L	0.1	0.9	BDL	1.0	BDL
27	Cd	mg/L	BDL	0.1	BDL	0.5	BDL
28	Cr	mg/L	BDL	0.9	0.2	0.3	0.2
	Bacteriological Parameters						
29	Faecal Coliform	MPN/100 ml.	1032	1007	976	845	715

3.1.18 Groundwater Quality

The analysis results with respect to groundwater quality parameters, given in **Table 3.20**, indicate that all the measured parameters are within/comparable to CPCB water quality norms. Faecal Coliform and Phenolic compounds have not been detected in any of the groundwater samples. The dissolved oxygen (DO) and Biological Oxygen Demand (BOD) concentrations in the samples analyzed varied between 2.0-6.0 mg/l (mean, 3.0 mg/l) and 2.4-6.3 mg/l (mean, 4.3 mg/l), respectively. The observed DO and BOD concentrations are in agreement with the drinking water quality criteria. This, in turn, indicates that groundwater in the investigated area are not polluted with respect to organic components.

The pH ranging from 7.0 to 8.6 with an average value of 8.0 indicate nearly neutral to moderately alkaline nature of groundwater in the investigated project area. The EC, TDS and total alkalinity measured in representative samples collected from project area, ranged between 539.0 µS cm^{-1} – 938.5 µS cm^{-1} (mean, 783 µS cm^{-1}), 347.0-587.0 mg/l (mean, 514 mg/l) and 277-388.0 mg/l (mean, 348 mg/l), respectively. The recorded high concentrations of EC indicate increased concentrations of major ions in the groundwater.

Most of the trace elements were found to be either below or comparable to the respective permissible limits as per IS 10500:1991. Elements such as B, Al, Mn, Cu, Pb, Cd & Cr were observed mostly below detection limits. The colour & odor of groundwaters in the investigated project area are acceptable, however turbidity was observed little higher at locations such as, Shrirampur and Jacobpur

Table 3:20: Analytical Results of Groundwater Quality [Values are in mg/l, except for pH (pH unit), EC (µS/cm), Colour (Hazen), Turbidity (NTU), & Feacal coliform (MPN/100 ml)]

Sl. No.	Parameter	Sampling Locations				
		GW-1	GW-2	GW-3	GW-4	GW-5
	Physico-chemical parameters					
1	pH	8.6	7.8	7.3	7.0	7.3
2	EC	914.9	938.5	787.0	677.6	539.0
3	Colour	3.2	1.5	2.8	2.8	1.2
4	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
5	Turbidity	8.1	6.7	5.8	<5	<5
6	Total Alkalinity	387.0	388.5	370.2	329.9	277.3
7	TDS	571.2	587.1	559.4	486.0	347.1
8	DO	6.0	4.6	2.7	2.0	2.1
9	BOD	2.9	2.4	4.3	5.6	6.3
10	SO_4^{2-}	20.9	26.6	16.3	9.6	12.2
11	Cl^-	24.0	37.9	33.2	17.2	14.0
12	PO_4^{3-}	1.2	-0.5	0.0	0.0	0.0
13	NO_3^-	28.5	39.9	41.8	36.6	27.7
14	F^-	0.8	0.1	0.6	0.1	0.1
15	Phenolic Compounds (asC_6H_5OH)	BDL	BDL	BDL	BDL	BDL
16	Na	38.3	50.4	34.2	25.0	25.0

17	Ca	72.3	82.3	80.0	65.3	30.4
18	Mg	38.9	43.1	43.3	34.9	14.5
19	B	0.6	BDL	BDL	BDL	BDL
20	Al	0.3	BDL	BDL	BDL	BDL
21	Fe	1.6	0.5	0.7	0.4	1.3
22	Mn	0.9	0.7	BDL	BDL	BDL
23	Cu	0.7	0.7	BDL	BDL	BDL
24	Zn	1.1	0.2	0.8	1.0	1.4
25	Pb	0.7	BDL	BDL	BDL	BDL
26	Cd	0.7	BDL	BDL	BDL	BDL
27	Cr	1.1	BDL	BDL	0.7	0.2
	Bacteriological Parameters					
28	Faecal Coliform	BDL	BDL	BDL	BDL	BDL

For ready reference of drainage pattern and elevation map (Figure **3.2**) has been prepared in a buffer of 10 km either side of project road alignment using IRS Resource SAT-1 LISS-III, the drainage network of study area has been shown in **Figure 3.7** while Satellite Imagery of the study area has been shown in **Figure 3.8**. The drainage pattern of the project influence area is from North to South.

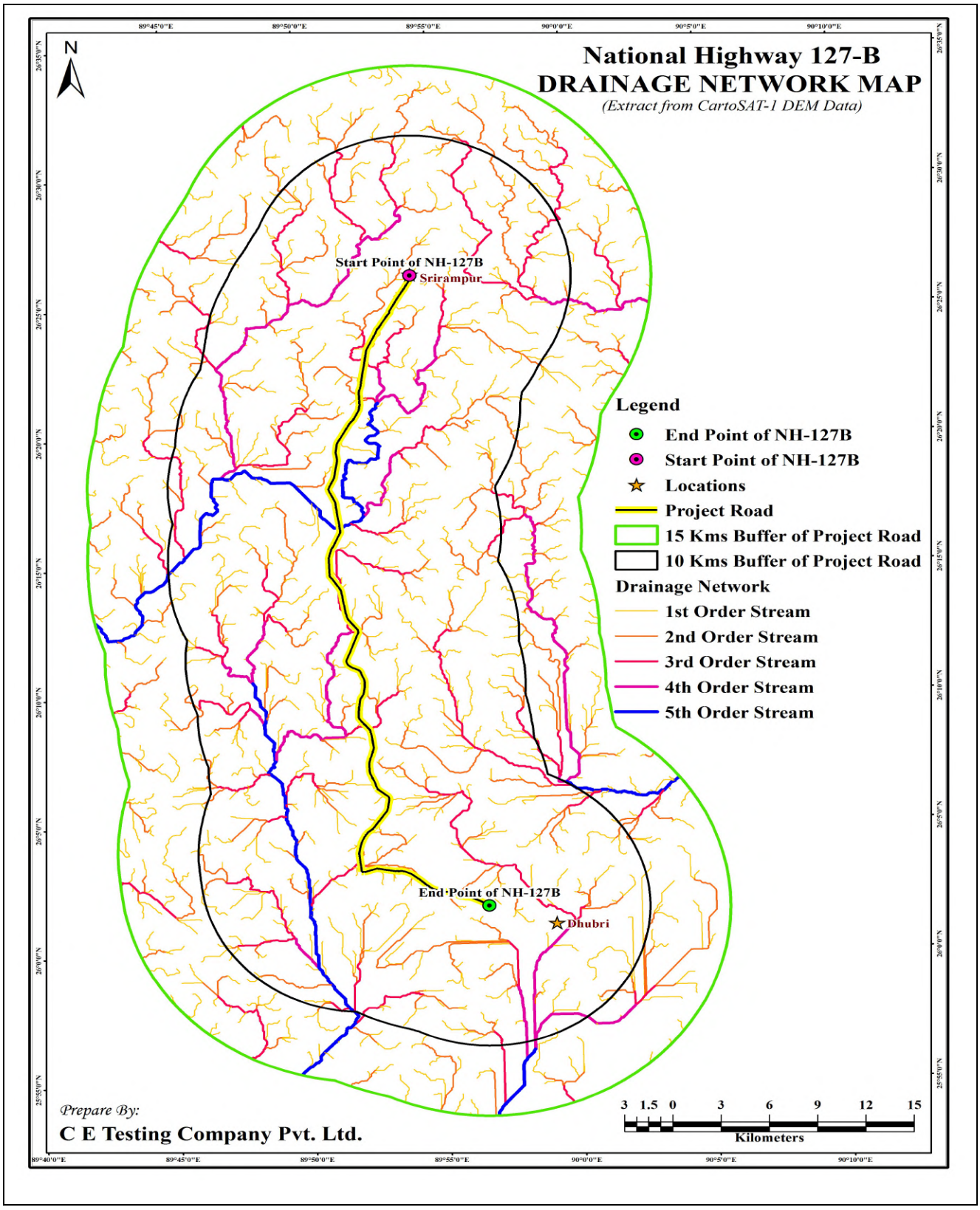


Figure 3.0 7 Drainage Network of Project Study Area

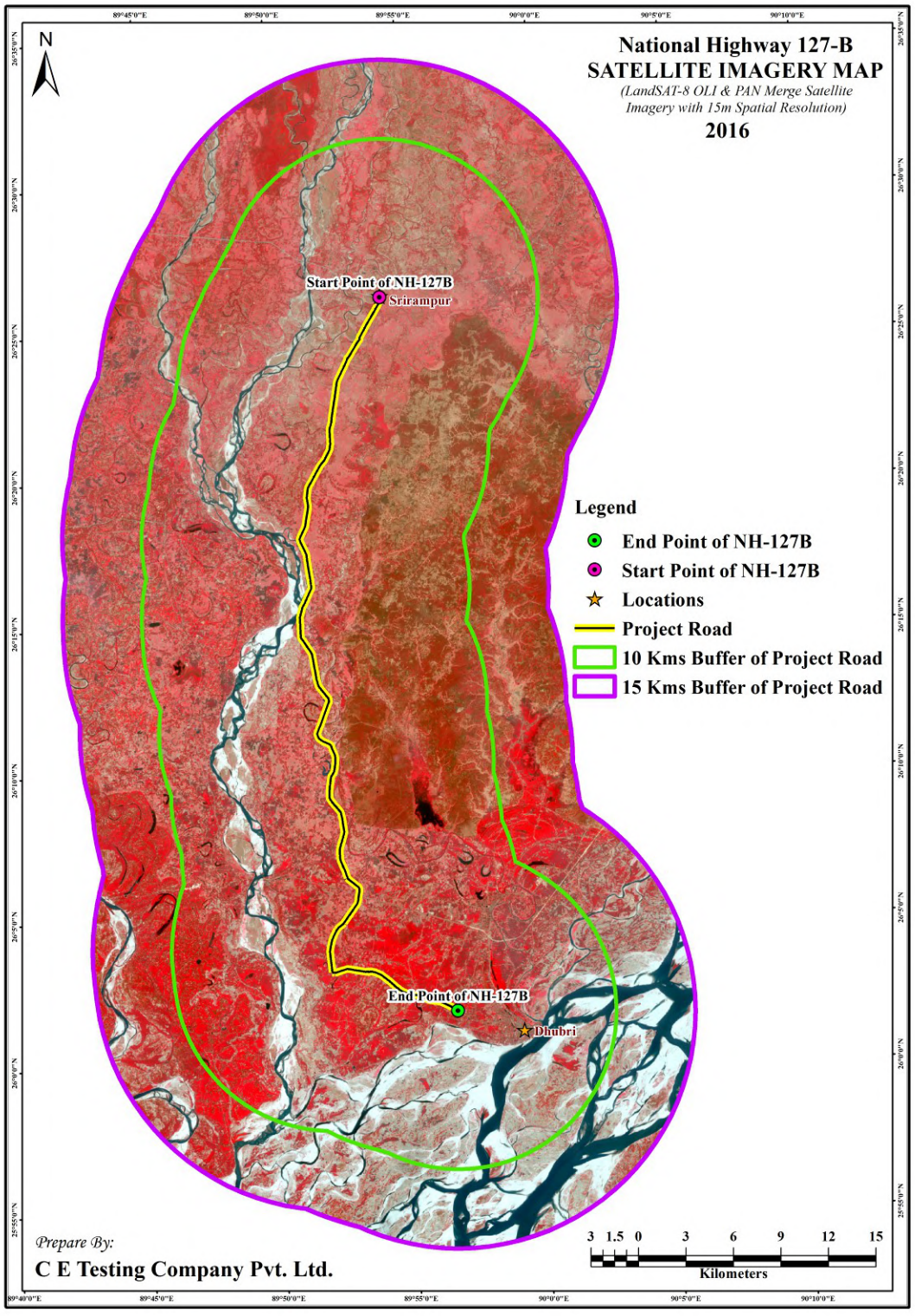


Figure 3.0 8: Satellite Image (Landsat-8 OLI) of Study Area

3.2 NATURAL ENVIRONMENT

The discussion and study of these social and environmental features enable to identify areas of concern in the entire stretch. Consultant's project site visit and available secondary information has been used to identify the area of concern.

3.2.1 Flora in Study Area

An ecological survey of the study area was conducted particularly with reference to recording the existing biological resources in the study area. Ecological studies are one of the important aspects of Environmental Impact Assessment with a view to conserve environmental quality and biodiversity. Ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprise of both plant and animal communities, which interact not only within and between themselves but also with the abiotic components viz. physical and chemical components of the environment.

Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important in Environmental Impact Assessment for safety of natural flora and fauna. The biological environment includes terrestrial and aquatic ecosystems.

The animal and plant communities co-exist in a well-organized manner. Their natural settings can get disturbed by any externally induced anthropological activities or by naturally occurring calamities or disaster. So, once this setting is disturbed, it sometimes is either practically impossible or may take a longer time to come back to its original state. Hence changes in the status of flora and fauna are an elementary requirement of Environmental Impact Assessment studies, in view of the need for conservation of environmental quality and biodiversity. Information on flora and fauna was collected within the study area. Relevant details on aquatic life within the study area were collected from related government offices.

Assam is one of the most important biodiversity "hot spots" in the North Eastern region of India. The area harbors wide varieties of wildlife species in its diverse mosaic of natural habitats. The wilderness habitat of Assam supports 689 species of birds, 194 species of mammals, 185 species of fish, 115 species of reptiles, 54 species of amphibians, more than 900 species of butterflies, and immense varieties of moths. In terms of floral diversity, Assam has documented 6,027 species of plants, of which 3,010 are flowering plants. The area sustained 33 endangered mammalian fauna, more than 20 endangered avian fauna under the Wildlife Protection Act, 1972, and 45 globally threatened avian fauna and 17 endemic birds. In addition, the state supports more than 15 endangered reptilian and amphibian fauna each, and 43 endangered insets fauna.

Vegetation around 5-10 km of the study area mostly comprises of large/ medium/ small trees bushy shrubs and annuals perennial or biennials herbs.

3.2.2 Flora

Predominant " tree species found in Jorhat and Golaghat districts are Amora (Spondias pinnata), Ajhar (Lagerstroomia spaciasa), Amari (Ameora wallichil), Bohela (Semicutpus anacardluml, Bhelu (Tetrameles nudifloral, Barun (Cretaeva nurvala), Bonjalphai (Castanopsis hystrixl, Bahramthuri (Talauma hodgsonil), Dimoru (Ficus hispida), Gainali (Premna bengalensis), Gamar; .' (Gmelina arboreal, Haldu (Adina cordifolia), Hatipoila (Pterospermum acerifolium), Jam (Syzygium cumim) , Jhow (Tamarix dioeca) , Kum (Careya arboreal, Kathal (Artocarpus integrifolia) and Kuthir (Bridelia retusa). Predominant herbs, climbers and grass species are Abulenga (Antidesma diandrum) , Athubhanga (Leea spps), Akalbih (Clerodendron indicum), " Bogilora (Randia dumatarum), Bhedelilata (Hedyotis scandens) , Dhoptita (Clerodendron viscosum) , Eragoch (Ricinus communis), Patidoi (Clinogyne dichotoma), Titaphul (Phlogocanthus thyrsilflours), Kamini kanchan (Murraya exotica), Makhitati (Flemingia braeteata), 'J> Kaupat (Phrynium imprecatum), Own (Leea crispa), Barkhi lata (Mellreurum enanllatum) , Bokul lata (Emballa ribas), Ghilalata (Entada phaseoloides) etc From the reconnaissance survey, the flora in the project area comprises of roadside trees, fruit trees in certain villages besides the vegetables and crops grown in the agriculture lands. The flora includes Sal, Banyan, Ferns (Angiopteris ereeta), Bamboo, Jack Fruit, Cane Bamboo and ., Teak.

3.2.3 Fauna in Study Area

Field studies were conducted along the project road know the present status of fauna of the study area. Apart from that, secondary data was collected by mode of interaction of local elderly people and Forest Working Plans of project districts. As per the Wild Life Act (1972), those animals, which have been enlisted in the schedules of the Wildlife Act, have been presented in subsequent section. The schedules are based on the species namely, rare, endangered, threatened, vulnerable etc. According to threat of extinction Schedule-I contains those species which need topmost priority, while II, III, IV and V have lesser degree of threat. Most of the avi-fauna has been listed in Schedule–IV. As per the list of avi-faunal species, these are mostly local migrant species only.

On the basis field observations, there is no major wildlife as there are no forest areas in and around the project road alignment. Primary field surveys are conducted through random observation in the study area and also information collected from elderly persons of the area, forest officials. This area hosts jackal, foxes and other animals. There are no endangered animals in project influence area.

As a state, Assam is very rich in bio diversity with variety of faunal populace, As a part of ., northeast, Assam is also known as home of migratory birds. During the winter season, Bio rich wetlands and forest areas attracts more foreign and local birds and it is also known as bird watching season. Some of the species recorded around theproject influence area are d Chlidonias hybridus (Whiskered Tern), A grandis (White-Vented Myna), Pod/caps cristaIus (Great Crested Grebe), Picoidesmacei (Fulvous-breasted Woodpecker) Pelecanusphilippensis (Spot-Billed Pelican), NycUcorax nycticorax (Black-Crowned Night Heron), Ixobrychus sinensis (Yellow Bitrern), Anaslomus oscitans (Asian Openbill), L javanicus (Lesser Adjutant), Plegadisfakinellus (Glossy Ibis), Anseranser(Greylag Goose), Anas crecc(Common Teal), Grus gms (Common Crane), Acridotheresginginianus (Bank Myna) Other Specious recorded are Cattle Egret Bubukus ibis, Great Egret Egretta alba, Intermediate Egret E. intennedia, little Egret E. garzetta, Common Sandpiper

Actitis hypo/euccs, Black-winged Stilt Himanwpus himanlopus, Common Black-headed Gull Larus ridibundus, Spotted Owlet Athene brama, Pied Kingfisher Ceryie rudis, Common Kingfisher Akedo atthis, Stork-billed Kingfisher Peiargopsiseapensi, House Sparrow P, dmnes/ieu, Predetory birds like Black Kite Milvus migrans, Brahminy Kite Haliastur indus, White-rumped VuHure Gyps bengaknsis, Long-billed Vulture G, indkus,

The wildlife does not offer a wide spectrum of species in the project area, Some of the identified animal's species are Jackal - Canis aureus, Jungle cat - Felis chaus, squirrels - Funambulus pennant, Hare - Lepus nigricollis nigricO/lis, Common mongoose - Harpestes edwardsi, Common rat snake - Plyas muccsus, Assam worm snake (Typhlina bothriorhynchus), monocellate cobra (Naja kaothia) , Assam trinket snake (Elaphe frenata) and Green whip snake - Ahaetulla nasulus,

3.2.4 Sensitive Area

No sensitive ecological habitats or ecosystems are identified within the direct influence area of the project corridor, Nambor Wildlife Sanctuary is the sensitive ecological habitat in the indirect influence area (above 10km buffer zone),

3.2.5 Recorded Forest Area in State

Forests play an important role in economic development and ecological stability. Forests provide numerous services such as environmental and ecological stability necessary for human sustenance. Forests are inevitable on earth for well being of mankind. They are not just the green cover we need to make the earth look beautiful; they have many functions integral for our survival and subsistence. With the development of civilization, large areas have been cleared to make way for farm, mines, towns and roads.

As per State Forest Report, the recorded forest area in the state is 26,832 Km2 according to their legal status, Reserved Forest constitute 66.58% and Unclassed Forest 33.42% of the total forest area.

3.2.6 Forest Status in Project District

Project road alignment traverse in two district namely Dhubri (approx 44 km) and Kokrajhar (approx) 10 K. As per FSR Assam report 2011, the 36.10% area of district Kokrajhar and 14.94% of district Dhubri. The details are given in below table 3.21.

Table 3:21Forest cover in district Dhubri and Kokrajhar

District	Geographical Area	2011 Assessment			Total	%of Geographical Area
		Very Dense Forest	Mod. Dense Forest	Open Forest		
Dhubri	2798	21	201	196	418	14.94
Kokrajhar	3169	208	716	220	1144	36.10

3.2.7 Strip Plantations along road

Most of the road length is lined with plantation of avenue trees of native variety, which are designated as protected forest for the purpose of its management; the number of tree within RoW are 4202 nos. and need to be removed.

3.3 SOCIO-ECONOMIC ENVIRONMENT

As stated in previous section, the project road alignment traverses from the three districts namely Dhubri and Kokrajhar district. The demographic profile of this district has been taken as reference for primary assessment. The Primary data/ Socio economic profile of the villages/ blocks/will be generated using structured questioner once the alignment is frizzed. This survey will include detailed community consultation, socio-economic & census survey and estimation of community properties resources, religious structure, and educational intuitions coming to RoW (if any). The detail of assessment on socio-economic profile has been given in separate chapter (SIA) of this report. The socio demographic status of project influence districts have been illustrated below section.

Socio-demographic setup- district Dhubri

Project road alignment is entirely located in district Dhubri. Dhubri is one of the plains districts of Assam. It falls in the Brahmaputra valley. The river Brahmaputra flows through the heart of Assam and touches almost all the districts. Dhubri was one of the three subdivisions of old Goalpara district. It has three subdivisions namely, Dhubri, Bilasipara and Mankachar. It has 9 revenue circles, which include 5 Statutory towns and 4 Census towns. Thus the district has 1,091 villages spread over 3 subdivisions and 9 Revenue Circles.It has 15 Community Development Blocks. The total area of the districts is 2176.00 Sq. Kms(Rural: 2144.06 Sq.Km. and Urban: 31.94 Sq.Km). In terms of area the district occupies the 17th rank of the total 27 districts in Assam. It has 168 Gaon Panchayats in all.

Important Soci-economic and demographic fact –District Dhurbi

- ✓ In the district, Dhubri (Pt) Revenue Circle is the most populous having 425809 persons while Gossaigaon (Pt) is the least populous Revenue Circle having 53842 persons.
- ✓ Among the CD Block, Gauripur CD Block has the highest number of population with 213877 whereas the lowest is found in Hatidhura (Part) CD Block with 53842.
- ✓ The district comprises nine (9) towns: 5 Statutory Towns and 4 Census Towns. Dhubri (MB) is the most populous with 63388 persons while Anand Nagar (CT) is the smallest in population with 2050 souls.
- ✓ While the highest number (138) inhabited villages is found in Birshingjarua CD Block and lowest inhabited villages (35) is found in Hatidhura (Pt) CD Block.

- ✓ The largest village by population is Borokalia Sharsho with 10628 souls under South Salmara CD Block and the smallest village is Gobrakuti under Agamoni CD Block with 12 persons.
- ✓ The famous Mahamaya Devalaya is situated at this District which is a famous religious place for pilgrimers.
- ✓ The district has the largest number of Char (an area use as residential place near to the bank of big river) villages with 480 numbers.

Total Population (Urban and rural)

Out of the total Dhubri population for 2011 census, 10.45 percent lives in urban regions of district. In total 203,701 people lives in urban areas of which males are 103,934 and females are 99,767. Sex Ratio in urban region of Dhubri district is 960 as per 2011 census data. Similarly child sex ratio in Dhubri district was 935 in 2011 census. Child population (0-6) in urban region was 22,983 of which males and females were 11,879 and 11,104. This child population figure of Dhubri district is 11.43 % of total urban population. Average literacy rate in Dhubri district as per census 2011 is 82.28 % of which males and females are 87.07 % and 77.30 % literates respectively. In actual number 148,695 people are literate in urban region of which males and females are 80,156 and 68,539 respectively.

As per 2011 census, 89.55 % population of Dhubri districts lives in rural areas of villages. The total Dhubri district population living in rural areas is 1,745,557 of which males and females are 893,914 and 851,643 respectively. In rural areas of Dhubri district, sex ratio is 953 females per 1000 males. If child sex ratio data of Dhubri district is considered, figure is 971 girls per 1000 boys. Child population in the age 0-6 is 345,279 in rural areas of which males were 175,213 and females were 170,066. The child population comprises 19.60 % of total rural population of Dhubri district. Literacy rate in rural areas of Dhubri district is 55.25 % as per census data 2011. Gender wise, male and female literacy stood at 60.02 and 50.21 percent respectively. In total, 773,646 people were literate of which males and females were 431,395 and 342,251 respectively.

Religion –wise Population

Description	Total	Percentage
Hindu	388,380	19.92 %
Muslims	1,553,023	79.67 %
Christian	4,107	0.21 %
Sikh	254	0.01 %

Description	Total	Percentage
Buddhist	101	0.01 %
Jain	1,846	0.09 %
Others	45	0.00 %
Not Stated	1,502	0.08 %

Population Density

The initial provisional data released by census India 2011, shows that density of Dhubri district for 2011 is 896 people per sq. km. In 2001, Dhubri district density was at 941 people per sq. km. Dhubri district administers 2,176 square kilometers of areas.

Literacy Rate

Average literacy rate of Dhubri in 2011 were 58.34 compared to 48.17 of 2001. If things are looked out at gender wise, male and female literacy were 63.10 and 53.33 respectively. For 2001 census, same figures stood at 55.84 and 40.02 in Dhubri District. Total literate in Dhubri District were 922,341 of which male and female were 511,551 and 410,790 respectively. In 2001, Dhubri District had 9,102,384 in its district.

Sex Ratio

With regards to Sex Ratio in district, it stood at 953 per 1000 male compared to 2001 census figure of 946. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 968 girls per 1000 boys compared to figure of 965 girls per 1000 boys of 2001 census data.

Child Population

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Dhubri. There were total 368,262 children under age of 0-6 against 326,739 of 2001 census. Of total 368,262 male and female were 187,092 and 181,170 respectively. Child Sex Ratio as per census 2011 was 968 compared to 965 of census 2001. In 2011, Children under 0-6 formed 18.89 percent of Dhubri District compared to 20.86 percent of 2001. There was net change of -1.97 percent in this compared to previous census of India.

Houseless Population

In 2011, total 207 families live on footpath or without any roof cover in Dhubri district of Assam. Total Population of all who lived without roof at the time of Census 2011 numbers to 815. This approx 0.04% of total population of Dhubri district.

Socio-demographic setup- district Kokrajhar

Kokrajhar, recognized as the gateway to the north-eastern region of India is a major district of Assam. The district of Kokrajhar nestled on the riverbank of Brahmaputra is bounded by Bhutan on the north and Dhubri district on the south. The Bongaigon district lies on the eastern side whereas West Bengal borders the west of the Kokrajhar district. Kokrajhar is well accessible by both roadway and railway. Kokrajhar was originally a part of undivided Goalpara district. Till 1956, it was merely a small village with a railway station that connected it to the rest of the world. In 1957, when Bimala Prasad Chaliha was the Chief Minister of Assam, a new Civil Sub-division was created after carving out the northern part of Dhubri Sub-division and some parts of Goalpara Sub-division. This new subdivision was called Kokrajhar Sub-division. Goalpara district thus became divided into three sub-divisions. The area covered by the then Kokrajhar Subdivision consisted of five tracts of the Eastern Dooars, viz., Bijni, Sidli, Chirang, Ripu and Guma with a total area of 1569.9 square miles or 4065.88 square kilometres.

Important Soci-economic and demographic fact –District Kokrajhar

- ✓ In Kokrajhar there are 9 Revenue Circles and 11 CD Blocks which comprises 1068 villages including 15 uninhabited villages.
- ✓ In the district, Gossaigaon (Pt) Revenue Circle is the most populous having 270952 persons while Bilasipara (Pt) is the least populous Revenue Circle having 8736 persons. Among the CD Block, Kokrajhar CD Block has the highest number of population with 218958 whereas the lowest is found in Golakganj (Part) CD Block with 3318.
- ✓ The district comprises four (4) towns: 2 Statutory Towns and 2 Census Towns. Kokrajhar (MB) is the most populous with 34136 persons while Salakati (CT) is the smallest in population with 4863 souls. While the highest number (238) inhabited villages is found in Kachugaon CD Block and lowest inhabited villages (4) is found in Bilasipara (Pt) CD Block.
- ✓ The largest village by population is Amguri Forest Block with 8393 soulsunder Kokrajhar CD Block and the smallest village is Bamuni with 5 persons under Debitola (Pt) CD Block.

Total Population of district Kokrajhar (Urban & Rural)

Out of the total Kokrajhar population for 2011 census, 6.19 percent lives in urban regions of district. In total 54,941 people lives in urban areas of which males are 28,459 and females are 26,482. Sex Ratio in urban region of Kokrajhar district is 931 as per 2011 census data. Similarly child sex ratio in Kokrajhar district was 947 in 2011 census. Child population (0-6) in urban region was 5,527 of which males and females were 2,839 and 2,688. This child population figure of Kokrajhar district is 9.98 % of total urban population. Average literacy rate in Kokrajhar district as per census 2011 is 87.86 % of which males and females are 91.97 % and 83.44 % literates respectively. In actual number 43,415 people are literate in urban region of which males and females are 23,562 and 19,853 respectively.

As per 2011 census, 93.81 % population of Kokrajhar districts lives in rural areas of villages. The total Kokrajhar district population living in rural areas is 832,201 of which males and females are 424,446 and 407,755 respectively. In rural areas of Kokrajhar district, sex ratio is 961 females per 1000 males. If child sex ratio data of Kokrajhar district is considered, figure is 954 girls per 1000 boys. Child population in the age 0-6 is 131,397 in rural areas of which males were 67,246 and females were 64,151. The child population comprises 15.84 % of total rural population of Kokrajhar district. Literacy rate in rural areas of Kokrajhar district is 63.63 % as per census data 2011. Gender wise, male and female literacy stood at 70.45 and 56.53 percent respectively. In total, 445,890 people were literate of which males and females were 251,658 and 194,232 respectively.

All details regarding Kokrajhar District have been processed by us after receiving from Govt. of India. We are not responsible for errors to population census details of Kokrajhar District.

Religion wise population

Description	Rural	Urban
Population (%)	93.81 %	6.19 %
Total Population	832,201	54,941
Male Population	424,446	28,459
Female Population	407,755	26,482
Sex Ratio	961	931
Child Sex Ratio (0-6)	954	947
Child Population (0-6)	131,397	5,527
Male Child(0-6)	67,246	2,839
Female Child(0-6)	64,151	2,688
Child Percentage (0-6)	15.79 %	10.06 %

Description	Rural	Urban
Male Child Percentage	15.84 %	9.98 %
Female Child Percentage	15.73 %	10.15 %
Literates	445,890	43,415
Male Literates	251,658	23,562
Female Literates	194,232	19,853
Average Literacy	63.63 %	87.86 %
Male Literacy	70.45 %	91.97 %
Female Literacy	56.53 %	83.44 %

Population Density

The population density of Kokrajhar district for 2011 is 269 people per sq. km. In 2001, Kokrajhar district density was at 266 people per sq. km. Kokrajhar district administers 3,296 square kilometers of areas.

Literacy Rate

Average literacy rate of Kokrajhar in 2011 were 65.22 compared to 52.29 of 2001. If things are looked out at gender wise, male and female literacy were 71.89 and 58.27 respectively. For 2001 census, same figures stood at 61.01 and 43.06 in Kokrajhar District. Total literate in Kokrajhar District were 489,305 of which male and female were 275,220 and 214,085 respectively. In 2001, Kokrajhar District had 4,797,838 in its district.

Sex Ratio

With regards to Sex Ratio in Kokrajhar, it stood at 959 per 1000 male compared to 2001 census figure of 946. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 954 girls per 1000 boys compared to figure of 955 girls per 1000 boys of 2001 census data.

Child Population

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Kokrajhar. There were total 136,924 children under age of 0-6 against 151,341 of 2001 census. Of total 136,924 male and female were 70,085 and 66,839 respectively. Child Sex Ratio as per census 2011 was 954 compared to 955 of census 2001. In 2011, Children under 0-6 formed 15.43 percent of Kokrajhar District compared to 17.95 percent of 2001. There was net change of -2.52 percent in this compared to previous census of India.

Houseless Population

In 2011, total 56 families live on footpath or without any roof cover in Kokrajhar district of Assam. Total Population of all who lived without roof at the time of Census 2011 numbers to 239. This approx 0.03% of total population of Kokrajhar district.

3.3.1 Archaeological Heritage

As per discussion with different stakeholders, field survey and statically information of ASI it has been confirmed that there is no archaeological heritage site coming to existing or proposed RoW and also not in immediate influence area of ASI site.

3.3.2 Religious Structure

There are small/medium size 30 religious structures falls/partially within RoW which may be impacted due to proposed road widening and improvement. Utmost care will be taken to conserve these structures but if there will not be any option then they will be properly relocated in consultations with the local community. The chainage wise details are presented in below table.

Table 3:22: List of Religious Structure and CPR along Project Highway

CPR details - Dhubri To Srirampur NH 127 B																	
Sl	**Chainage**	**Hand Pump**		**Wells**		**Ponds**		**Religious Structure**		**Schools**		**Hospital**		**Gov. Buildings**		**Others**	**Within RoW**
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	-	Y
1	0+020	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
2	0+050	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
3	0+050	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
4	0+600	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
5	1+200	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
6	2+500	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
7	2+900	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
8	3+600	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y

CPR details - Dhubri To Srirampur NH 127 B																	
Sl	**Chainage**	**Hand Pump**		**Wells**		**Ponds**		**Religious Structure**		**Schools**		**Hospital**		**Gov. Buildings**		**Others**	**Within RoW**
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	-	Y
9	4+350	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
10	7+200	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
11	7+300	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
12	10+200	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
13	11+700	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
14	11+750	-	-	-	-	-	-	-	-	-	-	-	-	L		-	Y
15	11+900	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
16	12+800	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
17	13+400	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
18	14+300	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
19	14+700	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
20	14+800	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
21	16+150	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
22	16+200	-	-	-	-	-	-	-	-	-	-	L	-	-	-	-	Y
23	16+500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	Y
24	16+500	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
25	16+600	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
26	19+200	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
27	19+600	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
28	19+800	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
29	19+850	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
30	21+300	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
31	21+500	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	Y
32	23+800	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	Y
33	25+600	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y

CPR details - Dhubri To Srirampur NH 127 B																	
Sl	**Chainage**	**Hand Pump**		**Wells**		**Ponds**		**Religious Structure**		**Schools**		**Hospital**		**Gov. Buildings**		**Others**	**Within RoW**
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	-	Y
34	26+200	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
35	26+400	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
36	26+800	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
37	27+200	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	Y
38	28+200	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	Y
39	28+300	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
40	28+350	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
41	28+375	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
42	28+400	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
43	28+600	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
44	28+650	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
45	29+200	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
46	29+300	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	Y
47	29+400	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
48	30+800	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
49	31+250	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
50	31+400	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
51	32+800	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
52	33+300	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
53	33+500	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
54	33+500	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
55	33+550	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
56	33+800	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
57	34+600	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
58	34+700	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y

CPR details - Dhubri To Srirampur NH 127 B																	
Sl	**Chainage**	**Hand Pump**		**Wells**		**Ponds**		**Religious Structure**		**Schools**		**Hospital**		**Gov. Buildings**		**Others**	**Within RoW**
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	-	Y
59	36+600	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
60	36+650	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
61	37+700	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	Y
62	37+750	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
63	37+800	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
64	38+500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	Y
65	38+800	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
66	39+500	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
67	39+850	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
68	40+600	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y
69	40+800	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
70	41+300	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
71	41+400	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	Y
72	42+200	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
73	42+700	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
74	46+800	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
75	47+100	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
76	48+500	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	Y
77	48+600	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
78	49+200	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-	Y
79	49+300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L	Y
80	49+300	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	Y
81	50+400	-	-	-	-	-	-	-	-	-	-	-	-	L	-	-	Y
82	50+450	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y
83	51+300	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	Y

CPR details - Dhubri To Srirampur NH 127 B																	
Sl	**Chainage**	**Hand Pump**		**Wells**		**Ponds**		**Religious Structure**		**Schools**		**Hospital**		**Gov. Buildings**		**Others**	**Within RoW**
		L	R	L	R	L	R	L	R	L	R	L	R	L	R	-	Y
84	51+500	-	-	-	-	-	-	L	-	-	-	-	-	-	-	-	Y

3.3.3 Local built heritage and art form

No such heritage exists along the proposed project road alignment.

3.3.4 Presence of Sensitive Receptors and community structures

There are few sensitive receptors such as Schools, religious centres and health care centres along the project road. The sensitive receptor established along the project road is being surveyed and which are as follow:

SR.NO	Type of CPR	LHS	RHS	TOTAL
1.	Hand Pump	02	01	03
2.	Wells	00	00	00
3.	Ponds	00	00	00
4.	Religious Structure	19	11	30
5.	Schools	08	06	14
6.	Hospital	01	02	03
7.	Gov. Buildings	15	16	31
8.	Other	01	02	03
	GRAND TOTAL	**46**	**38**	**84**

3.4 STAKEHOLDER CONSULTATION

3.4.1 Definition of stakeholder

"Any person or organization that is actively involved in a project, or whose interests may be positively or negatively affected by execution or completion of the project"

3.4.2 Consultation with Local Community

Informal Public Consultation was used as a tool to inform and educate stakeholders about the proposed project both before and after the development decisions were made. It assisted in

identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process helped in reducing the public resistance to change and enabled the participation of the local people in the decision making process.

Informal Public consultation has been carried out in this sub-project with the objectives of minimizing probable adverse impacts of the project through alternate design solutions (widening and re-alignment) and to achieve speedy implementation of the project through community awareness on the benefits of the project. Several informal consultations were organized at various locations, leading to public understanding of the processes and mechanisms through which developmental problems & needs are identified and resolved.

A Significant number of potentially affected persons (APs) expressed their views about the proposed project. It was noted that most of the likely affected people want the road construction to start without any further delay. They know that most significant impact is on Agricultural/Barren land and not on the structure as at most of the habitat area/village, realignment/bypass has been proposed. Most of them were agree to give their land if proper compensation is paid.

3.4.3 Consultation with the Govt. officials

Attempt was made to consult relevant govt. offices concerned with the project road. This included PWD officials, Forest official, Block Development Officers, Circle Inspectors etc. Despite repetitive visits, few of these officials were not available due to their busy schedule; wherever possible they were consulted and planned to be consulted in later stage of project development.

The consultation with these officials revealed that most of them were aware about the project. The details were shared in the meetings. The details of existing ROW were also shared with them and as alignment is finalized the impacts on agricultural land, common properties resources and structures are assessed and documented in Social Impact Assessment (SIA) Report.

3.4.4 Major outcome of Informal Consultation

- Most of the local communities consulted were agree to extend their full co-operation.
- Some of them were aware that road is being upgraded as chainaging and other inventory survey were already in progress and they have already interacted to them.
- Informal consultation was carried in context to road project; they were concern for water related problem and their remedy along with project road development. Many of them asking for drinking water facility and public toilet attached with Bus Stop.
- Significant number and good quality of bus shelter should be provided and it will be beneficial for passengers waiting for bus during rain and summer season.
- Provision of medical facility is essential, and may be considered under Social Development of the area.
- Villagers also expressed their concern related to un availability of drinking water, power supply, medical facilities, public toilets, drainage system prevail in the area. Though this particular component is not within the scope of this project but if required PWD-MoRTH can separately look into the scope of development of the area and provide the basic amenities.
- Many of the consulted people suggested providing solar light near junction Bush Shelter and major crossing.

- Most of the consulted community was concern for drainage problem in market area and they are expecting their remedy after construction of project road. However, it was conveyed that alignment proposed alignment is traversing in market area and proper mitigation measure will be adopted during construction. They also asked that during construction proper lighting should be provided in construction area to avoid accident as they have experienced in similar work sometimes ago.
- Villagers also suggested that, Public lavatories shall be built in the villages bus stops, especially for the females as a part of Social Development of village.

3.4.5 Plan for further consultation in the project

The effectiveness of the R&R program is directly related to continued involvement of those affected by the Project. Several additional rounds of consultations with APs will be organized during further stages of project preparation and implementation. The consultation will continue throughout the project execution.

The following set of activities are required to be undertaken during execution of project

- During planning phase the APs and other stakeholders were consulted in selection of road alignment for minimization of resettlement impacts, development of mitigation measures etc. However, during execution process should be repeated during acquisition/ demolising structures and CPRs as their sentiments are attached.
- Consultation and focus group discussions required to be conducted with the vulnerable groups like women, SC, ST, and OBC's to ensure that the vulnerable groups understand the process and their needs are specifically taken into consideration; and
- To make reasonable representation of women and local workers during project implementation and involved them in consultation.

CHAPTER-4

(ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES)

4 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural environmental components along the project road. The description of the impacts on the individual components has been structured as per the discussion in Chapter 3: Description of Environment of this report.

The anticipated impacts of the activities proposed as part of the project can occur during:

- Planning and Design Stage;
- Construction Stage; and
- Operation Stage.

The mitigation measures for the impacts have also been given.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Topography

IMPACTS

Construction Stage

During construction stage minor change in topography is expected due to construction of embankment in the Right of way at realignment and construction of major bridge, minor bridges, cross drainage structures and being crossed by project road alignment. The change is topography will be most visible at major/minor bridge sites and underpass sites. The change in Topography may also take place due to opening and operation of borrow areas for construction work. The design will consider the improvement of roadside drainage conditions through the improvement of cross-drainage structures. Design of the cross drainage structures will follow IRC Guidelines (IRC, 1995).

Operation Stage

The change in topography will also be due to the probable induced developments of the project. These induced developments will be in the form of residential, commercial and institutional in the indirect project influence area. There may be development in privately owned land near the alignment especially close to habitations. There is also possibility of breach in embankment due to soil erosion during monsoon or any other reason.

MITIGATION MEASURES

Construction Stage

Borrow areas would be opened, operated and closed as per clause no 305.2.2 of Specifications for Road and Bridge Works, Ministry of Shipping and Indian Road Congress (IRC): 10-1961 guidelines for excavation of earth from borrow areas. The borrow area preferably be filled with the rejected waste and then finally layer of Top Soil be spread over it before carrying out plantations, etc.

Borrow areas shall be excavated as per the intended end use by the owner. In some cases the owners of land want to develop the area in to pond for rearing fishes or for any other use.

The following criteria have been used for selection of borrow pits and amount that can be borrowed. They are as follows:

- Borrow areas should not be located on cultivable lands. However, if it becomes necessary to borrow earth from temporarily acquired cultivated lands, their depth should not exceed 45 cm. The topsoil to a depth of 15 cm shall be stripped and set aside. Thereafter, soil may be dug out to a further depth not exceeding 30 cm and used in forming the embankment.
- Borrow pit shall be selected from wasteland at least 500m away from the road;
- Priority should be given to the borrowing from humps above the general ground level within the road land;
- Priority should be given to the borrowing by excavating/enlarging existing tanks;
- Borrowing should be from land acquired temporarily and located at least 500m away from the road;
- Borrowing should be from mounds resulting from the digging of well and lowering of agricultural fields in vicinity of the road;
- In case of settlements, borrow pit shall not be selected within a distance 800m from towns or villages. If unavoidable, earth excavation shall not exceed 30 cm in depth.
- The haulage distance from site should not be too far.

Aggregate required for road construction should be procured from quarries approved by Assam State Pollution Control Board (ASPCB). Air and noise emissions from quarry must be well within the prescribed limit. (Please refer Appendix 4.1, guidelines for borrow area management)

Operation Stage

During operation stage, maintenance of embankment will be carried out, so that the embankment is not affected due to soil erosion. Benefits in the form of land levelling and tree plantations in the vicinity of the project road, in the vacant space in RoW, will enhance the local aesthetics.

4.1.2 Geology

IMPACTS

Construction Stage

The impact on geology may occur from extraction of minor minerals/earth as significant quantity Soil, Coarse Aggregates, sand will be required for construction of project road, and however it is unlikely of long term impact on geology of the area.

Operation Stage

The alignment is not passing through the area, which is rich in minerals, and proposed project is linear, therefore, loss of localized area is also not much. There will be minor requirement materials for regular maintenance. Hence insignificant impacts have been identified on the geology during the operation

MITIGATION

No new quarries are proposed to be opened for this project. The material will be obtained from the quarries which have all valid permits.

4.1.3 Seismicity

IMPACTS

During Construction

Major portion of project road is located in zone V. Road construction in this area will not have any impact on its overall earthquake potential since no blasting is envisaged at the construction site. However the embankment and structures may be subjected to Seismic effect. Area along project road does not come under fragile geological environment with the possibility of slope failures, soil erosion, landslide etc

Therefore, it is felt necessary that for structures founded on well consolidated foundation a provision of seismic ground acceleration of 7 per cent of gravity may be made.

During Operation

No Impact on seismicity is anticipated during operation phase.

MITIGATION MEASURES

The necessary factors in design shall be taken to resist the seismic forces.

4.1.4 Physiography

IMPACTS

During Construction

The impact of road construction on physiography is a function of the terrain of the area. It is most drastically altered in case of hilly terrain or where extensive cut-and-fill operations are involved. The project road generally passes through plain terrain, at few locations passes through rolling terrain. So the impact on physiography will not be felt in the stretches of project road except few places where realignment and bypasses have been planned. The visual impacts will be felt during

construction period. The visual impacts will be pleasing to eyes due to turfing on side slopes and plantation in open space. The change in physiography will be limited within the RoW of the project.

During Operation

No impact on physiography is anticipated during operation phase.

MITIGATION MEASURES

Since change in physiography will be pleasing to the eyes and construction of embankment for project road is a requirement, therefore, no mitigation measures are warranted except provision for adequate cross drainage structures and tree plantation.

4.1.5 Soil Erosion

IMPACTS

The textural estimation of soils indicates that soils of the area are Loamy in nature, except for soils collected near the Sonkosh banks, being Sandy Loam type. Invariably fair fractions of clay & silt were observed in the soils of project area. Therefore the potential for erosion is moderate to low.

Pre Construction

The soil erosion may take place due to following

- Site preparation may involve demolition of building, clearing of brushwood, tree removal, temporary rerouting of utilities, diversion or rechanneling of waterways. This brings risks of erosion to the exposed ground or stored topsoil.
- Setting up of workers camp along the project road may lead to loss of productive soils and impact the soil productivity especially at micro level.

During Construction

The soil erosion may take place at the slopes of the construction sites of cross drainage structures due to rains, at borrow areas and at construction sites which has been exposed during monsoon.

During Operation

The soil erosion may take place during operation at the slopes of the embankment at bridges of the project road. At other locations chances of soil erosion are also there as height of embankment will be generally more than 2.0 m all through road.

MITIGATION MEASURES

Design Stage

The slope of the project road at high embankment stretches has been fixed at 1:2 to 1:3, which is fairly stable and reduces the possibilities of slope failures. To check soil erosion on critical road embankment slopes turfing with grasses and shrubs will be carried out, in accordance with the recommended practice for treatment of embankment slopes for erosion control, IRC: 56-1974. At the locations of steep slopes such as location of major bridge, minor bridges and culverts, suitable

protection measures such as stone pitching will be adopted. At locations where provisions for 1:2 to 1:3 slopes are not possible the retaining wall will be provided.

Construction Stage

Prior to the start of the relevant construction, the Contractor shall submit to the Independent Engineer/Supervision Consultant for approval his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment / subgrade construction bridges and other structures across/near water courses, pavement courses and shoulders. They shall also submit for approval their proposed method of erosion / sedimentation control on service road / inspection road and borrow areas and his plans for disposal of waste materials. Work shall not be started until the erosion/sedimentation control schedules and methods of operations for the applicable construction have been approved by the Independent Engineer/Supervision Consultant.

The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill material operations shall be limited to the extent practicable. The contractor may be directed to provide immediate permanent or temporary erosion control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage to adjacent properties or cause contamination of nearby streams or other water courses.

Operation Stage

The turfing and other slope protection measures like sodding, turfing shall be monitored regularly and in case of any sign of cracks or non maintenance of slope protection measures immediate action will be taken to restore it to original position.

4.1.6 Compaction of soil

IMPACTS

Pre-Construction Stage

Compaction of soil will occur in the pre-construction phase due to movement of the construction equipment and machinery and during the setting up of construction camps.

Construction Stage

Compaction occurs beyond the carriageway and within the vegetated area of the RoW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compaction. This impact is direct and will be maximum within RoW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the RoW, where vegetation can grow and rain infiltration will take place.

Operation Stage

During the operation period compaction will be restricted to the carriageway of project road and service roads. Compaction cannot be said to be an impact of the operation stage as the pavement itself is a function of compacted base and sub base.

MITIGATION MEASURES

Pre-Construction Stage

During pre- construction stage plant, machinery and equipment will be unloaded at camp site only. All construction vehicles will move and parked at the designated location only. The movement of construction machinery and plants preferably is limited to RoW. All haul roads shall be constructed and maintained in good condition.

Construction Stage

During Construction phase all construction vehicles will move within the RoW and identified routes. In no case these shall ply through open land or agriculture fields.

Operation Stage

No mitigation measures are warranted.

4.1.7 Contamination of Soil

IMPACTS

Pre-Construction Stage

Contamination of soil in the pre-construction stage may be considered as a short-term residual negative impact. Soil contamination may take place due to solid waste contamination from the labour camp set up during pre-construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants etc. as these will come up in this stage.

Construction Stage

Contamination of soil during construction stage is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Contamination of soil can also occur near hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping being done near water body locations.

Operation Stage

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can be long term and irreversible depending upon the extent of spill. The contamination due to deposition of heavy metals such as Lead along the road in agriculture field is a cause for concern. However, monitoring of soil quality will be done during construction & operation phase.

MITIGATION MEASURES

(i) Contamination of Soil from Fuel and Lubricants

Construction Stage

At the various construction sites, the vehicles and equipment will be maintained and refuelled in such a fashion that lubricating oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refuelling sites are kept away from drainage channels and important water bodies. At the wash down and refuelling areas, "Oil Water Separators" shall be provided. All spills and petroleum products shall be disposed off in accordance to the ASPCB Guidelines. Fuel storage and refuelling areas will be located at least 500 m from all water bodies along the alignment of project road.

In all fuel storage and refuelling areas located on agricultural lands or productive lands, the topsoil preservation shall be carried out.

Operation Stage

Probability of contamination of soil being only from the road runoff, which is directed into nearest water bodies through well-designed drains, no impact on the soil during operation stage except in case of accidents, is anticipated. Accidental spillage will be handled as per established emergency procedure. This emergency procedure will be developed by the concessionaire once project road is opened for vehicular traffic. Provisions of oil and grease separator pits will be made at the outfall point of the side drains at the water bodies especially near water crossings and location of other minor bridges. Waste oil thus collected will be disposed off as per Hazardous Waste Management and Handling Rules, 2000.

(ii) Contamination of Soil from Construction Wastes and Quarry Materials

Construction Stage

It will be required that earth works are carried out strictly in accordance to the design drawings. Unsuitable earth, if required, will be dumped in approved areas. The spoils will be used to reclaim borrow pits and quarries, low-lying areas in barren lands and in settlements along the project corridors. All spoils will be disposed off and the site will be fully cleaned before handing over. The construction waste will be dumped in selected pits, developed on infertile land. Non-bituminous wastes from construction activities will be dumped in borrow pits and covered with a layer of the conserved topsoil. Bituminous wastes will be disposed off in approved dumping site.

Operation Stage

In operation stage no mitigation measures are warranted as no impacts have been identified.

4.1.8 Loss of Productive Soil

IMPACTS

Design stage

Loss of productive is very unlikely during design stage in this proposed project.

Pre-construction stage

Loss of productive soil, although during the construction stage only, is envisaged at locations of workers' camps, stockyards, storage godowns, etc. if these are located on fertile areas.

Construction stage

Loss of productive soil of Right of way will take place at stretches of project road falling in realignments and Bypasses. The loss of productive soil will be significant near new proposed alignment 41+250 to 54+230.

Operation Stage

No Impacts are anticipated in operation phase.

MITIGATION MEASURES

Design Stage

To the extent possible alignment has been selected to minimise acquisition of productive agricultural land. In the selection of borrow areas for the project, productive agricultural areas have been avoided for borrowing of materials unless and until unavoidable.

Traffic detours, temporary diversions required during construction will be finalized so as to avoid or minimise temporary acquisition of productive agricultural lands.

Pre Construction Stage

The worker camps and construction camps will be sited on unproductive land only unless unavoidable. Topsoil in case of productive land will be stripped to a depth of 150mm and stored as per IRC:10-1961 guidelines. After completion of work these areas shall be restored.

Construction Stage

At location of alignment in agriculture areas, at construction camps, borrow areas in productive lands and all areas to be permanently covered, the top soil will be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2m. The stockpiling will be done in slopes of 2:1, to reduce surface runoff and enhance percolation through the mass of stored soil. The locations of top soil storage will be identified by the Independent Engineer/Supervision Consultant.

The stored topsoil will be spread back to maintain the physiochemical and biological activity of the soil. The stored topsoil will be utilized for:

- Covering all disturbed areas including for the redevelopment of borrow areas;
- Top dressing of the embankments and fill slopes;
- Filling up of tree pits, proposed as part of compensatory afforestation; and
- Filling up of the median for shrub plantation

- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to RoW / Construction Camps.

4.1.9 Borrow Pits

IMPACTS

The significant quantity of earthworks for project road like Soil, Coarse Aggregates and Sand will be required. It has been estimated that the volume of earth available is sufficient for the earthworks.

Construction Stage

Cartage of the borrow materials to the construction sites is of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protections measures will be worked out for the minimising of such impacts during the haulage of borrow materials. Rehabilitation of borrow areas from which earth has been excavated, is a potential problem which needs to be addressed. In addition to visual blight, safety issues shall also be considered. Opening of Borrow Areas may result in loss of productive soil. Moreover, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards to prevent which redevelopment of borrow areas need to be worked out. Additionally, they can also act as breeding ground for vectors like mosquitoes just after monsoon.

MITIGATION MEASURES

Design Stage

For borrowing of earth for the project, several borrow area locations need to be identified and recommended during project execution.

Following precaution will be taken to restrict unauthorised borrowing by the contractors

- No borrow area shall be opened without permission of the Independent Engineer/Supervision Consultant. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Engineer that there is no suitable uncultivable land in the vicinity for borrowing, or there are private land owners willing to allow borrowing on their fields. It will be ensured by the contractor that, there will be no loss of productive soil and the requisite environmental considerations are met with.
- Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEFCC, MoRTH and as specified in IRC: 10-1961.
- Redevelopment of the identified borrows areas worked out, as part of the project preparation will be implemented to mitigate the impacts.

Construction Stage

To mitigate the adverse impact during excavation of borrow pits, following mitigation measures should be taken:

Indian Road Congress (IRC): 10-1961 guideline should be followed for excavation of earth from borrows areas.

Borrow areas should be excavated as per the intended end use by the owner. In some cases the owners of land want to develop the area in to pond for rearing fishes. The following criteria have been used for selection of borrow pits and amount that can be borrowed. They are as follows:

- **Non-Cultivable Lands**: -Borrow areas should not be located on cultivable lands. However, if it becomes necessary to borrow earth from temporarily acquired cultivated lands, their depth should not exceed 1.0 m of existing ground level. Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical to 4 horizontal. The topsoil to a depth of 15 cm shall be stripped and set aside. Thereafter, soil may be dug out to a further depth not exceeding 30 cm and used in forming the embankment.

- **Public or Private agricultural lands**:-Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, topsoil shall be preserved in stockpiles. A 150mm layer of the top soil shall be stripped off from the area designated for borrowing and it shall be stored in stock piles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.

- **Borrow pits on the riverside**:- The borrow pit shall be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood. Precautionary measures like the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills likely to result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day time only. The unpaved surfaces used for the haulage of borrow materials will be maintained properly.

Other mitigation measures:-

- Borrow pit shall be selected from wasteland at least 500m away from the project road;
- Priority should be given to the borrowing from humps above the general ground level within the road land;
- Priority should be given to the borrowing by excavating/enlarging existing tanks;
- Borrowing should be from land acquired temporarily and located at least 500m away from the road;

- Borrowing should be from mounds resulting from the digging of well and lowering of agricultural fields in vicinity of the road;
- In case of settlements, borrow pit shall not be selected within a distance 800m from towns or villages. If unavoidable, earth excavation shall not exceed 30 cm in depth.
- The haulage distance from site should not be too far.

Aggregate required for road construction should be procured from quarries approved by Assam State Pollution Control Board (ASPCB). Air and noise emissions from quarry should be well within the prescribed limit.

The contractor shall evolve site-specific redevelopment plans for each borrows area location.

4.1.10 Quarries

IMPACTS

The excavation of quarries and borrow pits used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect long-term adverse impacts on the environment. For project road cut operations is not required so it will not generate rock and soil material so it is likely that material from quarry and borrow areas could be needed depending on the appropriateness of the material quality. The impacts of Quarrying operations could be significant at various stages of road construction. Quarrying and crushing could have a critical impact especially on the air quality of the area especially the area downwind to the quarry. The stage wise impacts are as described below.

Pre Construction Stage

The bulk of the materials needed for the construction of the embankments will be procured from the existing quarries. As the quarries are already in operation with the requisite environmental clearances and redevelopment plans, no major impacts, which arise in making new quarries operational, are likely. Necessary environmental mitigation measures recommended by the State Pollution Control Board are being followed at these quarries.

Construction Stage

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being an eyesore, reduces visibility thereby increasing safety concerns. Dust is generated due to procurement and transport of raw materials from quarries and borrows sites to the road construction area. These impacts will persist till the activity ceases. The regions especially downwind to the quarries/borrow areas are more vulnerable to air pollution.

As no new quarry needs to be opened for this project, therefore, no new impacts are likely to arise due to quarrying operations.

MITIGATION MEASURES

Design Stage

As part of the project preparation process, an evaluation of all existing quarries along the corridor shall be carried out and the status in terms of the suitability of the quarry material and their legal status assessed. A recommended list of such operational, licensed quarries shall be provided in appropriate section of engineering DPR.

Construction Stage

It will be ensured that quarries from where material is taken have all valid permits and licenses. The Haul road network is properly maintained.

Operation Stage

No mitigation measures from project end are warranted.

4.1.11 Land Use

IMPACTS

Pre - Construction and Construction Stage

There will be change in landuse for land falling within the RoW of realignment of project road. The predominant landuse of alignments is agriculture land. The requirements of land to be acquired are significant for 45/60 m RoW as at most of the stretches the required ROW is generally not available with PWD and significant part of road alignment is new. The land details shall be provided in separate chapter of Land Acquisition Plan (LAP).

Operation Stage

In operation stage no impact on land use changes in RoW of project road are anticipated. However, there may be induced landuse changes close to RoW near urban areas and realignments.

MITIGATION MEASURES

The alignment has been avoided thoroughly productive agriculture fields as far as possible in order to avoid induced land use changes. No specific mitigation measured needed.

4.1.12 Meteorological Parameters

IMPACTS

The entire alignment of project road is located in a sub-tropical region with marked monsoon effects. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal and the addition of paved surface for road and its structures construction . There will be an increase in daytime temperature around RoW of alignment due to loss of shade trees. This rise in temperature will be localised as project road surroundings are open. The temperature rise phenomenon will be more prominent at locations of cutting of trees in clusters.

This increase in the daytime temperature assumes significance especially to the resident residing near RoW as the entire project stretch experiences mean temperatures as high as 31ºC during summers. Although the impact is significant, long-term and reversible in nature it shall be compensated for by compensatory plantation of trees. It must be noted that the impact is unavoidable. However, it may be pointed out that the project has taken care to minimise tree felling in the RoW by realigning the road to save dense tree plantation stretches.

MITIGATION MEASURES

Avoidance measures, as the minimising of the number of trees to be cut, have been worked out as part of the design finalisation. The project will involve significant cutting of trees in the RoW which is approximately 4202 in proposed road widening and improvement. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the construction of Project Road, the microclimate is likely to be temporarily modified by vegetation removal, and due to construction of paved pavement surface.

Compensatory afforestation in the available space of RoW, planting along the median and turfing of side slopes proposed shall help in restoring the green cover along the project corridor.

4.1.13 Ambient Air Quality

IMPACTS

Air quality along the project corridor will be impacted both during the construction and operation stages. Construction stage impacts will be of short term and have significant negative impacts on the construction workers as well as the settlements adjacent to the road, especially those in the downwind direction. Construction stage impacts will be confined generally to a band of width ranging from 50 to 100m from the edge of the Right of Way. However, it will continue for the construction duration of the project (approx 24 month to 30 month in the case of this proposed project).

During construction phase, there will be two main sources of air emissions i.e. mobile sources and fixed sources. Mobile sources are mostly vehicles involve in construction activities while emissions from fixed sources include diesel generator sets, construction equipment (e.g. compressors) and excavation/grading activities those produce dust emissions.

Certain amount of dust and gaseous emissions will be generated during the construction phase from excavation machine and road construction machines. Pollutants of primary concern include particulate matters. However, suspended dust particles may be coarse and will be settled within a short distance of construction area. Therefore, impact will be temporary and restricted within the closed vicinity of the construction activities along the road only.

Generation of exhaust gases is likely due to movement of heavy machinery for clearance of the RoW for construction. High levels of HC and NOx are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact will be much localized, it can spread downwind depending on the wind speeds. The Environmental

Management Plan will ensure that adequate measures are taken in siting of the plants and to prevent any impact on the health and safety of workers.

Considerable amount of emissions of carbon monoxide (CO), unburned hydrocarbon, sulphur-di-oxide, particulate matters, nitrogen oxides (NOx), etc, will be generated from the hot mix plants. Hot mix plants should be located away from the populated areas and be fitted with the air pollution control equipment.

Below mentioned sections present the impacts due the different project activities.

GENERATION OF DUST

Pre Construction & Construction Stages

Generation of dust is the most likely impact during these stages due to:

- Site clearance and use of heavy vehicles, machinery, etc.;
- Procurement and transport of raw materials and quarries to construction sites; the impacts will mostly be concentrated in the RoW. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.
- As the entire project corridor has a soil type with significant silt content and the construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. Dust is also likely to be generated due to the various construction activities including:
- Stone crushing operations in the crushers;
- Handling and storage of aggregates in the asphalt plants;
- Concrete batching plants; and
- Asphalt mix plants due to mixing of aggregates with bitumen.
- Generation of dust is a critical issue and is likely to have adverse impact on health of workers in quarries, borrow areas and stone crushing units. This is a direct adverse impact, which will last almost throughout the construction period.

In addition to air pollution due to activities mentioned above, there will be dust generation due to transport and material storage at site. This will prevail during early stage of construction period.

Operation Stage

Significant amount of dust generation is unlikely during the operation stage as project road shall be paved and there will be slope turfing.

GENERATION OF EXHAUST EMISSIONS

Pre Construction & Construction Stages

Generation of exhaust gases is very likely during the pre-construction stage due to movement of heavy machinery for clearance of the RoW for construction. This impact is envisaged to be insignificant during the pre-construction stage.

Emissions of SO_2, HC, CO and NOx are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact is much localised, it can spread downwind depending on the wind speeds. The Environmental Management Plan shall ensure that adequate measures are taken especially for health and safety of workers such as providing them with pollution/ nose masks during working hours. Also, the contractor shall ensure that hot mix plants, stockyards, crushers etc. are away from residential areas and residential quarters of all workers. If adequate measures are taken, impacts from generated gases can be considered negligible.

Operation Stage

The impact on air quality will be due to plying of vehicles. Increase in air pollution is also identified as one of the most undesirable impacts of any road development project. The impacts on air quality will, at any given time depend upon traffic volume/rate of vehicular emission within a given stretch and prevailing meteorological conditions. Excess discharge of exhaust gases can occur due to (i) inadequate vehicle maintenance; (ii) use of adulterated fuel in vehicles and/or (iii) poor road conditions. To predict air quality in the vicinity of project road alignment during operation phase air pollution modelling has been carried out to quantify the impacts incorporating all these variables.

MITIGATION MEASURES

Construction Stage

The asphalt plants, crushers and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement.

All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up which includes vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads. Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation. The hot mix plant will be fitted with dust extraction units. It shall be ensured that the dust emissions from the crusher and vibrating screen at the stone quarries do not exceed the emission standards set by Central Pollution Control Board.

To ensure the control of exhaust gas emissions from the various construction activities, the contractor shall take up the following mitigation measures:

An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided in the event of the emissions exceeding the ASPCB norms. Other potential measures include plantation around periphery of the hot-mix plants.

To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a season during the period the plant is in operation.

All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the prevailing standards/norms. A vehicle maintenance schedule prepared by the contractor and approved by the concerned engineer shall be adhered to.

Contractor/concessionaire will take necessary consent to establish and consent to operate from state pollution control board for hot mix plants.

Operation Stage

The maintenance of road surface is a requirement in construction phase to minimise emissions. This maintenance will be taken up by the concessionaire.

4.1.14 Water Resources

IMPACTS

The 2/4 laning of the project road may lead to two types of impacts on the hydrological environment, i.e., surface water and ground water. The project road crosses major water course except few water channels and rivers. These surface water bodies can be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project.

MITIGATION MEASURES

Design Stage

The impacts on surface water bodies have been avoided by suitable design modifications.

Construction stage

The tubewell/ handpump coming in the proposed right of way will be replaced. Required number of cross drainage structures have been planned for maintaining the natural drainage. Labor camps shall be sited at least 1000 m away from the water body.

4.1.15 Drainage

IMPACTS

Impacts of road construction, which lead to alteration of drainage, are generally due to construction of cross drainage at locations of water crossing. Alteration of drainage can lead to soil erosion of adjacent areas, disturb local vegetation. If the period of alteration is long, there are chances of local ecology being impaired. However, as mostly cross drainage works will be done in summers when the water levels are low in the streams, the impacts due to alteration of drainage can be minimized effectively with adequate mitigation measures and pre-planned construction schedules.

The performance of a pavement shall be improved considerably and adequate precautions shall be taken to obviate the accumulation of water on the pavement structure. Water from these drains shall cross the road underneath through culverts at appropriate locations. So that side drains and cross drains are properly integrated. This may also require additional culverts for effective drainage pattern. The proposed numbers of cross drainage structures such as bridges, culverts, major and minor bridges is presented Chapter -2, project description.

Pre Construction Stage

No drainage modification of surface flow of rivers/streams is envisaged during pre-construction period hence no impacts are anticipated.

Construction Stage

Construction along the watercourses will be carried out in the lean flow period. The construction activities will necessitate diversion of the waterways at few locations. During the construction there will be some diversion of waterway. This diversion of flow may significantly harm the aquatic habitat, present, if any. The waterway of cross drainages will be constricted, increasing velocity downstream of the bridge. This will mean increased sediment load with the flow, thereby allowing less sunlight to penetrate into the water and can reduce growth of micro flora. The impact shall be direct but short term in nature and shall last as long as construction continues.

Operation Stage

One of the unavoidable aftermaths of road construction is the increased surface run off. The addition of hard paved shoulders, which essentially increase paved impervious surface, will cause increased surface runoff in the project influence area. It is clear from widening schedule given in Chapter-2, project description, proposed road upgradation is 2/4 lane standard carriageway of 54. 616 km road length is to be widened from existing single/intermediate lanes. Increase in surface run-off is due to the creation of impervious surfaces that prevent the flow/percolation of water into the ground. The increased runoff from the project has been worked out as follows:

Increase in runoff (cu.m) = increase in runoff co-efficient due to construction x annual rainfall in the area (m) x area of the newly constructed surface.

The main carriageway is of BT/CC with single lane configuration with earthen shoulder of 1-2m on both side. The area of existing impervious width is 208180m^2.The entire lengths of project road traverses over loamy soil with runoff coefficient of 0.50 and the black top has a run-off coefficient 0.95. The increase in the runoff co-efficient has been worked out as 0.45, i.e, the difference between the runoff co-efficient of black top surface and alluvial soil has been adopted as increased run-off co-efficient due to the project. The mean of decadal rainfall for the project districts is 2244 mm.

The existing BT width is 3.70 to 6.00 meter, so an average it is considered 5.00 meter.

Total length of project road is 53616 meter.

Total length for 4 laning on existing alignment = 5406 meter.

Total length for 4 laning on new alignment= 12980 meter

Total length for 2 laning with paved shoulder = 35230 meter

The run off of has been calculated and this has been given in **Table 4.1** below.

Table 4:1: Increased Run-off along Project Road

Sl	Description	Total Length (m)	Paved Impervious width (m)	Impervious width (m2)	Increase in impervious width (m2)	Rainfall (m) (Average)	Run-off Coefficient	Increased run-off (m3)
1	Existing Road	40636	5	203180	203180-483306= 280126	2.244	0.45	488042.4
2	Proposed 4-Lane with PS on existing alignment	5406	17 m 17m Proposed -5m ,existing = 11m	59466				
2	New alignment 4 laning with paved shoulder	12980	17	220660				
	2-Lane with PS	40636	10m-5m=5m	203180				

Note – In final design slight variation in length and configuration is likely, however significant change in run-off is unlikely

Impacts due to surface runoff include increased soil erosion and local flooding or water logging. However, drains shall be provided on both sides to take care of surface runoff.

MITIGATION MEASURES

Design Stage

To ensure efficient cross-drainage and to prevent water logging along the sides, adequate size and number of cross-drainage structures have been provided. All cross-drainage structures have been designed to handle a 50-year peak flood level. There will also be provision of rain water harvesting structure to improve the percolation of rain water.

Construction Stage

The contractor will remove obstructions that may cause any temporary flooding of local drainage channels during construction. No spoil or construction materials will be stored outside the proposed RoW or at places obstructing the natural drainage system. During field investigation, the outfall of

proposed drain were also located by the team comprising of environmental expert, social expert and drainage engineer in consultation with the local people. Generally, it is preferred to dispose the proposed drain into a natural stream or nalla flowing through the culvert or bridges.

Based upon the findings of field investigations supplemented with proposed cross drainage structures inventory, it has been decided that following mitigation measures planned for effective drainage.

- An effective surface and subsurface drainage system of pavement structures shall be designed as stipulated in IRC:42 as per site conditions.
- An effective drainage system shall also be designed for the drainage of Wayside Amenities Services Area and other project road features.
- Storm water shall be directed away from the bridge deck by providing kerb & gutter and of the approaches a chute up to the bottom of the embankment and through a system of roadside channel. The drainage & protective work shall be designed to avoid embankment erosion.
- Water courses -these shall have adequate capacity for the design run-off and be located and shaped to avoid creating traffic hazard and erosion of soil.
- Drainage channels and pipe shall be installed at crossings with service pipes and utilities ensuring that conflicts do not occur.
- Drainage of project road on embankment and steep grade will require designed outlet by means of kerb and gutter and concrete chutes / spillways along the side slope of the embankment in order to prevents its erosion.
- Extra culverts shall be proposed to accommodate the drainage requirement along the alignment.
- Drainage arrangements shall be provided in respect of site conditions in the form of drainage layer and sub-surface drains in the full width of formation or below the shoulder so as to keep the pavement well drained at locations where these are required.
- Good engineering and construction practiced should be followed.

In sections along watercourses, and locations close to cross-drainage channels, the contractor will ensure that earth; stone or any other construction material shall be disposed off immediately at the designated landfill site so as to avoid blocking the flow of water along those channels. Silt fencing shall be provided at construction sites in proximity of water bodies.

All necessary precautions will be taken to construct temporary or permanent devices to prevent inundation. Temporary drains for collection and disposal of runoff into natural drainage system will be constructed. The contractors will take all the necessary measures to prevent temporary or permanent flooding of the work site or any adjacent area.

MITIGATION MEASURES FOR BRIDGE/CULVERT CONSTRUCTION SITES

There will be new construction, reconstruction and Widening, repair & Strengthening of bridges and culvert at different location of project road. The mitigatory measures to be adopted during construction are as follows:

- Construction will be carried out during lean flow period as far as possible;
- All slopes will be stone or brick pitched as per design recommendations;
- Silt fencing will be provided at base of embankment of entire water body;
- Siltation of soil into water bodies will be prevented;
- All solid waste/ construction material will be properly disposed off from bridge sites;
- Contractor will ensure that construction material/ solid wastes are not disposed off in water body;
- No oil or lubricant will be discharged from construction yard or machinery into water body; and
- The Construction materials will be stored at a minimum distance of 500m from the water body.

Operation Stage

To maintain an efficient storm water flow, all drains will be regularly cleaned as part of regular maintenance.

4.1.16 Loss of Water bodies / Groundwater sources

IMPACTS

The alignment of proposed project road is not passing through the significant water resource rich area.

Few groundwater sources-wells and hand pumps are located within the RoW of the proposed alignment of the project. The loss of these supplies of relatively pristine water would be a direct negative impact. However, the project envisages replacement of each source of water supply before removing the existing one. It is also envisaged that the affected population will provide its inputs on where to locate the new source. Therefore, the eventual impact of the proposed project may only be marginal.

MITIGATION MEASURES

Design Stage

Conservation / Avoidance of water supply sources such as tube wells, hand pumps, wells etc. have been worked out in the design of the alignment. However, at several locations, the impacting of these community resources has been unavoidable. Any source of community water (potable or otherwise), such as wells, hand pumps, and bore wells lost will be replaced immediately.

Pre- Construction Stage

The relocation of these water supply sources, both private and community sources, shall be completed prior to the commencement of the construction by the contractor, in accordance to the utility and community assets relocation plan prepared for the project. To prevent any stress on the local water sources due to the relocation, the process of dismantling shall commence only after the provision of the water supply source at the relocation site is agreed upon by the community. During construction stage ground water withdrawal will be taken up after the permission from Central Ground Water Board/Irrigation Department.

Operation Stage

During operation stage no impact on ground water resources is anticipated.

4.1.17 Increased Sediment and Degradation of Surface Water Quality

IMPACTS

Pre-construction and Construction Stage

The degradation of water quality can occur during construction stage from increased sediment load into watercourses near the construction site. This may be aggravated by removal of trees and consequent increase in soil erosion. Few water channels that cross the project road are unlikely to be subjected to such run-off discharges because they have properly raised berms on their banks.

Increased load of fine sediment will make the water more turbid. If the concentrations are exceptionally high (>185 mg/l), smaller fish can be harmed, however presence of fish in water bodies along the project road is rare. Heavier sediment may smother the algae growing in the lower strata and would completely alter the substratum of the watercourse. Excessive sediment loads may also mean disruption to areas where fish lay their eggs.

Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of worker's camps and from spillage in vehicle parking and/or fuel and lubricant storage areas.

Operation Phase

During the operation phase, there is little chance of degradation of water quality during normal operations. The implications of accidental discharge are potentially disastrous. But, it must be emphasised that the probability of such an accident is quite low, indeed one of the objectives of the design is the enhancement of road safety.

MITIGATION MEASURES

Construction Stage

To avoid contamination of the various surface water bodies and drainage channels in the vicinity of the construction site, construction work close to the streams/drains or other water bodies like community ponds will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per prevailing Assam State Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to the approved disposal sites. The vehicles and equipment will be properly maintained and refuelled on designated place on impermeable surface, so as to avoid contamination of the water bodies and drainage channels from fuel and lubricants. The slopes of embankment leading to water bodies will be modified and rechannelised so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations, to prevent contamination of water.

The sewage system for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse.

Operation Stage

Proper maintenance of the protection measures near the water sources would be ensured by the project proponents.

4.1.18 Flood Hazards

IMPACTS

The extent of impact due to flooding varies from some localised damage to the diverse damage to properties and mankind. Adequately sized drains to accommodate the increased discharge are a part of good engineering practice. The linear water way of major/minor bridges and other cross drainage structure has been kept appropriate width.

MITIGATION MEASURES

Design Stage

Project road pavement has been designed more than 1 m above HFL to avoid flooding of project road.

Construction Stage

During construction embankment will be protected through regular maintenance. Any damage due to rains will be repaired immediately. There will be proper drainage system at toe embankment so that excess water is immediately conveyed to nearest water body.

Operation Stage

In operation phase the turfing and protection measures will stabilize the embankment in first 2-3 years. In the initial two years proper maintenance will be carried out for any damage.

4.1.19 Surface Water Hydrology

IMPACTS

Pre - Construction and Construction Stage

During pre construction and construction stage there will be construction of embankment. This construction of embankment may change surface water hydrology if embankment is in the flood zone or near the water way. The water way will be constricted resulting in the increased velocity of stream. Hydrological impacts will be felt at bridge construction sites also if proper water way width is not maintained.

Operation Stage

No impact has been identified in operation stage.

MITIGATION

However, there is 1 major bridge and 11 minor bridges and 55 culverts in existing/proposed project road, the project road width with adequate water way will be maintained. The adequacy of waterway width has been decided by bridge design team based on hydrological model.

4.1.20 Ground Water Hydrology

IMPACTS

Pre Construction and Construction Stage

The impacts on ground water hydrology due to road construction will be in RoW on account of compaction and raising of embankment. The embankment may act as a barrier for ground water movement from either side of project road. These impacts will be felt immediately after construction and these will be irreversible in nature.

MITIGATION

The project plans adequate cross drainage structures and construction of rain water harvesting structures. These structures will help in adequate ground water recharge and collection of rain water for recharge. Localised ground water hydrological impacts will be minimized due to these mitigation measures.

4.1.21 Noise

IMPACTS

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion and smoothness of road surface (IRC: 104-1988).

The baseline noise levels monitored at various locations along the Project Road alignment indicate the baseline levels are well will within in the stipulated limits of CPCB for the respective land uses of monitoring locations. The noise is a matter of concern as during construction and operation phases there will be generation of significant noise.

It is evident from the Noise quality modelling (3.1.14, CHAPTER 3,) that the noise levels exceed the CPCB standards for the respective category of the receptor site at all the locations for 100m distance. Except for Receptor sites 3 and 4, which are commercial zones, at all the other locations noise levels will be within the limit at 500 and 1000 meter from the road during construction phase

The impacts on noise due to the project will be of significance in both the construction as well as the operation stages.

Some salient features related to potential noise impact of road development include:

- The road noise impact is greatest where road passes though populated areas,
- The range of noise level should be understood in relation to the habitation type also, for example, road noise in industrial areas is not likely to be problematic but at sensitive location like hospital, schools, worship place, its impact may be significant.

Pre-Construction stage

Noise levels during the pre construction stage are mostly expected to be indicative of prevalent baseline levels apart from localised noise levels at locations where pre construction stage activities are taking place such as establishment of workers camps, stockyards, and site clearing. These increased noise levels will prevail only for a short duration during the pre construction stage. Moreover, as these activities are not likely to be placed near settlement the increased noise impact is bound to be negligible.

Construction Stage

Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project corridor. The construction activities will include the excavation for foundations and grading of the site and the construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during construction stage. The typical noise levels associated with the various construction activities and the various construction equipments are presented in **Table 4.2**.

Table 4:2: Typical Noise Levels of Principal Construction Equipment

CLEARING		STRUCTURE CONSTRUCTION	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
EXCAVATION & EARTH MOVING		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
GRADING AND COMPACTING		LANDSCAPING AND CLEAN-UP	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
PAVING		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

Source: U.S. Environmental Protection Agency. Noise from Construction Equipment and Operations. Building Equipment and Home Appliances. NJID. 300.1. December 31. 1971

Though the noise levels presented for the various construction activities far exceed the permissible standards, it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment. Proper mitigation measures as to regulate the timings of construction, employing noise protection measures etc. need to be worked out.

MITIGATION MEASURES

Design Stage

In order to avoid noise and air impacts most of the habitations have been bypassed. There are few noise sensitive receptors near RoW and in the immediate vicinity.

As the noise sensitive receptor is noticed in the immediate vicinity of RoW, the project design will have provision for noise barriers in the form of wall.

Construction Stage

The plants and equipment used for construction will strictly conform to CPCB noise standards. Vehicles and equipment used shall be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers shall be checked and if found to be defective

shall be replaced. The noise level from any item of plants and machinery (measured at one metre from the edge of the equipment in free field) such as compactors, rollers, front end loaders, concrete mixers, cranes, vibrators and saws shall not exceed 75 dB (A), as specified in the Environmental Protection Rules, 1986.

It is evident from Noise prediction model (refer chapter 3) that the noise levels exceed the CPCB standards for the respective category of the receptor site at all the locations for 100m distance. Except for Receptor sites 3 (Oxiguri , semi-commercial) and 4 (Ujanpetla , Residential + commercial Area), which are commercial zones, at all the other locations noise levels will be within the limit at 500 and 1000 meter from the road during construction phase.

Site Controls: Stationary equipment will be placed along un-inhabited stretches as per distance requirements computed above as far as practicable to minimize objectionable noise impacts.

Scheduling of Project Activities: Operations will be scheduled to coincide with period when people would least likely to be affected. Construction activities will be strictly prohibited between 8 P.M. and 8 A.M. near residential areas. Special attention will be given near sensitive area like schools, religious places etc.

To protect construction workers from severe noise impacts, noise standards of industrial enterprises will be strictly enforced at construction site and construction camps and workers shall be provided with Personal Protective Equipment (PPE) such as ear plugs and muffs.

Operation Stage

During the operation phase, noise will be generated through the vehicles movement. Noise levels will depend up on traffic density, number of traffic events. Plantation along the road and improved road conditions will be helpful in reduction on noise levels during operation phase.

It is evident from (Noise prediction model, refer Chapter -3) , there will be increase in the noise levels due to enhanced traffic density as well as average speed of vehicles. It is pertinent to mention that in section 2, the noise level estimation is relatively lower than section 1(Shrirampur) and 3 (Oxiguri , semi-commercial) . The relative low noise level is may be due to its locality was away from any major commercial or industrial activities. A very thin settlement around the receptor location leads to low traffic density and hence low noise. At the both the sections (1 and 3) because of its proximity to highway, its pollution level will increase. Although high building density acts as a filter for traffic noise to distant areas, because of rural and agricultural settings the building density and height is relatively low at present which may increase with the developmental activity after road construction that will lead to the decrease in effective noise level at distant areas. It is also evident from the table that the estimated noise levels in all the three sections at different receptor locations are found to be within the prescribed limit of CPCB as far as traffic originated noise level was concerned.

To mitigate the impact of noise levels during operation phase, following mitigation measure are anticipated:

- It is suggested that roughness of project road should be as per IRC:SP:16-2004. As per IRC guidelines roughness <2000 mm/km is considered good for bituminous concrete surface.
- Bottle-necks should be avoided for smooth flow of traffic.
- Road should be designed in such a manner that no traffic congestion in the populated area along the road.
- Developing trees barriers between the road and sensitive area, wherever it is possible.
- Noise measurements should be carried out along the road to ensure the effectiveness of mitigation measures

The plantation grown will also act as a noise barrier. Predicted noise levels indicate that beyond 500m distance no impact of project road vehicular noise will be felt.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Flora and Fauna

IMPACTS

The major impact in this project on flora involves the removal of trees to permit construction and to provide clear zone for safety of the road users. **Table4.3** below presents the major adverse impacts on the flora & fauna and the indicators chosen to assess the impacts for this study.

Table 4:3: Impacts on flora & fauna due to Construction Activities

Impacts Due To Construction	Indicators
Tree felling	No. of trees to be fell
Vegetation	Area of vegetation loss
Cattle Grazing Ground	Area and location of grazing ground.

4.2.2 Forest Area

The proposed project stretch does not pass through any forest area. Hence there will not be any direct or indirect impact on status of forest.

Pre Construction Stage

The project has a significant, direct and long-term impact on the trees within the RoW. The cutting of trees shall have manifold impact. Most visible impact is the loss of shade. Also, there is a possibility of the local people being deprived of tree products, such as wood, fruits, leaves, etc. The numbers of trees to be cut have been given in **Table 4.4** below:

Table 4:4: Summary of Trees within RoW

	Girth Size (mm)				
	0 to 300	300 to 600	600 to 900	900 & above	Total
LHS					**2404**
RHS					**1798**
Total					**4202**

The micro-ecosystems supported by the trees are also a point of environmental concern. The removal of road side trees will not only lead to erosion, and depletion of the ground water table, but also to the loss of the micro-ecosystems developed in the project area. Since most of trees to be removed are in fertile agriculture fields, therefore these are productive either due to fruit bearing or due to timber usage.

Construction Stage

During the design and construction of the project road, vegetation in the form of trees, shrubs and grasses will be cleared. Matured trees are growing along the road, which will need to clear for 2 laning of the project road.

During construction stage 4202 numbers of trees will be removed from the RoW. The compensatory plantation and plantation in median (in 4 lane section) will also take place at the end of construction period.

Operation Stage

During operation stage there will be positive impact on flora as compensatory plantation in RoW will grow and turfing on side slopes will also mature.

MITIGATION MEASURES

Design Stage

The loss of trees will be compensated in accordance to the principles laid out in the Forest (Conservation) Act, 1980. Typical landscape plans have been prepared for the project road based on geographic, climatic and soil conditions. Compensatory plantation in the ratio of 1:2 (minimum, depends of forest clearance conditions) will be planned.

Construction Stage

No trees out of RoW will be felled. The trees to be felled will be marked inside the RoW. Construction vehicles, machinery and equipment will move or be stationed in the designated area only to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will

be ensured that the trampling of soil and damage to naturally occurring (RoW or Construction Camp) herbs and grasses will be avoided

4.2.3 Fauna

IMPACTS

No potential impact on fauna is envisaged due to widening of project road as per this is not near to any of the area rich in wildlife.

MITIGATION MEASURES

Construction Stage

All construction activities will be carried out in such a fashion that damage and disruption to fauna will be minimum. The construction workers will be given instructions to conserve/protect natural resources and fauna, including wild animals and aquatics lives.

Operation Stage

Although no impacts on fauna in operation stage are anticipated directly due to the project, certain measures shall be taken. In the operation phase a positive impact on fauna is anticipated due to enhanced tree cover in the RoW. The enhanced tree cover will provide a good nesting ground for the avi-fauna.

4.2.4 Aquatic Ecology

IMPACTS

The impacts on aquatic ecology will be mainly at/near Brahmaputra River (River Sonkosh tributary of Brahmaputra) & Gangadhar River crossings/flow along the road.

Pre Construction and Construction Stage

The impacts in pre construction and construction stage will be during project activity near water crossings for laying well foundations. This will require diversion of water way and many a times constricted flow. This constricted flow will cause turbidity in the downstream and aquatic fauna present will have adverse impact. These impacts will last up to construction phase.

Operation Stage

During operation stage no impacts are anticipated as bridge design provides adequate water way width.

MITIGATION MEASURES

Pre Construction and Construction Stage

The bridge designs have been finalised after hydrological study. This will ensure adequate water way width.

The construction near/along proposed Brahmaputra River (River Sonkosh tributary of Brahmaputra) & Gangadhar River bridge site will be taken up during lean flow period to minimise the impacts. No construction material will be stored within 100m water crossings. All construction wastes will be disposed off at the end of construction period.

Operation Stage

As no impacts have been identified, no mitigation measures are required.

4.3 HUMAN USE VALUES

4.3.1 Land Acquisition

The land acquisition is planned for widening and realignments. The project road requiring additional land for 2/4 lanes is being analyzed and details will be incorporated land acquisition plan (LAP).

4.3.2 Loss of Private Properties

Loss of private properties in the form residential commercial, and residential cum commercial is minimal as alignment has been finalised away from the habitations. However there may be loss of some properties. These are being counted as part of land acquisition plans.

4.3.3 Common Properties Resources

Common property resources such as schools, hand pumps, wells, Tube wells, religious structures etc falling in RoW of project road has been summarised in **Table 4.5** below:

Table 4:5: Common Properties Resources Falling in the RoW

SR.NO	CPR NAME	LEFT	RIGHT	TOTAL
1.	Hand Pump	02	01	03
2.	Wells	00	00	00
3.	Ponds	00	00	00
4.	Religious Structure	19	11	30
5.	Schools	08	06	14
6.	Hospital	01	02	03
7.	Gov. Buildings	15	16	31
8.	Other	01	02	03
	GRAND TOTAL	**46**	**38**	**84**

Change in land use

The development due to the Project will induce a change in the land use along the alignment. Change in land use will be sparked off as a result of land speculation. The road, which is flanked by agricultural fields, is vulnerable to land-use succession. There will be industrialisation/ commercialization in the immediate vicinity and this will also change land use. The availability of labour and easy access to markets in the urban areas will make roadside areas quite an incentive for the industrialist.

Reduced transportation costs and availability of high-speed transportation facilities for raw materials and products will be the most important advantage of the project. The uncontrolled industrialisation may lead to pollution to the environment. After development of project there will be major transformation in landuse in project influence area. This will improve economic conditions of people.

Land Speculation

Better connectivity will also mean that the value of roadside properties will rise almost overnight. The lure of business from road users is usually the main magnet.

4.3.4 Cropping Pattern and Crop Productivity

The proposed project is likely to bring in its wake, industrialisation and change in land use. This translates into change of land currently under agriculture to more commercial use. It is envisaged that due to this proposed change, the crop productivity in the agricultural belt immediately adjoining the RoW shall decrease. This impact is envisaged only to be valid for the agricultural land immediate to the RoW. Although the spatial impact is likely to be insignificant, the impact will be irreversible in nature. Cropping pattern after development of road will change as farmers may switch over to cash crops as there will availability of fast transport system to urban areas.

Exploitation of Resource base

Development of a road in areas previously not easily accessible can work like a double-edged sword for the environmental resources in the area. While the road would unlock potential value in the area, stimulate growth and make the environment hospitable, at the same time, the rapid depletion of natural resources is also possible.

Development of such vital infrastructure will lead to over exploitation of the environmental resources (e.g. too much groundwater withdrawal, indiscriminate wastewater disposal, from industrial areas etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

4.3.5 Consumption of Natural Resources

The proposed works for 2/4 lanning envisage the use of significant quantities of the earth, stone and grit and sand along with bitumen. The details will be in section of final engineering DPR.

4.3.6 Safety

IMPACTS

The concern for safety stems from the proposals for faster vehicular movement along the project road. Though speedy travel is one of the objectives of the project, it also increases the intensity of loss of life in case of an accident.

MITIGATION MEASURES

Design Stage

Safety of road users as well as of the vehicles plying on the project road is given highest importance and adequate measures have been incorporated in the design of the alignment. The design incorporates adequate numbers of pedestrian and vehicular crossing to facilitate crossing of the project road by the locals. Concrete crash barriers and / or metal beam guardrails shall be installed at the main carriageway.

Construction Stage

Construction activities cause hindrance to traffic movement and are also hazardous for the traffic. However, since most of the project road alignment is new, traffic management will be required on existing alignment only. Traffic management plans shall be prepared and temporary diversion routes will be identified to divert traffic from construction locations. Signboards indicating construction sites on the road and flags shall be erected. All the signboards giving caution, barricades for diverting the traffic shall be as per MoRTH specifications (IRC:35, IRC:67, IRC:79,IRC:99,IRC:SP:88)

Operation Stage

All safety measures put up at time of construction will be maintained properly. There will be special attention to signages.

4.3.7 Archaeological Monuments

IMPACTS

There are no archaeologically protected monuments falling within the RoW of project. Hence no impact is anticipated.

MITIGATION MEASURES

Since no impacts are identified, therefore, no mitigation measures are required.

4.3.8 Accidents involving hazardous materials

IMPACTS

The storage of the inflammable material may result in accidents.

MITIGATION MEASURES

Pre Construction and Construction Stage

During pre construction and construction stage the storage of hazardous materials will be permitted only after obtaining permissions/ license from Deputy Chief Controller of Explosives, Guwahati. However, this will not required as per project design.

Operation Stage

Accidents involving hazardous chemicals will generally be catastrophic to the environment, though the probability of occurrence is low. Prevention of an accident involving hazardous material is a better way of minimising the impacts. The provisions mandated by 'The Hazardous Wastes (Management and Handling) rules, 1989' and "Manufacture Storage and import of Hazardous Chemicals Rules" 1989 under the Environmental (Protection) Act, 1986 will be complied with. Vehicles delivering hazardous substances will be printed with appropriate warning signs.

In case of spillage, the report to relevant departments will be made and instructions will be followed in taking up the contingency measures immediately.

4.3.9 Cultural/Religious Properties

IMPACTS

Other cultural properties include temples, grave yard, Mazars and mosques. Few religious structures are being impacted as these fall within/close to the RoW. List of these religious structures including other CPR has been presented in previous chapter/section.

Loss/ Disruption of Access/ Cultural Properties

Pre Construction

One of the impacts of project road construction is interrupted access to the cultural properties on either side of RoW. There are chances that users of the cultural property may face difficulty in accessing the property during the period of pre- construction.

Construction Stage

Loss of Access is likely to be severed during the construction period, due to movement of construction machinery, construction and labour camps or setting up of borrow areas, setting up of service stations etc.

Operation Stage

During operation phase access to cultural properties will be minimal as vehicular and pedestrian under passes planned in the project will provide access to other cultural properties on either side of project road.

MITIGATION MEASURES

Design Stage

Alignment has been worked out to minimise impacts on cultural/religious properties along the corridor. All religious structures will be relocated first. This will be done in consultation with locals.

Construction Stage

All necessary and adequate care will be taken to minimize impacts on cultural properties close to RoW which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, graveyards, and any other important structures as identified during design.

The contractor shall ensure that no construction activities will spill over to these property's premises and precincts.

Access to cultural properties on either side of RoW such properties from the road shall be maintained clear and clean.

4.3.10 Project Displaced Population

Land acquisition will have impact on socio-economic conditions of project affected persons. The project affected persons have been identified for land acquisition the details has been provided in SIA, R&R Plan and Land Acquisition Plan.

Impact due to Construction of Embankment

The other major social impact identified due to project is loss of access to agricultural fields and habitations on either side of the alignment. In many instances there will be defragmentation of agricultural fields of the same landowner. This problem will be faced in bypasses and realignments. This will cause inconvenience to the locals.

Positive Social Impacts

The positive social impact due to project will be faster connectivity to major urban centres of the country, generation of huge employment during construction, and fast economic development in the post construction phase. There will be availability of improved infrastructure facilities. Overall life quality of public will improve in post construction phase.

MITIGATION MEASURES

The compensation to project affected persons will be paid as per Rehabilitation and Resettlement policy of State and prevailing Land Acquisition Act 2013. To facilitate access to agriculture fields on either side of project road pedestrian crossing have been planned.

4.3.11 Other Impacts on Social Environment

Construction and operation phases of the project road will have some beneficial impact on social environment. Significant increase in employment opportunity for local people is expected as local unskilled, semiskilled and skilled persons will gain direct or indirect employment during construction phase. Since the immigration of work force during construction phase is likely to be

very small, the social impacts on literacy, health care, transport facilities and cultural aspect are expected to be insignificant.

The impacts of the construction and operation of project road on the socio-economic environment are systematically discussed under the following categories:

- Influx of construction workers
- Economic impacts
- Acquisition of land and structures
- Relocation of community structures within the proposed ROW

The socio-economic impact is expected to be overwhelmingly beneficial. However, project road will require the relocation of few structures that are close to the alignment of project road.

4.3.12 Influx of Construction Workers

Construction stage

Although the construction contractors are likely to use unskilled labour drawn from local communities, use of specialized road building equipment will require trained personnel not likely to be found locally. Sudden and relatively short-lived influxes of construction workers to communities along the project will have the potential to 'skew' certain demographic variables and the traditional social coherence.

It is anticipated that the construction labour inputs for the construction of the project road will be in the order of about 300-400 persons per day. However, this number will fluctuate and the number in any particular activities will be lower.

The construction workforce will be made up of the following groups:

- Supervision, specialist and administrative personnel, normally about 5 per cent of the workforce - the contractor would probably arrange local accommodation using hotels, boarding houses or rented houses.
- Skilled workers, normally about 30 per cent of the workforce - the contractor will probably establish a construction camp for the skilled workers.
- Unskilled workers, normally about 65 per cent of the workforce - contractors normally recruit these workers locally and do not need to provide accommodation.
- The contract documents will require the contractor to obtain all necessary approvals before building a construction camp.

4.3.13 Economic Impacts

Construction Stage

The relatively short-lived economic impacts of the construction phase are likely to be experienced in local communities for the duration of construction as workers will make everyday purchases from local traders. This is likely to give a short-lived stimulus to these traders that will disappear as soon as the construction is complete. Wider, flow-on economic impacts will be experienced in other sectors of economy as a result of purchase of construction materials and the payment of wages and salaries.

Operation Stage

Once the widening and strengthening is complete, there is likely to be some long-term changes in the economic structures of the areas served by the project road.

CHAPTER-5

(ANALYSIS OF ALTERNATIVES)

5 ANALYSIS OF ALTERNATIVES

The consideration of alternatives of 2/4 laning of highway is one of the more proactive sides of environmental assessment - enhancing the project design through examining options instead of only focusing on the more defensive task of reducing adverse impacts of a single design. This calls for the systematic comparison of feasible alternatives for the proposed project site, technology and operational alternatives. Alternatives are compared in terms of their potential environmental impacts, capital and recurrent costs, suitability under local conditions and institutional, training and monitoring requirements.

Examining alternative means of carrying out a project involves answering the following three questions:

- What are the alternatives?
- What are the environmental impacts associated with each alternative? And
- What is the rationale for selecting the preferred alternative?

This chapter discusses the analysis of alternatives that have been considered for the road widening of Srirampur-Dhubri Road Section of NH-127B. It also includes a discussion on the "With" and "Without" project scenario. The methodology that has been adopted for the evaluation of the alternate alignment route for construction of Project Road and the selection based on engineering, economic, environmental and social considerations have been highlighted. The minimisation of environmental impacts by considering design alternatives determines the extent of mainstreaming of the environmental component. An evaluation of the various alignment options has been evaluated for arriving at the most promising alignment. This chapter looks at the decisions made during the project when alternatives were available and describes the rationale behind each decision. The EIA study with EMP and without EMP has also been discussed in the context of project road.

5.1 "WITH" AND "WITHOUT" PROJECT SCENARIO

In the state of Assam, the total freight transport output is likely to be doubled every 7 to 10 years and the passenger transport is also likely to be doubled every in 7 to 10 years. The 'With' and 'without' project scenarios are analysed with this backdrop of requirement of reliable quality infrastructure for sustained growth of state's economy and consequent well-being of its citizens.

The project will have multiple benefits. The project will unlock the potential of development of the area and fast connectivity. This project will also reduce the travel time substantially and it is expected that the journey from Srirampur in 30-40 minutes. The present journey time is more than 2-3 hours. In addition this project road will provide further other benefits like:

- Fast and safe connectivity resulting in saving in fuel, travel time and Total Transportation Cost to the Society;
- Employment opportunities to people;
- Development of local industry, agriculture and handicrafts;
- Transporting, processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening of opportunities for new occupations;
- Better approach to Medical & Educational services and quick transportation of Perishable goods like fruits , Vegetables and Dairy products; and
- Improved quality of life for people and so on

Providing better connectivity will ensure that goods and people from areas covered by the road can move in and out of the areas quicker and save time. Increased trade and commerce activity are expected. Accounting just for the savings in the Vehicle Operating Costs makes the project viable. However, there would be an increase in the vehicular pollution-air and noise, in the vicinity of the highway. Some agricultural land will have to be diverted for road use to widen and realignments planned. This construction will result in loss of private properties and loss of living.

If the project is not implemented, there is likelihood that the roads presently carrying the traffic between Srirampur-Dhubri Road will deteriorate further and rampant traffic disruptions will hinder the free flow of the traffic. In the absence of the project, the road agencies responsible for construction and maintenance of NH-127B will also find it extremely difficult to generate funds for such a massive improvement of the road infrastructure from their own resources. Increased air pollution, due to slow moving traffic and congestion, will follow suit. Noise levels in built up portions will rise due to deterioration of the pavement as well as increased honking.

Therefore, "With" project scenario, with its minor adverse impacts is more acceptable than the "Without" project scenario which would mean an aggravation of the existing problems. The potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is clear that the implementation of the project will be a definite advantage to State of Assam in order to achieve all-round development of its economy and progress of its people.

5.2 ROUTE ALTERNATIVES

The area of the proposed project road section was studied extensively. The project route consists of sparsely built-up and open portions keeping in view avoiding significant land acquisition and present and projected traffic growth bypasses and realignments have been proposed. Various alternative alignments were considered for the finalization of various bypasses and the most

suitable option were finalised based on less damaging to existing built-up structures, deviation from settlement areas etc. The details are presented in below section.

5.3 Alternative Alignment Option Study for NH-127B

Alternative alignment study has been done by DPR consultants at various locations of the project corridor to finalize the preferred alignment.

5.4

5.5 DESIGN, SAFETY & OTHER CRITERIA REQUIRED FOR COMPARING ALTERNATIVE ALIGNMENT OPTIONS

The criteria for selecting the preferred Alignment based on alternative alignment study are:

- **Design Speed:** The proposed alignment should maintain design speed between 80-100 kmph.
- **Riding Comfort:** The proposed alignment is such that passengers of the vehicle feel comfort while traveling through the proposed Road.
- **Land Acquisition**: Minimum land to be acquired. Try to acquire Govt. land as much as possible and minimum acquisition of existing structures has been used for fixation of proposed alignment.
- **Social Impact & Severance:** The proposed alignment has minimized effect upon the existing structures which minimizes the R&R impact of that locality.
- **Cost Effectiveness:** The Project cost consisting of Civil construction Cost, LA & R&R Utility Shifting cost of the proposed alignment has been kept minimal.
- **Safety:** The proposed alignment has been prepared in such a way that it requires minimum safety hazards along its entire length.

Alternative Alignment Option Study for Bypass in between existing km 20.700 to km 23.450 (Near Madhya Petla Village)

Legend

Options	Symble	Node	Length
Option-1		**A – B – C - D**	2750m
Option-2		**A – E – F – G - D**	2750m
Option-3		**A – E – G - D**	2725m

The Cost Comparison for proposed three alignment options are given below.


A
B
C
D
E
F
G
Option-III
Option-II
Option-I
Gangadhar River
Gadadhar River
Alokjhari
Bhatipetla
NH 127B
Image © 2016 CNES / Astrium
2003
45 R 785004.26 m E 2907092.60 m N elev 110 ft

S. No.	Design, Safety &other Parameter	Alignment Option - I (Follows the Existing alignment)	Alignment Option - II (Red alignment)	Alignment Option- III (Blue alignment)
1	**Design Speed**	100 Kmph	100 Kmph	100 Kmph
2	**Total Length**	Total length 2.750 km	New alignment length 2.750 km,	New alignment length 2.725 km,
3	**Land Acquisition**	4.13 Hectare	16.50 Hectare	16.35 Hectare
4	**Description of alignment**	This Alignment Passes in between Gangadhar River & Gadadhar River with in Builtup Area of Madhya Petla Village.	Greenfield Alignment having right angle crossing over Gadadhar River.	A greenfield alignment having Skew crossing over Gadadhar River.
5	**Social Impact and R&R**	Nearly 45 Nos. structures and one Big Temple are affected	Nearly 4 nos. structures are affected	No conflict with settlement or structures
6	**Structures and Protective Works**	Both side service/slip road, approx 800m Retaining/curtain wall/ grouted rip-rap, to protect embankment in contact with water and approx. 10 nos. balancing box culverts are required.	2 nos. minor Bridge (approx length 48m) required over Gadadhar River and approx. 8 nos. balancing box culverts are required.	1 nos. major Bridge required over Gadadhar River due to skew crossing (approx length 96m) and 1 no minor bridge required (approx length 48m) and approx. 8 nos. balancing box culverts are required.
7	**Civil Cost**	15.99 Crore (5.92 Cr. Per KM)	24.04 Crore (8.66 Cr. Per KM)	30.24 Crore (10.67 Cr. Per KM)
8	**R&R & LA Cost**	LA Cost = 3.06 Crore R&R Cost = 4.65 Crore	LA Cost = 8.15 Crore R&R Cost = 0.42 Crore	LA Cost = 8.08 Crore R&R Cost = Nil
9	**Total Cost including R&R and LA**	23.70 Crore	32.60 Crore	38.32 Crore
10	**Utility Shifting Cost**	Maximum	Minimum	Minimum

	Alignment Option - I (Follows the Existing alignment)	**Alignment Option - II (Red alignment)**	**Alignment Option- III (Blue alignment)**
Merits	➢ Totally following the existing alignment ➢ Land acquisition cost is less than option II & III	➢ Totally Greenfield alignment ➢ R& R cost is less than option I ➢ Right angle crossing over Gadadhar River	➢ Totally Greenfield alignment ➢ R& R cost is Nil
Demerits	➢ This Alignment Passes in between Gangadhar River & Gadadhar River with in Builtup Area of Madhya Petla Village. ➢ Approximately 45 nos. of houses are affected at Madhya Petla village. So, LA and R&R cost is high. ➢ Utility Shifting Cost maximum	➢ Civil cost is high because 2 nos. minor bridge is required over Gadadhar River. ➢ LA Cost High ➢ Utility Shifting Cost minimum	➢ Civil cost is high because 1 nos. major Bridge required over Gadadhar River due to skew crossing (approx length 96m) and 1 no minor bridge required (approx length 48m) ➢ LA Cost high compare to Option I ➢ Utility Shifting Cost minimum

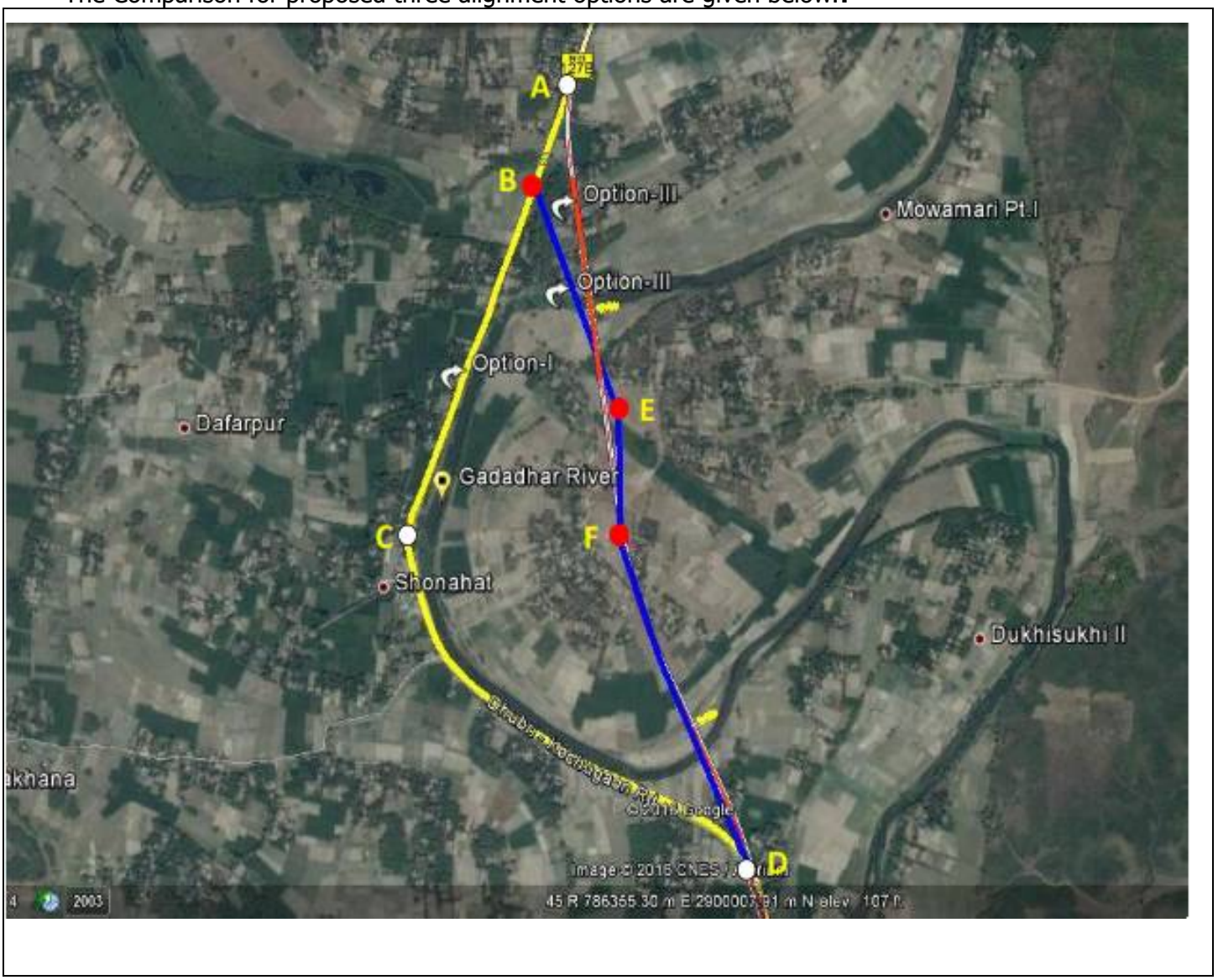
Hence, Alignment-3 is discarded being involving huge land acquisition cost and Civil Cost. Alignment-2 is preferred to Alignment-1 and recommended, as it is avoiding Gangadhar River and Built Up location of Madhya petal Village.

Alternative Alignment Option Study for Bypass in between existing km 28.850 to km 31.200 (Near Sonahat Village)

Legend

Options	Symble	Node	Length
Option-1		**A – B – C - D**	2350m
Option-2		**A – F - D**	1900m
Option-3		**A – E – F - D**	1660m

The Comparison for proposed three alignment options are given below.**:**



S. No.	Design, Safety &other Parameter	Alignment Option - I (Follows the Existing alignment)	Alignment Option - II (Red alignment)	Alignment Option- III (Blue alignment)
1	**Design Speed**	65 Kmph	100 Kmph	80 Kmph
2	**Total Length**	Total length 2.350 km	New alignment length 1.900 km,	New alignment length 1.660 km,
3	**Land Acquisition**	3.50 Hectare	Private Land=5.0 Ha; Govt Land = 6.40 Ha	Private Land=5.96 Ha; Govt Land = 4.0 Ha
4	**Description of alignment**	This Alignment passes along the Gadadhar River and Builtup Area of Sonahat Village.	Greenfield Alignment passes through maximum Govt. Lands.	Greenfield Alignment passes through minimum Govt. Lands.
5	**Social Impact and R&R**	Nearly 90 Nos. structures and one Big Mosque are affected	Nearly 5 nos. structures are affected	Nearly 10 nos. structures are affected
6	**Structures and Protective Works**	Both side service/slip road required in built up area, approx 1450m Retaining/curtain wall/ grouted rip-rap, to protect embankment in contact with water and approx. 8 nos. balancing box culverts are required.	2 nos. minor Bridge (approx length 48m) required over Gadadhar River and approx. 6 nos. balancing box culverts are required.	2 nos. minor Bridge (approx length 48m) required over Gadadhar River and approx. 6 nos. balancing box culverts are required.
7	**Civil Cost**	20.09 Crore (8.55 Cr. Per KM)	20.66 Crore (10.87 Cr. Per KM)	20.10 Crore (12.11 Cr. Per KM)
8	**R&R & LA Cost**	LA Cost = 2.61 Crore R&R Cost = 9.30 Crore	LA Cost = 2.47 Crore R&R Cost = 0.52 Crore	LA Cost = 2.94 Crore R&R Cost = 1.03 Crore
9	**Total Cost including R&R and LA**	32.00 Crore	23.65 Crore	24.08 Crore
10	**Utility Shifting Cost**	Maximum	Minimum	Minimum

	Alignment Option - I (Follows the Existing alignment)	**Alignment Option - II (Red alignment)**	**Alignment Option- III (Blue alignment)**
Merits	➢ Totally following the existing alignment ➢ Land acquisition cost is less than option II & III	➢ Totally Greenfield alignment ➢ R& R cost is less than option I & III	➢ Totally Greenfield alignment ➢ R&R cost is less than Option I
Demerits	➢ This Alignment passes along with Gadadhar River so protection cost is so high ➢ Approximately 90 nos. of houses are affected at Sonahat village. So, LA and R&R cost is also high. ➢ Poor Geometry. Design Speed has not reached as per standard.	➢ Civil cost is high because 2 nos. minor bridge is required over Gadadhar River.	➢ Civil cost is high because 2 nos. minor bridge is required over Gadadhar River. ➢ R& R cost is more than Option II

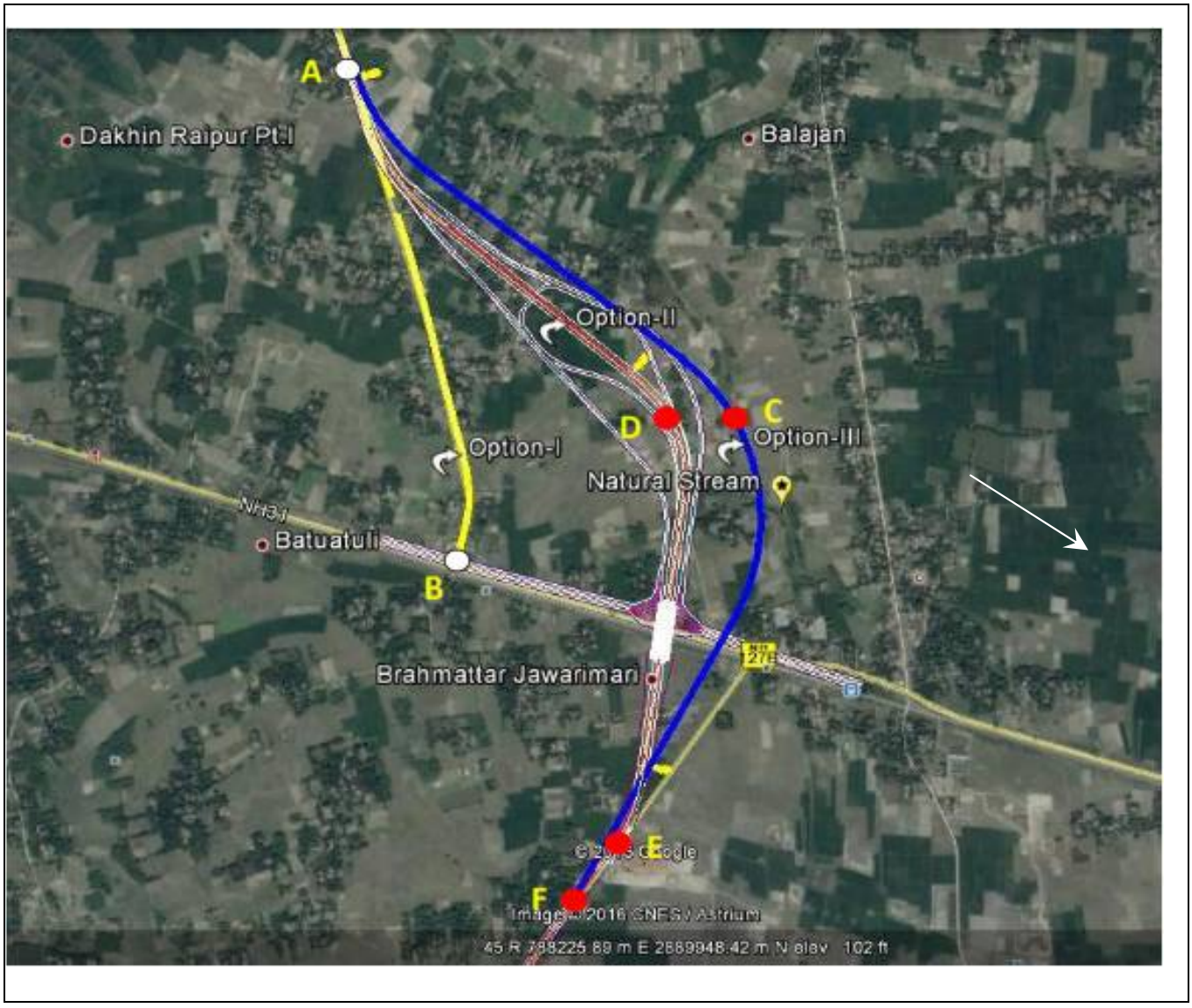
Hence, Alignment-1 is discarded being involving huge Civil Cost & R&R cost and poor geometry. Alignment-2 is preferred to Alignment-3 and recommended, due to acquisition of maximum Govt. land and total project cost is less compare to Alignment III option

Alternative Alignment Option Study for Bypass in between existing km 39.750 to km 41.900 (Near Saheb ganj Village)

Legend:

Options	Symble	Node	Length
Option-1		**A – B - F**	2150m
Option-2		**A – D - E**	2050m
Option-3		**A – C - F**	2250m

The Comparison for proposed three alignment options are given below.
The cost of Grade Separator is not considered in this Alignment Option Study as it is applicable for all three options.



S. No.	Design, Safety &other Parameter	Alignment Option - I (Follows the Existing alignment)	Alignment Option - II (Red alignment)	Alignment Option- III (Blue alignment)
1	**Design Speed**	100 Kmph	100 Kmph	100 Kmph
2	**Total Length**	Total length 2.150 km	New alignment length 2.050 km,	New alignment length 2.250 km,
3	**Land Acquisition**	3.23 Hectare	12.30 Hectare	13.50 Hectare
4	**Description of alignment**	This Alignment passes through Builtup Area of Saheb Ganj Village.	This Alignment passes through completely Greenfield land and some structures are to be effected.	This Alignment passes through completely Greenfield land & one settlement area are effected
5	**Social Impact and R&R**	Nearly 60 Nos. structures and one Big Mosque are affected	Nearly 6 nos. structures are affected	Nearly 25 nos. structures are affected
6	**Structures and Protective Works**	Both side service/slip road required in built up area and 1 no. grade separator required between NH-127B and NH-31.	1 no. grade separator required between NH-127B and NH-31.	1 no. grade separator required between NH-127B and NH-31.
7	**Civil Construction Cost (Without Grade Separator)**	10.43 Crore (4.85 Cr. Per KM)	8.53 Crore (4.16 Cr. Per KM)	9.33 Crore (4.15 Cr. Per KM)
8	**R&R & LA Cost**	LA Cost = 2.39 Crore R&R Cost = 6.20 Crore	LA Cost = 6.08 Crore R&R Cost = 0.52 Crore	LA Cost = 6.70 Crore R&R Cost = 2.58 Crore
9	**Total Cost including R&R and LA**	19.02 Crore	15.12 Crore	18.58 Crore
10	**Utility Shifting Cost**	Maximum	Minimum	Minimum

	Alignment Option - I (Follows the Existing alignment)	**Alignment Option - II (Red alignment)**	**Alignment Option- III (Blue alignment)**
Merits	➢ Totally following the existing alignment ➢ Land acquisition cost is less than option II & III	➢ This Alignment passes through completely Greenfield land and some structures are to be effected.	➢ Totally Greenfield alignment
Demerits	➢ Approximately 60 nos. of houses are affected at Saheb Ganj village. So, LA and R&R cost is also high.	➢ Total Cost is less than option I & III ➢ Short length than option III	➢ Total Cost is higher than option I & II

Hence, Alignment-1 is discarded being involving huge Civil Cost and R&R cost. Alignment-2 is preferred in comparison with Alignment-3 and recommended due to shorter length and lesser project cost.

5.6 EIA WITHOUT EMP

The Environment Impact Assessment without Environment Management Plan (EMP) will not be complete. The Coverage for project will be limited to establishment of baseline scenario and extent of impact due to project implementation. This study will not be useful in project road as Environmental Impact Assessment Notification 2006 stipulates the requirement of EMP (however in this project road Environmental Clearance is not required).

Environmental Management Plan suggests the environmental measures to monitor mitigate and manage the adverse impacts of the project on the components of valued ecosystem. If a project is implemented without EMP, it will be environmentally disastrous.

5.7 EIA WITH EMP

The EIA with EMP has a more sense as it will have detailed mitigation measures, budget and monitoring plan for the project for pre-construction, construction and operation phases. The responsibilities for implementation of mitigation measures will also there in the EMP. The EMP will help to mitigate adverse impacts of project, a plan for monitoring to check the efficacy of mitigation measures planned. Hence EIA with EMP is justified for the Project road. The implementation of EMP will also reduce inconvenience to local during construction and the project will become environmentally sustainable.

5.8 CONCLUSION

The widening & strengthening options for the project road alignment indicates that the environmental and social considerations have been given due weightage in the finalisation of the alignment. The minor adverse impacts would be manageable to an acceptable level by implementing Environmental Management Plan due this EIA with EMP has been considered an acceptable and justified option. The alignment of project is beyond a distance of 10 km from the environmental sensitive features such as Wildlife Parks, Bird sanctuaries, Notified wetlands and Heritage sites. The project influence area being rich in agricultural activities, therefore, alignment has been finalised by avoiding many orchards and cluster of trees. Village ponds have been avoided in the RoW.

CHAPTER-6

(STAKEHOLDER CONSULATION)

6 STAKEHOLDER CONSULTATIONS

The project will affect the communities residing near the RoW of project road and their activities. Moreover successful implementation of the project requires co-ordinated efforts of various stakeholders at different levels. Hence, consultations at different levels are being used as a tool to inform and educate stakeholders about the proposed action both before and after the development decisions are made. Public consultation was useful for gathering environmental data, understanding likely impacts and community's needs and preferences.

The various alternatives could be evolved and sustainable mitigation measures could be formulated through consultations. It assisted in identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process helped in reducing the public resistance to change and enabled the participation of the local people in the decision making process. The involvement of the various stakeholders ensured that the affected population and other stakeholders are informed consulted and are allowed to participate at various stages of project preparation.

6.1 OBJECTIVES

The objectives of the consultation process are the following:

- To promote public awareness about the proposed widening and strengthening of project road especially amongst the potentially impacted communities/individuals;
- To educate the potentially impacted communities/individuals about the proposed course of action and the project alternatives;
- To solicit the views of affected communities/individuals on environmental and social problems;
- To gather inputs from the affected communities/individuals in crucial decisions regarding mitigation of the identified environmental and social issues;
- To stimulate community self evaluation and analysis;
- To inform Project Affected Persons (PAPs) about the compensation and resettlement in the project; and
- To ensure lessening of public resistance to change by providing them a platform in the decision making process.

6.2 METHODOLOGY ADOPTED FOR PUBLIC CONSULTATIONS

6.2.1 Stages and Levels of Consultations

Public Consultations is an ongoing process till project is completely constructed. The consultations have helped in finalisation of the alignment for widening and strengthening for Srirampur-Dhubri Road Section of NH-127B.

Public consultations have been held at three levels as follows:

- **Local level** (village level/Block level) villagers whose properties, land, etc are being affected by the project;
- **District level** consultations with district administration including forest department, and
- **Institutional level** consultations with PWD, Forest Department and its concerned department.

6.2.2 Tools for Consultation

Public Consultations are being take-up using formal and informal discussions, and meetings with Government of Assam Officials of various departments.

Informal discussion

At the time of reconnaissance survey and baseline data collection, informal discussions have been held with the local public residing in indirect project influence area to obtain an overview of likely impacts and concerns of the community. Consultation was held at several locations along the project road alignment covering areas where public activity was intense and close to proposed alignment covering:

- Village Panchayats and
- Villagers

Figure 2: Informal Public Consultation along the project road alignment Photographs

	
Informal Public Consultation At Addabari Village Ch54+500	Informal Public Consultation At Barundanga Village Ch.28+500
	
Informal Public Consultation At Oxiguri Village Ch.13+500	Informal Public Consultation At Jakkopur Village Ch.3+500

Detailed coverage of Public Consultations is also provided in Social Impact Assessment Report while the more photographs of stakeholder consultation have been shown in **Appendix 3.1**.

Institutional Level Consultations

The institutional level consultations were held with representatives of institutions having stakes in implementation of the project. The institutions contacted included state forest department, District Administration, Revenue Department, etc.

In addition to the department listed above the officials from other departments were also contacted on several occasions. The contacted officials included Tehsildars, and NGOs.

6.2.3 Contents

The consultation with institutional officials focussed on the following issues

- Project description: - Need for the 2/4 lanning of project road, benefits of the project and etc.
- Social and environmental assessment processes vis-à-vis- GoI and GoT requirements;
- The extent / nature of negative social and environmental impact and the need for rehabilitation and resettlement in the project. Avoidance, mitigation and enhancement aspects in the project;
- Dissemination of R&R policy formulated for the project prescribing various R&R options to facilitate in improving or at a minimum regaining the former status of living of the people affected by the project at no cost to them; and
- People's participation in planning, implementation and Monitoring & Evaluation Stage.
- Clarifications were sought from Chief Conservator of forest and DFO offices regarding requirements of tree cutting permission.

6.2.4 Public Hearing, Schedule IV, under EIA Notification 2006 of MoEFCC

As per latest amendment in EIA notification this project road does not attract Environmental Clearance and subsequently Public Hearing is not required.

6.3 ISSUES RAISED AND ADDRESSAL IN THE PROJECT

During the environmental and social screening survey primary stake holders have been consulted at site and outcome of the consultations have been furnished in **Table 6.1**.

Table 6:1: Stakeholder Consultation, Issues and Addressal in Project Design

Issues Discussed	Outcome
Relocation Options Compensations/Assistance	PDPs whose residential structures are getting affected prefer not to get disturbed and if chance of disturbance is not avoidable then they shall be relocated very nearby. Shop owners and workers raised the issue of loss of their livelihood during the resettlement period for the loss of business. During consultation they were convinced to relocate the same to a nearby place thereby ensuring restoration of the livelihood of the workers. People are ready to shift if properly relocated and compensated. Most of the PDPs demanded house for house option in this place instead of money compensation.
Safety due to alignment	People expressed their views on the risk involved if the road the road is widened at the dense settlement area affecting residential structures on both sides.

Issues Discussed	Outcome
	The PDP's is getting affected proposed that they should be shifted to the one side of the road to ensure road safety for villagers/road users.
Relocation of school buildings Relocation of Temples	People expressed their views on the risk involved if the road passed through the village affecting residential structures on both sides. Relocation of schools and temples to sites identified in consultation with the villagers and the village panchayat. Differences in opinion among the villagers in demolishing/ shifting the temple.
Cross Drainage for bypass	People have shown their concern for proposed drainage pattern for the realignment of portion of project road. In this regard the lined rectangular drains with proper outfall shall be planned as part of project design of the main carriageway. Adequate cross drainage structures have been planned after study of hydrology of the study area.
Utilities and basic infrastructures	People showed their concern about what will happen with the utility lines if the road is widened. Adequate care shall be taken for the shifting of the utilities.
Employment during construction	People were of demand if the local people are given preference for employment during the construction phase of the project. Such options shall be explored to the extent possible and mostly the unskilled worked can be hired from the nearby locality.

6.4 Key Findings

The following are the key findings from the village / local level consultations.

- Participants were aware of the project and were willing to give up their agricultural land but not their house.
- People were also concerned about the religious structures, burial / cremation ground, trees, plantations, orchards that were getting affected;
- People in most of the cases, agreed to participate in the process of identifying alternate site for relocation of their structures
- The PAPs were also concerned about the rate of compensation, mode of payment and timely disbursement of the same.
- PAPs were concerned about the loss of livelihood as a result of large-scale acquisition of agricultural land.
- The PAPs were particularly concerned about the loss of community assets like the schools/religious structures.

6.5 Future Consultation Programme

The effectiveness of the R&R program as well as participation of local community is directly related to the degree of continuing involvement of those affected by the Project. Several

additional rounds of consultations with DPs will form part of the further stages of project preparation and implementation. A local NGO shall need to be entrusted with the task of conducting these consultations during RP implementation, which will involve agreements on compensation, assistance options, and entitlement package and income restoration measures suggested for the sub-project. The consultation will continue throughout the project implementation. The following set of activities will be undertaken for effective implementation of the Plan:

- In case of any change in engineering alignment planning the DPs and other stakeholders will be consulted in selection of road alignment for minimization of resettlement impacts, development of mitigation measures etc.
- Together with the NGO, the Project Implementation Unit (PIU) will conduct information dissemination sessions in the project area and solicit the help of the local community/ leaders and encourage the participation of the AP's in Plan implementation.
- During the implementation of RP, NGO will organize public meetings, and will appraise the communities about the progress in the implementation of project works, including awareness regarding road construction.
- Consultation and focus group discussions will be conducted with the vulnerable groups like women, SC, ST, and OBC's to ensure that the vulnerable groups understand the process and their needs are specifically taken into consideration.
- To make reasonable representation of women in the project planning and implementation they will be specifically involved in consultation.
- During land acquisition and compensation distribution process.

CHAPTER-7

(ENVIRONMENTAL MONITORING PROGRAMME)

7 ENVIRONMENTAL MONITORING PROGRAMME

7.1 MONITORING PROGRAMME OBJECTIVES

Monitoring programme has the underlying objective to ensure that the intended environmental mitigations are realized and this result in desired benefits to the target population causing minimal deterioration to the environmental parameters. Such programme targets proper implementation of the EMP. The broad objectives are:

- To evaluate the performance of mitigation measures proposed in the EMP;
- To evaluate the adequacy of Environmental Assessment;
- To suggest ongoing improvements in management plan based on the monitoring and to devise fresh monitoring on the basis of the improved EMP;
- To enhance environmental quality through proper implementation of suggested mitigation measures; and
- To meet the requirements of the existing environmental regulatory framework and community obligations.

7.2 PERFORMANCE INDICATORS

The significant physical, biological and social components affecting the environment at critical locations serve as wider/overall Performance Indicators. However, the following specific environmental parameters can be quantitatively measured and compared over a period of time and are, therefore, selected as specific Performance Indicators for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise.

Air Quality with respect to PM_{10}, $PM_{2.5}$, CO, NOx and SO_2 at selected locations.

Water Quality as per IS 10500:2012 and Surface water Quality as Specified by Central Pollution Control Board.

Noise levels near habitations, construction sites, and sensitive receptors close to RoW. The noise sensitive receptors include schools, hospitals and community/ religious places.

Survival rates of trees planted as compensatory plantation to compensate for lost trees and compensatory plantation raised for removal of roadside trees.

Ambient Air Quality (AAQ) Monitoring Parameters

Ambient air quality parameters recommended for monitoring road development projects are Particulate Matter PM_{10} and $PM_{2.5}$, Carbon Monoxide (CO), Oxides of Nitrogen (NOx) and Sulphur Dioxide (SO_2). These are to be monitored, right from the commencement of construction activity at construction camp sites, crushers on sites, excavation works, etc. Data should be generated once in a season excluding monsoon at the monitoring locations in accordance with the National Ambient Air Quality Standards formulated by CPCB in November 2009 and subsequent amendments. The National Ambient Air Quality Standards are annexed as **Appendix 7.1**.

7.3 WATER QUALITY MONITORING

The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, EC, DO, BOD, TN, Sodium absorption ration, Boron, Faecal coliform (for Surface water) and pH, EC, Colour, Odour, DO, BOD, Dilution factor, SO_4^{2-} , Cl- , PO_4^{3-},TN, F- Surfactant, Total suspended Solid and Faecal Coliform. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are given in the Environmental Monitoring Programme. The monitoring of the water quality is to be carried out at locations identified along the project road alignment during construction and operation phase. The Indian Standard Specifications – IS 10500 (2012) is annexed as **Appendix 7.2**.

7.4 NOISE LEVEL MONITORING

The measurements for monitoring noise levels would be carried out at sensitive receptors and construction sites along the project roads. The Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 2000 and subsequent amendment or the standards by Assam State Pollution Control Board if such standards are stricter than those of the CPCB are to be complied with. The CPCB standards are given in appendix 7.3 Sound pressure levels would be monitored on twenty-four hour basis. Noise should be recorded at "A" weighted frequency using a "slow time response mode" of the measuring instrument. The Ambient Air Quality Standards in respect of Noise are annexed as **Appendix 7.3**.

7.5 SUCCESS OF RE-VEGETATION

The construction of road will involve cutting of vegetation and tress. Such lost vegetation and trees will be required to be replaced by compensatory plantation. As per guidelines of state forest department compensatory afforestation has to be carried out @ 2: 1 (Two trees for every one tree cut or as per condition laid in Forest clearance). These compensatory plantations will have to be monitored by the implementing agency with the help of the Forest Department. Such monitoring will be conducted through random samples. Such sampling should cover at least 5% of the total length. There will be monitoring every year before on set of monsoon and a 75% survival will be maintained. Any deficiency noted will be planted in the monsoon season. This monitoring will continue for 3 years.

7.6 MONITORING PLAN

The monitoring plan covering various performance indicators, frequency and institutional arrangements of the project in the construction and operation stages, along with the estimated cost, is summarized in **Tables 7.1, 7.2** and **7.3.**

Table 7:1: Monitoring Parameters and Frequency

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
Air	Construction stage	SPM, RSPM, SO_2, NO_x, and CO	National Ambient Air Quality Standards	At Hot mix plant	Once in a season excluding the monsoon for 2 years	Continuous 24 hours/ or for 1 full working day	Check and modify control devices like bag filter/cyclones of hot mix plant.	MoRTH through approved monitoring agency	Concessionaire/Contractor
		SPM, RSPM, SO_2, NO_x and CO,	National Ambient Air Quality Standards	At identified 05 locations	Once in a season excluding the monsoon for 2 years	Continuous 24 hours/ or for 1 full working day	Check and modify control devices like bag filter/cyclones of hot mix plant.	MoRTH through approved monitoring agency	Concessionaire/Contractor
	Operation stage	SPM, RSPM, SO_2, NO_x, HC and CO,	National Ambient Air Quality Standards	At identified 05 location	Thrice in a year (winter, summer and post monsoon seasons) for 1 years	Continuous 24 hours/ or for 1 full working day	-	MoRTH through approved monitoring agency	Concessionaire/Contractor

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
Surface Water Quality	Construction stage	Drinking Water Parameter as defined in IS 10500: 1991 and Surface water standards of Central Pollution Control Board.	Surface Water quality standards by CPCB	At identified locations (05 Nos)	Once in a season excluding the monsoon for 2 years	Grab Sample	Checks modify oil interceptors and, Silt fencing devices.	MoRTH through approved monitoring agency	Concessionaire/Contractor
	Operation stage	Drinking Water Parameter as defined in IS 10500 (2012) and Surface water standards of Central Pollution Control Board	Surface Water quality standards by CPCB	At identified 05 locations	Once in a season excluding the monsoon for 1 years	Grab Sample	Check and modify oil interceptors, Silt fencing devices.	MoRTH through approved monitoring agency	Concessionaire/Contractor

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
Ground Water Quality	Construction stage	Drinking Water Parameter as defined in IS 10500 (2012)	Ground Water quality standards by CPCB	At identified 02 locations (Construction Camp and Worker Camp)	Once in a season excluding the monsoon for 02 years	Grab Sample	Check and modify oil interceptors, Silt fencing devices.	MoRTH through approved monitoring agency	MoRTH/ Contractor
	Operation stage	Drinking Water Parameter as defined in IS 10500 (2012)	Ground Water quality standards by CPCB	At identified 0 1 location (Worker Camp)	Once in a season excluding the monsoon for 1 years	Grab Sample	Check and modify oil interceptors, Silt fencing devices.	MoRTH through approved monitoring agency	MoRTH/ Contractor
Noise levels	Construction stage	L_{eq} dB(A) (Day & Night), Average and Peak values	Noise standards by CPCB	At equipment yards / locations/ in and along project road. 08 Locations	Once in a season excluding the monsoon for 02 years	Readings to be taken at 60 seconds interval for every hour and then L_{eq} are to be obtained for Day time and Night time	Check and modify equipment and devices used to protect noise level.	MoRTH through approved monitoring agency	MoRTH/ Contractor

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
	Operation stage	L_{eq} dB(A) (Day & Night), Average and Peak values	Noise standards by CPCB	At identified 5 locations	Once in a season excluding the monsoon for 1 years	Readings to be taken at 60 seconds interval for every hour and then L_{eq} are to be obtained for Day time and Night time	-	MoRTH through approved monitoring agency	MoRTH/ Contractor
Soil	Construction stage	Physical Parameters: Texture, Grain Size Distribution, Gravel, Sand, Silt, Clay; Chemical Parameters: pH (10%w/v slurry), Conductivity, Calcium, Magnesium, Sodium, Potassium, Sodium	Baseline	Near construction sites / along the alignment of Project Road / Construction Camps (04 locations Nos)	Once in a season excluding the monsoon for 2 years	-	-	MoRTH through approved monitoring agency	MoRTH/ Contractor

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
		Absorption Ratio, Total Nitrogen, Phosphorous, Organic matter							
	Operation Stage	Physical Parameters: Texture, Grain Size Distribution, Gravel, Sand, Silt, Clay; Chemical Parameters: pH (10%w/v slurry), Conductivity,	Baseline	Near Project Road at identified 03 locations	Once in a season excluding the monsoon for 1 years	-	-	MoRTH through approved monitoring agency	MoRTH/ Supervision Consultant /Contractor

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
		Calcium, Magnesium, Sodium, Potassium, Sodium Absorption Ratio, Total Nitrogen, Phosphorous, Organic matter							
Soil Erosion	Construction stage	Turbidity in Storm water	As specified by the Construction Managers of the Concessionaire	At the drains/canals , near construction site	Pre-monsoon and post-monsoon seasons for 02 years		Inspection and modification of silt fencing/ any leakage of drains to these surface water bodies	MoRTH through approved monitoring agency	MoRTH/ Supervision Consultant /Contractor
	Operation stage	Turbidity in Storm water Silt load in ponds	Water quality standards	At major water bodies .	1st year before onset of monsoon		Check drains, culverts ensure clear water way	MoRTH through approved monitoring agency	MoRTH/ Supervision Consultant /Contractor

Environment component	Project Stage	REGULAR MONITORING PARAMETERS						Institutional Responsibilities	
		Parameters	Standards	Location	Frequency	Duration	Action plan in case criteria exceeds	Implementation	Supervision
Construction Sites and Construction Camps	Construction Stage	Monitoring of: 1. Storage Area 2. Drainage Arrangements 3. Sanitation in Construction Camps	As specified by the Construction Managers of the Concessionaire	At Storage area and construction camps	Quarterly in the construction stage.		Check sanitation/ drainage and standards of camp sites and bring up to level of satisfaction Concessionaire / IE	MoRTH through approved monitoring agency	MoRTH/ Supervision Consultant /Contractor
Survival Plantation and Vegetation	Construction Stage	Monitor Plantation survival rate and maintain a minimum 75% survival	Minimum 75% Survival rate	At side slopes median and available place in RoW	Every Year prior to Monsoon	Every year till end of construction period.	Make for any loss than 75% in monsoon	MoRTH through approved monitoring agency	Environment Cell of MoRTH
	Operation Stage	Monitor Plantation survival rate and maintain a minimum 75% survival	Minimum 75% Survival rate	At side slopes median and available place in RoW	Every Year prior to Monsoon for 3 years	For first 3 years.	Make for any loss than 75% in monsoon	MoRTH through approved monitoring agency	Environment Cell of MoRTH

7.7 ENVIRONMENTAL REPORTING SYSTEM

Monitoring and Evaluation are critical activities in implementation of all projects. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for project management to keep the programme on schedule. By contrast evaluation is essentially a summing up at the end of the project to assess whether those activities actually achieved as was intended.

The reporting system will operate linearly with the contractor who is at the lowest rung of the implementation system reporting to the Independent Engineer/Supervision Consultant. All reporting by the contractor shall be on a quarterly basis. The Independent Engineer/Supervision Consultant shall be responsible for preparing targets for each of the identified EMP activities.

The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the Independent Engineer/Supervision Consultant quarterly during the implementation period. The operation stage monitoring reports may be annual or biennial provided the Project Environmental Completion Report shows that the implementation was satisfactory. Otherwise, the operation stage monitoring reports will have to be prepared as specified in the said Project Environmental Completion Report.

Responsibilities for overseeing will rest with the Environment Management Cell of the Executing Agency and Environmental Expert of Independent Engineer/Supervision Consultant. Capacity to quantitatively monitor relevant ecological parameters would be an advantage but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures in the EMP.

During the implementation period, a compliance report may include description of the items of EMP, which were not complied with by any of the responsible agencies. It would also report to the management of Executing Agency about actions taken to enforce compliance. It may however, be noted that certain items of the EMP might not be possibly complied with for a variety of reasons. The intention of the compliance report is not to suppress these issues but to bring out the circumstances and reasons for which compliance was not possible (such as jurisdictional issues). This would help in reinforcing the implementation of the EMP.

Photographic records will also be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. Reporting and Monitoring Systems for various stages of construction and related activities have been proposed to ensure timely and effective implementation of the EMP.

The reporting system has been prepared for each of the stage of road construction namely:

- Pre construction stage
- Construction Stage
- Operation Stage
- This reporting shall be done through:
- Reporting by the Contractor to the Concessionaire
- Concessionaire/PIU to Regional Office of Ministry of Environment and Forest.

The stage-wise reporting system is detailed out in the following **Table 7.2**.

Table 7:2: Suggested Stage-Wise Reporting System

S. No	Item	Contractor	Supervision / Monitoring	
		Implementation and Reporting to Independent Engineer		
Construction Stage				
1	Supervision of construction site and construction camp	Before start of work		Quarterly
2	Target sheet for Pollution Monitoring		As required	After Monitoring
3	Target sheet for roadside plantation		Quarterly	Annually
4	Target sheet for monitoring of cleaning water bodies		Monthly	Monthly
Operation Stage				
1	Target sheet for Pollution Monitoring		Quarterly	Annually
2	Target sheet for survival reporting of roadside plantation		Annually	Annually
3	Target sheet for monitoring of cleaning water bodies		Annually	Annually

7.8 MONITORING PLAN

An environmental monitoring budget for **INR 29,53,500.00 (RupeesTwenty nine lakhs fifty three thousand and five hundred only)** will be kept for construction as well as operation phase. This amount has also been included in the Environmental Budget in Chapter 8. A detail of environmental monitoring budget is given in **Table 7.3**.

Table 7:3: Environmental Monitoring Budget (Construction and Operation Phase)

COMPONENT	STAGE	ITEM	UNIT	Unit Cost (Rs.)	QUANTITY	TOTAL COST (INR)
Monitoring costs						
Air	Construction	Monitoring near all hot mix plant locations approved by the Engineer	No. of Samples	8,500	At 01 location once in a season excluding monsoon for 2 years. (6 Samples)	51000.00
		Monitoring at construction sites and at sensitive locations.	No. of Samples	8,500	At 05 locations once in a season excluding monsoon for 2 years (30 samples)	255000.00
	Operation	Ambient Air Quality Monitoring (locations as decided by the supervision consultant)	No. of Samples	8,500	At 05 locations for 1 years and once in each season excluding monsoon (total 15 samples)	127500.00
Water Quality	Construction	Surface Water Quality (River and Canal)	No. of Samples	6,500	At 05 locations once in a season excluding monsoon for 2 years (30 samples)	195000.00
		Ground Water Quality (Along RoW)	No. of Samples	6,500	At 05 locations once in a season excluding monsoon for 2 years and 3 2 location for drinking water (12 samples) (total 30+12) Samples)	273000.00
	Operations	Surface Water Quality (As per suggestion in monitoring plan)	No. of Samples	6,500	At 05 location once in each season excluding the monsoon season for 1 years (15 sample)	97500.00

COMPONENT	STAGE	ITEM	UNIT	Unit Cost (Rs.)	QUANTITY	TOTAL COST (INR)
		Ground Water Quality (As per recommendation in monitoring plan)	No. of Samples	6,500	At 05 location once in each season excluding the monsoon season for 1 years (total 15 sample)	97500.00
Noise	Construction	At equipment yards/ Hot mix plants / Construction Camps	No. of Samples	2,500	At 01 location once in each season excluding the monsoon season for 2 years (6 Samples)	15000.00
		As directed by the Engineer	No. of Samples	2,500	At 8 location once in each season excluding the monsoon season (with Air Quality Monitoring) for 2 years (48 Samples)	120000.00
	Operation	As directed by the Engineer	No. of Samples	2,500	At 8 locations Thrice in a year for 1 years (with Air Quality Monitoring) (24 Samples)	60000.00
Soil	Construction	At productive agricultural lands abutting traffic detours and traffic diversions, to be identified by the Engineer	No of Samples	6,000	At 03 locations once in each season excluding monsoon for 2 years (18 samples)	108000.00
	Operation	At accident/spill locations involving bulk transport carrying hazardous material	No of Samples	6,000	At 03 Locations once in each season excluding monsoon for 1 years (9 Samples)	54000.00
Plantation	Operation	All along the project corridor and making up of died saplings.		Lumpsum (5 lakh every year)	Once every year between and after monsoon for 3 years	1500000.00

COMPONENT	STAGE	ITEM	UNIT	Unit Cost (Rs.)	QUANTITY	TOTAL COST (INR)
					Total Monitoring Costs	**29,53,500.00**

CHAPTER-8

(ENVIRONMENTAL MANAGEMENT PLAN)

8 ENVIRONMENTAL MANAGEMENT PLAN

Environmental Management Plan (EMP) is the key to ensure that the environmental quality of the zone under impact does not deteriorate beyond the expected level due to the construction and operation of the project. The EMP comprises a set of measures to be taken in different stages like the design, construction and operation to eliminate, offset or reduce adverse environmental impacts to acceptable levels. Elimination/prevention is possible through elimination of impacts or by avoiding the action. This can also be achieved by reducing the scale of action. Remediation is repairing or restoring particular features of the environment adversely affected by the activity. Offsetting actions means compensating for impacts by providing additions to or substitutes for the affected environment. In the case of 2- lanning with paved shoulder of Srirampur- Dhubri Road Section of NH-127B, prevention gets limited only to the scaling down the magnitude of operations in environmentally sensitive stretches of the project road. Mitigation plans generally evolve around remediation and offsetting.

8.1 ENVIRONMENT MANAGEMENT PLAN MATRIX

The Environmental Management Plan is meant for mitigation/management /avoidance of the negative impacts and the enhancement of the various environmental components along the project road. Location, timeframe, implementation and overseeing/supervising responsibilities are listed in the EMP matrix for each mitigation measure to be taken. The measure adopted and /or to be adopted during the different stages of the project have been detailed in **Table 8.1**, for pre construction, construction and operation phases respectively.

8.2 Environmental Budget

An environmental budget for **1,31,32,875 (one crore thirty one lakh thirty two thousand eight hundred and seventy five only)**has been kept. The cost of Compensatory Afforestation and monitoring is also included in this budget. The detailed budget is provide in **Table 8.2**

Table 8:1: Environmental Management Plan Matrix

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
PRE-CONSTRUCTION STAGE				
Pre-Construction Activities by Project Implementation Unit				
P.1	Land Acquisition	The acquisition of land and private properties will be carried out in accordance with the Land Acquisition Act 2013 of Government of India. The Independent Engineer/Supervision Consultant has to ascertain that any additional environmental impacts resulting from acquisition of land shall be addressed and integrated into the EMP and other relevant documents.	Independent Engineer/ Supervision Consultant/Revenue Dept.,	Regional office of MoRTH/Local PIU
P.2	Preservation of Trees	▪ Widening and strengthening of project road involves removal of trees from RoW ▪ Tree cutting is to proceed only after all the legal requirements including obtaining of tree cutting permission from the Forest Dept./DoEF/Collector are completed and subsequently a written order is issued to the Contractor. ▪ Particular species declared as 'protected' by the State's Forest Dept. in the private land will be felled only after due clearance from the Forest Dept. is obtained. ▪ In the event of design changes, additional assessments including the possibility to save trees shall be made. ▪ Stacking, transport and storage of the wood will be done as per the relevant norms. ▪ Systematic corridor level documentation for the trees cut and those saved will be maintained by the Independent Engineer.	Nodal Officers, Forest Department, Contractor	Regional office of MoRTH/Local PIU
P.3	Relocation of Common Property Resources	Relocation of common property resources such as tube wells, hand pumps, wells, etc. will be done in consultation with locals at project cost before dismantling the existing CPRs.	Contractor	Regional office of MoRTH / Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
P.4	Relocation of affected Cultural and Religious Properties	The cultural properties have been avoided in the RoW. However, those requiring relocation will be relocated in consultation with locals and with proper rituals	Contractor	Regional office of MoRTH / Independent Engineer/ Supervision Consultant
Pre-construction activities by the Contractor/Independent Engineer/Supervision Consultant				
P.5	**Field Verification and Modification of the Contract Documents**			
P.5.1	Joint Field Verification	▪ Independent Engineer/Supervision Consultant and the Contractor will carry out joint field verification to ascertain the possibility of saving trees, environmental and community resources. ▪ The verification exercise shall assess the need for additional protection measures or changes in design/scale/nature of protection measures including the efficacy of enhancement measures suggested in the EMP. Proper documentation and justifications/reasons shall be maintained in all such cases where deviation from the original EMP is proposed.	Environment Expert of independent Engineer/ Supervision Consultant, Contractor	Regional office of MoRTH/Local PIU
P.5.2	Assessment of Impacts due to Changes/ Revisions/Additions in the Project Work	Independent Engineer/ Supervision Consultant will assess impacts and revise/modify the EMP and other required sections of the project document/s in the event of changes/revisions (including addition or deletion) in the project's scope of work.	Environment Expert of independent Engineer/Supervision Consultant	Regional office of MoRTH/Local PIU
P.5.3	Crushers, hot-mix plants and Batching Plants Location	▪ Hot mix plants and batching plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 1.0 km away from the nearest village/settlement preferably in the downwind direction. ▪ The Contractor shall submit a detailed lay-out plan for all such sites and approval of Independent Engineer/ Supervision Consultant shall be	Construction Manager of contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		necessary prior to their establishment. ▪ Arrangements to control dust pollution through provision of windscreens, sprinklers, and dust encapsulation will have to be provided at all such sites. ▪ Specifications of crushers, hot mix plants and batching plants will comply with the requirements of the relevant current emission control legislations and Consent/NOC for all such plants shall be submitted to the independent Engineer/ Supervision Consultant and MoRTH. ▪ The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted.		
P.5.4	Other Construction Vehicles, Equipment and Machinery	▪ All vehicles, equipment and machinery to be procured for construction will conform to the relevant Bureau of India Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986 will be strictly adhered to. ▪ Noise limits for construction equipments to be procured such as compactors, rollers, front loaders concrete mixers, cranes (moveable), vibrators and saws will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Act, 1986. ▪ The Contractor shall maintain a record of PUC for all vehicles and machinery used during the contract period.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant
P.6	**Identification and Selection of Material Sources**			
P.6.1	Borrow Areas	▪ The Contractor will not start borrowing earth from selected borrow areas until the formal agreement is signed between land owner and contractor and a copy is submitted to the Independent Engineer/Supervision Consultant. ▪ Planning of haul roads for accessing borrows materials will be undertaken during this stage. The haul roads shall be routed to avoid agricultural areas as far as possible; in case such a land is disturbed, the Contractor will rehabilitate it and will use the existing village roads wherever available.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		In addition to testing for the quality of borrow materials by the Independent Engineer/Supervision Consultant, they will be required to inspect every borrow area location prior to approval (follow criteria for evaluation of borrow areas).		
P.6.2	Quarry	▪ Quarry locations have been identified for the Project road. The material available from these quarries will be enough for the construction works is envisaged. ▪ In case the contractor decides to use quarries other than recommended by DPR consultants, then it will be selected based on the suitability of the materials. ▪ The contractor will procure necessary permission for procurement of materials from Mining Department, District Administration and State Pollution Control Board and shall submit a copy of the approval and the rehabilitation plan to the Independent Engineer/Supervision Consultant. ▪ Contractor will also work out haul road network and report to Construction Manager will inspect and approve the same subject to suitability.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant
P.6.3	Arrangement for Construction Water	▪ Contractor is not allowed to use any community water resources. ▪ To avoid disruption/disturbance to other water users, the contractor will extract water from fixed locations and consult the Independent Engineer/Supervision Consultant before finalizing the locations. ▪ The Contractor will provide a list of locations and type of sources from where water for construction will be used. ▪ The contractor will not be allowed to pump from any irrigation canal and surface water bodies used by community. ▪ The contractor will need to comply with the requirements of the State Ground Water Department and seek their approval for doing so and submit copies of the permission to Independent Engineer/Supervision Consultant.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant
P.7	Labour	The contractor preferably will use unskilled labour drawn from local	Construction Manager of	Independent Engineer/

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
	Requirements	communities to give the maximum benefit to the local community.	contractor	Supervision Consultant
P.8	Construction Camp Locations – Selection, Design and Lay-out	▪ Sitting of the construction camps will be as per the guidelines of Environmental Expert of Independent Engineer/Supervision Consultant. Locations identified by the contractor will report to the Independent Engineer/Supervision Consultant. ▪ Construction camps will not be proposed within 1.0 km from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. ▪ Location for stockyards for construction materials will be identified at least 1.0 km m from water courses. ▪ The waste disposal and sewage system for the camp will be designed, built and operated such that no odour is generated. Unless otherwise arranged by the local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by the Independent Engineer will have to be provided by the contractor.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant
P.9	Arrangements for Temporary Land Requirement	▪ The independent Engineer/Supervision Consultant as per prevalent rules will carry out negotiations with the landowners for obtaining their consent for temporary use of lands for construction sites/hot mix plants/traffic detours/borrow areas etc. ▪ The Environmental Expert of Independent Engineer/Supervision Consultant will be required to ensure that the clearing up of the site prior to handing over to the owner (after construction or completion of the activity) is included in the contract.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant
P.10	Orientation of Implementing Agency and Contractors	The Independent Engineer/Supervision Consultant shall organize orientation sessions and regular training sessions during all stages of the project. This shall include on-site training These sessions shall involve designated staff of the Contractors.	Construction Manager of contractor	Independent Engineer/ Supervision Consultant
CONSTRUCTION STAGE				

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
Activities to be Carried Out by the Contractor				
C.1	**Site Clearance**			
C.1.1	Clearing and Grubbing	▪ Vegetation will be removed from the construction zone before commencement of construction. All works will be carried out such that the damage or disruption to flora other than those identified for cutting is minimum. ▪ Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval the Independent Engineer. ▪ The contractor, under any circumstances will not cut or damage trees. Trees identified under the project will be cut only after receiving clearance from the Forest Dept.	Contractor	Independent Engineer/ Supervision Consultant
C.1.2	Generation of Debris from dismantling structures and surface	▪ Debris generated due to the dismantling of the surface will be suitably reused in the proposed construction, subject to the suitability of the materials and approval of the Construction Manager as follows: ▪ The existing base and sub-base material shall be recycled as sub-base of the haul road or access roads ▪ The contractor will make use of debris portion suitable for embankment filling. ▪ Balance portion of debris will be dispose off through filling up of wasteland or at pre-designated disposal locations, subject to the approval of Independent Engineer. ▪ All arrangements for transportation during construction including provision, maintenance, dismantling and clearing debris, will be considered incidental to the work and will be planned and implemented by the contractor as approved and directed by the Independent Engineer. ▪ The pre-designed disposal locations will be a part of Comprehensive Solid Waste Management Plan to be prepared by Contractor in consultation and with approval of Independent Engineer. ▪ Debris generated from pile driving or other construction activities shall be disposed off such that it does not flow into the surface water bodies or	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		form mud puddles in the area. ▪ The contractor shall identify dumping sites. The identified locations will be reported to the Independent Engineer. These locations will be checked on site and accordingly approved by the Independent Engineer prior to any disposal of waste materials.		
C.1.3	Other Construction Wastes Disposal	▪ The pre-identified disposal locations will be a part of Comprehensive Waste Disposal Solid Waste Management Plan to be prepared by the Contractor in consultation and with approval of Independent Engineer/Supervision Consultant. Location of disposal sites will be finalized prior to completion of the earthworks on any particular section of the road. ▪ The Independent Engineer/Supervision Consultant will approve these disposal sites after conducting a joint inspection on the site with the Contractor. ▪ Contractor will ensure that any spoils of material unsuitable for embankment fill will not be disposed off near any water course, agricultural land, and natural habitat like grass lands or pastures. Such spoils from excavation can be used to reclaim borrow pits and low-lying areas located in barren lands along the project corridors (is so desired by the owner/community). ▪ Non-bituminous wastes may be dumped in borrow pits (preferably located in barren lands) covered with a layer of the soil. No new disposal site shall be created as part of the project, except with prior approval of the Independent Engineer/Supervision Consultant. ▪ All waste materials will be completely disposed and the site will be fully cleaned and certified by Environmental Expert of Independent Engineer/Supervision Consultant before handing over. ▪ The contractor at its cost shall resolve any claim, arising out of waste disposal or any non-compliance that may arise on account of lack of action on his part.	Contractor	Independent Engineer/ Supervision Consultant
C.1.4	Stripping,	The topsoil from all areas of cutting and all areas to be permanently covered	Contractor	Independent Engineer/

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
	stocking and preservation of top soil	will be stripped to a specified depth of 150 mm and stored in stockpiles. A portion of the temporarily acquired area and/or Right of Way will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Independent Engineer/Supervision Consultant. The following precautionary measures will be taken to preserve them till they are used: (a) Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. To retain soil and to allow percolation of water, silt fencing will protect the edges of the pile. (b) Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or vegetation. (c) It will be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. Such stockpiled topsoil will be utilized for -covering all disturbed areas including borrow areas (not those in barren areas) top dressing of the road embankment and fill slopes, filling up of tree pits, in the agricultural fields of farmers, acquired temporarily. Residual topsoil, if there is any will be utilized for the plantation at median.		Supervision Consultant
C.1.5	Accessibility	▪ The contractor will provide safe and convenient passage for vehicles, pedestrians and livestock on either side of alignment and property accesses connecting the project road, providing temporary connecting road. ▪ The contractor will also ensure that work on existing accesses will not be	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		undertaken without providing adequate provisions and to the prior satisfaction of Environmental Expert of Independent Engineer/Supervision Consultant.		
C.1.6	Planning for Traffic Diversions and Detours	▪ Temporary diversions will be constructed with the approval of the Construction Manager and Environmental Expert of Independent Engineer/Supervision Consultant. ▪ Detailed Traffic Control Plans will be prepared and submitted to the independent Engineer for approval, five days prior to commencement of works on any section of the crossing of NH/SH/ODR/MDR. The traffic control plans shall contain details of temporary diversions, traffic safety arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures undertaken for transport of hazardous materials and arrangement of flagmen. ▪ The Contractor will provide specific measures for safety of pedestrians and workers at night as a part of traffic control plans. The Contractor will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. ▪ The contractor will also inform local community of changes to traffic routes, conditions and pedestrian access arrangements with assistance from Local bodies. The temporary traffic detours will be kept free of dust by sprinkling of water three times a day and as required under specific conditions (depending on weather conditions, construction in the settlement areas and volume of traffic).	Contractor	Independent Engineer/ Supervision Consultant
C.2	**Procurement of Construction Material**			
C.2.1	Earth from Borrow Areas for Construction	▪ No borrow area will be opened without permission of the Independent Engineer/Supervision Consultant. The location, shape and size of the designated borrow areas will be as approved by the Independent Engineer/Supervision Consultant and in accordance to the IRC recommended practice for borrow pits for road embankments (IRC 10: 1961). The borrowing operations will be carried out as specified in the	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		guidelines for sifting and operation of borrow areas. ▪ The unpaved surfaces used for the haulage of borrow materials, if passing through the settlement areas or habitations; will be maintained dust free by the contractor. Sprinkling of water will be carried out twice a day to control dust along such roads during their period of use. ▪ During dry seasons (winter and summer) frequency of water sprinkling will be increased in the settlement areas and Independent Engineer/Supervision Consultant will decide the numbers of sprinkling depending on the local requirements. ▪ Contractor will rehabilitate the borrow areas as soon as borrowing is over from a particular borrow area in accordance with the Guidelines for Redevelopment of Borrow Areas or as suggested by Independent Engineer/Supervision Consultant.		
C.2.2	Quarry Operations	The contractor shall obtain materials for quarries only after consent of the Department of Mining and District Administration.	Contractor	Independent Engineer/ Supervision Consultant
C.2.3	Transporting Construction Materials and Haul Road Management	▪ Contractor will maintain all roads (existing or built for the project), which are used for transporting construction materials, equipment and machineries as précised. All vehicles delivering fine materials to the site will be covered to avoid spillage of materials. ▪ All existing highways and roads used by vehicles of the contractor or any of his sub-contractor or suppliers of materials and similarly roads, will be kept clear of all dust/mud or other extraneous materials dropped by such vehicles. ▪ Contractor will arrange for regular water sprinkling as necessary for dust suppression of all such roads and surfaces. ▪ The unloading of materials at construction sites in/close to settlements will be restricted to daytime only.	Contractor	Independent Engineer/ Supervision Consultant
C.2.4	Construction Water	▪ Contractor will arrange adequate supply and storage of water for the whole construction period at his own costs. The Contractor will submit a list of source/s from where water will be used for the project to	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		Independent Engineer/Supervision Consultant. ▪ The contractor will source the requirement of water preferentially from ground water but with prior permission from the Ground Water Board. A copy of the permission will be submitted to Independent Engineer prior to initiation of construction. ▪ The contractor will take all precaution to minimize wastage of water in the construction process/ operation.		
C.3	**Construction Work**			
C.3.1	Disruption to Other Users of Water	▪ While working across or close to any perennial water bodies, contractor will not obstruct/ prevent the flow of water. ▪ Construction over and close to the non-perennial streams shall be undertaken in the dry season. If construction work is expected to disrupt users of community water bodies, notice shall be served well in advance to the affected community. ▪ The contractor will serve notice to the down stream users well in advance wherever excavation/drilling will take place in the water bodies. Contractor will ensure that the slopes are not steeper than 1:2 (vertical: horizontal) otherwise proper slope protection measures will be taken as given in IRC Guidelines. ▪ The contractor will take prior approval of the concerned Authority or Irrigation Department or Independent Engineer for any such activity. The Independent Engineer will ensure that contractor has served the notice to the downstream users of water well in advance.	Contractor	Independent Engineer/ Supervision Consultant
C.3.2	Drainage and Flood Control	Contractor will ensure that no construction materials like earth, stone, ash or appendage disposed off so as not to block the flow of water of any water course and cross drainage channels. Contractor will take all necessary measures to prevent the blockage of water flow. In addition to the design requirements, the contractor will take all required measures as directed by the Independent Engineer/Supervision	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		Consultant to prevent temporary or permanent flooding of the site or any adjacent area.		
C.3.3	Siltation of Water Bodies and Degradation of Water Quality	▪ The Contractor will not excavate beds of any stream/canals/ any other water body for borrowing earth for embankment construction. ▪ Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body (including wells) adjacent to the alignment and around the stockpiles at the construction sites close to water bodies. The fencing will be provided prior to commencement of earthwork and continue till the stabilization of the embankment slopes, on the particular sub-section of the road. ▪ The contractor will also put up sedimentation cum grease traps at the outer mouth of the drains located in truck lay byes and bus bays which are ultimately entering into any surface water bodies / water channels with a fall exceeding 1.5 m. ▪ Contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby water course.	Contractor	Independent Engineer/ Supervision Consultant
C.3.4	Slope Protection and Control of Soil Erosion	▪ The contractor will take slope protection measures as per design, or as directed by the Independent Engineer to control soil erosion and sedimentation through use of dykes, sedimentation chambers, basins, fibber mats, mulches, grasses, slope, drains and other devices. ▪ All temporary sedimentation, pollution control works and maintenance thereof will be deemed as incidental to the earth work or other items of work and as such as no separate payment will be made for them. ▪ Contractor will ensure the following aspects: ▪ During construction activities, the side slopes of all cut and fill areas will be graded and covered with stone pitching, grass and shrub as per design specifications. ▪ Turfing works will be taken up as soon as possible provided the season is favourable for the establishment of grass sods. Other measures of slope	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		stabilization will include mulching netting and seeding of batters and drains immediately on completion of earthworks. ▪ In borrow pits, the depth shall be so regulated that the sides of the excavation will have a slope not steeper than 1 vertical to 2 horizontal, from the edge of the final section of the bank. ▪ Along sections abutting water bodies, stone pitching as per design specification will protect slopes.		
C.4	**Pollution**			
C.4.1	**Water Pollution**			
C.4.1.1	Water Pollution from Construction Wastes	▪ The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system. Contractor will avoid construction works close to the streams or water bodies during monsoon. ▪ All waste arising from the project is to be disposed off in the manner that is acceptable to the State Pollution Control Board or as directed by the Independent Engineer/Supervision Consultant. ▪ The Contractor will certify that all liquid wastes disposed off from the sites meet the discharge standards.	Contractor	Independent Engineer/ Supervision Consultant
C.4.1.2	Water Pollution from Fuel and Lubricants	▪ The contractor will ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites will be located at least 500 m from rivers and irrigation canal/ponds. ▪ All location and lay-out plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Independent Engineer. ▪ Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Oil interceptors will be provided for vehicle parking, wash down and refuelling areas as per the design provided. ▪ In all, fuel storage and refuelling areas, if located on agricultural land or	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		areas supporting vegetation, the top soil will be stripped, stockpiled and returned after cessation of such storage. ▪ Contractor will arrange for collection and storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Independent Engineer/Supervision Consultant) and approved by Independent Engineer/Supervision Consultant. The waste oil will be sold to vendors authorized by MoEFCC for recycling. All spills and collected petroleum products will be disposed off in accordance with MoEFCC and ASPCB guidelines. ▪ Contractor will certify that all arrangements comply with the guidelines of ASPCB/MoEFCC or any other relevant laws.		
C.4.2	**Air Pollution**			
C.4.2.1	Dust Pollution	▪ The contractor will take every precaution to reduce the level of dust from crushers/hot mix plants, construction sites involving earthwork by sprinkling of water, encapsulation of dust source and by erection of screen/barriers. ▪ All the plants will be sited at least 500m in the downwind direction from the nearest human settlement. ▪ The contractor will provide necessary certificates to confirm that all crushers used in construction conform to relevant dust emission control legislation. ▪ The suspended particulate matter value at a distance of 40 m from a unit located in a cluster should be less than 500 umg/m^3. The pollution monitoring is to be conducted as per the monitoring plan. ▪ Alternatively, only crushers licensed by the ASPCB shall be used. The Contractor in such a case shall submit required certificates and consents. ▪ Hot mix plant will be fitted with dust extraction system.	Contractor	Independent Engineer/ Supervision Consultant
C.4.2.2	Emission from Construction Vehicles, Equipment and	▪ Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of ASPCB. ▪ The Contractor will submit PUC certificates for all vehicles/	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
	Machineries	equipment/machinery used for the project. Monitoring results will also be submitted to Independent Engineer/Supervision Consultant as per the monitoring plan.		
C.4.3	**Noise Pollution**			
C.4.3.1	Noise Pollution: Noise from Vehicles, Plants and Equipments	The Contractor will confirm the following: ▪ All plants and equipment used in construction (including crushing plant) shall strictly conform to the MoEFCC/CPCB noise standards. ▪ All vehicles and equipment used in construction will be fitted with exhaust silencers. ▪ Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. ▪ Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. ▪ Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Independent Engineer/Supervision Consultant to keep noise levels at the minimum. ▪ At the construction sites within 250 m of the nearest habitation, noisy construction work such as crushing, concrete mixing, batching will be stopped during the night time between 10.00 pm to 6.00 am. ▪ No noisy construction activities will be permitted around educational institutes/health centers (silence zones) up to a distance of 100 m from the sensitive receptors ▪ Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to Independent Engineer. Independent Engineer will be required to inspect regularly to ensure the compliance of EMP.	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
C.5	**Safety**			
C.5.1	Personal Safety Measures for Labour	Contractor will provide: ▪ Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete etc. ▪ Protective eye-shields to workers who are engaged in welding works ▪ Protective goggles and clothing to workers engaged in Factories Act, 1948 stone breaking activities and workers will be seated at sufficiently safe intervals ▪ Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. ▪ Adequate safety measures for workers during handling of materials at site are taken up. ▪ The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and exit. ▪ The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract. ▪ The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. ▪ The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. ▪ The contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. ▪ Contractor will provide facemasks for use to the workers when paint is	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		applied in the form of spray or a surface having lead paint dry is rubbed and scrapped. ▪ The Contractor will mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with zero tolerance. These will be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and will be approved by Independent Engineer/Supervision Consultant.		
C.5.2	Traffic and Safety	▪ The contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan/Drawings and as required by the Independent Engineer/Supervision Consultant for the information and protection of traffic approaching or passing through the section of any existing cross roads. ▪ The contractor will ensure that all signs, barricades, pavement markings are provided as per the MoRTH specifications. Before taking up of construction on any section of the existing lanes of the highway, a Traffic Control Plan will be devised and implemented to the satisfaction of Independent Engineer/Supervision Consultant.	Contractor	Independent Engineer/ Supervision Consultant
C.5.3	Risk from Electrical Equipment(s)	▪ The Contractor will take all required precautions to prevent danger from electrical equipment and ensure that - ▪ No material will be so stacked or placed as to cause danger or inconvenience to any person or the public. ▪ All necessary fencing and lights will be provided to protect the public in construction zones. ▪ All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Independent Engineer/Supervision Consultant.	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
C.5.4	Risk Force Measure	▪ The contractor will take all reasonable precautions to prevent danger to the workers and public from fire, flood etc. resulting due to construction activities. ▪ The contractor will make required arrangements so that in case of any mishap all necessary steps can be taken for prompt first aid treatment. Construction Safety Plan prepared by the Contractor will identify necessary actions in the event of an emergency.	Contractor	Independent Engineer/ Supervision Consultant
C.5.5	First Aid	The contractor will arrange for - ▪ A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone ▪ Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital.	Contractor	Independent Engineer/ Supervision Consultant
C.5.6	Informatory Signs and Hoardings	The contractor will provide, erect and maintain informatory/safety signs, hoardings in English, Hindi and local language, wherever required or as suggested by the Independent Engineer/Supervision Consultant.	Contractor	Regional office of MoRTH / Independent Engineer/ Supervision Consultant
C.6	**Flora and Fauna: Plantation/Preservation/ Conservation Measures**			
C.6.1	Road side Plantation Strategy	▪ Two times the number of trees to be felled would be planted, in the form of strip and block plantations depending on the availability of lands. Foliage and flowering shrubs will be planted on the median. Plans for compensatory plantation will be drawn up in consultation with the State Forest Department. Species composition and pattern of planting will be decided in consultation with the communities and Social Forestry wing of the Forest Department. ▪ Minimum 75 percent survival rate of the saplings will be acceptable otherwise the contractor will replace all casualties at his own cost to ensure this survival percentage. The contractor will maintain the plantation till they handover the project site. ▪ The Independent Engineer/Supervision Consultant will undertake regular	Horticulture/ Environmental Expert of Independent Engineer/Supervision Consultant	Regional office of MoRTH / Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		inspection of the survival rate of the plants and compliance of tree plantation guidelines.		
C.6.2	Flora and Fauna	▪ The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal). ▪ If any carcass of any wild animal/ wetland bird is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Independent Engineer/Supervision Consultant and carry out the instructions for dealing with the same. ▪ The Independent Engineer will report to the nearby forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials.	Contractor	Regional office of MoRTH / Independent Engineer/ Supervision Consultant
C.7	**Labor Camp Management**			
C.7.1	Accommodation	▪ Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labor camp. ▪ The location, layout and basic facility provision of each labor camp will be submitted to Independent Engineer/Supervision Consultant prior to their construction. ▪ The construction will commence only upon the written approval of the Independent Engineer/Supervision Consultant. ▪ The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Independent Engineer.	Contractor	Independent Engineer/ Supervision Consultant
C.7.2	Potable Water	The Contractor will construct and maintain all labor accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. The Contractor will also provide potable water facilities within the precincts of every workplace in an accessible place, as per standards set by the	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. The contractor will also guarantee the following: a) Supply of sufficient quantity of potable water (as per IS) in every workplace/labour camp site at suitable and easily accessible places and regular maintenance of such facilities. b) If any water storage tank is provided that will be kept such that the bottom of the tank at least 1m. from the surrounding ground level. c) If water is drawn from any existing well, this is within 30m proximity of any toilet, drain or other source of pollution, the well will be disinfected before water is used for drinking. d) All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof. e) A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. f) Testing of water will be done every month as per parameters prescribed in IS 10500:2012. Independent Engineer/Supervision Consultant will be required to inspect the labour camp once in a week to ensure the compliance of the EMP.		
C.7.3	Sanitation and	The contractor will ensure that	Contractor	Independent Engineer/

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
	Sewage System	▪ The sewage system for the camp are designed, built and operated in a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place ▪ separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women ▪ adequate water supply is to be provided in all toilets and urinals ▪ all toilets in workplaces are with dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition ▪ Night soil is to be disposed off by putting layer of it at the bottom of a permanent tank prepared for the purpose and covered with 15 cm. layer of waste or refuse and then covered with a layer of earth for a fortnight.		Supervision Consultant
C.7.4	Waste Disposal	▪ The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Independent Engineer/Supervision Consultant. ▪ Unless otherwise arranged by local authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical/health or municipal authorities or as directed by Environmental Expert of Independent Engineer/Supervision Consultant will have to be provided by the contractor.		Independent Engineer/ Supervision Consultant
C.8	**Contractor's Demobilization**			
C.8.1	Clean-up Operations, Restoration and Rehabilitation	▪ Contractor will prepare site restoration plans, which will be approved by the Independent Engineer/Supervision Consultant. The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. The contractor will clear all temporary structures; dispose all garbage, night soils and POL waste as per Comprehensive Waste Management Plan and as approved by Independent Engineer/Supervision Consultant. ▪ All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed on adjoining/ proximate barren land or areas identified by the Independent Engineer/Supervision	Contractor	Independent Engineer/ Supervision Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
		Consultant in a layer of thickness of 75 mm-150 mm. ▪ All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used/affected by the project will be left clean and tidy, at the contractor's expense, to the entire satisfaction of Independent Engineer/Supervision Consultant.		
OPERATION STAGE				
Activities to be Carried Out by the MoRTH through concerned agency				
O.1	Monitoring Operation Performance	▪ The Independent Engineer/Supervision Consultant will monitor the operational performance of the various mitigation/ enhancement measures carried out as a part of the project. ▪ The monitoring indicators include the survival rate of trees; utility of enhancement provision for relocated structures; status of rehabilitation of borrows areas; and utility of noise barriers.	MoRTH through monitoring agency	Independent Engineer/ Supervision Consultant After demobilization of IE/CSC, Regional office of MoRTH/ O&M Consultant
O.2	Maintenance of Drainage	▪ The contractor will ensure that all drains (side drains, median drain and all cross drainages) are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding. ▪ The contractor will ensure that all the sediment and oil and grease traps set up at the water bodies are cleared once in every three months.	MoRTH through monitoring agency	Regional office of MoRTH/ O&M Consultant
O.3	Pollution Monitoring	The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/contamination in the selected locations as suggested in pollution monitoring plan will be responsibility of the Concessionaire. The Concessionaire will appoint approved pollution monitoring agency for this purpose.	MoRTH through monitoring agency	Regional office of MoRTH/ O&M Consultant
O.3.1	Atmospheric Pollution	▪ Ambient air concentrations of various pollutants shall be monitored as envisaged in the pollution-monitoring plan. ▪ Road-side tree plantation will be maintained.	MoRTH through monitoring	Regional office of MoRTH/ O&M Consultant

S. No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Execution / Civil Work	Supervision/ Monitoring
			agency	
O.3.2	Noise Pollution	▪ Noise pollution will be monitored as per monitoring plan at different zones. Noise control programs are to be enforced strictly. ▪ Monitoring the effectiveness of the pollution attenuation barriers, if there is any, will be taken up thrice in the operation period.	MoRTH through monitoring agency	Regional office of MoRTH/ O&M Consultant
O.4.	Soil Erosion and Monitoring of Borrow Areas	Visual monitoring and inspection of soil erosion at borrow areas, quarries (if closed and rehabilitated), embankments and other places expected to be affected, will be carried out once in every three months as suggested in monitoring plan.	MoRTH through monitoring agency	Regional office of MoRTH/ O&M Consultant

Table 8.2: Environmental Budget

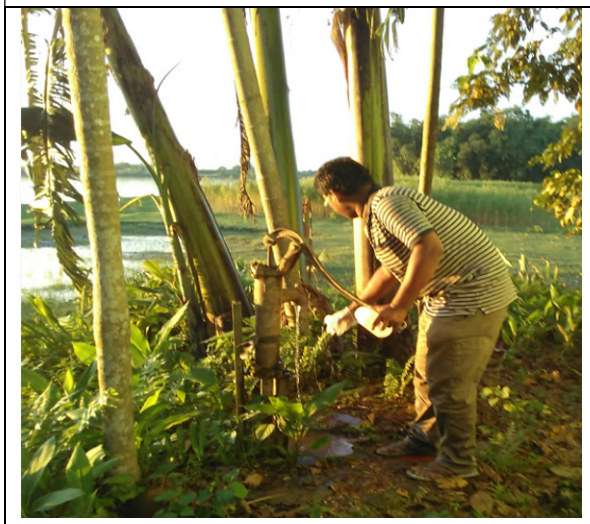
COMPONENT	STAGE	ITEM	UNIT	UNIT COST (Rs.)	QUANTITY	TOTAL COST (INR)
(A) Mitigation Costs						
Air	Construction	Dust Suppression with sprinkling of water, covers of the vehicles transporting construction material	No.	-	-	Covered in Engineering Cost
Water	Construction	Oil interceptor at parking of construction vehicle (1 camps and 2 oil interceptors at each)	No.	75,000	2	150000.00
		Site Fencing at identified locations	No.	1,00,000	05	500000.00
Flora	Construction	Compensatory Afforestation @ 1:2 ratio (Number of trees to be cut = 4202)	No.	1,000	4202x3	12606000
		Median plantations (Not Proposed)	Km	-	-	00.00
Safety	Constructions	Demarcating borrow areas clearly using fencing if needed	M	-	-	Covered in Engineering cost.
		Miscellaneous informatory signs and others	L.S.	-	-	Covered in Engineering cost
Soil erosion control Measure	Constructions	Slope stabilization, turfing, silt fencing etc	--	-	-	Covered in engineering cost
(A) Mitigation costs						**1,32,56,000.00**
(B) Monitoring Costs (for details please refer to Chapter 7)						
Sub-Total B- Monitoring Costs						29,53,500.00
(C) Training						

COMPONENT	STAGE	ITEM	UNIT	UNIT COST (Rs.)	QUANTITY	TOTAL COST (INR)
Environmental Awareness and training in Construction Stage						**5,00,000.00**

Sub Total A: Mitigation Costs	**1,32,56,000.00**
Sub Total B: Monitoring Cost	**29,53,000.00**
Sub Total C: Training Cost	**5,00,000.00**
TOTAL	**16,709,500**
Contingency @ 5%	**83,5475**
TOTAL EMP BUDGETE	**1,75,44,975**
Rupees one crore seventy five lakh forty four thousand nine hundred seventy five only ***Let's say one crore thirty seventy fivelakh.***	

Appendix 3.1: Project site photographs- showing different project activities (preparatory)









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Appendix 4.1: Guidelines for Borrow Areas Management

1. SELECTION OF BORROW AREAS

Location of borrow areas shall be finalized as per IRC: 10-1961 guidelines. The finalization of locations in case of borrows areas identified in private land shall depend upon the formal agreement between landowners and contractor. If, agreement is not reached between the contractor and landowners for the identified borrow areas sites, arrangement for locating the source of supply of material for embankment and sub-grade as well as compliance to environment requirements in respect of excavation and borrow areas as stipulated from time to time by the Ministry of Environment and Forests, Government of India, and local bodies, as applicable shall be the sole responsibility of the contractor.

The contractor in addition to the established practices, rules and regulation will also consider following criteria before finalizing the locations.

(1) The borrow area should not be located in agriculture field unless unavoidable i.e. barren land is not available.

(2) The borrow pits preferably should not be located along the roads.

(3) The loss of productive and agriculture soil should be minimum.

(4) The loss of vegetation is almost nil or minimum.

(5) The Contractor will ensure that suitable earth is available.

2. CONTRACTOR'S RESPONSIBILITY

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the sub-grade material when compacted to the density requirements shall yield the design CBR value of the sub-grade. Contractor shall begin operations keeping in mind following;

(1) Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plants is operating at the place of deposition.

(2) No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Contractor should be permitted to remove acceptable material from the site to suit his operational procedure.

(3) Where the excavation reveals a combination of acceptable and un-acceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the un-acceptable materials. The acceptable material shall be stockpiled separately.

(4) The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants are siting of temporary buildings or structures.

3. BORROWING FROM DIFFERENT LAND-FORMS

A. Borrow Areas located in Agricultural Lands

I. The preservation of topsoil will be carried out in stockpile.

II. A 15 cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).

III. Borrowing of earth will be carried out up to a depth of 1.5m from the existing ground level.

IV. Borrowing of earth will not be done continuously throughout the stretch.

V. Ridges of not less than 8m widths will be left at intervals not exceeding 300m.

VI. Small drains will be cut through the ridges, if necessary, to facilitate drainage.

VII. The slope of the edges will be maintained not steeper than 1:4 (vertical: Horizontal).

VIII. The depth of borrow pits will not be more than 30 cm after stripping the 15 cm topsoil aside.

B. Borrow Areas located in Elevated Lands

I. The preservation of topsoil will be carried out in stockpile.

II. A 15 cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).

III. At location where private owners desire their fields to be levelled, the borrowing shall be done to a depth of not more than 1.5m or up to the level of surrounding fields

C. Borrow Areas near River side

I. The preservation of topsoil will be carried out in stockpile.

II. A 15 cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).

III. Borrow area near to any surface water body will be at least at a distance of 15m from the toe of the bank or high flood level, whichever is maximum.

D. Borrow Areas near Settlements

I. The preservation of topsoil will be carried out in stockpile.

II. A 15 cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).

III. Borrow pit location will be located at least 0.75 km from villages and settlements. If un-avoidable, the pit will not be dug for more than 30 cm and drains will be cut to facilitate drainage.

IV. Borrow pits located in such location will be re-developed immediately after borrowing is completed. If spoils are dumped, that will be covered with a layers of stockpiled topsoil in accordance with compliance requirements with respect MoEFCC/PPCB guidelines.

E. Borrow Pits along the Road

Borrow pits along the road shall be discouraged and if deemed necessary and permitted by the Engineer; following precautions are recommended

I. The preservation of topsoil will be carried out in stockpile.

II. A 15 cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).

III. Ridges of not less than 8m widths should be left at intervals not exceeding 300m.

IV. Small drains shall be cut through the ridges of facilitate drainage.

V. The depth of the pits shall be so regulated that there bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of bank, the maximum depth of any case being limited to 1.5m.

VI. Also, no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10m.

4. REHABILITATION OF BORROW AREAS

The objective of the rehabilitation programme is to return the borrow pit sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing borrow pits in a stable condition is fundamental requirement of the rehabilitation process. This could be achieved by filling the borrow pit floor to approximately the access road level.

Re-development plan shall be prepared by the Contractor before the start of work inline with the owners will require and to the satisfaction of owner. The Borrow Areas shall be rehabilitated as per following;

- Borrow pits shall be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then excavation sloped will be smoothed and depression will be filled in such a way that it looks more or less like the original round surface.
- Borrow areas might be used for aquaculture in case landowner wants such development. In that case, such borrow area will be photographed after their post use restoration and Environment Expert of Supervision Consultant will certify the post use redevelopment.

The Contractor will keep record of photographs of various stages i.e., before using materials from the location (pre-project), for the period borrowing activities (construction Phase) and after rehabilitation (post development), to ascertain the pre and post borrowing status of the area.

Appendix 7.1.: National Ambient Air Quality Standards

The finding as Notified on 16th November 2009 by the Central Pollution Control Board (CPCB) in exercise of its powers conferred under Section 6 and Section 25 of the Environment Protect Act, 1986.

Pollutant	Time-Weighted	Concentration in Ambient Air	
	Average	Industrial, Residential and other rural area	Ecologically Sensitive Area (Notified by Central Government)
SO_2 ug/m^3	Annual*	50	20
	24 hours**	80	80
NO_x ug/m^3	Annual*	40	30
	24 hours**	80	80
PM_{10} ug/m^3	Annual*	60	60
	24 hours**	100	100
$PM_{2.5}$ ug/m^3	Annual*	40	40
	24 hours**	60	60
Lead ug/m^3	Annual*	0.50	0.50
	24 hours**	1.0	1.0
CO ug/m^3	8 Hours**	2000	2000
	1 Hour**	4000	4000
O_3 ug/m^3	8 Hours**	100	100
	1 Hour**	180	180
NH_3 ug/m^3	Annual*	100	100
	24 hours**	400	400

Source: Gazette of India, Part II-Section -3-Subsection (i)

* Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24-hourly at uniform interval.

** 24-hourly / 8-hourly values or 0.1 hourly monitored values shall be complied with 98% of the time in the year. However, 2% of the time, it may exceed but not on two consecutive days.

Appendix 7.2: Drinking Water Standards and Probable Effects on Human Health (BIS: IS: 10500, 2012)

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
1	COLOUR (HAZEN UNIT)	5	25	Aesthetically undesirable.
2	ODOUR	Essentially free		Aesthetically undesirable.
3	TASTE	Agreeable		Aesthetically undesirable.
4	TURBIDITY (NTU)	5	10	Indicates pollution/ contamination.
5	pH	6.5	8.5	Affects taste, corrodes supply system.
6	HARDNESS, as CaCO3, mg/l	300	600	Causes scaling, excessive soap consumption, calcification of arteries.
7	IRON, as Fe , mg/l	0.30	1.00	Causes staining of laundry and porcelain. In traces it is essential for nutrition.
8	CHLORIDE, as Cl , mg/l	250	1000	May be injurious to heart or kidney patients. Taste, indigestion, corrosion and palatability are affected.
9	RESIDUAL CHLORINE, only when Water is chlorinated	0.20	-	Excessive chlorination causes asthma, colitis and eczema
10	TOTAL DISSOLVED SOLIDS, mg/l	500	2000	May cause gastro-intestinal irritation, corrosion and laxative effect to new users.
11	CALCIUM, as Ca, mg/l	75	200	Excessive Cause incrustation, deficiency causes rickets, essential for nervous, muscular, cardiac functions and in coagulation of blood.
12	MAGNESIUM, as Mg, mg/l	30	100	Its salts are cathartics and diuretic. Excessive may cause laxative effect; deficiency causes structural and functional changes. It is activator of many enzyme systems.
13	COPPER, as Cu, mg/l	0.05	1.50	Beneficial in human metabolism, deficiency results in nutritional anaemia in infants. Large amounts may result in liver damage, causes central nervous system irritation and depression. Enhances corrosion of Al in

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
				water supply systems.
14	SULPHATE, as SO_4, mg/l	200	400	Causes gastro-intestinal irritation. Along with Mg or Na can have a cathartic effect. Concentration more than 750 mg/l may have laxative effect.
15	NITRATE, as N, mg/l	45	100	Causes infant methaenoglobinaemia, at very high concentration causes gastric cancer and effects central nervous and cardiovascular system.
16	FLUORIDE, as F, mg/l	1.00	1.50	Reduces dental carries, very high concentration may cause crippling skeletal fluorosis.
17	CADMIUM, as Cd, mg/l	0.01	No relaxation	Acute toxicity may be associated with renal, arterial hypertension, itai-itai (bone disease). Cd salts cause cramps, nausea, vomiting and diarrhoea.
18	LEAD, as Pb, mg/l	0.05	No relaxation	Burning in mouth, severe inflammation of gastro-intestinal tract with vomiting and diarrhoea. Chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, and anaemia etc.
19	ZINC, as Zn , mg/l	5	15	Essential and beneficial in human metabolism. Imparts astringent taste to water.
20	CHROMIUM, as Cr, mg/l	0.05	No relaxation	Cr6+ produces lung tumours, coetaneous and nasal mucous membrane ulcers and dermatitis.
21	ARSENIC, as As, mg/l	0.05	No relaxation	Causes skin damage, circulatory problems, increased risk of skin cancer.
22	ANTIMONY, as Sb, mg/l	0.006	No relaxation	Raises blood cholesterol, lowers blood sugar.
23	ALUMINIUM, as Al, mg/l	0.030	0.200	Leads to neurological disorders.
24	BARIUM, as Ba, mg/l	2	No relaxation	Increases blood pressure.
25	BERYLLIUM, as Be, mg/l	nil	0.0002	Is carcinogenic

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
26	CYANIDE, as CN, mg/l	0.05	No relaxation	Causes nerve damage, thyroid problem.
27	MERCURY, as Hg, mg/l	0.001	No relaxation	Neurological and renal disturbances. Excess causes gonadotoxic and mutagenic effects and disturbs the cholesterol metabolism.
28	MANGANESE, as Mn, mg/l	0.10	0.30	Essential as a cofactor in enzyme systems and metabolism processes. Excessive causes change in appetite and reduction in metabolism of iron to form haemoglobin. Imparts undesirable taste and stains plumbing fixtures and laundry.
29	SELENIUM, as Se, mg/l	0.01	No relaxation	Leads to hair, finger loss, and numbness in fingers or toes, circulatory problems.
30	BORON, as B, mg/l	1.00	5.00	Affects central nervous system, salts may cause nausea, cramps, convulsions, coma, etc.
31	ALKALINITY, as CaCO3, mg/l	200	600	Imparts unpleasant taste, deleterious to humans in presence of high pH, hardness and TDS.
32	PESTICIDES, ug/l	Nil	0.001	Imparts toxicity, accumulates in different organs of body, and affects immune and nervous systems. Carcinogenic.
33	PHOSPHATE, as PO_4, mg/l	No guideline		High concentration causes vomiting and diarrhoea stimulates secondary hyperthyroidism and bone loss.
34	SODIUM, as Na, mg/l	No guideline		Harmful to persons suffering from cardiac, renal and circulatory diseases.
35	POTASSIUM, as K, mg/l	No guideline		Essential nutrition element but excessive amounts are cathartic.
36	NICKEL, as Ni , mg/l	No guideline		Non-toxic element but may be carcinogenic in animals, can react with DNA resulting in DNA damage in animals.
37	PATHOGENS	1	10	Causes water borne diseases

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
	a)TOTAL COLIFORM No/dl b)FAECAL COLIFORM No/dl			like coliform jaundice; Typhoid, Cholera etc. produces infections involving skin mucous membrane of eyes, ears and throat.
38	RADIOACTIVITY: -BETA PARTICLES -ALPHA PARTICLES -RADIUM	0-4 millirem/year 0-15 picocuries/year 0-05 picocuries/year		Increases risk of cancer.

Appendix 7.3: Ambient Noise Level Limits (in Leq dB(A)),India

Area/Class	Day Time (6:00 AM to 9:00 PM)	Night Time (9:00 PM to 6:00 am)
	Standard	Standard
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

Source: Environment Protection Rules, 1986, Schedule III